# Final Report

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## P603 – Geological, Tectonic and Metallogenic Relations of South China

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# Geological, tectonic and metallogenic relations of South China

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## EXECUTUVE SUMMARY

This final report presents the GIS compilation of geology and mineral deposits of South China. Compilation of the geology database have been completed for Yunnan, Sichuan, Guizhou, Guangxi, Hunan, Guangdong, Jiangxi, Hubei, Fujian, Anhui, Zhejiang, Jiangsu and Shandong covering the entire South China Terrane. CD-ROMs including geology, geochronology and mineral deposit data for these provinces are delivered to the sponsors with this report. Altogether more than 3300 mineral deposits and occurrences, and 1067 geochronological data points have been compiled spatially from the published literature.

Nearly 400 mineral occurrences are recorded for Yunnan. At least five different styles of lead-zinc-silver mineralisation occur in Yunnan: (1) sedimentary exhalative (Sedex) deposits (e.g., Tertiary Jingding/Lanping deposit), (2) with copper in volcanic-hosted massive sulphide (VHMS) deposits (e.g., Carboniferous Laochang deposit, and the recently discovered Carboniferous Dapingzhang deposit), (3) with copper and tin in lead-zinc skarn deposits (e.g., Triassic Hongshan deposit), (4) with precious metals in veins and porphyry deposits (e.g., Beiya deposit), and (5) with copper in Sn-W vein and skarn deposits (e.g., Mengzimao). Yunnan also has the potential for Carlin-type and mesothermal gold, porphyry copper-gold, sedimentary copper and mafic-ultramafic-hosted Ni-Cu deposits.

Similarly to Yunnan, Sichuan province has the potential for base and precious metal mineralisation. About 300 mineral occurrences have been recorded for Sichuan. The province has significant stratabound lead-zinc-silver deposits, Carlin-type gold deposits and ultramafic-hosted Cu-Ni deposits. At least, two major styles of lead-zinc-silver mineralisation occur in Sichuan: (1) volcanic-hosted massive sulphide (VHMS) deposits (e.g., Triassic Gacun deposit), and (2) MVT deposits (e.g., Sinian Daliangzi deposit). Sichuan has excellent potential for the discovery of world class micro-disseminated Carlin-type gold deposits. Many Carlin-type deposits are distributed in NW Sichuan, Gansu and Shaanxi, an area also known as the 'northern Golden Triangle' of China.

Guizhou and Guangxi provinces are adjacent to Yunnan and Sichuan. There are approximately 250 metallic and non-metallic mineral occurrences recorded for Guizhou and about 420 for Guangxi. The two provinces are part of the 'southern Golden Triangle' of China, which forms the region at the junction of Yunnan, Guizhou, and Guangxi provinces. This region has excellent potential for Carlin-type gold deposits.

About 323 metallic mineral deposits have been compiled for Hunan and about 310 for Guangdong. Hunan and Guangdong provinces have many polymetallic lead-zinc deposits associated with Indosinian (Triassic) and Yanshanian (Jurassic to Cretaceous) magmatism (e.g. Shizhuyuan deposit). Significant Devonian to Carboniferous stratabound base and precious metal mineralisation also occur in these provinces and appear to be similar to Sedex type depsits (e.g. Fankou and Dabaoshan deoposits).

In addition, about 220 mineral occurrences for Jiangxi, 219 for Hubei, 152 for Anhui and 104 for Jiangsu provinces are recorded. 132 deposits for Fujian and 166 for Zhejiang and 340 occurrences for Shandong province are compiled. The Jiangxi province has major vein-type tungsten-tin-bismuth-beryllium-sulphide deposits associated with Yanshanian magmatism (e.g., Xihuashan deposit), and the largest porphyry copper deposit in China (e.g., Dexing deposit). Dexing has 1500 Mt ore @ 0.43 % Cu, 0.02 % Mo, 0.16 g/t Au and 1.9 g/t Ag approximately equivalent to 6.45 Mt Cu, 0.25 Mt Mo, 24 t Au and 285 t Ag. Au-(Ag-Mo)-rich porphyry-related Cu-Fe skarn deposits are also found in Jiangxi (Chengmenshan, 1.7 Mt metal @ 0.76 % Cu, 57 t @ av. 0.25 g/t Au and 224 t @ 9.9 g/t Ag, and Wushan, 2.48 Mt metal @ 1.38 % Cu, 67 t @ av. 0.5 g/t Au). This part of the Jiangxi province is also part of the Lower to Middle Yangtze River metallogenic belt of China that has more than 600 t Au. This metallogenic belt extends into the Hubei, Anhui and Jiangsu provinces. The most significant deposits are Tonglushan

(1 Mt metal @ 1.8 % Cu, 69 t @ 1.15 g/t Au), Jilongshan (0.3 Mt metal @ 1.6 % Cu, 37 t @ 4 g/t Au), Fengshandong (0.7 Mt metal @ 1.2 % Cu, 16 t @ 0.38 g/t Au), Shitouzui (1 Mt metal @ 1.8 % Cu, 19 t 0.5 g/t Au), and Jiguanzui (20 t @ 4.87 g/t Au).

Similar deposits are found in Anhui. These are Xinqiao (0.5 Mt metal @ 0.7 % Cu, 24 Mt metal @ 46 % Fe, 105 t Au @ 0.3 ? g/t Au in sulphide ore and 11.2 t Au @ 4.7 g/t Au in oxide ore), Manshan-Tiamashan (32 t @ 6.5 g/t Au), Shizishan (46 t @ 0.3 g/t Au) and Huangshialoshan (13.5 t @ 5.8 g/t Au). Jiangsu province also hosts skarn gold deposits (e.g., Fuiushan, 9 t @ 0.85 g/t Au). In addition, Jiangsu province has Sedex style deposits such as Qixiashan (0.4 Mt metal @ 2.6 % Pb, 0.8 Mt metal @ 0.8 % Zn and 0.4 Mt metal @ 17 % Mn with gold credit (27 t @ 0.9 g/t Au), although the deposits were often overprinted by skarn system associated with Yanshanian magmatism.

Fujian and Zhejiang provinces cover the South China foldbelt along the southeastern margin of the Yangtze craton and are characterised by well-developed Yanshanian intrusive to subvolcanic rocks associated with porphyry to epithermal type copper-gold mineralisation and mesothermal vein deposits. The most important example is the Zijinshan district in Fujian (~100 Mt of ore containing at least 1.6 Mt metal @ 1.09 % Cu and 15 t of Au @ 0.14 g/t Au and 619 t of Ag @ 6.2 g/t Ag). It is the only high-sulphidation epithermal system in China. Epithermal to mesothermal vein-types are found in Zhejiang (e.g., Zhilingtou, 2 Mt ore grading 12 g/t Au, 306 g/t Ag).

Although part of Shandong province is located in the North China Terrane, we included the entire province in our database to compare and contrast the palaeogeographic, tectonic and metallogenic relations of the South and North China Terranes. The province has unique world class granite-hosted orogenic gold deposits, and is a major producer of gold in China with ore reserves of more than 900 t Au. The most important gold deposits are: Linglong deposit (>100 t @ 3-30 g/t Au), Sanshandao deposit (~60 t @ 7 g/t Au), Cangshang (~60 t @ 4 g/t Au), Jiaojia (>60 t @ 7 g/t Au), Xincheng (>60 t @ 8 g/t Au), Wangershan (45 t @ 7-8 g/t Au), Jingqingding-Rushan (25 t @ 9 g/t Au), Donggerzhuang (20 t @ 11 g/t Au), Hedong and Shangzhuang (~20 t @ 7 g/t Au).

The methodology for GIS compilation for the project is reported by Dr. Eleanor Bruce. Detailed stratigraphic correlation and synthesis of fault history of South China across individual provinces are also presented by Dr. Clive Burrett and Dr. Ron Berry in this report.

The project successfully integrated the geology, tectonic and metallogenic relations of South China. The South China region is rich in mineral resources and has the potential for a world class mineral dsicovery. Many giant base metal deposits (e.g., Baiyinchang VHMS and Dongshenmio SEDEX deposits), Porphyry copper deposits (e.g., Yulong), copper-nickel deposit (e.g., Jinchuan), several world class orogenic gold deposits in Henan and Xinjiang provinces, and Carlin type deposits in Gansu and Shaanxi are also located in the North China Craton and in the suture zone along the South and North China Cratons. Similar studies should be undertaken for the North China Craton in order to understand the palaeogeographic, tectonic and metallogenic relation of the formation of these giant ore deposits of China during the collision and amalgamation of the South and North China Cratons.

## 1. INTRODUCTION AND BACKGROUND

This final report presents the research outcome of the AMIRA P603 project "Geological, Tectonic and Metallogenic Relations of Mineral deposits in South China". The P603 project has two programs: (1) GIS (Geographic Information System) compilation of geological, geochronological and mineral deposit data, and (2) stratigraphic, tectonic and metallogenic studies. This program builds on the SE Asia AMIRA P390A project, which was successfully completed in 1999. The aim of P603 was to establish a similar and compatible GIS, digital geoscience data set and mineral deposit database for South China. The full aims of the P603 project as previously outlined to the sponsors are:

1. To establish a GIS (ARC/INFO, ArcView and MapInfo) integrated, comprehensive digital geoscience data set and mineral deposit database for South China focussing on the distribution of ore deposits building on the successful AMIRA project P390A for mainland SE Asia.

2. To undertake a tectonic and metallogenic analysis of the selected mineralised belts in the region, with particular emphasis on geological features, structural relationships, and regional metal distribution based on the GIS database.

3. To develop a geotectonic and metallogenic model for the evolution and origin of mineralised belts in these regions.

South China is a resource-rich region just north of Myanmar, Lao PDR and Vietnam. The South China region includes the largest metallogenic provinces in China with world-class base and precious metal deposits (Mineral Deposits of China, 1990, 1992, 1995; Zhai and Deng, 1996; White, 2002; Yang et al., 2002). The Sanjiang region, along the western part of South China, covers Yunnan and Sichuan and is notable for its mineralised accreted island arcs, back-arcs and rift basins, and contains a diversity of mineral deposit types (Hou Zengqian et al, submitted 2002a, 2003a in press). Mineralisation styles in these provinces and adjacent parts of Myanmar, Laos and Vietnam show many similarities. For instance, the VHMS Pb-Zn-Ag-Cu type Laochang deposit in Yunnan and the Gacun deposit from Sichuan (e.g. Sun Haitian, 1992; Yang and Mo, 1993; Hou and Mo, 1993; Yang et al., 1993, 1999; Hou Zengqian et al., 1999; Hou Zengqian et al., submitted 2002a) have mineralisation styles comparable with the Bawdwin deposit in NE Myanmar (Khin Zaw, 1990, 1992; Khin Zaw and Burrett, 1997) and the Tesek Chini deposit in Malaysia (Khin Zaw et al., 1999a).

South China also hosts copper-(gold) bearing porphyries and mesothermal gold deposits (e.g., the Beiya, Yangla, Jincang deposits in Yunnan, the Denxiang deposit in Jiangxi, the Gaocun deposit in Guangdong). Some of these porphyry copper deposits may also contain molybdenum (e.g., the Machangqing deposit in Yunnan). Base metal skarn deposits in South China are widely distributed along the lower reaches of the Yangtze River (e.g., Taihe Zhou, 1995, 1999; Yusheng Zhai et al., 1996; Yiming Zhao et al., 1999; Yuanming Pan and Ping Dong, 1999). They are also major sources of gold in China, and gold only skarns or skarns with copper are also widely distributed along the lower reaches of Yangtze River (Yanjing Chen et al., in preparation), and account for more than 20 % of China's gold resources.

Cu-Fe type VHMS deposits and sandstone-hosted Sedex type deposits (e.g., Jingding) are found in the Sanjiang Region. Carlin-type gold deposits are also widely distributed in the northern Golden Triangle (Sichuan, Gansu and Shaanxi — also known as Chuan-Shaan-Gan) and the southern Golden Triangle (Guizhou, Guangxi and Yunnan — also known as Dian-Gui-Qian) (e.g., Taihe Zhou et al., 2002; Hu Ruizhong et al., 2002; Li and Peters, 1998; Peters, 2002).

Significant Devonian to Carboniferous base and precious metal mineralisation also occurs in the eastern part of the South China Terrane covering Guangdong, Fujian, Jianxi, Anhui and Jiangsu provinces along the margin of the Yangtze Craton (e.g., Gu Lianxing et al., 1993, 2000). Different metal associations are also recorded (e.g., Pb-Zn type Fankou deposit in Gaungdong province, Cu-Fe type Wushan and recently discovered Yongping deposits in Jiangxi province) (e.g., Gu Lianxing et al., 1993, 2000). South China also hosts significant tungsten-tin-sulphide skarn/vein deposits (Chen et al., 1992; Yingjun and Dongsheng, 1993) and these belts extend south into SE Asia. South China is also rich in antimony resources accounting for 55 % of the world's antimony reserves with large world class deposits such as the Xikuangshan and Woxi deposits in Hunan and Qinglong and Banpo in Guizhou (Wu Jaida et al., 1990; Wu Jaida, 1993; Xiongwei Hu et al., 1996).

## 2. GIS COMPILATION

The P603 project area is shown in Figure 1 together with the P390A project area for the GIS compilation of the SE Asian geology and mineral deposits. SE Asia and Mainland China regions are composed of major crustal terranes (Fig. 2). The P390A project covered two main geological terranes: the Shan-Thai Terrane (Myanmar, Laos, western Thailand and SW Yunnan south of the Red River suture zone) and the Indochina Terrane (Laos, Cambodia, eastern Thailand and Vietnam). This P603 project focuses on the South China Terrane. Provinces covered by this GIS compilation in the South China Terrane are shown in Figure 3. Although mineral resource data are available for South China, no comprehensive geoscience and mineral deposit data sets existed in digital format, and such a database has not yet been established in English.

Data capture and establishment of digital databases for South China were undertaken using ARC/INFO GIS software. The detailed methodology for GIS compilation was comprehensively described in the previous AMIRA reports (Khin Zaw and Rice, 1996a, 1996b, 1997a; Khin Zaw et al., 1997, 1998, 1999a, 1999b; Khin Zaw et al., 2000a, b). Additional information for the data capture is presented by Dr. Eleanor Bruce in this final report. Geological maps of the provinces at 1:500,000 or 1:1,000,000 scales have been digitised. These scales are useful for depicting regional deposit groupings and large-scale structures while the geological setting of individual deposits can be displayed. All digital data are presented to the sponsors in CD-ROM format with this final report. The following colour scheme has been adopted:

| Epoch | Colour |
|---|---|
| Quaternary | Yellow |
| Tertiary | Orange |
| Mesozoic | Green |
| Paleozoic | Blue |
| Precambrian | Purple |
| Intrusives and volcanic rocks | Red |
| Mafic and ultramafics | Black |

The different shading and patterns may be used to describe different stratigraphic and lithological units for a particular geological period (e.g. Cenozoic, Mesozoic, Paleozoic etc) but these retain the original colour of the geological period (e.g. green for Mesozoic). A similar colour scheme has been also used for the SE Asian P390A database.

Geology Legend: We have also established the ArcView Legend (avl. file) for the Geology Legend incorporating the lithological and stratigraphic characteristics. We documented and defined the polygon ID numbers and descriptions for each geological and stratigraphic-lithologic unit for each province. These polygon ID numbers and descriptions are important as these data may be extensively applied for future regional geological correlation across individual provincial boundaries. The GIS compilation of geology and mineral deposit database will be reported for each province as below.

## 2.1. Yunnan Province

The geology and metallogeny of Yunnan province was presented in the previous AMIRA report (Khin Zaw et al., 1999, 2000, 2001), and is briefly described here. Yunnan province has a total land area of 394,000 km$^2$ and a population of 40.94 million. It is bounded on the east by Guangxi and Guizhou, on the north by Sichuan and on the northwest by Tibet. It has a total boundary of 4000 km with Myanmar on the southwest, Laos PDR and Vietnam to the south. Yunnan province has potential for recoverable mineral resources of lead, zinc, silver, copper, gold, nickel, cobalt, tin, the platinum group, thallium, indium, and cadmium.

The Bureau of Geology and Mineral Resources (BGMR), Yunnan province has a GIS section that is responsible for compilation of geological, geophysical (gravity and aeromagnetics), geochemical (stream sediments) and remote sensing (e.g., TM and SPOT) data on scales of 1:50,000 to 1:1,000,000 for the Yunnan province. The Bureau has PC Arc/Info, MAPGIS, ArcView, MapInfo and TNTmips software. BGMR is also involved in the project "Integrated Assessment and Development of Mineral Resources within the Greater Mekong Subregion" organised by UN-ESCAP, Bangkok covering Myanmar, Cambodia, Yunnan, Lao PDR, Thailand and Vietnam, and they have presented a report to the UN-ESCAP about the mineral resource potential of Yunnan (Ding Jun, 1999). BGMR has also applied GIS techniques to resource assessment and mineral evaluation in parts of Yunnan province. The GIS section at BRGM has 22 staff but lacks of expertise in deposit database development. They have not prepared a mineral deposit database in English.

### 2.1.1. GIS coverage of geology for Yunnan

Geological studies in Yunnan province date back to the mid-19th Century, and the best English source of geological data for Yunnan can be found in the geological memoir Series 1, No. 21 on the Regional Geology of the Yunnan province (1991). Geological investigation in Yunnan started after 1911 and was well-developed during the war of resistance against Japan (1937–1945). The Bureau of Geology and Mineral Resources for Yunnan province was established in 1958 and systematic geological mapping has been undertaken since then. A 1:1,000,000 scale geological map was completed in 1965. The Bureau also produced geological maps at 1:200,000 scale covering Yunnan in 1985. Mapping on 1:50,000 scale was started in 1980. About 137 map sheets were completed by 1999 and mapping to fill the gap is in progress. For this P603 project, the 1:1,000,000 scale geological map of Yunnan has been digitised. A detailed digitised geological map of Yunnan province is shown in Figure 4 together with a revised polygon ID for each stratigraphic and lithologic unit.

### 2.2.2. MINDEP database for Yunnan

A considerable amount of spatial mineral deposit data for Yunnan province is available in the literature (e.g., Ding Jun, 1999). For the AMIRA SE Asia P390A project, mineral deposit data for western Yunnan have been compiled, and these data are included in the current P603 project database. The Chinese Academy of Geological Sciences (CAGS) published three sets of 1:4,000,000 scale Mineral Resources Maps of China in 1987 and 1:5,000,000 scale Mineral Resources Maps of China in 1992 and 1999 with explanatory notes for metals, non-metals and energy resources of China (Guo, 1987; Song, 1992; Chen Yuchuan, 1999). These maps show major metal and non-metal deposits of Yunnan. The Chinese Government also published "The Discovery History of Mineral Deposits of China-Yunnan" in 1996. This publication includes about 160 metal and non-metal occurrences of Yunnan. The Metal Mining Agency of Japan (MMAJ) has compiled more than 500 major mineral deposits in China including South China provinces on their web site (www.mmaj.jp). As suggested by the sponsors in the previous meetings, we established the spatial data of

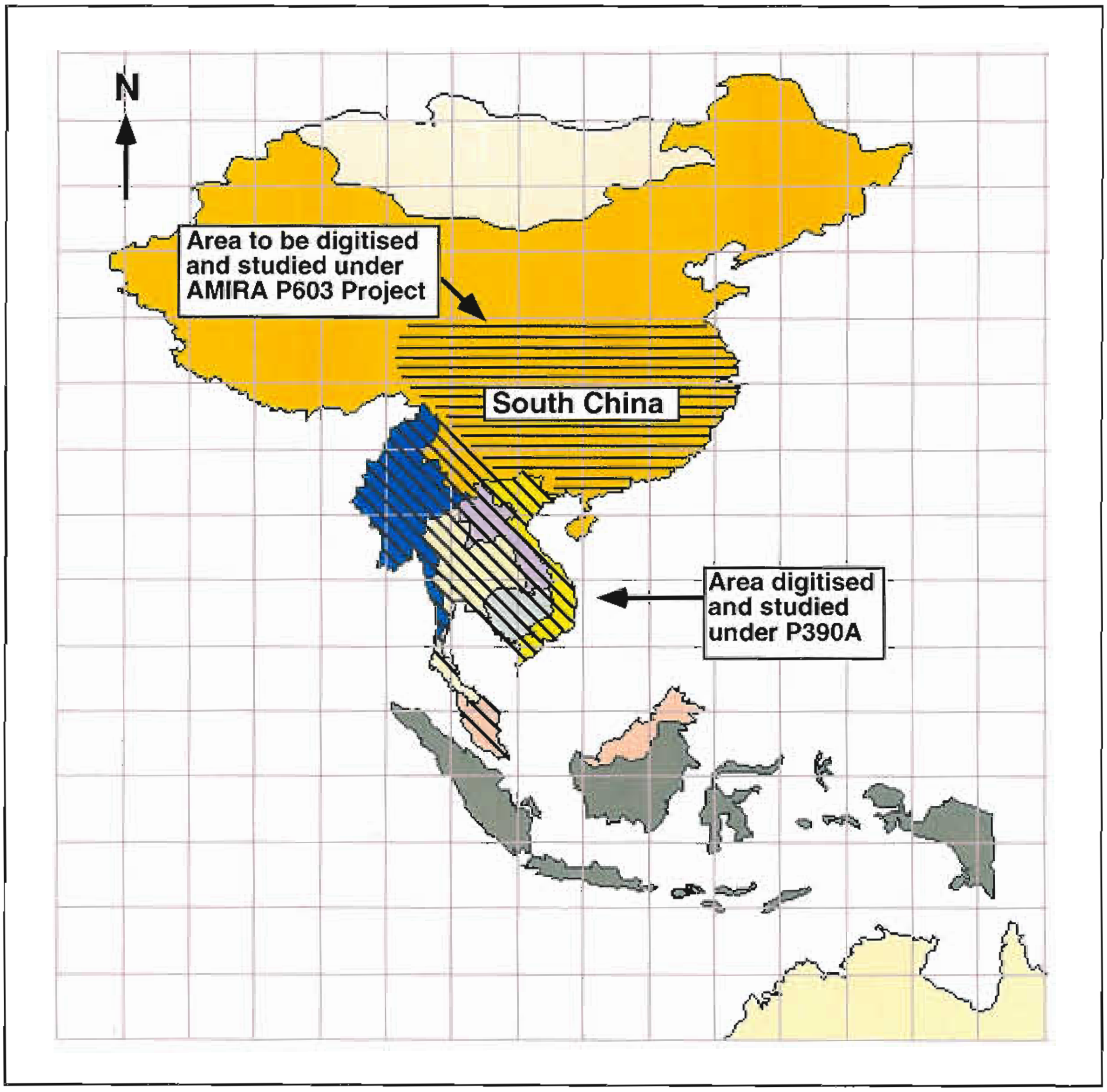


Fig. 1. Map showing the area to be digitised and studied under the AMIRA P603 project.

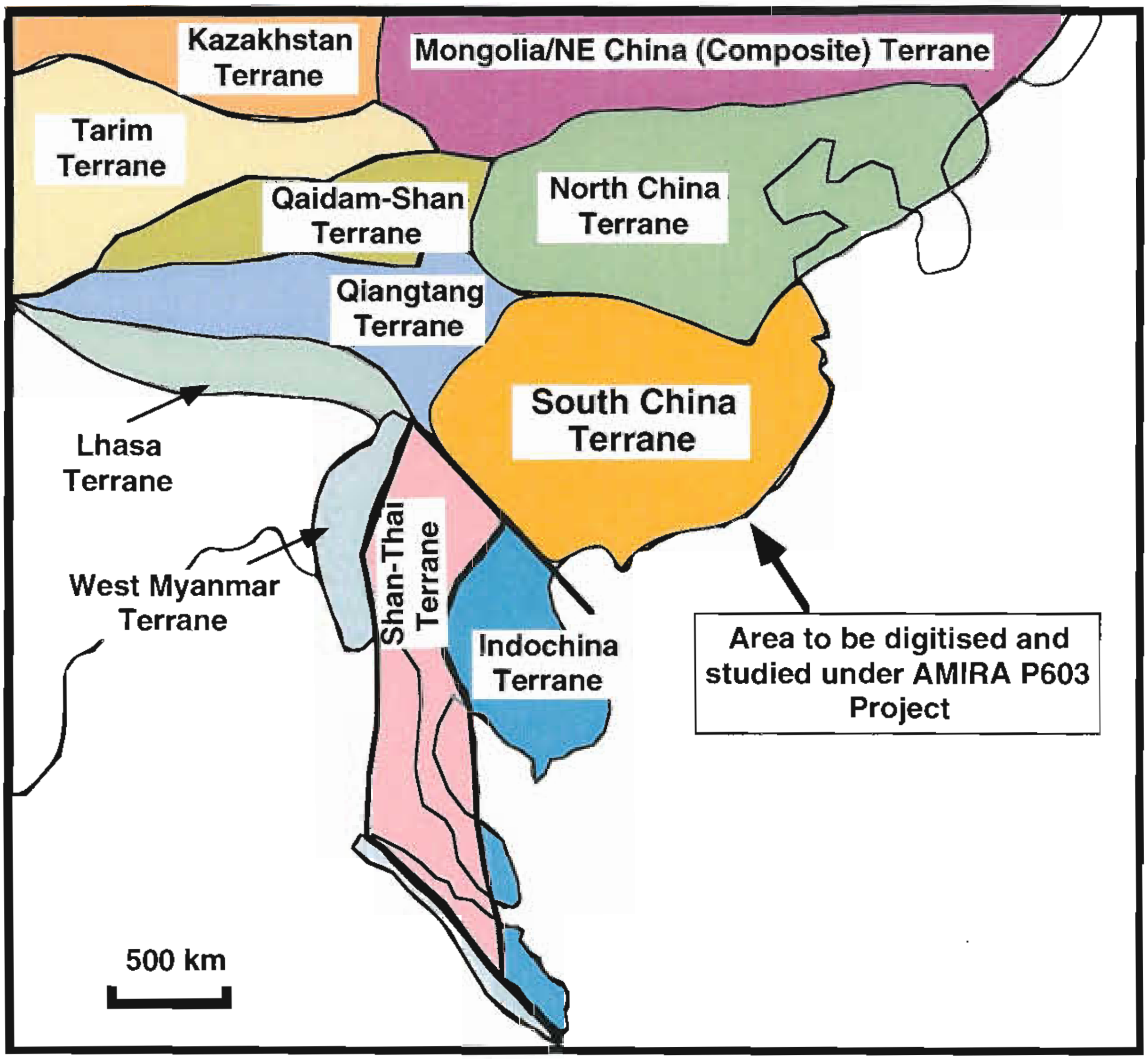


Fig.2. Map showing major crustal terranes in SE Asia and China and the area to be digitised and studied under the P603 project. West Myanmar, Shan-Thai and Indochina teranes have been digitised and studied under the P390A project.

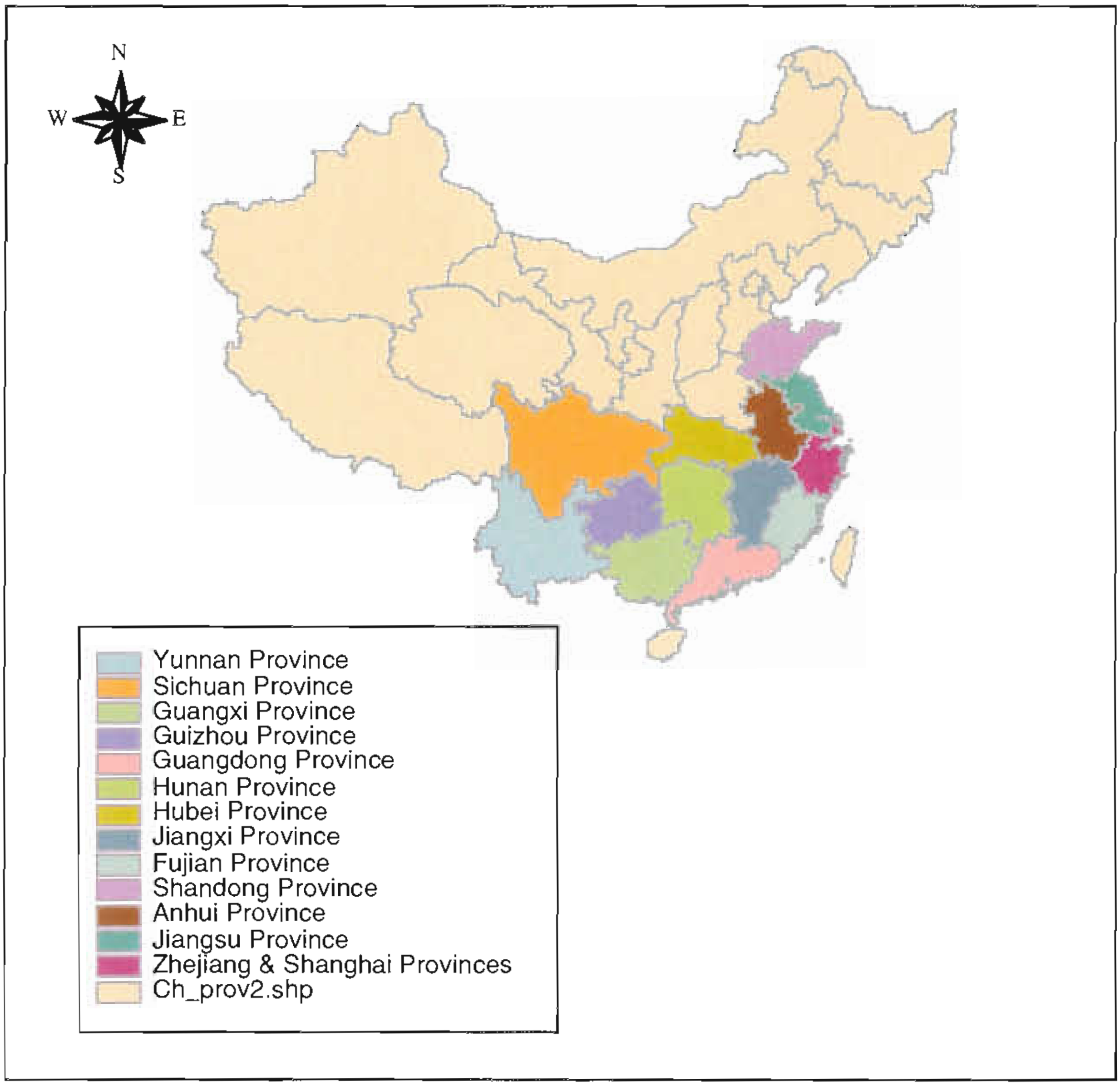


Fig. 3. Map showing provinces in South China to be covered by this AMIRA P603 project.

these deposits from the MMAJ maps. MMAJ listed about 50 major deposits from Yunnan. Dr. Khin Zaw visited BRGM, Yunnan and met with Dr. Ding Jun in 1999 and 2000 for collaborative mineral deposits research projects in Yunnan, and Dr. Ding Jun also provided Yunnan mineral deposit data in Chinese. However, as the seal of BRGM is not included in the agreement letter of intent, we excluded the data provided by Dr. Ding Jun in this database. We also acquired mineral deposit data for South China from ECONOMINE (http://www.econominechina.com/) and made an agreement to use the data for this project.

Nearly 400 mineral occurrences have been recorded for Yunnan including lead-zinc-copper±silver, iron, tin-tungsten, gold, and nickel-copper-platinum-palladium occurrences (Fig. 5). Many base metal deposits are widely distributed in Yunnan and there is potential for world class base metal discoveries in Yunnan.

Lead-zinc-silver deposits: The relationships of geology and lead-zinc-silver deposits are shown in Fig. 6. At least five different styles of lead-zinc-silver mineralisation occur in Yunnan:

1. With copper in sedimentary exhalative (Sedex) deposits (e.g., Tertiary Jingding/Lanping deposit) and Mississippi Valley Type (MVT) deposits (e.g., Carboniferous Qilinchang deposit),

2. With copper in volcanic-hosted massive sulphide (VHMS) deposits (e.g., Carboniferous Laochang deposit, and the recently discovered Carboniferous Dapingzhang deposit),

3. With copper and tin in lead-zinc skarn deposits (e.g., Triassic Dadongchang and Hongshan deposits),

4. With precious metals in veins and porphyry deposits (e.g., Beiya deposit), and

(5) With tin and copper in Sn-W vein and skarn deposits (e.g., Mengzimao).

Sedex and MVT deposits: The Jingding deposit is the largest Sedex type deposit in China (Fig. 6) and contains a geological resource of 220 Mt ore grading 7.0 % Zn+Pb, 5.8 g/t Ag and 0.08 % Cd (Kyle and Ning Li, 2002). The deposit is hosted in the Eocene Yunlong Formation consisting of sandstone, siltstone and limestone. These rocks form the upper section of the Lanping-Simao basin developed during the Permian to Tertiary. The deposit occurs in the northern part of the Lanping-Simao basin (e.g., Qingtong et al., 1992; Shangqing and Sanchuan, 1993; Junlie et al., 1994; Ning Li and Kyle, 1997; Kyle and Ning Li, 2002). The ores were deposited in a smaller sub-basin (probably a rift basin) rich in gypsum. The mineralisation is stratabound with enrichment of celestite (SrCO3) at the base and followed by barite, then sphalerite and galena. The deposit area is also characterised by thrusting of Upper Triassic limestone and Jurassic sandstone. The presence of MVT deposits has also been recently reported in Yunnan (e.g., Qilinchang deposit). The Qilinchang deposit is hosted in the Baizuo Formation (Lower Carboniferous) dolomite, and the ore reserves are about 3.32 Mt grading 17.5 % Zn and 6.6 % Pb (Chaoxian Zhou et al., 2001). The ore minerals are sphalerite, galena, and pyrite with a gangue of quartz and carbonates.

VHMS deposits: Major VHMS deposits in Yunnan occur in the Upper Palaeozoic island-arc related Changning-Menglian felsic volcanic belt. This belt is 20–60 km wide and 250 km long and extends south into Myanmar. The volcanics are mafic tholeiitic, felsic and alkaline and host both Pb-Zn-Cu-Ag and Cu-Zn types. The Laochang is a Pb-Zn-Cu-Ag type VHMS deposit and the mining activity at Laochang dates back to the 14th Century. The geological ore reserves of the deposit are at least 20 Mt ore grading 3.8 % Pb, 3.5 % Zn, 1.9 % Cu and 113 g/t Ag (Yang and Mo, 1993, 2001; per. comm., Yang, 1999; Hou Zengqian et al., 1999). The deposit is hosted in Upper Carboniferous volcaniclastic rocks of basaltic-andesitic composition with alkaline affinities (Yang and Mo, 1993; Yang et al., 1993, 1999) and the volcanic units are in fault contact with limestone. Major faults striking N-NW occur in the vicinity of the deposit. The ore is generally massive, fine-grained and banded but sedimentary features such as graded-bedding, ripple marks and sulphide clasts are reported. The ore minerals are sphalerite, galena, chalcopyrite, pyrite, pyrrhotite, arsenopyrite, minor sulphosalts, bornite, magnetite, hematite and cassiterite. Carbonate minerals are relatively abundant, and realgar and orpiment also occur at the top of the ore lenses.

The Dapinzhang deposit is a recently discovered Cu-Zn type, Upper Carboniferous VHMS deposit in Yunnan (Fig. 6) and is similar to the Laochang deposit. The deposit was discovered in 1996 by a Chinese geological team after following up a regional 1:200,000 scale Cu anomaly, and the geologists later found that local people had already started digging for copper within the Cu anomaly area. The deposit occurs within two small isolated Carboniferous, felsic volcanic inliers near the southwest margin of the Simao basin. The mineralisation occurs along a strike length of 3000 m and the width of sulphide zone is 10–70 m thick. The extent of the sulphide mineralisation has not been closed off towards the SE. The mineralisation consists of banded sulphides of chalcopyrite, sphalerite, galena and pyrite grading 4.1 % Cu, 1.1 % Zn, 0.6 % Pb, 3.5 g/t Au and 110.6 g/t Ag (per. comm., Paul Chromie, 2000; Hou Zengqian et al, submitted, 2002). The other VHMS deposits are the Cu-Zn type Tongchangie deposit, the cupriferous Sandashan deposit and Cu-Fe type Dahongshan deposit which are also hosted in Upper Carboniferous to Permian volcanics and metavolcanics.

The Qilinchang Zn-Pb deposit is an example of an MVT deposit in Yunnan. The deposit is hosted in dolomite and limestone of Carboniferous age. The reserves of the deposit are about 3.3 Mt grading 17.5 % Zn and 6.6 % Pb (Chaoxian Zhou et al., 2001). The mineral assemblages are sphalerite, galena, pyrite, and calcite. The presence of thick carbonate sequences of Late Proterozoic (Sinian) to Palaeozoic age and the tectonic setting also suggest that there is a potential for Sinian-aged MVT type base metal deposits in Yunnan. The Sinian MVT deposits are reported to the north, in the Sichuan province (e.g., Daliangzi deposit) (see later Sichuan section). The Daliangzi deposit is hosted in a Sinian carbonate sequence and contains 24 Mt grading 10.4 % Zn, 0.8 % Pb and 43 g/t Ag (e.g., Zheng and Wang, 1991). These deposits are similar in style to the MVT deposits of the Lennard Shelf, Western Australia. BHP discovered a new MVT deposit in the Sinian carbonate units in Sichuan and sold it to a third party. The Sinian is regarded as a local chronostratigraphic (time-rock) term for the pile of sediments deposited on the unconformity caused by the collision of Yangtze and Cathaysian terranes in South China at about 850 Ma. The Sinian sequence ranges in age from about 850 Ma to about 545 Ma (base of Cambrian) and is widely distributed in Yunnan. The Middle Proterozoic to Sinian carbonate sequence in the Janning-Anning county area of Yunnan hosts discordant Zn-Pb mineralisation in cavity-fill, veins and breccia (e.g., Liaocaoba). The nature of mineralisation is not well understood, and is thought to be discordant Sedex type mineralisation or MVT type mineralisation.

**Copper deposits:** Yunnan province has important copper mineralisation styles (Fig. 7). As described above, copper occurs in association with Zn-Pb-Ag-Au type VHMS, Cu-Zn type VHMS (e.g., Permo-Carboniferous Tongchangjie deposit, Yang et al., 1999), Cu-Fe type VHMS (e.g., Permo-Carboniferous Dahongshan deposit, Xu Qidong, 1999), and Sedex deposits. Yunnan also hosts Cu-Fe type Proterozoic deposits (e.g., Dongchuan deposits, Ruan Huichu et al., 1991; Chen Wenming, 1997) but many of these deposits are still poorly documented. These Dongchuan deposits appear to be copper-dominant Sedex deposits (sediment-hosted stratiform copper deposits).

Brown (1997) indicates that this type of copper deposit is an important, economically attractive, world-class mineral deposit type, traditionally represented by supergiants such as the Kupfershiefer of north-central Europe and the copper belt of Central Africa. They tend to be high-tonnage deposits because of their wide lateral extent along preferred stratigraphic units. As well, their copper grades frequently surpass those of 'competitive' deposit types such as porphyry copper ores and they may contain significant amounts of other highly desirable metals such as cobalt and silver. The presence of copper-cobalt and copper-silver occurrences is also noted in Yunnan. These copper-silver±cobalt associations occur in the Devonian "Red Bed" strata along a strike length of 2 km with a thickness of 2–4 m. The ore minerals are chalcopyrite, bornite, chalcocite, galena and tetrahedrite. Mineralogy and lateral continuity of the deposit show similarities that are typical of a sediment-hosted copper deposit.

Copper is also associated with epigenetic vein-type and epithermal/porphyry deposits in Yunnan (e.g., Beiya deposit) or porphyry deposits (e.g., Xuejiping deposit). Copper bearing vein and skarn (?) deposits are also present. Most of these porphyry copper systems are also associated with molybdenum, and are Himalayan (Tertiary) in age (e.g., Machangqing Cu-Mo porhyry/skarn deposit, Peng et al., 1998), and extend north into Tibet (Hou Zengqian et al., 2003 in press). Examples in Tibet are the Yulong, Mangzhong, Duoxiasongduo, and Malasongduo Cu-Mo (Au) deposits (Hou Zengqian et al., 2003b in press). In Yunnan, copper is also associated with intrusive-related nickel-platinum deposits in ultramafic-mafic rocks (see below).

**Gold deposits:** Yunnan has small-scale gold and silver mining, and the province remains largely unexplored for precious metals. Although Yunnan is not a significant gold producer, its geological and tectonic setting suggests that the province will become a gold producing region. The relationships of gold deposits, faults and granitoid intrusions in Yunnan are shown in Figure 8. Four distinct primary gold mineralisation types may be recognised: (1) Carlin-type gold deposits (e.g., Kuzhubao, Bashishan, Dihei and Miluo) (Chromie, 2002; Chromie and Khin Zaw, 2001; Chromie and Khin Zaw, submitted 2002), (2) epithermal ? Vein, and breccia gold deposits (e.g., Beiya deposit), (3) porphyry copper±gold deposits (e.g., Yangla deposit), and (4) medium to high-grade metamorphic rock-hosted, structurally controlled gold deposits along the Ailaoshan belt (e.g., Jinchang and Daping deposits). Presently available geological information suggests three other possible gold mineralisation styles: (1) skarn (?) copper±gold deposits, (2) Cyprus type copper±gold deposits and (3) gold-platinum-palladium in mafic-ultramafic intrusives.

The Carlin type deposits are located in SE Yunnan adjacent to the Guizhou and Guangxi provinces, a region known as the southern Golden Triangle. These deposits occur along the western margins of the South China Block; within the Youjiang margin sag-basin covering an area of approximately 100,000 $km^2$ at the junction between Guizhou, Guangxi and Yunnan provinces (Li and Peters, 1998, Peters, 2002). The Kuzhubao and Bashishan deposits in Yunnan host epigenetic micro-disseminated gold. The gold is hosted within Devonian carbonaceous mudstone units and along fault breccia zones at the contact between Triassic gabbro for the Kuzhubao deposit, and Devonian mudstone units for Bashishan. Gold mineralisation generally occurs within zones of high deformation, especially where later strike-slip and normal faults crosscut earlier low-angled thrust faults. Major sulphide minerals are euhedral and disseminated pyrite, rhombic and acicular arsenopyrite, as well as stibnite and minor iron-poor sphalerite. Gangue minerals are quartz, sericite, calcite, ankerite and chlorite (Chromie and Khin Zaw, 2001; Chromie and Khin Zaw, submitted, 2002). The nature of these deposits in Guizhou and Guangxi provinces will be described in later sections.

**Nickel deposits:** Yunnan has potential for Proterozoic ultramafic-hosted Voisey's Bay type Ni-Cu-Co±PGE mineralisation styles. The Voisey's Bay contains 136 Mt grading 1.59 % Ni and significant Cu-Co credits (Naldrett, 1997; Naldrett and Li, 2000). It is interesting to note that Ni-Cu-Co-PGE deposits also occur at Jinchuan in the Gansu province where mineralisation is hosted in Proterozoic mafic-ultramafic bodies (e.g., Guo and Dentith, 1997; Naldrett, 1997; Barnes and Tang, 1999). The Jichuan deposit hosts more than 500 Mt of ore grading 1.2 % Ni and 0.7 % Cu. Similar Proterozoic mafic-ultramafic bodies are distributed in Yunnan and Sichuan (for Sichuan see later section). Pt-Pd-Ni-Cu-Co occurrences are also recorded in Yunnan in association with these mafic and ultramafic rocks (Fig. 9).

There is also potential for the Noril'sk type Pt-Pd-Cu-Ni deposit which are associated with Permian to Triassic basaltic volcanic rocks and have 900 Mt grading 2.7 Ni (e.g., Naldrett, 1997). BHP explored for these styles in Yunnan and Sichuan (per. comm., Paul Chromie, 2000).

The Jinbaoshan Pt-Pd-Ni-Cu deposit, located approximately 134 km south of Dali in Mindu county, Yunnan province may be an example. The mineralisation includes platinum group metals; chalcopyrite and pentlandite forming as magmatic segregations into conformable layers within ultramafic sills composed principally of late Carboniferous-Permian ? peridotite intruding Devonian siltstone and dolomite. The deposit was discovered in 1971 by the Third Geological Brigade and further exploration work included geological mapping, magnetic surveys, trenching, aditing and diamond drilling. Chinese geologists estimated a geological resource of 31 Mt grading 1.49 g/t combined Pt+Pd with 1.4 % Cu, and 0.17 % Ni using 0.5 g/t Pt+Pd cutoff value. The deposit is currently under exploration by Pacific Minerals (http://www.pacific-minerals.com/). A new sedimentary exhalative Ni-Mo mineralisation style in Cambrian black shale is also reported at Deze, in Yunnan (Lott et al., 1999). The deposits appear to be related to a deep fracture zone extending from Yunnan, through Guizhou, Hunnan, to Zhejiang provinces.

## 3.2. Sichuan Province

Sichuan province lies between 97°21'-110°12'E and 26°03'-34°19'N and it is bordered by Yunnan to the south, Tibet to the west, Qinghai and Gansu to the northwest, Shaanxi and Hubei to the northeast and Guizhou and Hunan to the southwest. Several major orogenic belts in SE Asia and Yunnan pass through Sichuan province and extend into Tibet, Qinghai and Gansu. Similar to Yunnan, Sichuan province has the potential for recoverable mineral resources of lead, zinc, silver, copper, gold, nickel, cobalt, and the platinum group metals.

### 3.2.1. GIS coverage of geology for Sichuan

For GIS geology coverage, we digitised the 1:1,000,000 scale geological map from geological memoir Series 1, No. 23 on the Regional Geology of the Sichuan province (1991). Preparation of this memoir began in 1984 based on 80 regional geological map sheets at a scale of 1:200,000. The Sichuan province has a stratigraphy ranging in age from the Archaean to the Quaternary and contains important mineralised foldbelts at the western margin of the Yangtze Craton. A detailed digitised geological map of Sichuan province is shown in Figure 10 together with polygon ID for each stratigraphic and lithologic unit.

### 3.2.2. MINDEP database for Sichuan

Similar to Yunnan, considerable spatial mineral deposit data for the Sichuan province are available in the literature. Dr. Khin Zaw visited Chengdu and met with Prof. Luo Yaonan and the group from the Sichuan Bureau of Geology and Mineral Resources (SBGRM); and also with Prof. Liu Rong and his group from the SW Institute of Metallurgical Mineral Resources Exploration. Both groups assisted the development of the mineral deposit database for Sichuan province. Mr. Luo Yaonan of SBGRM provided an "Atlas of Geological Resources and Environment of Sichuan Province" published by the Chengdu Cartographic

Publishing House in 1998, and Mr. Liu Rong also provided a metallogenic map of Sichuan province showing mineral occurrences including metals, non-metals and energy resources. However, as in the case of Yunnan, there were no seals of SBGRM and the SW Institute of Metallurgical Mineral Resources Exploration in the letter of intent for collaborative mineral deposit research in Sichuan, therefore these maps are not used in this compilation. Dr. Wang Xiaocun from the SW Institute of Metallurgical Mineral Resources Exploration provided gold deposit data from his published work (e.g., Wang Xiaochung and Zhang Zhe-Ru, 1991).

Mineral Resources Maps of China published in 1987, 1992 and 1999 show the major metallic and non-metallic deposits of Sichuan. Metal Mining Agency of Japan (MMAJ) has compiled 32 major mineral deposits of Sichuan province (www.mmaj.jp). Dr. Khin Zaw also collaborated with researchers from the Institute of Mineral Resources, Beijing for a VHMS research project in Sichuan province (e.g., Gacun deposit). The book "The Discovery History of Mineral Deposits of China-Sichuan" published in 1996 also includes major metal and non-metal mineral occurrences. Nearly 300 mineral occurrences are recorded for Sichuan (Fig. 11).

**Lead-zinc-silver deposits:** The relationships of geology and lead-zinc-silver deposits are shown in Fig. 12. At least two major styles of lead-zinc-silver mineralisation occur in Sichuan:

1. Volcanic-hosted massive sulphide (VHMS) deposits (e.g., Triassic Gacun deposit), and

2. MVT deposit (e.g., Sinian Daliangzi deposit).

The Gacun deposit is an important polymetallic, Ag-rich (VHMS) deposit in Sichuan (Fig. 12) and occurs in the Triassic submarine, calc-alkaline volcanic belt which lies in the Yidun collisional orogenic zone of Southwestern China. The deposit has metal reserves of 4 million tones grading 0.44% Cu, 5.40% Zn, 3.70% Pb, 160g/t Ag and 0.44 g/t Au (Hou Zengqian et al, 2000; Hou Zengqian et al, 2001). It is hosted in felsic volcanics associated with an underlying mafic unit (bimodal suite). The volcanics underwent regional lower greenschist facies metamorphism and related deformation during the Yanshanian-Himalayan Orogeny, resulting in folding and shearing of the ore lenses. The deposit is made up of three mineralised zones: a sheet-like upper massive sulphide zone with exhalite (barite, chert and jasper), a middle stringer-stockwork stratabound zone hosted in rhyolitic volcanics and an underlying lower stringer stratabound zone occurring in dacitic volcanics. The ore zone is made up of a series of tabular lenses dipping 70– 80°W, and extends over a strike length of 1200 m and a depth of 700 m. The ore minerals are sphalerite, galena, chalcopyrite, pyrite, arsenopyrite, bournonite, boulangerite, and gold (Hou Zengqian et al., 2000, 2001). The deposit is similar to sheet-style VHMS deposits (Large et al., 2001) and is comparable to the Cambrian Rosebery VHMS deposit in western Tasmania (Khin Zaw et al., 1997a, 1999c).

Several carbonate-hosted Pb-Zn-Ag deposits occur within the Sinian dolomite unit of the Kang Dian foldbelt in western Sichuan. Currently mined resources include Daliangzi (24 Mt @ 10.4 % Zn, 0.75 % Pb, 43.1g/t Ag) and Tianbaoshan (20 Mt @ 10.1 % Zn, 1.4 % Pb, 93.6g/tAg) (Fig. 12). Host stratigraphy to Pb-Zn mineralisation is mainly the Sinian Upper Dengying Formation consisting of algal and vuggy dolomites which unconformably overlie a Proterozoic basement of phyllite and schists (Huili Group). Cambrian black siltstone, shale and sandstone unconformably overlie the host Sinian sequence and are in turn unconformably overlain by Permian limestone and basalts. Basement stratigraphy has a dominant EW fault structural trend. Sinian and younger platform stratigraphy have NW, NNW and NS fault strikes. Sulphide mineralisation occurs where NW and NNW fault strikes intersect close to regional EW thrust zones (per. comm., Paul Chromie, 2000).

The unconformity between the Cambrian and the Sinian Dengying is important for localising and trapping mineralising fluids. Mineralisation is predominantly epigenetic and occurs within fault-related breccias, veins, joints, karst features and solution collapse breccias. Sphalerite, galena, pyrite, barite and calcite mineralisation occur, along with occasional minor chalcopyrite, and fluorite. Black carbonaceous mudstones are frequently associated with sulphide mineralisation in breccia zones and open space karsts. Oxidised surface occurrences contain hydrozincite and are currently mined at several locations. Most of the known resources were earlier identified in remote areas from regional stream sediment sampling, soil sampling and structural mapping.

During 1993, the Sichuan Kang Dian exploration Joint Venture (SKD) was established comprising BHP Minerals Exploration Inc., two Chinese companies, the South West Metallurgical and Geological Exploration Bureau (SMGEB) and the China Non-Ferrous Metal Industrial Corporation (CNNC) to explore for Daliangzi type Pb-Zn deposits within the Sichuan Kang Dian area. Exploration methods consisted of reconnaissance, regional and detailed mapping, contour and grid soil geochemistry, induced polarisation (IP) surveying and drilling. As these deposits are similar to MVT deposits in the Lennard Shelf, western Australia (Dorling et al., 1998), BHP adopted the exploration model and criteria used in the Lennard Shelf area and discovered the Dayinchang deposit (5.6 Mt @ combined 3 % Zn +Pb) just south of the Daliangzi deposit.

**Gold deposits:** Sichuan has significant gold potential and lies at the northern Golden triangle of China (Sichuan, Gansu and Shaanxi). The region is currently one of the largest potential producers of gold in China and continues to be the focus of further extensive exploration. More than 30 gold deposits and prospects have been found in Sichuan alone over the past 10 years. These deposits have been compiled together with other gold deposits in Sichuan and their distribution is shown in Figure 13. Four distinct primary gold mineralisation deposit types can be recognised: (1) Carlin-type gold deposits in NW Sichuan adjacent to Gansu and Shaanxi provinces (e.g., Dongbeizai, Qiaoqiaoshang) (Gu Xuexiang, 1996; Wang Xia-Chun and Zhe-Ru Zhang, 1999), (2) tellurium-rich epithermal ? vein gold deposits (e.g., Dashuigou deposit, Jingwen Mao et al., 1995), (3) porphyry copper±gold deposits and (4) medium to high-grade metamorphic rock-hosted, structurally controlled gold deposits. Gold is also associated with VHMS deposits (e.g., Triassic Gacun deposit).

Before the 1980s, gold production in Sichuan was focussed on placer and intrusive-related vein deposits. Sedimentary rock (turbidite)-hosted gold deposits are currently more important in Sichuan. These gold deposits show many characteristics of Carlin-type gold deposits such as host rock, mineralogy and structural setting. The host rocks are mostly Devonian to Triassic carbonaceous, turbidite sequences within the Songpan-Garze accretionary wedge terrain, along the NW margins of the Yangtze Craton. They consist of largely sandstone-siltstone-mudstone, and it is interpreted that the host rocks were accumulated in the back arc basin situated between an active continental island margin (the Kunlun-Qinling fold belt) and a continental island arc (the Yidun island arc).

The dominant structure is N-S and E-W trending regional faults (Palaeozoic) that are crosscut by NW-SE trending faults (Mesozoic). Mineralisation appears to be associated with late structures and occurs mostly within graphitic shear zones or along the altered contacts with quartz-porphyritic or granodioritic dykes of Mesozoic age related to the Indosinian (Triassic) and Yanshanian (Jurassic to Cretaceous) orogeny. Ore mineral assemblages are pyrite, arsenopyrite, realgar, stibnite, scheelite, and traces of chalcopyrite, tetrahedrite, tennantite, sphalerite, galena, native arsenic, native gold, pyrrhotite and marcasite. The gangue minerals are mostly quartz, calcite and dolomite. The gold is commonly extremely fine-grained, usually less than 1 micron and refractory. The deposits also show different metal association from Au-As (Dondgbeizai), Au-W (Manaoke), Au-Sb (Qiuluo), and Au-U (Laerma) to Au (Pulongba).

The most important Carlin-type deposits in Sichuan are Dongbeizai and Qiaoqiaoshang (Jingweng Mao et al., 2002). Dongbeizai is one of the largest gold deposits discovered to date in western China (52 t @ 5.54 g/t Au or 1,689,000 oz Au). It is located in Songpan County, about 25 km northwest from the city of Songpan, at an elevation of 3000 m. It was discovered during early 1980 as a result of a reinvestigation program of old realgar showings by the Regional Geological Survey Team of Sichuan province (Gu Xuexiang, 1996). Qiaoqiaoshang is also a large deposit (15 t @ 4 g/t Au or 405,000 oz Au) similar to Dongbeizai. BHP extensively explored in the region (e.g., Maerkang) and drilled some of the prospects (e.g., Shuiniujia deposit).

**Nickel-copper deposits:** Sichuan has potential for Proterozoic ultramafic-hosted Voisey's Bay type Ni-Cu-Co±PGE mineralisation style and Permian to Triassic Noril'sk type Pt-Pd-Cu-Ni deposits. Proterozoic mafic-ultramafic bodies are distributed in Sichuan. Extensive exposure of Permian Emieshan flood basalt covers 250,000 square kilometers in SW China including Sichuan province. Other Palaeozoic ultramafic/mafic intrusions also occur near the basalt margins. Pt-Pd-Ni-Cu-Co occurrences are also recorded in Sichuan in association with these mafic and ultramafic rocks (Fig. 14).

BHP had explored for these styles in Sichuan, and BHP sampling from 1994–1996 shows ultramafic intrusions with nickel depletion in olivines. This chalcophile depletion may indicate the presence of sulphide elsewhere in the intrusions sampled (pers. comm., Paul Chromie, 2000). The important deposits are Lengshuiqing (2.5 Mt @ 0.9 % Ni, 0.5 % Cu and 1 g/t PGE) and Limahe (1.5 Mt @ 1 % Ni, 0.5 % Cu and about 1 g/t PGE) that are hosted in Proterozoic ultramafic rocks and Yangliuping (Danba) deposit in Permian basalt. The Daba deposit area has been explored by BHP and up to 4.7 % Ni and 0.6 % Cu and 3 g/t PGE have been reported (per. comm., Paul Chromie, 2000).

In addition, Cu-rich VHMS deposits also occur in Sichuan (e.g., Liwu deposit and Lalachang deposit) (Hou Zengqian et al., 1999). The Liwu deposit is hosted in Silurian-Devonian metavolcanics and forms as a layer-like massive to disseminated copper-zinc mineralisation (30 Mt grading 2.5 % Cu and 0.6 % Zn). The Lalachang deposit is a currently operating large, layered Cu-Fe deposit hosted in Middle

Proterozoic spilite-keratophyre sequence. The deposit has ore resources of 260 Mt grading 0.9 % Cu.

### 3.3. Guizhou Province

Guizhou province is bordered by Yunnan and Sichuan to the west, and Hunan and Guangxi to the east and south. According to Chinese geologists, the stratigraphy of Guizhou province is known as "Treasure House of Stratigraphy and Palaeontology". The province is characterised by marine clastic rocks of Middle to Late Proterozoic sequences, Palaeozoic to Early Mesozoic carbonates, and continental clastic rocks of Late Triassic to recent age. The province has considerable potential for base and precious metal deposits.

#### 3.3.1. GIS coverage of geology for Guizhou

For GIS geology coverage, we digitised a 1:500,000 scale geological map from geological memoir Series 1, No. 7 on the Regional Geology of the Guizhou province (1987). A detailed digitised geological map of Guizhou province is shown in Figure 15 together with polygon ID for each stratigraphic and lithologic unit.

#### 3.3.2. MINDEP database for Guizhou

More than 250 mineral occurrences have been recorded for Guizhou (Fig. 16). Metal Mining Agency of Japan (MMAJ) has compiled 22 major mineral deposits of the Guizhou province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits-Guizhou" published in 1996 also contains spatial information for metal and non-metal mineral occurrences in Guizhou province. The province has potential for deposits of micron sized (<1 mm) disseminated gold and these deposits also occur in Yunnan and Guangxi in a region known as the Southern Golden Triangle (Yunnan, Guizhou and Guangxi provinces). These deposits have several similarities with the sediment-hosted Carlin-type deposits in Nevada (Cunningham et al., 1988; Ashley et al., 1991; Chromie, 2002, Chromie and Khin Zaw, 2001; Li and Peters, 1998; Peters, 2002). The southern China Carlin-type gold deposits in Guizhou and Guangxi are hosted predominantly by Palaeozoic to Mesozoic aged siliciclastic and carbonate lithologies. These deposits have reserves of >30 metric tons of contained gold metal, with average grades ranging from 2 g/t to 8 g/t Au and some high grade intercepts of up to 16.8 g/t Au (Cunningham et al., 1988; Li and Peters, 1998; Peters, 2002).

The Carlin-type deposits in Guizhou include Lannigou, Zimudang, Getang, Yata, Banqi, Ceyang, and Sanchahe and they are hosted predominantly by Permian carbonate and Triassic siliciclastic lithologies. Among these deposits, Lannigou is the largest deposit (80 t @ 7 g/t Au), followed by Zimudang (60 t @ 5 g/t Au), Getang (22 t @ 6.2 g/t Au), Yata (~15 t @ ~5 g/t Au) and Banqi (~10 t @ ~5 g/t Au) (Taihe Zou et al., 2002; Hu Ruizhong et al., 2002) (Fig. 17). Similar to Carlin-type deposits in USA, they are mostly epigenetic hydrothermal micron-disseminated gold deposits with associated As, Hg, Sb + Tl mineralisation. Lead-zinc-copper, nickel-copper, and copper-tungsten-tin deposits are also widely distributed in Guizhou province (Fig. 18).

### 3.4. Guangxi Province

Guangxi province is bordered by Guangdong and Hunan at the east and northeast, Yunnan and Guizhou at the west and Vietnam to the southwest. A systematic geological survey in Guangxi began in 1965 by the Ministry of Geology and Mineral Resources of China and the Geology and Mineral Resources Bureau of Guangxi province. Guangxi province has the potential for tin, tungsten, lead, zinc, copper, iron, manganese, molybdenum, and gold deposits.

#### 3.4.1. GIS coverage of geology for Guangxi

For GIS geology coverage, we digitised a 1:1,000,000 scale geological map from geological memoir Series 1, No. 3 on the Regional Geology of the Guangxi province (1985). A detailed digitised geological map of the Guangxi province is shown in Figure 19 together with polygon ID for each stratigraphic and lithologic unit. Middle Proterozoic to Quaternary beds are well distributed in Guangxi province.

#### 3.4.2. MINDEP database for Guangxi

About 420 metallic and non-metallic mineral occurrences have been recorded for Guangxi (Fig. 20). Metal Mining Agency of Japan (MMAJ) has compiled 32 major mineral deposits in Guangxi province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits-Guangxi" published in 1996 also contains spatial information for 256 metal and non-metal mineral occurrences in Guangxi province. Similar to Guizhou, this province has potential for Carlin-type gold deposits. The Carlin-type deposits in Guangxi include Gaolong, Huaping, Jinya, Langquan, Lianlong, Luoluo, Mingshan, Siling and Xiangbo. Among these deposits, Jinya and Gaolong are large deposits with ~30 t @ 5.3 g/t Au and 25 t @ 4 g/t Au (Hu Ruizhong et al., 2002) (Fig. 21). Lead-zinc-copper and tin-sulphide deposits are also widely distributed in the province mainly associated with Yanshanian granites (Jurassic to Cretaceous) (Fig. 22). Stratabound Pb-Zn occurrences such as Shiding (Siding) Pb-Zn deposit also occur in Guangxi. These deposits are hosted in Devonian limestone, dolomite and sandstone, and Gu Lianxiang et al. (2000) indicate that they are comparable to Sedex deposits. Similar Sedex-like deposits also occur in the Guangdong province (as discussed in the later section).

Yanshanian granite related tin-tungsten-sulphide skarn deposits also widely occur in the Guangxi province. The most notable example is the Dachang ore field, and numerous geochemical studies have been undertaken on these deposits (e.g., Tanelli and Lattanzi, 1985; Lattanzi et al., 1989; Fu et al., 1991, 1993; Peng et al., 1997). The Dachang ore field has about 100 Mt of ore at 1 % Sn, 3 to 5 % combined Cu, Pb, Zn and Sb and 100 to 300 g/t Ag making it one of the largest tin-polymetallic deposits in the world (Fig. 22). Major deposits include Changpo, Bali, and Longtaoshan tin-sulphide deposit, Lamo copper-zinc deposit, shale-hosted Dafulou deposit and Kangma vein-greisen deposit. The Dachang deposits such as Changpo-Lamo are similar to the Renison-style carbonate replacement tin deposits in western Tasmania (Kitto, 1998).

## 3.5. Hunan Province

Hunan province lies between latitude 24°00'–30°00'N and longitude 109°10'–114°15'E and is bordered by Guizhou and Sichuan at the west, Hubei to the north, Jiangxi to the east, and Guangxi and Guangdong to the south in total covering a land area of 210,000 km$^2$. Geological mapping was undertaken by the Ministry of Geology and Mineral Resources of China and the Geology and Mineral Resources Bureau of Hunan province. The province has potential for iron, lead, zinc, copper, tin, tungsten, bismuth, antimony, molybdenum, and uranium deposits.

### 3.5.1. GIS coverage of geology for Hunan

For GIS geology coverage, we digitised the 1:1,000,000 scale geological map from geological memoir Series 1, No. 8 on the Regional Geology of the Hunan (1988). A detailed digitised geological map of Hunan province is shown in Figure 23 together with polygon ID for each stratigraphic and lithologic unit. The stratigraphic sequence ranging from Middle Proterozoic to Quaternary units are well distributed in the province; a particularly complete Palaeozoic sequence is exposed.

### 3.5.2. MINDEP database for Hunan

About 323 metallic mineral occurrences have been recorded for Hunan (Fig. 24). Metal Mining Agency of Japan (MMAJ) has compiled 34 major mineral deposits of the Hunan province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits-Hunan" published in 1996 also contains spatial information for metal and non-metal mineral occurrences of the Hunan province. The distribution of tungsten-tin and lead-zinc deposits is shown in Figure 25 and the gold deposits in Figure 26. The Hunan province has the potential to discover sizeable skarn-type and vein-type tungsten-polymetallic deposits. Many tungsten-tin-sulphide deposits are distributed in Hunan.

The Shizhuyuan deposit is the largest among the economically important skarn-greisen tungsten-polymetallic deposits in China (Jingweng Mao and Li Hongyan, 1995; Jingweng Mao et al., 1996a, b). These deposits occur along the contact between Upper Devonian dolomitic limestones and the Jurassic Yanshanian granitoids. The Shizhuyuan deposit is a very large low grade polymetallic calcic skarn deposit containing 800,000 tons of tungsten, 500,000 tons of tin, 200,000 tons of bismuth, 100,000 tons of molybdenum with beryllium, fluorine and copper. Recently a series of maganese skarn/veins with lead-zinc-silver mineralisation have been found in the area (Jingweng Mao et al., 1996a, b).

Lead-zinc skarn deposits are also found in Hunan (e.g., Huangshaping, Shuikoushan and Kangjiawan) associated with Yanshanian granite magmatism (Nanshi Zeng et al., 2000). These lead-zinc skarn depostis also commonly contain high silver content as well as copper, gold, tungsten, molybdenum and bismuth. Most of the gold occurrences in the Hunan province are minor intrusive-related vein type and alluvial deposits derived from these veins (Fig. 26). A few intrusive-related uranium deposits are also found in Hunan but no spatial data are available.

## 3.6. Guangdong Province

Guangdong province is the southernmost province of China, bordered by Guangxi to the west, Fujian to the east, Hunan and Jiangxi to the north, and South China Sea to the south covering a land area of more than 200,000 km$^2$. The province has undergone complex tectonic, magmatic and volcanic activities associated with the Caledonian (Early Palaeozoic), Variscan (Late Palaeozoic), Indosinian (Triassic), Yanshanian (Juassic-Cretaceous), and Himalayan (Tertiary) Orogenies. The intrusive rocks are genetically and closely related to iron, lead, zinc, copper, tin, tungsten, and rare-metal mineralisation.

### 3.6.1. GIS coverage of geology for Guangdong

For GIS geology coverage, we digitised the 1:1,000,000 scale geological map from geological memoir Series 1, No. 9 on the Regional Geology of the Guangdong (1988). Regional geological mapping of the Guangdong province on a scale of 1:200,000 commenced in 1950, and the 1:1 000, 000 scale geological map is based on the 1:200,000 maps. A detailed digitised geological map of Guangdong province is shown in Figure 27 together with polygon ID for each stratigraphic and lithologic unit. It is interesting to note that the oldest rock unit in the Guangdong province is the Sinian sediments.

### 3.6.2. MINDEP database for Guangdong

About 310 metallic mineral occurrences have been recorded for Guangdong (Fig. 28). Metal Mining Agency of Japan (MMAJ) has compiled 33 major mineral deposits of the Guangdong province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits-Guangdong" published in 1996 also contains spatial information for metal and non-metal mineral occurrences of the Guangdong province. The distribution of lead-zinc deposits is shown in Figure 29 and the gold deposits in Figure 30. Guangdong is a major producer of lead, zinc, copper and pyrite in China and has significant stratabound lead-zinc-silver-antimony deposits (e.g., Fankou), copper-(lead-zinc-tungsten) deposit (e.g., Dabaoshan) and pyrite deposits (e.g., Hongyan deposit) (Gu Lianxing et al., 1992, 2000, in preparation, 2002). The Fankou deposit (42 Mt @ 10 % Zn, 4.8 % Pb, and 101 g/t Ag) and Dabaoshan deposit (126 Mt @ 0.72 % Cu and 21 Mt @ 4 % Zn and 2.3 % Pb) are the most important deposits (Fig. 29). These deposits are hosted in Devonian to Carboniferous limestone, siltstone and sandstone. The tectonic setting of these deposits is poorly documented but it is suggested to be an intracontinental basin (Gu Lianxing et al., 1992, 2000, in preparation, 2002) or intra-arc trough between the island-arcs (Zhu Shangqing and Chi Sanchuan, 1993). The ore metals are Pb, Zn, and Cu with recoverable W, Sn, Ag, Au, Sb, Hg, U, Bi, Tl and Mo. Ore mineralogy is sphalerite, galena, pyrite, chalcopyrite with minor scheelite and stibnite.

The deposits show vertical and lateral stratigraphic zonation. The general trend from the base upwards is Fe-sulphide>Cu>(Cu-W)>Pb>Zn-Fe>Mn-carbonates, and laterally from feeders they show Cu>W>Pb>Zn>Ag-Fe>Mn zonation. The deposits are commonly controlled by the host rock lithology and growth faults (e.g., Fankou). Under the stratiform ores in some deposits, there are fissure-fillings, breccia-cementing and impregnated mineralisation that represent the submarine hydrothermal feeder zone, and sub-seafloor replacement of host limestone in the feeder zone. This is recognised at Fankou (per. comm. Gu Lianxing, 2000). These deposits have been compared with Sedex deposits (Gu Lianxing et al., 1993, 2000, in preparation, 2002). Although further detailed geological and geochemical studies are required to understand the origin of these deposits, the presence of the Sedex-like stratabound deposit in South China, however, suggest potential for the discovery of large Sedex deposits in the region.

Guangdong province also has significant mylonite-hosted, mesothermal gold deposits (e.g., Gaocun and Yunxi deposits, also known as Hetai goldfields), stretching from southeastern Guangxi to western Guangdong (Fig. 30). At least six major deposits have been discovered in the field since 1982 making it the largest goldfield in South China (Wang et al., 1997; Guilin Zhang et al., 2001). The gold mineralisation is confined to a series of ductile shear zones in the Yunkai metamorphic rocks (mica schist, feldspar-mica schist, and mica gneiss) of Sinian age. These rocks have been later affected by the Hercynian-Indosinian Orogeny resulting in a series of ENE oriented ductile shear zones (mylonite belts). The Gaocun deposit is hosted in one of these shear zones. The deposit is the largest in the field and has been mined since 1989. Prior to mining, it was estimated to contain 30,700 kg of gold grading 3 g/t Au with intersection as high as 73 g/t Au in sulfidic ores (Guilin Zhang et al., 2001). The Gaungdong province has a few porphyry tungsten deposits (e.g., Lianhuashan) (Mutschler et al., 1999).

## 3.7. Jiangxi Province

Jiangxi province is bordered by Hunan and Hubei to the west, Anhui to the north, Zhejiang and Fujian to the east and Guangdong to the south. Jiangxi province is bounded by latitude 24°29'–30°04'N and longitude 113°48'–118°28'E, covering an area of 166, 900 km$^2$ with a population of 41 million. The province has excellent potential for tungsten, tin, lead, zinc, and copper-gold deposits.

### 3.7.1. GIS coverage of geology for Jiangxi

For GIS geology coverage, we digitised the 1:500,000 scale geological map from geological memoir Series 1, No. 20 on the Regional Geology of the Jiangxi (1990). Jiangxi Bureau of Geology and Mineral Resources carried out regional geological mapping of the Jiangxi province on a scale of 1:200,000 and compiled the 1:500, 000 scale geological map. A detailed digitised geological map of Jiangxi province is shown in Figure 31 together with polygon ID for each stratigraphic and lithologic units.

### 3.7.2. MINDEP database for Jiangxi

About 220 metallic and non-metallic mineral occurrences have been recorded for Jiangxi (Fig. 32). Metal Mining Agency of Japan (MMAJ) has compiled 33 major mineral deposits in Jiangxi province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits-Jiangxi" published in 1996 also contains spatial information for metal and non-metal mineral occurrences in Jiangxi province. The distribution of tungsten-tin and lead-zinc deposits is shown in Figure 33 and the copper and gold deposits in Figure 34. The most important vein-type tungsten deposit is Xuhuashan, Dangping and Piaotang (Yan et al., 1980; Wu and Mei, 1982; Tanelli, 1982; Giuliani, et al., 1988). Similar vein-type deposits are also found in adjacent Myanmar (e.g., Mawchi mine, Khin Zaw and Khin Myo Thet, 1983, Hermyingyi Mine, Khin Zaw, 1978). The Mawchi Mine was one of the largest W (Sn) deposits in the world before World War II.

The province has potential for porphyry copper-gold-(molybdenum-silver) mineralisation. The Dexing district in the Jiangxi province is the largest porphyry copper ore field in China (1500 Mt ore @ 0.43 % Cu, 0.02 % Mo, 0.16 g/t Au and 1.9 g/t Ag approximately equivalent to 6.45 Mt Cu, 0.25 Mt Mo, 24 t Au and 285 t Ag) (Yusheng Zhai et al., 1997; Mutschler et al., 1999; Wenwu He et al., 1999). The Dexing deposits are associated with granodiorite porphyries of Yanshanian age (148–170 Ma) that intruded slate and phyllite of the Mesoproterozoic Shuanqiaoshan Group. The granodiorite porphyries lie along the intersection of a NW trending fault and NE trending anticlinal axis. The three orebodies, Tongchang, Fujiawu and Zhushahong are pipe-like in profile and circular in plan, with the largest, Tongchang, being 0.7 km in diameter. The contact zone between the porphyry and the host rocks is metamorphosed to hornfels. It is interesting to note that two thirds of the copper reserves in the Tongchang deposit are in the country rock and the contact zone. The ore minerals are pyrite, chalcopyrite, molybdenite, tennantite, bornite, and electrum. The other Au-rich porphyry is the Yinshan deposit (1 Mt metal @ 1.7 % Cu, 59 t @ 2 g/t Au).

The Jiangxi province also has porphyry-related Cu-Fe-Au skarn system associated with multiple phases of Yanshanian intrusions into carbonate-rich sequences that formed the Lower to Middle Yangtze River metallogenic belt (e.g., Taihe Zhou, 1995, 1999; Yusheng Zhai et al., 1996; Yiming Zhao et al., 1999; Yuanming Pan and Ping Dong, 1999; Yanjiang Chen et al., in preparation, 2002), and this belt accounted for more than 600 t Au in China. The most important Au-rich porphyry/skarn deposits in the Jiangxi province are Chengmenshan (1.7 Mt metal @ 0.76 % Cu, 57 t @ av. 0.25 g/t Au and 224 t @ 9.9 g/t Ag), and Wushan (2.48 Mt metal @ 1.38 % Cu, 67 t @ av. 0.5 g/t Au). This metallogenic belt extends into Hubei, Anhui and Jiangsu provinces (see below).

## 3.8. Hubei Province

Hubei province is located in the middle regions of the Yangtze River at latitude 29°05'–33°20'N and longitude 108°21'–116°07'E and is bordered by Shaanxi, Henan and Anhui to the north, Sichuan to the west, and Guizhou, Hunan and Jianxi provinces to the south covering an area of 185,000 km². The province constitutes two geologically important tectonic domains: the Qinling fold belt to the north and west and the Yangtze craton to the east and south. Magmatic activity related to Caledonian and Yanshanian-Himalayan orogeny in the Hubei province are genetically and closely related to iron, lead, zinc, copper, tin, tungsten, and rare metal mineralisation in the province.

### 3.8.1. GIS coverage of geology for Hubei

For GIS geology coverage, we digitised the 1:500,000 scale geological map from geological memoir Series 1, No. 20 on the Regional Geology of the Hubei (1990). Hubei Bureau of Geology and Mineral Resources carried out regional geological mapping of the Hubei province on a scale of 1:200,000 and compiled the 1:500, 000 scale geological map. A detailed digitised geological map of Hubei province is shown in Figure 35 together with polygon ID for each stratigraphic and lithologic units. Hubei province has well-developed Early Proterozoic strata forming part of the Qinling-Dabie fold belt between the North and South China Cratons. The Sinian and Palaeozoic sequence are also widely distributed in Hubei.

### 3.8.2. MINDEP database for Hubei

About 219 metallic mineral occurrences have been recorded for Hubei (Fig. 36) from published literature. Metal Mining Agency of Japan (MMAJ) has compiled 13 major mineral deposits of the Hubei province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits of China-Hubei" published in 1996 also contains spatial information for metal and non-metal mineral occurrences of the Hubei province. The distribution of lead-zinc deposits is shown in Figure 37 and the copper-gold deposits in Figure 38. The Hubei province hosts major Cu-Au metallogenic belt of China along the lower Yangtze River that extends west into Anhui, and consists of significant Cu-Fe or Pb-Zn skarn deposits with high precious metal credits.

The most significant deposits are Tonglushan (1 Mt metal @ 1.8 % Cu, 69 t @ 1.15 g/t Au), Jilongshan (0.3 Mt metal @ 1.6 % Cu, 37 t @ 4 g/t Au), Fengshandong (0.7 Mt metal @ 1.2 % Cu, 16 t @ 0.38 g/t Au), Shitouzui (1 Mt metal @ 1.8 % Cu, 19 t 0.5 g/t Au), and Jiguanzui (20 t @ 4.87 g/t Au). Some skarn deposits are Mo- and tungsten-rich (e.g., Tongshankou, Fengshandong, Longjiaoshan). Most of the deposits are located in the Daye district, and associated with multiple Yanshanian diorite-granodiorite intrusions. The country rocks are mainly Triassic carbonates and less commonly Carboniferous and Permian carbonates (e.g., Yuanming Pan and Ping Dong, 1999). Major ore minerals are chalcopyrite, chalcocite, bornite, pyrite, molybdenite, pyrite, magnetite, galena, sphalerite, tetrahedrite and pyrrhotite. The Hubei province also hosts gossan type gold deposit (also known as invisible gold in weathered supergene zone up to 5 g/t Au) (e.g., Shewushan) (Hong Hanlie et al., 1999).

## 3.9. Anhui Province

Anhui province is located at latitude 29°26'–34°38'N and longitude 114°45'–119°45'E and bordered by Henan to the west, Shandong to the north, Jiangsu at the west, and Zhejiang and Jiangxi provinces to the south covering an area of 139,000 km$^2$. The Yangtze River passes through the province, and the southern part of the province is mountainous with higher relief than the northern part. The Yanshanian magmatic intrusions into carbonate-rich Mesozoic (Triassic) sequences generated an important metallogenic episode forming the largest and richest skarn type iron, copper, gold and silver deposits in China.

### 3.8.1. GIS coverage of geology for Anhui

For GIS geology coverage, we digitised the 1:500,000 scale geological map from geological memoir Series 1, No. 5 on the Regional Geology of the Ahnui province (1987). This 1:500,000 scale geological map is based on the geological survey on a scale of 1:200,000. A detailed digitised geological map of Anhui province is shown in Figure 39 together with polygon ID for each stratigraphic and lithologic units. Similar to Hubei, the Ahui province has well-exposed Early Proterozoic strata forming part of the Qinling-Dabie fold belt between the North and South China cratons. Sinian and Palaeozoic sequences are also widely distributed.

### 3.8.2. MINDEP database for Anhui

About 152 metallic mineral occurrences have been recorded for Anhui (Fig. 40). Metal Mining Agency of Japan (MMAJ) has compiled 15 major mineral deposits for Anhui province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits of China-Anhui" published in 1996 also contains spatial information for metal and non-metal mineral occurrences in Anhui. The distribution of lead-zinc and copper-gold deposits is shown in Figure 41 and the gold deposits in Figure 42. As in the case of Hubei, the Anhui province consists of the western extension of the Cu-Au metallogenic belt of China along the lower Yangtze River. Most of the skarn deposits are porphyry related and cluster in the Tongling district, which is a major producer of copper, iron with a potential for economic zinc, lead, gold and silver. The deposits consist of Fe-Cu-Au, Cu-Au-Mo, Cu-Au, and Au-Cu metal associations.

The deposits are larger in size than those of Hubei and contain more iron and gold. The largest deposits are Xinqiao (0.5 Mt metal @ 0.7 % Cu, 24 Mt metal @ 46 % Fe, 105 t Au @ 0.3 ? g/t Au in sulphide ore and 11.2 t Au @ 4.7 g/t Au in oxide ore), Manshan-Tiamashan (32 t @ 6.5 g/t Au), Shizishan (46 t @ 0.3 g/t Au) and Huangshialoshan (13.5 t @ 5.8 g/t Au) (Guojian Xu, 2001; Taihe Zhou et al., 2002, Yinjiang Chen et al., in preparation, 2002). These skarn deposits mostly have copper grades of more than 1 % (e.g., Tongguanshan, 1.8 % Cu, Fenghuangshan, 1.24 % Cu). These deposits are commonly deformed or have been generated by multiple ore-forming episodes resulting in remobilisation and enrichment of metals. For instance, the largest Xinqiao Cu-Fe-S-Au-Ag deposit was considered to have formed as a Sedex deposit during the Early Carboniferous and was later overprinted by a skarn system related to Yanshanian diorite (110–168 Ma) (Guojian Xu, 2001; Gu Lianxing et al., in preparation, 2002). This resulted in high gold enrichment (116 t), although most of the gold is locked in chalcopyrite or pyrite.

Iron only deposits are also abundant in Anhui province (e.g., Changlongshan Fe deposit). The Changlongshan deposit is hosted in Middle Carboniferous to Lower Permian limestones and contains 29 Mt of metal grading 35.9–58.6 % Fe (Guojian Xu, 2000). Although these deposits are considered skarn deposits or Sedex overprinted by Yanshanian metasomatism. They are commonly strata-bound or stratiform, at a distance from outcropping intrusive rocks and have abundant hematite and a high REE content. Olympic Dam type deposits or IOCG (Iron Oxide Copper-Gold) deposit styles (e.g., Hitzman et al., 1992; Barton and Johnson, 1996; Davidson and Large, 1998) in Anhui province and in the other Middle to Lower Yangtze River provinces should be considered as potential exploration targets. Anhui province also has a porphyry Cu deposit (e.g., Shanxi deposit) associated with Late Jurassic to Early Cretaceous quartz diorite porphyry that intruded Silurian argillaceous siltstone and Jurassic sandstone (e.g., Yuanming Pan and Ping Dong, 1999).

## 3.8. Jiangsu Province and Shanghai City

Jiangsu province and Shanghai City are located at latitude 30°42'–35°08'N and longitude 116°20'–121°54'E. The province and the city are bordered by the East China Sea to the east, Anhui province to the west, Shandong province to the north and Zhejiang province to the south. Jiangsu province is hilly land in the western part and consists of mostly plains and lakes in the eastern part covering a total area of 108,000 square kilometers. The regional geology of Jiangsu province is characterised by Late Archean to Early-Middle Proterozoic flysch, ferruginous chert and spilite-keratophyre association followed by the Late Proterozoic clastic sequences. Sinian and Palaeozoic carbonate and clastic sequences are also exposed in the province. Mesozoic marine carbonates and Quaternary sediments cover most of the eastern part of the province. Considerable iron, copper, lead, zinc and silver deposits are found in the Palaeozoic and Mesozoic sedimentary rocks. Yanshanian (Jurassic-Cretaceous) magmatic-volcanic activity was also accompanied by iron, copper, lead, zinc, silver and gold deposits.

### 3.8.1. GIS coverage of geology for Jiangsu

For GIS geology coverage, we digitised the 1:500,000 scale geological map from geological memoir Series 1, No. 1 on the Regional Geology of the Jiangsu province (1984). Geological studies in the Jiangsu province started as early as 1920 and probably constitutes the earliest geological survey program in China. Academic staff from the University and Institutions in China (e.g., Nanjing University) and some geologists from Germany and France were also involved in the geological mapping and research work. Systematic geological mapping was started by the Jiangsu Geological Bureau from 1950 to 1970 and a geological map on a scale of 1:500,000 scale was produced in 1984. A detailed digitised geological map of Jiangsu province is shown in Figure 43 together with polygon ID for each stratigraphic and lithologic unit.

### 3.8.2. MINDEP database for Jiangsu

About 104 metallic mineral occurrences have been recorded for Jiangsu (Fig. 44). Metal Mining Agency of Japan (MMAJ) has compiled four major mineral deposits for Jiangsu province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits of China-Jiangsu" published in 1996 also contains spatial information for 79 metal and non-metal mineral occurrences. The remainder of the deposit data were acquired from published literature. The distribution of lead-zinc and gold deposits is shown in Figure 45. As the province is covered with Cenozoic sequences, mineral deposits are found only in the lower part of the Yangtze River part of the province. The province has major iron occurrences and some lead, zinc, copper and gold skarn deposits (e.g., Funiushan, 9 t @ 0.85 g/t Au). The Qixiashan Pb-Zn-Mn-Au-Ag deposit is considered as a Sedex deposit which is hosted in Carboniferous dolomite, limestone, shale and sandstone (Gu Lianxing et al., 2000), although it was overprinted by a skarn system associated with Yanshanian magmatism (Fig. 45). The deposit contains 0.4 Mt metal @ 2.6 % Pb, 0.8 Mt metal @ 0.8 % Zn and 0.4 Mt metal @ 17 % Mn with gold credits (27 t @ 0.9 g/t Au) (Gu Lianxing et al., in preparation, 2002; Yanjiang Chen, in preparation, 2002).

## 3.9. Fujian and Zhejiang Province

Fujian and Zhejiang provinces are located in the southwestern part of China with extensive coastlines to the east, and are bordered by Jiangxi, Anhui and Jiangsu to the west and north. The Taiwan Strait lies between the Fujian and Zhejiang coastlines and Taiwan Island. Fujian and Zhejiang provinces have similar areas. Fujian covers an land area of 121,300 km$^2$ (about the size of England) with a population of 20 million, and the Zhejiang has a land area of 108,800 km$^2$ with a population of more than 45 million. The topography is dominated by rolling hills in the northern and eastern coastal areas, and several islands stretch along the offshore region in the east.

Both Fujian and Zhejiang province have exposed rock sequences ranging in age from Upper Proterozoic, Sinian, Palaeozoic to Quaternary, and are characterised by multiple magmatic activities associated with Jinningian, Caledonian, Variscan-Indosinian, Yanshanian and Himalayan orogeny. These multiple orogenic and magmatic-volcanic events have close genetic relationships with metallic ore formation. Extending from Guangdong province, Fujian and Zhejiang had the most extensive Indosinian and Yanshanian intrusive-volcanic activities that formed an integral part of the South China fold belt consisting of a series of island arcs. The South China fold belt is a northwest extension of the Circum-Pacific metallogenic belt. Endogenous ore deposits such as tungsten, tin, molybdenum, beryllium, copper, niobium, tantalum, iron, and boron are associated with magmatic intrusions in the northwest part of Zhejiang, and molybdneum, lead, zinc, gold, silver and other non-metals such as alunite and pyrophyllite, fluorite and bentonite are associated with volcanism in the southeastern part of Zhejiang. Similarly rare metals, molybdenum, lead, zinc, copper, REE, tungsten, iron, gold and silver are moderately abundant in Fujian province.

### 3.9.1. GIS coverage of geology for Fujian and Zhejiang

For GIS geology coverage of Fujian and Zhejiang, we digitised the 1:500,000 scale geological map from geological memoir Series 1, No. 4 on the Regional Geology of the Fujian province (1985), and the 1:500,000 scale geological map from geological memoir Series 1, No. 11 on the Regional Geology of the Zhejiang (1989). Fujian Bureau of Geology and Mineral Resources carried out regional geological mapping of the Fujian on a scale of 1:200,000 as early as 1911, and compiled the 1:500, 000 scale geological map. Zhejiang Bureau of Geology and Mineral Resources undertook a regional geological mapping on a scale of 1:200,00 between 1959 and 1980 and produced the 1:500,000 scale geological map. Detailed digitised geological maps of Fujian and Zhejiang provinces are shown in Figures 46 and 47 together with polygon ID for each stratigraphic and lithologic unit.

**3.9.2. MINDEP database for Fujian and Zhejiang** About 132 metallic and non-metallic mineral occurrences for Fujian and 166 deposits for Zhejiang have been recorded (Figs 48 and 49). Metal Mining Agency of Japan (MMAJ) has compiled nine major mineral deposits of Fujian and 7 for Zhejiang provinces (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits of China-Fujian and Zhejiang" published in 1996 also contains spatial information for metal and non-metal mineral occurrences in Fujian (76) and Zhejiang (90). The distribution of lead-zinc and gold deposits in Fujian and Zhejiang are shown in Figures 50 and 51.

These two provinces cover the South China foldbelt along the southeastern margin of the Yangtze craton and are characterised by well-developed Yanshanian intrusive to subvolcanic rocks associated with porphyry to epithermal copper-gold mineralisation. The most important example is Zijinshan district where the only high-sulpihdation epithermal system in China has been reported. This is located 17 km north of Shanghang (Chil-Sop So et al., 1998). The district accounted for at least 100 Mt of ore containing at least 1.6 Mt metal @ 1.09 % Cu and 15 t of Au @ 0.14 g/t Au and 619 t of Ag @ 6.2 g/t Ag (Chil-Sop So et al., 1998; Mutschler et al., 1999) (Fig. 50). The Zijinshan deposits are associated with a Cretaceous volcanic and/or sub-volcanic dome of dacitic composition. The mineralised granodiorite porphyry occurs as a steeply dipping pipe intruding S-type Jurassic granite and Late Proterozoic phyllite and metasiltstone. The deposits show typical epithermal high-sulphidation alteration zonation assemblages from the deep sercite+ quartz+ pyrite (phyllic) upward to dickite+ quartz+ pyrite and alunite+quartz+pyrite. High copper is typically developed within the alunite alteration zone and shows gradual change of ore assemblages from digenite and enargite at deeper levels to covellite and gold in shallower levels. Subeconomic chalcopyrite+ tennantite+bornite mineralisation is associated with the deeper phyllic alteration zone (Chil-Sop So et al., 1998). Similar high-sulphidation Cu-Au deposits are found in adjacent SE Asian country (e.g., Monywa deposit in Myanmar, Khin Zaw et al., 1999a).

Zhejiang province is characterised by Proterozoic and Palaeozoic sequences of the Yangtze craton and the South China foldbelt separated by NE trending faults and ophiolitic melange along the southwestern Pacific margin. Gold and base metal mineralisation in the province is related to the plate interaction along this Pacific margin (Pirajno et al., 1996, 1997, 2002). The Cu-Au mineralisation is attributed to the Yanshanian tectono-magmatic activity, which resulted from the northeast subduction of the Pacific plate. The mineral deposits of Zhejiang province show a wide variety of styles and types, and were the subject of collaborative studies by the Department of Geology and Mineral Resources of Zhejiang province and the Geological Survey of Western Australia during 1994–1995 (Pirajno et al., 1996, 1997, 2002). The mineral deposits in Zhejiang province include precious (Au-Ag) and polymetallic copper-lead-zinc with precious metal credits as well as a number of industrial minerals (e.g., kaolin, fluorite).

The most important Cu-Au deposit is the vein-type Zhilingtou (2 Mt ore grading 12 g/t Au, 306 g/t Ag approximately equivalent to 18 t Au and 494 t Ag (Guojian Xu, 1995; Pirajno et al., 1996, 1997, 2002) (Fig. 51). The deposit is hosted in orthogneiss and paragneiss of Early Proterozoic age, overlain by intermediate to felsic volcanics of late Jurassic to Cretaceous age. The mineralised veins are gold and silver-rich or copper-, lead- and zinc-rich, and occur as stockwork, veins and breccia. The ore minerals are pyrite, sphalerite, galena, chalcopyrite, pyrrhotite, electrum and rare hessite and sylvanite. The gangue minerals include a variety of quartz from smoky to vuggy texture, sericite, chlorite, rhodonite and rhodochrosite. Geological, fluid inclusions and K-Ar age data suggest that although the deposit is hosted in the Precambrian metamorphic rocks, the mineral-isation is related to Yanshanian magmatism and appears to be similar to an epithermal style deposit (Guojian Xu, 1995). Many epithermal deposits tend to be silver only or silver dominant and can be classified as epithermal silver deposits (e.g., Dalinkou deposit).

Zhejiang province also has structurally controlled, shear-zone hosted, orogenic gold deposits (e.g., Haungshan gold deposit, 3.3 t @ 9 g/t Au). The deposits are hosted in basement rock (Proterozoic diorite) associated with Mesozoic volcanic rocks (Pirajno et al., 1996, 1997, 2002). The Huangshan orebody strikes 60° and dips 40–70° SE and is localised in the sheared diorite. The ore minerals are pyrite, galena and rare altaite, hessite and calaverite. Gold occurs as in-fills in the pyrite. The gangue minerals are sericite, ankerite, chlorite, muscovite, calcite and tourmaline. The province has potential for volcanic-hosted epithermal and mesothermal lead, zinc, copper and precious metal deposits.

## 3.8. Shandong Province

Although most workers consider that the northern part of the Shandong province is in the North China Terrane, we included it in our database for the

Shandong province in order to compare and contrast the palaeogeographic, tectonic and metallogenic relations of the South and North China Terranes. Shandong province is bounded by latitude 34°23–38° 24'N and longitude 114°48'–122°42'E covering an area of 156,700 km² with a population of 88 million. Shandong province has very substantial gold mineralisation in the Jiaodong Peninsula. The province has unique world class granite-hosted orogenic gold deposits, and the history of gold mining in the province dates back to the Tang Dynasty (907 AD). Shandong province is currently the most important gold province in China, both in terms of gold production (55 t Au in 2000), and ore reserves (more than 900 t Au). Many world class (>100 t Au) gold belts have been found in the province during the last two decades (Yumin Qiu et al., 2002).

### 3.8.1. GIS coverage of geology for Shandong

For GIS geology coverage, we digitised the 1:500,000 scale geological map from geological memoir Series 1, No. 26 on the Regional Geology of the Shandong province (1991). Detailed digitised geological maps of Shandong province is shown in Figure 52 together with polygon ID for each stratigraphic and lithologic unit.

### 3.8.2. MINDEP database for Shandong

About 340 metallic and non-metallic mineral occurrences have been recorded for Shandong (Fig. 53). Metal Mining Agency of Japan (MMAJ) has compiled 33 major mineral deposits in Shandong province (www.mmaj.jp). The book 'The Discovery History of Mineral Deposits of China-Fujian and Zhejiang" published in 1996 also contains spatial information for metal and non-metal mineral occurrences of the Shandong province. The distribution of gold deposits is shown in Figure 54.

Considerable geological and ore deposit research in the Shandong province has been undertaken by Chinese and overseas geologists (e.g., Jiuhua Xu et al., 1994; Yusheng Zhai, 1997; Wang et al., 1998; He Zhili et al., 1989; Taihe Zhou and Guxian Lu, 2000; Yumin Qiu et al., 2002 and references therein). Most of the gold deposits in the Shandong province are located in the Jiaodong Peninsula that is located in the North China Terrane. The peninsula is characterised by Archean and Proterozoic rocks intruded by Mesozoic granitoids. The gold mineralisation occurs as vein-type (Linglong type) and disseminated to stockwork style deposits (Jiaojia type). The majority of the deposits are hosted in granitoids and account for more than 90 % of the gold resources. Recent detailed geological and SHRIMP geochronological studies indicate that the gold mineralisation is related to the two Yanshanian magmatic events (160–150 Ma and 130–126 Ma) (Wang et al., 1998; Yumin Qiu et al., 2002).

Most of the deposits are structurally controlled along prominent NNE trending brittle-ductile shear zones, and associated with silicification, sericitisation and K-feldspar alteration. The orebodies vary from tens of meters to 2000–3000 m in length, 2 mm to 3–6 m in thickness and tens of metres to 500–600 m in depth. The ore minerals are native gold, electrum, pyrite, chalcopyrite, magnetite, pyrrhotite, galena and sphalerite.

The most important gold deposits are Linglong deposit (>100 t @ 3-30 g/t Au), Sanshandao deposit (~60 t @ 7 g/t Au), Cangshang (~60 t @ 4 g/t Au), Jiaojia (>60 t @ 7 g/t Au), Xincheng (>60 t @ 8 g/t Au), Wangershan (45 t @ 7-8 g/t Au), Jingqingding-Rushan (25 t @ 9 g/t Au), Donggerzhuang (20 t @ 11 g/t Au), Hedong and Shangzhuang ~20 t @ 7 g/t Au), and few others with 5 to 10 t Au @ 3-6 g/t Au. This province is the richest gold region in China and one of the largest granitoid-hosted orogenic gold belts in the world.

## 4. GEOCHRONOLOGY DATA COMPILATION

At the suggestion of the sponsors, we undertook a GIS compilation of geochronological data for South China. We made a literature review of previous geochronological studies in South China. Although there were geochronological studies, and data were presented in papers, journals and reports, no detailed and reliable spatial information for location and co-ordinates (latitude/longitude) of the sample points were available. However, considerable amounts of geochronological information are present on the maps from the geological memoir series produced by the various Bureaux of Geology and Mineral Resources. We compiled these data and presented to the sponsors in CD-ROM. All provinces in South China have age data except Guizhou province and the geochronological data were compiled from the following maps of each province:

(1) Magmatic Rock Map of Yunan Province (Attached Map 2 of Regional Geology of Yunan Province), 1:1,000,000 scale
(2) Magmatic Rock Map of Sichuan, 1:1,000,000 scale
(3) Magmatic Rock Map of the Guangxi Zhuang Autonomous Region of the People's Republic of China 1:1,000,000 scale
(2) Magmatic Rock Map of Hunan Province, 1:1,000,000 scale
(3) Magmatic rocks Map of Gaungdong Province, 1:1,000,000 scale

(4) Magmatic Rock Map of Jiangxi Province (Attached map 2 of Regional Geology of Jiangxi Province), 1:1,000,000 scale
(5) Magmatic Rock Map of Hubei Province, 1:1,000,000 scale
(6) Magmatic Rock Map of Anhui Province, 1:1,000,000 scale
(7) Geological Map of Bedrock of Jiangsu Province & Shanghai Municipality, 1:500,000 scale
(8) Intrusive Map of Fujian Province (Attached map 3 of Regional Geology of Fujian Province) 1:1,000,000 scale
(11) Magmatite Map of Zhejiang Province (Attached Map 2 of Regional Geology of Zhejiang Province) 1:500,000 scale
(9) Magmatite Map of Shandong Province (Attached Map 2 of Regional Geology of Shandong Province) 1:1,000,000

Altogether 1067 geochronological data points have been recorded (73 for Yunnan, 197 for Sichuan, 120 for Guangxi, 117 for Hunan, 194 for Guangdong, 97 for Jiangxi, 41 for Hubei, 52 for Anhui, 3 for Jiangsu, 77 for Fujian, 61 for Zhejiang and 35 for Shandong). Figures 55, 56, 57 and 58 show examples of the distribution of the geochronological data. The methods for geochronological data for South China involve largely K-Ar, Rb-Sr and U-Pb analyses for individual minerals or whole rock.

## 5. CONCLUSIONS

Geology coverages have been completed for Yunnan, Sichuan, Guizhou, Guangxi, Hunan, Guangdong, Jiangxi, Hubei, Fujian, Anhui, Zhejiang, Jiangsu and Shandong covering the entire South China Terrane provinces. CD-ROMs including geology and mineral deposit data for these provinces are presented to the sponsors with this report. Compilation of extensive and voluminous information on geology for these provinces consumes considerable time to include detailed stratigraphic and lithologic units. Table 1 shows how the project was progressed to complete the studies as proposed in the original document.

Table 1. Completed time schedule for GIS module during the time frame of the project.

| Province | Proposed program | 1999-2000 | 2000-2001 | 2001-2002 |
|---|---|---|---|---|
| Yunnan & Sichuan | Geology coverage | | | |
| | Deposit database | | | |
| Guangxi & Guizhou | Geology coverage | | | |
| | Deposit database | | | |
| Guangdong & Hunan | Geology coverage | | | |
| | Deposit database | | | |
| Hubei & Jiangxi | Geology coverage | | | |
| | Deposit database | | | |
| Fujian & Shandong | Geology coverage | | | |
| | Deposit database | | | |
| Anhui & Jiangsu | Geology coverage | | | |
| | Deposit database | | | |
| Zhejiang & Shanghai | Geology coverage | | | |
| | Deposit database | | | |

Note: Red line denotes completed program during the timeframe of the project.

The geological maps of each province have been placed onto the Digital Chart of the World, which is used as a base map for the project. In this project, we also made regional correlations of the broader tectono-stratigraphic units in South China and structural history of the region. Altogether more than 3300 mineral deposits and occurrences have been spatially compiled with forty attributes from the published literature.

Metallogenic relations of the South China Terrane are summarised below:

**Yunnan:** At least five different styles of lead-zinc-silver mineralisation occur in Yunnan: (1) sedimentary exhalative (Sedex) deposits (e.g., Tertiary Jingding/Lanping deposit), (2) with copper in volcanic-hosted massive sulphide (VHMS) deposits (e.g., Carboniferous Laochang deposit, and recently discovered Carboniferous Dapingzhang deposit), (3) with copper and tin in lead-zinc skarn deposits (e.g., Triassic Hongshan deposit), (4) with precious metals in veins and porphyry deposits (e.g., Beiya deposit), and (5) with copper in Sn-W vein and skarn deposits (e.g., Mengzimao). Yunnan also has potential for Carlin-type and mesothermal gold, porphyry copper-gold, sedimentary copper and mafic-ultramafic-hosted Ni-Cu deposits.

**Sichuan:** The province has significant stratabound lead-zinc-silver deposits, Carlin-type gold deposits and ultramafic-hosted Cu-Ni deposits. At least, two major styles of lead-zinc-silver mineralisation occur in Sichuan: (1) Volcanic-hosted massive sulphide (VHMS) deposits (e.g., Triassic Gacun deposit), and (2) MVT deposit (e.g., Sinian Daliangzi deposit). Sichuan has excellent potential for discovery of world class micro-disseminated Carlin-type gold deposits. Many Carlin-type deposits are distributed in NW Sichuan, Gansu and Shaanxi, an area also known as the northern Golden Triangle of China.

**Guizhou and Guangxi:** The two provinces are part of the southern Golden Triangle of China, which forms the region at the junction of Yunnan, Guizhou, and Guangxi provinces. This region has excellent potential for Carlin-type gold deposits. They also have stratabound base metal tin deposits and, in particular, Guangxi province has important world class tin deposits such as the Danchang deposits.

**Hunan and Guangdong:** These provinces have many polymetallic lead-zinc deposits associated with Indosinian (Triassic) and Yanshanian (Jurassic to Cretaceous) magmatism (e.g. Shiziyuan deposit). Significant Devonian to Carboniferous stratabound base and precious metal mineralisation also occurs in these provinces and appears to be similar to Sedex type deposits (e.g. Fankou and Dabaoshan deposits).

**Jiangxi and Hubei:** This province has major vein-type tungsten-tin-bismuth-beryllium-sulphide deposits associated with Yanshanian magmatism (e.g., Xihuashan deposit), and the largest porphyry copper deposit in China (e.g., Dexing deposits). Dexing has 1500 Mt ore @ 0.43 % Cu, 0.02 % Mo, 0.16 g/t Au and 1.9 g/t Ag approximately equivalent to 6.45 Mt Cu, 0.25 Mt Mo, 24 t Au and 285 t Ag. Au-(Ag-Mo)-rich porphyry-related Cu-Fe skarn deposits are also found in Jiangxi (Chengmenshan, 1.7 Mt metal @ 0.76 % Cu, 57 t @ av. 0.25 g/t Au and 224 t @ 9.9 g/t Ag, and Wushan, 2.48 Mt metal @ 1.38 % Cu, 67 t @ av. 0.5 g/t Au). This part of the Jiangxi province is also part of the Lower to Middle Yangtze River metallogenic belt that accounted for more than 600 t Au. This metallogenic belt extends into Hubei, Anhui and Jiangsu provinces. The most significant deposits are Tonglushan (1 Mt metal @ 1.8 % Cu, 69 t @ 1.15 g/t Au), Jilongshan (0.3 Mt metal @ 1.6 % Cu, 37 t @ 4 g/t Au), Fengshandong (0.7 Mt metal @ 1.2 % Cu, 16 t @ 0.38 g/t Au), Shitouzui (1 Mt metal @ 1.8 % Cu, 19 t 0.5 g/t Au), and Jiguanzui (20 t @ 4.87 g/t Au).

**Anhui and Jiangsu:** Anhui province has major skarn deposits such as Xinqiao (0.5 Mt metal @ 0.7 % Cu, 24 Mt metal @ 46 % Fe, 105 t Au @ 0.3 ? g/t Au in sulphide ore and 11.2 t Au @ 4.7 g/t Au in oxide ore), Manshan-Tiamashan (32 t @ 6.5 g/t Au), Shizishan (46 t @ 0.3 g/t Au) and Huangshialoshan (13.5 t @ 5.8 g/t Au). Jiangsu province also hosts skarn gold deposits (e.g., Fuiushan, 9 t @ 0.85 g/t Au). In addition, Jiangsu province has Sedex deposits such as Qixiashan (0.4 Mt metal @ 2.6 % Pb, 0.8 Mt metal @ 0.8 % Zn and 0.4 Mt metal @ 17 % Mn with gold credits (27 t @ 0.9 g/t Au), although it was overprinted by skarn system associated with Yanshanian magmatism. Iron-only deposits are also abundant in the Middle to Lower Yangtze River provinces such as Anhui, Jiangsu and also Hubei provinces. Although these deposits are considered skarn deposits, they are commonly stratabound or stratiform, at a distance from outcropping intrusive rocks and have abundant hematite and a high REE content. Olympic Dam type deposits or IOCG (Iron Oxide Copper-Gold) deposit styles should be considered as potential exploration targets in these provinces.

**Fujian and Zhejiang:** These provinces cover the South China foldbelt along the southeastern margin of the Yangtze craton and are characterised by well-developed Yanshanian intrusive to subvolcanic rocks associated with porphyry to epithermal type copper-gold mineralisation and mesothermal vein deposits. The most important example is the Zijinshan district in Fujian (~100 Mt of ore containing at least 1.6 Mt metal @ 1.09 % Cu and 15 t of Au @ 0.14 g/t Au and 619 t of Ag @ 6.2 g/t Ag). It is the only high-sulphidation epithermal system in China. Epithermal to mesothermal vein-type deposits are found in Zhejiang (e.g., Zhilingtou, 2 Mt ore grading 12 g/t Au, 306 g/t Ag).

**Shandong:** The province has unique world class granite-hosted orogenic gold deposits, and is the major producer of gold in China with ore reserves of more than 900 t Au. The most important gold deposits are: Linglong deposit (>100 t @ 3-30 g/t Au), Sanshandao deposit (~60 t @ 7 g/t Au), Cangshang (~60 t @ 4 g/t Au), Jiaojia (>60 t @ 7 g/t Au), Xincheng (>60 t @ 8 g/t Au), Wangershan (45 t @ 7-8 g/t Au), Jingqingding-Rushan (25 t @ 9 g/t Au), Donggerzhuang (20 t @ 11 g/t Au), Hedong and Shangzhuang ~20 t @ 7 g/t Au).

We have successfully integrated geology, tectonic and metallogenic relations of South China. The South China Craton is rich in mineral resources and has a diversity of mineral deposit styles. Similarly, the North China Craton hosts many giant base metal deposits (e.g., Baiyinchang VHMS district, 5.8 Mt metal resource @ 1.22 % Cu, and 0.4 % Pb and 2 % Zn, 1.02 g/t au and 16 g/t Ag (Hou Zhengqian et al., 1999; Hou Zhengqian et al, submitted, 2002b), Dongshenmio SEDEX deposit, 5 Mt metal Pb+Zn and 220 Mt ore sulphur, Yusheng Zhai et al., 1997), porphyry copper-molybdenum-gold deposits (Yulong district, ~1000 Mt ore @ 0.99 Cu %, 0.06 % Mo and 0.35 ppm Au, Hou Zhengqian et al., in press), copper-nikel deposit (e.g., Jinchuan), several world class orogenic gold deposits in Henan and Xinjiang, and Carlin type deposits in Gansu and Shaanxi provinces. Most of these deposits are located in the suture zone along the South and North Chian Cratons. It is imperative that similar integrated studies should be undertaken for the North China Craton in order to understand the palaeogeographic, tectonic and metallogenic relation of the formation of the giant ore deposits of China during the collision and amalgamation of the South and North China Cratons.

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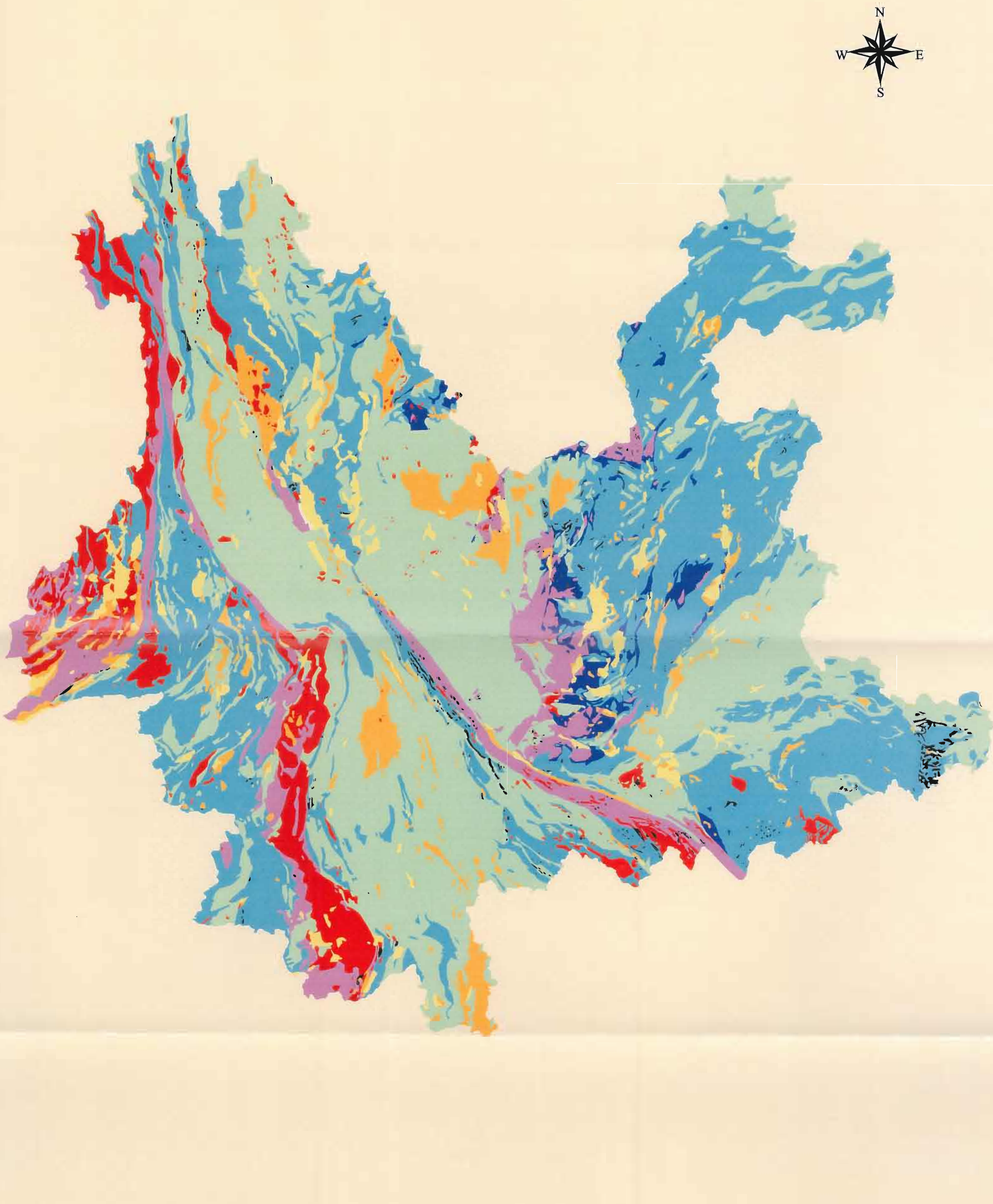
Fig. 4. Geology of Yunnan Province
(AMIRA P603 Project)



# Geology Legend (Yunnan)

## Geology Legend (Yunnan)

11110 100 Qh Intermediate-HOLOCENE
11110 100 Qh Intermediate-mafic-HOLOCENE
11110 100 Qh Undifferentiated-HOLOCENE
11120 101 Qp Dacite porphyry-L. PLEISTOCENE
11120 101 Qp Intermediate-felsic-L. PLEISTOCENE
11120 101 Qp Mafic-L. PLEISTOCENE
11120 101 Qp Undifferentiated-L. PLEISTOCENE
11150 102 Q Undifferentiated-QUATERNARY UNDIF.
11210 103 N2 Mafic-PLIOCENE
11210 103 N2 Syenite, orthophyre, subtrachyte-PLIOCENE
11210 103 N2 Undifferentiated-PLIOCENE
11220 104 N1 Undifferentiated-MIOCENE
11230 106 E3 Undifferentiated-OLIGOCENE
11230 110 E1 Undifferentiated-OLIGOCENE
11230.1 107 E2-3 Undifferentiated-OLIGOCENE
11240.2 108 E2^3 Quartz monzonitic porphyry-EOCENE
11240.2 108 E2^3 Undifferentiated-EOCENE
11240.3 109 E2^1-2 Undifferentiated-EOCENE
11260 105 N Mafic-TERTIARY UNDIF.
11260 105 N Undifferentiated-TERTIARY UNDIF.
11260 111 E Undifferentiated-TERTIARY UNDIF.
12110 300 K2 Undifferentiated-L. CRETACEOUS
12120.1 301 K1^2 Undifferentiated-E. CREATACEOUS
12120.2 302 K1^1 Undifferentiated-E. CREATACEOUS
12120.3 303 K1 Undifferentiated-E. CREATACEOUS
12210.1 304 J3 Undifferentiated-L. JURASSIC
12210.2 305 J2+3 Undifferentiated-L. JURASSIC
12220.2 306 J2 Undifferentiated-M. JURASSIC
12220.3 307 J1+2 Undifferentiated-M. JURASSIC
12230.2 308 J1 Undifferentiated-E. JURASSIC
12310.1 309 T3^2b Felsic-L. TRIASSIC
12310.1 309 T3^2b Undifferentiated-L. TRIASSIC
12310.2 310 T3^2a Undifferentiated-L. TRIASSIC
12310.3 311 T3^2 Undifferentiated-L. TRIASSIC
12310.3 312 T3^2 Intermediate-mafic-L. TRIASSIC
12310.4 312 T3^1 Felsic-L. TRIASSIC
12310.4 312 T3^1 Intermediate-Felsic-L. TRIASSIC
12310.4 312 T3^1 Mafic-L. TRIASSIC
12310.4 312 T3^1 Undifferentiated-L. TRIASSIC
12310.5 313 T3 Intermediate-L. TRIASSIC
12310.5 313 T3 Intermediate-mafic-L. TRIASSIC
12310.5 313 T3 Mafic-L. TRIASSIC
12310.5 313 T3 Undifferentiated-L. TRIASSIC
12320.1 314 T2^2 Dacite porphyry-M. TRIASSIC
12320.1 314 T2^2 Felsic-M. TRIASSIC
12320.1 314 T2^2 Intermediate-Felsic-M. TRIASSIC
12320.1 314 T2^2 Undifferentiated-M. TRIASSIC
12320.1 314 T2^2 Intermediate-M. TRIASSIC
12320.2 315 T2^1 Felsic-M. TRIASSIC
12320.2 315 T2^1 Intermediate-felsic-M. TRIASSIC
12320.2 315 T2^1 Intermediate-mafic-M. TRIASSIC
12320.2 315 T2^1 Undifferentiated-M. TRIASSIC
12320.3 316 T2 Undifferentiated-M. TRIASSIC
12320.4 317 T1+2 Undifferentiated-M. TRIASSIC
12330.2 318 T1 Undifferentiated-E. TRIASSIC
13110.1 500 P2 Intermediate-L. PERMIAN
13110.1 500 P2 Intermediate-felsic-L. PERMIAN
13110.1 500 P2 Intermediate-mafic-L. PERMIAN
13110.1 500 P2 Mafic-L. PERMIAN
13110.1 500 P2 Undifferentiated-L. PERMIAN
13110.1 501 P2 Mafic-L. PERMIAN
13110.2 501 P1-2 Intermediate-mafic-L. PERMIAN
13110.2 501 P1-2 Undifferentiated-L. PERMIAN
13130.2 502 P1 Intermediate-E. PERMIAN
13130.2 502 P1 Intermediate-felsic-E. PERMIAN
13130.2 502 P1 Intermediate-mafic-E. PERMIAN
13130.2 502 P1 Undifferentiated-E. PERMIAN
13140 503 P Undifferentiated-PERMIAN UNDIF.
13210.1 504 C3 Intermediate-L. CARBONIFEROUS
13210.1 504 C3 Intermediate-felsic-L. CARBONIFEROUS
13210.1 504 C3 Mafic-L. CARBONIFEROUS
13210.1 504 C3 Undifferentiated-L. CARBONIFEROUS
13210.2 505 C2+3 Undifferentiated-L. CARBONIFEROUS
13220.2 506 C2 Undifferentiated-M. CARBONIFEROUS
13220.3 507 C1+2 Undifferentiated-M. CARBONIFEROUS
13220.4 508 C1-2 Mafic-M. CARBONIFEROUS
13220.4 515 D1+2 Undifferentiated-M. CARBONIFEROUS
13230.3 509 C1 Mafic-E. CARBONIFEROUS
13230.3 509 C1 Undifferentiated-E. CARBONIFEROUS
13240 510 C Intermediate-mafic-CARBONIFEROUS UNDIF.
13240 510 C Undifferentiated-CARBONIFEROUS UNDIF.
13310.1 511 D3 Mafic-L. DEVONIAN
13310.1 511 D3 Undifferentiated-L. DEVONIAN
13310.2 512 D2+3 Undifferentiated-L. DEVONIAN
13310.3 513 D2-3 Undifferentiated-L. DEVONIAN
13320.3 514 D2 Undifferentiated-M. DEVONIAN
13330.2 516 D1 Undifferentiated-E. DEVONIAN
13340 517 D Undifferentiated-DEVONIAN UNDIF.
13410.1 518 S3 Undifferentiated-L. SILURIAN
13410.2 519 S2+3 Undifferentiated-L. SILURIAN
13410.3 520 S2-3 Undifferentiated-L. SILURIAN
13420.3 521 S2 Undifferentiated-M. SILURIAN
13420.4 522 S1+2 Undifferentiated-M. SILURIAN
13430.2 523 S1 Undifferentiated-E. SILURIAN
13440 524 S Undifferentiated-SILURIAN UNDIF.
13510.1 525 O3 Undifferentiated-L. ORDOVICIAN
13510.2 526 O2+3 Undifferentiated-L. ORDOVICIAN
13520.2 527 O2 Undifferentiated-M. ORDOVICIAN
13520.3 528 O1+2 Undifferentiated-M. ORDOVICIAN
13520.4 529 O1-2 Undifferentiated-M. ORDOVICIAN
13530.3 530 O1 Undifferentiated-E. ORDOVICIAN
13540 531 O Undifferentiated-ORDOVICIAN UNDIF.
13610.1 532 Ca3 Undifferentiated-L. CAMBRIAN
13610.2 533 Ca2+3 Undifferentiated-L. CAMBRIAN
13610.3 534 Ca2-3 Mafic-L. CAMBRIAN
13610.3 534 Ca2-3 Undifferentiated-L. CAMBRIAN
13620.3 535 Ca2 Undifferentiated-M. CAMBRIAN
13620.4 536 Ca1+2 Undifferentiated-M. CAMBRIAN
13620.4 540 Z-E2 Undifferentiated-M. CAMBRIAN
13630.2 537 Ca1 Undifferentiated-E. CAMBRIAN
13640 538 Ca Undifferentiated-CAMBRIAN UNDIF.
20000 701 AnCash Undifferentiated-PROTEROZOIC UNDIF.
21100 539 Pz1 Undifferentiated-L. PALEOZOIC
21110.199 702 Zb Undifferentiated-UP. SINIAN
21130.3 703 Za Mafic-LW. SINIAN
21130.3 703 Za Undifferentiated-LW. SINIAN
21140.4 704 Z Undifferentiated-SINIAN UNDIF.
22000.11 705 Pt2 gl Undifferentiated-M. PROTEROZOIC UNDIF.
22000.11 705 Pt2gl Gneiss-M. PROTEROZOIC UNDIF.
22000.12 706 Pt2ch Gneiss-M. PROTEROZOIC UNDIF.
22000.12 706 Pt2ch Undifferentiated-M. PROTEROZOIC UNDIF.
22000.131 707 Pt2xm Gneiss-M. PROTEROZOIC UNDIF.
22000.141 708 Pt2ln Undifferentiated-M. PROTEROZOIC UNDIF.
22000.15 709 Pt2dm Gneiss-M. PROTEROZOIC UNDIF.
22000.16 710 Pt2dy Undifferentiated-M. PROTEROZOIC UNDIF.
22000.17 711 Pt2lz Undifferentiated-M. PROTEROZOIC UNDIF.
22000.18 712 Pt2o Undifferentiated-M. PROTEROZOIC UNDIF.
22000.19 713 Pt2l Undifferentiated-M. PROTEROZOIC UNDIF.
22000.2 714 Pt2y Undifferentiated-M. PROTEROZOIC UNDIF.
22000.211 715 Pt2m Undifferentiated-M. PROTEROZOIC UNDIF.
22000.221 716 Pt2d Undifferentiated-M. PROTEROZOIC UNDIF.
22000.23 717 Pt2hs Undifferentiated-M. PROTEROZOIC UNDIF.
22000.24 718 Pt2h Undifferentiated-M. PROTEROZOIC UNDIF.
23000.1 719 Pt1cm Gneiss-L. PROTEROZOIC UNDIF.
23000.2 720 Pt1al Gneiss-L. PROTEROZOIC UNDIF.
23000.2 720 Pt1al Undifferentiated-L. PROTEROZOIC UNDIF.
23000.3 721 Pt1dh Undifferentiated-L. PROTEROZOIC UNDIF.
23000.4 722 Pt1jl Undifferentiated-L. PROTEROZOIC UNDIF.
23000.5 723 Pt1ys Undifferentiated-L. PROTEROZOIC UNDIF.
41200.109 201 g6^1 Granite, granite porphyry-EOGENE
41200.109 201 g6^1 granite-EOGENE
41200.121 202 hg6^1 Adamellite-EOGENE
41200.129 203 gp6^1 Granite porphyry-EOGENE
41200.129 203 gp6^1 Granite, granite porphyry-EOGENE
41200.141 204 lp6^1 Granite, granite porphyry-EOGENE
41200.148 205 zp6^1 Dacite porphyry-EOGENE
41200.211 210 hp6^1 Monzonite, monzonitic porphyry-EOGENE
41200.211 210 hp6^1 Monzonitic porphyry-EOGENE
41200.219 211 hop6^1 Granite, Monzonite-EOGENE
41200.219 211 hop6^1 Monzonite, Monzonitic porphyry-EOGENE
41200.219 211 hop6^1 Syenite, orthophyre, subtrachyte-EOGENE
41200.31 613 S Magnesian ultramafite-EOGENE
41200.31 613 S Ultramafic-EOGENE
41200.41 216 xo6^1 Granite syenite-EOGENE
41200.41 216 xo6^1 Syenite, orthophyre, subtrachyte-EOGENE
41200.422 217 xp6^1 Orthophyre-EOGENE
41200.422 217 xp6^1 Syenite, orthophyre, subtrachyte-EOGENE
41200.441 219 c6^1 Syenite, orthophyre, subtrachyte-EOGENE
41300 200 gh6 Granite porphyry-TERTIARY UNDIF.
41300 200 gh6 Granite, granite porphyry-TERTIARY UNDIF.
41300 200 gh6 Syenite, orthophyre, subtrachyte-TERTIARY UNDIF.
41300.211 206 dm6 Diorite, diorite-porphyrite-TERTIARY UNDIF.
41300.211 206 dm6 Diorite-porphyrite.
41300.219 207 dom6 Granite diorite, quartz diorit-TERTIARY UNDIF.
41300.23 208 hodm6 Granite-monzodioritic porphyrite-TERTIARY UNDIF.
41300.238 209 hop6 Granite monzonitic porphyry-TERTIARY UNDIF.
41300.238 209 hop6 Granite, monzonite-TERTIARY UNDIF.
41300.238 209 hop6 Monzonite, monzonitic porphyry-TERTIARY UNDIF.
41300.309 212 x6 Syenite, orthophyre, subtrachyte-TERTIARY UNDIF.
41300.328 214 t6 Subtrachyte-TERTIARY UNDIF.
41300.328 214 t6 Syenite, orthophyre, subtrachyte-TERTIARY UNDIF.
42100.111 401 g5^3(3) Granite, granite porphyry-CRETACEOUS UNDIF.
42100.111 401 g5^3(3) Granite-CRETACEOUS UNDIF.
42100.112 402 g5^3(2) Granite, granite porphyry-CRETACEOUS UNDIF.
42100.112 402 g5^3(2) Granite-CRETACEOUS UNDIF.
42100.113 403 g5^3(1) Adamellite-CRETACEOUS UNDIF.
42100.113 403 g5^3(1) Granite, granite porphyry-CRETACEOUS UNDIF.
42100.113 403 g5^3(1) Granite-CRETACEOUS UNDIF.
42100.114 400 g5^3 Granite, granite porphyry-CRETACEOUS UNDIF.
42100.114 400 g5^3 Granite-CRETACEOUS UNDIF.
42100.114 400 g5^3 Mafic-CRETACEOUS UNDIF.
42100.121 405 hg5^3(3) Adamellite-CRETACEOUS UNDIF.
42100.122 406 hg5^3(2) Adamellite-CRETACEOUS UNDIF.
42100.123 407 hg5^3(1) Adamellite-CRETACEOUS UNDIF.
42100.124 404 hg5^3 Adamellite-CRETACEOUS UNDIF.
42100.131 409 gp5^3(3) Granite porphyry-CRETACEOUS UNDIF.
42100.131 409 gp5^3(3) Granite, granite porphyry-CRETACEOUS UNDIF.
42100.132 410 gp5^3(2) Granite porphyry-CRETACEOUS UNDIF.
42100.133 408 gp5^3 Granite porphyry-CRETACEOUS UNDIF.
42100.133 408 gp5^3 Granite, diorite, quartz diorite-CRETACEOUS UNDIF.
42100.133 408 gp5^3 Granite, granite porphyry-CRETACEOUS UNDIF.
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42100.14 411 gd5^3 Granodiorite-CRETACEOUS UNDIF.
42100.15 412 lp5^3 Granite porphyry-CRETACEOUS UNDIF.
42100.21 413 do5^3 Granite, diorite, quartz diorite-CRETACEOUS UNDIF.
42100.31 414 bm5^3 gabbro, diabase (undivided)-CRETACEOUS UNDIF.
42100.41 444 x5^3 Syenite-CRETACEOUS UNDIF.
42100.41 444 x5^3 syenite, orthophyre, subtrachyte-CRETACEOUS UNDIF.
42200.11 415 g5^2 Granite, granite porphyry-JURASSIC UNDIF.
42200.11 415 g5^2 Granite-JURASSIC UNDIF.
42200.12 416 hg5^2 Adamellite-JURASSIC UNDIF.
42200.12 416 hg5^2 Granite, granite porphyry-JURASSIC UNDIF.
42200.13 417 gp5^2 Granite porphyry-JURASSIC UNDIF.
42200.21 418 d05^2 Diorite, diorite-porphyrite-JURASSIC UNDIF.
42200.21 418 d05^2 Granite, diorite, quartz diorite-JURASSIC UNDIF.
42200.22 419 d5^2 Diorite-JURASSIC UNDIF.
42200.23 420 dm5^2 Granite, granite porphyry-JURASSIC UNDIF.
42200.31 421 n5^2 Gabbro, diabase (undivided)-JURASSIC UNDIF.
42200.31 421 n5^2 Gabbro-JURASSIC UNDIF.
42200.32 422 bm5^2 Gabbro, diabase (undivided)-JURASSIC UNDIF.
42200.32 422 bm5^2 diabase-JURASSIC UNDIF.
42200.41 423 s5^2 Ferruginous ultramafite-JURASSIC UNDIF.
43400.111 424 g4-g5^1 Granite, granite porphyry-TRIASSIC UNDIF.
43400.111 424 g4-g5^1 Granite-TRIASSIC UNDIF.
43400.121 425 hg4-hg5^1 Adamellite-TRIASSIC UNDIF.
43400.122 452 hg4-hg5^1(a) Adamellite-TRIASSIC UNDIF.
43400.123 453 hg4-hg5^1(b) Adamellite-TRIASSIC UNDIF.
43400.131 426 gd4-gd5^1 Granite-TRIASSIC UNDIF.
43400.132 454 gd4-gd5^1(a) Granite-TRIASSIC UNDIF.
43400.142 456 g4^3-g5^1(a) Granite, granite porphyry-TRIASSIC UNDIF.
43400.142 456 g4^3-g5^1(a) Granite-TRIASSIC UNDIF.
43400.143 457 g4^3-g5^1(b) Adamellite-TRIASSIC UNDIF.
43400.143 457 g4^3-g5^1(b) Granite, granite porphyry-TRIASSIC UNDIF.
43400.143 457 g4^3-g5^1(b) Granite-TRIASSIC UNDIF.
43400.151 428 hg4^3-hg5^1 Adamellite-TRIASSIC UNDIF.
43400.152 458 hg4^3-hg5^1(a) Adamellite-TRIASSIC UNDIF.
43400.161 429 gd4^3-gd5^1 Granite-TRIASSIC UNDIF.
43400.161 430 gd4^3-gd5^1 Granite, granite porphyry-TRIASSIC UNDIF.
43400.162 460 gd4^3-gd5^1(a) Adamellite-TRIASSIC UNDIF.
43400.162 460 gd4^3-gd5^1(a) Granite-TRIASSIC UNDIF.
43400.163 461 gd4^3-gd5^1(b) Adamellite-TRIASSIC UNDIF.
43400.21 430 g5^1 Granite-TRIASSIC UNDIF.
43400.22 431 hg^1 Adamellite-TRIASSIC UNDIF.
43400.22 431 hg^1 Granite, granite porphyry-TRIASSIC UNDIF.
43400.23 432 gd5^1 Granite, granite porphyry-TRIASSIC UNDIF.
43400.23 432 gd5^1 Granite-TRIASSIC UNDIF.
43400.24 433 gp5^1 Granite porphyry-TRIASSIC UNDIF.
43400.24 433 gp5^1 Granite, granite porphyry-TRIASSIC UNDIF.
43400.25 434 lp5^1 Granite porphyry-TRIASSIC UNDIF.
43400.25 434 lp5^1 Granite, granite porphyry-TRIASSIC UNDIF.
43400.26 435 zp5^1 Felsic-TRIASSIC UNDIF.
43400.26 435 zp5^1 Intermediate-felsic-TRIASSIC UNDIF.
43400.31 436 do4^3-do5^1 Granite diorite, quartz diorite-TRIASSIC UNDIF.
43400.32 437 d5^1 Diorite, diorite-porphyrite-TRIASSIC UNDIF.
43400.32 437 d5^1 Diorite-TRIASSIC UNDIF.
43400.33 438 do5^1 Granite diorite, quartz diorite-TRIASSIC UNDIF.
43400.34 439 dom5^1 Diorite, diorite-porphyrite-TRIASSIC UNDIF.
43400.34 439 dom5^1 Granite, diorite, quartz diorite-TRIASSIC UNDIF.
43400.34 439 dom5^1 Quartz diorite porphyrite-TRIASSIC UNDIF.
43400.41 440 h-n5^1 Gabbro, diabase (undivided)-TRIASSIC UNDIF.
43400.41 440 h-n5^1 Monzonite and grabbro-TRIASSIC UNDIF.
43400.42 441 n5^1 Gabbro, diabase (undivided)-TRIASSIC UNDIF.
43400.42 441 n5^1 Gabbro-TRIASSIC UNDIF.
43400.43 442 bm5^1 Gabbro, diabase (undivided)-TRIASSIC UNDIF.
43400.43 442 bm5^1 diabase-TRIASSIC UNDIF.
43400.44 443 s5^1 Ferruginous ultramafite-TRIASSIC UNDIF.
43400.44 443 s5^1 ultramafic-TRIASSIC UNDIF.
44100.32 602 d4^3 Diorite, diorite-porphyrite-PERMIAN UNDIF.
44100.33 603 ho4^3 Monzonite, monzonitic porphyry-PERMIAN UNDIF.
44100.41 604 n-d4^3 Diorite, diorite-porphyrite-PERMIAN UNDIF.
44100.41 604 n-d4^3 Gabbro, diabase (undivided)-PERMIAN UNDIF.
44100.42 605 n4^3 Gabbro, diabase (undivided)-PERMIAN UNDIF.
44100.42 605 n4^3 Gabbro-PERMIAN UNDIF.
44100.43 606 bm4^3 Diabase-PERMIAN UNDIF.
44100.43 606 bm4^3 Gabbro, diabase (undivided)-PERMIAN UNDIF.
44100.44 607 N4^3 Mafic rock (undivided)-PERMIAN UNDIF.
44100.51 611 s4^3 Ferruginous ultramafite-PERMIAN UNDIF.
44100.51 611 s4^3 Ultramafic-PERMIAN UNDIF.
44400.21 600 g4 Gneissic granite-L. PALEOZOIC UNDIF.
44400.21 600 g4 Granite, granite porphyry-L. PALEOZOIC UNDIF.
44400.21 600 g4 Granite-L. PALEOZOIC UNDIF.
44400.22 601 hg4 Adamellite-L. PALEOZOIC UNDIF.
44400.31 608 n4 Gabbro, diabase (undivided)-L. PALEOZOIC UNDIF.
44400.31 608 n4 gabbro-L. PALEOZOIC UNDIF.
44400.32 609 bm4 Diabase-L. PALEOZOIC UNDIF.
44400.32 609 bm4 Gabbro, diabase (undivided)-L. PALEOZOIC UNDIF.
44400.33 610 N4 Gabbro, diabase (undivided)-L. PALEOZOIC UNDIF.
44400.33 610 N4 Mafic rock (undivided)-L. PALEOZOIC UNDIF.
44400.34 612 s4 Ferruginous ultramafite-L. PALEOZOIC UNDIF.
44400.34 612 s4 Ultramafic-L. PALEOZOIC UNDIF.
45400.12 615 hg3 Adamellite-E. PALEOZOIC UNDIF.
46100.1 800 g23 Granite-SINIAN UNDIF.
46100.2 801 hg23 Adamellite-SINIAN UNDIF.
47300.2 803 hg22 Adamellite-M. PROTEROZOIC UNDIF.
47300.3 804 gd22 Granodiorite-M. PROTEROZOIC UNDIF.
47300.4 805 n2 Gabbro, diabase (undivided)-M. PROTEROZOIC UNDIF.
47300.4 805 n2 Gabbro-M. PROTEROZOIC UNDIF.
47300.5 806 bm22 Diabase-M. PROTEROZOIC UNDIF.
47300.5 806 bm22 Gabbro, diabase (undivided)-M. PROTEROZOIC UNDIF.
47300.6 807 n22 Gabbro, diabase (undivided)-M. PROTEROZOIC UNDIF.
47300.6 807 n22 Gabbro-M. PROTEROZOIC UNDIF.
47300.6 807 n22 Ultramafic-M. PROTEROZOIC UNDIF.
48400.1 808 g21 Gneissic granite-E. PROTEROZOIC UNDIF.
48400.1 808 g21 Granite-E. PROTEROZOIC UNDIF.
48400.2 809 d21 Diorite, diorite-porphyrite-E. PROTEROZOIC UNDIF.
48400.3 810 do21 Quartz diorite-porphyrite-E. PROTEROZOIC UNDIF.
48400.5 811 bm21 Diabase-E. PROTEROZOIC UNDIF.
48400.5 811 bm21 Ultramafic-E. PROTEROZOIC UNDIF.
99000 900 Water

Fig. 5. Map showing mineral occurrences in Yunnan
(AMIRA P603 Project)

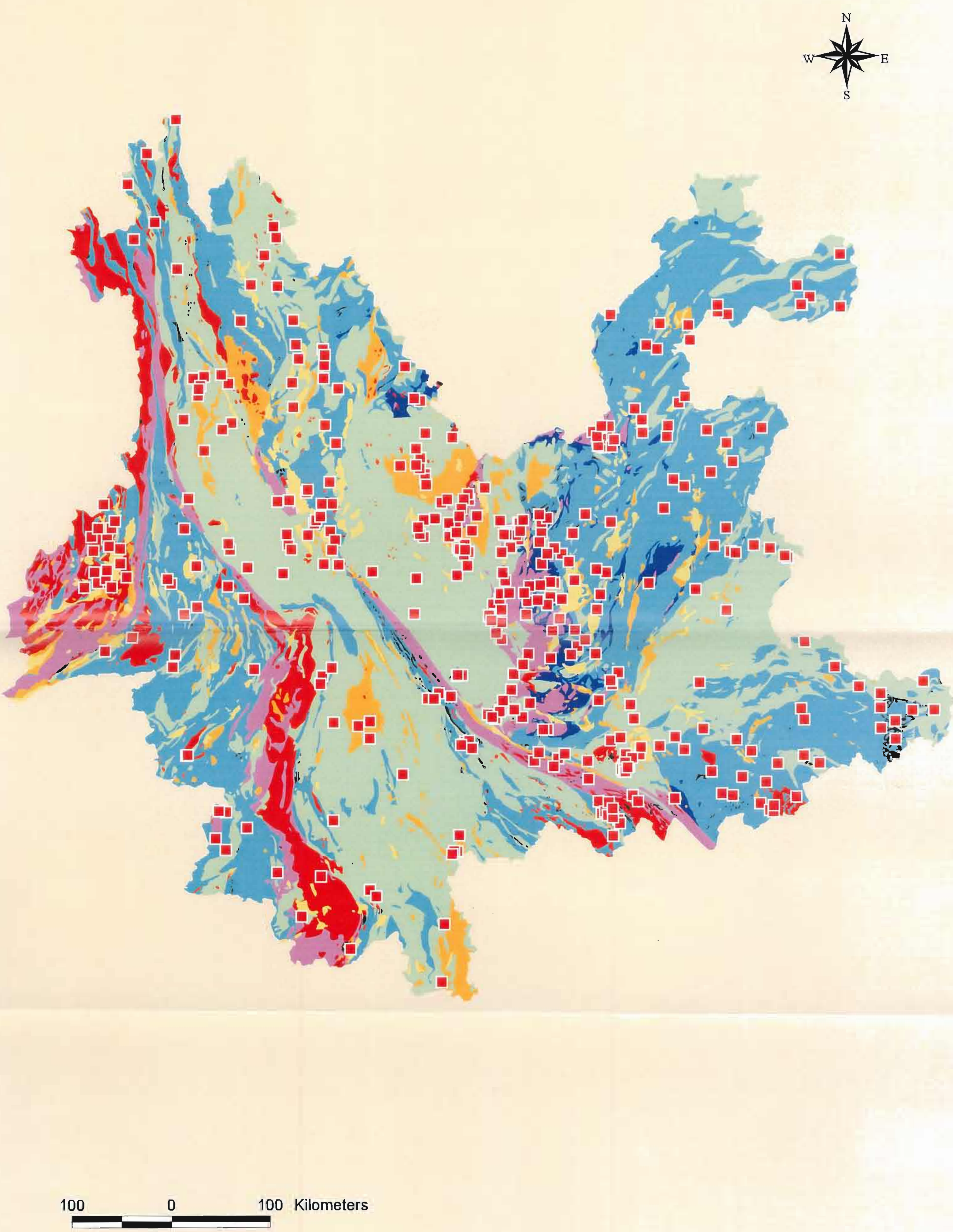


Fig. 6. Map showing geology and selected lead-zinc-silver occurrences in Yunnan
(AMIRA P603 Project)

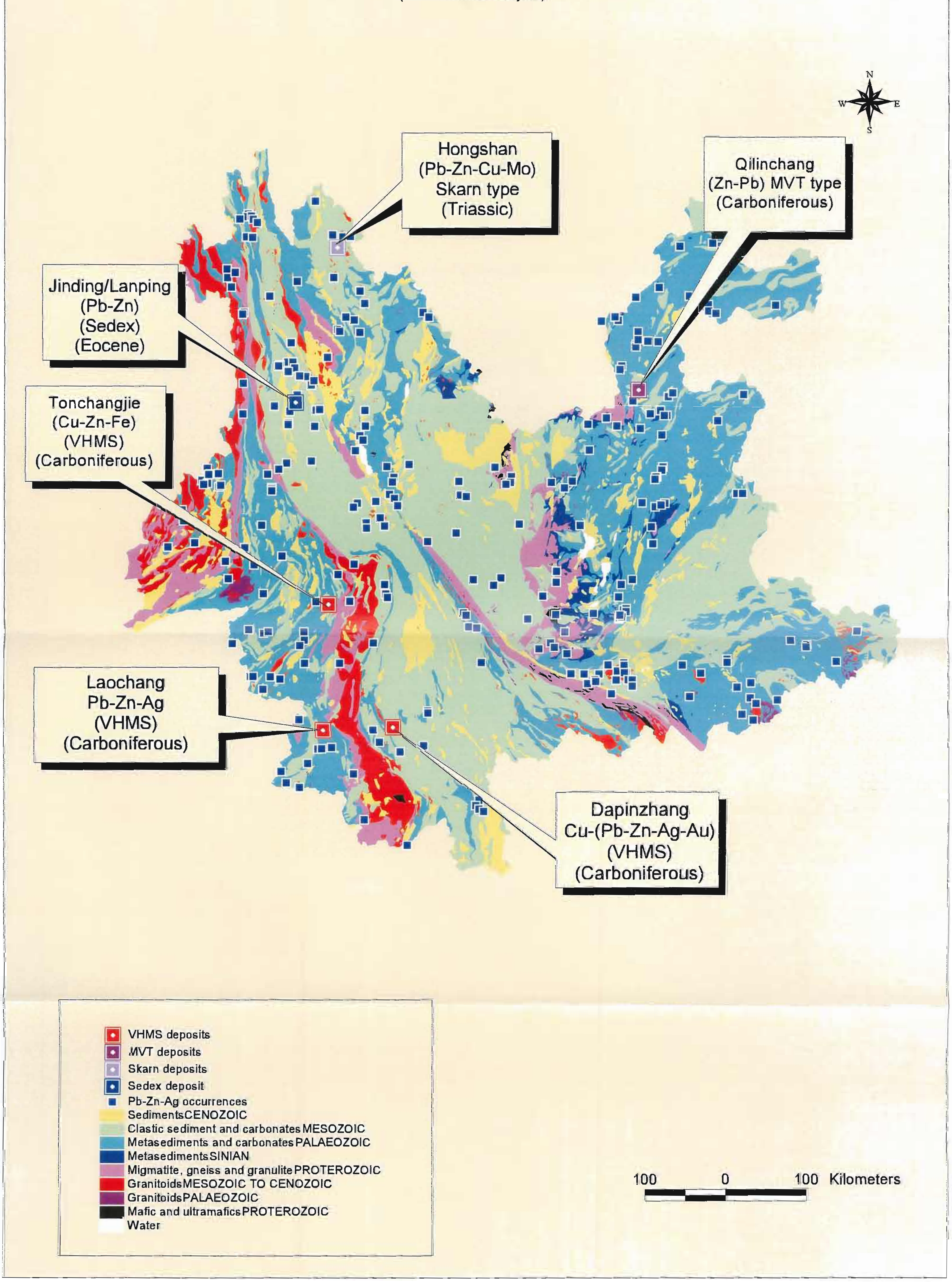


Fig. 7. Map showing geology and selected copper occurrences in Yunnan
(AMIRA P603 Project)

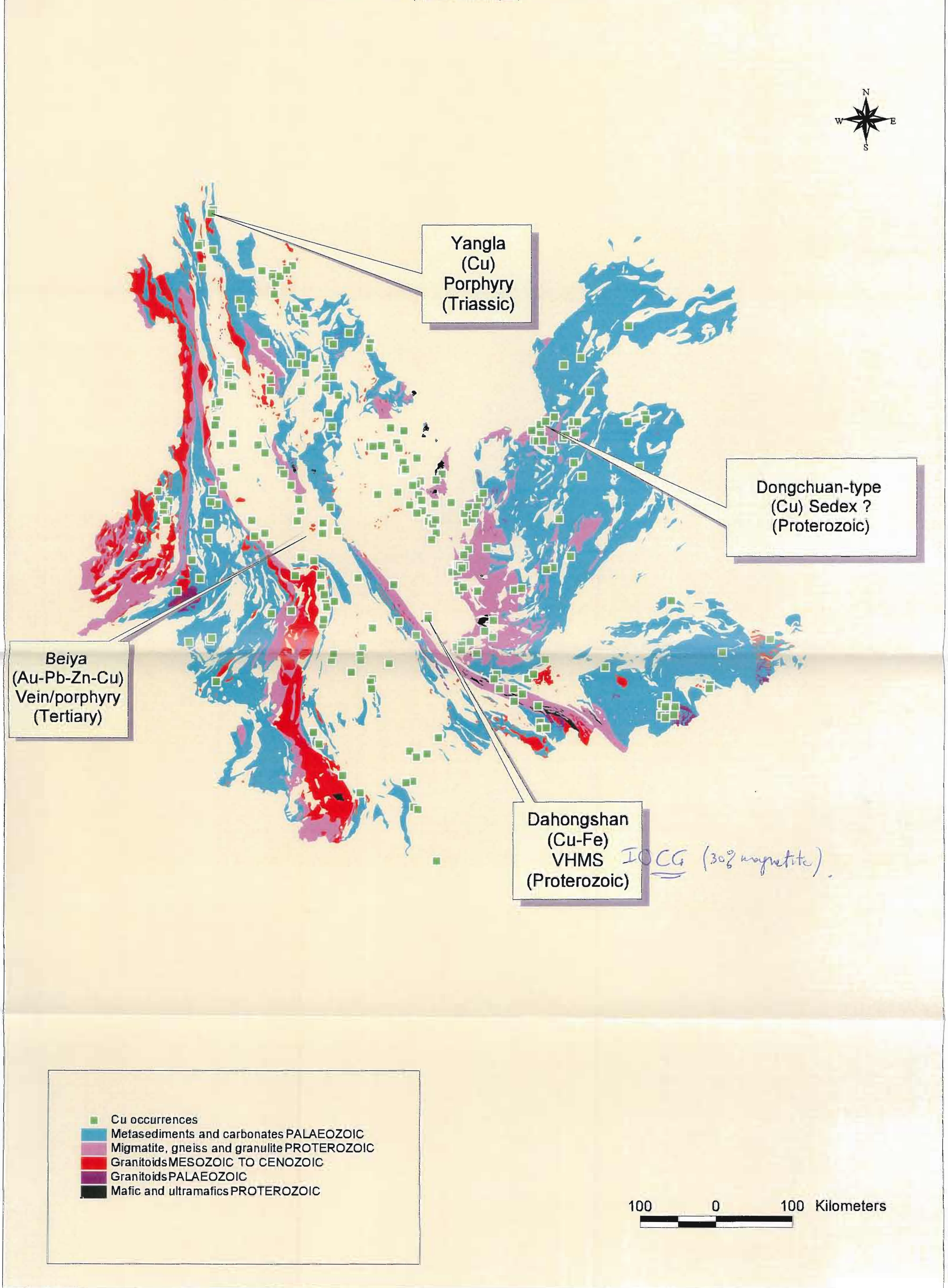


Fig. 8. Map showing gold deposits, granitoids and faults in Yunnan
(P603 Project)

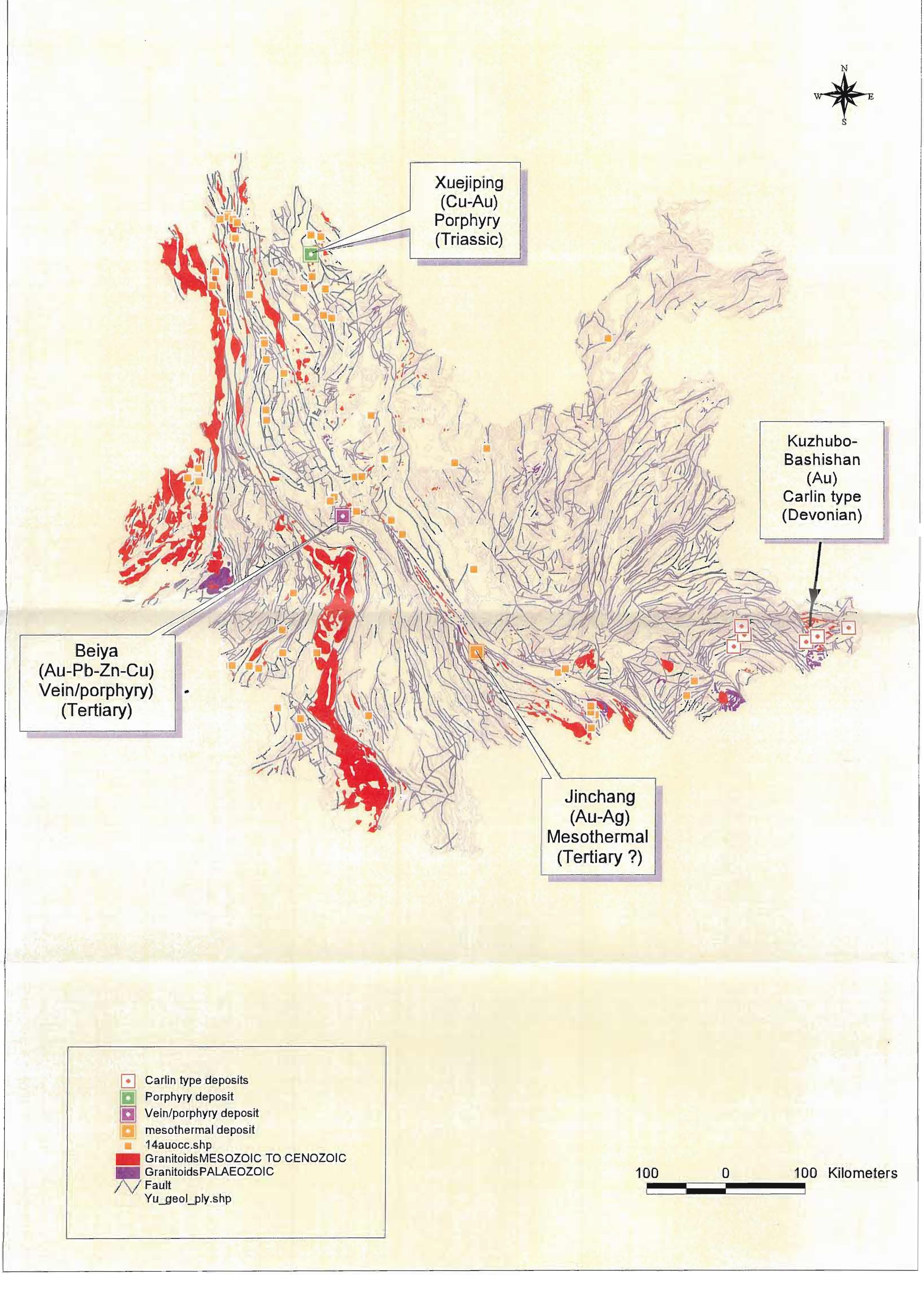


Fig. 9. Map showing nickel-copper-cobalt-platinum-pladium occurrences in Yunnan
(P603 Project)

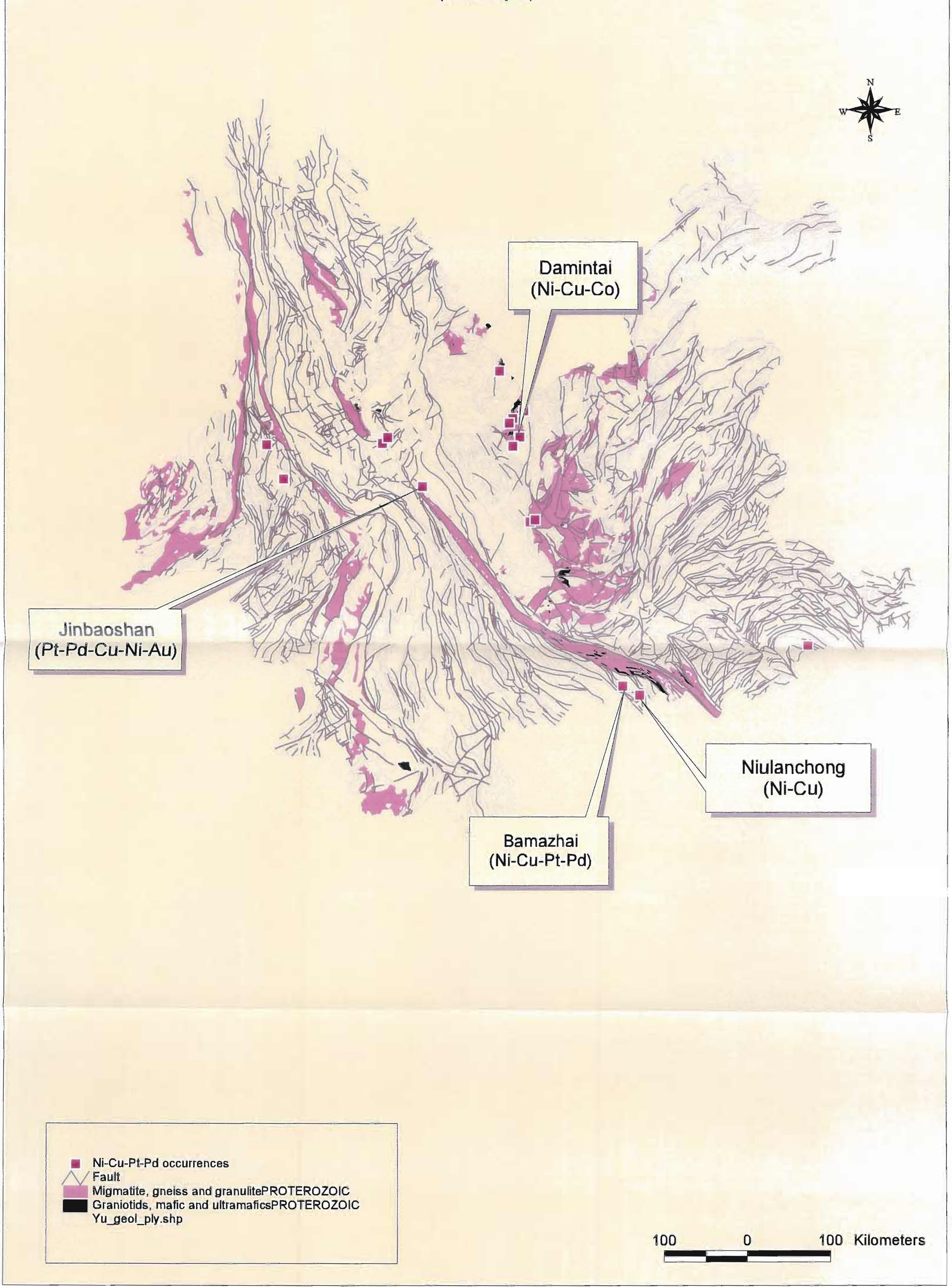
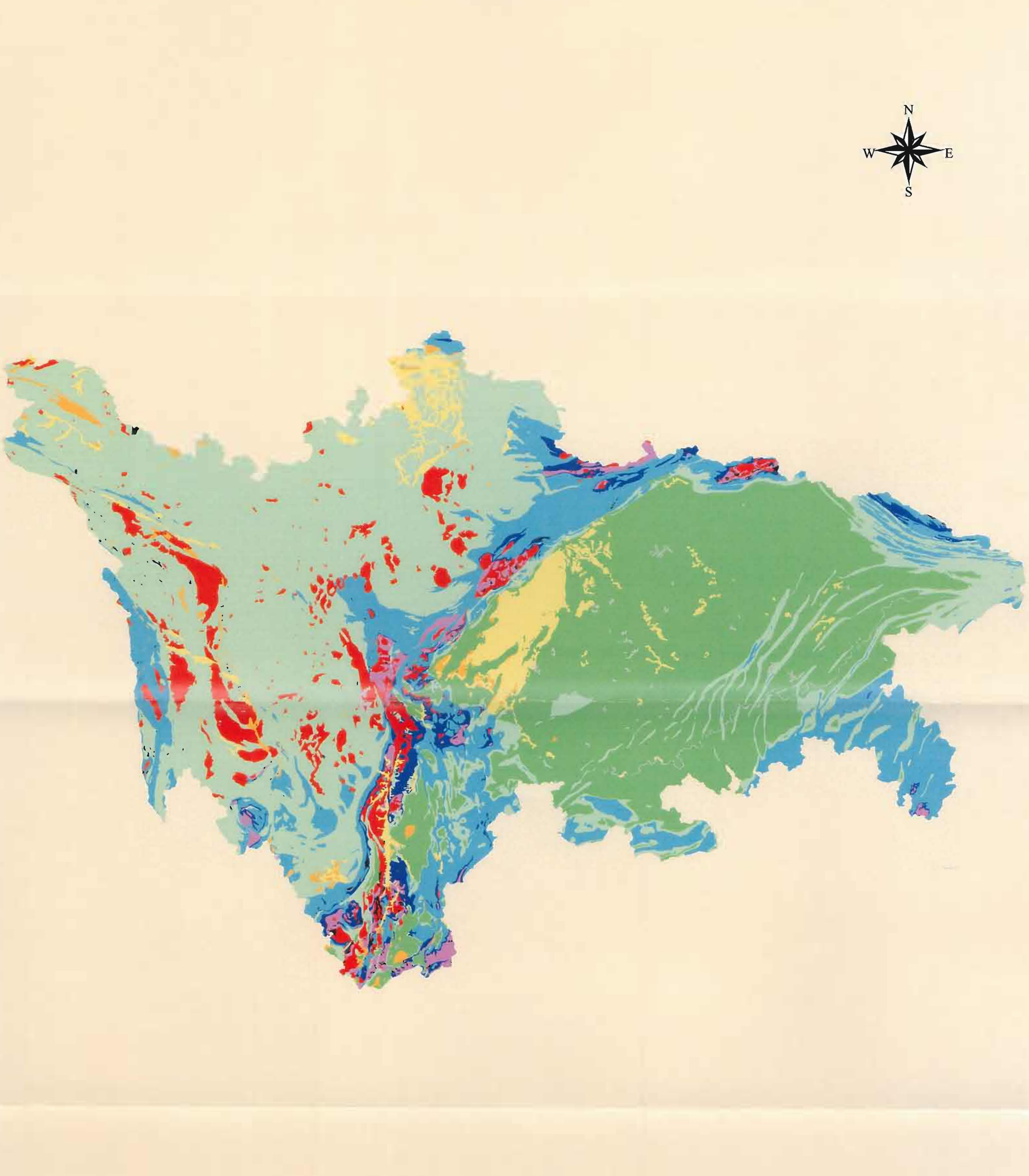


Fig. 10. Geology of Sichuan Province
(AMIRA P603 Project)



# Geology Legend (Sichuan)

Geology Legend (Sichuan)

11110 101 Qh Undifferentiated-HOLOCENE
11145 102 Qp Undifferentiated-PLEISTOCENE UNDIF.
11150 103 Q Undifferentiated-QUATERNARY UNDIF.
11225 104 N Mafic rock (Undivided)-NEOGENE UNDIF.
11240 105 E Alkaline rock (Undivided)-EOCENE
11260 106 R Undifferentiated-TERTIARY UNDIF.
12110.01 300 K2z Zhengyang Fm.-L. CRETACEOUS
12110.02 301 K2g Guankou Fm.-L. CRETACEOUS
12110.03 302 K2x Xiaoba Fm.-L. CRETACEOUS
12110.04 303 K2gk Gaokanba Fm.-L. CRETACEOUS
12110.05 304 K2s Sanhe Fm.-L. CRETACEOUS
12110.06 305 K2s+gk Sanhe and Gaokanba Fm-L. CRETACEOUS
12110.07 306 K1-2j Jiaguan Fm.-L. CRETACEOUS
12120.02 307 K1d Daerdang Fm.-E. CREATACEOUS
12120.03 308 K1w Wotoushan Fm.-E. CREATACEOUS
12120.04 309 K1w+d Wotoushan, Daerdang Fm.-E. CREATACEOUS
12120.05 310 K1t/K1f Tianmashan,Feitianshan Fm.-E. CREATACEOUS
12120.06 311 K1g Gudian Fm.-E. CREATACEOUS
12120.07 312 K1q Qiqusi Fm.-E. CREATACEOUS
12120.08 313 K1b Bailong Fm-E. CREATACEOUS
12120.09 314 K1c Cangxi Fm.-E. CREATACEOUS
12210.01 315 J3p Penglaizhen Fm-L. JURASSIC
12210.02 316 J3s Suining Fm.-L. JURASSIC
12210.03 322 J3g Guangou Fm.-L. JURASSIC
12210.04 323 J3n Niugundang Fm.-L. JURASSIC
12210.05 326 J3 Undifferentiated-L. JURASSIC
12220.01 317 J2s Shangshaximiao Fm.-M. JURASSIC
12220.02 318 J2xs Xiashaximiao Fm.-M. JURASSIC
12220.03 319 J2q/j2xn Qianfuyan,Xintiangou Fm.-M. JURASSIC
12220.04 320 J1-2 Zhenzhuchong, Ziliujing, Xintiangou Fm-M. JURASSIC
12220.04 324 J2x Xincun Fm.-M. JURASSIC
12220.05 327 J2 Undifferentiated-M. JURASSIC
12220.06 328 J1+2 Undifferentiated-M. JURASSIC
12230.01 325 J1y Yimen Fm.-E. JURASSIC
12230.02 321 J1/J1b Zhenzhuchong, Ziliujing,Baitianba Fm.-E. JURASSIC
12230.03 329 T3-J1 Undifferentiated-E. JURASSIC
12230.03 329 T3-J1 andesite-E. JURASSIC
12310.02 330 T3xj Xujiahe,Maantang,Kuahongdong Fm-L. TRIASSIC
12310.03 334 T3bg Baiguowan Fm.-L. TRIASSIC
12310.04 335 T3bd Baoding Fm.-L. TRIASSIC
12310.05 336 T3d Daqiaodi Fm.-L. TRIASSIC
12310.06 337 T3b Bingnan Fm.-L. TRIASSIC
12310.07 338 T3dg Dongqualing Fm.-L. TRIASSIC
12310.08 339 T3s+b Shemulong,Boda Fm-L. TRIASSIC
12310.09 343 T3y Yajiang Fm.-L. TRIASSIC
12310.1 344 T3xn2 Xinduqiao Fm.-L. TRIASSIC
12310.11 345 T3xn1 Xinduqiao Fm.-L. TRIASSIC
12310.12 346 T3xn Xinduqiao Fm.-L. TRIASSIC
12310.13 347 T3zh Zhehor Fm.-L. TRIASSIC
12310.14 348 T2-3z Zagunao Fm.-L. TRIASSIC
12310.15 350 T3yn Yingzhunianga Fm.-L. TRIASSIC
12310.16 351 T3lm Lamaya Fm.-L. TRIASSIC
12310.17 352 T3l Lanashan Fm.-L. TRIASSIC
12310.18 353 T3t Andesite - rhyolite-L. TRIASSIC
12310.18 353 T3t Rhyolite - felsite-L. TRIASSIC
12310.18 353 T3t Tumugou Fm.-L. TRIASSIC
12310.19 354 T3q Basalt-L. TRIASSIC
12310.19 354 T3q Qugasi Fm.-L. TRIASSIC
12310.2 355 T3 Undifferentiated-L. TRIASSIC
12310.21 356 T3j Jiapila Fm.-L. TRIASSIC
12310.22 357 T2-3 Undifferentiated-L. TRIASSIC
12320.01 331 T2l/T2b Leikoupo,Badong Fm.-M. TRIASSIC
12320.03 340 T2bs Baishan Fm.-M. TRIASSIC
12320.04 341 T2y Basalt-M. TRIASSIC
12320.04 341 T2y Yantang Fm.-M. TRIASSIC
12320.07 358 T2 Undifferentiated-M. TRIASSIC
12320.08 359 T1-2zh Basalt-M. TRIASSIC
12320.08 359 T1-2zh Zhongxinrong Gr.-M. TRIASSIC
12320.09 360 T1+2/T1-2 Undifferentiated-M. TRIASSIC
12330.01 332 T1j Jialingjiang Fm.-E. TRIASSIC
12330.02 333 T1f/T1d Feixianguan,Daye Fm.-E. TRIASSIC
12330.04 342 T1q Qingtianbao Fm.-E. TRIASSIC
12330.05 349 T1b Bocigou Fm.-E. TRIASSIC
12330.08 361 T1 Undifferentiated-E. TRIASSIC
12330.09 363 P2+T1 Basalt-E. TRIASSIC
12330.09 363 P2+T1 Undifferentiated-E. TRIASSIC
12340 362 T Undifferentiated-TRIASSIC UNDIF.
13120.02 501 P2 Basalt-M. PERMIAN
13120.02 501 P2 Undifferentiated-M. PERMIAN
13120.03 502 P2x Xuanwei Fm.-M. PERMIAN
13120.04 503 Pbeta Basalt-M. PERMIAN

13120.04 503 Pbeta Emeishan Basalt-M. PERMIAN
13130 504 P1 Basalt-E. PERMIAN
13130 504 P1 Undifferentiated-E. PERMIAN
13140.01 505 P Undifferentiated-PERMIAN UNDIF.
13140.02 506 C-P Undifferentiated-PERMIAN UNDIF.
13220 507 C2 Undifferentiated-M. CARBONIFEROUS
13230 508 C1 Undifferentiated-E. CARBONIFEROUS
13240.02 509 C Undifferentiated-CARBONIFEROUS UNDIF.
13240.03 510 D+C Undifferentiated-CARBONIFEROUS UNDIF.
13310.01 511 D3 Undifferentiated-L. DEVONIAN
13310.02 512 D2+3 Undifferentiated-L. DEVONIAN
13320.02 513 D2 Undifferentiated-M. DEVONIAN
13330.01 514 D1 Undifferentiated-E. DEVONIAN
13340.02 515 D Undifferentiated-DEVONIAN UNDIF.
13340.02 517 S-D Undifferentiated-DEVONIAN UNDIF.
13340.03 516 S+D Undifferentiated-DEVONIAN UNDIF.
13340.03 517 S-D Basalt-DEVONIAN UNDIF.
13410.01 518 S3 Undifferentiated-L. SILURIAN
13410.02 519 S2-3 Undifferentiated-L. SILURIAN
13420.02 520 S1+2 Undifferentiated-M. SILURIAN
13430.02 521 S1 Undifferentiated-E. SILURIAN
13440.03 522 S Undifferentiated-SILURIAN UNDIF.
13440.05 523 Smx3 Maoxian Gr.-SILURIAN UNDIF.
13440.06 524 Smx2 Maoxian Gr.-SILURIAN UNDIF.
13440.07 525 Smx1 Maoxian Gr.-SILURIAN UNDIF.
13440.08 526 Smx Maoxian Gr.-SILURIAN UNDIF.
13440.19 528 O+S/O-S Undifferentiated-SILURIAN UNDIF.
13445 527 AnS Undifferentiated-PRE-SILURIAN
13510.01 529 O2-3/O2+3 Undifferentiated-L. ORDOVICIAN
13520.02 530 O1-2 Undifferentiated-M. ORDOVICIAN
13530.02 531 O1 Undifferentiated-E. ORDOVICIAN
13540.02 532 O Basalt-ORDOVICIAN UNDIF.
13540.02 532 O Undifferentiated-ORDOVICIAN UNDIF.
13540.03 533 Cb+O/Cb-O Undifferentiated-ORDOVICIAN UNDIF.
13610.01 534 Cb3 Undifferentiated-L. CAMBRIAN
13610.02 535 Cb2-3 Undifferentiated-L. CAMBRIAN
13620.02 536 Cb2 Undifferentiated-M. CAMBRIAN
13630.01 537 Cb1 Undifferentiated-E. CAMBRIAN
13640.02 538 Cb Undifferentiated-CAMBRIAN UNDIF.
13640.03 539 Z-Cb Undifferentiated-CAMBRIAN UNDIF.
21110.01 701 Z2 Undifferentiated-UP. SINIAN
21120.01 702 Z1 Andesite - rhyolite-M. SINIAN
21120.01 702 Z1 Rhyolite - felsite-M. SINIAN
21120.01 702 Z1 Undifferentiated-M. SINIAN
21140.02 703 Z Undifferentiated-SINIAN UNDIF.
21220.01 704 Pt3bn Banxi Gr.-UP. PROTEROZOIC
22000.01 705 Pt2tn Huili Gr.-M. PROTEROZOIC UNDIF.
22000.02 706 Pt2f Huili Gr.-M. PROTEROZOIC UNDIF.
22000.03 707 Pt2f+tn Huili Gr.-M. PROTEROZOIC UNDIF.
22000.04 708 Pt2l Basalt-M. PROTEROZOIC UNDIF.
22000.04 708 Pt2l Huili Gr.-M. PROTEROZOIC UNDIF.
22000.05 709 Pt2l+f Huili Gr.-M. PROTEROZOIC UNDIF.
22000.06 710 Pt2t Huili Gr.-M. PROTEROZOIC UNDIF.
22000.07 711 Pt2h Huili Gr.-M. PROTEROZOIC UNDIF.
22000.08 712 Pt2hl Huili Gr.-M. PROTEROZOIC UNDIF.
22000.09 713 Pt2z Yanbiang Gr-M. PROTEROZOIC UNDIF.
22000.1 714 Pt2x Yanbiang Gr-M. PROTEROZOIC UNDIF.
22000.11 715 Pt2y Yanbiang Gr-M. PROTEROZOIC UNDIF.
22000.12 716 Pt2ht Yanbiang Gr-M. PROTEROZOIC UNDIF.
22000.13 717 Pt2dn Dengxiangying Gr.-M. PROTEROZOIC UNDIF.
22000.14 718 Pt2eb Ebian Gr.-M. PROTEROZOIC UNDIF.
22000.15 719 Pt2hn Huangshuihe Gr.-M. PROTEROZOIC UNDIF.
22000.16 720 Pt2bs Baishuihe Gr.-M. PROTEROZOIC UNDIF.
22000.17 721 Pt2s Huodiya Gr.-M. PROTEROZOIC UNDIF.
22000.18 722 Pt2m Huodiya Gr.-M. PROTEROZOIC UNDIF.
22000.19 723 Pt2bk Andesite - Basalt-M. PROTEROZOIC UNDIF.
22000.2 724 Pt2tm Andesite - rhyolite-M. PROTEROZOIC UNDIF.
22000.21 725 Pt2yn Andesite - rhyolite-M. PROTEROZOIC UNDIF.
22000.21 725 Pt2yn Trachyte-M. PROTEROZOIC UNDIF.
22000.22 726 Pt2qs Andesite - rhyolite-M. PROTEROZOIC UNDIF.
22000.23 727 Pt2 Undifferentiated-M. PROTEROZOIC UNDIF.
23000 728 Ar-Pt1 Kangding Gr.-LW. PROTEROZOIC UNDIF.
42100.01 400 g53 Granite-CRETACEOUS UNDIF.
42100.02 403 gh53 Monzonitic granite-CRETACEOUS UNDIF.
42100.03 404 ghp53 porphyritic monzogranite-CRETACEOUS UNDIF.
42100.04 406 gp53 Granite porphyry-CRETACEOUS UNDIF.
42100.05 499 gk53 Alkali granite-CRETACEOUS UNDIF.
42200.01 410 g52 Granite-JURASSIC UNDIF.
42200.02 411 go52 Plagioclase granite-JURASSIC UNDIF.
42200.03 412 gd52 Granodiorite-JURASSIC UNDIF.
42200.04 413 gh52 Monzonitic granite-JURASSIC UNDIF.
42200.05 414 ghp52 Porphyritic monzogranite-JURASSIC UNDIF.

42200.06 416 gp52 Granite porphyry-JURASSIC UNDIF.
42200.07 419 gx52 Alkali feldspar granite-JURASSIC UNDIF.
42300 475 n5 Gabbro-L. MESOZOIC UNDIF.
43400.01 420 g51 Granite-TRIASSIC UNDIF.
43400.02 421 go51 Plagioclase granite-TRIASSIC UNDIF.
43400.03 422 gd51 Granodiorite-TRIASSIC UNDIF.
43400.04 423 gh51 Monzonitic granite-TRIASSIC UNDIF.
43400.05 424 ghp51 Porphyritic monzogranite-TRIASSIC UNDIF.
43400.06 426 gp51 Granite porphyry-TRIASSIC UNDIF.
43400.07 429 d51 Diorite-TRIASSIC UNDIF.
43400.08 430 do51 Quartz diorite-TRIASSIC UNDIF.
43400.09 431 dho51 Quartz monzonite,monzonitic porphyry-TRIASSIC UNDIF.
43400.1 432 h51 Monzonite-TRIASSIC UNDIF.
43400.11 433 x51 Alkaline rock (Undivided)-TRIASSIC UNDIF.
43400.12 434 xo51 Alkaline rock (Undivided)-TRIASSIC UNDIF.
43400.13 435 dm51 Diorite-porphyrite-TRIASSIC UNDIF.
43400.14 436 n51 Gabbro-TRIASSIC UNDIF.
43400.15 437 nb51 Diabase Gabbro-TRIASSIC UNDIF.
43400.16 439 bm51 Dacite porphyrite-TRIASSIC UNDIF.
43400.17 442 yo51 Hornblendite-TRIASSIC UNDIF.
43400.18 444 jw51 Serpentinite-TRIASSIC UNDIF.
43400.19 446 Es51 Ultramafic Alkaline-TRIASSIC UNDIF.
43400.2 449 xk51 Alkali syenite-TRIASSIC UNDIF.
43400.21 450 xok51 Alkalic quartz - Syenite-TRIASSIC UNDIF.
43400.22 454 dh51 Monzodiorite-TRIASSIC UNDIF.
43400.23 455 S.51 Ultramafic-TRIASSIC UNDIF.
44100.01 601 go43 Plagioclase granite-PERMIAN UNDIF.
44100.02 602 gd43 Granodiorite-PERMIAN UNDIF.
44100.03 609 d43 Diorite-PERMIAN UNDIF.
44100.04 610 do43 Quartz diorite-PERMIAN UNDIF.
44100.05 614 xo43 Alkaline rock (Undivided)-PERMIAN UNDIF.
44100.06 616 n43 Gabbro-PERMIAN UNDIF.
44100.07 619 bm43 Diabase porphyrite-PERMIAN UNDIF.
44100.08 621 yt43 Pyroxenolite-PERMIAN UNDIF.
44100.09 623 s43 Peridotite-PERMIAN UNDIF.
44100.1 624 jw43 Serpentinite-PERMIAN UNDIF.
44100.11 626 Es43 Ultramafic Alkaline-PERMIAN UNDIF.
44100.12 635 S.43 Ultramafic-PERMIAN UNDIF.
44100.13 638 N.43 Mafic-PERMIAN UNDIF.
44200 641 gd42 Granodiorite-CARBONIFEROUS UNDIF.
45400 689 nb3 Diabase Gabbro-E. PALEOZOIC UNDIF.
46110.01 800 g23 Granite-SINIAN UNDIF.
46110.02 801 go23 Plagioclase granite-SINIAN UNDIF.
46110.03 803 gh23 Monzonitic granite-SINIAN UNDIF.
46110.04 809 gx23 Alkali feldspar granite-SINIAN UNDIF.
47310.01 810 g22 Granite-M. PROTEROZOIC UNDIF.
47310.02 811 go22 Plagioclase granite-M. PROTEROZOIC UNDIF.
47310.03 812 gd22 Granodiorite-M. PROTEROZOIC UNDIF.
47310.04 813 gh22 Monzonitic granite-M. PROTEROZOIC UNDIF.
47310.05 819 d22 Diorite-M. PROTEROZOIC UNDIF.
47310.06 820 do22 Quartz diorite-M. PROTEROZOIC UNDIF.
47310.07 821 dho22 Quartz porphyry-M. PROTEROZOIC UNDIF.
47310.08 826 n22 Gabbro-M. PROTEROZOIC UNDIF.
47310.09 827 nb22 Diabase Gabbro-M. PROTEROZOIC UNDIF.
47310.1 828 nd22 Diorite gabbro-M. PROTEROZOIC UNDIF.
47310.11 833 s22 Peridotite-M. PROTEROZOIC UNDIF.
47310.12 834 jw22 Serpentinite-M. PROTEROZOIC UNDIF.
47310.13 836 Es22 Ultramafic Alkaline-M. PROTEROZOIC UNDIF.
47310.14 837 En22 Mafic alkalic-M. PROTEROZOIC UNDIF.
47310.15 845 S.22 Ultramafic-M. PROTEROZOIC UNDIF.
47310.16 847 gx22 Alkali feldspar granite-M. PROTEROZOIC UNDIF.
47310.17 848 N.22 Mafic-M. PROTEROZOIC UNDIF.
49000.01 849 g21 Granite-ARCHEAN-E. PROTEROZOIC
49000.02 850 go21 Plagioclase granite-ARCHEAN-E. PROTEROZOIC
49000.03 851 gd21 Granodiorite-ARCHEAN-E. PROTEROZOIC
49000.04 853 ghp21 porphyritic monzogranite-ARCHEAN-E. PROTEROZOIC
49000.05 855 gp21 Granite porphyry-ARCHEAN-E. PROTEROZOIC
49000.06 859 do21 Quartz diorite-ARCHEAN-E. PROTEROZOIC
49000.07 867 n1-21 Gabbro-ARCHEAN-E. PROTEROZOIC
49000.08 868 nb1-21 Diabase Gabbro-ARCHEAN-E. PROTEROZOIC
49000.09 877 S.1-21 Ultramafic-ARCHEAN-E. PROTEROZOIC
49000.1 878 N.1-21 Mafic-ARCHEAN-E. PROTEROZOIC
90000.01 010 bm Diabase porphyrite-UNKNOWN
90000.02 020 S Ultramafic-UNKNOWN
90000.03 030 d Diorite-UNKNOWN
90000.04 040 g Granite-UNKNOWN
90000.05 050 n Gabbro-UNKNOWN
90000.06 729 Gg Granulite-UNKNOWN
90000.07 730 Gn Migmatite and migmatitic gneiss-UNKNOWN
99000 900 Water

Fig. 11. Map showing mineral occurrences in Sichuan
(AMIRA P603 Project)

Fig. 12. Map showing lead-zinc-copper-silver-gold occurrences in Sichuan (AMIRA P603 Project)

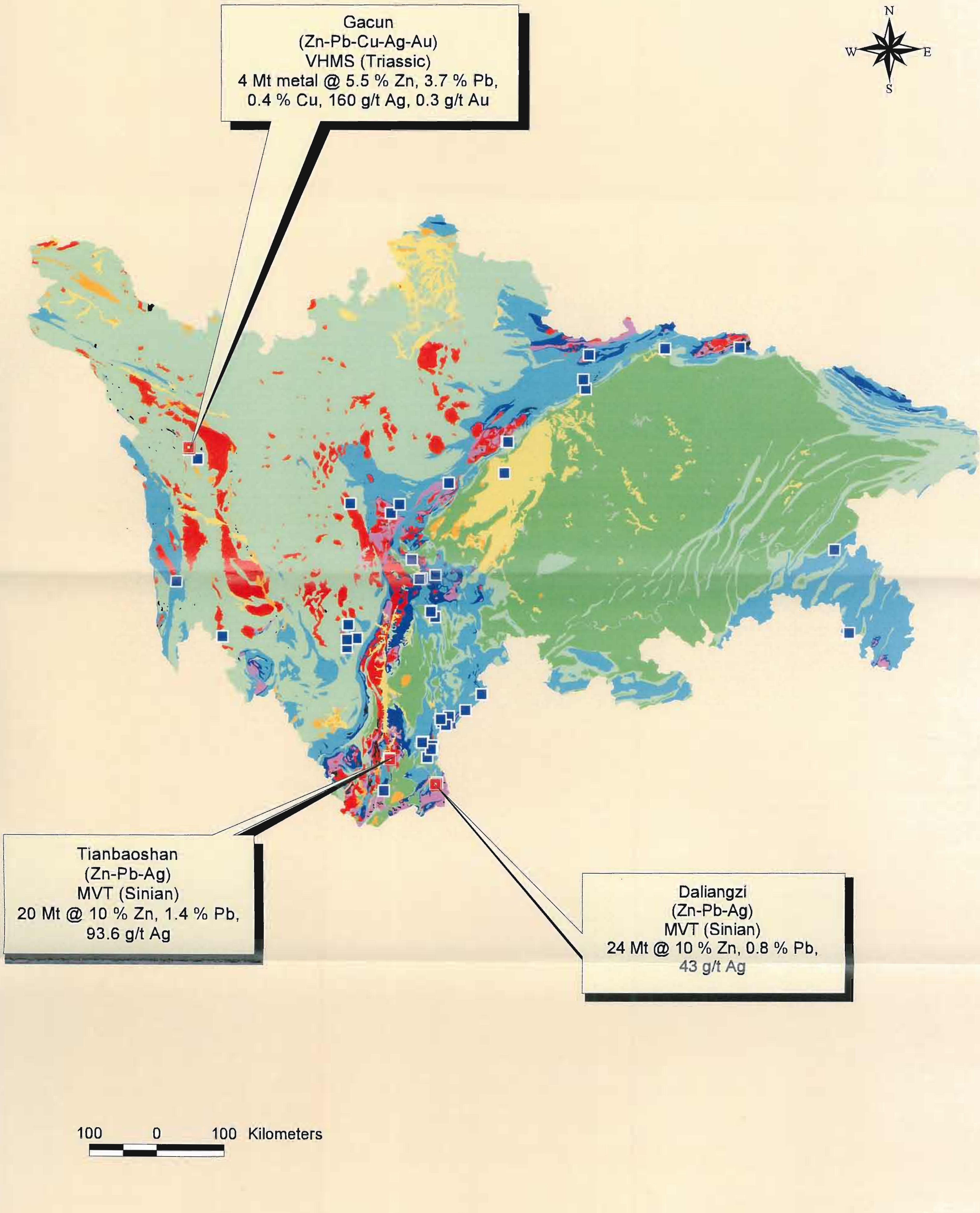


Fig. 13. Map showing gold occurrences in Sichuan
(AMIRA P603 Project)

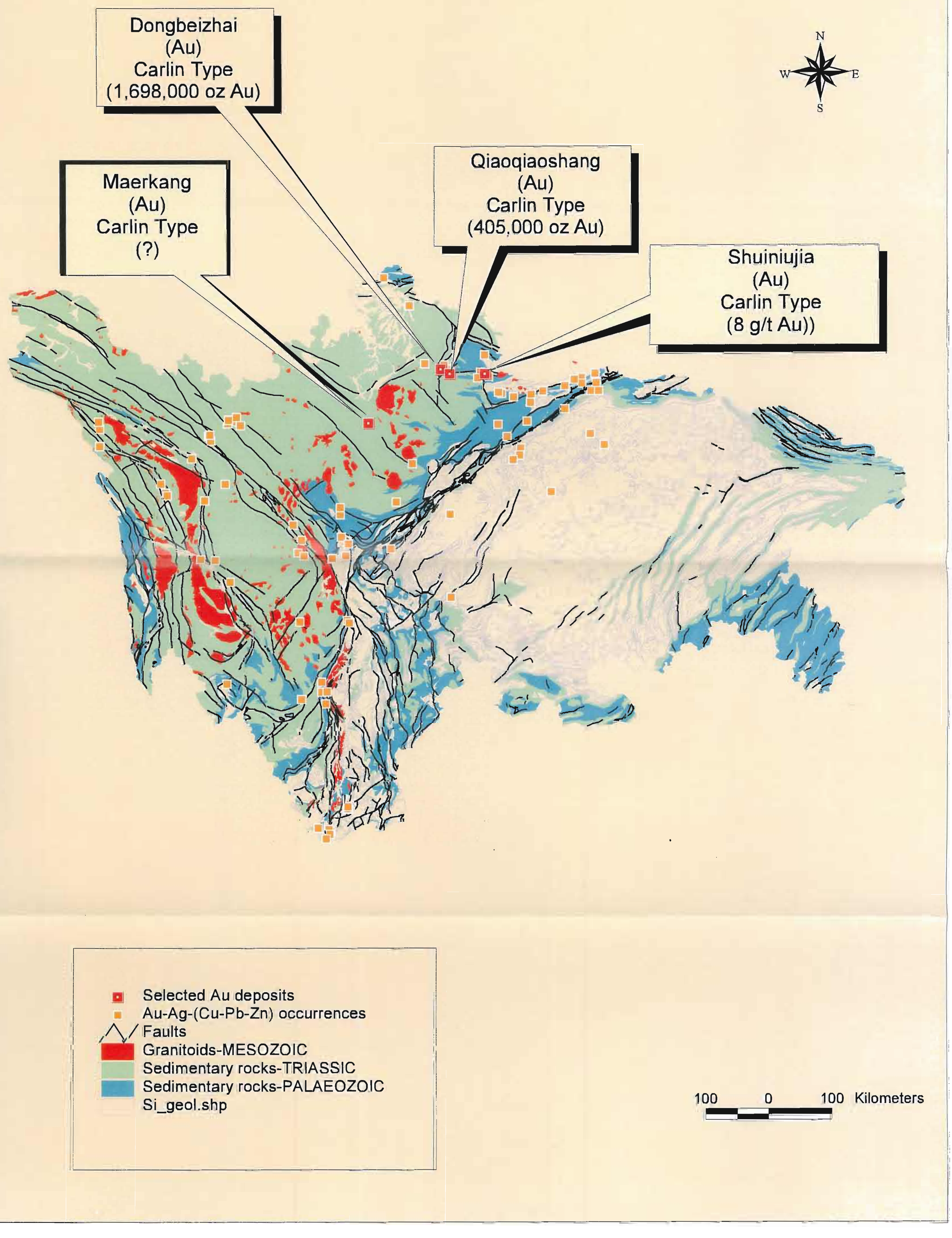


Fig. 14. Map showing copper-nickel and PGE occurrences in Sichuan
(AMIRA P603 Project)

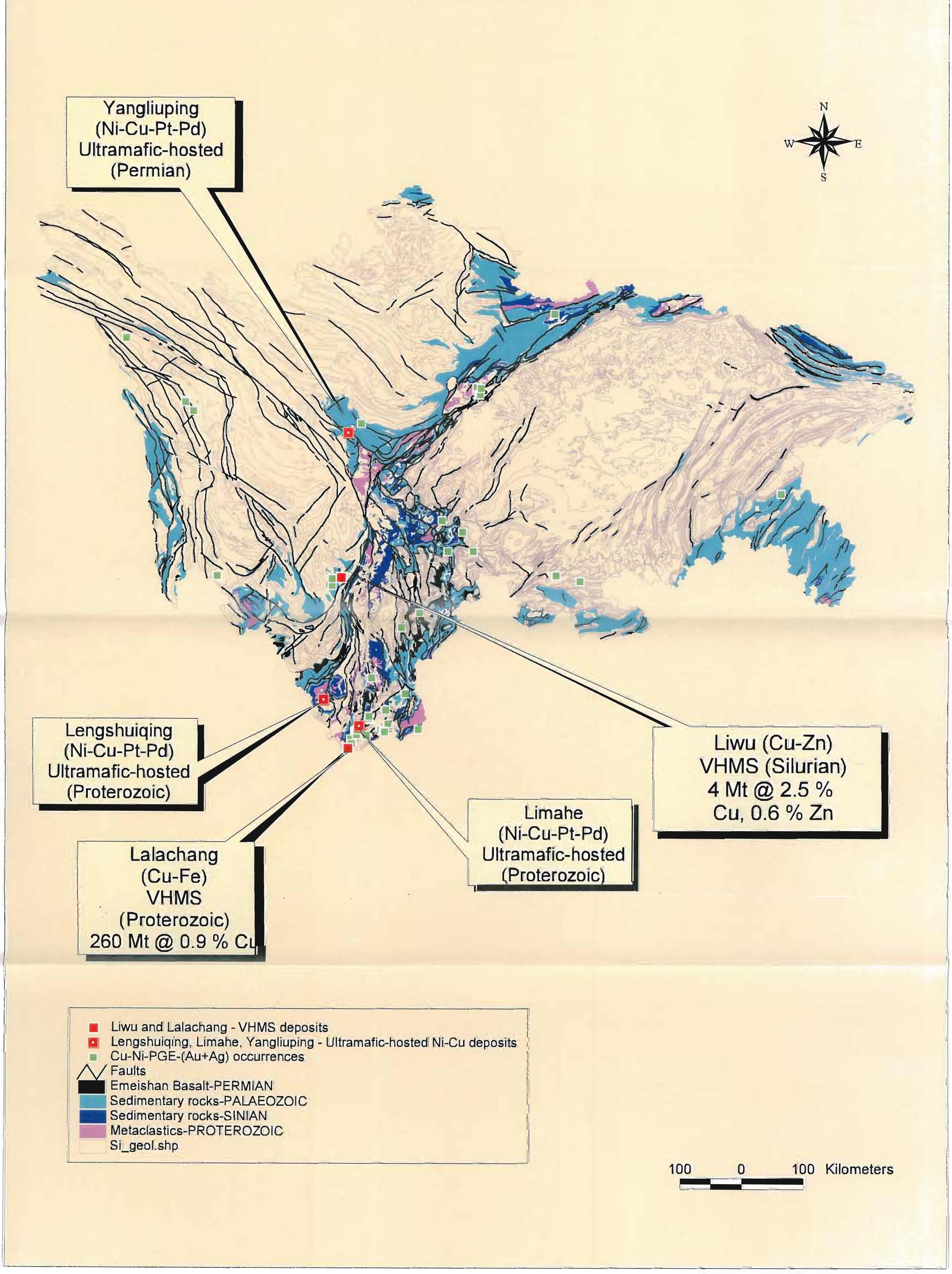
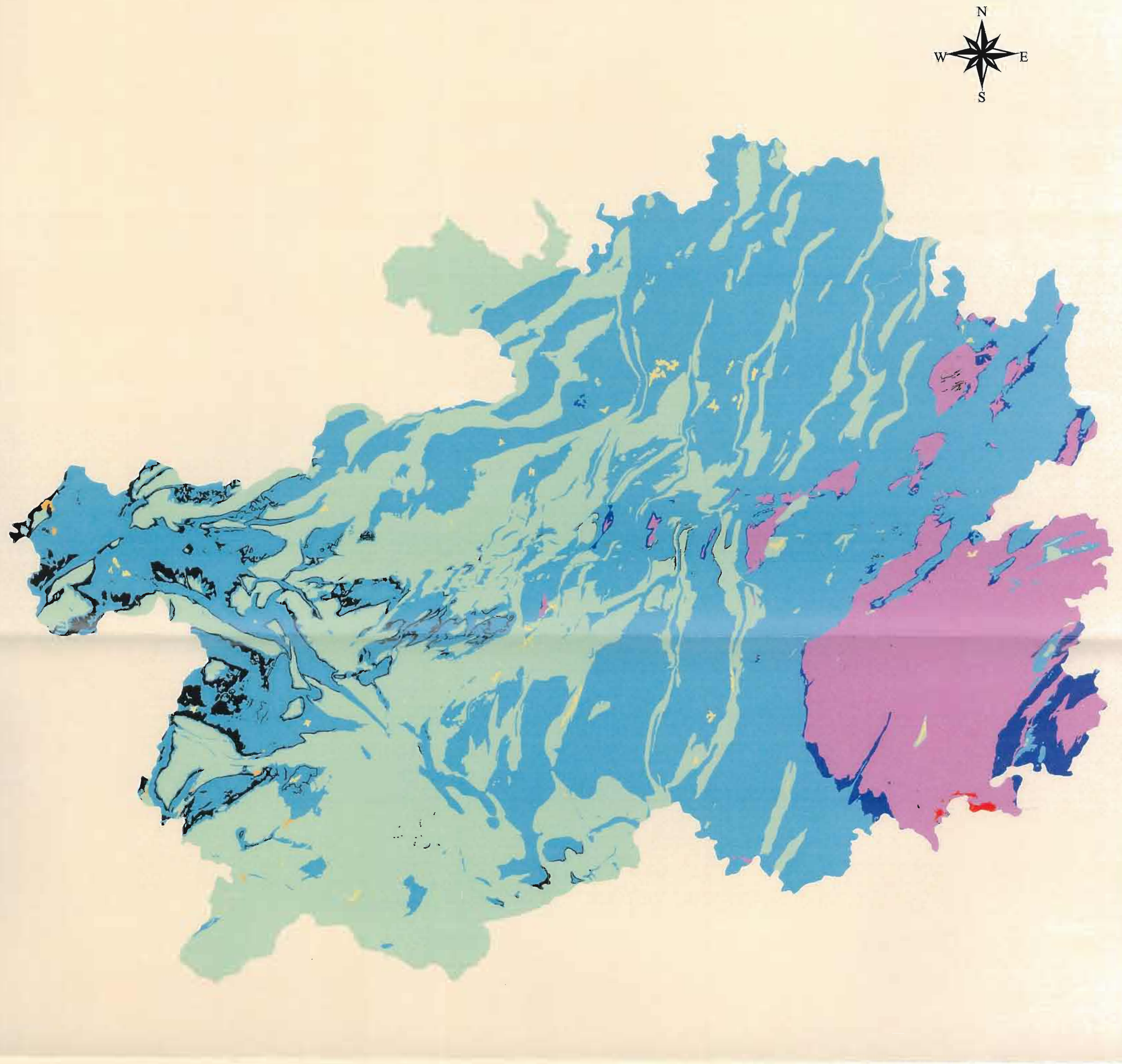


Fig. 15. Geology of Guizhou Province
(AMIRA P603 Project)



# Geology Legend (Guizhou)

Geology Legend (Guizhou)

11150 107 Qu Undifferentiated-QUATERNARY UNDIF.
11210.1 110 Ng Gaokanzi Fm.-PLIOCENE
11220.2 111 ws Wengshao Fm.-MIOCENE
11230.3 115 Ep-s Shinao Gr.-OLIGOCENE
11240.1 112 Esn Shinao Gr.-EOCENE
11240.2 114 E2p Shinao Gr.-EOCENE
12110.1 301 Kjd Jiading Gr.-L. CRETACEOUS
12110.21 303 K2j Maotai Gr.-L. CRETACEOUS
12110.22 304 K2z Maotai Gr.-L. CRETACEOUS
12110.23 305 K2h Maotai Gr.-L. CRETACEOUS
12110.24 306 K2z-j Maotai Gr.-L. CRETACEOUS
12110.25 307 K2h-j Maotai Gr.-L. CRETACEOUS
12120.2 308 K1sd Sandaohe Gr.-E. CREATACEOUS
12210.1 309 J3p Penglaizhen Fm.-L. JURASSIC
12210.2 310 J3s Suining Fm.-L. JURASSIC
12220.2 312 J2x Xiashaximiao Fm.-M. JURASSIC
12220.3 313 J2x-s Xiashaximiao & Shangshaximiao Fm.-M. JURASSIC
12220.4 316 J2u Undifferentiated-M. JURASSIC
12220.5 314 Jxl Xialufeng Fm.-M. JURASSIC
12220.6 315 Jzl Ziliujing Gr.-M. JURASSIC
12310.11 317 T3e Erqiao Fm.-L. TRIASSIC
12310.12 318 T3h Huobachong Fm.-L. TRIASSIC
12310.13 319 T3h-e Huobachong and Erqiao Fm.-L. TRIASSIC
12310.14 324 T3b Banan Fm.-L. TRIASSIC
12310.15 325 T3l Laishike Fm-L. TRIASSIC
12310.16 323 T3l-b Banan and Laishike Fm-L. TRIASSIC
12310.2 322 T3s Sanqiao Fm.-L. TRIASSIC
12310.3 321 T3s-e Sanqiao and Erqiao Fm.-L. TRIASSIC
12320.1 327 T2bd Badong Fm.-M. TRIASSIC
12320.12 326 Tf Falang Fm-M. TRIASSIC
12320.13 328 T2y Yangliujing Fm.-M. TRIASSIC
12320.14 329 T2y-f Yangliujing and Falang Fm-M. TRIASSIC
12320.15 357 T2g Guangling Fm.-M. TRIASSIC
12320.16 330 T2g-y Guanling and Yangliujing Fm.-M. TRIASSIC
12320.21 331 T2gc Gaicha Fm.-M. TRIASSIC
12320.22 333 T2l Longtou Fm.-M. TRIASSIC
12320.23 332 T2l-gc Longtou and Gaicha-M. TRIASSIC
12320.24 334 T2p Poduan Fm.-M. TRIASSIC
12320.25 335 T2p-l Poduan and Longtou-M. TRIASSIC
12320.31 336 T2b Bianyang Fm.-M. TRIASSIC
12320.32 337 T2q Qingyan Fm.-M. TRIASSIC
12320.33 338 T2x Xinyuan Fm.-M. TRIASSIC
12320.34 339 T2x-b Xinyuan and Bianyang Fm.-M. TRIASSIC
12320.4 342 T2xm Xuman Fm.-M. TRIASSIC
12330.11 343 T1m Maocaopu Fm.-E. TRIASSIC
12330.12 344 T1y Yelang Fm.-E. TRIASSIC
12330.13 345 T1y-m Yelang and Maocaopu-E. TRIASSIC
12330.21 347 T1yn Yongningzhen Fm.-E. TRIASSIC
12330.22 348 T1f Feixianguan Fm.-E. TRIASSIC
12330.23 346 T1f-yn Feixianguang & Yongningzhen Fm.-E. TRIASSIC
12330.25 350 T1y-yn Yelang and Yongningzhen Fm.-E. TRIASSIC
12330.26 512 P2w Wujiaping Fm.-E. TRIASSIC
12330.27 510 P2w-d Wujiaping and Dalong Fm.-E. TRIASSIC
12330.28 513 P2sw Shaiwa Gr.-E. TRIASSIC
12330.31 351 T1a Anshun Fm.-E. TRIASSIC
12330.32 352 T1d Daye Fm.-E. TRIASSIC
12330.33 353 T1d-a Daye and Anshun Fm.-E. TRIASSIC
12330.41 354 T1z Ziyun Fm.-E. TRIASSIC
12330.42 355 T1l Luolou Fm.-E. TRIASSIC
12330.43 356 T1l-z Luolou and Ziyun-E. TRIASSIC
13110.12 502 P2x Xuanwei Fm.-L. PERMIAN
13110.13 504 P2x-wj Xuanwei and Wangjiazhai Fm.-L. PERMIAN
13110.23 507 P2d Dalong Fm.-L. PERMIAN
13110.24 508 P2l-c Longtan and Changxing Fm.-L. PERMIAN
13110.25 509 P2l-d Longtan and Dalong-L. PERMIAN
13130.11 516 P1m Maokou Fm.-E. PERMIAN
13130.12 517 P1q Qixia Fm.-E. PERMIAN
13130.13 518 P1q-m Qixia and Maokou Fm.-E. PERMIAN
13130.14 525 P1s Sazhi Fm.-E. PERMIAN
13130.15 526 P1h Huagong Fm.-E. PERMIAN
13130.16 527 P1l Liangshan Fm.-E. PERMIAN
13130.21 519 P1l-q Liangshan and Qixia Fm.-E. PERMIAN
13130.22 520 P1l-m Liangshan and Maokou Fm.-E. PERMIAN
13130.23 521 P1s-m Sazhi and Maokou Fm.-E. PERMIAN
13130.24 522 P1h-m Huagong and Maokou-E. PERMIAN
13130.3 523 P1sd Sidazhai Fm.-E. PERMIAN
13130.4 524 hz Undifferentiated-E. PERMIAN
13210.11 528 C2l Longyin-L. CARBONIFEROUS
13210.12 530 C2m Maping Fm.-L. CARBONIFEROUS
13210.15 533 C2hs-d Huashiban and Dala Fm.-L. CARBONIFEROUS
13210.16 534 C2hs-m Huashiban & Maping Fm.-L. CARBONIFEROUS
13210.2 543 Cx-m Xiangbai and Maping Fm.-L. CARBONIFEROUS
13210.21 554 Cx-d Xiangbai and Dewu Fm.-L. CARBONIFEROUS
13210.3 529 Cz-m Zhewang to Maping Fm.-L. CARBONIFEROUS
13230 581 D3x-dh Xjangshuidong & Daihua Fm.-E. CARBONIFEROUS
13230.11 537 C1b Baizuo Fm.-E. CARBONIFEROUS
13230.14 542 C1x Xiangbai Fm.-E. CARBONIFEROUS
13230.15 536 C1x-b Xiangbai and Baizuo Fm.-E. CARBONIFEROUS
13230.16 540 C1x-s Xiangbai and Shangsi Fm.-E. CARBONIFEROUS
13230.21 538 C1d Dewu Fm.-E. CARBONIFEROUS
13230.26 553 C1bj-xg Bojiwan & Xinguanting-E. CARBONIFEROUS
13230.4 548 C1^b Undifferentiated-E. CARBONIFEROUS
13230.42 560 C1m Muhua Fm.-E. CARBONIFEROUS
13230.44 562 C1^a Merged unit-E. CARBONIFEROUS
13230.5 563 C1u Undivided lower carboniferous-E. CARBONIFEROUS
13230.52 556 C1g Gelaohe Fm.-E. CARBONIFEROUS
13230.54 558 C1z-t Zhewang and Tangbagou-E. CARBONIFEROUS
13230.6 535 C1z-b Zhewang and Baizuo Fm.-E. CARBONIFEROUS
13230.8 564 DCm D-C Merged-E. CARBONIFEROUS
13230.81 579 dh Daihua Fm.-E. CARBONIFEROUS
13310.1 565 Dd-y Dushan,Wangchengpo & Yaosuo Fm.-L. DEVONIAN
13310.23 568 D3w-y Wangchengpo and Yaosuo Fm.-L. DEVONIAN
13310.3 577 Dgp Gaopochang Fm-L. DEVONIAN
13320.11 572 D2d Dushan Fm.-M. DEVONIAN
13320.14 571 D2l-d Longdongshui, Dahekou and Dushan-M. DEVONIAN
13320.3 578 Dms Mangshan Gr.-M. DEVONIAN
13320.41 583 D2h Huohong Fm.-M. DEVONIAN
13320.45 582 Dn-h Nabiao and Huohong Fm.-M. DEVONIAN
13330.13 567 D1d-s Danlin and Shujiaping Fm.-E. DEVONIAN
13420.12 599 Sm-h Majiaochong,Rongxi,Xiushan Fm. etc.-M. SILURIAN
13420.13 600 Sm-x Majiaochong,Rongxi,Xiushan Fm. etc.-M. SILURIAN
13420.14 610 Slm-x Longmaxi,Xiangshuyuan,Leijiatun Fm.-M. SILURIAN
13420.15 611 Sx-x Xiangshuyuan & Leijiatun Fm.-M. SILURIAN
13420.2 612 Sgz Gaozhaitian Gr.-M. SILURIAN
13420.3 613 Swx Wengxiang Gr.-M. SILURIAN
13430.19 601 S1lm-lj Longmaxi,Xiangshuyuan,Leijiatun Fm.-E. SILURIAN
13430.191 602 S1x-lj Xiangshuyuan and Leijiatun Fm.-E. SILURIAN
13430.21 588 Su Undifferentiated-E. SILURIAN
13430.22 589 S1lm-hj Longmasi,Songkan Fm, etc.-E. SILURIAN
13430.23 590 S1hj Hanjiadian Gr.-E. SILURIAN
13430.27 593 S1lm-sh Longmasi,Songkan Fm.-E. SILURIAN
13430.28 594 S1lm-s Longmasi and Songkan Fm.-E. SILURIAN
13430.29 598 S1s-sh Songkan and Shiniulan-E. SILURIAN
13510.2 617 Ob-gy Baota,Jiancaogou, & Wufeng Fm.-L. ORDOVICIAN
13510.3 690 Ot-gy Tongzi,Honghuayuan,Meitan Fm. etc.-L. ORDOVICIAN
13510.4 619 Oh Huanghuachong Fm.-L. ORDOVICIAN
13520.11 687 O2b Baota Fm.-M. ORDOVICIAN
13520.13 689 Os-b Shizipu and Baota Fm.-M. ORDOVICIAN
13520.14 620 O2l Laikeshan Fm.-M. ORDOVICIAN
13520.16 630 O1tg-l Tonggao,Guniutan & Lanmutan Fm.-M. ORDOVICIAN
13520.2 618 Os-gy Shizipu,Baota,Jiancaogou Fm.-M. ORDOVICIAN
13520.3 691 Ot-b Tongzi,Honghuayuan,Meitan Fm. etc.-M. ORDOVICIAN
13530.24 621 O1m Meitan Fm.-E. ORDOVICIAN
13530.25 622 O1d Dawan Fm.-E. ORDOVICIAN
13530.27 625 O1t Tongzi Fm.-E. ORDOVICIAN
13530.28 623 O1t-h Tongzi & Honghuayuan Fm.-E. ORDOVICIAN
13530.29 615 O1t-m Tongzi,Honghuayuan & Meitan Fm.-E. ORDOVICIAN
13530.291 626 O1t-d Tongzi,Honghuayuan & Dawan Fm.-E. ORDOVICIAN
13530.292 614 O1t-g Tongzi,Honghuayuan Fm. etc.-E. ORDOVICIAN
13530.3 629 O1tg Tonggao Fm.-E. ORDOVICIAN
13530.32 631 gt Guotang Fm.-E. ORDOVICIAN
13530.33 632 ls Loushanguan Gr.-E. ORDOVICIAN
13610.11 633 mt Maotian Fm.-L. CAMBRIAN
13610.12 634 Ca3h Houba Fm.-L. CAMBRIAN
13610.13 635 Cag-ls Gaotai,Shilengshui,Pingjing Fm. etc.-L. CAMBRIAN
13610.161 650 Ca3c-z Chefu,Bitiao & Zhuitun Fm.-L. CAMBRIAN
13610.19 652 Cay-s Yangjiawan and Sandy Fm.-L. CAMBRIAN
13620.11 637 Ca2p Pingjing Fm.-M. CAMBRIAN
13620.16 639 Ca2g-s Gaotai & Shilengshui-M. CAMBRIAN
13620.17 638 Ca2g-p Gaotai,Shilengshui & Pingjing Fm.-M. CAMBRIAN
13620.33 645 Ca2k-j Kaili and Jialao-M. CAMBRIAN
13620.42 654 Ca2a Aoxi Fm.-M. CAMBRIAN
13620.43 655 Ca2a-h Aoxi and Huaqiao Fm.-M. CAMBRIAN
13620.45 656 Ca2d Duliujiang Fm.-M. CAMBRIAN
13620.6 640 Ca2dp Douposi Fm.-M. CAMBRIAN
13630.13 659 Ca1q Qiongzhusi Fm.-E. CAMBRIAN
13630.14 660 Ca1c-l Canglangpu & Longwangmiao Fm.-E. CAMBRIAN
13630.15 661 Ca1q-c Qiongzhusi & Canglangpu Fm.-E. CAMBRIAN
13630.21 663 Caq Qingxudong Fm.-E. CAMBRIAN
13630.22 664 Ca1j Jindingshan Fm.-E. CAMBRIAN
13630.23 665 Ca1m Mingxlnsi Fm.-E. CAMBRIAN
13630.24 666 Ca1n Niutitang Fm.-E. CAMBRIAN
13630.25 662 Ca1n-q Niutitang & Mingxinsi Fm.-E. CAMBRIAN
13630.26 668 Ca1m-j Mingxinsi and Jindingshan Fm.-E. CAMBRIAN
13630.27 667 Ca1n-m Niutitang and Mingxinsi Fm.-E. CAMBRIAN
13630.31 670 Ca1p Balang Fm.-E. CAMBRIAN
13630.32 671 Ca1b Bianmachong Fm.-E. CAMBRIAN
13630.33 672 Ca1jm Jiumenchong Fm.-E. CAMBRIAN
13630.34 669 Ca1b-j Bianmachong and Balang Fm.-E. CAMBRIAN
13630.35 681 Ca1jm-j Jiumenchong and Jindingshan Fm.-E. CAMBRIAN
13630.36 673 Ca1jm-p Jiumenchong,Bianmachong Fm. etc.-E. CAMBRIAN
13630.37 679 Ca1w Wuxun Fm.-E. CAMBRIAN
13630.38 674 Ca1jm-b Jiumenchong and Bianmachong Fm.-E. CAMBRIAN
13630.43 678 Ca1mc-p Muchang and Balang Fm.-E. CAMBRIAN
13630.44 680 Ca1z Zhalagou Fm.-E. CAMBRIAN
13630.51 701 yh Yuhucun Fm.-E. CAMBRIAN
13630.72 704 dy Dengying Fm.-E. CAMBRIAN
13630.73 708 Z2d-dy Doushantuo and Dengying Fm-E. CAMBRIAN
13630.82 711 Z2d-lc Doushantuo and Liuchapo Fm-E. CAMBRIAN
13630.84 714 Z2d-lb Doushantuo and Laobao Fm.-E. CAMBRIAN
21110.15 705 Z2y-dy Yangshui and Dengying Fm.-U. SINIAN
21130.1 715 Z1n Nantuo Fm.-LW. SINIAN
21130.109 728 Z1m Maluping Fm.-L. SINIAN
21130.119 729 Z1cj Chengjiang Fm.-L. SINIAN
21130.25 716 Z1t-n Tietiao and Nantuo Fm.-LW. SINIAN
21130.25 716 Z1t-n Undifferentiated-L. SINIAN
21130.26 717 Z1l-n Liangjiahu,Tietiao & Nantuo Fm.-L. SINIAN
21130.27 722 Z1t-g Tieslao, Datangpo & Guiping Fm.-L. SINIAN
21130.32 727 Z1c Changan Fm.-L. SINIAN
21130.33 725 Z1f-d Fulg and Datangpo Fm.-LW. SINIAN
21220.11 745 Pt2d Duyantang Fm.-U. PROTEROZOIC
21220.119 731 Pt3q Qingshuijiang Fm.-U. PROTEROZOIC
21220.119 731 Pt3q Undifferentiated-U. PROTEROZOIC
21220.12 747 Pt2w Waxi Fm.-U. PROTEROZOIC
21220.131 733 Pt3h Hongzixi Fm.-U. PROTEROZOIC
21220.132 748 Pt2tc Tongchang Fm.-U. PROTEROZOIC
21220.141 749 Pt2h Huixiangping Fm.-U. PROTEROZOIC
21220.15 750 Pt2x Xiaojiahe Fm.-U. PROTEROZOIC
21220.16 751 Pt2y Yujiagou Fm.-U. PROTEROZOIC
21220.17 752 Pt2t Taojinhe Fm.-U. PROTEROZOIC
21220.18 755 Pt2sb Sibao Gr.-U. PROTEROZOIC
21220.211 734 Pt3l Longli Fm.-U. PROTEROZOIC
21220.221 735 Pt3p Pinglue Fm.-U. PROTEROZOIC
21220.24 739 Pt3q-p Qingshuijiang & Pinglue Fm.-U. PROTEROZOIC
21220.24 739 Pt3q-p Undifferentiated-U. PROTEROZOIC
21220.25 737 Pt3z Zhangjiaba Fm.-U. PROTEROZOIC
21220.26 738 Pt3f Fanzhao Fm.-U. PROTEROZOIC
21220.27 742 Pt3w Wuye Fm.-U. PROTEROZOIC
21220.279 744 Pt3j Jialu Fm.-U. PROTEROZOIC
21220.32 741 Pt3g Gongdong Fm.-U. PROTEROZOIC
43200 341 Mxt Meta-alkaline ultramasic rock-M. TRIASSIC
44100 503 Bp Emeishan Basalt-PERMIAN UNDIF.
44100 503 Bp Undiferentiated-PERMIAN UNDIF.
44100 515 Bup Diabase-PERMIAN UNDIF.
45200 682 Mxs Meta-alkaline ultramafic rock-ORDOVICIAN UNDIF.
45200 683 Kbs Kimberlites-ORDOVICIAN UNDIF.
46200 743 Bupt3 diabase-U. PROTEROZOIC UNDIF.
46200.102 756 Ypt3 Granite & granitic migmatita-U. PROTEROZOIC UNDIF.
47200.102 753 Ypt2 Alaskite & granite pegmatite-M. PROTEROZOIC UNDIF.
47200.199 754 Upt2 Masic-ultramafic-M. PROTEROZOIC UNDIF.
99000 900 Water

Fig. 16. Map showing mineral occurrences in Guizhou Province
(AMIRA P603 Project)

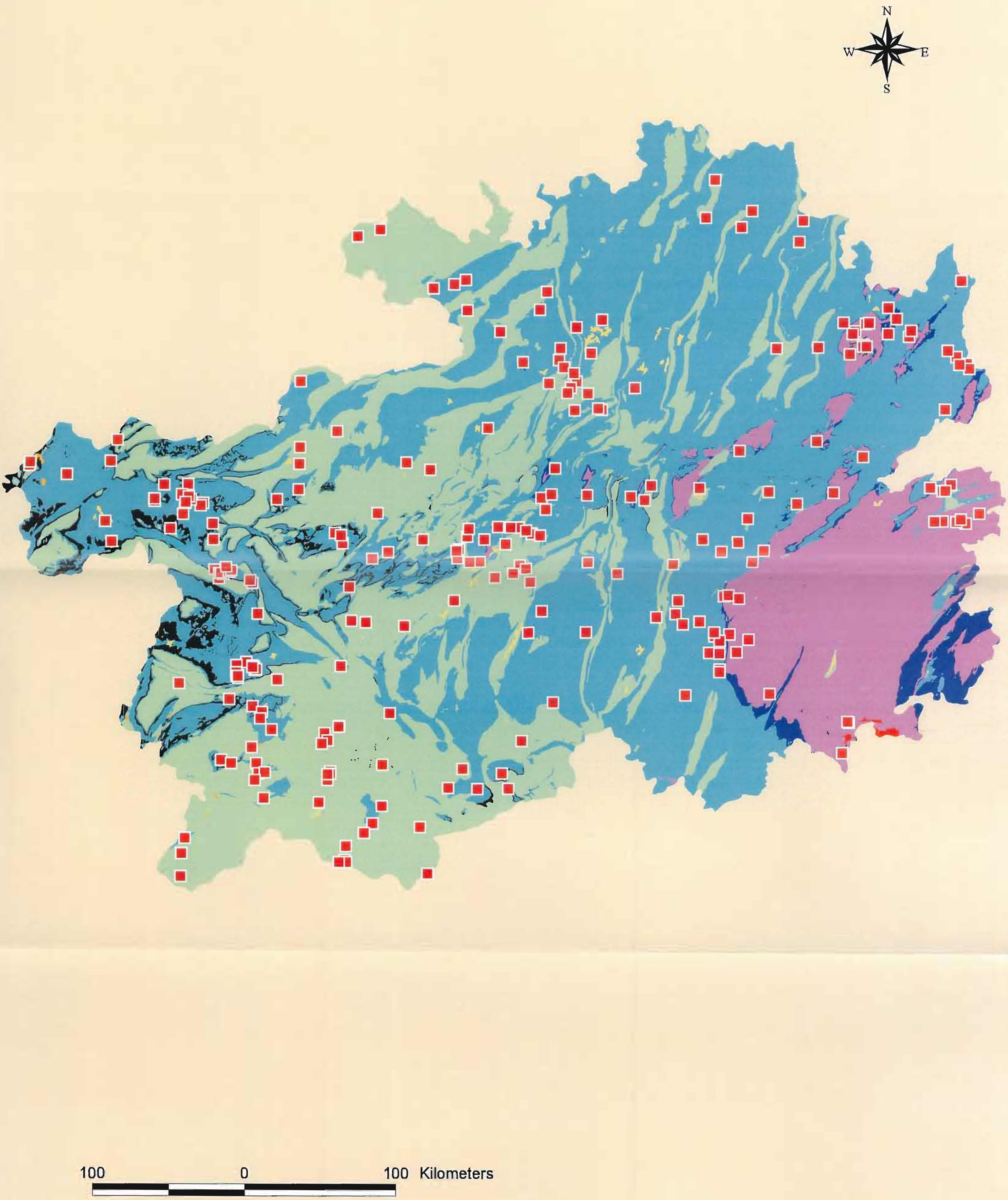


Fig. 17. Map showing gold occurrences in Guizhou Province
(AMIRA P603 Project)

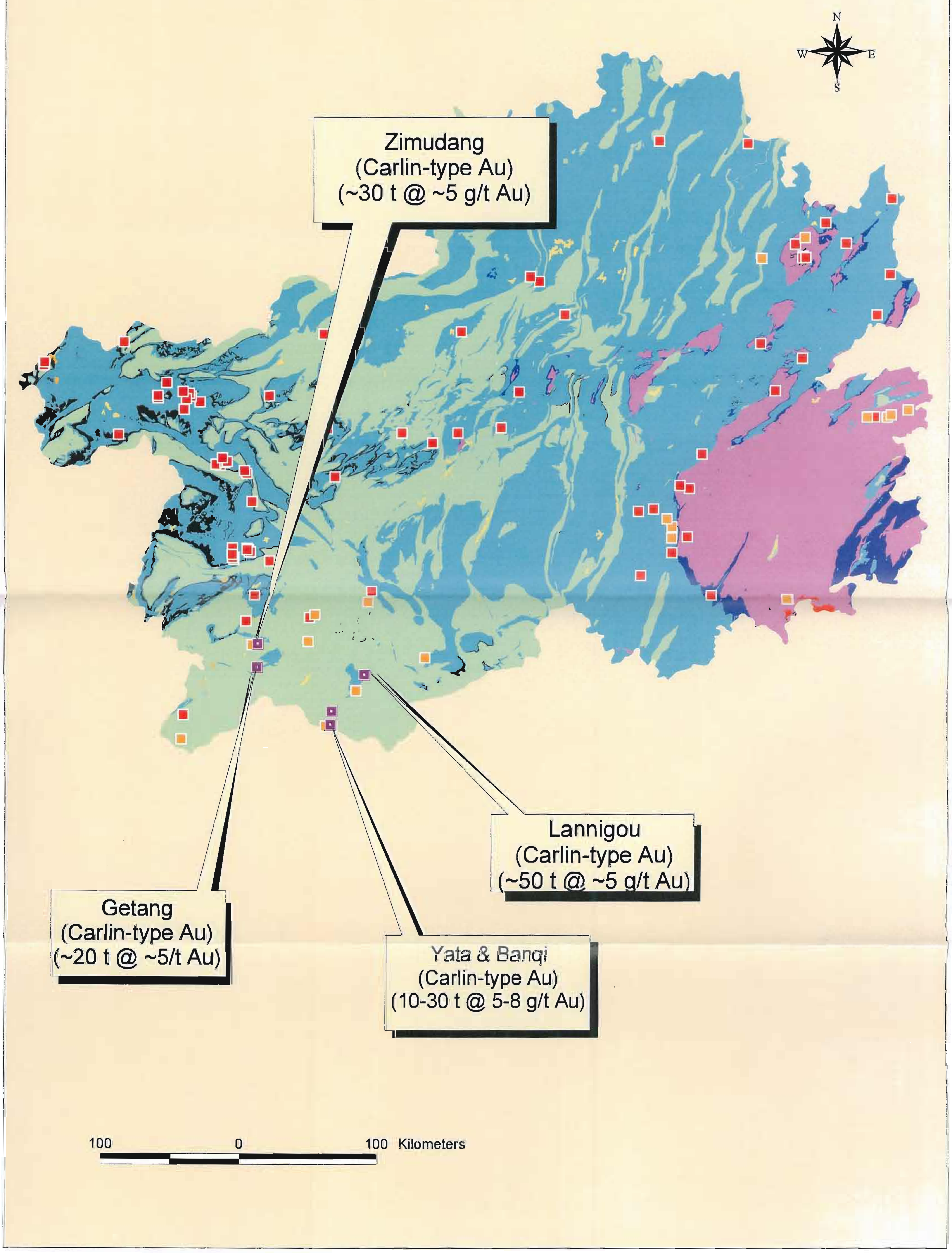


Fig. 18. Map showing copper-nickel, copper-tungsten, and lead-zinc occurrences in Guizhou Province (AMIRA P603 Project)

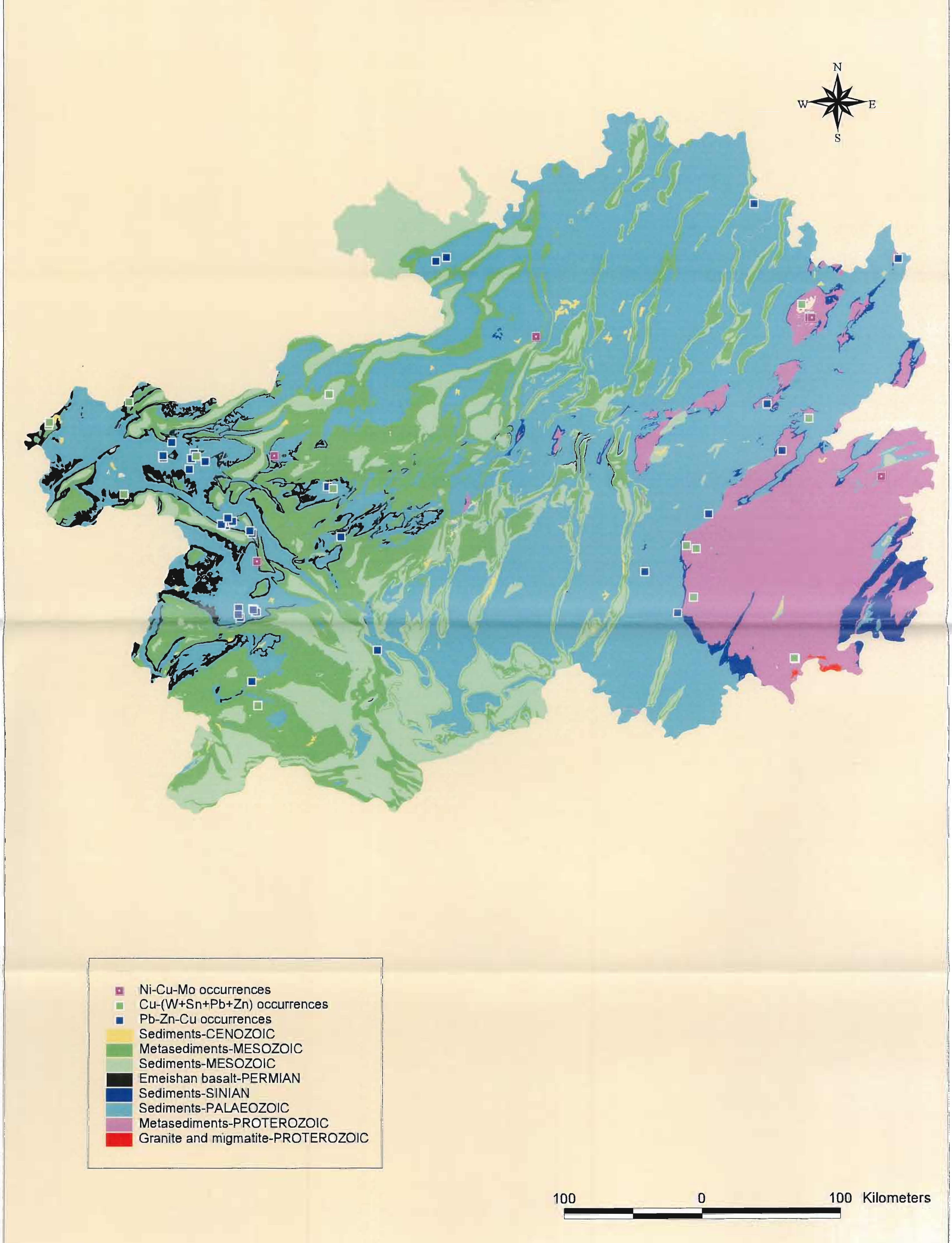
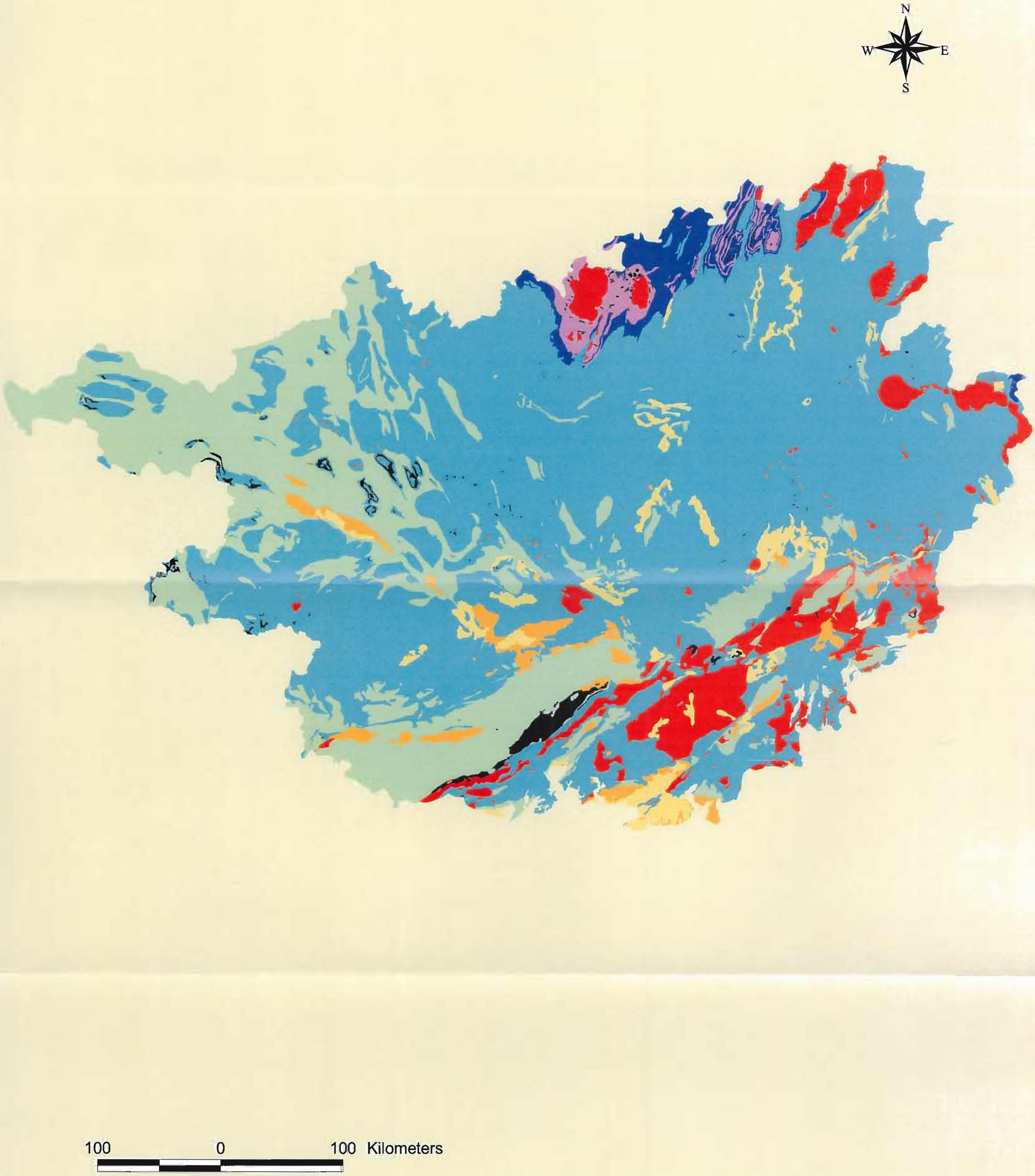


Fig. 19. Geology of Guangxi Province
(AMIRA P603 Project)



# Geology Legend (Guangxi)

Geology Legend (Guangxi)

11110 100 Qh Alluvial-HOLOCENE
11145 101 Qp Alluvial-PLEISTOCENE UNDIF.
11150 102 Q Alluvial-QUATERNARY UNDIF.
11225 103 Nnn Nankang Gr.-NEOGENE UNDIF.
11230.1 104 E3j Jianduling Fm.-OLIGOCENE
11230.2 105 E3f Fuping Fm.-OLIGOCENE
11230.3 106 E2+3yn Yongning Gr.-OLIGOCENE
11240.02 107 E2b Baigang Fm.-EOCENE
11240.03 108 E2n Nadu Fm.-EOCENE
11240.04 109 E2d Dongjun Fm.-EOCENE
11240.05 110 E2f Fenghuangshan Fm.-EOCENE
11240.06 111 E2l Liuchou Fm.-EOCENE
11240.07 112 E1-2 Undifferentiated-EOCENE
12110.01 301 K2l Intermediate volcanics-L. CRETACEOUS
12110.01 301 K2l Luowen Fm.-L. CRETACEOUS
12110.02 302 K2x Intermediate volcanics-L. CRETACEOUS
12110.02 302 K2x Volcanic breccia-L. CRETACEOUS
12110.02 302 K2x Xidong Fm.-L. CRETACEOUS
12110.03 303 K2 Undifferentiated-L. CRETACEOUS
12120.01 304 K1s Shuangyuzui Fm.-E. CREATACEOUS
12120.02 305 K1d Dapo Fm.-E. CREATACEOUS
12120.03 306 K1x Volcanic breccia-E. CREATACEOUS
12120.03 306 K1x Xinlong Fm.-E. CREATACEOUS
12120.04 307 K1yn Yongfu Gr.-E. CREATACEOUS
12210 308 J3 Undifferentiated-L. JURASSIC
12220.01 309 J2sh Shiti Gr.-M. JURASSIC
12220.02 310 J2nd Nadang Gr.-M. JURASSIC
12230.01 311 J1d Daling Fm.-E. JURASSIC
12230.02 312 J1b Baixing Fm.-E. JURASSIC
12230.03 313 J1t Tiantang Fm.-E. JURASSIC
12230.04 314 J1w Wangmen Fm.-E. JURASSIC
12230.05 315 J1 Undifferentiated-E. JURASSIC
12310.01 316 T3f Fulongao Fm.-L. TRIASSIC
12310.02 317 T3p Felsic volcanics-L. TRIASSIC
12310.02 317 T3p Pindong Fm.-L. TRIASSIC
12320.01 318 T2h2 Hekou Fm.-M. TRIASSIC
12320.02 319 T2h1 Hekou Fm.-M. TRIASSIC
12320.03 320 T2h Hekou Fm.-M. TRIASSIC
12320.04 321 T2b2 Baifeng Fm.-M. TRIASSIC
12320.05 322 T2b1 Baifeng Fm.-M. TRIASSIC
12320.06 323 T2b Baifeng Fm.-M. TRIASSIC
12320.06 323 T2b Felsic volcanics-M. TRIASSIC
12320.06 323 T2b Intermediate volcanics-M. TRIASSIC
12320.07 324 T2g Guohua Fm.-M. TRIASSIC
12330.01 325 T1b Beisi Fm.-E. TRIASSIC
12330.01 325 T1b Felsic volcanics-E. TRIASSIC
12330.01 325 T1b Mafic volcanics-E. TRIASSIC
12330.02 326 T1m Majiaoling Fm-E. TRIASSIC
12330.03 327 T1 Undifferentiated-E. TRIASSIC
12330.04 328 T1ll Felsic volcanics-E. TRIASSIC
12330.04 328 T1ll Luolou Gr.-E. TRIASSIC
13120 500 P2 Undifferentiated-E. PERMIAN
13130.01 501 P1m Maokou Stage-E. PERMIAN
13130.02 502 P1g Gufeng Fm.-E. PERMIAN
13130.03 503 P1q Qixia Stage-E. PERMIAN
13130.04 504 P1 Undifferentiated-E. PERMIAN
13140 505 P Undifferentiated-PERMIAN UNDIF.
13210.01 506 C3mp Maping Gr.-L. CARBONIFEROUS
13210.02 507 C2+3 Undifferentiated-L. CARBONIFEROUS
13220.02 508 C2h Huanglong Fm.-M. CARBONIFEROUS
13220.03 509 C2d Dapu Fm.-M. CARBONIFEROUS
13220.04 510 C2 Undifferentiated-M. CARBONIFEROUS
13230.01 511 C1d Datang Stage-E. CARBONIFEROUS
13230.02 512 C1y Yanguang Stage-E. CARBONIFEROUS
13230.03 513 C1 Undifferentiated-E. CARBONIFEROUS
13240 514 C Undifferentiated-CARBONIFEROUS UNDIF.
13310.01 515 D3 Liujiang and Wuzhishan fm.-L. DEVONIAN
13310.02 516 D3r Rongxian Fm.-L. DEVONIAN
13320.01 517 D2l Luofu Fm.-M. DEVONIAN
13320.02 518 D2d Donggangling Fm.-M. DEVONIAN
13320.03 519 D2b+d Beiliu and Donggangling Fm.-M. DEVONIAN

13320.04 520 D2 Nabiao and Luotu Fm-M. DEVONIAN
13320.05 521 D2xd Xiadong Gr.-M. DEVONIAN
13320.06 522 D2n Nubiao Fm.-M. DEVONIAN
13320.07 523 D2b Beiliu Fm.-M. DEVONIAN
13320.08 525 D2s Sipai Fm.-M. DEVONIAN
13320.09 526 D2s+t Sipai & Yingtang Fm.-M. DEVONIAN
13320.1 527 D2x Xindu Fm.-M. DEVONIAN
13330.01 528 D1t Tangding Fm.-E. DEVONIAN
13330.03 530 D1e Ertang Fm.-E. DEVONIAN
13330.04 531 D1h Huangjiangshan Fm.-E. DEVONIAN
13330.05 532 D1hx Hexian Fm.-E. DEVONIAN
13330.06 533 D1y Yujiang Fm.-E. DEVONIAN
13330.07 534 D1yl Yilan Fm.-E. DEVONIAN
13330.08 535 D1y+m Yujiang & Moding Fm.-E. DEVONIAN
13330.09 536 D1n Undiferentiated-E. DEVONIAN
13330.1 537 D1l Lianhuashan Fm.-E. DEVONIAN
13330.11 538 D1l+n Lianhuashan Fm. & Nagaoling Fm.-E. DEVONIAN
13330.12 539 D1s Shiqiao Fm.-E. DEVONIAN
13330.13 540 D1s+hx Shiqiao Fm. & Hexian Fm.-E. DEVONIAN
13330.14 541 D1qn Qinzhou Gr.-E. DEVONIAN
13410 542 S3fn Fangcheng Gr.-L. SILURIAN
13420 543 S2hp Hepu Gr.-M. SILURIAN
13430.01 544 S1lnc Lingshan Gr.-E. SILURIAN
13430.02 545 S1lnb Lingshan Gr.-E. SILURIAN
13430.03 546 S1lna Lingshan Gr.-E. SILURIAN
13430.03 546 S1lna migmatic rock-E. SILURIAN
13430.03 546 S1lna migmatite-E. SILURIAN
13510 548 O3 Migmatic rock-L. ORDOVICIAN
13510 548 O3 Undiferentiated-L. ORDOVICIAN
13520 549 O2 Migmatic rock-M. ORDOVICIAN
13520 549 O2 Undiferentiated-M. ORDOVICIAN
13530.01 550 O1s Shengping Fm.-E. ORDOVICIAN
13530.02 551 O1h Huang'ai Fm.-E. ORDOVICIAN
13530.03 552 O1b Baidong Fm.-E. ORDOVICIAN
13530.04 553 O1l Liuchen Fm.-E. ORDOVICIAN
13530.05 554 O1 Migmatic rock-E. ORDOVICIAN
13530.05 554 O1 Migmatite-E. ORDOVICIAN
13530.05 554 O1 Undifferentiated-E. ORDOVICIAN
13540 555 Cb-O Migmatic rock-ORDOVICIAN UNDIF.
13540 555 Cb-O Migmatite-ORDOVICIAN UNDIF.
13540 555 Cb-O Undiferentiated-ORDOVICIAN UNDIF.
13610.01 556 Cb3s Migmatite-L. CAMBRIAN
13610.01 556 Cb3s Sandu Fm.-L. CAMBRIAN
13610.02 557 Cb3 Undifferentiated-L. CAMBRIAN
13620 558 Cb2 Undifferentiated-M. CAMBRIAN
13640.01 559 Cbh3 Huangdongkou Fm-CAMBRIAN UNDIF.
13640.02 560 Cbh2 Huangdongkou Fm-CAMBRIAN UNDIF.
13640.03 561 Cbh1 Huangdongkou Fm-CAMBRIAN UNDIF.
13640.04 562 Cb1 Huangdongkou Fm-CAMBRIAN UNDIF.
13640.05 563 Cbc Migmatic rock-CAMBRIAN UNDIF.
13640.05 563 Cbc Migmatite-CAMBRIAN UNDIF.
13640.05 563 Cbc U. Formation-CAMBRIAN UNDIF.
13640.06 564 Cbx Xiaoneicheng Fm.-CAMBRIAN UNDIF.
13640.07 565 Cb-b Migmatic rock-CAMBRIAN UNDIF.
13640.07 565 Cb-b Migmatite-CAMBRIAN UNDIF.
13640.08 566 Cbb Bianxi Fm.-CAMBRIAN UNDIF.
13640.08 566 Cbb Migmatic rock-CAMBRIAN UNDIF.
13640.09 567 Cbp Migmatic granite-CAMBRIAN UNDIF.
13640.09 567 Cbp Piedi Fm.-CAMBRIAN UNDIF.
13640.1 568 Cba L Formation-CAMBRIAN UNDIF.
13640.11 568 Cba Migmatic rock-CAMBRIAN UNDIF.
13640.11 568 Cba Migmatite-CAMBRIAN UNDIF.
13640.12 569 Cbq Qingxi Fm.-CAMBRIAN UNDIF.
21120.01 700 Z2 Doushantuo & Laobao Fm.-M. SINIAN
21120.02 701 Z2x Xialong Fm.-M. SINIAN
21130.01 702 Z1n Nantuo Fm.-LW. SINIAN
21130.02 703 Z1f Fulu Fm.-LW. SINIAN
21130.03 704 Z1y Yingyangguan Fm.-LW. SINIAN
21130.04 706 Z1c Chang'an Fm.-LW. SINIAN
21220.01 707 Pt3dng Gongdong Fm.-UP. PROTEROZOIC
21220.02 708 Pt3dnh Hetong Fm.-UP. PROTEROZOIC
21220.03 709 Pt3dnb Baizhu Fm.-UP. PROTEROZOIC

22000.01 710 Pt2sby Yuxi Fm.-M. PROTEROZOIC UNDIF.
22000.02 711 Pt2sbw Wentong Fm.-M. PROTEROZOIC UNDIF.
22000.03 712 Pt2sbj Jiuxiao Fm.-M. PROTEROZOIC UNDIF.
22000.04 713 Pt2sb Sibu Gr.-M. PROTEROZOIC UNDIF.
41300.01 200 b6 Dolerite-TERTIARY UNDIF.
41300.03 202 j6 Vitroharzburgite-TERTIARY UNDIF.
41300.04 203 wm6 Picrite-porphyrite-TERTIARY UNDIF.
41300.05 204 dm53 Diorite-TERTIARY UNDIF.
42100.01 400 g53 Granite-CRETACEOUS UNDIF.
42100.02 401 gp53 Granite porphyry-CRETACEOUS UNDIF.
42100.03 402 lp53 Quartz porphyry-CRETACEOUS UNDIF.
42100.04 403 gdp53 Granodiorite porphyry-CRETACEOUS UNDIF.
42100.05 404 ld53 Quartz diorite-CRETACEOUS UNDIF.
42100.06 405 am53 Andesite porphyry-CRETACEOUS UNDIF.
42100.07 406 lhp53 Adamellite porphyry-CRETACEOUS UNDIF.
42100.08 407 r53 Pegmatite-CRETACEOUS UNDIF.
42100.09 408 c53 Lamprophyre-CRETACEOUS UNDIF.
42200.01 409 g52 Granite-JURASSIC UNDIF.
42200.02 410 gp52 Granite porphyry-JURASSIC UNDIF.
42200.03 411 qg52 Plagioclase granite-JURASSIC UNDIF.
42200.04 412 gd52 Granodiorite-JURASSIC UNDIF.
42200.05 413 ld52 Quartz diorite-JURASSIC UNDIF.
42200.06 414 d52 Diorite-JURASSIC UNDIF.
42200.07 415 lh52 Adamellite-JURASSIC UNDIF.
42200.08 416 x52 Adamellite-JURASSIC UNDIF.
42200.1 418 u52 Gabbro-JURASSIC UNDIF.
42200.11 419 c52 Lamprophyre-JURASSIC UNDIF.
42300.01 420 g52+3 Granite-L. MESOZOIC UNDIF.
42300.02 421 gp52+3 Granite porphyry-L. MESOZOIC UNDIF.
42300.03 422 lp52+3 Quartz porphyry-L. MESOZOIC UNDIF.
42300.04 423 gd52+3 Granodiorite-L. MESOZOIC UNDIF.
42300.05 424 gdp52+3 Granodiorite porphyry-L. MESOZOIC UNDIF.
42300.06 425 lh52+3 Adamellite-L. MESOZOIC UNDIF.
43400.01 426 g51d Granite-TRIASSIC UNDIF.
43400.02 427 g51c Granite-TRIASSIC UNDIF.
43400.03 428 gp51b Granoporphyry-TRIASSIC UNDIF.
43400.04 429 gdp51b Granodiorite porphyry-TRIASSIC UNDIF.
43400.05 430 g51a Granite-TRIASSIC UNDIF.
43400.06 431 gp51a Granoporphyry-TRIASSIC UNDIF.
43400.07 432 sg51a Plagiogranite-TRIASSIC UNDIF.
43400.08 433 gd51 Granodiorite-TRIASSIC UNDIF.
43400.09 434 g51a Granite-TRIASSIC UNDIF.
43400.1 435 gp51 Granite porphyry-TRIASSIC UNDIF.
43400.11 436 lp51 Quartz porphyry-TRIASSIC UNDIF.
43400.12 437 gd51 Granodiorite-TRIASSIC UNDIF.
43400.13 438 ld51 Quartz diorite-TRIASSIC UNDIF.
43400.14 439 lh51 Adamellite-TRIASSIC UNDIF.
43400.15 440 bm51 Diabase peridotite-TRIASSIC UNDIF.
43400.16 441 ldm53 Diorite-TRIASSIC UNDIF.
44400.01 600 g43 Granite-L. PALEOZOIC UNDIF.
44400.02 601 g42 Granite-L. PALEOZOIC UNDIF.
44400.03 602 c4 Lamprophyre-L. PALEOZOIC UNDIF.
44400.04 603 bm4/s51 Diabase peridotite-L. PALEOZOIC UNDIF.
45100.01 604 g33 Gneissose granite-SILURIAN UNDIF.
45100.01 604 g33 Granite-SILURIAN UNDIF.
45100.02 605 gp33 Granoporphyry-SILURIAN UNDIF.
45100.02 606 Felsic volcanics-SILURIAN UNDIF.
45100.03 607 gd33 Granodiorite-SILURIAN UNDIF.
45100.04 608 gdp33 Granodiorite porphyry-SILURIAN UNDIF.
45100.05 609 ld33 Quartz diorite-SILURIAN UNDIF.
46200.01 800 g23(2) Granite-UP. PROTEROZOIC UNDIF.
46200.02 801 bm23(1) Diabase-UP. PROTEROZOIC UNDIF.
46200.03 802 N23(1) Mafic-UP. PROTEROZOIC UNDIF.
46200.04 803 s23(1) Peridotite-UP. PROTEROZOIC UNDIF.
46200.05 804 S23(1) Ultramafic-UP. PROTEROZOIC UNDIF.
47100.01 805 sg22b Plagioclase granite-M. PROTEROZOIC UNDIF.
47100.02 806 gd22b Granodiorite-M. PROTEROZOIC UNDIF.
47200.01 807 N22a Mafic-M. PROTEROZOIC UNDIF.
47200.02 808 n22a Pyroxenolite-M. PROTEROZOIC UNDIF.
47200.03 809 S22a Ultramafic-M. PROTEROZOIC UNDIF.
99000 900 Water

Fig. 20. Map showing mineral occurrences in Guangxi Province
(AMIRA P603 Project)

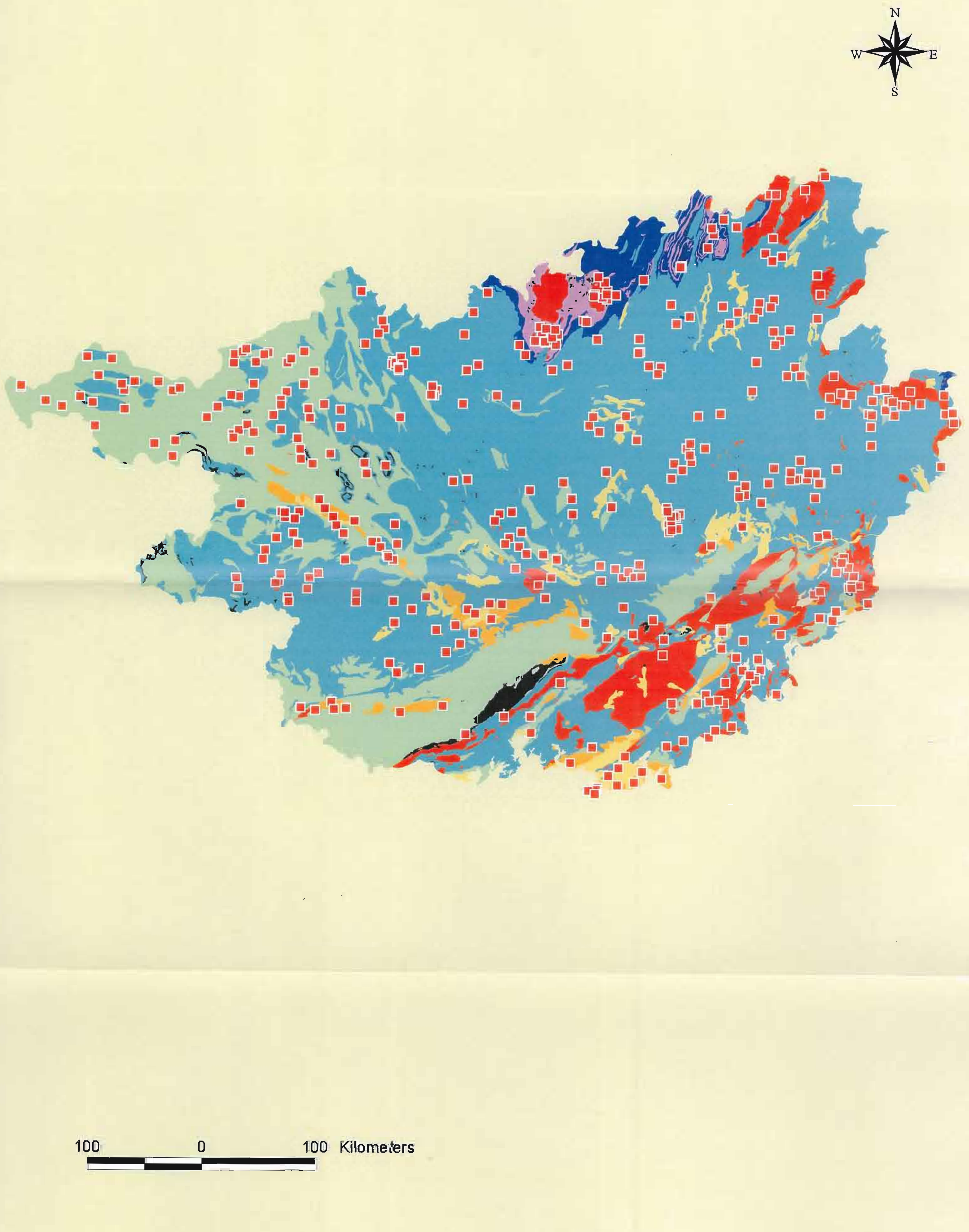


Fig. 21. Map showing gold occurrences in Guangxi Province
(AMIRA P603 Project)

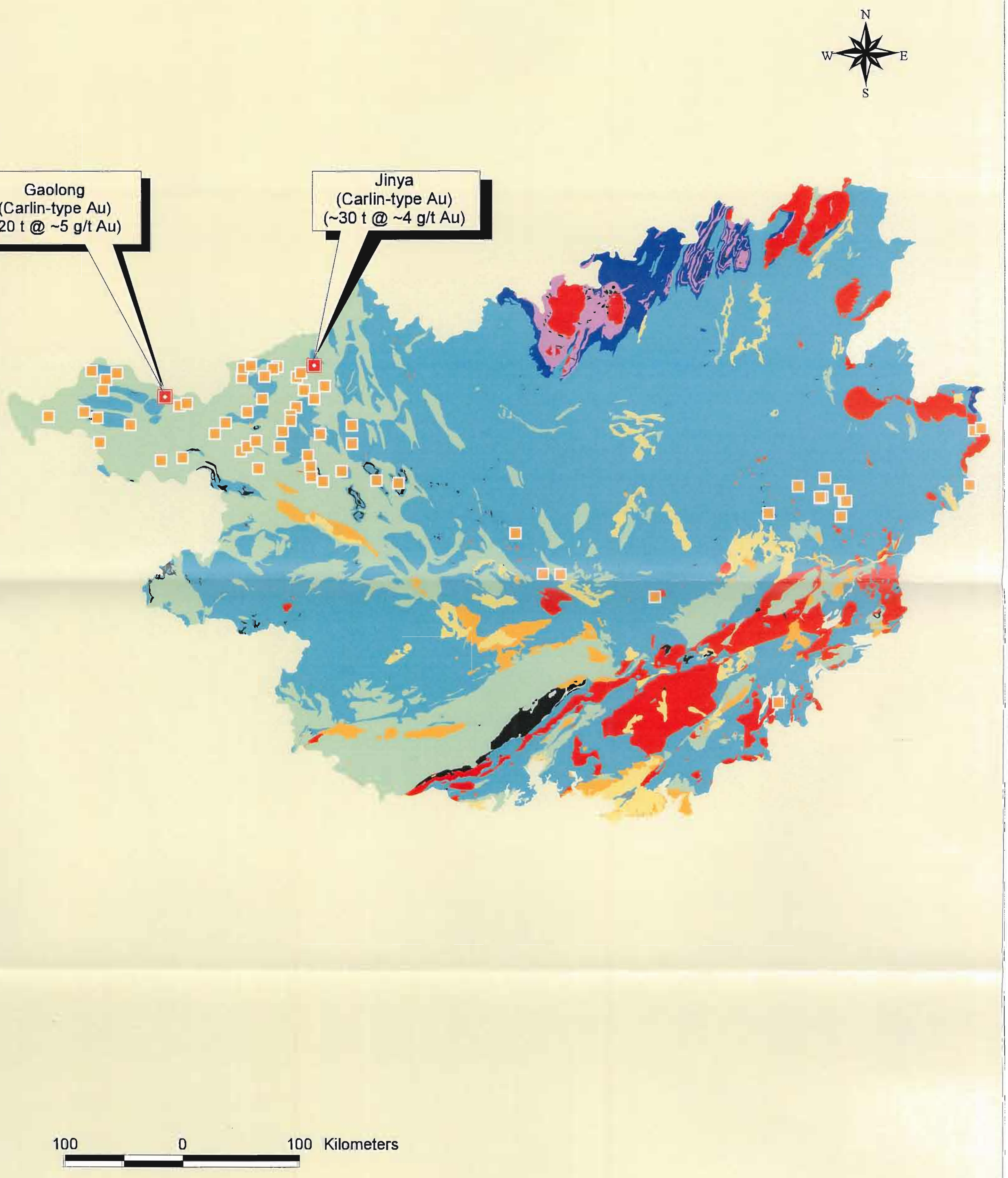


Fig. 22. Map showing tungsten-tin and lead-zinc-copper occurrences in Guangxi
(AMIRA P603 Project)

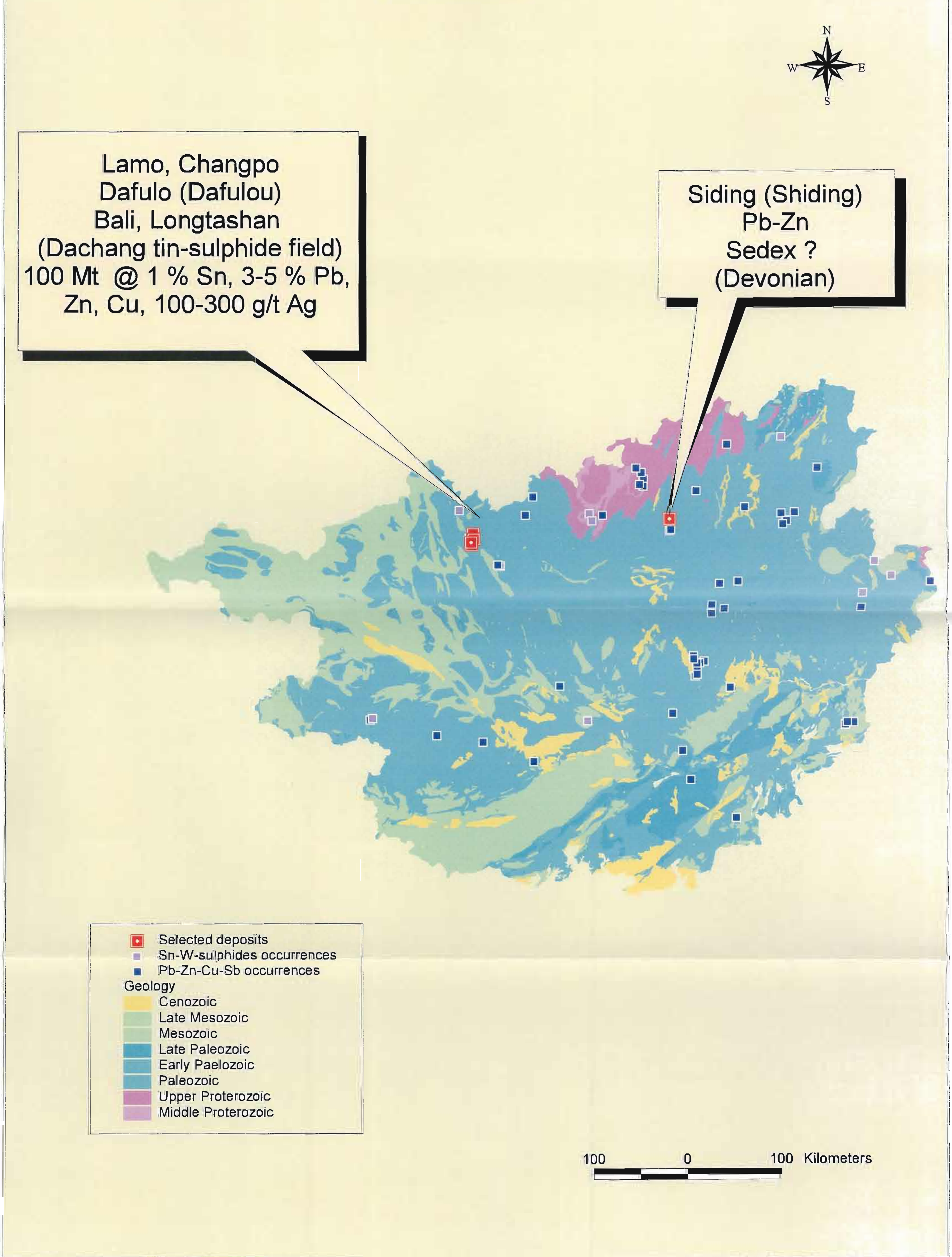
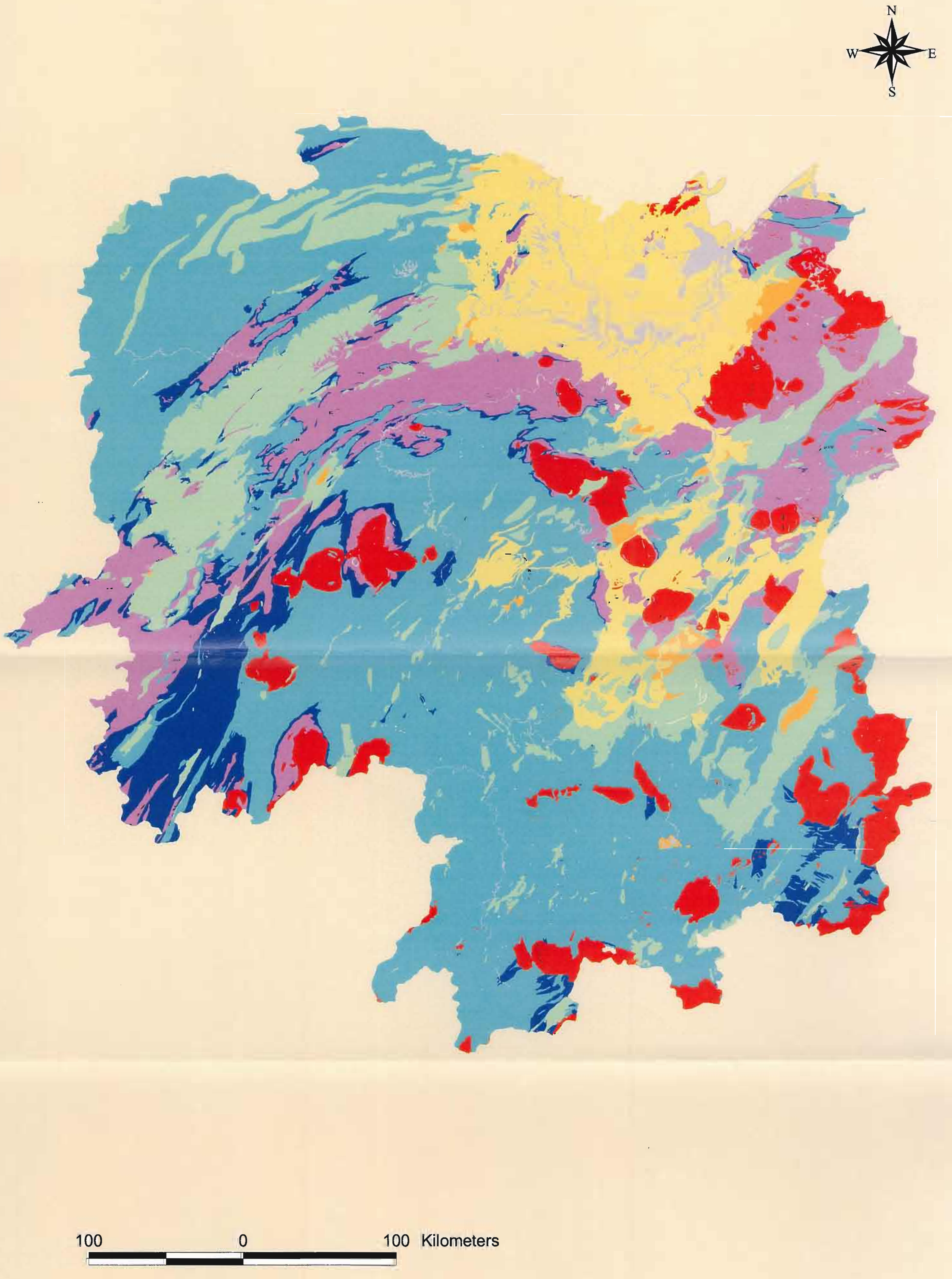


Fig. 23. Geology of Hunan Province
(AMIRA P603 Project)



# Geology Legend (Hunan)

Geology Legend (Hunan)

11110.1 101 Qh Sand, Clay and Gravel-HOLOCENE
11145.11 102 Qpbs Baishuijiang Fm.-PLEISTOCENE UNDIF.
11145.12 112 Qpxs Xiashu Fm.-PLEISTOCENE UNDIF.
11145.13 103 Qpt Tieshan Fm (Glaciation)-PLEISTOCENE UNDIF.
11145.14 104 Qpmw Mawangdui Fm-PLEISTOCENE UNDIF.
11145.15 105 Qpb Baishajing Fm.-PLEISTOCENE UNDIF.
11145.16 111 Qpmt Matoupu Fm. (Glaciation)-PLEISTOCENE UNDIF.
11145.17 106 Qpc Chenjiazui Fm. (Glaciation)-PLEISTOCENE UNDIF.
11145.18 107 Qpx Xinkaipu Fm.-PLEISTOCENE UNDIF.
11145.19 108 Qphn Huangushan Fm. (Glaciation)-PLEISTOCENE UNDIF.
11145.21 113 Qpm Miluo Fm.-PLEISTOCENE UNDIF.
11145.22 114 Qph Huxianshan Fm. (Glaciation)-PLEISTOCENE UNDIF.
11145.3 110 Qp Pleistocene Undiferencied-PLEISTOCENE UNDIF.
11220 115 N1l Luojiu Fm.-MIOCENE
11240.12 118 E2h Hanshou Fm.-EOCENE
11240.13 121 E2l Limuping Fm.-EOCENE
11250.11 116 E1 Undiferentiated-PALEOCENE
11250.12 119 E1j Jianjiaxi Fm.-PALEOCENE
11250.13 122 E1x Xialiushi Fm.-PALEOCENE
11250.14 123 E1z Zaoshi Fm.-PALEOCENE
12110.11 303 K2g Gaocun Fm.-L. CRETACEOUS
12110.12 304 K2j Jinjian Fm.-L. CRETACEOUS
12110.13 305 K2x Xiaodong Fm.-L. CRETACEOUS
12110.14 307 K2y Yanmatou Fm.-L. CRETACEOUS
12110.15 308 K2f Fenshuiao Fm.-L. CRETACEOUS
12110.16 309 K2dn Dongtang Fm.-L. CRETACEOUS
12110.17 310 K2d Daijiaping Fm.-L. CRETACEOUS
12110.2 302 K2 Undifferentiated-L. CRETACEOUS
12120.11 306 K1dn Dongxiachang Fm.-E. CREATACEOUS
12120.12 312 K1sn Sanyanggang Fm.-E. CREATACEOUS
12120.13 314 K1s Shenhuangshan Fm.-E. CREATACEOUS
12120.14 313 K1q Qijiahe Fm.-E. CREATACEOUS
12120.15 315 K1d Dongjing Fm.-E. CREATACEOUS
12120.16 311 K1 Early Cretaceous Undiv.-E. CREATACEOUS
12140 301 K Undifferentiated-CRETACEOUS UNDIF.
12220.12 319 J2b Baixiangdai Fm.-M. JURASSIC
12220.13 318 J2y Yuelong Fm.-M. JURASSIC
12220.14 320 J2s Shigu Fm.-M. JURASSIC
12220.2 316 J2 Undiferenced-M. JURASSIC
12230.11 321 J1j Jielongqiao Fm.-E. JURASSIC
12230.111 329 T3x + J1j Xiaojiangkou and Jielongqiao-E. JURASSIC
12230.12 325 J1g Gaojiatian Fm.-E. JURASSIC
12230.13 327 J1m Maoxianling Fm.-E. JURASSIC
12230.14 326 J1s Shikang Fm.-E. JURASSIC
12230.15 328 J1x Xintianmen Fm.-E. JURASSIC
12230.2 324 J1 Lower Jurassic Undiv.-E. JURASSIC
12230.3 323 T3 + J1 Upper Triassic to Lower Jurassic undiv.-E. JURASSIC
12310.11 330 T3yn Yingzuishan Fm.-L. TRIASSIC
12310.14 332 T3 Zaoshang,Sanqiutian,Sanjiachong Fm. etc.-L. TRIASSIC
12320.1 333 T2b Badong Fm.-M. TRIASSIC
12320.2 338 T2s Sanbaoao Fm.-M. TRIASSIC
12330.11 334 T1j Jialingjiang Fm.-E. TRIASSIC
12330.12 335 T1d Daye Fm.-E. TRIASSIC
12330.21 342 T1q Qilingshan Fm.-E. TRIASSIC
12330.22 343 T1g Guanzishan Fm.-E. TRIASSIC
12330.23 344 T1z Zhangjiaping Fm.-E. TRIASSIC
13120.11 502 P2d Dalong Fm.-M. PERMIAN
13120.12 503 P2c Changxing Fm.-M. PERMIAN
13120.2 504 P2l Longtan Fm.-M. PERMIAN
13120.3 501 P2 Dalong, Changxing and Wujiaping Fms.-M. PERMIAN
13130.11 507 P1m Maokou Fm.-E. PERMIAN
13130.12 509 P1d Dangchong Fm.-E. PERMIAN
13130.2 508 P1q Qixia Fm.-E. PERMIAN
13130.3 506 P1 Maokou and Qixia Fm.-E. PERMIAN
13140 505 P Permian Undiv.-PERMIAN UNDIF.
13210.1 513 C3c Chuanshan Fm.-L. CARBONIFEROUS
13210.2 512 C2+3 Middle to Upper Carboniferous Undiv.-L. CARBONIFEROUS
13220.11 510 C2h Huanglong Fm.-M. CARBONIFEROUS
13220.11 594 C1s+C2h Shangbaochong,Huanglong Fm-M. CARBONIFEROUS
13230.11 515 C1d Datangian Fm.-E. CARBONIFEROUS
13230.12 517 C1z Zharfgshuwan Fm.-E. CARBONIFEROUS
13230.13 511 C1s Shangbaochong Fm.-E. CARBONIFEROUS
13230.14 516 C1y Yanguanian Fm.-E. CARBONIFEROUS
13230.2 595 C1 Undifferentiated-E. CARBONIFEROUS
13310.11 521 D3mj Mujingtang Fm.-L. DEVONIAN
13310.12 523 D3x Xikuangshan Fm.-L. DEVONIAN
13310.13 525 D3yl Yuelushan Fm.-L. DEVONIAN
13310.14 522 D3m Maanshan Fm.-L. DEVONIAN
13310.15 524 D3s Shetianqiao Fm.-L. DEVONIAN

13310.16 526 D3y Yunlugong Fm.-L. DEVONIAN
13310.2 520 D3 Undifferentiated-L. DEVONIAN
13310.3 519 D2y + D3 Yuntaiguan,Huangjiadeng,Xiejingsi Fm.-L. DEVONIAN
13320.11 528 D2q Qiziqiao Fm.-M. DEVONIAN
13320.12 529 D2s Shahe Fm.-M. DEVONIAN
13320.13 530 D2m Maochong Fm.-M. DEVONIAN
13320.14 532 D2t Tiaomajian Fm.-M. DEVONIAN
13320.15 533 D2b Banshan Fm.-M. DEVONIAN
13320.2 531 D2b-t Banshan and Tiaomajian-M. DEVONIAN
13320.3 527 D2 Undifferentiated-M. DEVONIAN
13330.11 535 D1y Yuankou Fm.-E. DEVONIAN
13420.11 537 S2x Xiaoxi Fm.-M. SILURIAN
13420.12 538 S2w Wujiayuang Fm.-M. SILURIAN
13420.2 536 S2 Undifferentiated-M. SILURIAN
13430.11 539 S1r+lz Lazike and Rongxi Fm.-E. SILURIAN
13430.12 544 S1zh2 Zhoujiaxi Gr.-E. SILURIAN
13430.2 542 S1l Longmaxi Fm.-E. SILURIAN
13430.21 541 S1l+x Longmaxi & Xiaoheba Fm.-E. SILURIAN
13430.23 543 S1gj Gaojiabian Gr.-E. SILURIAN
13430.24 545 S1zh1 Zhoujiaxi Gr.-E. SILURIAN
13430.3 540 S1 Early Silurian Undiv.-E. SILURIAN
13510.1 547 O3w Wufeng Fm.-L. ORDOVICIAN
13510.2 551 O3s Sushuichong Fm-L. ORDOVICIAN
13510.3 552 O3t Tianmashan Fm-L. ORDOVICIAN
13510.4 546 O2+3 Undifferentiated-L. ORDOVICIAN
13520.1 548 O2 Baota and Lingxiang Fm-M. ORDOVICIAN
13530.11 555 O1h+d+g Guniutan and Honghuayuan-E. ORDOVICIAN
13530.12 556 O1t+j+s Taohuashi,Jiuxi,Shenenwan-E. ORDOVICIAN
13530.13 558 O1q Qiaotingzi Fm-E. ORDOVICIAN
13530.14 560 O1^2 Undifferentiated-E. ORDOVICIAN
13530.21 561 O1n+f Nanjinguan and Fenxiang Fm-E. ORDOVICIAN
13530.22 562 O1p+m Panjiazui and Madaoyu Fm-E. ORDOVICIAN
13530.23 563 O1b Baishuixi Fm-E. ORDOVICIAN
13530.24 564 O1^1 Undifferentiated-E. ORDOVICIAN
13530.3 554 O1 Early Ordovician Undiv.-E. ORDOVICIAN
13610.11 566 Ca3hz Haozituo Gr-L. CAMBRIAN
13610.12 568 Ca3z Zhuidun Fm-L. CAMBRIAN
13610.13 569 Ca3s Shenjiawan Fm-L. CAMBRIAN
13610.14 573 Ca2+3 Undifferentiated.-L. CAMBRIAN
13610.15 574 Cats3 Tashan-L. CAMBRIAN
13610.16 570 Ca3b Bitiao Fm-L. CAMBRIAN
13610.17 571 Ca3c Chefu Fm-L. CAMBRIAN
13610.2 567 Ca3 Undifferentiated-L. CAMBRIAN
13610.21 565 Ca2k+Ca3hz Kongwangxi & Haozituo Gr-L. CAMBRIAN
13620.12 576 Ca2k Kongwangxi Fm-M. CAMBRIAN
13620.13 572 Ca2h Huaqiao Fm-M. CAMBRIAN
13620.16 580 Cats2 Tashan-M. CAMBRIAN
13620.21 577 Ca2g Gaotai Fm-M. CAMBRIAN
13620.23 578 Ca2a Aoxi Fm-M. CAMBRIAN
13620.24 579 Ca2t Tanxi Fm-M. CAMBRIAN
13620.3 575 Ca2 Undifferentiated-M. CAMBRIAN
13630.11 581 Ca1sl Shilongdong Fm-E. CAMBRIAN
13630.12 583 Ca1q Qingxudong Fm-E. CAMBRIAN
13630.21 588 Ca1t Tianheban Fm-E. CAMBRIAN
13630.23 584 Ca1p Palang Fm-E. CAMBRIAN
13630.31 589 Ca1sh Shipai Fm-E. CAMBRIAN
13630.32 592 Ca1m Muchang Fm-E. CAMBRIAN
13630.34 590 Ca1s Shuijingtuo Fm-E. CAMBRIAN
13630.4 586 Ca1x Xiaoyanxi Fm-E. CAMBRIAN
13630.5 587 Cats1 Tashan-E. CAMBRIAN
13630.6 582 Ca1 Undifferentiated.-E. CAMBRIAN
21120.11 702 Z2dn Dengying Fm-M. SINIAN
21120.12 703 Z2d Doushantuo Fm-M. SINIAN
21120.13 706 Z2l Liuchapo Fm-M. SINIAN
21120.14 707 Z2j Jinjiadong Fm-M. SINIAN
21120.15 712 Z2t Tianzidi Fm-M. SINIAN
21120.2 701 Z2 Middle Sinian Undiv.-M. SINIAN
21130.11 704 Z1 Dongshanfeng, Xiangmeng, Nantuo Fm-L. SINIAN
21130.12 708 Z1h Hongjiang Fm-L. SINIAN
21130.13 709 Z1x Xiangmeng Fm-L. SINIAN
21130.14 711 Z1x+h Xiangmeng and Hongjiang-L. SINIAN
21130.15 710 Z1j Jiangkou Fm-L. SINIAN
21130.16 713 Z1s Sizhoushan Fm.-L. SINIAN
21140 705 Z Undifferentiated-SINIAN UNDIF.
21220.11 716 Pt3bnx Banxi Gr-U. PROTEROZOIC
21220.12 717 Pt3bnw Banxi Gr-U. PROTEROZOIC
21220.13 719 Pt3bnmb Banxi Gr-U. PROTEROZOIC
21220.21 727 Pt3bnm Banxi-UP. PROTEROZOIC
21220.22 720 Pt3bng Banxi Gr-U. PROTEROZOIC
21220.3 715 Pt3bn Banxi Gr-U. PROTEROZOIC

22000.11 722 Pt2ln5 Lengjiaxi Gr-M. PROTEROZOIC UNDIF.
22000.12 723 Pt2ln4 Lengjiaxi Gr-M. PROTEROZOIC UNDIF.
22000.13 724 Pt2ln3 Lengjiaxi Gr-M. PROTEROZOIC UNDIF.
22000.14 725 Pt2ln2 Lengjiaxi Gr-M. PROTEROZOIC UNDIF.
22000.15 726 Pt2ln1 Lengjiaxi Gr-M. PROTEROZOIC UNDIF.
22000.16 721 Pt2ln Lengjiaxi Gr-M. PROTEROZOIC UNDIF.
42100.11 201 lp5^3 Quartz porphyry-CRETACEOUS UNDIF.
42100.12 202 gp5^3 Granite porphyry-CRETACEOUS UNDIF.
42100.13 203 g5^3 Granite-CRETACEOUS UNDIF.
42100.14 204 gdp5^3 Granodiorite porphyry-CRETACEOUS UNDIF.
42100.15 205 hop5^3 Quartz monzonitic porphyry-CRETACEOUS UNDIF.
42100.16 206 g5^2(3)d Granite-CRETACEOUS UNDIF.
42100.17 207 g5^2(3)c Granite-CRETACEOUS UNDIF.
42100.18 208 hg5^2(3)c Monzonitic granite-CRETACEOUS UNDIF.
42100.19 209 g5^2(3)b Granite-CRETACEOUS UNDIF.
42100.2 210 hg5^2(3)b Monzonitic granite-CRETACEOUS UNDIF.
42100.21 211 g5^2(3)a Granite-CRETACEOUS UNDIF.
42100.22 212 hg5^2(3)a Monzonitic granite-CRETACEOUS UNDIF.
42100.24 214 lp5^2(2)b Quartz porphyry-CRETACEOUS UNDIF.
42100.26 216 g5^2(2)b Granite-CRETACEOUS UNDIF.
42100.27 217 hg5^2(2)b Monzonitic granite-CRETACEOUS UNDIF.
42100.28 218 gd5^2(2)b Granodiorite-CRETACEOUS UNDIF.
42100.29 219 g5^2(2)a Granite-CRETACEOUS UNDIF.
42100.3 220 hg5^2(2)a Monzonitic granite-CRETACEOUS UNDIF.
42100.31 221 gd5^2(2)a Granodiorite-CRETACEOUS UNDIF.
42100.32 222 lp5^2(2) Quartz porphyry-CRETACEOUS UNDIF.
42100.33 223 gp5^2(2) Granite porphyry-CRETACEOUS UNDIF.
42100.34 224 g5^2(2) Granite-CRETACEOUS UNDIF.
42100.35 225 hg5^2(2) Monzonitic granite-CRETACEOUS UNDIF.
42100.36 226 gdp5^2(2) Granodiorite porphyry-CRETACEOUS UNDIF.
42100.37 227 gd5^2(2) Granodiorite-CRETACEOUS UNDIF.
42100.38 228 go5^2(2) Plagiogranite-CRETACEOUS UNDIF.
42100.39 229 d5^2(2) Diorite-CRETACEOUS UNDIF.
42100.4 230 xo5^2(2) Quartz syenite-CRETACEOUS UNDIF.
42100.41 231 j5^2(2) Alitite-CRETACEOUS UNDIF.
42100.42 232 lp5^2(1) Quartz porphyry-CRETACEOUS UNDIF.
42100.43 233 gp5^2(1) Granite porphyry-CRETACEOUS UNDIF.
42100.44 234 g5^2(1) Granite-CRETACEOUS UNDIF.
42100.45 235 hg5^2(1) Monzonitic granite-CRETACEOUS UNDIF.
42100.46 236 gdp5^2(1) Granodiorite porphyry-CRETACEOUS UNDIF.
42100.47 237 gd5^2(1) Granodiorite-CRETACEOUS UNDIF.
42300.1 238 C5 Lamprophyre-L. MESOZOIC UNDIF.
42300.2 239 N5 Mafic-L. MESOZOIC UNDIF.
42300.3 240 S5 Ultramafic-L. MESOZOIC UNDIF.
43100.11 241 h5^1(2)d Monzonite-L. TRIASSIC
43100.12 242 g5^1(2)c Granite-L. TRIASSIC
43100.13 243 hg5^1(2)c Monzonitic granite-L. TRIASSIC
43100.14 244 g5^1(2)b Granite-L. TRIASSIC
43100.15 245 hg5^1(2)b Monzonitic granite-L. TRIASSIC
43100.16 246 gp5^1(2)a Granite porphyry-L. TRIASSIC
43100.17 247 g5^1(2)a Granite-L. TRIASSIC
43100.18 248 hg5^1(2)a Monzonitic granite-L. TRIASSIC
43100.19 249 gd5^1(2)a Granodiorite-L. TRIASSIC
43200.11 250 g5^1(1)b Granite-M. TRIASSIC
43200.12 251 hg5^1(1)b Monzonitic granite-M. TRIASSIC
43200.13 252 g5^1(1)a Granite-M. TRIASSIC
43200.14 253 hg5^1(1)a Monzonitic granite-M. TRIASSIC
45200.11 254 g3(2)c Granite-ORDOVICIAN UNDIF.
45200.12 255 g3(2)b Granite-ORDOVICIAN UNDIF.
45200.13 256 g3(2)a Granite-ORDOVICIAN UNDIF.
45200.14 257 hg3(2)a Monzonitic granite-ORDOVICIAN UNDIF.
45200.15 258 gd3(2)a Granodiorite-ORDOVICIAN UNDIF.
45200.16 259 do3(2)a Quartz diorite-ORDOVICIAN UNDIF.
45200.17 260 d3(2)a Diorite-ORDOVICIAN UNDIF.
45300.11 261 gd3(1)b Granodiorite-CAMBRIAN UNDIF.
45300.12 262 go3(1)a Plagiogranite-CAMBRIAN UNDIF.
45300.13 263 gd3(1)a Granodiorite-CAMBRIAN UNDIF.
46300.11 264 gp2^3(2) Granite porphyry-UP. PROTEROZOIC UNDIF.
46300.12 265 N2^3 Mafic-UP. PROTEROZOIC UNDIF.
46300.13 266 (N-S)2^3 Mafic-ultramafic-UP. PROTEROZOIC UNDIF.
46300.14 267 S2^3 Ultramafic-UP. PROTEROZOIC UNDIF.
46400.11 268 g2^2(2)b Granite-M. PROTEROZOIC UNDIF.
46400.12 269 hg2^2(2)b Monzonitic granite-M. PROTEROZOIC UNDIF.
46400.14 270 gd2^2(2)b Granodiorite-M. PROTEROZOIC UNDIF
46400.15 271 gd2^2(2)a Granodiorite-M. PROTEROZOIC UNDIF.
90000.01 1 g Granite-UNKNOWN
90000.1 10 Mr Granite-UNKNOWN
90000.11 11 gr Granite pegmatite-UNKNOWN
99000 900 Water

Fig. 24. Map showing mineral occurrences in Hunan
(AMIRA P603 Project)

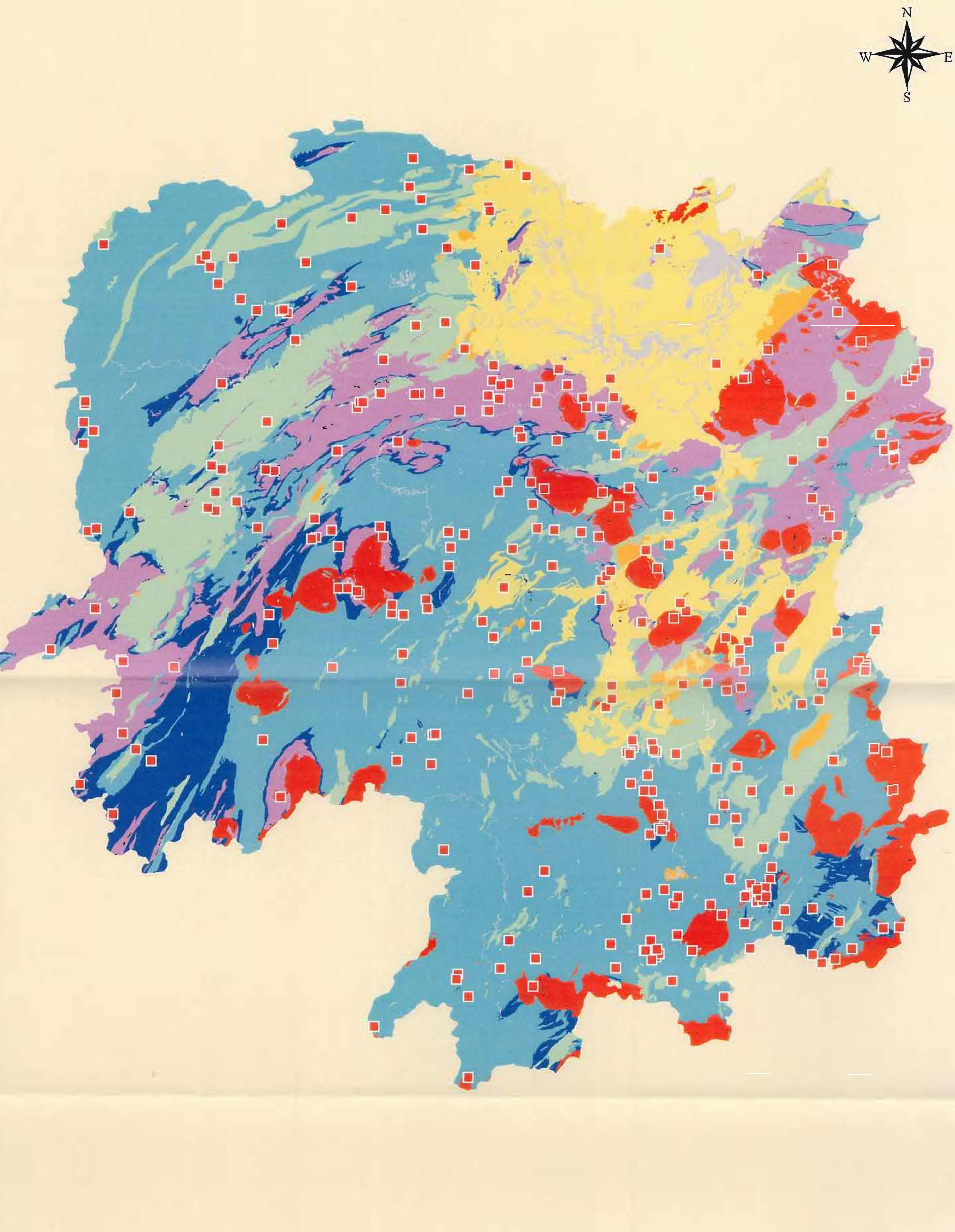


Fig. 25. Map showing lead-zinc-copper occurrences in Hunan (AMIRA P603 Project)

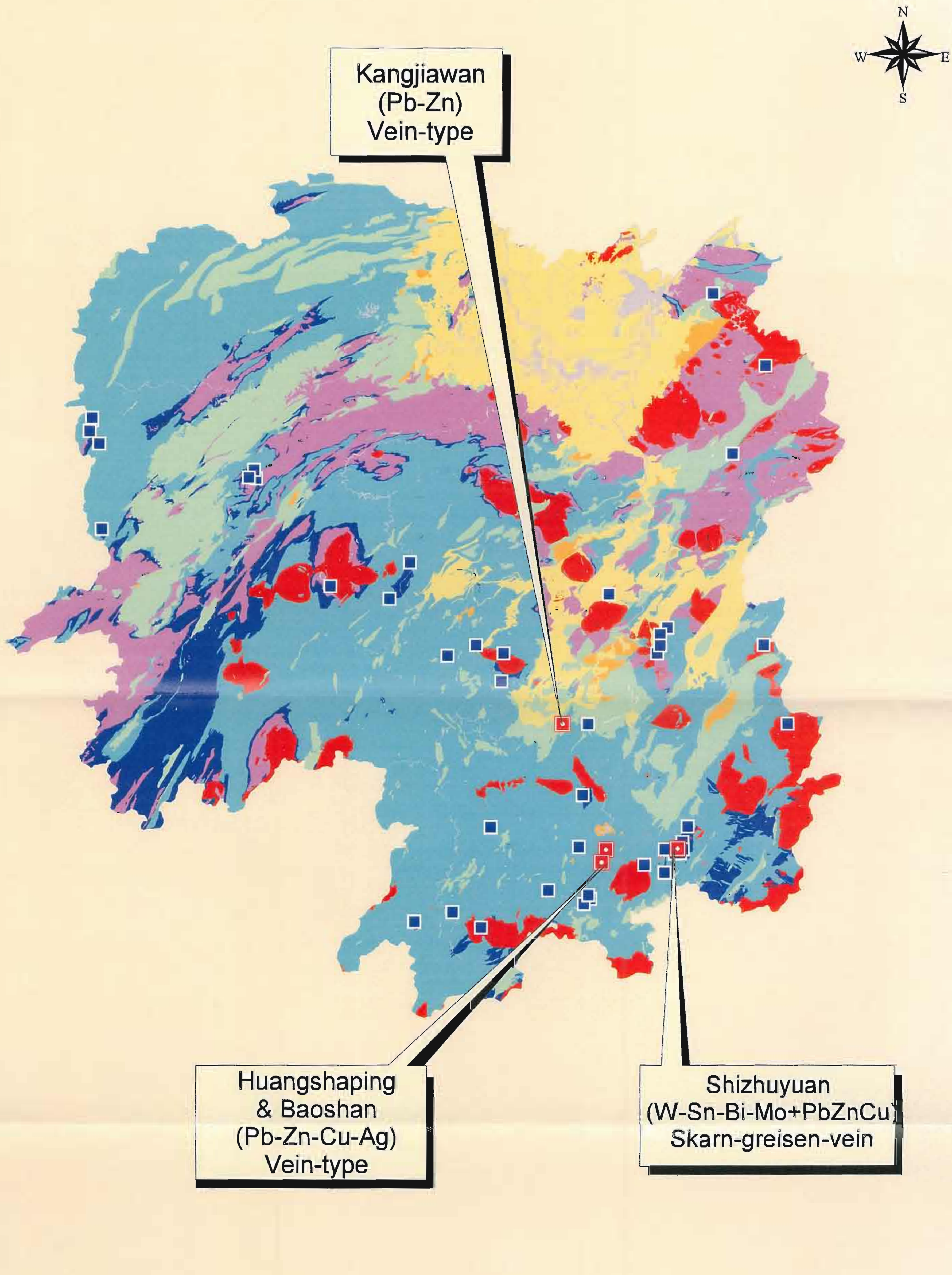


Fig. 26. Map showing gold occurrences in Hunan
(AMIRA P603 Project)

Fig. 27. Geology of Guangdong Province
(AMIRA P603 Project)

# Geology Legend (Guangdong)

Geology Legend (Guangdong)

11110 101 Q4 Denglongsha,Wanqingsha,Henglan Fm. etc.-HOLOCENE
11110 101 Q4 Intermixedfacies-marine and continental-HOLOCENE
11110 101 Q4 Marine sediment-HOLOCENE
11120.1 102 Q3 Marine sediment-L. PLEISTOCENE
11120.1 102 Q3 Xinan,Shipai,Tianyang Fm.-L. PLEISTOCENE
11120.2 103 Q2-3 Undiferentiated-L. PLEISTOCENE
11130.2 104 Q2 Beihai Fm.-M. PLEISTOCENE
11130.2 104 Q2 Intermixed facies-marine and continental-M. PLEISTOCENE
11130.2 104 Q2 Marine sediment-M. PLEISTOCENE
11140 105 Q1 Datai, Zhanjiang Fm.-E. PLEISTOCENE
11140 105 Q1 Intermixd facies of marine and continental-E. PLEISTOCENE
11140 105 Q1 Marine sediment-E. PLEISTOCENE
11210 106 N2 Laohuling,Gaopengling,Wanshan Fm.etc-PLIOCENE
11220 107 N1 Huangniuling,Shangcun,Zhujiang Fm. etc.-MIOCENE
11225 108 N Undifferentiated-NEOGENE UNDIF.
11230.2 110 E2-3 Danxia Gr.-OLIGOCENE
11240.2 111 E2 Buxin,Baouyue,Huayong Fm. etc.-EOCENE
11250 112 E1 Luofozhai Gr.-PALEOCENE
11260 113 E Undifferentiated-TERTIARY UNDIF.
12110 301 K2 Felsic volcanic rock-L. CRETACEOUS
12110 301 K2 Intermediate volcanic rock-L. CRETACEOUS
12110 301 K2 Intermediate-felsic volcanic rock-L. CRETACEOUS
12110 301 K2 Nanxiong,Zhajiang, Baowan Gr.-L. CRETACEOUS
12120 302 K1 Felsic volcanic rock-E. CREATACEOUS
12120 302 K1 Guancaohu, Baizushan,Louding Gr.-E. CREATACEOUS
12210 303 J3 Felsic volcanic rock-L. JURASSIC
12210 303 J3 Gaojiping gr.-L. JURASSIC
12210 303 J3 Intermediate-felsic volcanic rock-L. JURASSIC
12210.1 309 J3a Gaojiping Gr. Lower Subgroup-L. JURASSIC
12210.1 309 J3a Intermediate volcanic rock-L. JURASSIC
12210.1 309 J3a Intermediate-felsic volcanic rock-L. JURASSIC
12210.2 310 J3b Felsic volcanic rock-L. JURASSIC
12210.2 310 J3b Gaojiping Gr. Upper Subgroup-L. JURASSIC
12210.2 310 J3b Intermediate volcanic rock-L. JURASSIC
12210.2 310 J3b Intermediate-felsic volcanic rock-L. JURASSIC
12210.2 310 J3b Marine sediment-L. JURASSIC
12220 304 J2 Zhangping and Maziping Fm.-M. JURASSIC
12230 305 J1 Felsic volcanic rock-E. JURASSIC
12230 305 J1 Undifferentiated-E. JURASSIC
12230.1 311 J11 Jinji Fm.-E. JURASSIC
12230.2 312 J12 Qiaoyuan Fm.-E. JURASSIC
12310 306 T3 Genkou and Xiaoyunwushan Gr.-L. TRIASSIC
12320 307 T2 Huangfen Gr.-M. TRIASSIC
12330 308 T1 Daye Gr.-E. TRIASSIC
13120 501 P2 Shuizhutang,Meitian,Jiupi Fm. Etc.-M. PERMIAN
13130.1 502 P1 Qixia,Maokou,Gutian,Qixia Fm. Etc.-E. PERMIAN
13130.2 503 P1+2 Undiferentiated-E. PERMIAN
13210.1 504 C2+3 Hutian gr. Guangpianshan gr.-L. CARBONIFEROUS
13230.1 505 C1^2 Shidengzi,Ceshui Fm. etc.-E. CARBONIFEROUS
13230.2 506 C1^1 Shaodong,Menggong'ao Fm. Etc.-E. CARBONIFEROUS
13230.3 507 C1 Yanguan and Datang Stage-E. CARBONIFEROUS
13310.1 508 D3^2 Xikuangshan fm and Dawushi Fm.-L. DEVONIAN
13310.2 509 D3^1 Shetianqiao and Chunwan Fm.-L. DEVONIAN
13310.3 510 D3 Shuangtou Gr.-L. DEVONIAN
13310.4 511 D2+3 Undifferentiated-L. DEVONIAN
13320.2 512 D2^2 Donggangling & Qiziqiao Fm.-M. DEVONIAN
13320.3 513 D2^1 Guitou and Xindu Fm.-M. DEVONIAN
13320.4 514 D2 Dinghshan Gr.-M. DEVONIAN
13330 515 D1^2 Hexian Fm.-E. DEVONIAN
13410 516 S3 Lingxia Gr.-L. SILURIAN
13420 517 S2 Wentoushan Fm.-M. SILURIAN
13430 518 S1 Liantan Fm.-E. SILURIAN
13510.2 521 O2-3 Longtouzhai and Sanjian Gr.-L. ORDOVICIAN
13510.2 521 O2-3 Migmatitic rocks-L. ORDOVICIAN
13520.2 522 O2 Changkengshui,Shatang & Jianling Fm.-M. ORDOVICIAN
13530 523 O1 Suweiling Gr.-E. ORDOVICIAN
13540.1 526 Ca Bacun & Tuolie Gr.-ORDOVICIAN UNDIF.
13540.1 526 Ca Migmatitic rocks-ORDOVICIAN UNDIF.
13540.2 529 Caa Bacun Gr. Lower Subgroup-ORDOVICIAN UNDIF.
13540.2 529 Caa Migmatitic rocks-ORDOVICIAN UNDIF.
13540.3 528 Cab Bacun Gr. Middle Subgroup-ORDOVICIAN UNDIF.
13540.4 527 Cac Bacun Gr. Upper Subgroup-ORDOVICIAN UNDIF.
21120 701 Z2 Lechangxia gr.-M. SINIAN
21130 702 Z1 Migmatic rocks-LW. SINIAN
21130 702 Z1 Yingyangguan Gr.-LW. SINIAN
21140 703 Z Migmatic granite-SINIAN UNDIF.
21140 703 Z Various kinds of migmatic rocks-SINIAN UNDIF.
21140 703 Z Yunkai & Baoban Gr.-SINIAN UNDIF.

41100.02 203 b6^3b Basalt-NEOGENE
41100.02 203 b6^3b Basaltoid-NEOGENE
41100.04 204 b6^3c Basalt-NEOGENE
41100.04 204 b6^3c Basaltoid-NEOGENE
41200.01 207 b6^1 Basalt-EOCENE
41200.02 208 t6^1 Trachyte-EOCENE
41300.01 209 b6 Basalt-TERTIARY UNDIF.
41300.02 210 a6 Andesite-TERTIARY UNDIF.
41300.03 211 bm6 Diabase porphyrite-TERTIARY UNDIF.
41300.04 212 u6 Gabbro-TERTIARY UNDIF.
41300.05 213 s6 lherzolite-TERTIARY UNDIF.
42100.01 801 gpK2 Granite porphyry-CRETACEOUS UNDIF.
42100.02 802 gpK1 Granite porphyry-CRETACEOUS UNDIF.
42100.03 803 dmK1 Diorite-porphyrite
42200.01 804 fJ3 Albitophyre-JURASSIC UNDIF.
42200.02 805 xpJ3 Syenite porphyry-JURASSIC UNDIF.
42200.03 806 lpJ3 Quartz porphyry-JURASSIC UNDIF.
42200.04 807 gpJ3 Granite porphyry-JURASSIC UNDIF.
42200.05 808 lxpJ3 Quartz syenite porphyry-JURASSIC UNDIF.
42200.06 809 lhpJ3 Quartz monzonitic porphyry-JURASSIC UNDIF.
42200.07 811 gdpJ3 Granodiorite porphyry-JURASSIC UNDIF.
42200.08 812 domJ3 Quartz diorite porphyrite-JURASSIC UNDIF.
42200.09 813 zmJ3 Dacite porphyrite-JURASSIC UNDIF.
42300.01 401 lp5^3(2) Quartz porphyry-L. MESOZOIC UNDIF.
42300.02 402 gp5^3(2) Granite porphyry-L. MESOZOIC UNDIF.
42300.03 403 g5^3(2) Porphyritic K-feldspar granite-L. MESOZOIC UNDIF.
42300.04 404 e5^3(2) Nepheline syenite-L. MESOZOIC UNDIF.
42300.05 405 xo5^3(2) Quartz syenite-L. MESOZOIC UNDIF.
42300.07 407 g5^3(1)A Granite-L. MESOZOIC UNDIF.
42300.08 408 g5^3(1) Biotite granite-L. MESOZOIC UNDIF.
42300.09 409 hgp5^3(1) Adamellite porphyry-L. MESOZOIC UNDIF.
42300.1 410 hg5^3(1) Adamellite-L. MESOZOIC UNDIF.
42300.11 411 gdp5^3(1) Granodiorite porphyry-L. MESOZOIC UNDIF.
42300.12 412 gd5^3(1) Granodiorite-L. MESOZOIC UNDIF.
42300.13 413 dom5^3(1) Quartz diorite porphyrite-L. MESOZOIC UNDIF.
42300.14 414 ho5^3(1) Quartz monzonite-L. MESOZOIC UNDIF.
42300.15 415 xp5^3(1) Felspar porphyry-L. MESOZOIC UNDIF.
42300.16 416 do5^3(1) Quartz diorite-L. MESOZOIC UNDIF.
42300.17 417 d5^3(1) Diorite-L. MESOZOIC UNDIF.
42300.18 418 yo5^3(1) Hornblendite-L. MESOZOIC UNDIF.
42300.19 419 g5^2(3)A Porphyritic biotite granite-L. MESOZOIC UNDIF.
42300.2 420 g5^2(3) Biotite granite-L. MESOZOIC UNDIF.
42300.21 421 hg5^2(2) Adamellite-L. MESOZOIC UNDIF.
42300.22 422 gd5^2(2) Granodiorite-L. MESOZOIC UNDIF.
42300.23 423 do5^2(2) Quartz diorite-L. MESOZOIC UNDIF.
42300.24 424 d5^2(2) Diorite-L. MESOZOIC UNDIF.
42300.25 425 u5^2(2) Gabbro-L. MESOZOIC UNDIF.
42300.26 426 s5^2(2) Peridotite-L. MESOZOIC UNDIF.
42300.27 427 g5^2(1)A Porphyritic biotite granite-L. MESOZOIC UNDIF.
42300.28 428 g5^2(1) Porphyritic biotite granite-L. MESOZOIC UNDIF.
42300.29 612 Mg5^2-3 Migmatitic rocks-L. MESOZOIC UNDIF.
42300.29 612 Mg5^2-3 migmatitic granite-L. MESOZOIC UNDIF.
43400.01 429 gd5^1 Granodiorite-TRIASSIC UNDIF.
43400.02 430 hg5^1 Adamellite-TRIASSIC UNDIF.
43400.03 431 h5^1 Monzonite-TRIASSIC UNDIF.
43400.04 432 dm5^1 Diorite-porphyrite-TRIASSIC UNDIF.
43400.05 433 do5^1 Quartz diorite-TRIASSIC UNDIF.
43400.06 434 d5^1 Diorite-TRIASSIC UNDIF.
43400.07 435 u5^1 Gabbro-TRIASSIC UNDIF.
43400.08 436 fo5^1 Hornblendite-TRIASSIC UNDIF.
43400.09 437 ft5^1 Pyroxenolite-TRIASSIC UNDIF.
44400.01 601 hg4 Porphyritic biotite adamellite-L. PALEOZOIC UNDIF.
44400.02 602 gd4 Granodiorite-L. PALEOZOIC UNDIF.
44400.03 604 hbr4 Mica pyroxene monzonite-L. PALEOZOIC UNDIF.
44400.04 606 u4 Gabbro-L. PALEOZOIC UNDIF.
44400.07 613 Mg4 Migmatitic granite-L. PALEOZOIC UNDIF.
44400.07 613 Mg4 Migmatitic granitoid-L. PALEOZOIC UNDIF.
44400.07 613 Mg4 Migmatitic rocks-L. PALEOZOIC UNDIF.
45100 814 dpO-S Rhyolite-SILURIAN UNDIF.
45400.01 607 g3 Granite-E. PALEOZOIC UNDIF.
45400.02 608 gd3 Granodiorite-E. PALEOZOIC UNDIF.
45400.03 609 hg3 Adamellite-E. PALEOZOIC UNDIF.
45400.04 610 do3 Quartz diorite-E. PALEOZOIC UNDIF.
45400.05 611 s3 Pyroxene peridotite-E. PALEOZOIC UNDIF.
45500.07 615 Mg3 Migmatitic granitoid-UNOWN AGE
45500.07 615 Mg3 Migmatitic rocks-UNOWN AGE
45500.07 615 Mg3 migmatitic granite-UNOWN AGE
99000 900 Water

Fig. 28. Map showing mineral occurrences in Guangdong
(AMIRA P603 Project)

Fig. 29. Map showing lead-zinc-copper occurrences in Guangdong
(AMIRA P603 Project)

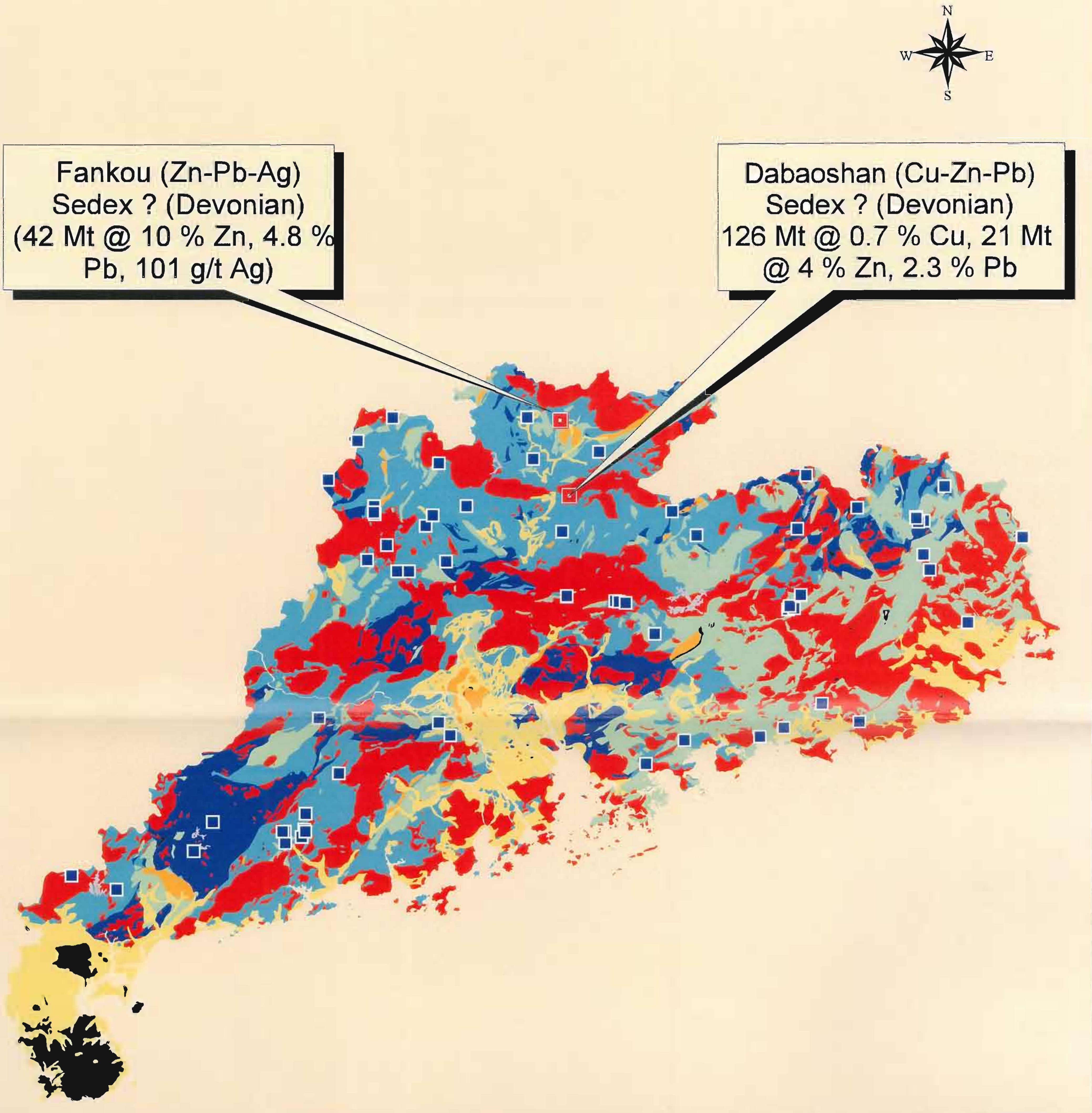
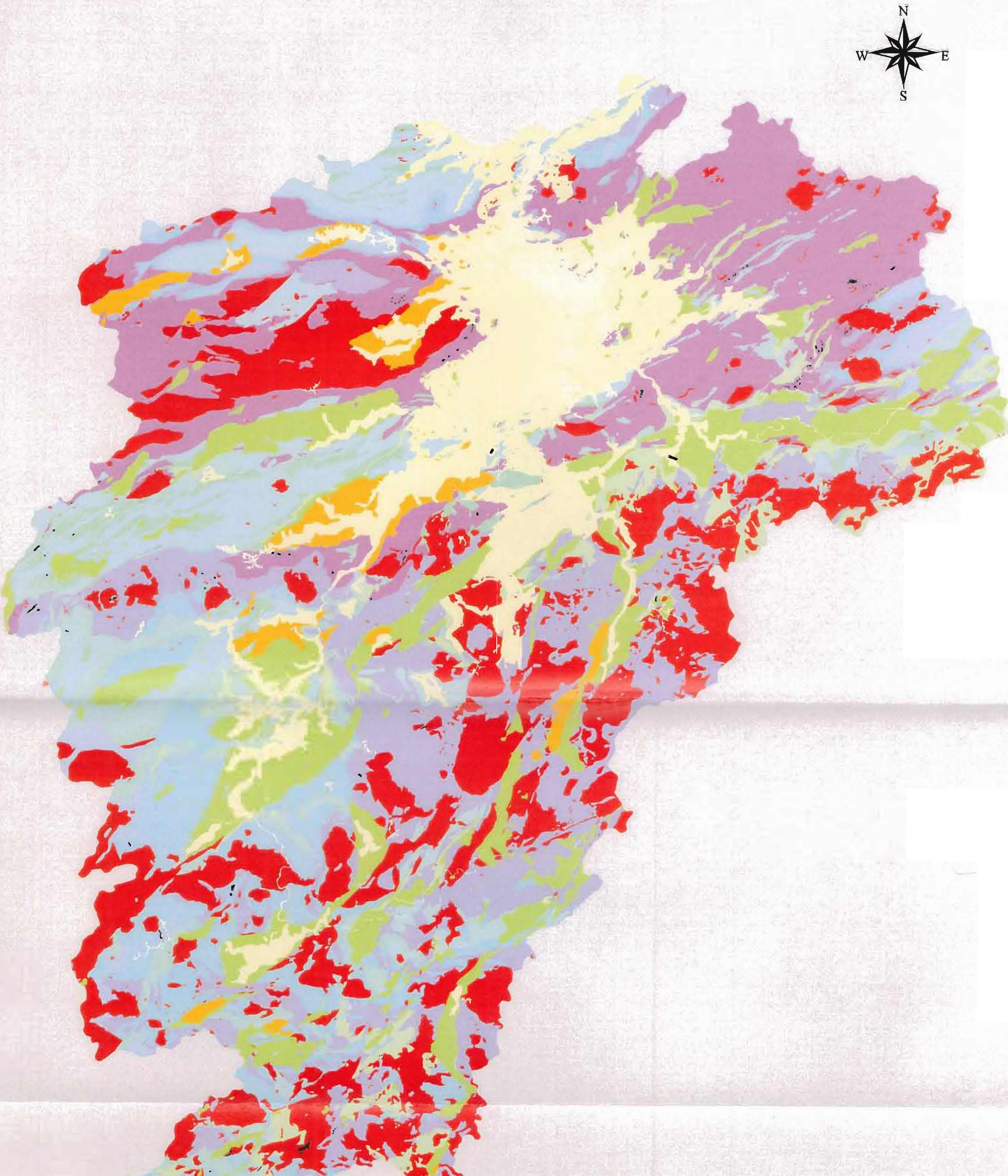


Fig. 30. Map showing gold occurrences in Guangdong
(AMIRA P603 Project)

Fig. 31. Map showing Geology of Jiangxi Province
(AMIRA P603 Project)



# Geology Legend (Jiangxi)

Geology Legend (Jiangxi)

11110 101 Q4 Lianxu Fm -HOLOCENE
11110.01 111 Q4al Lianxu Fm -HOLOCENE
11110.02 116 Q4lal Lianxu Fm -HOLOCENE
11120.01 121 Q32al Xingang Fm -UP. PLEISTOCENE
11120.02 124 Q32fal Xingang Fm -UP. PLEISTOCENE
11120.03 131 Q31al Liantang Fm -UP. PLEISTOCENE
11120.04 133 Q31pal Liantang Fm -UP. PLEISTOCENE
11120.05 138 Q31gl Liantang Fm -UP. PLEISTOCENE
11120.06 140 Q31el-dl Liantang Fm -UP. PLEISTOCENE
11130.01 141 Q2al Jinxian Fm -M. PLEISTOCENE
11130.02 105 Q1-2 Undifferentiated -M. PLEISTOCENE
11130.02 147 Q2f Jinxian Fm -M. PLEISTOCENE
11130.03 148 Q2gl Jinxian Fm -M. PLEISTOCENE
11130.04 149 Q2fgl Jinxian Fm -M. PLEISTOCENE
11130.05 150 Q2el-dl Jinxian Fm -M. PLEISTOCENE
11130.06 160 Q1-2el-dl Undifferentiated -M. PLEISTOCENE
11140.02 161 Q1al Ganxiam Fm -LW. PLEISTOCENE
11140.03 163 Q1pal Ganxiam Fm -LW. PLEISTOCENE
11140.04 166 Q1lal Ganxiam Fm -LW. PLEISTOCENE
11225 107 N Toupi Gr -NEOGENE UNDIF.
11240.01 108 E21 Pinghu Fm -EOCENE
11240.02 109 E1-2 Linjiang Fm (Qingjiang basin only) -EOCENE
11240.02 109 E1-2 Linjiang Fm-EOCENE
11250.02 110 E1 Chijiang Fm + Shizikou Fm -PALAEOCENE
12110.01 301 K22-2 Upper part of Nanxiong Fm -UP. CRETACEOUS
12110.01 301 K22-2 Upper part of Nanxiong Fm-UP. CRETACEOUS
12110.02 302 K22-1 Lower part of Nanxiong Fm-UP. CRETACEOUS
12110.02 302 K22-1 Lower part of Nanxiong Fm-UP. CRETACEOUS
12110.03 303 K22 Nanxiong Fm -UP. CRETACEOUS
12110.04 304 K21 Ganzhou Fm -UP. CRETACEOUS
12110.04 304 K21 Ganzhou Fm-UP. CRETACEOUS
12120 305 K1 Huobashan Gr -LW. CRETACEOUS
12210.01 306 J32-2 Ehuling Fm -UP. JURASSIC
12210.01 306 J32-2 Ehuling Fm -UP JURASSIC
12210.02 307 J32-1 Daguding Fm -UP. JURASSIC
12210.02 307 J32-1 Daguding Fm-UP. JURASSIC
12210.03 308 J32 Jilongzhang Fm -UP. JURASSIC
12210.03 308 J32 Jilongzhang Fm-UP. JURASSIC
12210.04 309 J31 Zhoujiayuan Fm -UP. JURASSIC
12210.04 309 J31 Zhoujiayuan Fm-UP. JURASSIC
12210.04 309 J31 Zhoujiayuan Fm -UP. JURASSIC
12210.04 309 J31 Zhoujiayuan Fm -UP. JURASSIC
12210.04 319 J31 Zhoujiayuan Fm -UP. JURASSIC
12220 310 J2 Luoao Fm -M. JURASSIC
12230 311 J1 Linshan Fm -LW. JURASSIC
12310 312 T3 Anyuan Fm -UP. TRIASSIC
12310 312 T3 Anyuan Fm-UP. TRIASSIC
12320.01 313 T2 Yangjia Gr -M. TRIASSIC
12320.02 314 T1+2 Jialingjiang Fm-M. TRIASSIC
12330.02 315 T1 Daye Gr -LW. TRIASSIC
13120.01 501 P22 Changxing Fm-M. PERMIAN
13120.02 502 P21 Wujiaping Fm-M. PERMIAN
13120.03 503 P2 Wujiaping, Leping, Wulinshan Fm -M. PERMIAN
13130.01 504 P12 Maokou Fm-LW. PERMIAN
13130.02 505 P11 Qixia Fm -LW. PERMIAN
13130.03 506 P1 Maokou Fm+Shizixing Fm+Yichun-LW. PERMIAN
13140 507 P Combined - All Permian Fm -PERMIAN UNDIF.
13210.01 508 C22 Chuanshan Fm -UP. CARBONIFEROUS
13210.02 509 C21 Huanglong Fm/ Outangdi Fm-UP. CARBONIFEROUS
13210.02 514 D3+C21 Huanglong Fm+Wutong Gr-UP. CARBONIFERC
13210.03 510 C2 Chuanshan Fm and Huanglong Fm-UP. CARBONIFEF
13230.01 511 C12 Datang Fm -LW-PERMIAN
13230.02 512 C11 Yanguan Fm-LW. CARBONIFEROUS
13230.03 513 C1 Lower Carboniferous Fm -LW. CARBONIFEROUS
13310.01 515 D32 Xikuangshan Fm -UP. DEVONIAN
13310.02 516 D31 Shetianqiao Fm-UP. DEVONIAN
13310.03 517 D3 Shetianqiao Fm-UP. DEVONIAN
13320.01 518 D22 Qiziqiao Fm -M. DEVONIAN
13320.02 519 D21 Tiaomajian Fm-M. DEVONIAN
13320.03 520 D2 Tiaomajian Fm and Qiziqiao Fm-M. DEVONIAN
13410 521 S3 Xikeng Fm -UP. SILURIAN
13420 522 S2 Xiajiaqiao Fm and Lixi Fm-M. SILURIAN
13430.01 523 S12+3 Dianbei Fm and Qinngshuijiang Fm-LW. SILURIAN
13430.02 524 S11 Undifferentiated -LW. SILURIAN
13430.03 525 S1 Undifferentiated -LW. SILURIAN
13510.01 526 O3 Tangtou Fm -UP. ORDOVICIAN
13510.02 527 O2+3 Middle and Upper Ordovician Fm-UP. ORDOVICIAN

13510.03 528 O22-O3 Guting Gr -UP. ORDOVICIAN
13520.03 529 O2 Hule Fm+Yanwashan Fm-M. ORDOVICIAN
13530 529 O2 Hule Fm+Yanwashan Fm-LW. ORDOVICIAN
13530 530 O1 Yinzhubu Fm + Ningguo Fm-LW. ORDOVICIAN
13530 530 O1 Yinzhubu Fm + Ningguo Fm-LW. ORDOVICIAN
13610.01 531 Ca3 Huayansi Fm + Xiyangsham Fm-UP. CAMBRIAN
13610.01 531 Ca3 Huayansi Fm + Xiyangsham Fm-UP. CAMBRIAN
13610.01 531 Ca3 Huayansi Fm + Xiyangsham Fm-UP. CAMBRIAN
13610.02 532 Ca2+3 Yangliugang, Huayansi, Xiyangshan Fm-UP. CAMBRIAN
13620.02 533 Ca2 Yangliugang Fm-M. CAMBRIAN
13620.02 533 Ca2 Yangliugang Fm-M. CAMBRIAN
13620.02 533 Ca2 Yangliugang Fm-M. CAMBRIAN
13630 534 Ca1 Undifferentiated -LW. CAMBRIAN
13630 534 Ca1 Undifferentiated Migmatite zone-LW. CAMBRIAN
13630 534 Ca1 Undifferentiated Partially Migmatized zone-LW. CAMBRIAN
21120 701 Z2 Doushantou Fm + Dengying Fm-M. SINIAN
21120 701 Z2 Doushantou Fm + Dengying Fm-M. SINIAN
21120 701 Z2 Doushantou Fm + Dengying Fm-M. SINIAN
21130 702 Z1 Dongmen Fm+Nantou Fm-LW. SINIAN
21130 702 Z1 Dongmen Fm+Nantou Fm-LW. SINIAN
21130 702 Z1 Dongmen Fm+Nantou Fm-LW. SINIAN
21220 703 Pt31 Luokedong Fm-UP. PROTEROZOIC
22000.01 704 Pt22 Shuangqiaoshan Fm-M. PROTEROZOIC UNDIF.
22000.01 704 Pt22 Shuangqiaoshan Fm-M. PROTEROZOIC UNDIF.
22000.01 704 Pt22 Shuangqiaoshan Fm-M. PROTEROZOIC UNDIF.
22000.02 705 Pt21 Shuangqiaoshan Fm-M. PROTEROZOIC UNDIF.
22000.02 705 Pt21 Shuangqiaoshan Fm-M. PROTEROZOIC UNDIF.
41300.01 201 um6^2 Gabbro diabase -TERTIARY UNDIF.
41300.02 202 g6^1 Granite -TERTIARY UNDIF.
42100.01 401 g5^2(3) Granite -CRETACEOUS
42100.011 423 gp5^2(3) Granite porphyry -CRETACEOUS
42100.012 424 lp5^2(3) Quartz porphyry -CRETACEOUS
42100.02 402 u5^2(3) Gabbro -CRETACEOUS
42100.021 425 bm5^2(3) Diabase -CRETACEOUS
42100.03 403 s5^2(3) Peridotite -CRETACEOUS
42150.01 404 g5^2(2)b Granite -CRETACEOUS - JURASSIC
42150.011 426 hg5^2(2) b Adamellite -CRETACEOUS - JURASSIC
42150.012 427 gn5^2(2) b Plagioclase-rich granite -CRETACEOUS - JURASSIC
42150.013 428 gp5^2(2) b Granite porphyry -CRETACEOUS - JURASSIC
42150.014 429 lp5^2(2)b Quartz porphyry -CRETACEOUS - JURASSIC
42150.015 431 gr5^2(2) b Granite pegmatite -CRETACEOUS - JURASSIC
42150.02 405 gd5^2(2)b Granodiorite -CRETACEOUS - JURASSIC
42150.021 432 gh5^2(2) b Granomonzonite -CRETACEOUS - JURASSIC
42150.022 433 gdp5^2(2) b Granodiorite -CRETACEOUS - JURASSIC
42150.03 406 d5^2(2) b Diorite -CRETACEOUS - JURASSIC
42150.031 434 dm5^2(2) b Biotite porphyrite -CRETACEOUS - JURASSIC
42150.032 435 xo5^2(2) b Quartz syenite -CRETACEOUS - JURASSIC
42150.033 436 ho5^2(2) b Quartz monzonite -CRETACEOUS - JURASSIC
42150.04 407 x5^2(2) a Syenite -CRETACEOUS - JURASSIC
42150.041 437 xo5^2(2) a Quartz syenite -CRETACEOUS - JURASSIC
42150.042 438 xop5^2(2) a Quartz syenite porphyry -CRETACEOUS - JURASSIC
42150.043 439 xp5^2(2) a Syenite porphyry -CRETACEOUS - JURASSIC
42150.044 440 tp5^2(2) a Trachyte porphyry -CRETACEOUS - JURASSIC
42150.05 408 g5^2(2) a Granite -CRETACEOUS - JURASSIC
42150.051 442 gp5^2(2) a Acid lava and volcaniclastic rock -CRETACEOUS - JUR
42150.051 442 gp5^2(2) a Granite porphyry -CRETACEOUS - JURASSIC
42150.052 443 lp5^2(2) a Quartz porphyry -CRETACEOUS - JURASSIC
42150.053 444 hg5^2(2) a Adamellite -CRETACEOUS - JURASSIC
42150.054 445 go5^2(2) a Plagio granite -CRETACEOUS - JURASSIC
42150.06 409 gd5^2(2) a Granodiorite -CRETACEOUS - JURASSIC
42150.061 446 gop5^2(2) a Plagiogranite porphyry -CRETACEOUS - JURASSIC
42150.062 447 gx5^2(2) a Granosyenite -CRETACEOUS - JURASSIC
42150.063 448 gdp5^2(2) a Granodiorite porphyry -CRETACEOUS - JURASSIC
42150.064 449 zm5^2(2) a Dacite porphyrite -CRETACEOUS - JURASSIC
42150.07 410 d5^2(2) a Diorite -CRETACEOUS - JURASSIC
42150.071 450 do5^2(2) a Quartz diorite -CRETACEOUS - JURASSIC
42150.072 451 ho5^2(2) a Quartz monzonite -CRETACEOUS - JURASSIC
42150.073 452 hp5^2(2) a Monzonite porphyry -CRETACEOUS - JURASSIC
42150.074 453 dm5^2(2) a Diorite-porphyrite -CRETACEOUS - JURASSIC
42150.075 454 dom5^2(2) a Andesite porphyrite -CRETACEOUS - JURASSIC
42150.076 455 am5^2(2) a Andesite porphyrite -CRETACEOUS - JURASSIC
42150.08 411 u5^2(2) Gabbro -CRETACEOUS - JURASSIC
42150.081 456 um5^2(2) Gabbro diabase -CRETACEOUS - JURASSIC
42150.082 457 bm5^2(2) Diabase -CRETACEOUS - JURASSIC
42150.09 412 s5^2(2) Peridotite -CRETACEOUS - JURASSIC
42150.091 458 wm5^2(2) Picrite-porphyrite -CRETACEOUS - JURASSIC
42200.01 413 g5^2(1) b Granite -JURASSIC UNDIF.
42200.011 459 gp5^2(1) b Granite porphyry -JURASSIC UNDIF.

42200.012 460 xg5^2(1) b Potash feldspar granite -JURASSIC UNDIF.
42200.013 461 hg5^2(1) b Adamellite -JURASSIC UNDIF.
42200.014 462 gn5^2(1) b Plagioclase-rich granite -JURASSIC UNDIF.
42200.02 414 gh5^2(1) b Granomonzonite -JURASSIC UNDIF.
42200.021 463 gd5^2(1) b Granodiorite -JURASSIC UNDIF.
42200.022 464 gx5^2(1) b Granosyenite -JURASSIC UNDIF.
42200.03 415 d5^2(1) b Diorite -JURASSIC UNDIF.
42200.031 465 do5^2(1) b Quartz diorite -JURASSIC UNDIF.
42200.04 416 g52(1) a Granite -JURASSIC UNDIF.
42200.041 466 lp5^2(1) a Quartz porphyry -JURASSIC UNDIF.
42200.042 467 hg5^2(1) a Adamellite -JURASSIC UNDIF.
42200.05 417 gh5^2(1) a Granomonzonite -JURASSIC UNDIF.
42200.051 468 gd5^2(1) a Granodiorite -JURASSIC UNDIF.
42200.052 469 gdp5^2(1) a Granodiorite porphyry -JURASSIC UNDIF.
42200.06 418 d5^2(1) a Diorite -JURASSIC UNDIF.
42200.061 470 do5^2(1) a Quartz diorite -JURASSIC UNDIF.
42200.062 471 xc5^2(1) a Minette -JURASSIC UNDIF.
42200.07 419 u5^2(1) Gabbro -JURASSIC UNDIF.
42200.071 472 bm5^2(1) Diabase -JURASSIC UNDIF.
42200.072 473 N5^2(1) Basic rock -JURASSIC UNDIF.
42200.08 420 yo5^2(1) Hornblendite -JURASSIC UNDIF.
42200.081 474 jw5^2(1) Serpentinite -JURASSIC UNDIF.
43400.01 421 g5^1 Granite -TRIASSIC UNDIF.
43400.011 475 hg5^1 Adamellite -TRIASSIC UNDIF.
43400.02 422 gd5^1 Granodiorite -TRIASSIC UNDIF.
43400.03 601 g4^3 Granite -TRIASSIC UNDIF.
43400.04 602 gd4^3 Granodiorite -TRIASSIC UNDIF.
43400.05 603 d4^1-2 Diorite -TRIASSIC UNDIF.
43400.051 621 do4^1-2 Quartz diorite -TRIASSIC UNDIF.
43400.06 604 u4^1-2 Gabbro -TRIASSIC UNDIF.
45400.01 605 g3^3 Granite -E. PALAEOZOIC UNDIF.
45400.011 613 hg3^3 Adamellite -E. PALAEOZOIC UNDIF.
45400.012 614 go3^3 Plagio granite -E. PALAEOZOIC UNDIF.
45400.02 606 gh3^3 Granomonzonite -E. PALAEOZOIC UNDIF.
45400.03 607 g3^2-3 Granite -E. PALAEOZOIC UNDIF.
45400.031 616 hg3^2-3 Adamellite -E. PALAEOZOIC UNDIF.
45400.032 617 gn3^2-3 Plagioclase-rich granite -E. PALAEOZOIC UNDIF.
45400.033 618 go3^2-3 Plagio granite -E. PALAEOZOIC UNDIF.
45400.04 608 gd3^2-3 Granodiorite -E. PALAEOZOIC UNDIF.
45400.041 619 do3^2-3 Quartz diorite -E. PALAEOZOIC UNDIF.
45400.042 620 gx4^2-3 Granosyenite -E. PALAEOZOIC UNDIF.
45400.043 623 gh3^2-3 Granomonzonite -E. PALAEOZOIC UNDIF.
45400.05 609 g3^2 Granite -E. PALAEOZOIC UNDIF.
45400.051 624 hg3^2 Adamellite -E. PALAEOZOIC UNDIF.
45400.052 625 go3^2 Plagio granite -E. PALAEOZOIC UNDIF.
45400.06 610 gd3^2 Granodiorite -E. PALAEOZOIC UNDIF.
45400.061 626 gh3^2 Granomonzonite -E. PALAEOZOIC UNDIF.
45400.07 611 Mg3^1 Migmatitic granite -E. PALAEOZOIC UNDIF.
45400.08 612 ud3^1 Gabbro diorite -E. PALAEOZOIC UNDIF.
45400.09 801 u2^3(2) Gabbro -E. PALAEOZOIC UNDIF.
45400.1 802 s2^3(2) Peridotite -E. PALAEOZOIC UNDIF.
45400.101 811 yo2^3(2) Hornblendite -E. PALAEOZOIC UNDIF.
47310.01 803 g2^3(1)c Granite -M. PROTEROZOIC UNDIF.
47310.02 804 gh2^3(1) b Plagioclase-rich granite -M. PROTEROZOIC UNDIF.
47310.03 805 gh2^3(1)a Plagioclase-rich granite -M. PROTEROZOIC UNDIF.
47310.04 806 um2^3(1) Gabbro diabase -M. PROTEROZOIC UNDIF.
47310.041 812 bm2^3(1) Diabase -M. PROTEROZOIC UNDIF.
47310.042 813 yt2^3(1) Pyroxenite -M. PROTEROZOIC UNDIF.
47310.043 814 yo2^3(1) Hornblendite -M. PROTEROZOIC UNDIF.
47310.044 815 yw2^3(1) Serpentinite -M. PROTEROZOIC UNDIF.
47310.045 816 S2^31 Ultra-basic rock -M. PROTEROZOIC UNDIF.
47310.05 807 s2^3(1) Peridotite -M. PROTEROZOIC UNDIF.
47310.06 808 Mg2^2 Migmatitic granite -M. PROTEROZOIC UNDIF.
47310.07 809 u2^2 Gabbro -M. PROTEROZOIC UNDIF.
47310.071 817 bm2^2 Diabase -M. PROTEROZOIC UNDIF.
47310.072 818 N2^2 Basic rock -M. PROTEROZOIC UNDIF.
47310.08 810 s2^2 Peridotite -M. PROTEROZOIC UNDIF.
47310.081 819 yj2^2 Nornblende pyroxenite -M. PROTEROZOIC UNDIF.
90000.01 001 u Gabbro -UNKNOWN
90000.02 002 d Diorite -UNKNOWN
90000.03 003 z Dacite -UNKNOWN
90000.04 004 gt Aplite -UNKNOWN
90000.05 005 r Pegmatite -UNKNOWN
90000.06 006 gp Granite porphyry -UNKNOWN
90000.07 007 lp Quartz porphyry -UNKNOWN
99000 900 Water Undifferentiated

Fig. 32. Map showing mineral occurrences in Jiangxi
(AMIRA P603 Project)

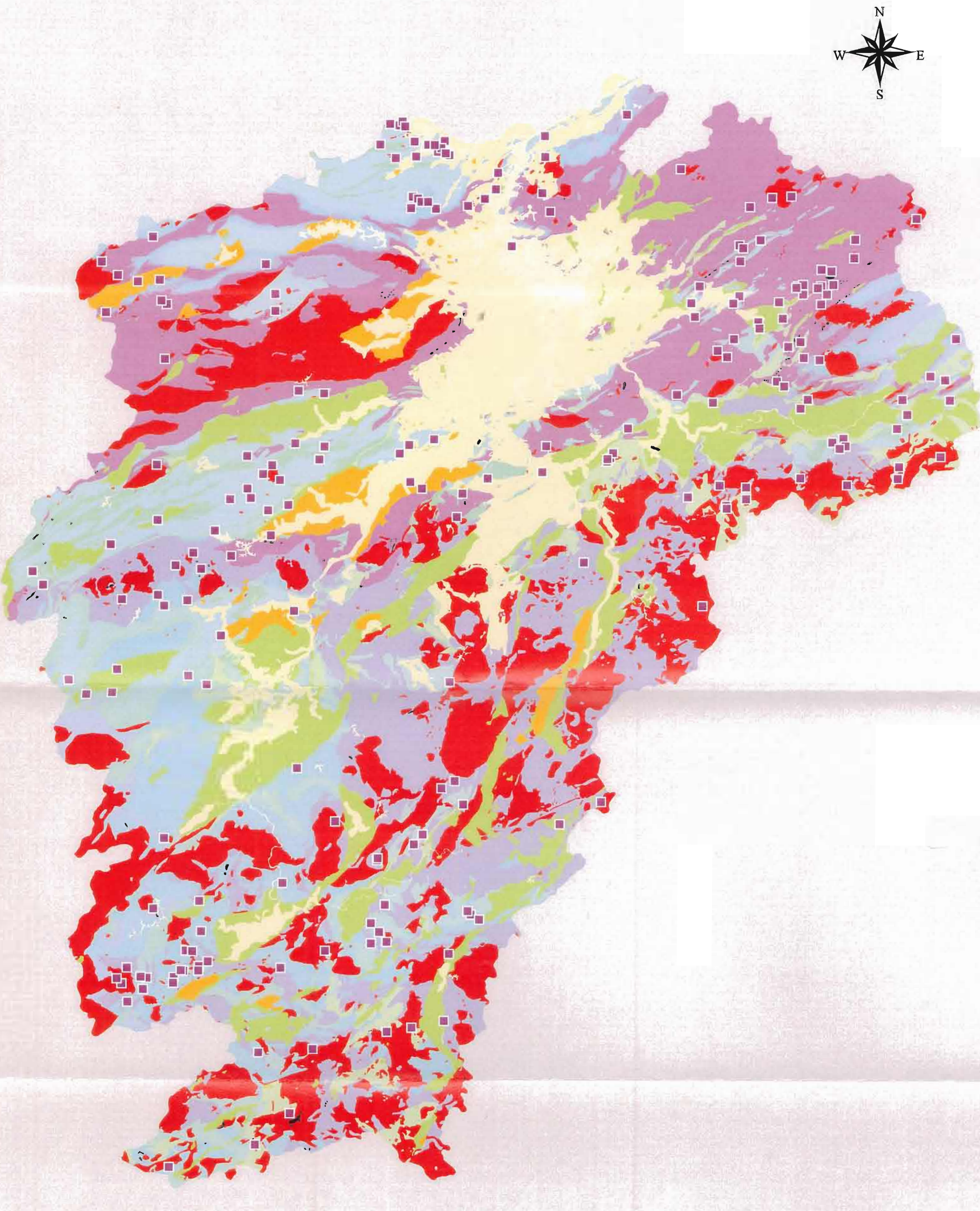


Fig. 33. Map showing lead, zinc, tungsten and tin occurrences in Jiangxi
(AMIRA P603 Project)

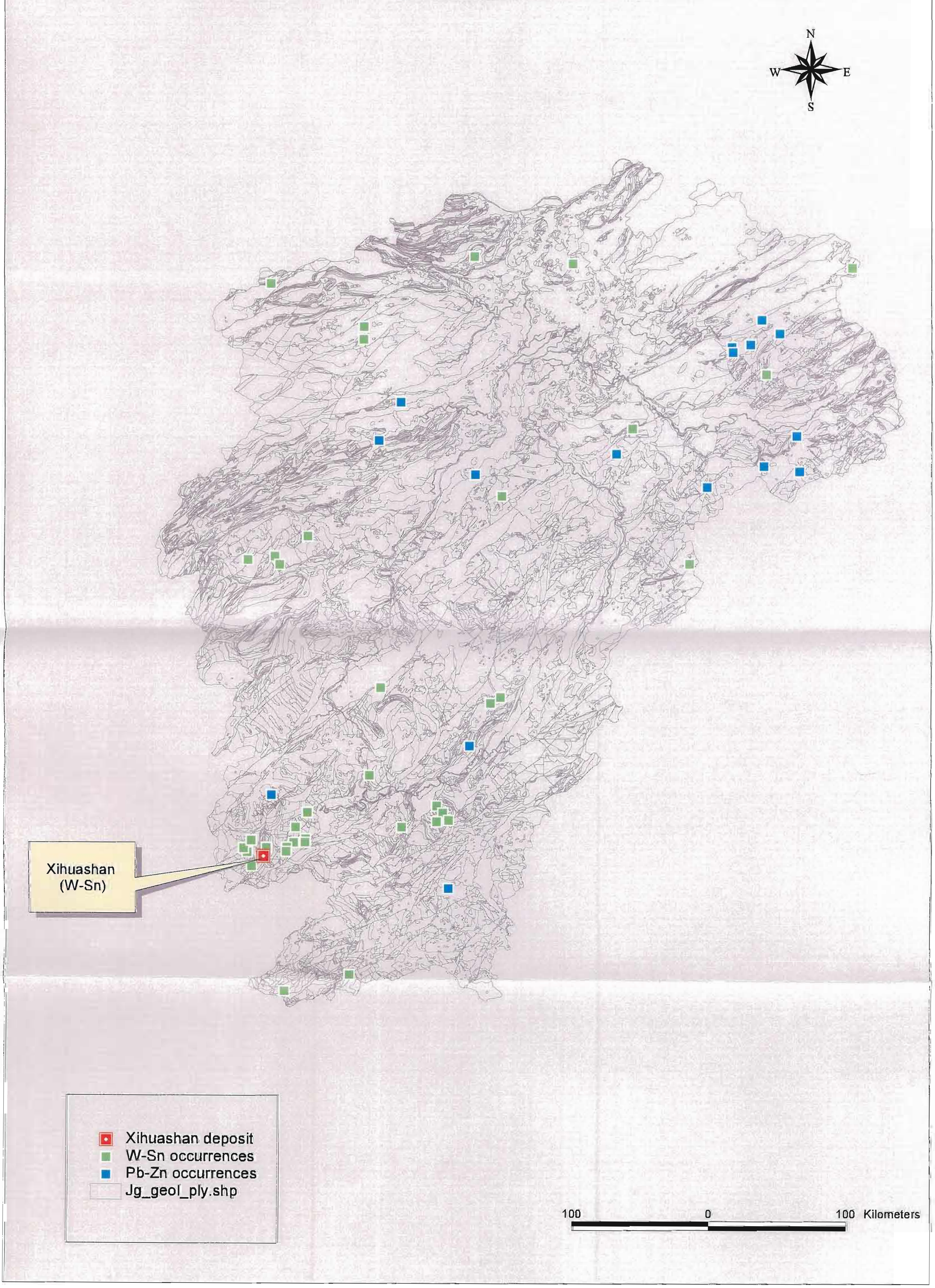


Fig. 34. Map showing copper-gold occurrences in Jiangxi
(AMIRA P603 Project)

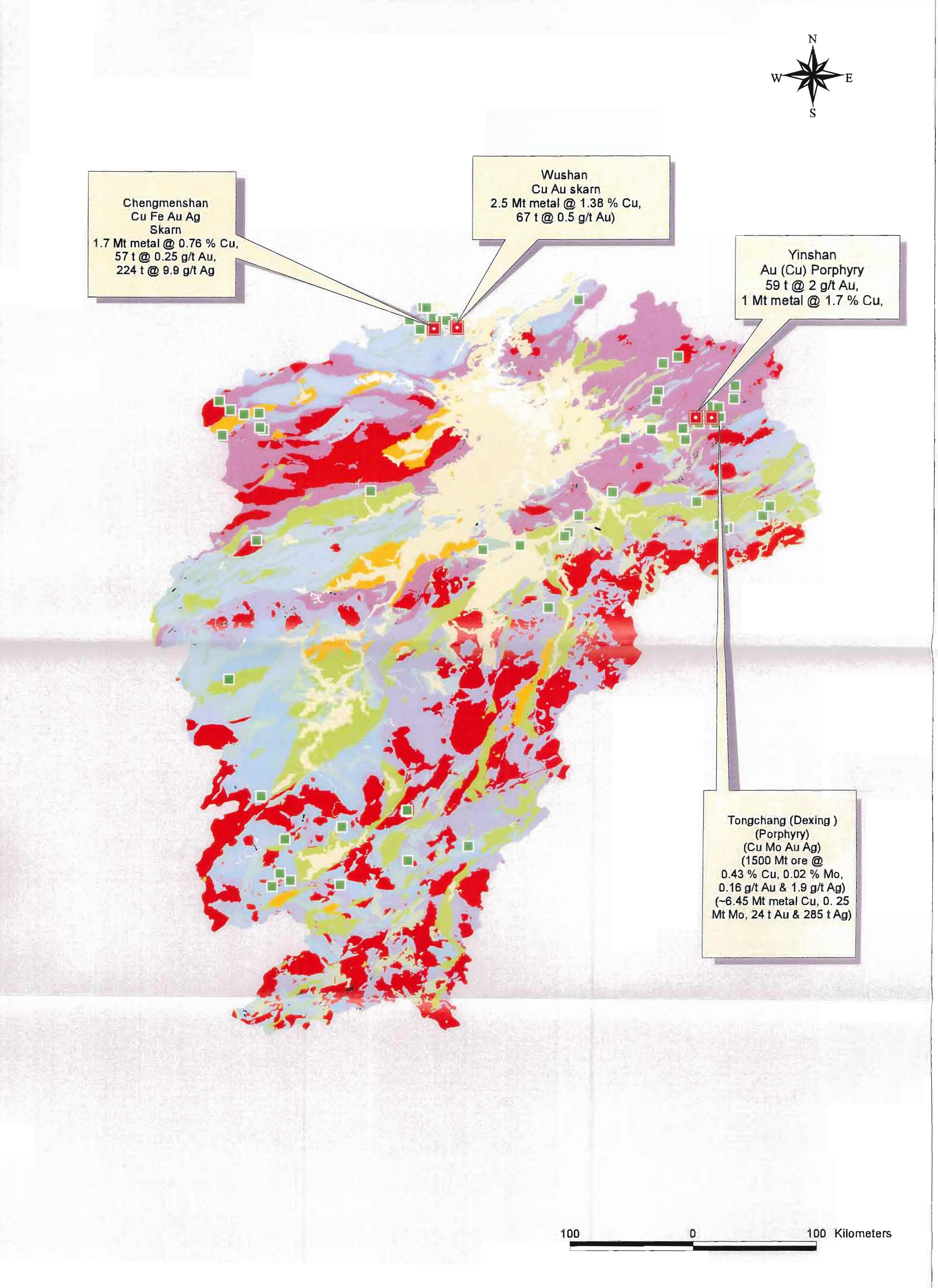
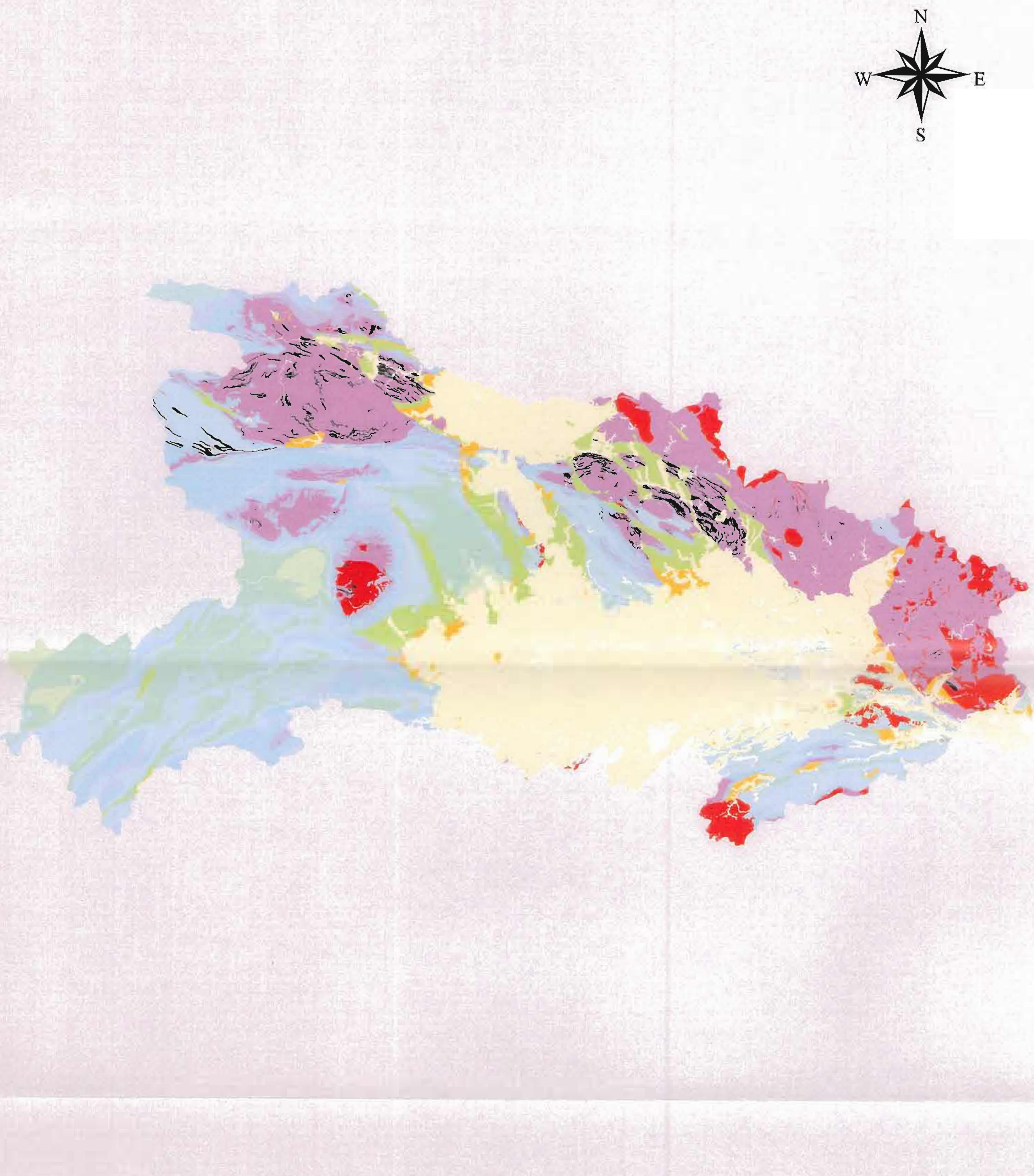


Fig. 35. Map showing Geology of Hubei Province
(AMIRA P603 Project)



# Geology Legend (Hubei)

Geology Legend (Hubei)

11110 101 Q4p Pingyuan Fm. -HOLOCENE
11120 102 Q3y Yidu Fm. -UP. PLEISTOCENE
11130 103 Q2s Shanxiyao Fm. -M. PLEISTOCENE
11140 104 Q1y Yunchi Fm. -LW. PLEISTOCENE
11210.01 107 N2d Duodaoshi Fm. -PLIOCENE
11225.01 105 Ns+h Hongfa Fm-NEOGENE UNDIF.
11225.02 106 Nf Fenghuangzhen Fm. -NEOGENE UNDIF.
11260.01 110 Ef Fangjiahe Fm. -TERTIARY UNDIF.
11260.02 111 Ej Jiamacao Fm. -TERTIARY UNDIF.
11260.02 111 Ej Jiamacao Fm. Basic-TERTIARY UNDIF.
11260.04 113 Eg+h Grey-green Fm&Gyps-salt Fm-TERTIARY UNDIF.
11260.05 116 E Balying Fm. Yuhuangding Fm -TERTIARY UNDIF.
11260.06 114 K2yn+Eb Yuntaishan Fm&Baishakou Fm-TERTIARY UNDIF.
11260.07 115 (K2-E)dn Donghu Gr. -TERTIARY UNDIF.
11260.07 115 (K2-E)dn Undifferentiated Basic-TERTIARY UNDIF.
12110.03 301 K2hg Hugang Fm. -UP. CRETACEOUS
12110.04 302 K2z Zhengyang Fm. -UP. CRETACEOUS
12110.05 303 K2p Paomagang Fm. -UP. CRETACEOUS
12110.06 304 K2hn Honghuatao Fm. -UP. CRETACEOUS
12110.07 305 K2lj Luojingtan Fm. -UP. CRETACEOUS
12110.09 309 K2g Gonganzhai Fm. -UP. CRETACEOUS
12110.09 309 K2g Gonganzhai Fm. Basic-UP. CRETACEOUS
12110.1 310 K2h Hejiapo Fm. -UP. CRETACEOUS
12120.01 306 K1w Wulong Fm. -LW. CRETACEOUS
12120.02 307 K1s Shimen Fm. -LW. CRETACEOUS
12120.03 311 K1q Quanshuihe Fm. -LW. CRETACEOUS
12120.04 312 K1d Dasi Fm. -LW. CRETACEOUS
12120.05 313 K1l Lingxiang Fm. -LW. CRETACEOUS
12210.01 314 J3p Penglaizhen Fm. -UP. JURASSIC
12210.02 315 J3s Suining Fm. -UP. JURASSIC
12210.03 321 J3m Majiashan Fm. -UP. JURASSIC
12220.01 316 J2s Shangshaximiao Fm. -M. JURASSIC
12220.02 317 J2x Xiashaximiao Fm. -M. JURASSIC
12220.03 318 J2n Niejiashan Fm. -M. JURASSIC
12220.04 322 J2hj Huajiahu Gr. -M. JURASSIC
12230.01 323 J1j Jinshandian Fm. -LW. JURASSIC
12230.03 324 J1c+d Chengchao Fm&Dawangchong Fm-LW.JURASSIC
12230.04 319 J1t Tongzhuyuan Fm. -LW. JURASSIC
12230.05 325 (T3+Jn)wc Wuchang Gr. -LW. JURASSIC
12230.06 320 J1 Lower Series -LW. JURASSIC
12310.02 326 T3s Shazhenxi Fm. -UP. TRIASSIC
12310.03 327 T3w Wanglongtan Fm. -UP. TRIASSIC
12310.04 328 T3j Jiuligang Fm. -UP. TRIASSIC
12310.05 330 T3jg Jigongshan Fm. -UP. TRIASSIC
12320.01 329 T2b Badong Fm. -M. TRIASSIC
12320.02 331 T2p Puqi Fm. -M. TRIASSIC
12320.03 333 T2l Lushuihe Fm. -M. TRIASSIC
12320.04 332 T2l+p Lushuihe Fm and Puqi Fm. -M. TRIASSIC
12330.01 335 T1j Jialingjiang Fm. -LW. TRIASSIC
12330.02 334 T1g Guangyinshan Fm. -LW. TRIASSIC
12330.03 336 T1d Daye Fm. -LW. TRIASSIC
13120.01 501 P2 Longdongchuan, Yundoutan Fm-M. PERMIAN
13130 502 P1 Shuixiakou, Wulipo Fm-LW. PERMIAN
13140 503 P P1 and P2 -PERMIAN UNDIF.
13220 505 C2 Chuanshan, Huanlong Fm-M. CARBONIFEROUS
13220 509 D2 Yanglinggou, Dafenggou Fm-M. CARBONIFEROUS
13230 506 C1 Hezhou, Gaolishan Fm-LW. CARBONIFEROUS
13240.01 504 C C1 and C2 combined -CARBONIFEROUS UNDIF.
13240.02 507 D+C Devonian to Carboniferous-CARBONIFEROUS UNDIF.
13310 508 D3 Nanyangshan, Lengshuihe Fm-UP. DEVONIAN
13320.02 528 D2+3 Yuntaiguan, Huangjiadeng Fm-M. DEVONIAN
13330 510 D1 Gongguan and Xichahe Fm. -LW. DEVONIAN
13410.01 516 S3 Maoshan Fm. -UP. SILURIAN
13410.02 515 S2+3 Maoshan and Fentou Fm. -UP. SILURIAN
13420.02 511 S2 Leigongjian, Shamao Fm-M. SILURIAN
13420.02 511 S2 Leigongjian, Shamao Fm--Alkaline M. SILURIAN
13420.03 512 S12 Meiziya and Luoreping Fm-M. SILURIAN
13420.03 512 S12 Meiziya and Luoreping Fm. Alkaline-M. SILURIAN
13430.02 514 S1 Lanjiatan Fm&Gaojiabian Fm-LW. SILURIAN
13430.03 513 S11 Daguiping and Longmaxi Fm-LW. SILURIAN
13430.03 513 S11 Daguiping and Longmaxi Fm. Alkaline-LW. SILURIAN
13510.01 519 O3 Liangchakou, Wufeng Fm-UP. ORDOVICIAN
13510.02 517 O2+3 Liangchakou Fm-UP. ORDOVICIAN
13520.02 520 O2 Liangchakou, Baota Fm-M. ORDOVICIAN
13530.01 521 O1 Diaochuanggou, Shuiliantie Fm-ORDOVICIAN
13540.01 518 O Ordovician Lower, Middle&Upper-ORDOVICIAN UNDIF.
13540.02 522 Ca2+O Guchenfang Gr. -ORDOVICIAN UNDIF.
13610.01 523 Ca3 Wugongya, Maotian Fm-UP. CAMBRIAN
13610.02 525 Ca2+3 Baxiantie, Sanyoumiao Fm-UP. CAMBRIAN
13620.01 524 Ca2 Yuejiaping, Guangzhuling Fm-M. CAMBRIAN
13630.01 526 Ca1 Shuigoukou, Jianzhuba Fm-LW. CAMBRIAN
13640.02 527 Ca Cambrian Lower, Middle&Upper Fm-CAMBRIAN UNDIF.
21120 701 Z2 Dengying, Doushantou Fm-M. SINIAN
21130 702 Z1 Nantuo, Datangpo Fm-LW. SINIAN
21140 703 Z Sinian Lower&Upper Fm-SINIAN UNDIF.
21220.01 704 Pt3yl Yaolinghe Gr. -UP. PROTEROZOIC
21220.01 704 Pt3yl Yaolinghe Gr. Basic-UP. PROTEROZOIC
21220.02 705 Pt3mc Macaoyuan Gr. -UP. PROTEROZOIC
21220.03 706 Pt3hs Huashan Gr. -UP. PROTEROZOIC
22000.01 710 Pt2t2 Teargang Fm. Upper Mbr. -M. PROTEROZOIC UNDIF.
22000.02 718 Pt2y Yuanziwan Fm-M. PROTEROZOIC UNDIF.
22000.02 718 Pt2y Yuanziwan Fm. Acidic-M. PROTEROZOIC UNDIF.
22000.02 718 Pt2y Yuanziwan Fm. Medium acidic-M. PROTEROZOIC UNDIF.
22000.03 707 Pt2sh Shuangtai Fm-M. PROTEROZOIC UNDIF.
22000.03 707 Pt2sh Shuangtai Fm. Acidic-M. PROTEROZOIC UNDIF.
22000.04 711 Pt2t1 Teargang Fm. Lower Mbr. -M. PROTEROZOIC UNDIF.
22000.04 711 Pt2t1 Teargang Fm. Lower Mbr. Basic-M. PROTEROZOIC UNDIF.
22000.05 719 Pt2l Liulin Fm-M. PROTEROZOIC UNDIF.
22000.05 719 Pt2l Liulin Fm. Acidic-M. PROTEROZOIC UNDIF.
22000.05 719 Pt2l Liulin Fm. Basic-M. PROTEROZOIC UNDIF.
22000.06 721 Pt2w Wagangxi Fm-M. PROTEROZOIC UNDIF.
22000.07 722 Pt2sn Songziyuan Fm-M. PROTEROZOIC UNDIF.
22000.08 723 Pt2s-ym Shicaohe, Wenshuihe Fm-M. PROTEROZOIC UNDIF.
22000.09 730 Pt2dn Dangpuling Fm-M. PROTEROZOIC UNDIF.
22000.1 731 Pt2lj Lijiazui Fm-M. PROTEROZOIC UNDIF.
22000.11 732 Pt2ch Chenjiachong Fm-M. PROTEROZOIC UNDIF.
22000.12 733 Pt2lh Luohanling Fm-M. PROTEROZOIC UNDIF.
22000.13 734 Pt2h Hanjiawa Fm-M. PROTEROZOIC UNDIF.
22000.14 735 Pt2ty Taiyangsi Fm-M. PROTEROZOIC UNDIF.
22000.15 740 Pt2mk Meikeng Fm-M. PROTEROZOIC UNDIF.
22000.16 736 Pt2ln Lengjiaxi Gr. -M. PROTEROZOIC UNDIF.
22000.17 741 Pt2c Cuijiaao Fm-M. PROTEROZOIC UNDIF.
22000.18 742 Pt2yj Yijiaqiao Fm-M. PROTEROZOIC UNDIF.
22000.19 739 Pt2c+yj Cuijiaao &Yijiaqiao Fm-M. PROTEROZOIC UNDIF.
22000.2 708 Pt2yn Yangping Fm-M. PROTEROZOIC UNDIF.
22000.21 709 Pt2yp Yaoping Fm-M. PROTEROZOIC UNDIF.
22000.21 709 Pt2yp Yaoping Fm. Acidic-M. PROTEROZOIC UNDIF.
22000.22 713 Pt2m2 Mopan Fm. Upper Mbr. -M. PROTEROZOIC UNDIF.
22000.22 713 Pt2m2 Mopan Fm. Upper Mbr. Acidic-M. PROTEROZOIC UNDIF.
22000.22 713 Pt2m2 Mopan Fm. Upper Mbr. Basic-M. PROTEROZOIC UNDIF.
22000.22 713 Pt2m2 Mopan Fm. Upper Mbr. Medium acidic-M. PROTEROZOIC UNDIF.
22000.22 713 Pt2m2 Mopan Fm. Upper Mbr. Medium-M. PROTEROZOIC UNDIF.
22000.23 714 Pt2m1 Mopan Fm. Lower Mbr. -M. PROTEROZOIC UNDIF.
22000.23 714 Pt2m1 Mopan Fm. Lower Mbr. Acidic-M. PROTEROZOIC UNDIF.
22000.24 712 Pt2m Mopan Fm. -M. PROTEROZOIC UNDIF.
22000.25 716 Pt2q2 Qijiaoshan Fm. Upper Mbr. -M. PROTEROZOIC UNDIF.
22000.25 716 Pt2q2 Qijiaoshan Fm. Upper Mbr. Acidic-M. PROTEROZOIC UNDIF.
22000.25 716 Pt2q2 Qijiaoshan Fm. Upper Mbr. Basic-M. PROTEROZOIC UNDIF.
22000.25 716 Pt2q2 Qijiaoshan Fm. Upper Mbr. Medium acidic-M. PROTEROZOIC UNDIF.
22000.26 717 Pt2q1 Qijiaoshan Fm. Lower Mbr. -M. PROTEROZOIC UNDIF.
22000.26 717 Pt2q1 Qijiaoshan Fm. Lower Mbr. Acidic-M. PROTEROZOIC UNDIF.
22000.26 717 Pt2q1 Qijiaoshan Fm. Lower Mbr. Basic-M. PROTEROZOIC UNDIF.
22000.26 717 Pt2q1 Qijiaoshan Fm. Lower Mbr. Medium acidic-M. PROTEROZOIC UNDIF.
22000.27 715 Pt2q Oijiaoshan Fm-M. PROTEROZOIC UNDIF.
22000.27 715 Pt2q Qijiaoshan Fm. Acidic-M. PROTEROZOIC UNDIF.
22000.27 715 Pt2q Qijiaoshan Fm. Middle migmatized rock belt-M. PROTEROZOIC UNDIF.
22000.27 715 Pt2q Oijiaoshan Fm. Weak migmatized rock belt-M. PROTEROZOIC UNDIF.
22000.28 720 Pt2g Gujing Fm. -M. PROTEROZOIC UNDIF.
22000.28 720 Pt2g Gujing Fm. Acidic-M. PROTEROZOIC UNDIF.
22000.29 724 Pt2tz Taizi Fm. -M. PROTEROZOIC UNDIF.
22000.3 725 Pt2k Kuangshishan Fm. -M. PROTEROZOIC UNDIF.
22000.31 726 Pt2dw Dawokeng Fm. -M. PROTEROZOIC UNDIF.
22000.32 727 Pt2l Luanshigou Fm. -M. PROTEROZOIC UNDIF.
22000.33 728 Pt2d Dayanping Fm. -M. PROTEROZOIC UNDIF.
22000.34 729 Pt2yw Yingwodong Fm. -M. PROTEROZOIC UNDIF.
23000.01 743 Pt1fh2 Feihushan Fm. Upper Mbr. -LW. PROTEROZOIC UNDIF.
23000.01 743 Pt1fh2 Feihushan Fm. Upper Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.01 743 Pt1fh2 Feihushan Fm. Upper Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.02 744 Pt1fh1 Feihushan Fm. Lower Mbr. -LW. PROTEROZOIC UNDIF.
23000.02 744 Pt1fh1 Feihushan Fm. Lower Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF
23000.02 744 Pt1fh1 Feihushan Fm. Lower Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.03 745 Pt1m2 Maqiao Fm. Upper Mbr. -LW. PROTEROZOIC UNDIF.
23000.03 745 Pt1m2 Maqiao Fm. Upper Mbr. Acidic-LW. PROTEROZOIC UNDIF.
23000.03 745 Pt1m2 Maqiao Fm. Upper Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.03 745 Pt1m2 Maqiao Fm. Upper Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.04 746 Pt1m1 Maqiao Fm. Lower Mbr. -LW. PROTEROZOIC UNDIF.
23000.04 746 Pt1m1 Maqiao Fm. Lower Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.04 746 Pt1m1 Maqiao Fm. Lower Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.05 747 Pt1t3 Tieye Fm. Upper Mbr. -LW. PROTEROZOIC UNDIF.
23000.05 747 Pt1t3 Tieye Fm. Upper Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.06 748 Pt1t2 Tieye Fm. Middle Mbr. -LW. PROTEROZOIC UNDIF.
23000.06 748 Pt1t2 Tieye Fm. Middle Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.06 748 Pt1t2 Tieye Fm. Middle Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.07 749 Pt1t1 Tieye Fm. Lower Mbr. -LW. PROTEROZOIC UNDIF.
23000.07 749 Pt1t1 Tieye Fm. Lower Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.07 749 Pt1t1 Tieye Fm. Lower Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.07 749 Pt1t1 Tieye Fm. Lower Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.08 750 Pt1b4 Baotouhu Fm. 4th Mbr. -LW. PROTEROZOIC UNDIF.
23000.08 750 Pt1b4 Baotouhu Fm. 4th Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.08 750 Pt1b4 Baotouhu Fm. 4th Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.09 751 Pt1b3 Baotouhu Fm. 3th Mbr. -LW. PROTEROZOIC UNDIF.
23000.09 751 Pt1b3 Baotouhu Fm. 3th Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.09 751 Pt1b3 Baotouhu Fm. 3th Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.1 752 Pt1b2 Baotouhu Fm. 2nd Mbr. -LW. PROTEROZOIC UNDIF.
23000.1 752 Pt1b2 Baotouhu Fm. 2nd Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.1 752 Pt1b2 Baotouhu Fm. 2nd Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.11 753 Pt1b1 Baotouhu Fm. 1st Mbr. -LW. PROTEROZOIC UNDIF.
23000.11 753 Pt1b1 Baotouhu Fm. 1st Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.11 753 Pt1b1 Baotouhu Fm. 1st Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.11 753 Pt1b1 Baotouhu Fm. 1st Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.12 754 Pt1h3 Hepu Fm. Upper Mbr. -LW. PROTEROZOIC UNDIF.
23000.12 754 Pt1h3 Hepu Fm. Upper Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.12 754 Pt1h3 Hepu Fm. Upper Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.12 754 Pt1h3 Hepu Fm. Upper Mbr. Weak migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.13 755 Pt1h2 Hepu Fm. Middle Mbr. -LW. PROTEROZOIC UNDIF.
23000.13 755 Pt1h2 Hepu Fm. Middle Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.13 755 Pt1h2 Hepu Fm. Middle Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.14 756 Pt1h1 Hepu Fm. Lower Mbr. -LW. PROTEROZOIC UNDIF.
23000.14 756 Pt1h1 Hepu Fm. Lower Mbr. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.15 757 Pt1f Fangjiachong Fm. -LW. PROTEROZOIC UNDIF.
23000.15 757 Pt1f Fangjiachong Fm. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.15 757 Pt1f Fangjiachong Fm. Strong migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.16 759 Pt1tn3 Tiantaishan Fm. Upper Mbr. -LW. PROTEROZOIC UNDIF.
23000.16 759 Pt1tn3 Tiantaishan Fm. Upper Mbr. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.17 760 Pt1tn2 Tiantaishan Fm. Middle Mbr. -LW. PROTEROZOIC UNDIF.
23000.18 761 Pt1tn1 Tiantaishan Fm. Lower Mbr. -LW. PROTEROZOIC UNDIF.
23000.19 758 Pt1tn Tiantaishan Fm. -LW. PROTEROZOIC UNDIF
23000.19 758 Pt1tn Tiantaishan Fm. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.2 762 Pt1hn Huangtuzhai Fm. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.21 763 Pt1g Guanmenshan Fm. -LW. PROTEROZOIC UNDIF.
23000.21 763 Pt1g Guanmenshan Fm. Middle migmatized rock belt-LW. PROTEROZOIC UNDIF.
23000.22 765 Pt1kn3 Gongling Gr. Upper rock assemblage -LW. PROTEROZOIC UNDIF.
23000.22 765 Pt1kn3 Gongling Gr. Upper rock-LW. PROTEROZOIC UNDIF.
23000.23 766 Pt1kn2 Gongling Gr. Middle rock assemblage -LW. PROTEROZOIC UNDIF.
23000.24 767 Pt1kn1 Gongling Gr. Lower rock assemblage -LW. PROTEROZOIC UNDIF.
23000.25 764 Pt1kn Gongling Gr. -LW. PROTEROZOIC UNDIF.
23000.26 768 Pt1yn Yangpo Gr. -LW. PROTEROZOIC UNDIF.
42100.01 401 g53 Granite -CRETACEOUS
42100.02 402 xg53 Kaligranite -CRETACEOUS
42100.03 403 hg53 Monzonitic granite -CRETACEOUS
42100.05 405 ho53 Quartz monzonite -CRETACEOUS
42100.06 406 h53 Monzonite -CRETACEOUS
42100.07 407 do53 Quartz diorite -CRETACEOUS
42100.08 408 hdo53 Quartz - monzodiorite -CRETACEOUS
42100.09 409 x53 Syenite -CRETACEOUS
42100.1 410 pxg53 Porphyritic Kaligranite -CRETACEOUS
42100.11 411 phg53 Porphyritic monzogranite -CRETACEOUS
42100.12 412 pgd53 Porphyritic granodiorite -CRETACEOUS
42100.13 413 gp53 Granite porphyry -CRETACEOUS
42100.14 414 xgp53 Kaligranite - porphyry -CRETACEOUS
42100.15 415 gdp53 Granodiorite porphyry -CRETACEOUS
42100.16 416 dom53 Quartz diorite porphyrite -CRETACEOUS
42100.17 417 hdom53 Quartz monzonitic porphyry -CRETACEOUS
42100.18 418 dm53 Diorite-porphyrite -CRETACEOUS
42100.19 419 xop53 Quartz orthophyre vein -CRETACEOUS
42200.01 420 go52 Plagio granite -JURASSIC UNDIF.
42200.02 421 hg52 Monzonitic granite -JURASSIC UNDIF.
42200.03 422 gd52 Granodiorite -JURASSIC UNDIF.
42200.04 423 do52 Quartz diorite -JURASSIC UNDIF.
42200.05 424 hdo52 Quartz - monzodiorite -JURASSIC UNDIF.
42200.06 425 d52 Quartz - monzodiorite -JURASSIC UNDIF.
42200.07 426 hd52 Monzodiorite -JURASSIC UNDIF.
42200.08 427 pg52 Porphyritic granite -JURASSIC UNDIF.
42200.09 428 phg52 Porphyritic monzogranite -JURASSIC UNDIF.
42200.1 429 phdo52 Porphyritic quartz-monzonite -JURASSIC UNDIF.
42200.11 431 dom52 Quartz diorite porphyrite -JURASSIC UNDIF.
42200.12 432 hdom52 Quartz-monzodioritic porphyrite -JURASSIC UNDIF.
42200.13 433 dm52 Diorite-porphyrite -JURASSIC UNDIF.
45400.01 601 N3 Basic rock -E. PALAEOZOIC UNDIF.
45400.02 602 u3 Gabbro -E. PALAEOZOIC UNDIF.
45400.03 603 bm3 Diabase, Diabase porphyrite -E. PALAEOZOIC UNDIF.
45400.05 605 yt3 Pyroxenite and Pyroxenite porphyrite -E. PALAEOZOIC UNDIF.
45400.06 606 cs3 Kimberlites -E. PALAEOZOIC UNDIF.
45400.07 607 xo3 Quartz syenite -E. PALAEOZOIC UNDIF.
45400.08 608 x3 Syenite -E. PALAEOZOIC UNDIF.
45400.09 609 cx3 Carbonatite -E. PALAEOZOIC UNDIF.
45400.1 610 xop3 Quartz orthophyre vein -E. PALAEOZOIC UNDIF.
45400.11 611 xp3 Syenite porphyry -E. PALAEOZOIC UNDIF.
49500.01 801 g23 Granite -UNDEFINED
49500.01 814 g21 Granite -UNDEFINED
49500.02 802 xg23 Kaligranite -UNDEFINED
49500.02 815 xg21 Kaligranite -UNDEFINED
49500.03 803 hg23 Monzonitic granite -UNDEFINED
49500.03 816 hg21 Monzonitic granite -UNDEFINED
49500.04 804 do23 Quartz diorite -UNDEFINED
49500.04 817 gd21 Granodiorite -UNDEFINED
49500.05 805 d23 Diorite -UNDEFINED
49500.05 818 do21 Quartz diorite -UNDEFINED
49500.06 806 u23 Gabbro -UNDEFINED
49500.06 819 N21 Basic rock -UNDEFINED
49500.07 807 bm23 Diabase, Diabase porphyrite -UNDEFINED
49500.07 820 u21 Gabbro -UNDEFINED
49500.08 808 yt23 Pyroxenite and Pyroxenite porphyrite -UNDEFINED
49500.08 821 S21 Ultramafic -UNDEFINED
49500.09 809 N22 Basic rock -UNDEFINED
49500.09 822 s21 Ultramafic -UNDEFINED
49500.1 823 yo21 Hornblendite -UNDEFINED
49500.11 811 S22 Ultramafic -UNDEFINED
49500.11 824 pg21 Porphyritic granite -UNDEFINED
49500.12 812 yt22 Pyroxenite and Pyroxenite porphyrite -UNDEFINED
49500.12 825 phg21 Porphyritic monzogranite -UNDEFINED
49500.12 826 Mg21 Migmatitic granite Strong migmatized rock belt-UNDEFINED
49500.13 813 jw22 Serpentinite -UNDEFINED
49500.13 826 Mg21 Migmatitic granite -UNDEFINED
90000.01 001 g Granite -UNKNOWN
90000.02 002 t Aplite -UNKNOWN
90000.04 004 gd Granodiorite -UNKNOWN
90000.05 005 ho Quartz monzonite -UNKNOWN
90000.06 006 d Diorite -UNKNOWN
90000.07 007 N Basic rock -UNKNOWN
90000.08 008 S Ultramafic -UNKNOWN
90000.09 009 yt Pyroxenite and Pyroxenite porphyrite -UNKNOWN
90000.1 010 yo Hornblendite -UNKNOWN
90000.11 011 gp Granite porphyry -UNKNOWN
90000.12 012 pg Porphyritic granite -UNKNOWN
90000.13 013 dm Diorite-porphyrite -UNKNOWN
90000.14 053 xg Kaligranite -UNKNOWN
90000.15 054 q Quartz vein -UNKNOWN
90000.16 055 gr Granite pegmatite -UNKNOWN
90000.17 056 r Pegmatite -UNKNOWN
90000.18 060 gdp Granodiorite porphyry -UNKNOWN
90000.19 061 h Monzonite -UNKNOWN
90000.2 062 do Quartz diorite -UNKNOWN
90000.21 063 dom Quartz diorite porphyrite -UNKNOWN
90000.22 067 bm Diabase, Diabase porphyrite -UNKNOWN
90000.23 068 c Lamprophyre -UNKNOWN
90000.26 069 xc Minette -UNKNOWN
90000.27 071 x Alkaline rock (undivided) -UNKNOWN
90000.28 072 x Syenite -UNKNOWN
99000 900 Water Undifferentiated

Fig. 36. Map showing mineral occurrences in Hubei
(AMIRA P603 Project)

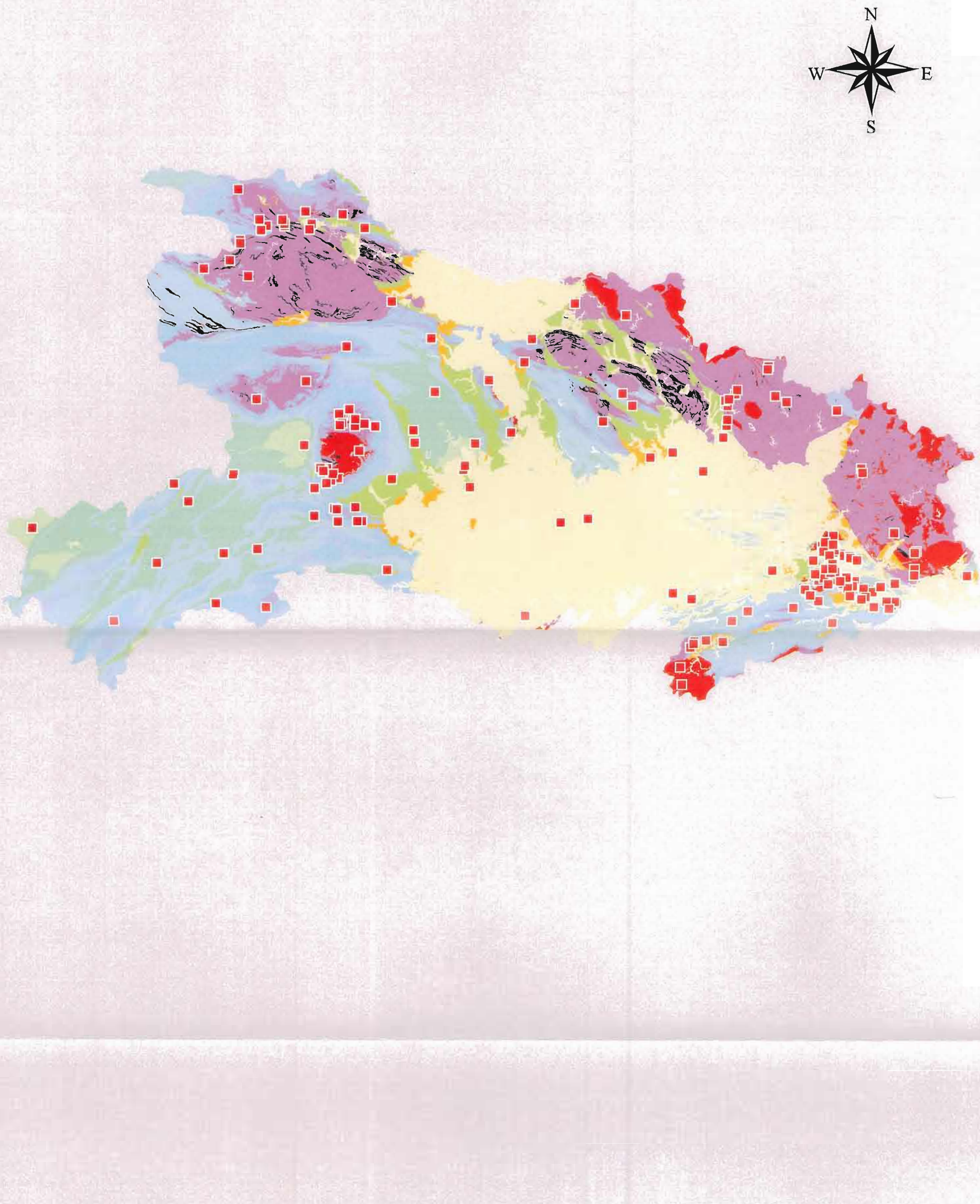


Fig. 37. Map showing lead-zinc occurrences in Hubei
(AMIRA P603 Project)

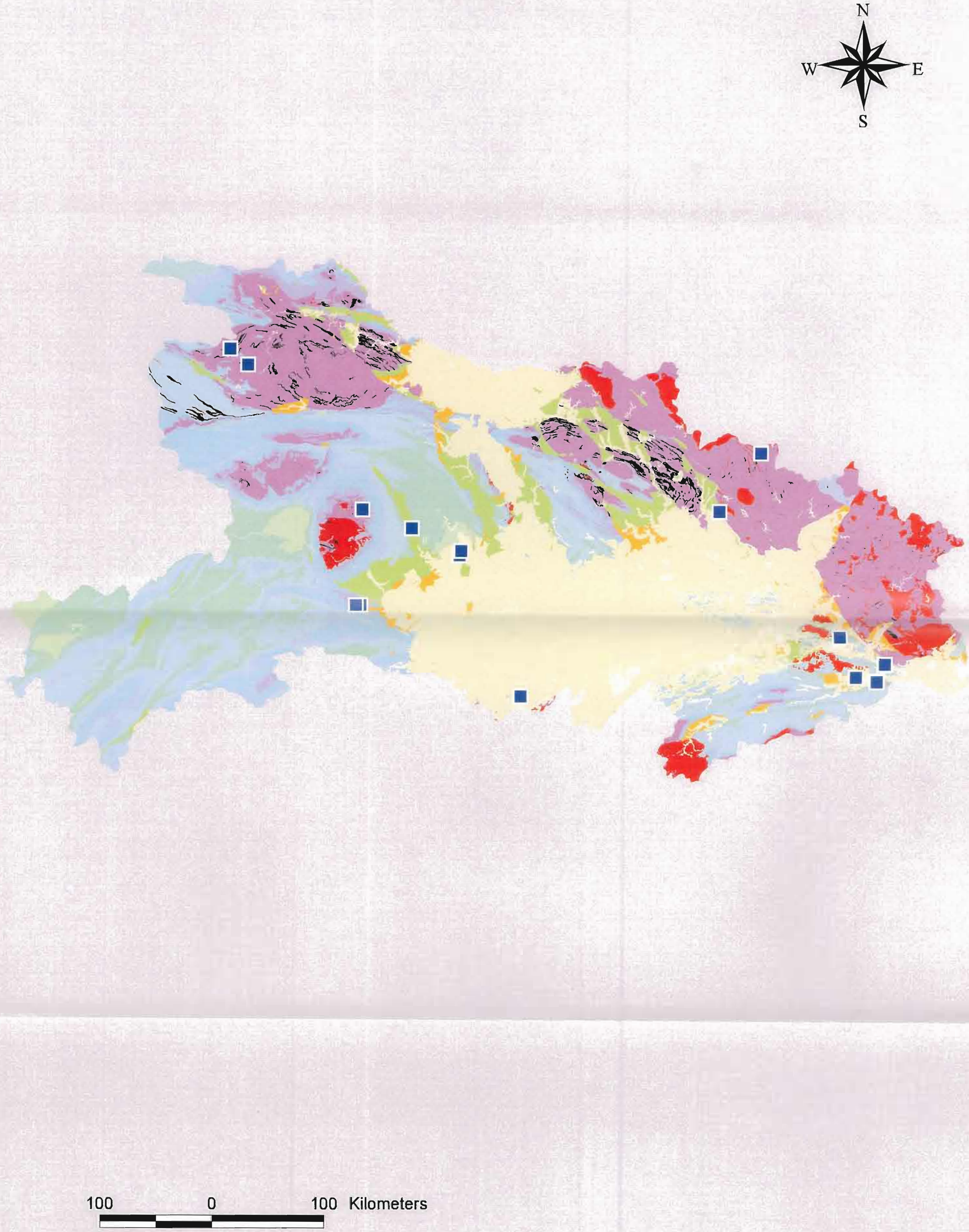


Fig. 38. Map showing copper-gold occurrences in Hubei
(AMIRA P603 Project)

Fig. 39. Geology of Anhui Province
(AMIRA 603 Project)

# Geology Legend (Anhui)

Geology Legend (Anhui)

11110.03 803 Q4d^al Dadun Fm -HOLOCENE
11110.04 804 Q4f^al Fenglezhen Fm -HOLOCENE
11110.05 805 Q4w^al Wuhu Fm -HOLOCENE
11110.05 889 Q4w^l Wuhu Fm -HOLOCENE
11110.05 959 Q4w^l-al Wuhu Fm -HOLOCENE
11120.01 106 Q3 Undifferentiated -UP. PLEISTOCENE
11120.02 807 Q3m^al Maolang Fm -UP. PLEISTOCENE
11120.04 872 Q3x-ln^dl Xiashu Fm & Tanjiacun Fm -UP. PLEISTOCENE
11120.04 960 Q3x-ln^el-dl Xiashu Fm & Tanjiacun Fm -UP. PLEISTOCENE
11120.08 808 Q3q^al Qizui Fm -UP. PLEISTOCENE
11120.09 809 Q3x-ln^al Xiashu Fm & Tanjiacun Fm -UP. PLEISTOCENE
11130.01 811 Q2^al Undifferentiated -M. PLEISTOCENE
11130.02 950 Q2p^el-dl Panji Fm -M. PLEISTOCENE
11130.03 918 Q2b^gl Bogang Fm -M. PLEISTOCENE
11130.03 948 Q2b^el-dl Bogang Fm -M. PLEISTOCENE
11130.03 952 Q2b^pl-al Bogang Fm -M. PLEISTOCENE
11130.04 814 Q2m^al Machong Fm -M. PLEISTOCENE
11130.04 919 Q2m^gl Machong Fm -M. PLEISTOCENE
11130.05 815 Q2q^al Qijiaji Fm -M. PLEISTOCENE
11130.05 920 Q2q^gl Qijiaji Fm -M. PLEISTOCENE
11130.06 942 Q2t^ev Taodian Fm -M. PLEISTOCENE
11140.04 820 Q1z^al Zhuchong Fm -LW. PLEISTOCENE
11210.01 122 N2 Undifferentiated -PLIOCENE
11210.02 123 N2m Minghuazhen Fm -PLIOCENE
11210.03 124 N2z Zhengyangguan Fm -PLIOCENE
11210.04 125 N2g Guiwu Fm -PLIOCENE
11210.04 125 N2g Guiwu Fm Basic volcanics-PLIOCENE
11210.05 126 N2a Anqing Fm -PLIOCENE
11220.03 129 N1x Xiacaowan Fm -MIOCENE
11220.04 130 N1h Huaguoshan Fm -MIOCENE
11220.04 130 N1h Huaguoshan Fm Basic volcanics-MIOCENE
11240.03 134 E2t Tujinshan Fm -EOCENE
11240.04 135 E2q Qijiaqiao Fm -EOCENE
11240.05 136 E2g Gaoloushan Fm -EOCENE
11240.06 137 E2z Zhangshanji Fm -EOCENE
11240.07 138 E2s Shuangtasi Fm -EOCENE
11240.08 139 E2w Wuxueling Fm -EOCENE
11250.01 140 E1 Undifferentiated -PALAEOCENE
11250.03 142 E1dn Dingyuan Fm -PALAEOCENE
11250.05 144 E1h^1 Hongqiao Fm Lower Mm -PALAEOCENE
11250.06 145 E1h^2 Hongqiao Fm Upper Mm -PALAEOCENE
11250.06 145 E1h^2 Hongqiao Fm Upper Mm Intermediate volcanics-PALAEOCENE
11250.07 146 E1s Shunshanji Fm -PALAEOCENE
11250.08 147 E1w Wanghudun Fm -PALAEOCENE
11250.09 149 E1d Doumu Fm -PALAEOCENE
11250.1 149 E1w-d Wanghundun Fm & Doumu Fm -PALAEOCENE
12110.01 301 K2 Undifferentiated -UP. CRETACEOUS
12110.02 302 K2qz Quizhuang Fm -UP. CRETACEOUS
12110.03 303 K2z Zhangqiao Fm -UP. CRETACEOUS
12110.04 304 K2x Xietuqiao Fm -UP. CRETACEOUS
12110.05 305 K2s Sanjianpu Fm -UP. CRETACEOUS
12110.06 306 K2q Qitangcun Fm -UP. CRETACEOUS
12110.07 307 K2xn Xuannan Fm -UP. CRETACEOUS
12110.08 308 K2xn^1 Xuannan Fm Lower Mm -UP. CRETACEOUS
12110.09 309 K2xn^2 Xuannan Fm Middle Mm -UP. CRETACEOUS
12110.1 310 K2xn^3 Xuannan Fm Upper Mm -UP. CRETACEOUS
12110.11 311 K2qy Qiyunshan Fm -UP. CRETACEOUS
12110.12 312 K2xy Xiaoyan Fm -UP. CRETACEOUS
12120.01 313 K1 Undifferentiated -LW. CRETACEOUS
12120.02 314 K1x Xinzhuang Fm -LW. CRETACEOUS
12120.03 315 K1s Shibala Fm -LW. CRETACEOUS
12120.04 316 K1f Fushan Fm -LW. CRETACEOUS
12120.04 316 K1f Fushan Fm Intermediate volcanics-LW. CRETACEOUS
12120.05 317 K1n Niangniangshan Fm Alkaline volcanics-LW. CRETACEOUS
12120.06 318 K1g Guangde Fm -LW. CRETACEOUS
12120.07 319 K1y Yangwan Fm -LW. CRETACEOUS
12120.08 320 K1xn Xintan Fm -LW. CRETACEOUS
12120.09 321 K1h Huizhou Fm -LW. CRETACEOUS
12210.01 323 J3 Undifferentiated -UP. JURASSIC
12210.01 323 J3 Undifferentiated Acidic volcanics-UP. JURASSIC
12210.02 324 J3m Maotanchang Fm -UP. JURASSIC
12210.02 324 J3m Maotanchang Fm Diorite-UP. JURASSIC
12210.02 324 J3m Maotanchang Fm Intermediate volcanics-UP. JURASSIC
12210.03 325 J3hs Heishidu Fm -UP. JURASSIC
12210.04 326 J3h Honghuaqiao Fm -UP. JURASSIC
12210.05 327 J3hn Huangshiba Fm -UP. JURASSIC
12210.05 327 J3hn Huangshiba Fm Intermediate volcanics-UP. JURASSIC
12210.06 328 J3l Longmenyuan Fm -UP. JURASSIC
12210.06 328 J3l Longmenyuan Fm Intermediate volcanics-UP. JURASSIC
12210.07 329 J3zh Zhuanqiao Fm -UP. JURASSIC
12210.07 329 J3zh Zhuanqiao Fm Intermediate volcanics-UP. JURASSIC
12210.08 330 J3s Shuangmiao Fm -UP. JURASSIC
12210.08 330 J3s Shuangmiao Fm Intermediate-basic volcanics-UP. JURASSIC
12210.09 331 J3p Pengjiakou Fm -UP. JURASSIC
12210.1 332 J3j Jiangzhen Fm -UP. JURASSIC
12210.1 332 J3j Jiangzhen Fm Intermediate volcanics-UP. JURASSIC
12210.1 332 J3j Jiangzhen Fm Intermediate-basic volcanics-UP. JURASSIC
12210.11 333 J3w Wanggongmiao Fm -UP. JURASSIC
12210.12 334 J3ln Longwangshan Fm -UP. JURASSIC
12210.12 334 J3ln Longwangshan Fm Intermediate volcanics-UP. JURASSIC
12210.13 335 J3d Dawangshan Fm -UP. JURASSIC
12210.13 335 J3d Dawangshan Fm Acidic volcanics-UP. JURASSIC
12210.13 335 J3d Dawangshan Fm Intermediate volcanics-UP. JURASSIC
12210.14 336 J3g Gushan Fm -UP. JURASSIC
12210.15 337 J3z Zhongfencun Fm -UP. JURASSIC
12210.15 337 J3z Zhongfencun Fm Acidic volcanics-UP. JURASSIC
12210.16 338 J3c Chkha Fm -UP. JURASSIC
12210.16 338 J3c Chkha Fm Intermediate-acidic volcanics-UP. JURASSIC
12210.17 339 J3k Kedoushan Fm -UP. JURASSIC
12210.17 339 J3k Kedoushan Fm Acidic volcanics-UP. JURASSIC
12210.18 340 J3b Bingqiu Fm -UP. JURASSIC
12210.19 341 J3sh Shiling Fm -UP. JURASSIC
12210.2 342 J3y Yangtang Fm -UP. JURASSIC
12210.21 343 J3lc Laocun Fm Acidic volcanics-UP. JURASSIC
12220.01 345 J2 Undifferentiated -M. JURASSIC
12220.01 345 J2 Undifferentiated Acidic volcanics-M. JURASSIC
12220.01 345 J2 Undifferentiated Intermediate-acidic volcanics-M. JURASSIC
12220.02 346 J2z Zhouqongshan Fm -M. JURASSIC
12220.03 347 J2l Luoling Fm -M. JURASSIC
12220.044 348 J2h Hongqin Fm -M. JURASSIC
12230.01 349 J1 Undifferentiated -LW. JURASSIC
12230.02 350 J1f Fanghushan Fm -LW. JURASSIC
12230.03 351 J1m Moshan Fm -LW. JURASSIC
12230.04 352 J1y Yuetan Fm -LW. JURASSIC
12310.01 353 T3 Undifferentiated -UP. TRIASSIC
12310.02 354 T2-3 Undifferentiated -UP. TRIASSIC
12320.02 355 T2 Undifferentiated -M. TRIASSIC
12330 356 T1 Undifferentiated -LW. TRIASSIC
12340.01 505 C Undifferentiated -TRIASSIC UNDIF.
12340.02 506 Cms Meishan Gr -TRIASSIC UNDIF.
13120 501 P2 Undifferentiated -M. PERMIAN
13130 502 P1 Undifferentiated -LW. PERMIAN
13140 503 P Undifferentiated -PERMIAN UNDIF.
13220 504 C2 Undifferentiated -M. CARBONIFEROUS
13310.01 507 D3 Undifferentiated -UP. DEVONIAN
13310.02 529 D3w Wutong Fm -UP. DEVONIAN
13410.01 508 S3 Undifferentiated -UP. SILURIAN
13410.2 509 S2+3 Undifferentiated -UP. SILURIAN
13420.02 510 S2 Undifferentiated -M. SILURIAN
13420.02 512 S1x-h Xiaxiang Fm & Heixi Fm -M. SILURIAN
13420.03 513 S1x Xiaxiang Fm -M. SILURIAN
13420.04 514 S1h Heixi Fm -M. SILURIAN
13430.01 511 S1 Gaojiabian Fm -LW. SILURIAN
13440 862 S Undifferentiated -SILURIAN UNDIF.
13510 515 O3 Undifferentiated -UP. ORDOVICIAN
13520.01 516 O2 Undifferentiated -M. ORDOVICIAN
13520.02 517 O1+2 Undifferentiated -M. ORDOVICIAN
13530.02 518 O1 Undifferentiated -LW. ORDOVICIAN
13540 954 O Undifferentiated -ORDOVICIAN UNDIF.
13610.01 519 Ca3 Undifferentiated -UP. CAMBRIAN
13610.03 520 Ca3l Tuanshan Fm -UP. CAMBRIAN
13610.04 521 Ca3q Qingkeng Fm -UP. CAMBRIAN
13610.05 522 Ca3tn Tangcun Fm -UP. CAMBRIAN
13610.06 523 Ca3h Huayansi Fm -UP. CAMBRIAN
13610.07 524 Ca3x Xiyangshan Fm -UP. CAMBRIAN
13610.09 526 Ca2-3sh Shanwading Gr -UP. CAMBRIAN
13620.03 527 Ca2 Undifferentiated -M. CAMBRIAN
13630 528 Ca1 Undifferentiated -LW. CAMBRIAN
13640 953 Ca Undifferentiated -CAMBRIAN UNDIF.
21120.01 701 Z2 Lantian Fm & Piyuancun Fm -M. SINIAN
21120.02 702 Z2sx Suxian Gr -M. SINIAN
21120.03 703 Z2ln Langan Gr -M. SINIAN
21120.04 704 Z2d Doushantuo Fm -M. SINIAN
21120.05 705 Z2dn Dengying Fm -M. SINIAN
21130.01 706 Z1 Undifferentiated -LW. SINIAN
21130.02 707 Z1xh Xuhuai Gr -LW. SINIAN
21130.03 708 Z1z Zhougang Fm -LW. SINIAN
21130.04 709 Z1s Sujiawan Fm -LW. SINIAN
21130.05 710 Z1x710 Xiuning Fm -LW. SINIAN
21130.06 711 Z1l Leigongwu Fm -LW. SINIAN
21150.02 713 Qnbg Bagongshan Gr -QINGBAIKOUIAN
21150.02 714 Qnx Xiangyunzhai Fm -QINGBAIKOUIAN
21150.03 958 Qnfz Fozliing Gr -QINGBAIKOUIAN
21150.05 715 Qnpn Panjialing Fm -QINGBAIKOUIAN
21150.06 716 Qnz Zhutuan Fm -QINGBAIKOUIAN
21150.08 718 Qnd Dengjia Fm -QINGBAIKOUIAN
21150.08 718 Qnd Dengjia Fm Intermediate volcanics-QINGBAIKOUIAN
21150.09 719 Qnp Puling Fm -QINGBAIKOUIAN
21150.09 719 Qnp Puling Fm Intermediate volcanics-QINGBAIKOUIAN
21150.1 720 Qnj Jingtan Fm -QINGBAIKOUIAN
21150.1 720 Qnj Jingtan Fm Acidic volcanics-QINGBAIKOUIAN
21150.1 720 Qnj Jingtan Fm Intermediate volcanics-QINGBAIKOUIAN
22000.01 721 Pt2 Undifferentiated -M. PROTEROZOIC UNDIF.
22000.02 722 Pt2b Beijiangjun Fm -M. PROTEROZOIC UNDIF.
22000.02 722 Pt2b Beijiangjun Fm Quartz diorite-M. PROTEROZOIC UNDIF.
22000.03 723 Pt2x Xileng Fm -M. PROTEROZOIC UNDIF.
22000.03 723 Pt2x Xileng Fm Acidic volcanics-M. PROTEROZOIC UNDIF.
22000.04 724 Pt2x^1 Xileng Fm Lower Mm -M. PROTEROZOIC UNDIF.
22000.04 724 Pt2x^1 Xileng Fm Lower Mm Acidic volcanics-M. PROTEROZOIC UNDIF.
22000.05 725 Pt2x^2 Xileng Fm Middle Mm -M. PROTEROZOIC UNDIF.
22000.06 726 Pt2x^3 Xileng Fm Upper Mm -M. PROTEROZOIC UNDIF.
22000.06 726 Pt2x^3 Xileng Fm Upper Mm Acidic volcanics-M. PROTEROZOIC UNDIF.
22000.08 728 Pt2bn Banglao Fm -M. PROTEROZOIC UNDIF.
22000.09 729 Pt2m Mukeng Fm -M. PROTEROZOIC UNDIF.
22000.1 730 Pt2n Niuwu Fm -M. PROTEROZOIC UNDIF.
23000.01 731 Pt1 Undifferentiated -LW. PROTEROZOIC UNDIF.
23000.02 732 Pt1b Baiyunshan Fm -LW. PROTEROZOIC UNDIF.
23000.02 732 Pt1b Baiyunshan Fm Acidic volcanics-LW. PROTEROZOIC UNDIF.
23000.03 733 Pt1qn Qingshishan Fm -LW. PROTEROZOIC UNDIF.
23000.04 734 Pt1sn Songji Fm -LW. PROTEROZOIC UNDIF.
23000.05 735 Pt1x Xiaoxihe Fm -LW. PROTEROZOIC UNDIF.
23000.05 735 Pt1x Xiaoxihe Fm Migmatitic gneiss-LW. PROTEROZOIC UNDIF.
23000.06 736 Pt1xn Xianrenchong Fm -LW. PROTEROZOIC UNDIF.
23000.07 737 Pt1s Shuangshan Fm -LW. PROTEROZOIC UNDIF.
23000.08 738 Pt1q Qiaotouji Fm -LW. PROTEROZOIC UNDIF.
23000.1 740 Pt1l Liuping Fm -LW. PROTEROZOIC UNDIF.
23000.12 742 Pt1p Puhe Fm -LW. PROTEROZOIC UNDIF.
31000.01 743 Ar2 Undifferentiated -UP. ARCHEAN
31000.01 743 Ar2 Undifferentiated Diadysite-UP. ARCHEAN
31000.01 743 Ar2 Undifferentiated Migmatitic gneiss-UP. ARCHEAN
31000.02 744 Ar2x Xigudui Fm -UP. ARCHEAN
31000.02 744 Ar2x Xigudui Fm Migmatitic gneiss-UP. ARCHEAN
31000.03 745 Ar2z Zhuangzili Fm -UP. ARCHEAN
31000.03 745 Ar2z Zhuangzili Fm Diadysite-UP. ARCHEAN
31000.03 745 Ar2z Zhuangzili Fm Migmatitic gneiss-UP. ARCHEAN
31000.04 746 Ar2fn Fengshanli Fm -UP. ARCHEAN
31000.04 746 Ar2fn Fengshanli Fm Diadysite-UP. ARCHEAN
31000.04 746 Ar2fn Fengshanli Fm Migmatitic gneiss-UP. ARCHEAN
31000.05 747 Ar2xz Xiaozhangzhuang Fm -UP. ARCHEAN
31000.05 747 Ar2xz Xiaozhangzhuang Fm Diadysite-UP. ARCHEAN
31000.06 748 Ar2yn Yinjian Fm -UP. ARCHEAN
31000.07 749 Ar2hq Huogiu Gr -UP. ARCHEAN
31000.08 750 Ar2kn Kanji Gr -UP. ARCHEAN
31000.09 751 Ar2fc Fuchashan Fm -UP. ARCHEAN
31000.1 752 Ar2d Dahengchan Fm -UP. ARCHEAN
31000.11 753 Ar2f Fangjiachong Fm -UP. ARCHEAN
31000.11 753 Ar2f Fangjiachong Fm Migmatitic gneiss-UP. ARCHEAN
31000.12 754 Ar2h Hepu Fm -UP. ARCHEAN
31000.12 754 Ar2h Hepu Fm Migmatitic gneiss-UP. ARCHEAN
31000.13 755 Ar2b Baotouhe Fm Migmatitic gneiss-UP. ARCHEAN
31000.14 756 Ar2y Yingshangou Fm -UP. ARCHEAN
31000.14 756 Ar2y Yingshangou Fm Migmatitic gneiss-UP. ARCHEAN
31000.15 757 Ar2s Shuizhuhe Fm -UP. ARCHEAN
31000.15 757 Ar2s Shuizhuhe Fm Migmatitic gneiss-UP. ARCHEAN
31000.16 758 Ar2w Wen jialing Fm -UP. ARCHEAN
31000.16 758 Ar2w Wen jialing Fm Migmatitic gneiss-UP. ARCHEAN
31000.17 759 Ar2l Liufan Fm -UP. ARCHEAN
31000.17 759 Ar2l Liufan Fm Diadysite-UP. ARCHEAN
31000.17 759 Ar2l Liufan Fm Migmatitic gneiss-UP. ARCHEAN
31000.18 760 Ar2q Qiaoling Fm -UP. ARCHEAN
31000.18 760 Ar2q Qiaoling Fm Diadysite-UP. ARCHEAN
31000.18 760 Ar2q Qiaoling Fm Migmatitic gneiss-UP. ARCHEAN
31000.19 761 Ar2c Changjiahe Fm -UP. ARCHEAN
31000.19 761 Ar2c Changjiahe Fm Diadysite-UP. ARCHEAN
31000.19 761 Ar2c Changjiahe Fm Migmatitic gneiss-UP. ARCHEAN
41200.01 201 E2abm Andesite-basalt-porphyrite -EOCENE
41200.02 202 E2sbm Olivine diabase (or basalt) porphyrite -EOCENE
42093.01 402 g5^3(3) Granite -CRETACEOUS
42093.02 403 gp5^3(3) Granoporphyry -CRETACEOUS
42093.02 403 gp5^3(3) Granoporphyry Gabbro-CRETACEOUS
42094.01 404 g5^3(2) Granite -CRETACEOUS
42094.01 404 g5^3(2) Granite Monzogranite-CRETACEOUS
42094.01 404 g5^3(2) Granite Quartz syenite-CRETACEOUS
42094.01 404 g5^3(2) Granite Syenite-CRETACEOUS
42094.02 405 hg5^3(2) Monzogranite -CRETACEOUS
42094.02 405 hg5^3(2) Monzogranite Granite-CRETACEOUS
42094.03 406 gd5^3(2) Granodiorite -CRETACEOUS
42094.04 407 x5^3(2) Syenite -CRETACEOUS
42094.05 408 kx5^3(2) Alkali syenite -CRETACEOUS
42094.06 409 xo5^3(2) Quartz syenite -CRETACEOUS
42094.06 409 xo5^3(2) Quartz syenite Syenite-CRETACEOUS
42094.07 410 xp5^3(2) Syenite porphyry -CRETACEOUS
42094.07 410 xp5^3(2) Syenite porphyry Syenite-CRETACEOUS
42094.08 411 xop5^3(2) Quartz syenite porphyry -CRETACEOUS
42094.08 411 xop5^3(2) Quartz syenite porphyry Quartz syenite-CRETACEOUS
42094.08 411 xop5^3(2) Quartz syenite porphyry Syenite-CRETACEOUS
42095.01 412 do5^3(1) Quartz diorite -CRETACEOUS
42095.02 413 dom5^3(1) Quartz diorite porphyrite -CRETACEOUS
42095.03 414 h5^3(1) Monzonite -CRETACEOUS
42095.04 415 nh5^3(1) Augite-monzonite -CRETACEOUS
42095.05 416 ho5^3(1) Adamellite -CRETACEOUS
42095.05 416 ho5^3(1) Adamellite Monzonite-CRETACEOUS
42095.06 417 hp5^3(1) Monzonite porphyry -CRETACEOUS
42095.07 418 hop5^3(1) Adamellite porphyry -CRETACEOUS
42100.01 204 K1lp Rhyolite porphyry -CRETACEOUS
42100.02 205 K1tp Trachyte porphyry -CRETACEOUS
42100.03 206 K1ktp Aegirite-augite trachyte porphyry -CRETACEOUS
42142 419 gd5^2(4) Granodiorite -L. JURASSIC
42143 420 d5^2(3) Diorite -L. JURASSIC
42144.01 421 n5^2(2) Gabbro -L. JURASSIC
42144.02 422 bm5^2(2) Diabase -L. JURASSIC
42145 423 ys5^2(1) Augite-peridotite -L. JURASSIC
42150.01 221 J3lp Rhyolite porphyry -CRETACEOUS - JURASSIC
42150.01 424 g5^2 Granite -CRETACEOUS - JURASSIC
42150.01 424 g5^2 Granite Quartz diorite-CRETACEOUS - JURASSIC
42150.02 208 J3d Diorite -CRETACEOUS - JURASSIC
42150.02 425 hg5^2 Monzogranite -CRETACEOUS - JURASSIC
42150.03 209 J3dm Diorite-porphyrite -CRETACEOUS - JURASSIC
42150.03 426 gd5^2 Granodiorite -CRETACEOUS - JURASSIC
42150.04 210 J3ndm Gabbrodiorite porphyrite -CRETACEOUS - JURASSIC
42150.04 427 gdp5^2 Granodiorite porphyry -CRETACEOUS - JURASSIC
42150.05 428 gop5^2 Plagiogranite porphyry -CRETACEOUS - JURASSIC
42150.06 212 J3tam Trachyandesitic porphyrite -CRETACEOUS - JURASSIC
42150.06 429 d5^2 Diorite -CRETACEOUS - JURASSIC
42150.07 213 J3tp Trachyte porphyry -CRETACEOUS - JURASSIC
42150.07 430 nd5^2 Augite diorite -CRETACEOUS - JURASSIC
42150.08 214 J3hp Monzonitic porphyry -CRETACEOUS - JURASSIC
42150.08 431 do5^2 Quartz diorite -CRETACEOUS - JURASSIC
42150.09 215 J3bm Basalt porphyrite -CRETACEOUS - JURASSIC
42150.09 432 dm5^2 Diorite-porphyrite -CRETACEOUS - JURASSIC
42150.09 432 dm5^2 Diorite-porphyrite Granodiorite-CRETACEOUS - JURASSIC
42150.1 433 dom5^2 Quartz diorite porphyrite -CRETACEOUS - JURASSIC
42150.1 433 dom5^2 Quartz diorite porphyrite Diorite-CRETACEOUS - JURASSIC
42150.1 433 dom5^2 Quartz diorite porphyrite Quartz diorite-CRETACEOUS - JURASSIC
42150.11 434 n5^2 Gabbro -CRETACEOUS - JURASSIC
42150.12 435 dyo5^2 Plagiohornblendite -CRETACEOUS - JURASSIC
42150.13 436 yo5^2 Hornblendite -CRETACEOUS - JURASSIC
43100.02 438 hg5^1 Monzogranite -L. TRIASSIC
43100.02 438 hg5^1 Monzogranite Granodiorite-L. TRIASSIC
43100.03 439 gd5^1 Granodiorite -L. TRIASSIC
43100.03 439 gd5^1 Granodiorite Monzogranite-L. TRIASSIC
45700 440 bm2^5 Diabase -L. SINIAN
45700 440 bm2^5 Diabase Gabbro-L. SINIAN
46310.01 441 g2^4 Granite -QINGBAIKOUIAN
46310.02 442 gd2^4 Granodiorite -QINGBAIKOUIAN
46310.03 443 d2^4 Diorite -QINGBAIKOUIAN
46310.04 444 do2^4 Quartz diorite -QINGBAIKOUIAN
46310.05 445 dyo2^4 Plagiohornblendite -QINGBAIKOUIAN
46310.06 216 Qnlp Rhyolite porphyry Acidic volcanics-QINGBAIKOUIAN
46310.07 217 Qnbm Diabase -QINGBAIKOUIAN
46320 218 Pt2bm Spilite-porphyrite -M. PROTEROZOIC
48300 446 yw2^1 Serpentine -E. PROTEROZOIC UNDIF.
48600.01 447 g1^2(2) Granite -L. ARCHEAN
48600.02 448 hg1^2(2) Monzogranite -L. ARCHEAN
48600.02 448 hg1^2(2) Monzogranite Granite-L. ARCHEAN
48600.03 449 Mg1^2(2) Migmatitic granite -L. ARCHEAN
48600.03 449 Mg1^2(2) Migmatitic granite Diorite-L. ARCHEAN
48600.03 449 Mg1^2(2) Migmatitic granite Granite-L. ARCHEAN
48600.03 449 Mg1^2(2) Migmatitic granite Migmatitic monzogranite-L. ARCHEAN
48600.04 450 Mxg1^2(2) Migmatitic kaligranite -L. ARCHEAN
48600.04 450 Mxg1^2(2) Migmatitic kaligranite Migmatitic gneiss-L. ARCHEAN
48600.05 451 Mhg1^2(2) Migmatitic monzogranite -L. ARCHEAN
48600.06 452 Mgd1^2(2) Migmatitic granodiorite -L. ARCHEAN
48600.06 452 Mgd1^2(2) Migmatitic granodiorite Migmatitic granite-L. ARCHEAN
48600.07 453 do1^2(2) Quartz diorite -L. ARCHEAN
48605.01 454 n1^2(1) Gabbro -L. ARCHEAN
48605.02 455 dyo1^2(1) Plagiohornblendite -L. ARCHEAN
48605.03 456 yo1^2(1) Hornblendite -L. ARCHEAN
48605.04 457 yt1^2(1) Pyroxenite -L. ARCHEAN
48605.04 457 yt1^2(1) Pyroxenite Intermediate volcanics-L. ARCHEAN
48605.05 458 sy1^2(1) Olivine pyroxenite -L. ARCHEAN
48605.06 459 s1^2(1) Peridotite -L. ARCHEAN
48605.07 460 ys1^2(1) Augite-peridotite -L. ARCHEAN
90000.01 461 g Granite -UNKNOWN
90000.02 462 gp Granoporphyry -UNKNOWN
90000.03 463 lp Quartz porphyry -UNKNOWN
90000.04 464 d Diorite -UNKNOWN
90000.05 465 dom Quartz diorite porphyrite -UNKNOWN
90000.06 466 yw Serpentine -UNKNOWN
90000.07 219 am Andesite porphyrite -UNKNOWN
90000.08 220 ys Augite-peridotite -UNKNOWN
90000.09 003 gdp Granodiorite porphyry -UNKNOWN
90000.1 004 gop Plagiogranite porphyry -UNKNOWN
90000.11 006 r Pegmatite -UNKNOWN
90000.12 007 l Aplite -UNKNOWN
90000.13 009 do Quartz diorite -UNKNOWN
90000.14 010 dm Diorite-porphyrite -UNKNOWN
90000.15 013 xp Syenite porphyry -UNKNOWN
90000.16 014 xop Quartz syenite porphyry -UNKNOWN
90000.17 015 hp Monzonite porphyry -UNKNOWN
90000.18 016 hop Quartz monzonite-porphyry -UNKNOWN
90000.19 017 lp Trachyte porphyry -UNKNOWN
90000.2 018 u Leucite porphyry -UNKNOWN
90000.21 019 c Lamprophyre -UNKNOWN
90000.22 020 n Gabbro -UNKNOWN
90000.23 021 bm Diabase & Basalt-porphyrite -UNKNOWN
90000.24 023 ysm Augite-peridotite -UNKNOWN
90000.25 024 q Quartz vein -UNKNOWN
99000 900 Water Undifferentiated

Fig. 40. Map showing mineral occurrence in Anhui
(AMIRA 603 Project)

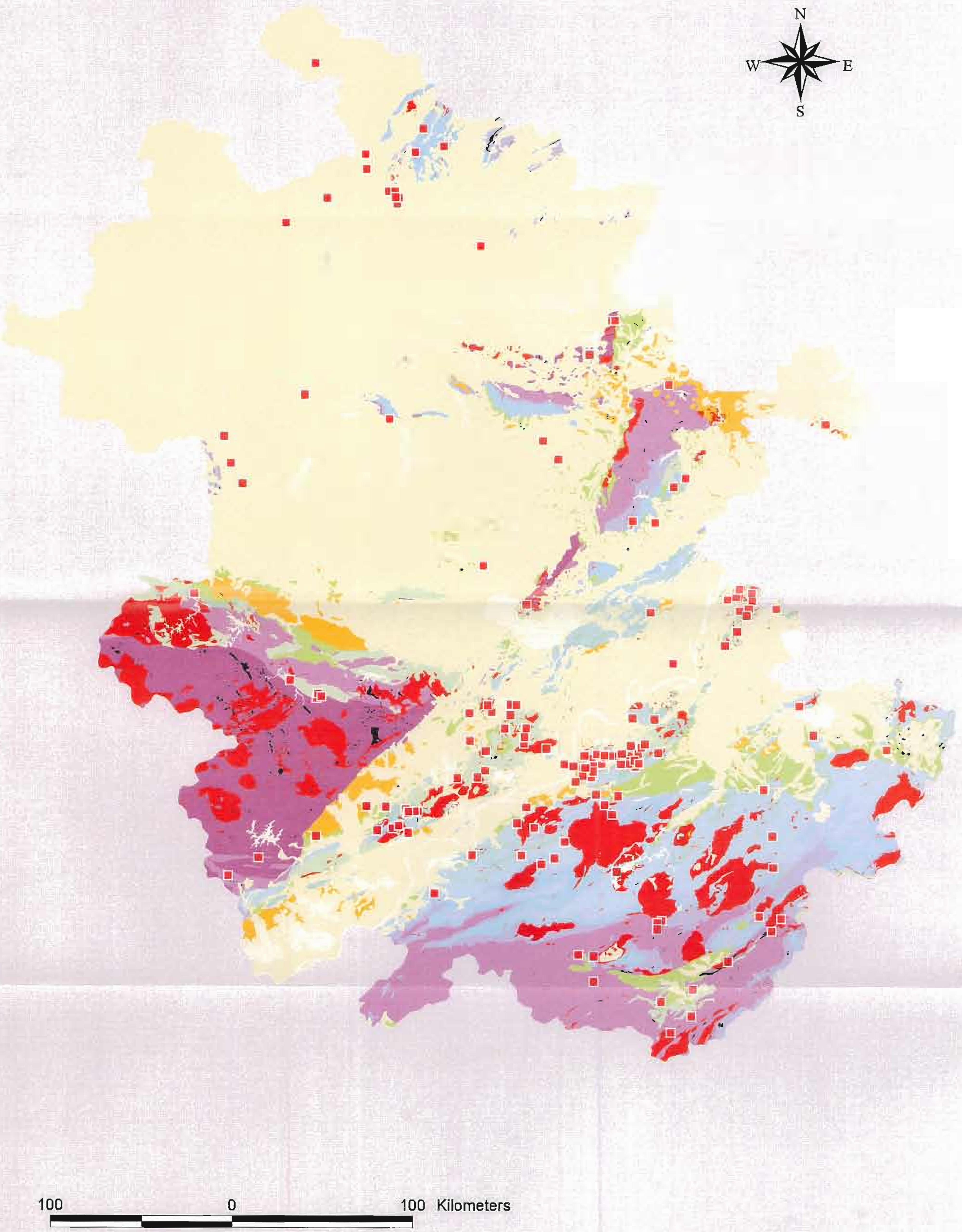


Fig. 41. Map showing lead-zinc occurrence in Anhui
(AMIRA 603 Project)

Fig. 42. Map showing copper-iron-gold occurrences and granitoids in Anhui
(AMIRA 603 Project)

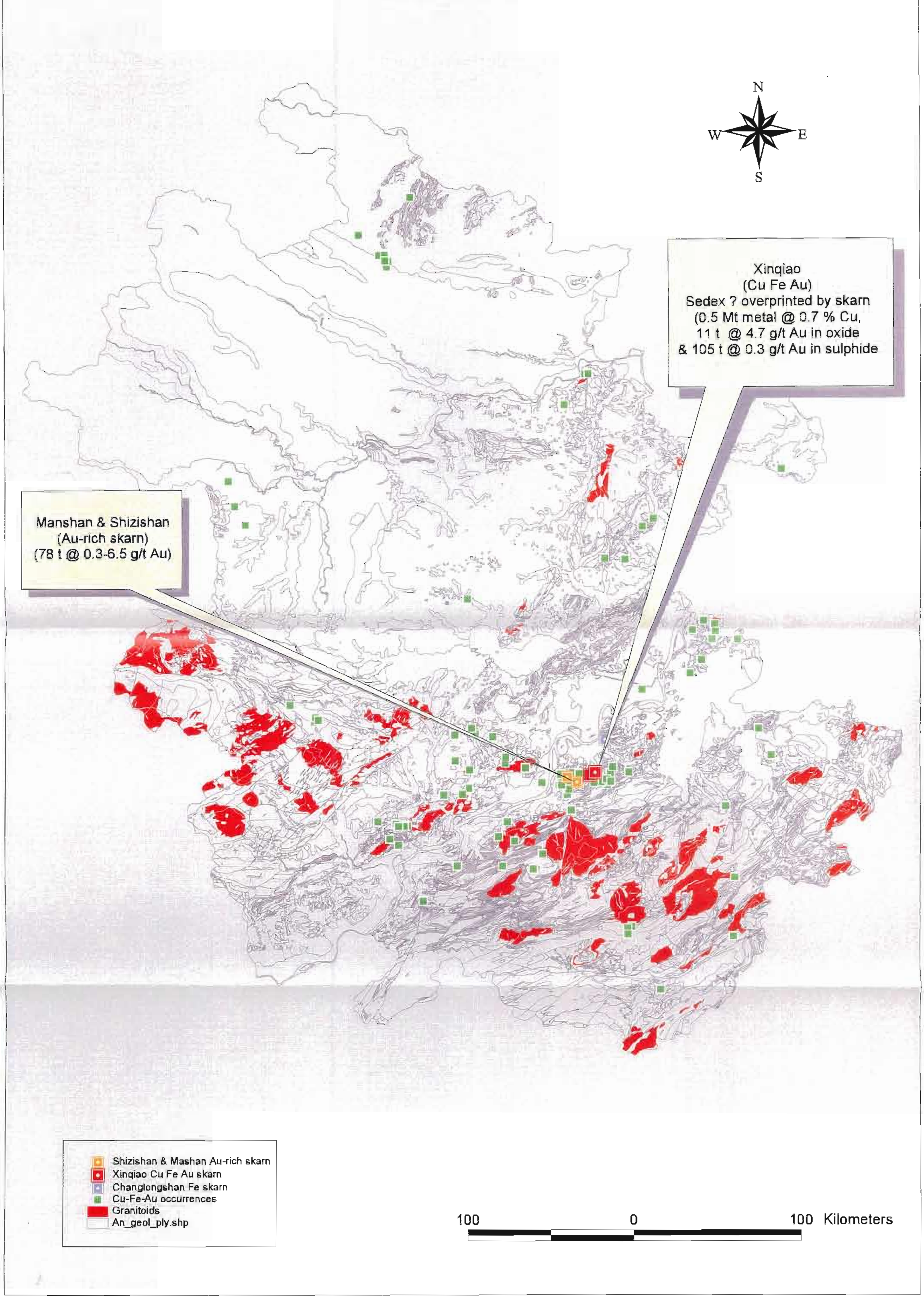


Fig. 43. Geology of Jiangsu Province
(AMIRA P603 Project)

# Geology Legend (Jiangsu)

Geology Legend (Jiangsu)

11110 111 Q4^al Undifferentiated -HOLOCENE
11110 121 Q4^h Undifferentiated -HOLOCENE
11110 131 Q4^al-l Undifferentiated -HOLOCENE
11110 141 Q4^l Undifferentiated -HOLOCENE
11110 151 Q4^l-h Undifferentiated -HOLOCENE
11110 161 Q4^m Undifferentiated -HOLOCENE
11110 171 Q4^al-m Undifferentiated -HOLOCENE
11120.01 112 Q3^al Undifferentiated -UP. PLEISTOCENE
11120.01 182 Q3^al-d Undifferentiated -UP. PLEISTOCENE
11120.01 192 Q3^pl-d Undifferentiated -UP. PLEISTOCENE
11120.02 113 Q3q^al Qizui Fm -UP. PLEISTOCENE
11120.02 183 Q3q^al-d Qizui Fm -UP. PLEISTOCENE
11120.02 203 Q3q^pl-al Qizui Fm -UP. PLEISTOCENE
11120.03 114 Q3x^al Xiashu Fm -UP. PLEISTOCENE
11120.03 184 Q3x^al-d Xiashu Fm -UP. PLEISTOCENE
11120.03 194 Q3x^pl-d Xiashu Fm -UP. PLEISTOCENE
11120.03 214 Q3x^el-d Xiashu Fm -UP. PLEISTOCENE
11130.01 115 Q2^al Undifferentiated -M. PLEISTOCENE
11130.01 225 Q2^cgt Undifferentiated -M. PLEISTOCENE
11130.03 117 Q1+2^al Undifferentiated -M. PLEISTOCENE
11140.02 118 Q1^al Undifferentiated -LW. PLEISTOCENE
11140.02 136 Q1^al-l Undifferentiated -LW. PLEISTOCENE
11145 140 Q^al-i Undifferentiated -PLEISTOCENE UNDIF.
11145 190 Q^al-d Undifferentiated -PLEISTOCENE UNDIF.
11145 200 Q^pl-d Undifferentiated -PLEISTOCENE UNDIF.
11145 220 Q^el-d Undifferentiated -PLEISTOCENE UNDIF.
11210.02 232 N2s Suqian Fm -PLIOCENE
11210.03 233 N2y Yuhuatai Fm -PLIOCENE
11210.04 234 N2f Fangshan Fm -PLIOCENE
11210.04 234 N2f Fangshan Fm Basaltic-PLIOCENE
11220.02 236 N1x Xiacaowan Fm -MIOCENE
11220.03 237 N1d Dongxuanguan Fm -MIOCENE
11225.01 238 N Undifferentiated -NEOGENE UNDIF
11230.01 240 E3 Undifferentiated -OLIGOCENE
11240.04 245 E2g Undifferentiated -EOCENE
11240.06 247 E1-2 Undifferentiated -EOCENE
11250.03 249 E1 Undifferentiated -PALAEOCENE
11260 251 E Undifferentiated -TERTIARY UNDIF.
12110.02 302 K2w Wangshi Fm -UP. CRETACEOUS
12110.03 303 K2p Pukou Fm -UP. CRETACEOUS
12110.04 304 K2c Chishan Fm -UP. CRETACEOUS
12120.02 306 K1q Qingshan Fm -LW. CRETACEOUS
12120.02 306 K1q Qingshan Fm Andesitic-LW. CRETACEOUS
12120.03 307 K1g Gecun Fm -LW. CRETACEOUS
12120.04 308 K1gu Gushan Fm -LW. CRETACEOUS
12120.05 309 K1n Niangniangshan Fm -LW. CRETACEOUS
12120.06 310 K1k Undifferentiated -LW. CRETACEOUS
12210.01 311 J3 Undifferentiated -UP. JURASSIC
12210.03 313 J3x Xihengshan Fm -UP. JURASSIC
12210.04 314 J3l Longwangshan Fm -UP. JURASSIC
12210.04 314 J3l Longwangshan Fm Andesitic-UP. JURASSIC
12210.04 314 J3l Longwangshan Fm Trachyandesitic-UP. JURASSIC
12210.041 335 J3l+y Longwangshan Fm + Yunheshan Fm -UP. JURASSIC
12210.042 333 J3l-d Longwangshan Fm - Dawangshan Fm -UP. JURASSIC
12210.05 315 J3y Yunheshan Fm -UP. JURASSIC
12210.052 334 J3y+d Yunheshan Fm + Dawangshan Fm -UP. JURASSIC
12210.06 316 J3d Dawangshan Fm -UP. JURASSIC
12210.06 316 J3d Dawangshan Fm Andesitic-UP. JURASSIC
12210.06 316 J3d Dawangshan Fm Rhyolitic-UP. JURASSIC
12210.06 316 J3d Dawangshan Fm Trachyandesitic-UP. JURASSIC
12210.06 316 J3d Dawangshan Fm Trachytic-UP. JURASSIC
12210.07 317 J3la Laocun Fm -UP. JURASSIC
12210.07 317 J3la Laocun Fm Rhyolitic-UP. JURASSIC
12210.08 318 J3h Huangian Fm -UP. JURASSIC
12220.01 319 J1-2 Undifferentiated -M. JURASSIC
12310.01 323 T3 Undifferentiated -UP. TRIASSIC
12320.02 328 T2 Undifferentiated -M. TRIASSIC
12320.05 329 T1+2 Undifferentiated -M. TRIASSIC
12330.02 330 T1 Undifferentiated -LW. TRIASSIC
12330.03 331 T1x Xiaqinglong Fm -LW. TRIASSIC
13120.01 501 P2 Undifferentiated -M. PERMIAN
13120.04 504 P2l Longtan Fm -M. PERMIAN
13120.05 505 P2c Changxing Fm -M. PERMIAN

13130.01 507 P1 Undifferentiated -LW. PERMIAN
13130.04 510 P1q Qixia Fm -LW. PERMIAN
13140.01 513 P Undifferentiated -PERMIAN UNDIF
13140.02 514 C+P Undifferentiated -PERMIAN UNDIF.
13210.01 515 C3 Undifferentiated -UP. CARBONIFEROUS
13210.03 517 C3c Chuanshan Fm -UP. CARBONIFEROUS
13210.04 518 C2+3 Undifferentiated -UP. CARBONIFEROUS
13220.02 519 C2 Undifferentiated -M. CARBONIFEROUS
13220.04 521 C2h Huanglong Fm -M. CARBONIFEROUS
13220.05 522 C1+2 Undifferentiated -M. CARBONIFEROUS
13230.02 523 C1 Undifferentiated -LW. CARBONIFEROUS
13240.02 528 C Undifferentiated -CARBONIFEROUS UNDIF.
13240.03 529 D+C Undifferentiated -CARBONIFEROUS UNDIF.
13310.01 530 D3 Undifferentiated -UP. DEVONIAN
13320.01 532 D1-2 Undifferentiated -M. DEVONIAN
13340.02 534 D Undifferentiated -DEVONIAN UNDIF.
13340.03 535 S+D Undifferentiated -DEVONIAN UNDIF.
13420.01 536 S2 Undifferentiated -M. SILURIAN
13420.03 538 S1+2 Undifferentiated -M. SILURIAN
13430.02 539 S1 Undifferentiated -LW. SILURIAN
13440.02 541 O+S Undifferentiated -SILURIAN UNDIF.
13520.01 545 O2 Undifferentiated -M. ORDOVICIAN
13520.02 546 O2g Gezhunag Fm -M. ORDOVICIAN
13520.05 549 O1+2 Undifferentiated -M. ORDOVICIAN
13520.06 550 O1-2 Undifferentiated -M. ORDOVICIAN
13530.03 551 O1 Undifferentiated -LW. ORDOVICIAN
13530.05 557 O1h Honghuayuan Fm -LW ORDOVICIAN
13540.02 560 O Undifferentiated -ORDOVICIAN UNDIF
13540.03 561 Ca+O Undifferentiated -ORDOVICIAN UNDIF.
13610.01 562 Ca3 Undifferentiated -UP. CAMBRIAN
13610.02 563 Ca3g Gushan Fm -UP. CAMBRIAN
13610.05 566 Ca3gu Guanyintai Fm -UP. CAMBRIAN
13610.06 567 Ca2+3 Undifferentiated -UP. CAMBRIAN
13610.07 568 Ca2-3 Undifferentiated -UP. CAMBRIAN
13620.03 569 Ca2 Undifferentiated -M. CAMBRIAN
13620.06 574 Ca1+2 Undifferentiated -M. CAMBRIAN
13630.02 575 Ca1 Undifferentiated -LW. CAMBRIAN
13630.04 577 Ca1m Mantou Fm -LW. CAMBRIAN
13630.05 578 Ca1mu Mufushan Fm -LW CAMBRIAN
13640.02 579 Ca Undifferentiated -CAMBRIAN UNDIF.
21120.01 701 Z2 Undifferentiated -M. SINIAN
21120.02 702 Z2d Doushantuo Fm -M. SINIAN
21120.03 703 Z2dn Dengying FM -M. SINIAN
21130.03 706 Z1n Nantuo Fm -LW. SINIAN
21220.01 707 Pt3hh2 Huaihe Gr, U.Subgroup -UP. PROTEROZOIC
21220.02 708 Pt3z Zhaowei Fm -UP. PROTEROZOIC
21220.021 726 Pt3z+n Zhaowei Fm+Niyuan Fm -UP PROTEROZOIC
21220.03 709 Pt3n Niyuan Fm -UP. PROTEROZOIC
21220.032 725 Pt3n+jd Niyuan Fm+Jiudingshan Fm -UP. PROTEROZOIC
21220.04 710 Pt3jd Jiudingshan Fm -UP. PROTEROZOIC
21220.042 728 Pt3jd+zh Jiudingshan Fm-UP. PROTEROZOIC
21220.05 711 Pt3zh Zhangqu Fm -UP. PROTEROZOIC
21220.06 712 Pt3w Weiji Fm -UP. PROTEROZOIC
21220.061 729 Pt3w+s Weiji Fm+Shijia Fm -UP. PROTEROZOIC
21220.07 713 Pt3s Shijia Fm -UP. PROTEROZOIC
21220.08 714 Pt3wn Wangshan Fm -UP. PROTEROZOIC
21220.1 716 Pt3x Xinxing Fm -UP. PROTEROZOIC
21220.101 727 Pt3x+j Xinxing Fm+Jushan Fm -UP. PROTEROZOIC
21220.11 717 Pt3j Jushan Fm -UP. PROTEROZOIC
21220.12 718 Pt3jy Jiayuan Fm -UP. PROTEROZOIC
22000.01 722 Pt2 Undifferentiated -M. PROTEROZOIC UNDIF.
22000.02 719 Pt2zh Zhangbaling Gr -M. PROTEROZOIC UNDIF.
22000.03 720 Pt2y Yuntai Fm -M. PROTEROZOIC UNDIF.
22000.04 721 Pt2j Jingping Fm -M. PROTEROZOIC UNDIF.
23000.01 723 Ar-Pt1p Pingchang Fm -LW. PROTEROZOIC UNDIF
23000.02 724 Ar-Pt1z^2 Zhubian Fm Upper Mm -LW. PROTEROZOIC UNDIF.
23000.02 724 Ar-Pt1z^2 Zhubian Fm Upper Mm-LW. PROTEROZOIC UNDIF.
41100.01 401 Cb6^2f Subbasalt -NEOGENE
41100.02 402 Cbm6^2f Subdiabase -NEOGENE
41300.01 422 bm6 Diabase -TERTIARY UNDIF
42092 423 lp5^3(4) Quartz porphyry -CRETACEOUS
42093.01 424 hop5^3(3) Quartz monzonitic porphyry -CRETACEOUS
42093.02 425 ph5^3(3) Porphyritic monzonite -CRETACEOUS
42093.03 426 d5^3(3) Diorite -CRETACEOUS
42093.04 427 pd5^3(3) Porphyritic diorite -CRETACEOUS

42093.05 428 dm5^3(3) Diorite-porphyrite -CRETACEOUS
42093.06 429 pdo5^3(3) Porphyritic quartz diorite -CRETACEOUS
42093.07 430 dop5^3(3) Quartz dioritic porphyry -CRETACEOUS
42094.01 431 g5^3(2) Granite -CRETACEOUS
42094.02 432 gp5^3(2) Granite porphyry -CRETACEOUS
42094.03 433 lp5^3(2) Quartz porphyry -CRETACEOUS
42094.04 434 kg5^3(2) Potash feldspar granite -CRETACEOUS
42094.05 435 hg5^3(2) Monzonitic granite -CRETACEOUS
42094.06 436 hgp5^3(2) Monzonitic granite-porphyry -CRETACEOUS
42094.07 437 gd5^3(2) Granodiorite -CRETACEOUS
42094.08 438 gdp5^3(2) Granodiorite porphyry -CRETACEOUS
42094.09 439 dop5^3(2) Quartz dioritic porphyry -CRETACEOUS
42095.01 441 g5^3(1) Granite -CRETACEOUS
42095.02 442 pg5^3(1) Porphyritic granite -CRETACEOUS
42095.03 443 ho5^3(1) Quartz monzonite -CRETACEOUS
42095.04 444 pho5^3(1) Porphyritic quartz-monzonite -CRETACEOUS
42095.05 445 hop5^3(1) Quartz monzonitic porphyry -CRETACEOUS
42095.06 446 do5^3(1) Quartz diorite -CRETACEOUS
42095.07 447 pdo5^3(1) Porphyritic quartz diorite -CRETACEOUS
42095.08 448 dop5^3(1) Quartz dioritic porphyry -CRETACEOUS
42095.09 449 hp5^3(1) Monzonitic porphyry -CRETACEOUS
42100.01 403 Cep5^3n Subpseudoleucitic porphyry -CRETACEOUS
42100.01 450 g5^3 Granite -CRETACEOUS
42100.02 404 Cx5^3n Subsyenite -CRETACEOUS
42100.02 451 hop5^3 Quartz monzonitic porphyry -CRETACEOUS
42100.02 455 d5^2 Diorite -CRETACEOUS
42100.03 405 Ca5^3gu Subandesite -CRETACEOUS
42100.03 452 ho5^3 Quartz monzonite -CRETACEOUS
42100.03 456 dm5^2 Diorite-porphyrite -CRETACEOUS
42100.04 406 Cj5^3 Subkimberlite -CRETACEOUS
42100.04 453 xp5^3 Orthophyre -CRETACEOUS
42100.04 457 n5^2 Gabbro -CRETACEOUS
42200.01 407 Cl5^2d Subrhyolite -JURASSIC UNDIF
42200.01 454 pg5^2 Porphyritic hornblendic granite -JURASSIC UNDIF
42200.02 408 Cz5^2d Subdacite -JURASSIC UNDIF
42200.03 409 Cd5^2d Subgabbro diorite -JURASSIC UNDIF.
42200.04 410 Cdm5^2d Subgabbro dioritic porphyrite -JURASSIC UNDIF.
42200.05 411 Ca5^2d Subandesite -JURASSIC UNDIF
42200.07 413 Cto5^2d Subquartz trachyte -JURASSIC UNDIF.
42200.08 414 Cta5^2d Subtrachyandesite -JURASSIC UNDIF.
42200.09 415 Ct5^2d Subtrachyte -JURASSIC UNDIF.
42200.1 416 Ca5^2l Subandesite -JURASSIC UNDIF
42200.12 418 Cdm5^2l Subgabbro dioritic porphyrite -JURASSIC UNDIF
42200.13 419 Cta5^2l Subtrachyandesite -JURASSIC UNDIF.
42200.14 420 Ct5^2l Subtrachyte -JURASSIC UNDIF.
42200.15 421 Cl5^2la Subrhyolite -JURASSIC UNDIF.
49500 458 bm2^3 Diabase -UNDEFINED
49700 459 gm2^2 Mixed granite -UNDEFINED
49800.01 460 ni2^1 Eclogite -UNDEFINED
49800.02 461 S2^1 Peridotite and Pyroxenite -UNDEFINED
90000.01 001 g Granite -UNKNOWN
90000.02 002 gp Granite porphyry -UNKNOWN
90000.03 003 r Pegmatite -UNKNOWN
90000.04 004 lp Quartz porphyry -UNKNOWN
90000.05 005 gdp Granodiorite porphyry -UNKNOWN
90000.06 006 i Aplite -UNKNOWN
90000.07 007 hg Monzonitic granite -UNKNOWN
90000.08 008 q Quartz vein -UNKNOWN
90000.09 009 hop Quartz monzonitic porphyry -UNKNOWN
90000.1 010 xop Quartz orthophyre vein -UNKNOWN
90000.11 011 dop Quartz dioritic porphyry -UNKNOWN
90000.12 012 hp Monzonitic porphyry -UNKNOWN
90000.13 013 x Syenite -UNKNOWN
90000.14 014 xp Orthophyre -UNKNOWN
90000.15 015 dm Diorite-porphyrite -UNKNOWN
90000.16 016 rp Feldspathic porphyry -UNKNOWN
90000.17 017 c Lamprophyre -UNKNOWN
90000.18 018 dc Camptonite -UNKNOWN
90000.19 019 kc Alkali lamprophyre -UNKNOWN
90000.2 020 bm Diabase -UNKNOWN
90000.21 021 ccy Nepheline olivinic pyroxenite -UNKNOWN
90000.22 022 wm Picrite-porphyrite -UNKNOWN
99000 900 Water Undifferentiated

Fig. 44. Map showing mineral occurrences in Jiangsu
(AMIRA P603 Project)

Fig. 45. Map showing lead, zinc, copper and gold deposits in Jiangsu
(AMIRA P603 Project)

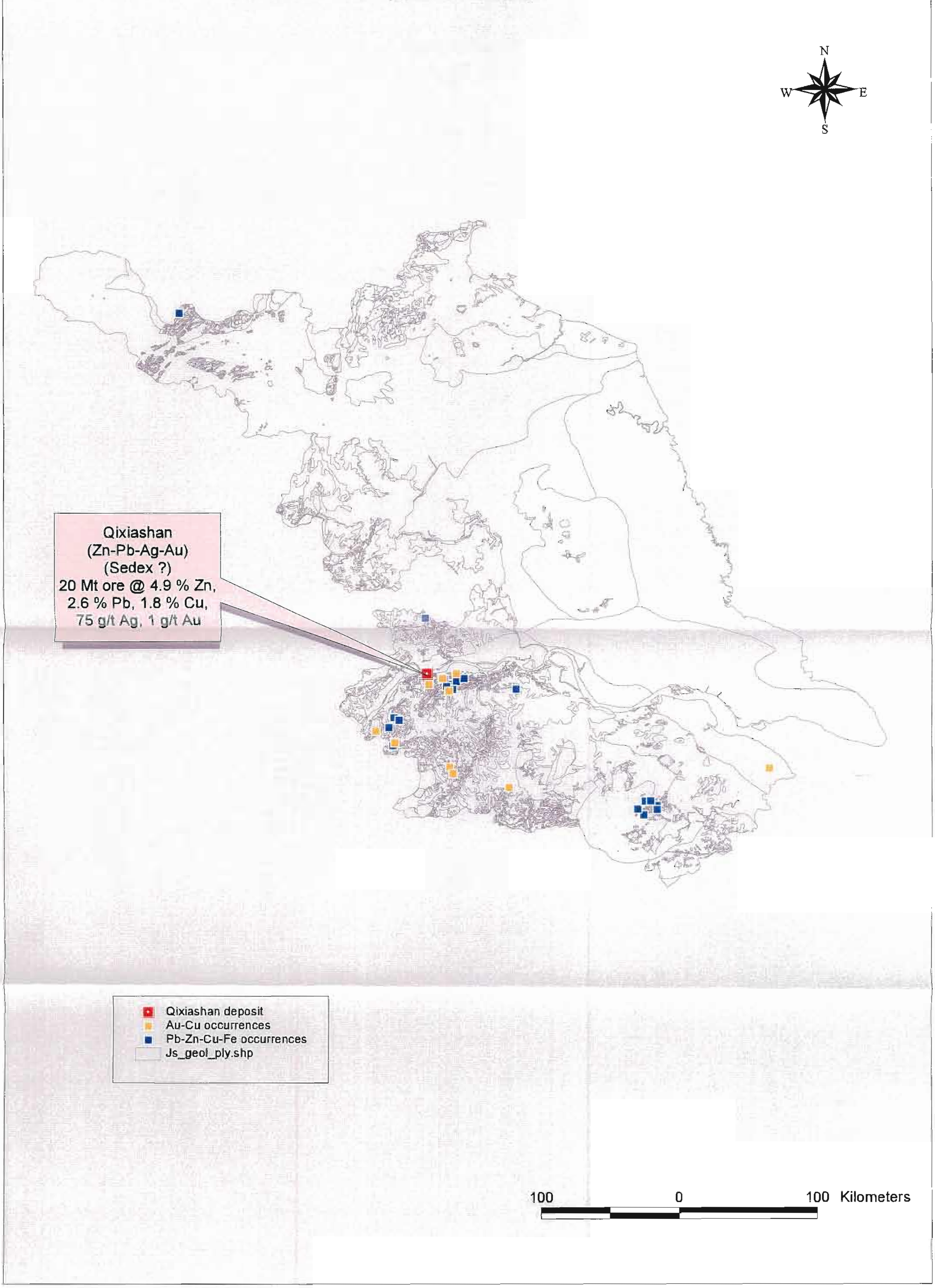
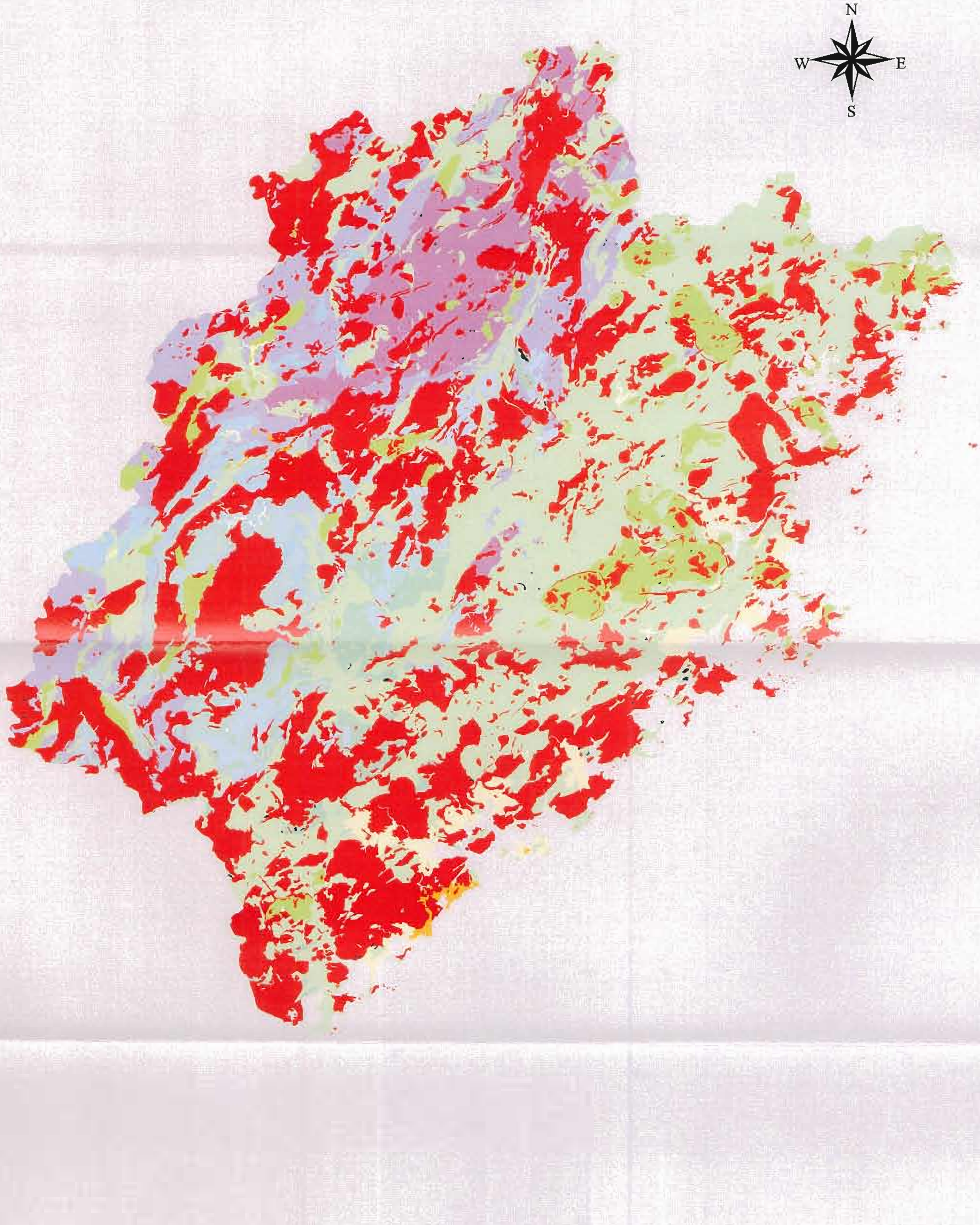


Fig. 46. Geology of Fujian Province
(AMIRA P603 Project)



# Geology Legend (Fujian)

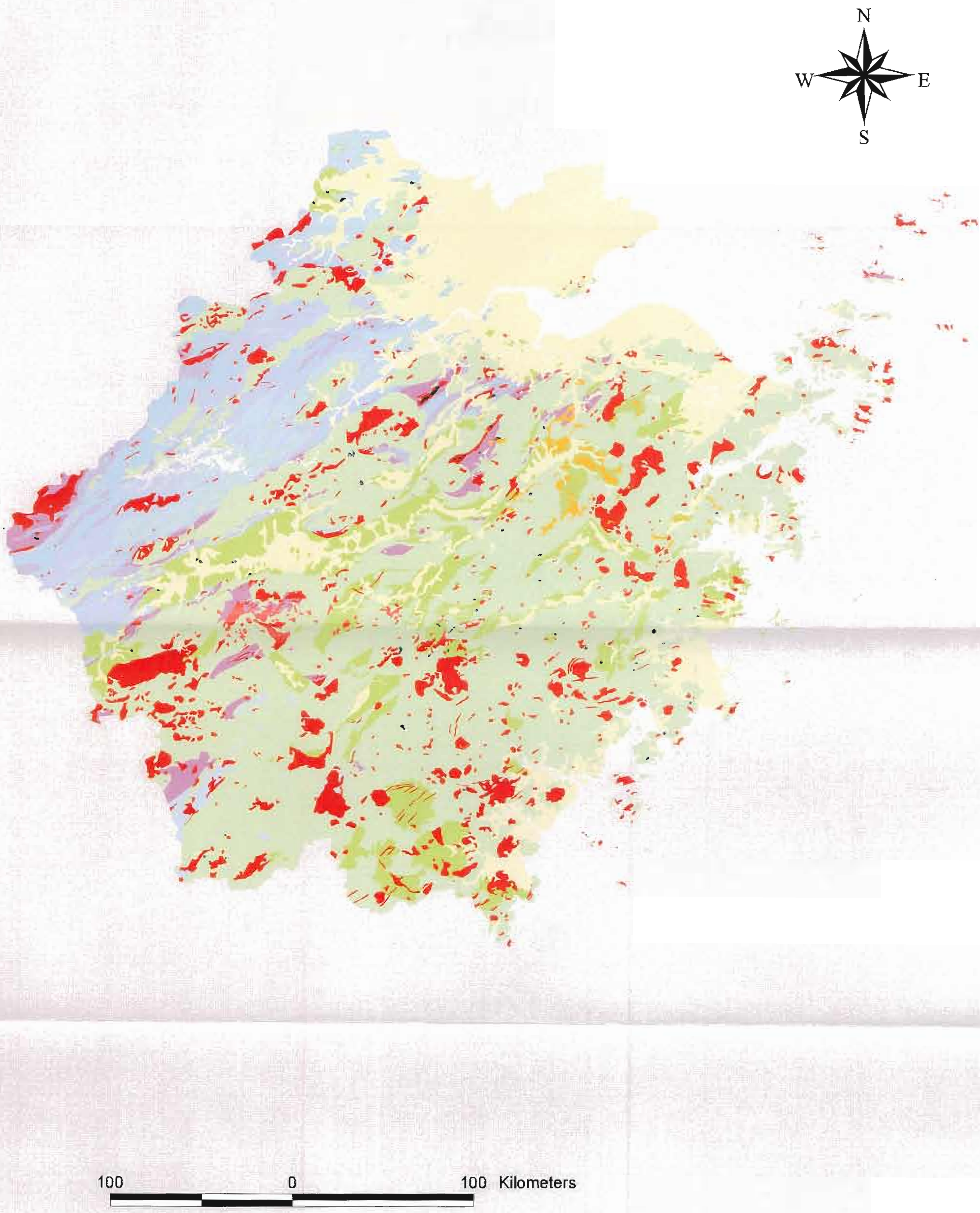
Geology Legend (Fujian)

11110 101 Qh Undifferentiated -HOLOCENE
11145 102 Qp Undifferentiated -PLEISTOCENE UNDIF.
11225 103 Nft Fotan Gr -NEOGENE UNDIF.
11225 103 Nft Fotan Gr Basalt-NEOGENE UNDIF.
12110.01 301 K2ch Chishi Gr -UP. CRETACEOUS
12110.02 302 K2s Shaxian Gr -UP. CRETACEOUS
12120.01 304 K1sh2 Upper Fm -LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Andesite-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Dacite-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Rhyolite-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Rhyolitic-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Trachyte-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Tuff lava-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Tuff-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Volcanic agglomerate-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm breccia-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Volcanic Ignimbrite-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Volcanic Rhyolite LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm VolcanicTuff lava-LW. CRETACEOUS
12120.01 304 K1sh2 Upper Fm Volcanic breccia; Tuff-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm -LW CRETACEOUS
12120.02 305 K1sh1 Lower Fm Andesite-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Dacite LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Ignimbrite-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Migmatite-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Tuff lava-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Tuff-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Volcanic Ignimbrite-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Volcanic breccia; Tuff lava-LW. CRETACEOUS
12120.02 305 K1sh1 Lower Fm Volcanic breccia; Tuff-LW. CRETACEOUS
12120.03 303 K1h Hokou Fm -LW. CRETACEOUS
12210.01 306 J3b Bantou Fm -UP. JURASSIC
12210.01 306 J3b Bantou Fm Dacite (dacitic)-UP. JURASSIC
12210.01 306 J3b Bantou Fm Ignimbrite-UP. JURASSIC
12210.01 306 J3b Bantou Fm Migmatite (partial)-UP. JURASSIC
12210.01 306 J3b Bantou Fm Rhyolite (rhyolitic)-UP JURASSIC
12210.01 306 J3b Bantou Fm Tuff lava-UP. JURASSIC
12210.01 306 J3b Bantou Fm Tuff-UP. JURASSIC
12210.01 306 J3b Bantou Fm Volcanic breccia; Tuff lava-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm -UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Ignimbrite-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Rhyolite-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Tuff lava-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Tuff-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Volcanic breccia-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Volcanic breccia; Rhyolite-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Volcanic breccia; Tuff lava-UP. JURASSIC
12210.02 307 J3n^d Bantou Fm 4th Mm Volcanic breccia; Tuff-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm -UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Acid lava-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Andesite (andesitic)-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Dacite (dacitic)-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Ignimbrite-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Intermediate-acidic lave-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Migmatite (partial)-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Rhyolite (rhyolitic)-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Trachyte-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Tuff lava-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Tuff-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Volcanic agglomerate; Tuff lava-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Volcanic breccia-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Volcanic breccia; Dacite-UP. JURASSIC
12210.03 308 J3n^c Bantou Fm 3rd Mm Volcanic breccia; Ignimbrite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm -UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Acid granular lava-UP JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Andesite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Dacite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Ignimbrite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Migmatite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Rhyolite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Trachyte-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Tuff lava-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Tuff-UP JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic agglomerate-UP JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic agglomerate; Ignimbrite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic agglomerate; Tuff lava-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic agglomerate; Tuff-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic breccia-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic breccia; Ignimbrite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic breccia; Rhyolite-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic breccia; Tuff lava-UP. JURASSIC
12210.04 309 J3n^b Bantou Fm 2nd Mm Volcanic breccia; Tuff-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm -UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Andesite-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Dacite-UP. JURASSIC

12210.05 310 J3n^a Bantou Fm 1st Mm Ignimbrite-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Rhyolite (rhyolitic)-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Tuff lava-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Tuff-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Volcanic breccia; Ignimbrite-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Volcanic breccia-UP. JURASSIC
12210.05 310 J3n^a Bantou Fm 1st Mm Volcanic breccia; Tuff-UP. JURASSIC
12210.06 311 J3c Changlin Fm -UP. JURASSIC
12210.06 311 J3c Changlin Fm Rhyolite-UP. JURASSIC
12220 312 J2z Zhangping Fm -M. JURASSIC
12230 313 J1l Lishan Fm -LW. JURASSIC
12230 313 J1l Lishan Fm Andesite (andesitic)-LW. JURASSIC
12240 314 T3-J Undifferentiated -JURASSIC UNDIF
12240 314 T3-J Undifferentiated Migmatite (partial)-JURASSIC UNDIF.
12240 314 T3-J Undifferentiated Migmatite-JURASSIC UNDIF.
12310.02 315 T3j Jiaokeng Fm -UP. TRIASSIC
12310.03 316 T3w Wenbinshan Fm -UP. TRIASSIC
12310.04 317 T3d Dakeng Fm -UP. TRIASSIC
12320 318 T2a Anren Fm -M. TRIASSIC
12330.01 319 T1xw Xiwei Fm -LW. TRIASSIC
12330.02 320 T1x Xikou Fm -LW. TRIASSIC
13120.01 501 P2c Changxing Fm -M. PERMIAN
13120.02 502 P2d Dalong Fm -M. PERMIAN
13120.03 503 P2cp Cuipingshan Fm -M. PERMIAN
13130.01 504 P1t Tongziyan Fm -LW. PERMIAN
13130.02 505 P1w Wenbishan Fm -LW. PERMIAN
13130.03 506 P1q Qixia Fm -LW. PERMIAN
13130.04 507 C3+P1q Chuanshan and Qixia Fm -LW. PERMIAN
13210.02 508 C3c Chuanshan Fm -UP. CARBONIFEROUS
13220 509 C2h Huanglong Fm -M. CARBONIFEROUS
13230.01 510 C1l Lindi Fm -LW. CARBONIFEROUS
13230.02 511 C1-2 Undifferentiated -LW. CARBONIFEROUS
13310.01 512 D3tz Taozikeng Fm -UP. DEVONIAN
13310.01 512 D3tz Taozikeng Fm Migmatitic granite-UP. DEVONIAN
13310.02 513 D3t Tianwadong Fm -UP. DEVONIAN
13510.01 514 O2-3l^b Upper Mm -UP. ORDOVICIAN
13510.02 515 O2-3l^a Lower Mm -UP. ORDOVICIAN
13530 516 O1wf Weifang Gr -LW. ORDOVICIAN
13610 517 Ca3dn Dongkengkou Gr -UP CAMBRIAN
13620.01 518 Ca1-2ln^b Upper Mm -M. CAMBRIAN
13620.02 519 Ca1-2ln^a Lower Mm -M. CAMBRIAN
13800 701 Z2-Pz1 Undifferentiated -LW. PALAEOZOIC UNDIF.
21120.02 705 Z2h Huangfan Fm -M. SINIAN
21120.03 706 Z2n Nanyan Fm -M. SINIAN
21120.04 704 Z2 Undifferentiated -M. SINIAN
21120.04 704 Z2 Undifferentiated Migmatite (partial)-M. SINIAN
21120.04 704 Z2 Undifferentiated Migmatite-M. SINIAN
21130.01 702 Z1l Longbeixi Fm -LW SINIAN
21130.02 703 Z1d Dikou Fm -LW. SINIAN
21130.02 703 Z1d Dikou Fm Migmatite-LW. SINIAN
21130.03 707 Z1dn Dingwuling Fm -LW. SINIAN
21130.03 707 Z1dn Dingwuling Fm Migmatite (partial)-LW. SINIAN
21130.03 707 Z1dn Dingwuling Fm Migmatite-LW. SINIAN
21130.04 709 Z1lz^c Upper Mm -LW. SINIAN
21130.04 709 Z1lz^c Upper Mm Migmatite-LW. SINIAN
21130.05 710 Z1lz^b Middle Mm -LW. SINIAN
21130.05 710 Z1lz^b Middle Mm Migmatite (partial)-LW. SINIAN
21130.05 710 Z1lz^b Middle Mm Migmatite-LW. SINIAN
21130.06 711 Z1lz^a Lower Mm -LW. SINIAN
21130.06 711 Z1lz^a Lower Mm Migmatite (partial)-LW. SINIAN
21130.06 711 Z1lz^a Lower Mm Migmatite-LW. SINIAN
21130.07 708 Z1w Wundun Fm -LW. SINIAN
21130.07 708 Z1w Wundun Fm Migmatite (partial)-LW. SINIAN
21130.07 708 Z1w Wundun Fm Migmatite-LW. SINIAN
21220.01 712 Pt3my^d 4th Mm -UP. PROTEROZOIC
21220.01 712 Pt3my^d 4th Mm Migmatite (partial)-UP. PROTEROZOIC
21220.01 712 Pt3my^d 4th Mm Migmatite-UP. PROTEROZOIC
21220.02 713 Pt3my^c 3rd Mm -UP. PROTEROZOIC
21220.02 713 Pt3my^c 3rd Mm Migmatite (partial)-UP. PROTEROZOIC
21220.02 713 Pt3my^c 3rd Mm Migmatite-UP. PROTEROZOIC
21220.03 714 Pt3my^b 2nd Mm -UP. PROTEROZOIC
21220.03 714 Pt3my^b 2nd Mm Migmatite (partial)-UP. PROTEROZOIC
21220.03 714 Pt3my^b 2nd Mm Migmatite-UP. PROTEROZOIC
21220.04 715 Pt3my^a 1st Mm -UP. PROTEROZOIC
21220.04 715 Pt3my^a 1st Mm Migmatite-UP. PROTEROZOIC
41300.01 201 n6 Gabbro -TERTIARY UNDIF
41300.02 202 nm6 Gabbro porphyrite -TERTIARY UNDIF
41300.03 203 nb6 Gabbro diabase -TERTIARY UNDIF.
41300.04 204 b6 Diabase -TERTIARY UNDIF.
41300.05 205 bm6 Diabase porphyrite -TERTIARY UNDIF.
42100.01 401 gp5^3(2) Granite porphyry -CRETACEOUS
42100.01 441 lK1 Rhyolite -CRETACEOUS
42100.02 402 ep5^3(1)d Syenite porphyry -CRETACEOUS
42100.03 403 e5^3(1)d Syenite -CRETACEOUS
42100.03 443 epK1 Syenite porphyry -CRETACEOUS
42100.04 404 eop5^3(1)d Quartz syenite porphyry -CRETACEOUS
42100.04 444 eopK1 Quartz syenite porphyry -CRETACEOUS
42100.04 444 eopK1 Quartz syenite porphyry Ignimbrite-CRETACEOUS
42100.04 444 eopK1 Quartz syenite porphyry-CRETACEOUS

42100.05 405 lp5^3(1)d Quartz porphyry -CRETACEOUS
42100.05 445 egpK1 Potash granite-porphyry -CRETACEOUS
42100.06 406 gp5^3(1)d Granite porphyry -CRETACEOUS
42100.06 406 gp5^3(1)d Granite porphyry Granite-CRETACEOUS
42100.06 446 gpK1 Granite porphyry -CRETACEOUS
42100.07 407 egp5^3(1)d Potash granoporphyry -CRETACEOUS
42100.07 447 hopK1 Quartz monzonitic porphyry -CRETACEOUS
42100.08 408 eg5^3(1)d Potash granite fine-grained -CRETACEOUS
42100.09 409 g5^3(1)d Granite fine-grained -CRETACEOUS
42100.09 449 domK1 Quartz diorite porphyrite -CRETACEOUS
42100.1 410 eg5^3(1)c Miarolitic potash granite -CRETACEOUS
42100.1 410 eg5^3(1)c Miarolitic potash granite Granite-CRETACEOUS
42100.1 410 eg5^3(1)c Miarolitic potash monzogranite-CRETACEOUS
42100.1 410 eg5^3(1)c Miarolitic potash granite Potash granite-CRETACEOUS
42100.1 450 amK1 Andesitic porphyrite -CRETACEOUS
42100.11 411 g5^3(1)c Miarolitic granite -CRETACEOUS
42100.11 411 g5^3(1)c Miarolitic granite Granite-CRETACEOUS
42100.11 411 g5^3(1)c Miarolitic granite Monzonitic granite-CRETACEOUS
42100.12 412 g5^3(1)b Granite -CRETACEOUS
42100.12 412 g5^3(1)b Granite Monzonitic granite-CRETACEOUS
42100.13 413 hg5^3(1)b Monzonitic granite -CRETACEOUS
42100.13 413 hg5^3(1)b Monzonitic granite Granite-CRETACEOUS
42100.14 414 ho5^3(1)a Quartz monzonite -CRETACEOUS
42100.14 414 ho5^3(1)a Quartz monzonite Quartz diorite-CRETACEOUS
42100.15 415 gd5^3(1)a Granodiorite -CRETACEOUS
42100.15 415 gd5^3(1)a Granodiorite Granite-CRETACEOUS
42100.15 415 gd5^3(1)a Granodiorite Pyroxene diorite-CRETACEOUS
42100.16 416 do5^3(1)a Quartz diorite -CRETACEOUS
42100.17 417 d5^3(1)a Diorite -CRETACEOUS
42100.18 418 nd5^3(1)a Pyroxene diorite -CRETACEOUS
42100.19 419 n5^3(1)a Gabbro -CRETACEOUS
42100.2 420 s5^3(1)a Enstatite-peridotite -CRETACEOUS
42200.01 421 e5^2(3)d Syenite -JURASSIC UNDIF.
42200.01 451 amJ3 Andesitic porphyrite -JURASSIC UNDIF.
42200.02 422 eo5^2(3)d Quartz syenite -JURASSIC UNDIF.
42200.02 452 tamJ3 Trachyandesitic porphyrite -JURASSIC UNDIF.
42200.03 423 gp5^2(3)d Granite porphyry -JURASSIC UNDIF.
42200.03 453 lJ3 Rhyolite -JURASSIC UNDIF
42200.04 424 g5^2(3)d Granite fine-grained -JURASSIC UNDIF
42200.04 454 lpJ3 Rhyolitic porphyry -JURASSIC UNDIF.
42200.05 425 g5^2(3)c Biotite granite -JURASSIC UNDIF.
42200.05 425 g5^2(3)c Biotite granite Granite-JURASSIC UNDIF.
42200.05 425 g5^2(3)c Biotite granite Monzonitic granite-JURASSIC UNDIF
42200.05 455 epJ3 Syenite porphyry -JURASSIC UNDIF.
42200.06 426 ho5^2(3)b Quartz monzonite -JURASSIC UNDIF.
42200.06 426 ho5^2(3)b Quartz monzonite Quartz diorite-JURASSIC UNDIF.
42200.06 456 gepJ3 Granosyenite porphyry -JURASSIC UNDIF
42200.07 427 gd5^2(3)b Granodiorite -JURASSIC UNDIF
42200.07 427 gd5^2(3)b Granodiorite Granite-JURASSIC UNDIF.
42200.07 427 gd5^2(3)b Granodiorite Monzonitic granite-JURASSIC UNDIF.
42200.07 427 gd5^2(3)b Granodiorite Quartz diorite-JURASSIC UNDIF
42200.07 427 gd5^2(3)b Granodiorite Trachyte (trachytic)-JURASSIC UNDIF.
42200.07 457 gpJ3 Granite porphyry -JURASSIC UNDIF.
42200.08 428 do5^2(3)b Quartz diorite -JURASSIC UNDIF
42200.08 458 hgpJ3 Monzogranoporphyry -JURASSIC UNDIF
42200.09 429 d5^2(3)b Diorite -JURASSIC UNDIF.
42200.09 459 hopJ3 Quartz monzo-porphyry -JURASSIC UNDIF
42200.1 430 nd5^2(3)b Pyroxene diorite -JURASSIC UNDIF.
42200.1 460 gdpJ3 Granodiorite porphyry -JURASSIC UNDIF.
42200.11 431 hg5^2(3)a Cataclastic monzonitic granite -JURASSIC UNDIF
42200.11 431 hg5^2(3)a Cataclastic monzonitic Granite-JURASSIC UNDIF.
42200.11 431 hg5^2(3)a Cataclastic monzonitic Granodiorite-JURASSIC UNDIF
42200.11 431 hg5^2(3)a Cataclastic monzonitic granite-JURASSIC UNDIF
42200.11 461 domJ3 Quartz diorite porphyrite -JURASSIC UNDIF
42200.12 432 gm5^2(3) Migmatitic granite -JURASSIC UNDIF.
42200.12 432 gm5^2(3) Migmatitic granite--JURASSIC UNDIF.
42200.12 462 dmJ3 Diorite-porphyrite -JURASSIC UNDIF.
42200.13 433 hgm5^2(3) Migmatitic monzonitic granite -JURASSIC UNDIF
42200.13 433 hgm5^2(3) Migmatitic monzonitic granite-JURASSIC UNDIF
42200.14 434 gdm5^2(3) Migmatitic granodiorite -JURASSIC UNDIF
42200.15 435 e5^2(2) Syenite -JURASSIC UNDIF.
42200.16 436 g5^2(2) Porphyroid biotite granite -JURASSIC UNDIF
42200.16 436 g5^2(2) Porphyroid biotite granite Granite-JURASSIC UNDIF.
43400.01 437 hg4-5^1 Gneissic biotite monzonitic granite -TRIASSIC UNDIF.
43400.01 437 hg4-5^1 Gneissic biotite granite-RIASSIC UNDIF.
43400.02 438 gd4-5^1 Gneissic grandiorite -TRIASSIC UNDIF
43400.02 438 gd4-5^1 Gneissic grandiorite Granite-TRIASSIC UNDIF.
43400.03 439 do4-5^1 Gneissic quartz diorite -TRIASSIC UNDIF.
43400.03 439 do4-5^1 Gneissic quartz diorite-TRIASSIC UNDIF.
43400.04 440 n4-5^1 Gabbro -TRIASSIC UNDIF
45400.01 601 hg3 Gneissic biotite monzonitic granite -E. PALAEOZOIC UNDIF.
45400.01 601 hg3 Gneissic biotite monzonitic granite-E. PALAEOZOIC UNDIF.
45400.02 602 gm3 Migmatitic granite two mica granite -E. PALAEOZOIC UNDIF.
45400.02 602 gm3 Migmatitic granite two mica granite-E. PALAEOZOIC UNDIF.
45400.02 602 gm3 Migmatitic granite two mica granite-E. PALAEOZOIC UNDIF.
45400.03 603 s3 Gneissic peridotite -E. PALAEOZOIC UNDIF.
90000 604 r Pegmatitic vein (group) -UNKNOWN
98000 900 Water Undifferentiated

Fig. 47. Geology of Zhejiang Province
(AMIRA P603 Project)



# Geology Legend (Zhejiang)

Geology Legend (Zhejiang)

11110.01 125 Q4d^al Dagutang Fm. -HOLOCENE
11110.01 182 Q4d^m Dagutang Fm. -HOLOCENE
11110.02 183 Q4z^m Zhongjiachan Fm. -HOLOCENE
11110.03 127 Q4hn^al Huangtianfan Fm. -HOLOCENE
11110.03 184 Q4hn^m Huangtianfan Fm. -HOLOCENE
11110.05 124 Q4y^al Yinjiangqiao Fm. -HOLOCENE
11110.05 143 Q4y^pl Yinjiangqiao Fm. -HOLOCENE
11120.02 130 Q3c^al Shanmenjie Fm. -UP. PLEISTOCENE
11120.02 149 Q3c^pl Shanmenjie Fm. -UP. PLEISTOCENE
11120.04 133 Q3y^al Yangmeiling Fm. -UP. PLEISTOCENE
11120.04 152 Q3y^pl Yangmeiling Fm. -UP. PLEISTOCENE
11130.02 135 Q2d^al Dayantou Fm. -M. PLEISTOCENE
11130.02 154 Q2d^pl Dayantou Fm. -M. PLEISTOCENE
11140.02 139 Q1q^al Qianjiang Fm. -LW. PLEISTOCENE
11140.02 156 Q1q^pl Qianjiang Fm. -LW. PLEISTOCENE
11140.03 140 Q1t^al Tangxi Fm. -LW. PLEISTOCENE
11140.05 161 Q1^pl Undifferentiated -LW. PLEISTOCENE
11210.01 120 N2d Daoshiqiao Fm. -PLIOCENE
11210.02 121 N2t Tonglingzhu Fm. -PLIOCENE
11210.02 121 N2t Tonglingzhu Fm. Acid ignimbrite-PLIOCENE
11210.02 121 N2t Tonglingzhu Fm. Basic lava-PLIOCENE
11210.03 122 N2 Undifferentiated -PLIOCENE
11210.03 122 N2 Undifferentiated Basic lava-PLIOCENE
12110.01 306 K2^2 Laijia Fm. Second Mm -UP. CRETACEOUS
12110.02 307 K2^1 Laijia Fm. First Mm -UP. CRETACEOUS
12110.03 305 K2l Laijia Fm. -UP CRETACEOUS
12110.04 308 K2t Tangshang Fm. -UP. CRETACEOUS
12110.04 308 K2t Tangshang Fm. Acid ignimbrite-UP. CRETACEOUS
12110.04 308 K2t Tangshang Fm. Acid tuff-UP. CRETACEOUS
12110.05 302 K2^3 Jinhua Fm. Third Mm -UP. CRETACEOUS
12110.06 303 K2^2 Jinhua Fm. Second Mm -UP. CRETACEOUS
12110.07 304 K2^1 Jinhua Fm. First Mm -UP. CRETACEOUS
12110.08 301 K2j Jinhua Fm. -UP. CRETACEOUS
12120.01 309 K1f Fangyan Fm. -LW. CRETACEOUS
12120.01 309 K1f Fangyan Fm. Basic lava-LW. CRETACEOUS
12120.02 311 K1c^2 Chaochuan Fm. Second Mm -LW. CRETACEOUS
12120.02 311 K1c^2 Chaochuan Fm. Second Mm Acid ignimbrite-LW. CRETACEOUS
12120.02 311 K1c^2 Chaochuan Fm. Second Mm Acid tuff-LW. CRETACEOUS
12120.03 312 K1c^1 Chaochuan Fm. First Mm -LW. CRETACEOUS
12120.03 312 K1c^1 Chaochuan Fm. First Mm Intermediate lava-LW. CRETACEOUS
12120.04 310 K1c Chaochuan Fm. -LW. CRETACEOUS
12120.04 310 K1c Chaochuan Fm. Basic lava-LW. CRETACEOUS
12120.04 310 K1c Chaochuan Fm. Intermediate lava-LW. CRETACEOUS
12120.05 313 K1g Guantou Fm. -LW. CRETACEOUS
12120.05 313 K1g Guantou Fm. Acid ignimbrite-LW. CRETACEOUS
12120.05 313 K1g Guantou Fm. Acid tuff-LW. CRETACEOUS
12120.05 313 K1g Guantou Fm. Intermediate lava-LW. CRETACEOUS
12210.01 315 J3z Zhucun Fm. -UP. JURASSIC
12210.01 315 J3z Zhucun Fm. Acid ignimbrite-UP. JURASSIC
12210.01 315 J3z Zhucun Fm. Acid tuff-UP. JURASSIC
12210.01 315 J3z Zhucun Fm. Intermediate lava-UP. JURASSIC
12210.01 315 J3z Zhucun Fm. Intermediate-acid ignimbrite-UP. JURASSIC
12210.01 315 J3z Zhucun Fm. Intermediate-acid tuff-UP. JURASSIC
12210.02 314 J3hn Hengshan Fm. -UP. JURASSIC
12210.03 317 J3j Jiuliping Fm. -UP. JURASSIC
12210.03 317 J3j Jiuliping Fm. Acid ignimbrite-UP. JURASSIC
12210.03 317 J3j Jiuliping Fm. Acid lava-UP. JURASSIC
12210.03 317 J3j Jiuliping Fm. Acid tuff-UP. JURASSIC
12210.03 317 J3j Jiuliping Fm. Intermediate lava-UP. JURASSIC
12210.04 318 J3c Chawan Fm. -UP. JURASSIC
12210.04 318 J3c Chawan Fm. Acid tuff-UP. JURASSIC
12210.04 318 J3c Chawan Fm. Intermediate lava-UP. JURASSIC
12210.04 318 J3c Chawan Fm. Intermediate-acid ignimbrite-UP. JURASSIC
12210.04 318 J3c Chawan Fm. Intermediate-acid lava-UP. JURASSIC
12210.05 316 J3s Shouchang Fm. -UP. JURASSIC
12210.06 320 J3x Xishantou Fm. -UP. JURASSIC
12210.06 320 J3x Xishantou Fm. Acid ignimbrite-UP. JURASSIC
12210.06 320 J3x Xishantou Fm. Acid lava-UP. JURASSIC
12210.06 320 J3x Xishantou Fm. Acid tuff-UP. JURASSIC
12210.06 320 J3x Xishantou Fm. Intermediate lava-UP JURASSIC
12210.06 320 J3x Xishantou Fm. Intermediate-acid ignimbrite-UP. JURASSIC
12210.06 320 J3x Xishantou Fm. Intermediate-acid lava-UP. JURASSIC
12210.06 320 J3x Xishantou Fm. Intermediate-acid tuff-UP. JURASSIC
12210.07 321 J3g Gaowu Fm. -UP. JURASSIC
12210.07 321 J3g Gaowu Fm. Acid ignimbrite-UP. JURASSIC
12210.07 321 J3g Gaowu Fm. Acid lava-UP. JURASSIC
12210.07 321 J3g Gaowu Fm. Acid tuff-UP. JURASSIC
12210.07 321 J3g Gaowu Fm. Intermediate-acid ignimbrite-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. -UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Acid ignimbrite-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Acid lava-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Acid tuff-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Intermediate lava-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Intermediate-acid ignimbrite-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Intermediate-acid lava-UP. JURASSIC
12210.08 319 J3h Huangjian Fm. Intermediate-acid tuff-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. -UP JURASSIC
12210.09 323 J3d Dashuang Fm. Acid ignimbrite-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. Acid lava-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. Acid tuff-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. Intermediate lava-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. Intermediate-acid ignimbrite-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. Intermediate-acid lava-UP. JURASSIC
12210.09 323 J3d Dashuang Fm. Intermediate-acid tuff-UP. JURASSIC
12210.1 322 J3l Laocun Fm. -UP. JURASSIC
12210.1 322 J3l Laocun Fm. Acid ignimbrite-UP. JURASSIC
12210.1 322 J3l Laocun Fm. Acid lava-UP. JURASSIC
12210.1 322 J3l Laocun Fm. Acid tuff-UP. JURASSIC
12210.1 322 J3l Laocun Fm. Intermediate lava-UP. JURASSIC
12220.01 324 J2w Wentang Fm. -M. JURASSIC
12220.03 327 J2y Yushanjian Fm. -M. JURASSIC
12220.04 328 J2m Majian Fm. -M. JURASSIC
12220.05 329 J2ml Maolong Fm. -M. JURASSIC
12220.06 325 J2 Undifferentiated -M. JURASSIC
12230.01 330 J1f Fengping Fm -LW. JURASSIC
12310.01 331 T3w Wuzao Fm. -UP. TRIASSIC
12310.05 336 T1 Undifferentiated -UP. TRIASSIC

12330.04 335 T1z Zhengtang Fm. -LW. TRIASSIC
12330.05 721 P2 + T1 Undifferentiated -LW. TRIASSIC
13120.06 505 P2 Undifferentiated -M. PERMIAN
13130.04 508 P1 Undifferentiated -LW. PERMIAN
13130.05 717 C3 + P1 Undifferentiated -LW. PERMIAN
13140 719 P Undifferentiated -PERMIAN UNDIF.
13210.02 510 C3c Chuanshan Fm. -UP. CARBONIFEROUS
13210.03 511 C3 Undifferentiated -UP. CARBONIFEROUS
13210.04 720 C2+3 Undifferentiated -UP CARBONIFEROUS
13220.03 513 C2 Undifferentiated -M. CARBONIFEROUS
13220.04 723 C1+2 Undifferentiated -M. CARBONIFEROUS
13230.02 514 C1y Yejiatang Fm. -LW. CARBONIFEROUS
13230.05 517 C1 Undifferentiated -LW. CARBONIFEROUS
13240 718 C Undifferentiated -CARBONIFEROUS UNDIF.
13310.02 520 D3x Xihu Fm. -UP. DEVONIAN
13310.03 518 D3w Wutong Fm. -UP. DEVONIAN
13310.04 521 D3 Undifferentiated -UP. DEVONIAN
13370 522 Pz2hx Hexi Gr. -UP. PALAEOZOIC UNDIF.
13410.01 524 S3t Tongjiawu Fm. -UP. SILURIAN
13410.02 523 S3m Maoshan Fm. -UP. SILURIAN
13420.02 526 S2 Undifferentiated -M. SILURIAN
13420.03 731 S1+2 Undifferentiated -M. SILURIAN
13430.02 527 S1d Dabaidi Fm. -LW. SILURIAN
13430.03 528 S1a Anji Fm. -LW. SILURIAN
13430.04 529 S1 Undifferentiated -LW. SILURIAN
13510.01 531 O3w Wenchang Fm -UP. ORDOVICIAN
13510.02 530 O3yn Yankou Fm. -UP. ORDOVICIAN
13510.03 533 O3s Sanqushan Fm. -UP. ORDOVICIAN
13510.04 534 O3c Changwu Fm. -UP. ORDOVICIAN
13510.05 532 O3y Yuqian Fm. -UP. ORDOVICIAN
13510.06 535 O3h Huangnigang Fm. -UP. ORDOVICIAN
13510.07 726 O3 Undifferentiated -UP. ORDOVICIAN
13520.04 539 O2 Undifferentiated -M. ORDOVICIAN
13520.05 724 O1+2 Undifferentiated -M. ORDOVICIAN
13530.07 546 O1 Undifferentiated -LW. ORDOVICIAN
13540 725 O Undifferentiated -ORDOVICIAN UNDIF.
13610.01 547 Ca3x Xiyangshan Fm. -UP. CAMBRIAN
13610.02 548 Ca3h Huayanci Fm. -UP. CAMBRIAN
13610.03 549 Ca3ch Chaofeng Gr. -UP. CAMBRIAN
13610.04 550 Ca3 Undifferentiated -UP. CAMBRIAN
13610.05 728 Ca2+3 Undifferentiated -UP. CAMBRIAN
13620.03 552 Ca2 Undifferentiated -M. CAMBRIAN
13620.03 727 Ca1+2 Undifferentiated -M. CAMBRIAN
13630.05 556 Ca1 Undifferentiated -LW. CAMBRIAN
13640 730 Ca Undifferentiated -CAMBRIAN UNDIF.
13800 707 Z-Pz1^ln Longquan Gr. -LW. PALAEOZOIC UNDIF.
21120.03 703 Z2 Undifferentiated -M. SINIAN
21130.01 704 Z1l Leigongwu Fm. -LW. SINIAN
21130.02 705 Z1z Zhifang Fm. -LW. SINIAN
21130.03 706 Z1 Undifferentiated -LW. SINIAN
21140.02 729 Z Undifferentiated -SINIAN UNDIF.
21142.01 709 AnZch^d D Mm -PRE-SINIAN
21142.01 709 AnZch^d D Mm Acid lava-PRE-SINIAN
21142.01 709 AnZch^d D Mm Partially migmatitic rock-PRE-SINIAN
21142.021 732 AnZch^b+c Undifferentiated -PRE-SINIAN
21142.031 713 AnZch^b B Mm -PRE-SINIAN
21142.06 708 AnZs Shangshu Fm. -PRE-SINIAN
21142.06 708 AnZs Shangshu Fm. Acid lava-PRE-SINIAN
21142.06 708 AnZs Shangshu Fm. Acid tuff-PRE-SINIAN
21142.07 710 AnZh Hongchicun Fm. -PRE-SINIAN
21142.08 712 AnZl Luojiamen Fm. -PRE-SINIAN
21142.09 715 AnZch Undifferentiated Partially migmatitic rock-PRE-SINIAN
21142.1 716 AnZsh Shuangxiwu Gr. -PRE-SINIAN
21142.1 716 AnZsh Shuangxiwu Gr. Intermediate lava-PRE-SINIAN
41300.01 201 ecδ Ijolite -TERTIARY UNDIF.
41300.02 202 cbδ Alnoite -TERTIARY UNDIF.
41300.03 203 Σδ Ultra-basic tock -TERTIARY UNDIF.
41300.04 204 bmδ Diabase porphyrite -TERTIARY UNDIF
41300.05 205 nmδ Gabbro porphyrite -TERTIARY UNDIF
41300.06 206 nbδ Gabbro diabase -TERTIARY UNDIF.
41300.07 207 bN2 Basalt -TERTIARY UNDIF.
41300.08 208 cbN2 Nepheline basalt -TERTIARY UNDIF.
41300.09 209 bmN2 Diabase porphyrite -TERTIARY UNDIF
42094.02 402 xpK2 Syenite porphyry -CRETACEOUS
42094.03 403 xopK2 Quartz syenite porphyry -CRETACEOUS
42094.04 404 lK2 Rhyolite -CRETACEOUS
42094.04 404 lK2 Rhyolite Acid lava-CRETACEOUS
42094.05 405 lpK2 Rhyolite porphyry -CRETACEOUS
42094.06 406 zK2 Dacite -CRETACEOUS
42094.06 406 zK2 Dacite Alkalic lava-CRETACEOUS
42094.07 407 zmK2 Dacite porphyrite -CRETACEOUS
42095.01 408 xop5^3(1)d Quartz syenite porphyry -CRETACEOUS
42095.02 409 xo5^3(1)d Quartz syenite -CRETACEOUS
42095.03 410 gp5^3(1)d Granite porphyry -CRETACEOUS
42095.04 411 xgp5^3(1)d K-feldspar granite-porphyry -CRETACEOUS
42095.04 411 xgp5^3(1)d K-feldspar granite-porphyry K-feldspar granite-CRETACEOUS
42095.05 412 xg5^3(1)d Fine-microscopic-grained K-feldspar granite -CRETACEOUS
42095.05 412 xg5^3(1)d Fine-microscopic-grained K-feldspar granite K-feldspar granite-CRETACEOUS
42095.05 412 xg5^3(1)d Fine-microscopic-grained K-feldspar granite porphyroid texture-CRETACEOUS
42095.06 413 hgp5^3(1)c Monzonitic granite-porphyry -CRETACEOUS
42095.06 413 hgp5^3(1)c Monzonitic granite-porphyry K-feldspar granite-CRETACEOUS
42095.06 413 hgp5^3(1)c Monzonitic granite-porphyry Monzonitic granite-CRETACEOUS
42095.07 414 g5^3(1)c Granite -CRETACEOUS
42095.07 414 g5^3(1)c Granite K-feldspar granite-CRETACEOUS
42095.07 414 g5^3(1)c Granite porphyroid texture-CRETACEOUS
42095.08 415 xg5^3(1)c Medium-fine-grained K-feldspar granite -CRETACEOUS
42095.08 415 xg5^3(1)c Medium-fine-grained K-feldspar granite K-feldspar granite-CRETACEOUS
42095.08 415 xg5^3(1)c Medium-fine-grained K-feldspar granite Monzonitic granite-CRETACEOUS
42095.08 415 xg5^3(1)c Medium-fine-grained K-feldspar granite porphyroid texture-CRETACEOUS
42095.09 416 hg5^3(1)c Monzonitic granite -CRETACEOUS
42095.09 416 hg5^3(1)c Monzonitic granite K-feldspar granite-CRETACEOUS
42095.1 417 gd5^3(1)b Granodiorite -CRETACEOUS
42095.1 417 gd5^3(1)b Granodiorite Granite-CRETACEOUS
42095.11 418 gdp5^3(1)b Granodiorite porphyry -CRETACEOUS
42095.12 419 ho5^3(1)b Quartz monzonite -CRETACEOUS
42095.13 420 hop5^3(1)b Quartz monzonite-porphyry -CRETACEOUS
42095.14 426 d5^3(1)a Diorite -CRETACEOUS
42095.15 427 dm5^3(1)a Diorite-porphyrite -CRETACEOUS

42095.16 428 do5^3(1)a Quartz diorite -CRETACEOUS
42095.16 428 do5^3(1)a Quartz diorite Diorite-CRETACEOUS
42095.16 428 do5^3(1)a Quartz diorite Monzonitic granite-CRETACEOUS
42095.16 428 do5^3(1)a Quartz diorite Quartz syenite porphyry-CRETACEOUS
42095.17 429 dom5^3(1)a Quartz diorite porphyrite -CRETACEOUS
42095.18 430 nm5^3(1)a Gabbro porphyrite -CRETACEOUS
42095.19 431 nb5^3(1)a Gabbro diabase -CRETACEOUS
42095.2 421 lK1 Rhyolite -CRETACEOUS
42095.2 421 lK1 Rhyolite Acid lava-CRETACEOUS
42095.21 422 lpK1 Rhyolite porphyry -CRETACEOUS
42095.21 422 lpK1 Rhyolite porphyry Acid lava-CRETACEOUS
42095.22 423 uopK1 Quartz-felsite porphyry -CRETACEOUS
42095.23 424 unpK1 Plagioclase-felsite porphyry -CRETACEOUS
42095.24 425 zmK1 Dacite porphyrite -CRETACEOUS
42095.25 432 amK1 Andesite porphyrite -CRETACEOUS
42095.25 432 amK1 Andesite porphyrite Acid lava-CRETACEOUS
42095.26 433 abmK1 Adesite-basalt porphrite -CRETACEOUS
42095.27 816 npk1 Subvolcanic -CRETACEOUS
42095.28 817 ak1 Subvolcanic -CRETACEOUS
42160.01 434 x5^2(3) Syenite -L JURASSIC
42160.02 435 xp5^2(3) Syenite porphyry -L. JURASSIC
42160.02 435 xp5^2(3) Syenite porphyry Quartz syenite porphyry-L. JURASSIC
42160.03 436 xo5^2(3) Quartz syenite -L. JURASSIC
42160.03 436 xo5^2(3) Quartz syenite Quartz diorite-L. JURASSIC
42160.03 436 xo5^2(3) Quartz syenite Quartz syenite porphyry-L. JURASSIC
42160.04 437 xop5^2(3) Quartz syenite porphyry -L. JURASSIC
42160.05 438 g5^2(3) Granite -L. JURASSIC
42160.05 438 g5^2(3) Granite porphyroid texture-L. JURASSIC
42160.06 439 gp5^2(3) Granite porphyry -L. JURASSIC
42160.06 439 gp5^2(3) Granite porphyry Granite-L. JURASSIC
42160.07 440 xg5^2(3) K-feldspar granite -L. JURASSIC
42160.07 440 xg5^2(3) K-feldspar granite Granite-L. JURASSIC
42160.07 440 xg5^2(3) K-feldspar granite porphyroid texture-L. JURASSIC
42160.08 441 xgp5^2(3) K-feldspar granite-porphyry -L. JURASSIC
42160.09 442 hg5^2(3) Monzonitic granite -L. JURASSIC
42160.1 443 hgp5^2(3) Monzonitic granite-porphyry -L. JURASSIC
42160 11 453 xpJ3 Syenite porphyry -L. JURASSIC
42160.12 454 tpJ3 Trachyte porphyry -L. JURASSIC
42160.13 455 lJ3 Rhyolite -L. JURASSIC
42160.13 455 lJ3 Rhyolite Acid lava-L. JURASSIC
42160.14 456 lpJ3 Rhyolite porphyry -L. JURASSIC
42160 14 456 lpJ3 Rhyolite porphyry Acid lava-L. JURASSIC
42160.15 457 gpJ3 Granite porphyry -L. JURASSIC
42160.15 457 gpJ3 Granite porphyry Granite-L. JURASSIC
42160.17 459 upJ3 Felsite-prophyry -L. JURASSIC
42160.17 459 upJ3 Felsite-prophyry Acid lava-L. JURASSIC
42160 18 460 uopJ3 Quartz-felsite porphyry -L. JURASSIC
42160.18 460 uopJ3 Quartz-felsite porphyry Acid tuff-L. JURASSIC
42160.19 461 alJ3 Acid ignimbrite -L. JURASSIC
42160.2 462 zmJ3 Dacite porphyrite -L. JURASSIC
42160.2 462 zmJ3 Dacite porphyrite Intermediate-acid lava-L. JURASSIC
42160.21 463 aJ3 Andesite -L. JURASSIC
42160.22 464 amJ3 Andesite porphyrite -L JURASSIC
42160.22 464 amJ3 Andesite porphyrite Intermediate lava-L JURASSIC
42160.23 465 dmJ3 Diorite-porphyrite -L. JURASSIC
42161.16 444 gd5^2(2) Granodiorite -L JURASSIC
42161.16 444 gd5^2(2) Granodiorite Granite-L. JURASSIC
42161.17 445 gdp5^2(2) Granodiorite porphyry -L. JURASSIC
42161.17 445 gdp5^2(2) Granodiorite porphyry Granite-L. JURASSIC
42161.17 445 gdp5^2(2) Granodiorite porphyry Granodiorite-L JURASSIC
42161.18 446 ho5^2(2) Quartz monzonite -L. JURASSIC
42161.19 447 d5^2(2) Diorite -L. JURASSIC
42161.2 448 do5^2(2) Quartz diorite -L. JURASSIC
42161.2 448 do5^2(2) Quartz diorite Granodiorite-L. JURASSIC
42161.2 448 do5^2(2) Quartz diorite Quartz syenite-L JURASSIC
42161.21 449 dom5^2(2) Quartz diorite porphyrite -L JURASSIC
42161.21 449 dom5^2(2) Quartz diorite porphyrite Quartz syenite-L. JURASSIC
42161.22 450 dc5^2(2) Mica-augite lamprophyre -L. JURASSIC
42161.23 451 nb5^2(2) Gabbro diabase -L. JURASSIC
42161.24 452 n5^2(2) Gabbro -L. JURASSIC
42162.01 466 gM5^2(1) Migmatitic granite -L. TRIASSIC - M. JURRASIC
43400.01 467 g5^1 Granite -TRIASSIC UNDIF.
43400.02 468 gd5^1 Granodiorite -TRIASSIC UNDIF.
43400.02 468 gd5^1 Granodiorite Granite-TRIASSIC UNDIF
43400.03 469 dm5^1 Diorite-porphyrite -TRIASSIC UNDIF.
43400.04 470 do5^1 Quartz diorite -TRIASSIC UNDIF.
43400.05 471 n5^1 Gabbro -TRIASSIC UNDIF.
45400.01 601 Jw3 Serpentine -E. PALAEOZOIC UNDIF.
45400.02 602 ys3 Harzburgite -E. PALAEOZOIC UNDIF
45400.03 603 hgM3 Migmatitic monzonitic granite -E PALAEOZOIC UNDIF.
45400.04 604 gdM3 Migmatitic granodiorite Granodiorite-E. PALAEOZOIC UNDIF.
47310.01 801 gM2^3 Migmatitic granite -M. PROTEROZOIC UNDIF.
47310.02 802 xgM2^3 Migmatitic K-feldspar granite -M. PROTEROZOIC UNDIF.
47310.03 803 hgM2^3 Migmatitic monzonitic granite -M. PROTEROZOIC UNDIF.
47310.04 804 gdM2^3 Migmatitic granodiorite -M. PROTEROZOIC UNDIF.
47310.04 804 gdM2^3 Migmatitic granodiorite Granodiorite-M. PROTEROZOIC UNDIF.
47310.05 805 xoM2^3 Migmatitic quartz syenite -M. PROTEROZOIC UNDIF
47310.06 806 hoM2^3 Migmatitic quartz-monzonite -M. PROTEROZOIC UNDIF.
47310.07 807 g2^3 Granite -M. PROTEROZOIC UNDIF.
47310.08 808 gp2^3 Granite porphyry -M. PROTEROZOIC UNDIF
47310.09 809 bm2^3 Diabase -M. PROTEROZOIC UNDIF
47310.1 810 lpAnZs Rhyolite porphyry Acid lava-M. PROTEROZOIC UNDIF.
47310 11 811 aAnZs Andesite -M. PROTEROZOIC UNDIF.
48500.01 812 bm2^2 Diabase porphyrite -PROTEROZOIC UNDIF.
48500.02 813 do2^2 Quartz diorite -PROTEROZOIC UNDIF.
48500.03 814 doM2^2 Migmatitic quartz-diorite -PROTEROZOIC UNDIF.
48500.04 815 y2^2 Hornblendite -PROTEROZOIC UNDIF.
90000.01 001 gp Granite porphyry -UNKNOWN
90000.02 002 lp Rhyolitic porphyry -UNKNOWN
90000.03 003 u Felsite -UNKNOWN
90000.04 004 up Felsite-prophyry -UNKNOWN
90000.05 005 xgp K-feldspar granite-porphyry -UNKNOWN
90000.06 006 gdp Granodiorite porphyry -UNKNOWN
90000.08 008 xp Syenite porphyry -UNKNOWN
90000.09 009 O Quartz vein -UNKNOWN
99000 900 Water Undifferentiated

Fig. 48. Map showing mineral occurrences in Fujian
(AMIRA P603 Project)

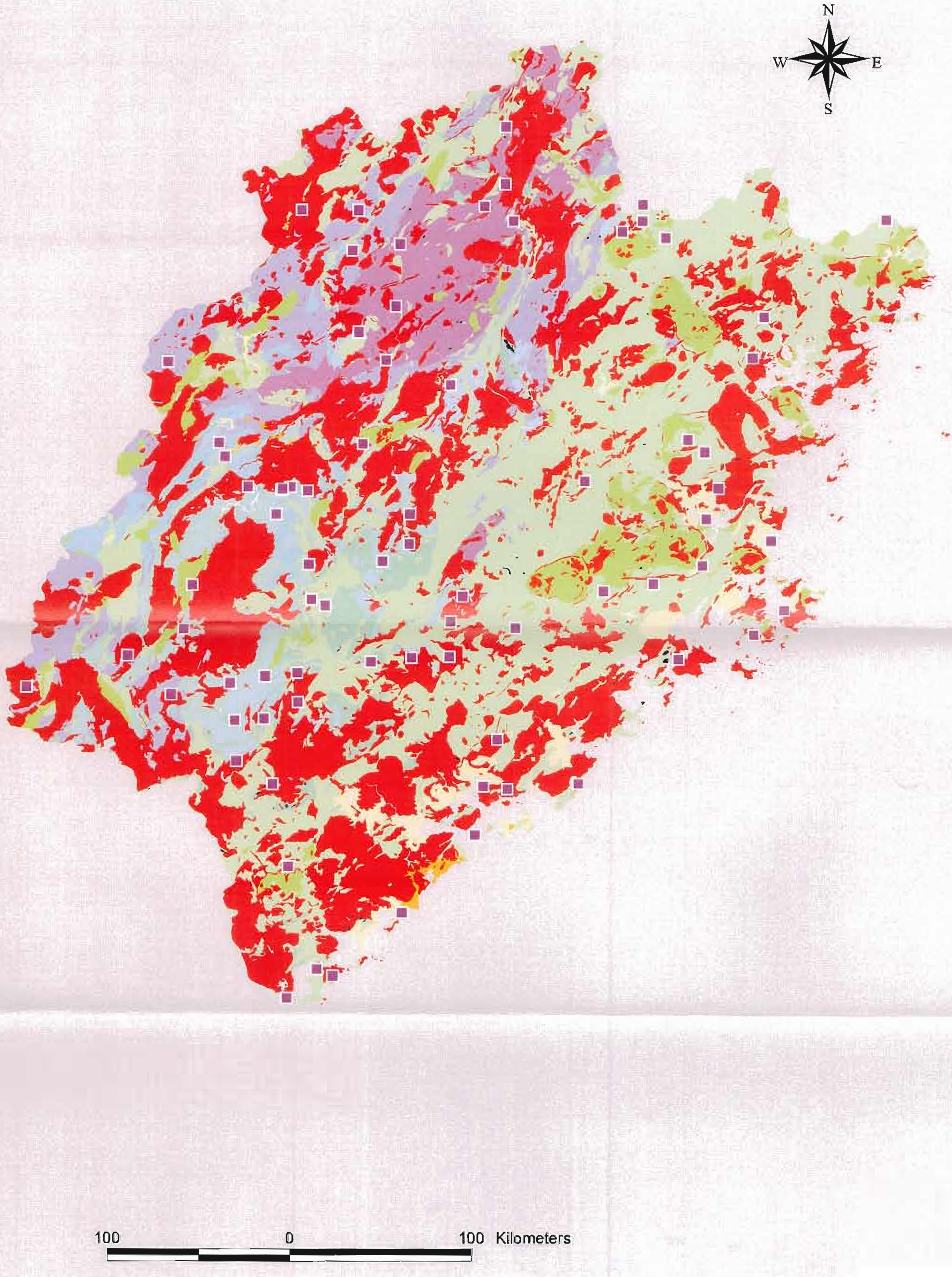


Fig. 49. Map showing mineral occurrences in Zhejiang
(AMIRA P603 Project)

Fig. 50. Map showing lead, zinc, copper, gold and silver occurrences in Fujian
(AMIRA P603 Project)

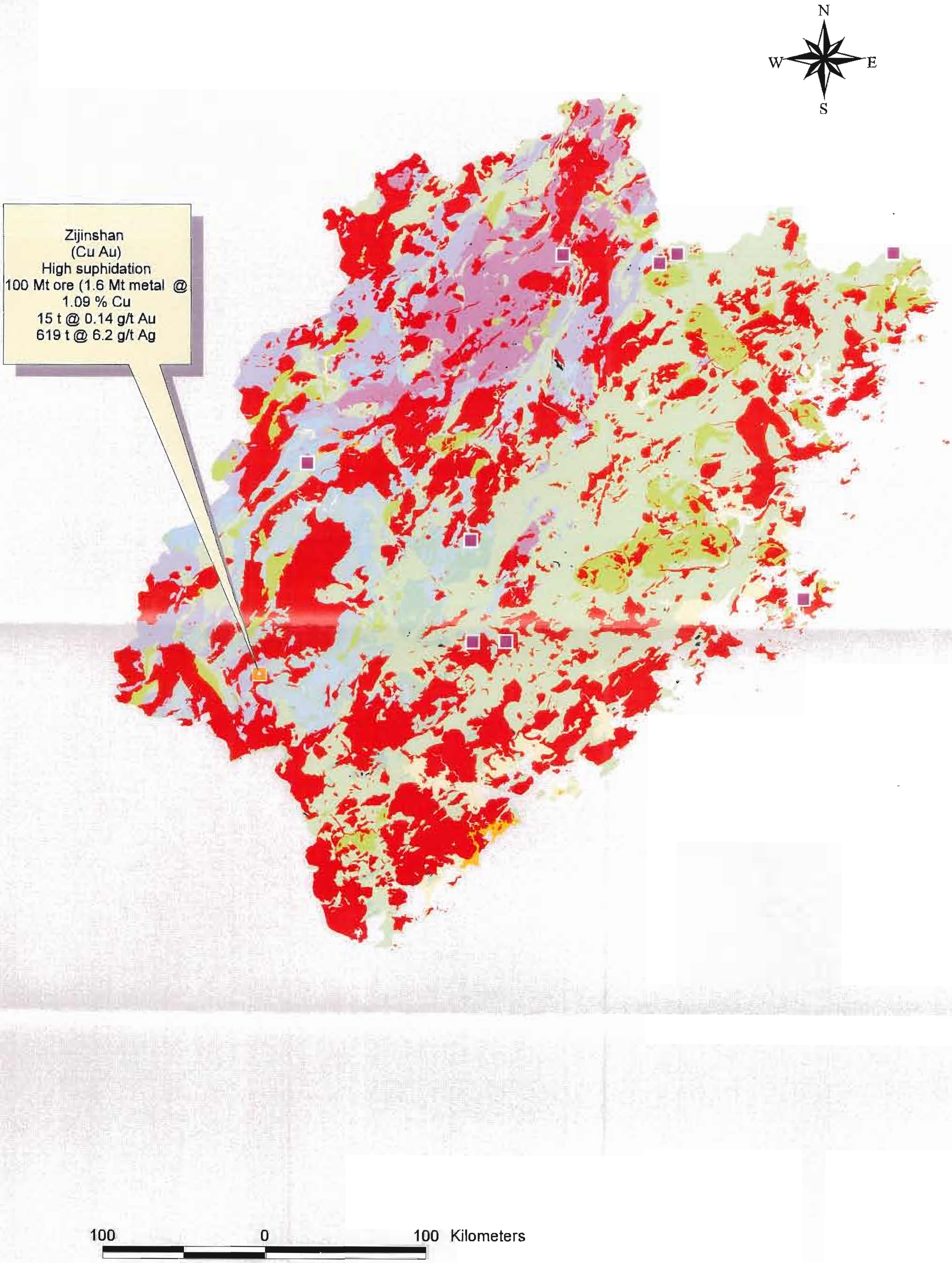


Fig. 51. Map showing lead, zinc, copper, gold and silver occurrences in Zhejiang
(AMIRA P603 Project)

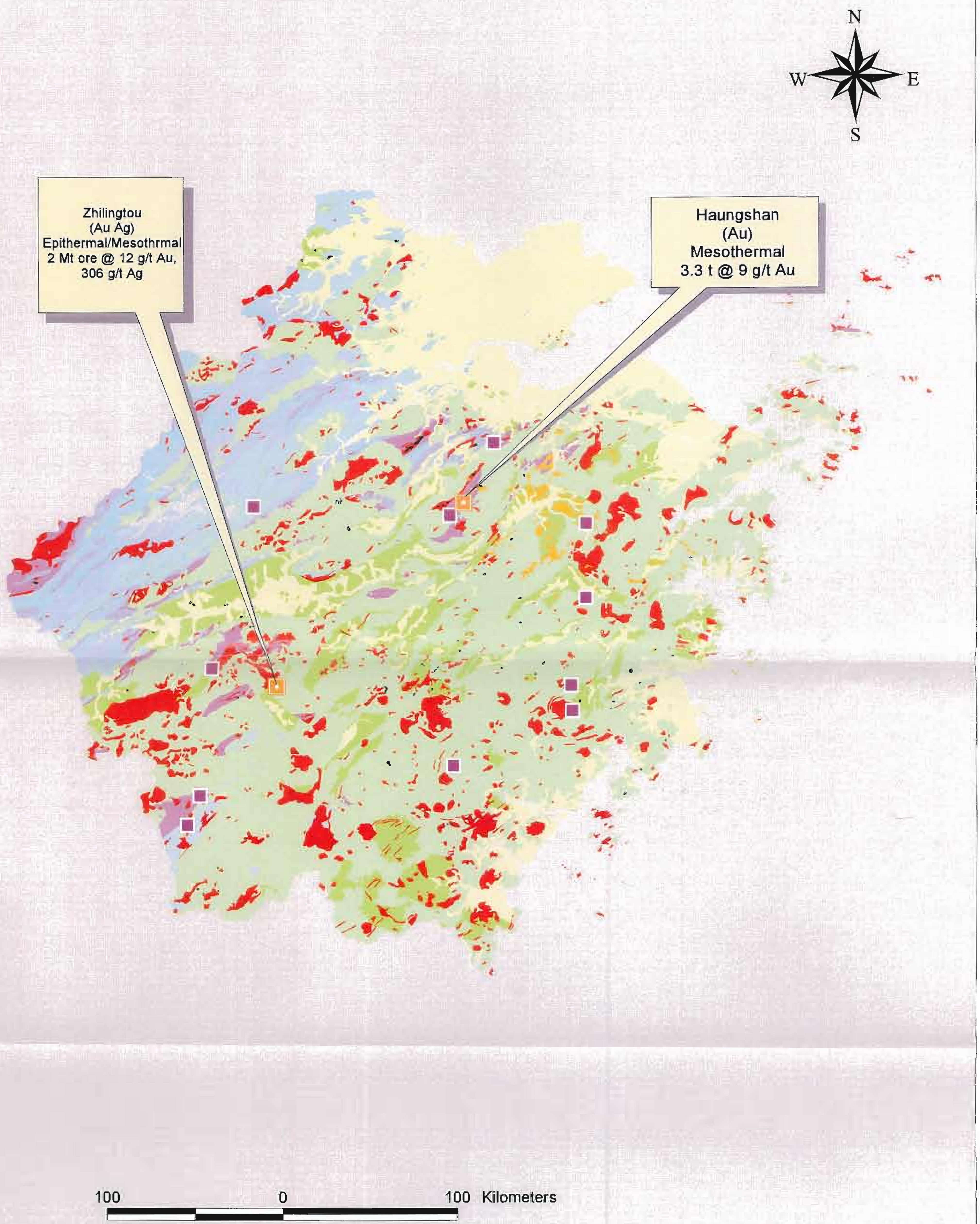
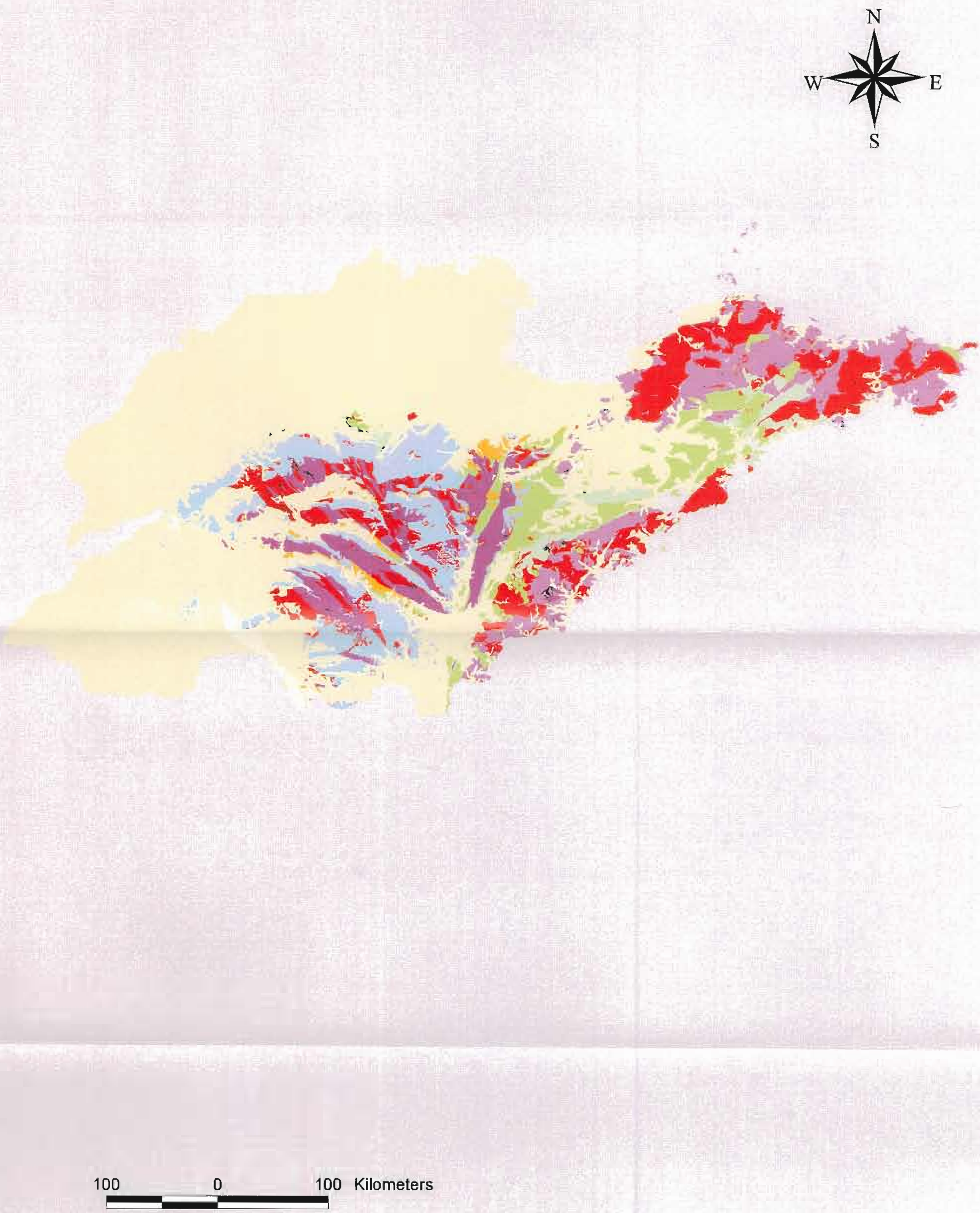


Fig. 52. Geology of Shandong Province
(AMIRA P603 Project)



# Geology Legend (Shandong)

Geology Legend (Shandong)

11110.02 102 Q4^al Undifferentiated -HOLOCENE
11110.03 103 Q4^pl Undifferentiated -HOLOCENE
11110.04 104 Q4^m Undifferentiated -HOLOCENE
11110.08 108 Q3+4^al Undifferentiated -HOLOCENE
11110.09 109 Q3+4^m Undifferentiated -HOLOCENE
11110.11 111 Q3-4^al Undifferentiated -HOLOCENE
11110.12 112 Q3-4^m Undifferentiated -HOLOCENE
11120.08 114 Q3^al Undifferentiated -UP. PLEISTOCENE
11120.09 115 Q3^pl Undifferentiated -UP. PLEISTOCENE
11120.1 116 Q3^dl Undifferentiated -UP. PLEISTOCENE
11130.02 118 Q2^al Undifferentiated -M. PLEISTOCENE
11130.04 120 Q2^dl Undifferentiated -M. PLEISTOCENE
11130.06 122 Q1+2^al Undifferentiated -M. PLEISTOCENE
11150.01 123 Q Undifferentiated -QUATERNARY UNDIF.
11150.02 124 Q^eld Undifferentiated -QUATERNARY UNDIF.
11150.03 125 N-Qb Undifferentiated -QUATERNARY UNDIF.
11150.03 125 N-Qb Undifferentiated Basic volcanics-QUATERNARY UNDIF.
11210.01 126 N2y Raoshan Fm. -PLIOCENE
11220.01 127 N1s Shanwang Fm. -MIOCENE
11220.02 128 N1n Niushan Fm. -MIOCENE
11220.02 128 N1n Niushan Fm. Basic volcanics-MIOCENE
11225 129 N Undifferentiated -NEOGENE UNDIF.
11230.01 130 E2-3g^3 Guanzhuang Fm. 3rd Mm. -OLIGOCENE
11230.02 131 E2-3g^2 Guanzhuang Fm. 2nd Mm. -OLIGOCENE
11230.03 132 E2-3g^1+2 Guanzhuang Fm 1st & 2nd Mm. -OLIGOCENE
11230.04 133 E2-3g^1 Guanzhuang Fm. 1st Mm. -OLIGOCENE
11230.05 134 E2-3g Guanzhuang Fm. -OLIGOCENE
11230.06 135 E2-3w Wutu Fm. -OLIGOCENE
11260 136 E Undifferentiated -TERTIARY UNDIF.
12110.01 301 K2w^3 Wangshi Fm. 3rd Mm. -UP. CRETACEOUS
12110.02 302 K2w^2 Wangshi Fm. 2nd Mm. -UP. CRETACEOUS
12110.02 302 K2w^2 Wangshi Fm. 2nd Mm. Basic volcUP. CRETACEOUS
12110.03 303 K2w^1 Wangshi Fm. 1st Mm. -UP. CRETACEOUS
12110.03 303 K2w^1 Wangshi Fm. 1st Mm. Basic volcUP. CRETACEOUS
12110.04 304 K2w Wangshi Fm. -UP. CRETACEOUS
12120.01 305 K1q^3 Qingshan Fm. 3rd Mm. -LW. CRETACEOUS
12120.01 305 K1q^3 Qingshan Fm. 3rd Mm. Acid to intermediate volc-LW. CRETACEOUS
12120.01 305 K1q^3 Qingshan Fm. 3rd Mm. Intermediate volc-LW. CRETACEOUS
12120.02 306 K1q^2-3 Qingshan Fm. 2nd & 3rd Mm. -LW. CRETACEOUS
12120.02 306 K1q^2-3 Qingshan Fm. 2nd & 3rd Mm. Acid volcanics-LW. CRETACEOUS
12120.02 306 K1q^2-3 Qingshan Fm. 2nd & 3rd Mm. Intermediate volc-LW. CRETACEOUS
12120.03 307 K1q^2 Qingshan Fm. 2nd Mm. -LW. CRETACEOUS
12120.03 307 K1q^2 Qingshan Fm. 2nd Mm. Acid to intermediate volc-LW. CRETACEOUS
12120.03 307 K1q^2 Qingshan Fm. 2nd Mm. Intermediate volcanics-LW. CRETACEOUS
12120.03 307 K1q^2 Qingshan Fm. 2nd Mm. Intermediate volcanics-LW. CRETACEOUS
12120.04 308 K1q^1-2 Qingshan Fm. 1st & 2nd Mm. -LW. CRETACEOUS
12120.05 309 K1q^1 Qingshan Fm. 1st Mm. -LW. CRETACEOUS
12120.05 309 K1q^1 Qingshan Fm. 1st Mm. Acid to intermediate volc-LW. CRETACEOUS
12120.05 309 K1q^1 Qingshan Fm. 1st Mm. Intermediate volc-LW. CRETACEOUS
12120.05 309 K1q^1 Qingshan Fm. 1st Mm. Intermediate volc-LW. CRETACEOUS
12120.06 310 K1q Qingshan Fm. -LW. CRETACEOUS
12120.06 310 K1q Qingshan Fm. Acid to intermediate volc-LW. CRETACEOUS
12120.06 310 K1q Qingshan Fm. Intermediate volc-LW. CRETACEOUS
12210.01 311 J3f Fenshuiling Fm. -UP. JURASSIC
12210.02 312 J2-3s Santai Fm. -UP. JURASSIC
12210.02 313 J1-2w Wennan Fm. -UP. JURASSIC
12210.03 314 J1-2f Fangzi Fm. -UP. JURASSIC
12210.03 316 J3l^4 Lai yang Fm. 4th Mm. -UP. JURASSIC
12210.04 317 J3l^3 Lai yang Fm. 3rd Mm. -UP. JURASSIC
12210.04 317 J3l^3 Lai yang Fm. 3rd Mm-UP. JURASSIC
12210.05 318 J3l^2 Lai yang Fm. 2nd Mm. -UP. JURASSIC
12210.06 319 J3l^1 Lai yang Fm. 1st Mm. -UP. JURASSIC
12210.07 320 J3l Lai yang Fm. -UP. JURASSIC
12210.08 826 J3 Undifferentiated -UP. JURASSIC
12240.01 315 J Undifferentiated -JURASSIC UNDIF.
13120.01 501 P2f Fenghuangshan Fm. -M. PERMIAN
13120.02 502 P1-2s Shi hezi Fm. -M. PERMIAN
13130.02 503 P1sx Shanxi Fm. -LW. PERMIAN
13140 504 P Undifferentiated -PERMIAN UNDIF.
13220.01 506 C2t Taiyuan Fm. -M. CARBONIFEROUS
13220.02 507 C2b Benxi Fm. -M. CARBONIFEROUS
13240 508 C Undifferentiated -CARBONIFEROUS UNDIF.
13520.01 509 O2g+b Gezhuang Fm.-M. ORDOVICIAN
13520.02 512 O1-2d+b Donghuangshan Fm-M. ORDOVICIAN
13520.03 514 O1+2 Undifferentiated -M. ORDOVICIAN
13530.01 510 O1t+w Tuyu Fm-LW. ORDOVICIAN

13530.02 511 O1d+b Donghuangshan Fm.-LW. ORDOVICIAN
13530.04 513 O1z Zhifangzhuang Fm. -LW. ORDOVICIAN
13540.01 515 O Undifferentiated -ORDOVICIAN UNDIF.
13540.02 516 Ca+O Undifferentiated -ORDOVICIAN UNDIF.
13610.01 518 Ca3 Undifferentiated -UP. CAMBRIAN
13610.02 519 Ca2+3 Undifferentiated -UP. CAMBRIAN
13620.02 520 Ca2 Undifferentiated -M. CAMBRIAN
13620.03 521 Ca1+2 Undifferentiated -M. CAMBRIAN
13630.02 522 Ca1 Undifferentiated -LW. CAMBRIAN
13640.03 523 Ca Undifferentiated -CAMBRIAN UNDIF.
21220.01 701 Pt3x Xiangkuang Fm. -UP. PROTEROZOIC
21220.02 702 Pt3n Nanzhuang Fm. -UP. PROTEROZOIC
21220.03 703 Pt3f Fuzikuang Fm -UP. PROTEROZOIC
21220.04 704 Pt3b Baoshankou Fm. -UP. PROTEROZOIC
21220.05 705 Pt3fl+s Fulaishan Fm-UP. PROTEROZOIC
21220.06 706 Pt3fl Fulaishan Fm. -UP PROTEROZOIC
21220.07 707 Pt3t-Tongjizhuang Fm-UP. PROTEROZOIC
21220.08 708 Pt3t+fl Tongjiazhuang Fm.-UP. PROTEROZOIC
21220.09 709 Pt3t Tongjiazhuang Fm-UP. PROTEROZOIC
21220.1 710 Pt3e+t Erqingshan Fm-UP. PROTEROZOIC
21220.11 711 Pt3e Erqingshan Fm. -UP. PROTEROZOIC
21220.13 713 Pt3h+e Heishanguang Fm-UP. PROTEROZOIC
21220.14 714 Pt3tm Tumen Gr. -UP. PROTEROZOIC
23000.01 715 Pt1zf Zhifu Fm. -LW. PROTEROZOIC UNDIF.
23000.02 716 Pt1g Gangyu Fm. -LW. PROTEROZOIC UNDIF.
23000.03 717 Pt1j Jutun Fm. -LW. PROTEROZOIC UNDIF.
23000.04 718 Pt1j-z Jutun Fm.-LW. PROTEROZOIC UNDIF.
23000.05 719 Pt1z Zhanggezhuang Fm.-LW. PROTEROZOIC UNDIF.
23000.06 720 Pt1zj Zhujiakuang Fm. -LW. PROTEROZOIC UNDIF.
23000.07 721 Pt1m Mingcun Fm. -LW. PROTEROZOIC UNDIF.
23000.08 722 Pt1s Shanzhangjia Fm. -LW. PROTEROZOIC UNDIF.
23000.09 723 Pt1fz Fenzishan Gr. -LW. PROTEROZOIC UNDIF
23000.1 724 Pt1k Kunshan Fm. -LW. PROTEROZOIC UNDIF.
23000.11 725 Pt1h Haiyankou Fm. -LW. PROTEROZOIC UNDIF.
23000.12 726 Pt1wl Wulian Gr. -LW. PROTEROZOIC UNDIF.
23000.13 727 Ar-Pt1f Fuyang Fm. -LW. PROTEROZOIC UNDIF.
23000.13 727 Ar-Pt1f Fuyang Fm-LW. PROTEROZOIC UNDIF.
23000.13 825 Pt1y Undifferentiated -LW. PROTEROZOIC UNDIF.
23000.14 728 Ar-Pt1m Minshan Fm. -LW PROTEROZOIC UNDIF.
23000.14 728 Ar-Pt1m Minshan Fm-LW. PROTEROZOIC UNDIF.
23000.15 729 Ar-Pt1p Pengkuang Fm. -LW. PROTEROZOIC UNDIF.
23000.15 729 Ar-Pt1p Pengkuang Fm-LW. PROTEROZOIC UNDIF
23000.15 729 Ar-Pt1p Pengkuang Fm-LW. PROTEROZOIC UNDIF.
23000.16 730 Ar-Pt1jd Jiaodong Gr.-LW. PROTEROZOIC UNDIF.
23000.17 731 Ar-Pt1y Yujiaing Fm-LW. PROTEROZOIC UNDIF.
23000.18 732 Ar-Pt1q Qiuguanzhuang Fm-LW. PROTEROZOIC UNDIF.
23000.19 733 Ar-Pt1z Zhenjiagou Fm. -LW PROTEROZOIC UNDIF.
23000.19 733 Ar-Pt1z Zhenjiagou Fm-LW. PROTEROZOIC UNDIF.
23000.19 733 Ar-Pt1z Zhenjiagou Fm-LW. PROTEROZOIC UNDIF.
23000 2 734 Ar-Pt1d Dashangou Fm. -LW. PROTEROZOIC UNDIF.
23000.2 734 Ar-Pt1d Dashangou Fm-LW. PROTEROZOIC UNDIF
23000.21 735 Ar-Pt1jn Jiaonan Gr. -LW PROTEROZOIC UNDIF.
30000.1 736 Ars Shancaoyu Fm. -ARCHEAN UNDIF.
30000.1 736 Ars Shancaoyu Fm. Migmatite-ARCHEAN UNDIF.
30000.11 737 Ary Yanlingguan Fm. -ARCHEAN UNDIF.
30000.11 737 Ary Yanlingguan Fm. Migmatite-ARCHEAN UNDIF.
30000.12 738 Art Taipingding Fm. -ARCHEAN UNDIF
30000.12 738 Art Taipingding Fm. Migmatite-ARCHEAN UNDIF.
30000.13 739 Arw Wanshanzhuang Fm Migmatite-ARCHEAN UNDIF.
30000.14 740 Arts Taishan Gr. -ARCHEAN UNDIF.
41300.01 201 nm6 Gabbro porphyrite -TERTIARY UNDIF
42100.01 401 g5^3(1) Granite -CRETACEOUS
42100.02 402 g5^3(2) Granite -CRETACEOUS
42100.02 402 g5^3(2) Granite Granodiorite-CRETACEOUS
42100.03 403 gd5^3 Granodiorite -CRETACEOUS
42100.04 404 gd5^3(1) Granodiorite -CRETACEOUS
42100.04 404 gd5^3(1) Granodiorite Granite-CRETACEOUS
42100.04 404 gd5^3(1) Granodiorite Migmatite-CRETACEOUS
42100.05 405 gd5^3(2) Granodiorite -CRETACEOUS
42100.05 405 gd5^3(2) Granodiorite Granite-CRETACEOUS
42100.06 406 xg5^3(2) Kaligranite -CRETACEOUS
42100.07 407 gp5^3 Granite porphyry -CRETACEOUS
42100.08 408 gp5^3(1) Granite porphyry -CRETACEOUS
42100.09 409 gp5^3(2) Granite porphyry -CRETACEOUS
42100.1 410 gdp5^3 Granite porphyry -CRETACEOUS
42100.11 411 gdp5^3(1) Granite porphyry -CRETACEOUS
42100.14 414 lp5^3(1) Quartz porphyry -CRETACEOUS
42100.15 415 lp5^3(2) Quartz porphyry -CRETACEOUS

42100.16 416 hop5^3 Quartz-monzonite porphyry -CRETACEOUS
42100.17 417 hg5^3(1) Monzogranite -CRETACEOUS
42100.17 417 hg5^3(1) Monzogranite Granodiorite-CRETACEOUS
42100.18 418 hg5^3(2) Monzogranite -CRETACEOUS
42100.19 419 hgp5^3 Adamellite porphyry -CRETACEOUS
42100.2 420 lpg5^3 Rhyolitic granite porphyry -CRETACEOUS
42100.21 421 d5^3(1) Diorite -CRETACEOUS
42100.22 422 nd5^3 Pyroxene diorite -CRETACEOUS
42100.23 423 nd5^3(1) Pyroxene diorite -CRETACEOUS
42100.24 424 nd5^3(2) Pyroxene diorite -CRETACEOUS
42100.25 425 dm5^3 Diorite-porphyrite -CRETACEOUS
42100.26 426 dm5^3(1) Diorite-porphyrite -CRETACEOUS
42100.27 427 dm5^3(2) Diorite-porphyrite -CRETACEOUS
42100.28 428 np5^3 Felsite -CRETACEOUS
42100.29 429 dop5^3 Quartz-diorite porphyry -CRETACEOUS
42100.3 430 dop5^3(1) Quartz-diorite porphyry -CRETACEOUS
42100.31 431 am5^3 Andesite porphyrite -CRETACEOUS
42100.32 432 xd5^3(1) Syenodiorite -CRETACEOUS
42100.33 433 xdo5^3 Quartz-syenodiorite -CRETACEOUS
42100.35 435 n5^3(1) Gabbro -CRETACEOUS
42100.36 436 nm5^3 Gabbro porphyrite -CRETACEOUS
42100.37 437 nm5^3(1) Gabbro porphyrite -CRETACEOUS
42100.38 438 x5^3 Syenite -CRETACEOUS
42100.39 439 x5^3(1) Syenite -CRETACEOUS
42100.42 442 xo5^3(1) Quartz syenite -CRETACEOUS
42100.43 443 xo5^3(2) Quartz syenite -CRETACEOUS
42100.44 444 xop5^3 Quartz syenite porphyry -CRETACEOUS
42100.45 445 h5^3 Monzonite -CRETACEOUS
42100.46 446 h5^3(1) Monzonite -CRETACEOUS
42100.47 447 h5^3(2) Monzonite -CRETACEOUS
42100.48 448 ho5^3 Quartz monzonite -CRETACEOUS
42100.49 449 ho5^3(1) Quartz monzonite -CRETACEOUS
42100.5 450 ho5^3(2) Quartz monzonite -CRETACEOUS
42100.51 451 xp5^3 Syenite porphyry -CRETACEOUS
42100.52 452 xp5^3(1) Syenite porphyry -CRETACEOUS
42100.53 453 xp5^3(2) Syenite porphyry -CRETACEOUS
42200.01 601 g5^2 Granite -JURASSIC UNDIF.
42200.02 602 g5^2(1) Granite -JURASSIC UNDIF.
42200.03 603 hg5^2(1) Monzogranite -JURASSIC UNDIF.
42200.04 604 gd5^2(2) Granodiorite -JURASSIC UNDIF.
42200.04 604 gd5^2(2) Granodiorite Granite-JURASSIC UNDIF.
42200.05 605 n5^2 Gabbro -JURASSIC UNDIF.
48450.01 801 g2 Granite -PROTEROZOIC UNDIF.
48450.02 802 d2 Diorite -PROTEROZOIC UNDIF.
48450.03 803 do2 Quartz diorite -PROTEROZOIC UNDIF
48450.04 804 n2 Gabbro -PROTEROZOIC UNDIF.
48450.05 805 ny2 Amphibolite -PROTEROZOIC UNDIF
48450.06 806 yo2 Hornblendite -PROTEROZOIC UNDIF.
48450.07 807 nyo2 Pyroxene-hornblendite -PROTEROZOIC UNDIF.
48450.08 808 nt2 Eclogite -PROTEROZOIC UNDIF.
48450.09 809 yw2 Serpentinite -PROTEROZOIC UNDIF.
48450.1 810 s2 Peridotite -PROTEROZOIC UNDIF.
48800.01 811 g1 Granite -ARCHEAN UNDIF
48800.01 811 g1 Granite Migmatitic granite-ARCHEAN UNDIF.
48800.02 812 gd1 Granodiorite -ARCHEAN UNDIF
48800.03 813 d1 Diorite -ARCHEAN UNDIF.
48800.06 816 yo1 Hornblendite -ARCHEAN UNDIF.
48800.07 817 yw1 Serpentinite -ARCHEAN UNDIF.
90000.01 001 r Pegmatite vein -UNKNOWN
90000.02 002 gdp Granodiorite porphyry vein -UNKNOWN
90000.03 003 bm Diabase dyke -UNKNOWN
90000.04 004 zp5 Dacite porphyry -UNKNOWN
90000.05 005 taop5 Quartz-trachyandesite -UNKNOWN
90000.06 006 tol5 Quartz-trachyandesitic tuff lava -UNKNOWN
90000.07 007 tap5 Trachyandesite porphyry -UNKNOWN
90000.08 008 am5 Andesite porphyrite -UNKNOWN
90000.09 820 gm Granitoid -UNKNOWN
90000.09 820 gm Granitoid Granodiorite-UNKNOWN
90000.09 820 gm Granitoid Migmatitic granite-UNKNOWN
90000.1 821 dm Diorite -UNKNOWN
90000.1 821 dm Diorite Migmatitic granite-UNKNOWN
90000.11 822 g5^3 Granite porphyry -UNKNOWN
90000.12 823 hg5^3 Adamellite -UNKNOWN
90000.13 824 gn Granitoid -UNKNOWN
90000.14 827 gd^3(1) Granodiorite -UNKNOWN
99000 900 Water Undifferentiated

Fig. 53. Map showing mineral occurrences in Shandong
(AMIRA P603 Project)

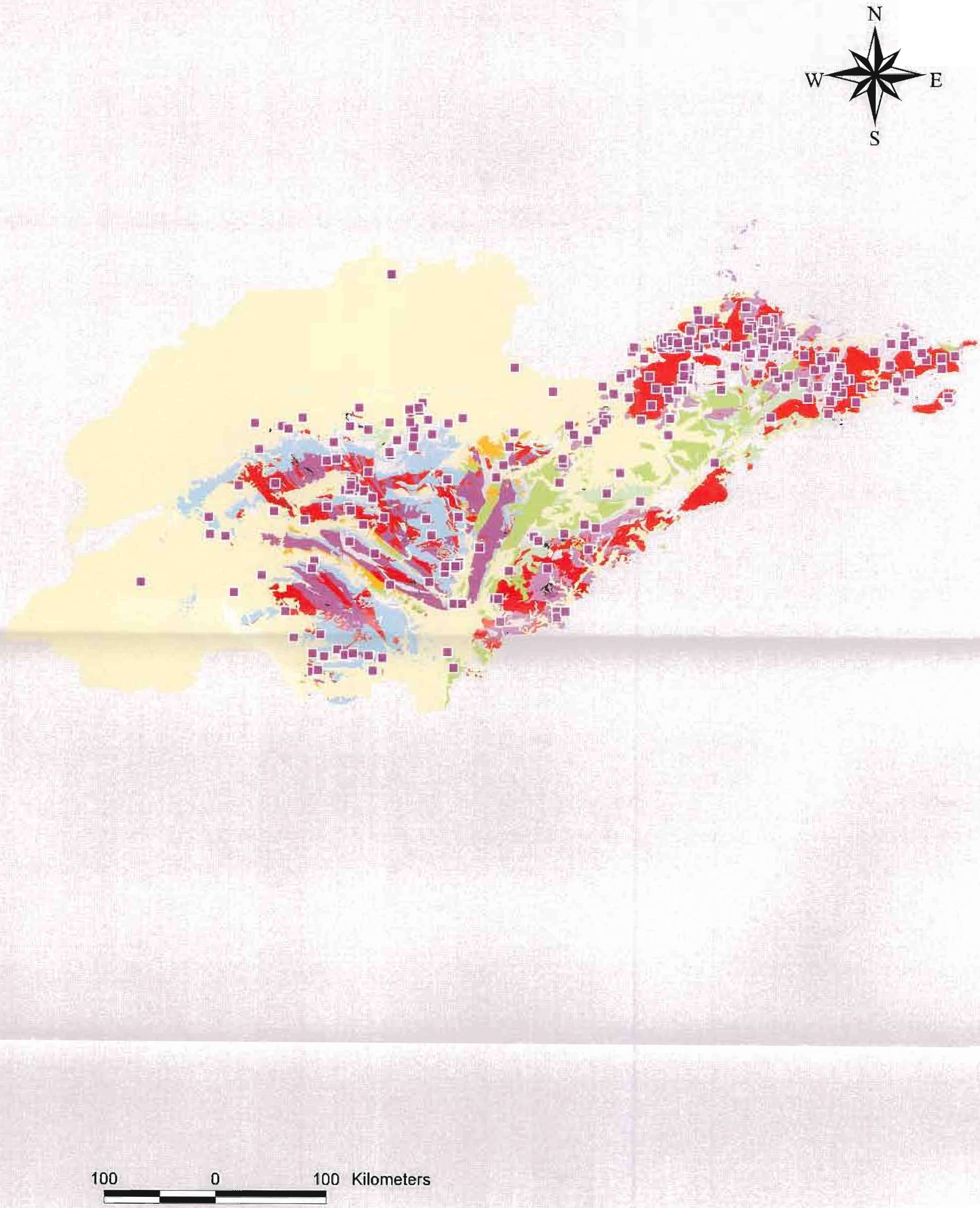


Fig. 54. Map showing major gold occurrences, faults and granitoids in Shandong
(AMIRA P603 Project)

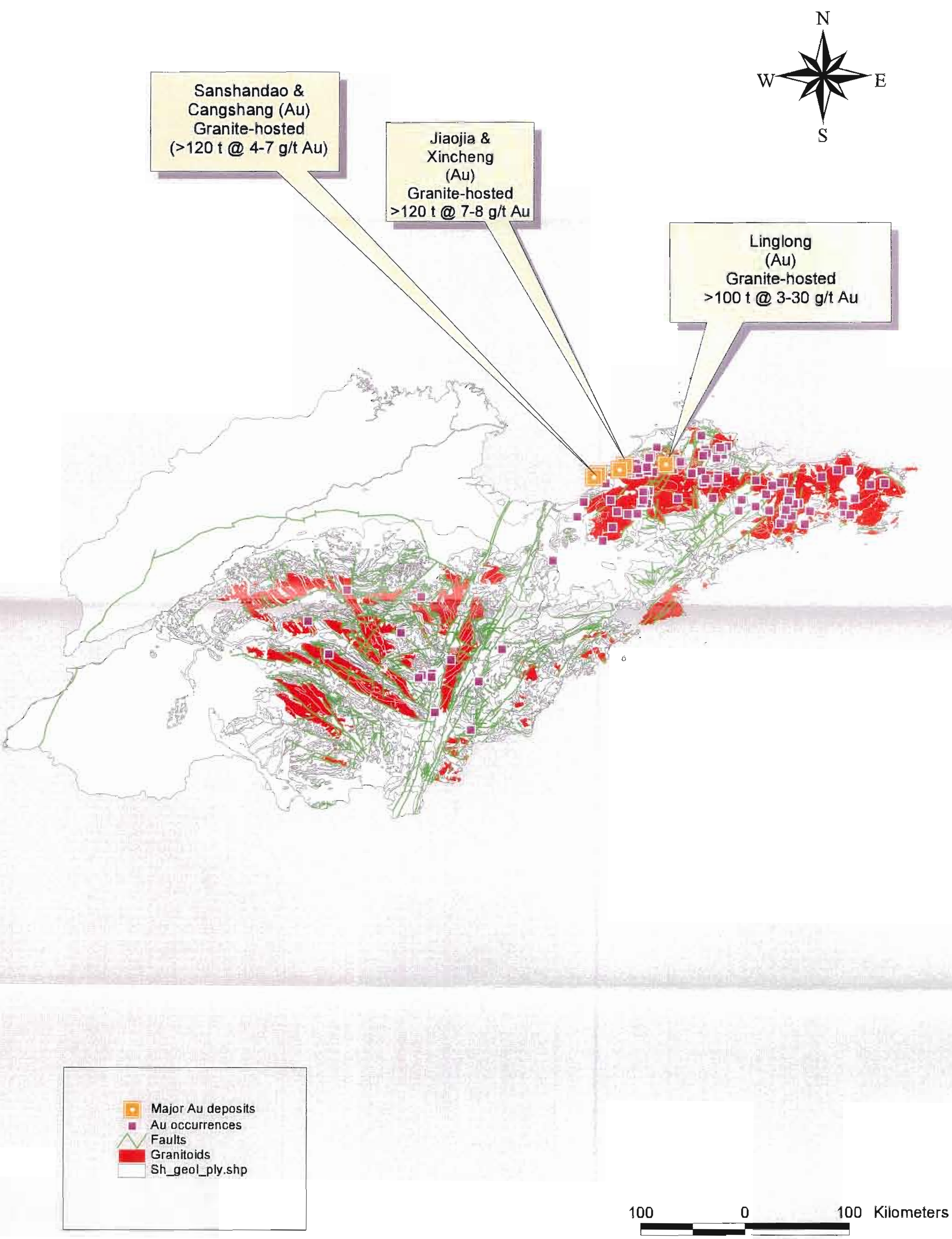


Fig. 55. Map showing compilation of geochrological data points
(AMIRA P603 Project)

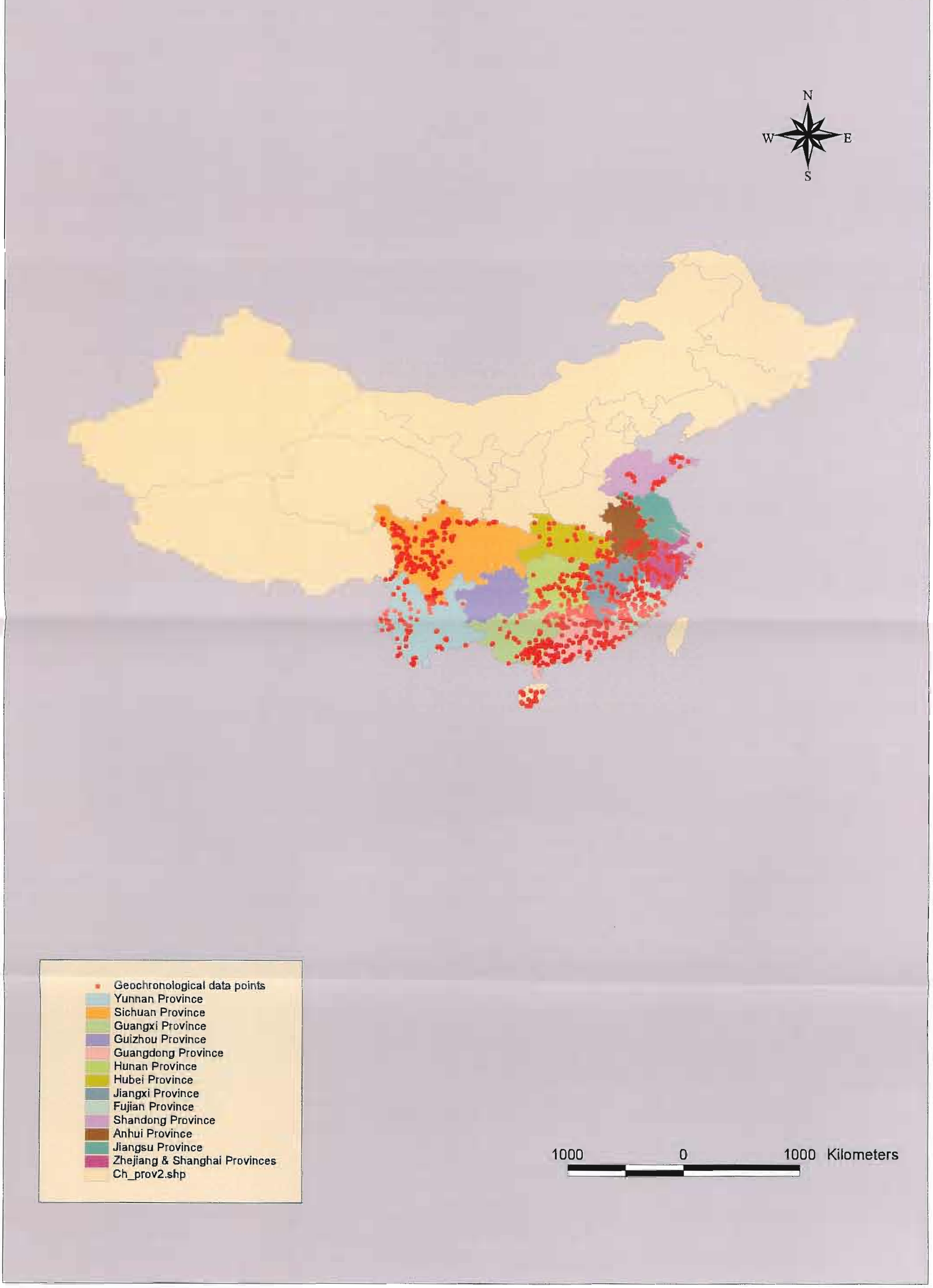


Fig. 56. Map showing comparison of geochrological data points for South China and SE Asia
(AMIRA P603 Project)

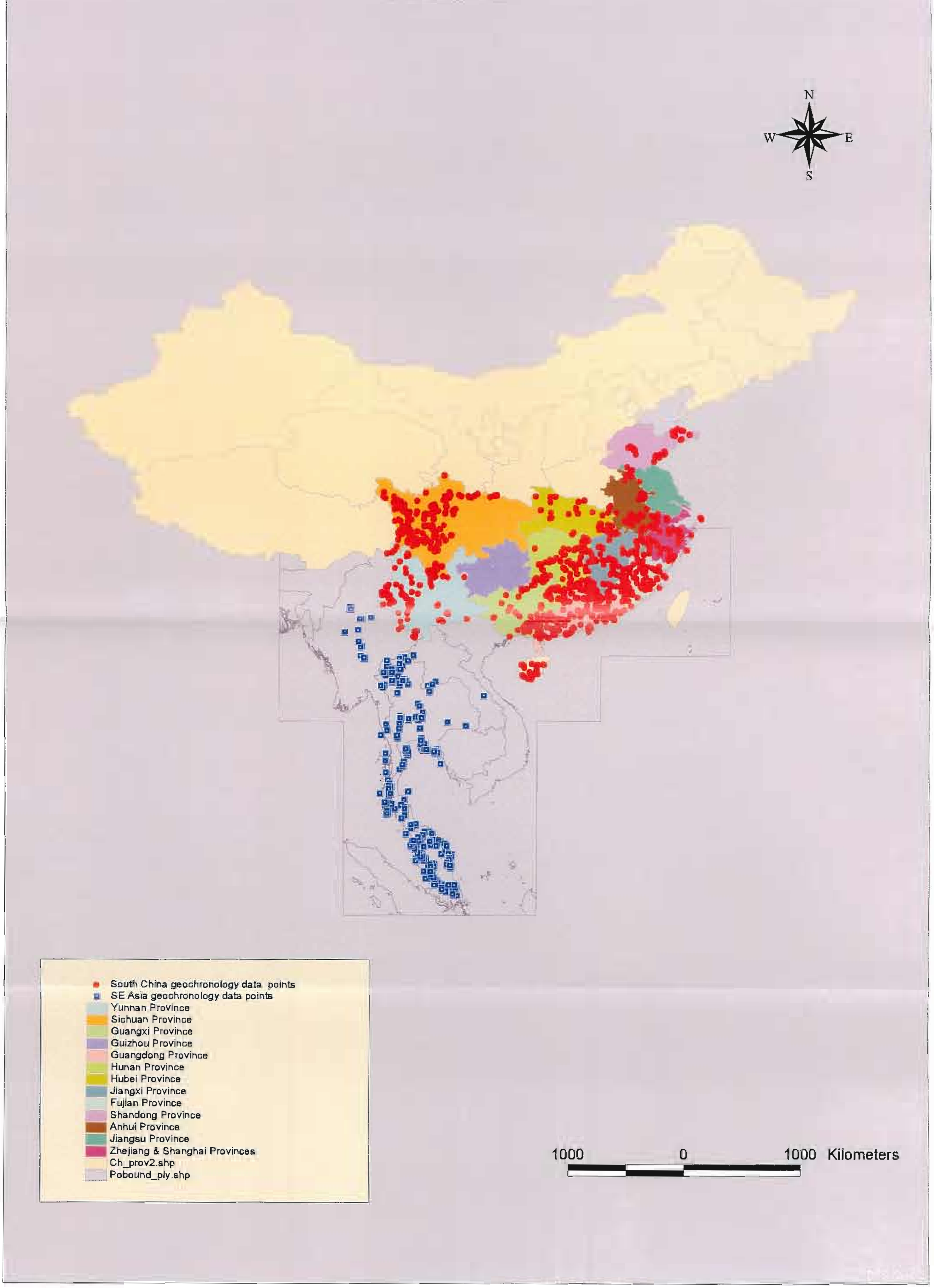


Fig. 57. Map showing Archaean and Proterozoic ages for South China
(AMIRA P603 Project)

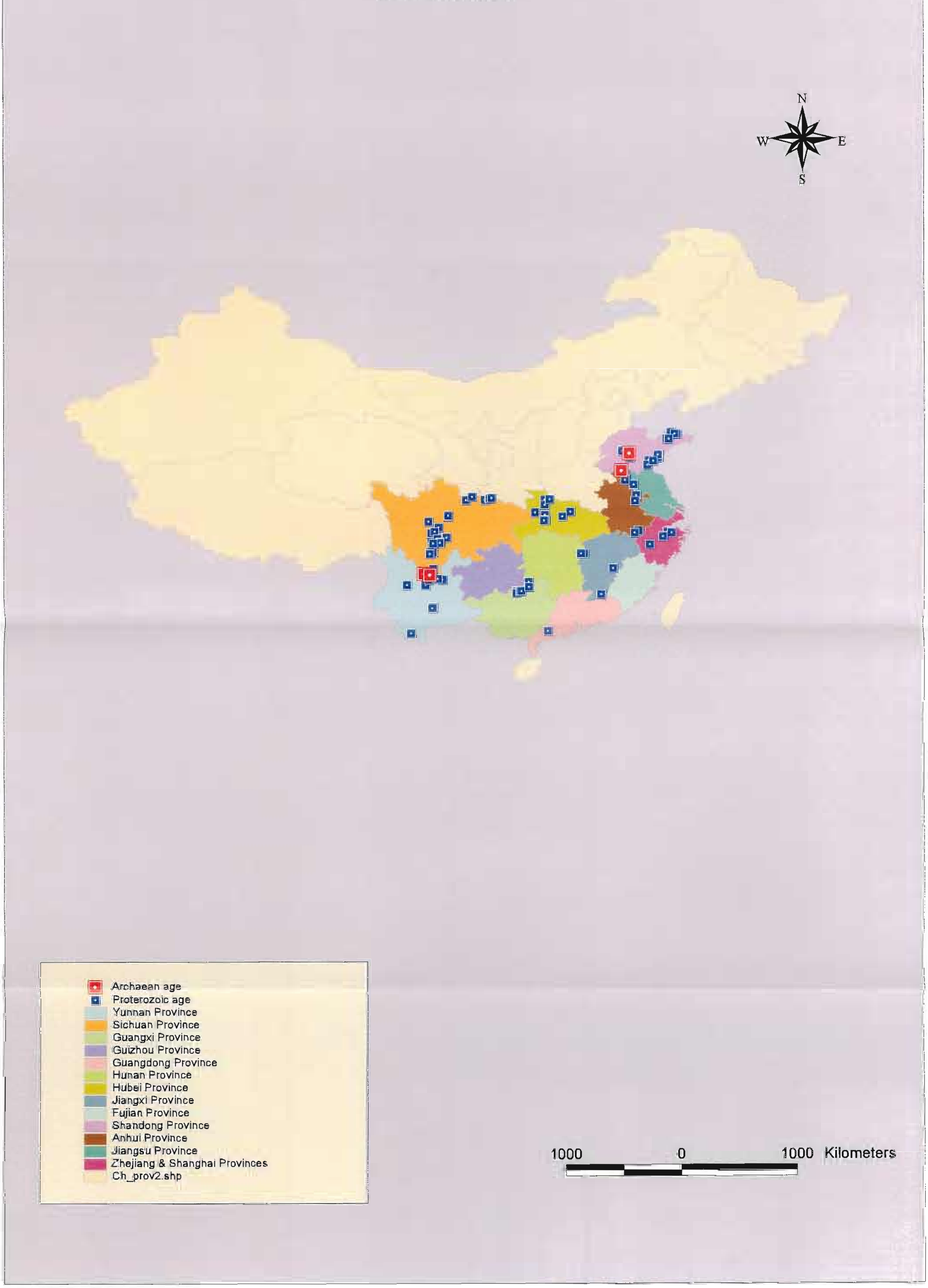
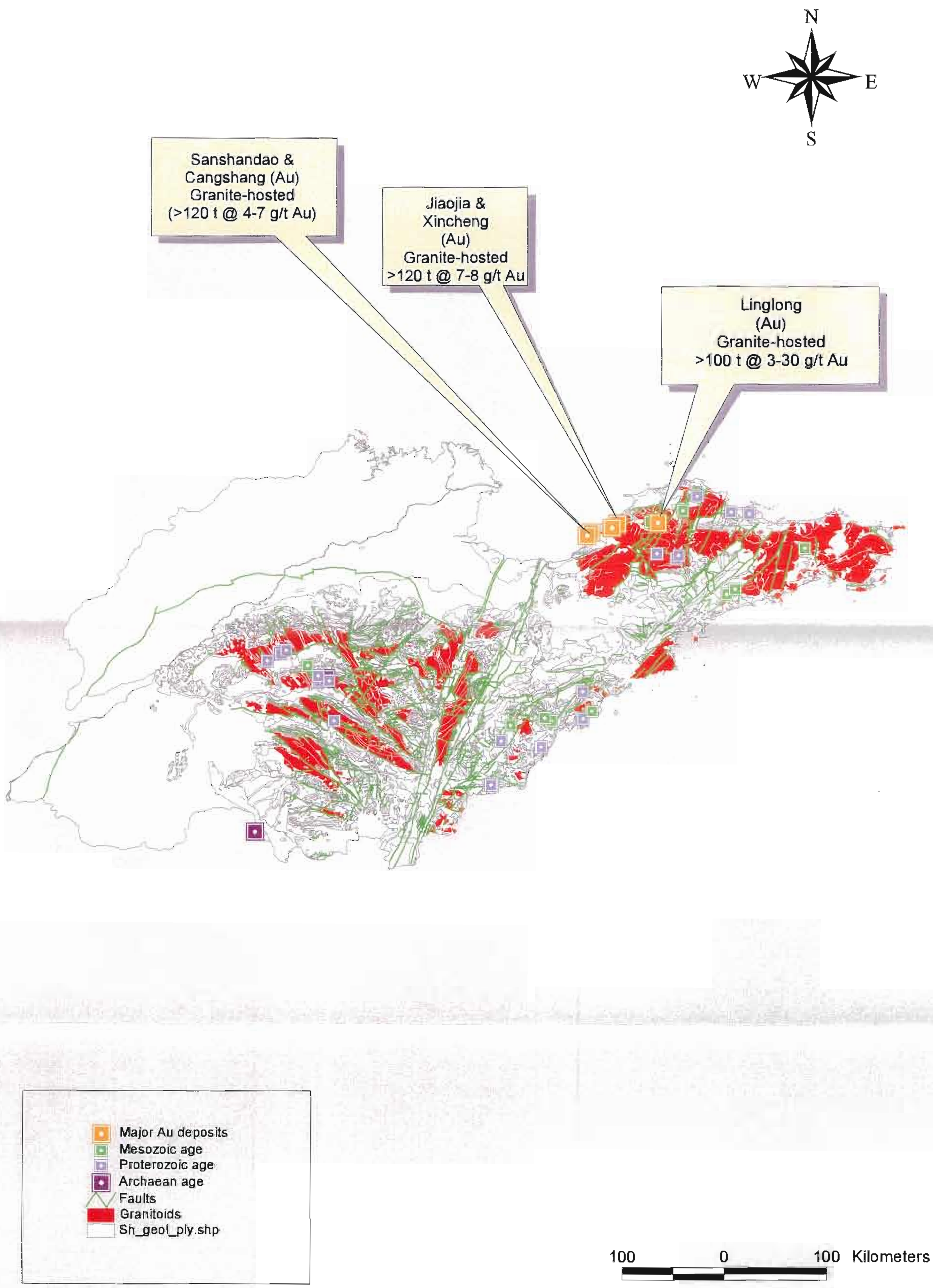


Fig. 58. Map showing major gold occurrences, faults, granitoids and geochronological data in Shandong (AMIRA P603 Project)



# Geological GIS Database of South China

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The Geographical Information Systems (GIS) database contains a compilation of geological data for the 13 provinces of South China included in P603. Spatial data sourced from published geological provincial mapsheets and research information have been integrated to provide a continuous coverage of the P603 study region. Due to the disparate nature of the source data and the differing levels of spatial scales from which the digital information was captured there was a major focus on documentation and reliability assessment in this component of the project.

Techniques used in the digital capture of the spatial data and methods use in database development have been outlined in previous P603 Progress reports. This report will briefly outline the resulting data sets, data accuracy and documentation issues.

## COMPONENTS OF THE DATABASE

The GIS database is provided in three CD-ROM volumes with each volume containing data for a specific GIS software (ArcInfo, ArcView and MapInfo) as requested in the initial project sponsors meeting. Information provided on each CD volume has been organized into directories relating to the data content. The data directories include:

Geology
Fault Lines
Counties (1:1M scale sourced from CIESIN 1990)

## BROADSCALE GEOLOGY

The geological unit boundaries were captured for each province on a scale of either 1:1,000,000 or 1:500,000 using a combination of hardcopy mapsheets and interpretative research conducted by the geological experts involved in the project (Table 1). The geological database has been designed to allow the query and analysis of geological features on a regional basis. A customised database structure was designed to ensure full representation of the complexity of geological data available from the source mapsheets and research information. The database is stored in MS Access with a single database used to contain the descriptive information for all provinces (refer to AMIRA P603 Progress Report 3 for a description of this database structure).

The geological database contains both polygon and line features. The polygons represent geological mapping units and the line features represent fault lines, boundaries of geological units, water bodies and political areas. The MS Access database is called *scgeology.mdb* and contains 2 tables the first storing information relating to polygon features (*PolygonDescription*) and the second relating to line features (*LineDescription*). The data has been captured with topological data structure allowing the placement of fault lines and polygon boundaries to be queried according to adjacent features.

*PolygonDescription* stores all attribute information for the geological mapping datasets and contains 20 fields. These fields allow the entire geological mapping sheet to be queried based on a range of different attributes including geological age, geological formation, geological group, rock emplacement and rock description. Further information on these attributes is provided in the associated Data Dictionary documentation.

It was necessary to adjust the GIS data layers for each province to a common spatial reference using the *China Administrative Regions GIS Data 1:1M* (CIESIN, 1990) data set as discuss in the P603 November 2000 report. In addition to providing a common spatial reference this adjustment prevents gaps and overlaps in the mapped data caused by mapping discrepancies at provincial boundaries. However, it should be recognised that this may cause positional distortion of geological unit boundaries and faultlines in the border regions (approximately 15–30 km either side of provincial boundaries). The implications of this distortion are outlined in the metadata documentation.

**Table 1.** Summary of geological data layers

| Province | Data Capture Scale | Number of Polygons |
|---|---|---|
| Yunnan Sheng | 1:1,000,000 | 8020 |
| Sichuan Sheng | 1:1,000,000 | 5695 |
| Guangxi Sheng | 1:1,000,000 | 6775 |
| Guizhou Sheng | 1:500,000 | 10605 |
| Guangdong | 1:1,000,000 | 5730 |
| Jiangxi Sheng | 1:500,000 | 8975 |
| Hunan Sheng | 1:500,000 | 10650 |
| Hubei Sheng | 1:500,000 | 10370 |
| Anhui Sheng | 1:500,000 | 8300 |
| Fujian Sheng | 1:500,000 | 8936 |
| Zhejian Sheng | 1:500,000 | 7100 |
| Jiangsu Sheng | 1:500,000 | 3700 |
| Shandong Sheng | 1:500,000 | 5000 |

## FAULT LINES

The Fault Line database was extracted as a subset of the Geological database and contains only line features relating to geological structures. Each line feature has been coded to distinguish the geological structures. The descriptive data associated with the spatial data set is contained in the MS Access table *LineDescription*. In provincial border regions artificial kinks in the fault lines may occur due to the appending of provincial maps and the geographical adjustment process.

## DATA RELIABILITY ASSESSMENT

The GIS database has been developed at a regional scale using source data that allows for a positional reliability of approximately 1 km. Geological and fault line GIS data layers contained within the database have not been field validated due to the broadscale of data capture. Accuracy of the thematic or attribute data was assessed based on comparison with the hardcopy map sheets and research expertise. GIS programs were written to automate the error checking procedures and any identified errors, such as wrongly described features, were corrected. Despite the rigorous error checking techniques an attribute accuracy of 95% has been assigned to account for undetected errors. Errors in the spatial data consistency (for example, disconnected fault lines or over extended line features) were also identified and removed using a combination of automated and manual techniques.

## DOCUMENTATION

Data Dictionary and metadata documentation has been provided to ensure data is used appropriately based on its described level of reliability. This documentation allows potential users to determine the data sets 'fitness of use' for their intended application.

The Data Dictionary contains a description of the data set and the structure of associated files. Each spatial data set is linked to an attribute table or .dbf file that is used to assign descriptive data to the spatial features. These files can be linked to other descriptive files based on a common link field. The field properties and content for each file is described in the Data Dictionary.

Metadata is a description of the characteristics of data that has been collected for a specific purpose (ANZLIC Guidelines, 1996). Metadata was compiled and included on the GIS database CD-ROMs to provide detailed information on data sources, data collection methods, integration techniques, processing history, map projection specifications, scale and geographic extent of data sets. These metadata documents are based on the ANZLIC Metadata Standard Guidelines, and are included on each CD volume. Contact details are also included in the event a sponsor company requires further information to determine the appropriateness of use or encounters a problem in working with the database.

# Paleogeographic and Tectonic Development of South China

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## INTRODUCTION

Until the last 20 or so years, tectonic thinking in China was dominated by the teachings of J.S. Lee (Li Siguang) who wrote the first comprehensive summary of China's geology (Lee 1939). He taught that the tectonics of China was and is dominated by east-west faults which controlled the distribution and development of *geosynclines*. This thinking continues in more recent Chinese syntheses (e.g. Ren Jishun et al 1987) and underlies much of Chinese geological writing. Of course, this approach ignores structures at a high angle to east-west, which are plentiful in China. Although geological thinking in China now accepts plate tectonic and terrane concepts many authors seem only to half believe the concepts and geosynclinal and non-mobilistic concepts are still firmly embedded in many, if not most, Chinese geologists' views of the earth. Almost all Chinese geological and tectonic maps published by Chinese geologists stop at China's borders. This encourages an insular view of Chinese geology by most Chinese geologists. My impression is that most Chinese geologists now accept plate tectonics in order to get their papers published but are reluctant to accept really that China is a collage of allochthonous terranes that amalgamated over 3 gy and with disparate provenances in Siberia. Kazakhstan and in different sectors of Gondwana. For example, a leading Chinese geologist Ren Jishun (1996) writes about the formation of the 'Chinese protoplatform' between 1000 and 800 Ma and its disintegration into the Yangtze, Sino-Korean and Tarim blocks at 550–500 Ma, their joining Gondwana at 440–400 Ma "with the main body of China becoming a component of Laurasia" between 230–220 Ma. This is a 'wooden blocks in a bathtub' view of terranes which is unlikely to be accurate.

A broad, non-controversial subdivision of the geology of China is shown in Figure 1. The major Phanerozoic blocks/cratons/microcontinents/platforms are North China (Sinokorean Paraplatform) South China (consisting of the Yangtze paraplatform and South China Fold Belt (= Cathaysia) and Tarim. The first tectonic synthesis of Asia was written by Emile Argand in 1924 who used collisions of Tarim and China to account for the development of orogenesis within the intervening geosynclines.

Almost 30 years ago Burrett (1974) subdivided Asia into blocks (which we would now call terranes) and on the basis of contrasting geologies and highly different Paleozoic biogeographic units suggested that these blocks were separated by large oceans and that suturing of these blocks continued into the Jurassic. The coincidence of belts of ultramafics and island-arc volcanics with early Paleozoic faunal province boundaries was used as evidence for the paleo-separation of the blocks. The timing of biogeographic amalgamations and major unconformities were used to date the timing of terrane suturing.

Subsequent reviews (e.g. Enkin et al. 1992; Klimetz 1983; Nie 1991; Watson et al. 1987) have confirmed the outlines of the major Phanerozoic terranes and the chronology of their collisions (Table 1).

The major suture in China follows the Qinling (Shan) Mountains and it was suggested (based on unconformities and biogeography) that the North China Block (NCB) fused with the South China Block (SCB) in the late Triassic along the Qinling (Burrett 1974). This was very controversial in 1974, and was met with total scepticism by Chinese geologists in talks given throughout China in 1979. However, two years later, McElhinny et al. (1981) published the first paleomagnetic evidence for the separation of the NCB and SCB based on Permian data and in 1985, Lin et al. demonstrated that the Cambrian-Tertiary apparent polar wander curves for the NCB and SCB did not converge until the Triassic (Lin et al., 1985).

At the same time the terrane concept was being accepted worldwide and by the early 1980s many

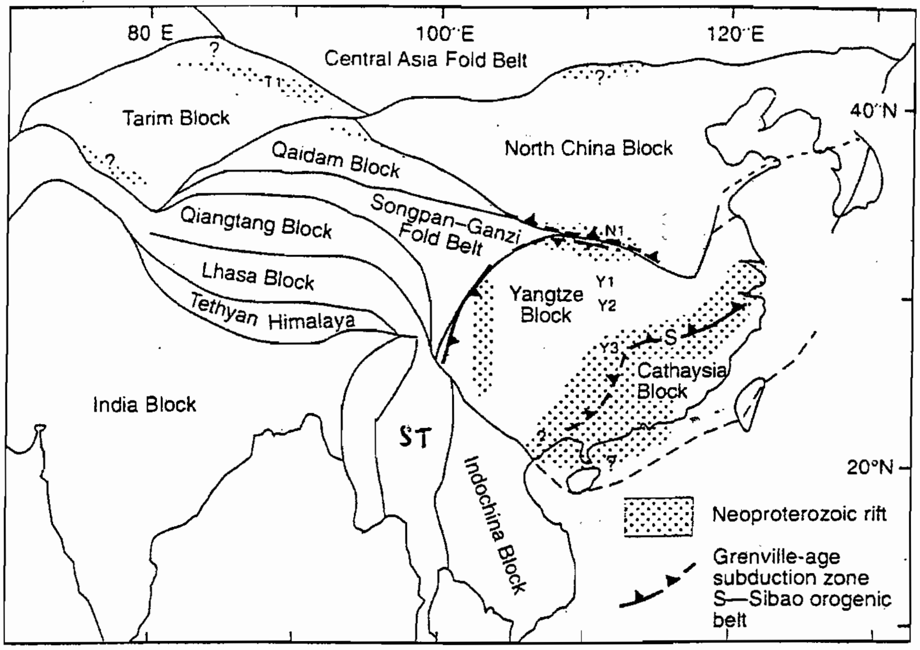



Figure 1. Major terranes in China ST= Shan Thai Terrane. From Li et al. (1996).

Table 1 Terminology of major orogenic cycles in China (from Ren 1996)

| Names of cycles | | | Age (Ma) | Age of main orogeny (Ma) | Major tectonic events |
|---|---|---|---|---|---|
| Megacycle | | Cycle | | | |
| | | Himalayan | | 40–2 | Collision between India and Eurasia, creating Himalayas, Quinghai-Tibet Plateau, Kunlun, Qilian and Tianshan rejuvenated Mts; gradual formation of modern geomorphology of China |
| | | | 80 | | |
| | Alpine | Yanshanian | | 160–120 | Collision of Asia with N America and W Pacifica, leading to intense tectono-magmatic activation in E China |
| | | | 200 | | |
| Phanerozoic | | Indosinian | | 230–220 | Opening of Tethys, responsible for break-up of Pangea into Laurasia and Gondwana, with main body of China becoming a component of Laurasia |
| | | | 260 | | |
| | Variscan | | | 350–280 | Closing of paleo-Asian ocean resulting in formation of Pangea |
| | | | 400 | | |
| | Caledonian | | | 440–400 | Assembly of Paleo-Chinese blocks, joining gondwana, with main body of China forming a part of Gondwana |
| | | | 500–550 | | |
| | Xingkaian (Pan-African) | | | 550–500 | Disintegration of Chinese protoplatform into Paleo-Chinese blocks, including Sino-Korea, Yangtze, Tarim, etc. |
| | | | 1000–800 | | |
| Neo-Proterozoic | Yangtzeian (Jinningian) | | | 1000–800 | Formation of Chinese Protoplatform |
| | | | 1900–1700 | | |
| Paleo-Proterozoic | Zhongtiaoan | | | 1900–1700 | Formation of Sino-Korean platform |
| | | | 2400–2600 | | |
| Neo-Archean | Wutaian and Fupingian | | | 2600–2400 | Formation of crystalline basement of Sino-Korean platform |
| | | | 3000 | | |
| Paleo-Archean | Qianxian and older | | | 3000 | Emergence of ancient continental nuclei, with oldest crust of 3800 Ma discovered in N China |
| | | | 3800 | | |

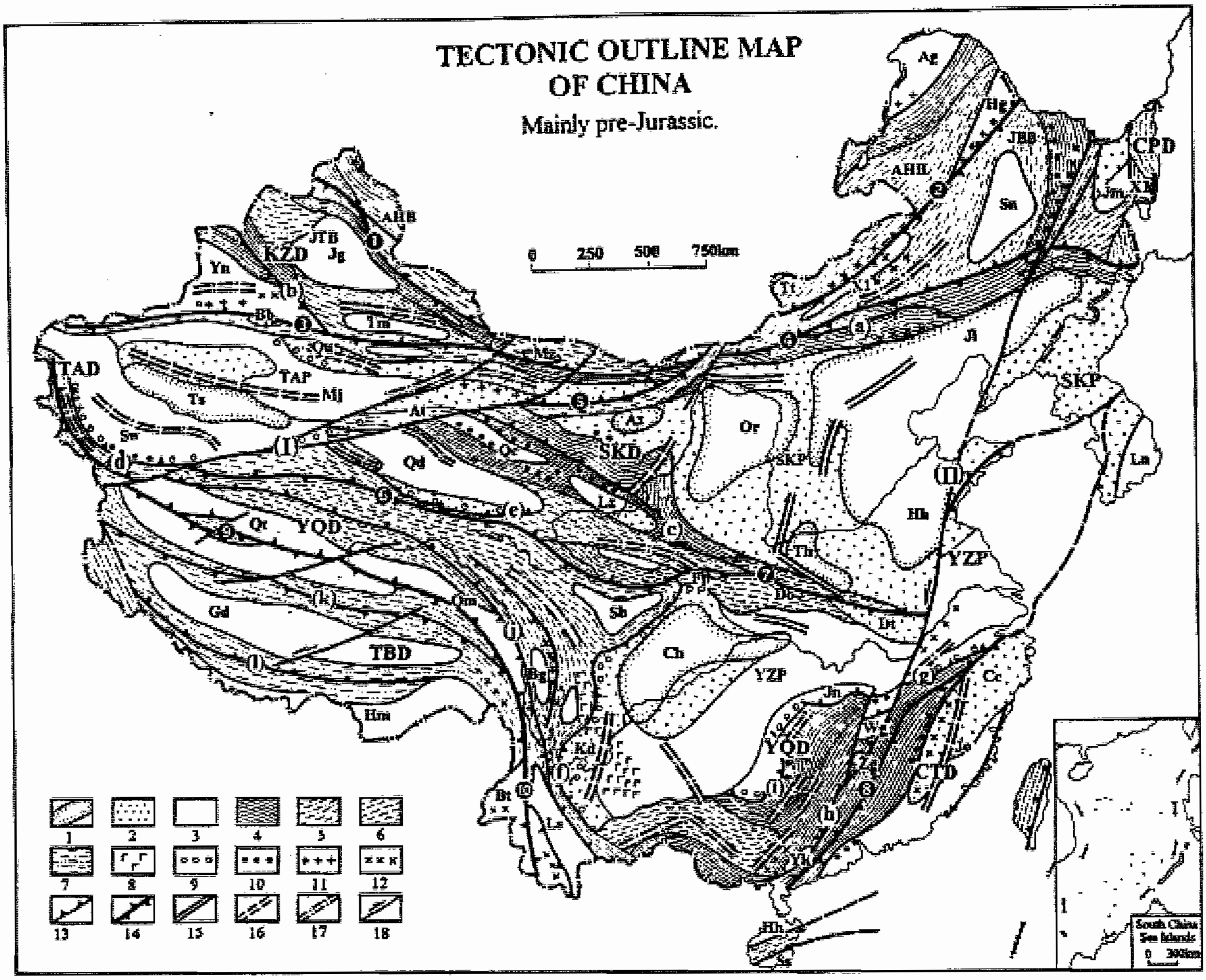



*Figure 1*

1 *Continental nuclei, 2800 Ma* ($Ar_3$)
2 *Protoplatforms, 1800 Ma* ($Pt_1$)
3 *Platform and massifs 800 Ma* ($Pt_3$)
4 *Caledonides*
5 *Hercynides*
6 *Indosinides*
7 *Yanshanides and Himalayaides*
8 *Permian basalts*
9 *Jinningian* ($Pt_{2-3}$) *granitic zones (J)*
10 *Caledonian* ($Pz_1$) *granitic zones (C)*
11 *Hercynian* ($Pz_2$) *granitic zones (H)*
12 *Hercynian–Indosinian (P-T) granitic zones*
13 *Accretional crustal consumption zones (AZ)*
14 *Convergent crustal consumption zones (CZ)*
15 $Pt_{2-3}$ *aulacogens and rifts*
16 *Z–O aulacogens*
17 *D–T aulacogens*
18 *Strike-slip faults, mostly post-Indosinian.*

*Tectonic units:*

AHB *Altai–Hingan Belt:*
Ag *Arguna Massif*
Hg *northern Hingan Massif;*
Tt *Tuotuoshan Massif*
JBB *Jamus–Bureya Belt:*
Jm *Jamus Massif*
Sn *Songnen Massif*
Xl *Xilinhot Massif.*
KZD *Kazakhstan Domain:*
Yn *Yinnin Massif*
Jg *Junggar Massif*
Tm *Turpan–Hami Massif.*
TAD *Tarim Domain:*
TAP *Tarim Platform:*
Ts *Central Tarrim Nucleus*
Sw *South-western Region*
Mj *Manjyar Region*
Qu *Quruktagh Region*
At *Altun Region*
Bb *Bayanblak Massif*
Mz *Mazongshan Massif.*
SKD *Sino-Korea Domain:*
SKP *Sino-Korea Platform:*
Or *Ordos Nucleus*
Jl *Jiliao Nucleus*
Hb *Hehuai Nucleus*
Th *Taihua Nucleus*
Ax *Alxa Nucleus*
Qc *Central Qilian Massif*
Lx *Longxi Massif*
Qd *Qaidam Massif.*
YQD *Yangtze–Qiangtang Domain:*
YZP *Yangtze Platform:*
Ch *Chuanzhong Nucleus*
Kd *Kangdian Region*
Kd *Jiangnan Region*
Dt *Dabie–Tongbe Massif*
Do *Douling Massif*
Fp *Fuping Massif*
Qt *Qiangtang Massif*
Qm *Qamdo Massif*
Bg *Batang Massif*
Sb *Songpan–Bikou Massif*
Ls *Lincang–Simao Massif*
Wg *Wugong Massif*
Zg *Zhuguang Massif*
Yk *Yunkai Massif.*
CTD *Cathaysian Domain:*
Cc *Chencai Massif*
Jo *Jianou Massif*
Ln *Lingnan Massif*
Hn *Hainan Massif*
Ss *South China Sea Massif.*
TBD *Tibet–Burma Domain:*
Gd *Gangdise Massif*
Hm *Himalaya Massif*
Bt *Baoshan–Tengchong Massif.*
CPD *Circum-Pacific Domain:*
Xk *Xingkai Massif.*

*CZ Convergent zones:*

1 *EKCZ Ertix–Kalameili (H)*
2 *HGCZ Heganshan (H)*
3 *TMCZ South Tianshan –Mazongshan (H)*
4 *SLCZ Soulun–Linxi (H)*
5 *EUCZ Enger Usu (H)*
6 *XMCZ Xingou–Magin (I)*
7 *FTCZ Fengxian –Tongcheng (I)*
8 *SSCZ Shaoxing–Shaoguan (C)*
9 *LSCZ Longmucuo–Shuanghu (I)*
10 *MCZ Changning–Menglian (I).*

*AZ Accretional zones:*

(a) *OSAZ Ondor Sum (C)*
(b) *AXAZ Aibihu–Xingxingxia (H)*
(c) *QQAZ North Qilian–North Qinling (C)*
(d) *KWAZ West Kunlun (J)*
(e) *KEAZ East Kunlun (J)*
(f) *LHAZ Longmenshan–Honghe (J)*
(g) *SCAZ Shexian–Changsha (J)*
(h) *WYAZ Wugong–Yunkai (C)*
(i) *SBAZ Sibao (J)*
(j) *JTAZ Jinshajiang–Tengtiaohe (I)*
(k) *BNAZ Banggong–Nujiang (YH)*
(l) *YZAZ Yarlung Zangbo (YH).*

*(J Jinningian; C Caledonian; H Hercynian; I Indosinian; YH Yanshanian–Himalayan)*

*SF Strike-slip faults:*

(I) *Altun;*
(II) *Tanlu.*

Figure 2. Tectonic elements of China from Wang and Mo (1995).

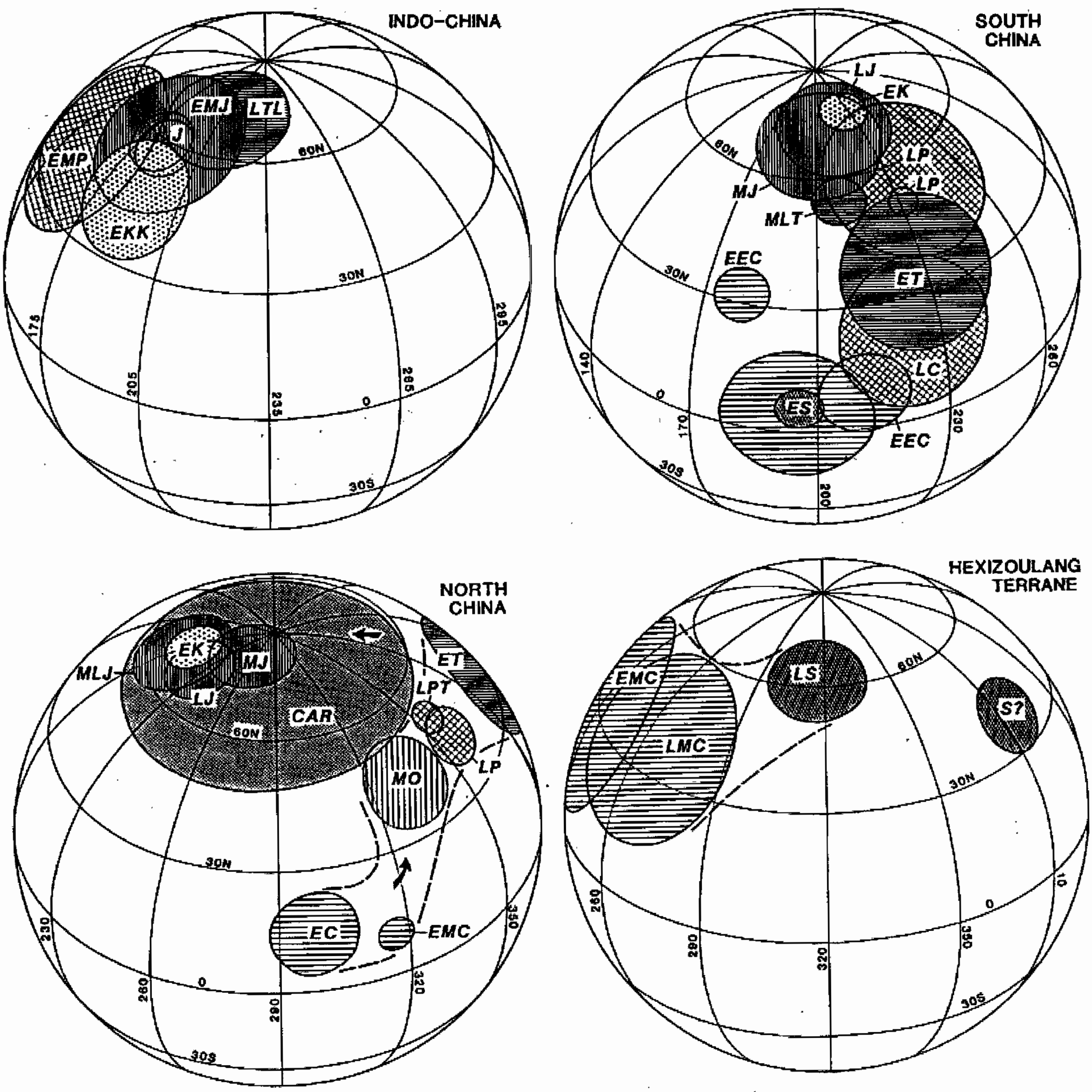



Figure 3. Paleomagnetic APW paths for some terranes in China. EC= Early Cambrian, EEC= Early Early Cambrian, MO= middle Ordovician, MLT = middle late Triassic. Data compiled by Burrett 1987 unpublished.

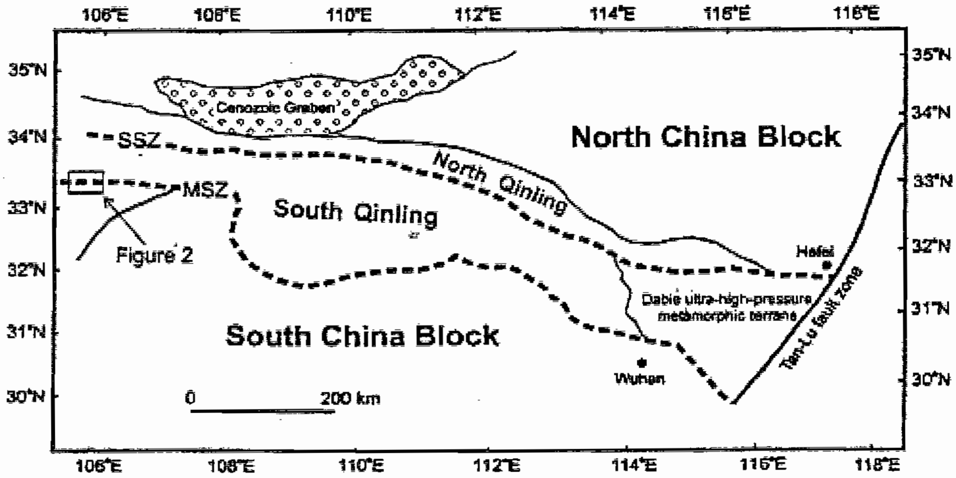



Figure 4. The main Qinling belt showing position of Dabie Shan high pressure metamorphic terrane from Meng and Sheng (1999).

influential Chinese geologists accepted an allochthonous terrane analysis for China (e.g. Wang H.Z. 1981).

The discovery and detailed study of ophiolites (e.g. Xie and Guo 1984) and ultra high pressure metamorphics in the Dabie Shan belt of the eastern main Qinling Shan (Fig.4) and in the Su-Lu area further to the northeast confirmed the Qinling Shan as a major suture between the NCB and the SCB (Zhang, Guowei, et al. 1995; Zhang, Ru-yuan et al. 1995).

The Dabie Shan coesite and diamond-bearing eclogites have protolith ages of ca. 780 Ma with an ultrahigh-P overprint at 240–220 Ma, enjoyed extreme subhorizontal shortening at 200–180 Ma. Extension followed at 133–122 Ma (Hacker et al. 1995; Oberhansli et al. 2002). The mineral assemblages imply burial and exhumation of continental crust from depths of 100km! (Faure et al. 2000). The Qinling belt is displaced along the Tanlu Fault and its exact position either within or north of or south of the Jiaodong Peninsula remains controversial (Faure et al. 2000; Wang et al. 1998; Zhai 2002) as is its position within or south of the Korean peninsula.

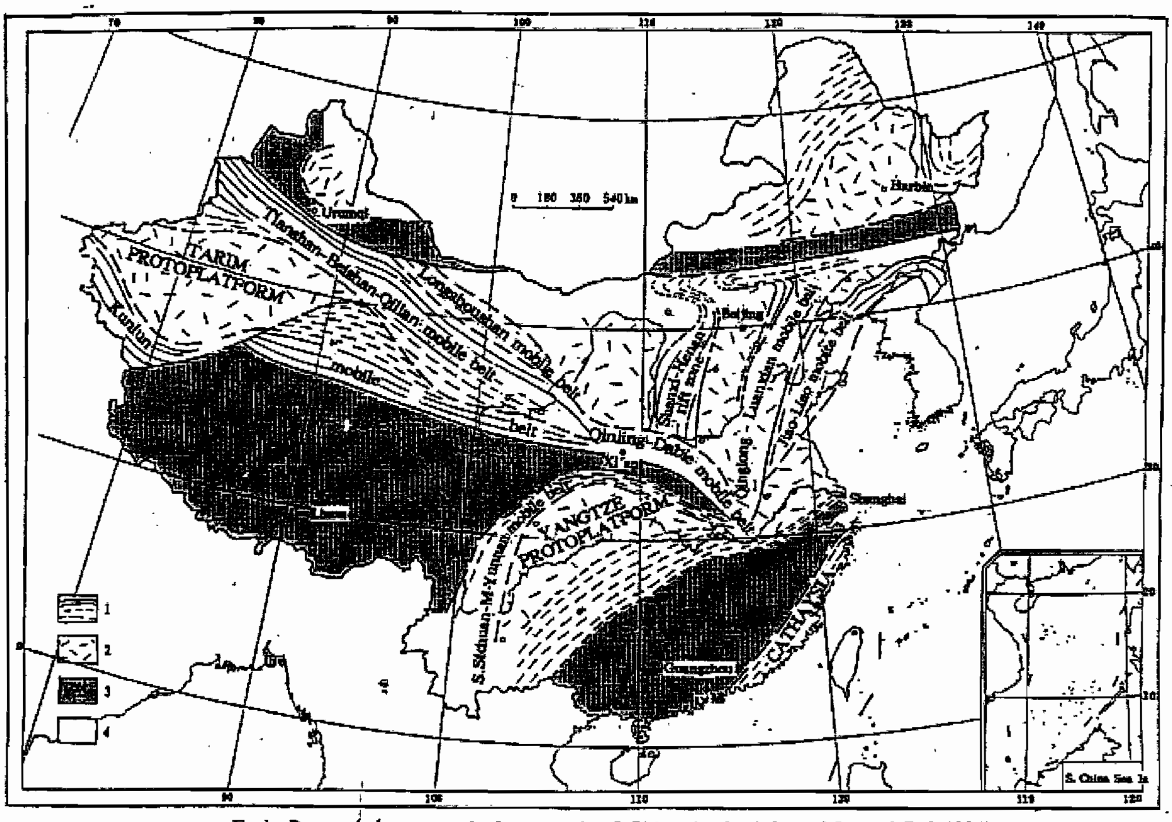
The differences between the NCB and the SCB crust are confirmed by extensive studies on Nd and Pb isotopes and compilations of reliable magmatic and metamorphic dates. The oldest rocks in China are in the NCB. Nd model ages range from 4Ga up. The Precambrian geological development of NCB is very similar in terms of ages, greenstone belts and rift basins to that of northern Australia and very different to that of SCB. Precambrian SCB consists of Mesoproterozoic to Neoproterozoic volcanic arcs/back-arc basins younging to the southeast.

The SCB consists of two major Proterozoic terranes — the Yangtze and Cathaysia (Fig. 5).

The Cathaysia block/terrane is similar in extent to the South China Fold Belt on many maps. Two prominent and influential tectonicians Ken Hsu and Celai Sengor suggested that Cathaysia and the Yangtze block collided during the Mesozoic (e.g. Sengor at al. 1988). Simple stratigraphic and biogeographic data showed that this was a silly idea even at the time. All subsequent data show that this was a Neoproterozoic suture with Neoproterozoic ophiolites with dates around 1000–800 Ma. However, recent dates on synorogenic granite-orthogneisses from the Kangdian axis of Sichuan Province suggest to Li et al. (2002) that the collision further east was of Grenvillian age at ca.1007 Ma. It is not clear, though, that events in Sichuan were related to the closure of the Proterozoic ocean that separated Yangtze and Cathaysia.

Parts of Yunnan belong to the Shan-Thai Terrane (or Sibumasu Terrane) that extends from Yunnan to Burma to western Thailand, western Malaysia and Sumatra. The Shan-Thai Terrane collided with the Indo-China and South China Terranes in the late Triassic. The Simao Terrane was set-up to include the area between the Ailaoshan Terrane in the east of Yunnan and the Changning-Menglian suture in the west (Fig. 6). The continuation of the Simao Terrane may be in Xizang to the north and with parts of the Indo-China Terrane to the south east (Fig. 7).

There was little data on the provenance of the




Early Precambrian tectonic framework of China (revised from Ma and Bai 1994).
(1) Early Proterozoic mobile belts; (2) Archaean craton; (3) ocean; (4) boundary between tectonic provinces.

Figure 5. Early Proterozoic tectonic framework of China

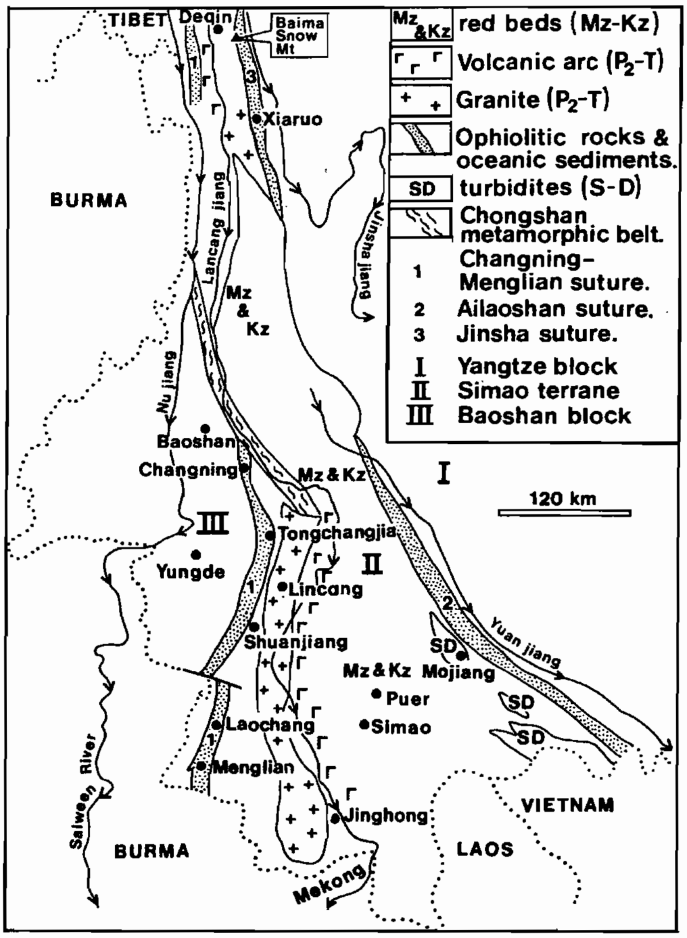



Figure 6. Sutures and terranes in Yunnan from Wu et al. (1995).

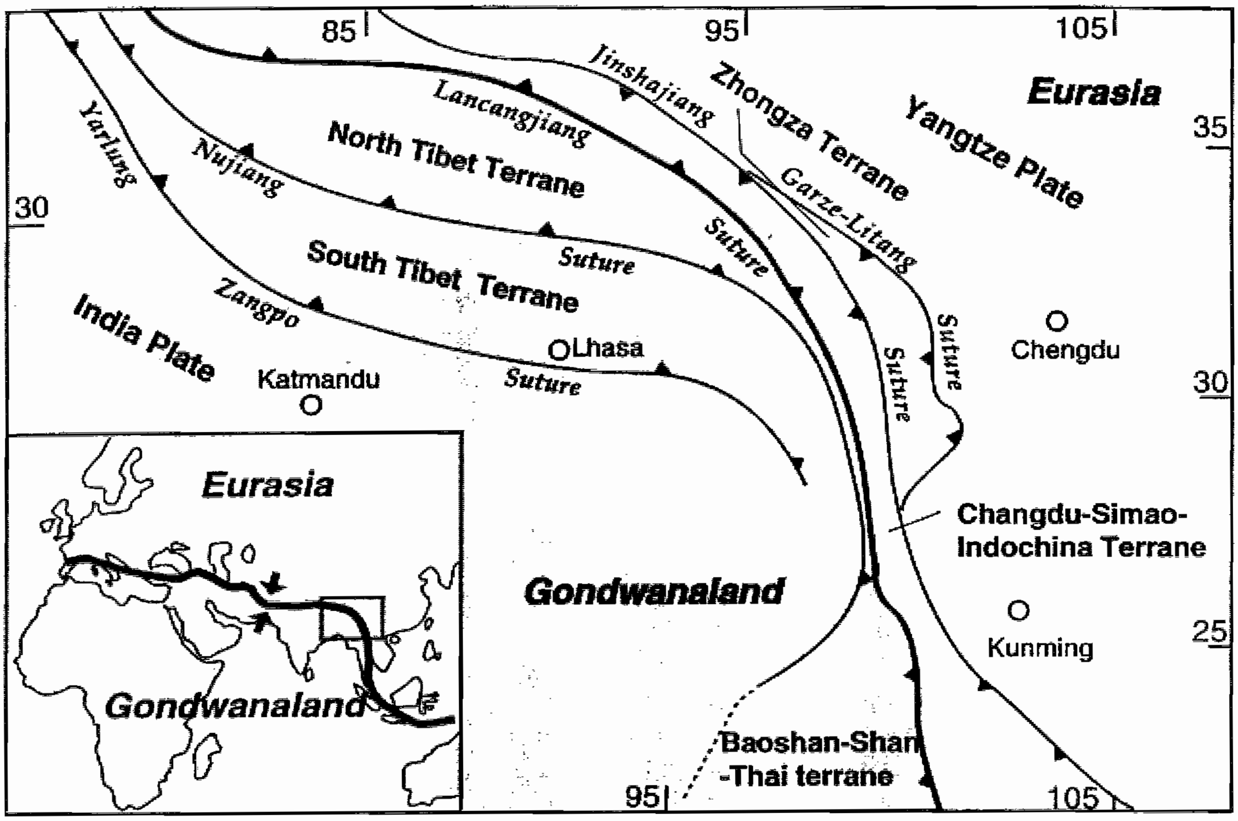



Figure 7. Sutures in Xizang and Yunnan from Yang (1998)

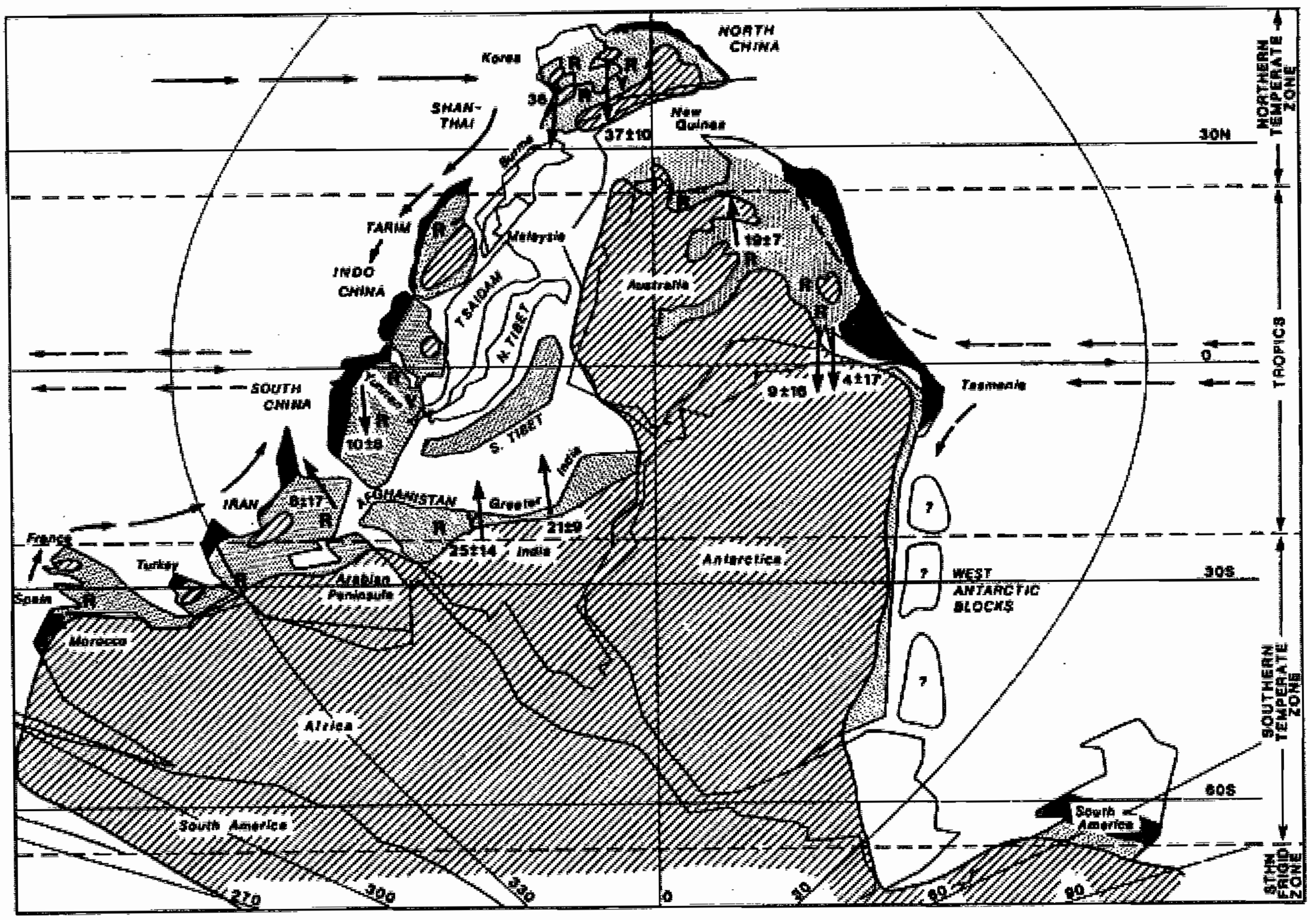



Figure 8. Reconstruction of Greater Gondwanaland for the Early Cambrian. Arrows on continental crust are paleomagnetic declinations with paleolatitudes.

Chinese and SE Asian terranes when they were first delineated in the 1970s. Subsequent work on palaeomagnetism and biogeography has confirmed that the Shan-Thai (Burrett and Stait 1985), South China, North China, Tarim and the smaller Tibetan (Xizang) terranes were part of a Greater Gondwana during the early Paleozoic (Burrett et al. 1986, 1990). The provenance of the Indo-China Composite Terrane remains enigmatic.

Using data from fossils and paleomagnetism, Burrett et al. (1986, 1990) placed South China to the present day west of Australia as part of a Greater Gondwana. This positioning (Fig. 8) was accepted as reasonable by most later workers. More recently acquired Proterozoic paleomagnetism supports this placement. However, Zheng-Xiang Li at the Tectonics SRC in Perth has published many papers advocating placement of the SCB between eastern Australia and Laurentia at about 800 Ma with subsequent rifting from eastern Australia at about 750 Ma (see list of references in Li et al. 2002). Quantitative comparisons between the Precambrian terranes of South China and eastern Australia do not, however, support this model (Burrett and Berry, in prep.).

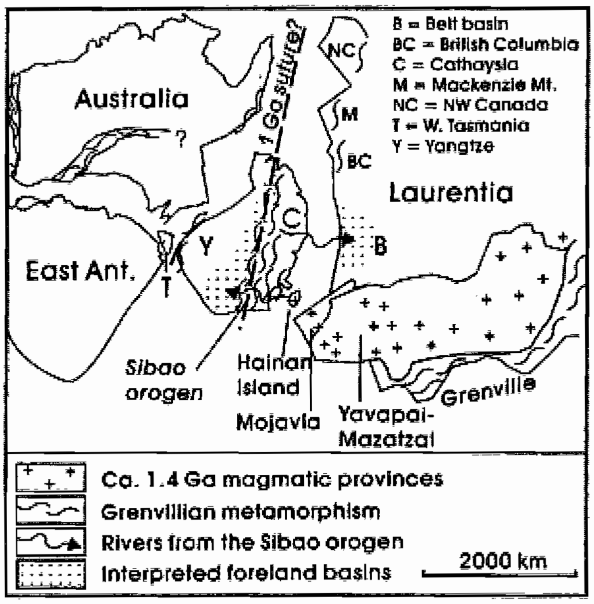



Figure 9. Placement of SCB between Laurentia and eastern Australia at about 800Ma (from Li et al 2002).

## SUMMARY GEOCHRONOLOGICAL HISTORY

In the following geochronological summary, the most likely tectonic scenarios are presented and alternative models are only briefly mentioned.

### Precambrian

The oldest rocks in South China are Archean in age but are rare. The extent of Archean shown in Figure 10 is grossly exaggerated.

In the Mesoproterozoic, South China consisted of the Cathaysia Terrane in the east extending from Guangdong northeastwards to Zhejiang and probably includes the Ryeongnam Terrane of southern South Korea. Cathaysia is separated from the composite Yangtze Terrane by a broad orogenic belt active from > 1200 Ma to about 800 Ma trending from Guangxi to north Zhejiang. Yangtze was bordered by tectonically active margins in the north (along the Qinling), in the south, west and east. Yangtze consists of island arc complexes and microcontinents that fused probably in the Sibao orogeny at about 1000 Ma approximately at the same time as the Grenvillian orogeny. Cathaysia probably collided with the Yangtze collage at about 850 Ma (Jinningian orogeny) although, based on data from Sichuan, Li et al. (2002) argue for a 1000 Ma collision.

Cathaysia has felsic igneous events at 2713, 2280, 2063, 1837, 1743, 1686, 1438, 1100, 890 and 644 Ma and major deformation events at ca. 1850 Ma and 868 Ma.

Western Yangtze has major felsic igneous activity at 2957, 2450, 1657, 907 and 890–830 and deformation at 1000 and 850 Ma.

The Kunyang 'Group' in Yunnan and the Kangding form a north-south belt of definite pre-Sinian Precambrian rocks (Fig. 12). This was a Mesoproterozoic arc complex deformed at about 1000 Ma with synorogenic granite-gneisses at 1007 Ma (Li et al. 2002). A late Proterozoic rift developed after 1000 Ma with deformation at 850 Ma caused by the collision of Cathaysia and Yangtze. The Kangding Precambrian remained an uplifted axis that acted as a narrow paleogeographic high and a source of sediment from the Sinian to the Tertiary.

Extensive continental rhyolitic-dacitic volcanics were erupted during the Sinian. Post- Jinningian (post-ca. 860 Ma) to pre-basal Cambrian sedimentary piles in South China are included in the Sinian chronostratigraphic unit which is an approximate temporal equivalent of the Australian Adelaidean. The South China Sinian (Fig. 13) starts with post-orogenic 'molasse' followed by thick siliciclastics which include extensive glacial deposits followed by 1000 m of widespread platform carbonates. Deep marine conditions are recognised along the Qinling margin in Sichuan and in Hunan. The Dabieshan basic magmatic protoliths were formed at 780 Ma

## Palaeozoic

Shallow platform carbonates were extensive during the Early Paleozoic with land along the Kangding axis and deeper water sediments along the Qinling and in Cathaysia (Figs 14, 15). Siliciclastic sedimentation in the Baoshan region of Yunnan was on the Shan-Thai Terrane. In the Cambrian, tropical platform carbonates were widespread in western SCB and in Shandong Province on the NCB with deeper water and magmatism in the eastern part of the SCB.

During the early Paleozoic the biogeographic and paleomagnetic evidence suggests that SCB and NCB were part of Greater Gondwana. It is probable that rifting of SCB from Gondwana occurred during the latest Ordovician-Silurian probably along the southwest margin of the SCB. The Xingkaian folding may be the result of the establishment of a subducting margin along the leading, southeast margin of the SCB.

The eastern margin became more active in the Late Ordovician-Silurian with folding and granite intrusions in Hunan and Guangxi (the Xingkaian orogeny). This orogeny was restricted to the southeast of South China, as in other areas of South China, there are complete and uninterrupted sections of Ordovician to Silurian. This orogeny led to widespread uplift and/or regression through the Silurian especially in the south of the SCB and in Shandong Province (NCB).

Widespread terrestrial conditions were followed by the expansion of carbonate platforms in the Devonian, Carboniferous and Permian.

Floral evidence suggests that the NCB and SCB blocks were close enough for floral interchange in the Carboniferous (Fig. 18).

There was localised mid-Permian folding in western Sichuan and extensive Late Permian eruption of continental flood basalts (the Emei Traps) in Yunnan and Guizhou.

## Mesozoic-Cenozoic

During the Triassic, an extensive carbonate platform contracted, resulting in widespread terrestrial conditions in the Jurassic. The Songpan-Ganzi area in western Sichuan was a huge region of Triassic turbiditic sedimentation with mainly a South China provenance in the early Triassic and a north China provenance in the late Triassic. The collision of North China and South China along the Qinling and the collision of Shan-Thai with South China occurred in the Late Triassic. Triassic granites are widespread in Shan-Thai, Sichuan and Hunan (Figs 22, 23).

During the Jurassic and Cretaceous subduction (Figs 24, 25) from the west and the east led to widespread intrusion of Yenshanian granites in Sichuan and Guangxi. Subduction along the paleo-Pacific margin led to extensive extrusion of calc-alkaline volcanics in the Jurassic to Cretaceous. The Late Triassic collisions produced the paleo-Bayan Har and paleo-Qinling mountains which became major sources of sediment feeding the terrestrial Jurassic Sichuan basin.

Mid-Tertiary folding (the 'Himalayan' orogeny) in western Sichuan was due to the collision of India with Asia (Fig. 26). The progressive indentation of India into Asia (Fig. 27) also resulted in the fragmentation of China and SE Asia and transcurrent movement along several very long faults which continue to the present (Fig. 28). Numerous papers have been written on the far-field effects of the collision of India with China. The indentation of India into China continues as shown by GPS measurements, with India moving north at 44 mm/y and China sliding (escaping) east at 10 mm/y and ESE at 23 mm/y. Much of the movement took/takes place along the huge strike-slip faults of China such as the Altyn Tagh and the Red River Fault and the resultant interesting patterns of extension and shortening are a major control on the Cenozoic history of the SCB (Larson et al. 1999; Zhang et al. 1990; Yue and Liou 1999).

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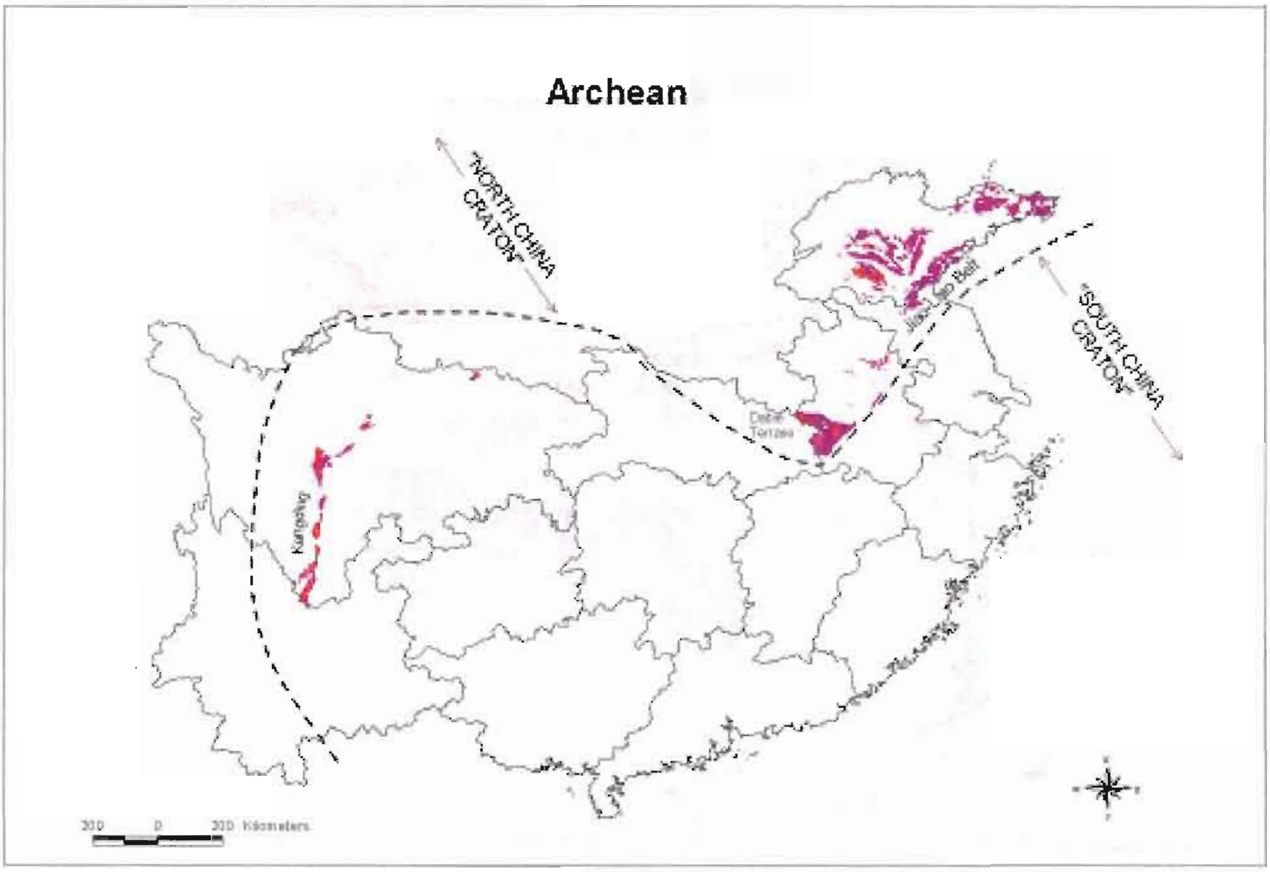



Figure 10. Maximum extent of Archean in the Yangtze Terrane, Dabie Terrane and in Shandong Province.

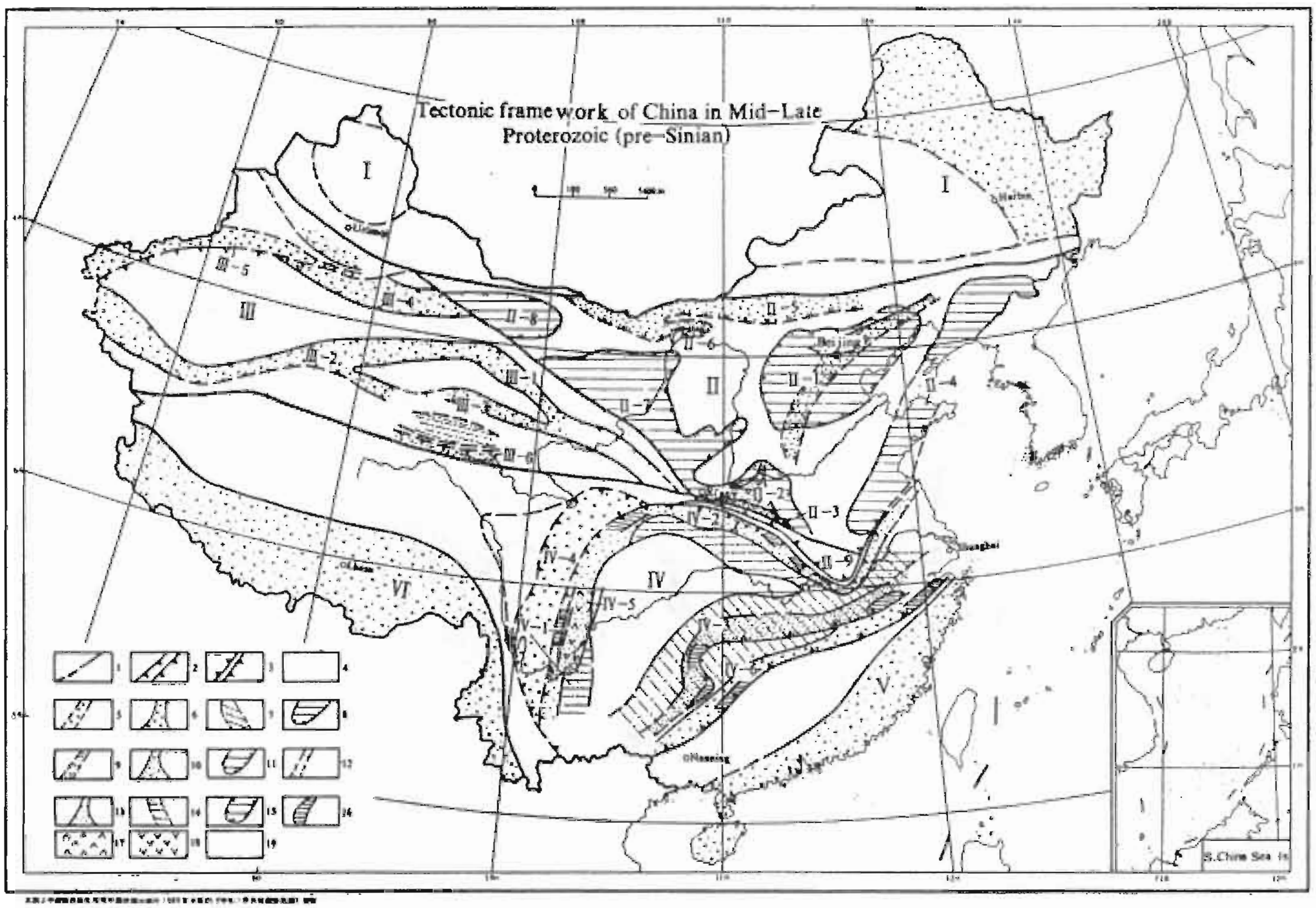



Figure 11. Tectonic framework of China for the Mesoproterozoic to Neoproterozoic (pre-Sinian).from Ma and Bai (1998).

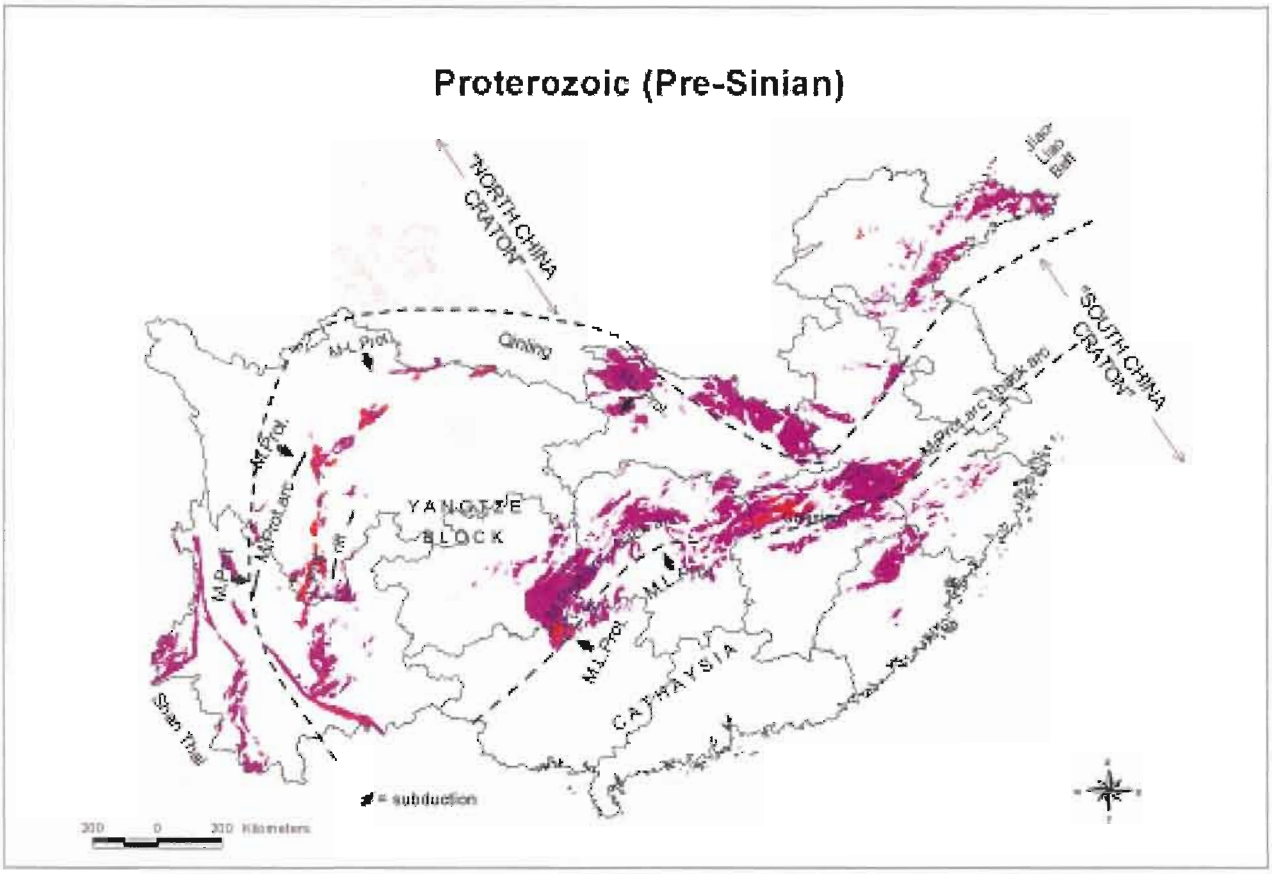



Figure 12. Pre-Sinian Proterozoic paleogeography. The SCB forms at 850Ma.

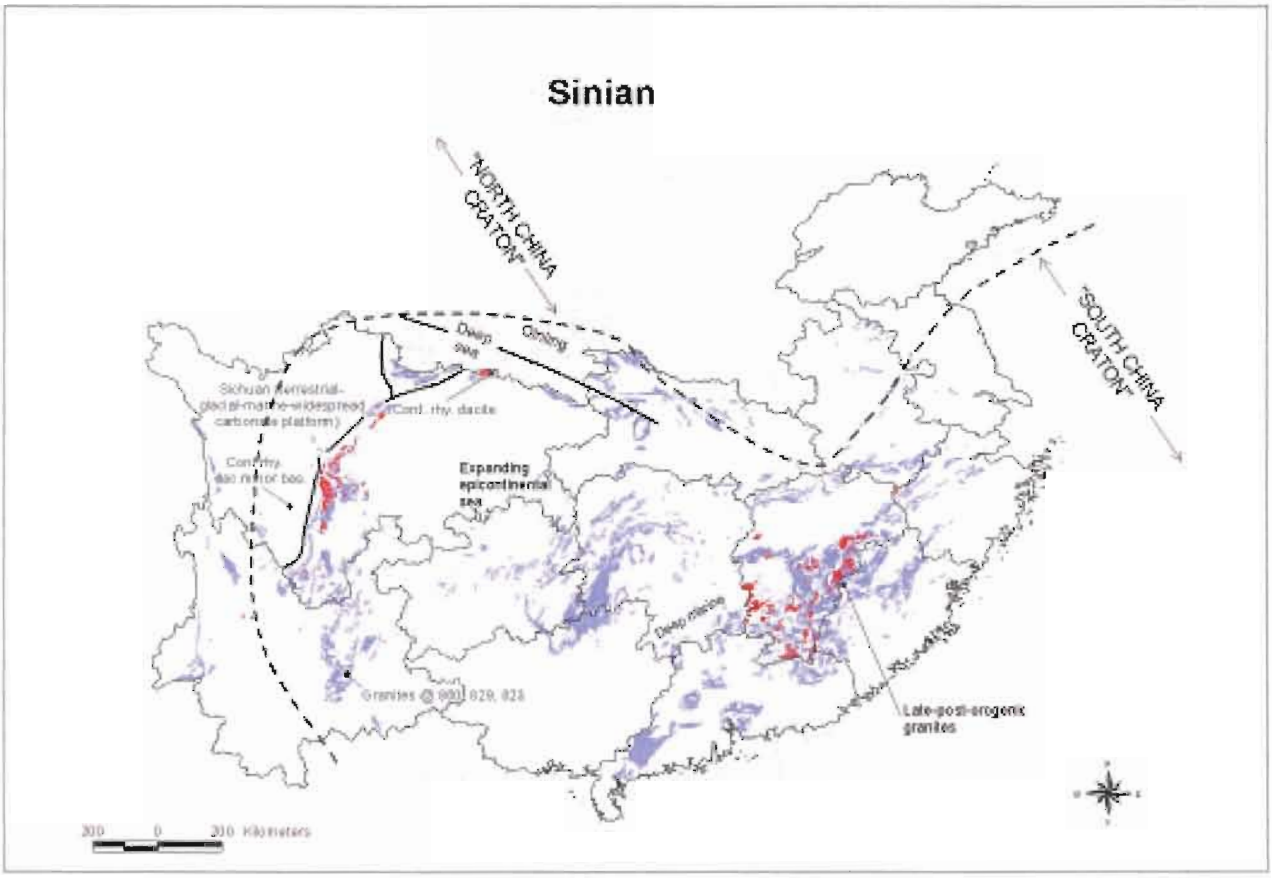



Figure 13. Sinian paleogeography of SCB.

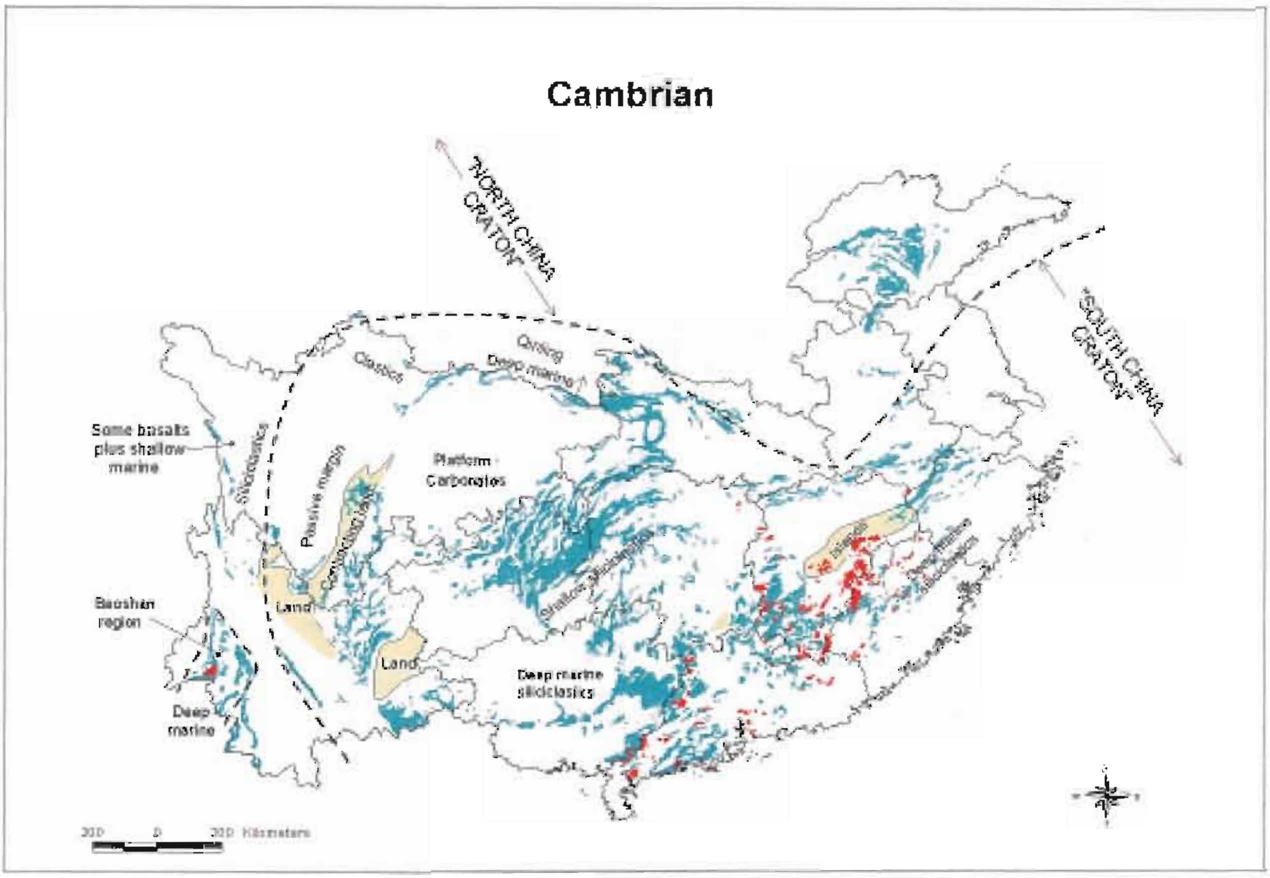



Figure 14. Cambrian paleogeography.

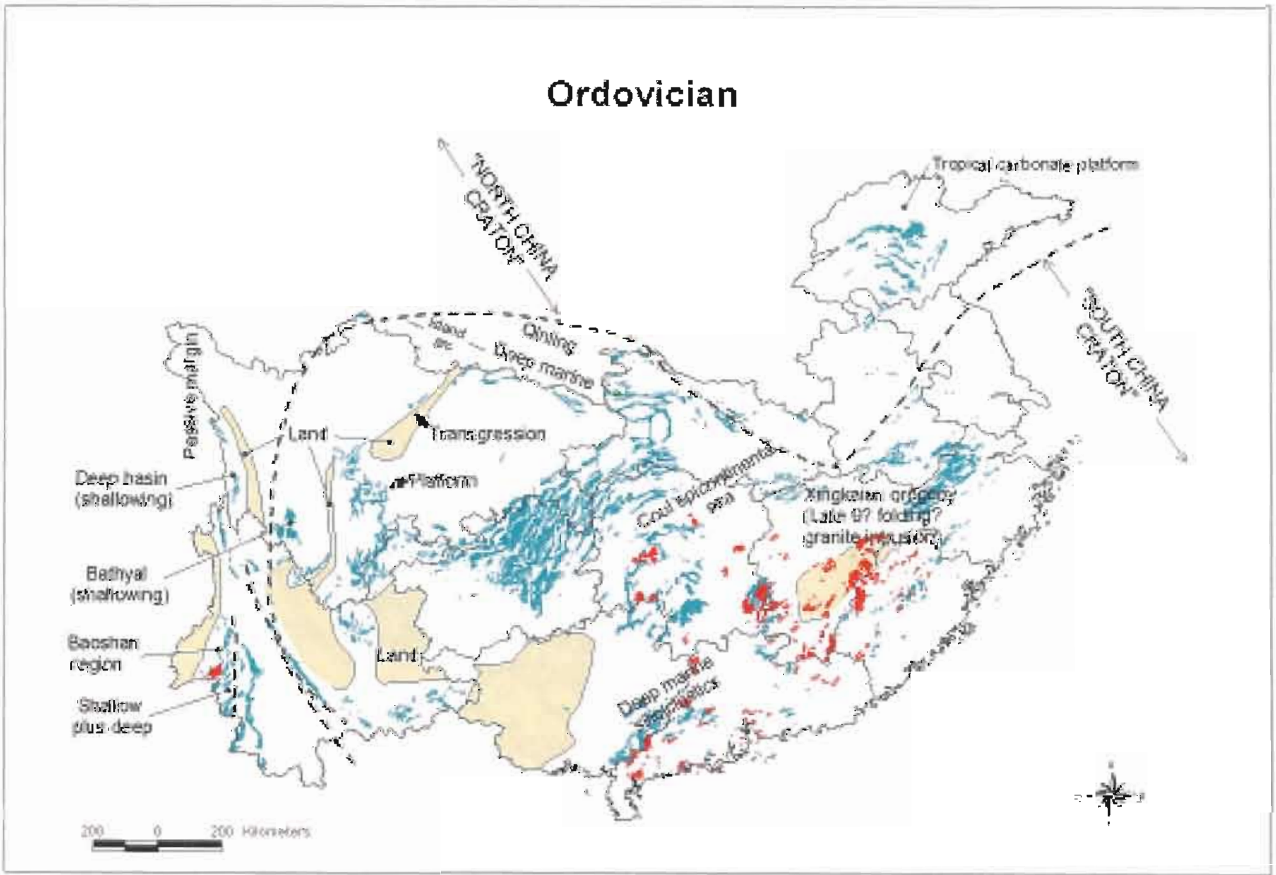



Figure 15. Ordovician paleogeography.

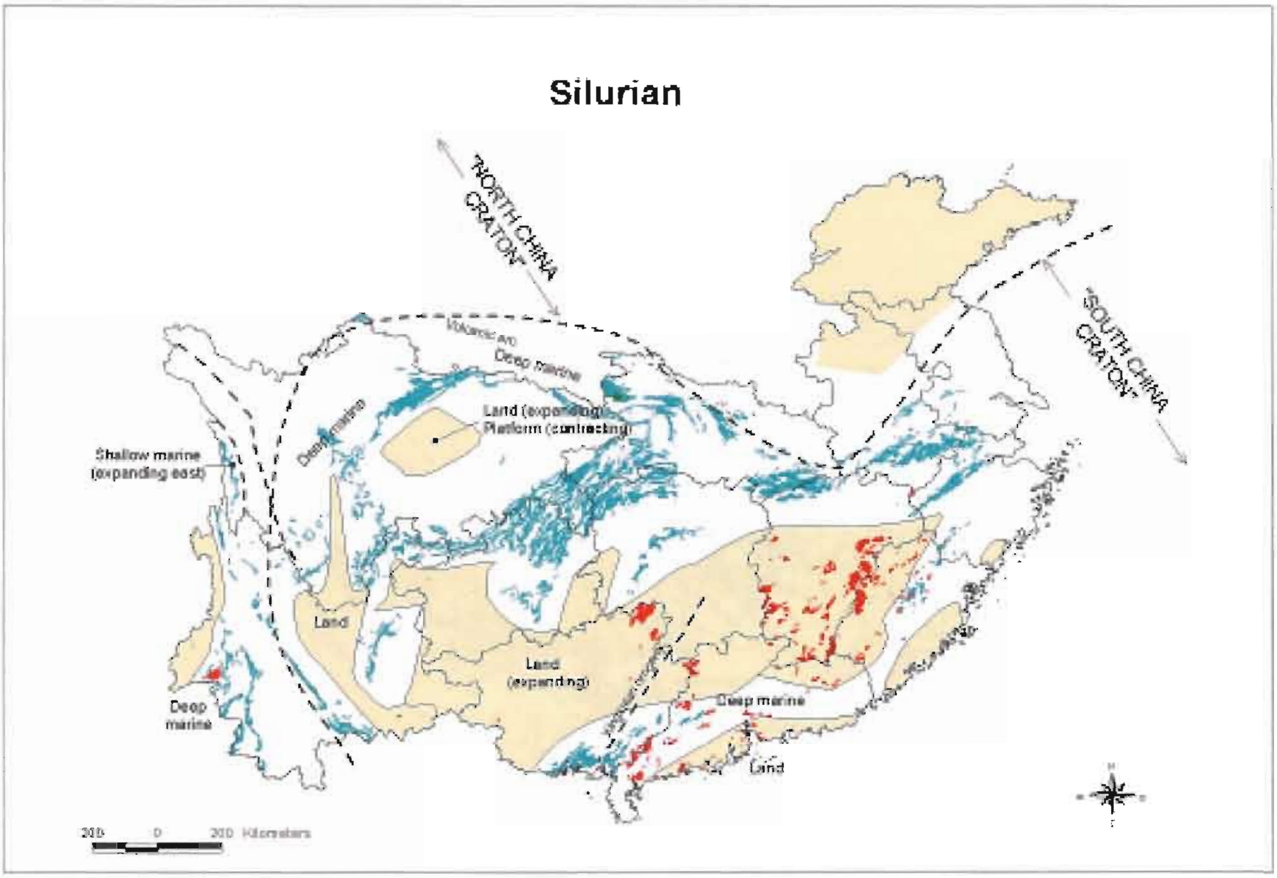



Figure 16. Silurian paleogeography.

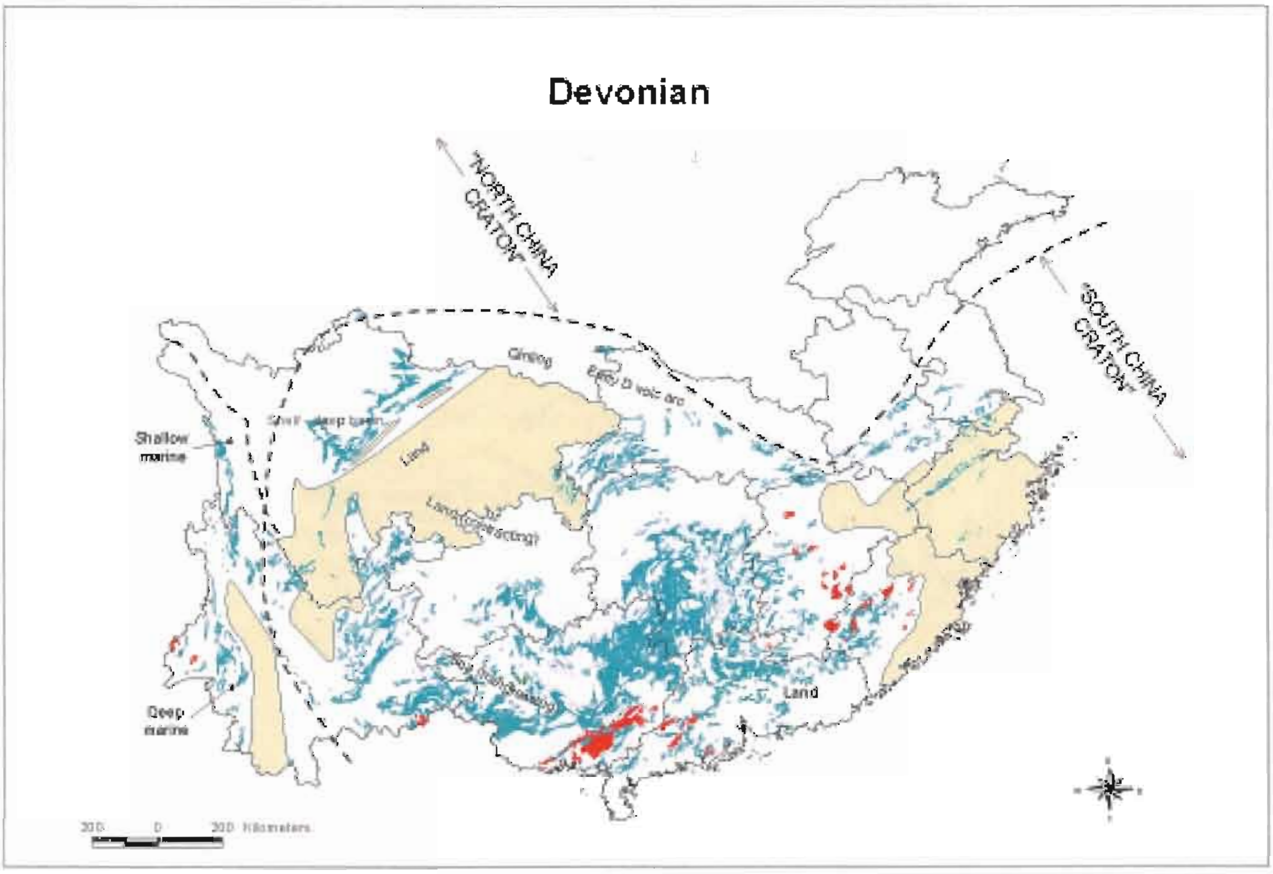



Figure 17. Devonian paleogeography.

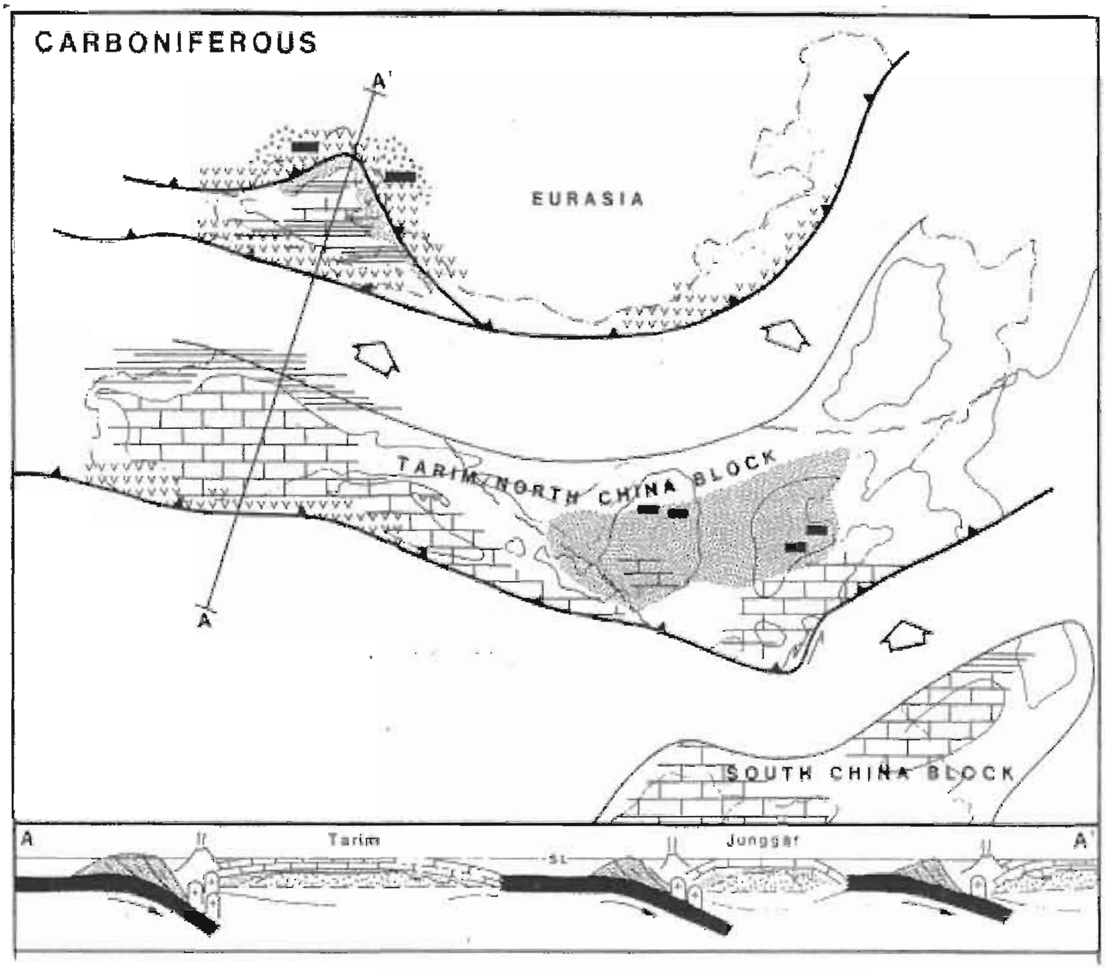



Figure 18. Carboniferous paleotectonic sketch from Watson et al. (1987).

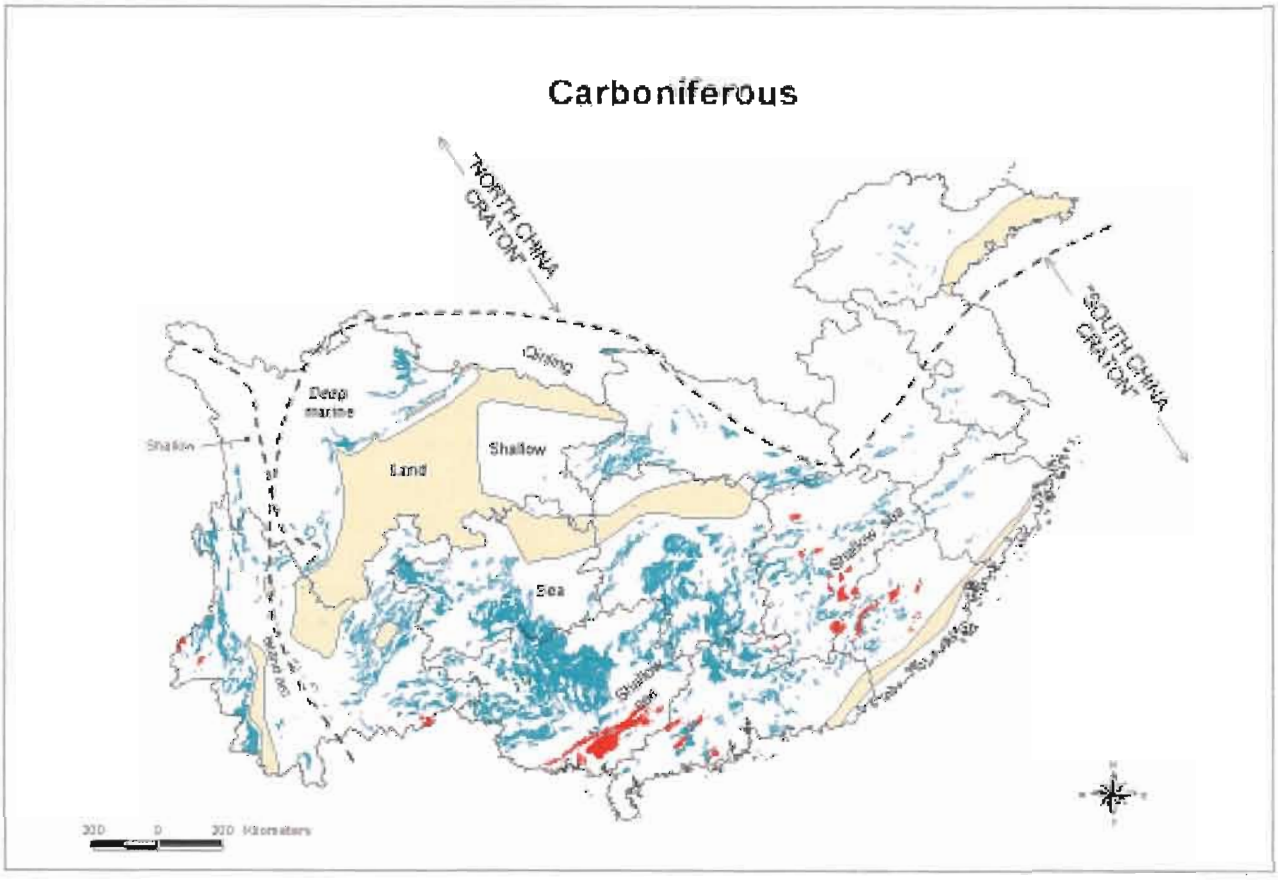



Figure 19. Carboniferous paleogeography.

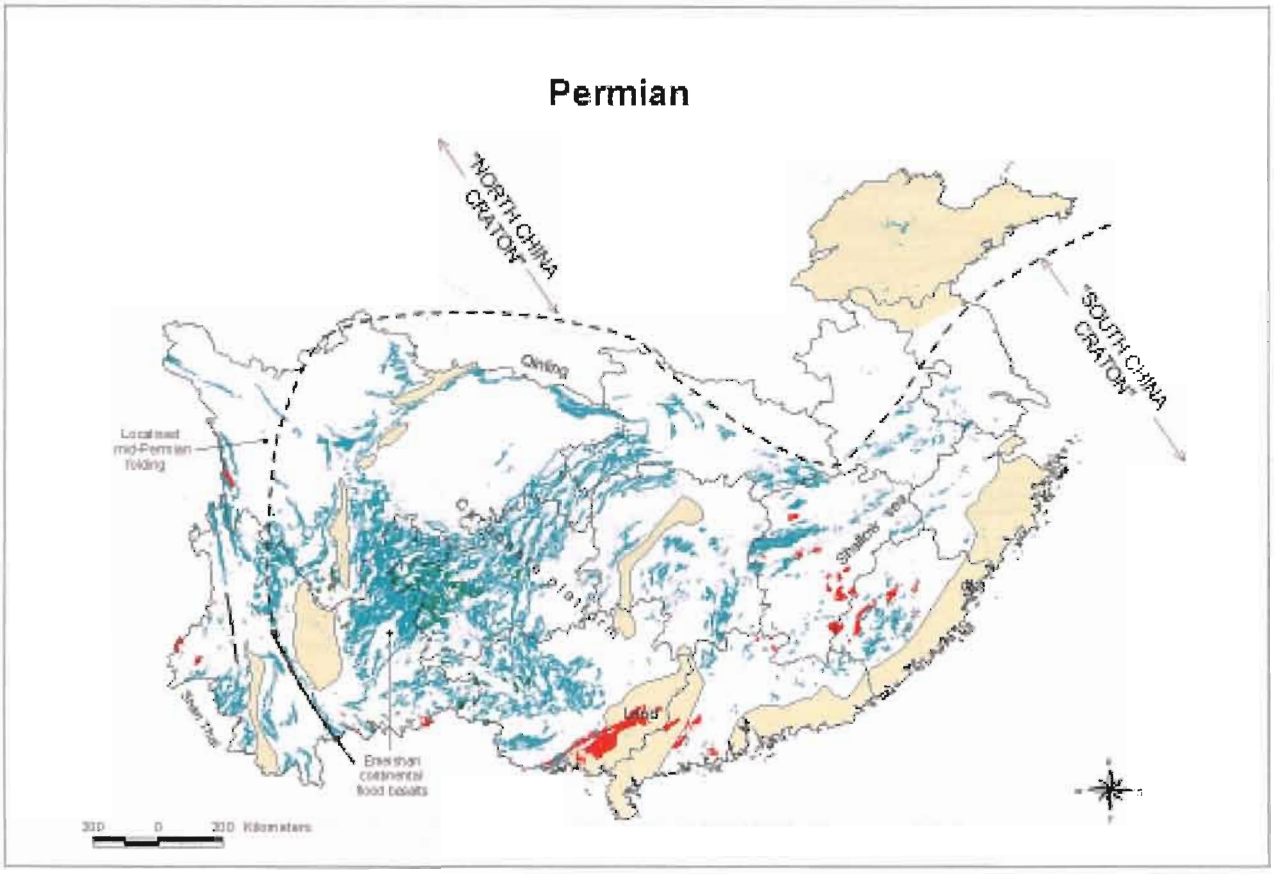



Figure 20. Permian paleogeography.

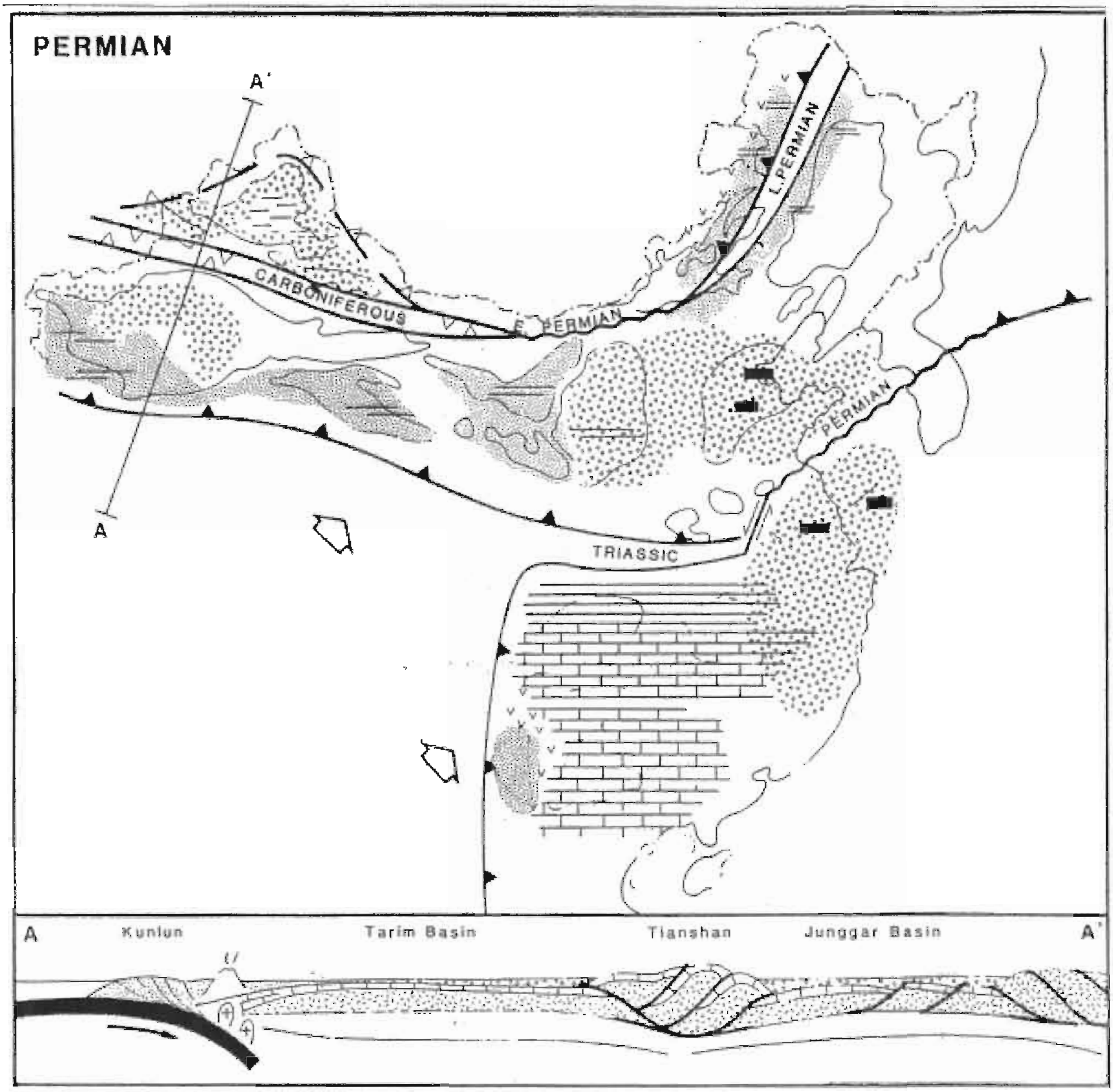



Figure 21. Permian paleotectonic sketch from Watson et al (1987).

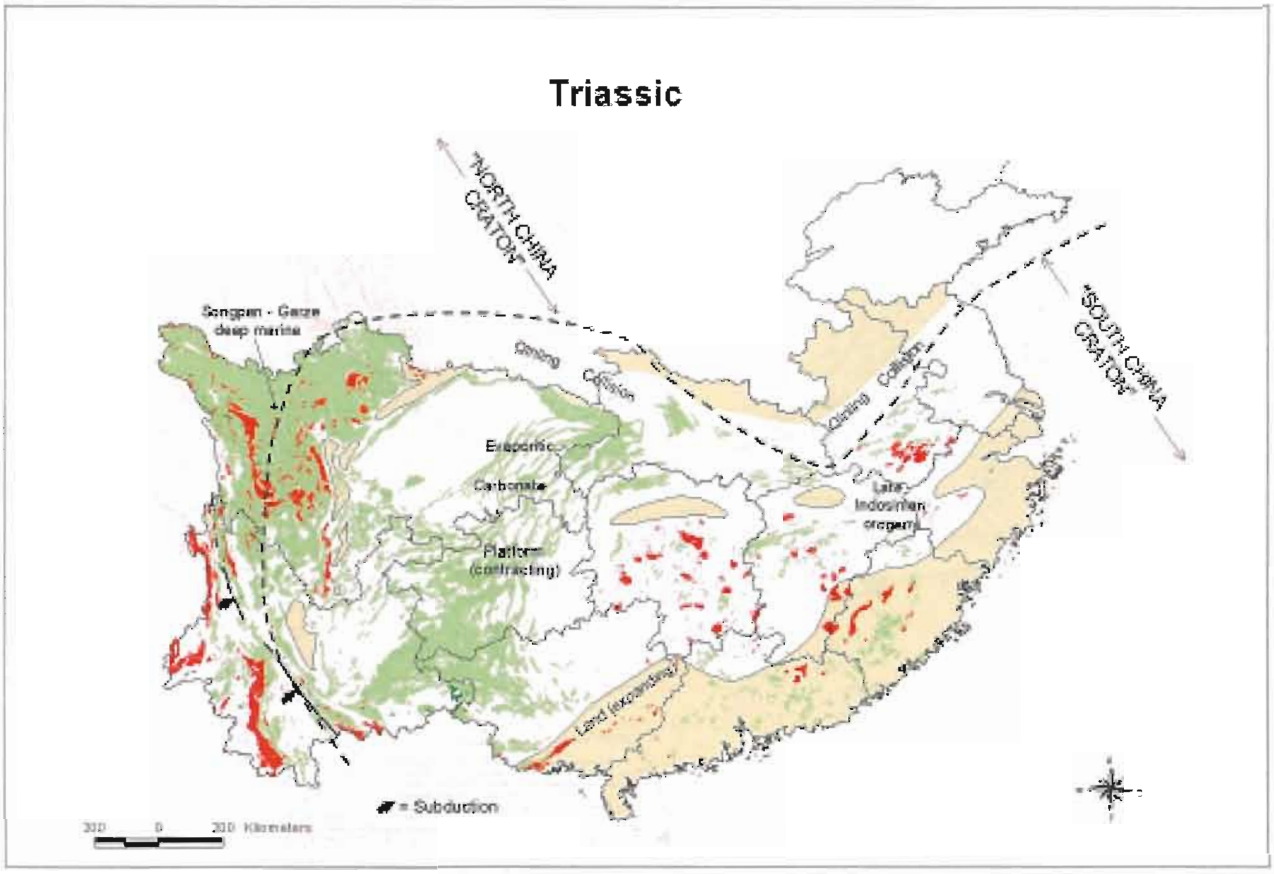



Figure 22. Triassic paleogeography.

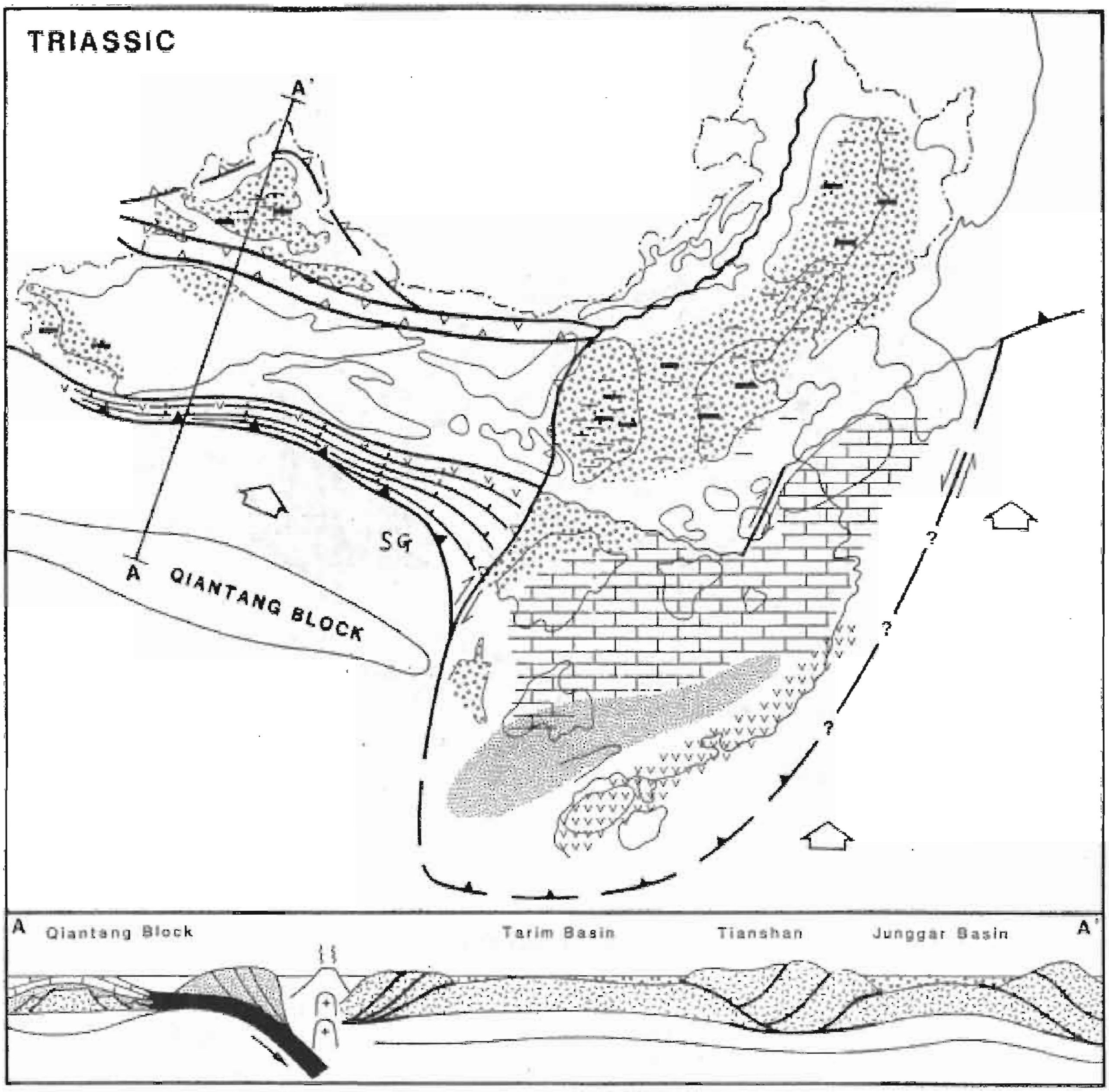



Figure 23. Paleotectonic sketch for the Triassic from Watson et al (1987). SCB fuses with NCB in the Late Triassic. SG = Songpan Ganzi turbiditic accretionary wedge.

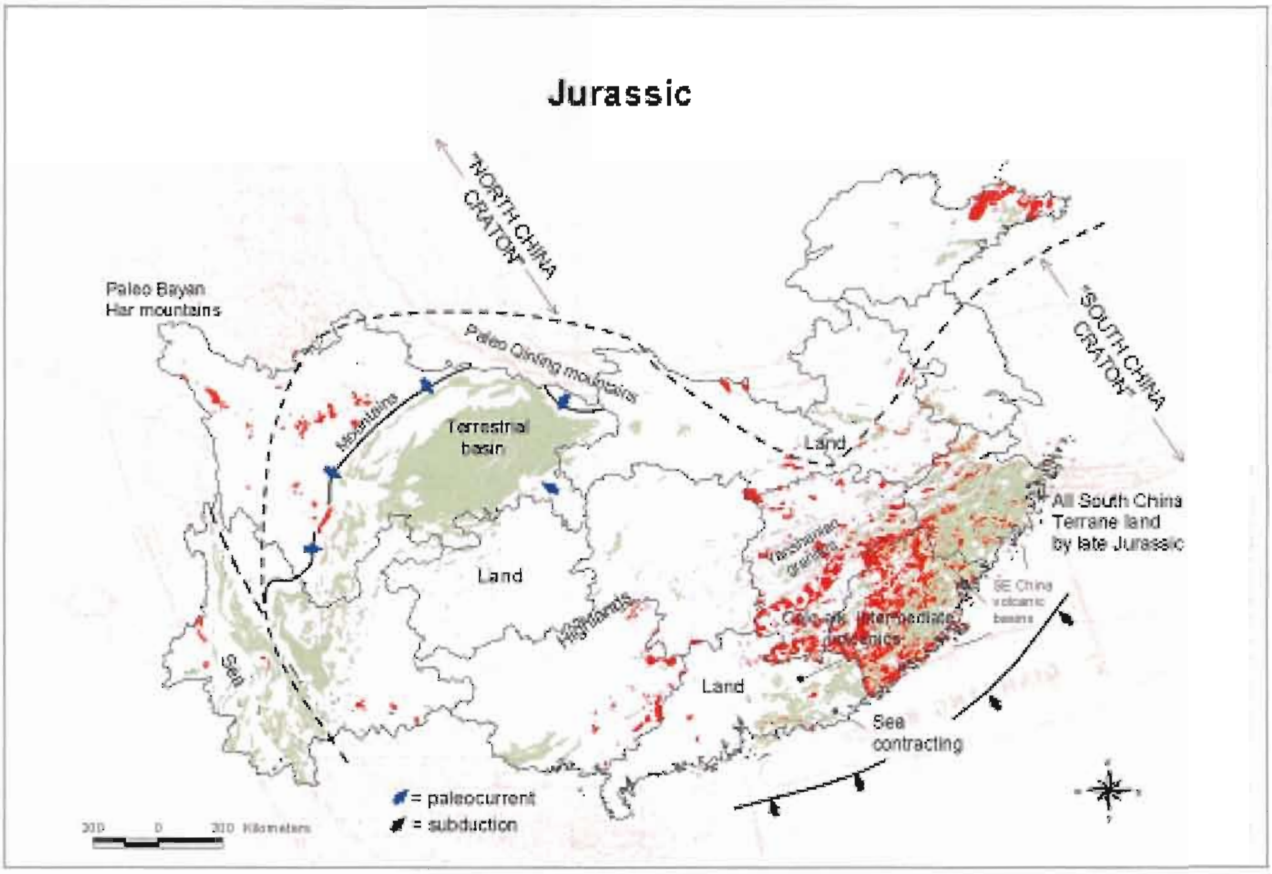



Figure 24. Jurassic paleogeography.

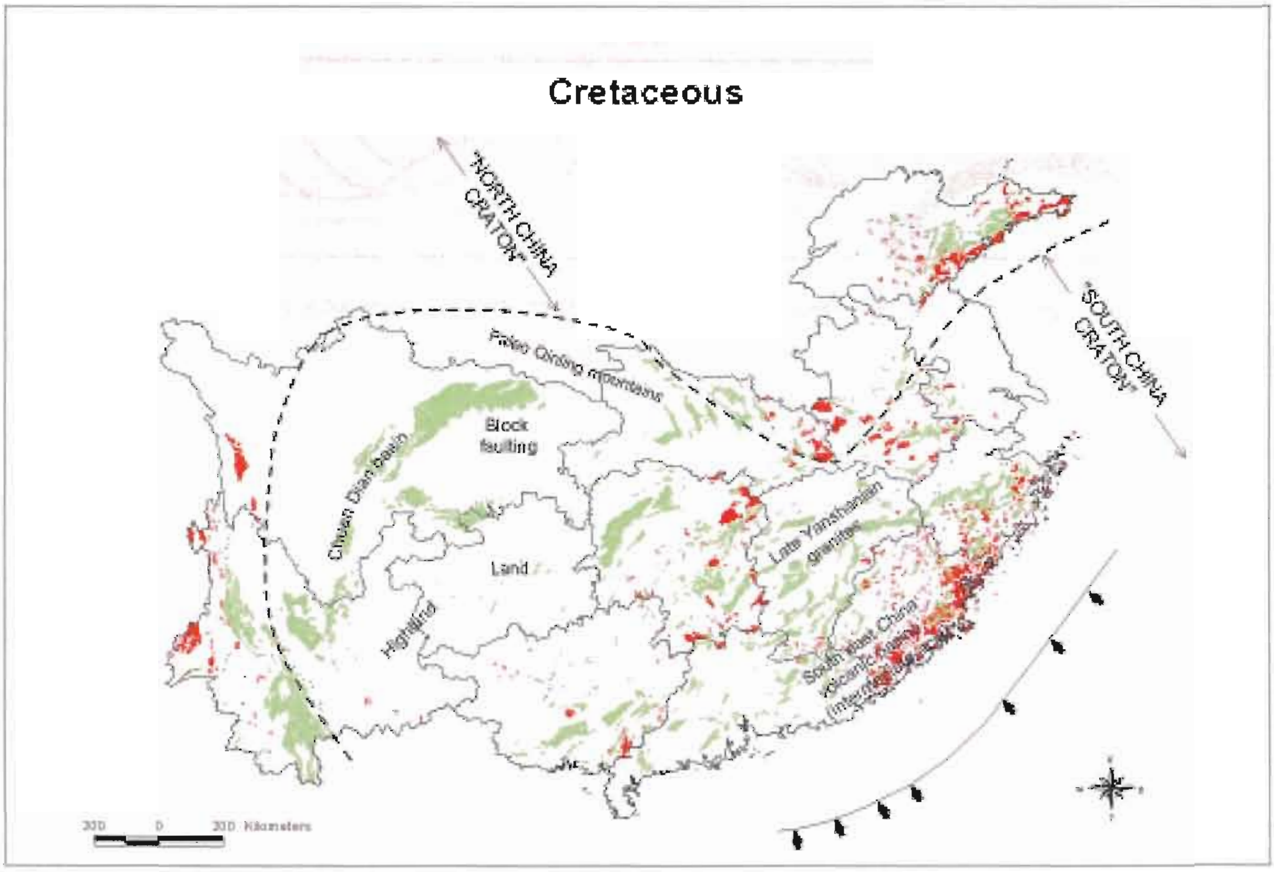



Figure 25. Cretaceous paleogeography.

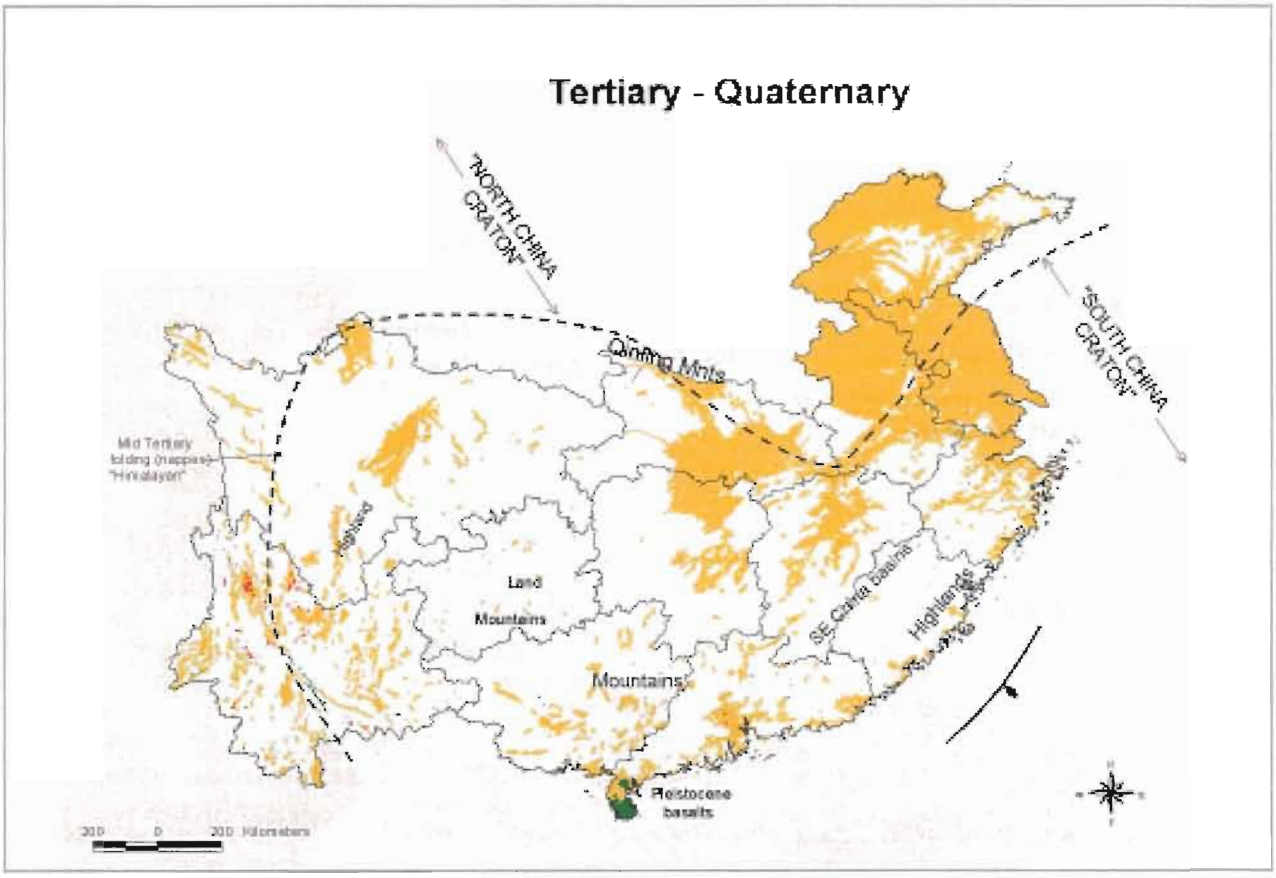



Figure 26. Cenozoic paleogeography.

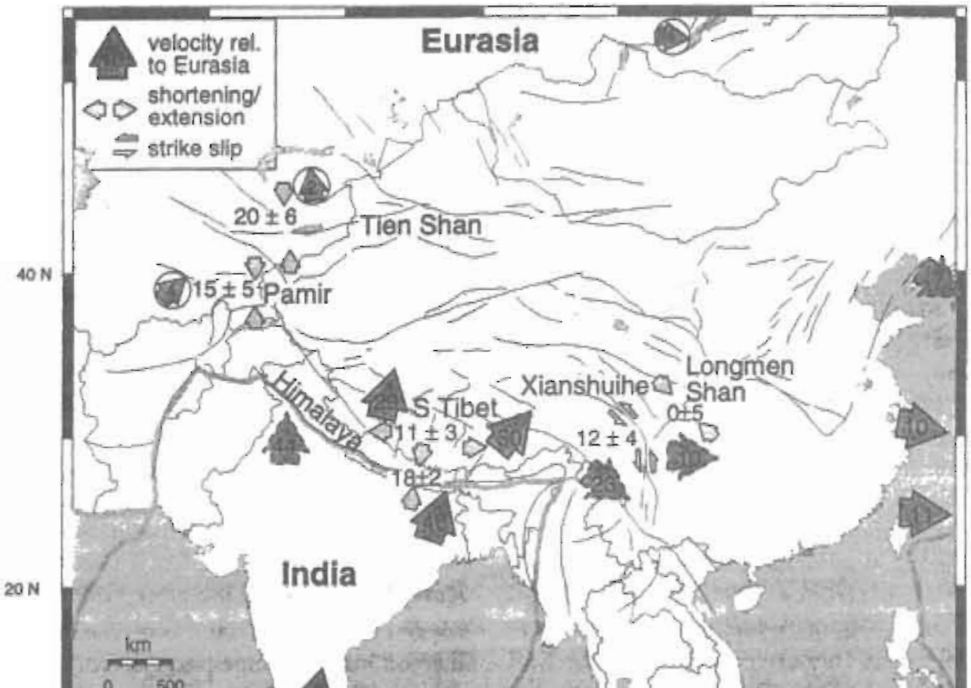



Figure 27. Indentation of India into Asia showing areas of shortening and extension. Velocities in mm per annum based on GPS measurements (Larson et al. 1999).

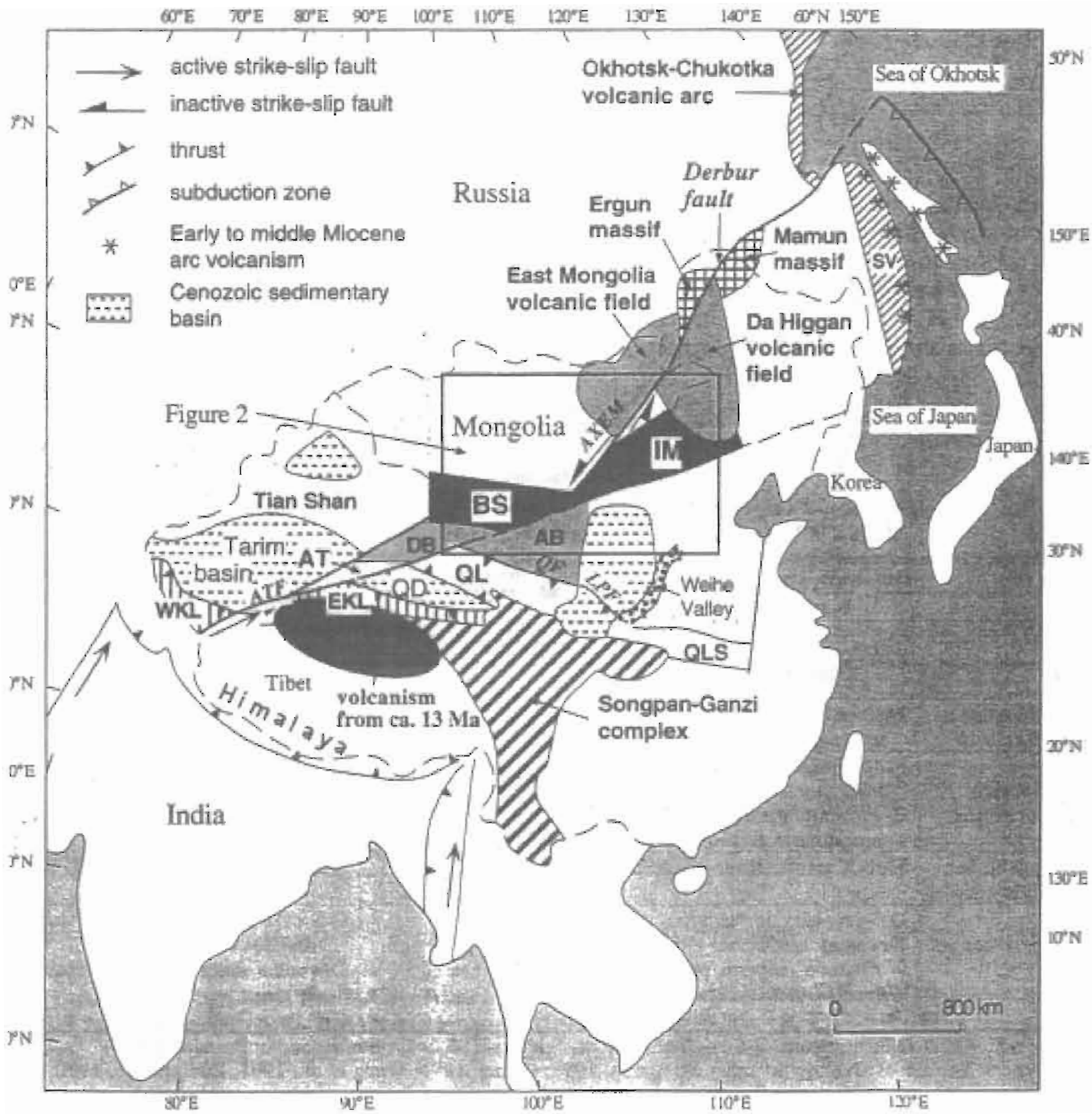


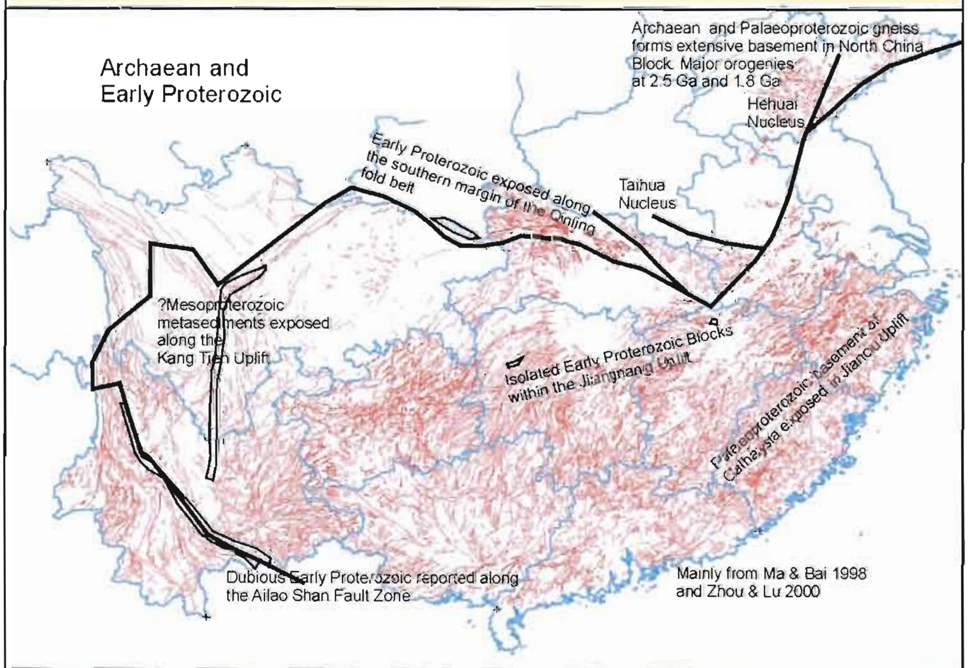

Figure 28. Major transcurrent faults, volcanism and Tertiary basins formed as a result of the indentation of India from Yue and Liou (1999).

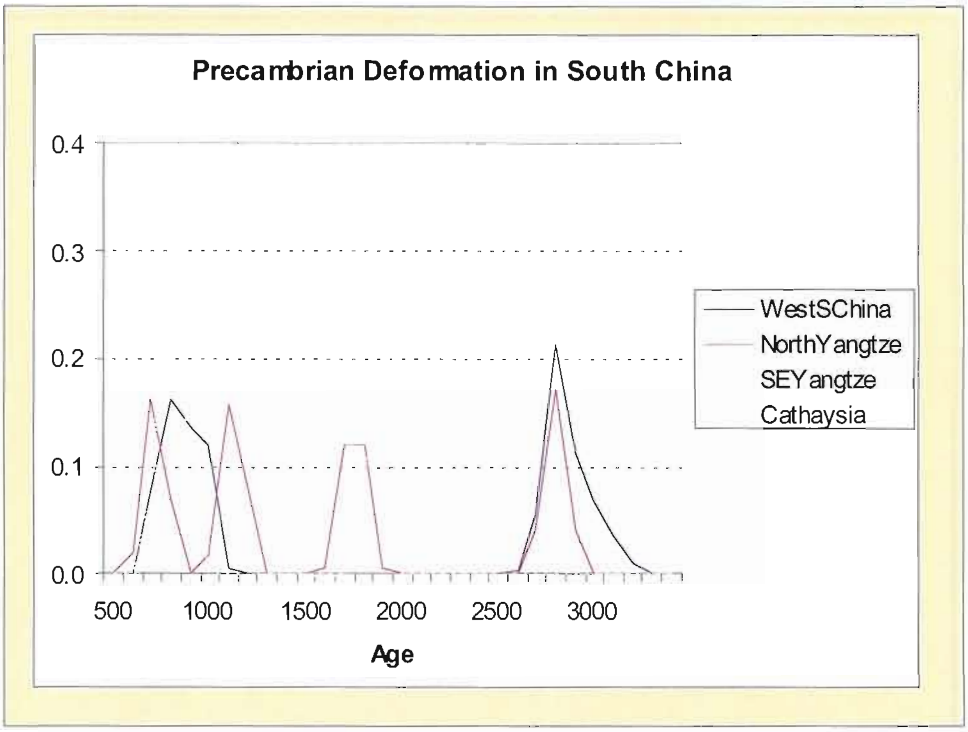
# Structural History of South China

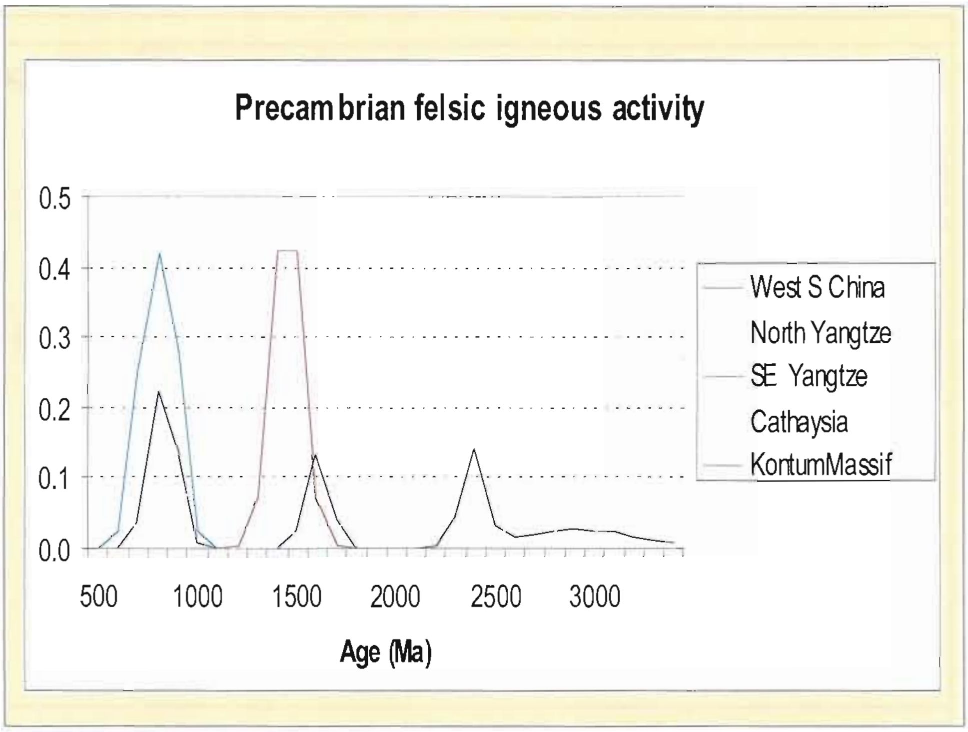
November 2002

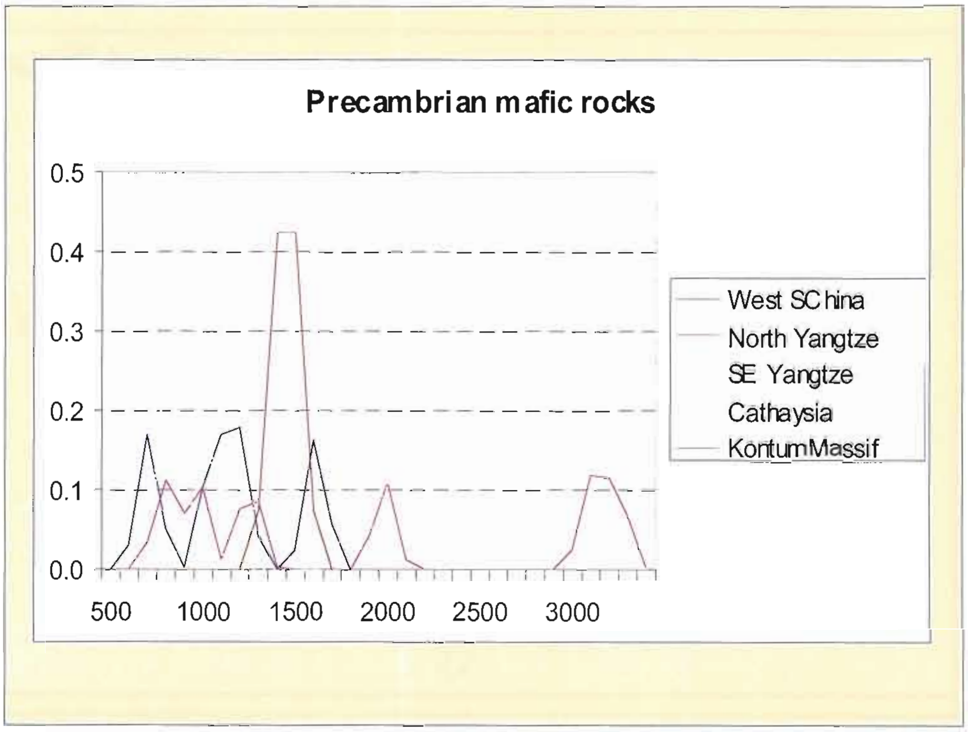
Ron Berry

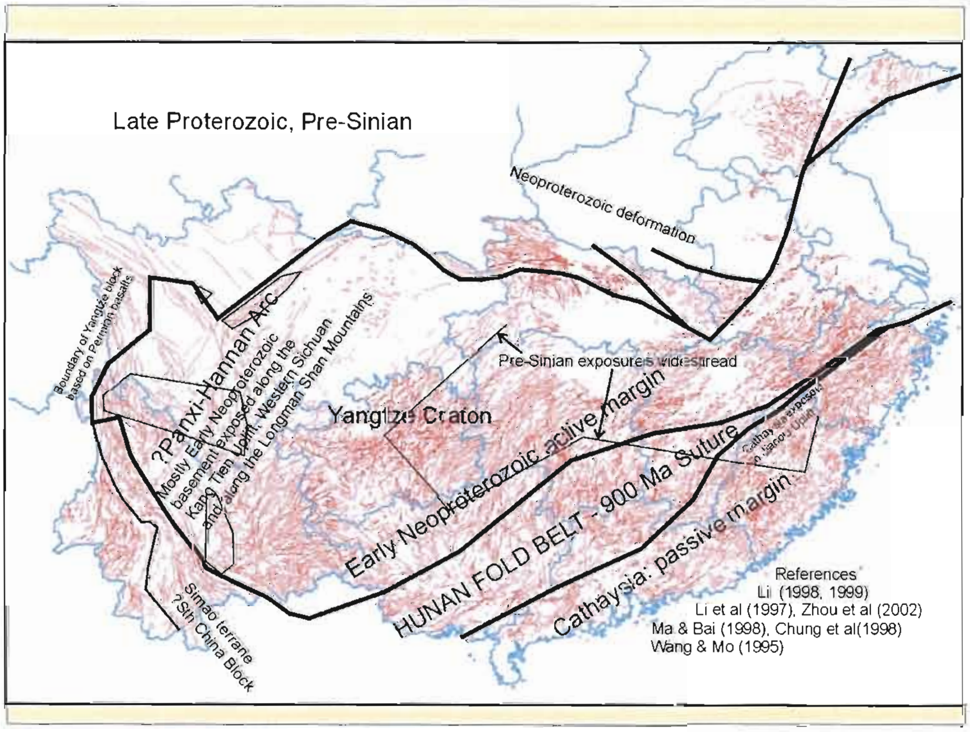
CODES SRC

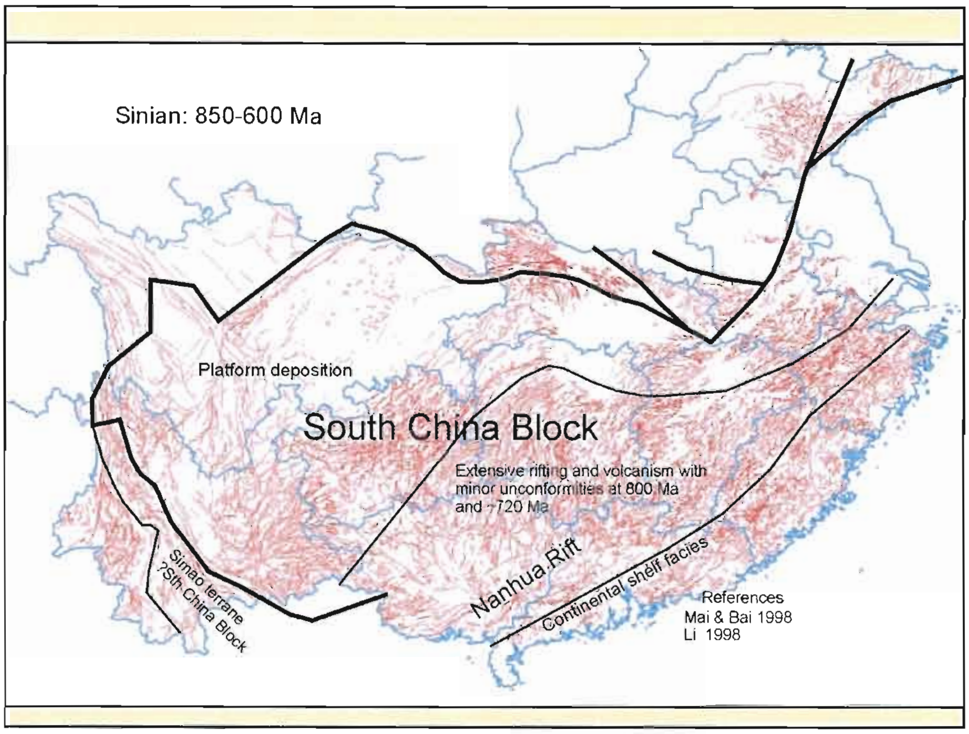



Precambrian Deformation in South China
0.4
0.3
0.2
0.1
0.0
500
1000
1500
2000
2500
3000
Age
WestSChina
NorthYangtze
SEYangtze
Cathaysia

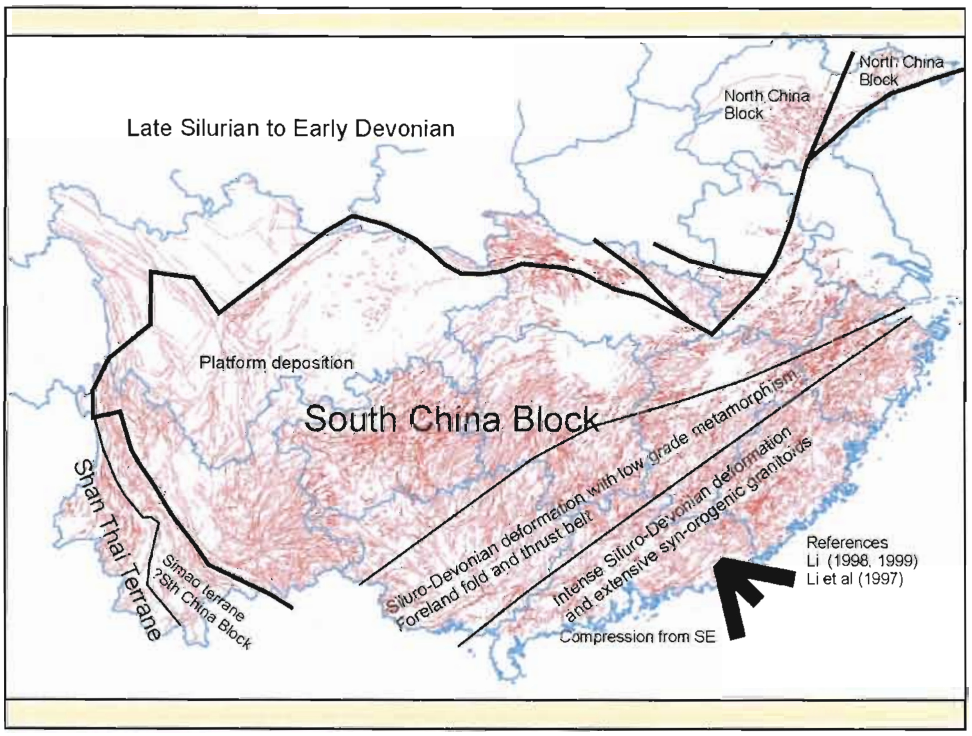

Precambrian felsic igneous activity
0.5
0.4
0.3
0.2
0.1
0.0
500
1000
1500
2000
2500
3000
Age (Ma)
West S China
North Yangtze
SE Yangtze
Cathaysia
KontumMassif


Precambrian mafic rocks
0.5
0.4
0.3
0.2
0.1
0.0
500
1000
1500
2000
2500
3000
West SChina
North Yangtze
SE Yangtze
Cathaysia
KontumMassif

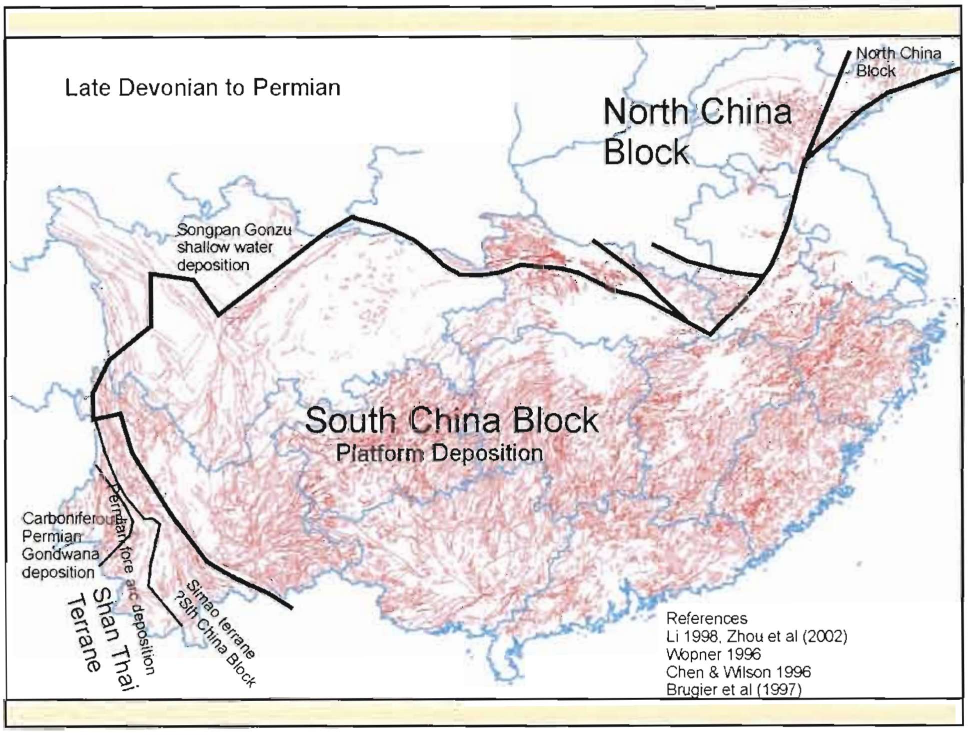

Late Proterozoic, Pre-Sinian
Neoproterozoic deformation
Boundary of Yangtze block based on Permian basalts
?Panxi-Hannan Arc
Mostly Early Neoproterozoic basement exposed along the Kang Tien Uplift, Western Sichuan and along the Longman Shan Mountains
Pre-Sinian exposures widespread
Yangtze Craton
Early Neoproterozoic active margin
HUNAN FOLD BELT - 900 Ma Suture
Cathaysia: passive margin
Simao terrane
?Sth China Block
References
Li (1998, 1999)
Li et al (1997), Zhou et al (2002)
Ma & Bai (1998), Chung et al(1998)
Wang & Mo (1995)

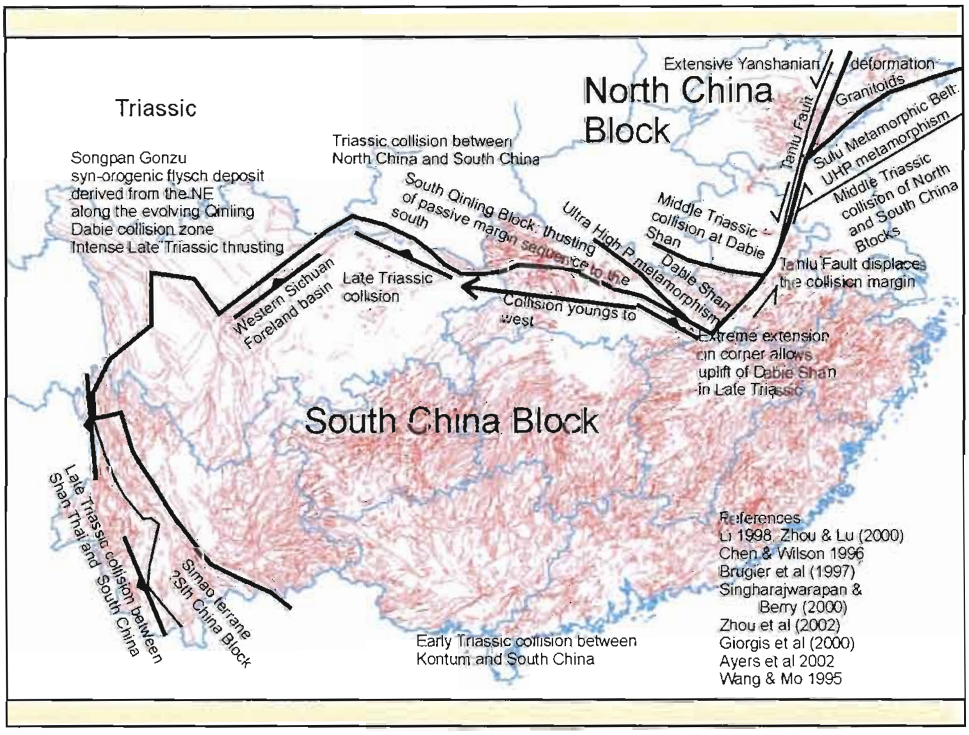


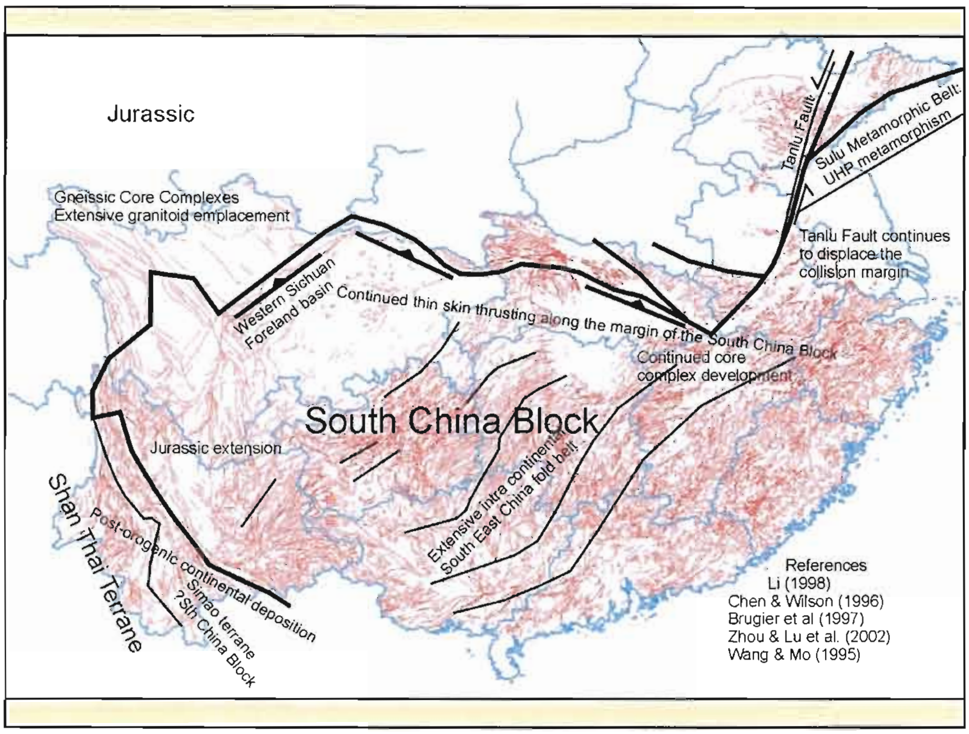
Sinian: 850-600 Ma
Platform deposition
South China Block
Extensive rifting and volcanism with minor unconformities at 800 Ma and ~720 Ma
Nanhua Rift
Continental shelf facies
Simao terrane ?Sth China Block
References
Mai & Bai 1998
Li 1998

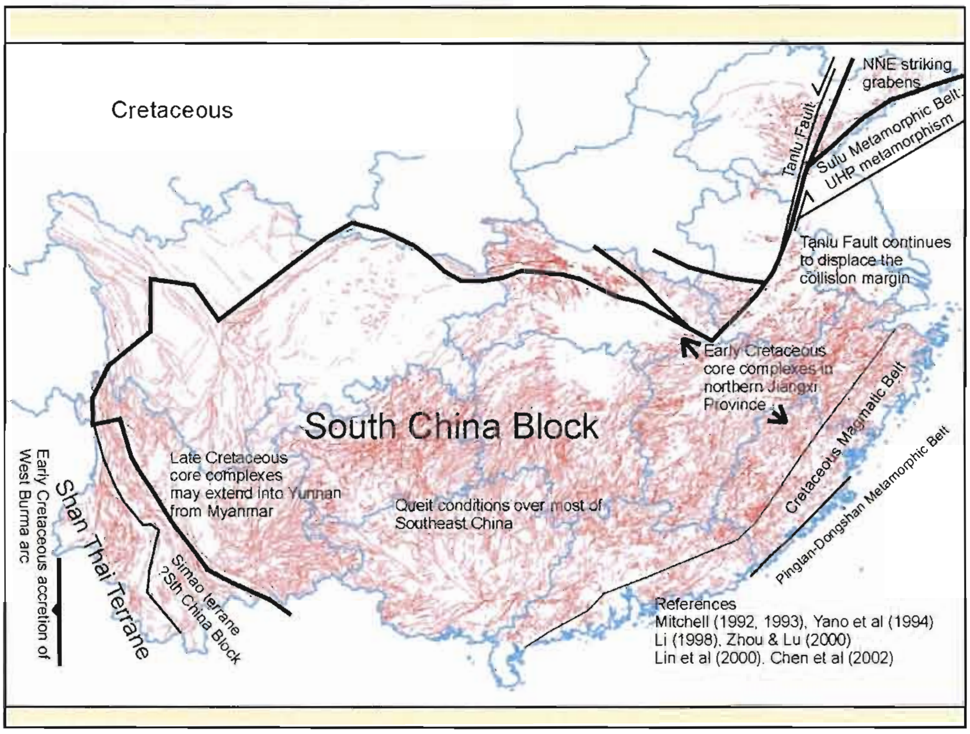



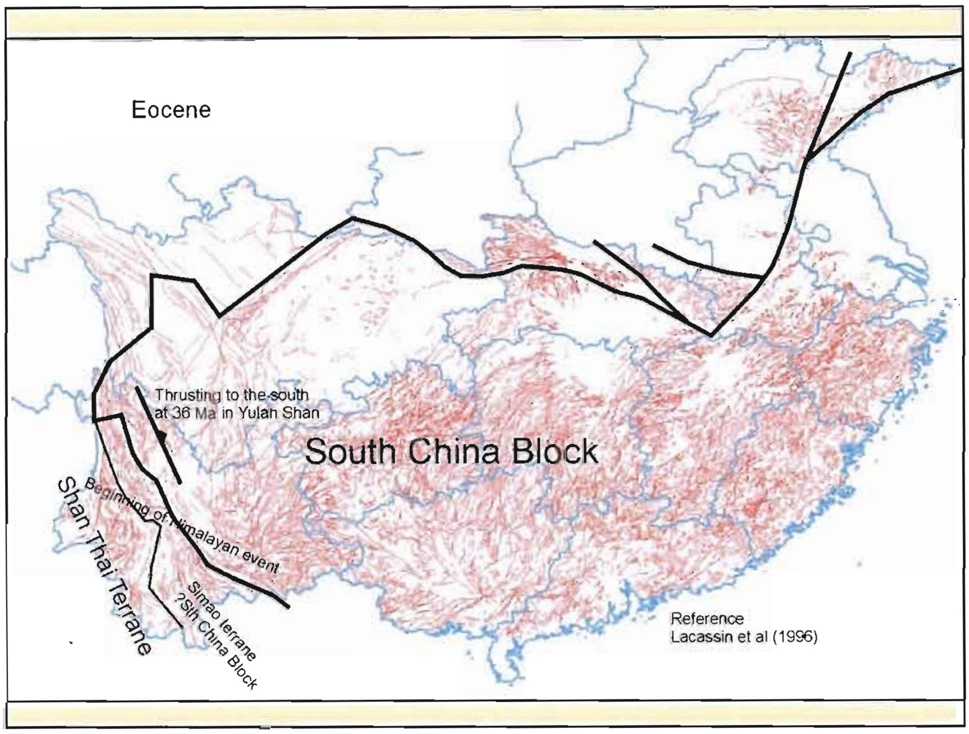
Late Silurian to Early Devonian
North China Block
North China Block
Platform deposition
South China Block
Siluro-Devonian deformation with low grade metamorphism
Foreland fold and thrust belt
Intense Siluro-Devonian deformation and extensive syn-orogenic granitoids
Shan Thai Terrane
Simao terrane ?Sth China Block
Compression from SE
References
Li (1998, 1999)
Li et al (1997)

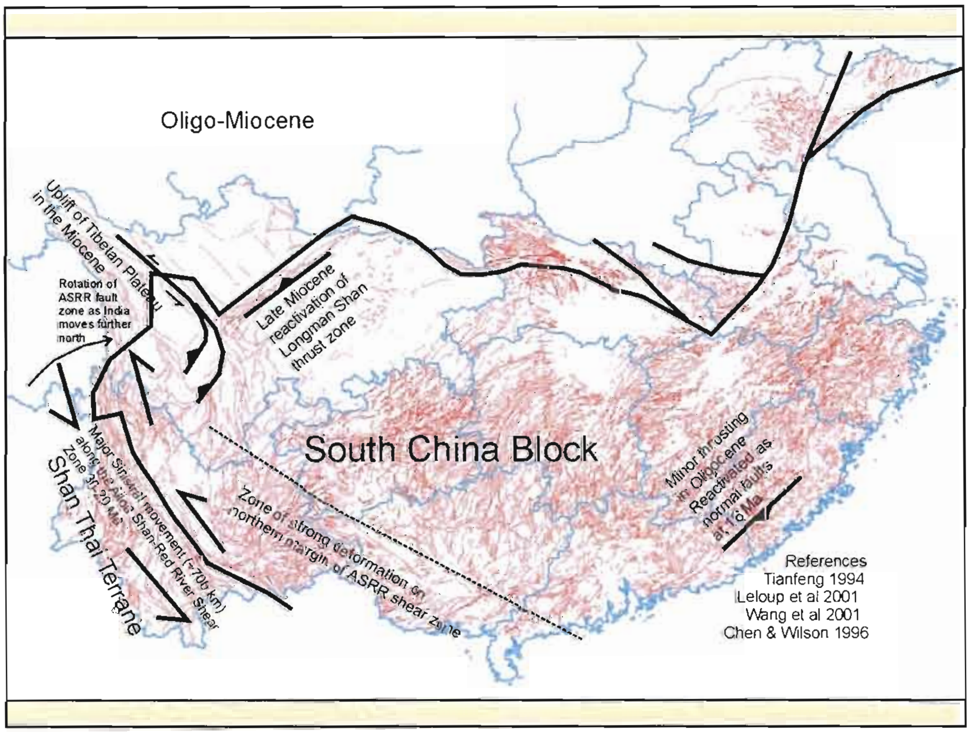

Late Devonian to Permian
North China Block
North China Block
Songpan Gonzu shallow water deposition
South China Block
Platform Deposition
Carboniferous Permian Gondwana deposition
Permian fore arc deposition
Shan Thai Terrane
Simao terrane ?Sth China Block
References
Li 1998, Zhou et al (2002)
Wopner 1996
Chen & Wilson 1996
Brugier et al (1997)

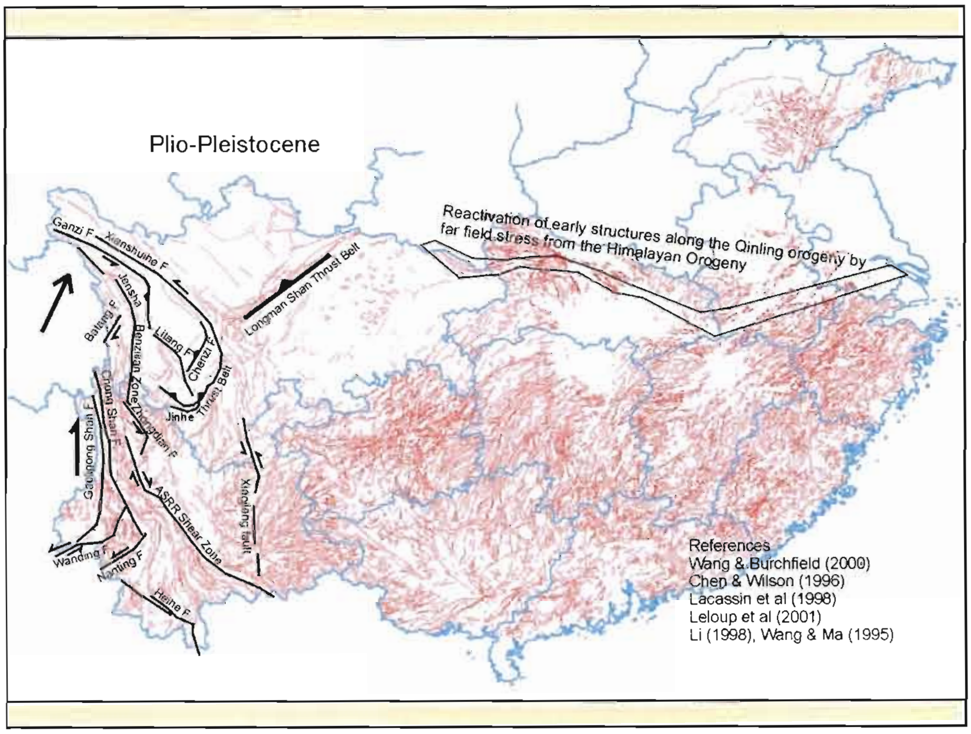

Triassic
Extensive Yanshanian deformation
Granitoids
North China Block
Tanlu Fault
Sulu Metamorphic Belt: UHP metamorphism
Middle Triassic collision of North and South China Blocks
Songpan Gonzu syn-orogenic flysch deposit derived from the NE along the evolving Qinling Dabie collision zone
Intense Late Triassic thrusting
Triassic collision between North China and South China
South Qinling Block: thusting of passive margin sequence to the south
Ultra High P metamorphism
Middle Triassic collision at Dabie Shan
Dabie Shan
Tanlu Fault displaces the collision margin
Western Sichuan Foreland basin
Late Triassic collision
Collision youngs to west
Extreme extension on corner allows uplift of Dabie Shan in Late Triassic
South China Block
Late Triassic collision between Shan Thai and South China
Simao terrane ?Sth China Block
Early Triassic collision between Kontum and South China
References
Li 1998 Zhou & Lu (2000)
Chen & Wilson 1996
Brugier et al (1997)
Singharajwarapan & Berry (2000)
Zhou et al (2002)
Giorgis et al (2000)
Ayers et al 2002
Wang & Mo 1995

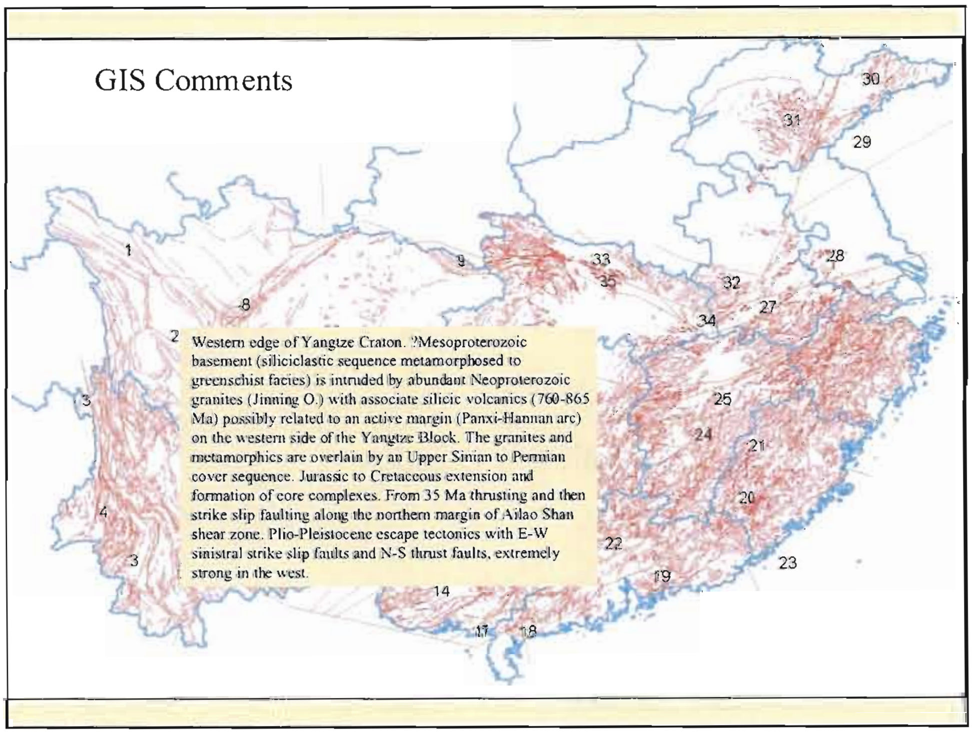

Jurassic
Gneissic Core Complexes
Extensive granitoid emplacement
Western Sichuan Foreland basin
Continued thin skin thrusting along the margin of the South China Block
Tanlu Fault
Sulu Metamorphic Belt: UHP metamorphism
Tanlu Fault continues to displace the collision margin
Continued core complex development
South China Block
Jurassic extension
Extensive intra continental South East China fold belt
Shan Thai Terrane
Post-orogenic continental deposition
Simao terrane
?Sth China Block
References
Li (1998)
Chen & Wilson (1996)
Brugier et al (1997)
Zhou & Lu et al. (2002)
Wang & Mo (1995)


Cretaceous
NNE striking grabens
Tanlu Fault
Sulu Metamorphic Belt: UHP metamorphism
Tanlu Fault continues to displace the collision margin
Early Cretaceous core complexes in northern Jiangxi Province
South China Block
Cretaceous Magmatic Belt
Pingtan-Dongshan Metamorphic Belt
Late Cretaceous core complexes may extend into Yunnan from Myanmar
Queit conditions over most of Southeast China
Early Cretaceous accretion of West Burma arc
Shan Thai Terrane
Simao terrane
?Sth China Block
References
Mitchell (1992, 1993), Yano et al (1994)
Li (1998), Zhou & Lu (2000)
Lin et al (2000), Chen et al (2002)


Eocene
Thrusting to the south
at 36 Ma in Yulan Shan
South China Block
Beginning of Himalayan event
Shan Thai Terrane
Simao terrane
?Sth China Block
Reference
Lacassin et al (1996)


Oligo-Miocene
Uplift of Tibetan Plateau
in the Miocene
Rotation of
ASRR fault
zone as India
moves further
north
Late Miocene
reactivation of
Longman Shan
thrust zone
South China Block
Major Sinistral movement (~700 km)
along the Ailao Shan-Red River Shear
Zone 35-20 Ma
Shan Thai Terrane
Zone of strong deformation on
northern margin of ASRR shear zone
Minor thrusting
in Oligocene
Reactivated as
normal faults
at 16 Ma
References
Tianfeng 1994
Leloup et al 2001
Wang et al 2001
Chen & Wilson 1996


Plio-Pleistocene
Reactivation of early structures along the Qinling orogeny by far field stress from the Himalayan Orogeny
Ganzi F
Xianshuihe F
Longmen Shan Thrust Belt
Jensha
Batang F
Litang F
Chenzi F
Benzilan Zone
Zhongdian F
Thrust Belt
Jinhe
Chong Shan F
Gaoligong Shan F
ASRR Shear Zone
Xiaojiang fault
Wanding F
Nanting F
Heihe F
References
Wang & Burchfield (2000)
Chen & Wilson (1996)
Lacassin et al (1998)
Leloup et al (2001)
Li (1998), Wang & Ma (1995)


GIS Comments
Western edge of Yangtze Craton. ?Mesoproterozoic basement (siliciclastic sequence metamorphosed to greenschist facies) is intruded by abundant Neoproterozoic granites (Jinning O.) with associate silicic volcanics (760-865 Ma) possibly related to an active margin (Panxi-Hannan arc) on the western side of the Yangtze Block. The granites and metamorphics are overlain by an Upper Sinian to Permian cover sequence. Jurassic to Cretaceous extension and formation of core complexes. From 35 Ma thrusting and then strike slip faulting along the northern margin of Ailao Shan shear zone. Plio-Pleistocene escape tectonics with E-W sinistral strike slip faults and N-S thrust faults, extremely strong in the west.

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