Powerpoint Presentation Handout

Geological, Tectonic and Metallogenic Relations of South China (P603)

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Ross Large

CODES

Geological, Tectonic and Metallogenic Relations in South China (P603)

- **Aims of the Project**
  - 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
  - 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
  - To develop a geotectonic and metallogenic model for the evolution and origin of mineralised belts in these regions.

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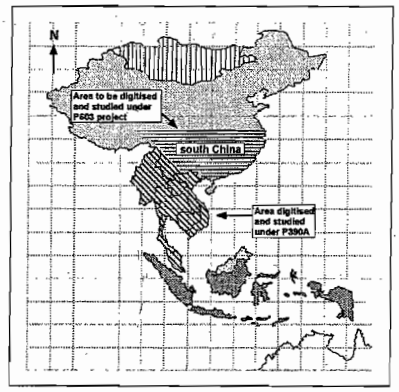

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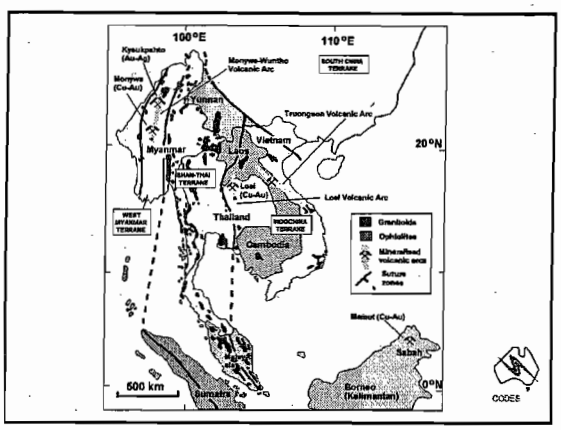
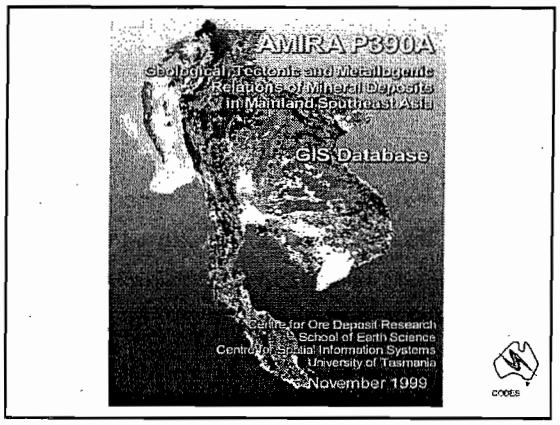
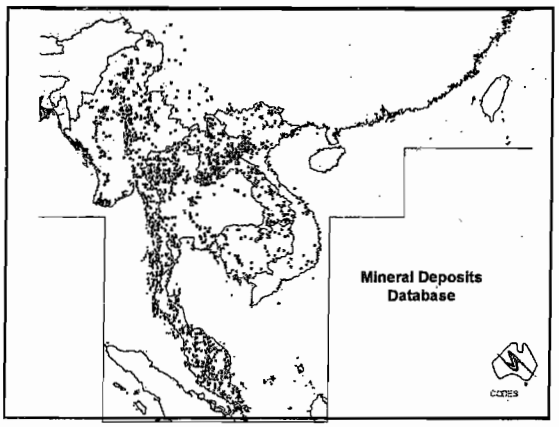
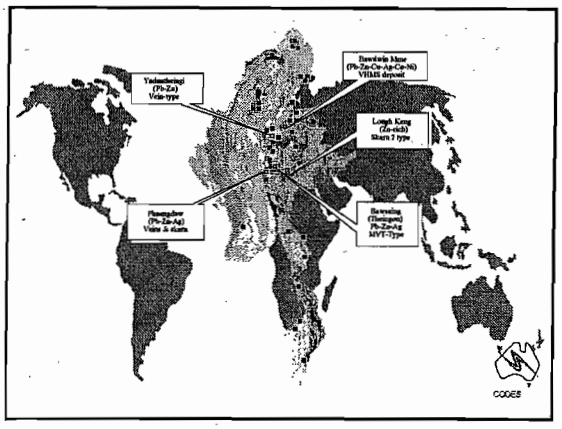
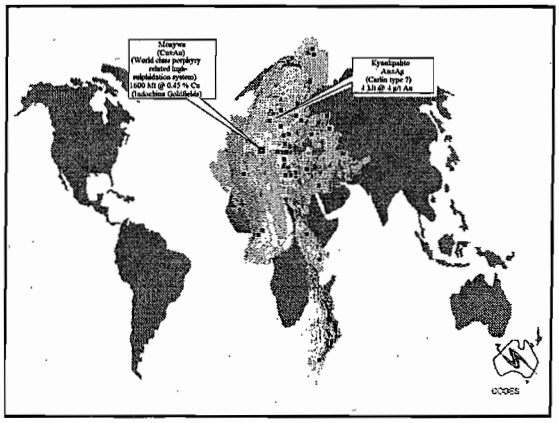
Fig. 1. Map showing the area to be digitised and studied under the proposed AMIRA project

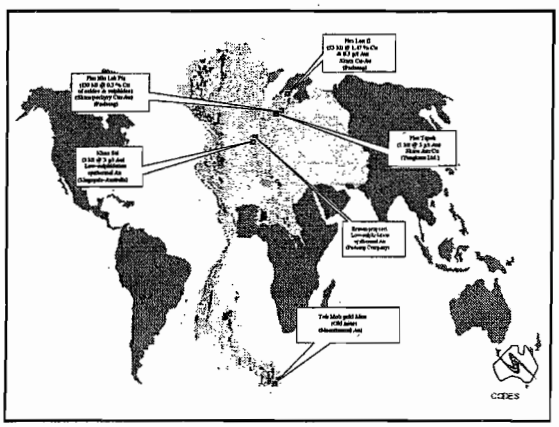

100°E
110°E
20°N
0°N
500 km
Myanmar
Thailand
Cambodia
Vietnam
Laos
Sumatra
Borneo (Kalimantan)
Sabah
Granitoids
Ophiolites
Suture zones
CODES


AMIRA P390A
Geological, Tectonic and Metallogenic Relations of Mineral Deposits in Mainland Southeast Asia
GIS Database
Centre for Ore Deposit Research
School of Earth Science
University of Tasmania
November 1999
CODES


Mineral Deposits Database
CODES


Yukon-Tanana
(Fe-Zn)
Vein-type
Flambeau
(Pb-Zn-Au)
Vein & skarn
Ladolam
(Au-rich)
Skarn ? type
Hellyer
(Tasmania)
Pb-Zn-Ag
MVT-Type
CODES


Kyzylsubie
Au±Ag
(Carlin type ?)
4 Mt @ 4 g/t Au
CODES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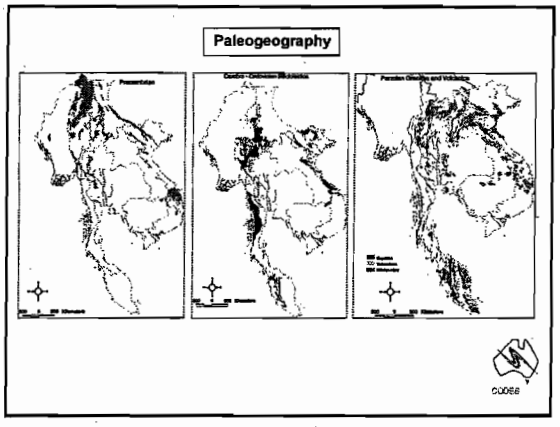
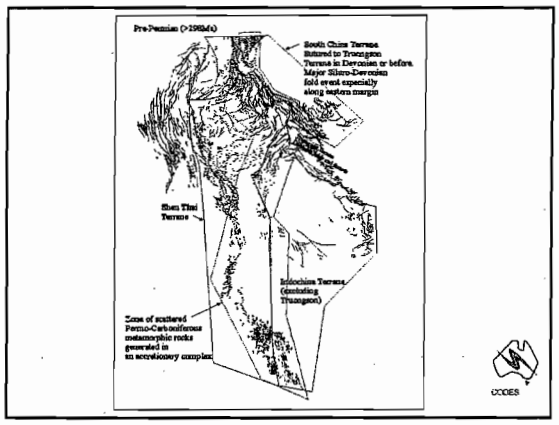
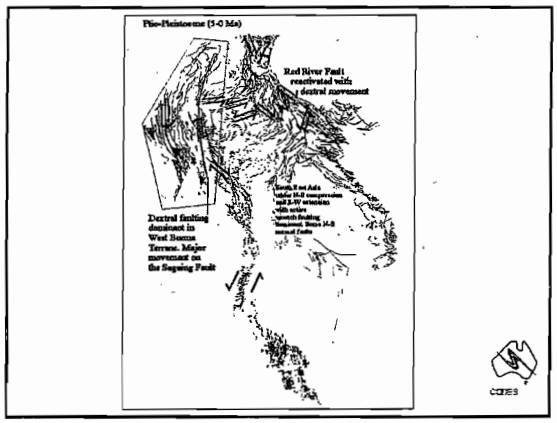
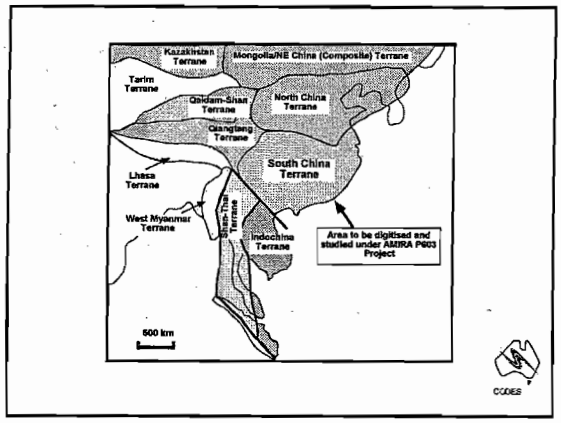
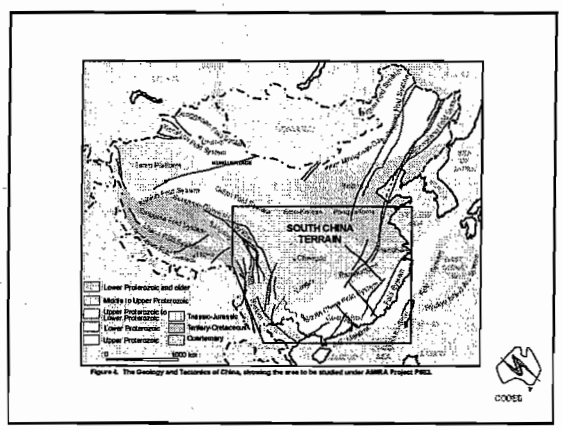
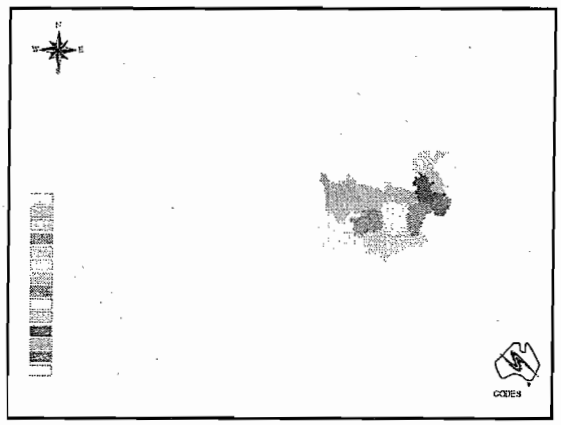

Paleogeography
CODES

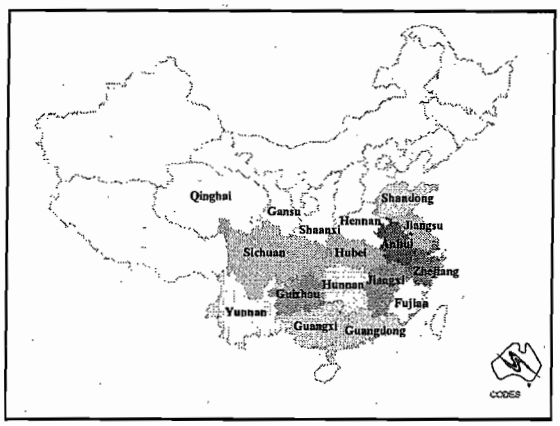

Pre-Permian (>298Ma)
South China Terrane
Sibumasu Terrane
Indochina Terrane
(including Truongson)
CODES

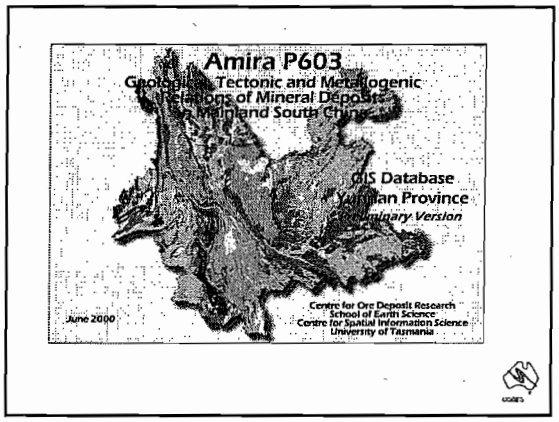

Plio-Pleistocene (5-0 Ma)
Red River Fault
reactivated with
dextral movement
CODES

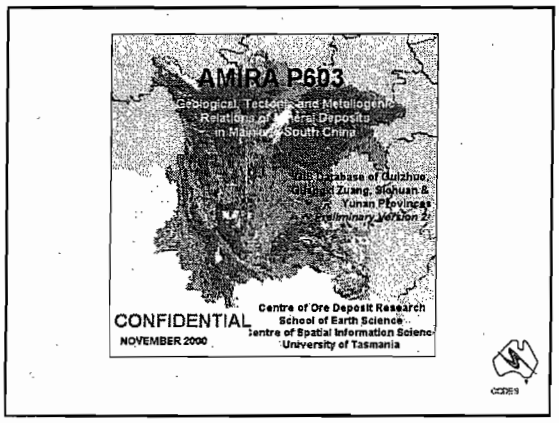

Kazakhstan Terrane
Mongolia/NE China (Composite) Terrane
Tarim Terrane
Qaidam-Qilian Terrane
North China Terrane
Qiangtang Terrane
South China Terrane
Lhasa Terrane
West Myanmar Terrane
Shan-Thai Terrane
Indochina Terrane
Area to be digitised and studied under AMIRA P603 Project
500 km
CODES

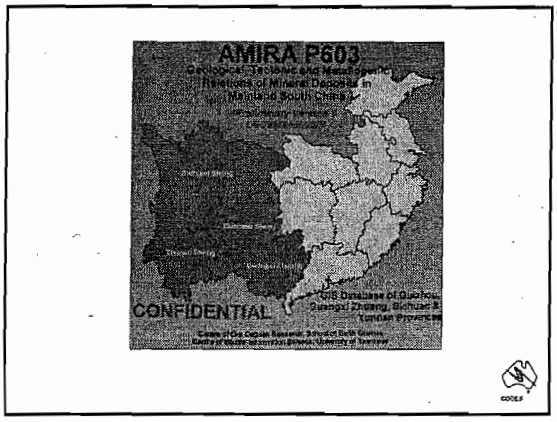

SOUTH CHINA TERRAIN
Lower Proterozoic and older
Middle to Upper Proterozoic
Upper Proterozoic to Lower Proterozoic
Lower Proterozoic
Upper Proterozoic
Triassic-Jurassic
Tertiary-Cretaceous
Quaternary
CODES


N
W
E
CODES


Qinghai
Gansu
Shaanxi
Sichuan
Hubei
Hennan
Shandong
Jiangsu
Anhui
Zhejiang
Jiangxi
Hunnan
Guizhou
Yunnan
Fujian
Guangxi
Guangdong
CODES


Amira P603
Geological, Tectonic and Metallogenic
Relations of Mineral Deposits
in Mainland South China
GIS Database
Yunnan Province
Preliminary Version
June 2000
Centre for Ore Deposit Research
School of Earth Science
Centre for Spatial Information Science
University of Tasmania
CODES


AMIRA P603
Geological, Tectonic and Metallogenic
Relations of Mineral Deposits
in Mainland South China
GIS Database of Guizhou,
Guangxi Zuang, Sichuan &
Yunan Provinces
Preliminary Version 2
CONFIDENTIAL
NOVEMBER 2000
Centre of Ore Deposit Research
School of Earth Science
Centre of Spatial Information Science
University of Tasmania
CODES



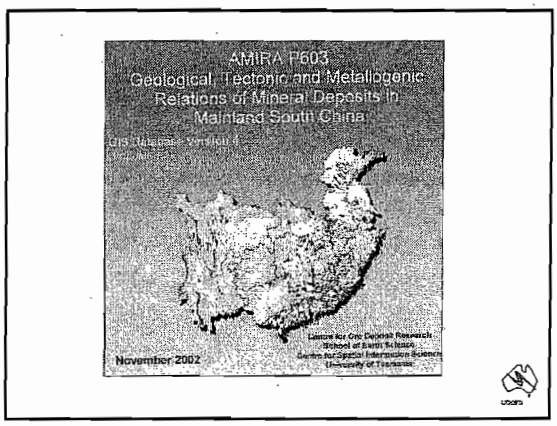
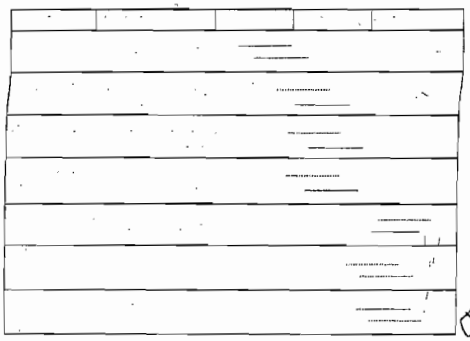
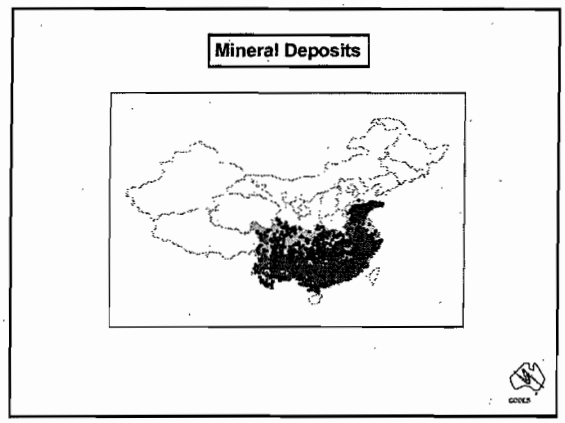
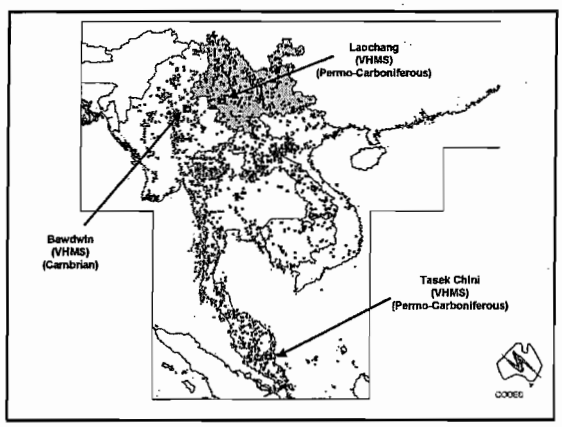


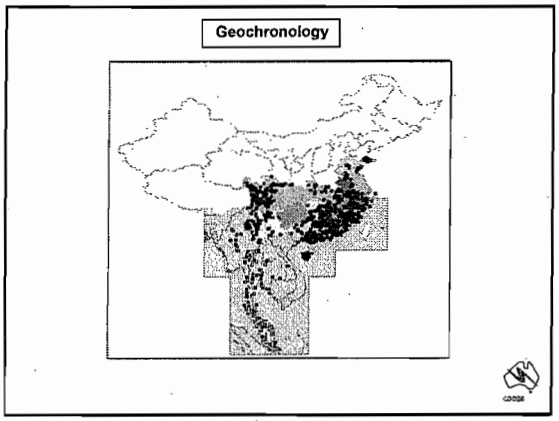
Table 2. Status for GIS compilation for each province in southern China covering the South China geological terrane.





3,300 mineral deposits

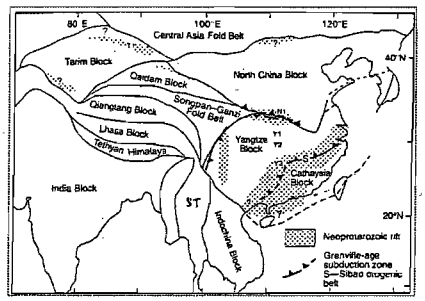




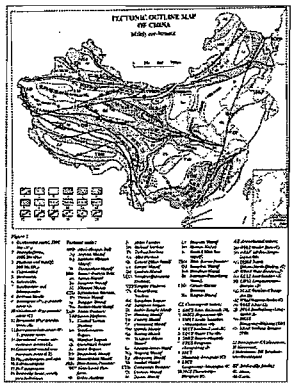
1067 Dates.

Paleogeographic and Tectonic Development of South China

Clive Burrett
School of Earth Sciences, University of Tasmania

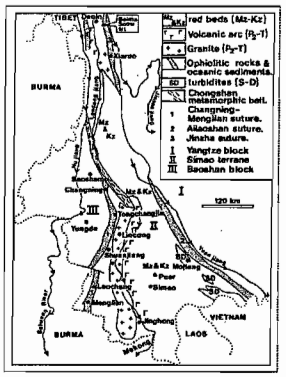


Major terranes/blocks (Li et al., 1996)

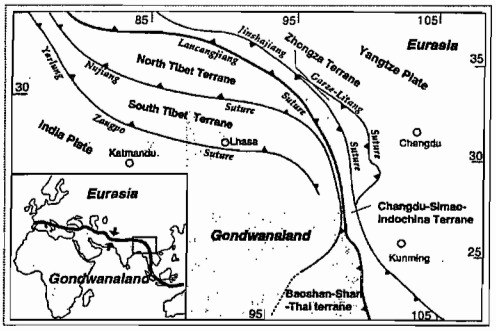


Tectonic outline map-tectonics stops at China borders (Wang & Mo, 1995)

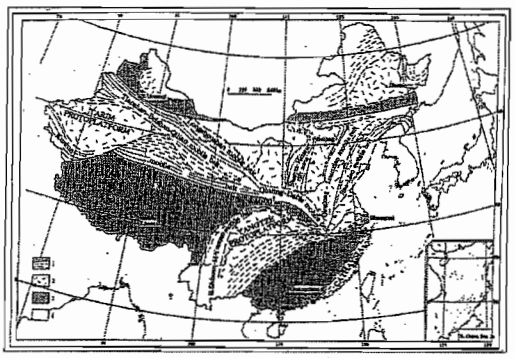
Names of cycles		Age (Ma)	Age of main orogeny (Ma)	Major tectonic events
Megacycle	Cycle			
	Himalayan		40–2	Collision between India and Eurasia, creating Himalayas, Qinghai-Tibet Plateau, Kunlun, Qilian and Tianshan rejuvenated Mts; gradual formation of modern geomorphology of China
		80		
	Alpine Yanshanian		160–120	Collision of Asia with N America and W Pacific, 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 Fuping		2600–2400	Formation of crystalline basement of Sino-Korean platform
		3000		
Paleo-Archean	Qianxhan and older		3000	Emergence of ancient continental nuclei, with oldest crust of 3800 Ma discovered in N China
		3800		



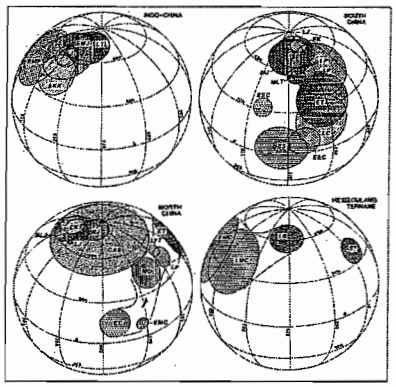
Simao terrane Yunnan (Wu et al., 1995)



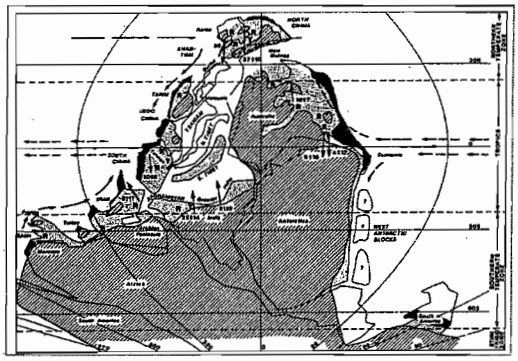
Suture in Xizing and Yunnan (Yang, 1998)



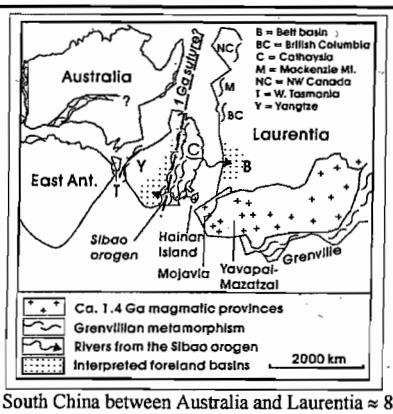
Early Precambrian framework of China (Ma & Bai, 1994)



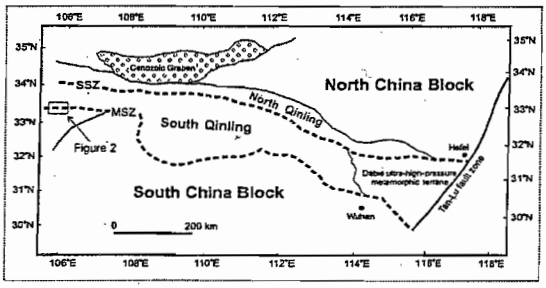
APW paths compiled by Burrett (1987, unpub. data)



Greater Gondwanaland (Burrett et al., 1986)

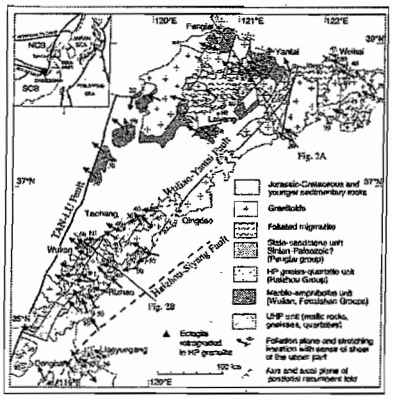


South China between Australia and Laurentia ≈ 800 Ma (Li et al., 2002)

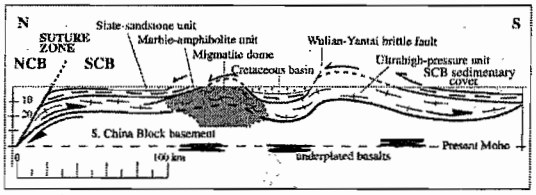


Qinling collision belt (Meng & Sheng, 1999)

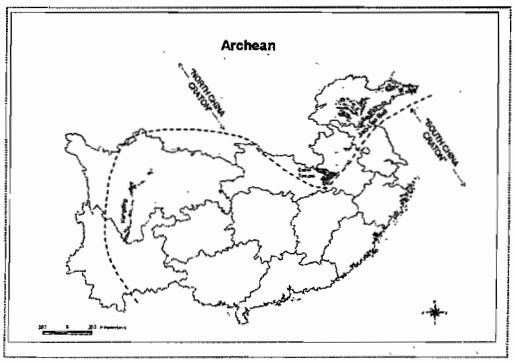
Geology of Shandong Province

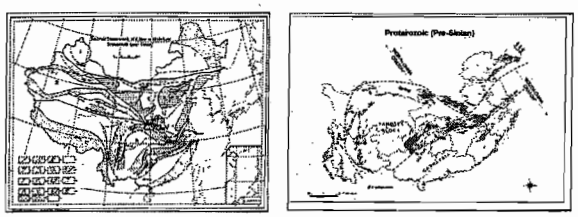


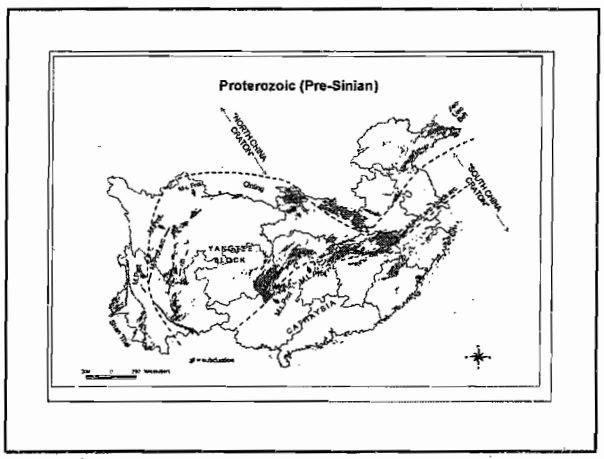
Structural and kinematic map of Sulu area (Faure et al., 2001)

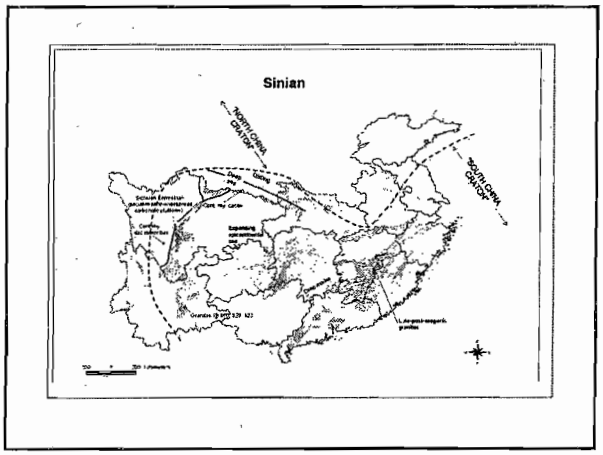


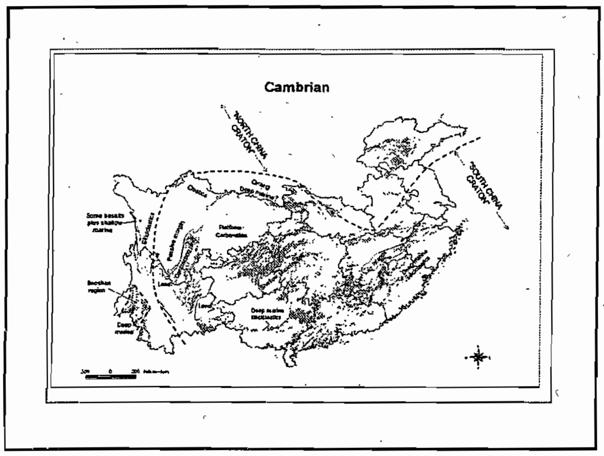
Crustal-scale cross section of Jiaodong peninsula (Faure et al., 2001)

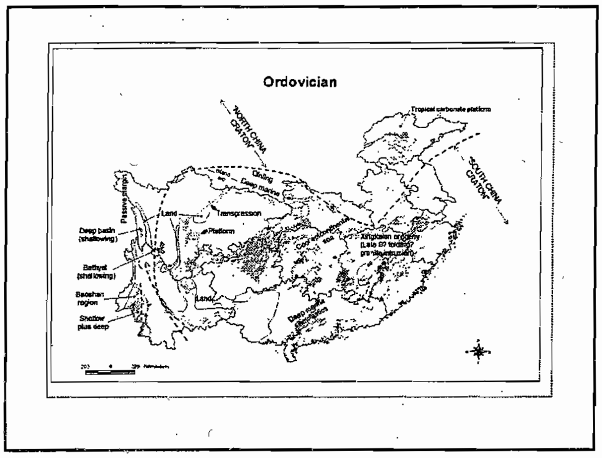


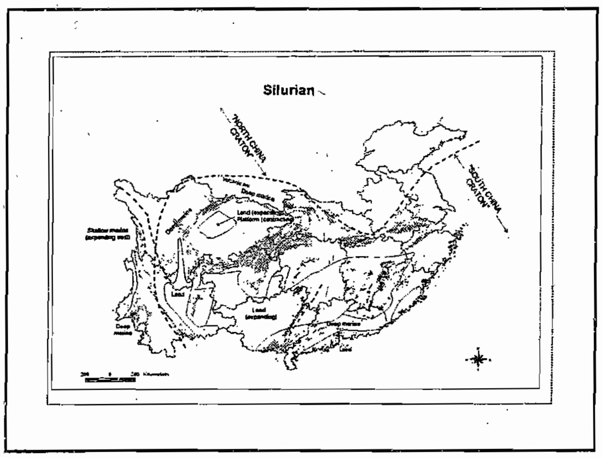

Proterozoic (Pre-Sinian)

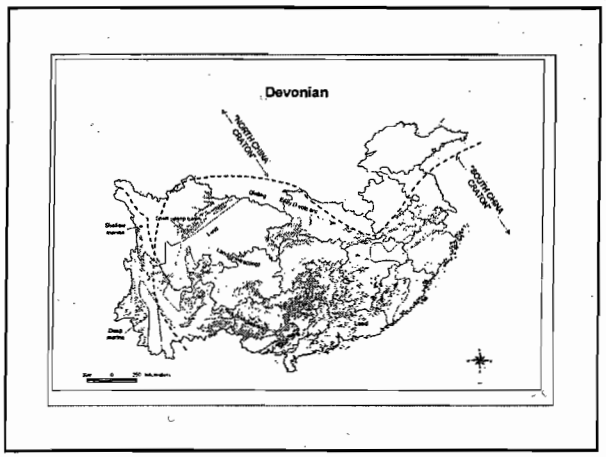

Proterozoic (Pre-Sinian)
NORTH CHINA CRATON
SOUTH CHINA CRATON
TARIM BLOCK
CATHAYSIA

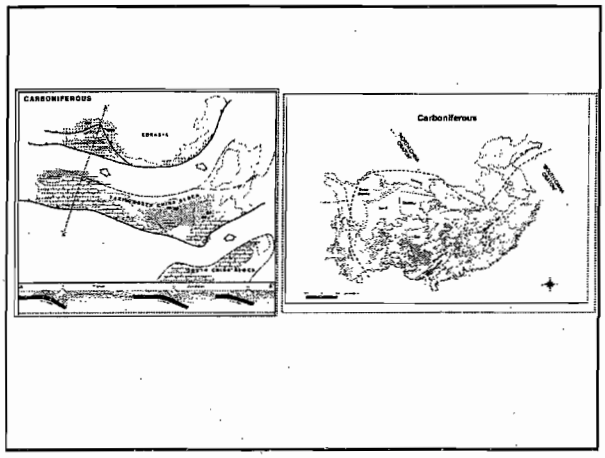

Sinian
NORTH CHINA CRATON
SOUTH CHINA CRATON

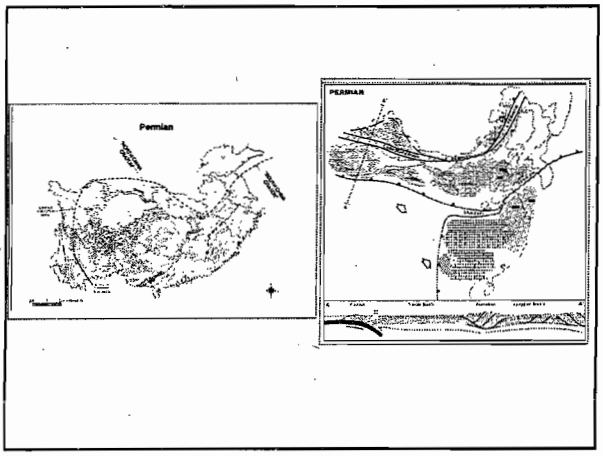

Cambrian
NORTH CHINA CRATON
SOUTH CHINA CRATON

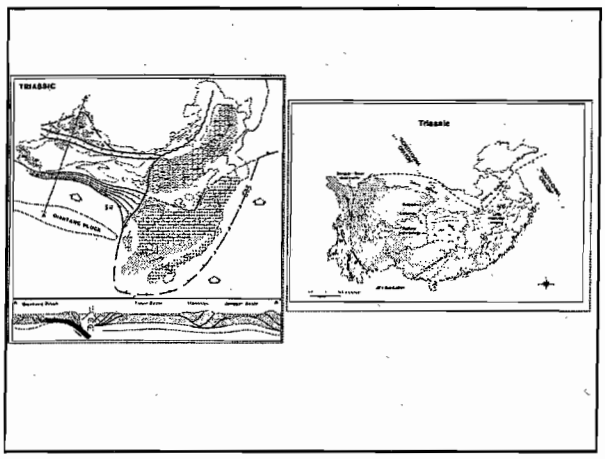

Ordovician
NORTH CHINA CRATON
SOUTH CHINA CRATON

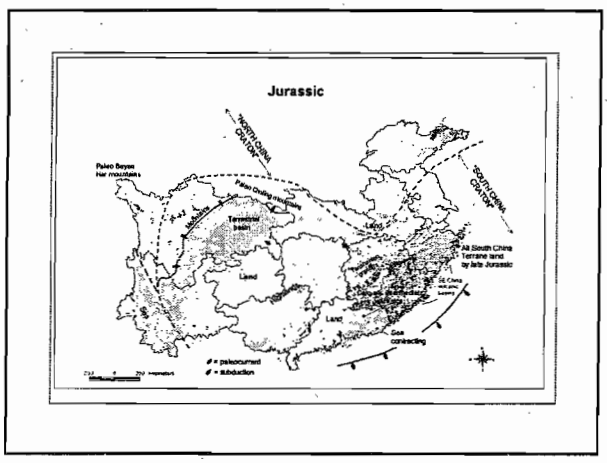

Silurian
NORTH CHINA CRATON
SOUTH CHINA CRATON

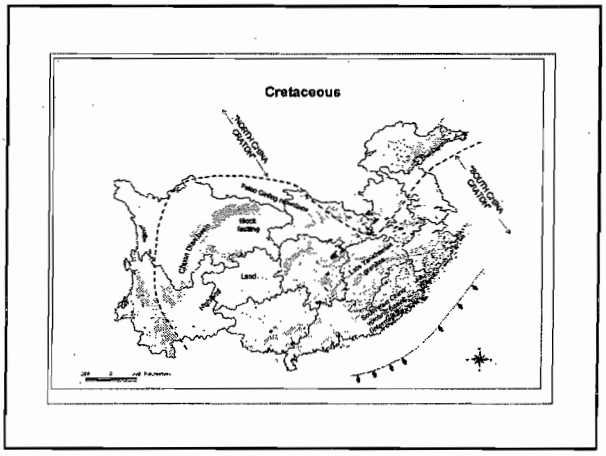

Devonian
NORTHERN CAPE
NORTHERN CAPE

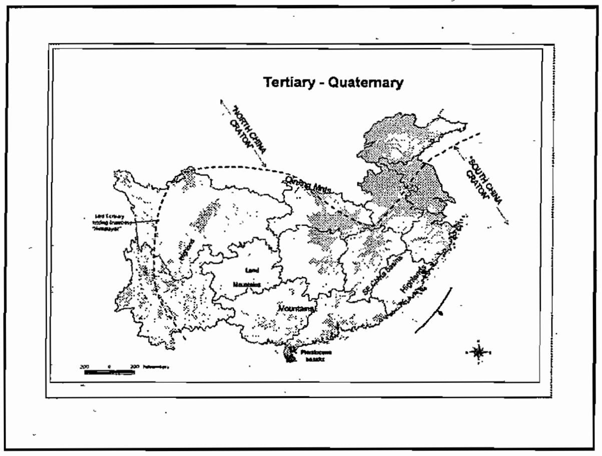

CARBONIFEROUS
Carboniferous

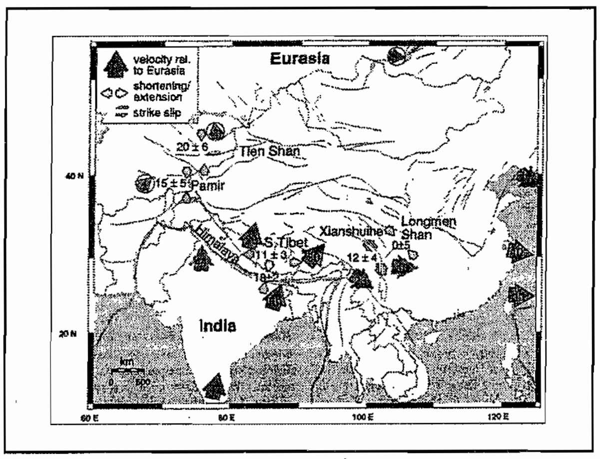

Permian
PERMIAN

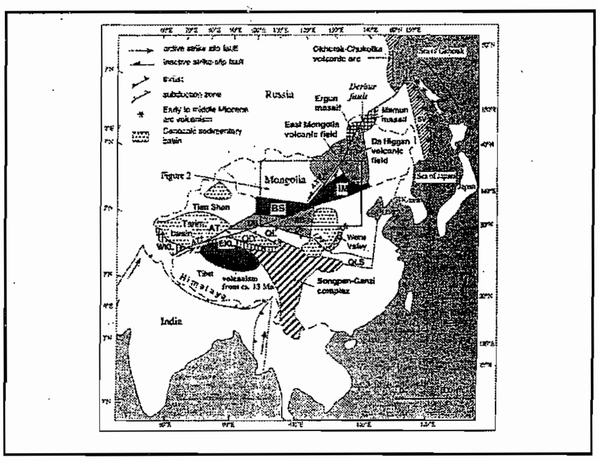

TRIASSIC
Triassic


Jurassic
NORTH CHINA CRATON
SOUTH CHINA CRATON
Paleo Baoyan Har mountains
Terrestrial basin
Land
Sea connecting


Cretaceous
NORTH CHINA CRATON
SOUTH CHINA CRATON
Back basins
Land


Tertiary - Quaternary
NORTH CHINA CRATON
SOUTH CHINA CRATON

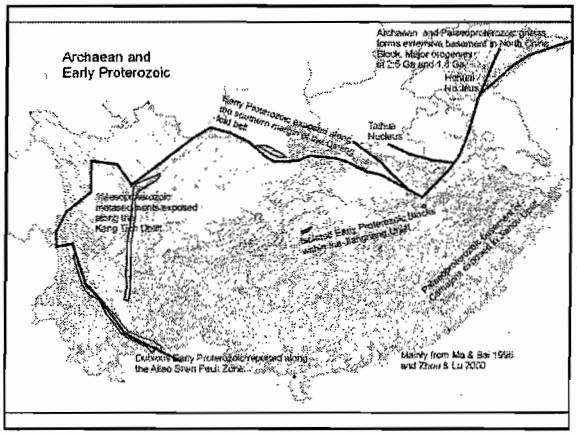

velocity rel. to Eurasia
shortening/ extension
strike slip
Eurasia
20 ± 6
Tien Shan
15 ± 5
Pamir
S. Tibet
11 ± 3
Xianshuihe
12 ± 4
Longmen Shan
India
40 N
20 N
60 E
80 E
100 E
120 E

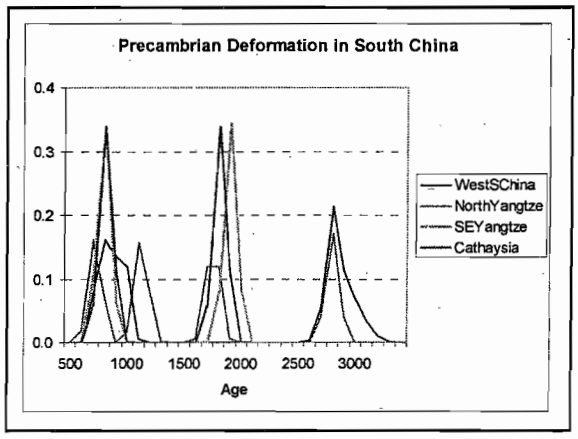

Okhotsk-Chukotka volcanic arc
Russia
East Mongolia volcanic field
Da Hinggan volcanic field
Mongolia
Tien Shan
Songpan-Ganzi complex
India

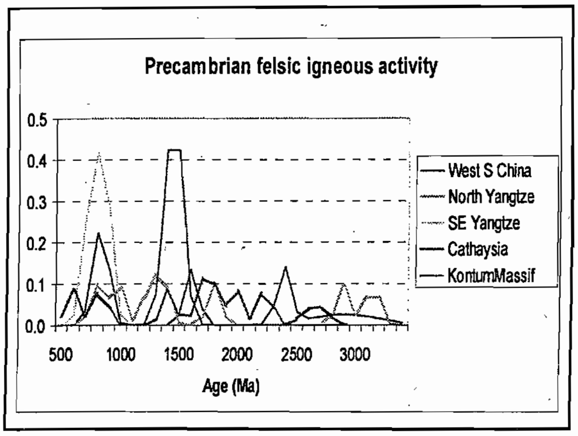
Structural History of South China

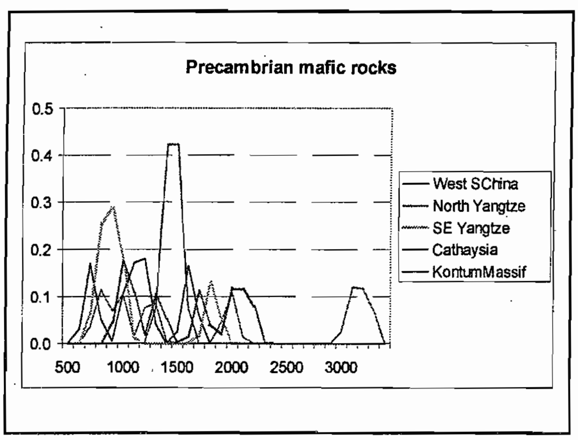
December 2002

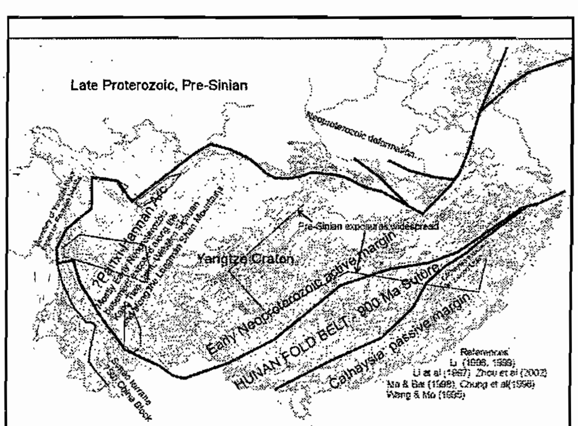
Ron Berry
CODES SRC

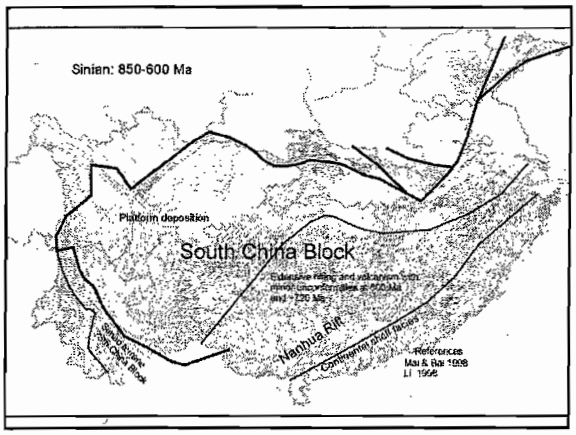


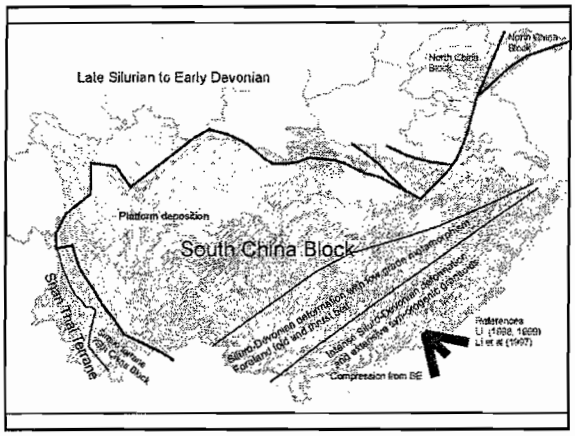


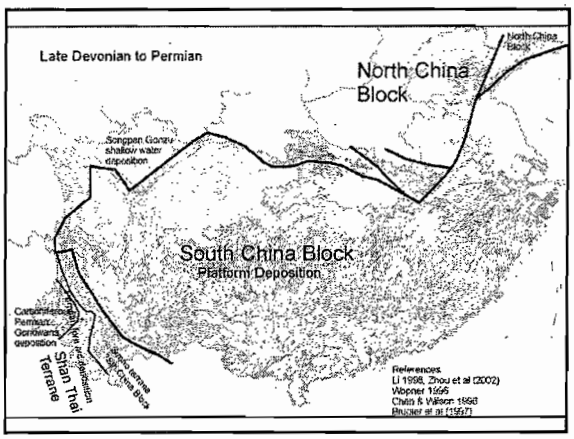

Precambrian felsic igneous activity
0.5
0.4
0.3
0.2
0.1
0.0
500
1000
1500
2000
2500
3000
Age (Ma)
West S China
North Yangtze
SE Yangtze
Cathaysia
KontumMassif

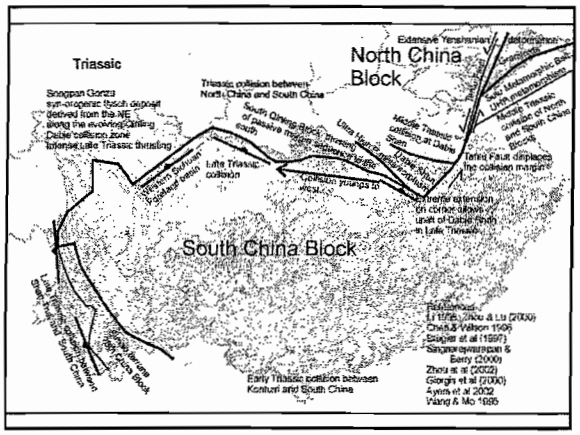

Precambrian mafic rocks
0.5
0.4
0.3
0.2
0.1
0.0
500
1000
1500
2000
2500
3000
West SChina
North Yangtze
SE Yangtze
Cathaysia
KontumMassif

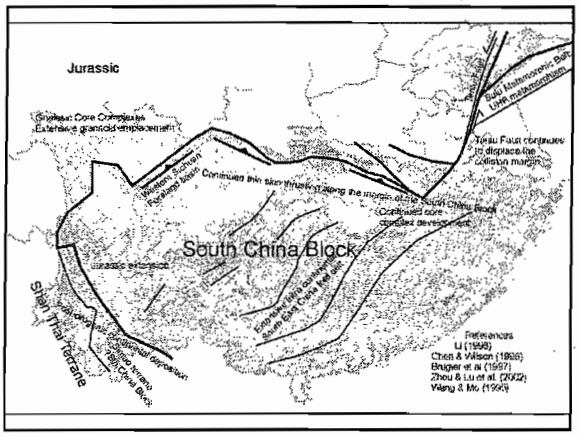

Late Proterozoic, Pre-Sinian
Yangtze Craton
Pre-Sinian exposures widespread
Early Neoproterozoic active margin
HUNAN FOLD BELT, 900 Ma suture
Cathaysia: passive margin
Neoproterozoic deformation

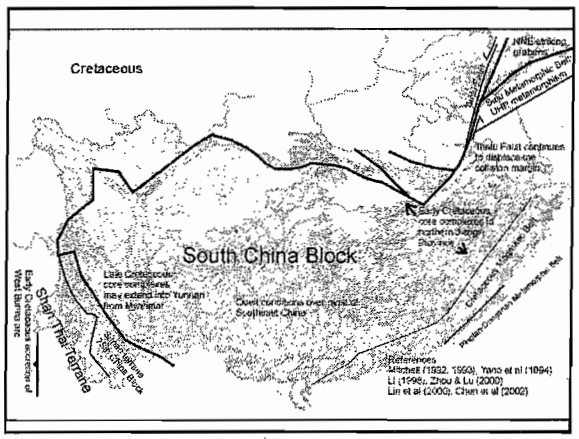

Sinian: 850-600 Ma
Platform deposition
South China Block
Nanhua Rift
Continental shelf facies
References
Mao & Bai 1998
LI 1998

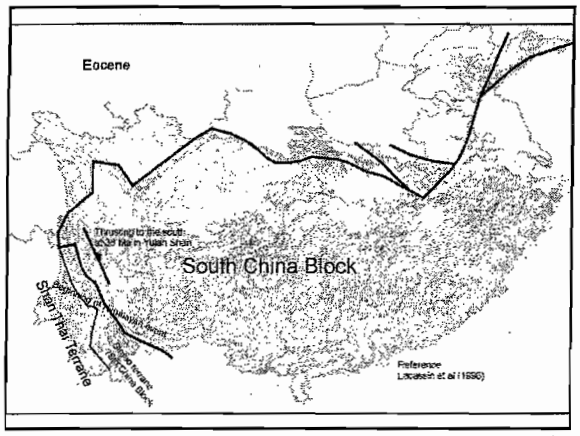

Late Silurian to Early Devonian
North China Block
North China Block
Platform deposition
South China Block
Shan-Thai Terrane
Compression from SE
References
LI (1998, 1999)
LI et al (1997)

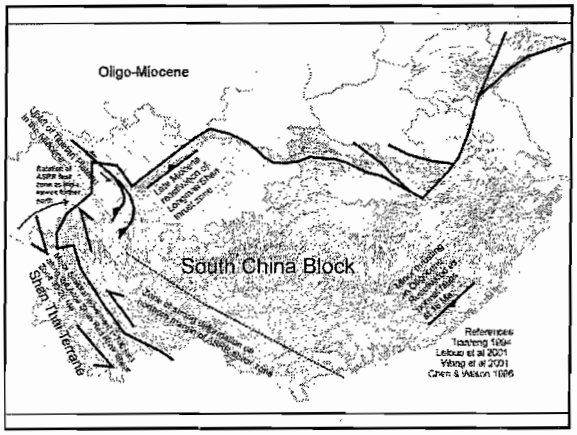

Late Devonian to Permian
North China Block
North China Block
Songpan Ganzi shallow water deposition
South China Block
Platform Deposition
Shan Thai Terrane
References
LI 1998, Zhou et al (2002)
Wopner 1995
Chen & Wilson 1996
Rhuzev et al (1997)

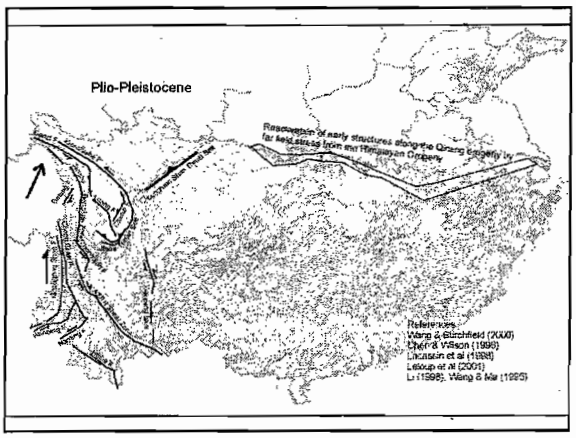

Triassic
North China Block
Triassic collision between North China and South China
Songpan Garzê
Late Triassic collision
South China Block
Early Triassic collision between Kontum and South China
Zhou & Lu (2000)
Chen & Wilson 1996
Enkin et al 2002
Wang & Mo 1995


Jurassic
South China Block
Shan-Thai Terrane
References
Li (1998)
Chen & Wilson (1996)
Zhou & Lu et al. (2002)
Wang & Mo (1995)

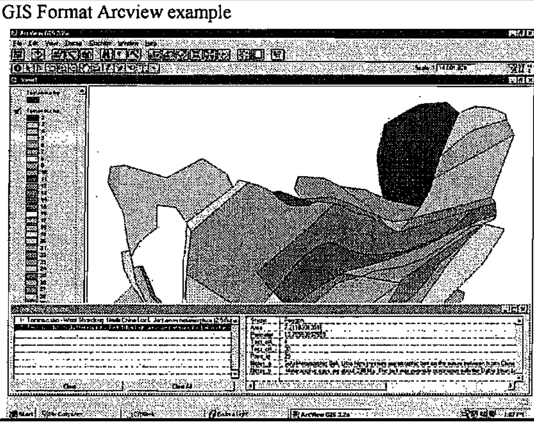

Cretaceous
South China Block
Shan-Thai Terrane
References
Li (1998), Zhou & Lu (2000)


Eocene
South China Block
Shan-Thai Terrane
Reference
Lacassin et al (1998)


Oligo-Miocene
South China Block
Shan-Thai Terrane
References
Tapponnier et al 2001
Wang et al 2001
Chen & Wilson 1996


Plio-Pleistocene
References
Wang & Burchfiel (2000)
Chen & Wilson (1996)
Lacassin et al (1998)
Leloup et al (2001)
Li (1998), Wang & Ma (1993)

GIS Format Arcview example



Excel Spreadsheet with polygon data

	Description		
1	Songpan Garze Fold Belt. Cambrian-Permian shallow water siliciclastic deposition. Triassic Songpan Garze syn-orogenic flysch deposit (up to 15 km thick) derived from the NE along the evolving Qinling Dabie collision zone. Intensely deformed and thrust in the Late Triassic. Distinctive isolated core complexes are probably of Jurassic age. Mesozoic granites are widespread. Major reactivation and thrusting during the Himalayan collision largely in the Plio-Pleistocene.	Songpan Garze Fold Belt. Cambrian-Permian shallow water siliciclastics. Triassic Songpan Garze syn-orogenic flysch deposit (15 km thick) derived from Qinling Dabie collision zone.	Intensely deformed/thrust in Late Triassic. Isolated Jurassic core complexes. Mesozoic granites. Major reactivation and thrusting during the Himalayan collision largely in the Plio-Pleistocene.
2	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	Western Yangtze Craton. ?Mesoproterozoic basement (greenschist facies siliciclastics) Neoproterozoic granites (Jinning O.) and silicic volcanics (760-865 Ma) Active margin (Panxi-Hannan arc).	Upper Sinian-Permian cover sequence. Jurassic to Cretaceous core complexes. From 35 Ma thrusting, then strike slip faulting on margin of Ailao Shan SZ. Plio-Pleistocene E-W extensional faults and N-S thrust faults
3	The Changning Menglian Belt correlates with the Sukothai Fold Belt in Thailand. Formed by the collision between the Shan-Thai and Indochina terranes. Composed of Andean margin sediments and accretionary complex of Permian to Middle Triassic age. The whole sequence was folded and complexly thrust in the Late Triassic as a result of the collision. Post-collisional (Jurassic) sediments are rare. Deformed by the Himalayan collision in the Oligocene through to present. Lies in the transpressional zone on the south side of Ailao Shan.	Changning Menglian Belt correlates with Sukothai Fold Belt, Thailand. Formed by Triassic collision between Shan-Thai and Indochina terranes. Permian-Middle Triassic Andean margin sediments/accretionary complex.	Folded and thrust in the Late Triassic. Post-collisional (Jurassic) sediments rare. Deformed by the Himalayan collision in the Oligocene to present. Transpressional zone on S side of Ailao Shan.
4	Baoshan and Tengchong blocks. Possible Proterozoic metamorphic rocks widely exposed in the western (Tengchong) block. The Baoshan block forms the eastern section. Upper Palaeozoic glaciomarine facies indicate these two blocks are Gondwanan in origin and probably form the northern extension of the Shan Thai terrane. Mildly deformed continental Jurassic sediments unconformable overlie the	Baoshan and Tengchong blocks, northern extension of the Shan Thai terrane. ?Proterozoic metamorphic rocks in western (Tengchong) block. Upper Palaeozoic glaciomarine facies are Gondwanan in	Mildly deformed continental Jurassic sediments. Deformed by the Himalayan collision in the Oligocene through to present. Lies in the transpressional zone on the south side of Ailao Shan.
5	Simao terrane: ?South China Block. Late Devonian to Permian sediments form a basement probably related to the South China platform deposition. Intensely deformed in the Triassic. Mesozoic to Cenozoic sediments widely exposed. Late Cretaceous core complexes may extend from Myanmar. The Himalayan collision begins with thrusting at 35 Ma. Strike slip faulting on the Ailao Shan produced ~700	Simao terrane: Late Devonian-Permian sediments ?South China platform deposition. Triassic deformation. Mesozoic to Cenozoic sediments widely exposed. Late Cretaceous	Himalayan collision begins at 35 Ma. 700 km sinistral displacement on Ailao Shan between 35 and 20 Ma. Thrusts well developed in Simao block. NE striking sinistral faults active in
6	Kang Tien Uplift: 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 (780-865 Ma) possibly related to an active margin (Panxi-Hannan arc) on the western side of the Yangtze Block. The granites and metamorphic rocks are overlain by an Upper Sinian to Permian cover sequence. Jurassic to Cretaceous extension and formation of core	Kang Tien Uplift: Western Yangtze Craton. ?Mesoproterozoic basement (greenschist facies siliciclastics) Neoproterozoic granites (Jinning O.) and silicic volcanics (760-865 Ma) Active margin (Panxi-Hannan arc).	Upper Sinian to Permian cover sequence. Jurassic to Cretaceous extension and core complexes. From 35 Ma thrusting, then strike slip faulting along the margin of Ailao Shan SZ. Plio-Pleistocene uplift of the Kang Tien
7	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). The granites and metamorphics are overlain by an Upper Sinian to Permian cover sequence. From 35 Ma thrusting and then strike slip faulting along the northern margin of Ailao Shan shear zone, Plio-	Western Yangtze Craton. ?Mesoproterozoic basement (greenschist facies siliciclastics) Neoproterozoic granites (Jinning O.) and silicic volcanics (760-865 Ma) Active margin (Panxi-Hannan arc).	Upper Sinian to Permian cover sequence. From 35 Ma thrusting, then strike slip faulting along N margin of Ailao Shan SZ. Plio-Pleistocene deformation with sinistral offset on Xianshuihe fault

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Mineral Deposits in South China I (P603)

Research Team:

Khin Zaw
Eleanor Bruce
Clive Burrett
Ron Berry
Ross Large

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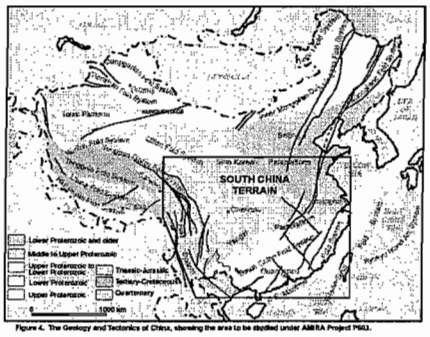


Figure 4. The Geology and Tectonics of China, showing the area to be studied under AMIRA Project P603.

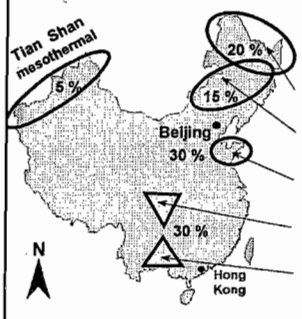
CODES

China's Gold Production

Production: 25 t in 1980 to currently 180 t Au

70 major gold deposits

reserves >4500 t Au

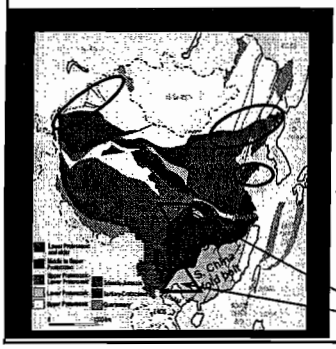


- Hei Long Jiang - placer
- North China - greenstone & - mesothermal
- East Shandong - mesothermal
- Quingling - Carlin-type & Chuan-Shan-Gan - mesothermal
- Southern China - Carlin-type Dian-Gui-Qian

Compiled from Yang (1996), Zhou (1999), Zhou et al. (2002) & Chromie (2002)

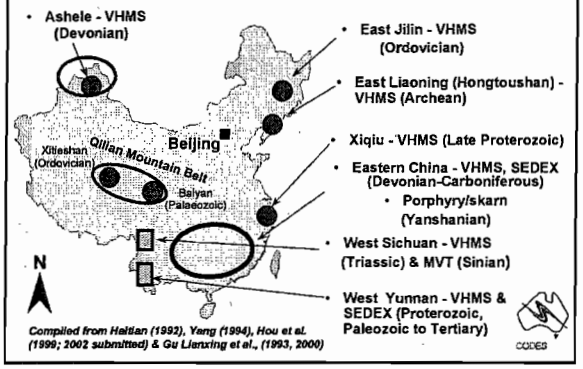
CODES

Regional Geological Setting of China's Gold Districts



- China's gold deposits occur mostly within fold belts along the margins of 3 major cratons:
  - Sino-Korean (L - M Prot.)
  - Tarim (M - U Prot.)
  - Yangtze (M - U Prot.)
- Chinese Carlin-type gold deposits occur in two Palaeozoic - Mesozoic sedimentary basins along the margins of the Yangtze Craton:
  - (N Gold Triangle)
  - (S. Gold Triangle)

China's Base Metal Deposits



- Ashele - VHMS (Devonian)
- East Jilin - VHMS (Ordovician)
- East Liaoning (Hongtoushan) - VHMS (Archean)
- Xiqiu - VHMS (Late Proterozoic)
- Eastern China - VHMS, SEDEX (Devonian-Carboniferous)
  - Porphyry/skarn (Yanshanian)
- West Sichuan - VHMS (Triassic) & MVT (Sinian)
- West Yunnan - VHMS & SEDEX (Proterozoic, Paleozoic to Tertiary)

Compiled from Haitian (1992), Yang (1994), Hou et al. (1999; 2002 submitted) & Gu Lianxing et al., (1993, 2000)

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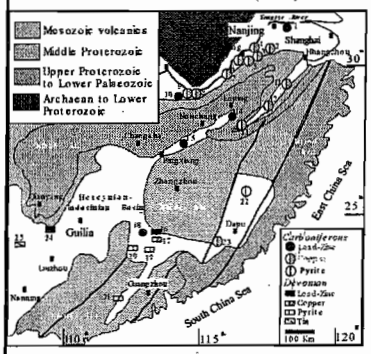

1. Qixiashan; 2. Maqushan (E Tongshan)
3. Xingqiao; 4. Tongguanshan
6. Dongguashan; 6. Meishan
7. West Tongshan; 8. Chenmenshan
9. Wushan; 10. Yinshan
11. Linghou; 12. Yongping
13. Dongxiang; 14. Lehua
15. Qibaoshan; 16. Fankou
17. Dabaoshan; 18. Yangjiutang
19. Xinlu; 20. Hongyan
21. Dajiangping; 22. Longfengchang
23. Yushui; 24. Shiding
25. Dachang

Location of major Upper Palaeozoic massive sulphide deposits in southeastern China (after *Gu Lianxing et al., 1993, 2000*).

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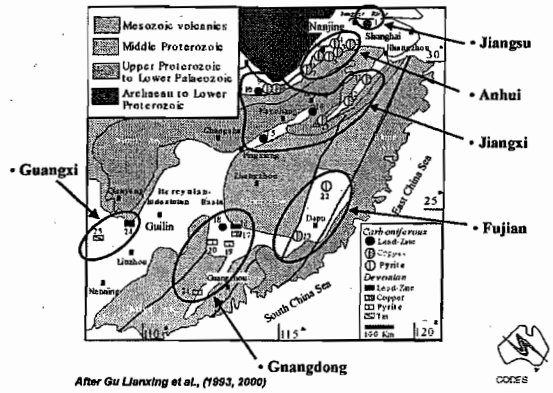
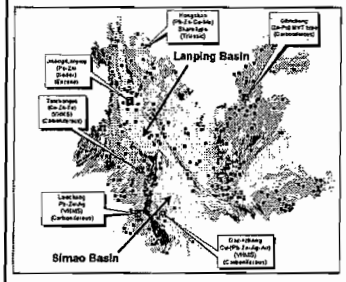


Yunnan Mineral Deposits

Lead-Zinc-Silver deposits



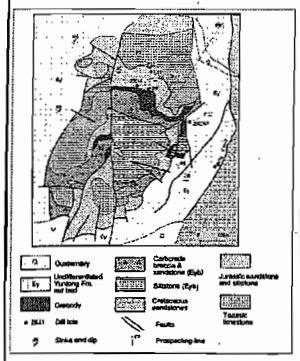
(1) Sedex deposits
(2) VHMS deposits
(3) Skarn deposits
(4) Vein/porphyry deposits
(5) MVT deposits

- Newly discovered Dapinzhang deposit has 6.2 % Cu, 3 % Zn, 0.7 % Pb 3.5 g/t Au, and 111 g/t Ag

(5) Presence of thick carbonate sequence and palaeotectonic setting suggest potential for Late Proterozoic (Sinian) MVT deposits in Yunnan

- Dallangzi MVT deposit in Sichuan has 24 Mt @ 10.4 % Zn, 0.8 % Pb and 43 g/t Ag

Geological setting of the Jinding deposit, Yunnan



(1) The largest Sedex deposit in China

(2) Geological reserves of 220 Mt @ 7 % Zn+Pb, 5.8 g/t Ag & 0.08 % Cd

(3) Hosted in Eocene Yunlong Fm

(4) The ore were deposited in smaller sub-basin (rift basin)

(5) Thrusting of Triassic limestone and Jurassic sandstone over younger rocks

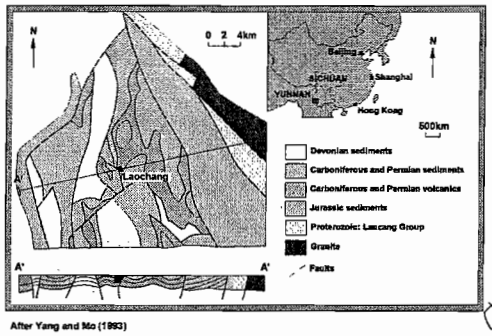
(6) Enriched in Sr in the form of celestite ($SrCO_3$)

(7) Celestite at the base and followed by barite, then sphalerite and galena

After Ning Li and Kyle (1997) and Kyle and Ning Li (2002)

CODES

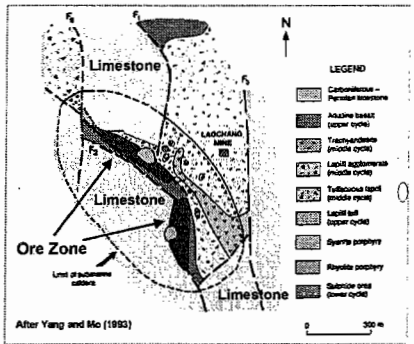
Regional geological setting of the Laochang deposit, Yunnan



After Yang and Mo (1993)

CODES

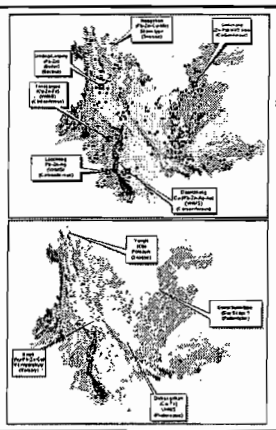
Geological setting of the Laochang deposit, Yunnan



After Yang and Mo (1993)

After Yang and Mo (1993) 15-20 Mt@3.5 % Zn, 3.8 % Pb, 1.9 % Cu, 113 g/t Ag (per. Com. Yang, 2000)

CODES



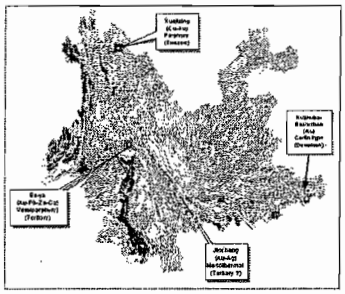
Copper deposits

(1) VHMS deposits
(2) Vein/skarn deposits
(3) Ni-Cu deposits
(4) Porphyry deposits

(5) Potential for sedimentary copper deposits: Proterozoic Dongchuan (Sedex) deposits

Sedex Cu is attractive due to (1) lateral extent (2) copper grades sometimes surpass porphyry Cu with desirable metal such as cobalt and silver

Gold deposits



(1) Au-bearing Porphyry (e.g. Xuejiping)

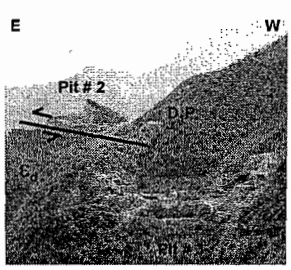
(2) Vein/breccia deposits (e.g., Beiya)

(3) Mesothermal gold deposits (e.g., Jinchang)

(4) Pt-Pd-Ni-Cu-Au deposits

(5) Carlin type deposits

Kuzhubao Gold Prospect (KZB)

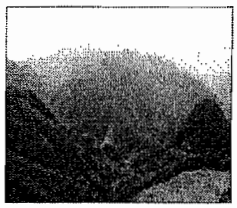


KZB Oxide Au Pits (1400 m ASL)

(Chromie and Khin Zaw, 2001 and submitted)

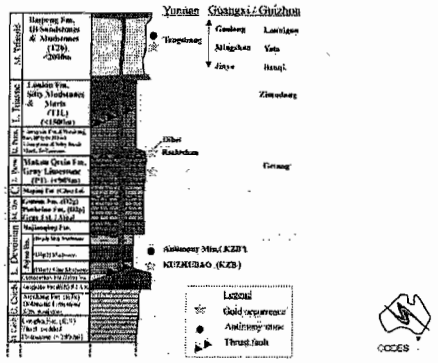
- Discovered late 1980's by Chinese Geological Team from 20 ppb Au SS anomaly
- Devonian black carbonaceous pyritic mudstone host (D_1P)
- Cambrian dolomite base($\mathcal{E}_d$)
- Micro- disseminated gold + py + asp within (D_1P) where early thrust faults are x-cut by high angle normal faults
- Sulphide ores within D_1P mudstone: 1 - 18 g/t Au
- oxide: <5 m thick @ < 7 g/t Au

Southern China "Carlin-type" Gold Deposits



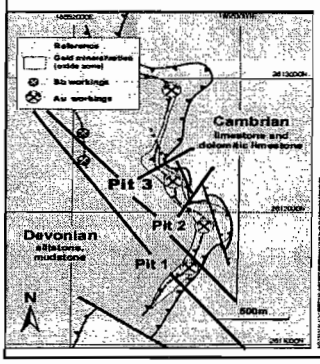
CODES

Regional Stratigraphy - SGT
(Nanpanjiang Basin, China)

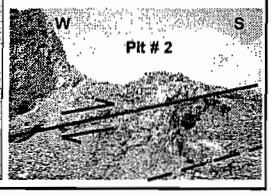


CODES

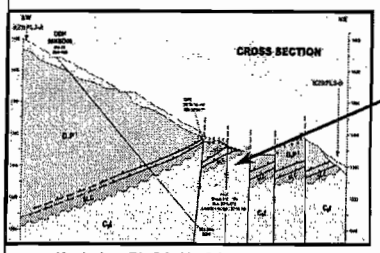
Kuzhubao Prospect
Geology & Oxide Gold Mining Pits

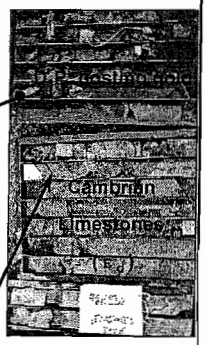


- Unconformity b/w Devonian Mudstones (D_1P) and Cambrian Limestones (ε_d)
- Reverse faulting along D_1P and ε_d contact
- Later NW-SE strike-slip and NE-SW normal faults



Kuzhubao Gold Prospect - Pit # 3

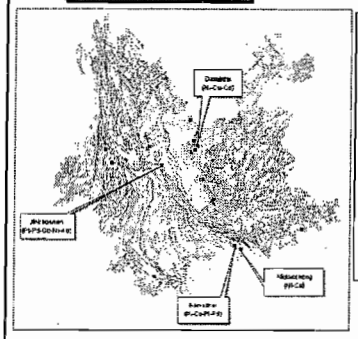




- Kuzhubao Pit # 3: N - S low angle thrust faults x-cut by NW-SE normal faults.
- Unconformity b/w Devonian Mudstone (D1P) and Cambrian Lime stone

(Chromie and Khin Zaw, submitted)

Nickel-copper deposits



Potential for Ni-Cu-Co-PGE deposits in Yunnan

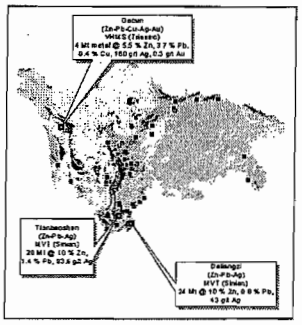
(1) Proterozoic Voisey's Bay type (136 Mt @ 1.59 Ni with significant Cu-Co credit) (Naldrett, 1997)

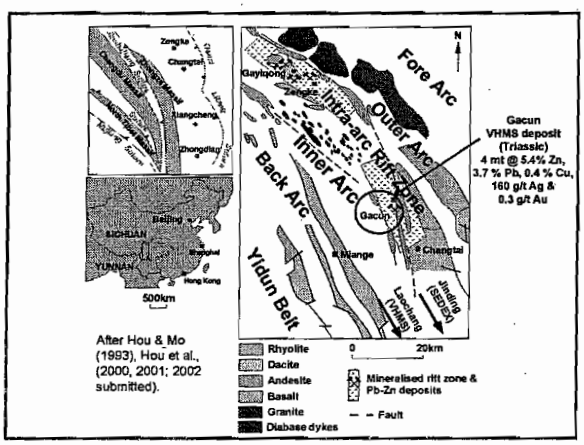
- The Proterozoic Jinchuan deposit in Gansu hosts more than 500 Mt @ 1.2 % Ni and 0.7 % Cu (Naldrett, 1997)

(2) Permian to Triassic Noril's sk type (900 Mt @ 2.7 Ni) (Naldrett, 1997)

- Jinbaoshan (Permian)

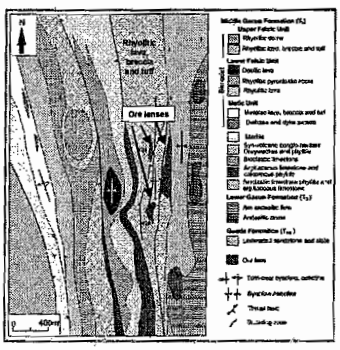
VHMS and MVT deposits, Sichuan





After Hou & Mo (1993), Hou et al., (2000, 2001; 2002 submitted).

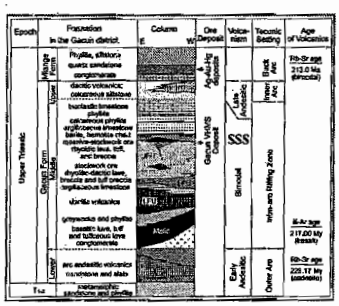
Triassic Gacun VHMS deposit, Sichuan



After Hou et al. (2000, 2001)

CODES

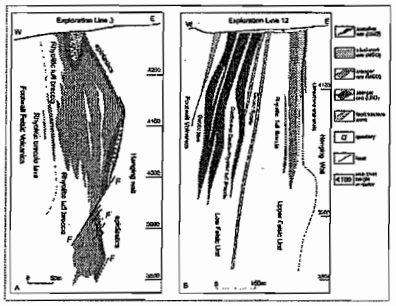
Triassic Gacun VHMS deposit, Sichuan



After Hou et al. (2000, 2001)

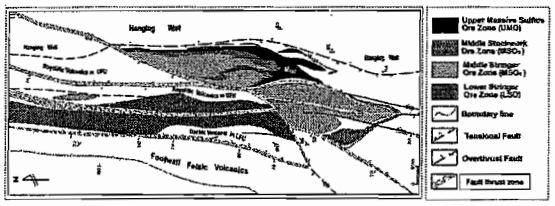
CODES

Triassic Gacun VHMS deposit, Sichuan



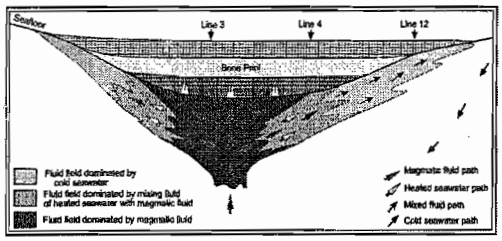
After Hou et al. (2000, 2001)

Triassic Gacun VHMS deposit, Sichuan



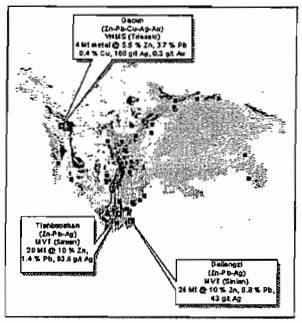
After Hou et al. (2000, 2001)

Triassic Gacun VHMS deposit, Sichuan



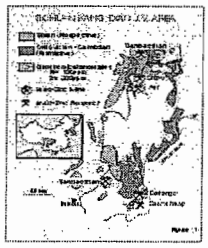
After Hou et al. (2000, 2001)

VHMS and MVT deposits, Sichuan

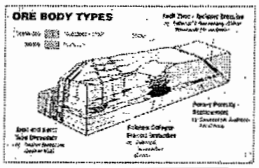


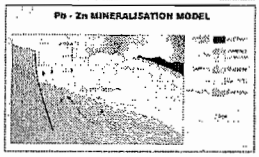
CODES

Pb-Zn MINERALISATION IN SICHUAN AREA



After Chromie (1999)

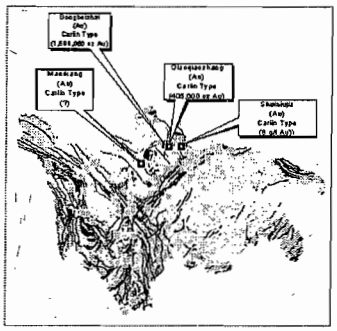




- Dalangzi MVT deposit in Sichuan has 24 Mt @ 10.4 % Zn, 0.8 % Pb and 43 g/t Ag
- Dayinchang MVT deposit in Sichuan has 5 Mt @ 3 % Zn+Pb

CODES

Gold deposits, Sichuan



CODES

Characteristics of Sediment -Hosted Gold Deposits in Sichuan Province, P. R. C.

Gold Mineralisation *(similarities to "Carlin-types")*

- Micro-disseminated sediment-hosted gold *(refractory ore)*
- Epigenetic: occurring within graphitic shear zones with quartz & /or carbonate stock work veining and also along altered contacts with quartz-porphyritic dykes *(Mesozoic aged ?)*
- Associated with pyrite, arsenopyrite, realgar and orpiment

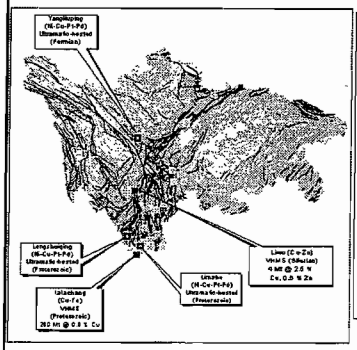
Host Rocks:

- Devonian to Triassic aged carbonaceous turbidites
- Occur as sequences within the Songpan-Garze accretionary wedge terrain, along the NW margins of the Yangtze Craton

Structural Setting:

- Dominant N-S & E-W trending regional faults *(Palaeozoic)* cross-cut by later NW & NE trending faults *(Mesozoic)*

Cu-Ni deposits, Sichuan



Proterozoic Cu-Fe VHMS (Lalachang) & Silurian Cu-Zn VHMS deposit (Liwu))

Potential for Ni-Cu-Co-PGE deposits in Sichuan

(1) Permian to Triassic Noril's sk type (900 Mt @ 2.7 Ni) (Naldrett, 1997)

(2) Proterozoic Voisey's Bay type (136 Mt @ 1.59 Ni with significant Cu-Co credit) (Naldrett, 1997)

(3) Yangliuping (Permian) and Lengshuiqing and Limahe (Proterozoic)

Cu-Ni deposits, Sichuan (Continued)

- Permian flood basalt's cover about 250,000 km2
- Major N-S regional structures along Kang Dian up-lift
- Palaeozoic ultramafic intrusions occur near basalt margins
- Small Ni-Cu mines occur with 1-4 % NI, 0.5-2 % Cu & 0.05-3 g/t PGE
- Previous BHP sampling from 1994-1996 shows ultramafic intrusions with Ni depletion of olivines suggesting presence of Ni-sulphides elsewhere in the intrusions sampled (Paul Chromie, per. Com., 2000)

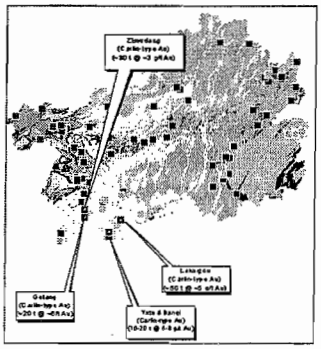
Mineral Deposits in South China II (P603)

Research Team:

Khin Zaw
Eleanor Bruce
Clive Burrett
Ron Berry
Ross Large

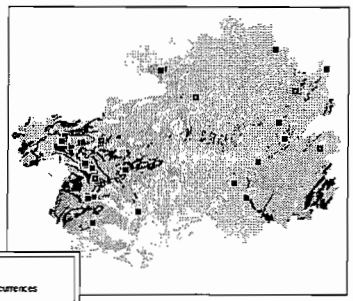
CODES

Gold deposits, Guizhou



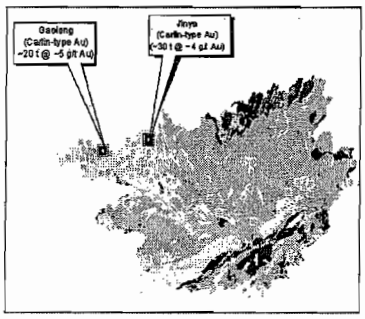
CODES

Ni-Cu and Pb-Zn-Cu-Sn-W deposits, Guizhou



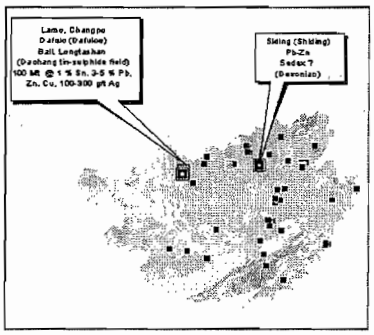
CODES

Gold deposits, Guangxi



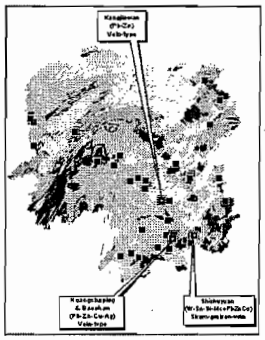
CODES

Pb-Zn-Sn-W deposits, Guangxi



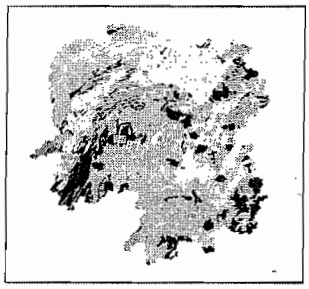
CODES

Base metal deposits, Hunan



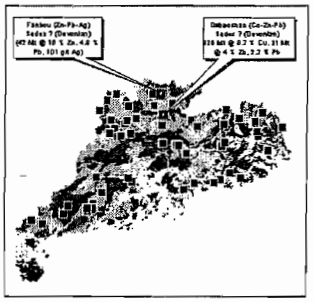
CODES

Gold deposits, Hunan



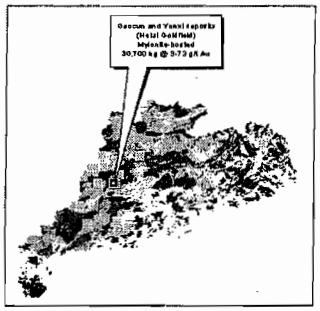
CODES

Base metal deposits, Guangdong



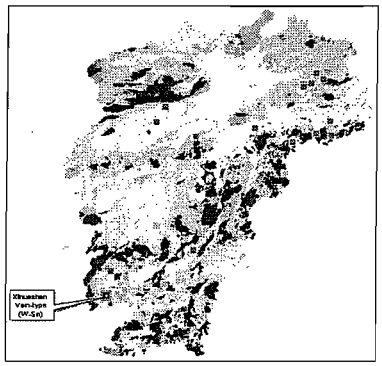
CODES

Gold deposits, Guangdong



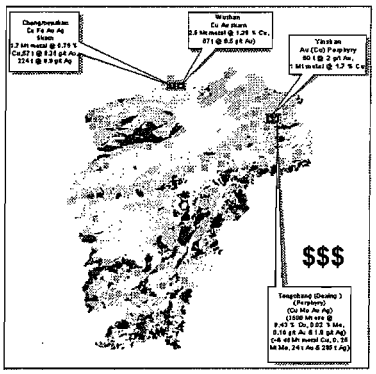
CODES

Tungsten, tin, lead and zinc deposits, Jiangxi



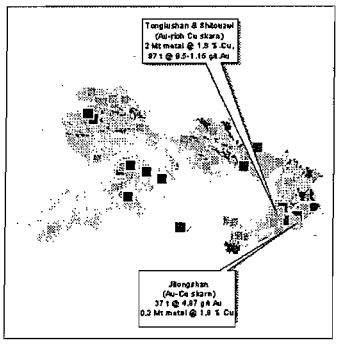
CODES

Copper-Gold deposits, Jiangxi



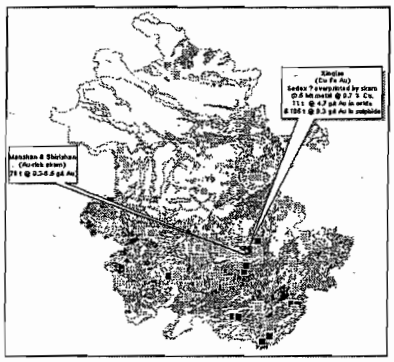
CODES

Lead, zinc, copper and gold deposits, Hubei



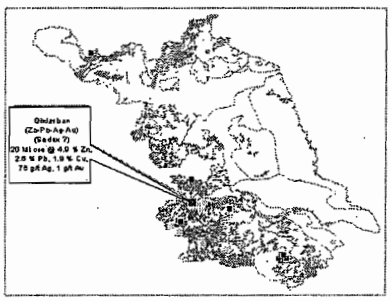
CODES

Lead, zinc, copper and gold deposits, Anhui



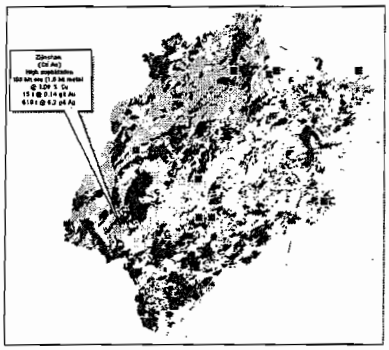
CODES

Lead, zinc, copper and gold deposits, Jiangsu



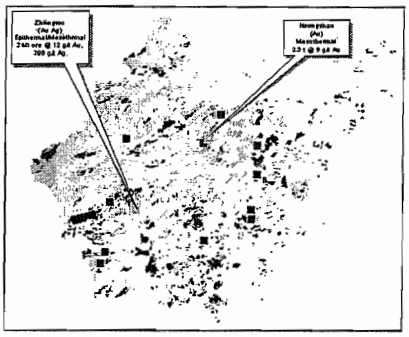
CODES

Gold deposits, Fujian Province



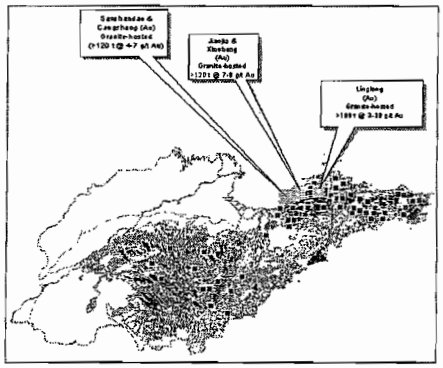
CODES

Gold deposits, Zhejiang



CODES

Gold deposits, Shandong



CODES

Summary

- Compilation of geology database for Yunnan, Sichuan, Guizhou, Guangxi, Hunan, Guangdong, Jiangxi, Hubei, Anhui, Jiangsu, Fujian, Zhejiang and Shandong provinces have been completed.
- CD-ROMs are delivered to the sponsors.
- Mineral deposit database for the above provinces have been compiled.
- Yunnan has at least five different styles of lead-zinc mineralisation (e.g., Sedex, VHMS, skarn, vein/breccia).
- Yunnan also has potential for Carlin type gold, porphyry, sedex Cu and mafic-ultramafic hosted Ni-Cu deposits

CODES

Summary

- Sichuan has potential for VHMS, Carlin type gold, porphyry, and mafic-ultramafic hosted Ni-Cu deposits
- Guizhou and Guangxi (part of Southern Golden Triangle) have Carlin type gold, Sn-W-sulphides (e.g., Dachang) and possibly of Sedex (e.g., Shiding)
- Yanshanian granite-related Sn-W-Bi-Au-base metal sulphide deposits are widespread in Hunan and Guangdong.
- Guangdong has Sedex deposits (e.g. Dabaoshan, Fankou) and mylonite-hosted, mesothermal Au deposits

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Summary

- Jiangxi province has vein-type W-Sn-Bi-Be-sulphide deposits and the largest porphyry Cu deposit in China (Dexing: 6.5 Mt metal @ 0.43 % Cu, 0.02 % Mo, 0.16 g/t Au and 1.9 g/t Ag)
- Jiangxi also has world class Sedex/skarn deposits such as Chengmenshan and Wushan (4 Mt metal @ 0. 76-1.4 % Cu, 124 t @ 0.25-0.5 g/ Au)
- Similar skarn Cu-Au deposits (e.g., Tonglushan, Shitouzui, Jiguanzui, Xinqiao, Manshan, Shizishan) are also found in Hubei, Anhui and Jaingsu along the Lower to Middle Yangtze River metallogenic belt

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Summary

- Fujian and Zhejiang provinces cover South China foldbelt along the margin of the Yangtze Craton and characterised by well-developed Yanshanian intrusive to subvolcanic rocks.
- The most important examples are porphyry/high-sulphidation Zijinshan deposit in Fujian (1.6 Mt metal @ 1.09 % Cu, 15 t @ 0.14 g/t Au, 619 t @ 6.2 g/t Ag) and Epithermal-mesothermal transition deposits in Zhejiang (e.g., Zhilingtou)
- Shandong province is a major producer of Au in China with reserves of >900 t Au and has unique world class granitoid-hosted Au deposits (e.g., Linglong, Sanshandao, Jiaojia, >100 Au @ 3-30 g/t Au av. > 5 g/t Au).

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Summary

- We successfully integrated the geology, tectonic and metallogenic relations of South China in this project.
- South China is rich in mineral resources and has the potential for world class ore discovery; in addtion to exisitng ore types such as VHMS, Sedex, skarn, potential for new mineralisation style such as IOCG (Iron Oxide Copper Gold)
- Similarly Noth China is rich in minerals. Many giant base metal deposits such as Baiyinchang VHMS and Dongshenmio Sedex) and porphyry (Yulong), Ni-Cu-Pt-Pd (Jinchuan), Carlin type and orogenic Au deposits are located in North China Craton and in the suture zone along the South and North China Cratons

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Summary

- It is imperative to undertake similar studies for North China Craton to understand palaegeographic, tectonic and metallogenic relation of formation of the giant ore deposits of China during the collision and amalgamation of South China and North China Cratons

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