GEO-RESOURCES & GEO-ENVIRONMENTAL ASSESSMENT IN CHINA

(ABSTRACT)

ZHANG DAQUAN (China Geological Survey)

Following the rapid development of China economy, the demand for geo-resources increases fairly fast, the investment from all around of world come into China, and the mining market is "flourishing" today. Meanwhile, the concern about the national sustainability of nonfuel minerals production and environmental quality are growing, too.

1. The state of mineral resources in China

China is rich in mineral resources. After the long period work, especially large-scale geological exploration conducted since the founding of the People's Republic of China (1949), 171 kinds of mineral resources have been discovered. Among which, 156 commodities have explored reserves, including 9 types of energy resource, 54 metallic minerals, 90 nonmetallic minerals, plus groundwater, mineral water and carbon dioxide gas. The total value of potential reserves places China third in the world. but the amount per person is relatively low, accounting for only 58% of the average in the world, ranking 53rd. Various deposits are among the richest, including rare earth element, W, Sn, Sb, Mo, Bi, Be, coal, magnesite, barite, fluorite, talc, graphite, bentonite, fireclay, asbestos, gypsum, wollastonite, diatomaceous earth, and building stone. On the other hand, the country is lacking in oil, high-grade iron, Cr, Mn, Cu, PGE, potash salt and diamond. By now, about 200 thousand localities of ore deposits or mineral occurrences have been discovered, among which, 20 thousand ore deposits have been investigated in detail, including 90 super giant deposits.

However, few geological work has been done in the vast western territory of China or under the depth of 500m below surface, suggesting a great potential for more discovery. Owing to the diversity of geological settings for mineralization in China, there is great potential for ore prospecting.

2. Geological Setting

The present Chinese continental crust has evolved from the process of jointing,

deformation and developing of paleo-cratons or paleo-massif through the long history of geology. The basic geological and tectonic units of the Chinese continent include the relative stable regions (paleo-plates or massif) and the active belts (suture zones and/or collision belts). There are three large land mass or plates and five active belts in China.

The three main landmass (plate) include: (1) the North China landmass, which were formed after the Lvliang Movement (1800 Ma) and at the basement of Archean and/or Lower Proterozoic metamorphic rocks; (2) the Tarlimu lanmass, formed after the Jinning Movement (1000Ma) and at the basement of pre-Sinian metamorphic rocks; (3) the Yangtze landmass, also formed after the Jinning Movement and mainly at the basement of Proterozoic metamorphic rocks.

The five active belts include: (1) the Tianshan-Xing'an active belt, which consist with a series of fold belts and micro-plates and formed after the Caledonian-Hercynian movement; (2) the Kunlun-Qilianshan-Qinling active belt, which is an important belt between North China and South China and activated at different epoches of Jinning, Caledonian, Hercynian, Indosinian, Yanshanian and Himalayan; (4) the Sichuan- Yunnan-Qinghai-Tibet active belt, which is the most important active belt of Tethys- Himalayan in the southwestern China; and (5) the western circum-Pacific active belt, mainly overprinted on the Paleozoic and pre-Paleozoic tectonic belts in the eastern China and featured by strong activation of Mesozoic-Cenozoic volcanism-magmatism in East China, large-scale granitoid intrusion in the Nanling Region, NE-NNE-trending movement of blocks and rifting-magmatism in the margin area of paleo-landmass.

3. Some major achievements for geo-resources exploration

In recent years, Chinese government pay much attention to the geo-resources exploration, and the encouraging commodities are: Fe, Cu, Al, Pb, Zn, Mn, Ni, W, Sn, K, Au; the encouraging metallogenic belt：Three Rivers Areas of Southwest China, Gandis, Tianshan Mountains, Nanling, Great Xing'an Mountains, Altai, Kunlun-Arjin, Beishan, Qinling and so on.

Some expert predict that the total proven extent of mineral exploration is about 1/3, among which, the proven reserves of Fe, Cu, Al, Pb, Zn, Mn, Ni, W, Sn, Au, are 26%~59. According to the prediction, the non-proven reserves of iron are 70 billion tons, the proven extent 47%. Copper 120~156 million tons, 34%~41% extent；bauxite

4 billion tons, 40%。In the later several years, we accessed the 565 middle-large size mines, and about 200 mines still have the resources potential for further exploration.

3.1 Great potential in West China for exploring some short commodities—Copper exploration in East Tethyan

The East Tethyan Copper belts almost has the same potential with that famous Andeans belts in South America. Along the belts, we found a series of middle-large size deposit, such as: the Zhunuo, Chuibaizi, Tinggong, Chongjiang, and so on. The perspective reserves are over 20 million tons, plus the proven Yulong copper deposit, the whole reserves will be near 50 million tons.

Pulang copper deposit: *In Three Rivers belts, proven reserves over 4 million tons, and some good mineral occurrences in the periphery, the total reserves nearly over 10 million tons.*

Qulong copper deposit: *the proven reserves copper 8 million tons, and molybdenum 0.5 million tons.*

3.2 Great potential in West China for exploring some short commodities—Lead & Zinc exploration around the Upper Yangtse block.

Around the Upper Yangtse block，a series of "MVT" type and "SEDEX" type Lead & Zinc deposit have been found. We called it "Yangtse" type. This type of deposit are mainly controlled by the Early Paleozoic carbonate rocks, and represent the future exploration target of China.

Mayuan lead & zinc deposit in Shanxi province: *lay in the dolomite of |Dengying fomation, Sinian Period, the proven reserves 2.2 million tons.*

Bingdong Mountain lead & zinc deposit in West Hubei: *lay in the dolomite of Doushantuo formation, Sinian Period, with the reserves 1.45 million tons.*

3.3 Great potential in West China for exploring some short commodities—Mineral exploration in very low working extent metallogenic belts

Lots of new exploring clues has been found in these areas though the 1:250 thousand regional mapping and the 1:200 thousand aeromagnetic mapping. Including some rich iron deposit in West Kunlun mountains, along the Qinghai-Tibet realway, and Nouth Gandis.

Baiganhu tungsten & tin deposit in Qimantage areas:*In west part of East Kunlun belts, we found a new tungsten & tin resources base.*

3.4 Great potential in West China for exploring some short

commodities—K-salt resources exploration in Luobopo saline

Luobopo K-salt Deposit: Liquid KCl reserves 155 million tons. And the mine has been developed, and will reach a output nearly 1.2 million tons in the year 2009.

3.5 Great potential in West China for exploring some short commodities—Gold exploration

Xiongcun gold & copper deposit: *invested by Canada Southwest Corporation, and only the No.1 ore body proved the reserves 120 tons of gold; the No.2 ore body has much more potential than the No.1.*

Yangshan Gold Deposit: *a super-large size gold mine discovered by the financial invest especially for gold surveying. From 2001-2006, the total reserves are 258 tons of gold. The deposit are disseminated quartz veins type.*

Dachang Gold deposit: *25 ore bodies, average grade 5.97g/t, the total reserves 115.09 tons. Now the local government (Gansu Province) are cooperating with CANADA INTER-SITIC Corporation for further exploration.*

3.6 Great potential in Middle & East China for exploring the deep—Iron exploration in North China's Landmass

A series of discoveries have been found in Anshan-Benxi city in Liaoning province, the East Hebei province, Hengshan-Wutaishan in Shanxi province, Wuyang-Xincai in Henan Province, and the West Shandong Province, for exploring the iron ore in the deep of the mine.

3.7 Great potential in Middle & East China for exploring the deep—Bauxite exploration in Shanxi & Guangxi province

The newly found large size bauxite deposits: *Tianhe, Kuancaoping, Bayanquan, Tieshuigou, Xiangwang, Pangjiazhuang, Wangrun, and so on in Shanxi province; and the Longhe, Tiandong periphery, Pingguo periphery, Fushui-Chongzuo in Guangxi Province.*

3.8 Great potential in Middle & East China for exploring the deep—Gold exploration in the old mine

Qingchengzi Gold deposit in Liaoning: *Wandigou reserves 135 tons; Linjia-Sandaogou reserves 46tons.*

Sizhuang gold mine in Laizhou, Shandong province: *East Shandong areas are the most important gold base in China, the whole proven reserves 1000 tons of gold. But the reserves are calculated mainly 500m shallow underground, he "Second*

Exploration Space" 500～1500m maybe have the potential 2000 tons. Sizhang gold mine is the perfect example for exploring in the deep, with reserves 51.83 tons.

3.9 Great potential in Middle & East China for exploring the deep—Further exploration in the deep or exterior of the old mine

Qiaotou Iron deposit in Benxi, Liaoning: *Near the 1:10000magnetic abnormity, we implemented a dill hole (ZK001), and the ore body appear from 1279m till the end of the hole 1500m (without penetrated the ore). The Perspective reserves will be 1 billion tons of iron.*

Copper, Zinc exploration in Hongtousan, Liaoning: *newly increased reserves 110 thousand tons of copper.*

Qian'an Iron Mine: *10603m dillhole, and increased reserves 110 millin tons of iron.*

Daye Iron deposit in Hubei: *newly increased reserves 23 million tons of iron, and 100 thousand tons of copper.*

Huize Lead & Zinc deposit in Yunnan Province: *Newly increased reserves 1500 thousand tons of zinc, 710 thousand tons of lead, 624 tons of silver, and 1370 thousand tons of slfur.*

Jining iron deposit in Shandong Province: *after 1600m deep in the drill hole, three layers of magnetite 107.8m has been discovered, average grade 25～35%, and the potential reserves over 1 billion tons of iron.*

Tongshan Copper Deposit: *8 dill holes, the increased copper reserves 136 thousand tons.*

Fuxin Coal Mine in Liaoning: *3 dillholes, reserves 73 million tons of coal, and enlarge the exploiting time over 30 years.*

3.10 Groundwater exploitation in water shortage area of western China

In about 80 counties in 13 western provinces, we have drilled 334 deep wells in NW China and 60 thousand shallow wells in SW China, which supply totally 0.7 million m^3/a drinking water for 3 million peoples. Through this project, new exploitation methods and development models have been established.

4. Geo-environmental assessment

About 1000 lives and tens of billions RMB estates were lost every year. Reducing the consequence of the landslides is an important work for the government and the geologists in China.

Geo-hazards census in mountainous counties were carried out in 1999. Up to now, geo-hazards census of 700 mountain landslide-prone counties was finished. Another 800 counties census is in its progress. The result shows that the landslide-prone area is about 1,800,000 Km2. A set of combined warning system was set up in every county.

With the data of Geo-hazards census , the annual successful forecasting number of Geo-hazards increased from 34 in 1999 to 721 in 2004.

With the database of geo-hazards census, we set up a prediction system and issued the warning through CCTV. Example: in 2003, 800 landslides fatalities were predicated.

The effective landslide monitoring and management system has setup, and the casualties decreased from 1573 in 1999 to 724 in 2004.

For further understanding of geo-hazard distribution and formation , a detailed geo-hazard survey started in serious hazardous areas at a scale of 1: 50000 in 2005. This survey will emphasizes the geological condition, formation mechanism, character and distributing rule of landslides and supply abundant data for geo-hazard prevention.

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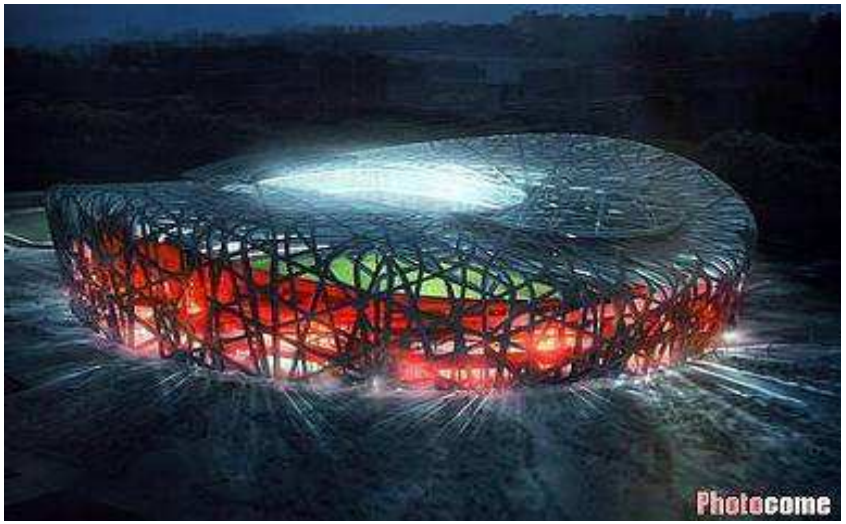
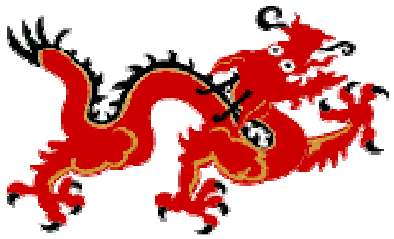
ZHANG DAQUAN

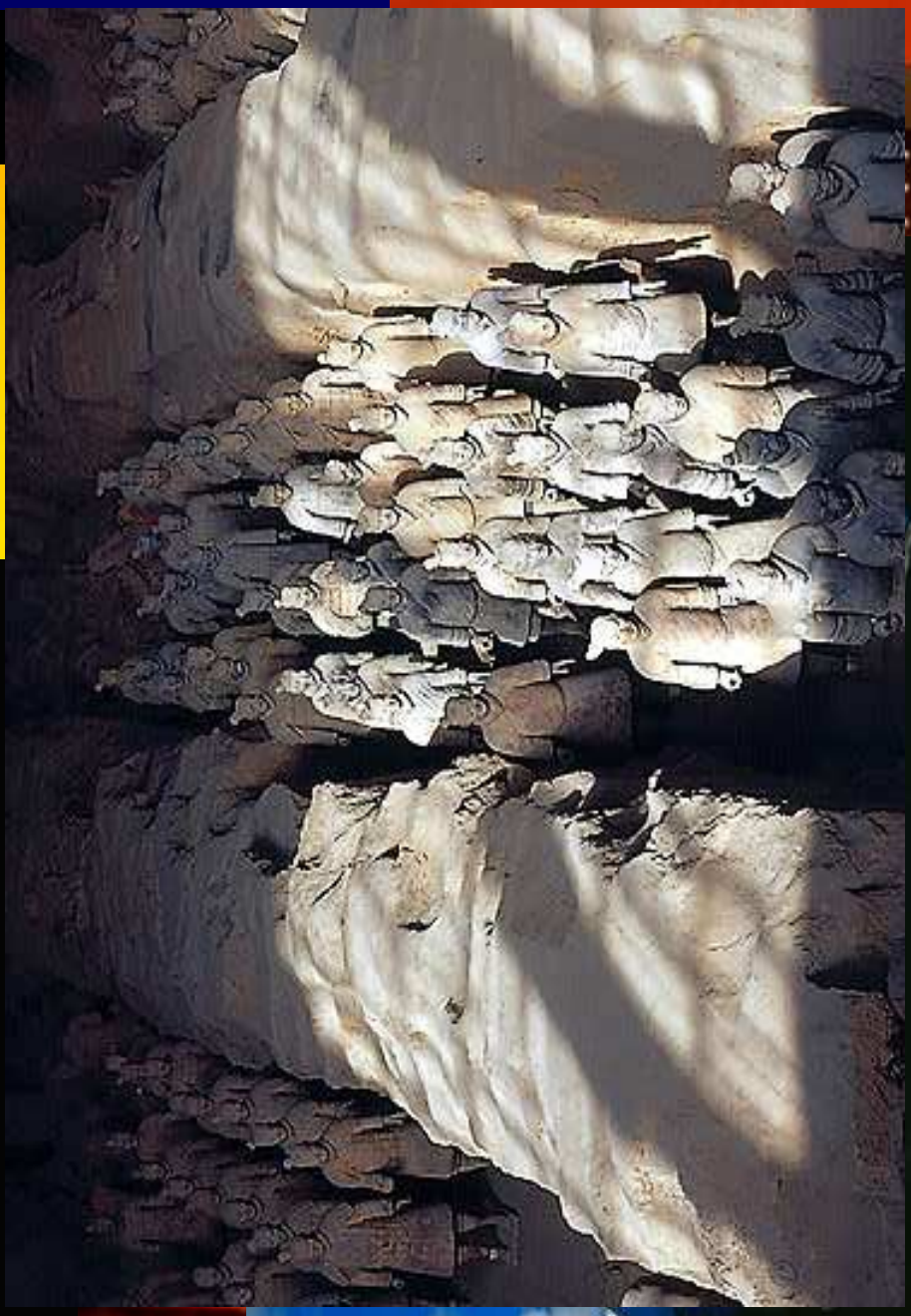
(China Geological Survey)

2007.11.27





One World One dream



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3. Geo-environmental assessment
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The state of mineral resources in China

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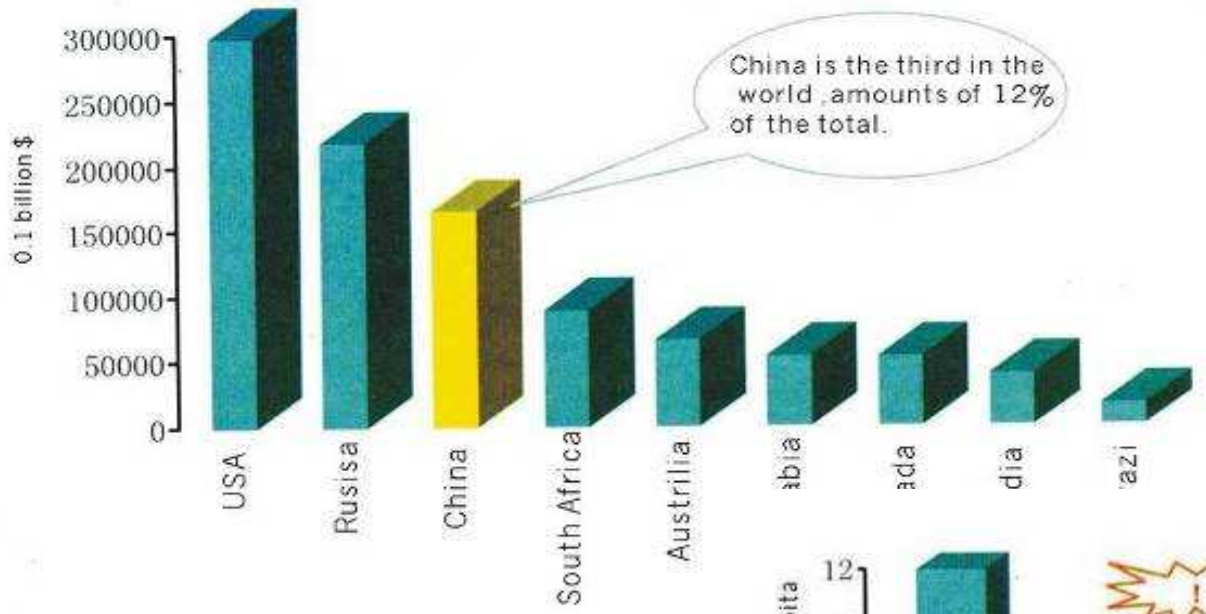
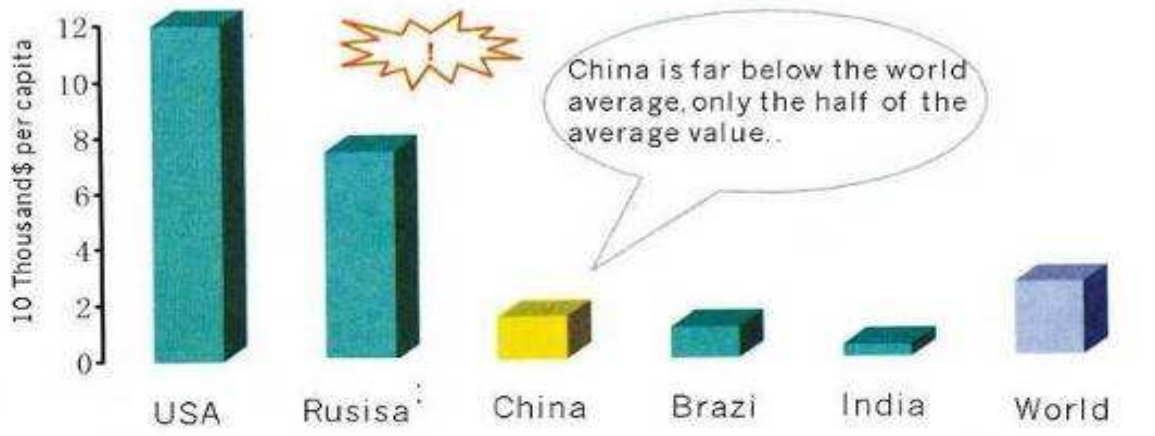
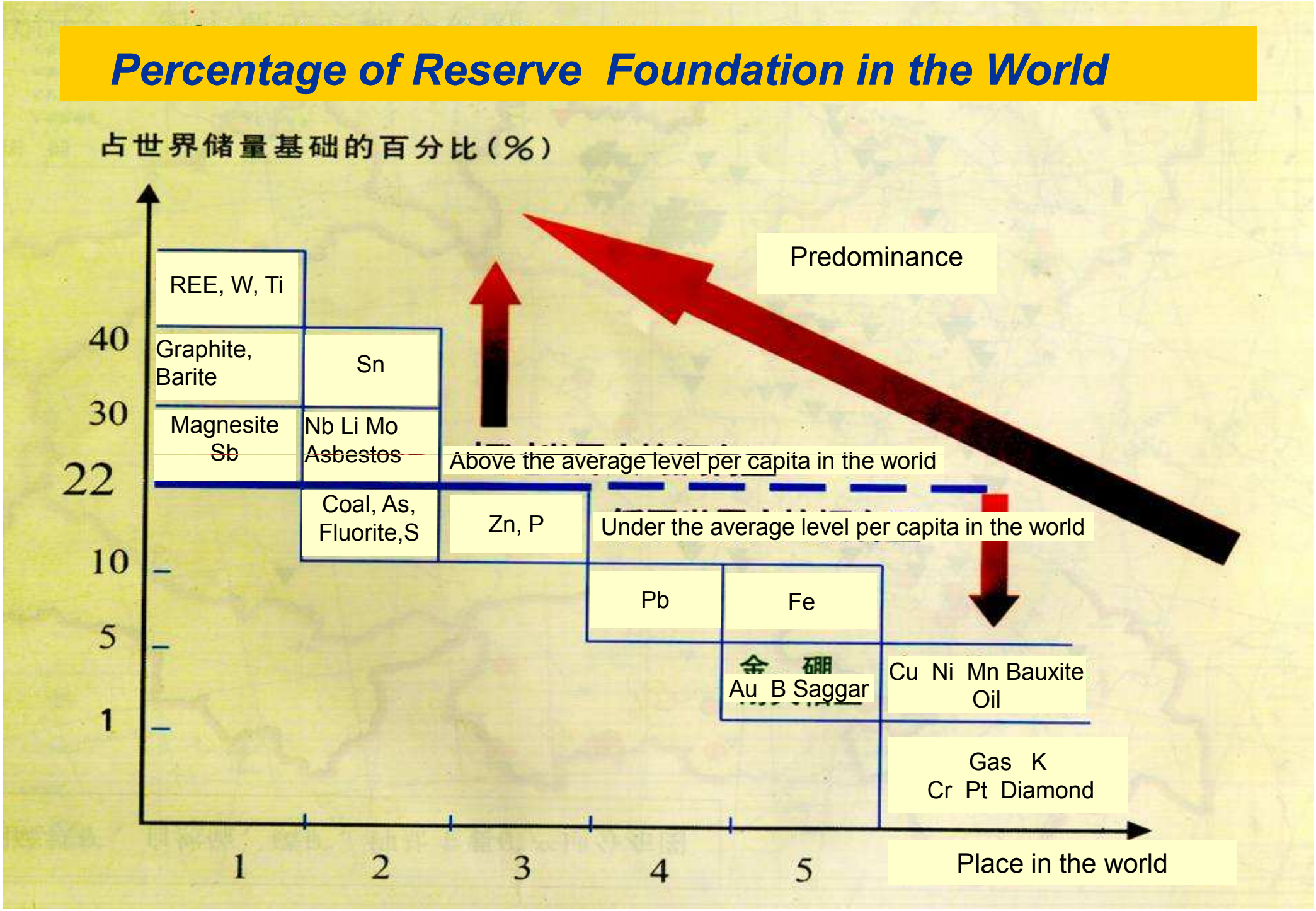


The contrast of the mineral reserves(t between some major countries



The contrast of the individual mineral reserves(total value of potentiality) between some major countries

Percentage of Reserve Foundation in the World



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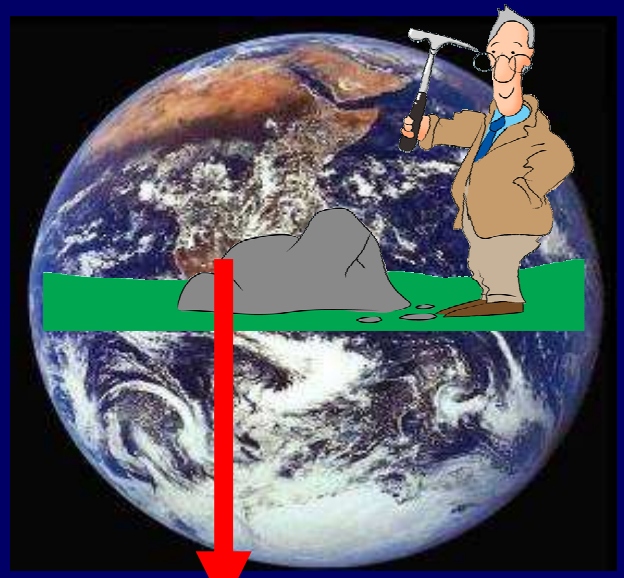
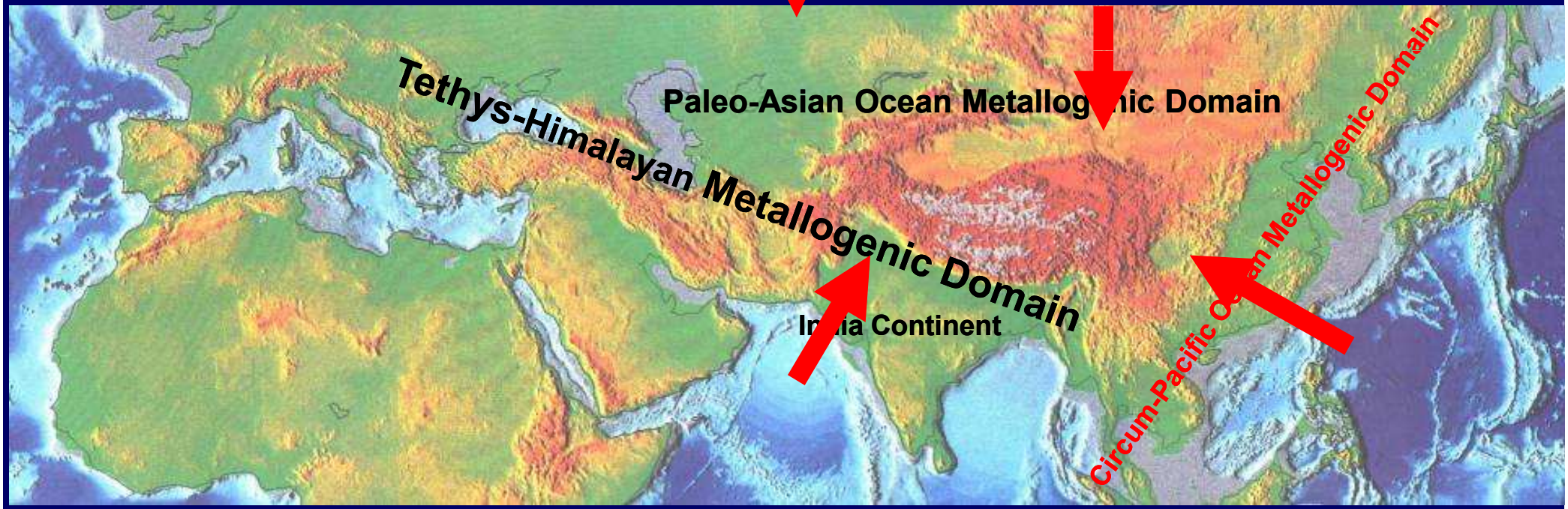
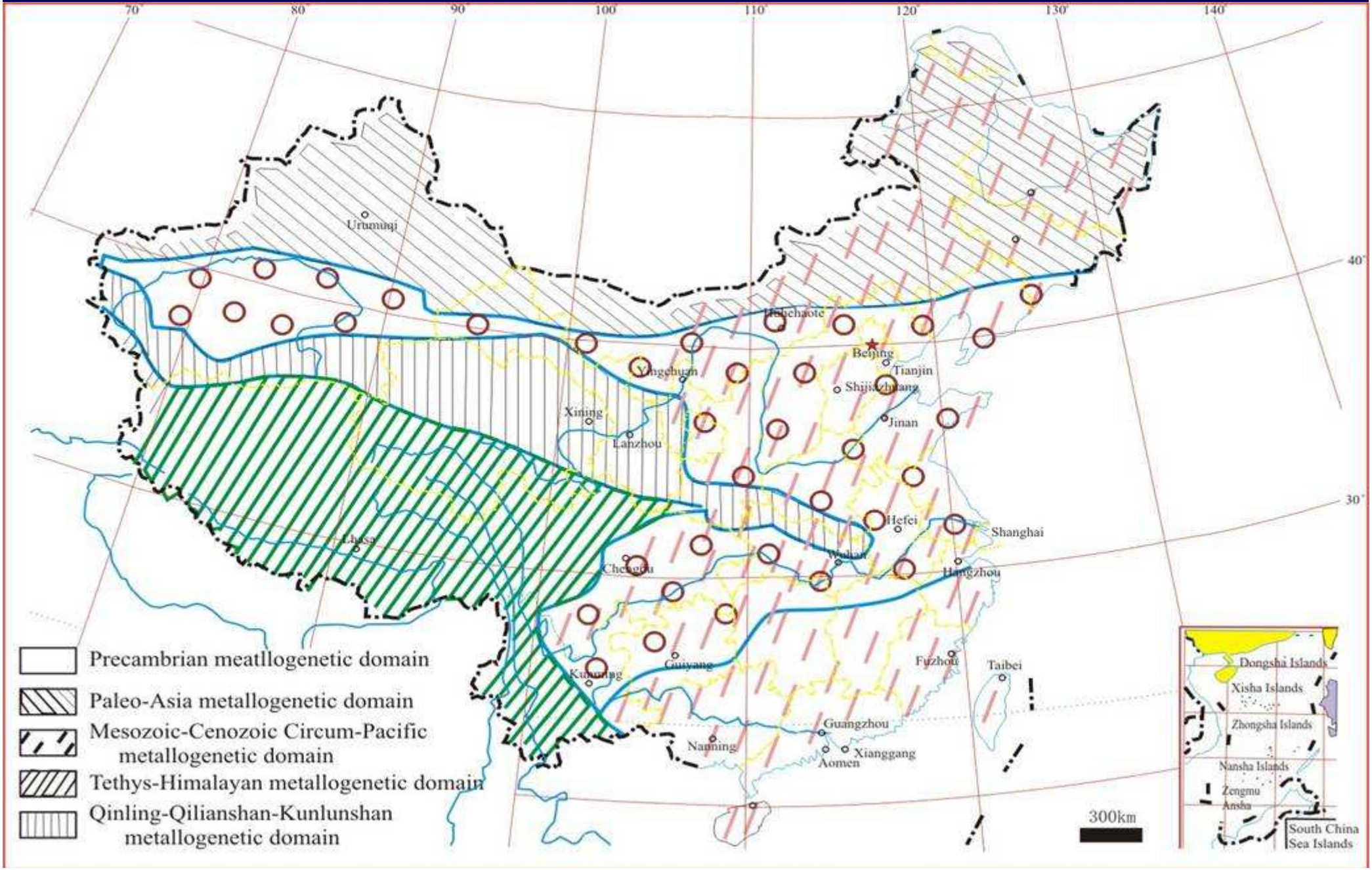


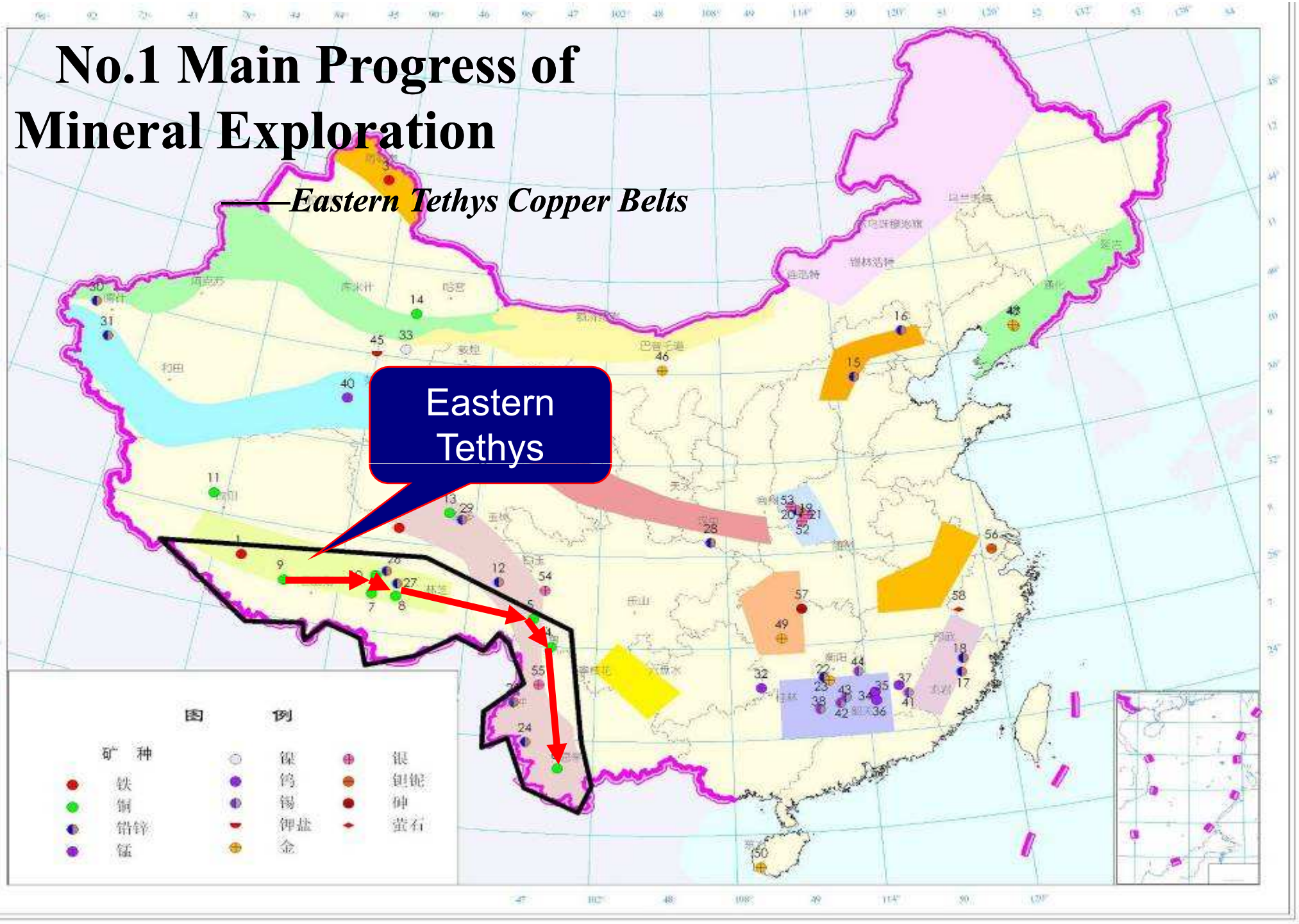

Tethys-Himalayan Metallogenic Domain
Paleo-Asian Ocean Metallogenic Domain
India Continent
Circum-Pacific Ocean Metallogenic Domain

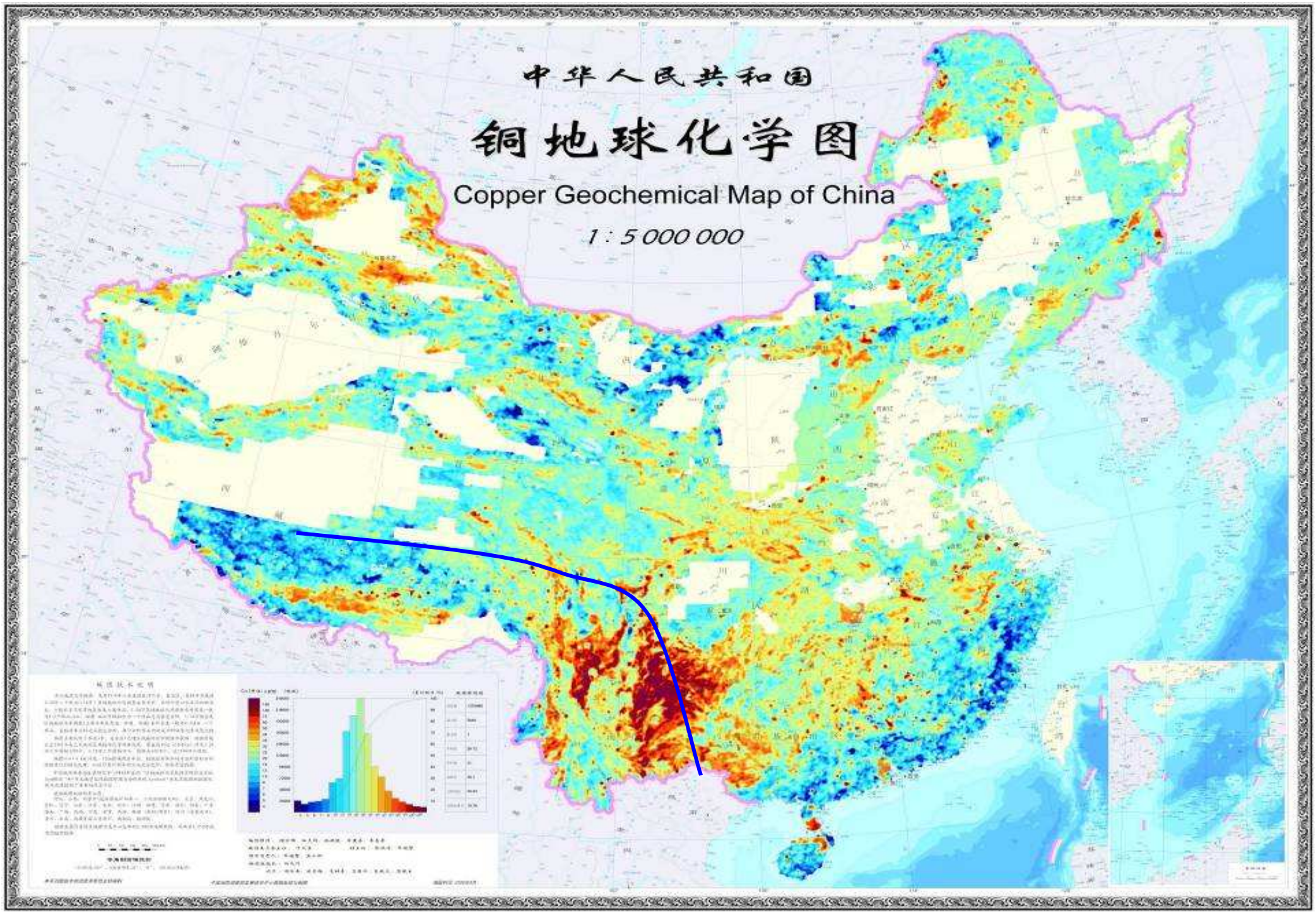
The five metallogenic domains in China



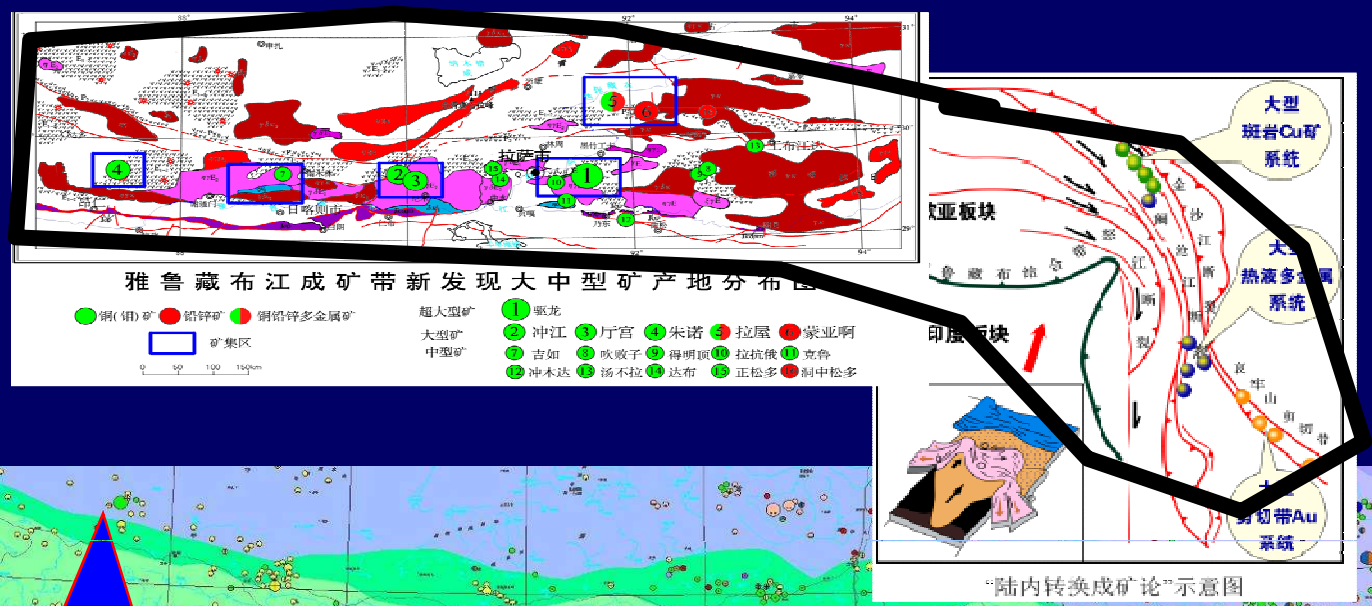
No.1 Main Progress of Mineral Exploration

——Eastern Tethys Copper Belts




中华人民共和国
铜地球化学图
Copper Geochemical Map of China
1 : 5 000 000

Eastern Tethys Copper Belt



Duobuza porphyry copper deposit

Nixiong rich iron deposit

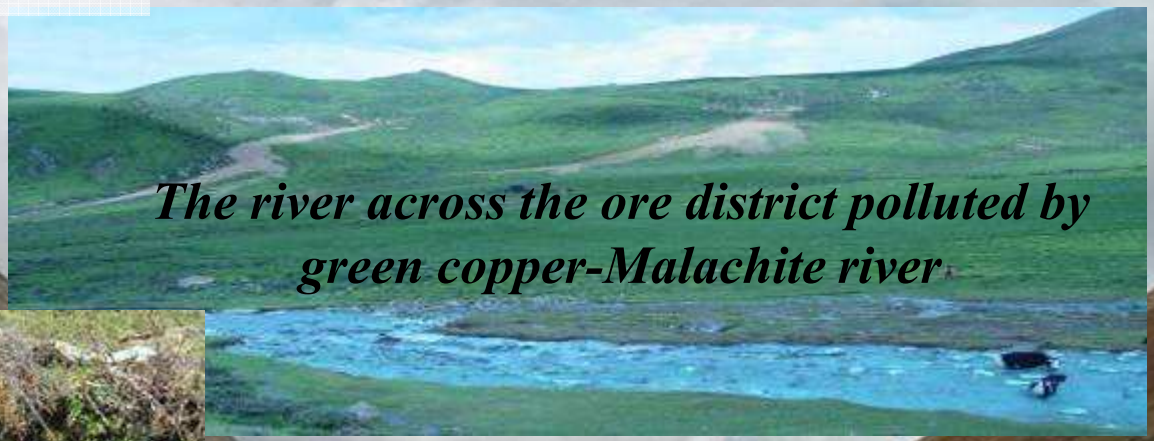
Qulong porphyry copper deposit

Yuulong porphyry copper deposit

Pulang porphyry copper deposit

Eastern Tethys Copper Belt

Qulong copper deposit

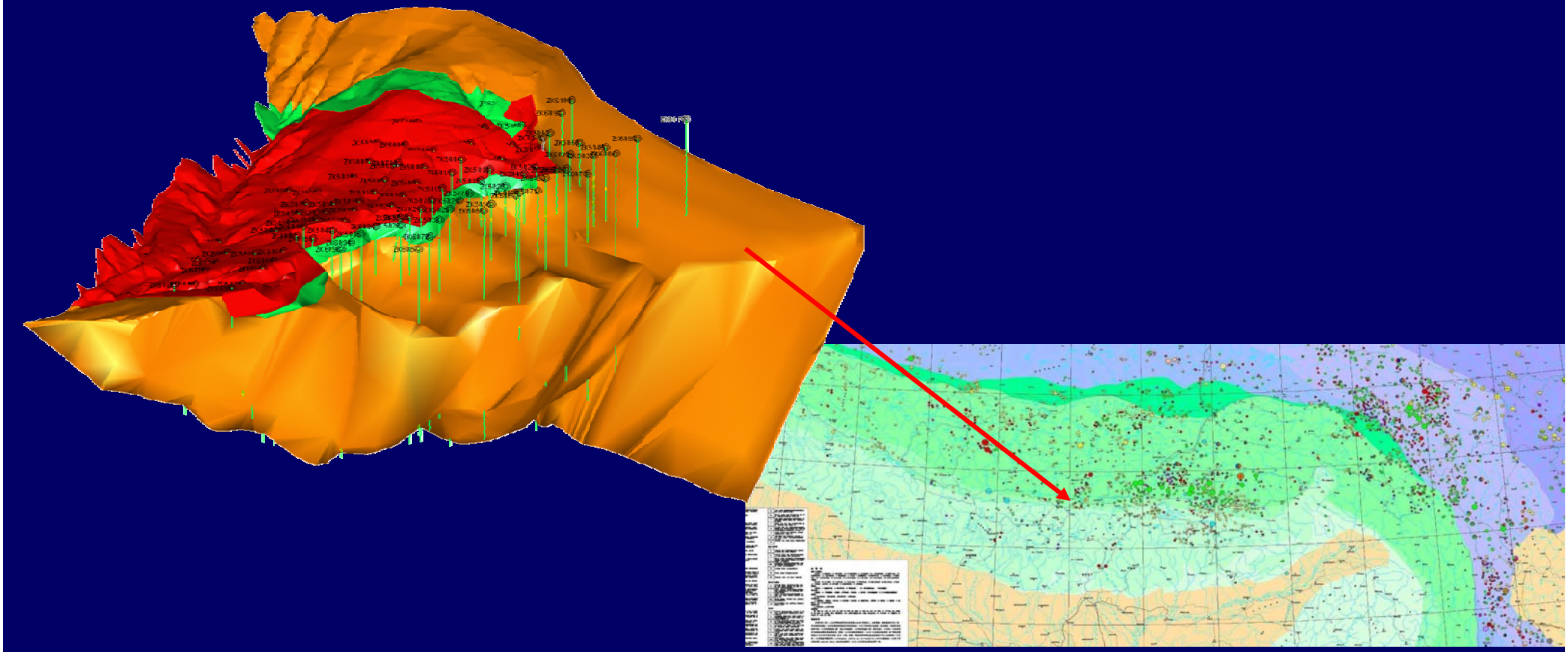


The river across the ore district polluted by green copper-Malachite river

The wall for countyard in local district is built by malachite stone

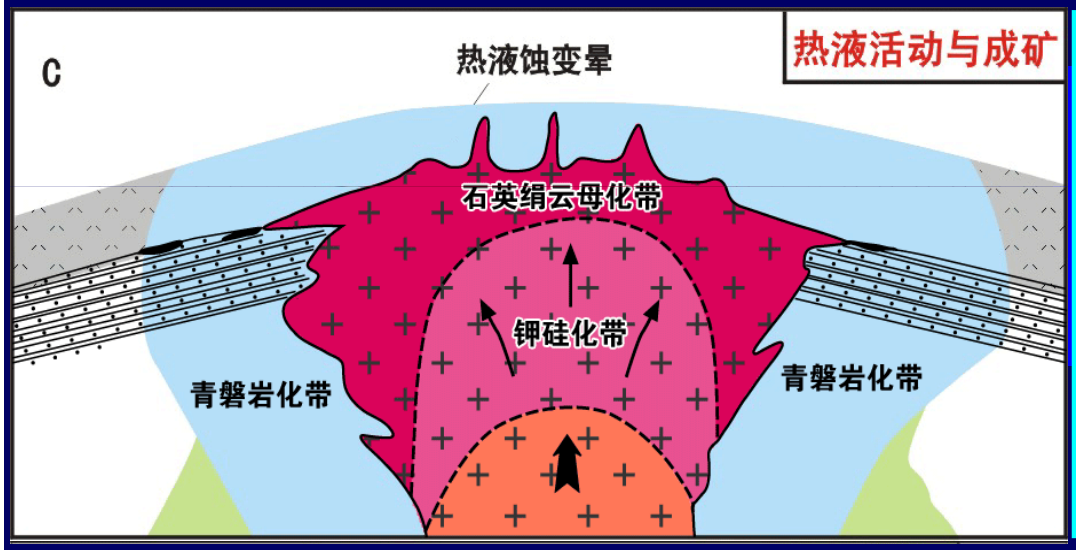
The proven reserves copper 8 million tons、silver 5931 tons and molybdenum 0.5 million tons.

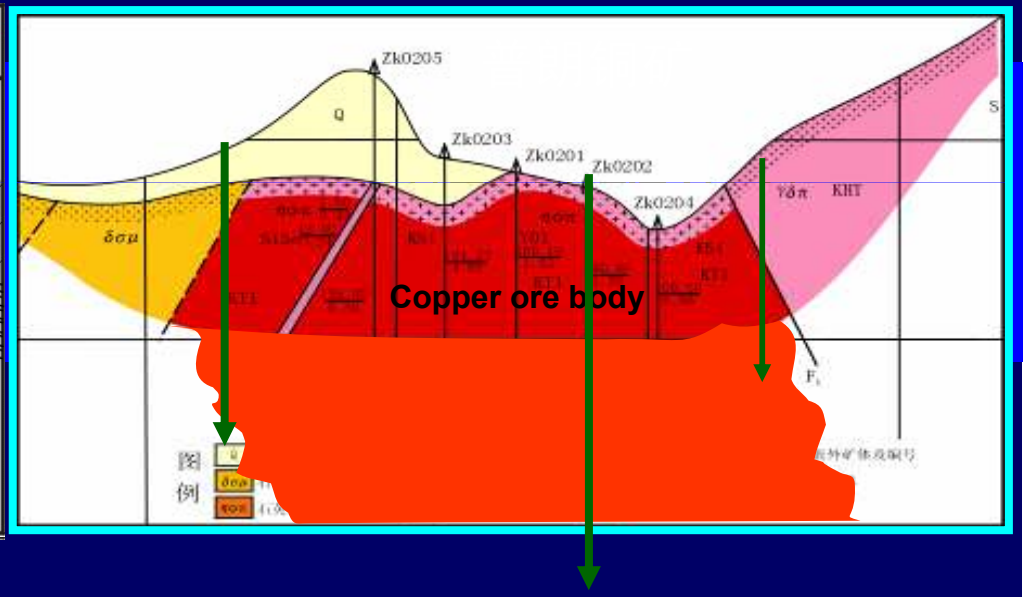
Xiongcun gold & copper deposit:

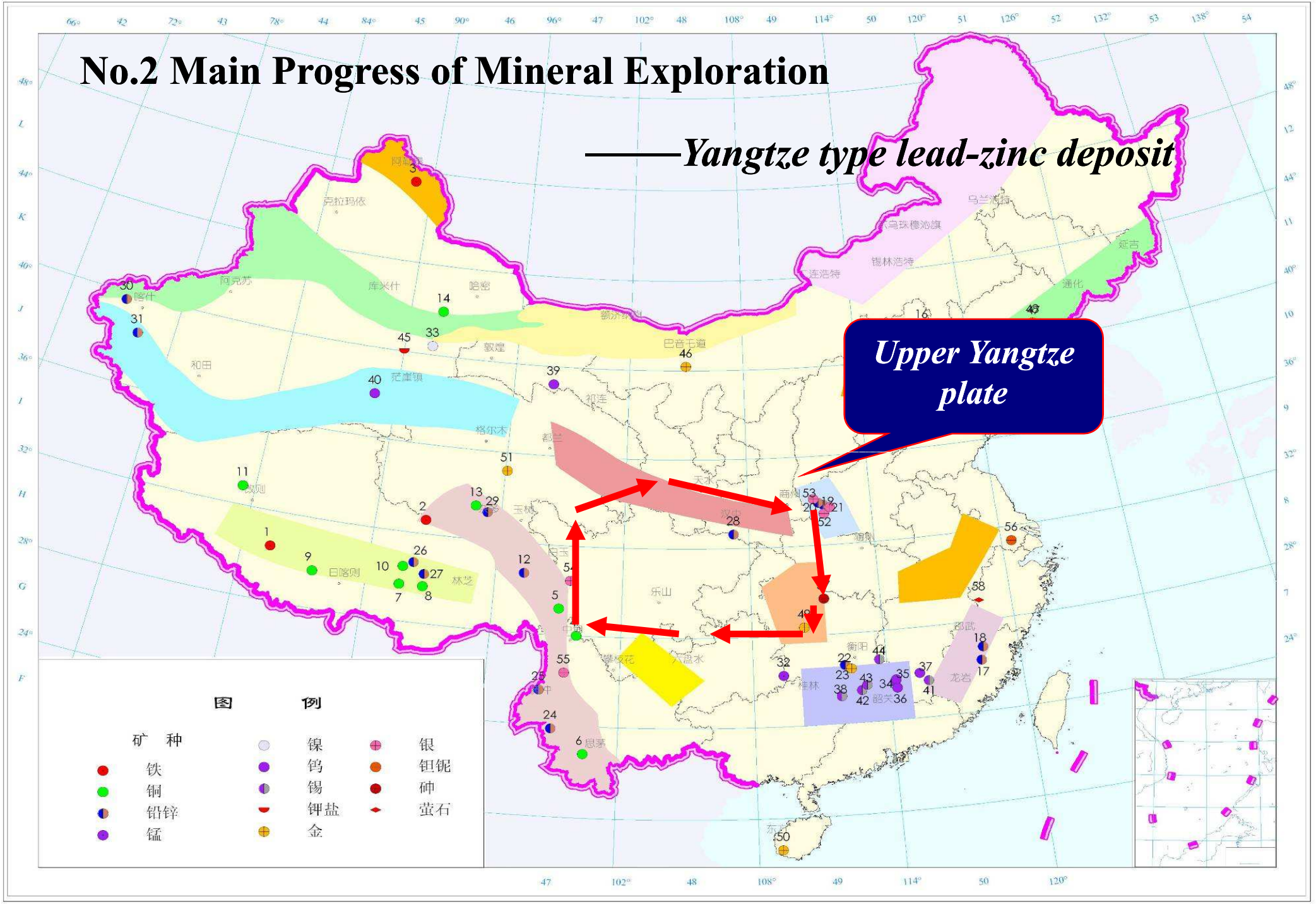


Eastern Tethys Copper Belt

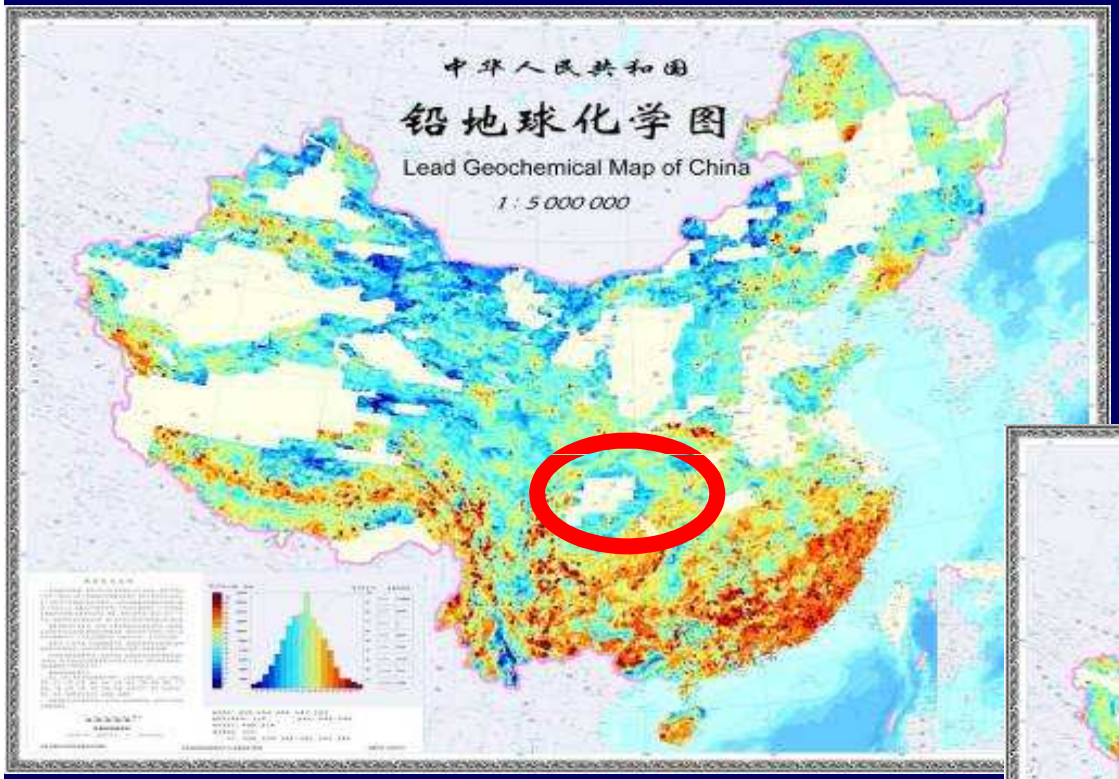
Pulang copper deposit





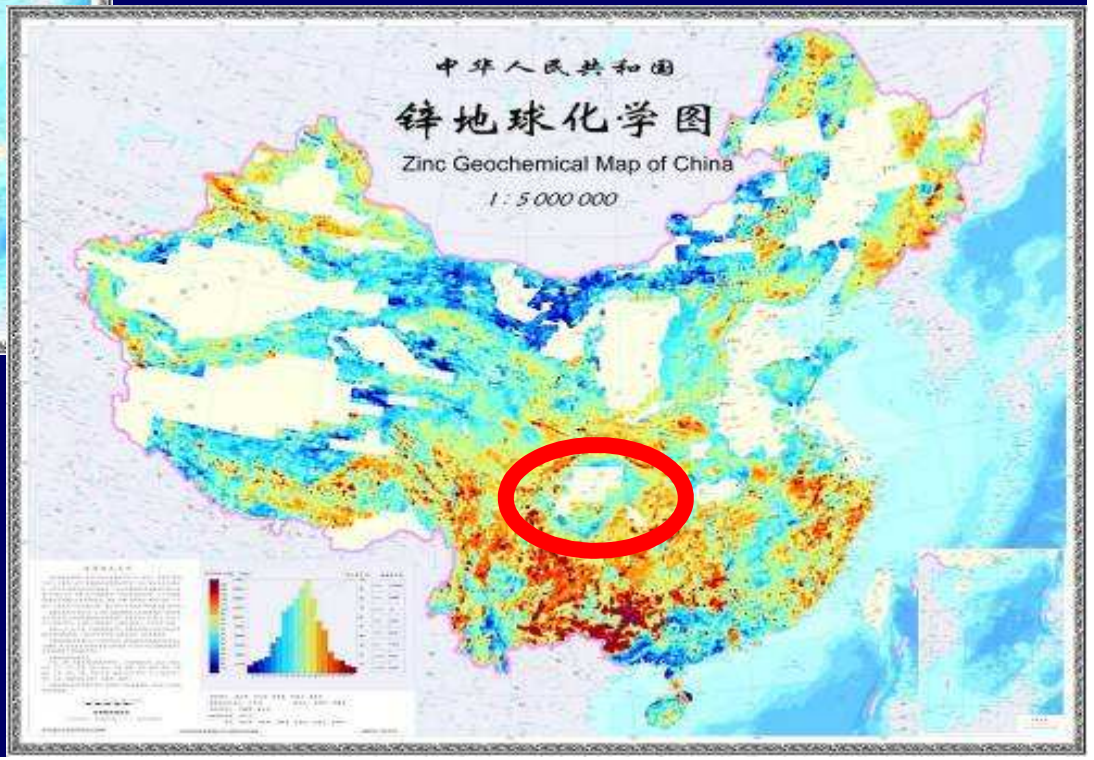

No.2 Main Progress of Mineral Exploration
——Yangtze type lead-zinc deposit
Upper Yangtze plate
图 例
矿 种
铁
铜
铅锌
锰
镍
钨
锡
钾盐
金
银
钼铌
砷
萤石

Upper Yangtze plate



Pb

Zn



Upper Yangtze plate

Yangtze type lead-zinc deposits

No.3 Main Progress of Mineral Exploration

—Luobopo K-salt Deposit:

Luobopo K-salt Deposit

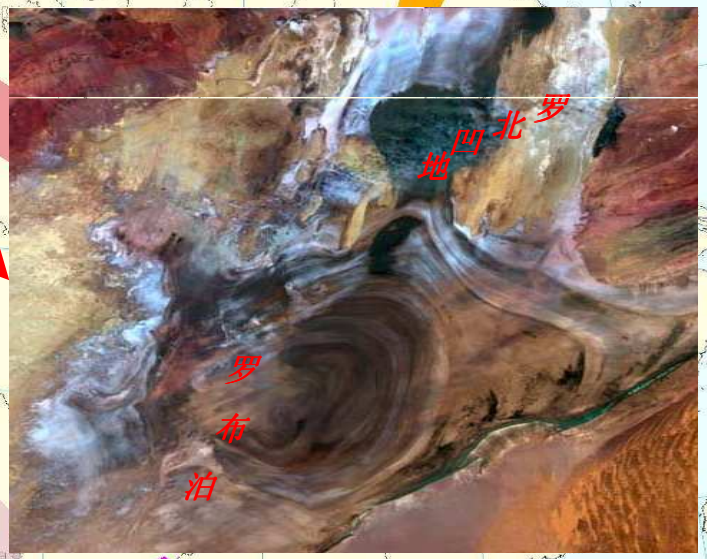


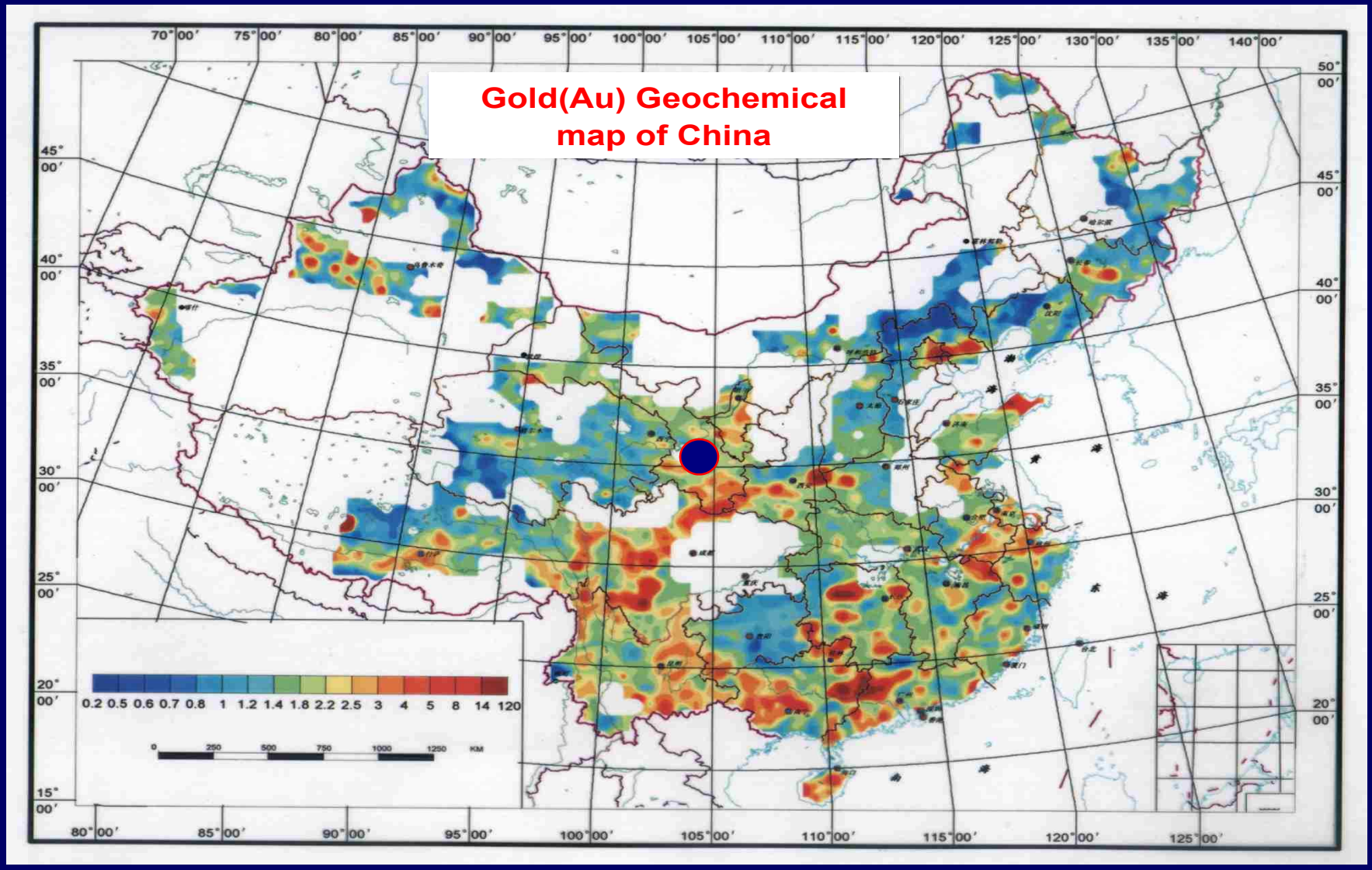
图 例

矿 种

铁
铜
铅锌
锰
镍
钨
锡
钾盐
金
银
钼铌
砷
萤石

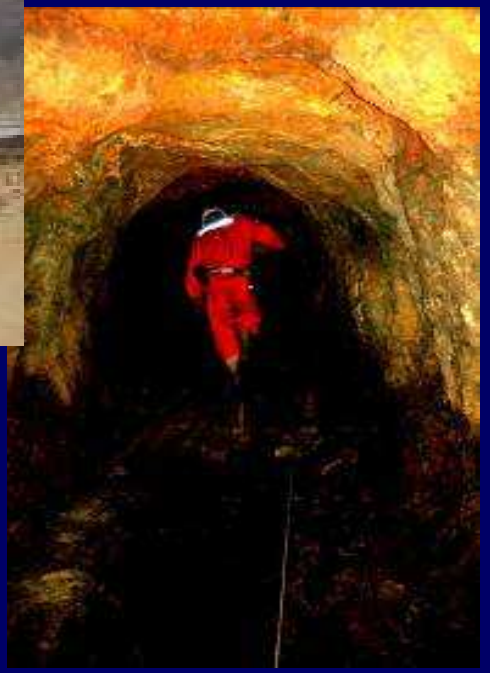
Luobopo K-salt Deposit:

No.4 Main Progress of Mineral Exploration
—Prospecting of Gold deposit



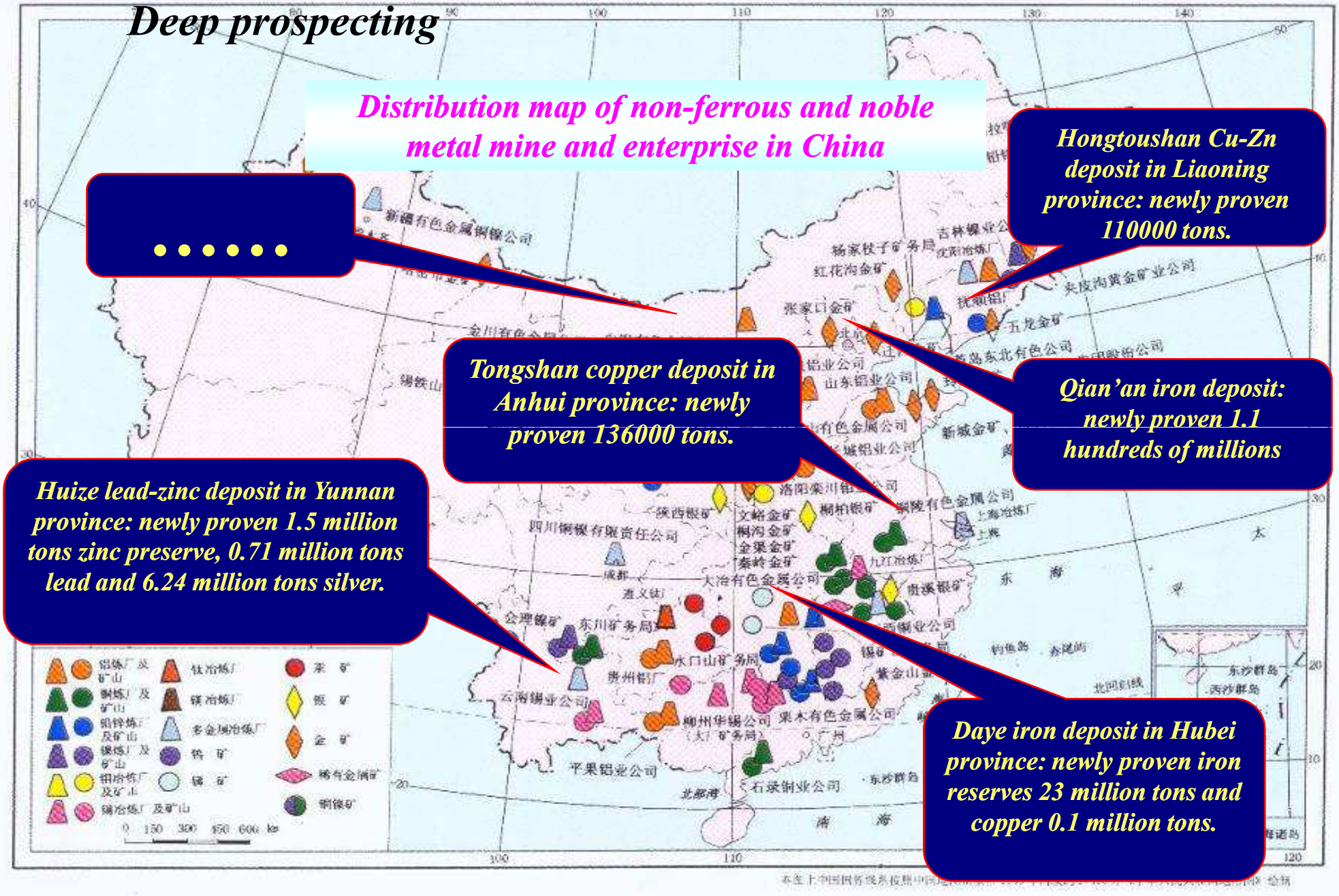
No.5 Main Progress of Mineral Exploration —Deep prospecting

Newly core drilling machine



Deep prospecting

Distribution map of non-ferrous and noble metal mine and enterprise in China



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Hongtoushan Cu-Zn deposit in Liaoning province: newly proven 110000 tons.

Tongshan copper deposit in Anhui province: newly proven 136000 tons.

Qian'an iron deposit: newly proven 1.1 hundreds of millions

Huize lead-zinc deposit in Yunnan province: newly proven 1.5 million tons zinc preserve, 0.71 million tons lead and 6.24 million tons silver.

Daye iron deposit in Hubei province: newly proven iron reserves 23 million tons and copper 0.1 million tons.

No.6 Main Progress of Mineral Exploration —Water exploitation

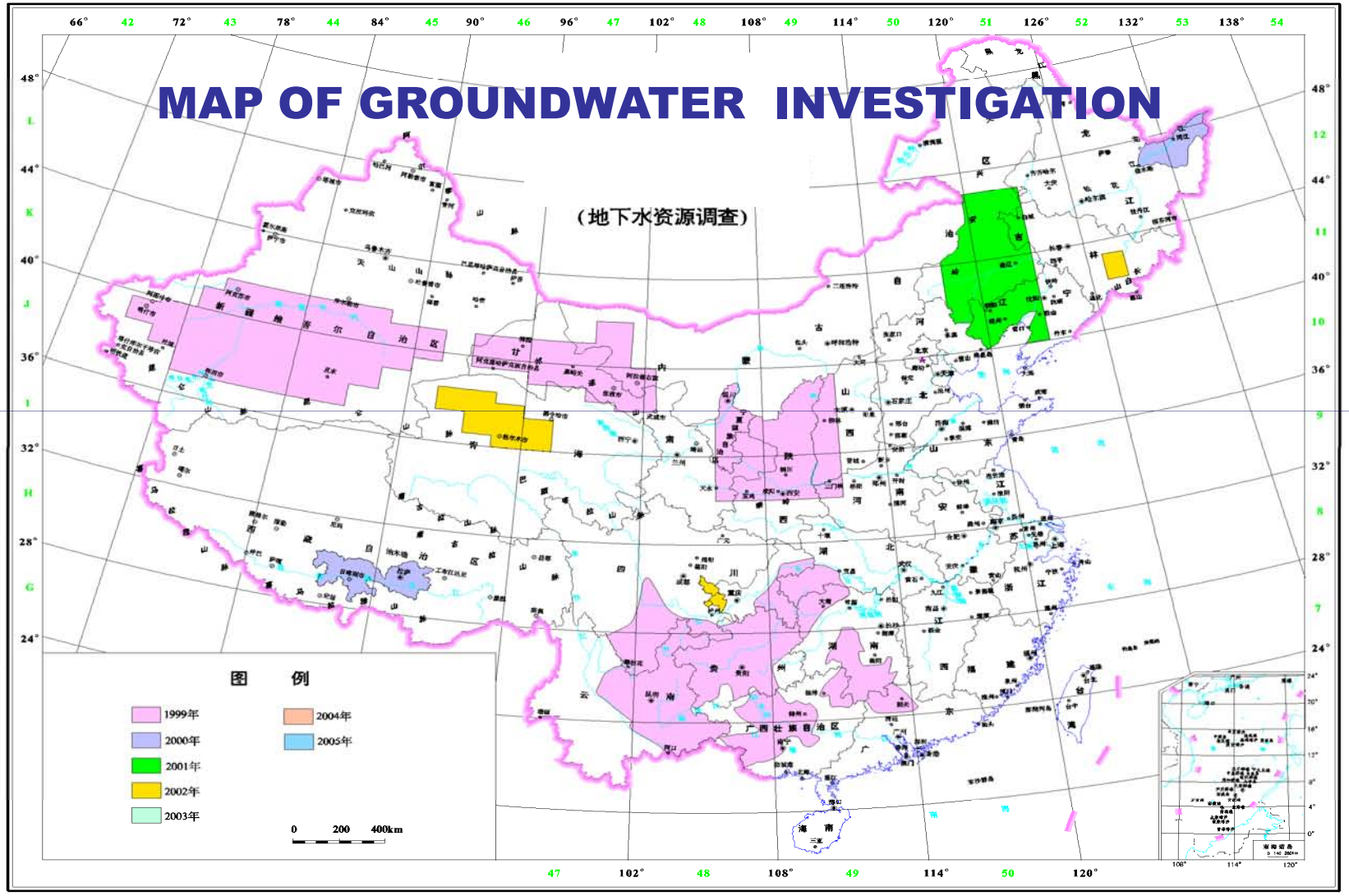
图 例 及 说 明

缺水地区类型

- 黄土高原区
- 内陆盆地山前平原区
- 红层盆地区
- 山地高原区

示范点

- 2001年示范点
- 2002年示范点
- 2003年示范点


MAP OF GROUNDWATER INVESTIGATION
（地下水资源调查）
图 例
1999年
2000年
2001年
2002年
2003年
2004年
2005年
0 200 400km

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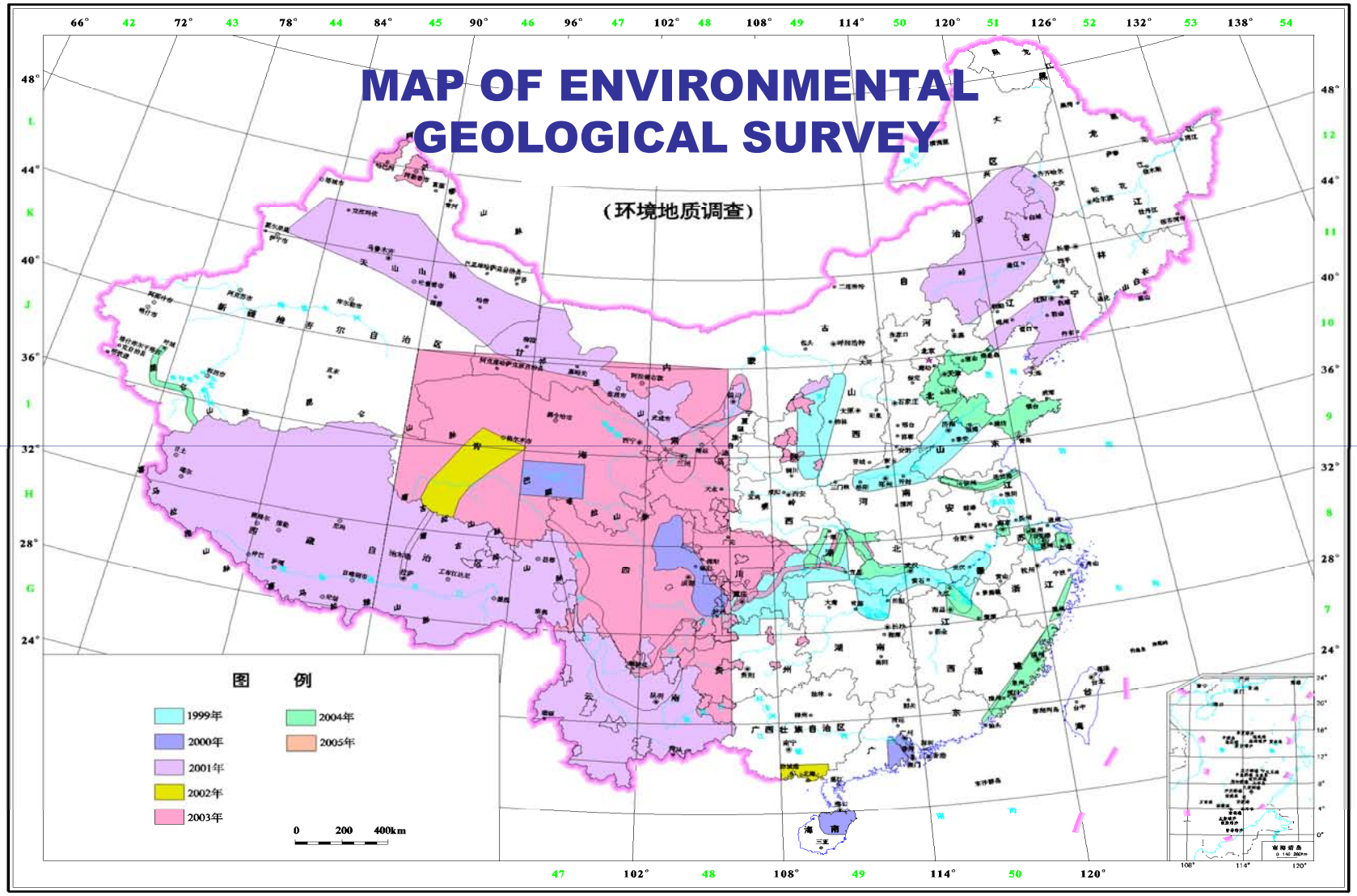
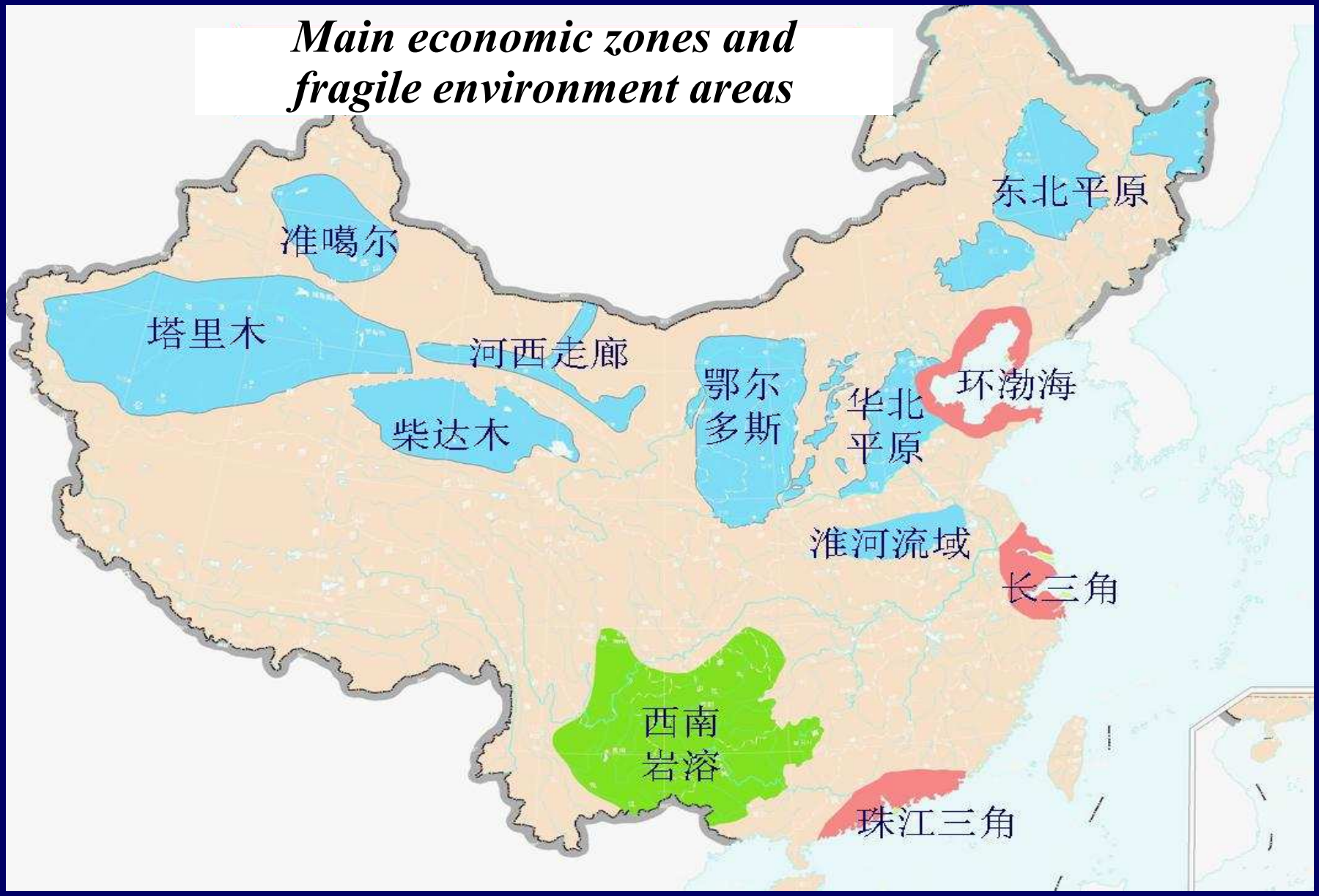
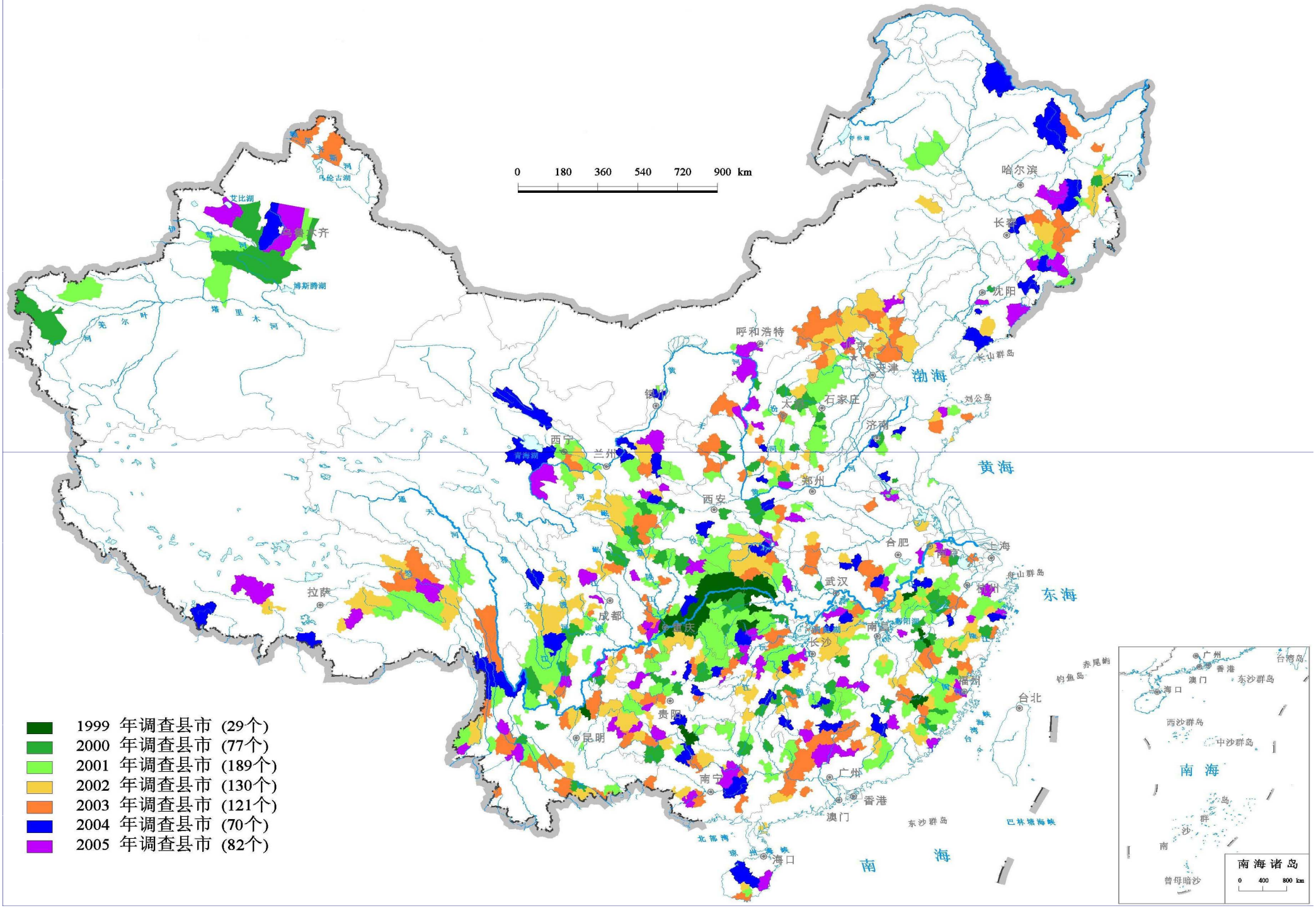
Geo-environmental Investigation and Assessment in the Important Economic Zones and Fragile Environment Areas

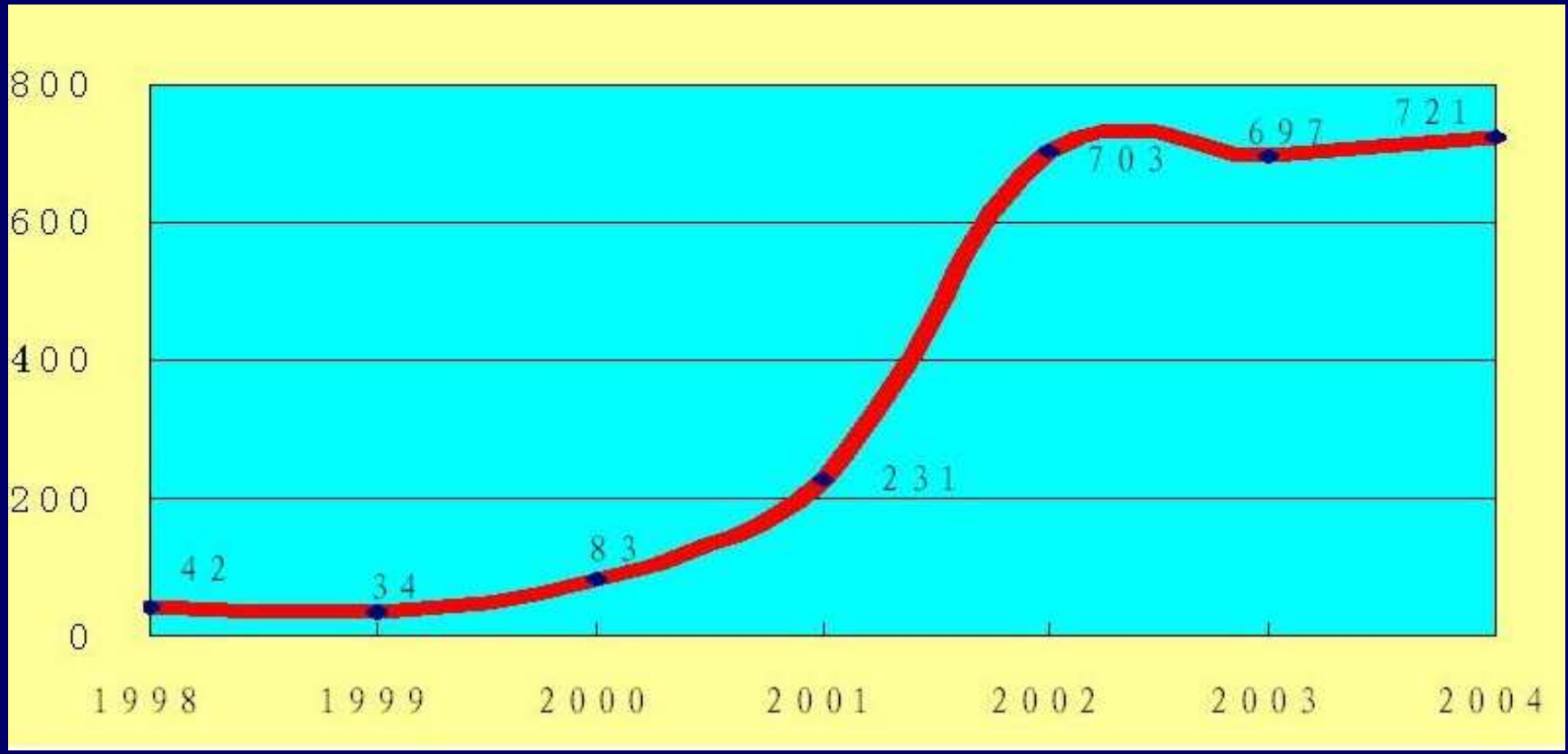
- ✓ ***3 economic zones:*** *Geo-environment investigation and planning;*
- ✓ ***Main plain basins in north China:*** *groundwater dynamic investigation and groundwater pollution investigation;*
- ✓ ***Karst area in southwest China:*** *hydro-geological investigation and rock desertification mitigation;*
- ✓ ***Geo-hazards investigation, monitoring and pre-warning in high risk areas.***


MAP OF ENVIRONMENTAL GEOLOGICAL SURVEY
（环境地质调查）
图 例
1999年
2000年
2001年
2002年
2003年
2004年
2005年
0 200 400km

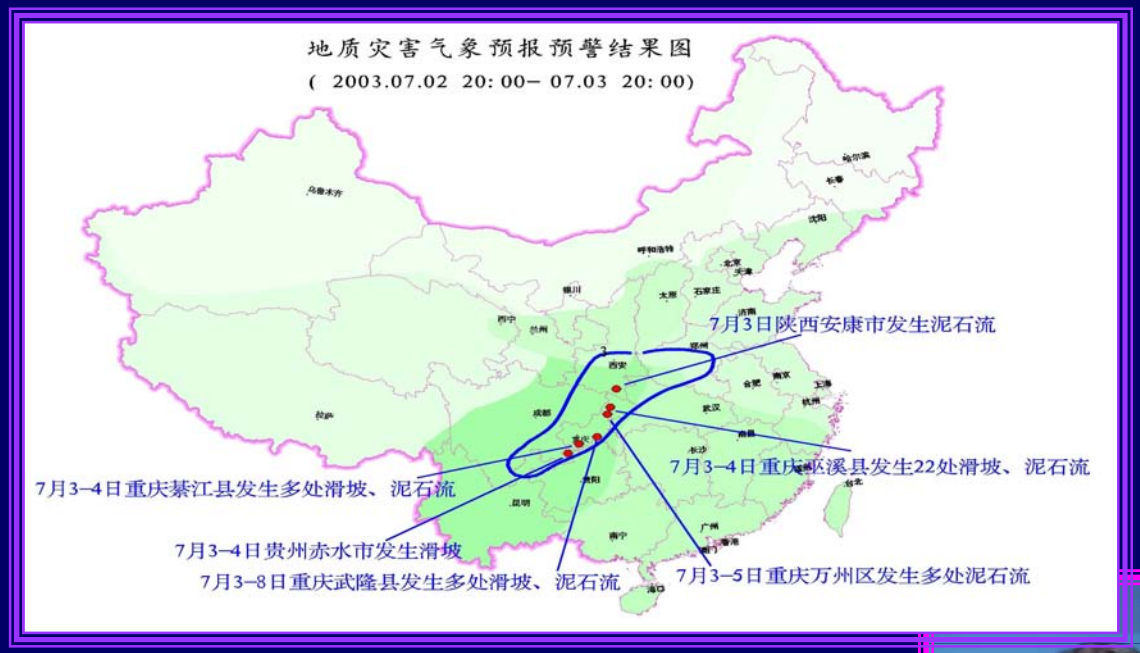

Main economic zones and fragile environment areas
东北平原
淮噶尔
塔里木
河西走廊
柴达木
鄂尔多斯
华北平原
环渤海
淮河流域
长三角
西南岩溶
珠江三角


0 180 360 540 720 900 km
1999 年调查县市 (29个)
2000 年调查县市 (77个)
2001 年调查县市 (189个)
2002 年调查县市 (130个)
2003 年调查县市 (121个)
2004 年调查县市 (70个)
2005 年调查县市 (82个)
哈尔滨
长春
沈阳
呼和浩特
北京
天津
渤海
石家庄
济南
西宁
兰州
郑州
西安
黄海
合肥
上海
武汉
东海
拉萨
成都
重庆
长沙
南京
贵阳
昆明
南宁
广州
香港
澳门
台北
海口
南海
东沙群岛
巴林塘海峡
南海诸岛
0 400 800 km

Successful landslides forecasting

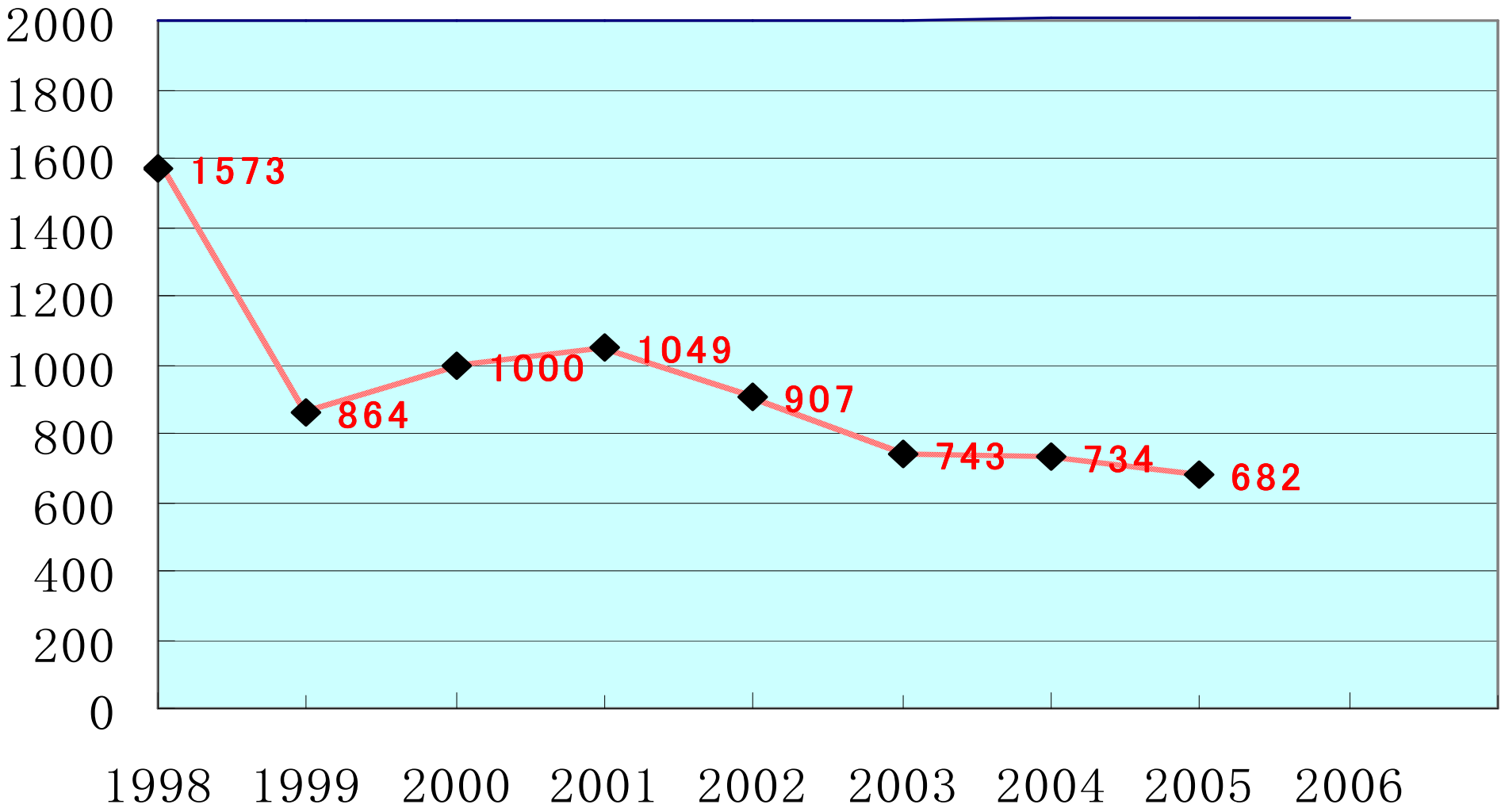


With the data of Geo-hazards census , the annual successful forecasting number of Geo-hazards increased from 34 in 1999 to 721 in 2004.



National prediction system for rainfall-induced landslides

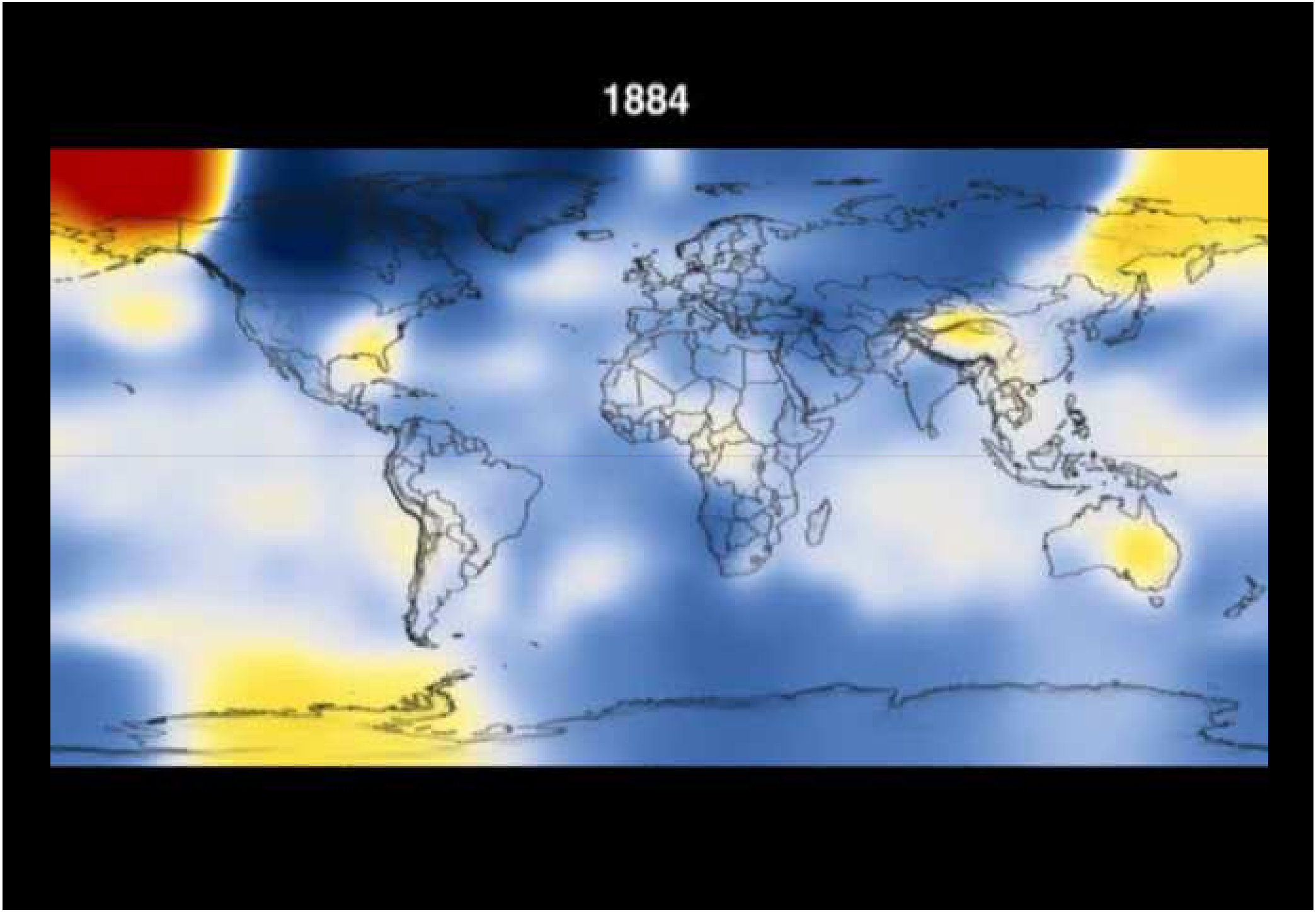
The death toll caused by geo-hazard from 1998 to 2005

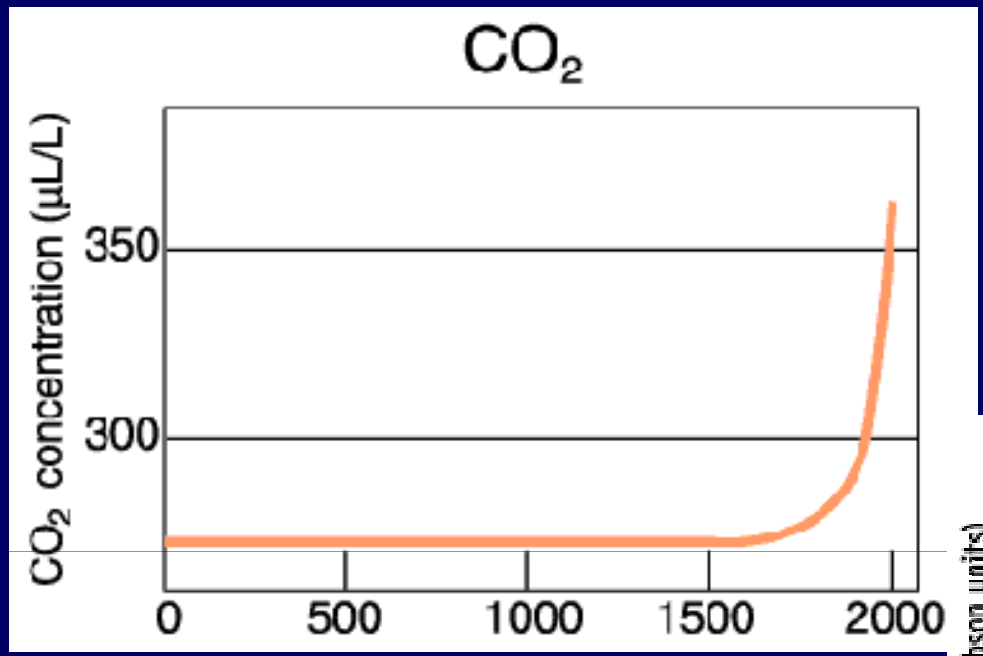


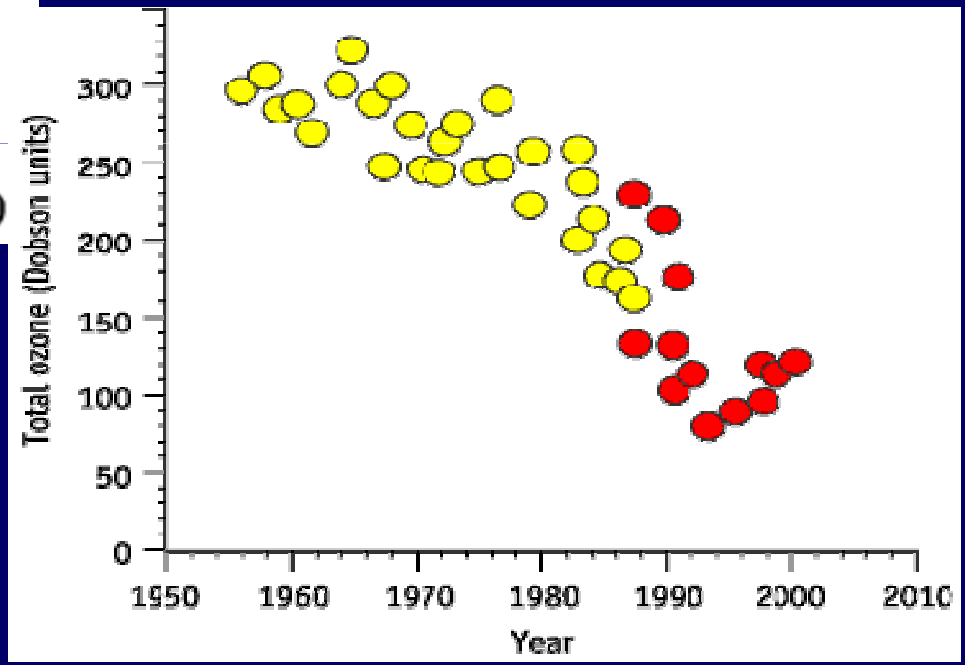
Contents

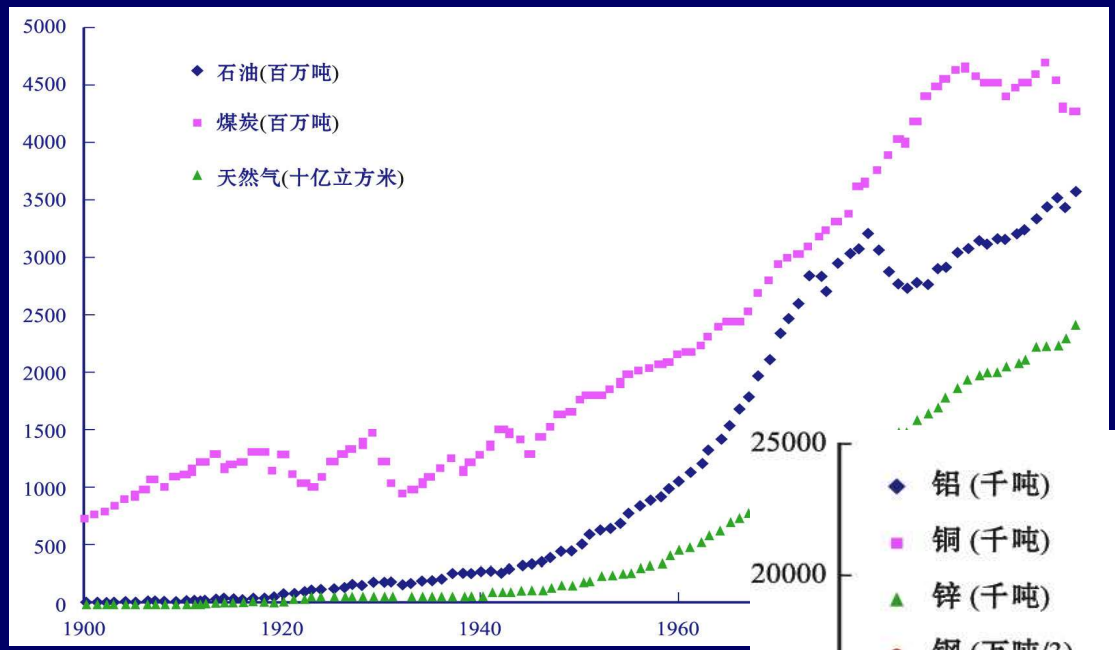
1. The state of mineral resources in China
2. Some major achievements for geo-resources exploration
3. Geo-environmental assessment
4. Some environmental issues

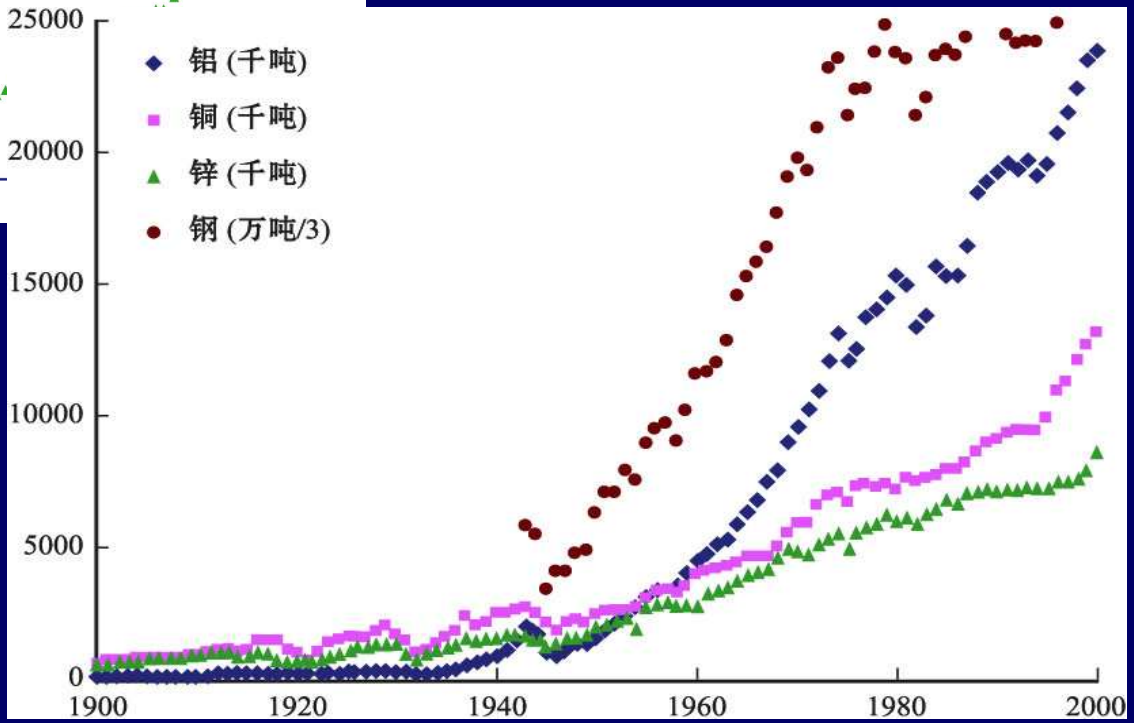
Our common families: Earth


1884


CO_2
CO_2 concentration (µL/L)
350
300
0
500
1000
1500
2000


Total ozone (Dobson units)
300
250
200
150
100
50
0
1950
1960
1970
1980
1990
2000
2010
Year


5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1900
1920
1940
1960
石油(百万吨)
煤炭(百万吨)
天然气(十亿立方米)


25000
20000
15000
10000
5000
0
1900
1920
1940
1960
1980
2000
铝 (千吨)
铜 (千吨)
锌 (千吨)
钢 (万吨/3)

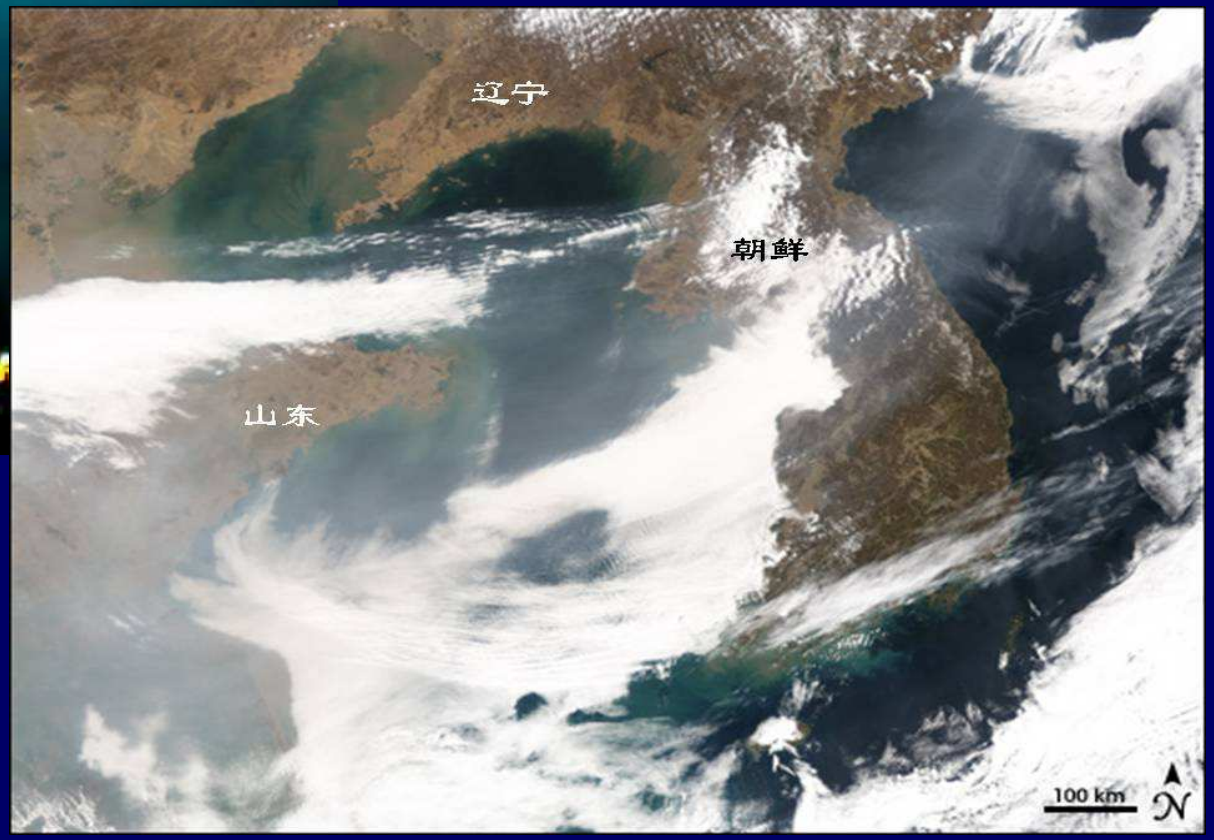
In China, because of the rapid progress of economy, the mineral resources exploration & production & consumption are increasing very fast.


全国地质工作程度系列图
钨矿产分布图
图 例
按矿产规模分类
超大型(3个)
大型(35个)
中型(86个)
小型(206个)
矿点(1483个)
矿化点(54个)
0 125 250 500 750 1000 公里

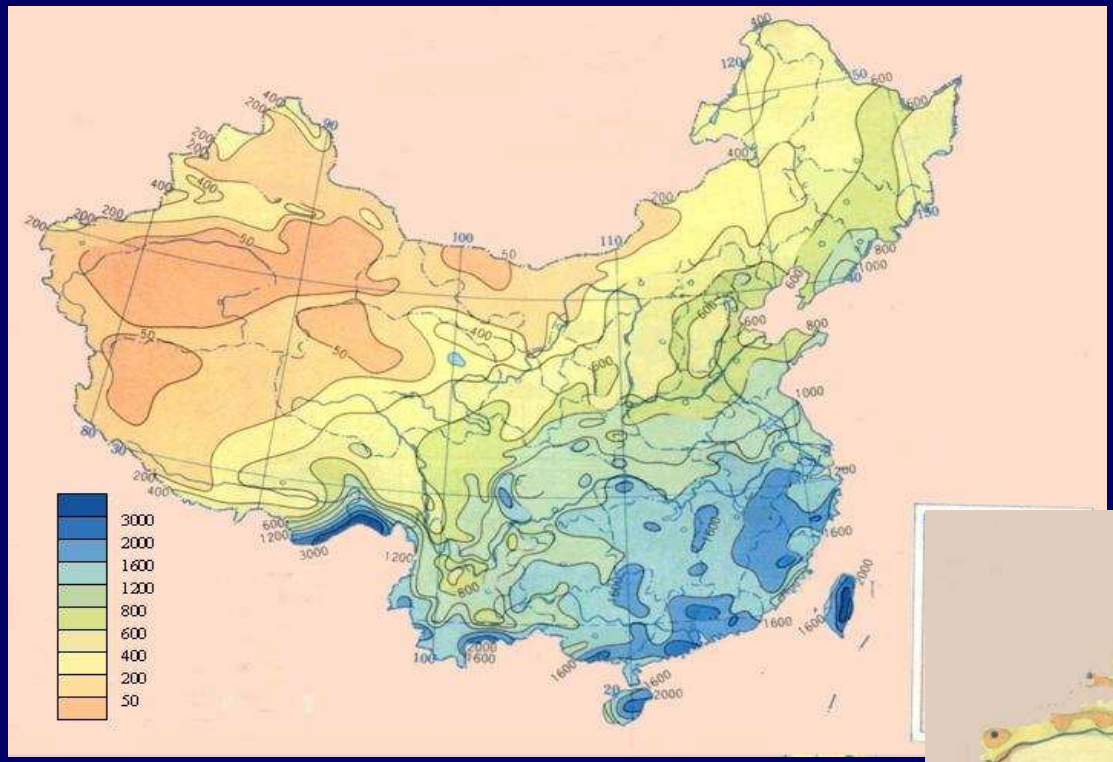
In 2006, the China's GDP accounts of 5.5% of the world total, but consumed 54% cement, and 30% iron, 15% energy resources. Water pollution, air pollution, and acid rain, are very severe.

sandstorm

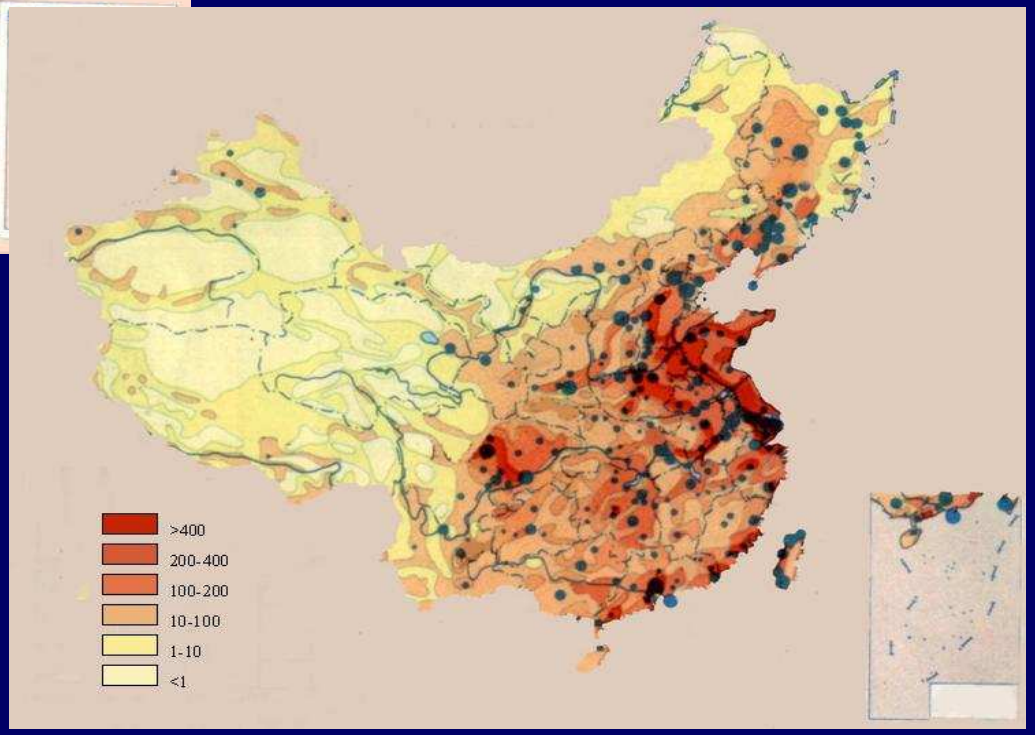
July 13th, 2004, Sand dust attack Gansu province



March 28th, 2005, Sand dust blew from West to East



Water resources



The population density of China

Water pollution

land slide

Grand sink


RITSUMEI
cnsphoto

China's economic growth is realized at an excessively high cost of resources and the environment.

"Geological sciences and geological structures do not end at national boundaries. Working on the same planet, geologists need to communicate and share knowledge with each other, and to draw on each other's experiences."

Quote from speech by Chinese Premier Wen Jiabao
19 June 2007 Episodes, Vol 30, no 2


Thank You!