

# Potential for Discovery of World-class Ore Deposits in China

## 在中国找到世界级金属矿的潜力

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# Main Deposit Types 主要矿床类型



- ◆ Magmatic Cr, Ni-Cu-PGE, Ti-V  
岩浆岩型Cr, Ni-Cu-PGE, Ti-V矿床
- ◆ Porphyry-epithermal Cu-Mo-Au-Ag  
斑岩-浅成热液型Cu-Mo-Au-Ag矿床
- ◆ Skarn Cu-Au-Pb-Zn-Sn 矽卡岩型Cu-Au-Pb-Zn-Sn矿床
- ◆ Volcanogenic massive sulfide (VMS) Cu-Zn-Pb-Au-Ag  
VMS型Cu-Zn-Pb-Au-Ag矿床
- ◆ Sedimentary exhalative (Sedex) Pb-Zn-Cu-Ag-Sn  
Sedex型Pb-Zn-Cu-Ag-Sn矿床
- ◆ Mississippi Valley-type (MVT) Pb-Zn  
MVT型Pb-Zn矿床
- ◆ Sediment-hosted Cu-Pb-Zn-Sb-Hg-Al-Mn-Sr-Ba  
层控型Cu-Pb-Zn-Sb-Hg-Al-Mn-Sr-Ba矿床
- ◆ Orogenic Au-Ag deposits  
造山带型Au-Ag矿床

# Some Important Porphyry Ore Deposits

## 一些重要的斑岩型矿床

### El Teniente, Chile

12,482 Mt @ 0.63% Cu, 0.02% Mo, 0.035 g/t Au (79 Mt Cu, 2.5 Mt Mo, 437 t Au)

### Chuquibambilla, Chile

7,521 Mt @ 0.55% Cu, 0.024% Mo, 0.04g/t Au (41 Mt Cu, 1.8 Mt Mo, 301 t Au)

### Grasberg, Indonesia

2,480 Mt @ 1.13% Cu, 1.05g/t Au (28 Mt Cu, 2,480 t Au)

### Bingham Canyon, USA

3,228 Mt @ 0.88% Cu, 0.02% Mo, 0.50g/t Au (28 Mt Cu, 1,603 t Au)

### Escondida, Chile

2300 Mt @ 1.15% Cu (26.0 Mt Cu)

### Oyu Tolgoi, Mongolia

2,467 Mt @ 0.68% Cu, 0.32g/t Au (16.8 Mt Cu, 790 t Au)

### Kal'makyr, Uzbekistan

2,700 Mt @ 0.40% Cu, 0.51g/t Au (10.8 Mt Cu, 1,374 t Au)

### Batu Hijau, Indonesia

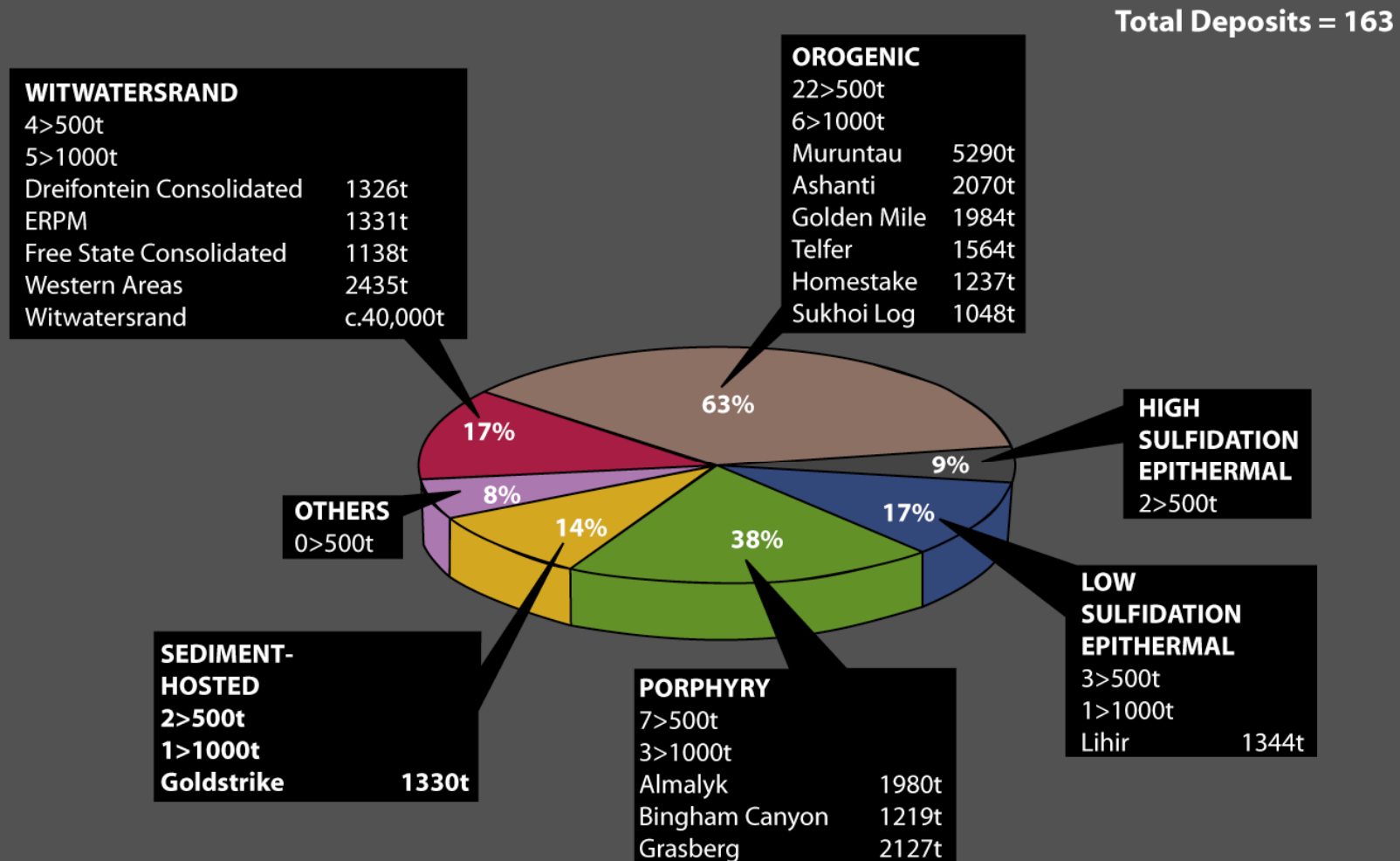
1,644 Mt @ 0.44% Cu, 0.35g/t Au (7.2 Mt Cu, 572 t Au)

### Climax, USA

900 Mt @ 0.24% Mo (2.2 Mt Mo)

# GOLD DEPOSITS (>100t Au)

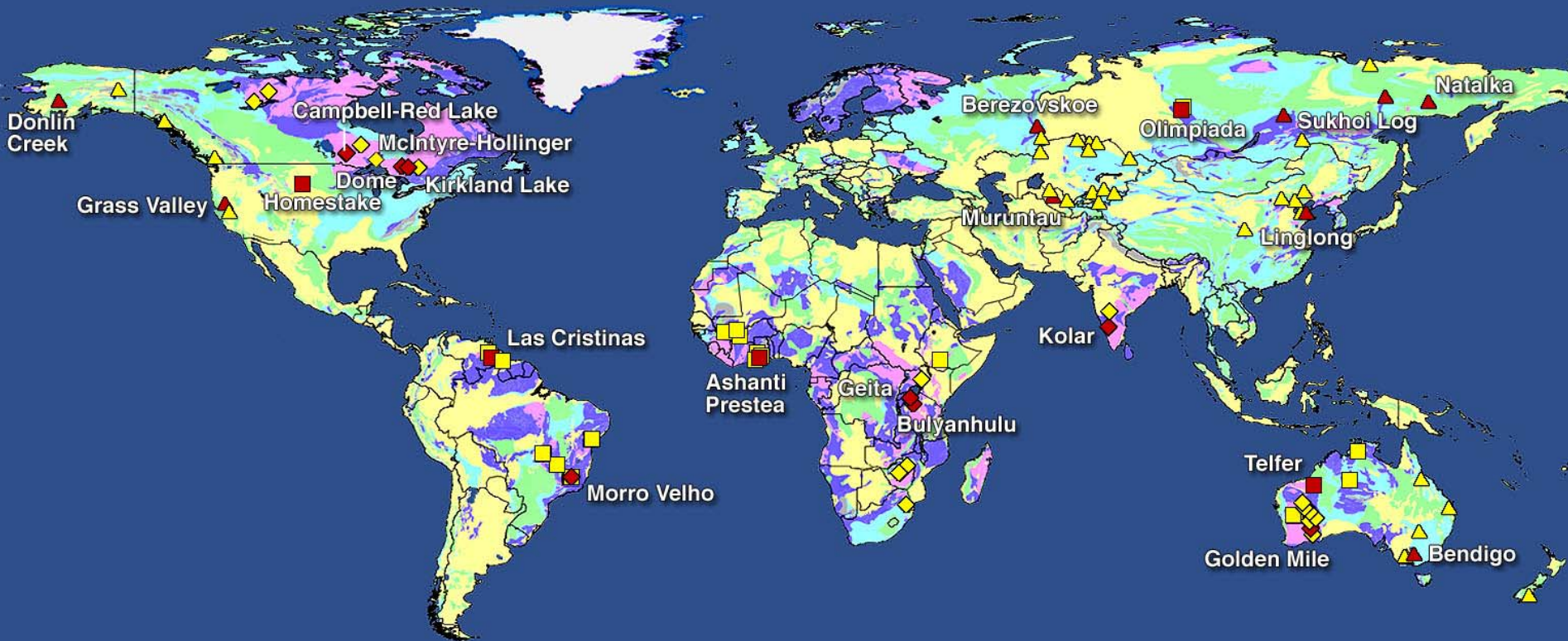
## 金矿床 (>100t Au)



*after R. Foster (2002)*

# Orogenic Gold Giants (from GSC World Gold Database)

## 造山带型大型金矿床



### Legend

#### Lithology

■ Cenozoic	■ Paleozoic	■ Archean	■ Precambrian
■ Mesozoic	■ Proterozoic	■ Phanerozoic	■ Proterozoic-Phanerozoic

#### Deposit Age

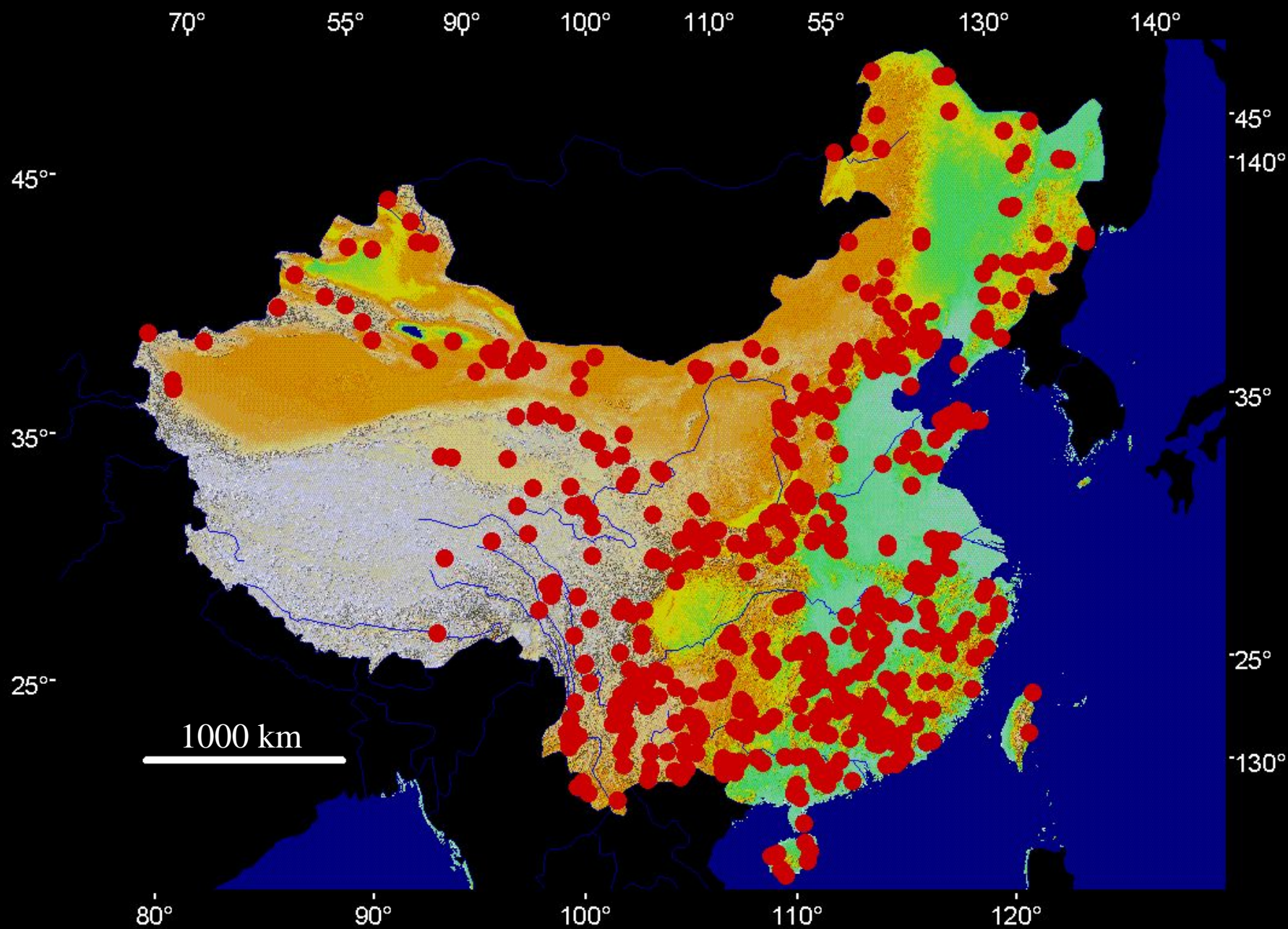
◇ Archean	△ Phanerozoic
□ Proterozoic	

#### Deposit Size

◆ 70t to 499t Au	◆ 500t + Au
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Gosselin and  
Dubé, 2004





# Mineral Resources in China 中国的矿产资源

- ◆ 171 economic minerals with proven reserves being established for 156 commodities  
171个矿种中有156个具有探明储量
- ◆ >200,000 mineral deposits and occurrences including 25,000 sizable and 87 large deposits  
>200,000个矿床和矿产地中，包括25,000个成型矿床和87个大型矿床
- ◆ Abundant W, Sn, Mo, Sb, REE, Nb, Ta, V, Ti, Hg, Li and Be  
丰富的W, Sn, Mo, Sb, REE, Nb, Ta, V, Ti, Hg, Li and Be资源
- ◆ Abundant fluorite, magnesite, mirabilite, gypsum/anhydrite, bentonite, asbestos, talc, graphite, wollastonite and vermiculite  
丰富的萤石，菱镁矿，芒硝，石膏/硬石膏，蒙托石，石棉，滑石，石墨，硅灰石，蛭石等资源
- ◆ Shortage of chromite, PGE, high-grade Cu/Mn/Fe ores, potash, trona and diamond  
缺少铬铁矿，PGE，高品位Cu/Mn/Fe矿，钾盐，天然碱和金刚石

# Mining Industry of China 中国矿业

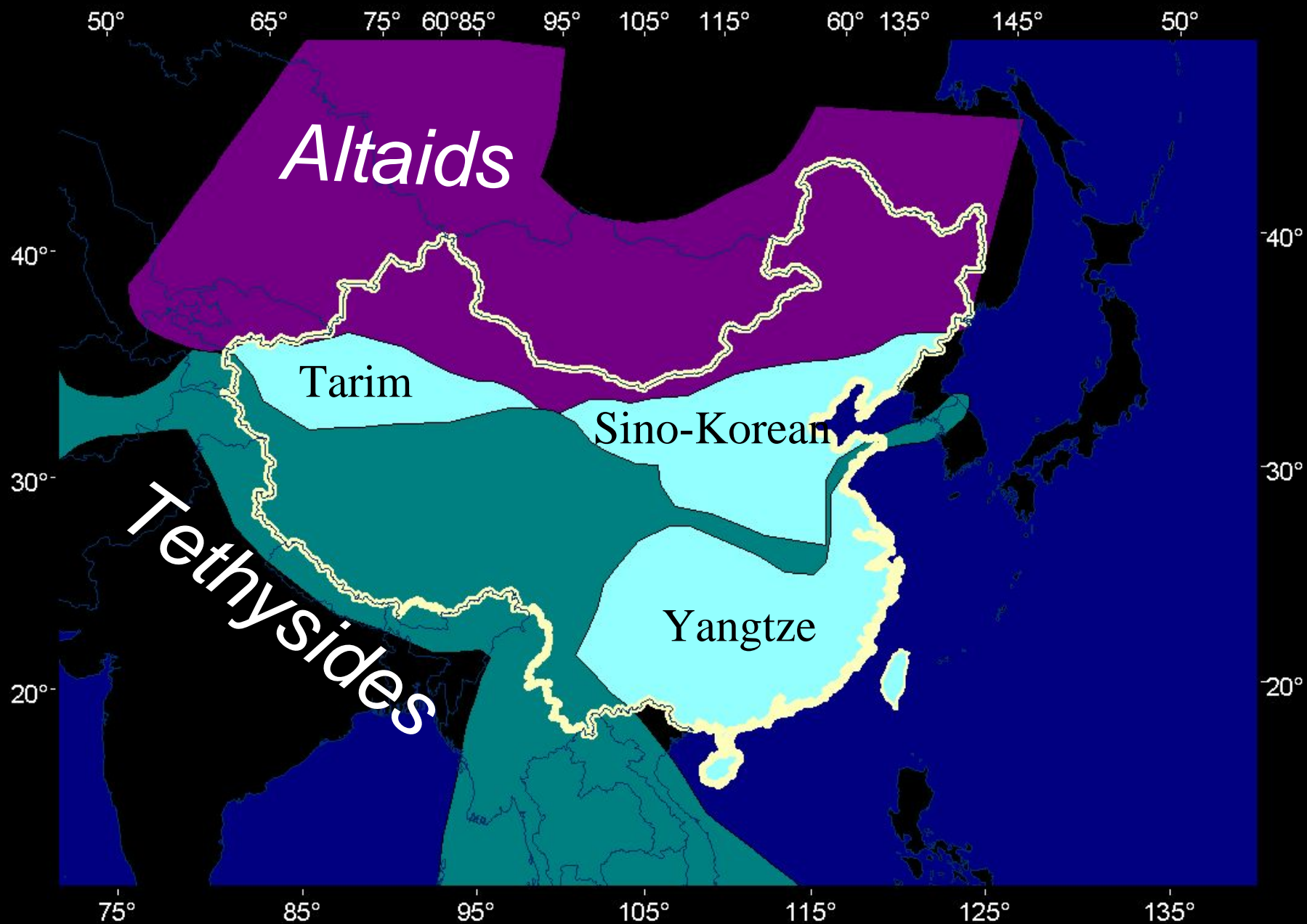


- ◆ China imports >400 million tonnes or 45% iron ore produced in the world  
中国每年进口>4亿吨矿石，相当于45%的世界铁矿石产量
- ◆ 80% of copper supplies rely on imports  
80%的铜依赖进口
- ◆ China spends >US\$40 billion per year importing minerals  
中国每年花高于400亿美元用于进口矿产
- ◆ China produces ~250 t gold, but from >1,000 gold mines  
中国每年产约250吨金，但产金矿山超过1000个
- ◆ 10,300 state-owned mines  
10,300个国有矿山
- ◆ >300,000 collectively-owned and private mines  
>300,000个集体所有制和私人矿山
- ◆ About 21 million people employed  
大约两千一百万矿业从业人员

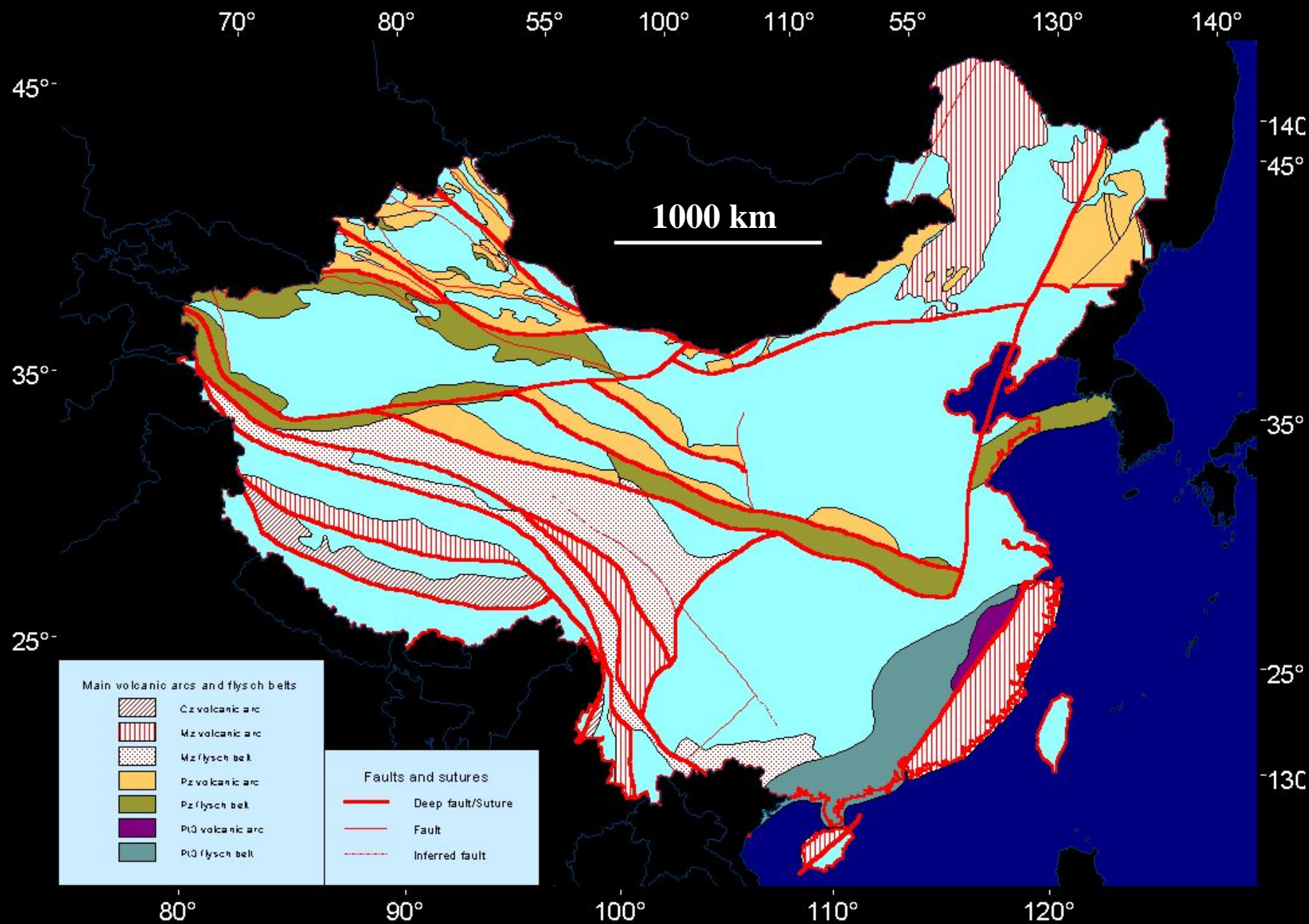


# Geological Database地质数据

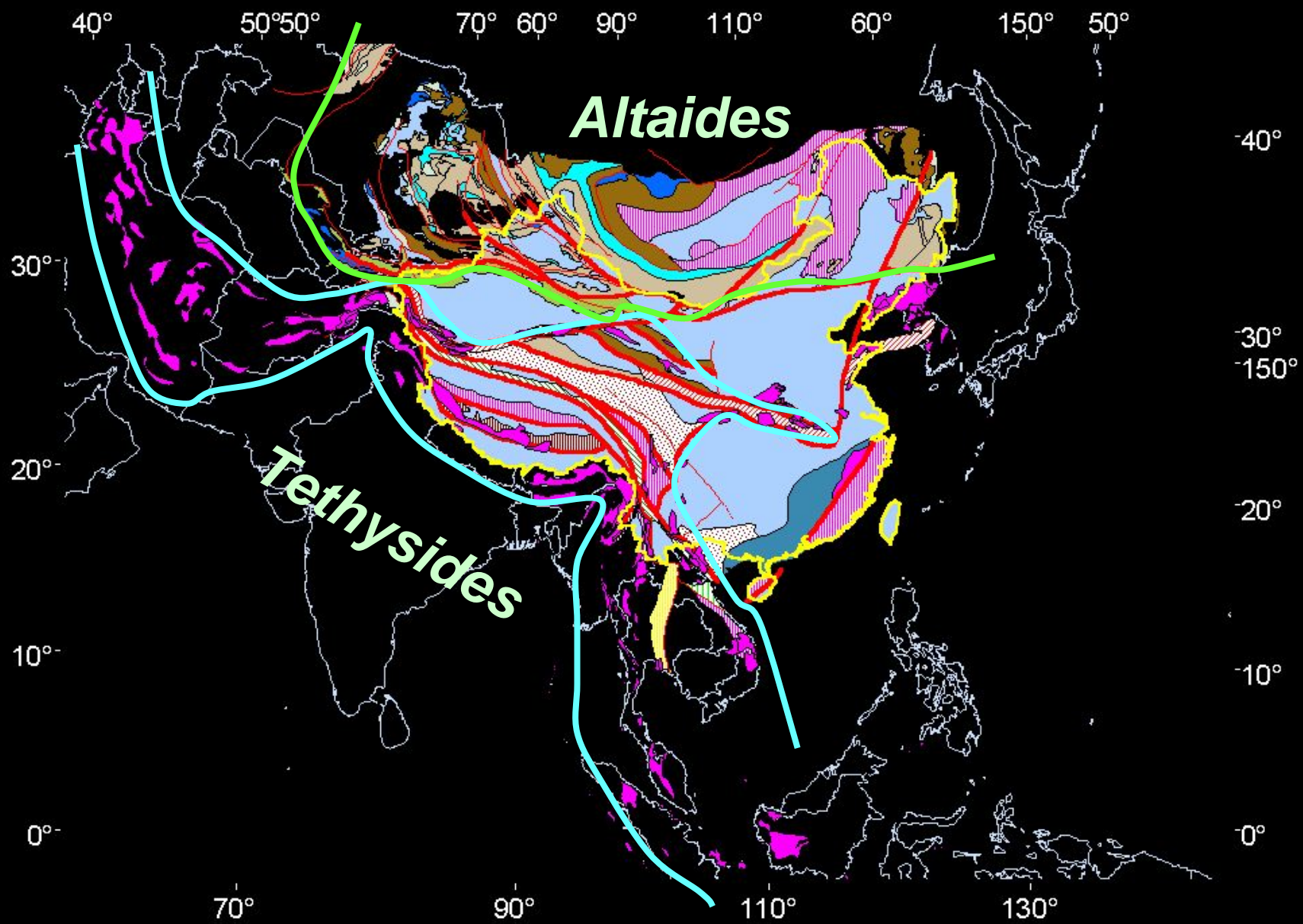
地调项目 Survey Program	覆盖率 Coverage of mainland area
1/1,000,000 geological map	98.7%
1/200,000 geological map	72%
1/50,000 geological map	16%
1/200,000 and 1/500,000 geochemical survey	65%
1/1,000,000 gravity survey	73%
1/200,000 gravity survey	31%
Airborne survey	97%
Remote sensing survey	16%



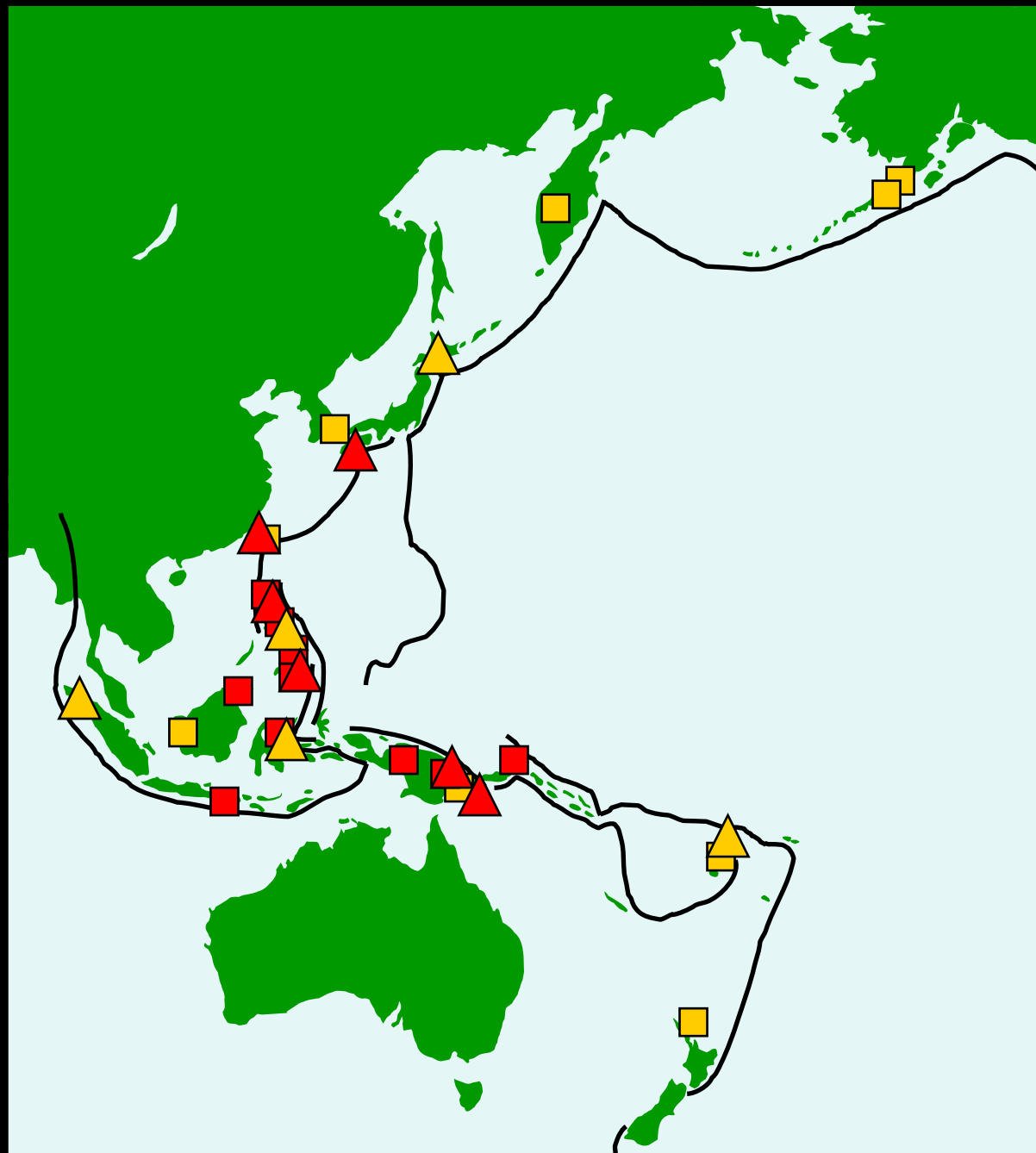












# PORPHYRY COPPER DEPOSITS

斑岩铜矿

■ BIG

■ LITTLE

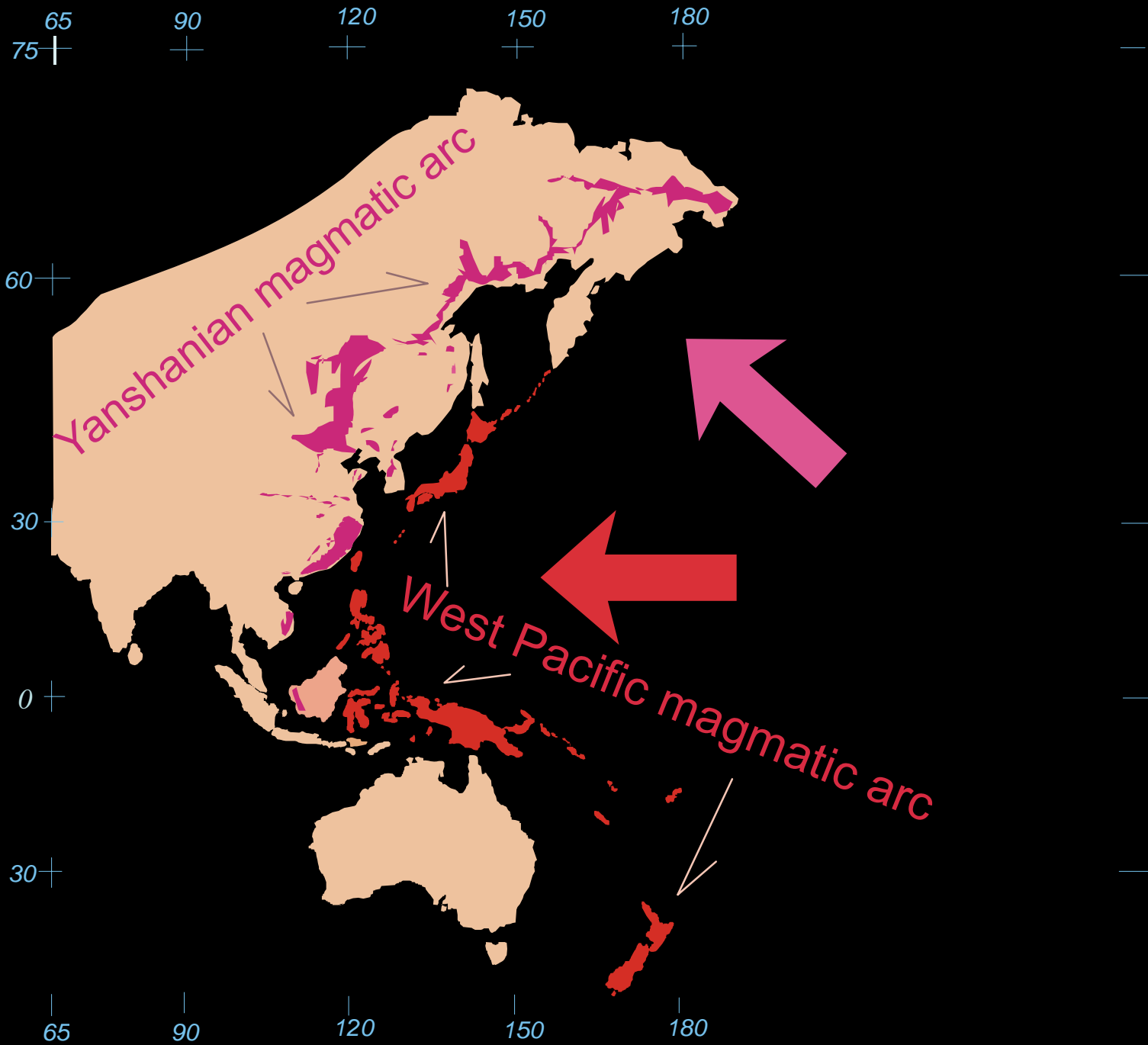
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# HIGH SULFIDATION GOLD DEPOSITS

高硫金矿

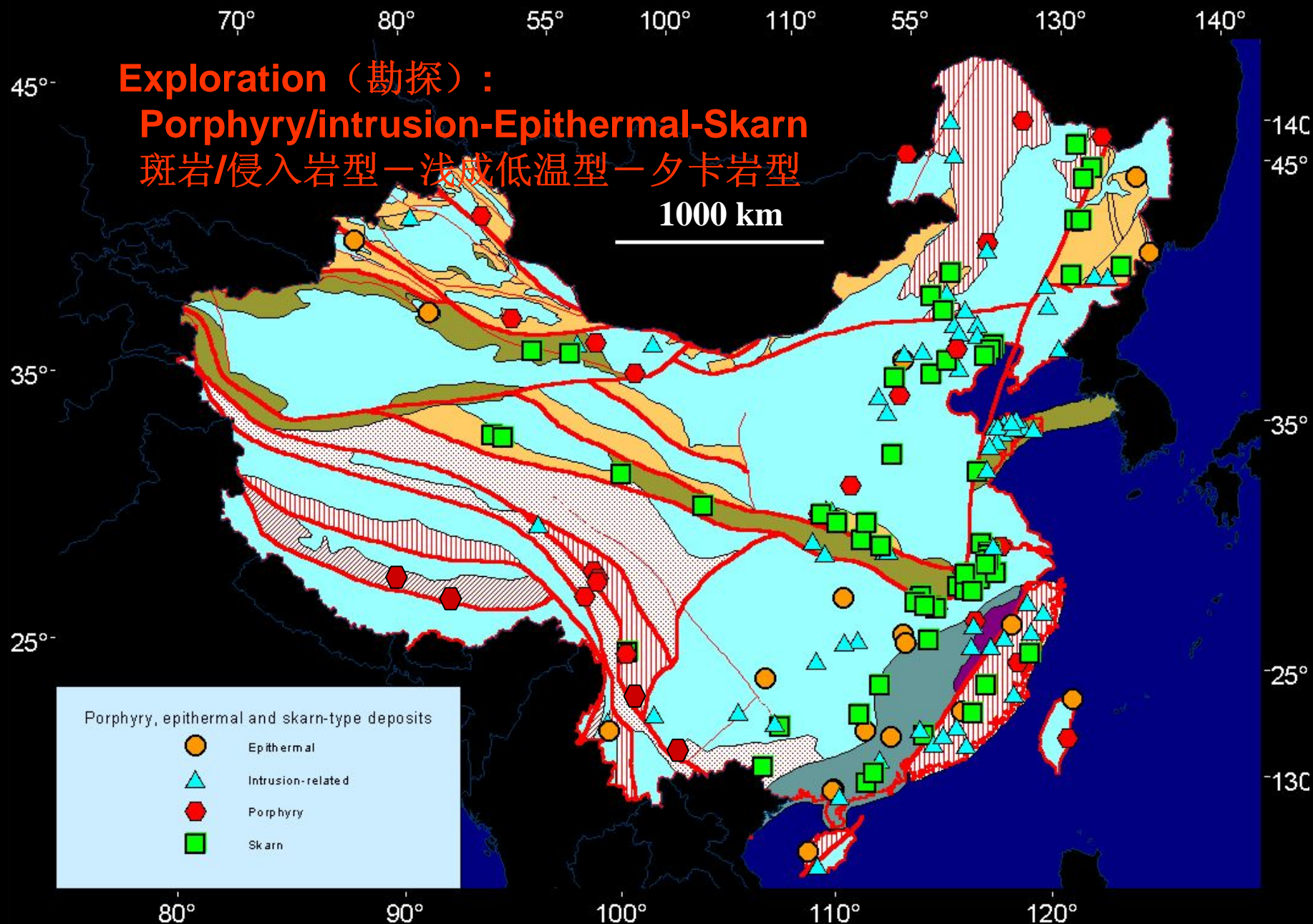
▲ BIG

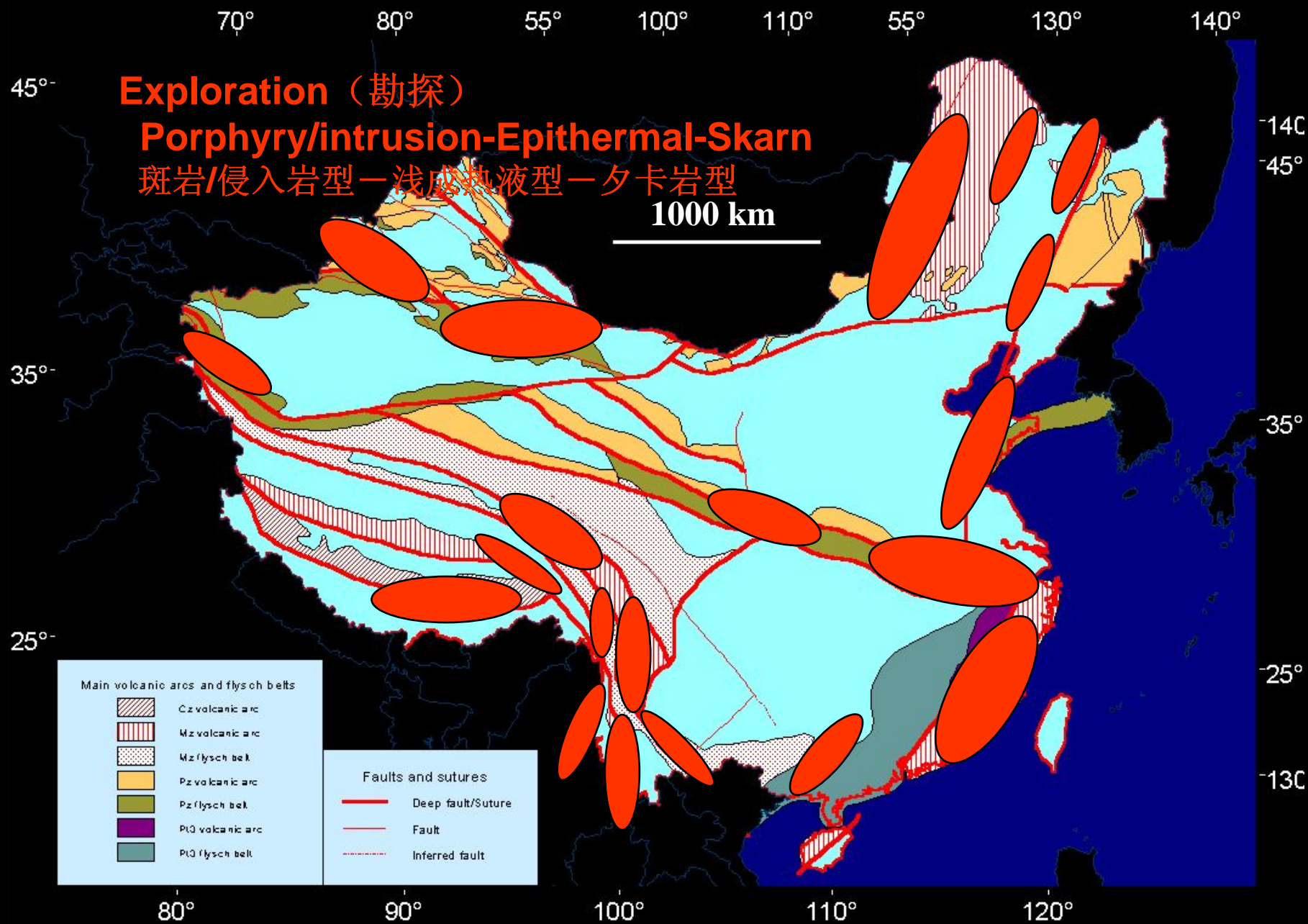
▲ LITTLE



**Exploration (勘探):**  
**Porphyry/intrusion-Epithermal-Skarn**  
斑岩/侵入岩型—浅成低温型—夕卡岩型

1000 km





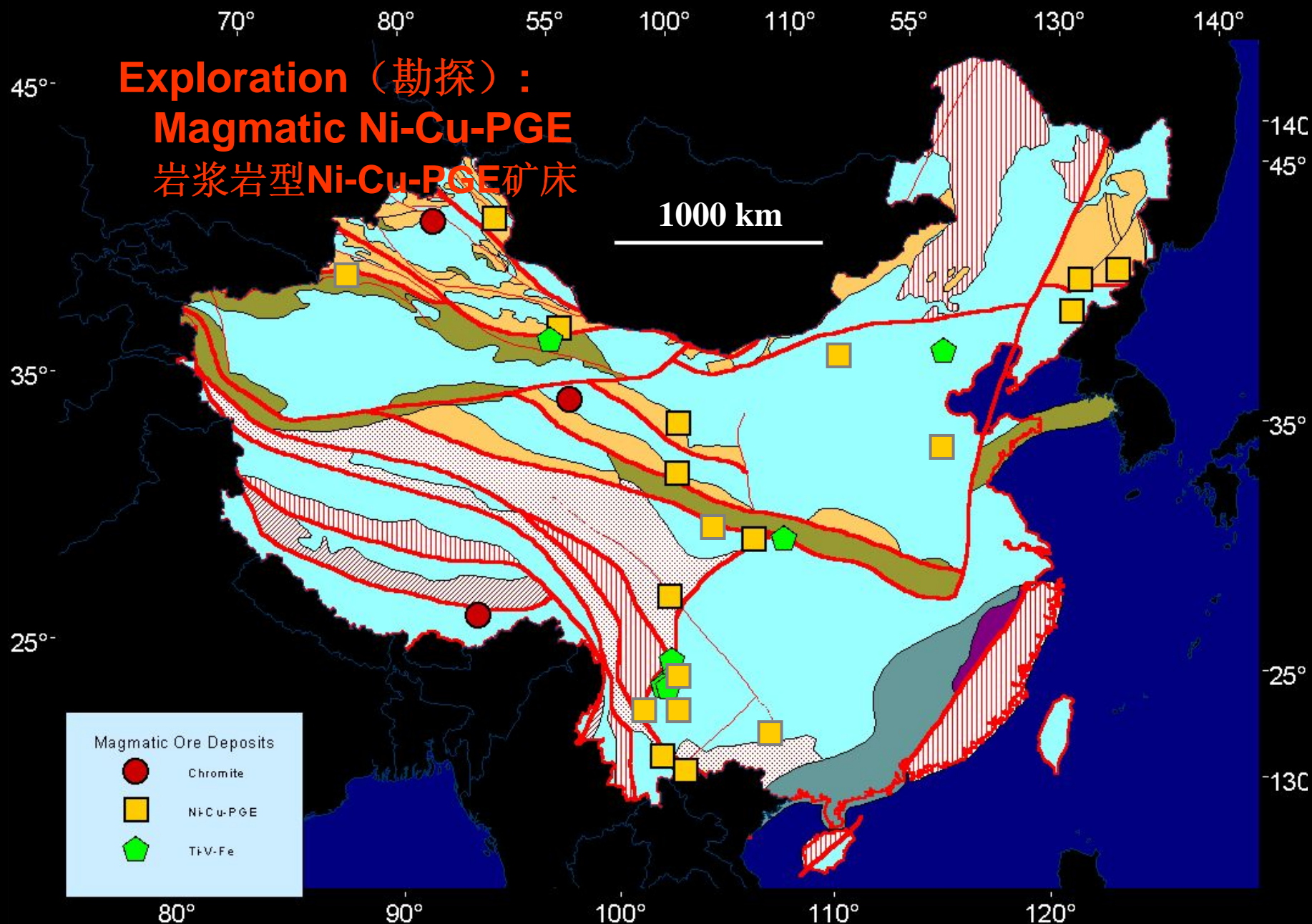


**Exploration (勘探):**  
**Magmatic Ni-Cu-PGE**  
岩浆岩型Ni-Cu-PGE矿床

1000 km

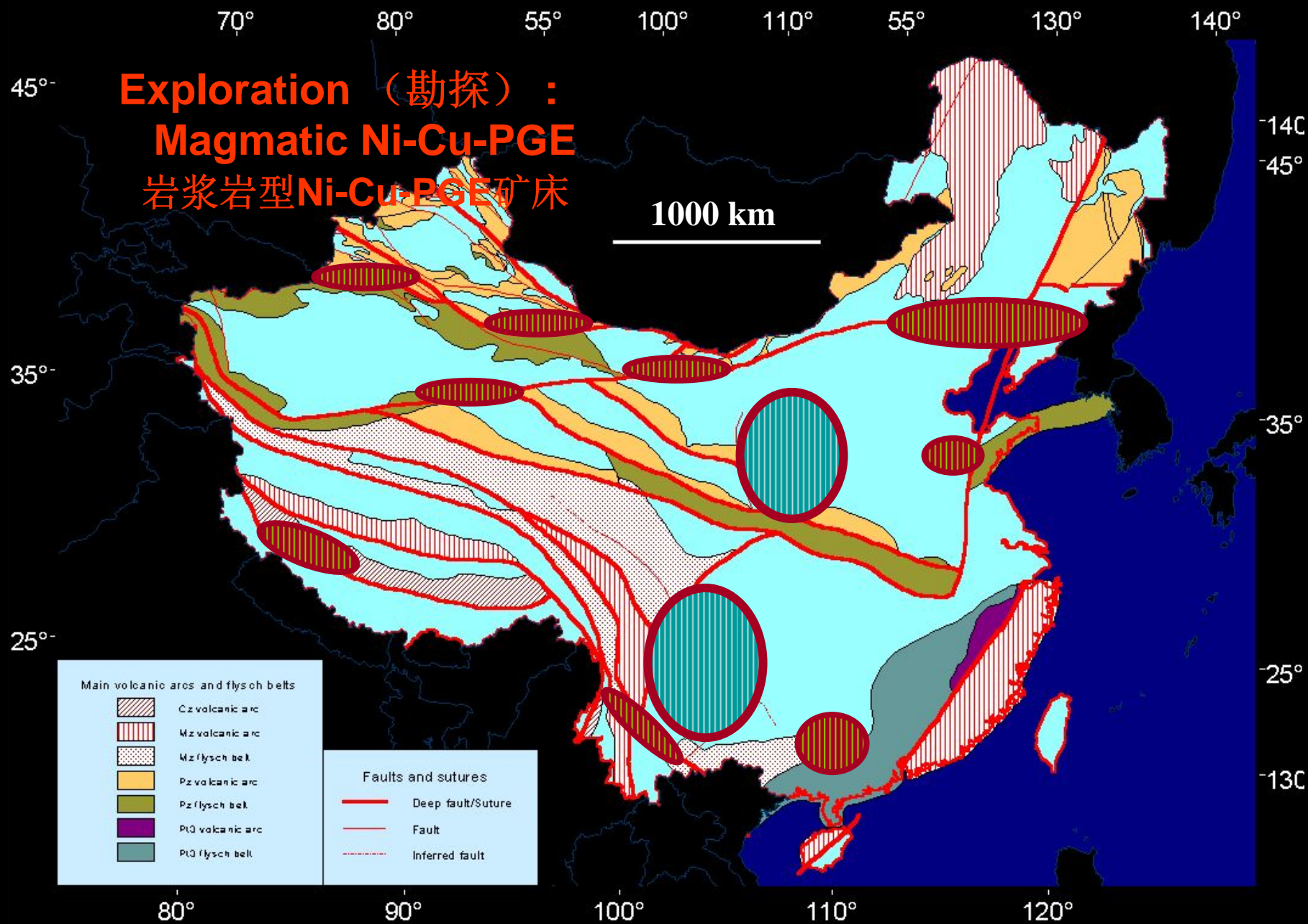
Magmatic Ore Deposits

- Chromite
- Ni-Cu-PGE
- ◆ Ti-V-Fe

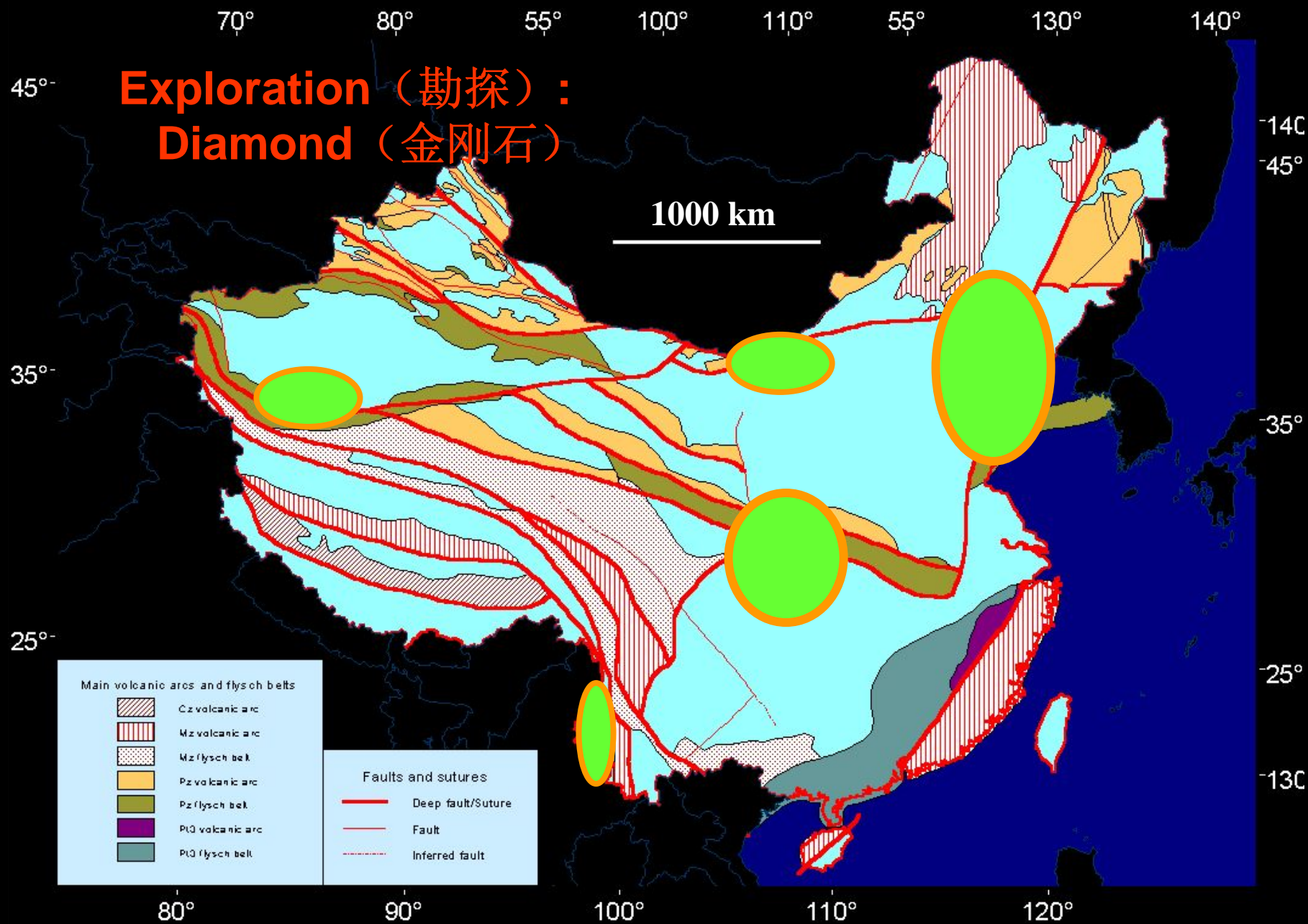




# Exploration (勘探): Magmatic Ni-Cu-PGE 岩浆岩型Ni-Cu-PGE矿床

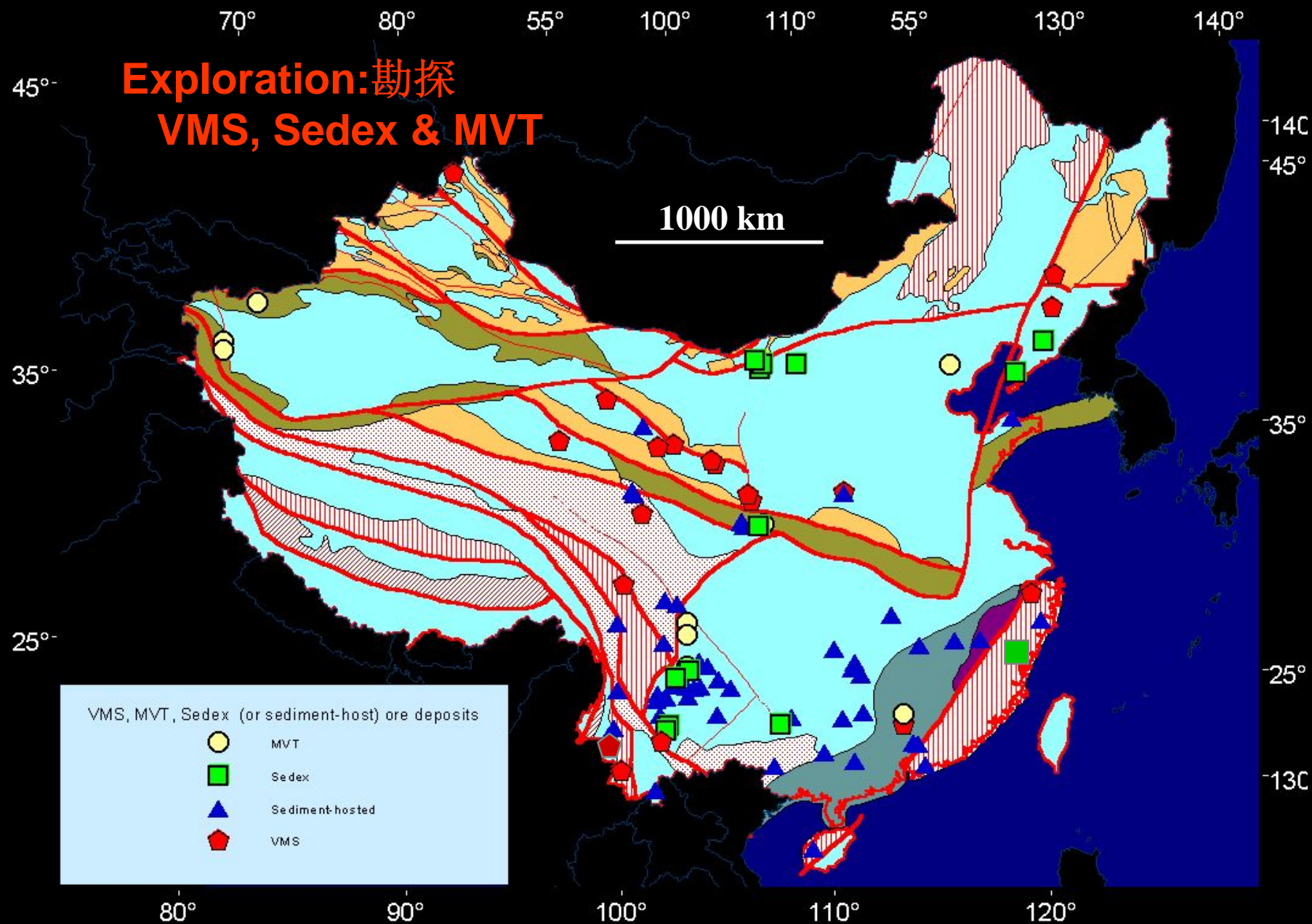


# Exploration (勘探): Diamond (金刚石)

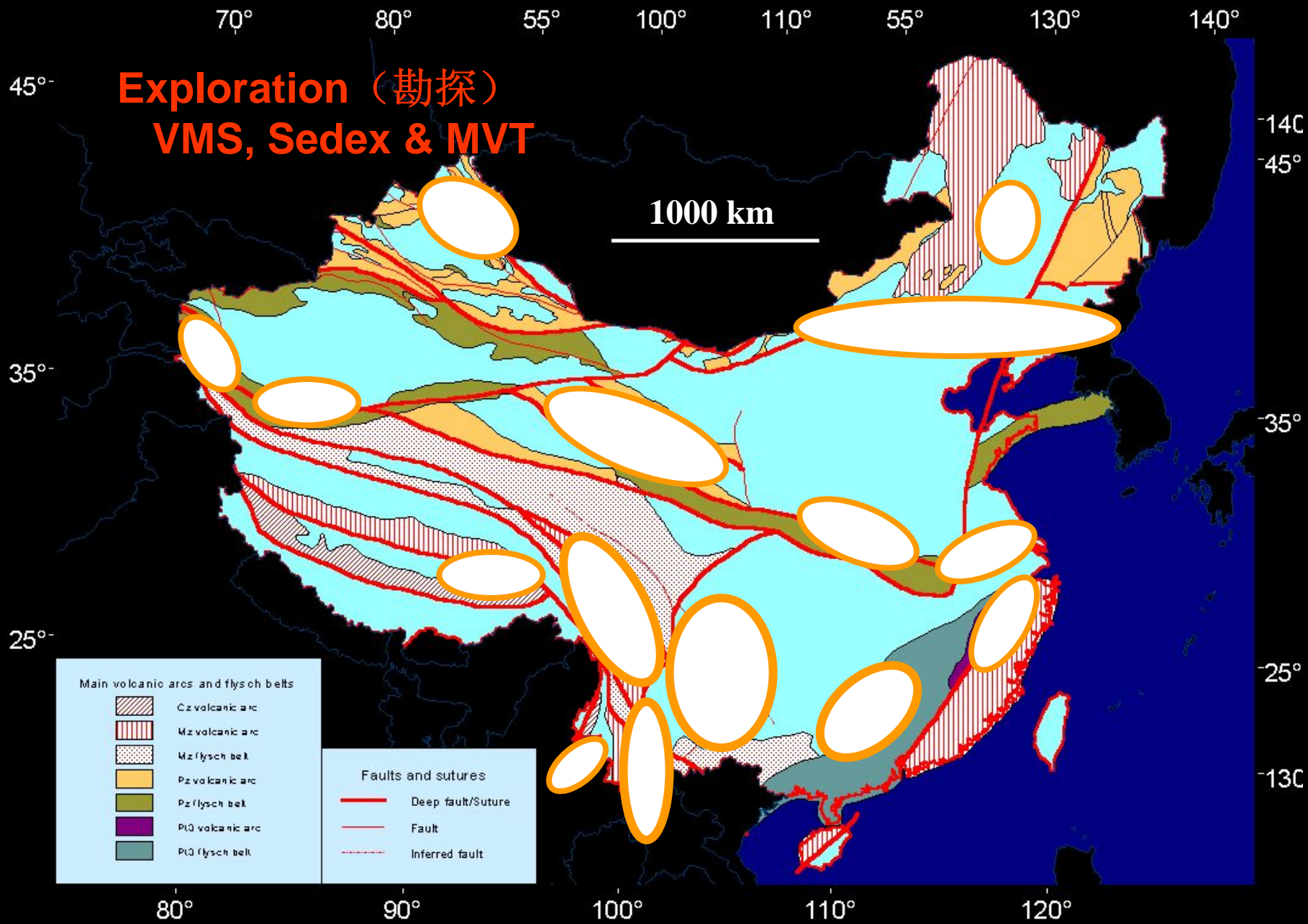




# Exploration: 勘探 VMS, Sedex & MVT



# VMS, Sedex & MVT



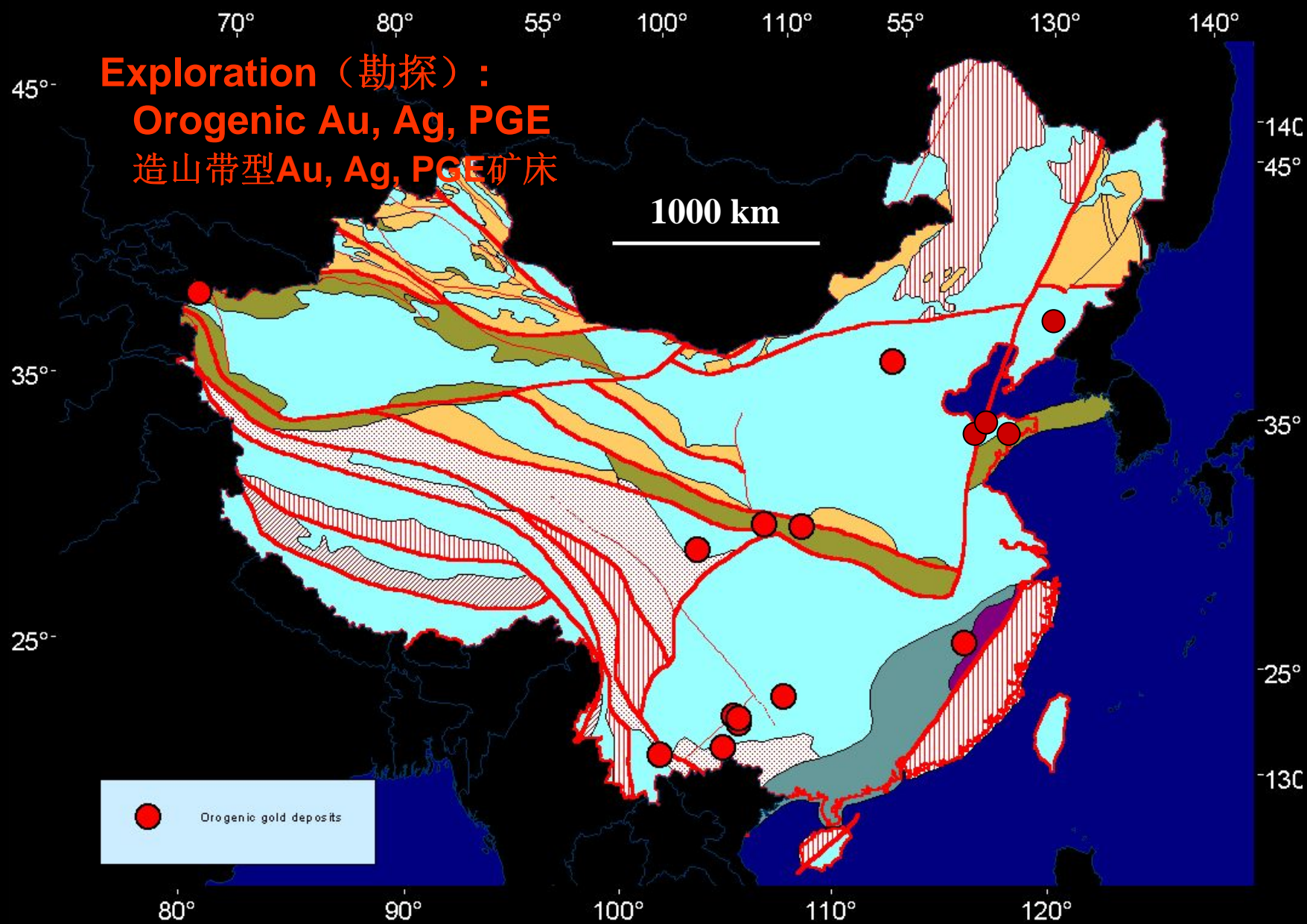


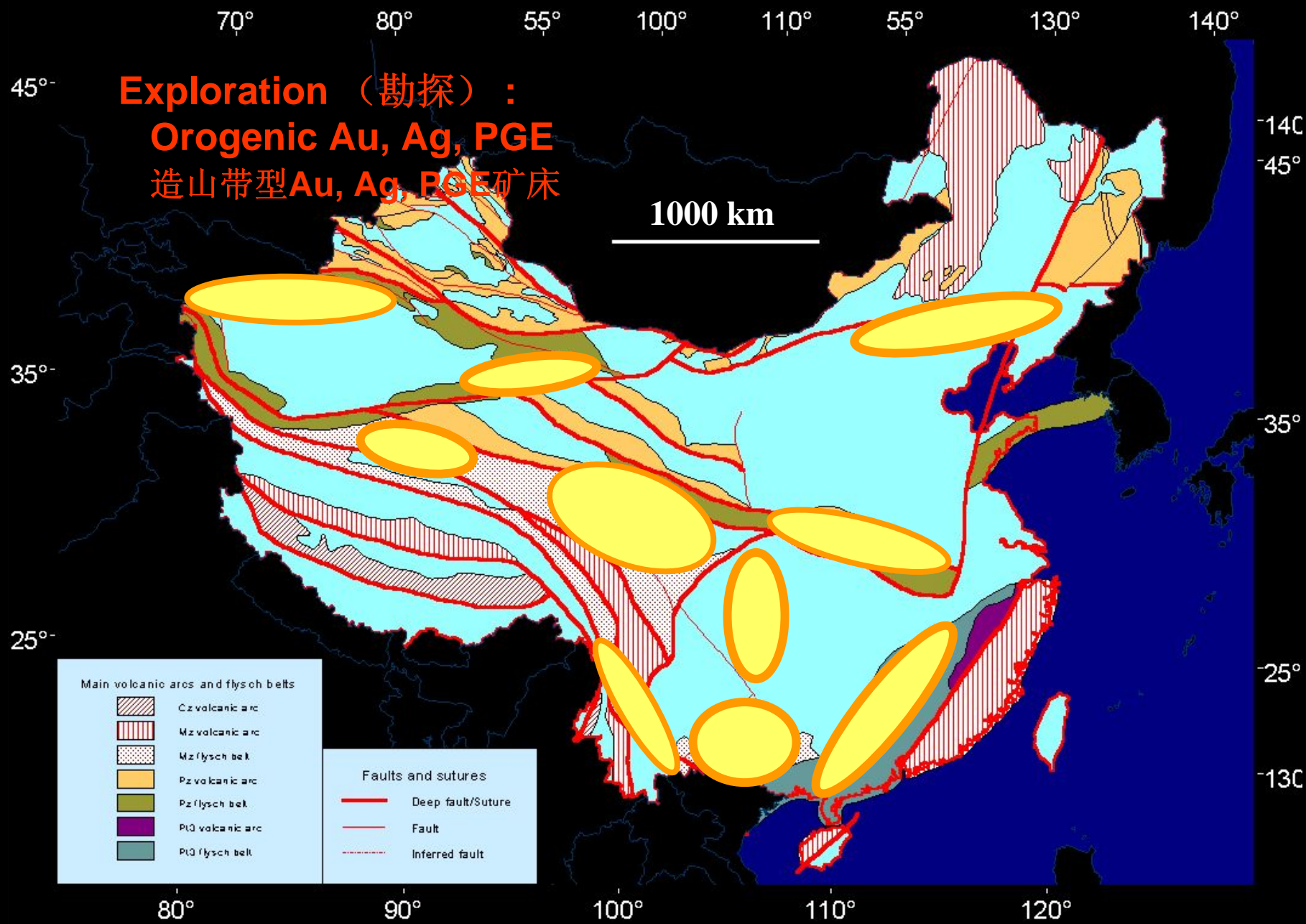
## 层控型、铁氧化型、红层型

1000











# How to Find a World Class Ore Deposit? 如何找到世界级金属矿？

- ◆ Geochemistry (地球化学)
- ◆ Geophysics (地球物理)
- ◆ Geology (地质学)

**2005**



**2004**



**2006**



# Summary (概要)

- ◆ Exploration since 1950s has indicated that China has abundant resources of rare metals and industry minerals, but a shortage of chromite, high grade Cu/Mn/Fe ores, PGEs, diamonds and potash.  
五十年代至今的矿业勘探表明中国有丰富的稀有金属和非金属矿资源，但是缺少铬铁矿、高品位的Cu/Mn/Fe矿资源、PGE、钻石和钾盐。
- ◆ Significant potential for world-class ore deposits remains particularly in the largely unexplored area of western China.  
中国具有找到世界级大矿的很大潜力，特别西部大面积未开发区域。
- ◆ The Altaides, Tethysides and the Yanshanian volcanoplutonic belt have high potential for porphyry-epithermal-skarn, VMS, Sedex, orogenic (Muruntau-style?) and redbed type targets.  
阿尔泰地区、古特提斯周边和燕山火山岩带都有很大潜力发现斑岩型—浅成热液型—矽卡岩型、VMS、Sedex、造山带型（Muruntau-style?）和红层型靶区。

- ◆ The cratons and marginal rift zones are favorable for magmatic Ni-Cu-PGEs, REE, diamonds, sediment-hosted, MVT and perhaps new type targets.

板块和边缘裂谷带都是形成岩浆型Ni-Cu-PGEs, REE, 钻石, 层控型, MVT 的有利地带和新型矿床的靶区。

- ◆ New technologies and capital are needed exploration of many identified metallogenic belts and for development of large ore deposits in the western provinces

许多已知成矿带的勘探和西部省份的大型金属矿床的开发都需要新勘探技术和资金。