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石英脉型金矿床

——概念、背景、特征与成因

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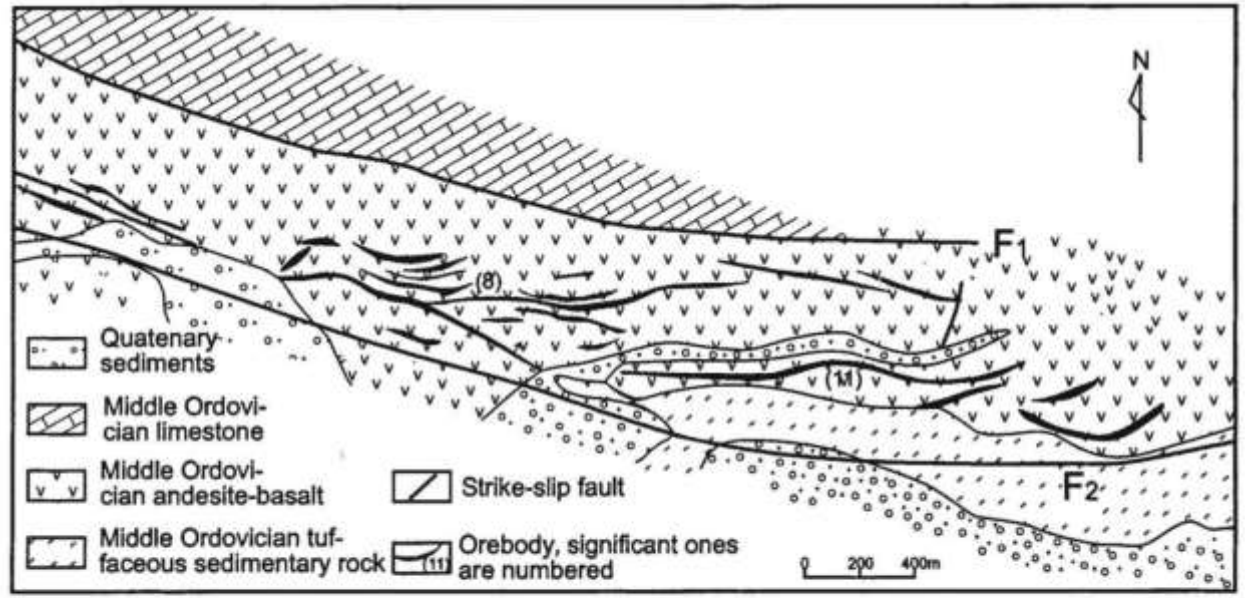
石英脉型金矿是指呈脉状、由热水溶液交代和沉淀而形成的一种类型矿床；围岩可以是变质岩、沉积岩和岩浆岩；成因上抑或与岩浆作用抑或与变质作用有关。

研究历史复杂：热液脉状金矿床 → 剪切带型金矿 → 造山型金矿 → 造山型特点金矿 + 花岗质岩石有关的热液型金矿

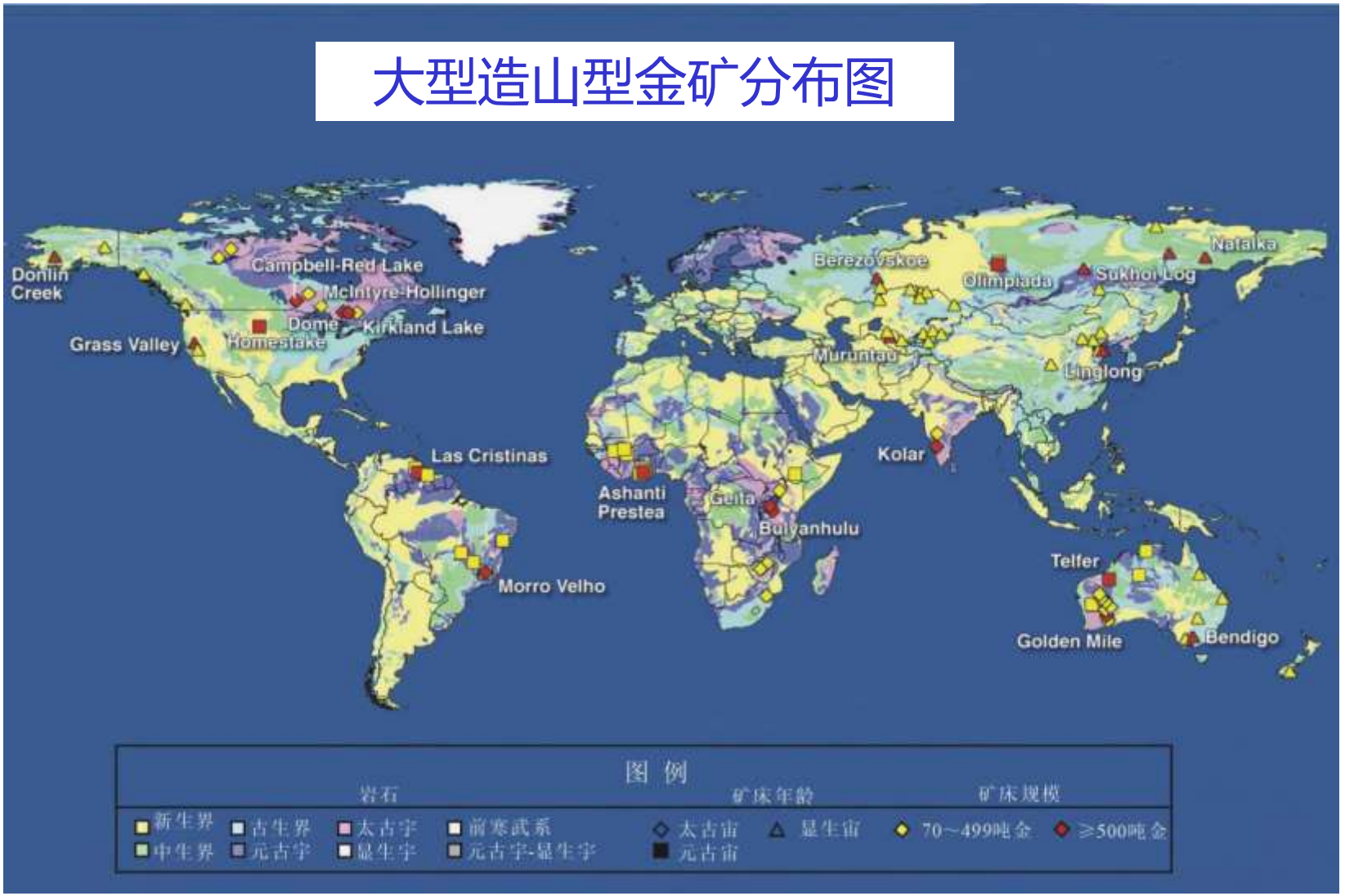
一、造山型金矿床与造山旋回

发育在变质地体或造山带中，受构造控制的后生脉型金矿，它们在时间和空间上与增生构造有关。从全球范围来看，大型造山型金成矿省主要出现在各地区主要增生造山作用过程中，其地球动力学背景的特殊之处在于外来地体之间、或外来地体与先存大陆边缘之间的压扭增生（或斜向增生）作用。

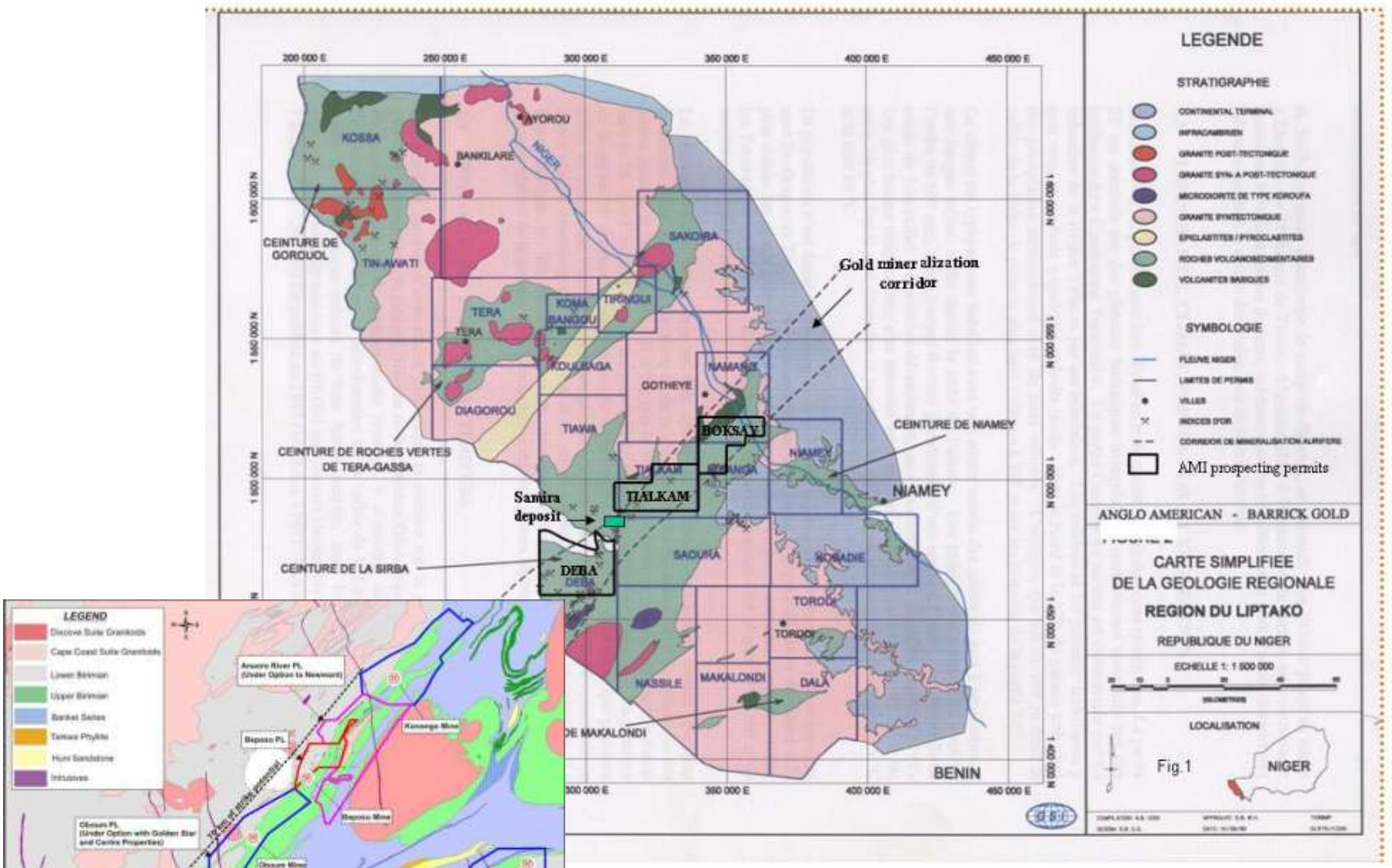
甘肃北祁连山寒山金矿平面图



大型造山型金矿分布图



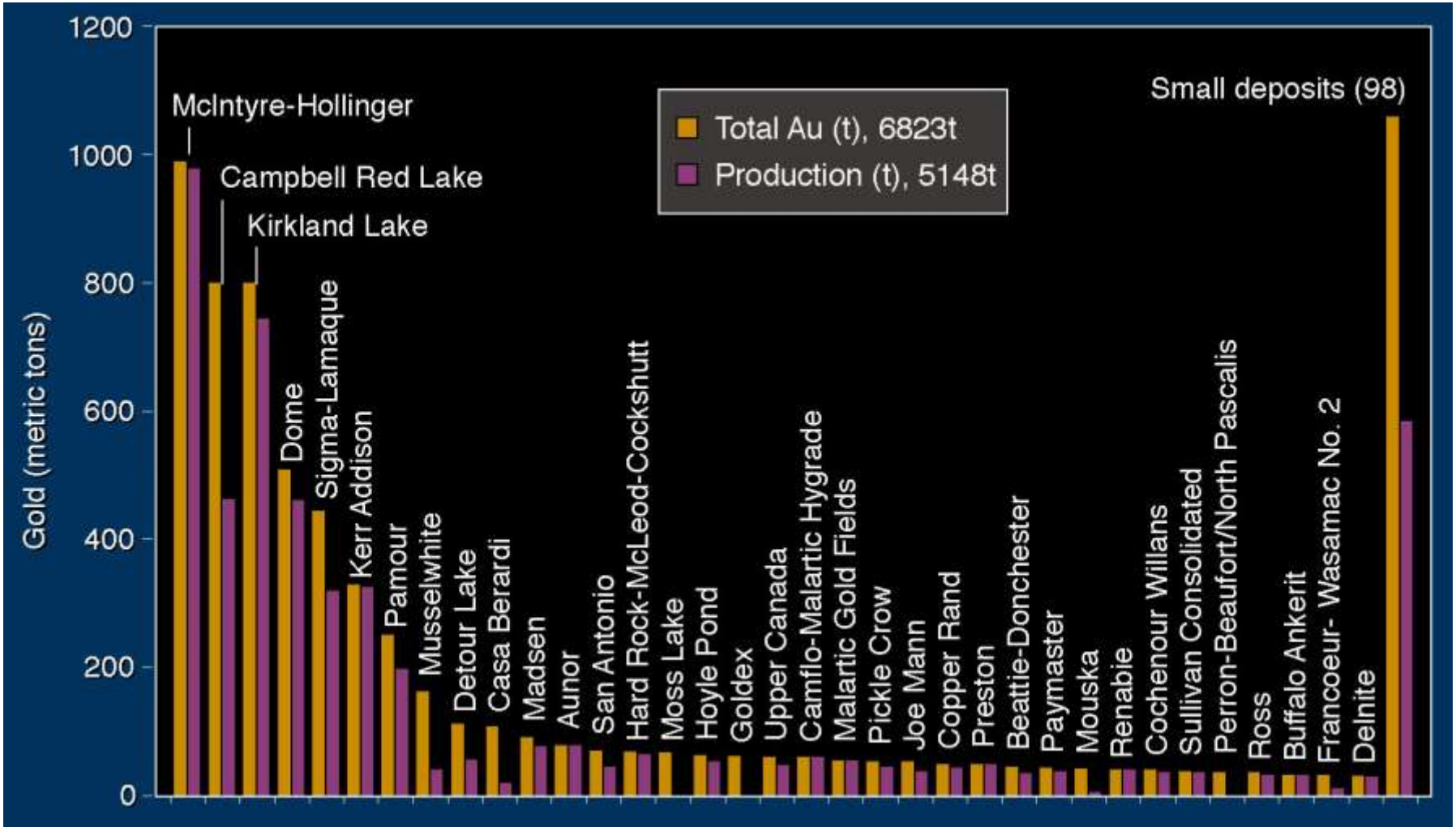
（Gosselin et al., 2004）



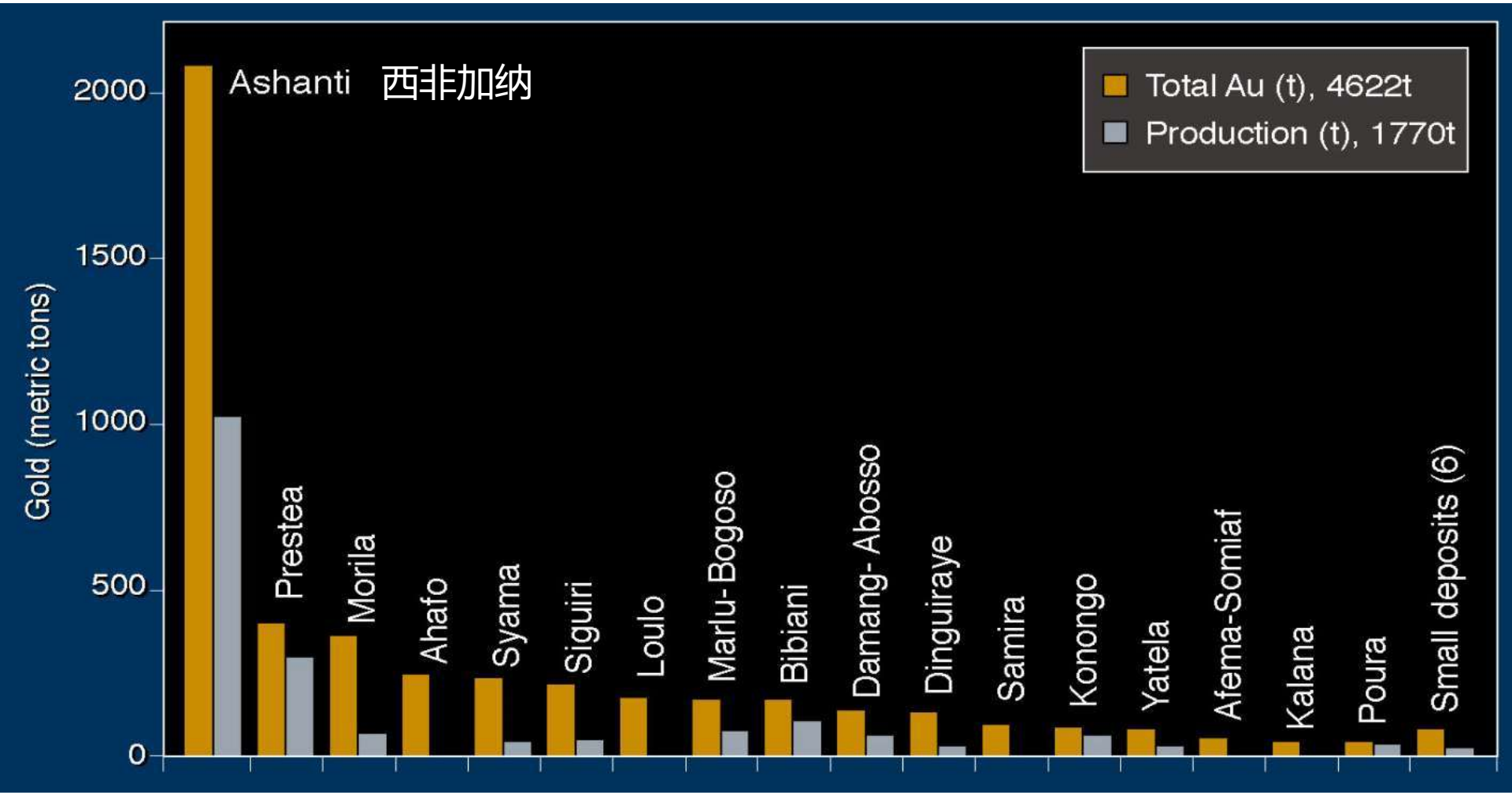
非洲加纳和尼日尔金矿带：位于西非和中非两个地块之间

在全球范围内，造山型金矿床的成矿时代分布较广，从太古宙到新生代都有分布。主要形成于31亿年、27 - 25亿年、21 - 18亿年和6 - 0.5亿年，其中新太古代成矿规模最大。

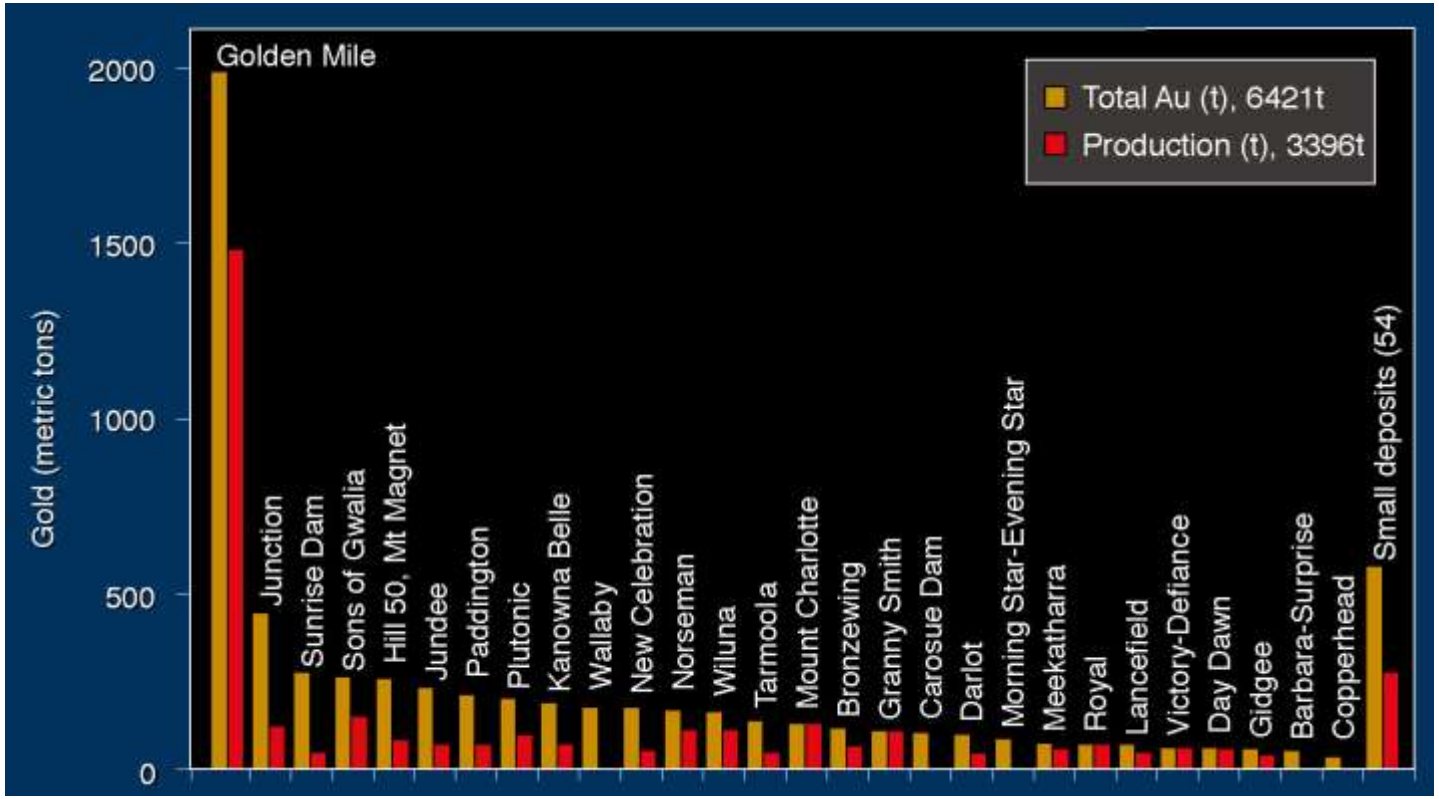
太古宙造山型金矿床资源量占全球造山型金矿资源量的42.9%，其中新太古代占绝对主导地位；元古宙造山型金矿床占全球造山型金矿床的20.2%，且绝大部分集中在古元古代；古生代和中-新生代造山型金矿床分别占13.8%和23.1%。



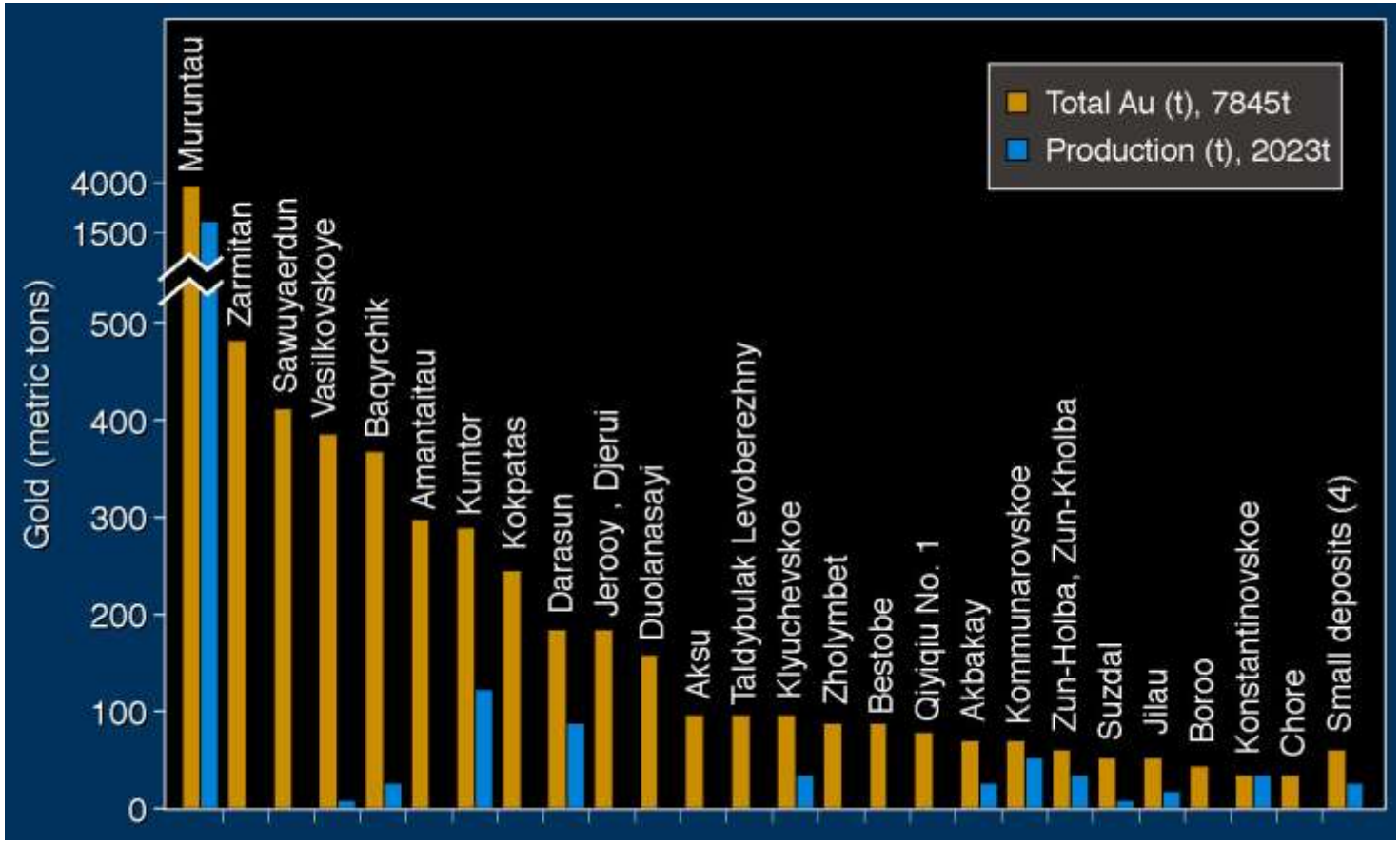
太古代31亿年左右主要造山型金矿床



晚太古代晚期（27-25亿年）主要造山型金矿床



早元古代晚期（21-18亿年）主要造山型金矿床

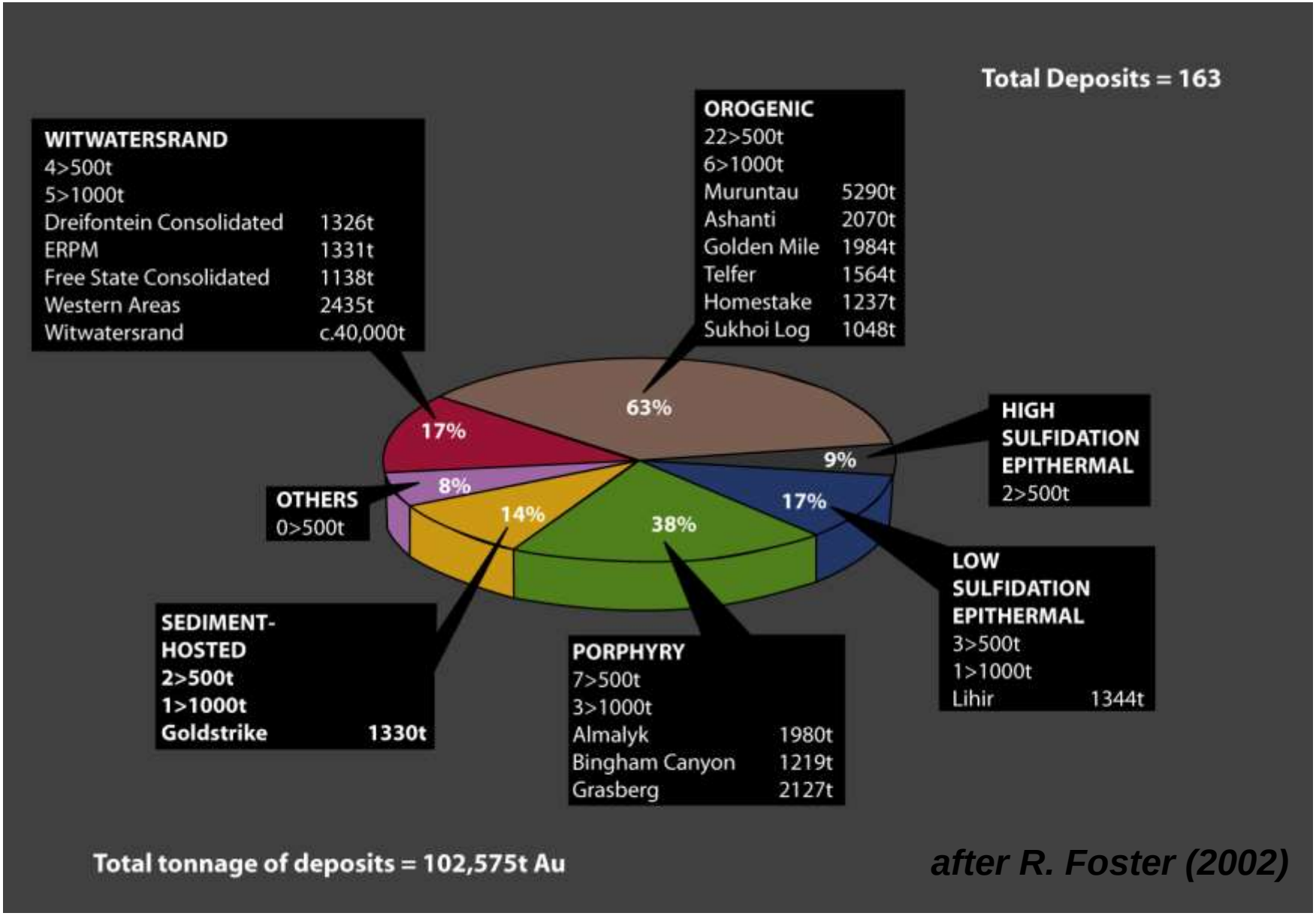


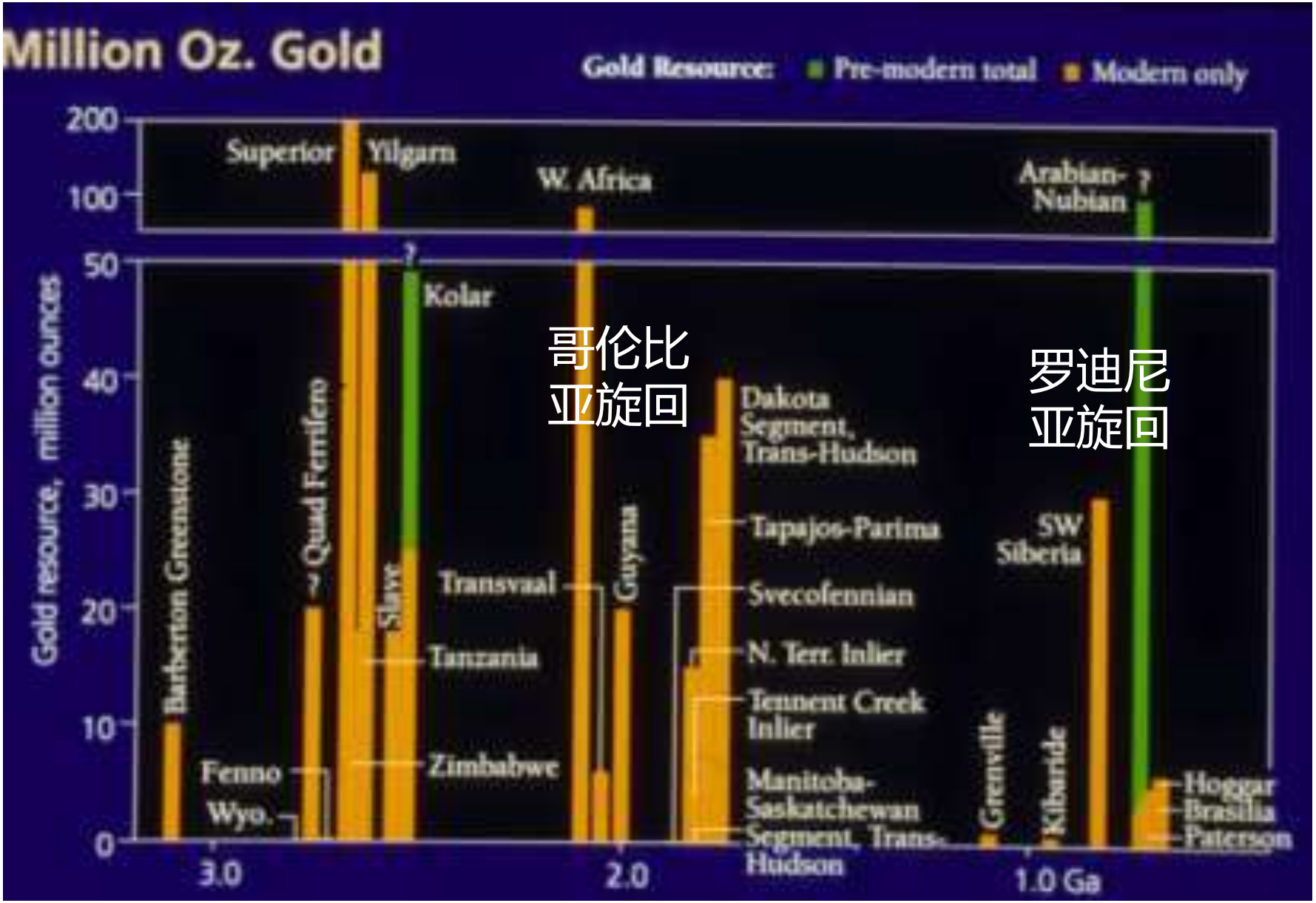
显生宙主要造山型金矿床

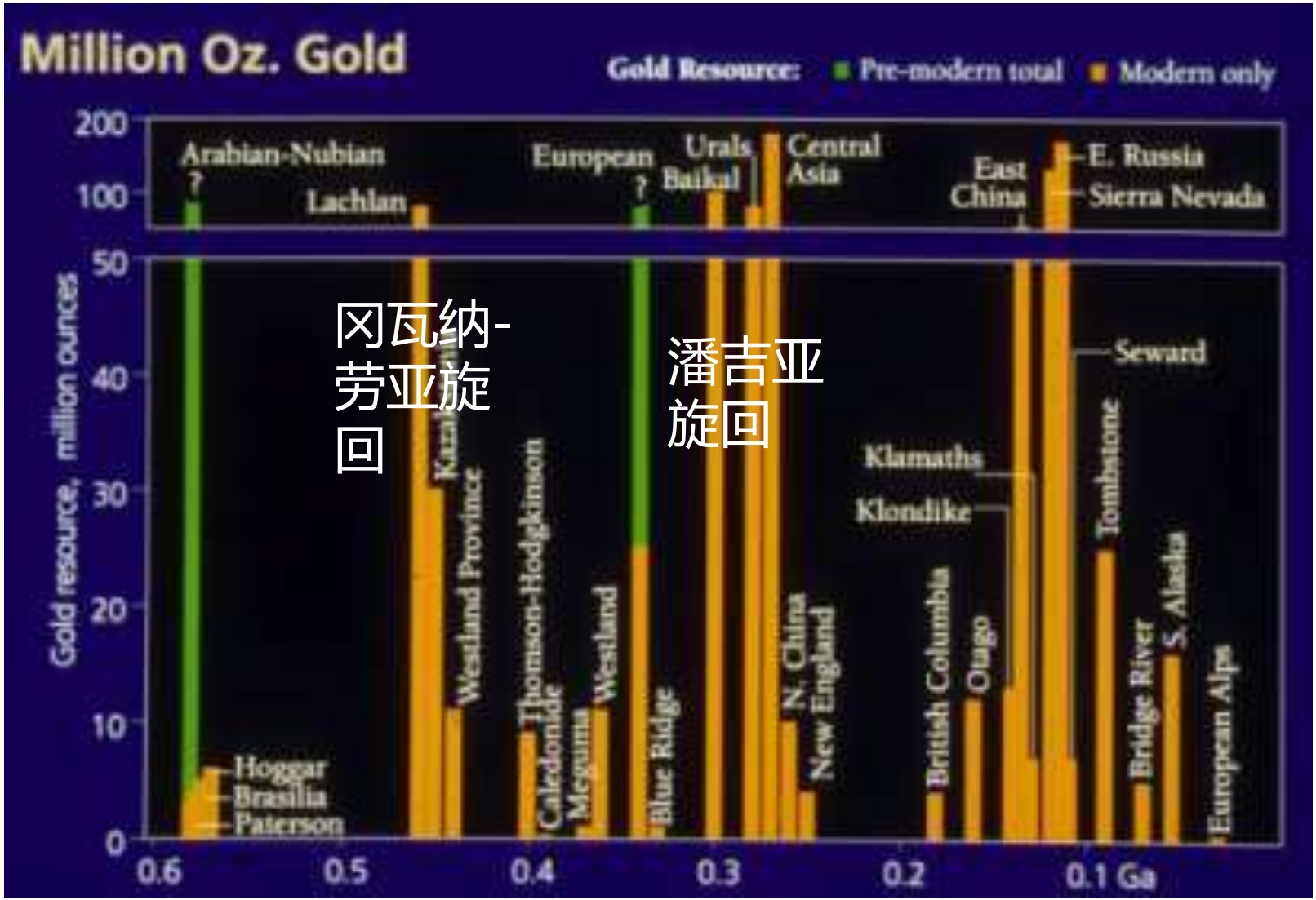

Eurasia Variscan Au
古生代造山型金矿
Caledonides
Massif Central
Variscides
Russian
Bohemian Massif
Craton
Alpides
Angara
Craton
Berezovsk
Sukhoi Log
Zun-Kholba
ALTAIDS
Bakyrchik
Daugystau-
Amantaytau
Muruntau
Xiaoyinpan
Wulashan
Sawayaerdun
Arabian
Craton
TETHYSIDES
N. China
Craton
Yangtze
Craton
Indian
Craton
Pacific Ocean
pЄ cratons
pЄ massifs
Pz accretionary complexes
Passive margin
Basin

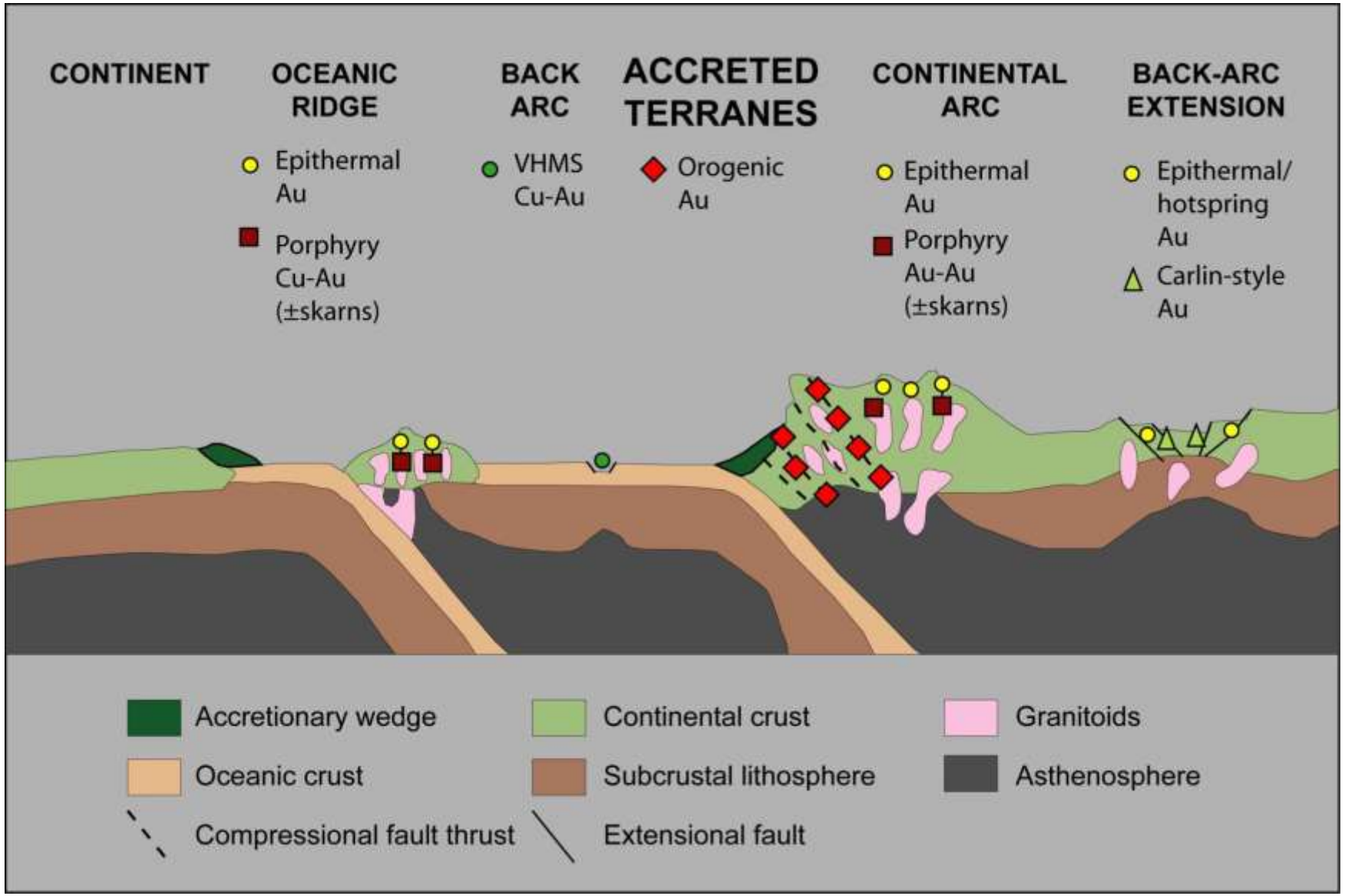
中新生代主要造山型金矿床分布图

世界上储量大于100吨的金矿床

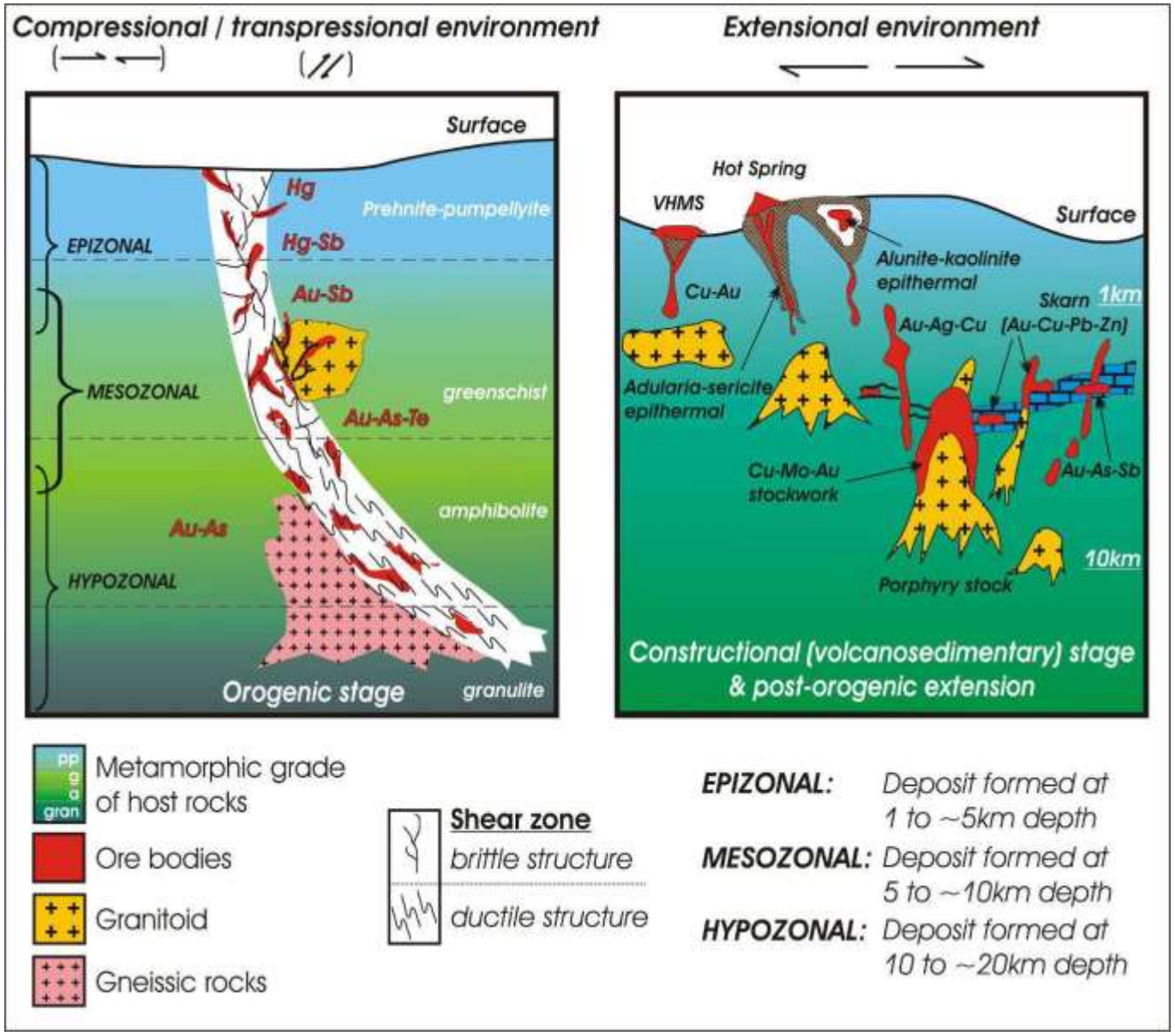



Million Oz. Gold
Gold Resource: Pre-modern total Modern only
200
100
50
40
30
20
10
0
Gold resource, million ounces
Superior
Yilgarn
W. Africa
Arabian-Nubian
?
Kolar
哥伦比亚旋回
罗迪尼亚旋回
Barberton Greenstone
~ Quad Ferrifero
Slave
Transvaal
Tanzania
Zimbabwe
Guyana
Dakota Segment, Trans-Hudson
Tapajos-Parima
Svecofennian
N. Terr. Inlier
Tennent Creek Inlier
Manitoba-Saskatchewan Segment, Trans-Hudson
Fenno
Wyo.
SW Siberia
Grenville
Kibaride
Hoggar
Brasilia
Paterson
3.0
2.0
1.0 Ga


Million Oz. Gold
Gold Resource: Pre-modern total Modern only
Gold resource, million ounces
200
100
50
40
30
20
10
0
0.6
0.5
0.4
0.3
0.2
0.1 Ga
Arabian-Nubian
?
Lachlan
European
?
Urals
Baikal
Central
Asia
East
China
E. Russia
Sierra Nevada
冈瓦纳-劳亚旋回
潘吉亚旋回
Seward
Klamaths
Klondike
Tombstone
Hoggar
Brasilia
Paterson
Kazakhstan
Westland Province
Thomson-Hodgkinson
Caledonide
Meguma
Westland
Blue Ridge
N. China
New England
British Columbia
Otago
Bridge River
S. Alaska
European Alps



Groves et al. (1998)



Groves et al. (1998)

二、矿床的主要特征

1. 构造背景
2. 矿体形态
3. 矿石特征
4. 围岩蚀变
5. 成因

1. 成矿构造背景

太古宙金矿床主要产于花岗绿岩地体中的绿岩带中
（Yilgarn, Zimbabwe, South Africa, Brazil, Kolar, Superior）

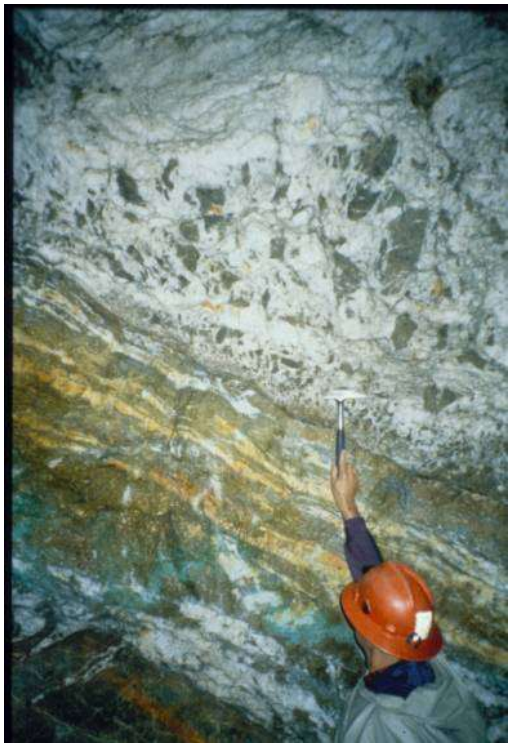
显生宙金矿床主要产于增生的洋壳系列和大陆边缘
（Mother Lode, Russian Far East, Tasman, Central Asia, Alaska）

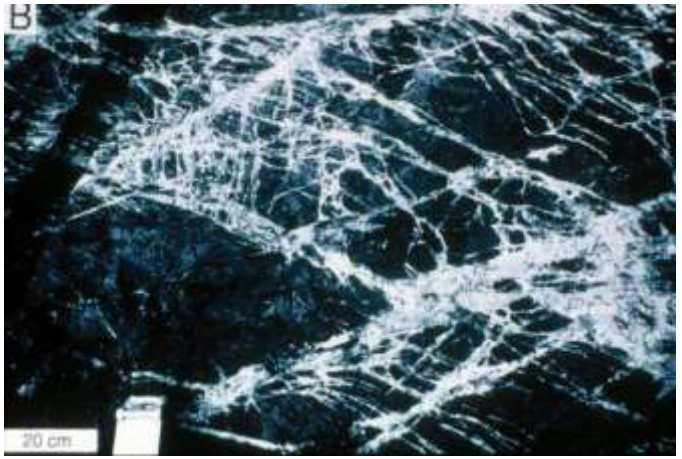
绝大多数超大型成矿省位于绿片岩相变质地体中。造山型金矿床都产在变质地体中，这是众多明显相似特征中最为突出的。

金矿床受构造控制，产于超岩石圈断裂带的二级或更低级的断层羽中。这些构造具有高角度倾斜位移，常有反向滑动，但也有伴随一些横推断层。

矿床基本上严格地受控于脆性-韧性变形的转变（或过程），金沉淀同步于变形作用。

构造控制的矿脉样式





2. 矿体形态

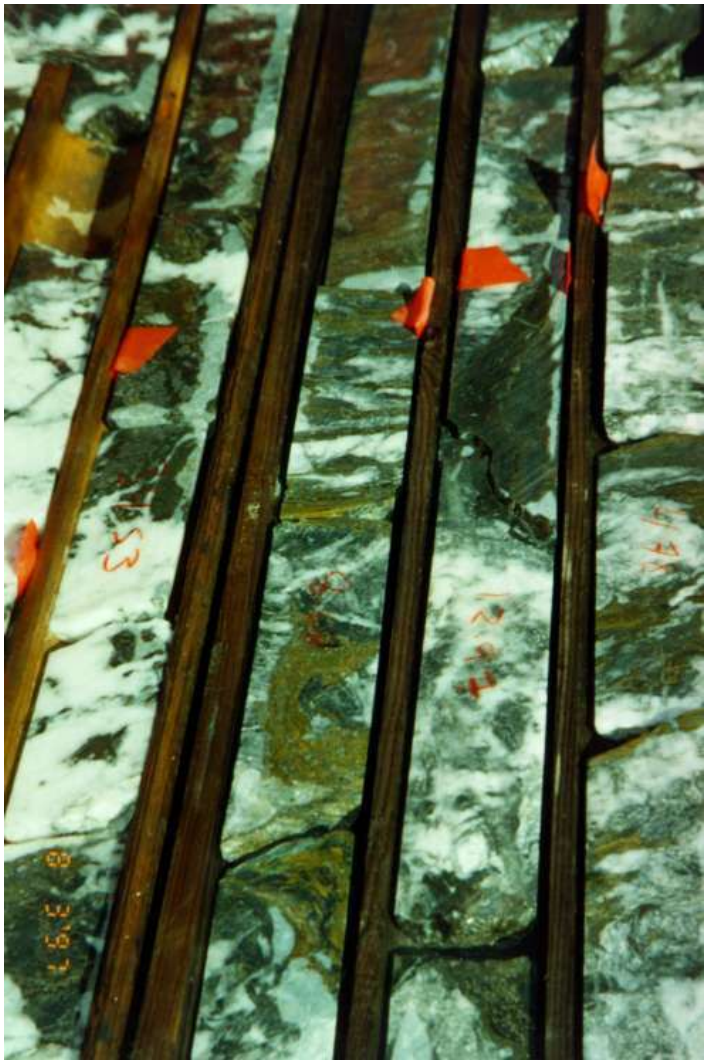
石英脉

网脉

矿化构造岩

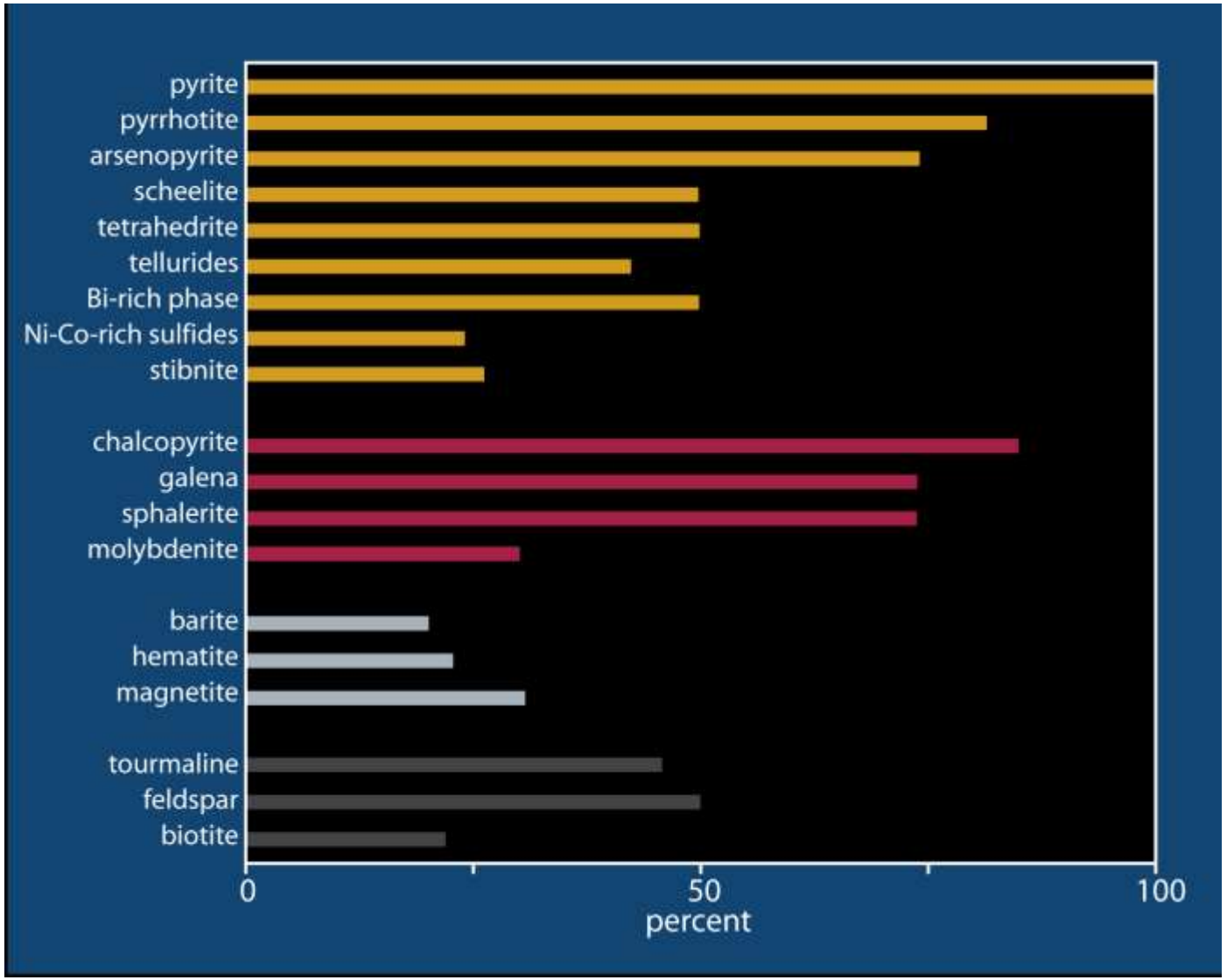
非洲西部布基纳法索Archean quartz vein, Poura gold mine, Burkina Faso

Archean Gold Vein
Hope Bay, Canada

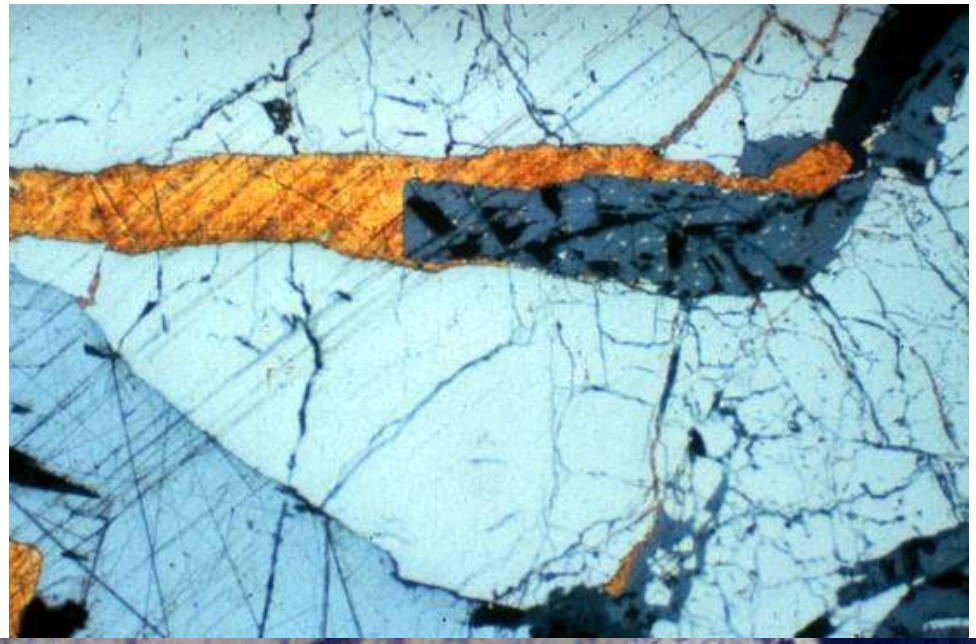


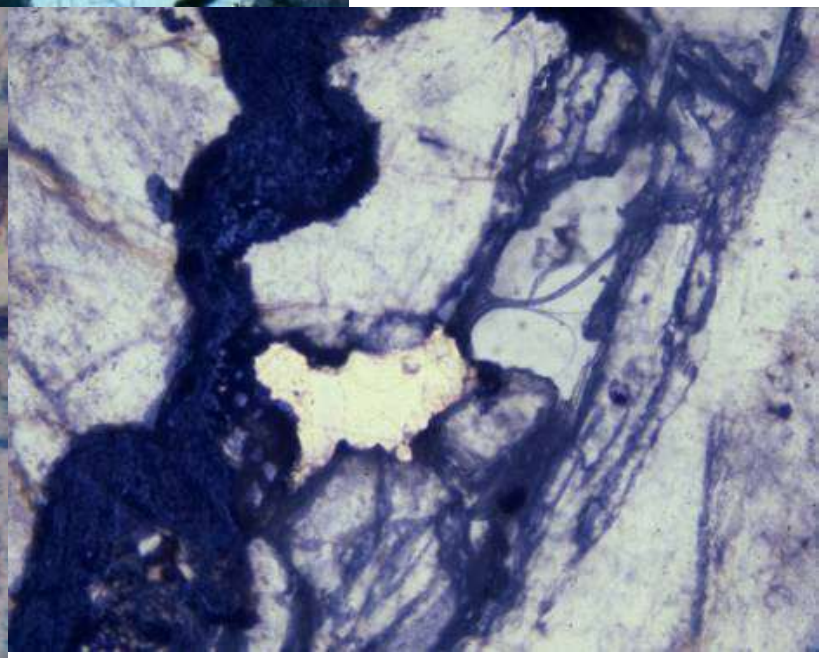
Muruntau, Uzbekistan

3. 金矿石特点


pyrite
pyrrhotite
arsenopyrite
scheelite
tetrahedrite
tellurides
Bi-rich phase
Ni-Co-rich sulfides
stibnite
chalcopyrite
galena
sphalerite
molybdenite
barite
hematite
magnetite
tourmaline
feldspar
biotite
0
50
100
percent

主要矿物组合





Au、Ag（±As、Sb、Te、W、Mo、Bi、B）强富集，Cu、Pb、Zn、Hg和Tl弱富集。

Au/Ag比值平均为5。

4. 围岩蚀 变

- 太古宙发育广泛的碳酸岩蚀变（方解石 - 白云石 - 菱铁矿）
- 绢云母化蚀变在各时代金矿床中都发育
- 强烈蚀变带一般较窄

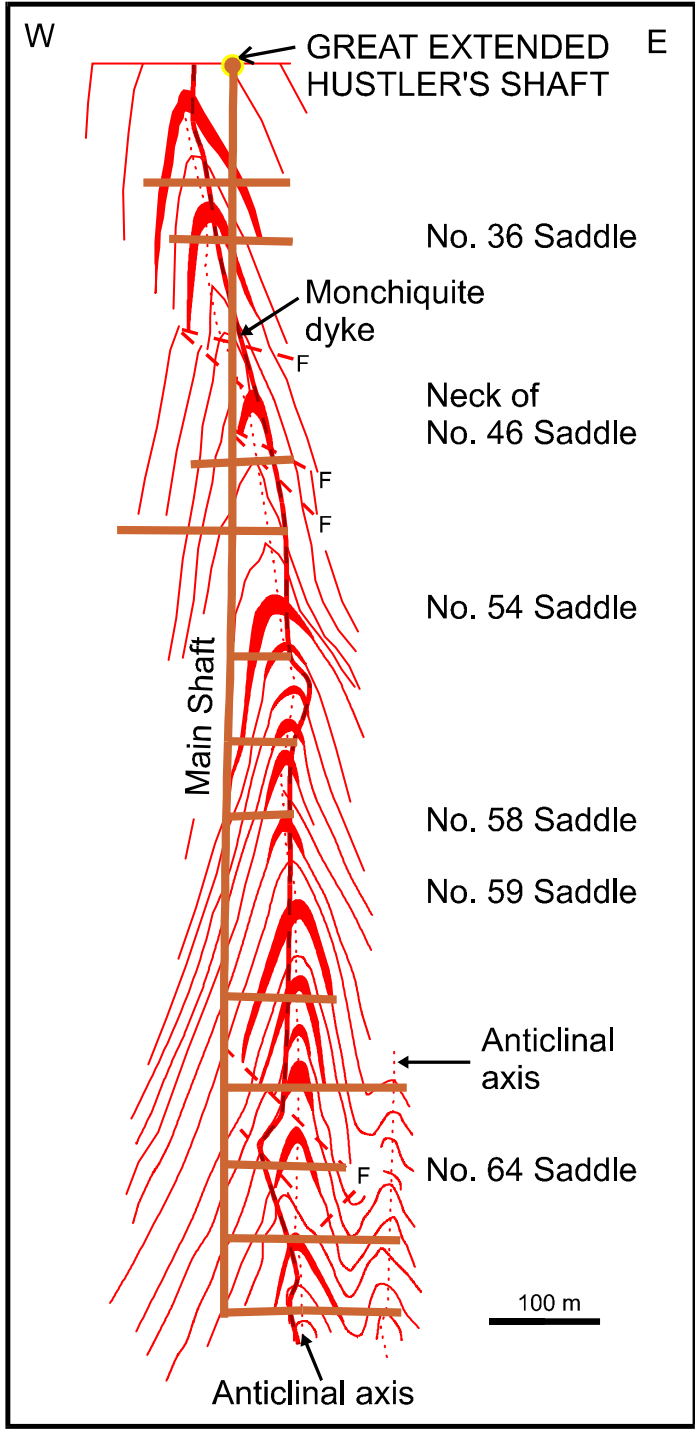
分带性

- 金属分带较弱，主要为垂直分带
- 蚀变分带较弱，比较明显分带的是太古宙的碳酸岩蚀变分带。

5. 矿床成因

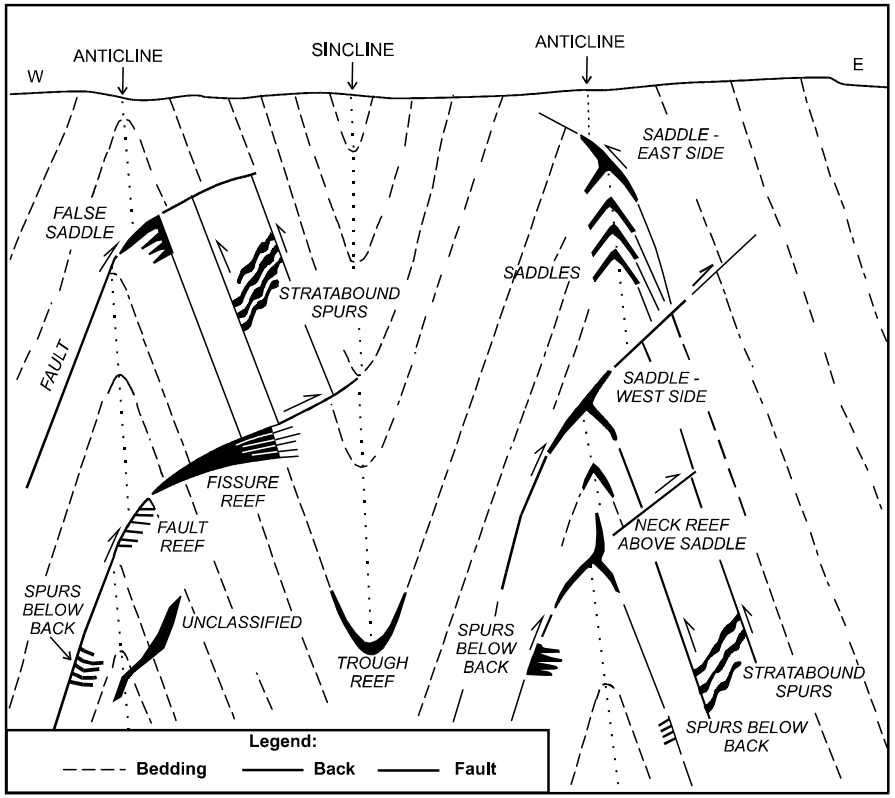
- 深部地壳的变质流体
- 就位于深断裂构造带中

鞍状矿体

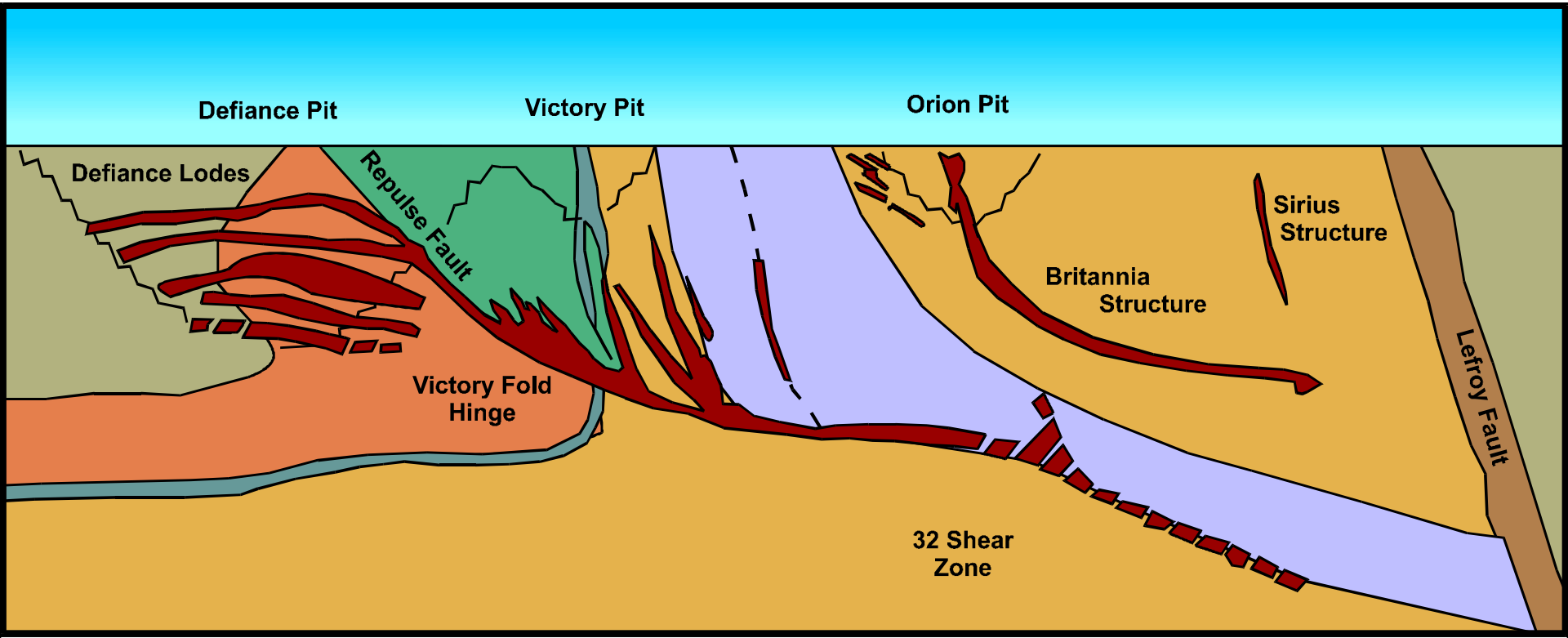


澳大利亚维多利亚Ballarat Goldfield

The Bendigo district



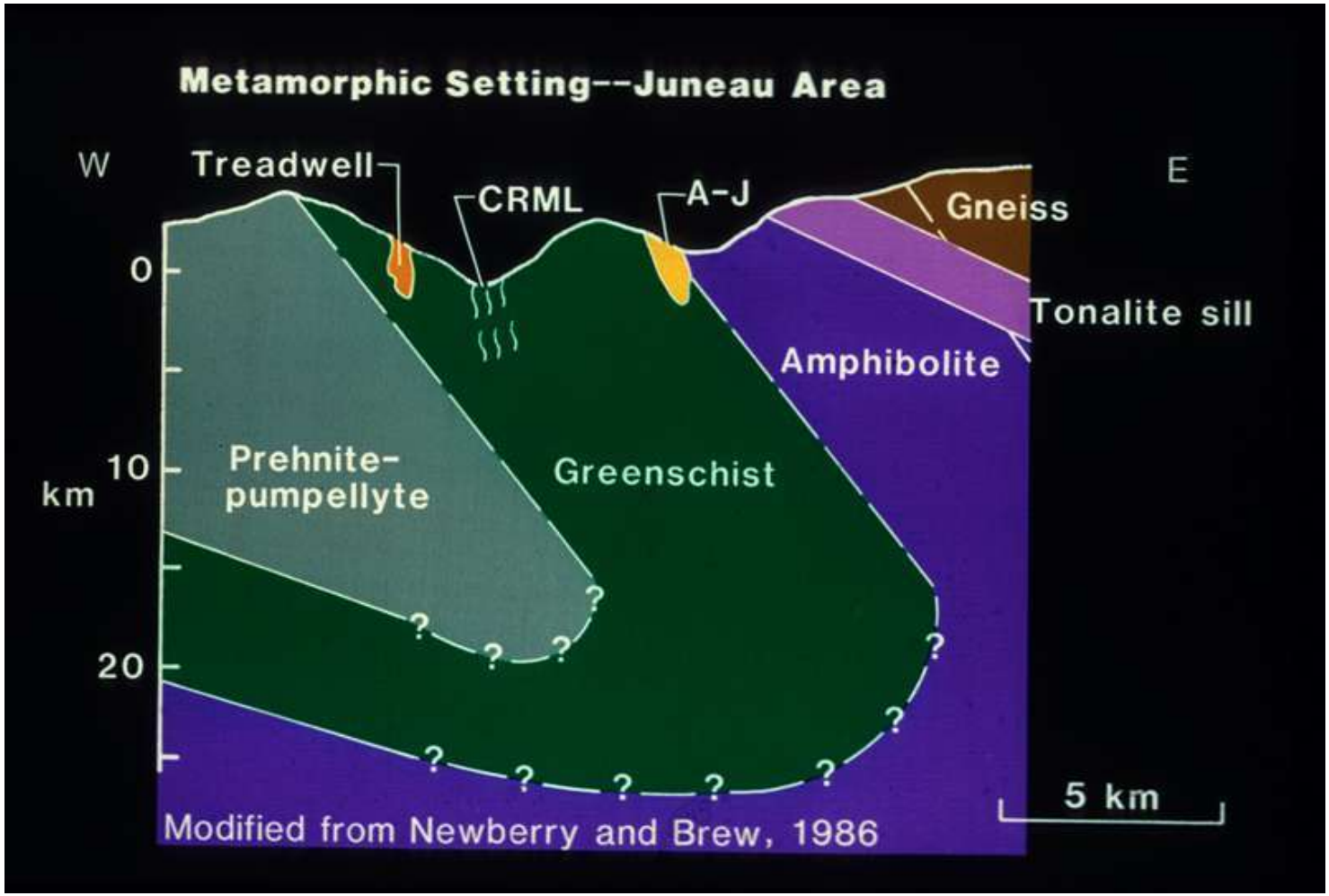
The Defiance, Victory and Orion open pits, Western Australia



北美科迪勒拉金矿带


Nome
Alaska Range
Fairbanks
Willow Creek
Klondike
Chichagof
Juneau
Coast
North America
Craton
Bridge River
Klamath
Carlin
Sierra Nevada
Grass Valley
East Gold Belt
Mother Lode
500 km
Gold districts
Batholiths

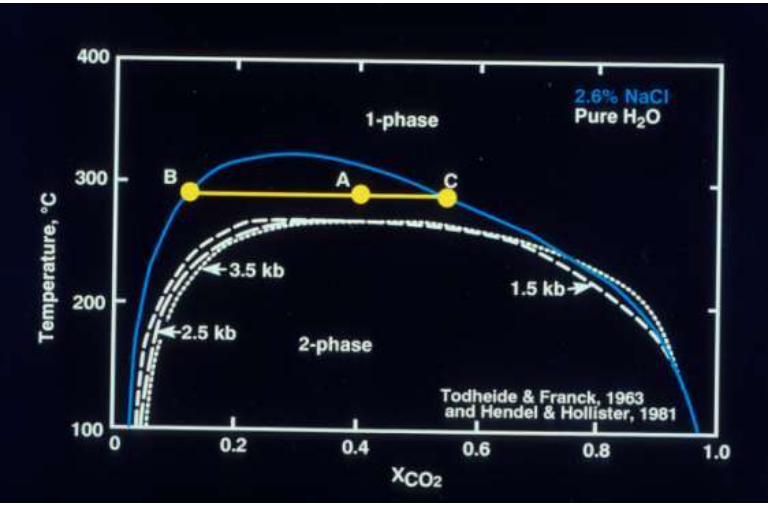

Gold Deposits of
the Juneau Gold Belt
100 km
Coast Range
Megalineament
Canada
U.S.
Kensington
Chilkat
Range
Coast Mountains
AJ
Juneau
Treadwell
Chichagof
Island
Chichagof
Queen
Charlotte
Fault
Pacific Ocean
Chatham
Strait Fault
Admiralty Island
Sumdum
Chief
N

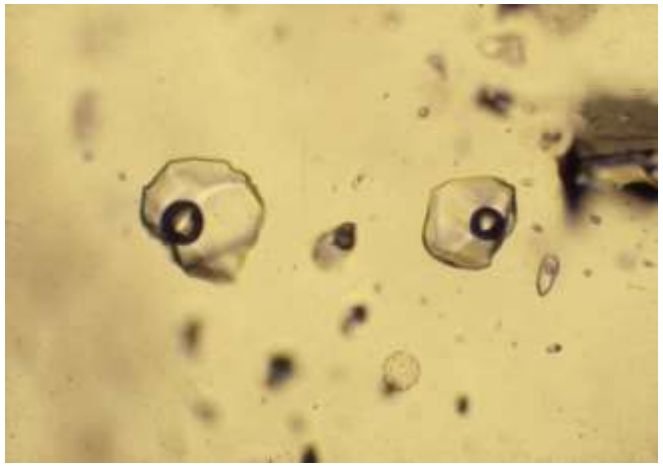

Metamorphic Setting--Juneau Area
W
E
Treadwell
CRML
A-J
Gneiss
Tonalite sill
Amphibolite
Greenschist
Prehnite-
pumpellyte
0
10
20
km
5 km
Modified from Newberry and Brew, 1986

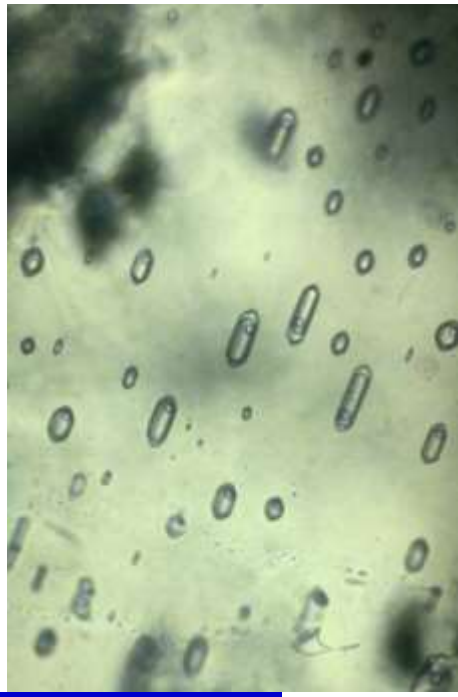
成矿流体特征

- 温度　　~ 250-400 °C
- 压力　　>1-4 kb
- 成分　　H_2O-CO_2 + CH_4, N_2, H_2S
- 盐度　　<5-8 NaCl eq

造山型金矿流体

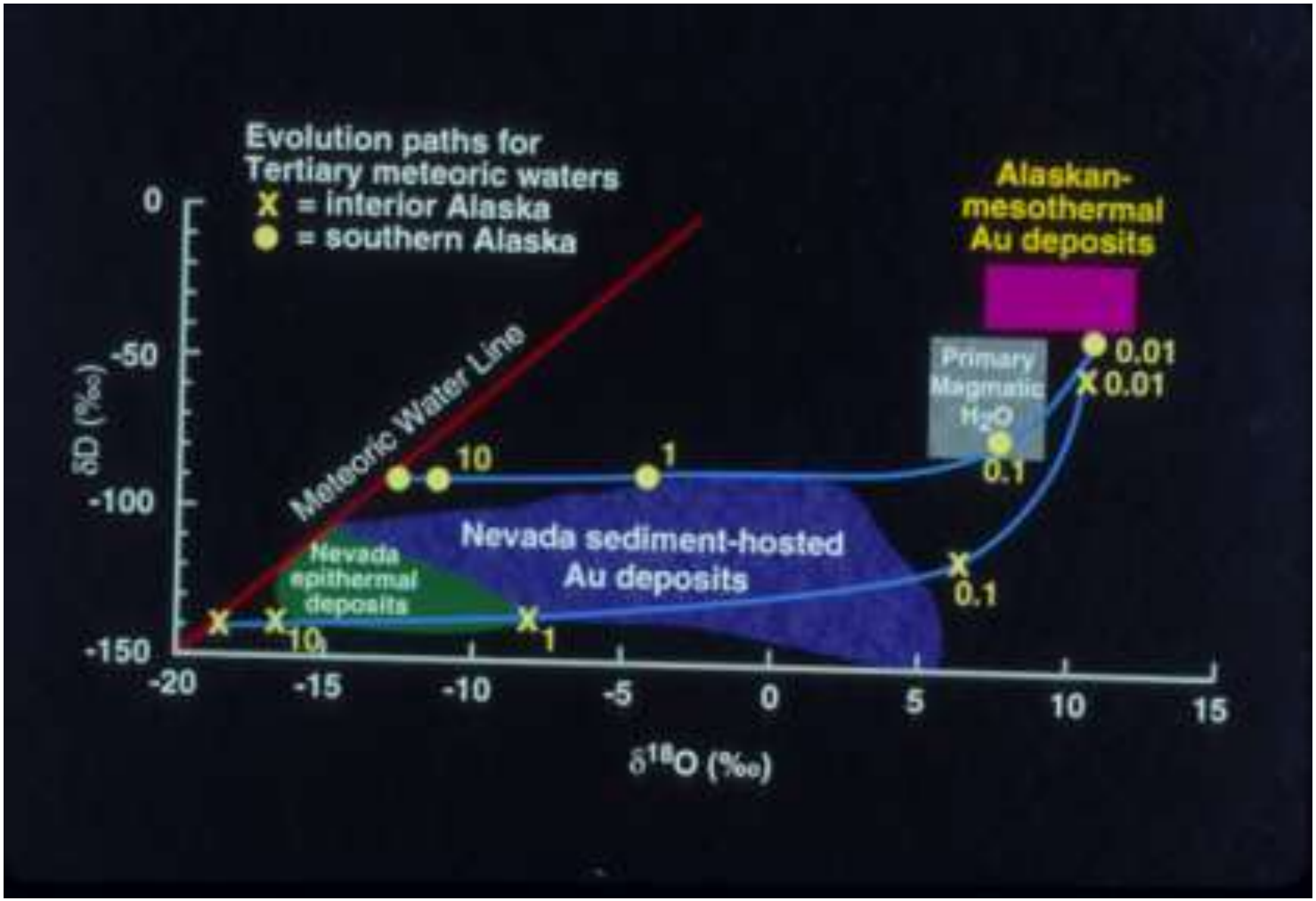




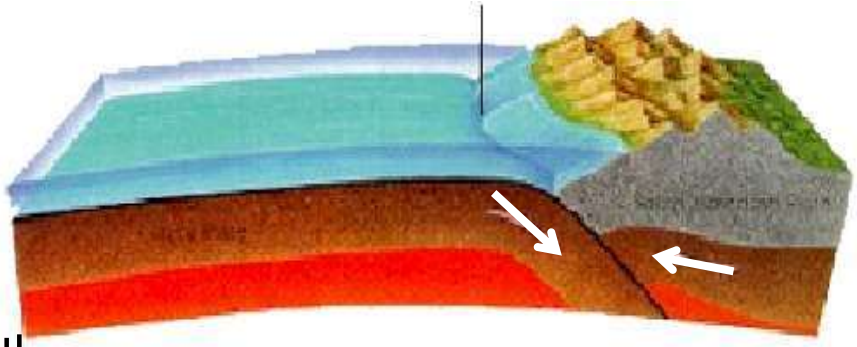


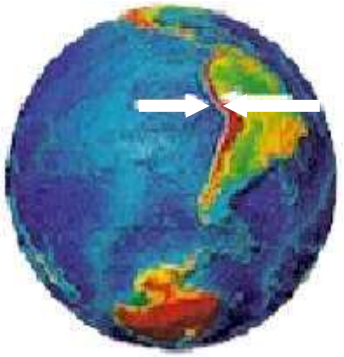
- Temperatures ~ 250-400 °C
- Pressure >1-4 kb
- Fluid comp High CO_2 + H_2O, N_2, CH_4
- Salinity <5-8 NaCl eq

Orogenic Au deposits

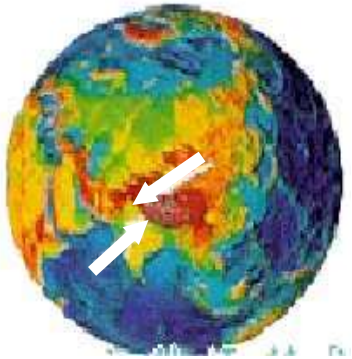


三、造山型金矿主要成因环境类型





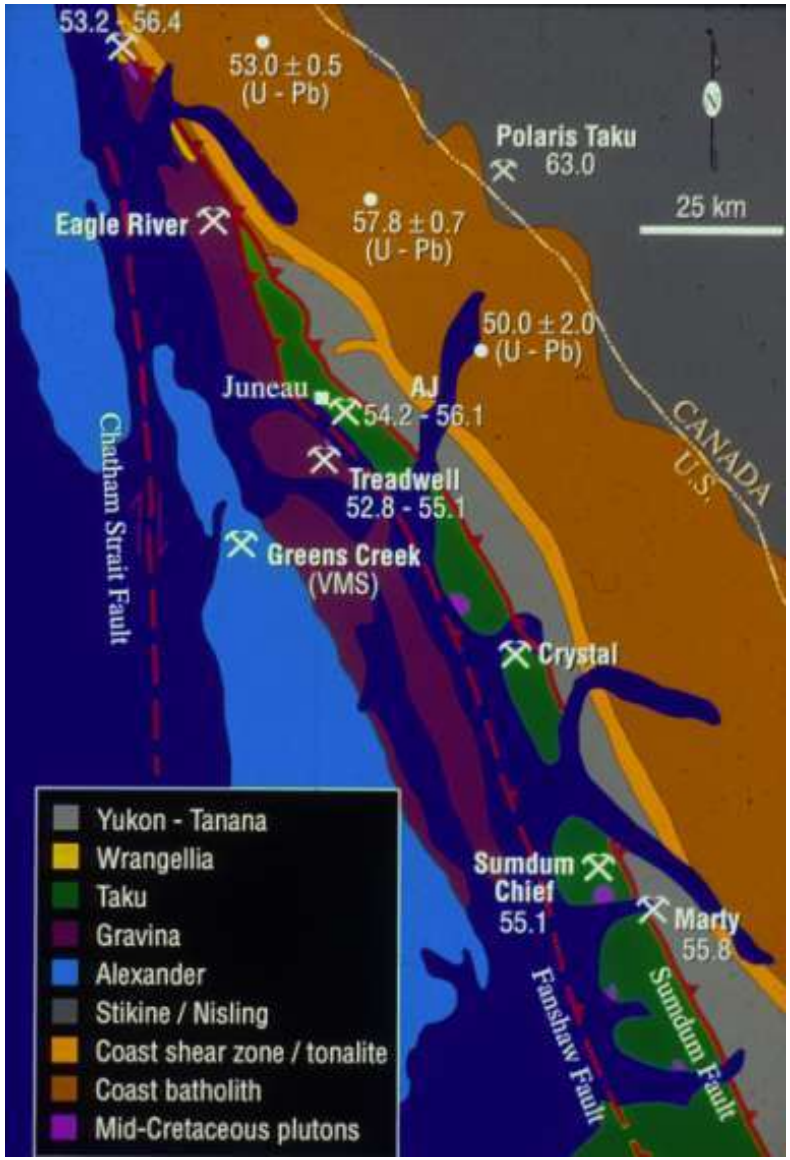
I. 环太平洋型：俯冲造山带



II. 喜马拉雅型：碰撞造山带

III. 中亚型（显生宙增生型）造山带：大量幔源物质的添加；具有老陆块与年轻造山带陆壳镶嵌的结构特征

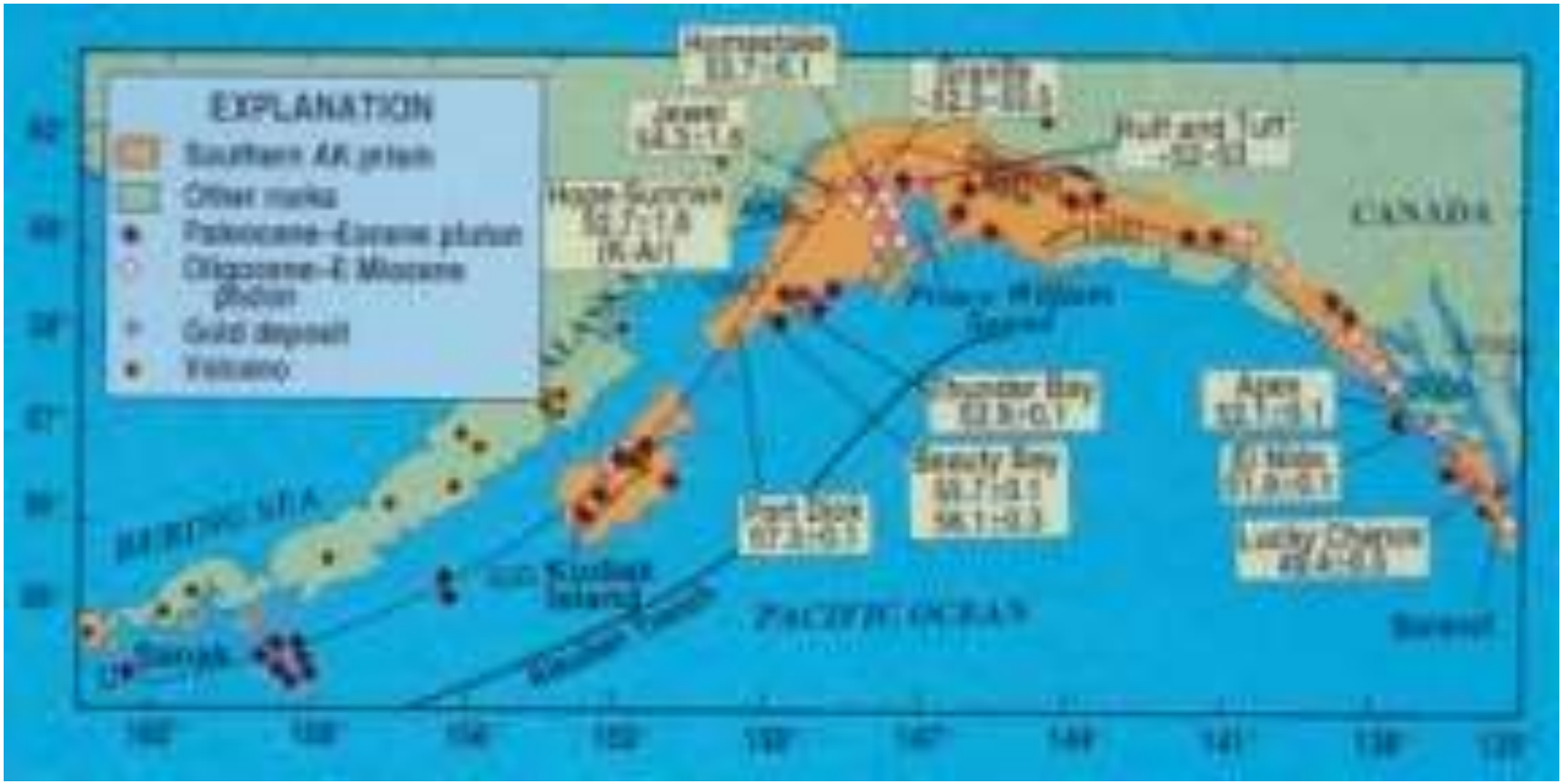
1. 汇聚期挤压走滑型金矿

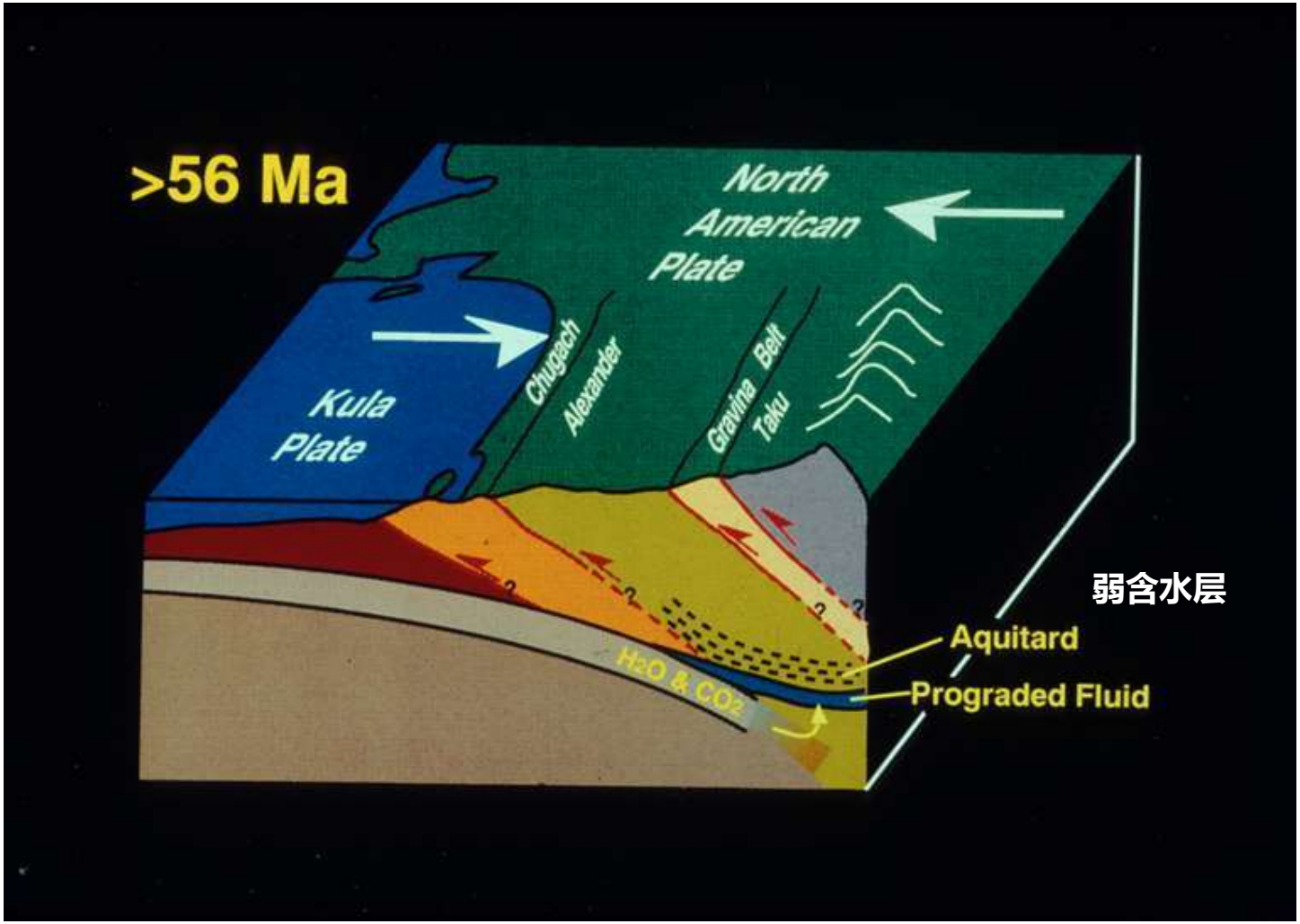


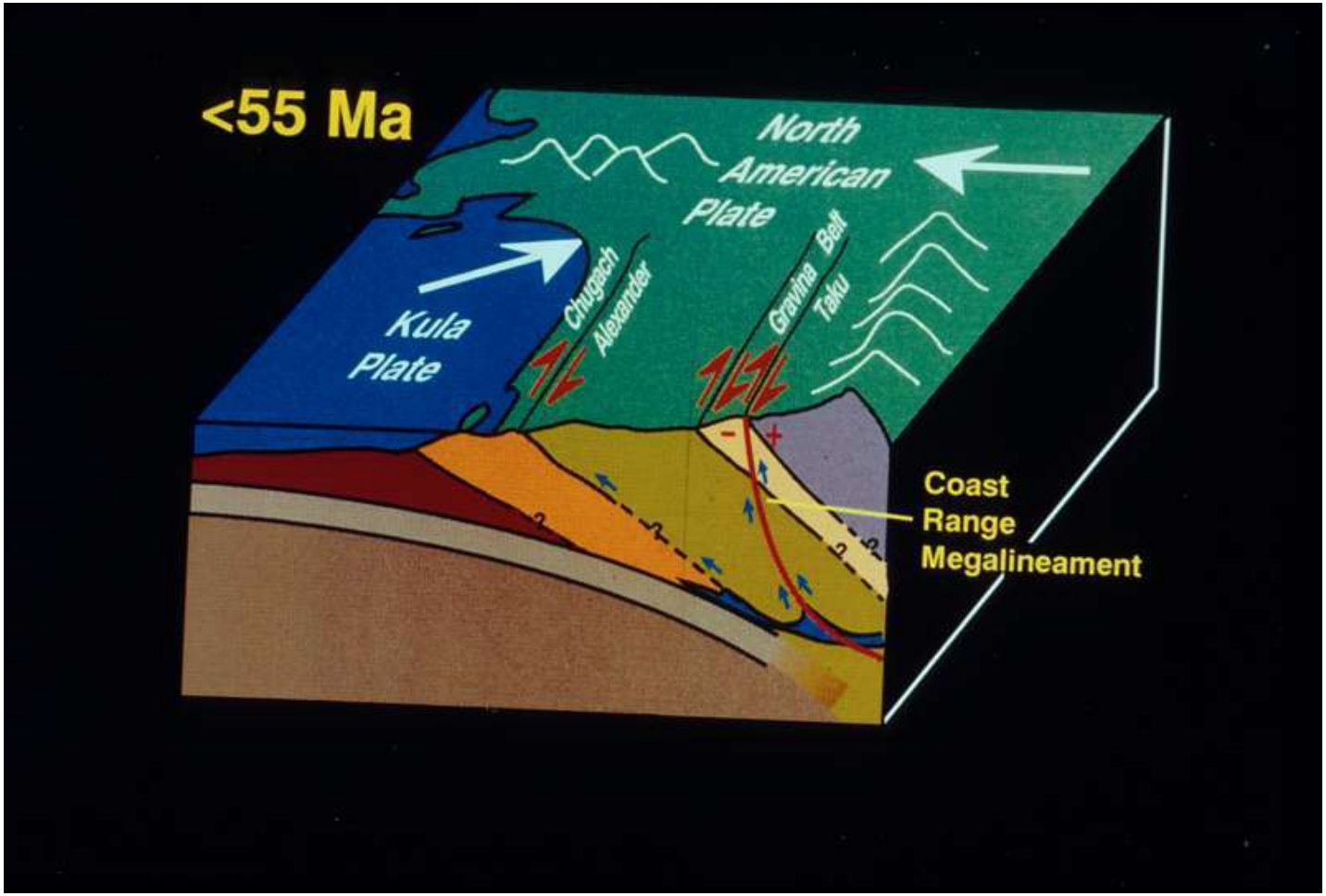
Kensington/Jualin

成矿时代

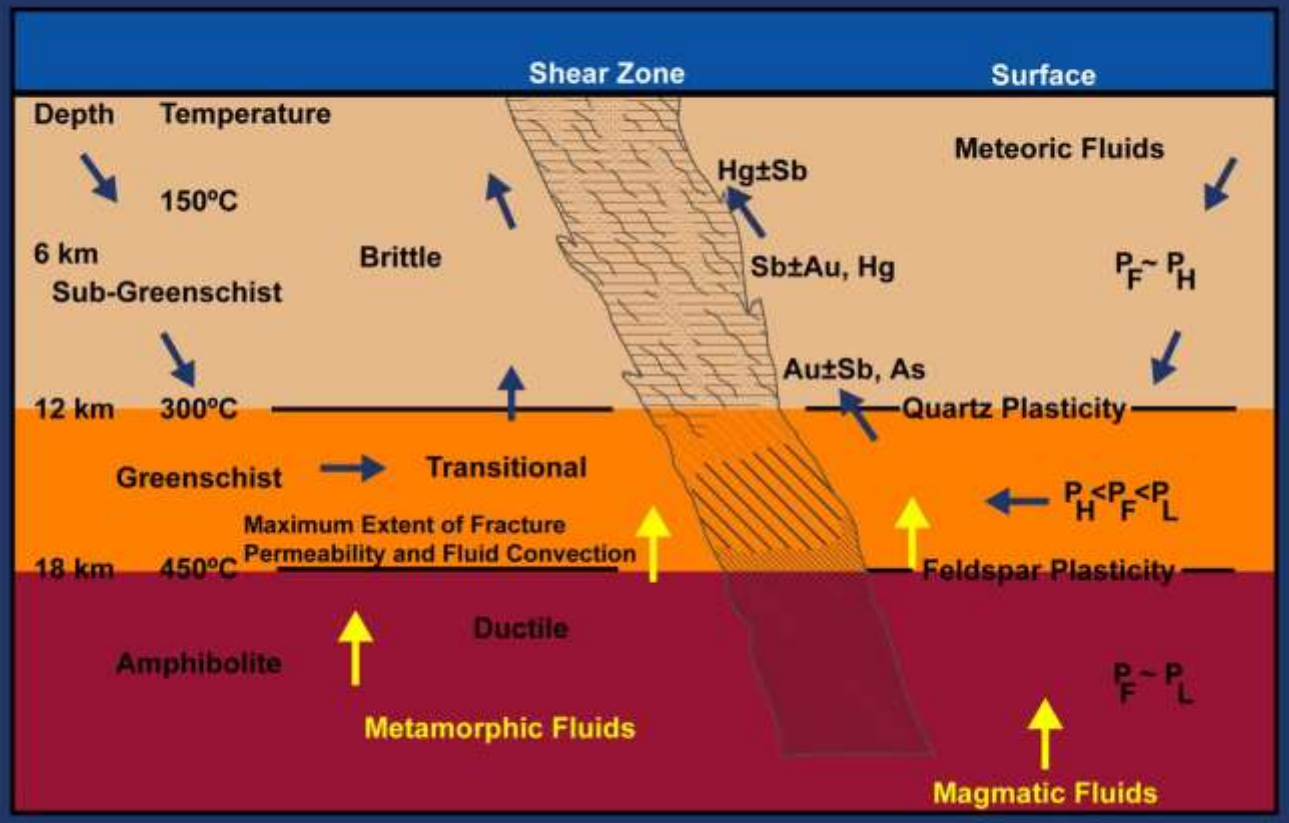
北美金矿床时代


EXPLANATION
Southern AK prism
Other rocks
Paleocene-Eocene pluton
Oligocene-E Miocene pluton
Gold deposit
Volcano
CANADA
BERING SEA
PACIFIC OCEAN

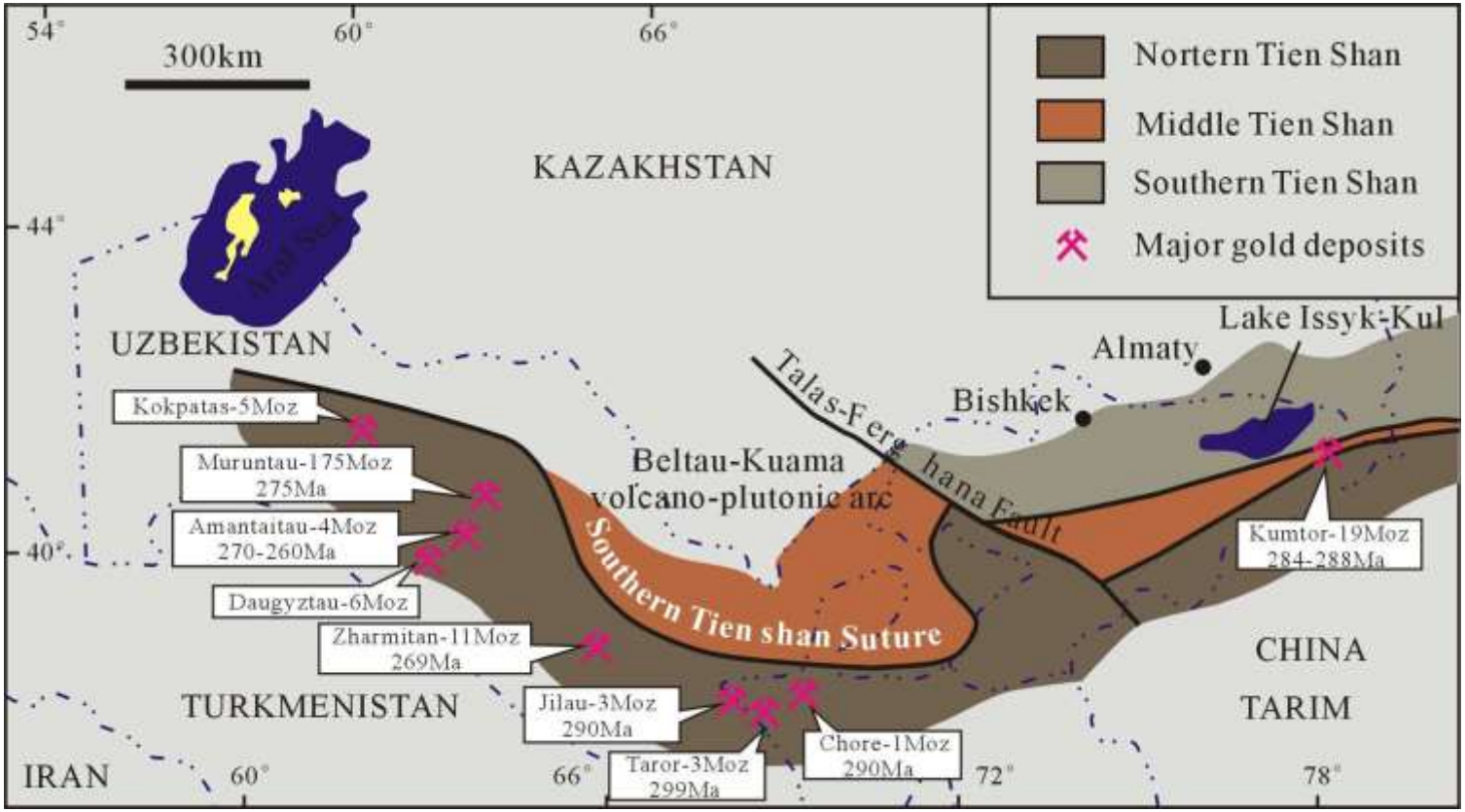

>56 Ma
North American Plate
Kula Plate
Chugach
Alexander
Gravina Belt
Taku
弱含水层
Aquitard
Prograded Fluid
H2O & CO2


<55 Ma
North American Plate
Kula Plate
Chugach
Alexander
Gravina Belt
Taku
Coast Range Megalineament

Hydrogeological Model of the Crust

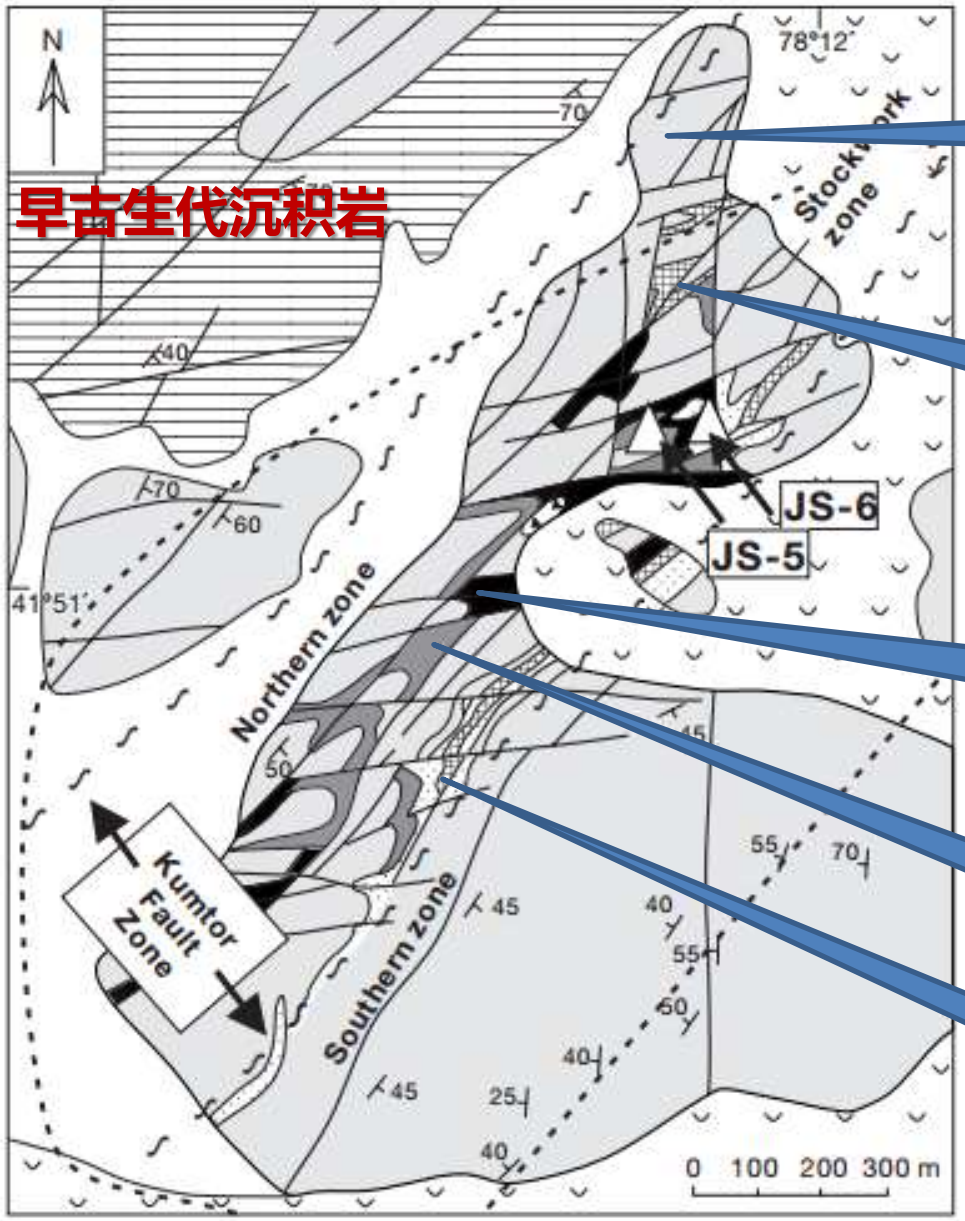


2. 后造山伸展环境成矿作用 （1）天山-北山-华北北缘成矿带



后造山形成的南天山世界巨型金矿带

1.5公里长/200-400米宽/延伸1000米



新元古代板岩和千枚岩

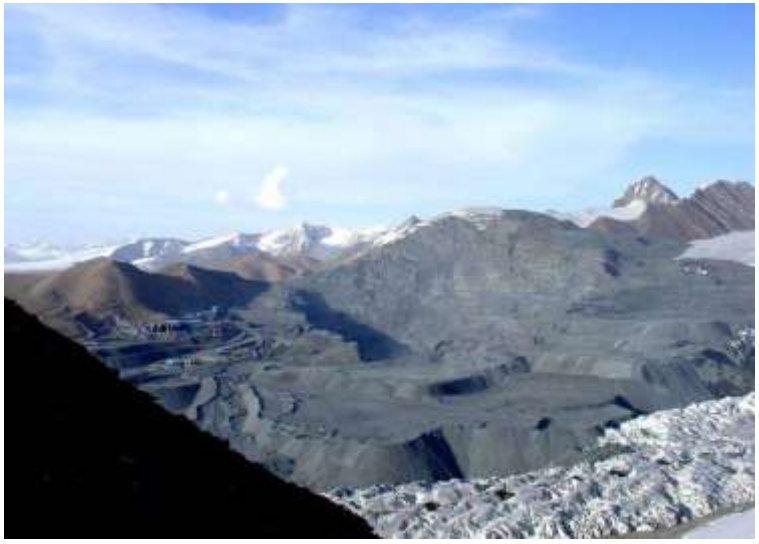
碳酸盐岩-石英-黄铁矿蚀变

黄铁矿-钠长石-碳酸盐岩蚀变

石英-绢云母蚀变

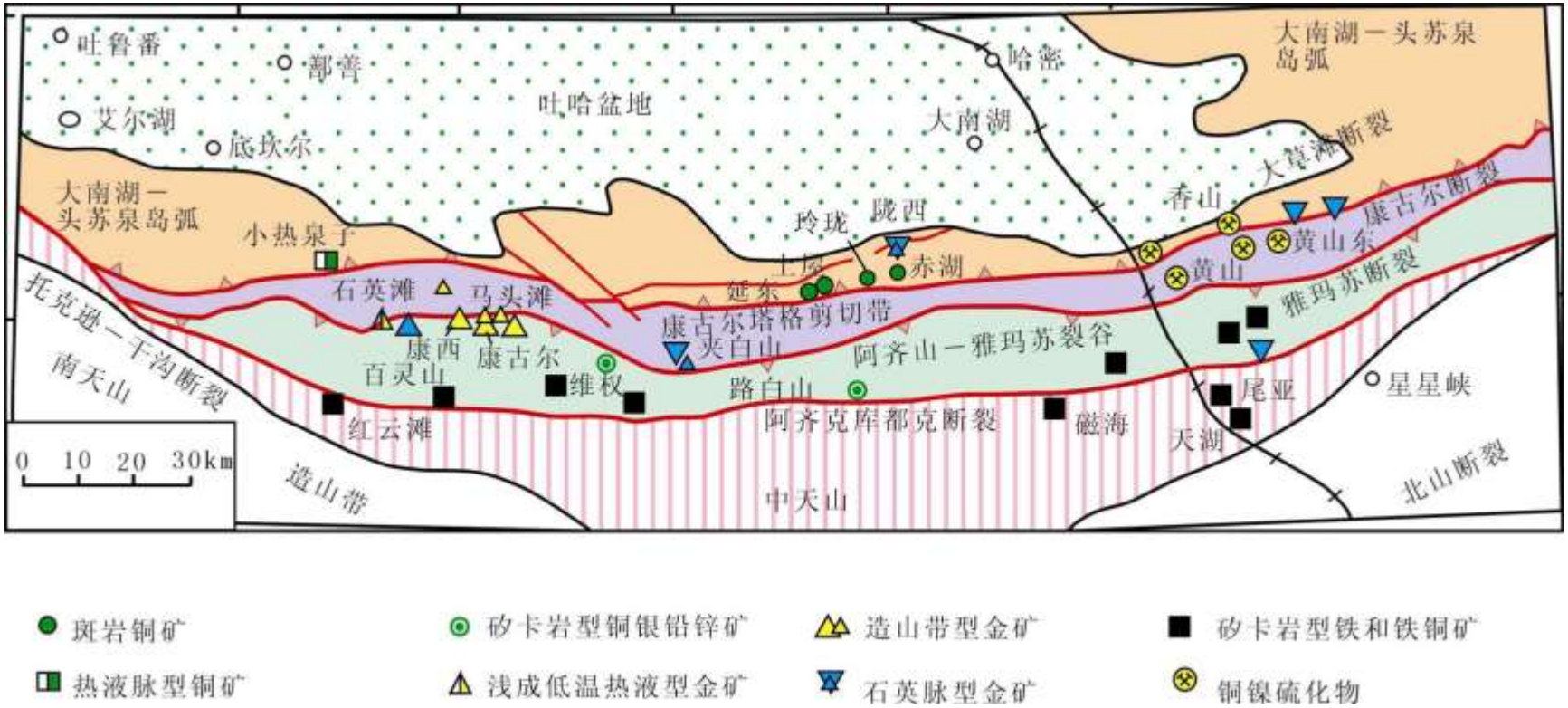
黄铁矿-钾长石-碳酸盐岩蚀变

吉尔吉斯斯坦Kumtor金矿平面图

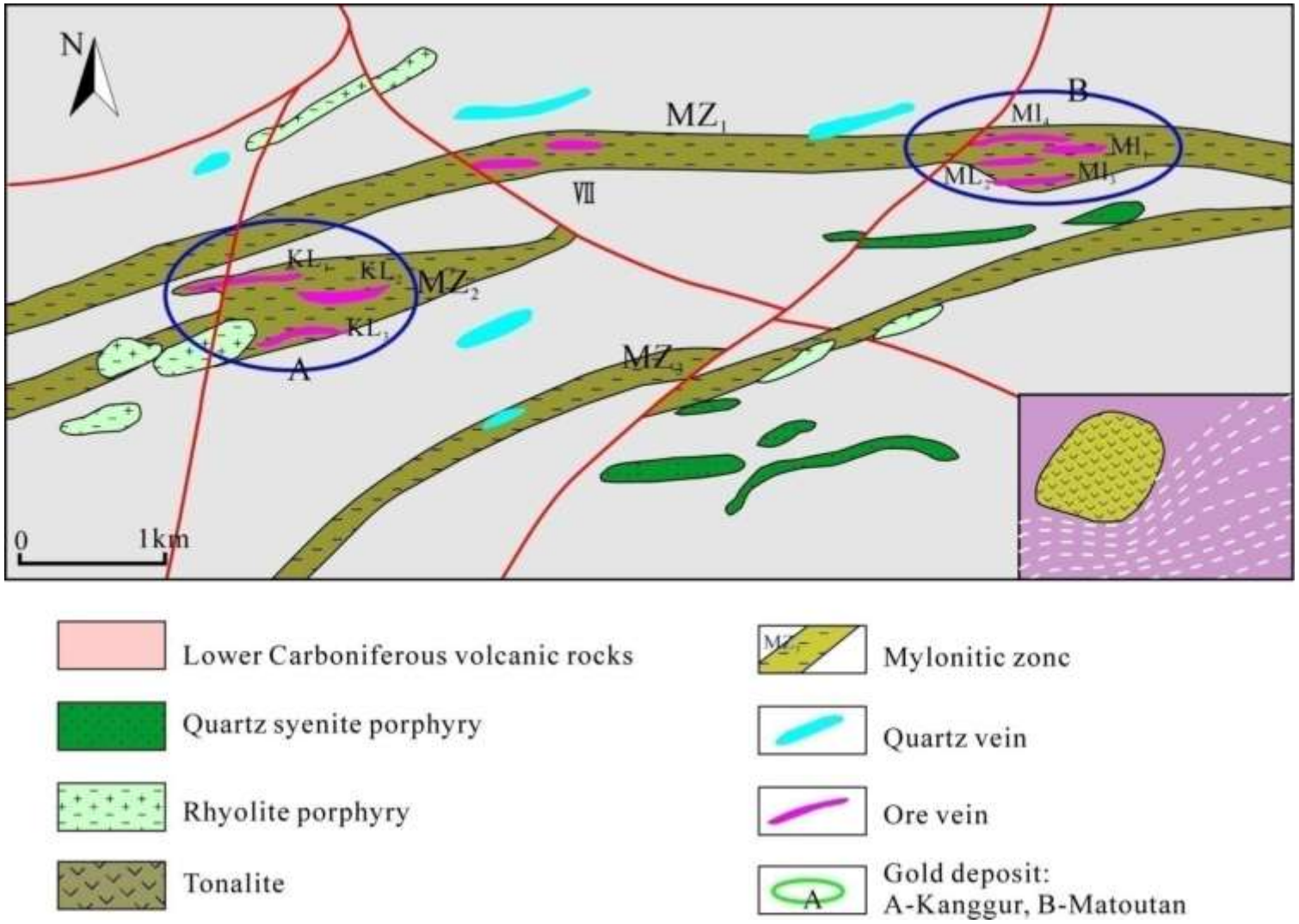


吉尔吉斯斯坦Kumtor金矿露天采场

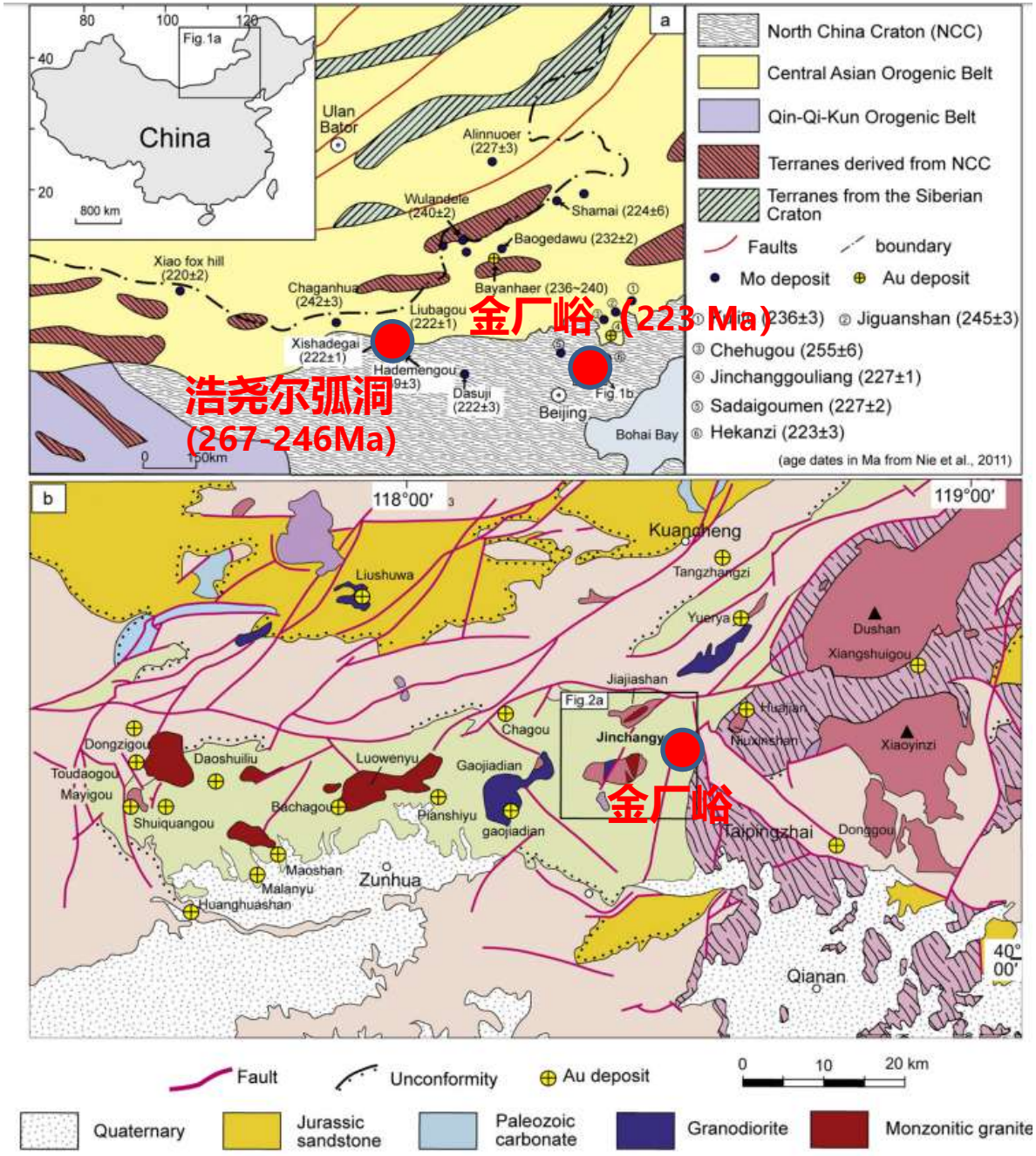
乌兹别克斯坦Muruntau金矿露天采场



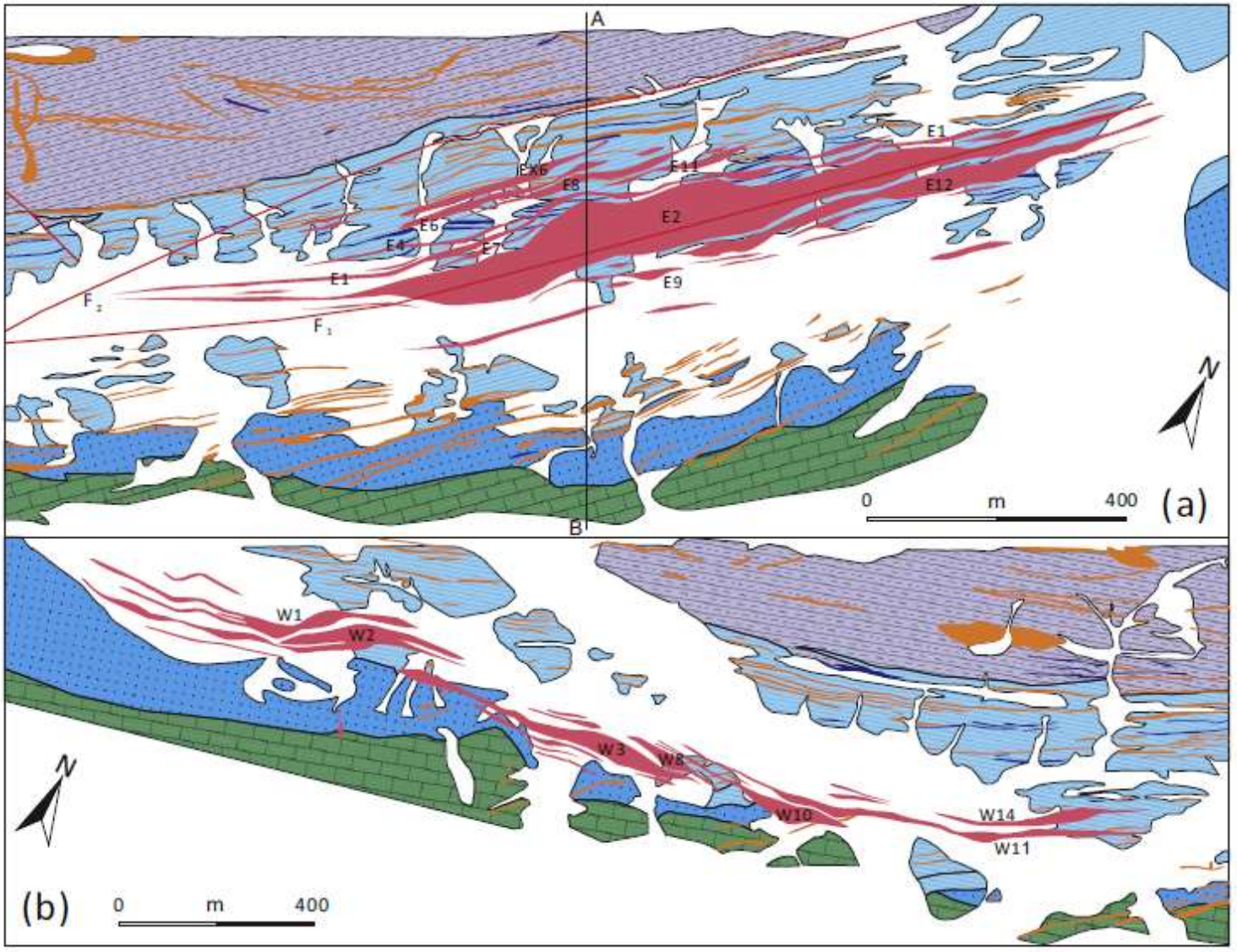
东天山多金属矿带: 众多矿床类型, 除了斑岩铜矿外, 绝大多数为后造山环境的产物



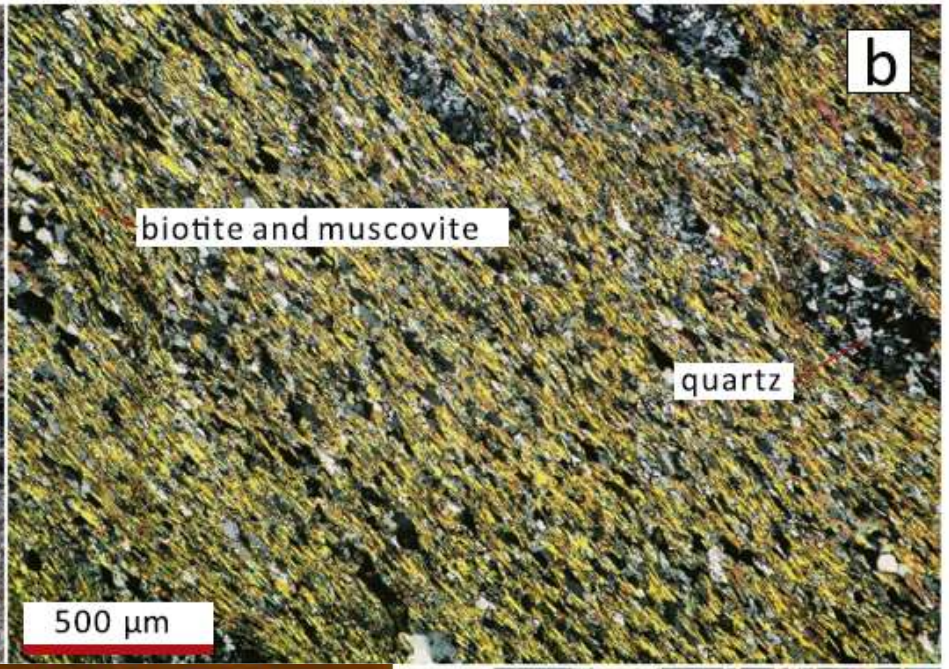
东天山康古尔-马头滩剪切带型金矿床 (45 tons / 12 g/t)

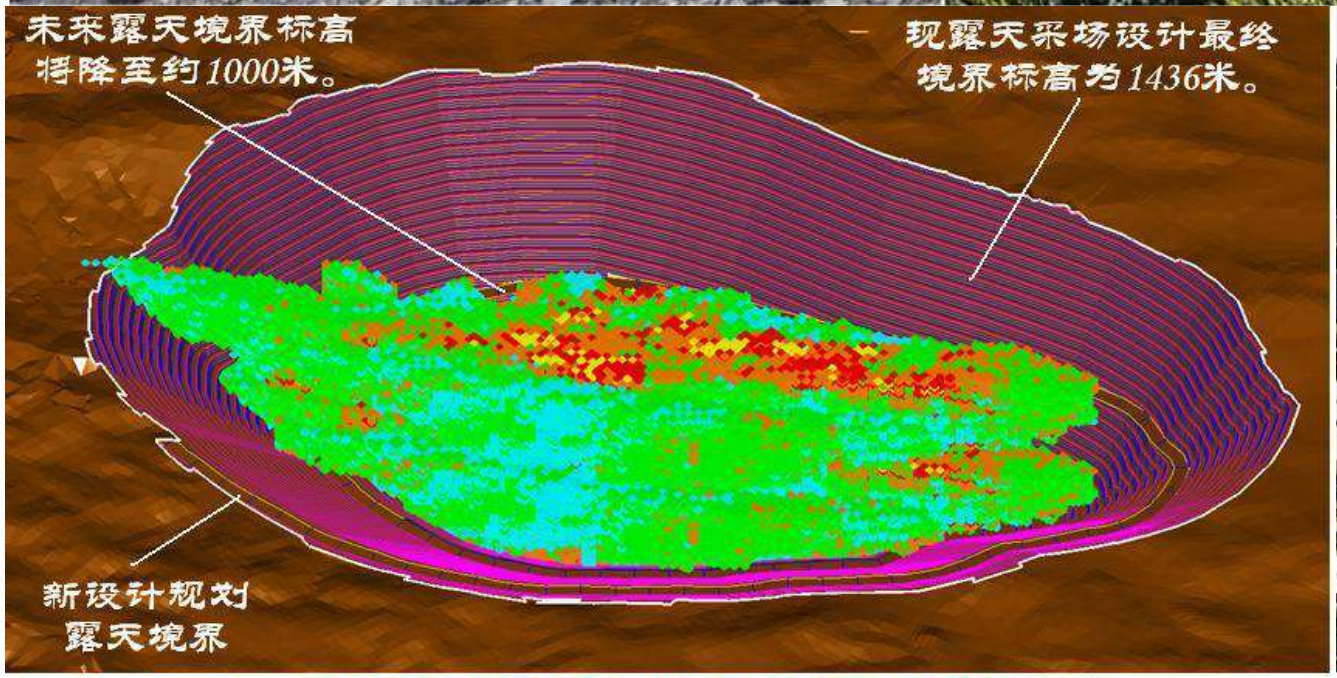


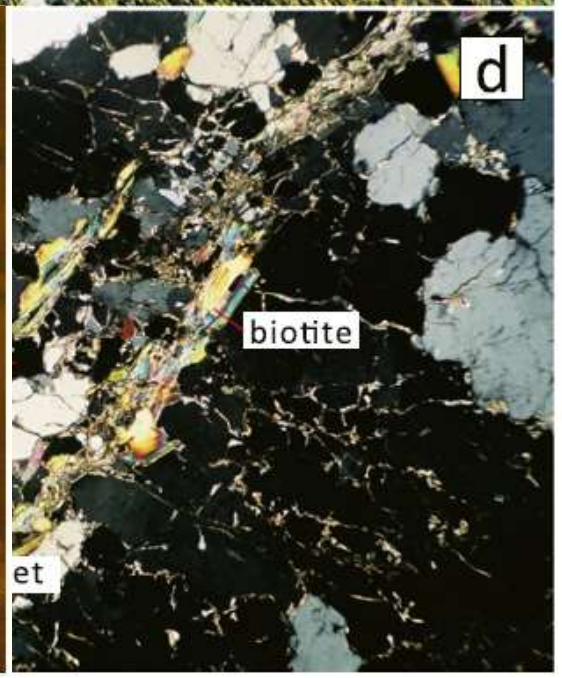
北山-华北地块北缘金矿分布图



浩尧尔弧洞金矿平面图（213吨/0.62g/t）

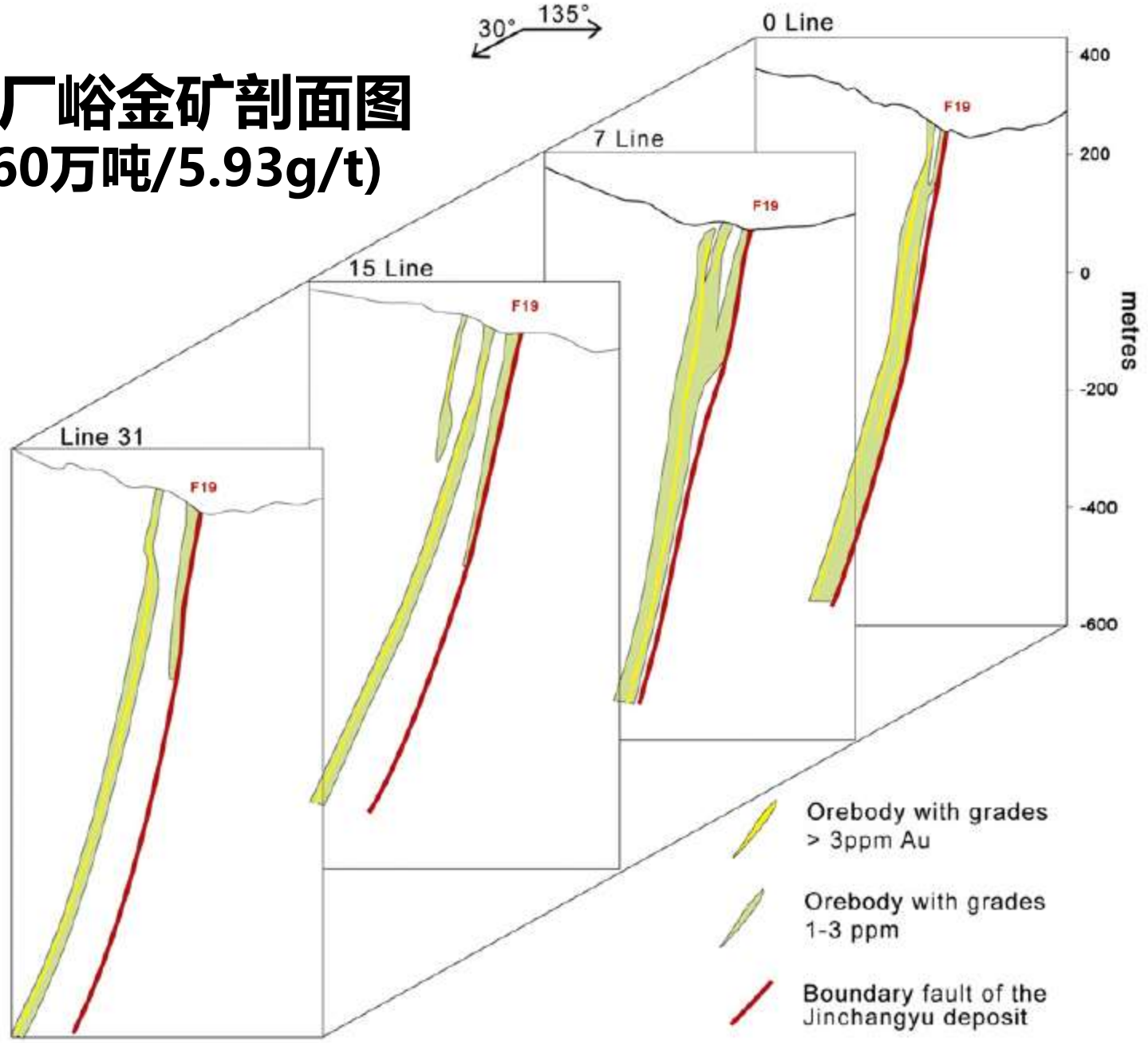


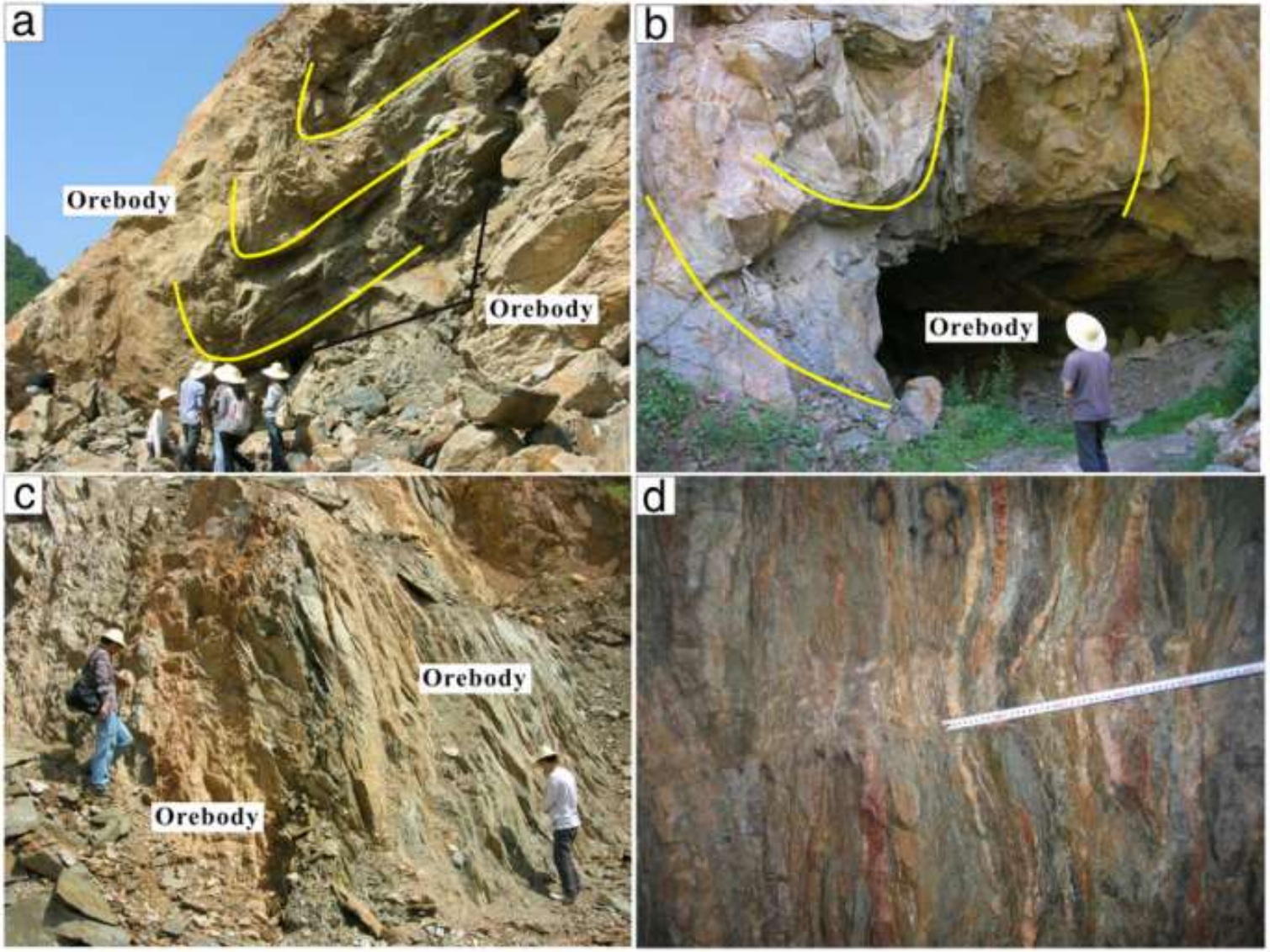




2011年探矿新增资源开发规划图

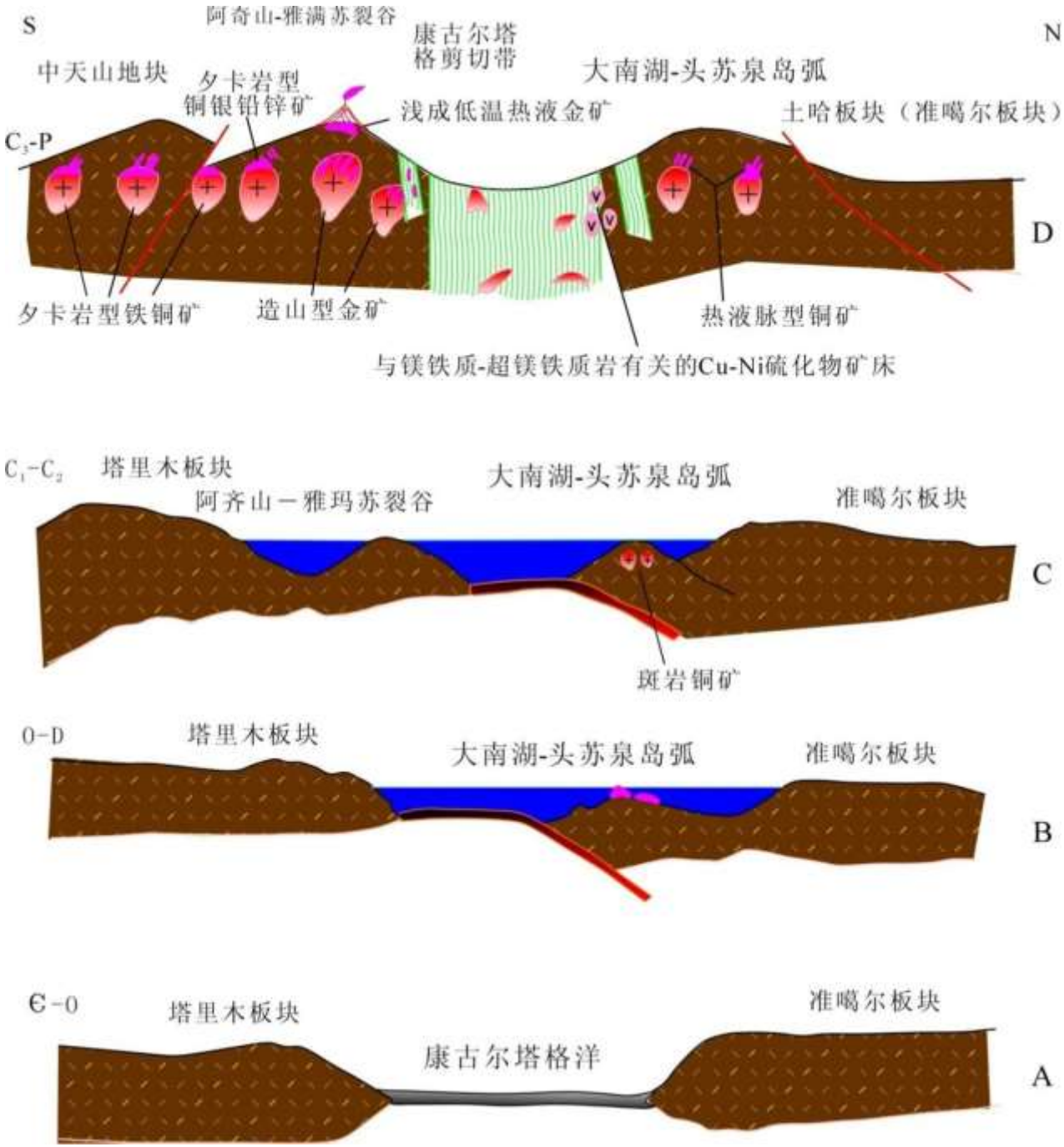
金厂峪金矿剖面图
(60万吨/5.93g/t)

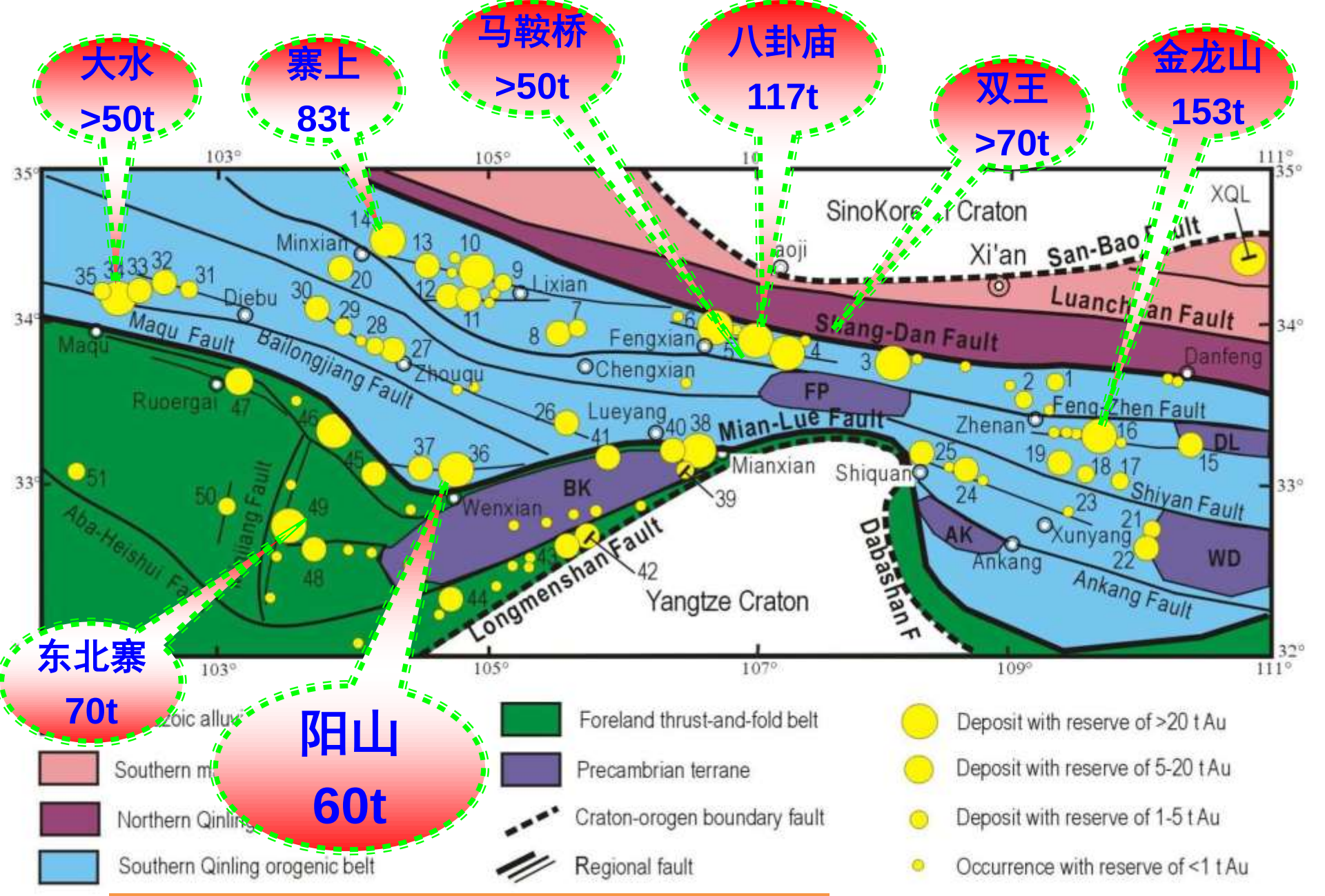




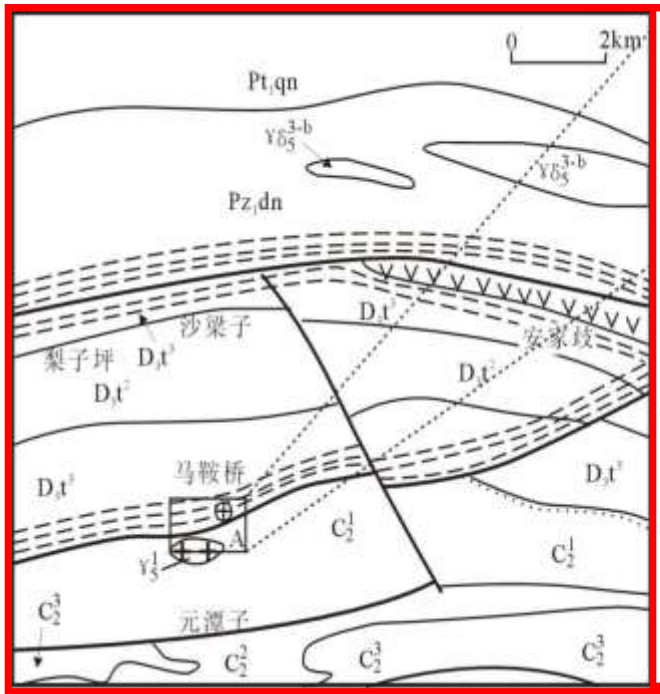
金厂峪金矿

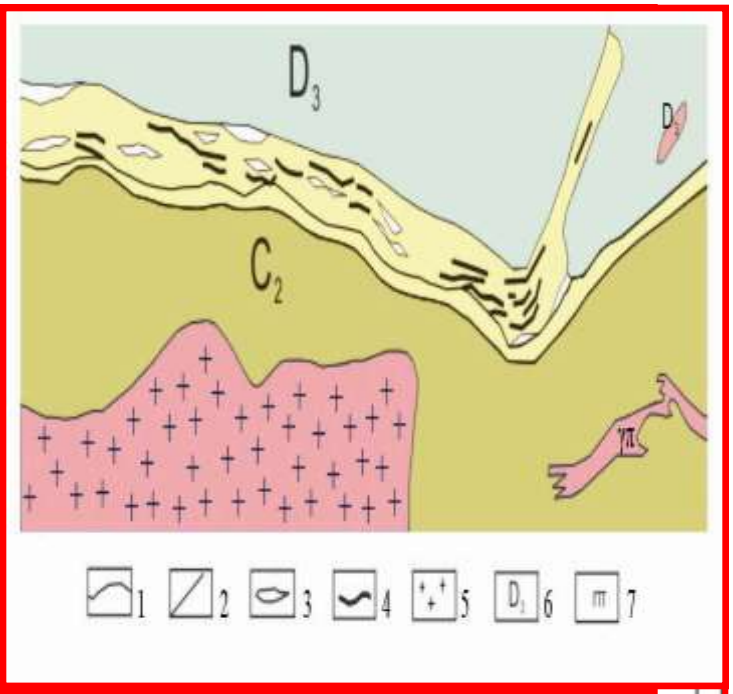
东天山矿带成矿的地球动力学模型



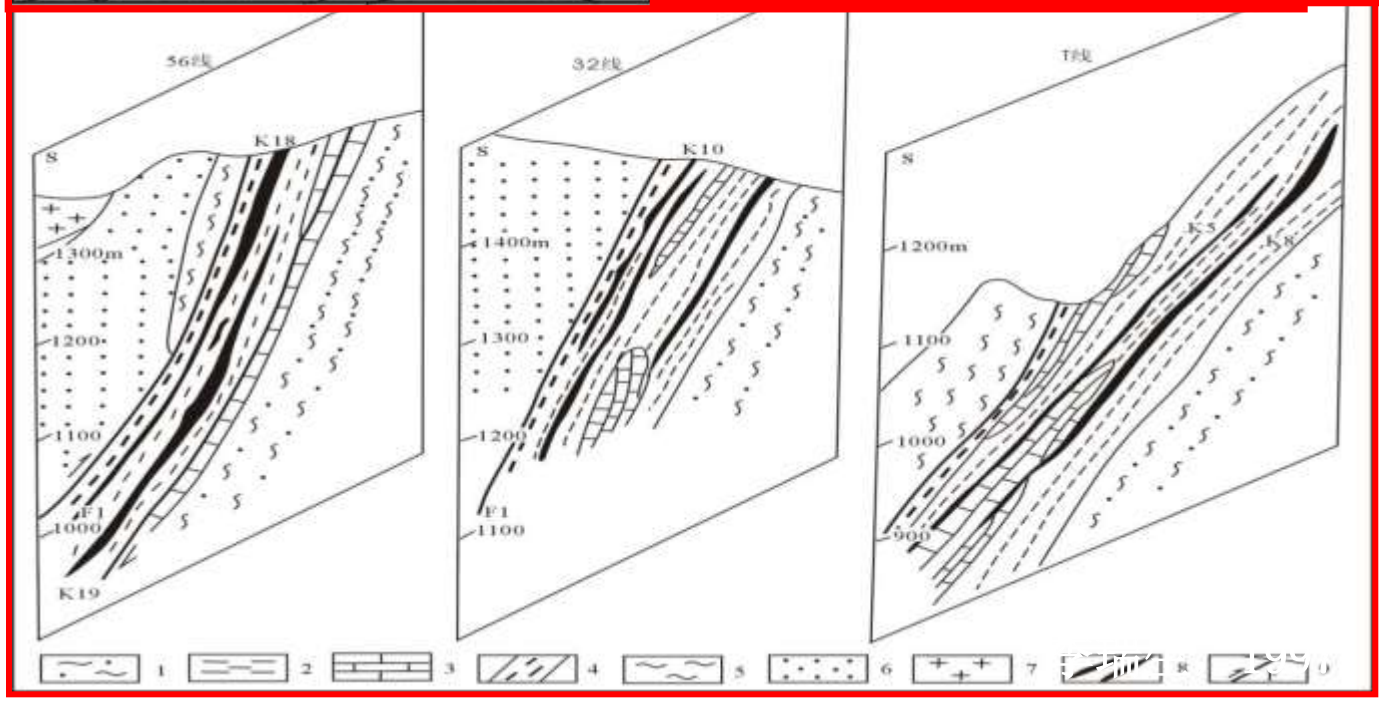

大水
>50t
寨上
83t
马鞍桥
>50t
八卦庙
117t
双王
>70t
金龙山
153t
东北寨
70t
阳山
60t
Minxian
Lixian
Diebu
Maqu
Maqu Fault
Bailongjiang Fault
Ruoergai
Zhouqu
Fengxian
Chengxian
Lueyang
Wenxian
Mianxian
Shiquan
Zhenan
Danfeng
Xi'an
Baoji
XQL
SinoKorean Craton
Shang-Dan Fault
Luanchuan Fault
Feng-Zhen Fault
Shiyan Fault
Ankang Fault
Mian-Lue Fault
Longmenshan Fault
Dabashan F
Aba-Heishui Fa
FP
BK
AK
DL
WD
Yangtze Craton
Xunyang
Ankang
103°
105°
107°
109°
111°
35°
34°
33°
32°
Foreland thrust-and-fold belt
Precambrian terrane
Craton-orogen boundary fault
Regional fault
Deposit with reserve of >20 t Au
Deposit with reserve of 5-20 t Au
Deposit with reserve of 1-5 t Au
Occurrence with reserve of <1 t Au
Southern Qinling orogenic belt

（2）西秦岭造山型金矿床

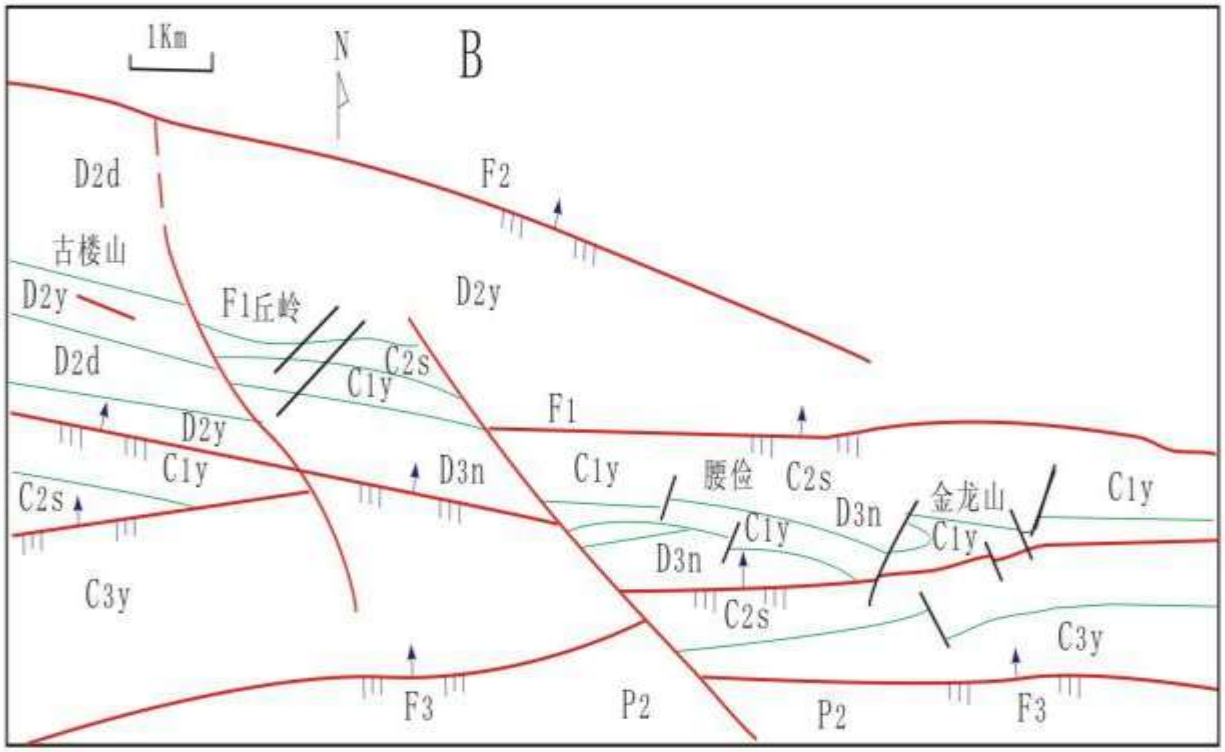


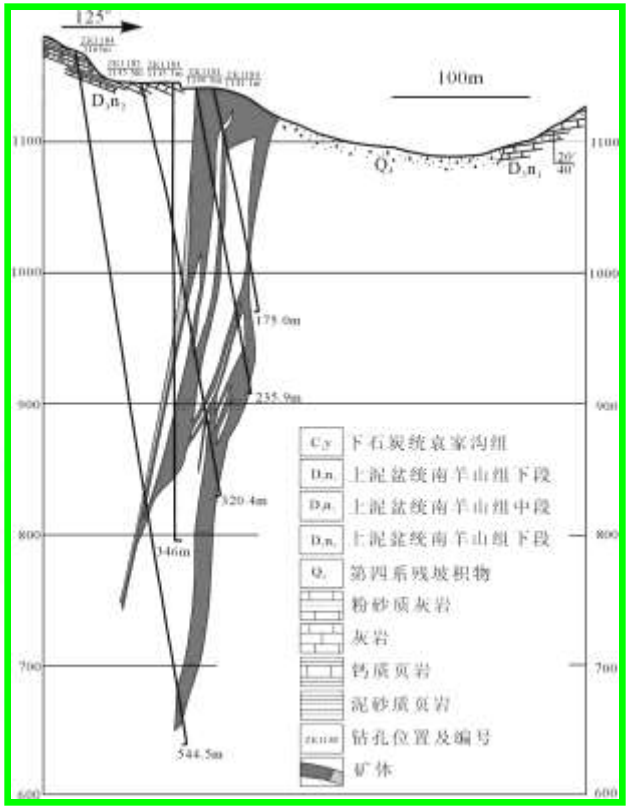


- 定位于E-W脆-韧性剪切带中
- 矿床空间定位和矿体展布受脆—韧性剪切带控制
- 金矿体定位于剪切带中剪切变形强烈部位。



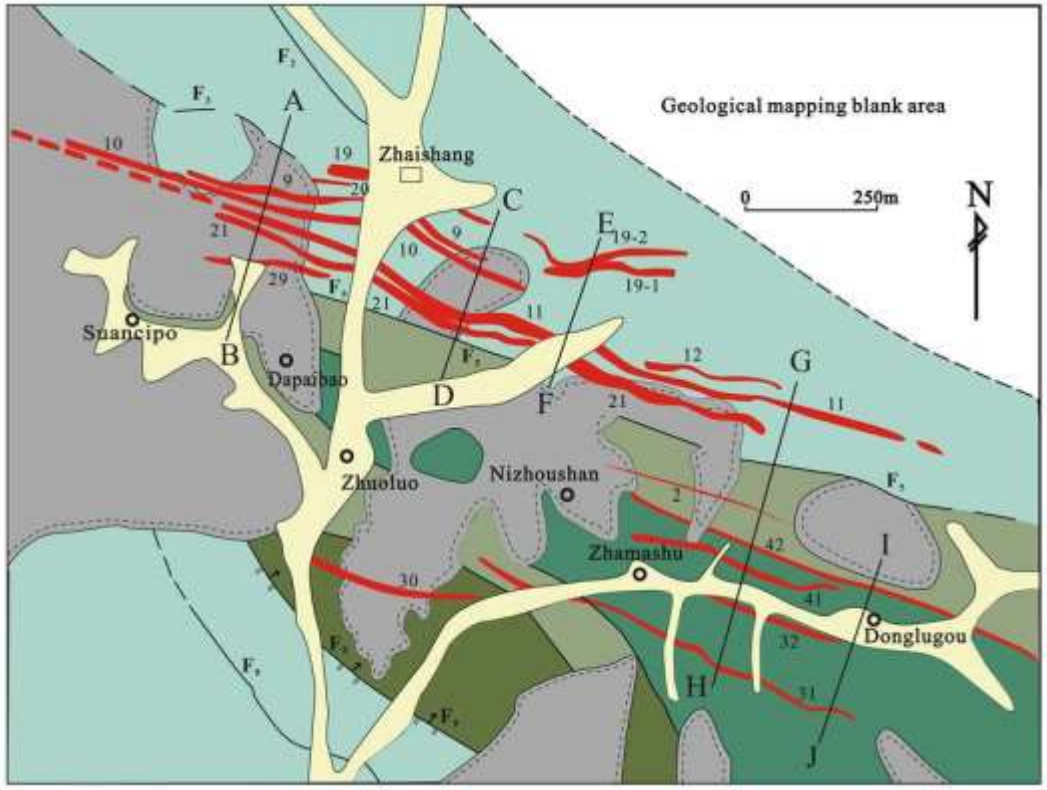
马鞍桥金矿



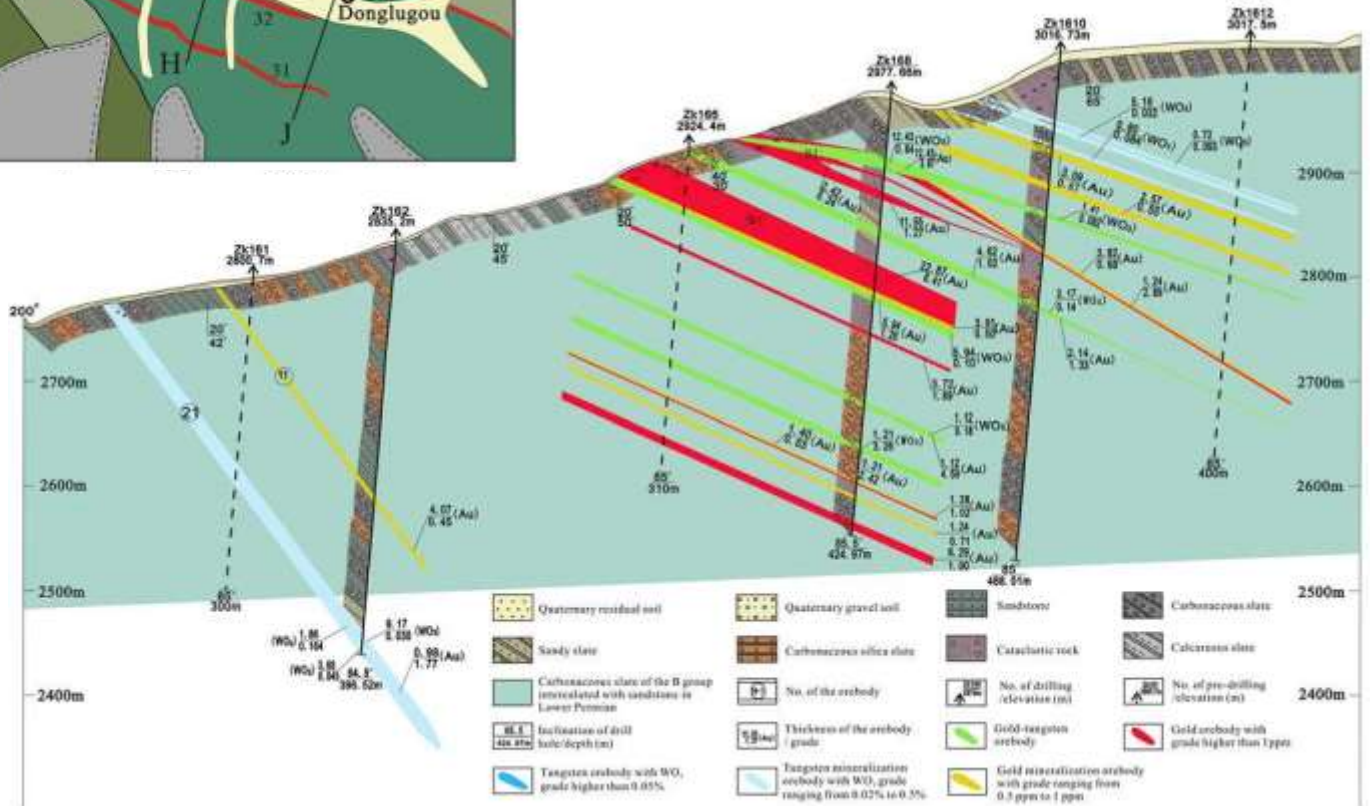


- 金矿床位于镇旬盆地中
- 矿体赋存于复式向斜北翼或背斜南翼
- 矿带展布与矿体定位受地层岩相及韧—脆性剪切变形构造控制

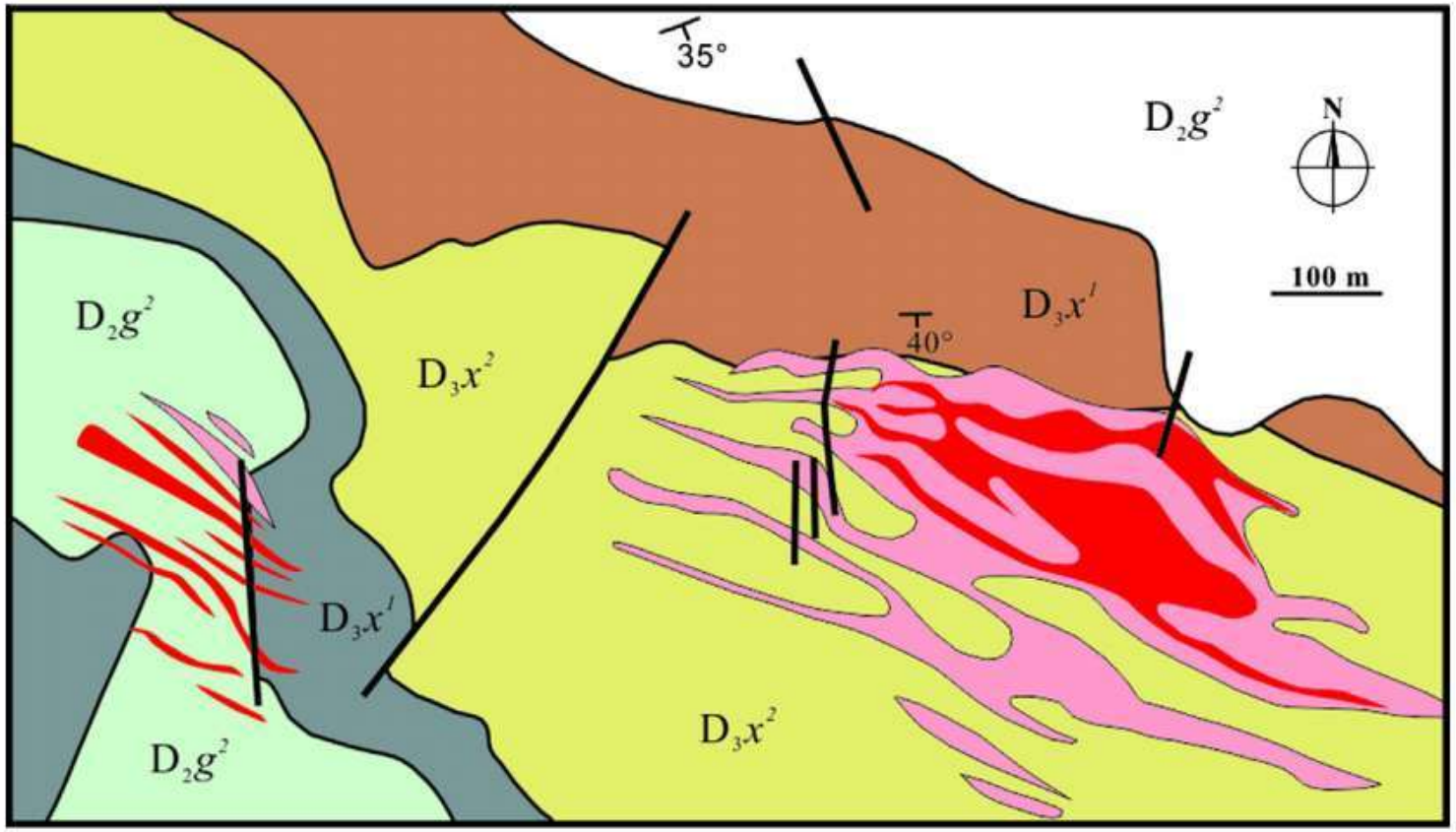
金龙山金矿


Geological mapping blank area
0
250m
N
Zhaishang
Snancipo
Dapaibao
Zhuoluo
Nizhoushan
Zhamashu
Donglugou
A
B
C
D
E
F
G
H
I
J
19-2
19-1

127t Au


Zk1610
3016.73m
Zk1612
3017.5m
Zk168
2977.05m
Zk165
2924.4m
Zk162
2835.2m
Zk161
2850.7m
2900m
2800m
2700m
2600m
2500m
2400m
Quaternary residual soil
Quaternary gravel soil
Sandstone
Carbonaceous slate
Sandy slate
Carbonaceous silica slate
Cataclastic rock
Calcareous slate
No. of the orebody
Gold-tungsten orebody

寨上金矿

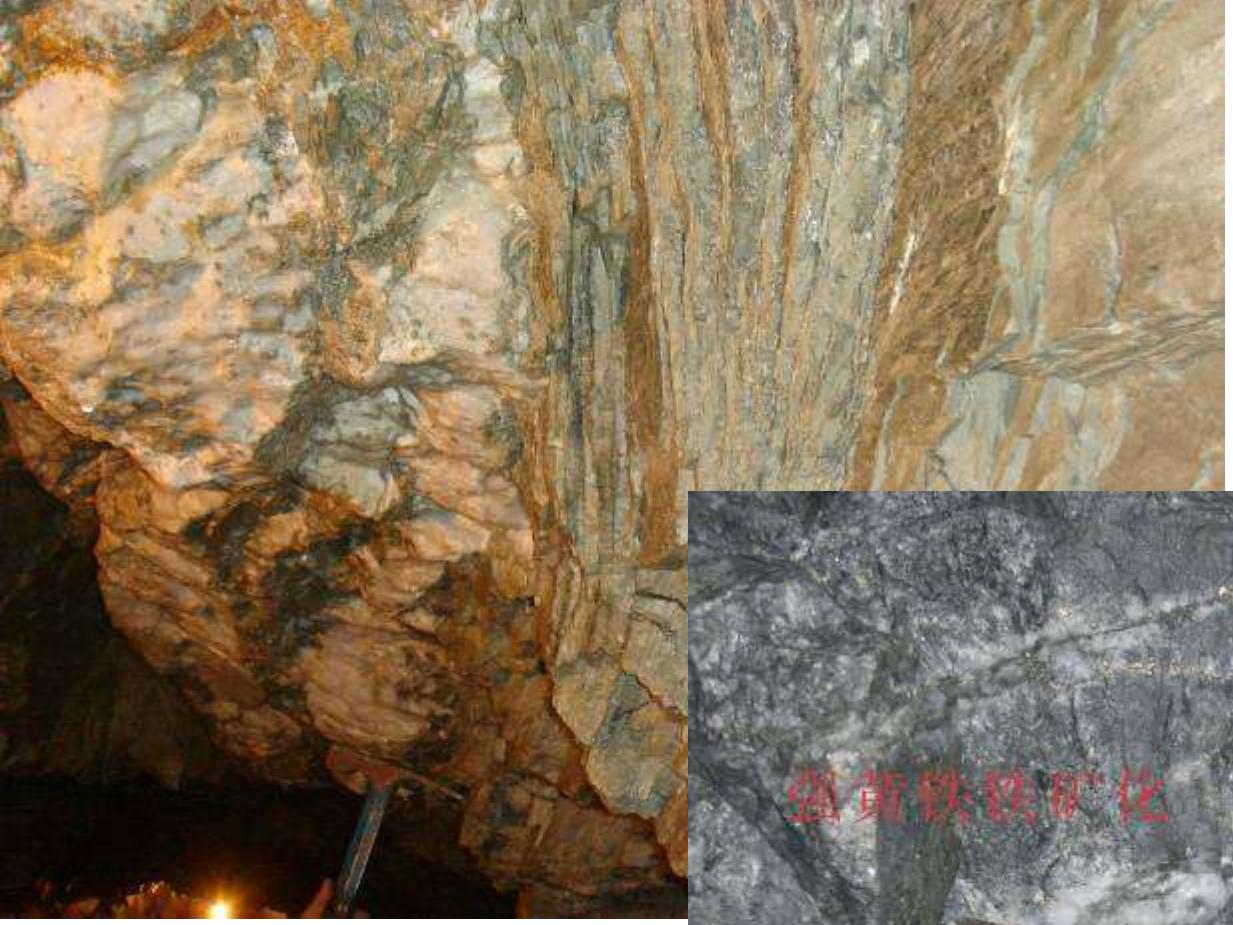

35°
D_2g^2
N
100 m
D_2g^2
D_3x^2
40°
D_3x^1
D_3x^1
D_3x^2
D_2g^2
D_2g^2 Middle Devonian silty ferrodolomite phyllite
D_3x^1 Upper Devonian marl limestone
D_3x^2 Upper Devonian spotted ferrodolomite phyllite
D_3x^1 Upper Devonian marl, limestone
D_2g^2 Upper Devonian crystalline limeston
Gold orebody
Fault
Alteration zone; silicification, pyritization, carbonatization

八卦庙金矿

八卦庙金矿床

柴蚂金矿床

丝毛岭金矿床



沈家湾金矿床

双王金矿床

马鞍桥金矿床

成矿时代

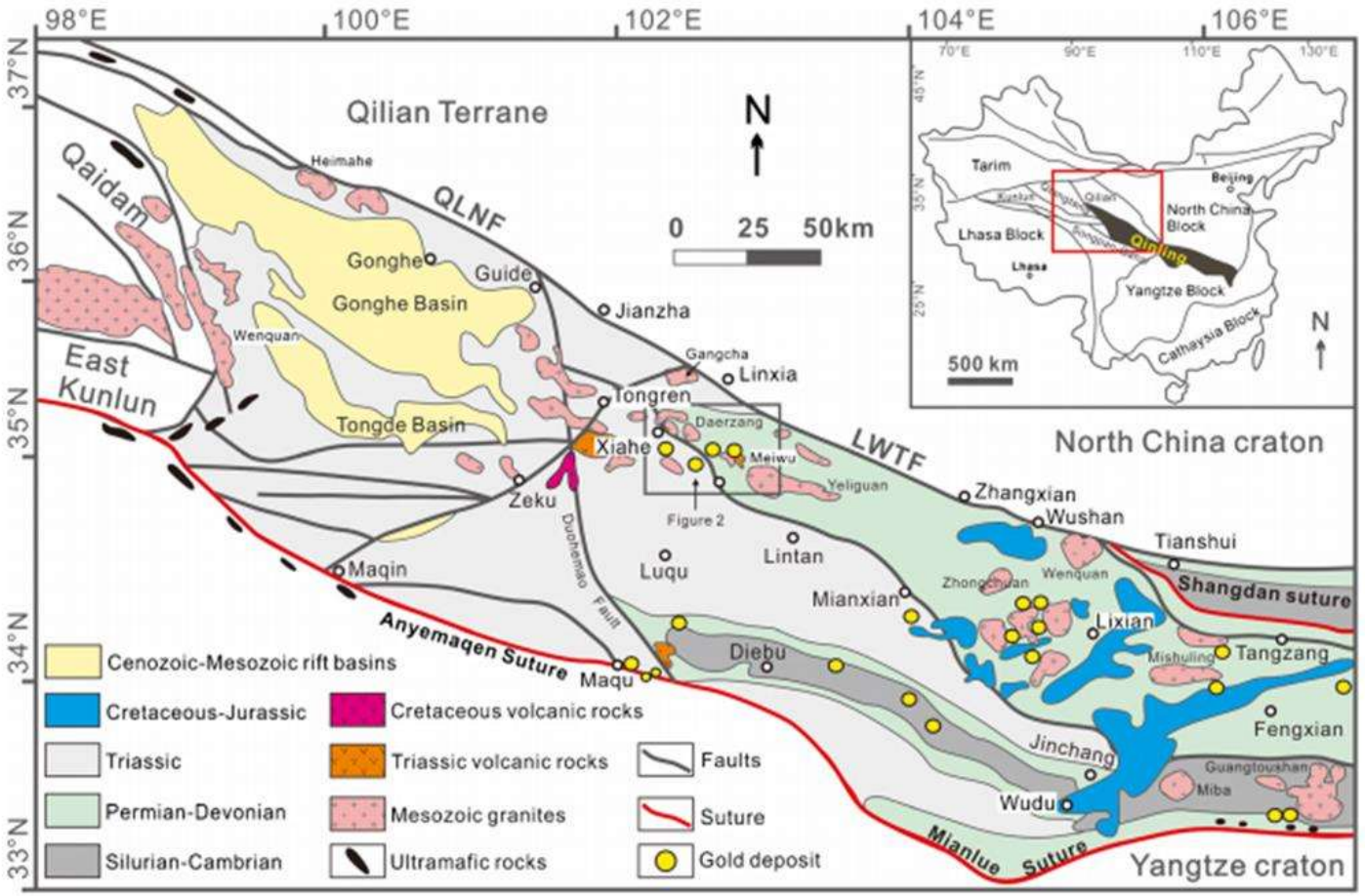
双王金矿床钾长石Ar-Ar 年龄为**202 - 198.3Ma**（石准立等，1993）

八卦庙金矿床NW向石英脉Ar-Ar坪年龄为**232.58±1.59Ma**，等时线年龄为**222.14±3.45Ma**（冯建忠等，2002）

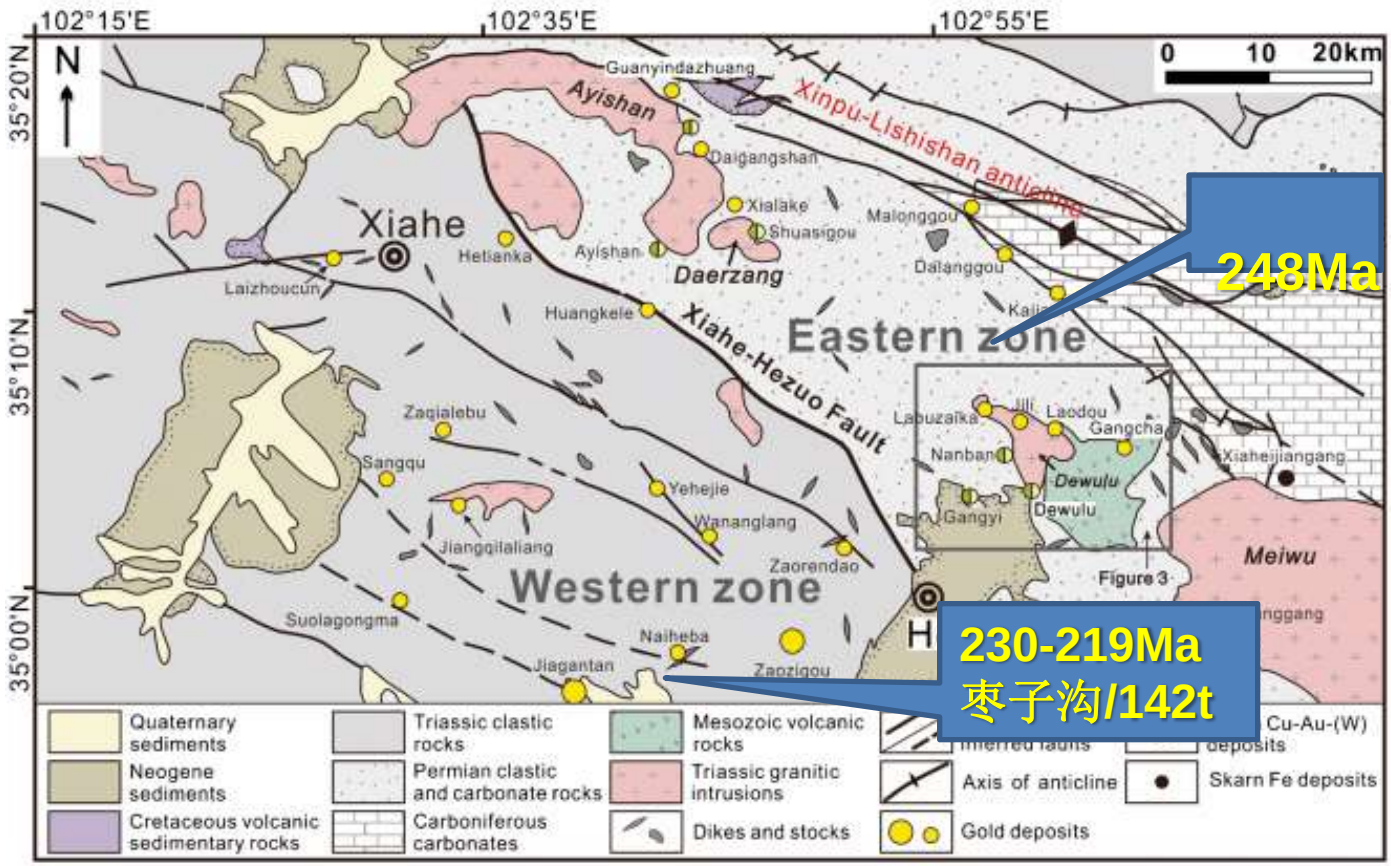
丝毛岭金矿床绢云母Ar-Ar坪年龄为**211.9±1.5Ma**（李霞等，2014）

总体上，多数研究者认为金的成矿作用发育在**印支期**（韦龙明，2003；Mao et al.，2002；张复新等，2004；陈衍景等，2010）。

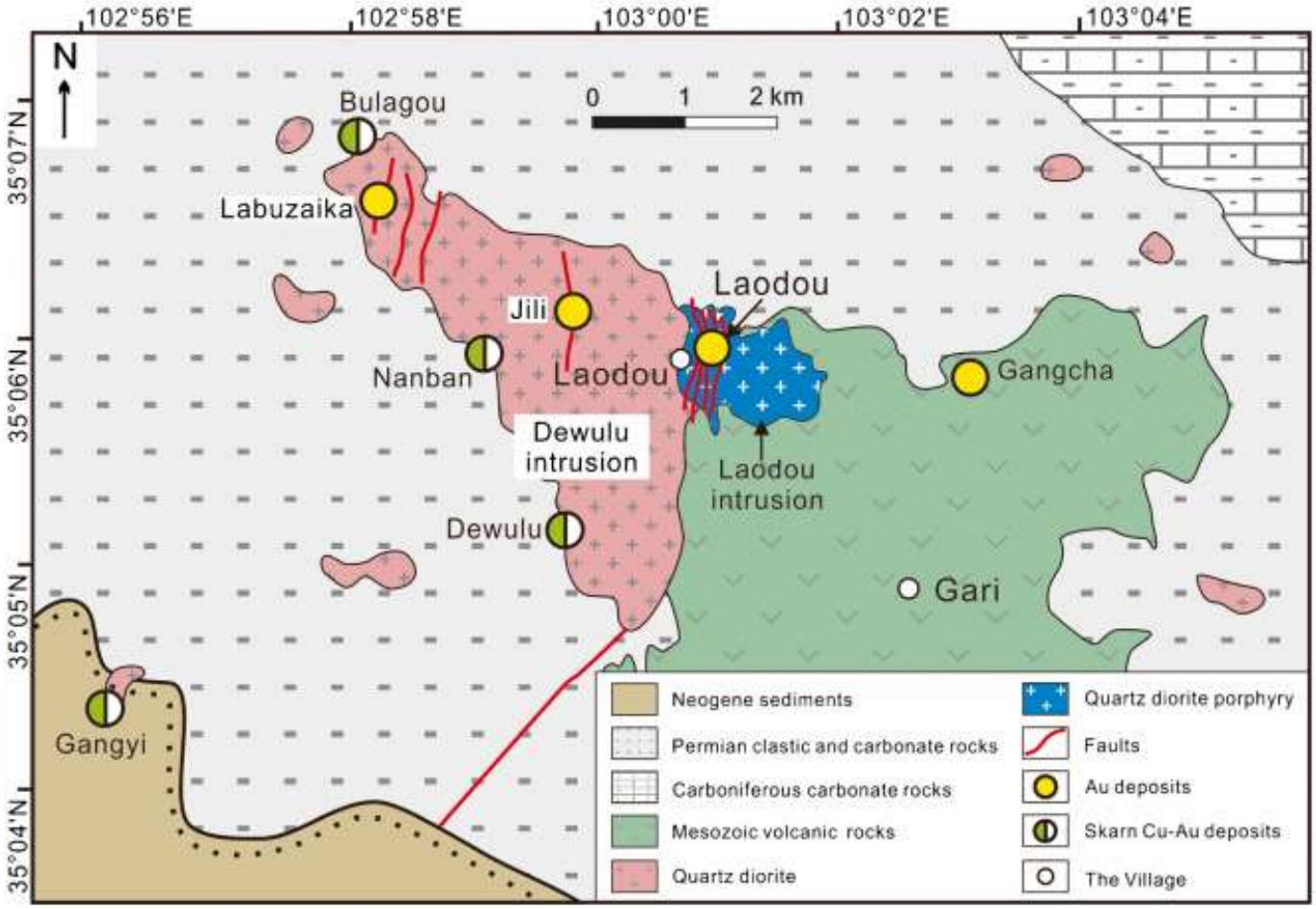
类型	岩体名称/岩脉位置	岩性	测试方法	测试结果/Ma	资料来源
凤太矿集区岩浆岩脉	二里河矿区	闪长玢岩脉	LA-ICP-MS	214±2	王瑞廷等，2011
		英云闪长岩脉	SHRIMP	221±3	刘树文等，2011
	孔棺	花岗闪长斑岩脉	LA-ICP-MS	230.4±1.8	项目组未发表数据
	金铜沟	花岗闪长斑岩脉		230.7±1.8	
	凉水湾	花岗斑岩脉		219.9±1.9	
	西坝北侧岩枝	黑云母二长花岗岩		223.5±1.4	
	古迹岩株	黑云母花岗岩		223.7±1.0	
	东塘子矿区	花岗斑岩脉		221.8±1.1	
	大沟	闪长岩脉		225.0±1.0	
凤太矿集区岩体	花红树坪岩体	花岗闪长岩		225.9±1.2	
	西坝岩体	花岗闪长岩	LA-ICP-MS	218±1	张帆等，2009
		花岗闪长岩	LA-ICP-MS	201.2±3.3	张宗清等，2006
		石英闪长质包体	SHRIMP	214±3	Zhang et al.,2012
		二长花岗岩	LA-ICP-MS	219±1	张帆等，2009
		细粒闪长岩	SHRIMP	215±3	刘树文等，2011
		花岗闪长岩脉	SHRIMP	221±3	
	何家庄岩体	花岗闪长岩	LA-ICP-MS	246±3	刘树文等，2011
		花岗闪长岩	LA-ICP-MS	248±2	杨朋涛等，2013
		花岗闪长岩		247±4	
凤太矿集区临区南秦岭岩浆岩	华阳岩体	二长花岗岩	LA-ICP-MS	214±2	孟旭阳等，2013
		二长花岗岩		228±2	
		二长花岗岩	LA-ICP-MS	207±1	刘树文等，2011
		二长花岗岩		198±1	
	光头山岩体	糜棱岩化英云闪长岩	LA-ICP-MS	221±6	吴峰辉等，2009
		二长花岗岩	LA-ICP-MS	214±2	刘树文等，2011
		二长花岗岩		182±5	
		黑云母斜长花岗岩	LA-ICP-MS	216±2	孙卫东等，2000
	黄渚关岩体	中心相花岗闪长岩	LA-ICP-MS	214±1	王天刚等，2010
		边缘相花岗岩		213±3	
		花岗闪长岩	LA-ICP-MS	217.9±4.0	国阿千等，2011
	厂坝岩体	二云母花岗岩		213±2	王天刚等，2010
		二长花岗岩		216.3±4.3	国阿千等，2011
	糜署岭岩体	石英二长（闪长）岩		214.5±1.6	李佐臣等，2013
		二长花岗岩		213±3	秦江峰，2010
	迷坝岩体	二长花岗岩	LA-ICP-MS	220±2	孙卫东等，2000
		闪长花岗岩		211±2	
	新院岩体	花岗闪长岩	LA-ICP-MS	214±2	孙卫东等，2000



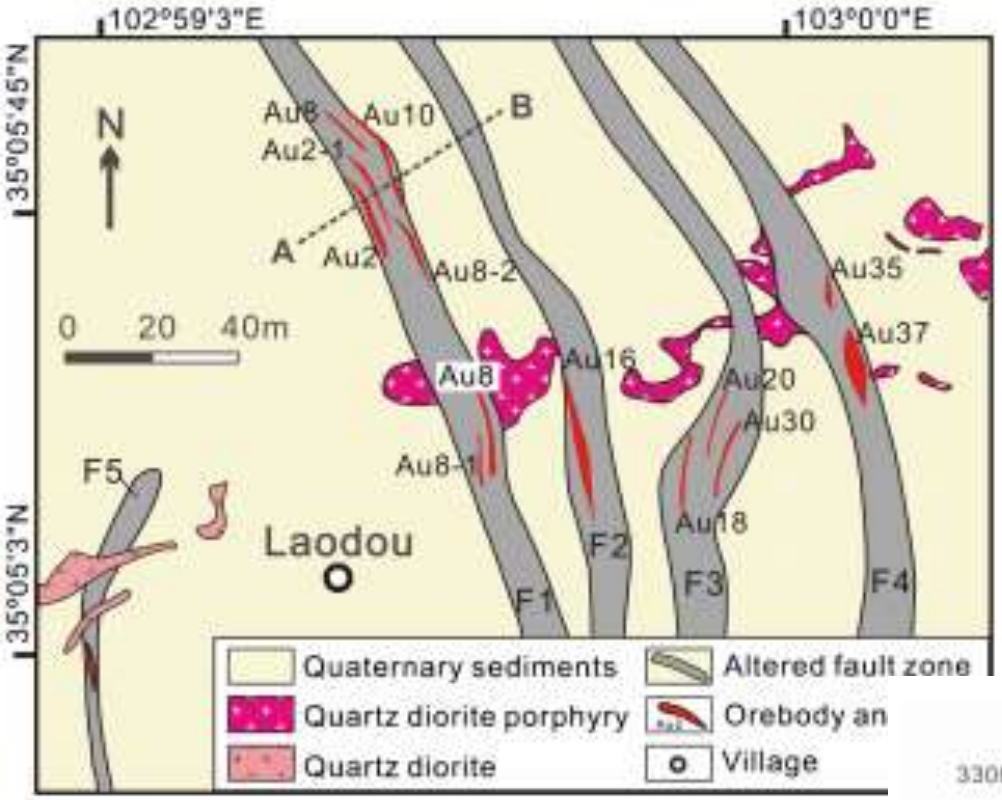
西秦岭-甘南金矿床的分布图



甘南夏河-合作地区金矿分布图



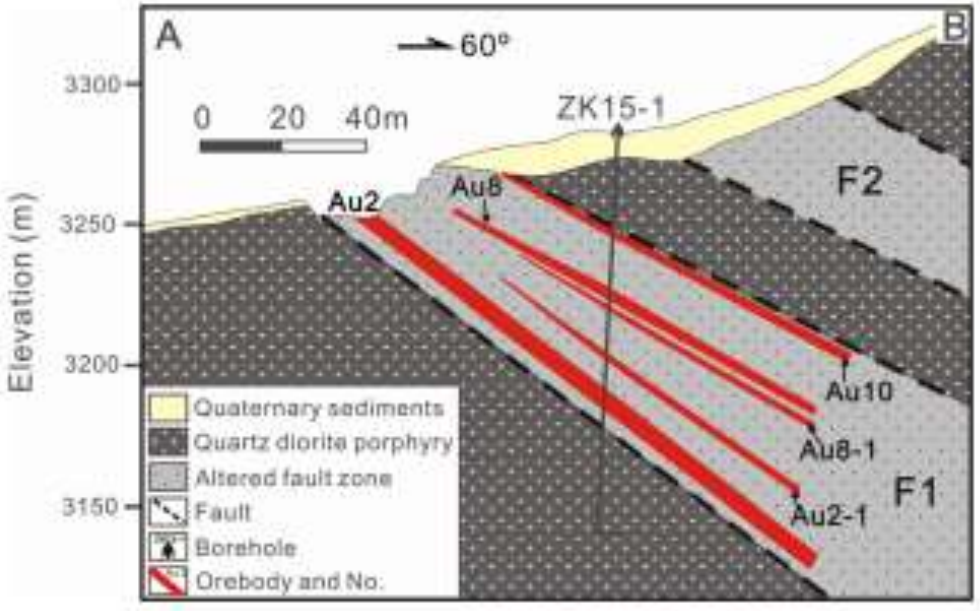
老豆矿田斑岩铜矿与造山型金矿分布图

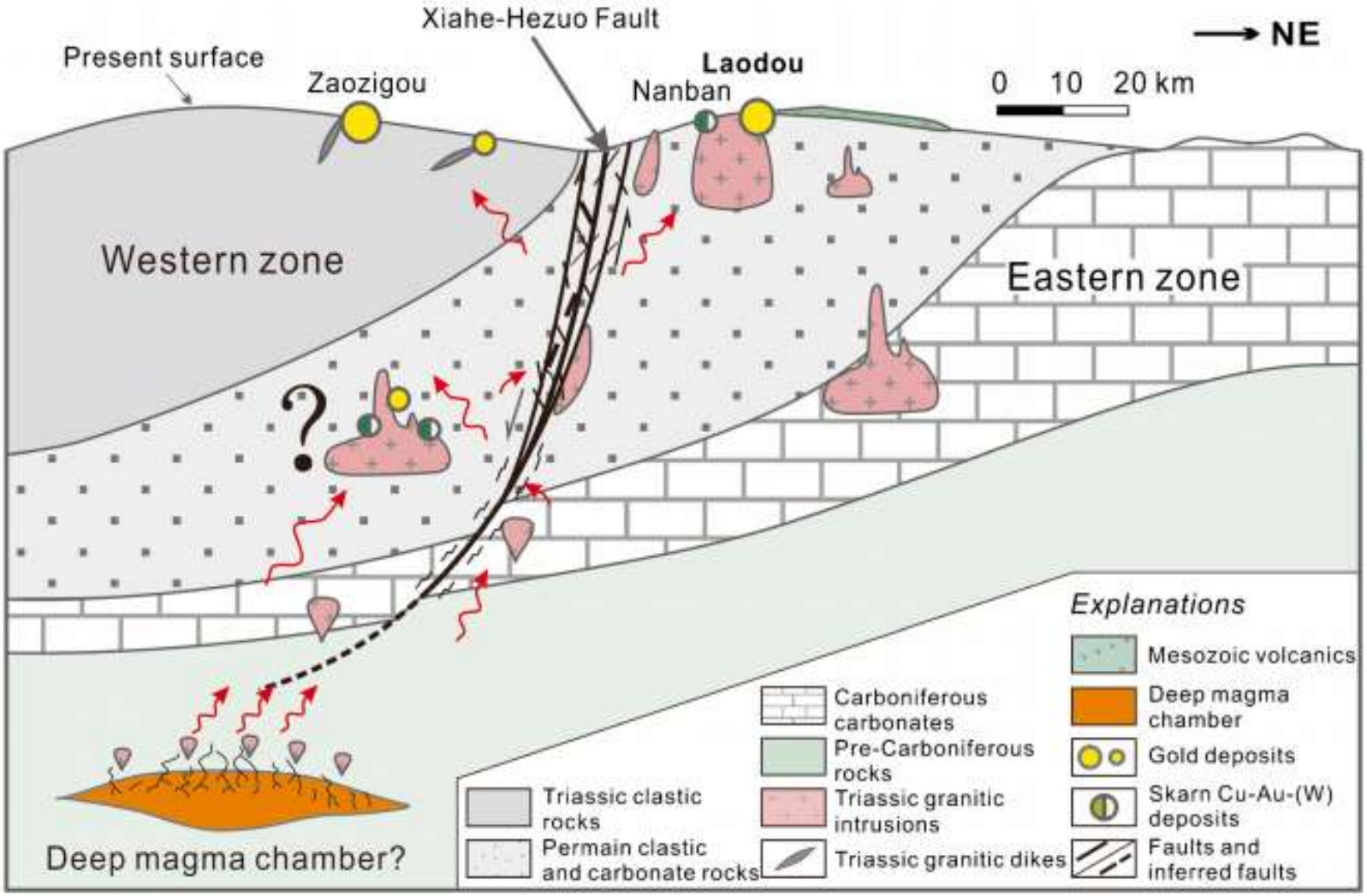


老豆金矿的平面图

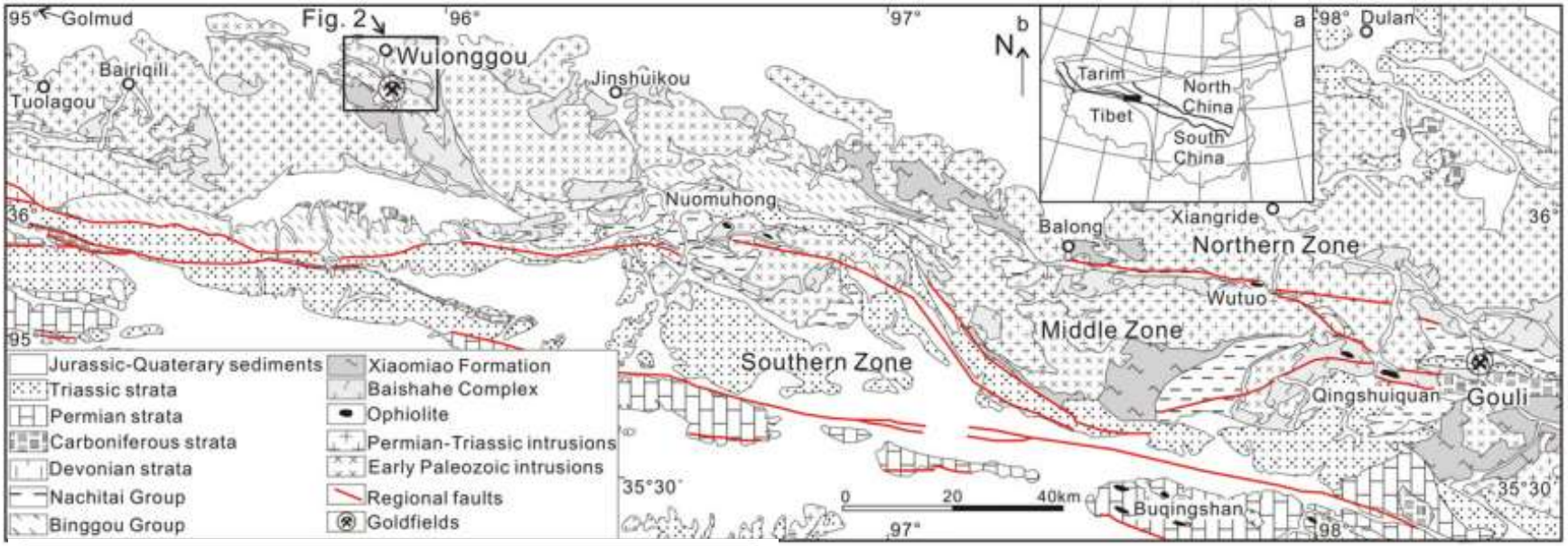
沿NNW方向的一组蚀变断裂带分布，呈微细粒浸染状

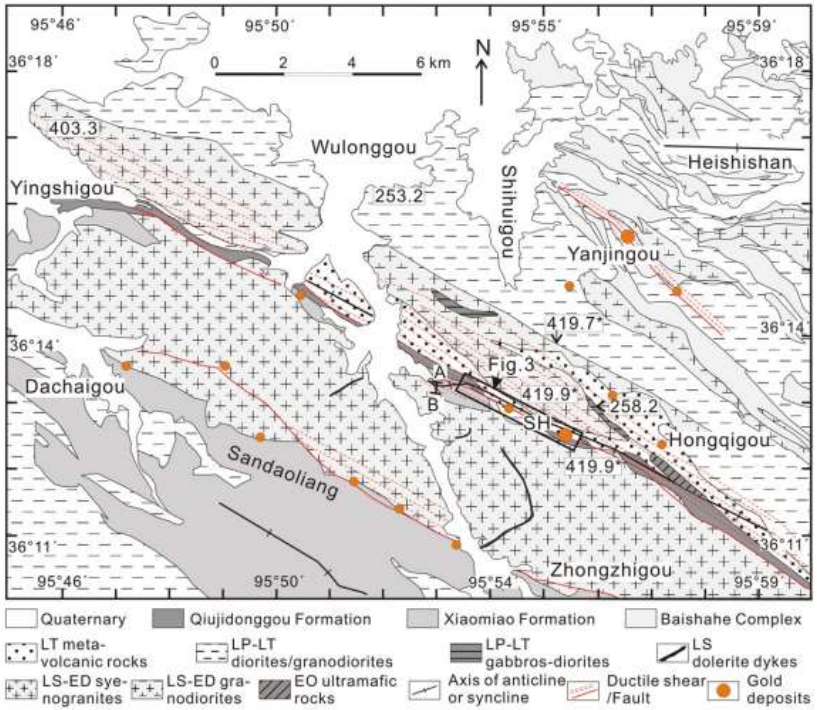
左图：老豆金矿的剖面图



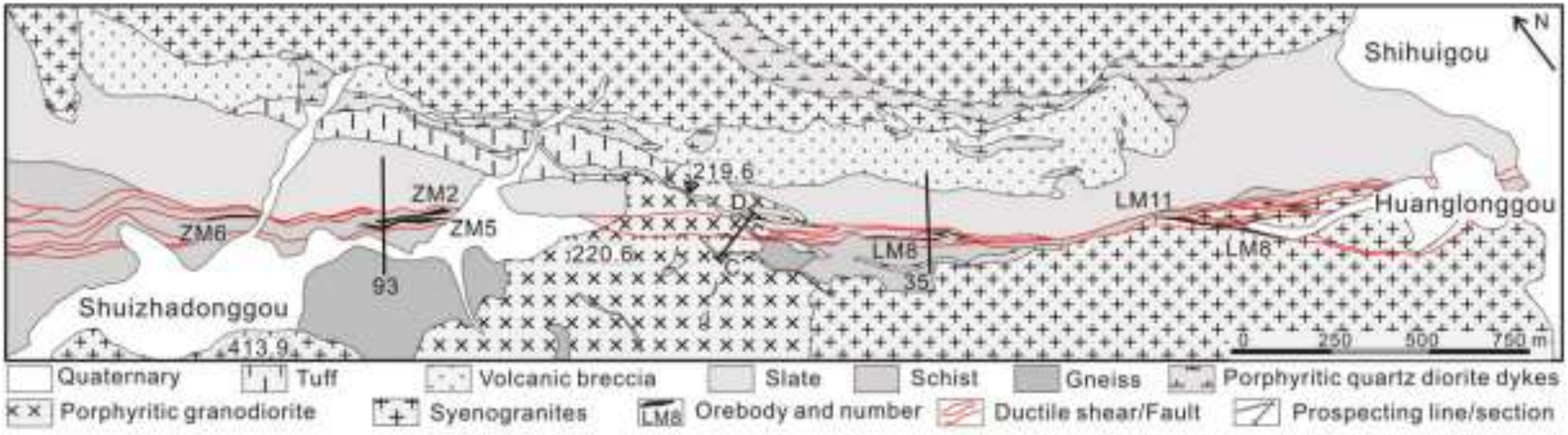


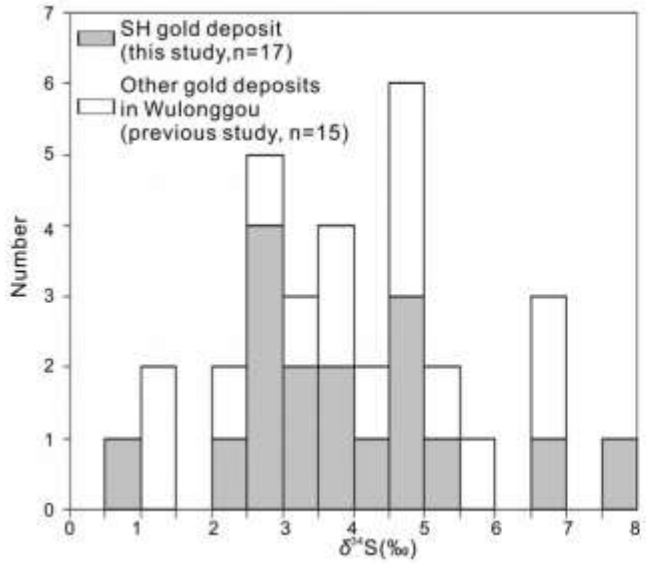
甘南金矿与斑岩铜矿-造山型金矿的成矿模式图（据Jin et al., 2017）

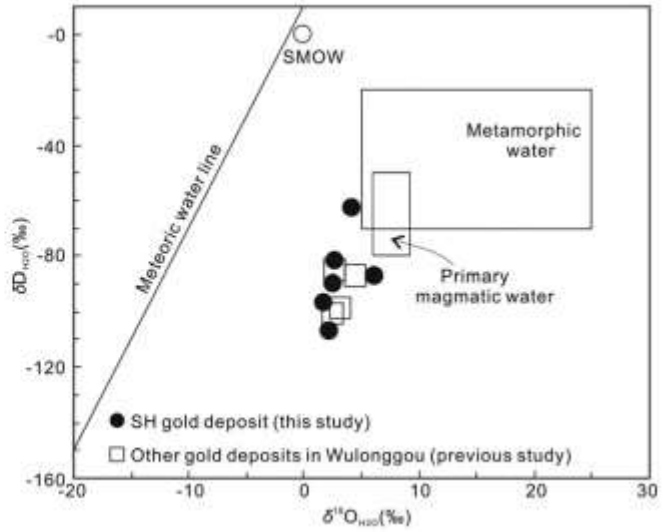




青海东昆仑五龙沟金矿田地质和金矿分布图

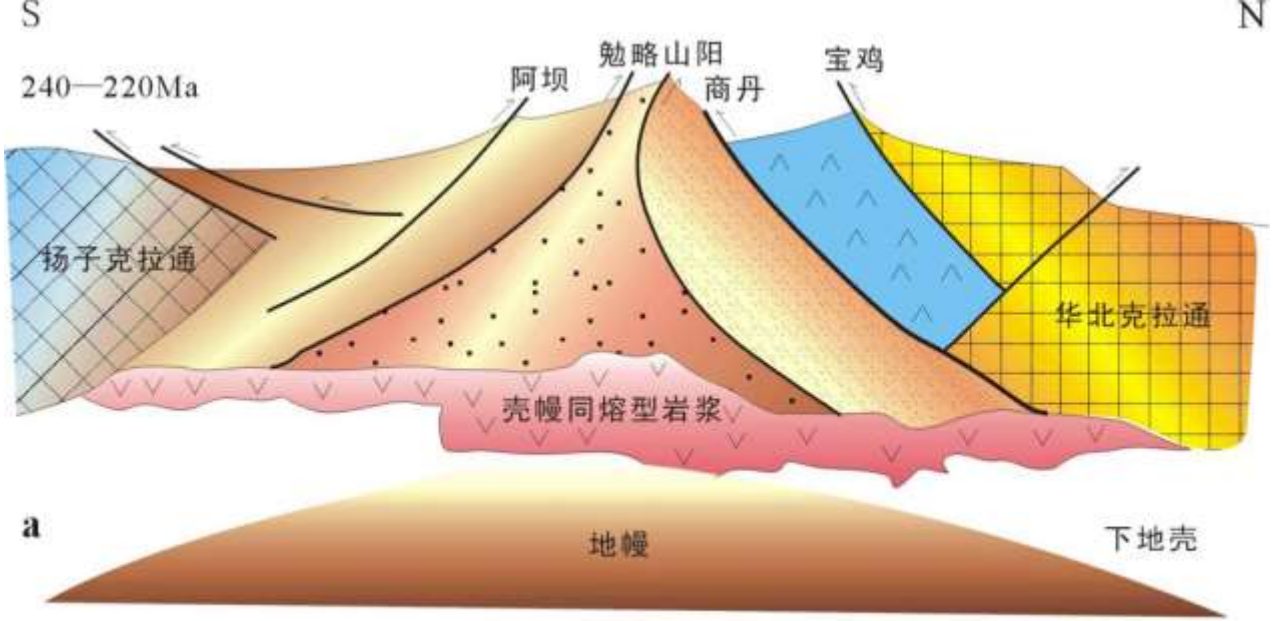


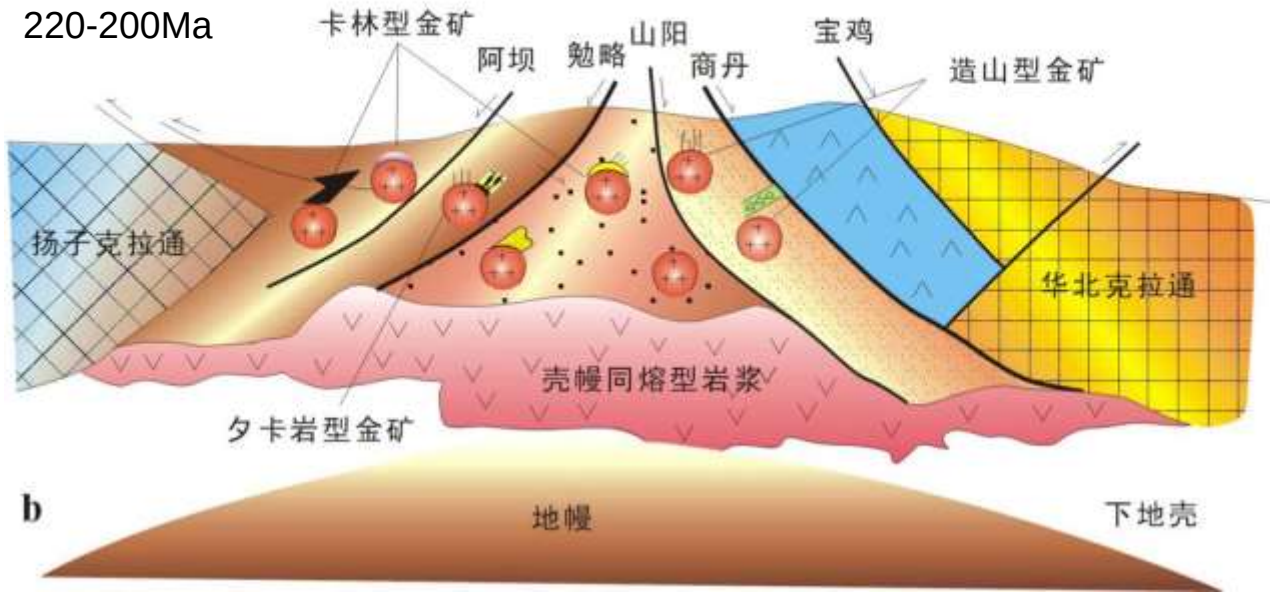




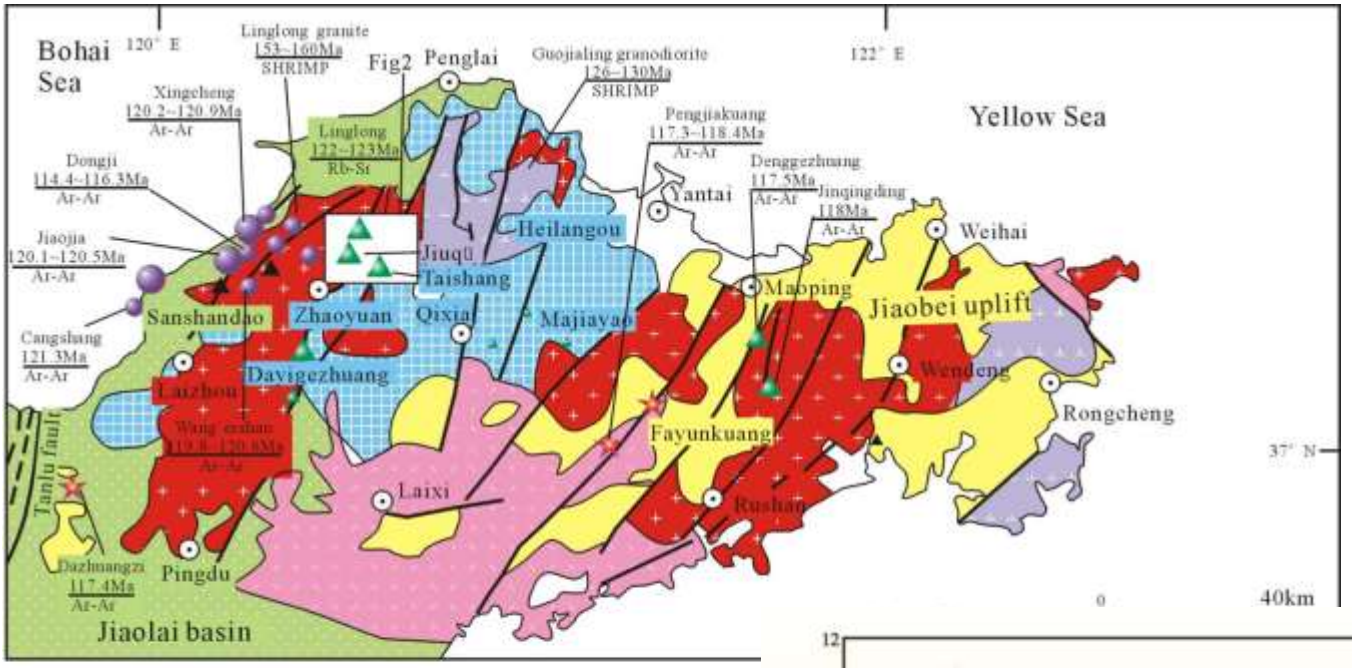
五龙沟金矿：造山型特点——剪切带控矿；其硫同位素和氢氧同位素显示与岩浆流体有关（据Zhang et al., 2017）

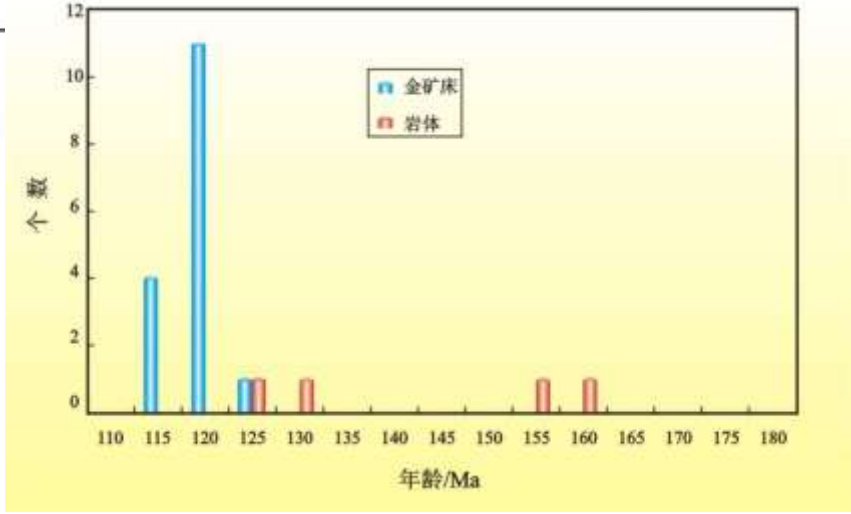
西秦岭中生代早中期碰撞造山及后造山金矿成矿模式

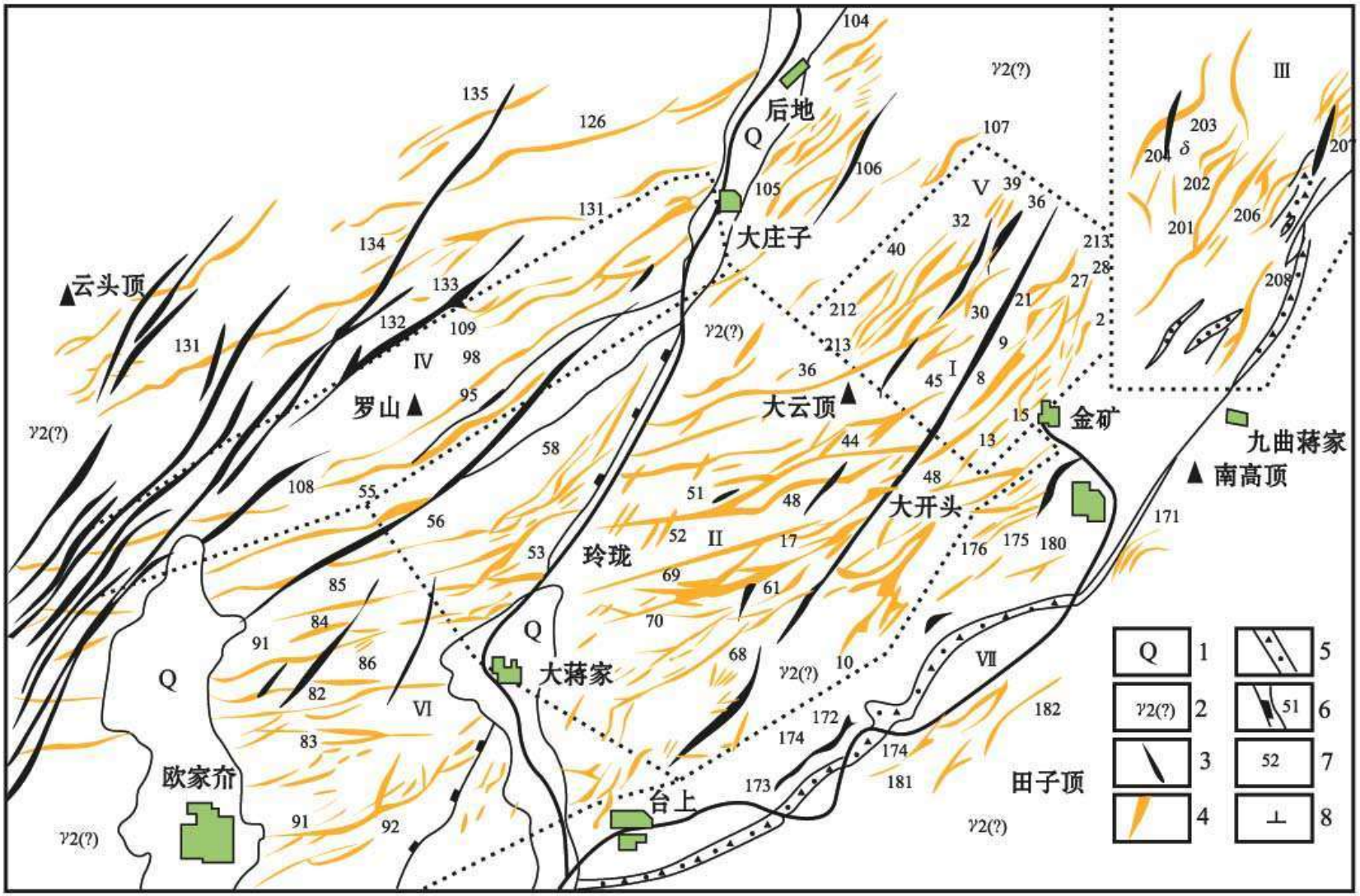




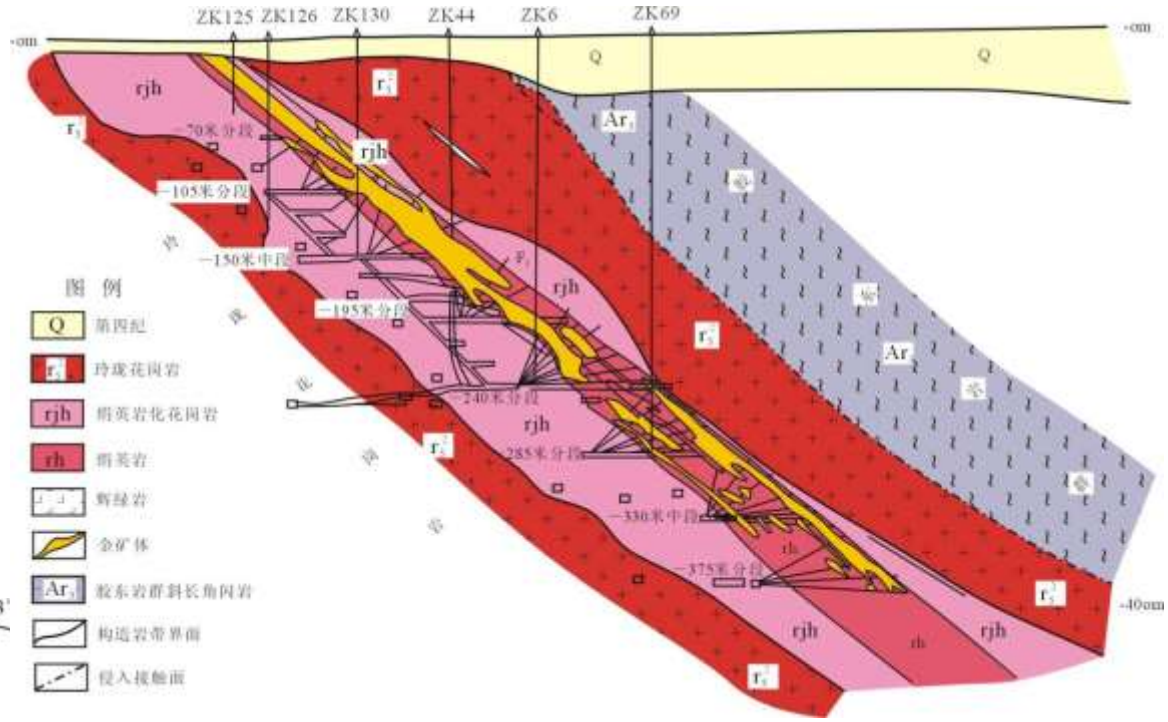
3. 伸展环境脉状金矿床　（1）胶东地区

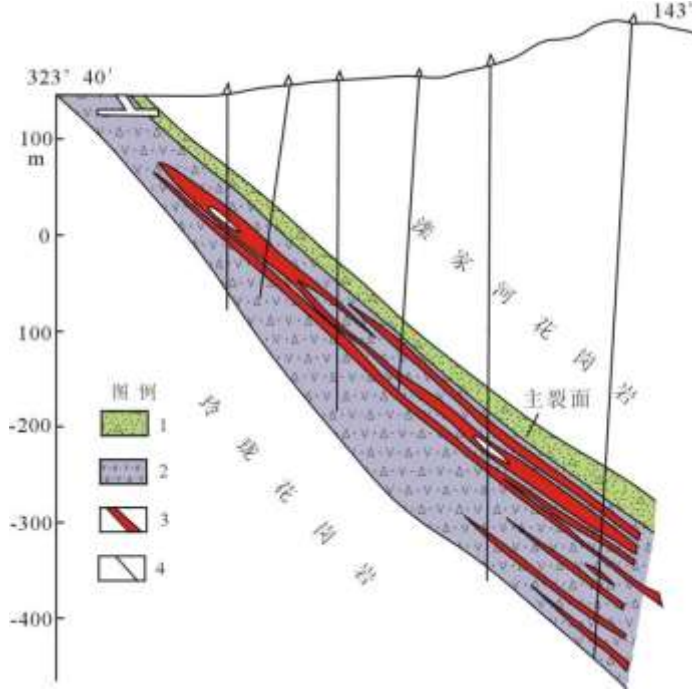






玲珑金矿田暗色岩墙与金矿脉





台上（左图）和三山岛（上图）金矿剖面图

分别代表石英脉型和蚀变岩型金矿特点及蚀变分带

胶东地区成岩成矿时代

玲珑式花岗岩： 153-160 Ma

郭家岭式花岗闪长岩：126-130 Ma （钠化）

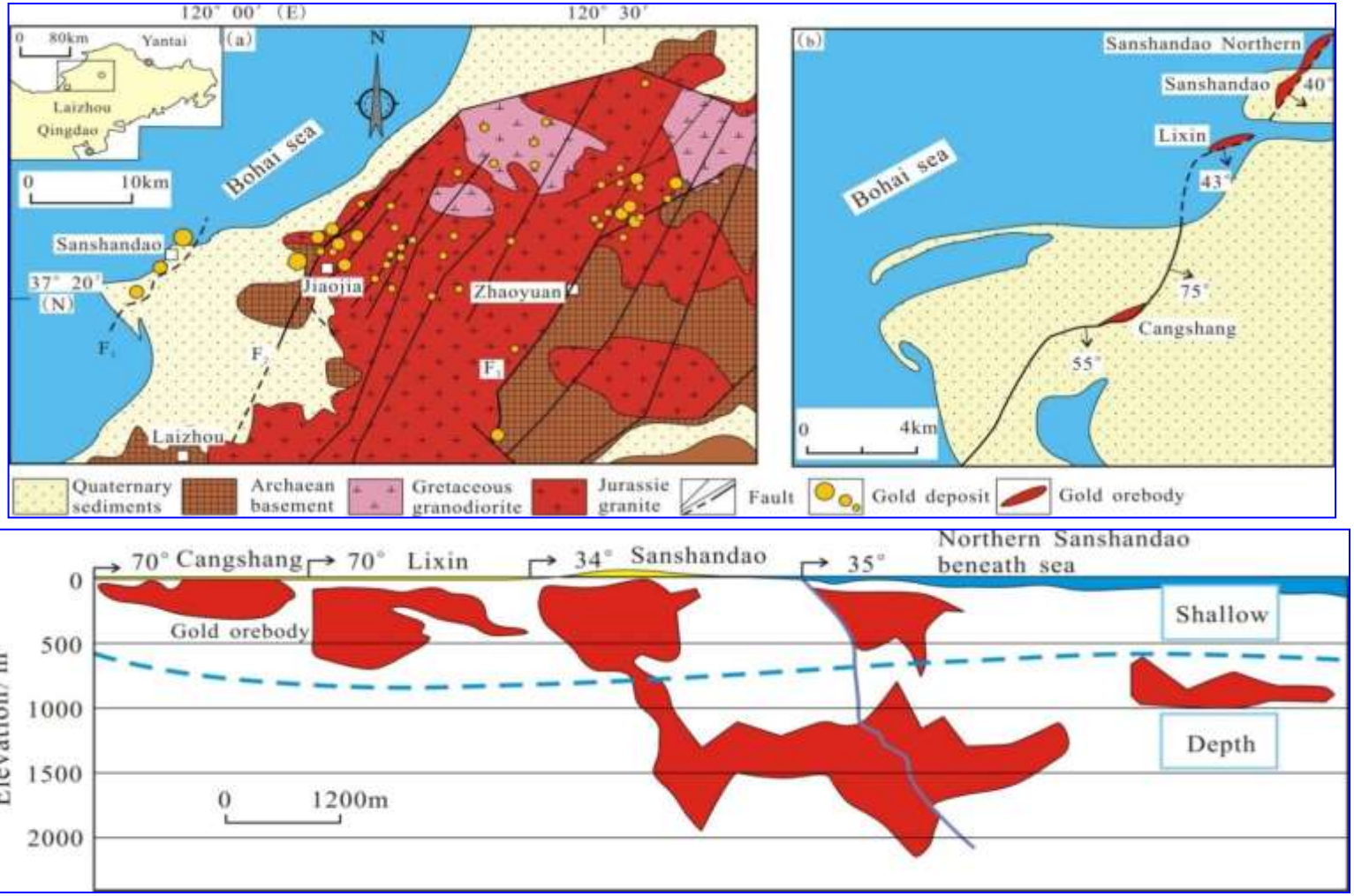
暗色岩墙：110-120 Ma （钾化）

金矿化：114-123 Ma， 118-120 Ma为峰值

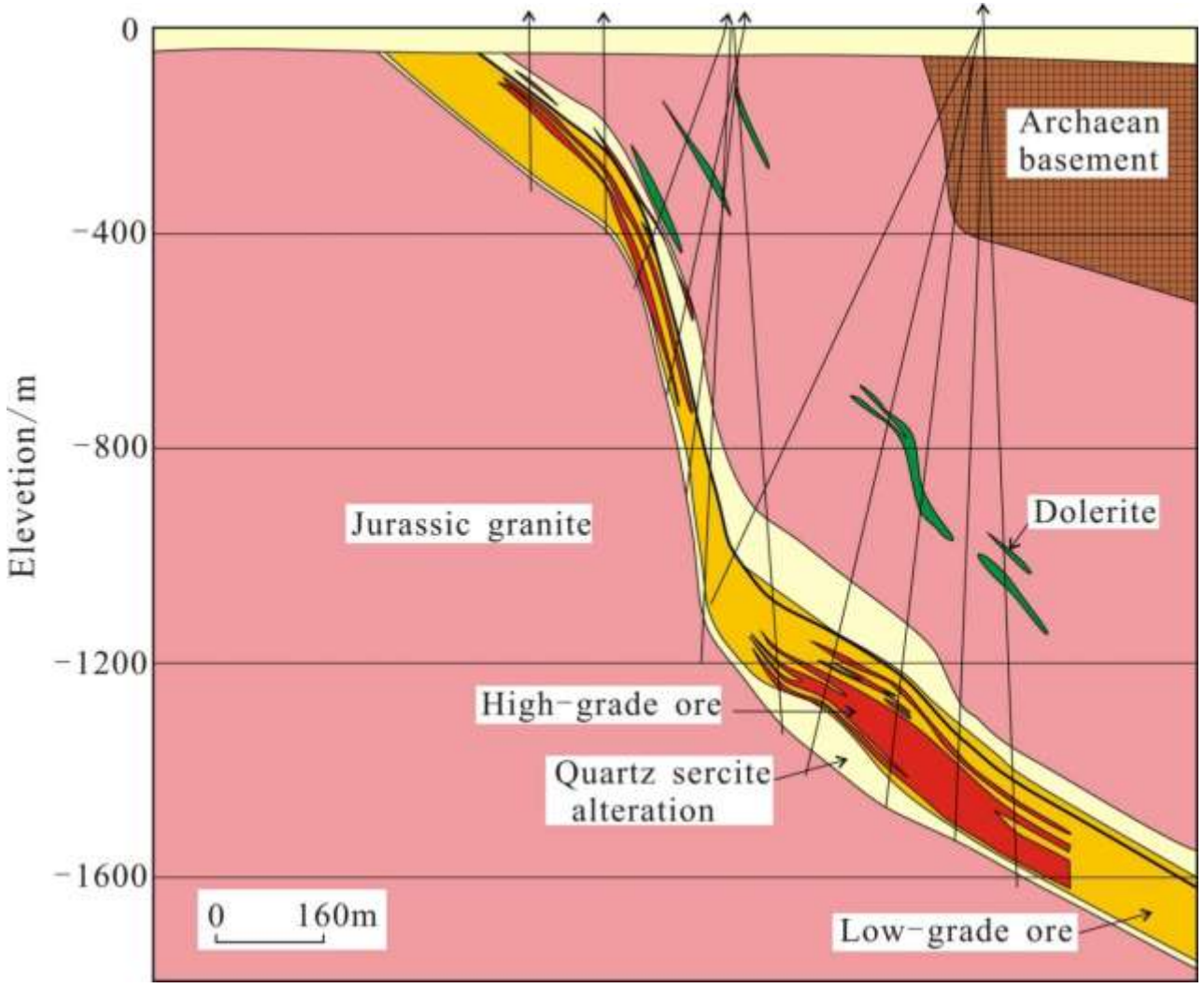
石英脉型矿床： 117-123 Ma

破碎蚀变岩型矿床： 114-121 Ma

角砾岩型矿床：117-118 Ma

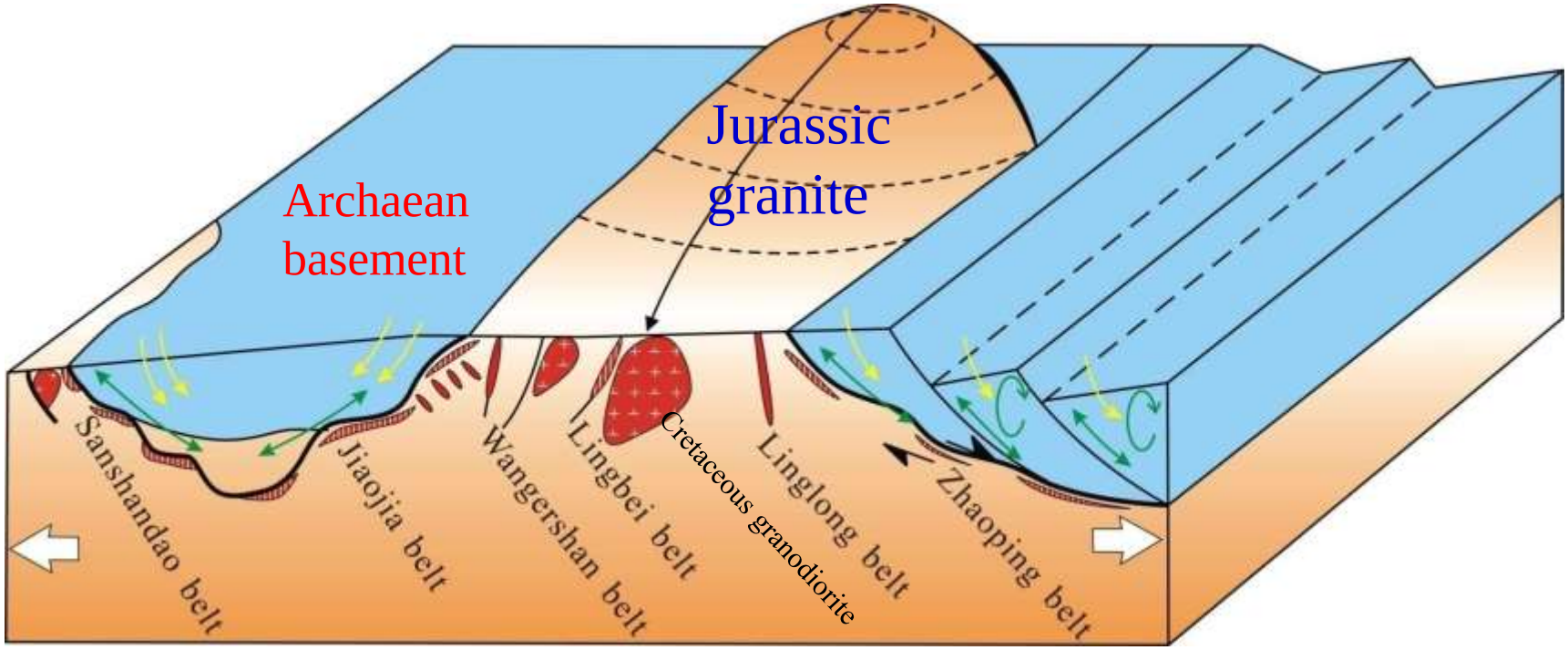


Sanshandao gold belt: from less 100 t to more than 1000t; Jiaojia gold belt from 400t to 1200 t.

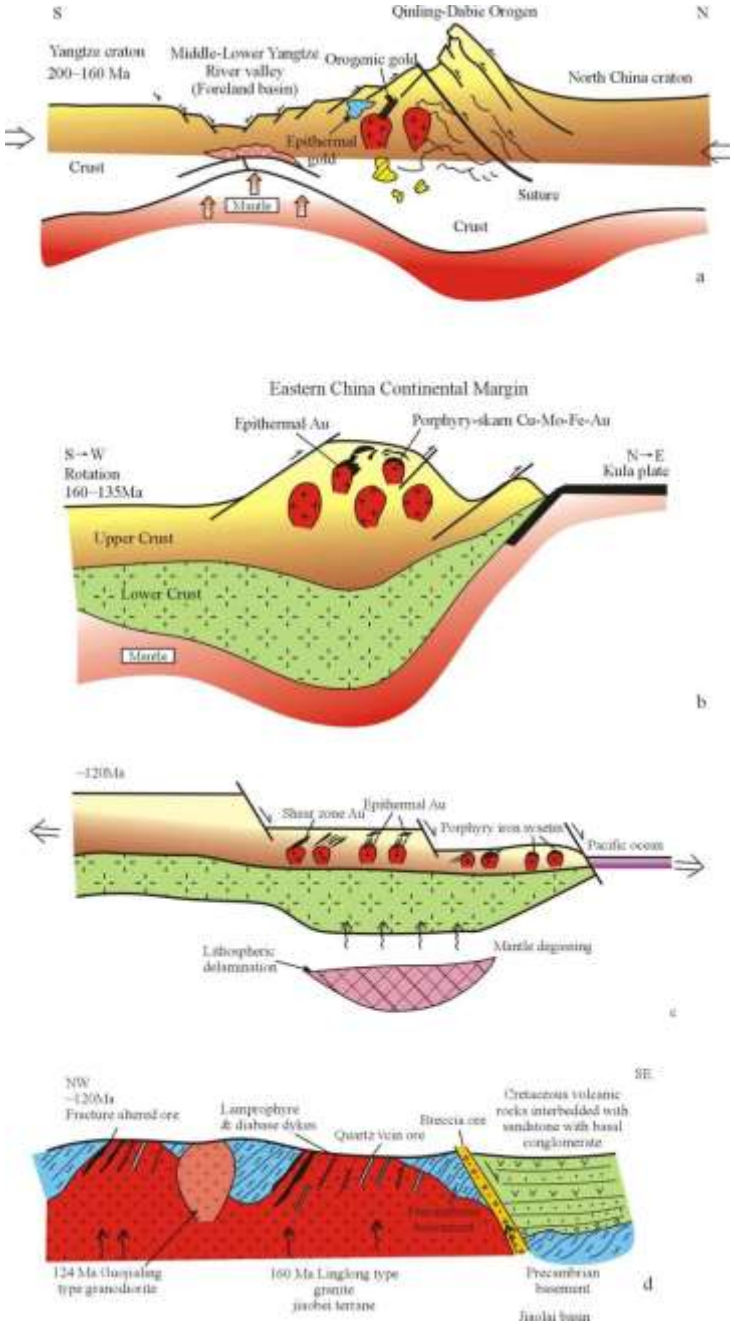


(据宋春明等，2014)

The gold mineralization is controlled by a groups of pull apart locations along the Trans-extensional fractures at ages of 120-110 Ma following the trans-compressional fractures at ages of 160 – 135 Ma



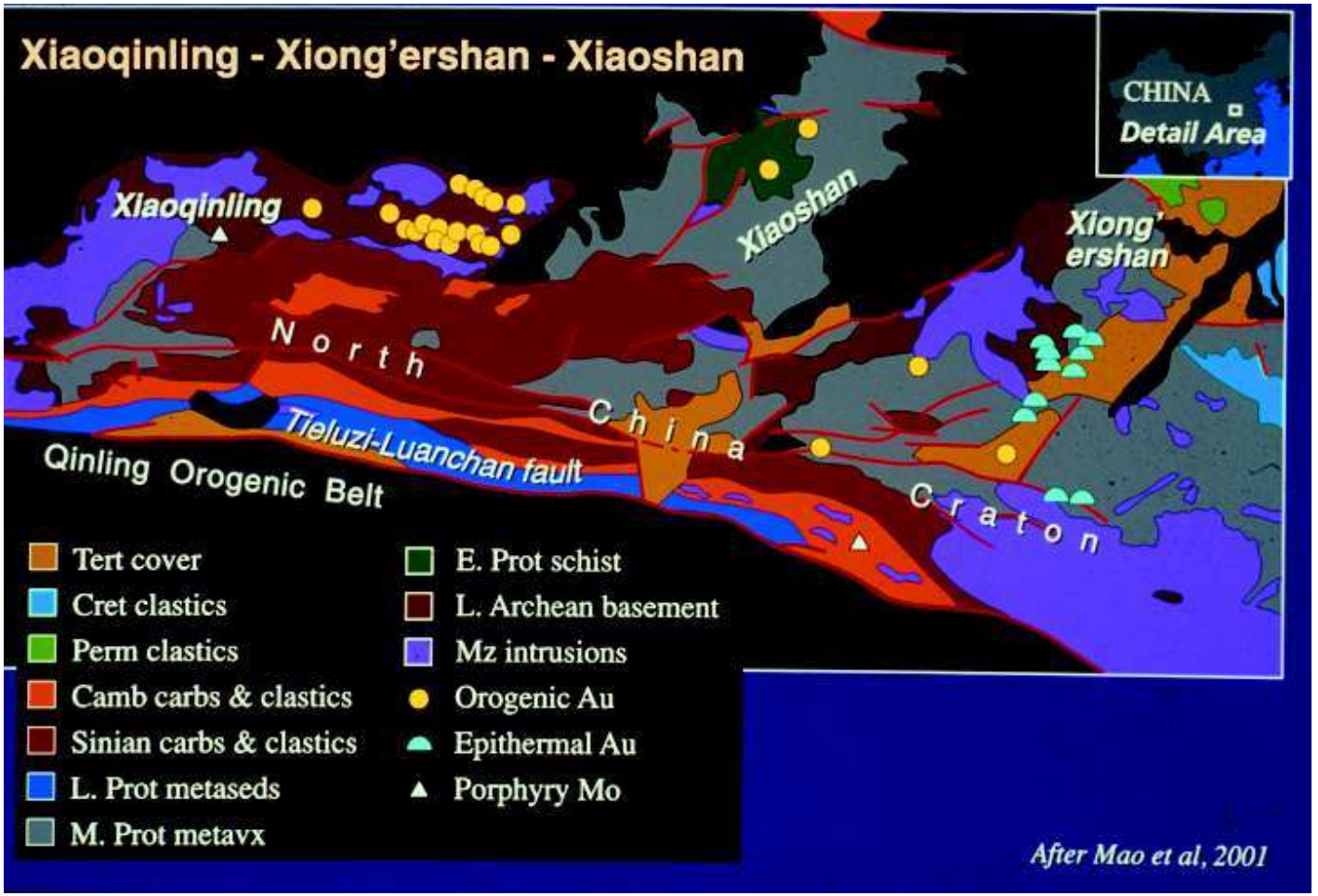
拆离断层控制-成因上与白垩纪花岗闪长岩有关的金矿成矿模型图 (据宋明春等，2014)



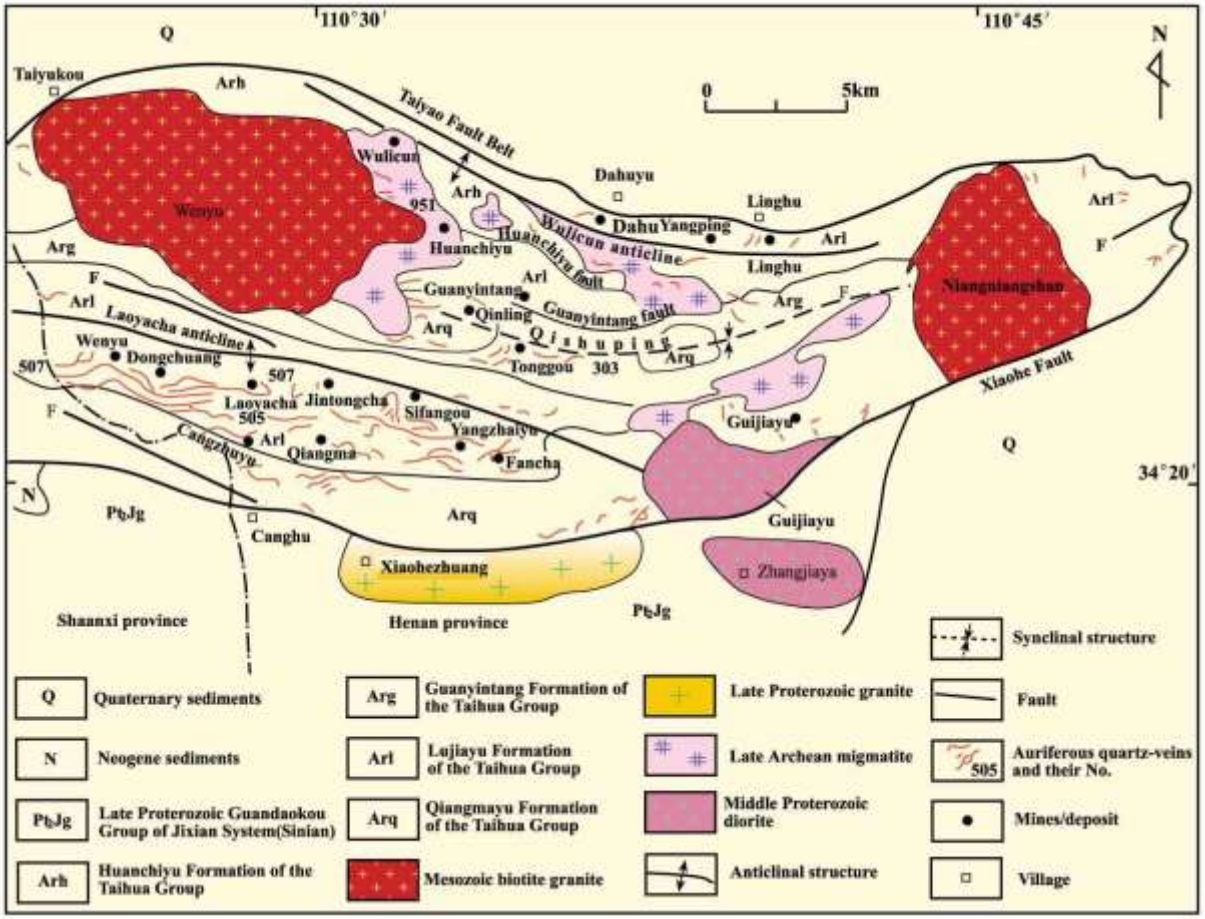
胶东金矿成矿动力学模型和矿床模型

(after Mao et al, 2008)

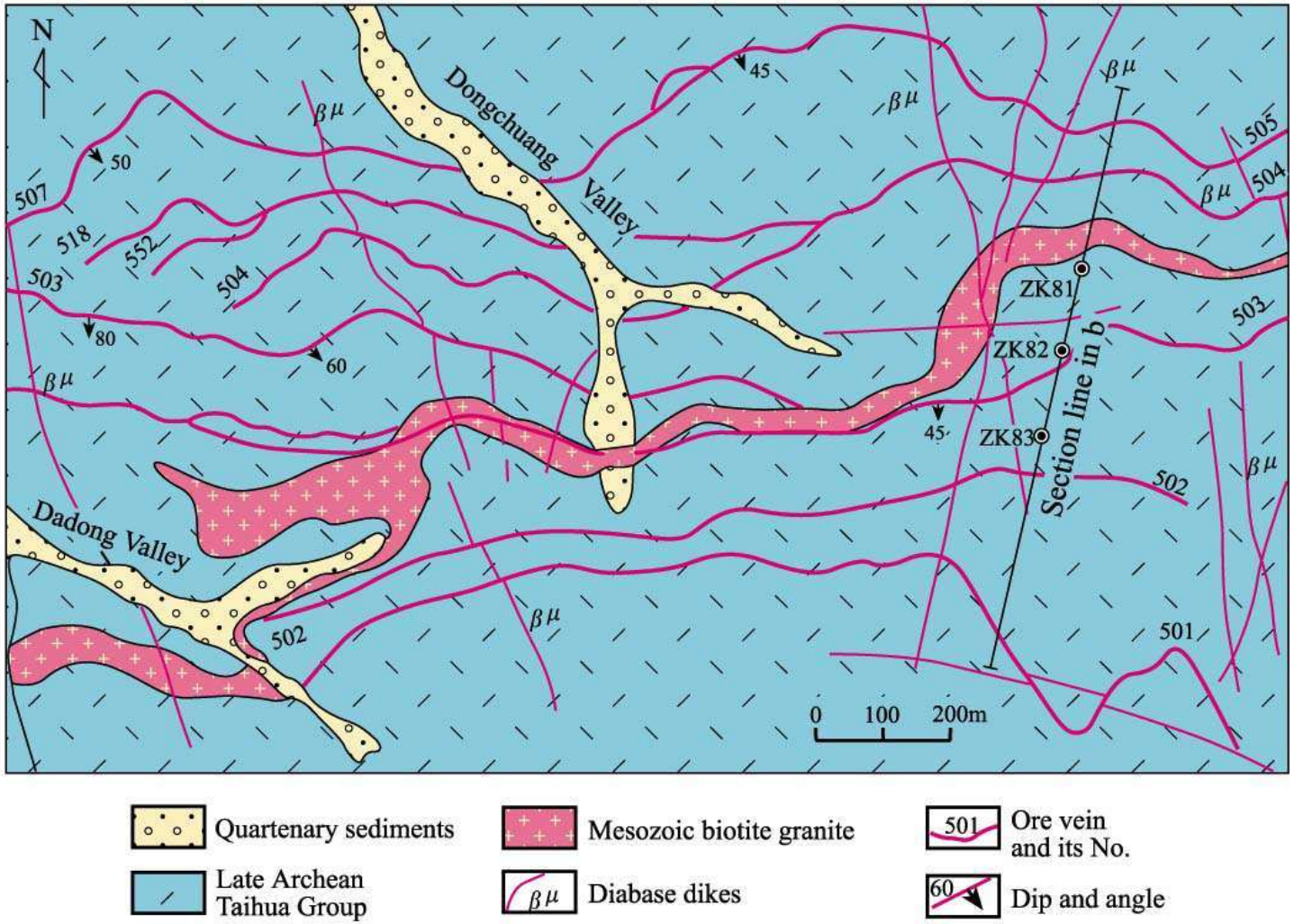
(2) 小秦岭 - 熊耳山金矿集中区

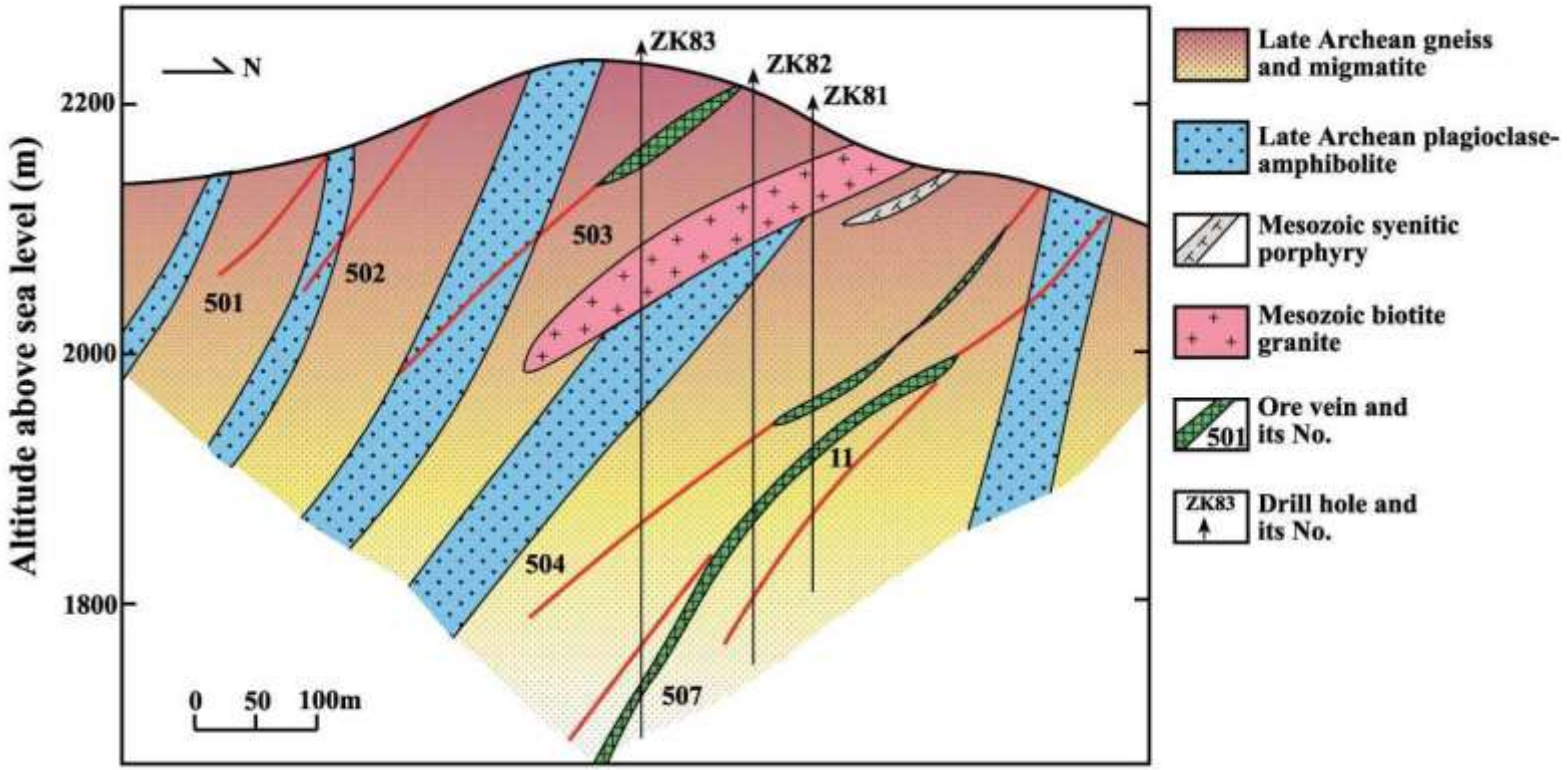


河南小秦岭地区金矿分布图



河南省东闯金矿平面图


N
Dongchuang Valley
Dadong Valley
βμ
45
50
507
518
552
503
504
80
60
505
ZK81
ZK82
ZK83
Section line in b
502
501
0 100 200m
Quartenary sediments
Late Archean Taihua Group
Mesozoic biotite granite
Diabase dikes
501 Ore vein and its No.
60 Dip and angle


N
ZK83
ZK82
ZK81
2200
2000
1800
Altitude above sea level (m)
501
502
503
504
507
11
0 50 100m
Late Archean gneiss and migmatite
Late Archean plagioclase-amphibolite
Mesozoic syenitic porphyry
Mesozoic biotite granite
501
Ore vein and its No.
ZK83
Drill hole and its No.

河南省东闯金矿剖面图

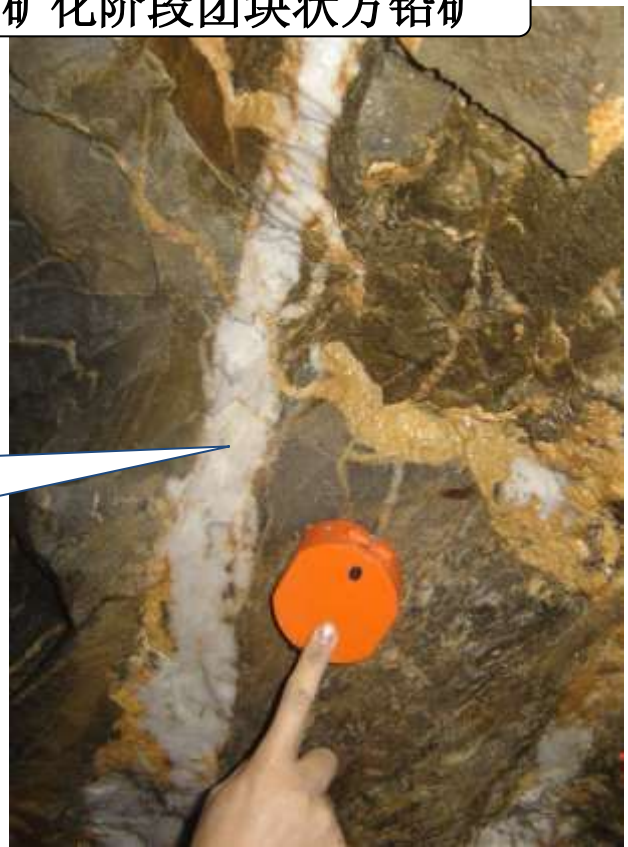
第Ⅰ矿化阶段-乳白色石英脉

第Ⅲ矿化阶段团块状方铅矿

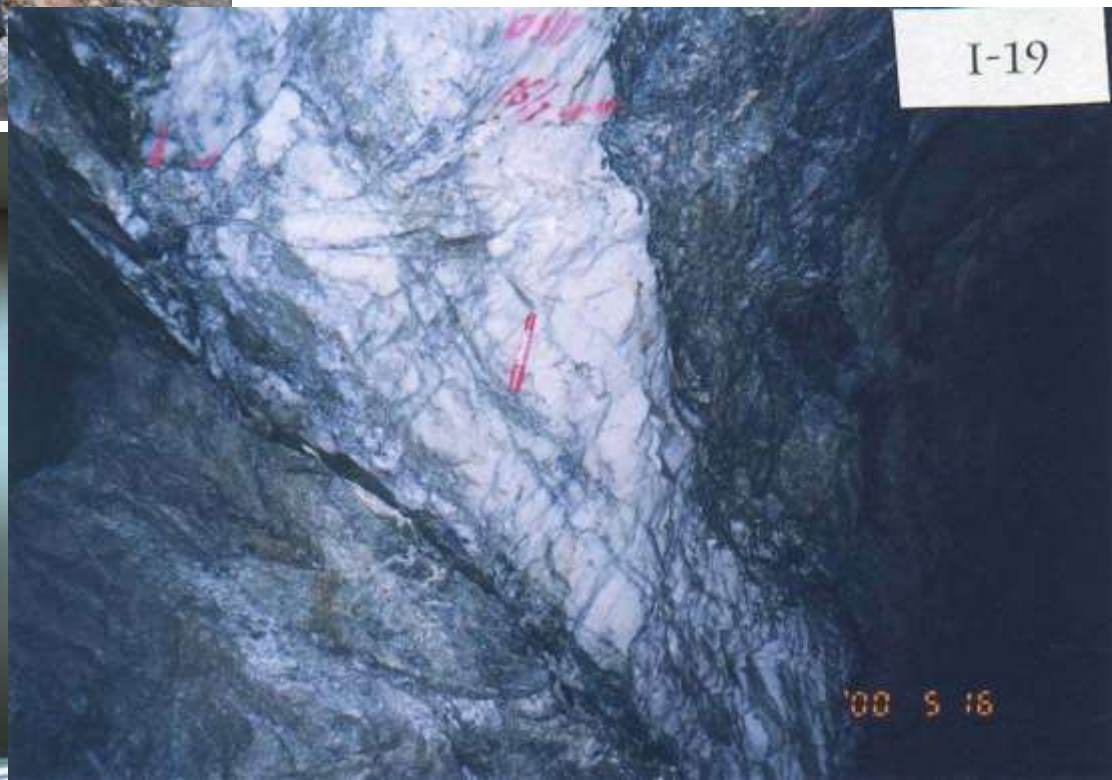
第Ⅱ矿化阶段条带状黄铁矿

上部为金铅银，下部为金

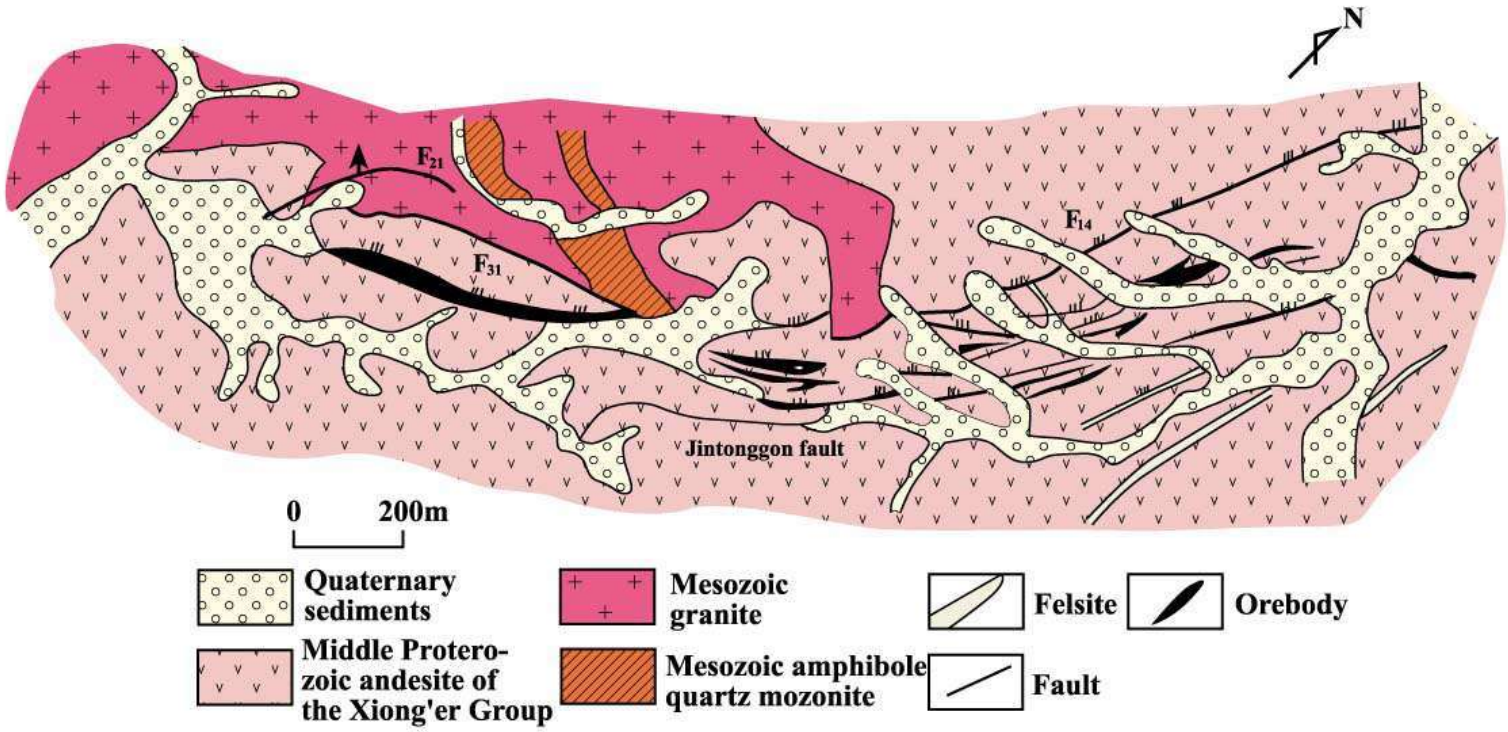
第Ⅳ矿化阶段石英碳酸盐脉



以太华群变质岩为主岩的石英脉型金矿

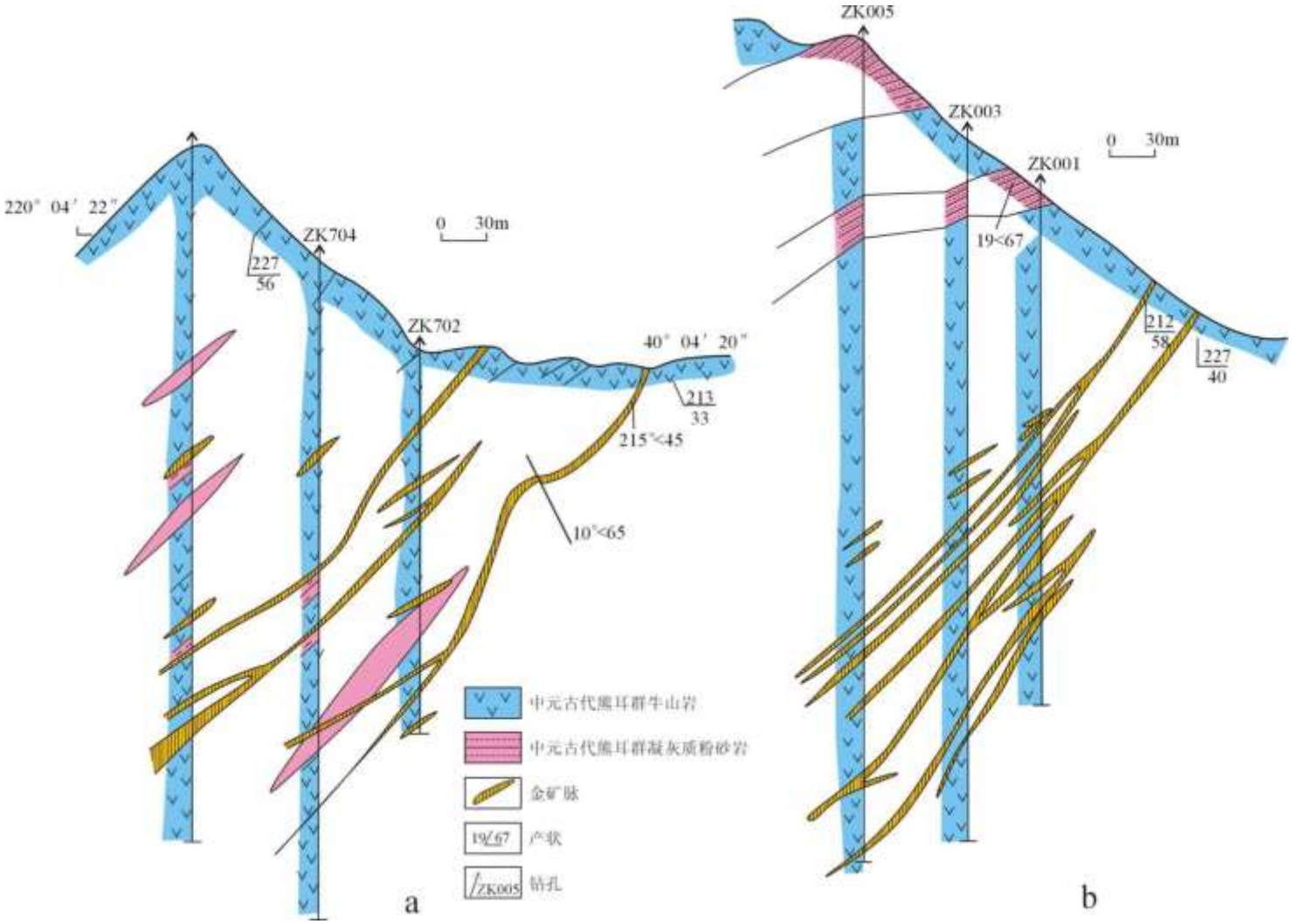


河南上宫金矿平面图

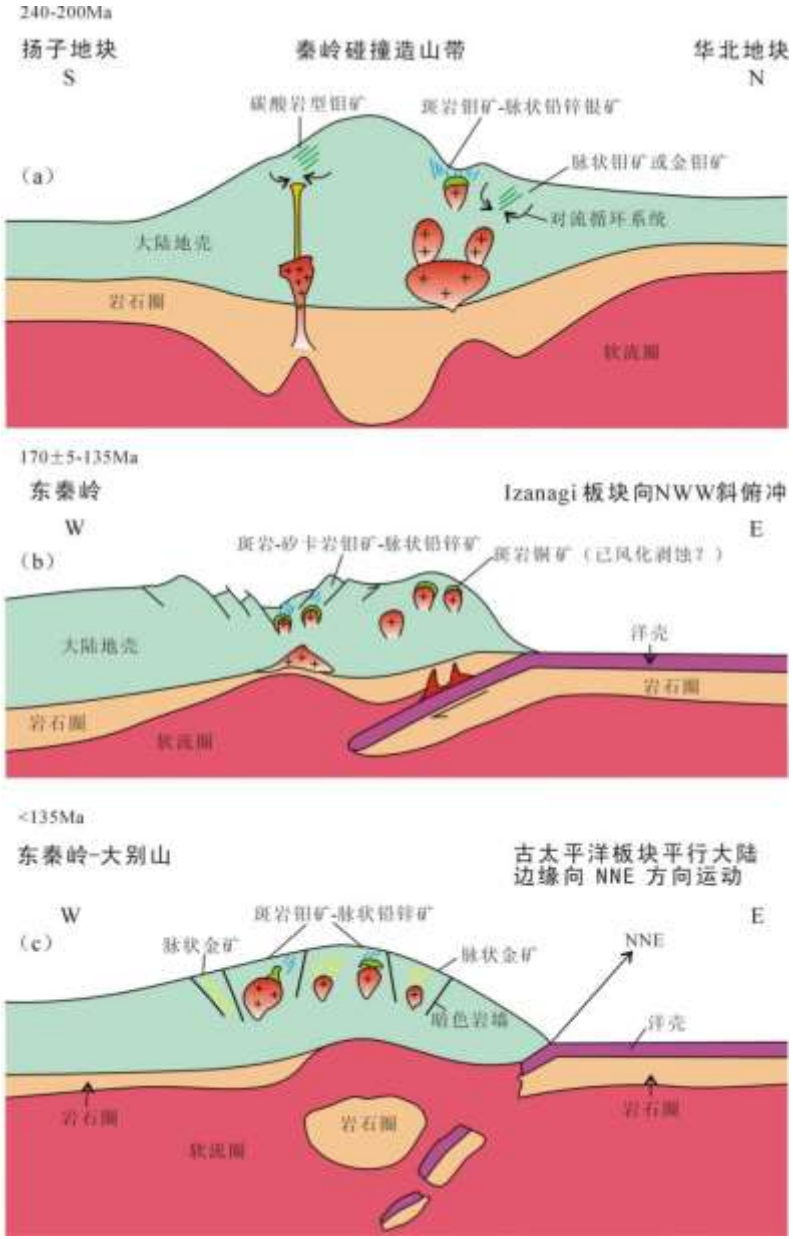


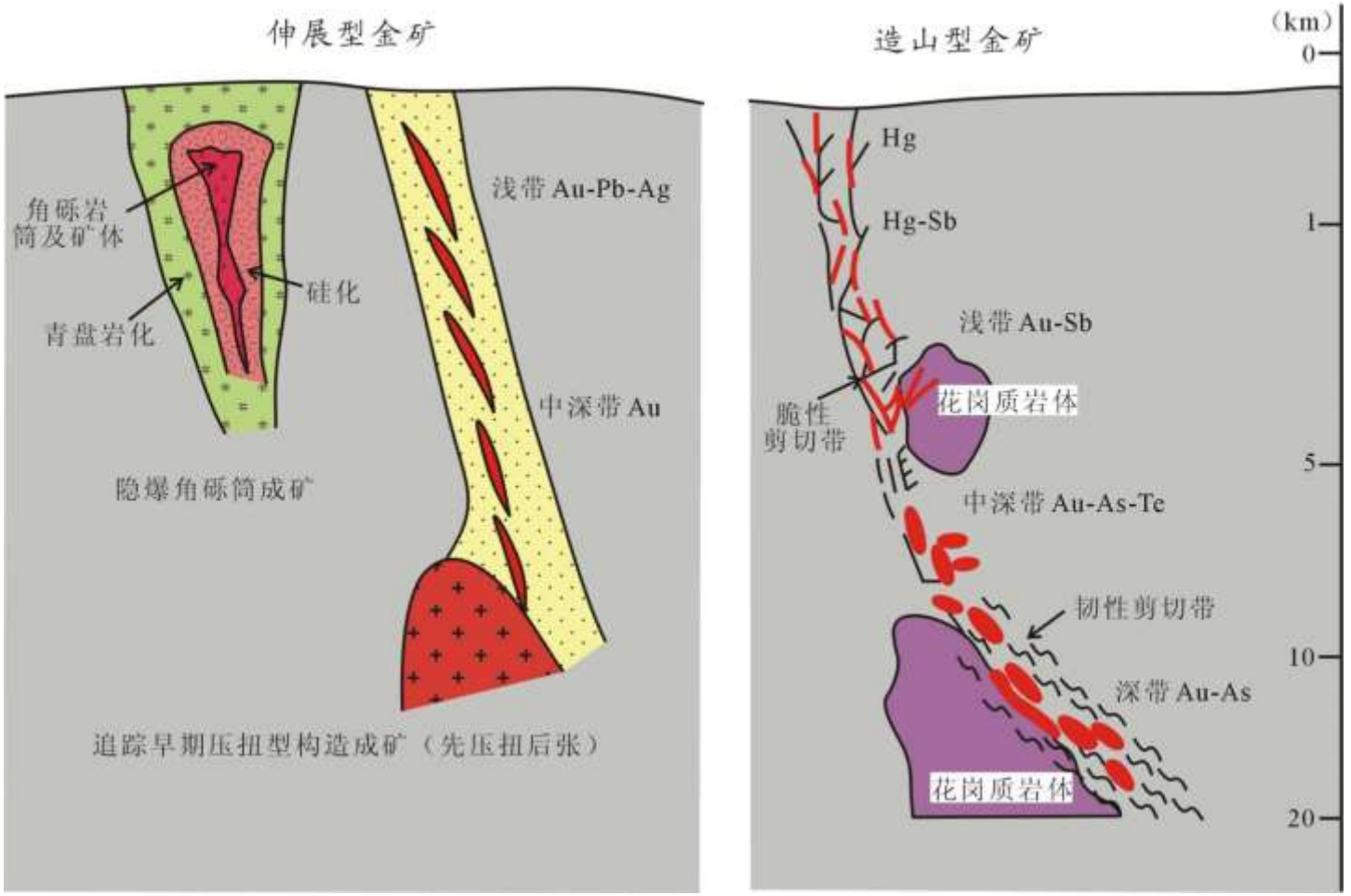
无论是太华群还是熊耳群为成矿容岩，其控矿构造的形式是相似的，即由压扭性构造转化为张扭性构造或张性构造。

北岭金矿剖面图


220° 04′ 22″
ZK704
227
56
0 30m
ZK702
40° 04′ 20″
213
33
215°<45
10°<65
a
ZK005
ZK003
ZK001
19<67
212
58
227
40
b
中元古代熊耳群牛山岩
中元古代熊耳群凝灰质粉砂岩
金矿脉
19/67 产状
ZK005 钻孔

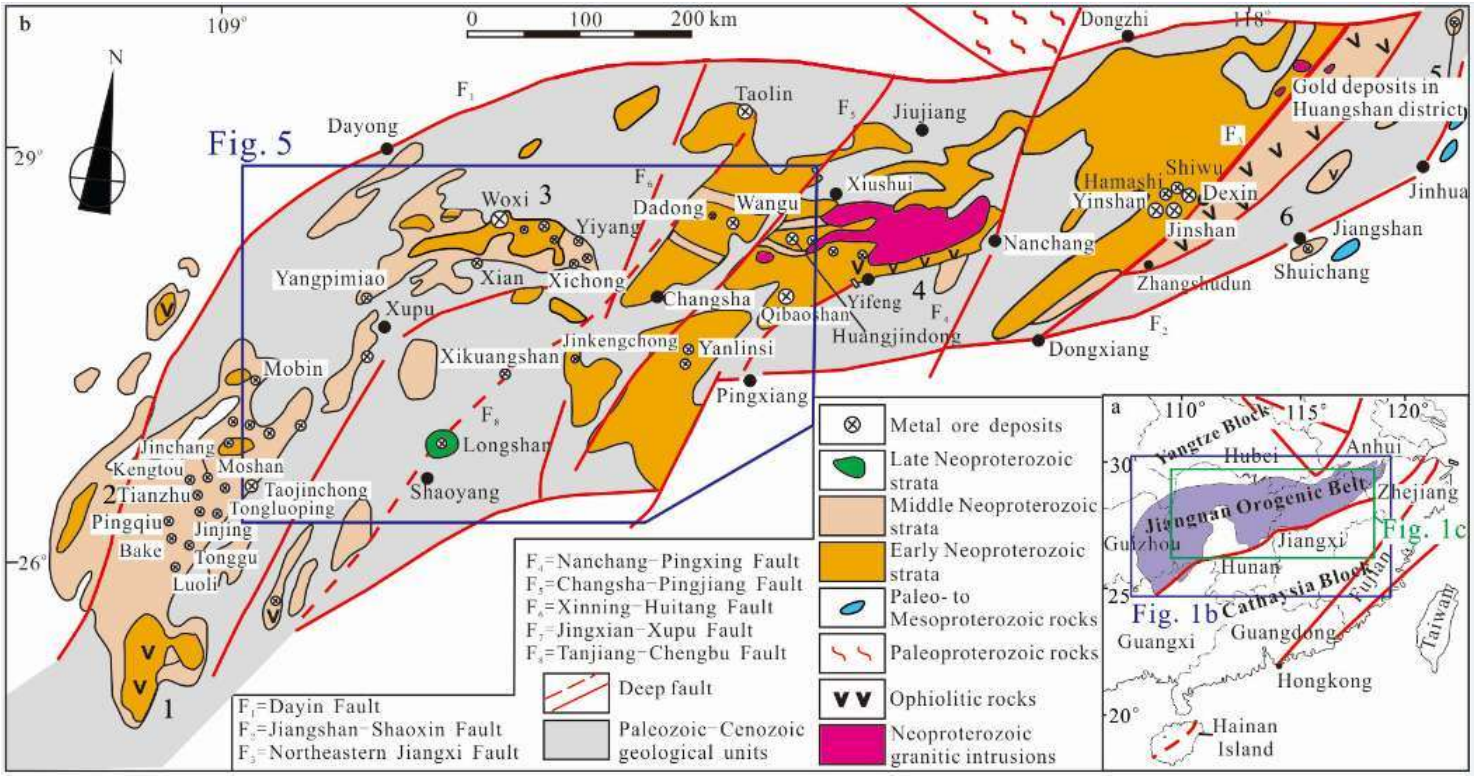
东秦岭-大别地区的成矿地球动力学背景





造山型和伸展型两类金矿成矿模型

3. 江南古陆造山带金多金属矿床



江南古陆金矿带金矿分布图

金矿床分布密集，已探明金金属量达970吨

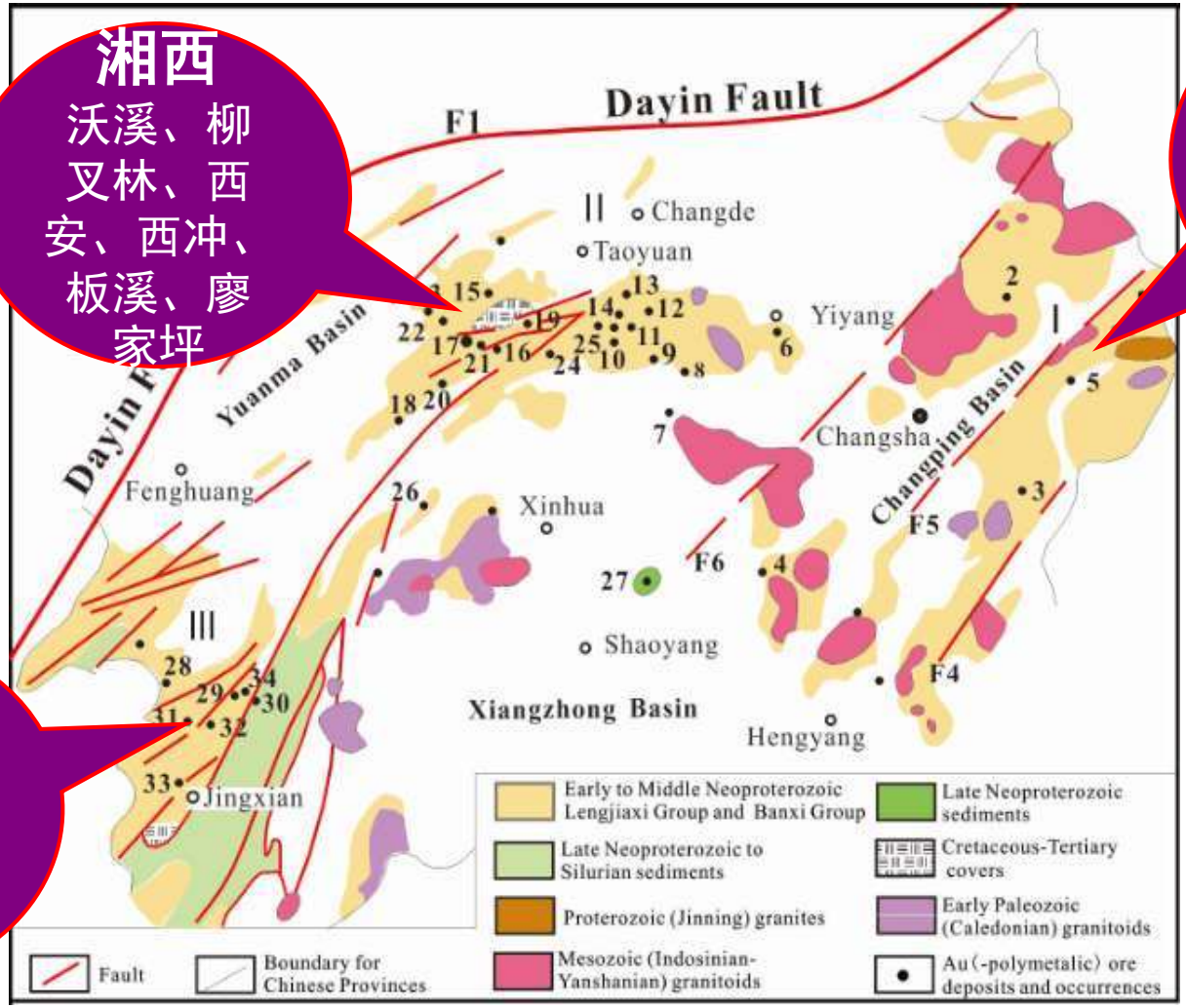
两种不同成矿认识

造山型/沉积-(变质)改造

- 成矿元素主要来源于新元古代浅变质火山-碎屑沉积岩系
- 成矿元素活化、迁移和富集源于新元古代、早古生代和晚中生代的流体活动

岩浆-热液型

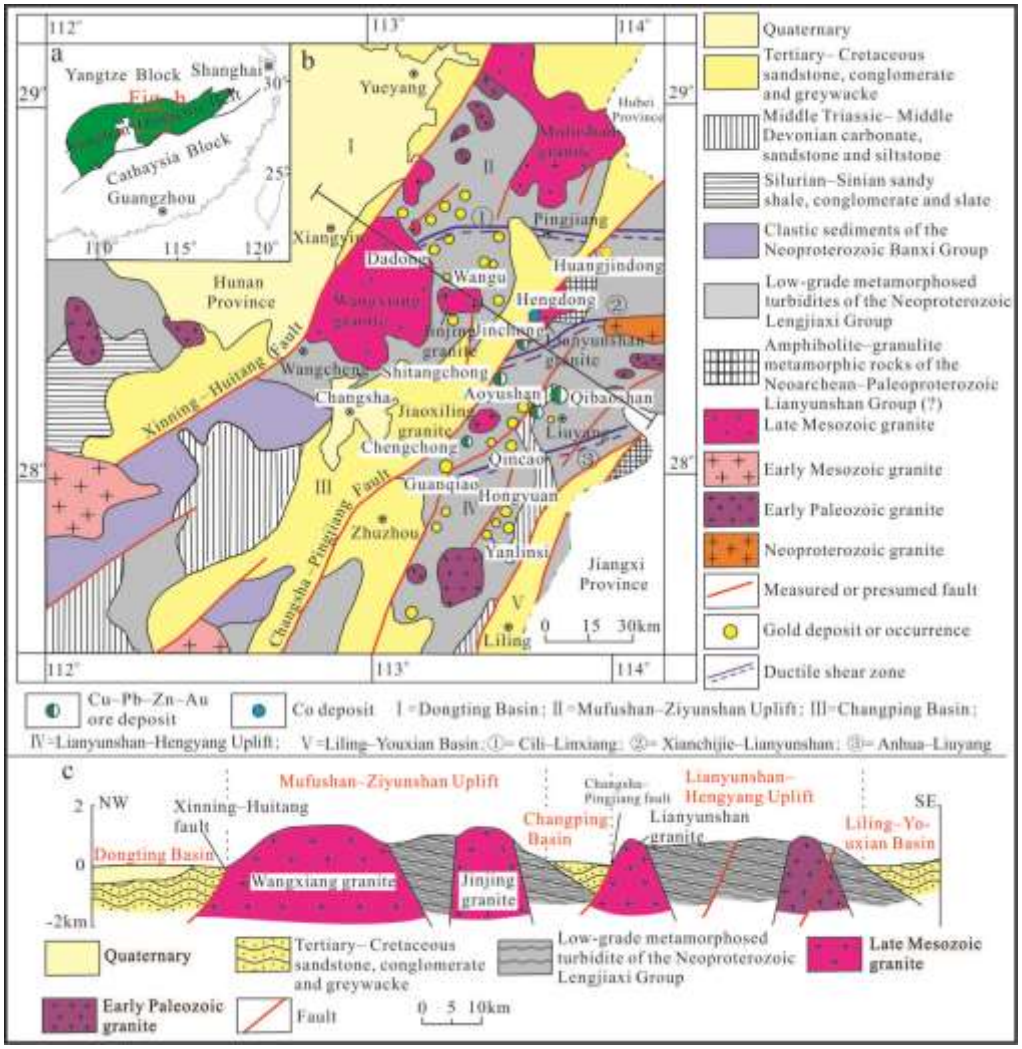
- 成矿元素来源于岩浆热液
- 来源于晚中生代长英质岩脉、甚至是更老的中-基性岩
- 空间上，与晚中生代花岗岩密切



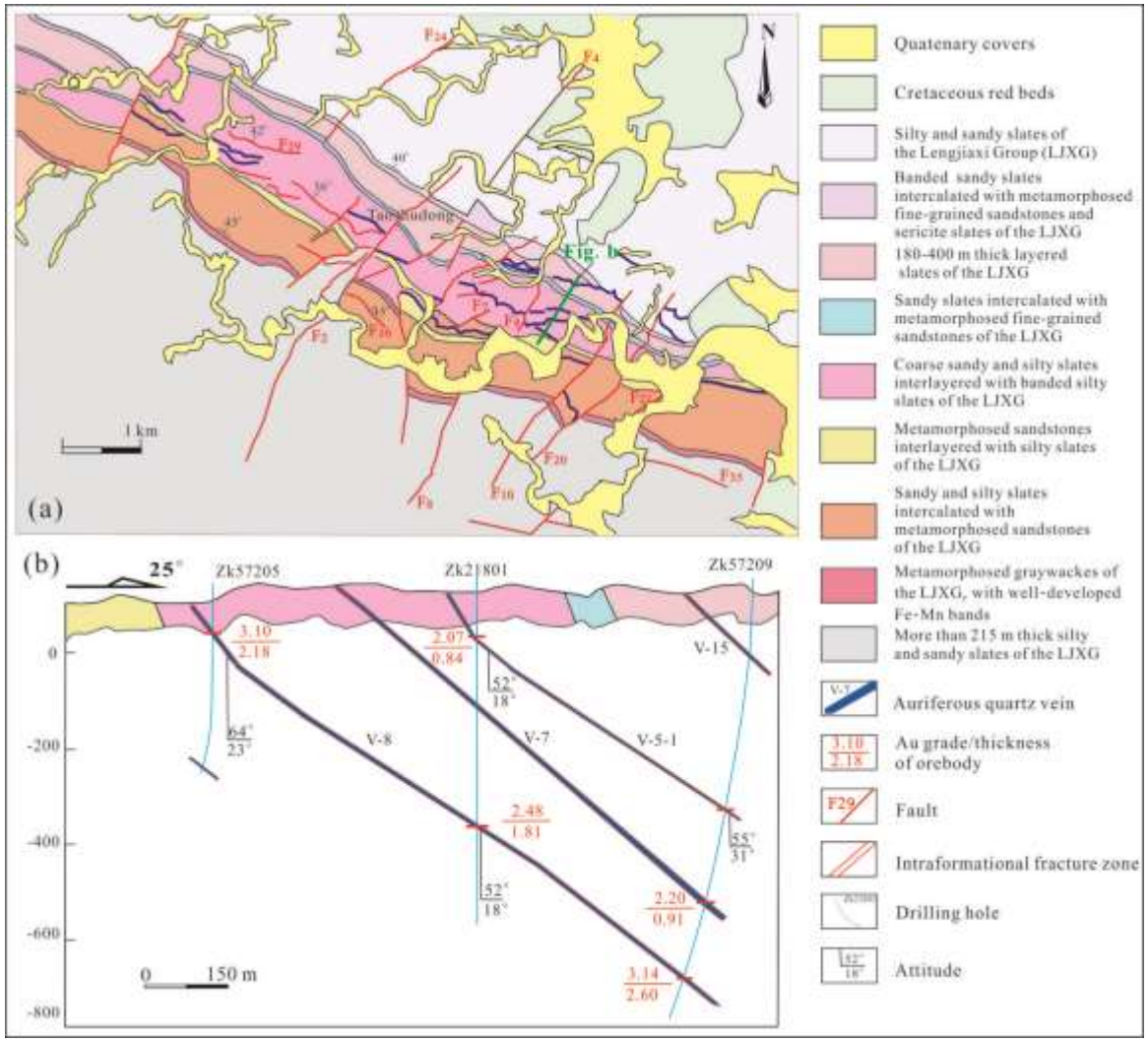
江南金矿带湖南段金属矿床分布图

探明和潜在的金资源量>350吨

湘东北成矿地质特征——盆岭构造和Au、Cu成矿



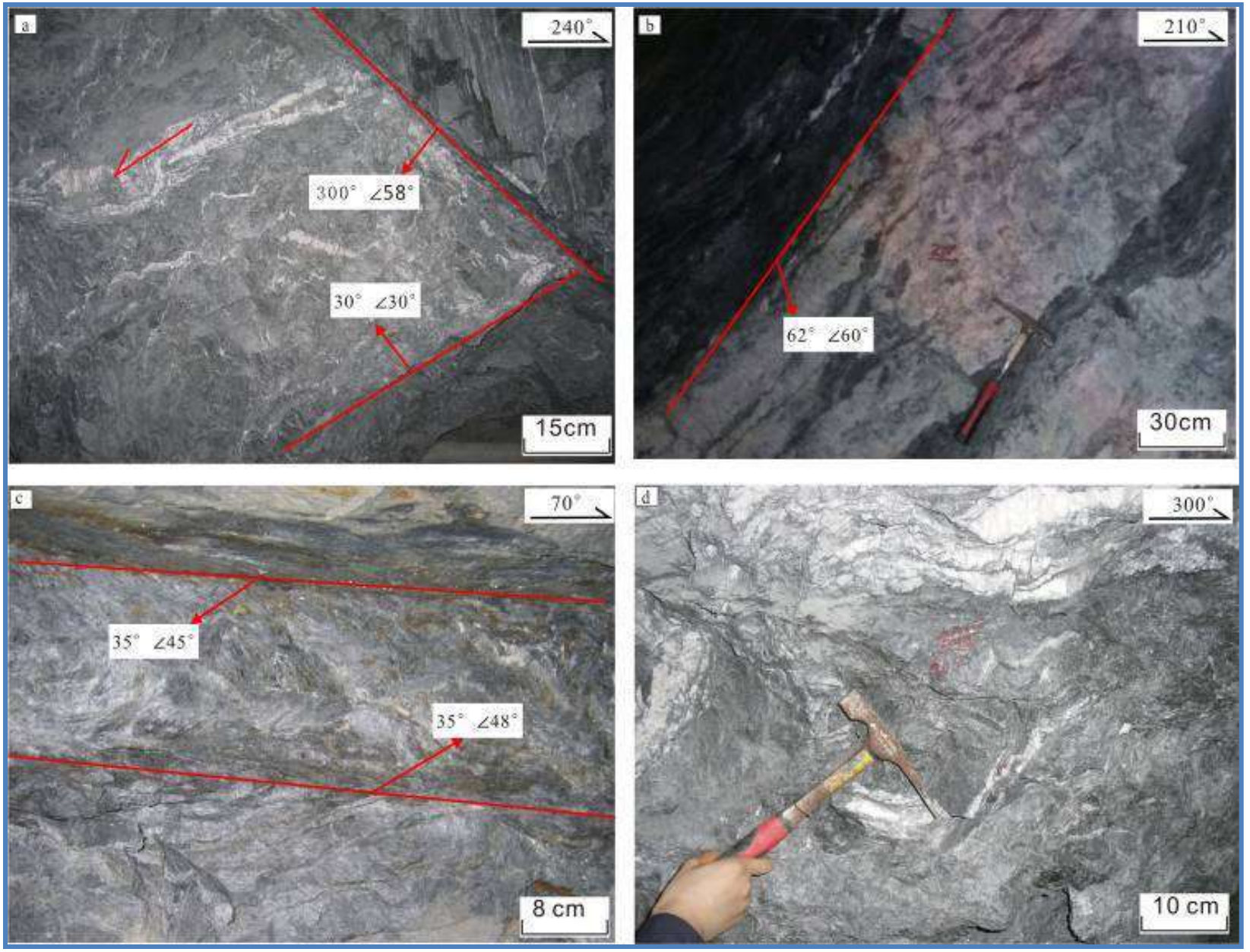
湘东北大万Au矿： 150吨



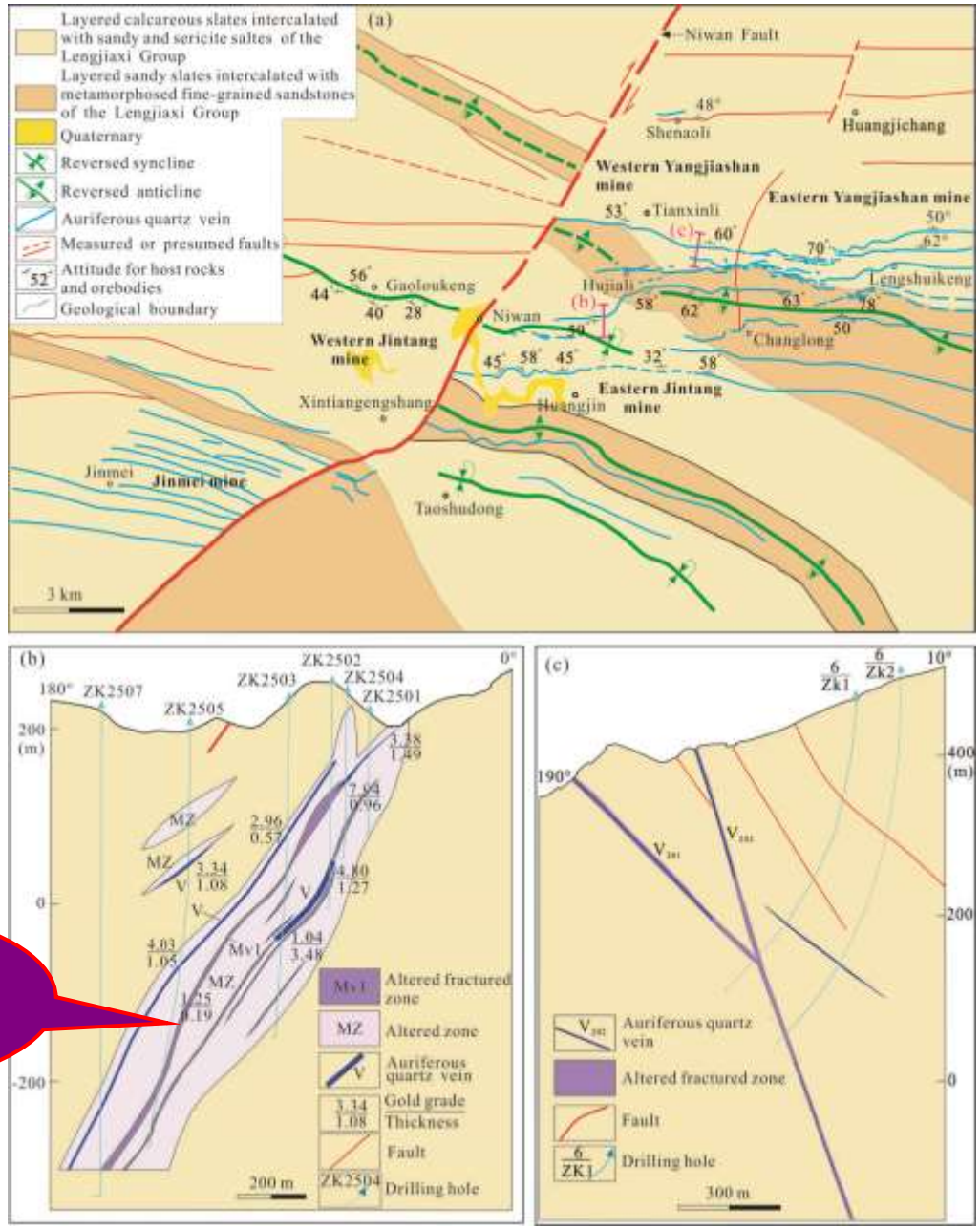
大万矿区矿体赋存于冷家溪群中，含矿构造为NWW向层间破碎带

矿石类型：石英脉型、蚀变岩型和构造角砾岩型

大万金矿


a
240°
300° ∠58°
30° ∠30°
15cm
b
210°
62° ∠60°
30cm
c
70°
35° ∠45°
35° ∠48°
8 cm
d
300°
10 cm

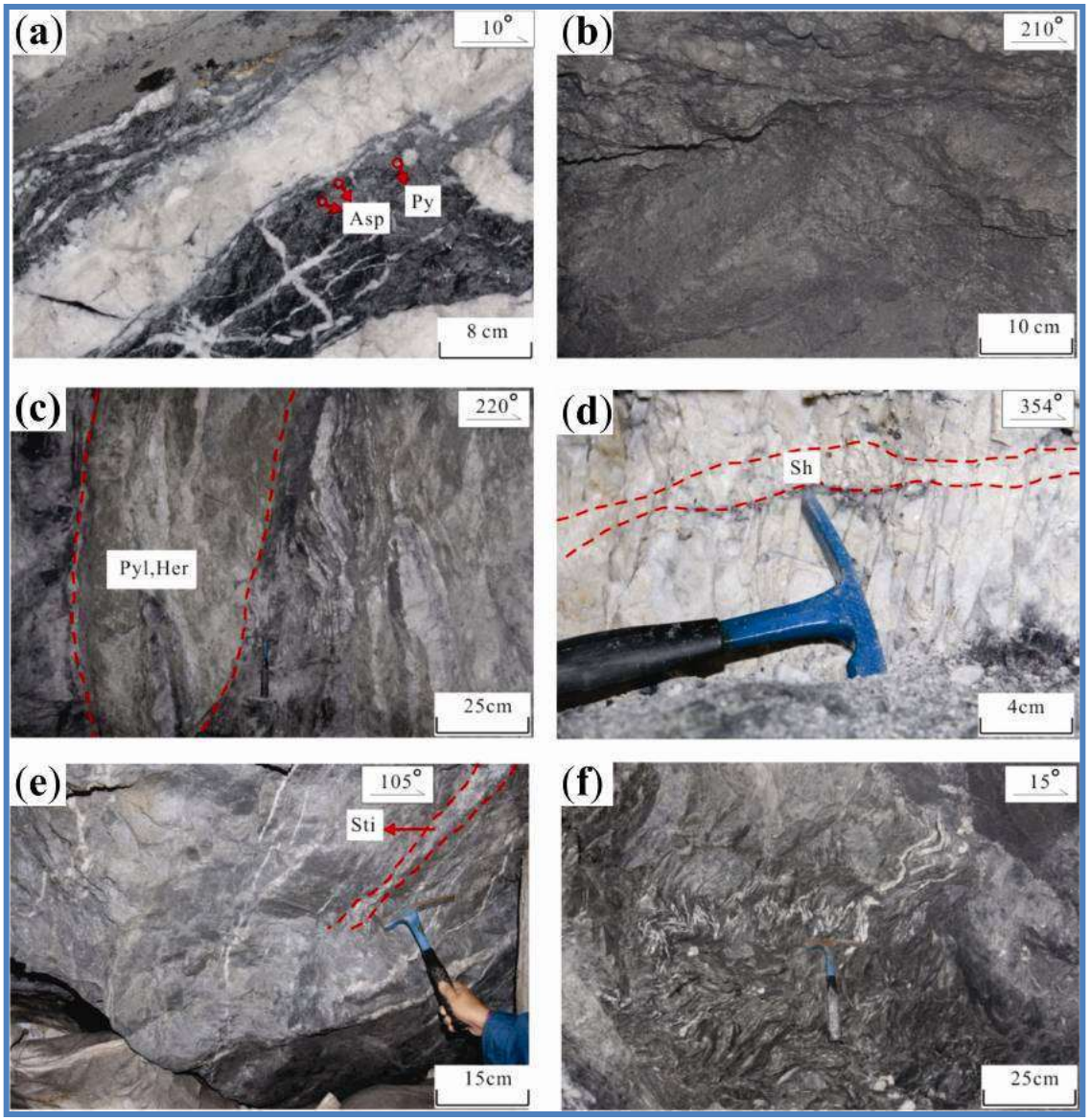
湘东北黄金洞Au矿： 60吨以上



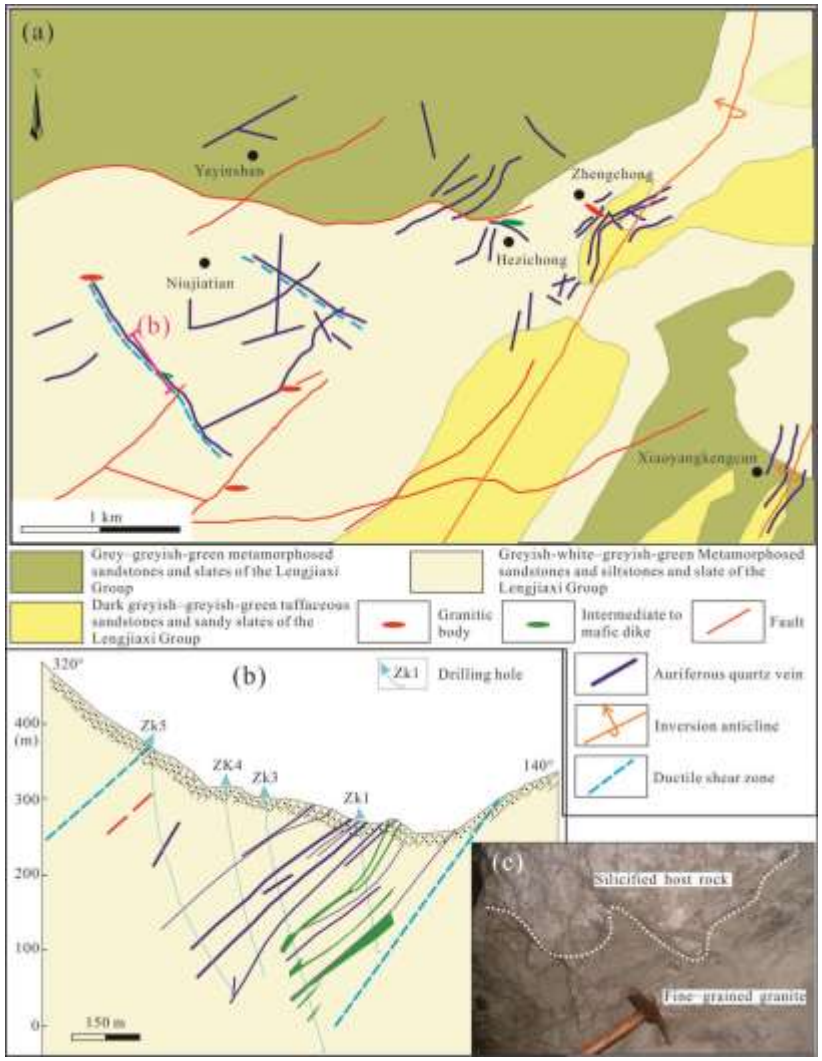
层间破碎带

矿石类型：石英脉型、蚀变碎裂岩型、构造角砾岩型

黄金洞金矿

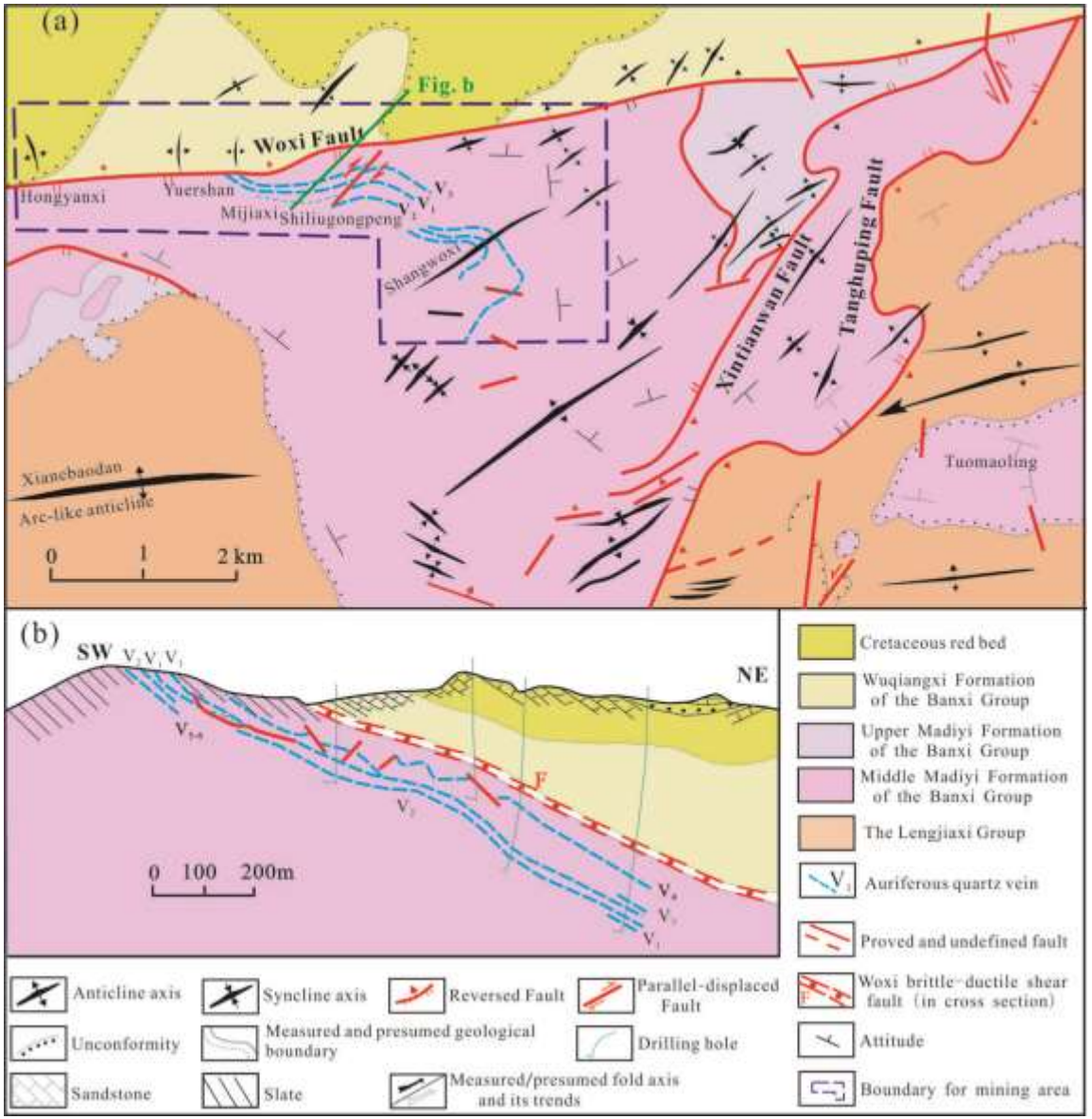


湘东北雁林寺Au矿： 10吨以上

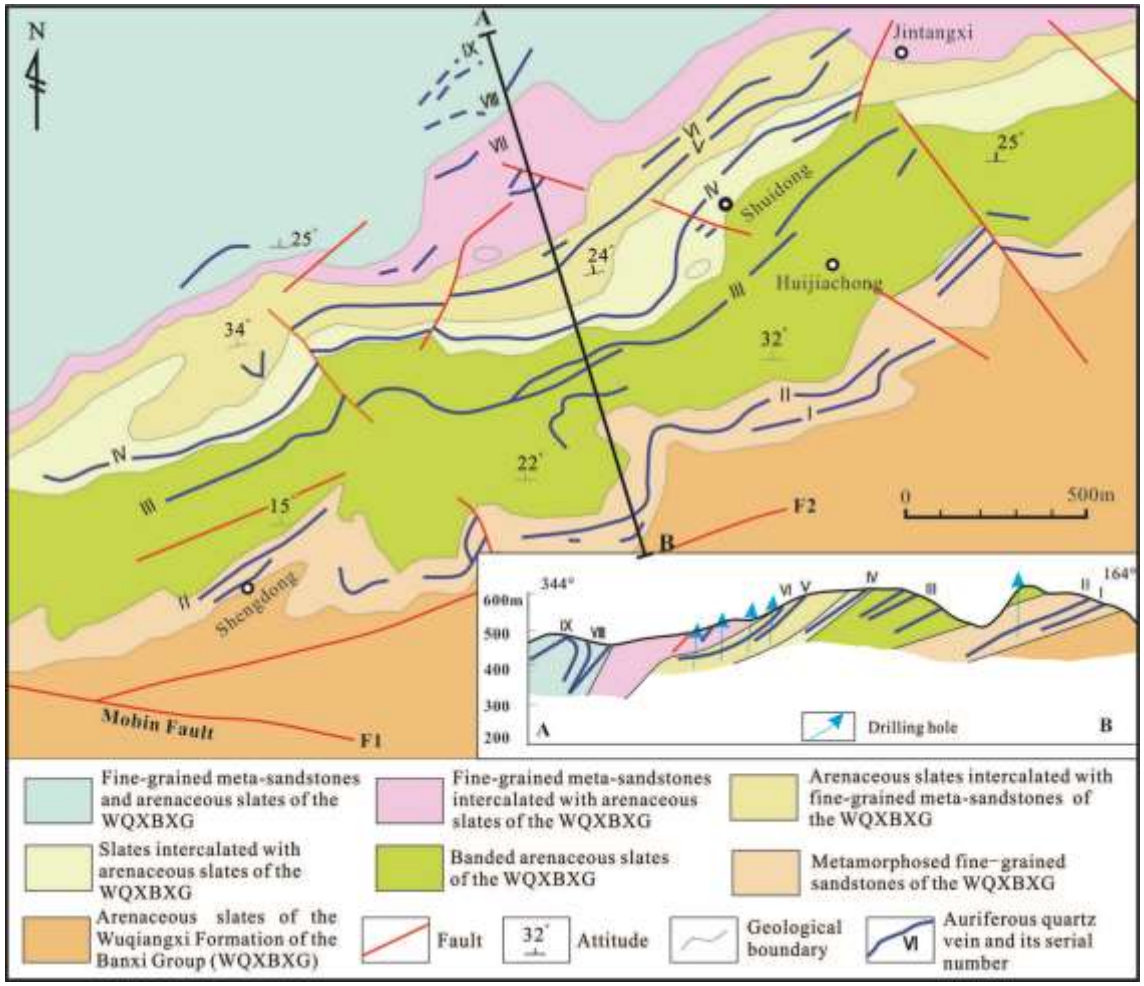


赋存于冷家溪群中，已发现规模较大的含金矿脉20余条，走向长350-2100 m，品位达20 g/t。预测金资源100吨以上

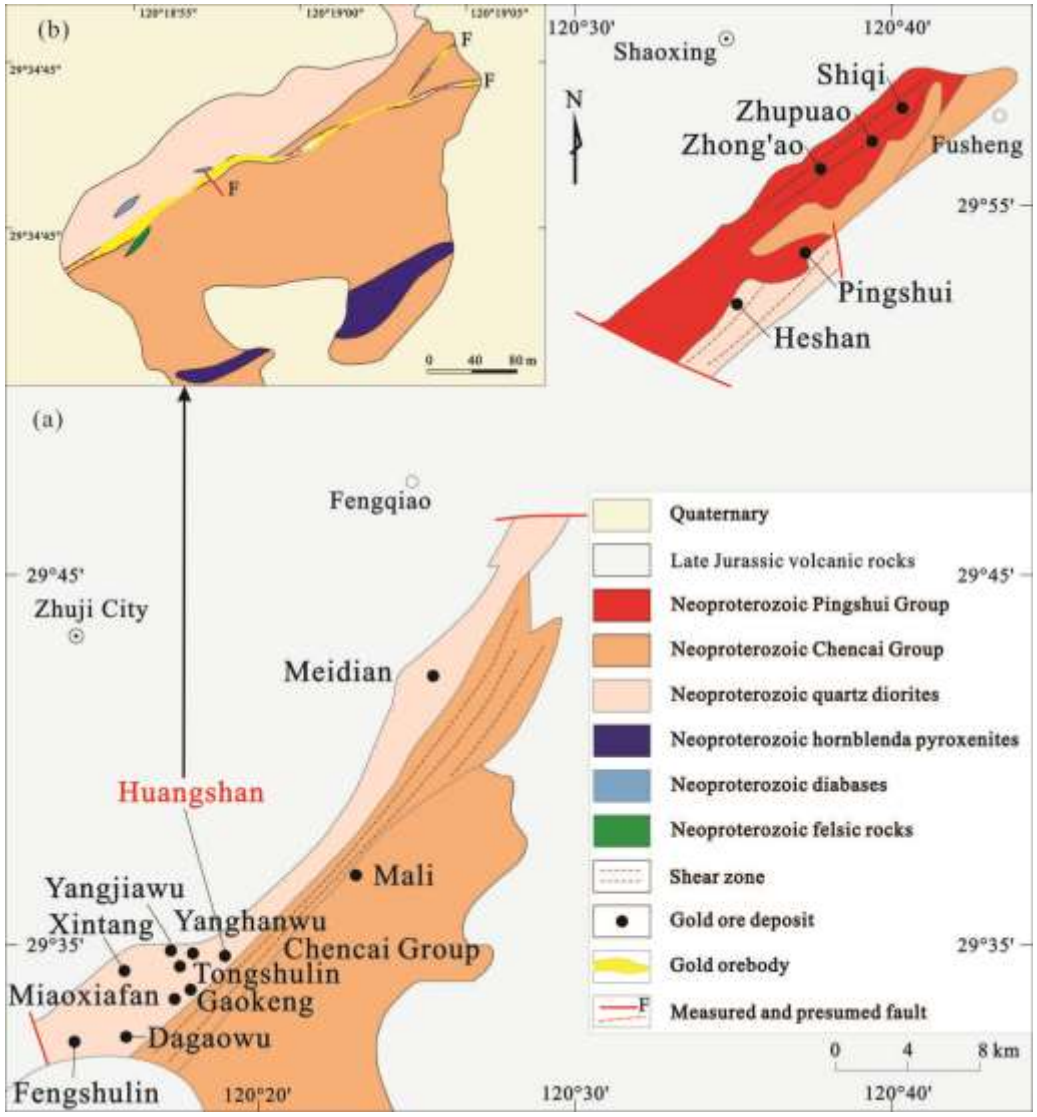
湘西沃溪W-Sb-Au矿： 25万吨WO_3、167万吨Sb、40吨Au



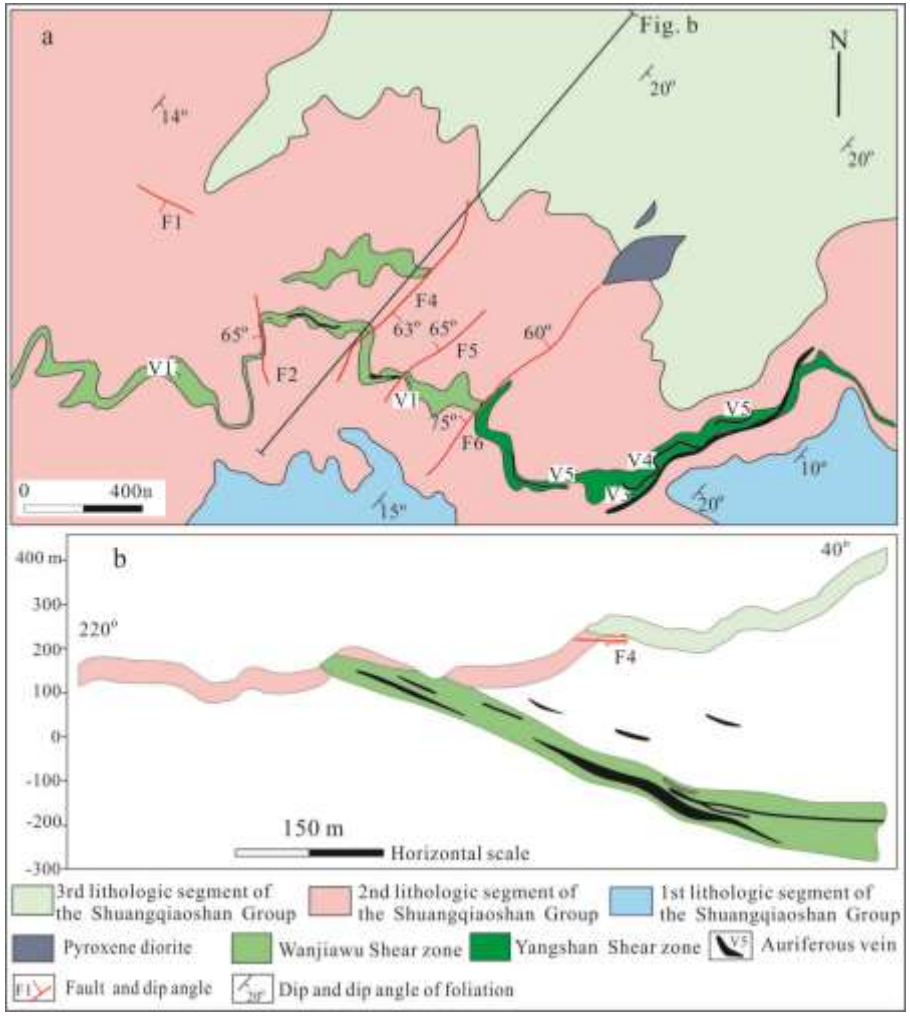
湘西漠滨Au矿

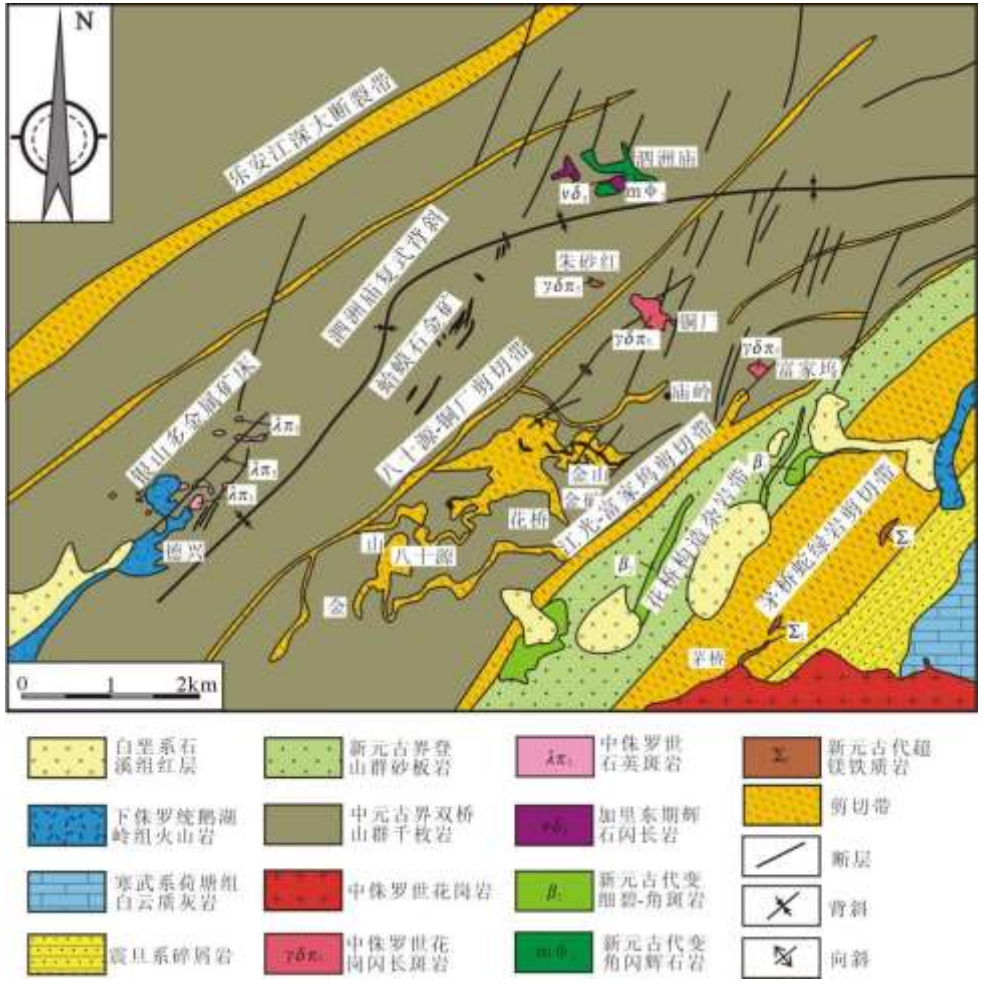

N
A
B
Jintangxi
Shuidong
Huijiachong
Shengdong
Mohin Fault
F1
F2
25°
24°
34°
32°
22°
15°
0
500m
344°
164°
600m
500
400
300
200
Drilling hole
Fine-grained meta-sandstones and arenaceous slates of the WQXBXG
Fine-grained meta-sandstones intercalated with arenaceous slates of the WQXBXG
Arenaceous slates intercalated with fine-grained meta-sandstones of the WQXBXG
Slates intercalated with arenaceous slates of the WQXBXG
Banded arenaceous slates of the WQXBXG
Metamorphosed fine-grained sandstones of the WQXBXG
Arenaceous slates of the Wuqiangxi Formation of the Banxi Group (WQXBXG)
Fault
Attitude
Geological boundary
Auriferous quartz vein and its serial number

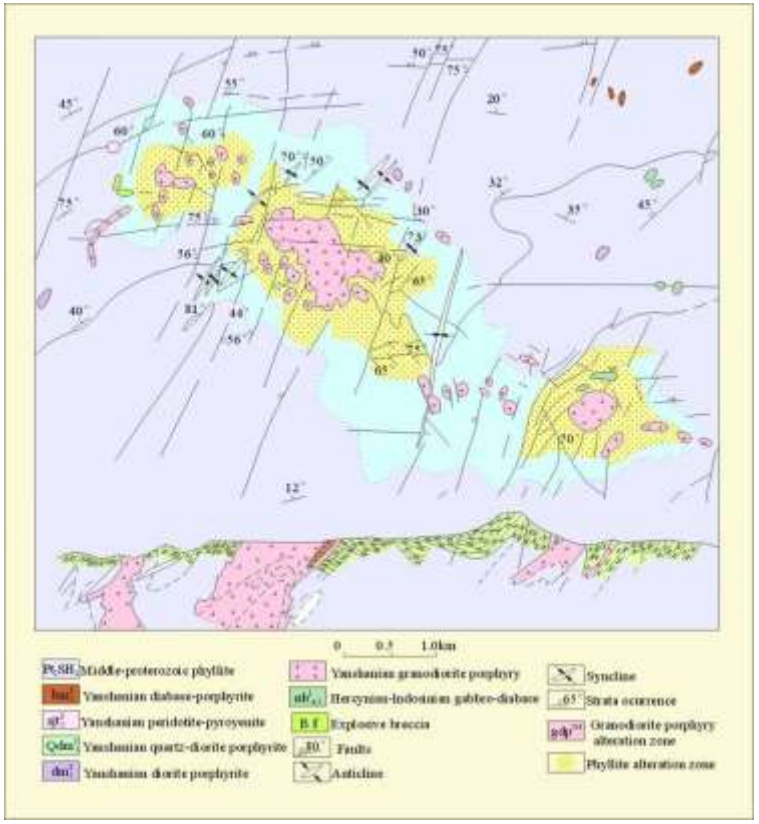
江南带北东部的浙江璜山、诸稽金矿：30吨以上

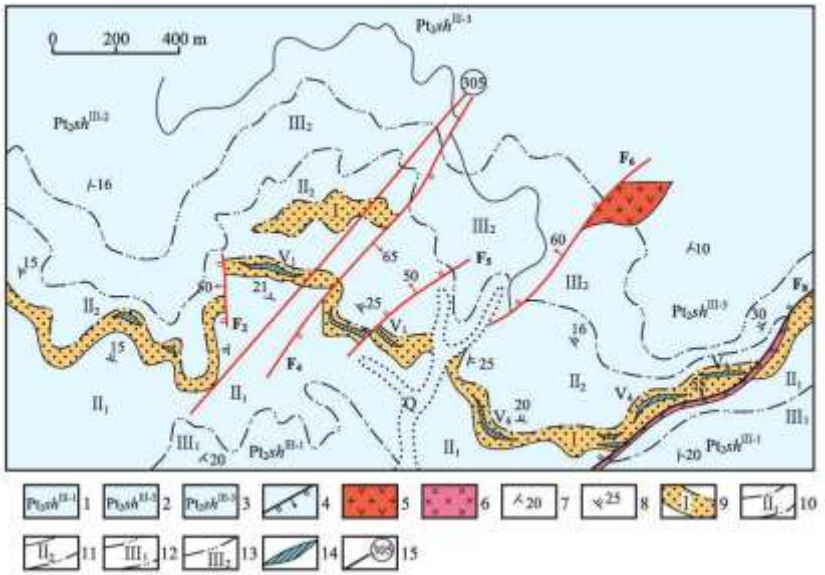


江南带江西金山金矿：预测金资源300吨

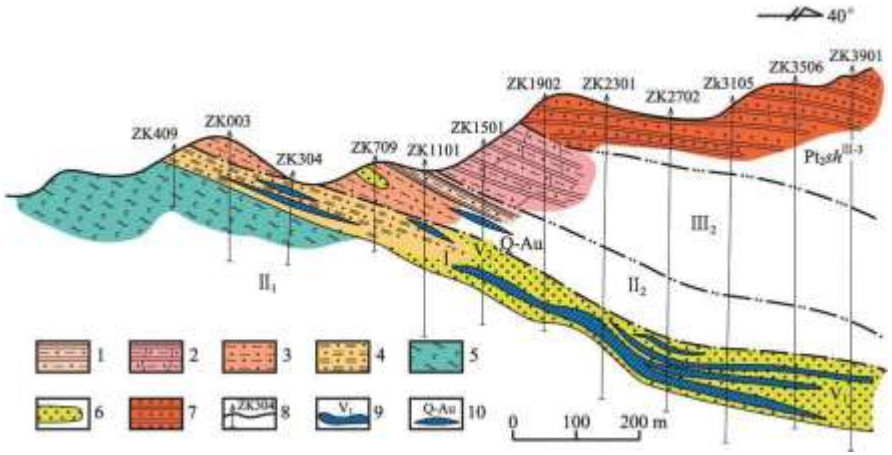




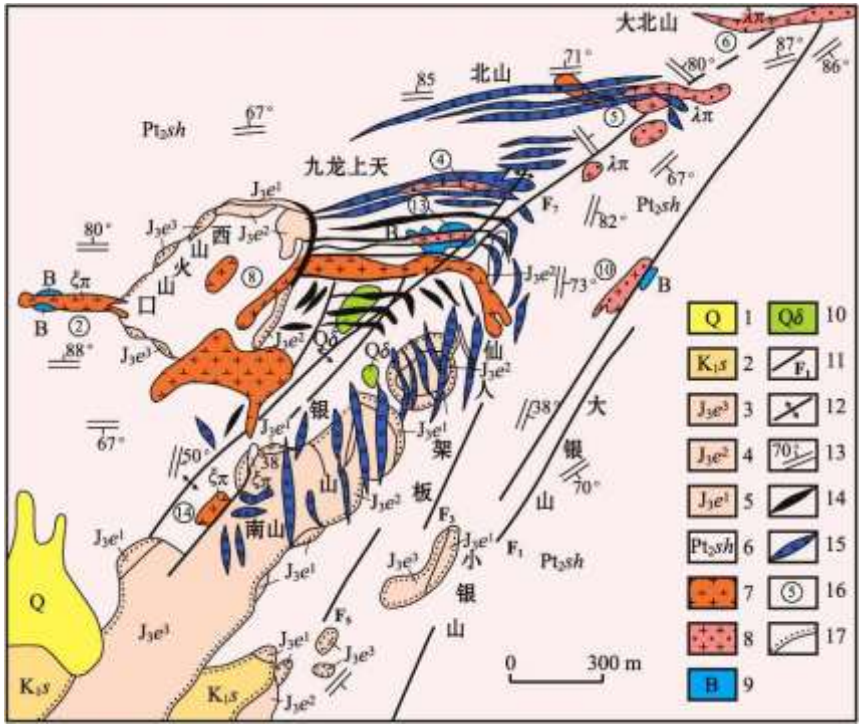


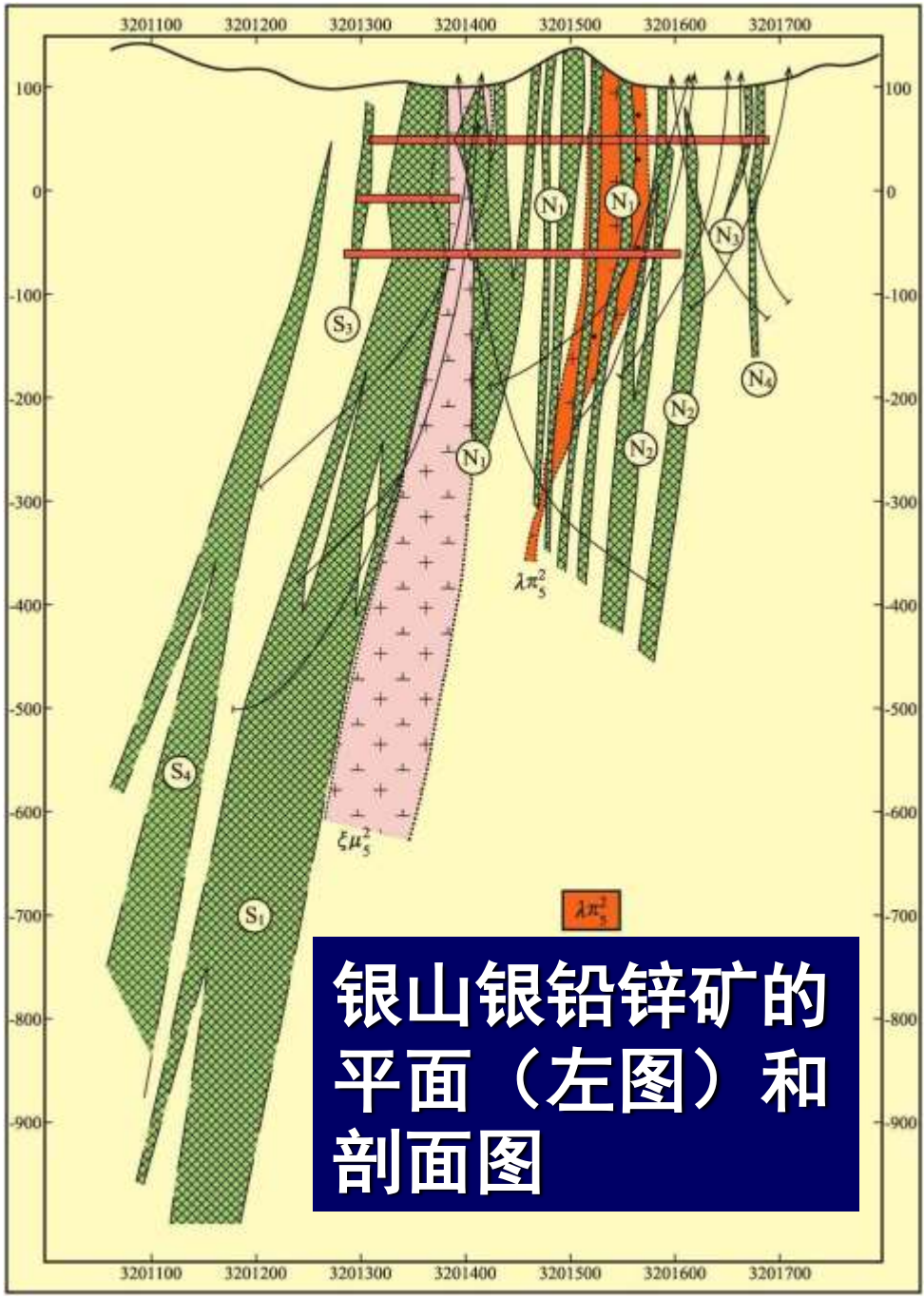


德兴铜金矿田矿床分布图

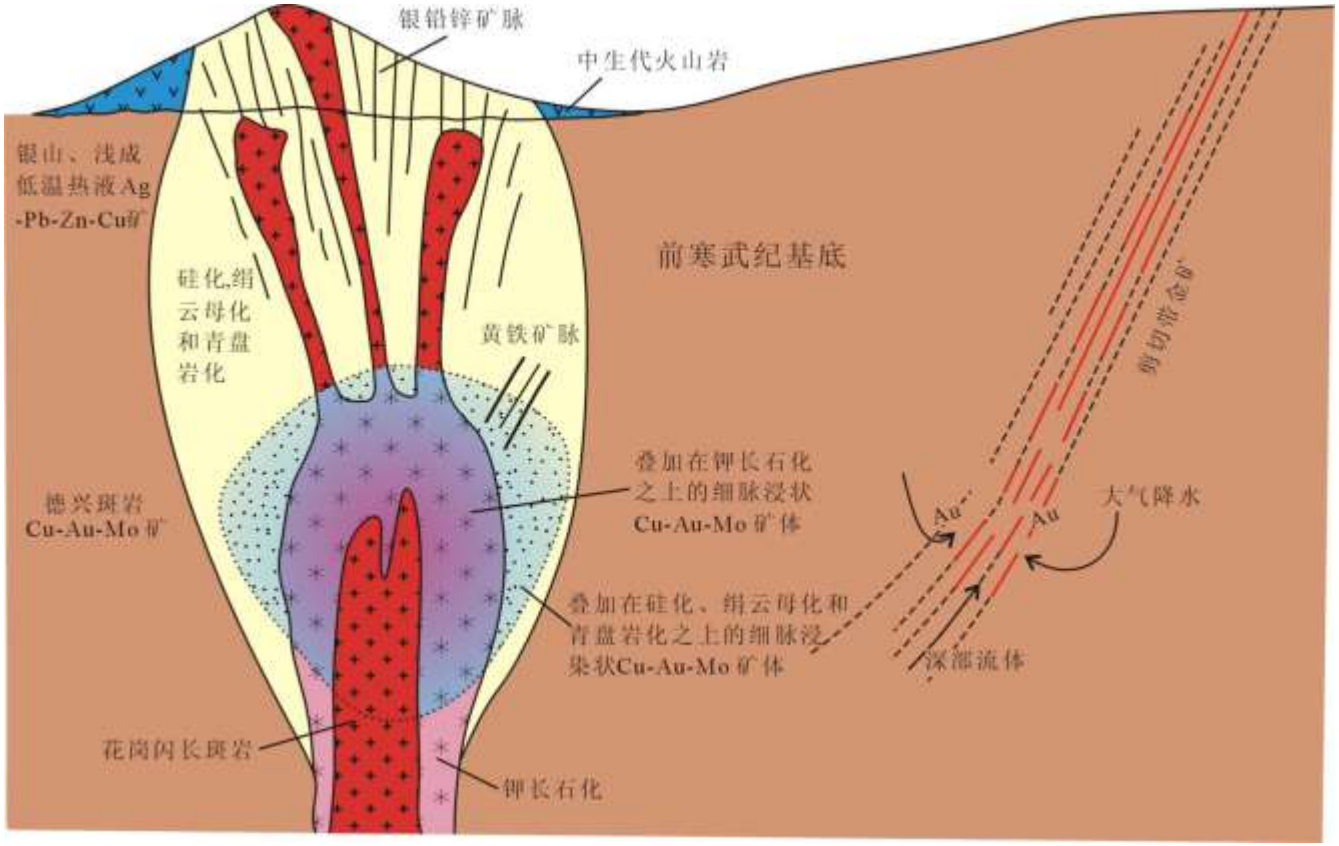


金山金矿剖面图



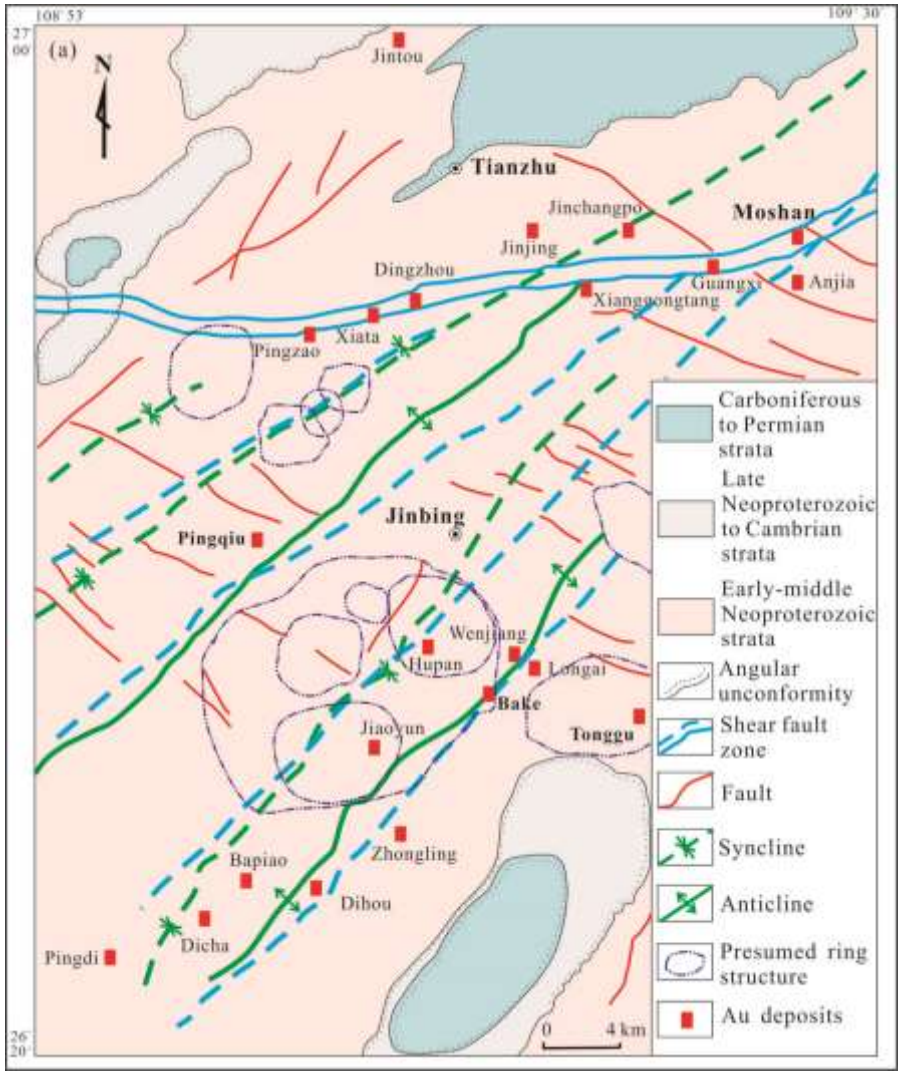


银山银铅锌矿的平面（左图）和剖面图



德兴矿田斑岩铜多金属矿床的矿床模型

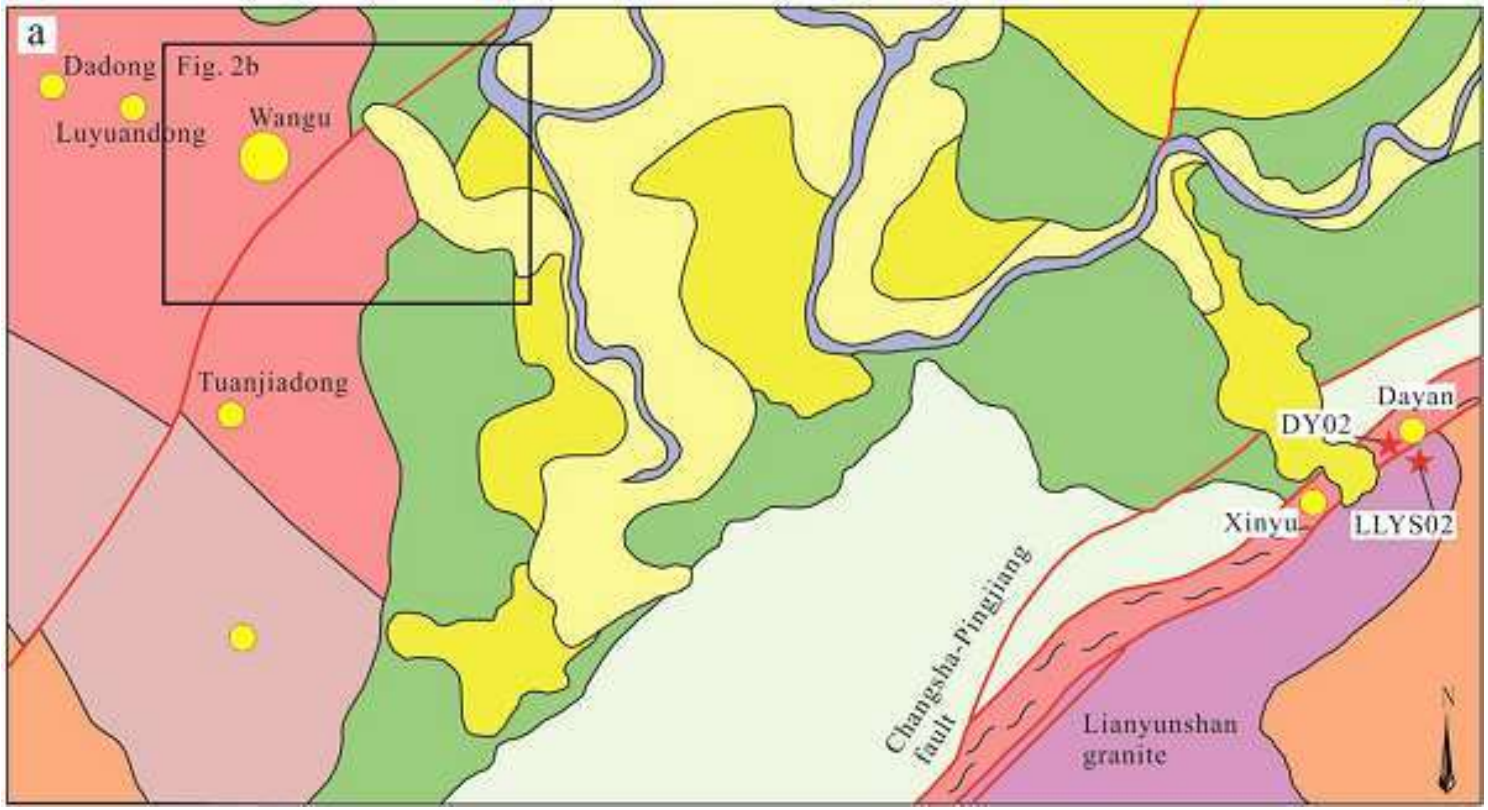
黔西南金矿：预测金资源130吨

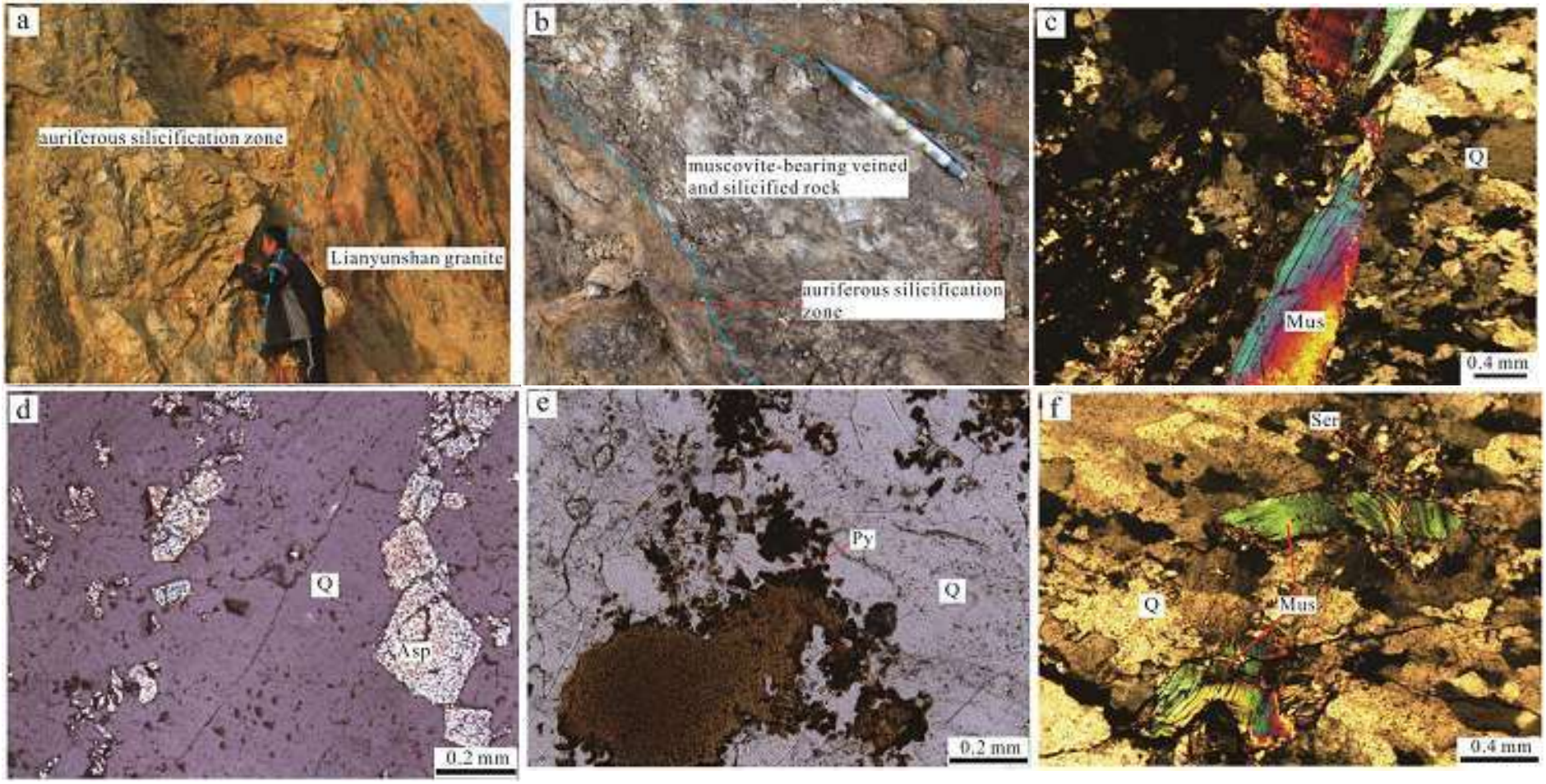


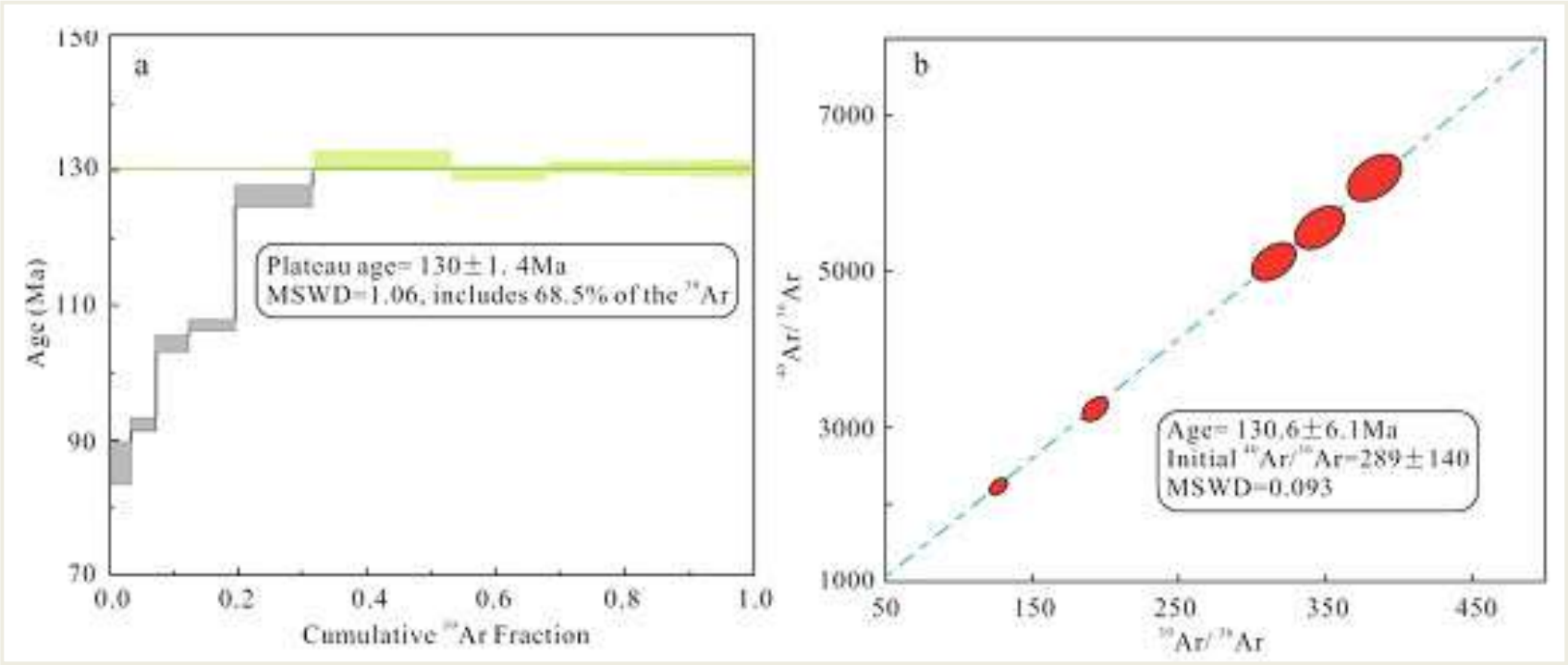
主要地质特征—总结

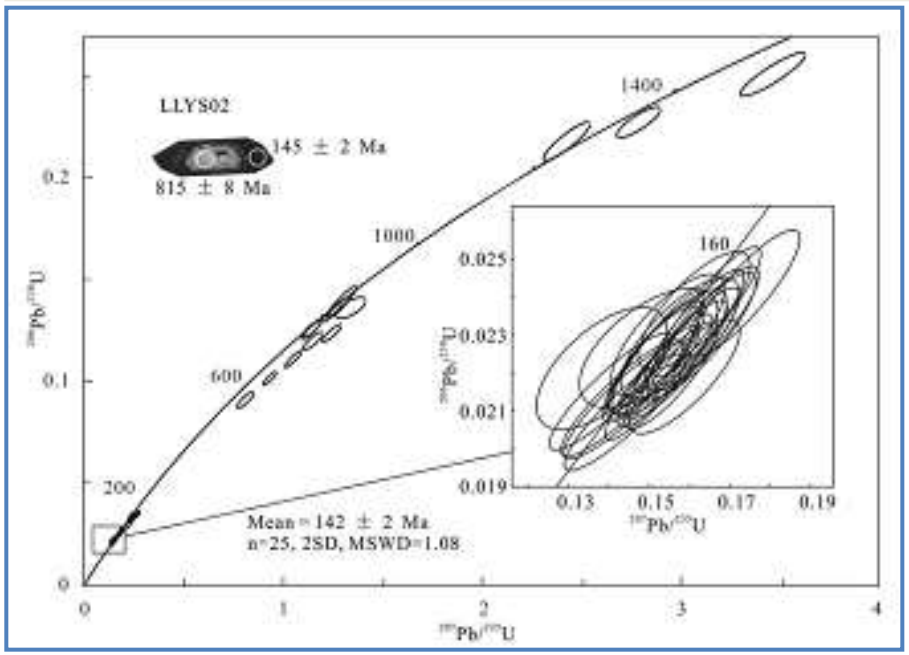
- 矿体赋存在新元古代浅变质地层中，大多距离岩体有一定距离；
- 控矿构造为NWW向**层间破碎带**或者NE向断裂，少量为NS向断裂；
- 矿石类型：石英脉型、蚀变岩型和构造角砾岩型；
- 蚀变类型包括硅化、毒砂化、黄铁矿化和绿泥石化等；
- 矿石矿物为毒砂、黄铁矿、辉锑矿、白钨矿、自然金+少量的方铅矿、闪锌矿、黄铜矿和锑铜矿等；脉石矿物为石英、方解石及少量绿泥石和叶蜡石等
- 成矿阶段：1）石英脉，2）石英+毒砂+黄铁矿，3)石英+方解石或者碳酸盐脉

成矿时代—湘东北万古金矿定年




a
auriferous silicification zone
Lianyunshan granite
b
muscovite-bearing veined and silicified rock
auriferous silicification zone
c
Q
Mus
0.4 mm
d
Q
Asp
0.2 mm
e
Py
Q
0.2 mm
f
Ser
Q
Mus
0.4 mm



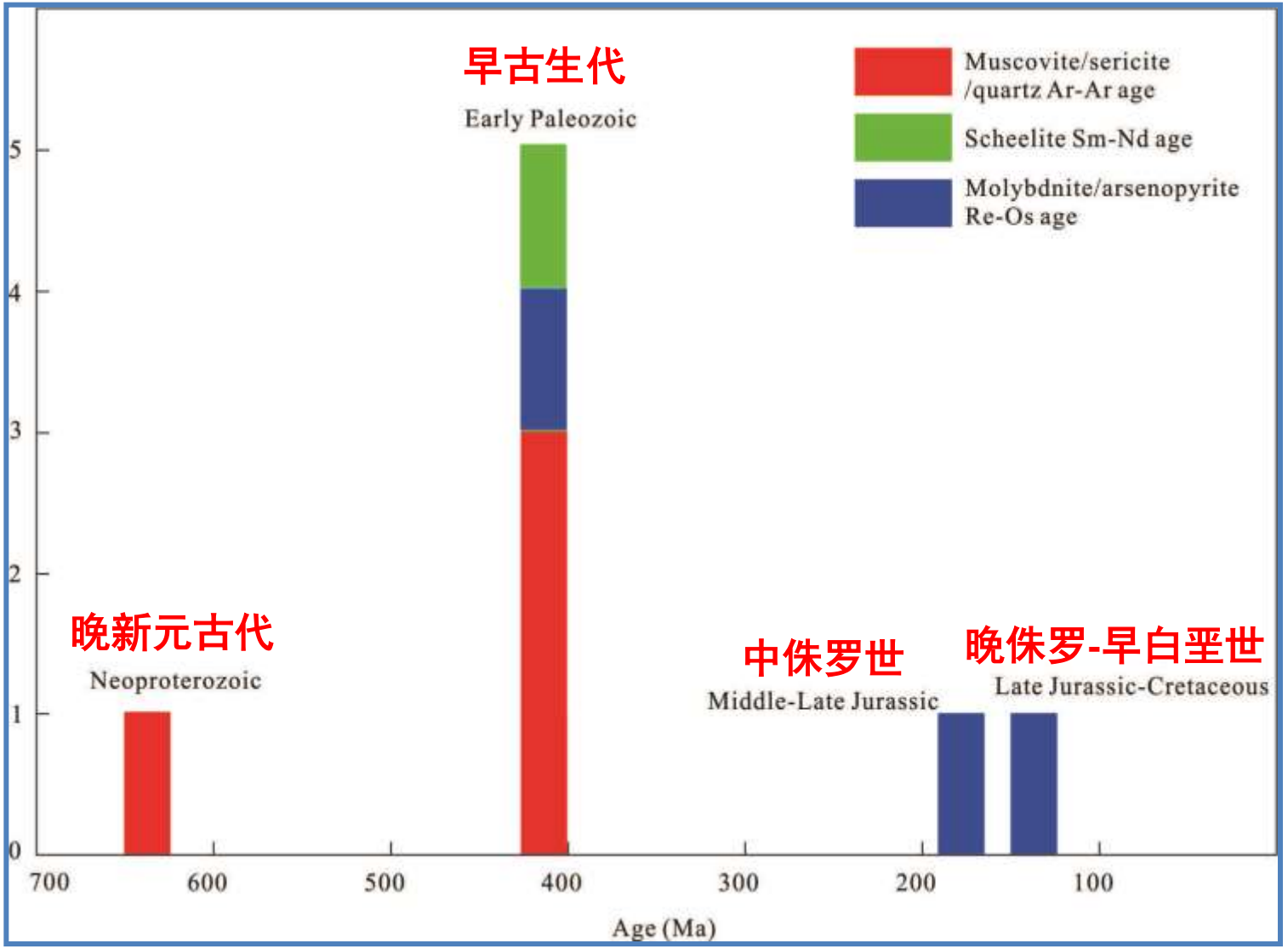


湘东北万古金矿化年龄

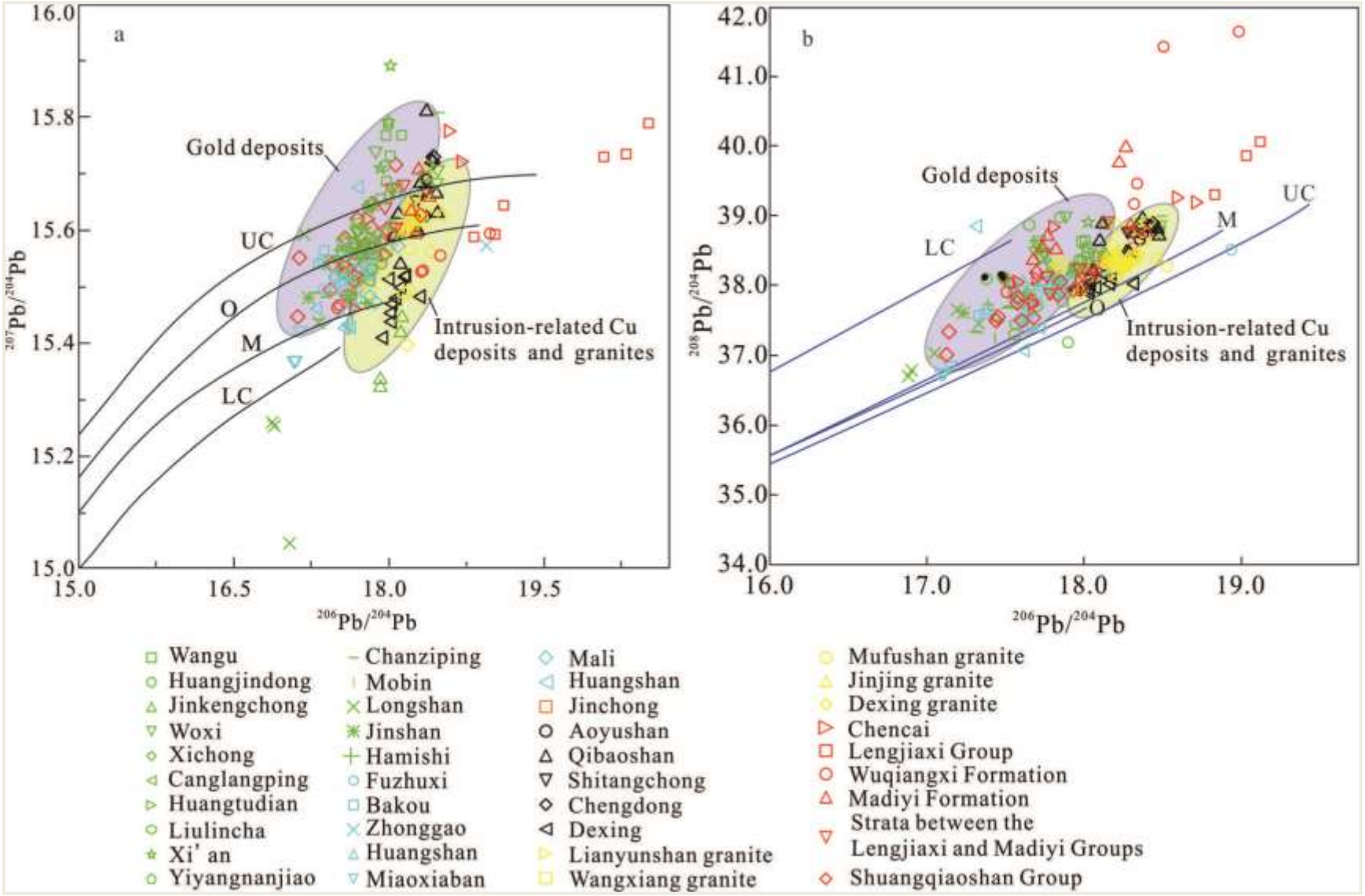
130-142 Ma（许德如等）

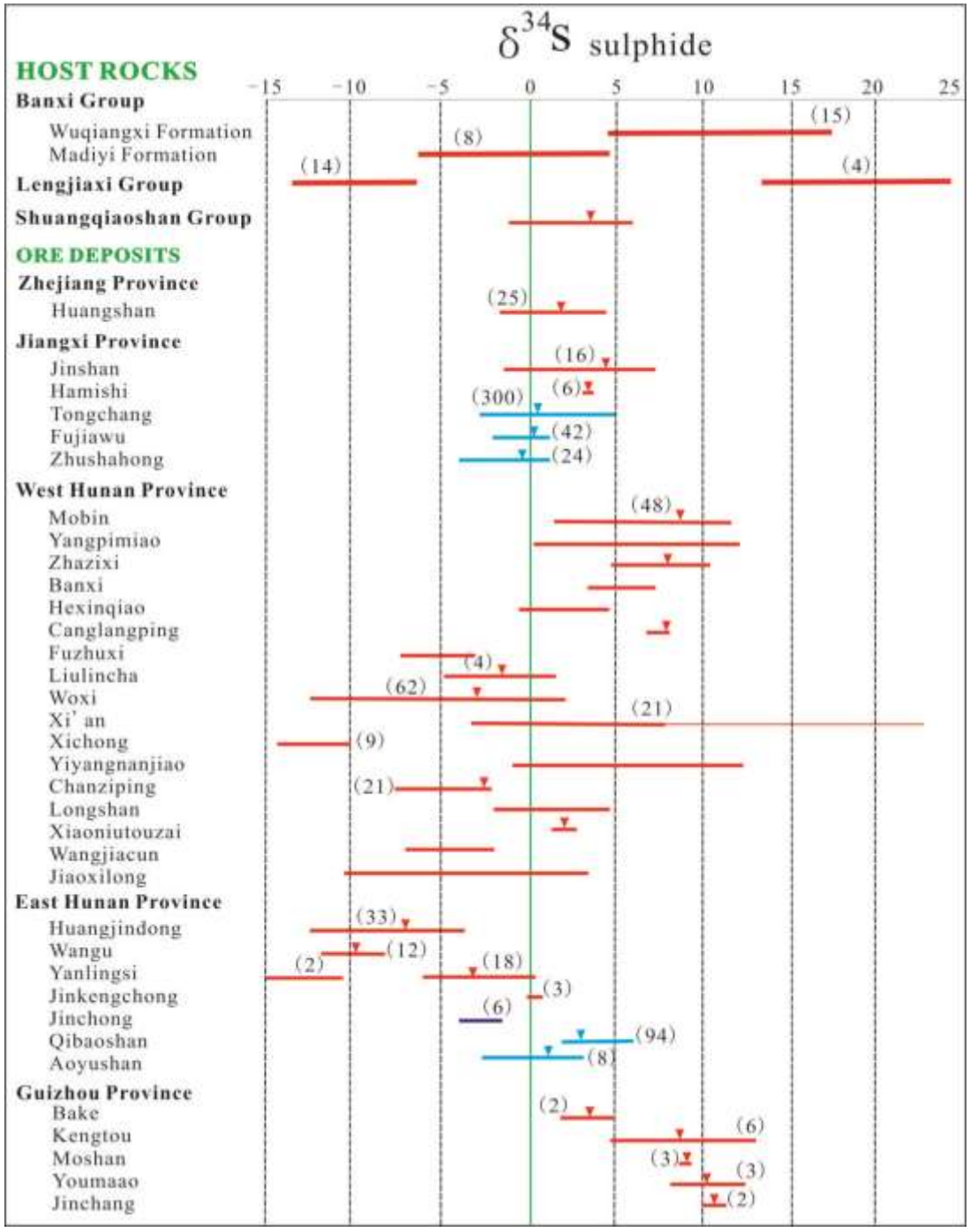
江南造山带金矿化时代

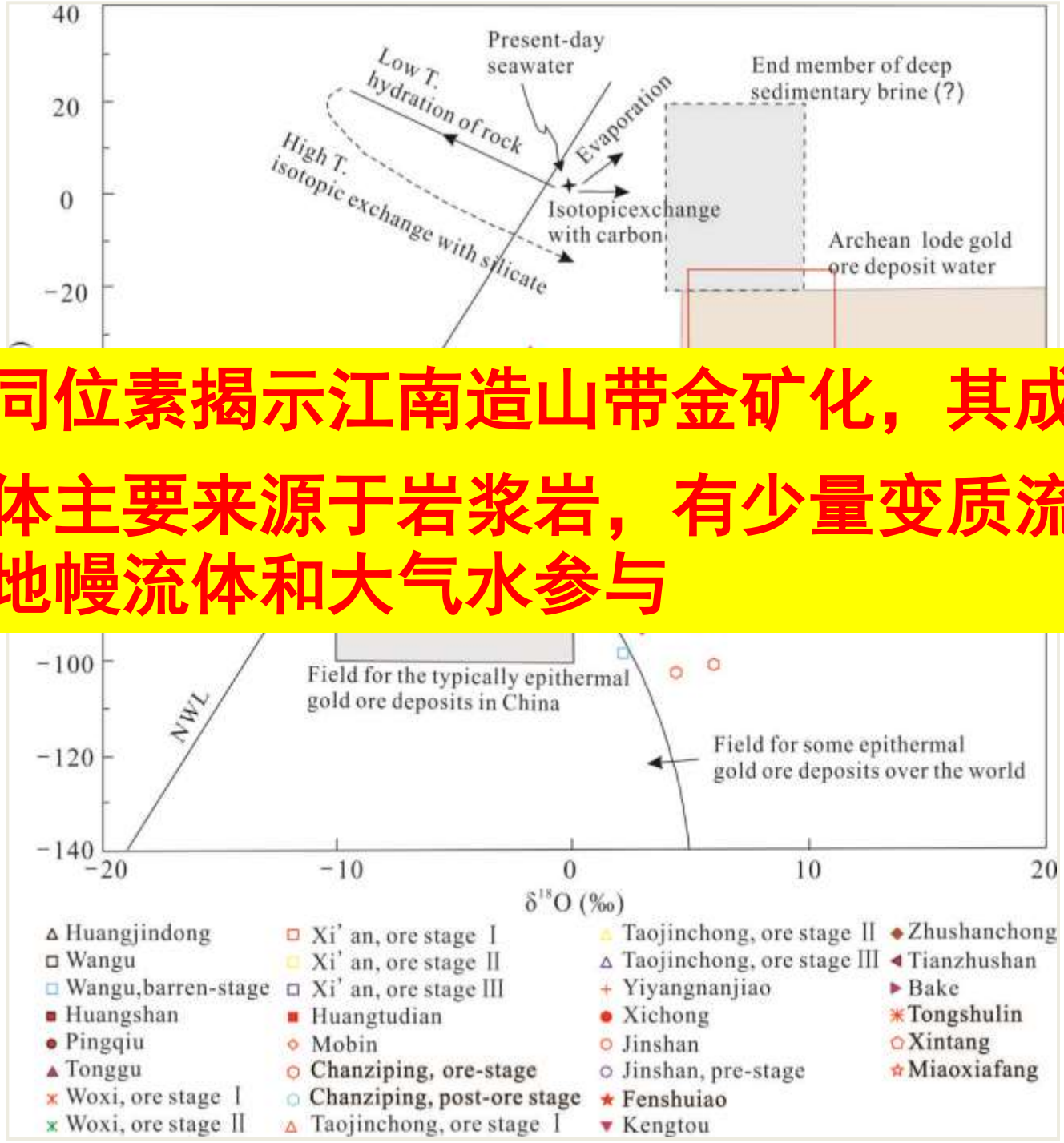
新元古代、加里东期、早燕山期、晚燕山期



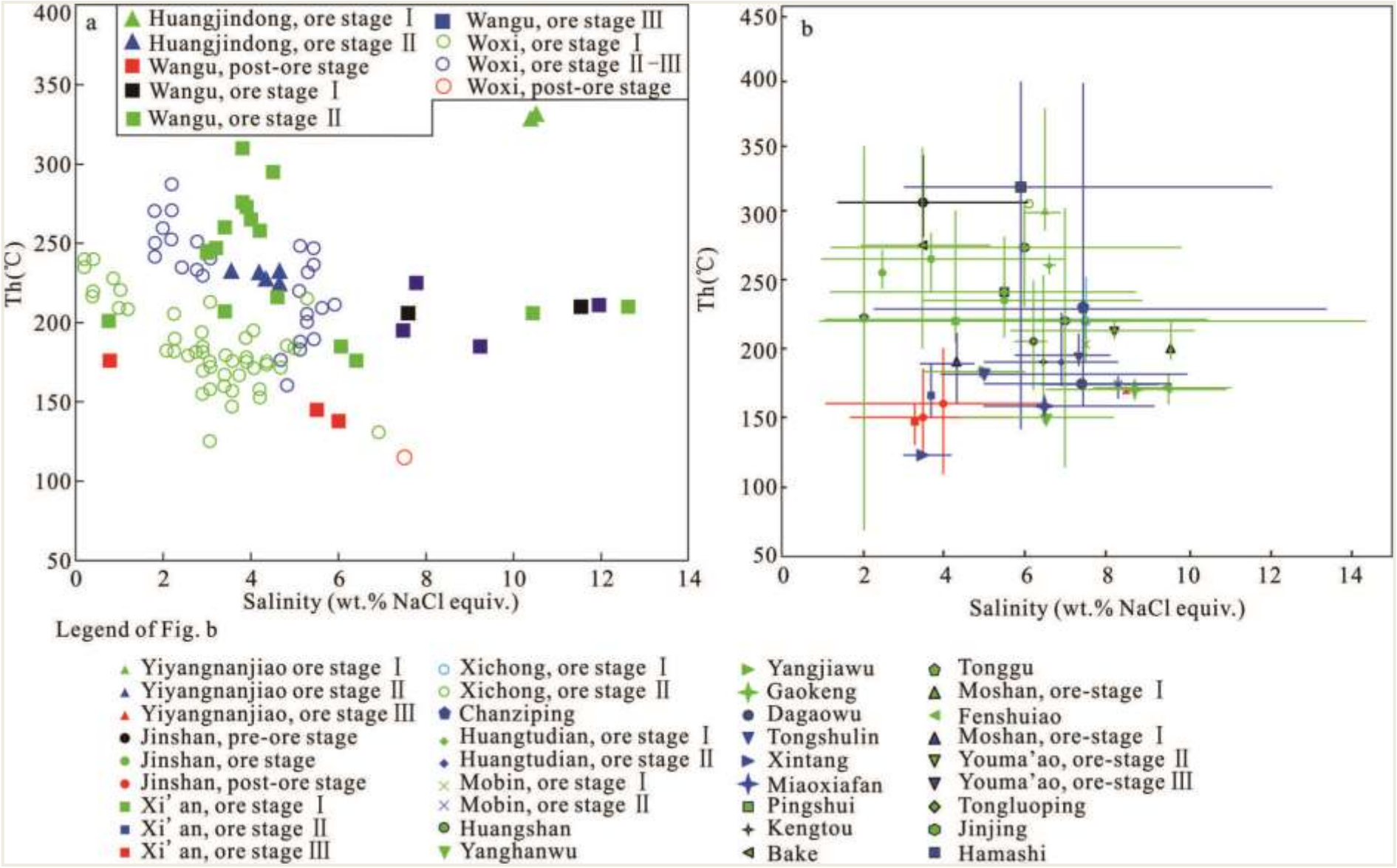
矿床地球化学


a
Gold deposits
UC
O
M
LC
Intrusion-related Cu deposits and granites
$^{207}Pb/^{204}Pb$
$^{206}Pb/^{204}Pb$
b
Gold deposits
LC
UC
M
O
Intrusion-related Cu deposits and granites
$^{208}Pb/^{204}Pb$
$^{206}Pb/^{204}Pb$
Wangu
Huangjindong
Jinkengchong
Woxi
Xichong
Canglangping
Huangtudian
Liulincha
Xi' an
Yiyangnanjiao
Chanziping
Mobin
Longshan
Jinshan
Hamishi
Fuzhuxi
Bakou
Zhonggao
Huangshan
Miaoxiaban
Mali
Huangshan
Jinchong
Aoyushan
Qibaoshan
Shitangchong
Chengdong
Dexing
Lianyunshan granite
Wangxiang granite
Mufushan granite
Jinjing granite
Dexing granite
Chencai
Lengjiaxi Group
Wuqiangxi Formation
Madiyi Formation
Strata between the Lengjiaxi and Madiyi Groups
Shuangqiaoshan Group


δ34S sulphide
−15
−10
−5
0
5
10
15
20
25
HOST ROCKS
Banxi Group
Wuqiangxi Formation
Madiyi Formation
Lengjiaxi Group
Shuangqiaoshan Group
ORE DEPOSITS
Zhejiang Province
Huangshan
Jiangxi Province
Jinshan
Hamishi
Tongchang
Fujiawu
Zhushahong
West Hunan Province
Mobin
Yangpimiao
Zhazixi
Banxi
Hexinqiao
Canglangping
Fuzhuxi
Liulincha
Woxi
Xi' an
Xichong
Yiyangnanjiao
Chanziping
Longshan
Xiaoniutouzai
Wangjiacun
Jiaoxilong
East Hunan Province
Huangjindong
Wangu
Yanlingsi
Jinkengchong
Jinchong
Qibaoshan
Aoyushan
Guizhou Province
Bake
Kengtou
Moshan
Youmaao
Jinchang
(15)
(8)
(14)
(4)
(25)
(16)
(6)
(300)
(42)
(24)
(48)
(4)
(62)
(21)
(9)
(21)
(33)
(12)
(2)
(18)
(3)
(6)
(94)
(8)
(2)
(6)
(3)
(3)
(2)

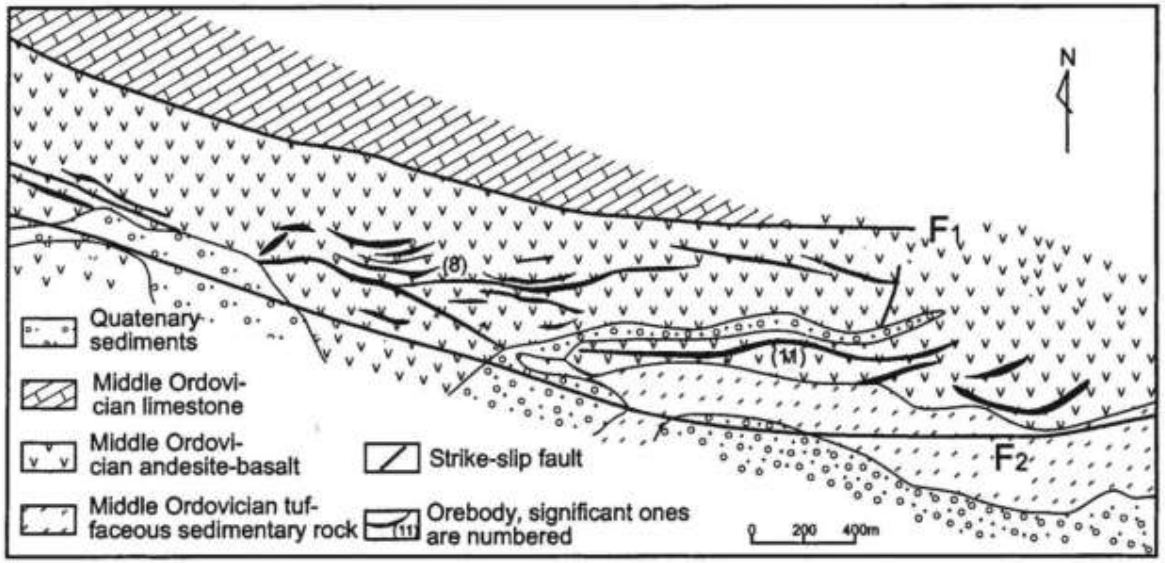


多同位素揭示江南造山带金矿化，其成矿流体主要来源于岩浆岩，有少量变质流体及地幔流体和大气水参与

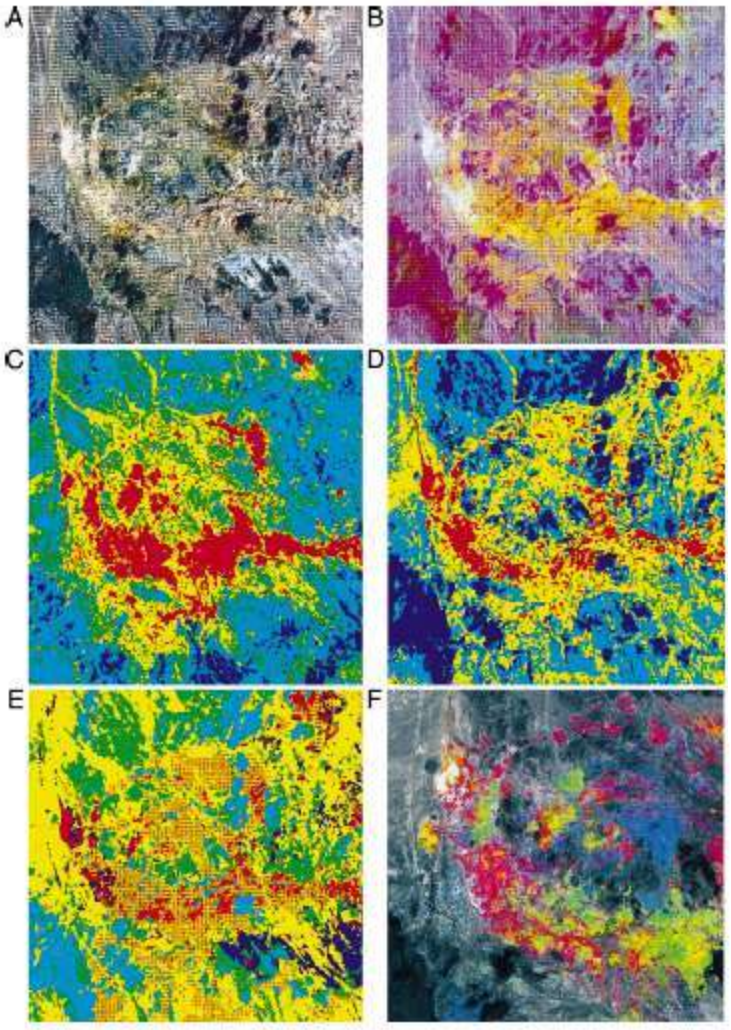


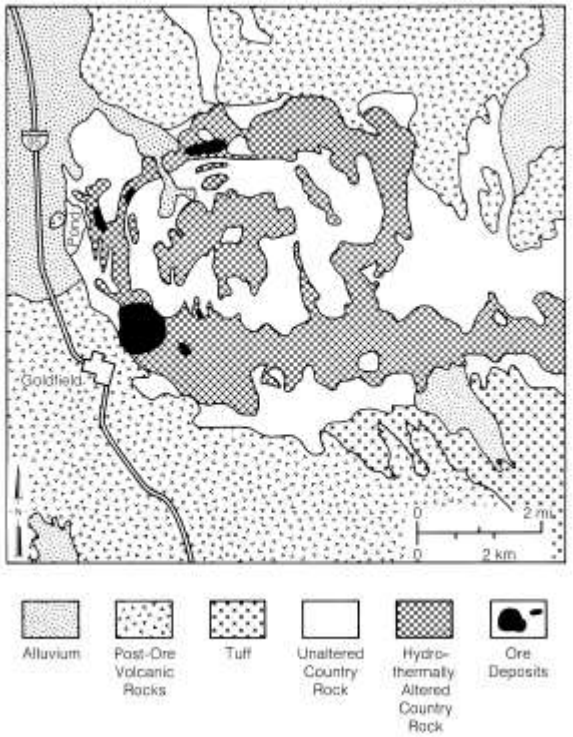
成矿流体具有富CO_2，中低温、低盐度的特征

四、造山型金矿找矿与勘查



甘肃北祁连山寒山金矿平面图





美国内华达州Goldfield 矿区遥感影像填图：红色-伊利石；绿色-明矾石；蓝色-高岭石; 黄色-围岩（Sabins, 1999)

具体勘查：覆盖区或深部：必须地质、地球物理有机结合。如果是斑岩型或浅成低温热液型矿床相对比较简单；如果是脉状矿，构造性质和变化规律尤其重要，其次是地球物理的电磁等性质，围岩性质也重要，关系到对地球物理信息的准确判断和合理解释。只有有效地综合各类信息，才能实现高效勘查。知识来自于实践，知识就是力量，知识就是金钱。

谢

谢