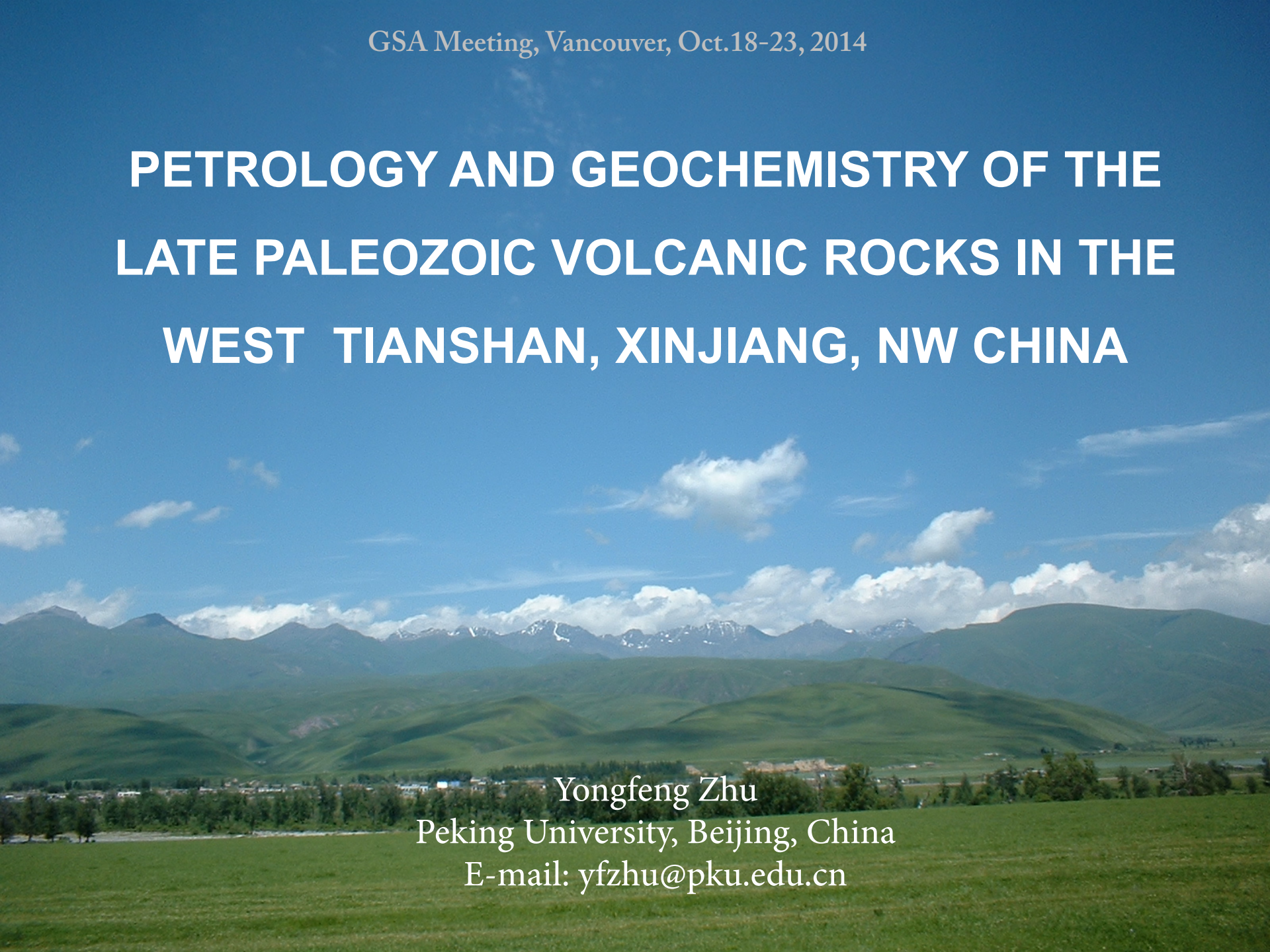
GSA Meeting, Vancouver, Oct.18-23, 2014

PETROLOGY AND GEOCHEMISTRY OF THE LATE PALEOZOIC VOLCANIC ROCKS IN THE WEST TIANSHAN, XINJIANG, NW CHINA



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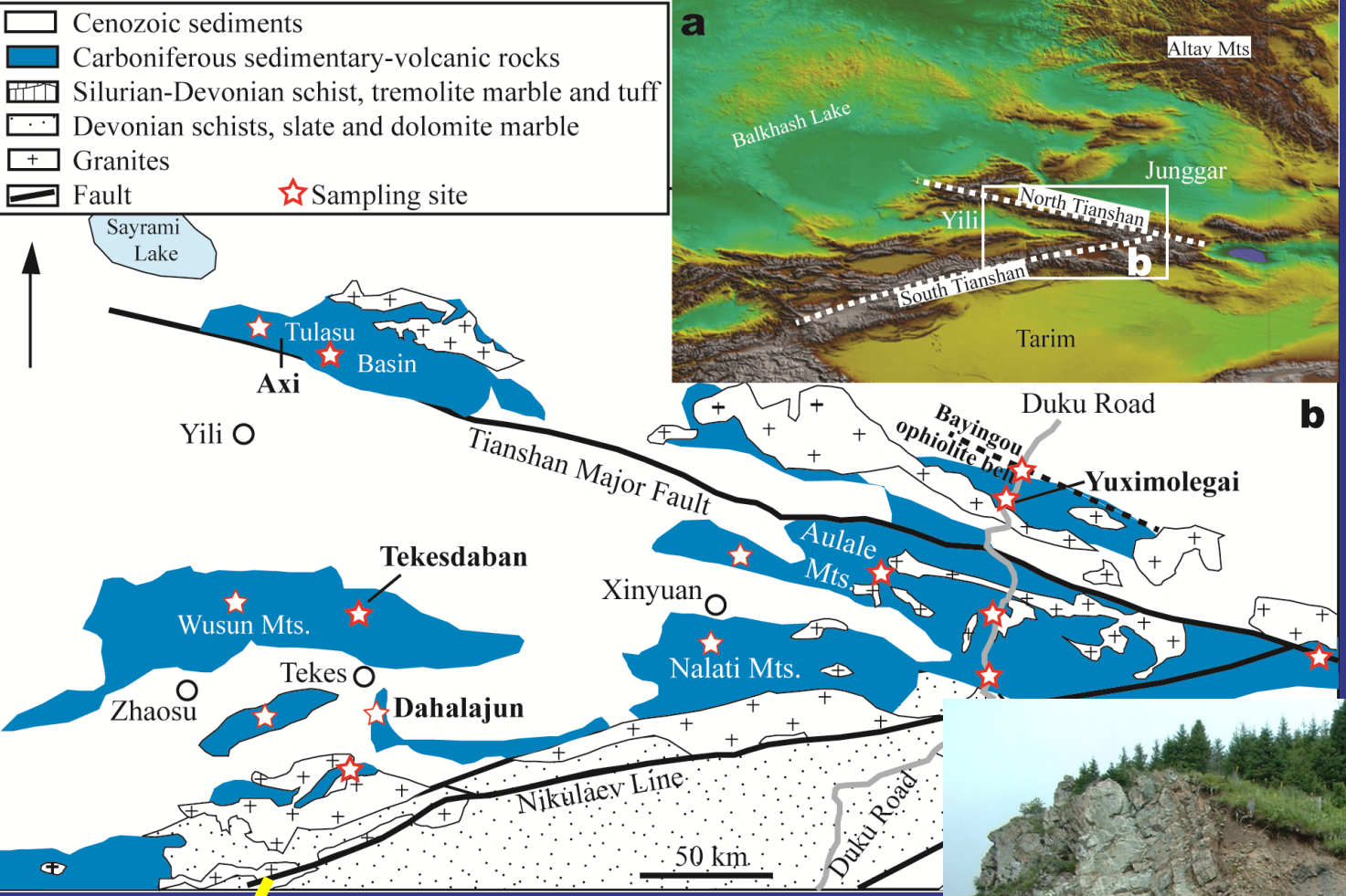
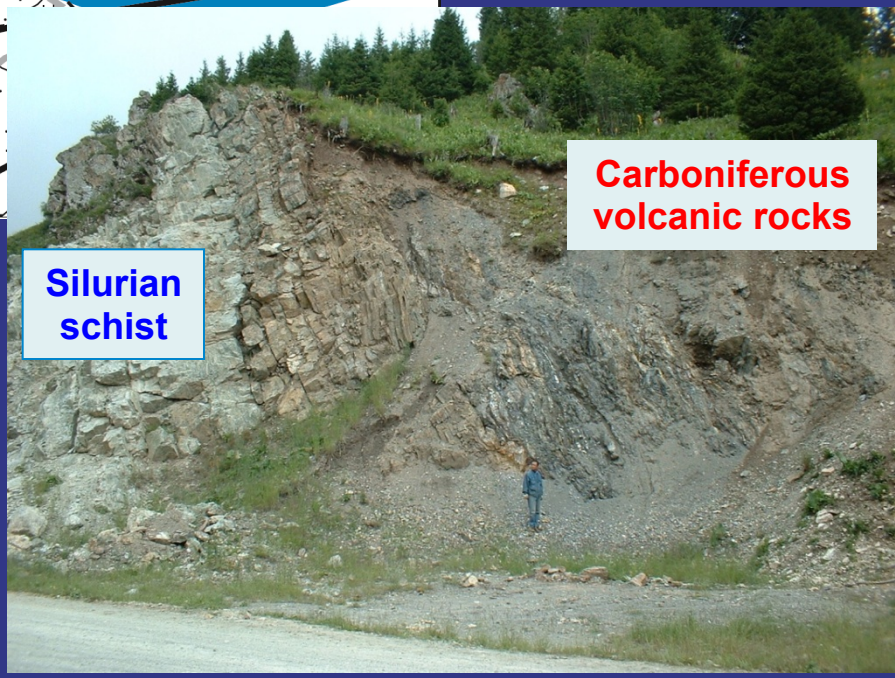
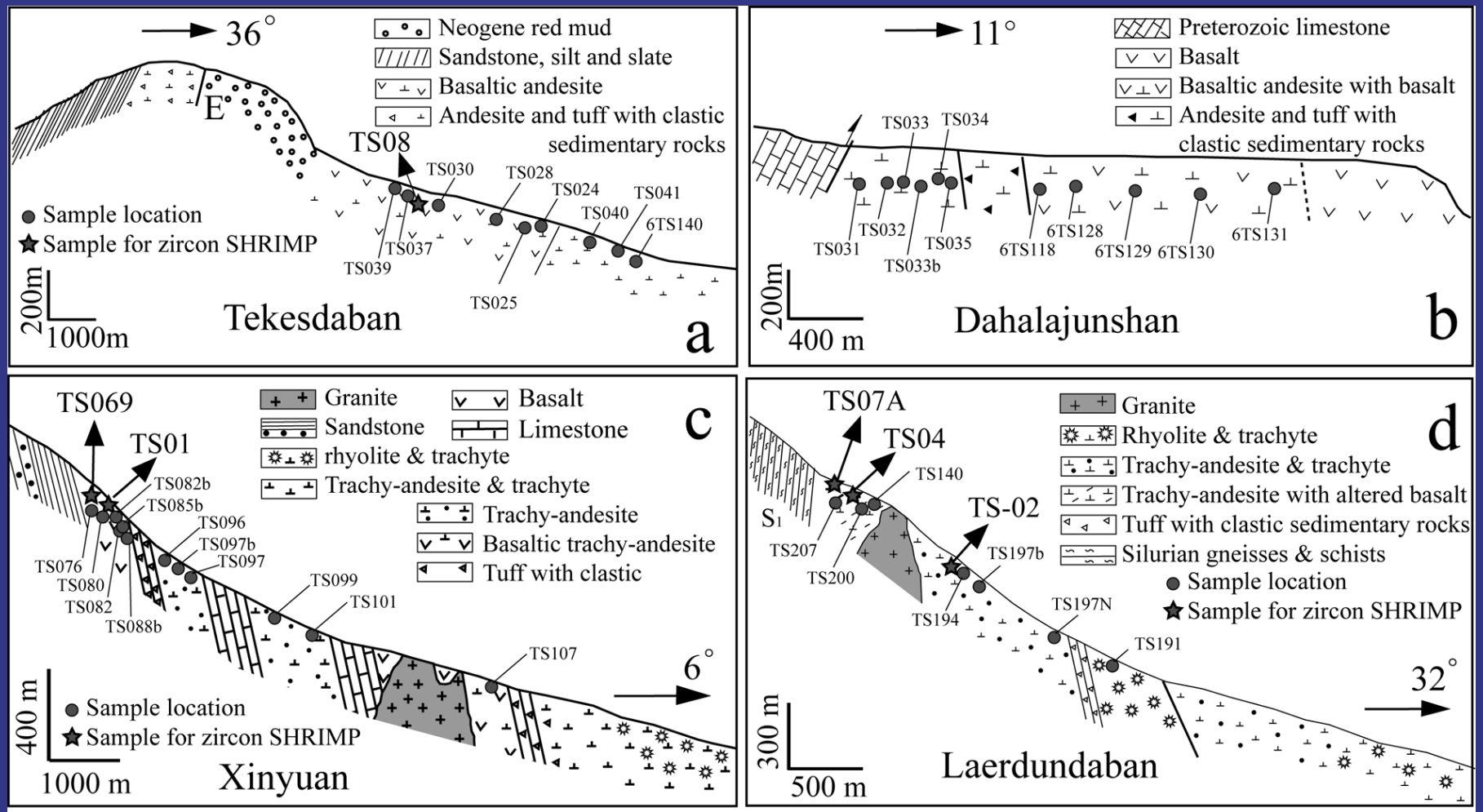


Blueschist and coesite eclogite found along the Nikulaev-Nalati Fault, suggesting deep subduction of south Tianshan oceanic crust (Zhang LF et al. 2002, 2005, 2013)





Representative geological sections for late Paleozoic volcanic-sedimentary rocks


Basalt


Andesite


Limestone


Flysch

These late Paleozoic volcanic-sedimentary rocks were covered by late Carboniferous conglomerate and sandstone in both north and south Tianshan.

Conglomerate

Comparisons for geological records

South Tianshan:

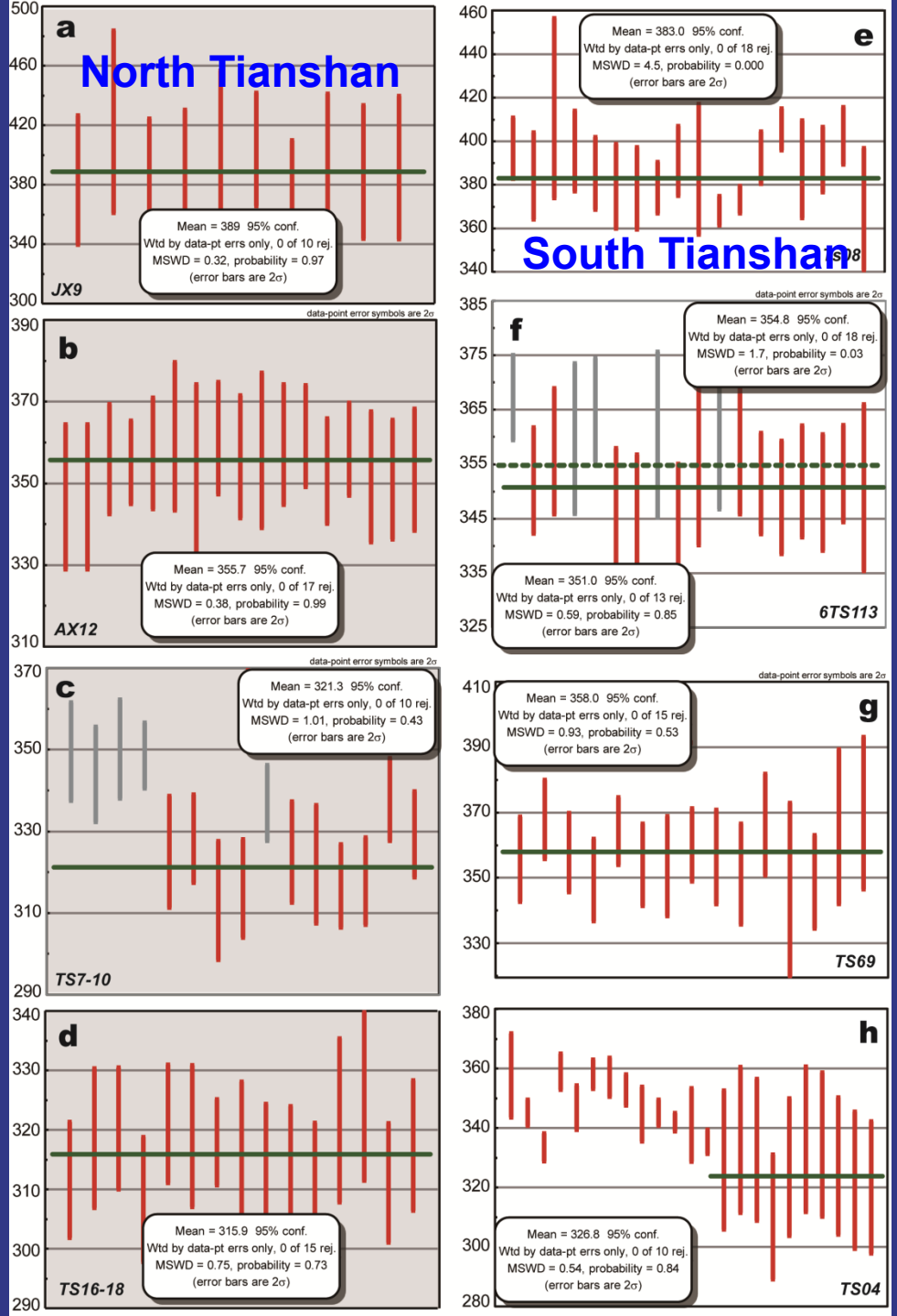
volcanic rocks accompany ophiolitic melanges,

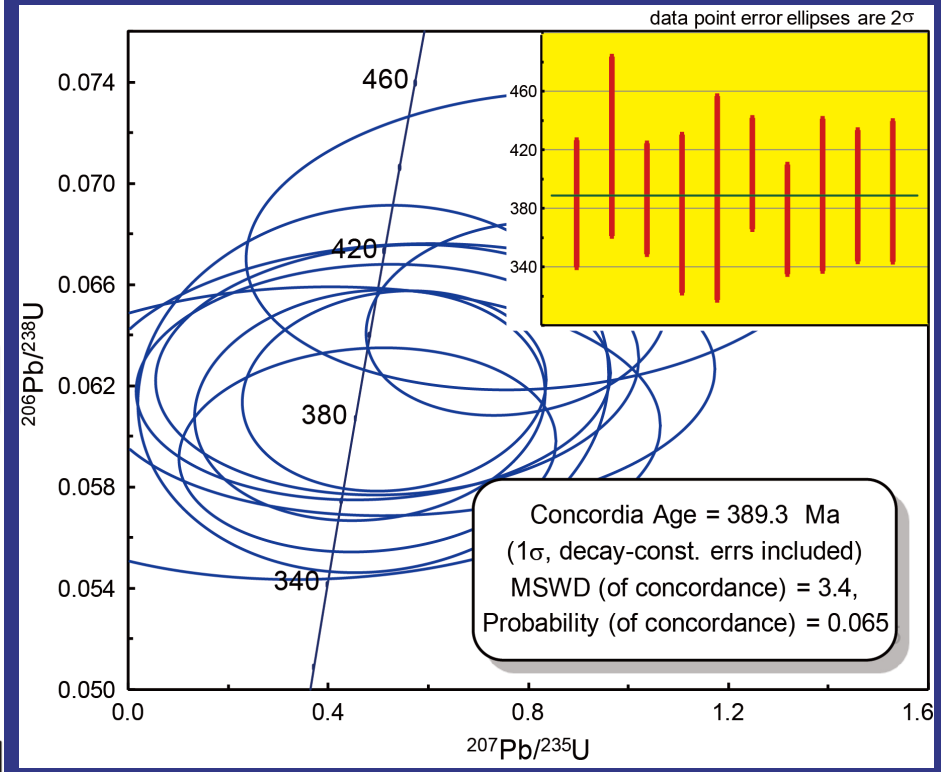
sedimentary, and metamorphic rocks (eclogite & blueschist)

North Tianshan:

volcanic rocks accompany ophiolitic melanges,

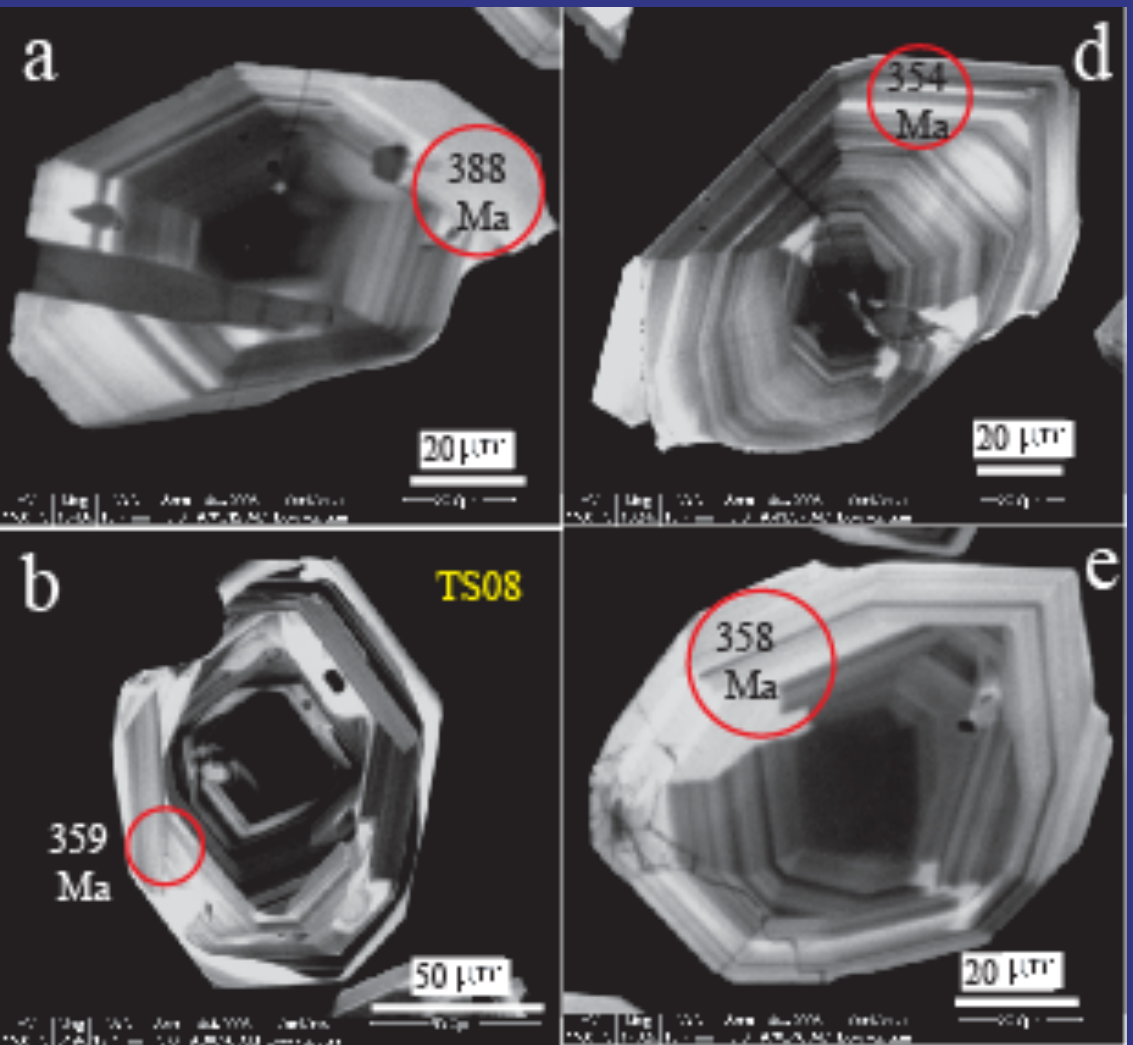
sedimentary, and metamorphic rocks (greenschist)

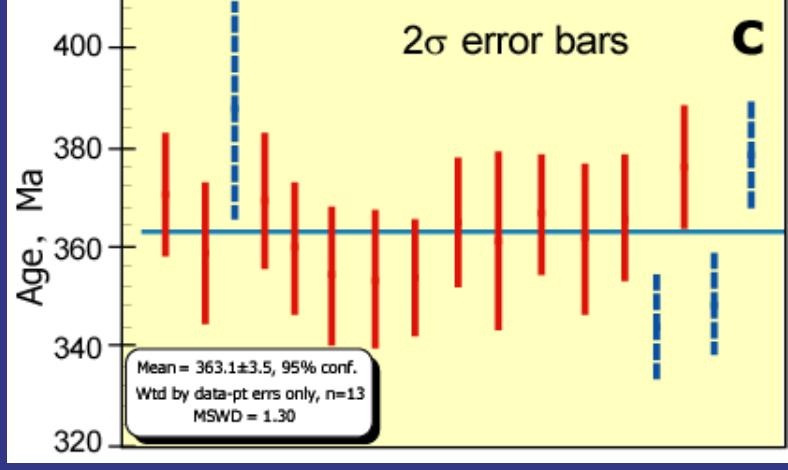




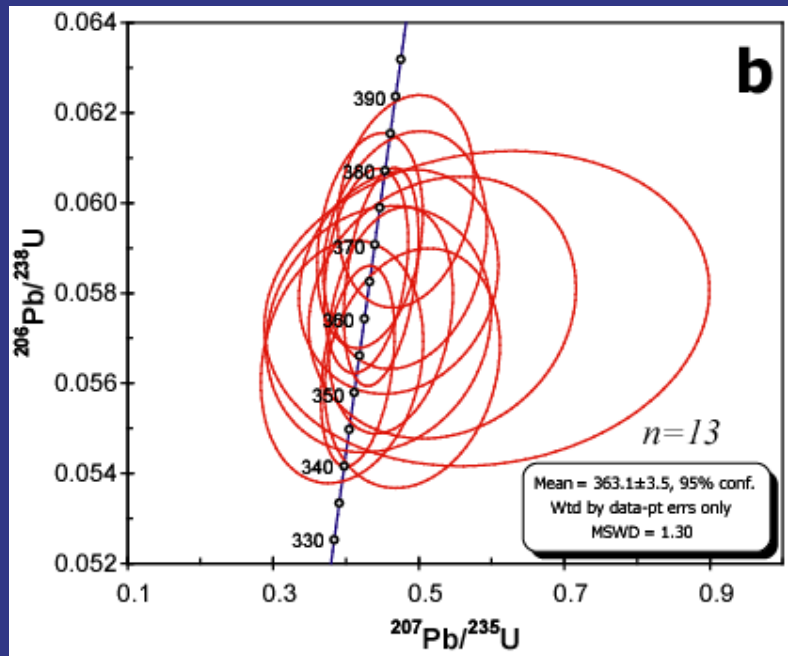
Volcanic rocks in North Tianshan with U-Pb ages of 389 - 313Ma are similar to volcanic rocks in south Tianshan (383 - 316Ma)

Zircons separated from basaltic andesite in Tekesdaban

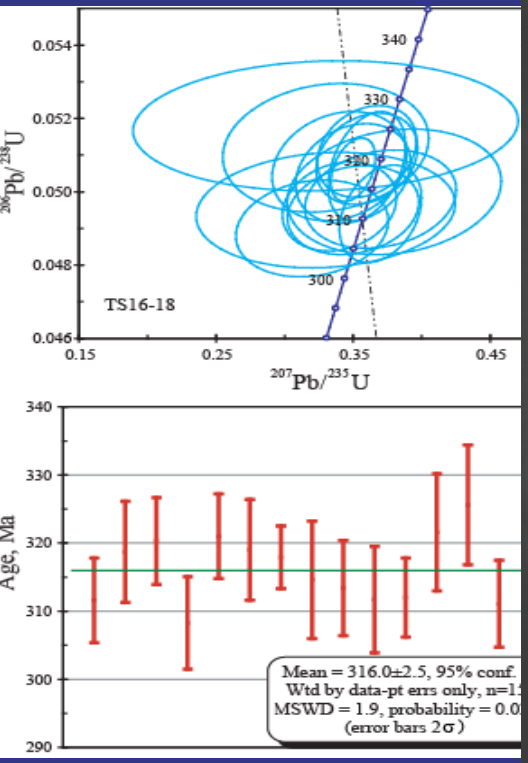


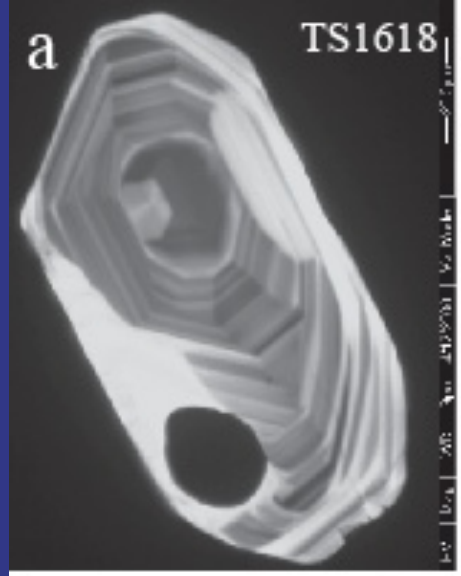


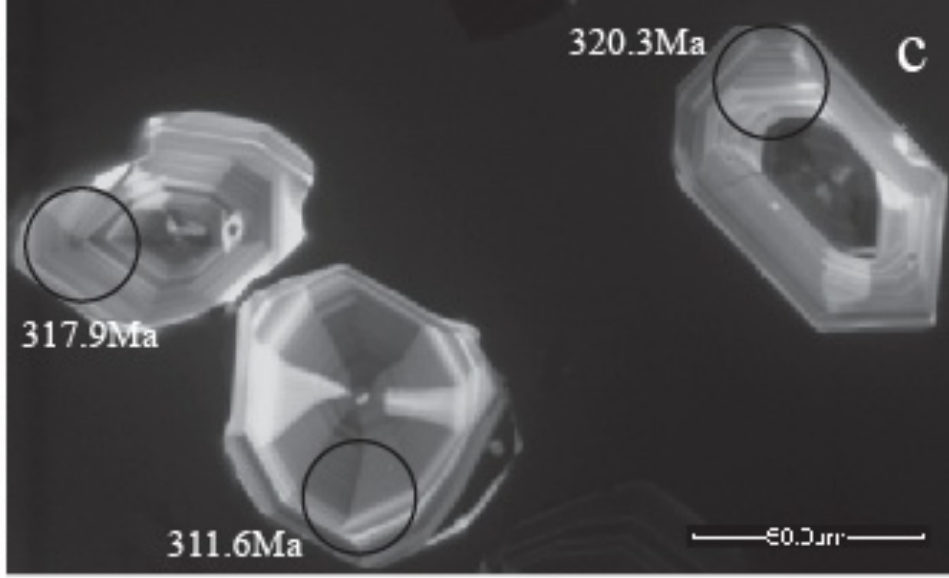
363.1 ±3.5Ma
MSWD = 1.3

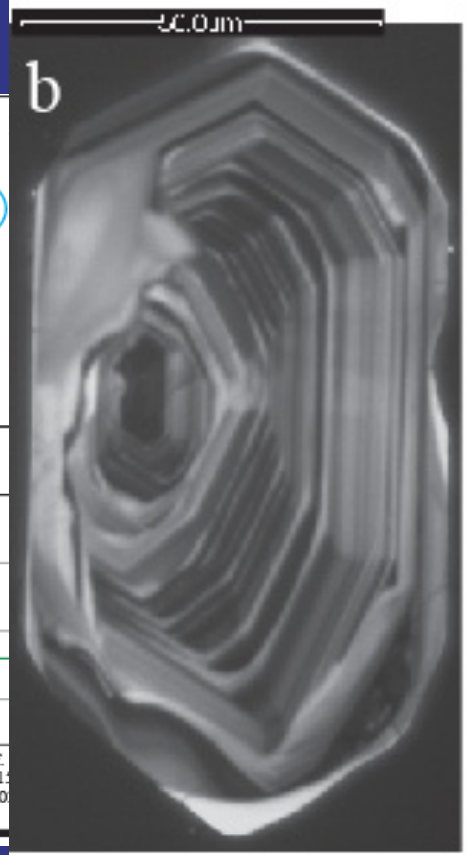


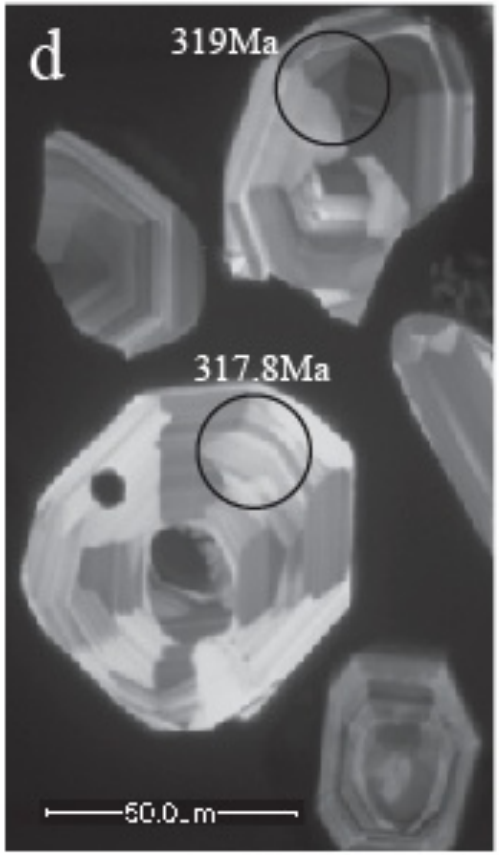
Rhyolite in Laerdundaban 316 ±2.5 Ma

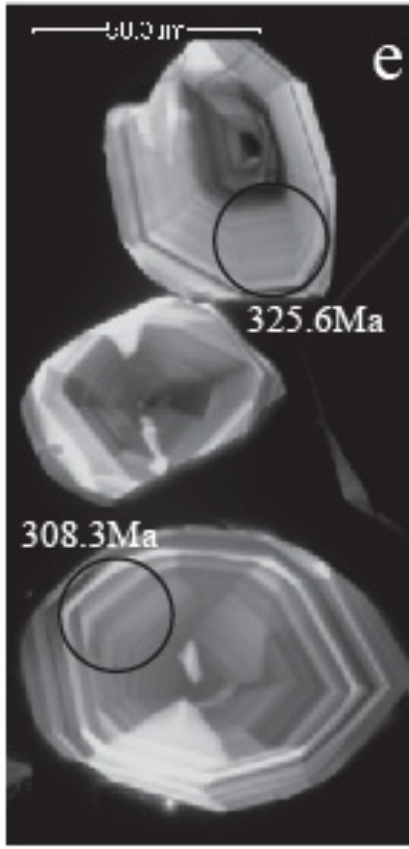


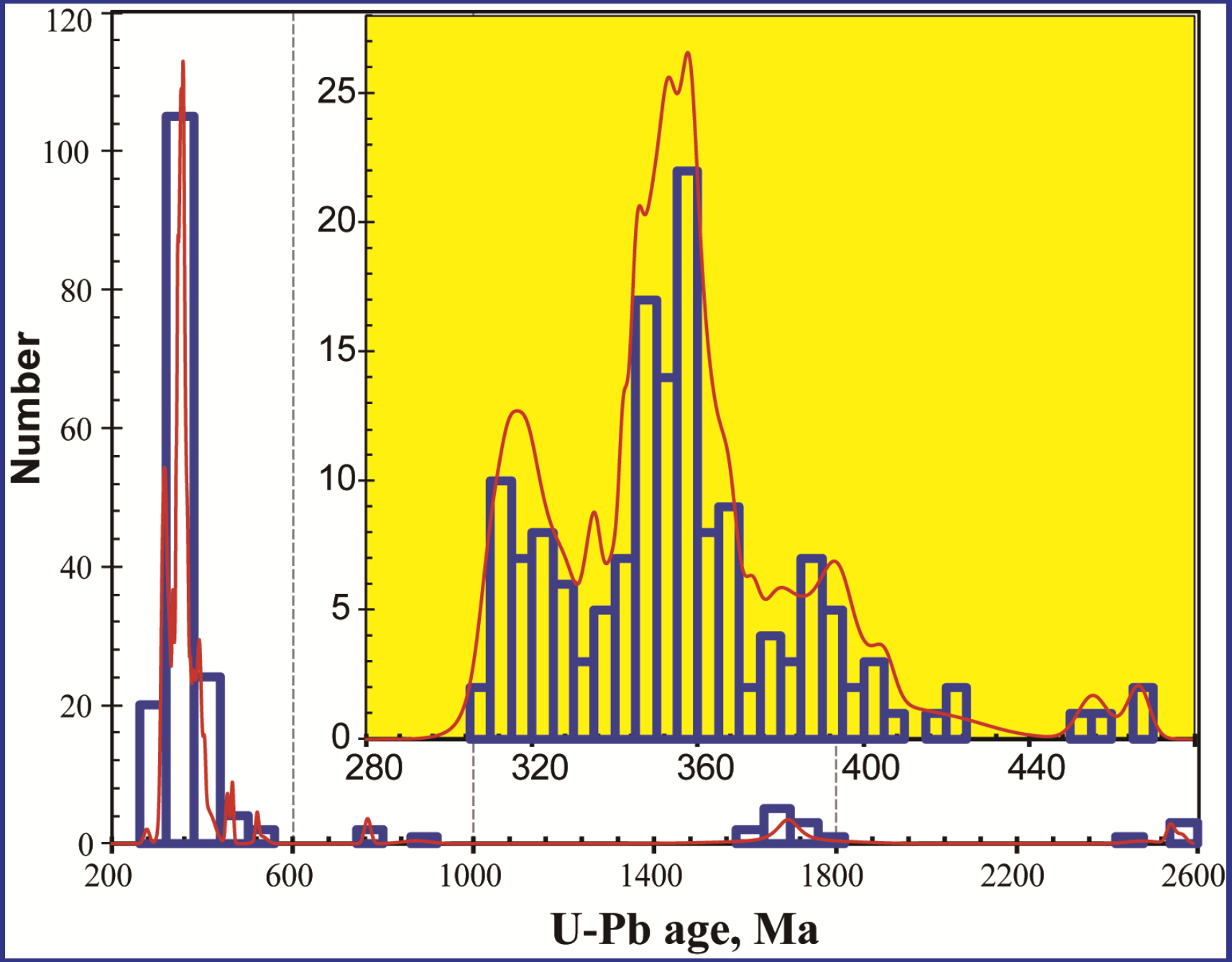


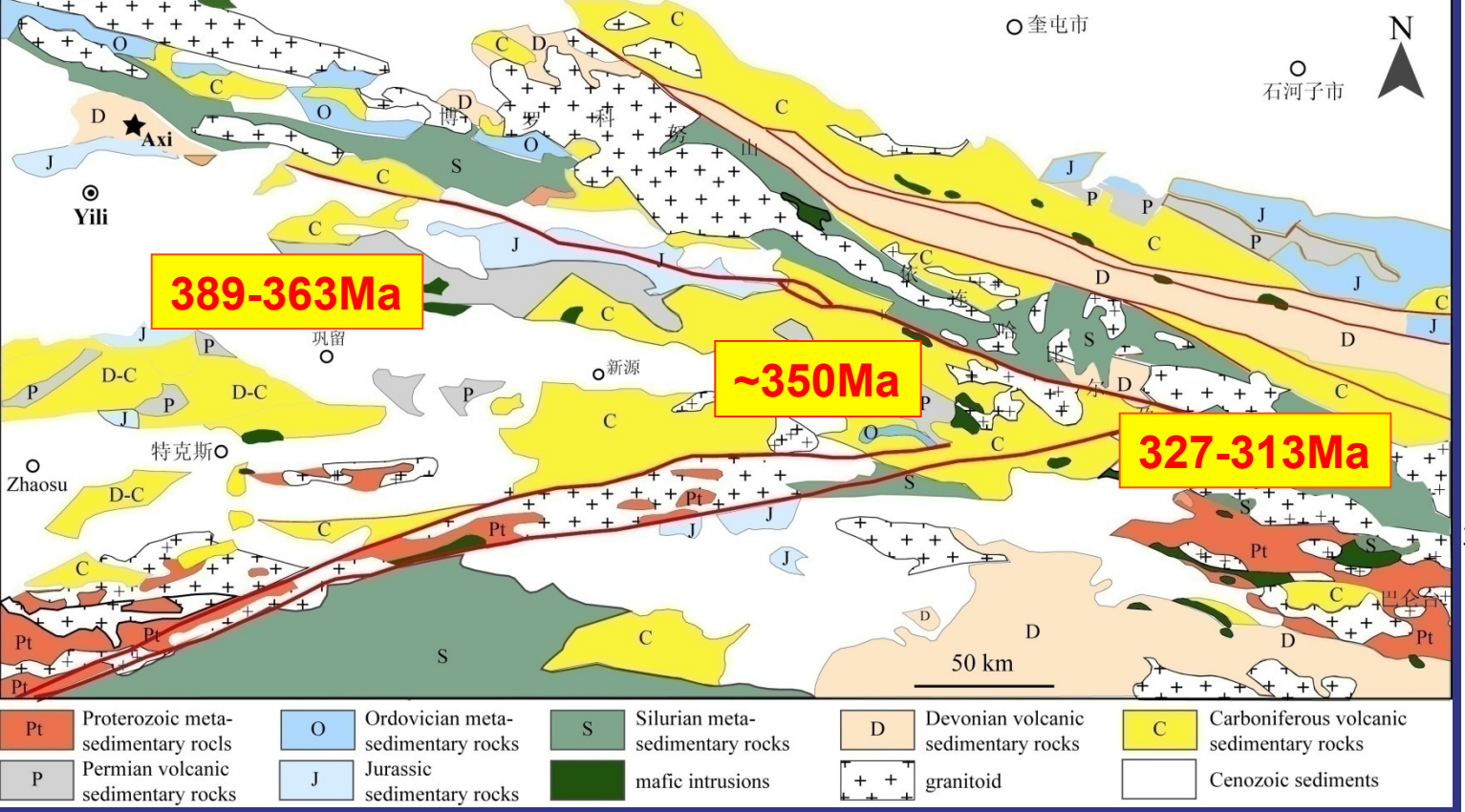


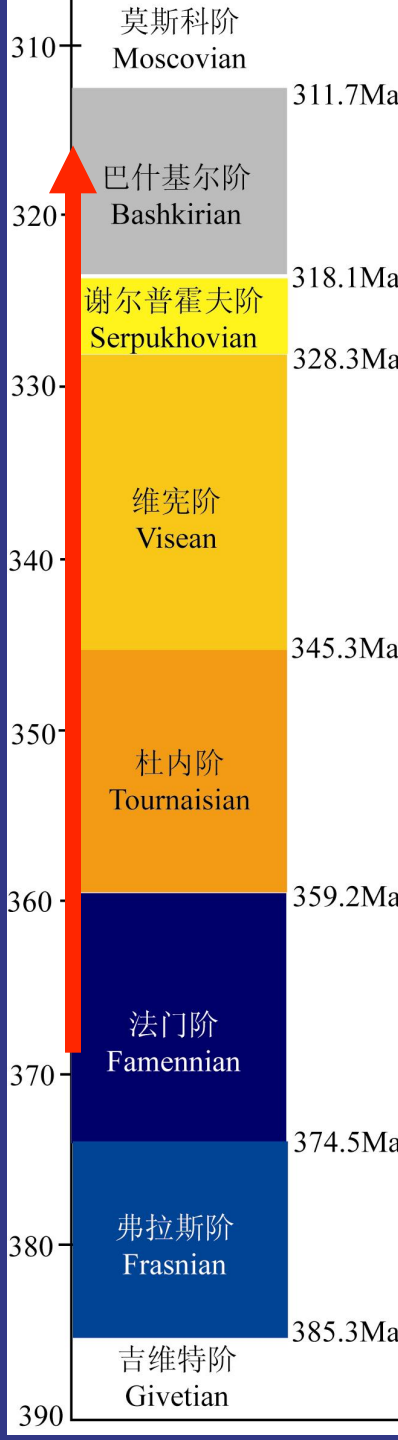







Number
U-Pb age, Ma
120
100
80
60
40
20
0
200
600
1000
1400
1800
2200
2600
25
20
15
10
5
0
280
320
360
400
440



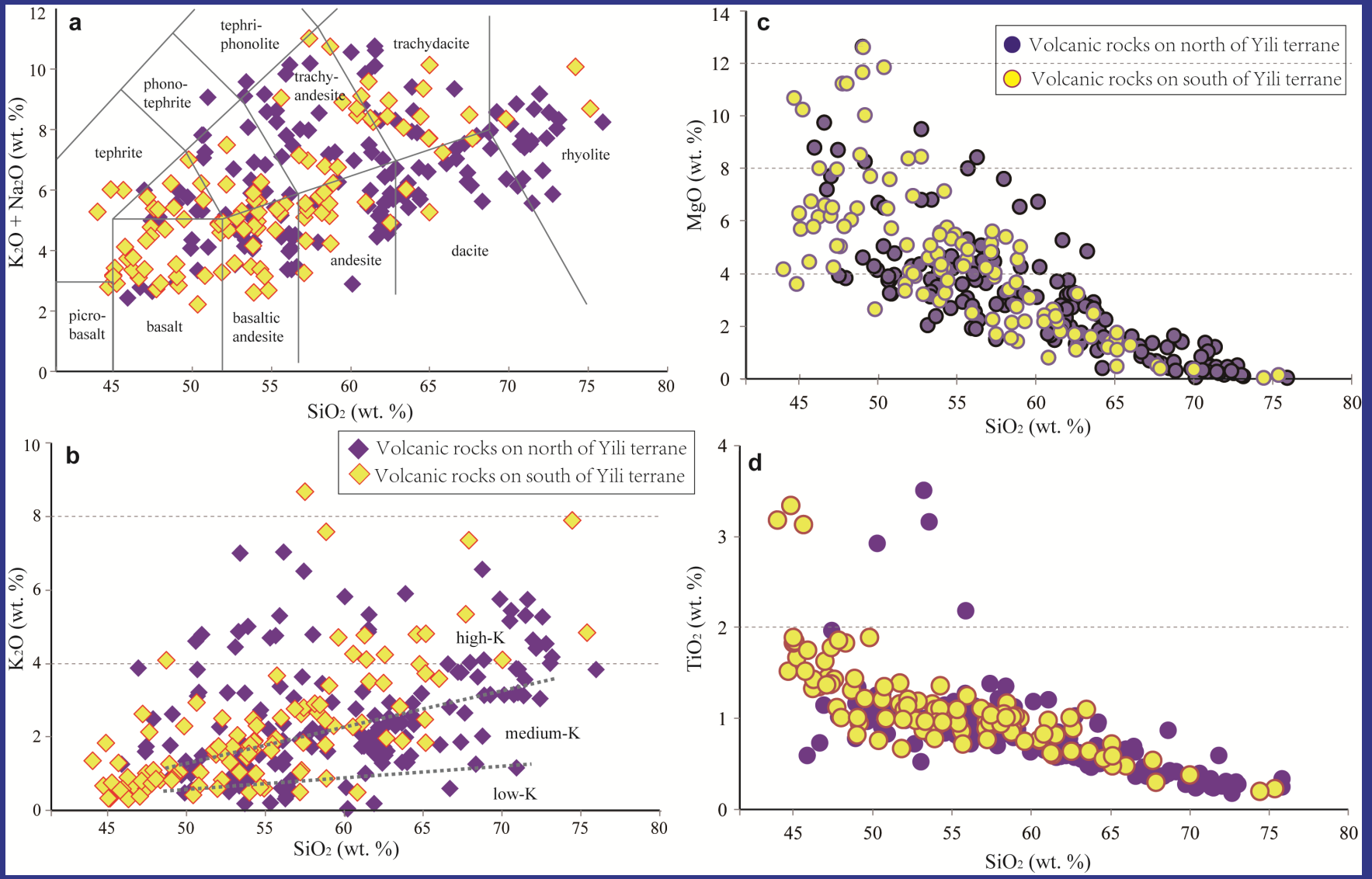


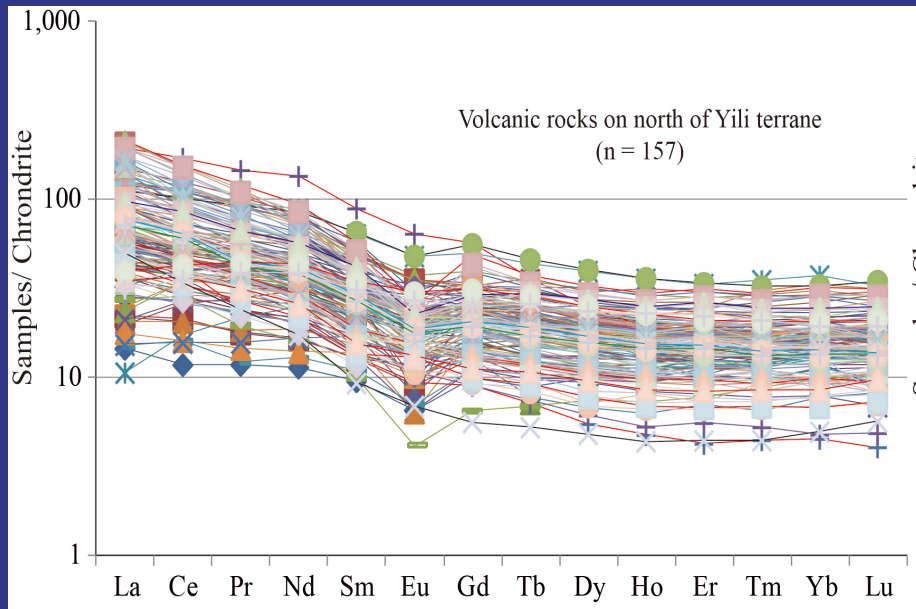
Devonian **Early Carboniferous** **Late Carboniferous**

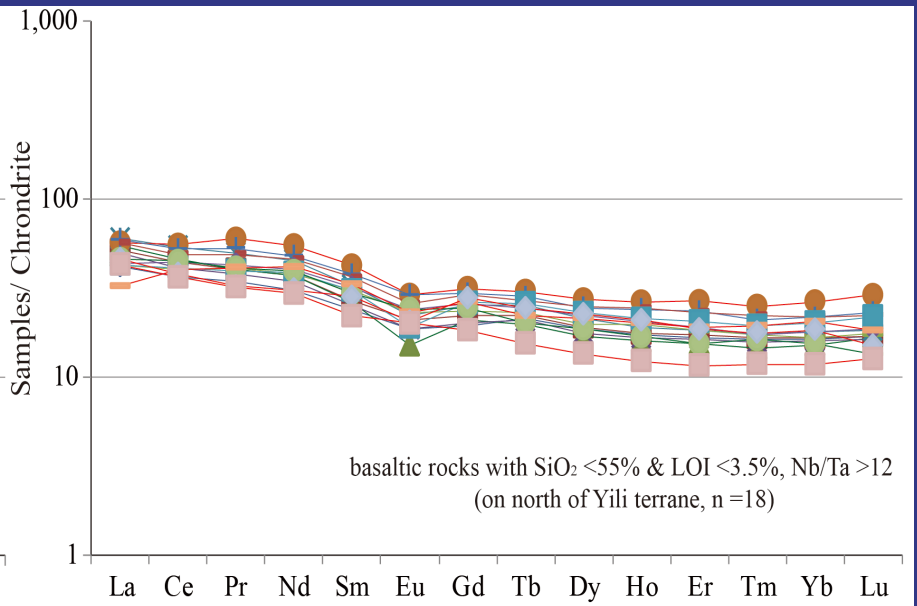
389-363Ma → 354-350Ma → 327-313Ma

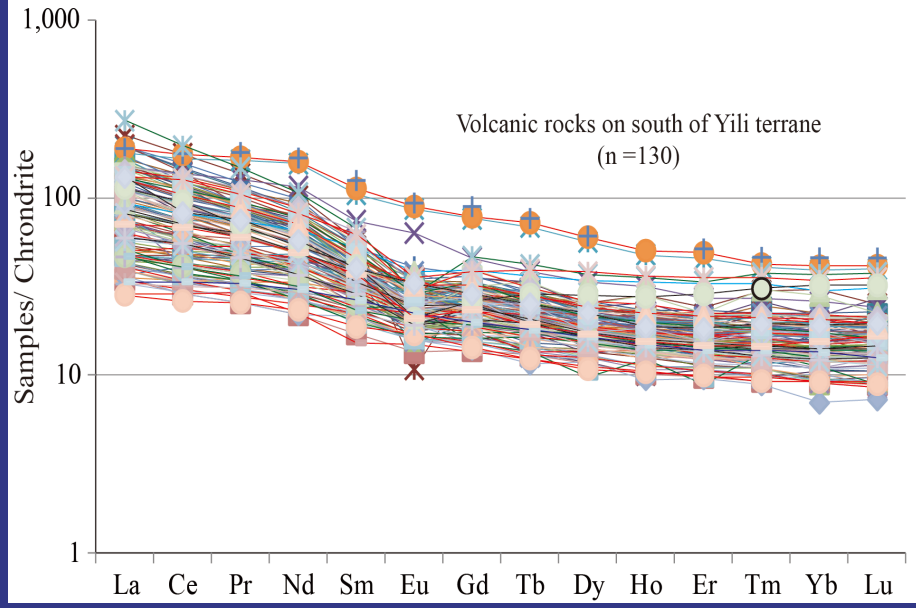
Towards eastern part, andesite, rhyolite, tuff and volcanoclastic rocks are the major components of the volcano-sedimentary sequences, basaltic rocks are rare. The time span of volcanic rocks is quite large (76Ma: from 389Ma to 313Ma) based on zircon U-Pb data. Magmatic activity in western part was earlier (Devonian – early Carboniferous) than that in eastern part (mainly late Carboniferous).

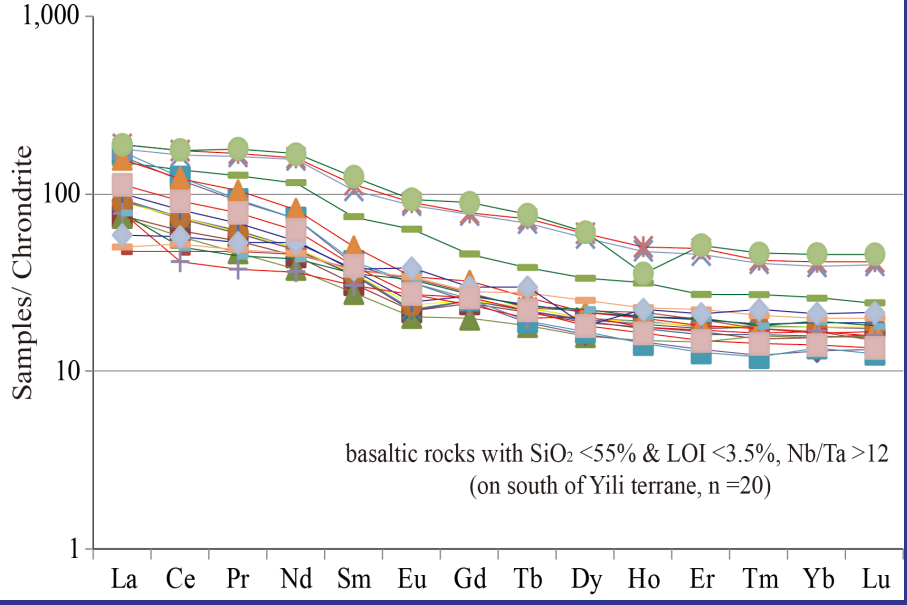
These late Paleozoic volcanic rocks are composed of rhyolite, trachyte, dacite, andesite, trachy-andesite, basalt, and tuff. Felsic rocks (>70%) are widely cropped out, basaltic rocks occur locally (mostly in western part).

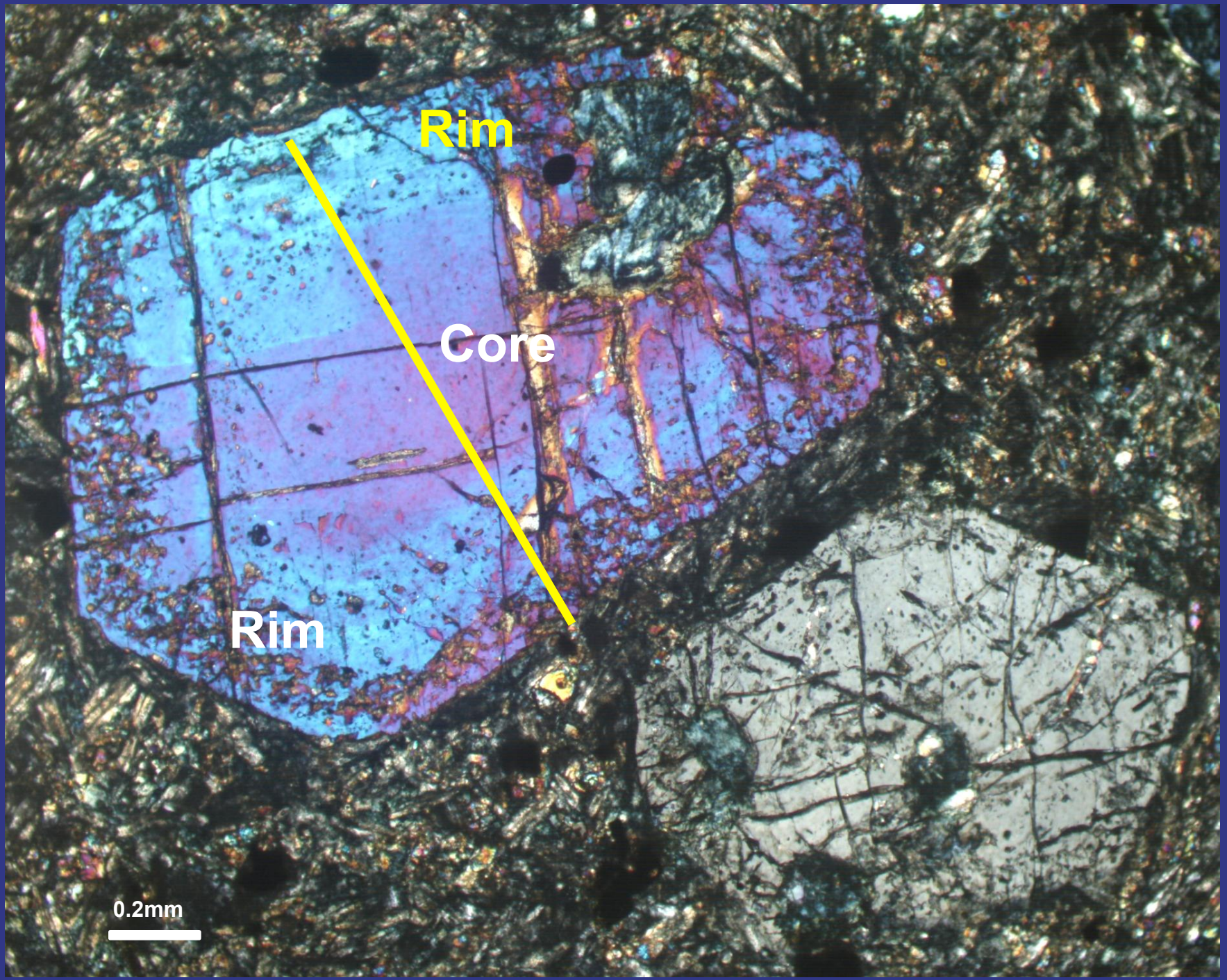


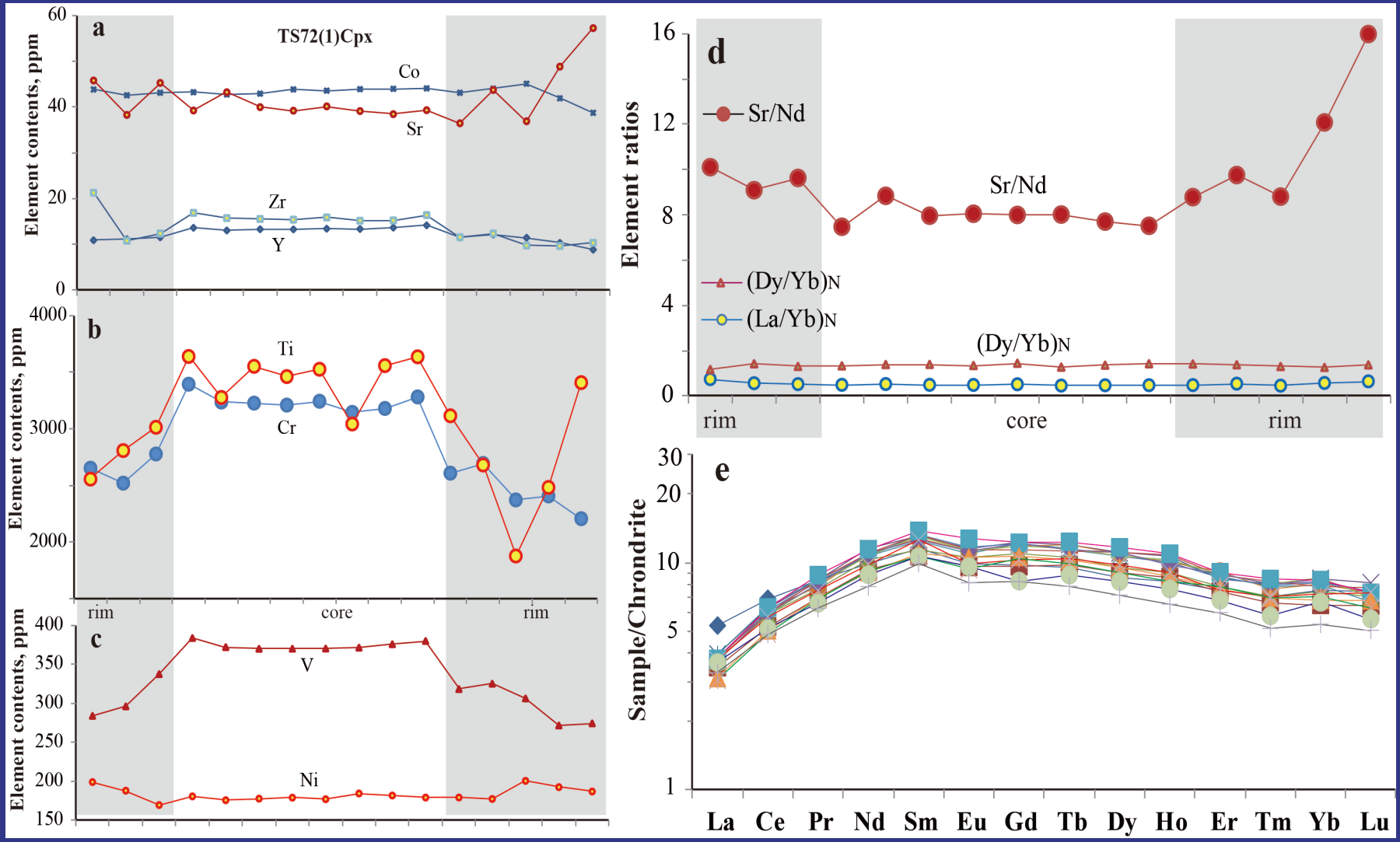

1,000
100
10
1
Samples/ Chrondrite
Volcanic rocks on north of Yili terrane
(n = 157)
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu


1,000
100
10
1
Samples/ Chrondrite
basaltic rocks with SiO2 <55% & LOI <3.5%, Nb/Ta >12
(on north of Yili terrane, n =18)
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu

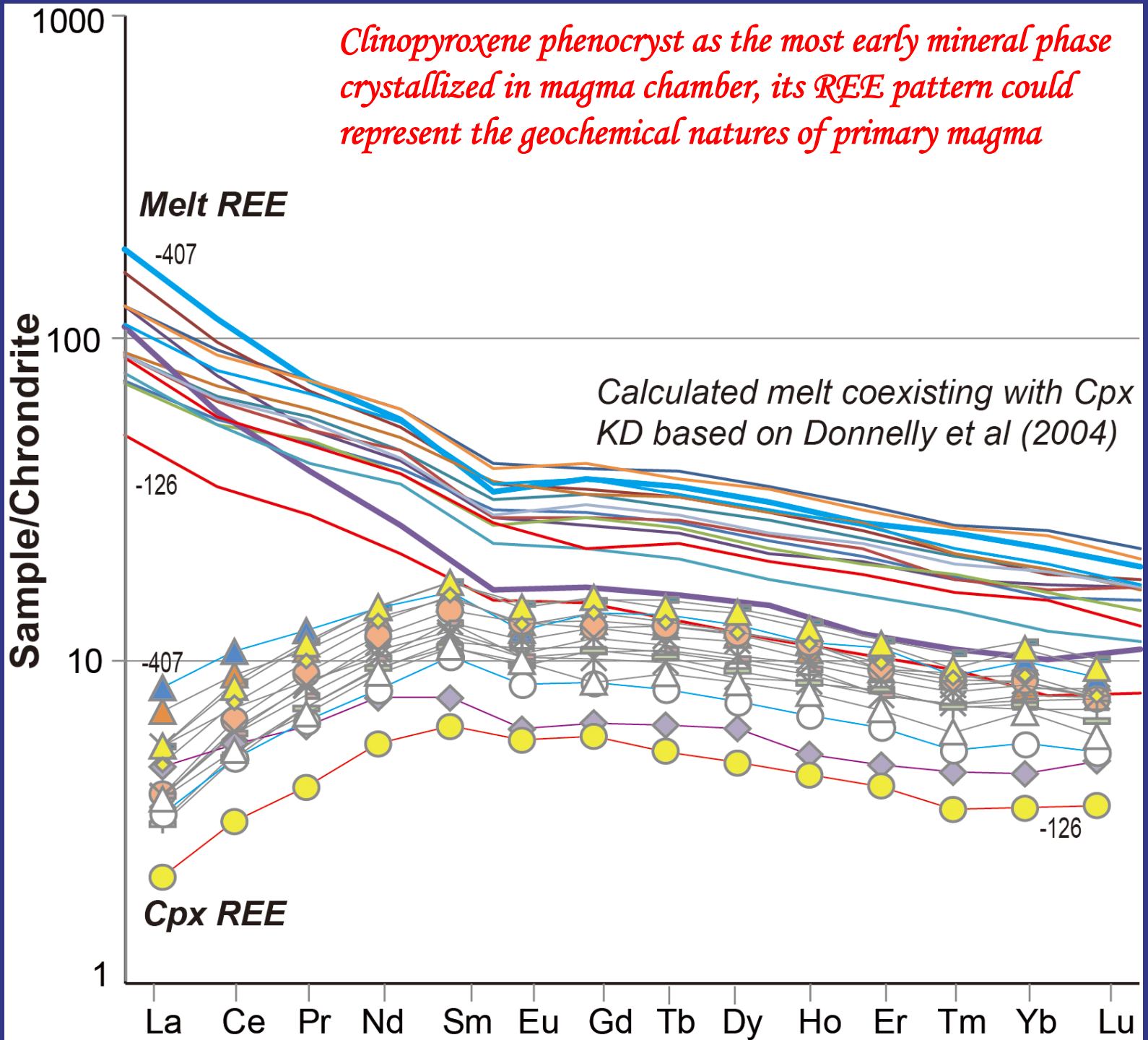

1,000
100
10
1
Samples/ Chrondrite
Volcanic rocks on south of Yili terrane
(n =130)
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu

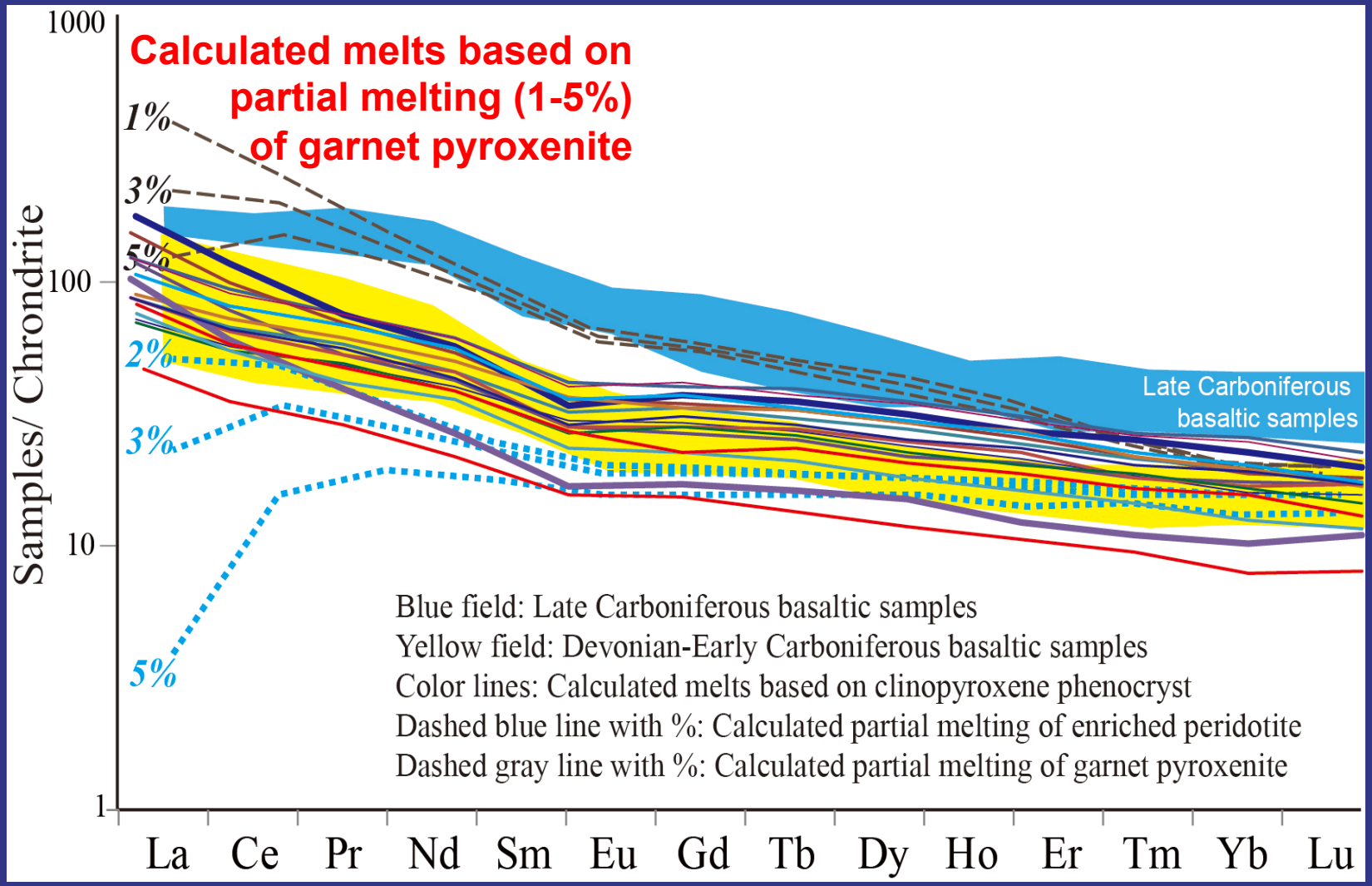

1,000
100
10
1
Samples/ Chrondrite
basaltic rocks with SiO2 <55% & LOI <3.5%, Nb/Ta >12
(on south of Yili terrane, n =20)
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu


Rim
Core
Rim
0.2mm



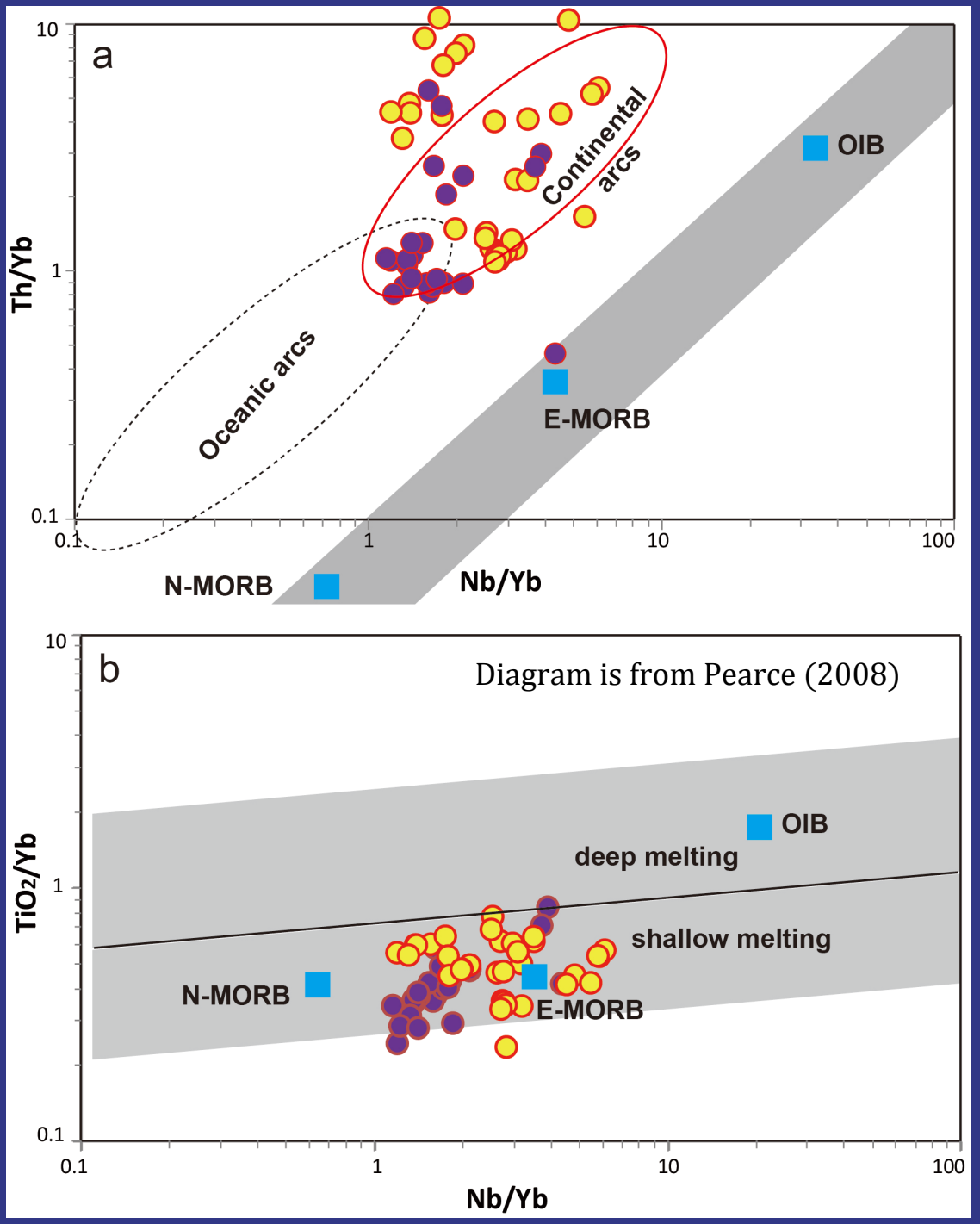
Clinopyroxene phenocryst shows chemical zoning.
Its core contains relatively high Ti, Cr, V, and Zr.
Clinopyroxene rim shows increase of Sr and REE.


Clinopyroxene phenocryst as the most early mineral phase crystallized in magma chamber, its REE pattern could represent the geochemical natures of primary magma
Melt REE
-407
-126
Calculated melt coexisting with Cpx
KD based on Donnelly et al (2004)
-407
-126
Cpx REE
Sample/Chrondrite
1000
100
10
1
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu

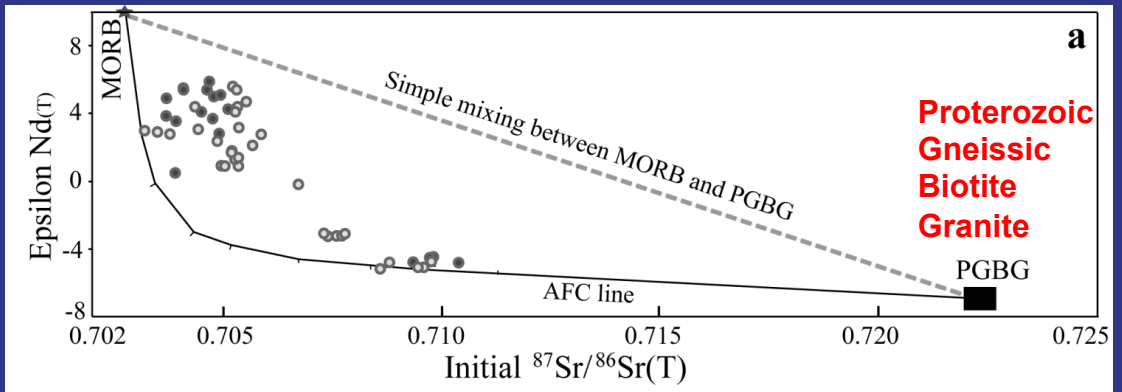


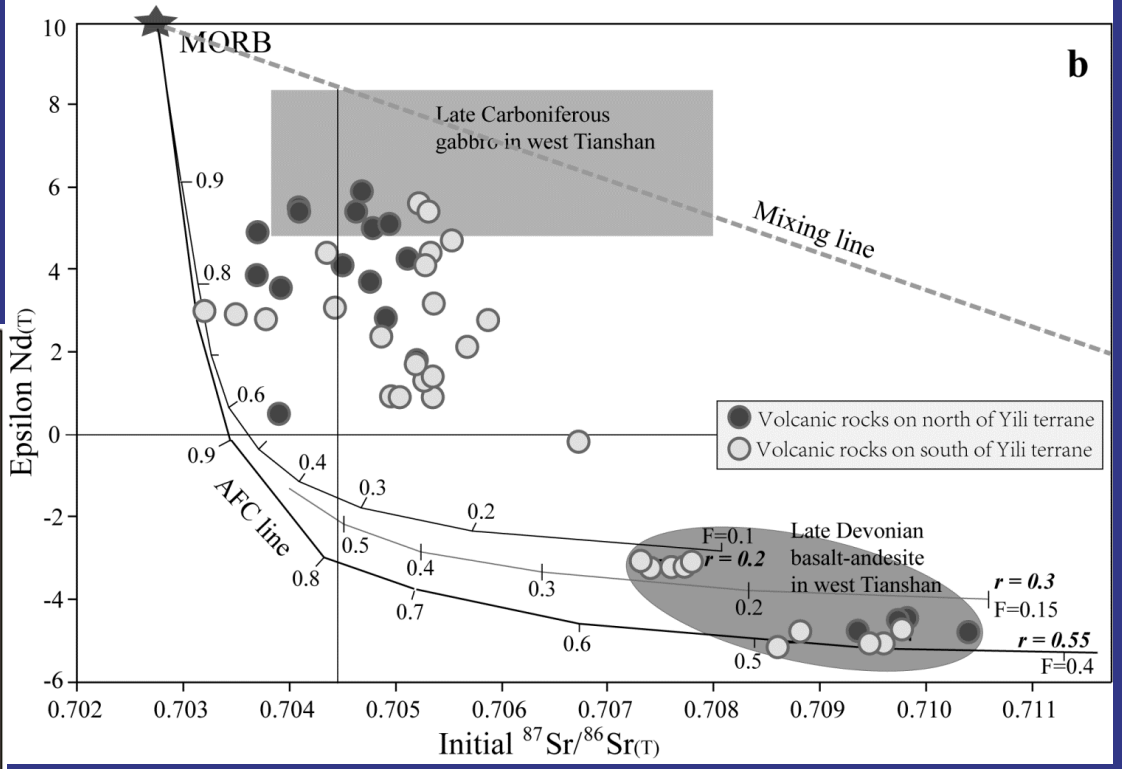
Partial melting (2%-3%) of enriched peridotite could estimate the Devonian – early Carboniferous basaltic rocks.

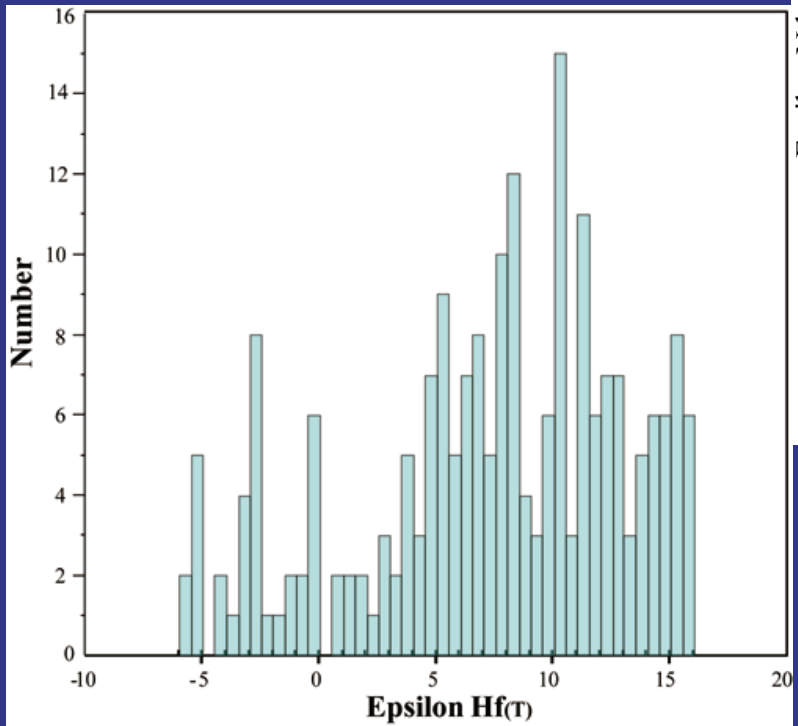
However, partial melting (3%-5%) of mantle rocks could NOT match the late Carboniferous basaltic rocks.

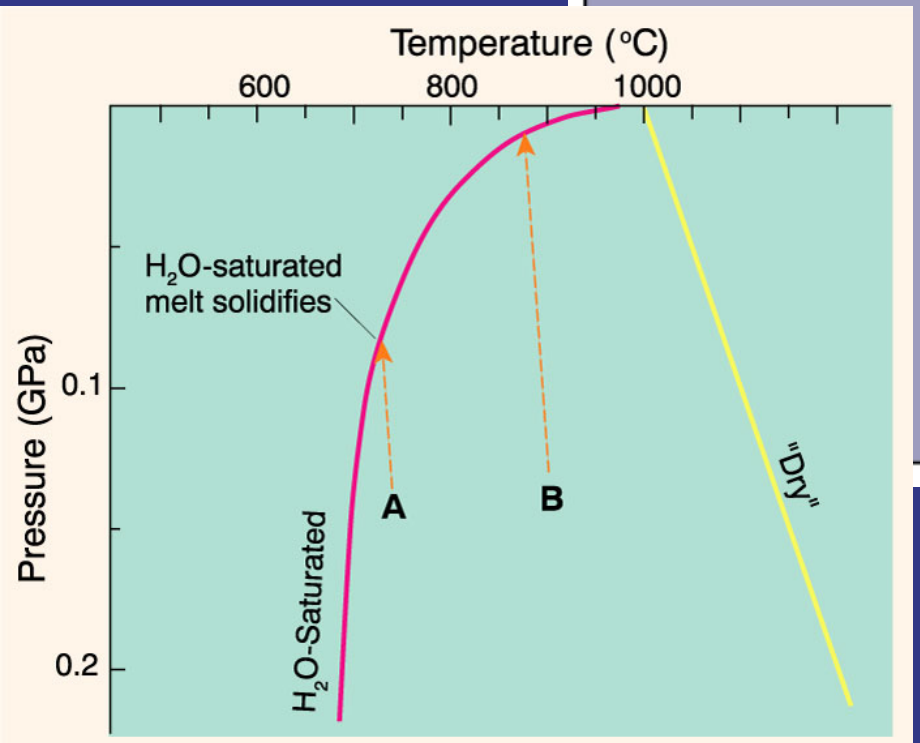

a
Th/Yb
Nb/Yb
10
1
0.1
0.1
1
10
100
Continental arcs
Oceanic arcs
OIB
E-MORB
N-MORB
b
Diagram is from Pearce (2008)
TiO2/Yb
Nb/Yb
deep melting
shallow melting
OIB
N-MORB
E-MORB

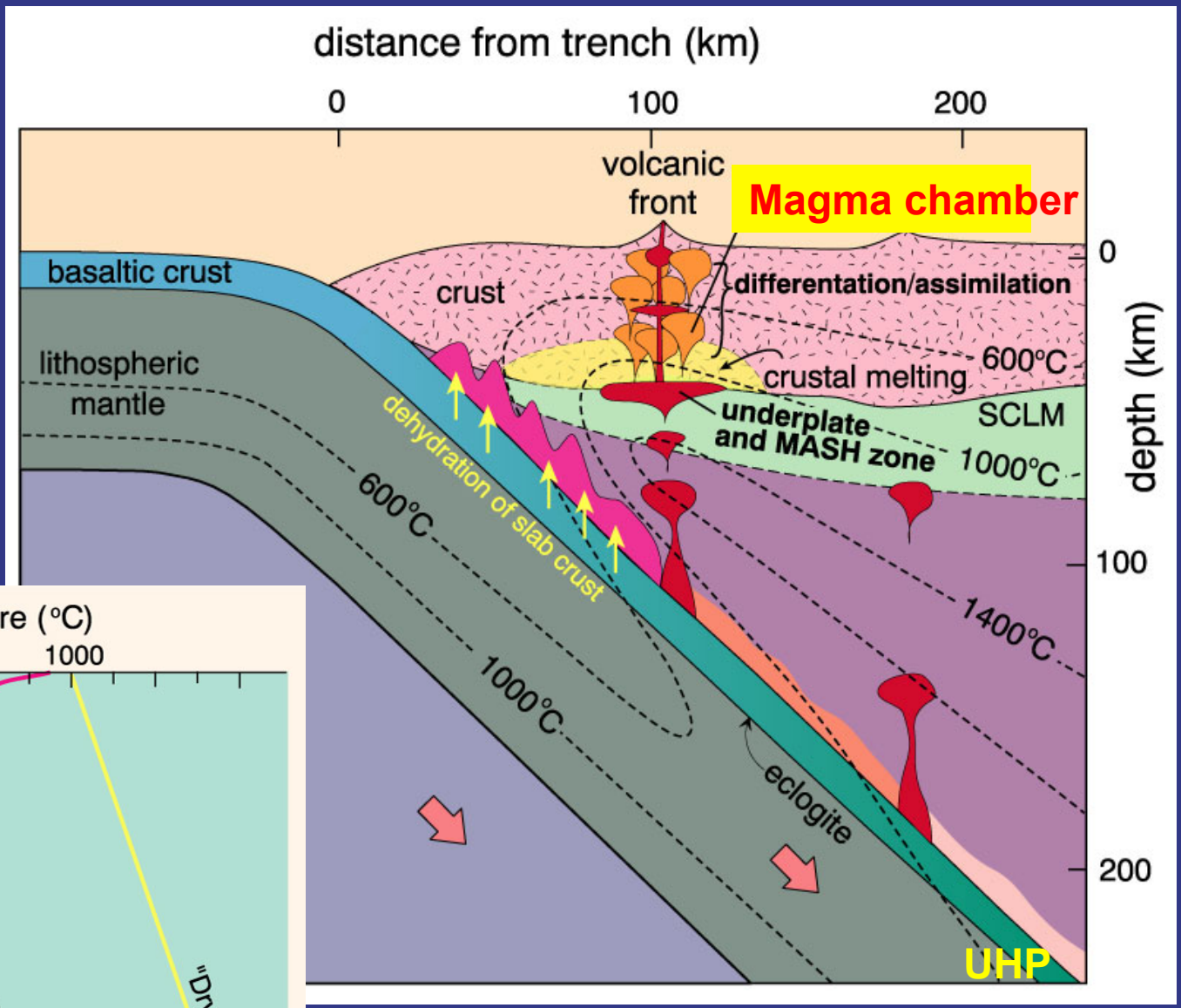
AFC model could explain Devonian basaltic rocks with high initial Sr isotopic ratios and negative epsilon Nd values, while Carboniferous basaltic rocks do not involved in assimilation of continental crust, suggesting major contributions of depleted mantle in magma sources.





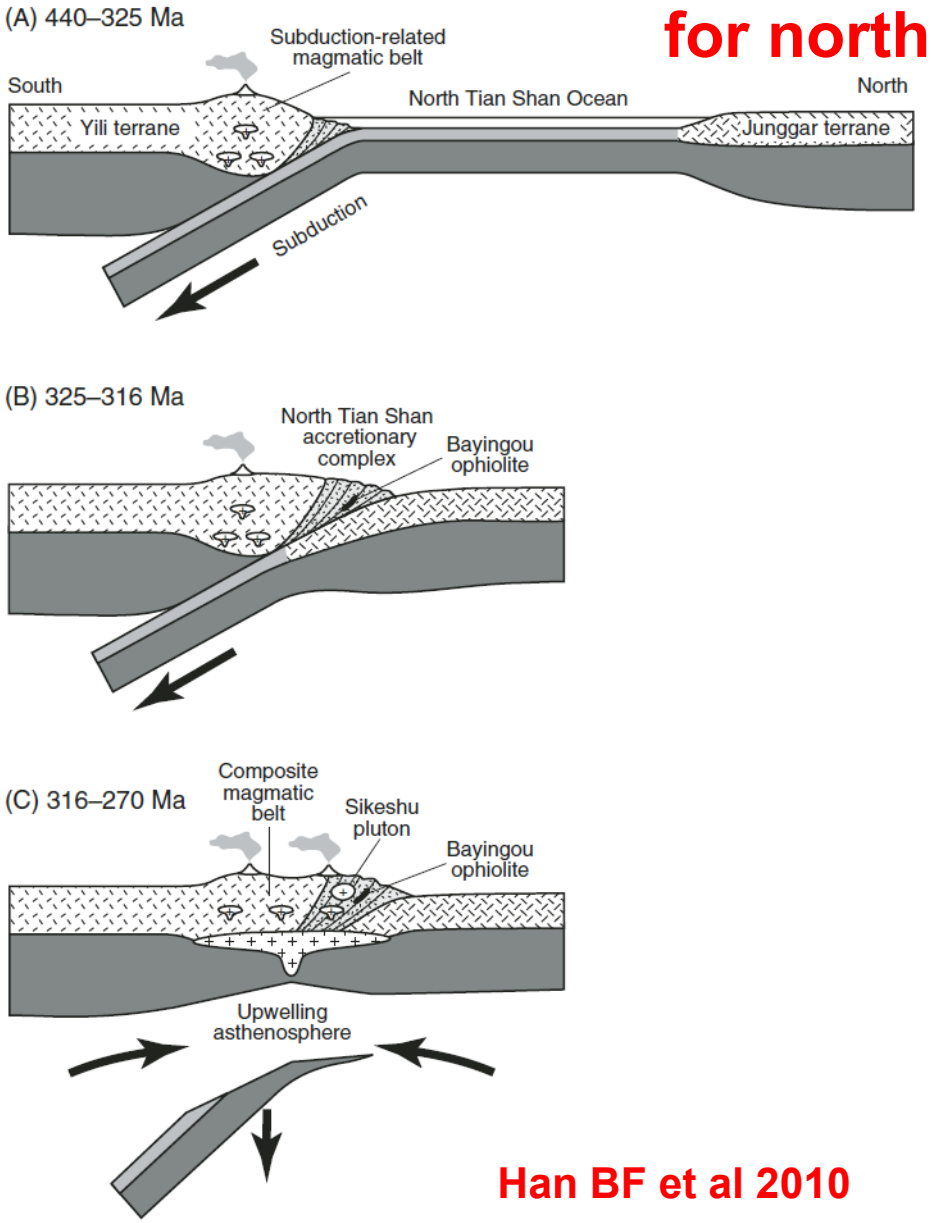






Both the melting materials and the melting depths controlled geochemistry of arc magmatic rocks

for north Tianshan



Han BF et al 2010

Figure 10. Three-stage tectonic model. (A) Southward subduction of the North Tian Shan Ocean beneath the Yili terrane, producing arc magmatism in northern margin of the Yili terrane. (B) Collision between the Yili and Junggar terranes and formation of the North Tian Shan accretionary complex. (C) Emplacement of the Sikeshu pluton into the accretionary complex and development of a composite magmatic belt in northern margin of the Yili terrane (see text for details).

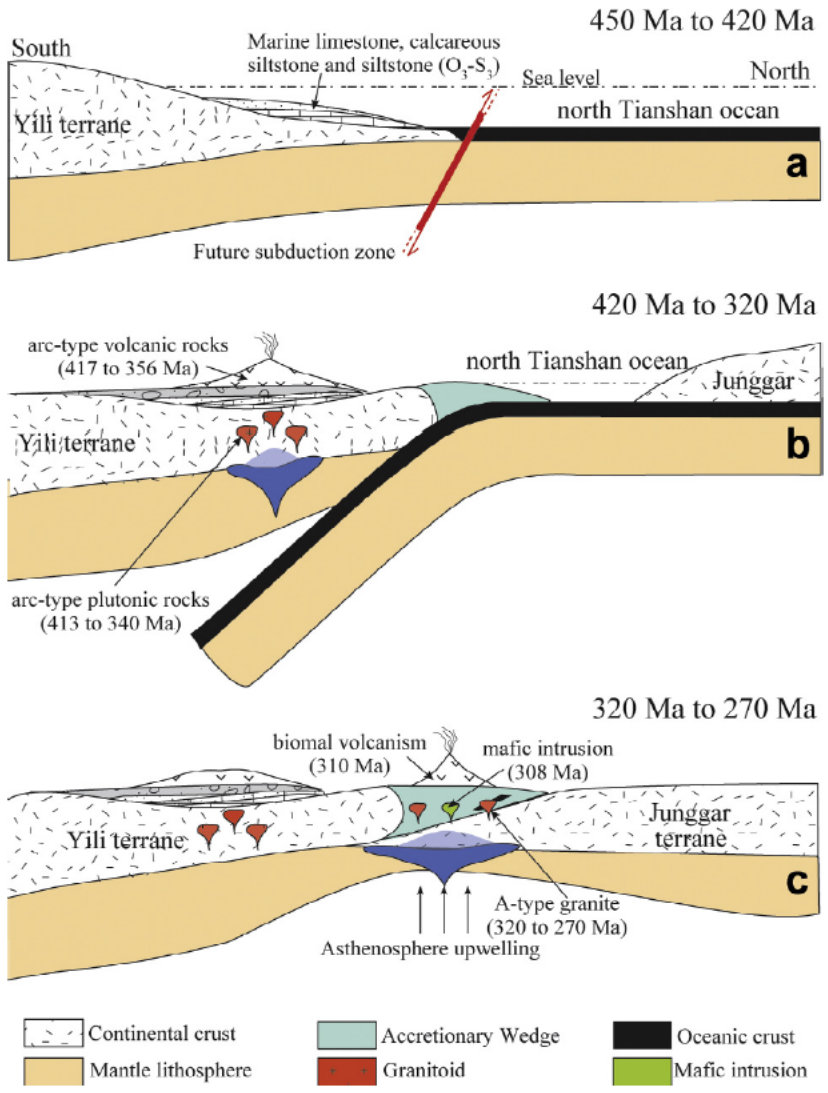
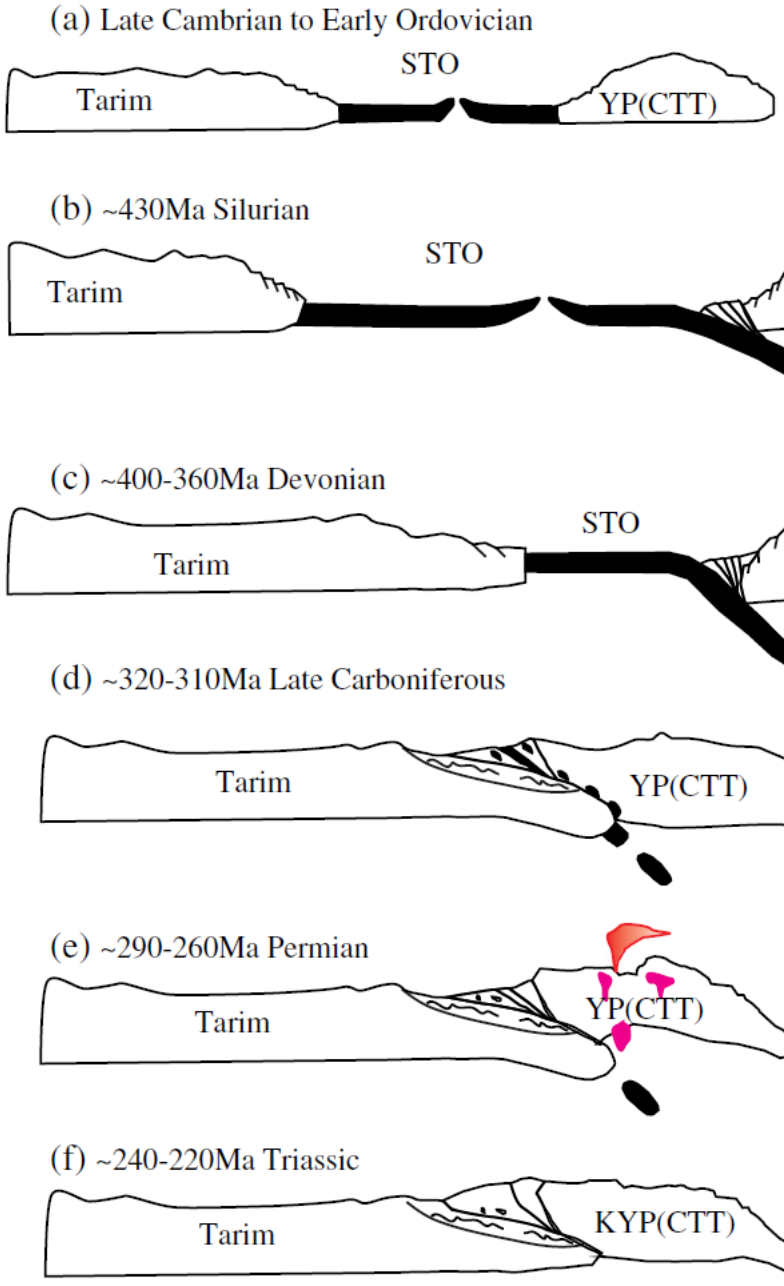


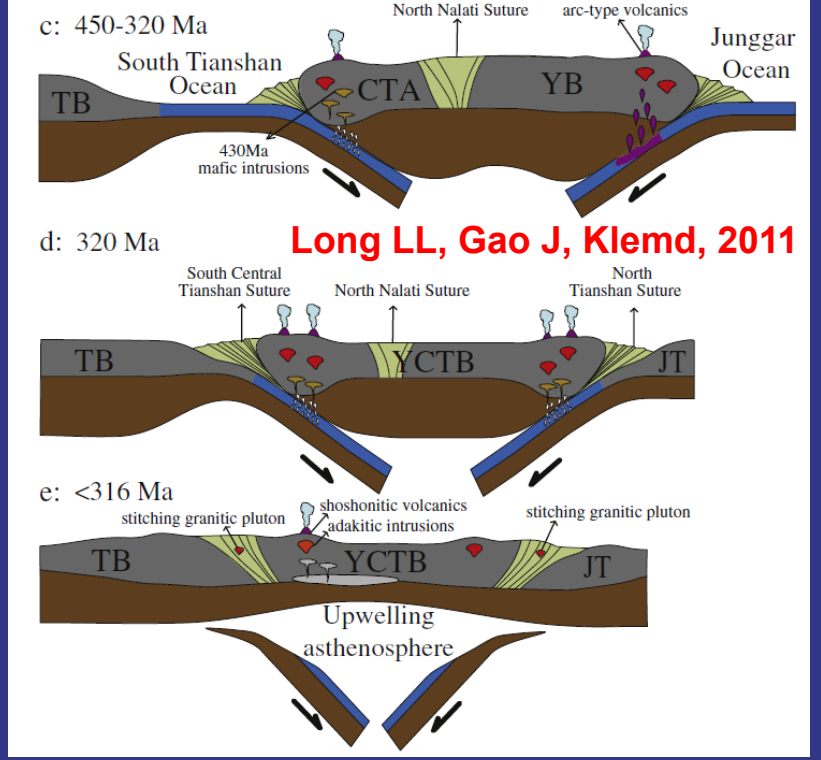
Fig. 13. Modeled tectonic evolution diagram of North Tianshan Orogenic belt in Paleozoic.

An and Zhu 2013

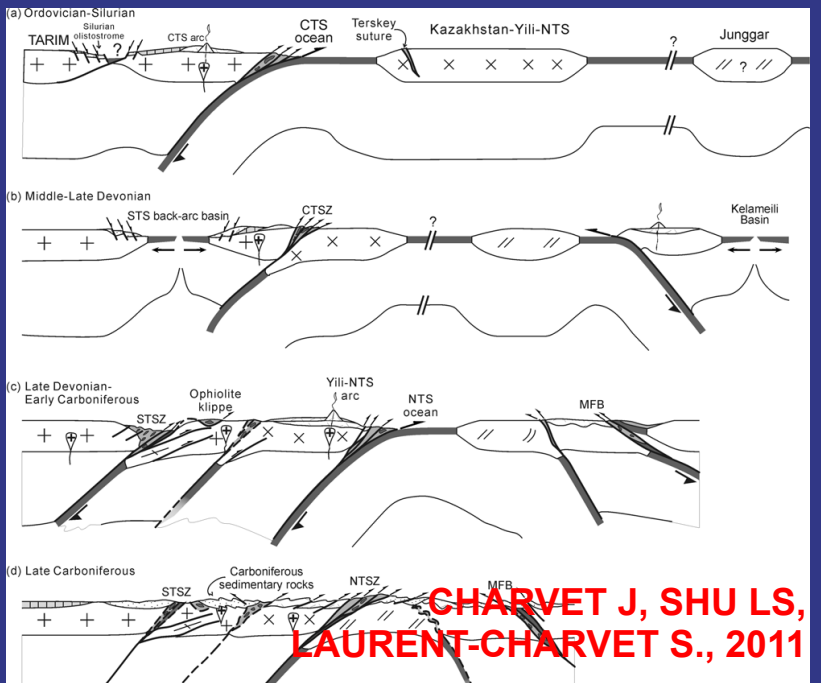
for south Tianshan



Xia B, Zhang LF. 2014 Lithos



Long LL, Gao J, Klemd, 2011

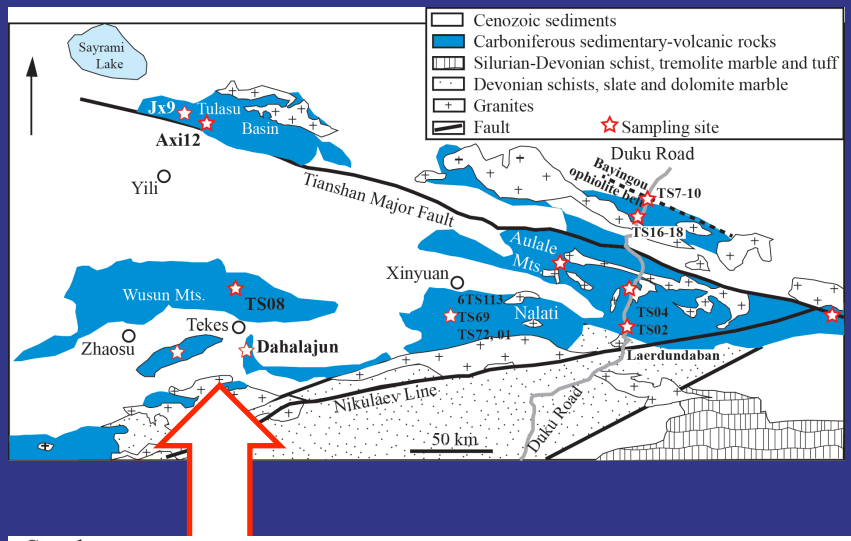


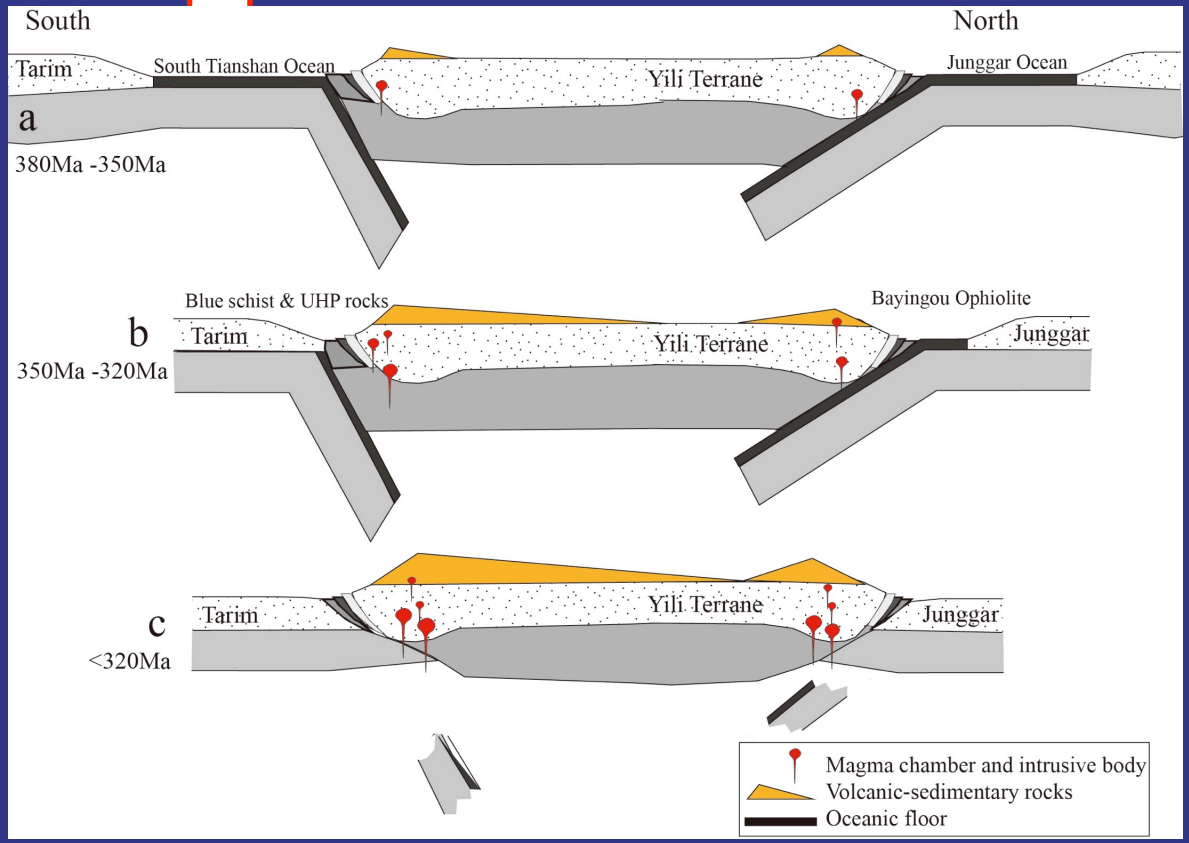
CHARVET J, SHU LS, LAURENT-CHARVET S., 2011

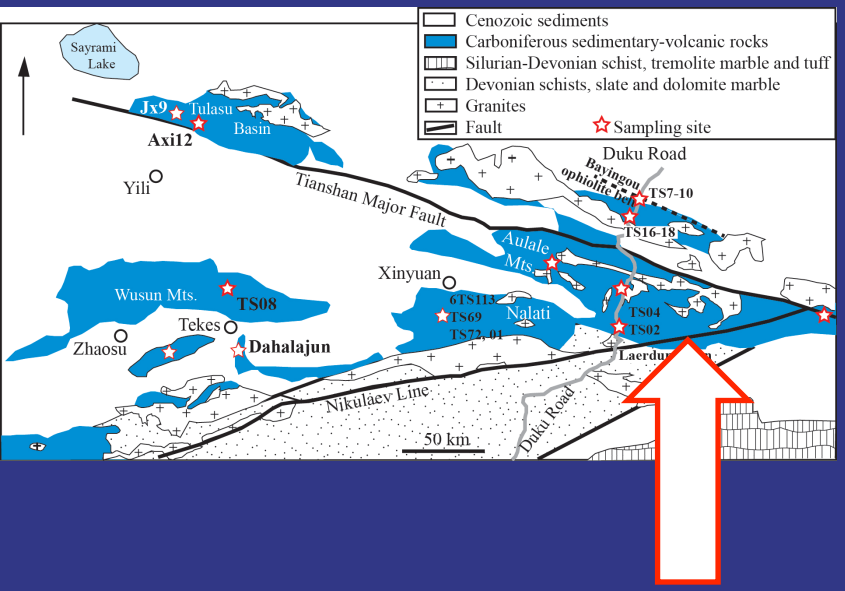
For western part

Volcanic rocks in north and south Tianshan represent two arcs of Junggar and south Tianshan Oceans, rspectively.

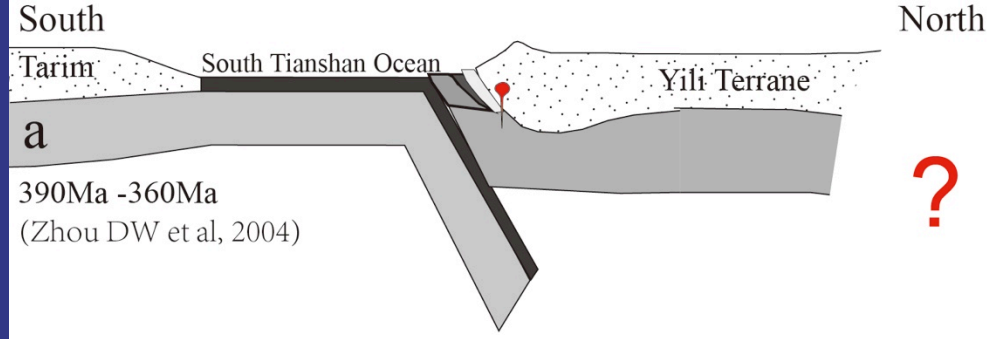
Tectonics shifted from continental arc (western part, Devonian to early Carboniferous) to post-collisional setting (eastern part: late Carboniferous).



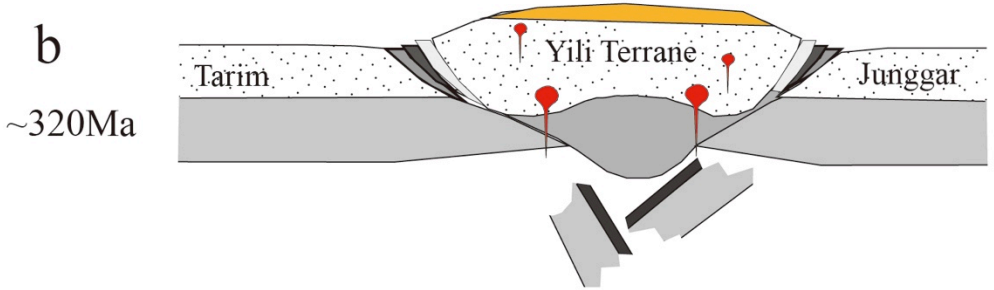


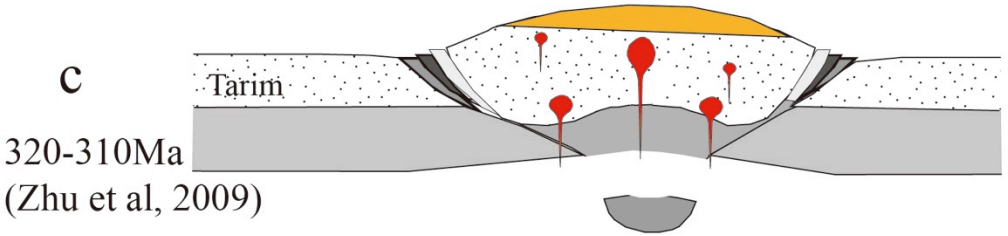


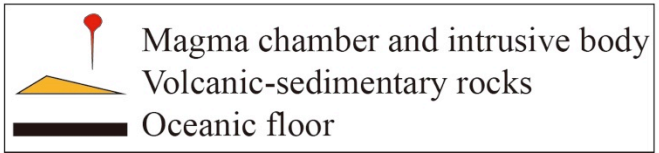
For eastern part



Geological records for subduction of North Tianshan oceanic crust during 360-320Ma are still missing







Thanks for your attention

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