Article:
Yang, X, Mao, J, Poulton, SW orcid.org/0000-0001-7621-189X et al. (4 more authors) (2021) The origin of early-Paleozoic banded iron formations in NW China. Gondwana Research, 93. pp. 218-226. ISSN 1342-937X

https://doi.org/10.1016/j.gr.2021.02.008

Fig. 1.

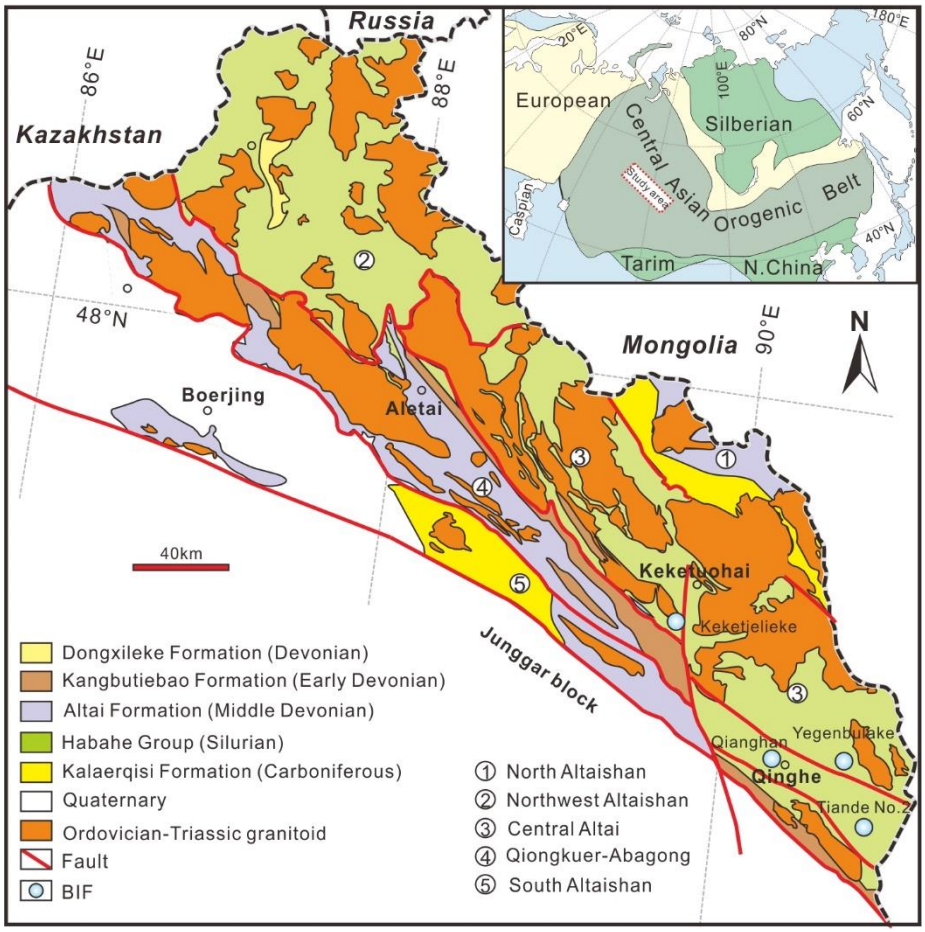
Russia
Kazakhstan
Mongolia
86°E
88°E
90°E
48°N
N
Boerjing
Aletai
40km
Keketuohai
Keketjelieke
Junggar block
Qianghan
Yegenbutake
Qinghe
Tiande No.2
① North Altaishan
② Northwest Altaishan
③ Central Altai
④ Qiongkuer-Abagong
⑤ South Altaishan
Dongxileke Formation (Devonian)
Kangbutiebao Formation (Early Devonian)
Altai Formation (Middle Devonian)
Habahe Group (Silurian)
Kalaerqisi Formation (Carboniferous)
Quaternary
Ordovician-Triassic granitoid
Fault
BIF
European
Central Asian Orogenic Belt
Silberian
Tarim
N.China
Caspian
Study area
20°E
80°N
100°E
180°E
60°N
40°N

Fig. 2.

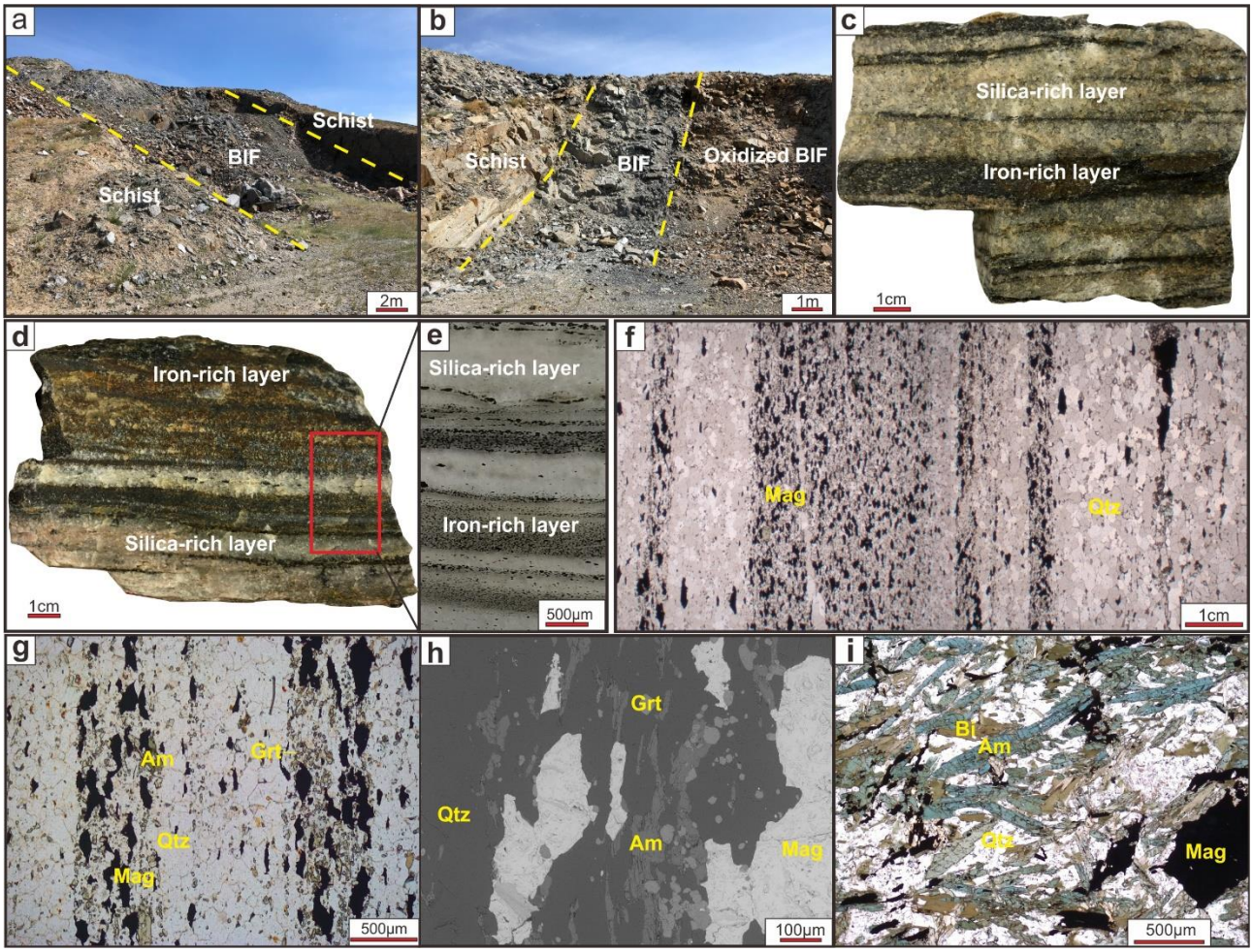
a
Schist
BIF
Schist
2m
b
Schist
BIF
Oxidized BIF
1m
c
Silica-rich layer
Iron-rich layer
1cm
d
Iron-rich layer
Silica-rich layer
1cm
e
Silica-rich layer
Iron-rich layer
500μm
f
Mag
Qtz
1cm
g
Am
Grt
Qtz
Mag
500μm
h
Grt
Qtz
Am
Mag
100μm
i
Bt
Am
Qtz
Mag
500μm

Fig. 3.

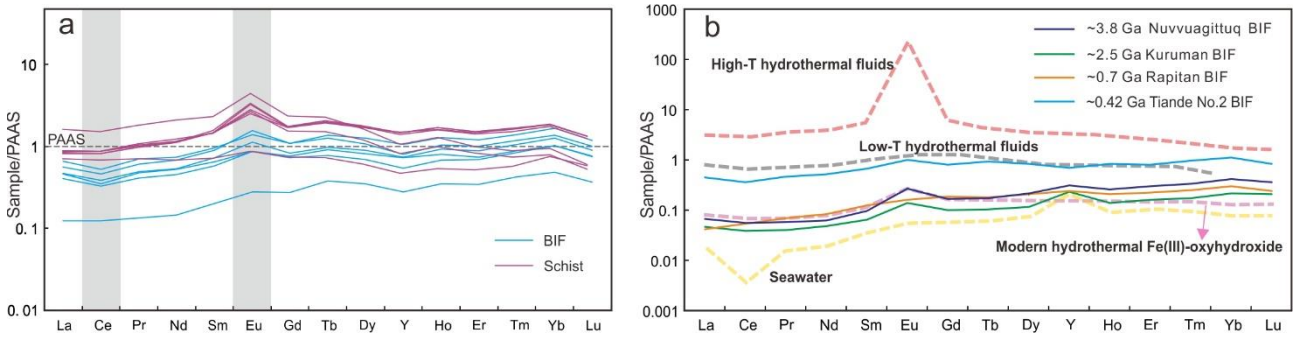
a
Sample/PAAS
10
1
0.1
0.01
PAAS
BIF
Schist
La Ce Pr Nd Sm Eu Gd Tb Dy Y Ho Er Tm Yb Lu
b
1000
100
10
1
0.1
0.01
0.001
~3.8 Ga Nuvvuagittuq BIF
~2.5 Ga Kuruman BIF
~0.7 Ga Rapitan BIF
~0.42 Ga Tiande No.2 BIF
High-T hydrothermal fluids
Low-T hydrothermal fluids
Modern hydrothermal Fe(III)-oxyhydroxide
Seawater
La Ce Pr Nd Sm Eu Gd Tb Dy Y Ho Er Tm Yb Lu

Fig. 4.

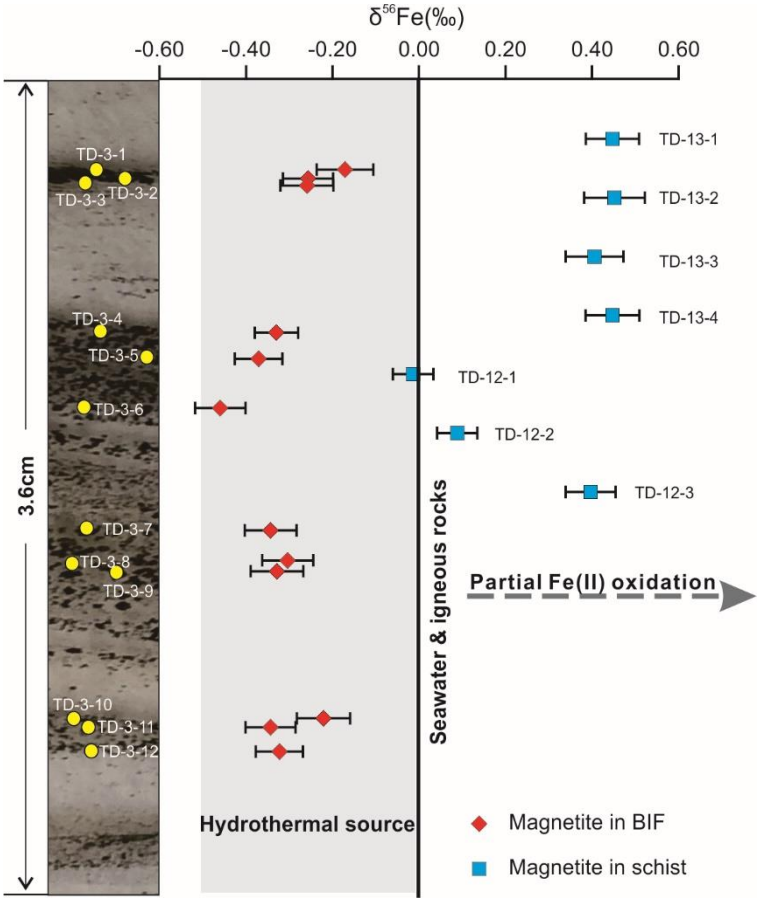
δ56Fe(‰)
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
TD-3-1
TD-3-2
TD-3-3
TD-3-4
TD-3-5
TD-3-6
TD-3-7
TD-3-8
TD-3-9
TD-3-10
TD-3-11
TD-3-12
3.6cm
TD-13-1
TD-13-2
TD-13-3
TD-13-4
TD-12-1
TD-12-2
TD-12-3
Seawater & igneous rocks
Partial Fe(II) oxidation
Hydrothermal source
Magnetite in BIF
Magnetite in schist

Fig. 5.

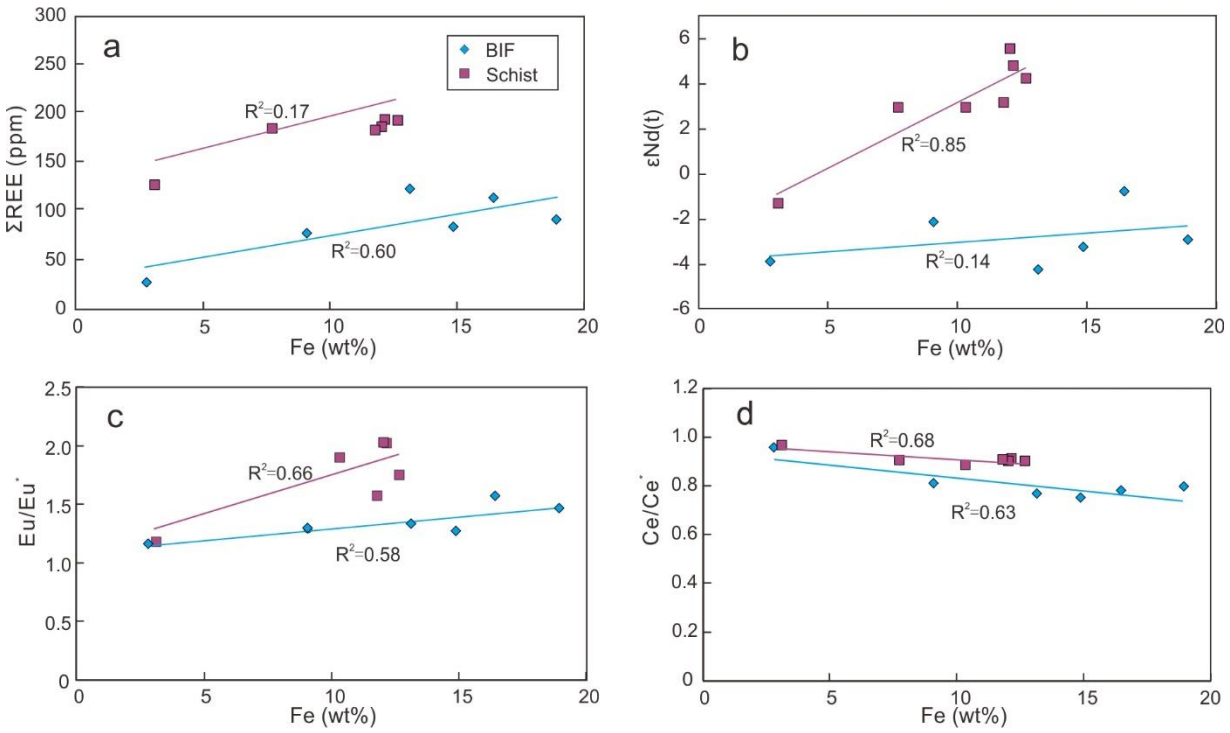
a
BIF
Schist
ΣREE (ppm)
R²=0.17
R²=0.60
Fe (wt%)
b
εNd(t)
R²=0.85
R²=0.14
Fe (wt%)
c
Eu/Eu*
R²=0.66
R²=0.58
Fe (wt%)
d
Ce/Ce*
R²=0.68
R²=0.63
Fe (wt%)

Fig. 6.

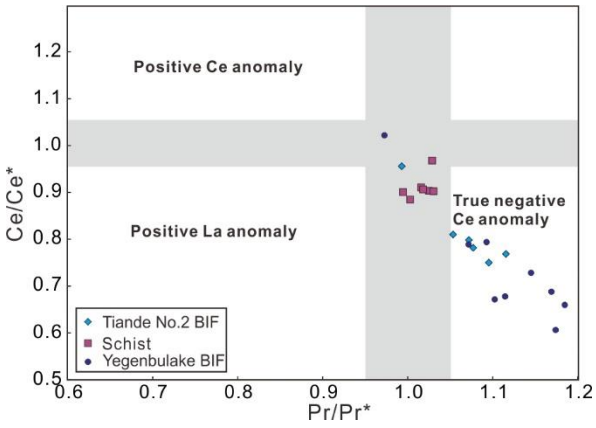
Positive Ce anomaly
Positive La anomaly
True negative
Ce anomaly
Tiande No.2 BIF
Schist
Yegenbulake BIF
Ce/Ce*
Pr/Pr*
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2

Fig. 7.

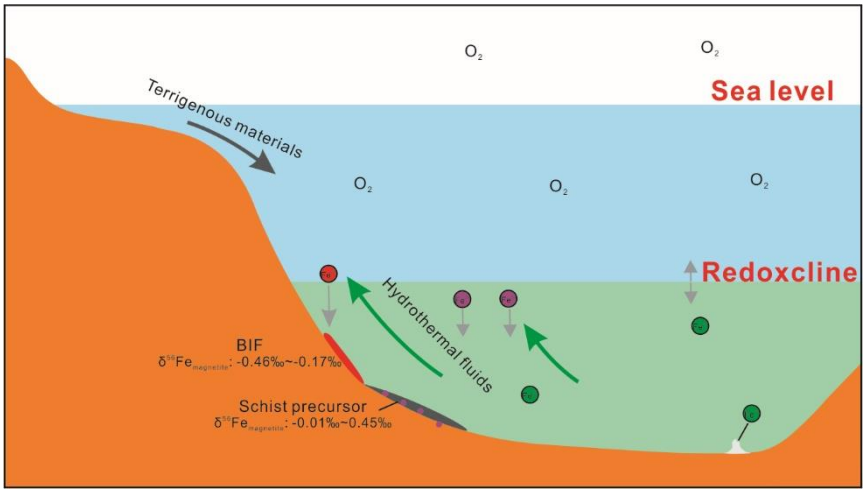
O2
O2
Sea level
Terrigenous materials
O2
O2
O2
Redoxcline
Hydrothermal fluids
BIF
δ56Femagnetite: -0.46‰~-0.17‰
Schist precursor
δ56Femagnetite: -0.01‰~0.45‰

Table 1 Nd and Fe isotopic compositions of Tiande No.2 BIF and schist samples.

Sample	Lithology	Nd(ppm)	Sm(ppm)	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$	2σ	$\varepsilon_{Nd}(t)$	T_{DM2}(Ma)	$\delta^{56}Fe$(‰)	2σ	$\delta^{57}Fe$(‰)	2σ
TD-1	BIF	15.2	3.22	0.12807	0.512340	0.000012	-2.0	1336	-0.21	0.07	-0.31	0.09
TD-2		17.6	3.56	0.12229	0.512267	0.000009	-3.2	1426	-0.32	0.07	-0.46	0.09
TD-3		18.1	3.99	0.13327	0.512314	0.000007	-2.9	1400	-0.24	0.07	-0.35	0.08
TD-4		22.9	5	0.13200	0.512420	0.000012	-0.8	1226	-0.18	0.07	-0.30	0.08
TD-5		25	5.32	0.12865	0.512233	0.000007	-4.2	1508	-0.30	0.07	-0.44	0.08
TD-6		4.9	1.11	0.13695	0.512273	0.000006	-3.9	1481	-0.17	0.07	-0.24	0.08
TD-7	Schist	41.7	8.11	0.11758	0.512569	0.000007	3.0	926				
TD-8		71.3	12.9	0.10938	0.512547	0.000007	3.0	925				
TD-9		39.6	8.28	0.12641	0.512660	0.000019	4.2	820				
TD-10		38.7	8.72	0.13622	0.512717	0.000009	4.8	773				
TD-11		39.2	8.21	0.12662	0.512729	0.000007	5.6	712				
TD-12		23.4	4.04	0.10438	0.512316	0.000013	-1.3	1270				
TD-13		38.1	8.18	0.12980	0.512614	0.000009	3.2	909				

Note: $^{147}Sm/^{144}Nd$ are calculated using whole-rock Sm and Nd contents.

Table 2 In-situ Fe isotopic compositions of magnetite from Tiande No.2 BIF and schist samples.

Spot	Lithology	$\delta^{56}Fe$(‰)	2σ	$\delta^{57}Fe$(‰)	2σ
TD-3-01	Magnetite in BIF	-0.17	0.07	-0.26	0.12
TD-3-02		-0.26	0.06	-0.32	0.11
TD-3-03		-0.26	0.06	-0.36	0.11
TD-3-04		-0.33	0.05	-0.51	0.10
TD-3-05		-0.37	0.05	-0.53	0.11
TD-3-06		-0.46	0.06	-0.63	0.12
TD-3-07		-0.34	0.06	-0.50	0.11
TD-3-08		-0.30	0.06	-0.43	0.12
TD-3-09		-0.33	0.06	-0.47	0.12
TD-3-10		-0.22	0.06	-0.23	0.11
TD-3-11		-0.34	0.06	-0.55	0.12
TD-3-12		-0.32	0.05	-0.48	0.11
TD-13-1	Magnetite in schist	0.45	0.06	0.61	0.11
TD-13-2		0.45	0.07	0.65	0.12
TD-13-3		0.41	0.07	0.59	0.11
TD-13-4		0.45	0.06	0.69	0.11
TD-12-1		-0.01	0.05	0.01	0.09
TD-12-2		0.09	0.05	0.16	0.08
TD-12-3		0.40	0.06	0.64	0.10