10.101[illegible]/[illegible]0016[illegible]56[illegible]16000042

[illegible]

[illegible] 10003 [illegible] 210016 [illegible] 36[illegible]4[illegible]-5305 [illegible]

(Received 1[illegible] 2015; accepted [illegible] 2016; first published online 1[illegible] 2016)

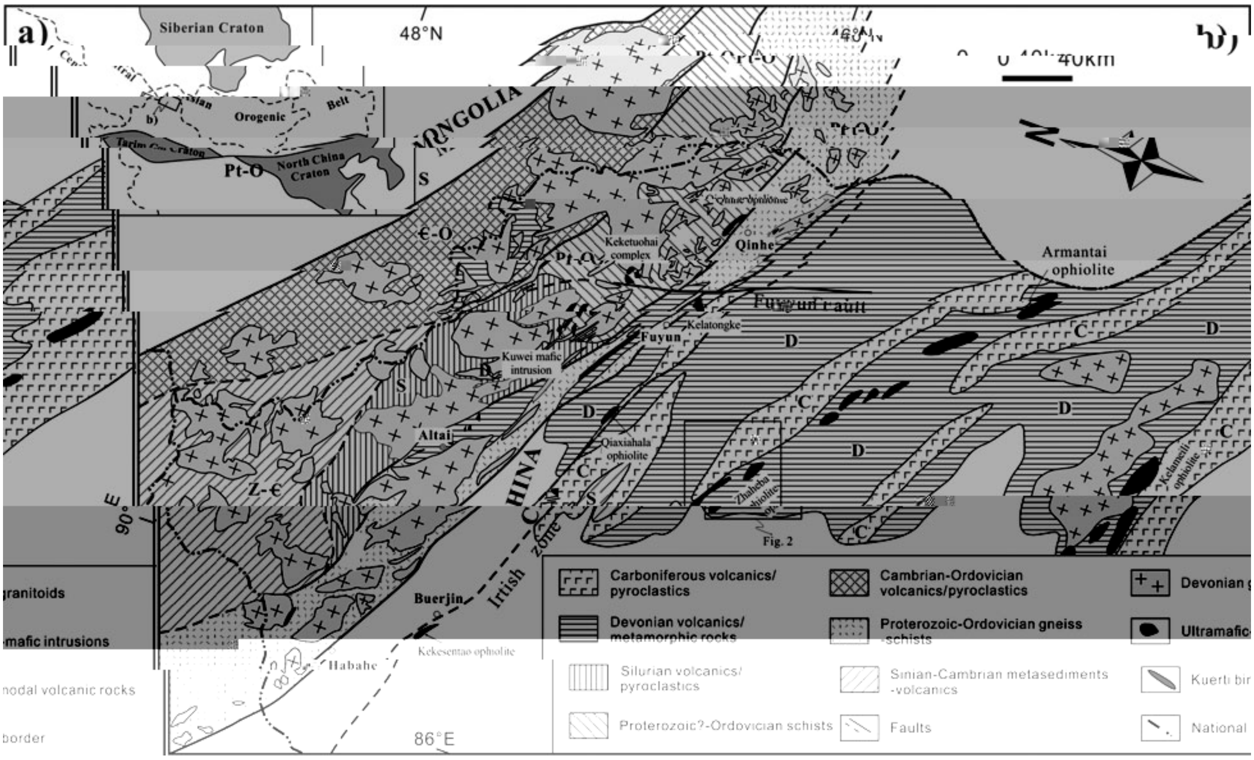
Abstract – [illegible] ~4[illegible]5 [illegible] ~400 [illegible] εNd(t) (13[illegible]20) [illegible] δ[illegible] (+5.3[illegible]‰) [illegible]

1. Introduction

[illegible] (et al. 200[illegible]; [illegible] & [illegible], 200[illegible]; [illegible] et al. 2012; [illegible] et al. 2012, 2013; [illegible] et al. 2013), [illegible] et al. 200[illegible] [illegible] et al. 200[illegible]a). [illegible] (1[illegible]; [illegible] 2000; [illegible] 1[illegible]3; [illegible] & [illegible], 2003; [illegible] et al. 200[illegible]; [illegible], 2014). [illegible] & [illegible] (2011) [illegible] (2014) [illegible]

[illegible] ([illegible]), [illegible] ([illegible] & [illegible], 1[illegible]3; [illegible] & [illegible], 2000; [illegible] et al. 2002; [illegible] et al. 2004, 200[illegible]a) [illegible] (et al. 200[illegible]a,b; [illegible] & [illegible], 2012). [illegible] (1[illegible]3; [illegible] et al. 2003; [illegible] et al. 2003; [illegible] et al. 200[illegible]a) [illegible]

[illegible]



1. ( ) ... et al. 200).

... (1) ... (2) ...

... > 0 % ... (. 3 ,). ... et al. 2013) ... (40 0 %) ... (30 50 %) ... (5 10 %) ... (. 3) ...

2. R a , b a a

... (1, 2) ... (. 3) ... 15 ... (. 2, ...) 1 5 ... 1 ...

... et al. 2006) ... (. 2) ... (1, 3) ...

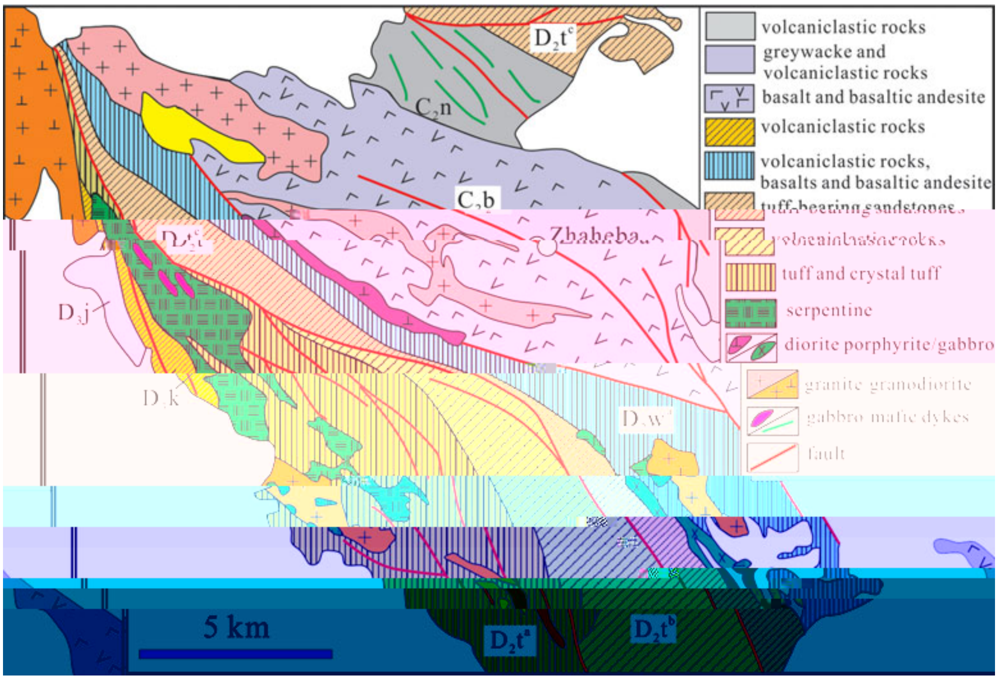


Fig. 2. [illegible] *et al.* 200[illegible], 200[illegible] [illegible] 1[illegible] 3).

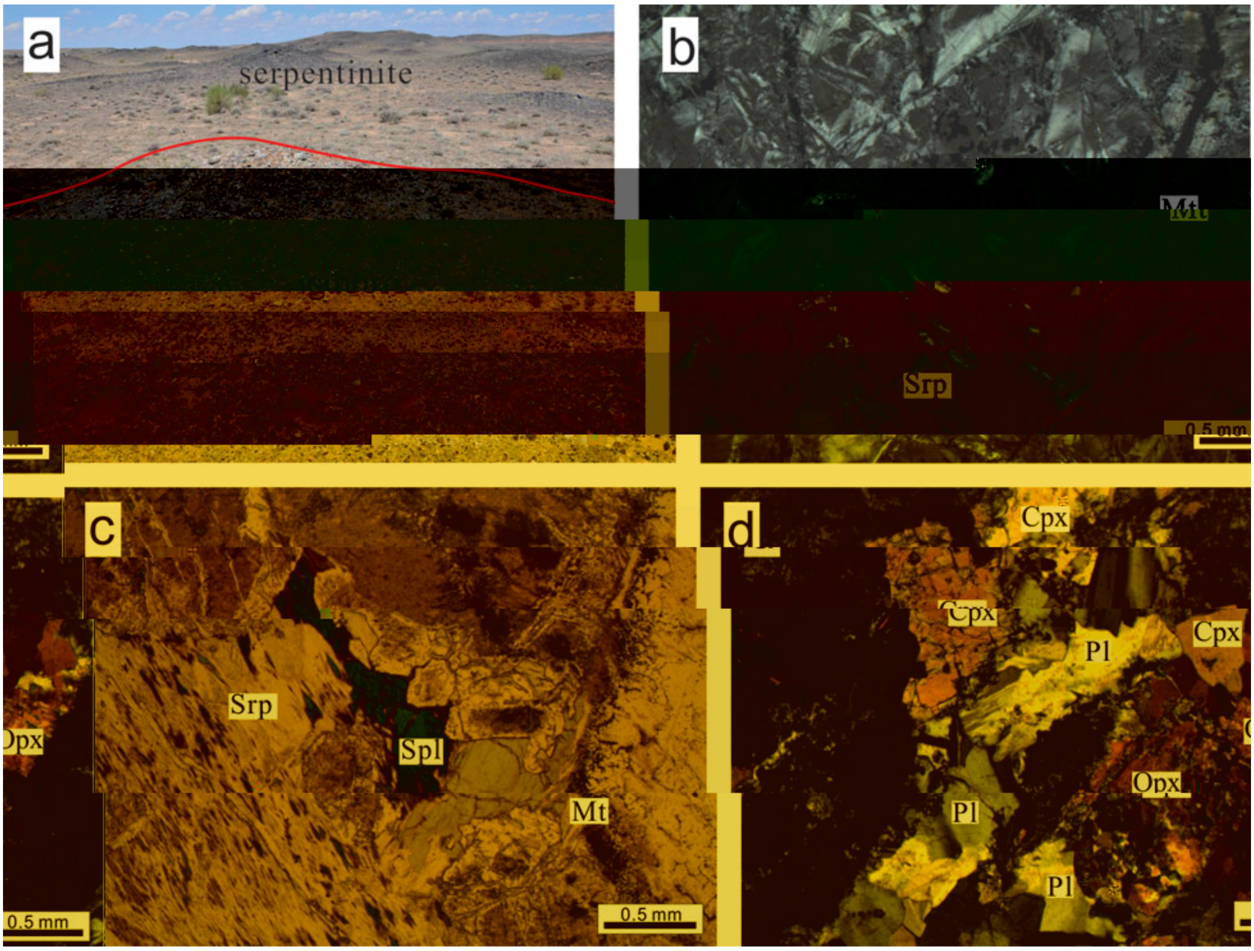


Fig. 3. [illegible]

3. A a ca c

3.a. Z c U Pb a a H O a a

(2013 01, 46° 32′ 51 °2′ 4)
(2013 02, 46° 33′ 2 °2′36)

( )

( )

et al. (2011).

(*et al.* 2010) (, 2003).

5 %

1

2,

12 0

et al. (2010*a*).

= 0.0020052),

( )

δ 5.31 ‰ (*et al.* 2010*b*).

δ 5.44 ± 0.21 ‰ (2),

5.4 ± 0.2 ‰ (*et al.* 2013).

3

3.b. M a a a

00

15 15

20

4 5

3.c. W c a a

100

et al. (2004).

2 %.

6000

et al. (2004). 50

3

-1, -2 -2,

-1

3,

3 5 %.

1.

3

( )

et al. (2004).

143 /144 =

0.11 4 146 /144 = 0. 21

0. 102

0. 0506 -1,

143 /144 0.512104

0.5126 1 -1.

2.

4. A a ca

4.a. Z c U Pb a

100 150 μ

1 1 2 1.

(. 4).

(22 123) (

5) 0.4

0. 30

4 5. ± 2.5

[illegible] 1. [illegible]

[illegible]	2013[illegible]01-1	2013[illegible]01-3	20132[illegible]01-4	2013[illegible]01-5	2013[illegible]01-6	2013[illegible]01-	2013[illegible]01-	2013[illegible]0[illegible]1	2013[illegible]0[illegible]2	2013[illegible]0[illegible]4
					Major elements (%)					
[illegible] 2	3 . 0	4 .20	3 .41	3 .62	3 .22	3 . 2	3 .05	4 .22	46.4	51.2
[illegible] 2	0.05	0.20	0.05	0.05	0.04	0.05	0.04	0.14	0.12	0.2
[illegible] 3	0.61	1. 6	1.04	0.6	0. 0	0. 4	0. 0	1 .2	1 .64	1 .33
[illegible] 3	.44	4.6	.	.36	.5	.16	. 4	3.6	3.24	3.
[illegible]	0.0	0.10	0.11	0.11	0.11	0.0	0.11	0.0	0.0	0.0
[illegible]	3 .21	24.5	3 . 2	3 .	3 .0	3 .31	3 .44	10.04	.03	5.

1.

	2013 01-1	2013 01-3	20132 01-4	2013 01-5	2013 01-6	2013 01-	2013 01-	2013 0L 1	2013 0L 2	2013 0L 4
	0.005	0.064	0.00	0.005	0.00	0.003	0.003	0.051	0.044	0.222
	0.021	0.34	0.044	0.042	0.0 2	0.031	0.033	0.310	0.25	1.450
	0.004	0.04	0.00	0.00	0.011	0.005	0.005	0.04	0.043	0.21
	0.011	0.232	0.036	0.044	0.012	0.034	0.00	0.123	0.0 0	0. 3
	0.0 0	0.036	0.03	0.03	0.06	0.026	0.025	0.046	0.031	0.06
	0.26	1. 10	6.600	1. 0	0. 3	0.233	1.150	1.5 0	0.516	0.1 5
	0.406	0.0 2	0.12	0.112	0.0	0.1	0.054	0.16	0.1 1	0.6 5
	0.046	0.034	0.014	0.02	0.050	0.030	0.010	0.050	0.02	0.130
	0.1 1	0.144	0.203	0.364	0.042	0.0 4	0.0	0.066	0.042	0.0 3
	2013 0L 5	2013 0L 6	2013 0L (1)	2013 0L (1)	2013 0L (1)	2013 03 2 (1)	2013 03 3 (1)	2013 03 4 (1)	2013 03 5 (1)	2013 0L 3 (2)
					Major elements (%)					
2	4 .1	45.	4 .	53.1	51. 1	50.40	50.54	50.52	51.22	52.3
2	0.34	0.15	1.40	1.24	1.31	1. 0	1.63	1.31	1.1	0.33
3	1	1 .5	16.5	16.1	15. 3	15.	16. 6	15.55	15.4	1 .61
3	4.52	3.34	.	.11	.43	.0	.50	.42	. 2	3.44
	0.0	0.0	0.11	0.10	0.11	0.13	0.11	0.14	0.12	0.0
	6.	.42	4. 0	4.2	4.41	5.	3.2	6.06	.14	4.
	11.03	12.61	6.22	5. 5	6.3	6. 5	4.52	.4	.26	. 0
	4. 6	.3	. 2	.3	.00	4.52	.31	4. 0	4.0	.11
	0.13	0.11	0.3	0.31	0.42	2.04	0.33	1.2	2.03	0.1
5	0.04	0.02	0.62	0.62	0.65	0. 4	0.6	0.4	0.44	0.04
	3. 2	3.26	4.24	2.54	2. 3	2.2	5.14	2.65	1. 3	2.
	. 5	. 2	. 6	. 0	.4	.40	. 1	.6	.6	. 1
	4.	.4	.11	. 0	.42	6.56	.64	6.0	6.11	.2
#	5	1	55	54	54	56	41	56	64	4
					Trace elements (ppm)					
	.0	4. 5	1.16	1.12	1.4	.0	40.4	5.2	6. 2	5. 1
	0.22	0.135	1.2 4	1.6 3	1.316	1. 53	1.034	1.100	0.5 5	0.62
	25.0	23.	1 .6	1 .5	1 .5	.5	1 .2	25.2	1	1 .0
	11	3.	1 6	166	1 2	22	22	254	1	5.
	34.	163	60.5	62.6	64.1	116	1	0.	203	23.
	24.2	21.6	26.	23.6	24.6	2 .	2 .5	2 .0	2 .0	16.4
	4.	1 5	63.6	50.	51.4	6.	2 .	5 .3	132	1.1

[illegible] 1. [illegible]

[illegible]	2013 [illegible] 01[illegible] 5	2013 [illegible] 01[illegible] 6	2013 [illegible] 01[illegible] ([illegible] 1)	2013 [illegible] 01[illegible] ([illegible] 1)	2013 [illegible] 01[illegible] ([illegible] 1)	2013 [illegible] 03[illegible] 2 ([illegible] 1)	2013 [illegible] 03[illegible] 3 ([illegible] 1)	2013 [illegible] 03[illegible] 4 ([illegible] 1)	2013 [illegible] 03[illegible] 5 ([illegible] 1)	2013 [illegible] 01[illegible] 3 ([illegible] 2)
[illegible]	3[illegible]	1.20	3[illegible].60	46.[illegible]0	4[illegible].30	23.40	43.00	25.20	32.[illegible]0	6.56

[illegible] 1. [illegible]

[illegible]	2013 [illegible] 01 11 ([illegible] 2)	2013 [illegible] 02 1 ([illegible] 2)	2013 [illegible] 02 2 ([illegible] 2)	2013 [illegible] 03 1 ([illegible] 1)	2013 [illegible] 03 6 ([illegible] 1)	2013 [illegible] 01 10 ([illegible] 2)	04 06 ([illegible] 1)	04 24 ([illegible] 1)	04 2 ([illegible] 1)	03 1 ([illegible] 1)
					Trace elements (ppm)					
[illegible]	1 .4	36.	42.4	26.0	32.4	1 .	/	/	/	/
[illegible]	0.3 5	0.153	0.35	1.1	0. 4	0.46	/	/	/	/
[illegible]	32.5	33.2	34.5	25.1	26.3	32.1	13.4	20.5	1 .	20.3
[illegible]	1 4	203	21	33	341	1 5	144	1 4	214	265
[illegible]	56.5	44.2	4 .	1 .	22.2	53.	15	162	214	265
[illegible]	34.	3 .5	3 .3	23.1	24.	33.	20.6	30.	2 .	20.2
[illegible]	66.4	4.6	6.4	25.4	2 .1	66.6	.1	114	5.5	.02
[illegible]	6.4	236.4	256.	205.4	20 .	114.20	/	/	/	/
[illegible]	4 .0	44.1	4 .0	4.	103	44.1	/	/	/	/
[illegible]	12.0	11.1	11.2	14.	13.6	12.0	/	/	/	/
[illegible]	0.5	1.420	1.0 0	3.130	3.2 0	0.5 3	4.	1 .1	22.0	1 .2
[illegible]	1	1 50	5	2 0	24	6 6	1	31	111	6
[illegible]	13.0	13.0	13.2	21.1	22.	12.5	13.2	13.2	14.	20.1
[illegible]	54.	42.3	41.5	144	154	52.	243	133	164	151
[illegible]	1.2	0. 4	0. 55	11.315	11. 5	1.25	20.2	12.	21.	12.2
[illegible]	0.025	0.030	0.02	0.051	0.052	0.02	/	/	/	/
[illegible]	0.3 1	0.2 6	0.32	1.560	1.450	0.360	/	/	/	/
[illegible]	0.2	1. 20	1.030	0.365	0.406	0.336	/	/	/	/
[illegible]	11	3 2	346	25	50	4.3	/	/	/	/
[illegible]	10. 0	. 40	.610	26.40	26. 0	10.50	30.6	32.2	40.1	26.4
[illegible]	23.00	1 . 0	1 .40	51.50	54. 0	22.30	5 .	62.	2.3	52.5
[illegible]	2. 0	2.520	2.510	5. 50	6.1 0	2.6 0	6.	. 4	10.5	6.4
[illegible]	11. 0	11. 0	11.60	22.30	24.30	11.60	2 .5	31.2	43.1	24.4
[illegible]	2.540	2. 00	2.6 0	4.4 0	4. 00	2.3 0	4.5	5.2	6.	4. 5
[illegible]	0. 6	0. 1	0. 0	1.163	1.25	0. 3	1.45	1.5	2.0	1.03
[illegible]	2.4 0	2. 13	2. 54	4.14	4.46	2.522	3.56	4.01	5.35	4.23
[illegible]	0.3 6	0.3	0.3	0.612	0.660	0.3 4	0.4	0.54	0.64	0.63
[illegible]	2.1 0	2.150	2.220	3.420	3.6 0	2.130	2.5	2.	3.24	3. 5
[illegible]	0.46	0.446	0.444	0. 2	0. 5	0.46	0.4	0.52	0.5	0.
[illegible]	1.350	1.230	1.240	2.120	2.2 0	1.310	1.32	1.3	1.45	2.25
[illegible]	0.1 0	0.16	0.1 5	0.304	0.32	0.1 4	0.1	0.2	0.2	0.34
[illegible]	1.210	1.050	1.120	1. 60	2.110	1.210	1.25	1.23	1.24	2.13
[illegible]	0.1 4	0.164	0.165	0.2 1	0.323	0.1 3	0.20	0.1	0.1	0.34
[illegible]	1.3 0	0. 41	1.040	3.2 0	3.510	1.460	5.3	3.2	4.16	3. 2
[illegible]	0.0 4	0.062	0.051	0.5	0.644	0.0	1.35	0.6	1.16	0.6
[illegible]	0.151	2.0	1.50	2. 5	1.	0.33	/	/	/	/
[illegible]	0.3 4	0.206	0.200	45.20	35.10	0.41	.13	.0	4.1	21.06
[illegible]	1. 0	0. 61	0. 1	. 60	.2 0	1. 0	4.50	2.63	3.20	.41
[illegible]	0.500	0.304	0.302	2. 30	3.4 0	0.501	1.	0.6	1.46	2.5

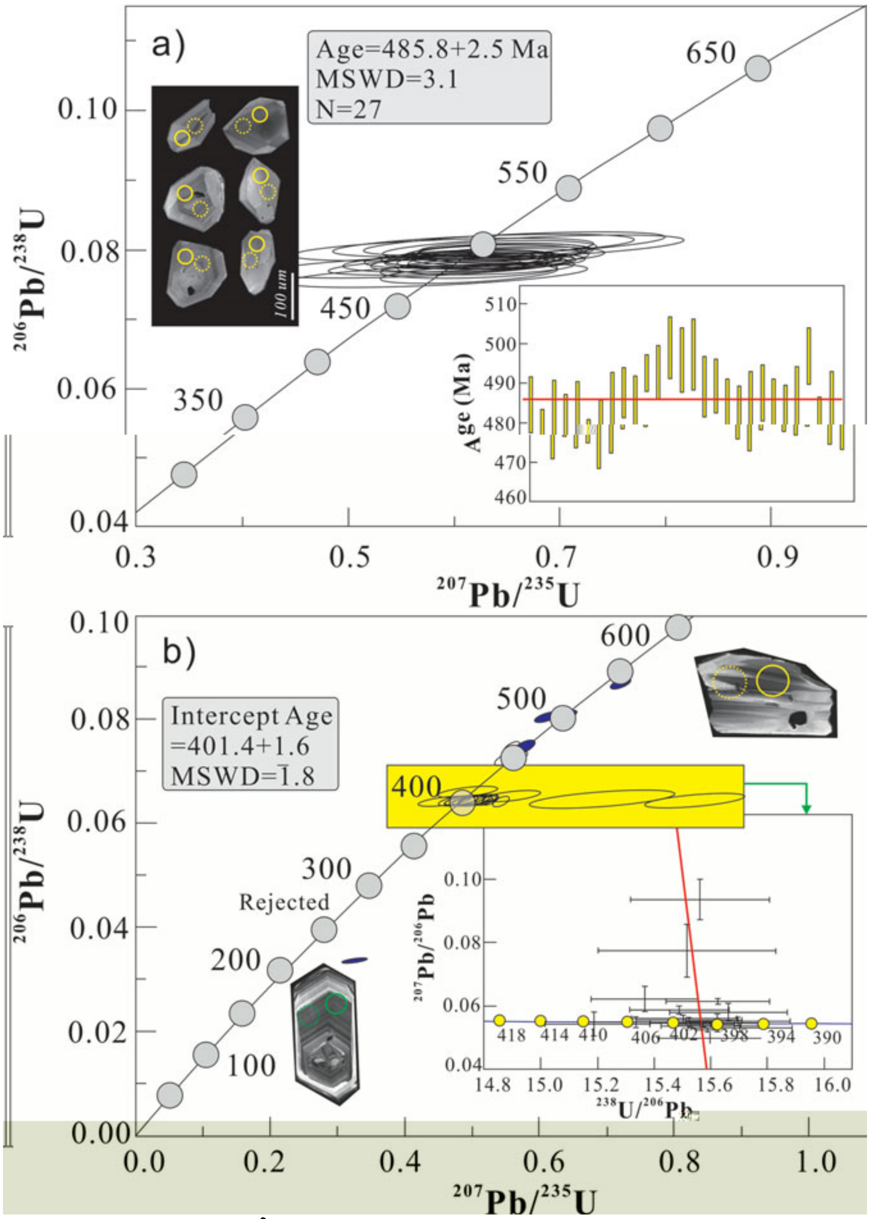
[illegible] 04 06, 04 26, 04 2 [illegible] 04 1 [illegible] *et al.* (200 *a*).

[illegible]

2. [illegible]

		[illegible]	[illegible]	[illegible]	[illegible]	[illegible] (1σ)	[illegible]	[illegible]	[illegible]	14 / 144	143 / 144 (1σ)	(143 / 144)	(t)
2013 01 3	(2)	0.36	3 2	0.002	0. 04030(2)	0. 04015	2.4	10.	0.13 4	0.512 3 (40)	0.5124 4	6.
2013 01 10	(2)	0.5	6 6	0.0024	0. 04 5 (23)	0. 04 45	2.3	11.6	0.1235	0.512 0 (43)	0.5124 6	.1
2013 03 1	(1)	3.13	2 0	0.0335	0. 06324(20)	0. 06133	4.4	22.3	0.121	0.512533(4)	0.512214	1.
2013 03 2	(1)	2.	1320	0.0063	0. 042 (20)	0. 04255	4. 5	2 .6	0.1046	0.512 1 (51)	0.512445	6.3
2013 03 3	(1)	.06	516	0.0452	0. 0536 (43)	0. 05111	5.	36.	0.0	0.512 0 (30)	0.512450	6.4
2013 03 4	(1)	.65	14 0	0.01	0. 0422 (51)	0. 04120	4.55	24.5	0.1123	0.512 03(53)	0.51250	.5

(t) = 10 000((143 /144) (t)/(143 /144) (t)−1) (t) (/) [illegible] 401 [illegible]



4. [illegible] 1σ [illegible] 2σ ( ) [illegible]

(. 4 = 2 , / , = 3.1). [illegible] 4 ± 4 [illegible] (*et al.* 2003). [illegible] 100 200 μ [illegible]

[illegible] 1 3. [illegible] 1 (1), [illegible] 0% [illegible] (2) [illegible]

(2, . 4). 2 450 500 21 1 206 23 401 ± 2 (= 3.3) 206 23 207 235 401.4 ± 1.6 (= 1.) 206 23 . 4), (, 1 3).

4.b. M a c

4.b.1. Spinel composition

(. 3). 100 300 μ 4 3 2 (100 /(+)) 44 60 (100 /(+)) 25 61. *et al.* 2010). ( ) *et al.* 2013).

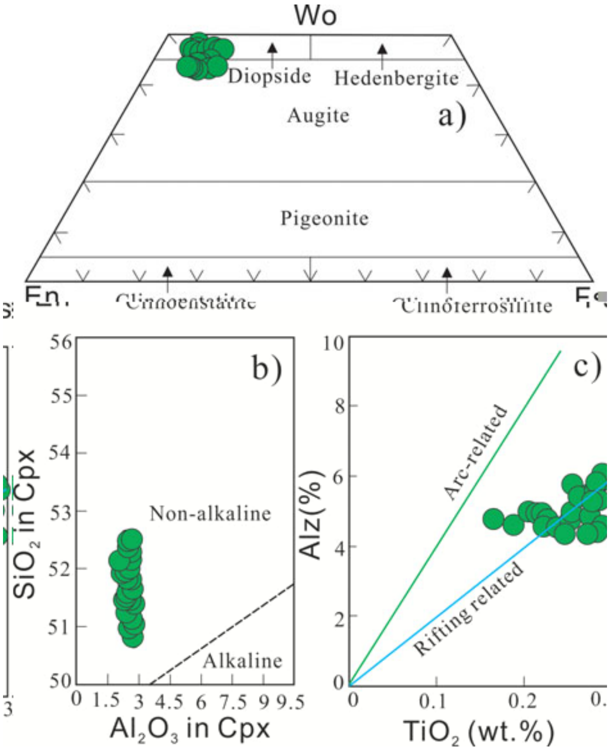
4.b.2. Pyroxene compositions

(= 4 6). 2 (0.5 %) 5). 41 4 46 55 (. 5). 3 2 2 (. 5).

4.c. W c a c

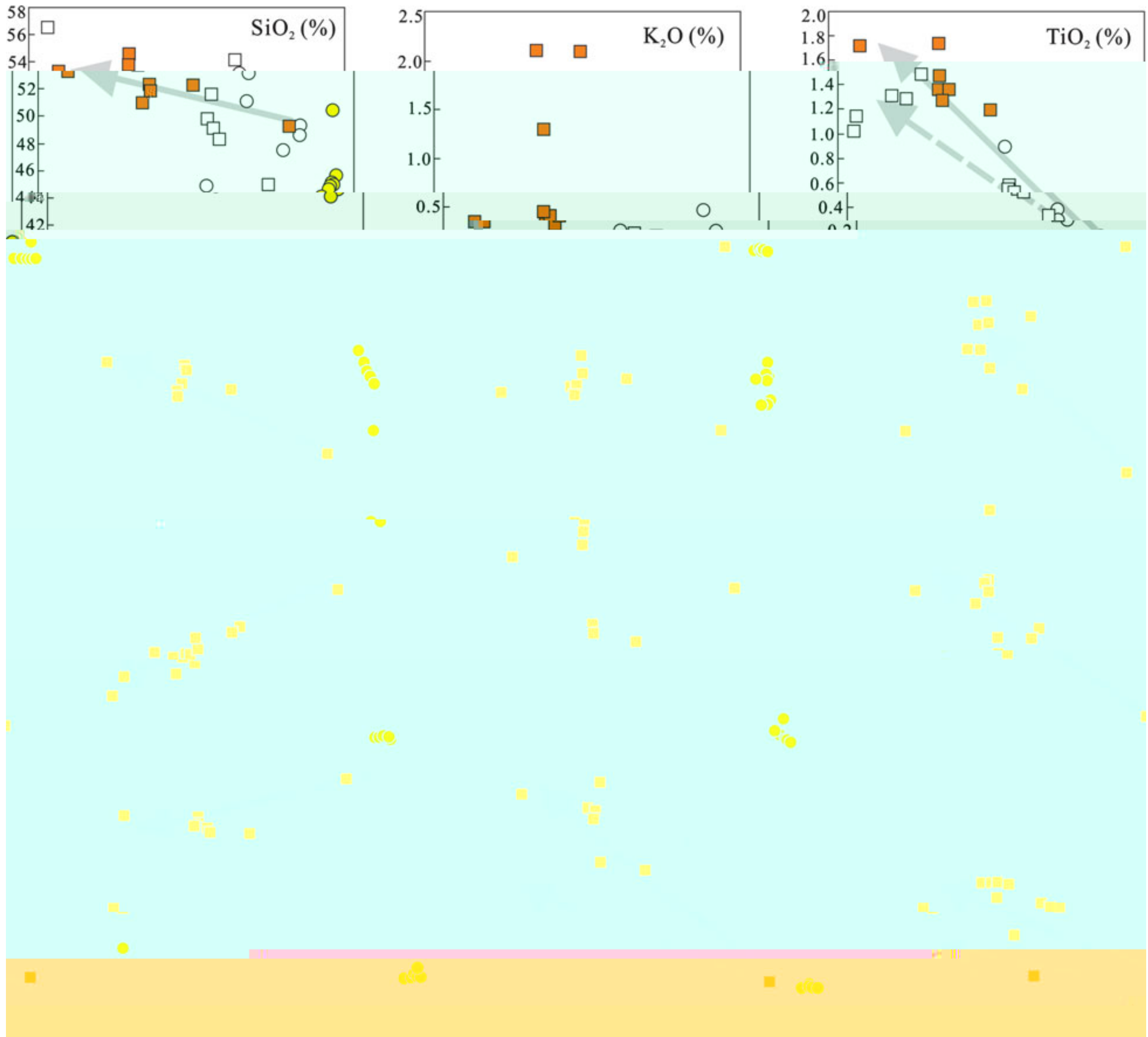
4.c.1. Serpentinites and cumulates

( ) (> 12 %,) 2 (40 %), 3 (1.0 %), (0.03 0.06 %), (0.04 0. 2 %) 2 (0.04 0.05 %). 3



5. ( ) ( ) ( ) 2 (%) 3 (%) ( ) ( ) 2 (%)

1 (1) (. 6). (3 103) (5) (1). (> 12 %) ( ) ( ) ( ). 3 3 2, ( ) (1) ( ), , 2014 & (1). 2 45. % 51.2 %, 3 (3.24 4.6 %), 3 (1 .3 1 .6 %, 2013 01-3), (.54 15.42 %), 2 (0.12 0.34 %), (2. 1 .3 %, 2013 01-3) (0.11 0.46 %), (1).

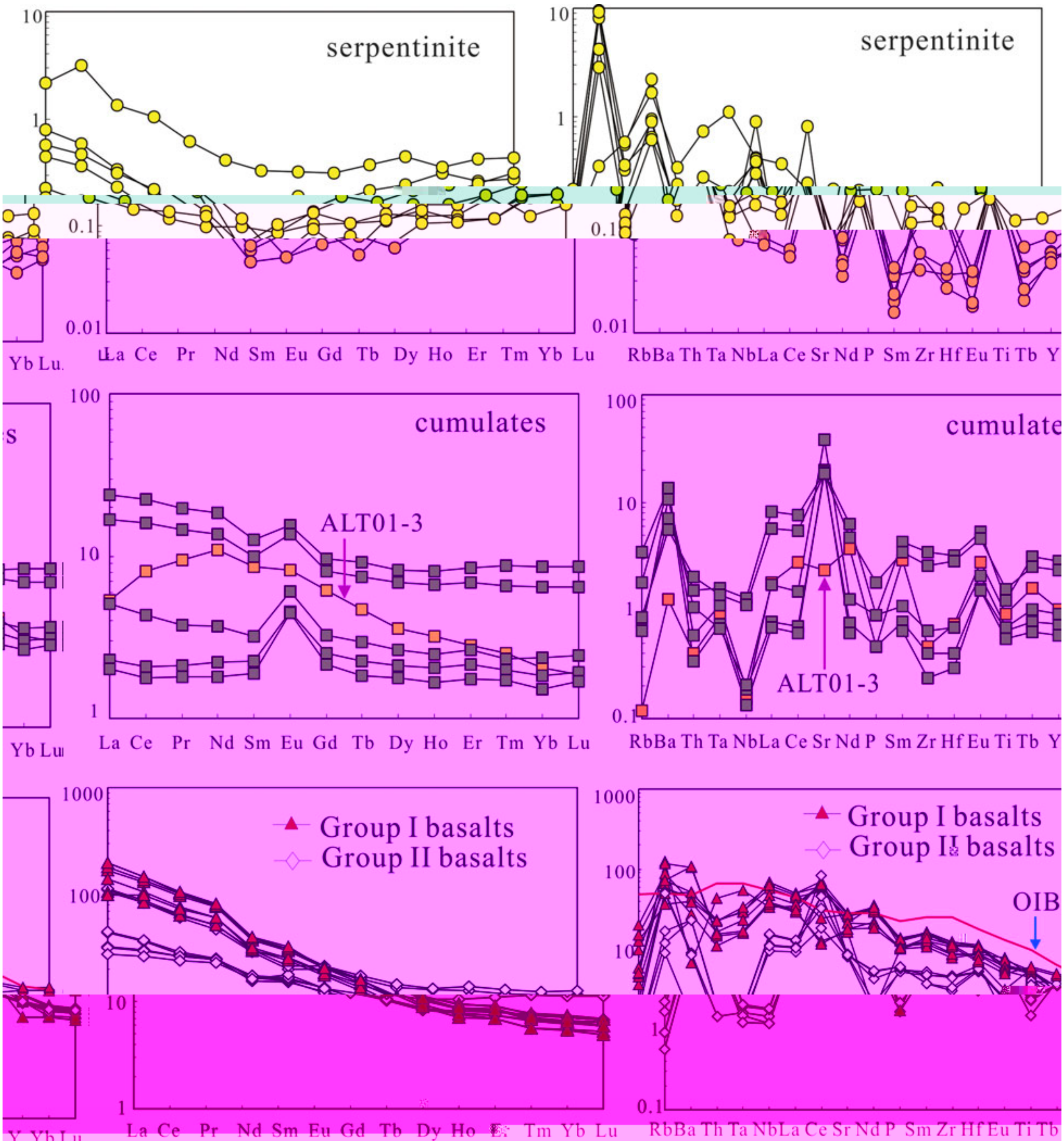


[illegible] 6. [illegible] *et al.* 200 [illegible]

[illegible] (Fig. 6). [illegible] 5 [illegible] 41 [illegible] = 1.3 [illegible] 2. [illegible] = 1.1 [illegible] 2.2). [illegible] 2013 [illegible] 01-3 [illegible] = 0.2 [illegible] 0.4) [illegible]

4.c.2. Basalts

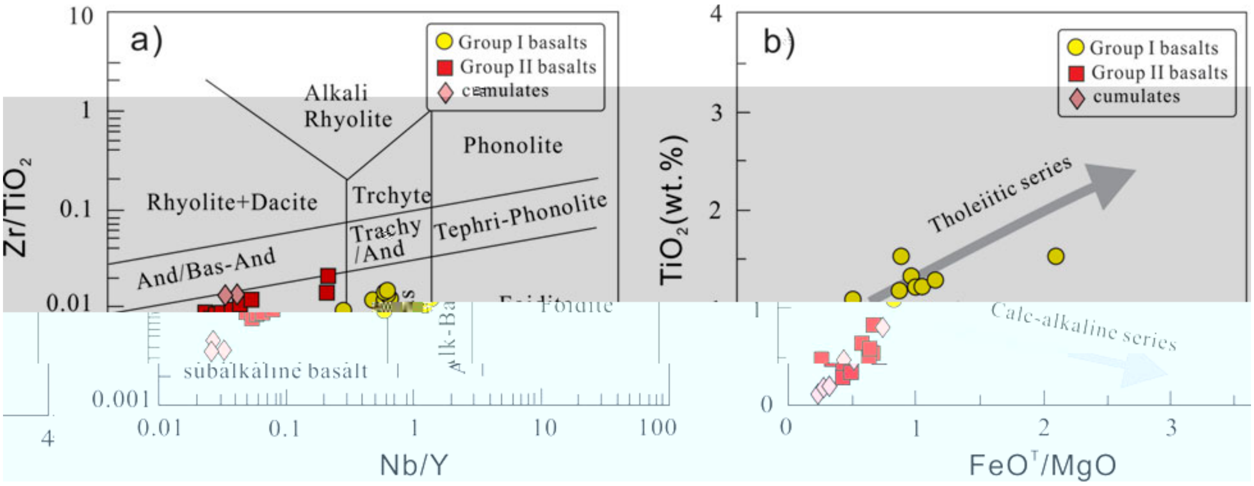
[illegible] 43.15 % [illegible] 5 .65 % ([illegible] 52 %, [illegible] 1) [illegible] 1 ([illegible] 1) [illegible] 2 ([illegible] 2). [illegible] 2 [illegible]). [illegible] 1 [illegible] 2 [illegible] 1 [illegible] 2 [illegible] 6). [illegible] 1 [illegible] 124 [illegible] 205 [illegible] 2 [illegible] 50 [illegible] 60 [illegible] 1 [illegible] 10 [illegible] 30 ([illegible] 20) [illegible]



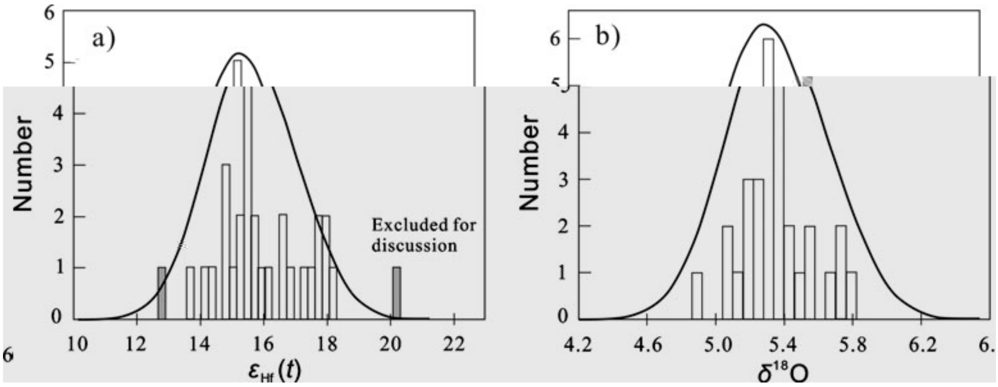
(1.02 1.21) ... 0.44 ... (~0.11) ...

4. ...

(0.0024 0.0452) ... (0. 04030 0. 0536) ... (0. 04015 0. 05111, 2013 ... 0.0 ... 0.13 4 ... 0.512 0 ... 0.512 3 ... ε(t) ... +6.3 ... + .5 (2013 ... +1.).



( ) ( ) (1 4).



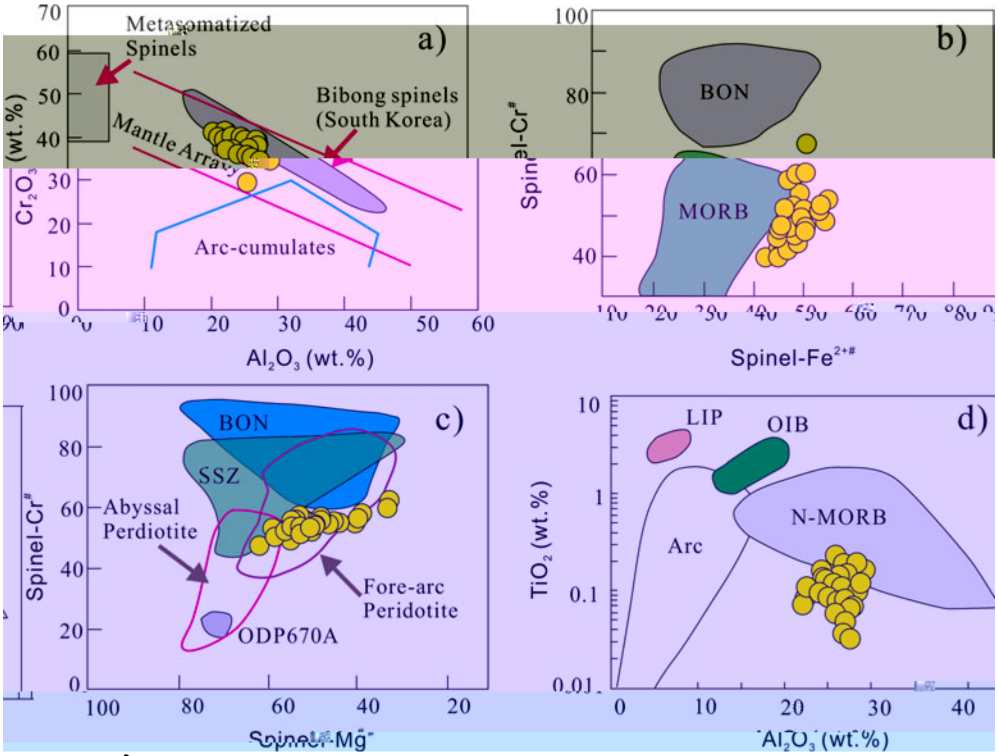
( ) ε (t) ( )

(2013 01) 2 ε (t = 4 5) 13 20. 2 5 5 ε (t) (> 16) ε (t), 15. δ 4. 1 ‰ 5. 3 ‰, δ 5.3 ± 0.23 ‰ ( ). ~400 ε (t) 1.4 .2 6 0 20 (*et al.* 200).

5. D

5.a. T Z a ba

c. 4 6 401 (503 ±) (416 ± 3) *et al.* 2012 *et al.* 200 *b*, 1). (401) (4 6) (1 3). (1),

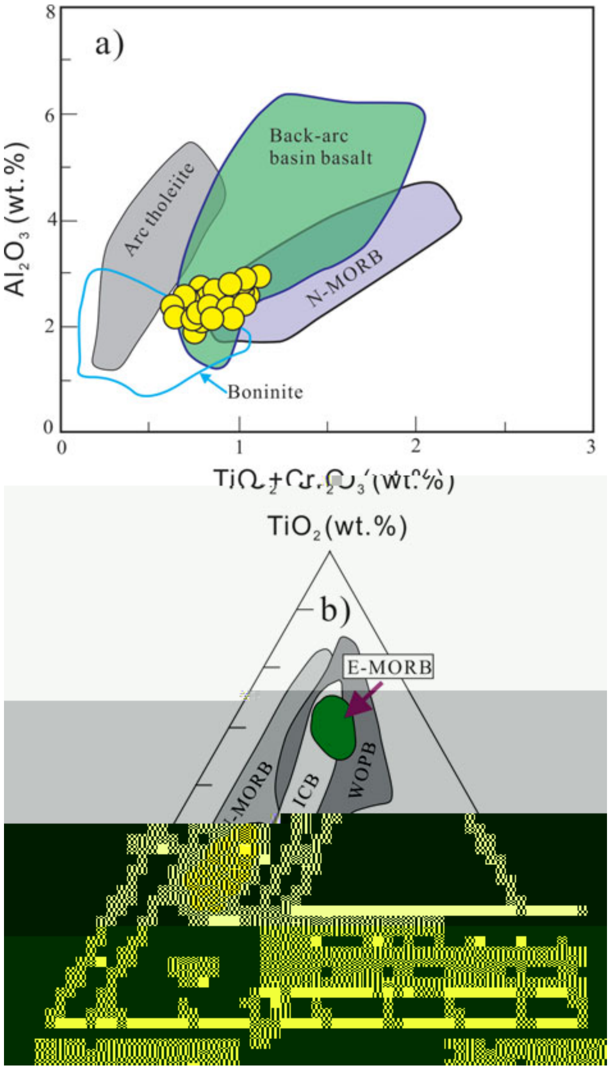


10. ([illegible]) [illegible] ( ) [illegible] 3 [illegible] 3 (%) [illegible] & [illegible], 2000). ( ) [illegible] (100 [illegible] / ([illegible] +)) [illegible] 2+ [illegible] (100 [illegible] 2+/(2+ +)) [illegible] ([illegible], 1 [illegible] 4 [illegible] & [illegible], 2001). ( ) [illegible] (100 [illegible] / ([illegible] +)) [illegible] (100 [illegible] / (+)) [illegible] ([illegible] *et al.* 1 [illegible] 5). ( ) [illegible] 2 [illegible] 3 [illegible] & [illegible], 2001). [illegible]

[illegible] (500 [illegible] 4 0 [illegible]) ([illegible] *et al.* 2003 [illegible] *et al.* 2015 [illegible]), [illegible] (430 [illegible] 400 [illegible]) ([illegible] *et al.* 200 [illegible] b, 2014 [illegible]) [illegible] (3 [illegible] 0 [illegible] 350 [illegible]) ([illegible] *et al.* 2003 [illegible] *et al.* 2006).

5.b. O [illegible] a c [illegible] a [illegible]

[illegible] & [illegible], 2002 [illegible] *et al.* 2010



11. ( ) ( ) $_3$ $_2$ + $_3$ ( ) $_2$ $_2$/100

( ).

5 , $_3$ $_2$ + $_3$

(. 11) $_2$/100 $_2$

(. 11)

(.).

(. 12),

(. 12).

et al. (2002)

( ).

5.c. P D a ba

2. 1. (11 24 , 15), $_5$ (0.4 0.6 %) (11 15, 60) ( ) (& 1 2 & , 2001) (. 13).

(1) & , 2002) (2) (& , 1 2 , & , 1 3 *et al.* 1 6).

1.

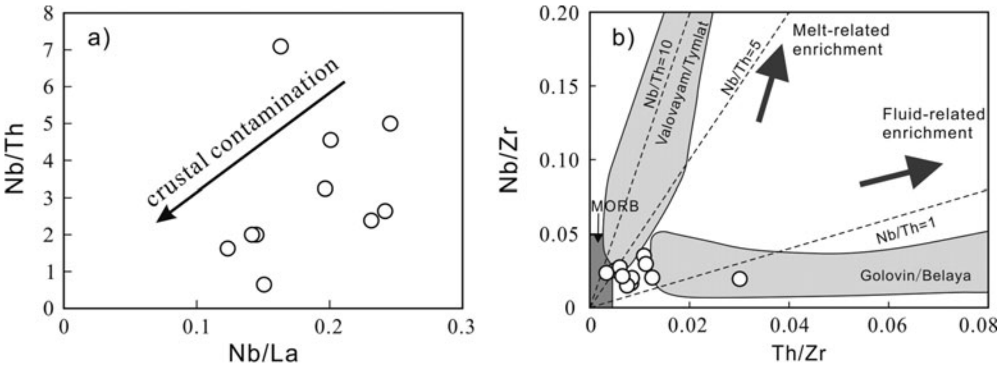
(& , 200 *et al.* 2011). / [6] (0. 04120 0. 06133) (*t*) (+1. + .5). / (3.44 20.4) (1.51 2.54) (& 1 6).

1

(*et al.* 1 6 1 6).

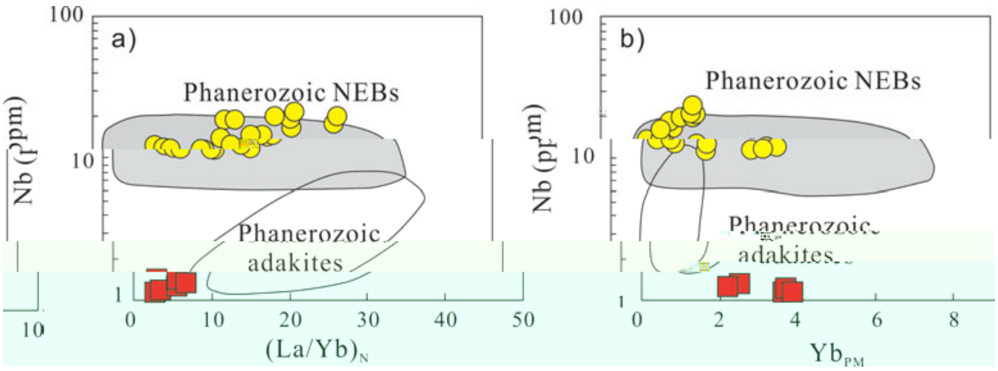
(& , 2000).

(& 1 2 *et al.* 1 6). *et al.* (200)



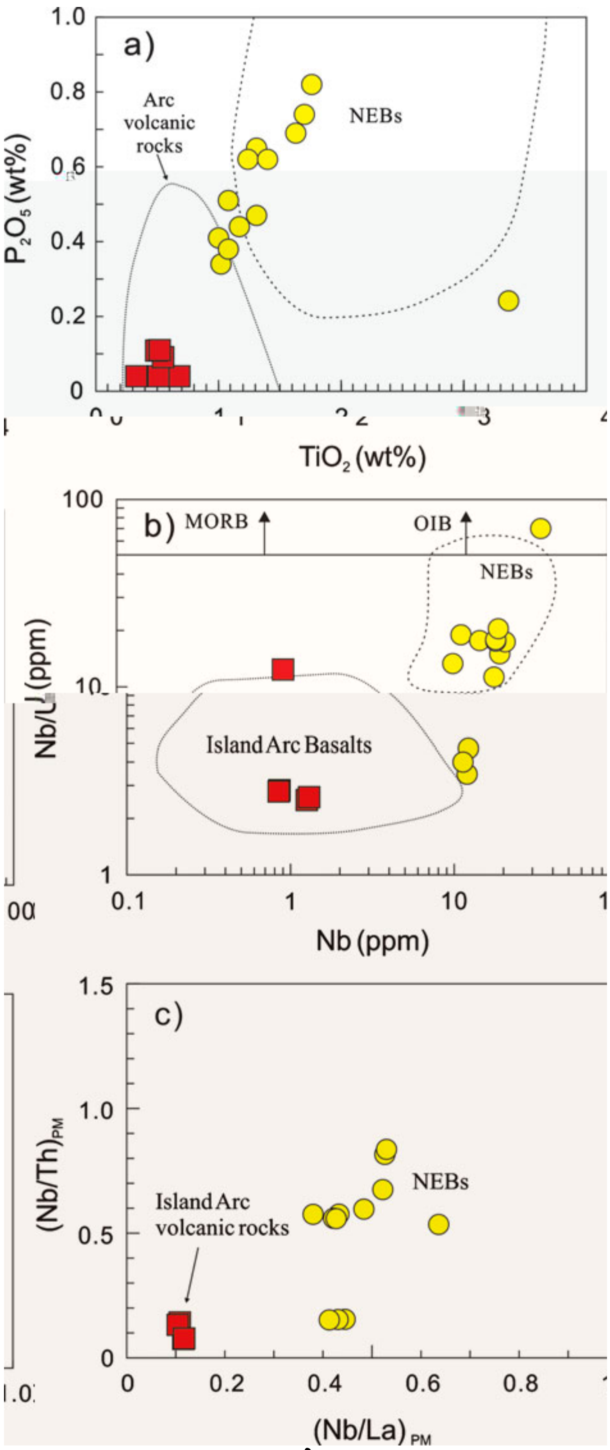
a)
crustal contamination
Nb/Th
Nb/La
b)
Nb/Th=10
Valovayam/Tymlat
Nb/Th=5
Melt-related enrichment
Fluid-related enrichment
MORB
Nb/Th=1
Golovin/Belaya
Nb/Zr
Th/Zr

Fig. 12.



a)
Phanerozoic NEBs
Phanerozoic adakites
Nb (ppm)
(La/Yb)N
b)
Phanerozoic NEBs
Phanerozoic adakites
Nb (ppm)
YbPM

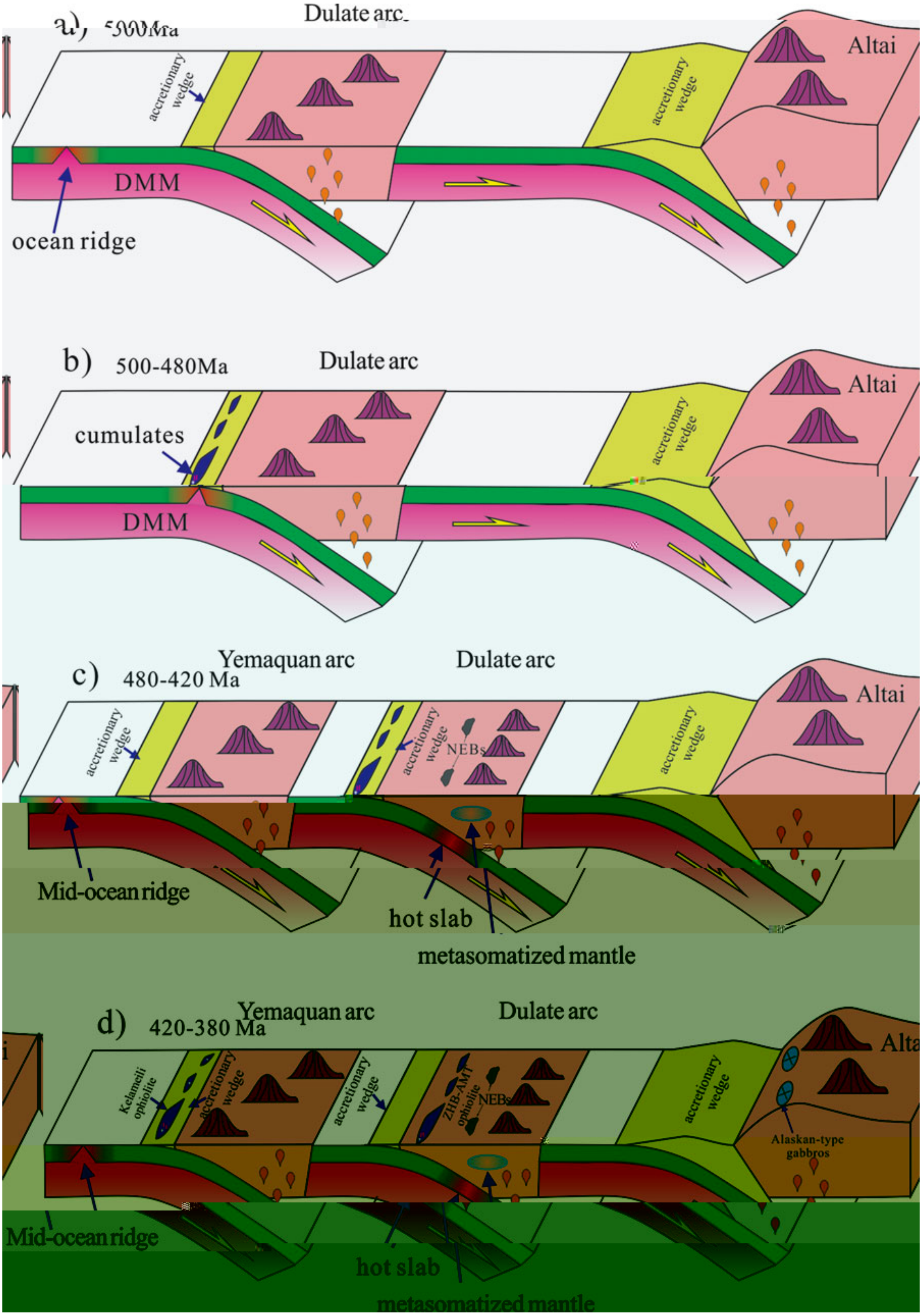
Fig. 13.



14. ... *et al.* (1 5) ...

... *et al.* (2015) ... 400 3 0 ...

... 460 3 5 ... *c.* 400 ... *et al.* 2006, 200 ... *et al.* 200 ... *et al.* 200 ... *et al.* 200 , 200 ... *et al.* 2012 ... *et al.* 2015). ... & 2002 ... *et al.* 200). ... *et al.* 2015). ... 5.), ... 2 ... 15) ... *et al.* (200 , 200 *b*) ... *et al.* 200). ... & ... 200 ... *et al.* 2013). ... 15). (1) ... (*c.* 500), ... 15) ... (2) ... (500 4 0), ... 15) ... (3) ... (4 0 420), ... (45 ... *et al.* 2015) ... (440 ... *et al.* 2014) ... 15) ...


Dulate arc
Altai
accretionary wedge
accretionary wedge
DMM
ocean ridge
b) 500-480Ma
Dulate arc
Altai
cumulates
accretionary wedge
DMM
c) 480-420 Ma
Yemaquan arc
Dulate arc
Altai
accretionary wedge
accretionary wedge
NEBs
accretionary wedge
Mid-ocean ridge
hot slab
metasomatized mantle
d) 420-380 Ma
Yemaquan arc
Dulate arc
Kelameili ophiolite
accretionary wedge
accretionary wedge
ZHB-AMT ophiolite
NEBs
accretionary wedge
Alaskan-type gabbros
Mid-ocean ridge
hot slab
metasomatized mantle

[illegible] 15. ([illegible]

(4) ... (420 3 0) (*et al.* 2014 ... *et al.* 2015). ... 1. ... 2. ... (. 15). ... (400 3 0). ...

6. C ...

(1) ... ~4 5 ... *c.* 400 ...

(2) ...

(3) ...

Ac ... 305 ... (2011 ... 06 03-01).

S ... a ... a ... a

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R ... c ...

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