Geol. Mag. **154** (3), 2017, pp. 419–440. © Cambridge University Press 2016
10.101 / 0016 56 16000042

‡, ‡†, ‡
& ‡
, 10003 ,
‡ 210016,
, 36 4 -5305,

(*Received* 1 2015; *accepted* 2016; *first published online* 1 2016)

[redacted] ac

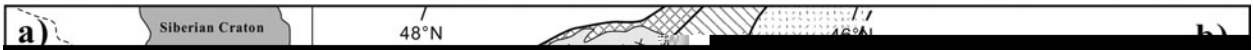
~4 5 ~400 1% ε (*t*) (13 20) δ (+5.3 ‰) 1%

1. I c

(e. *et al.* 200 & 200 11 *et al.* 2012 *et al.* 2012, 2013 *et al.* 2013), *et al.* 200 *et al.* 200 a). *et al.* 2000 & 2003 *et al.* 200 2014). & (2011) (2014)

& 2000 *et al.* 2002 *et al.* 2004, 200 a) *et al.* 200 a,b 2012). *et al.* 2003 *et al.* 2003 *et al.* 200 a)

†



[redacted]

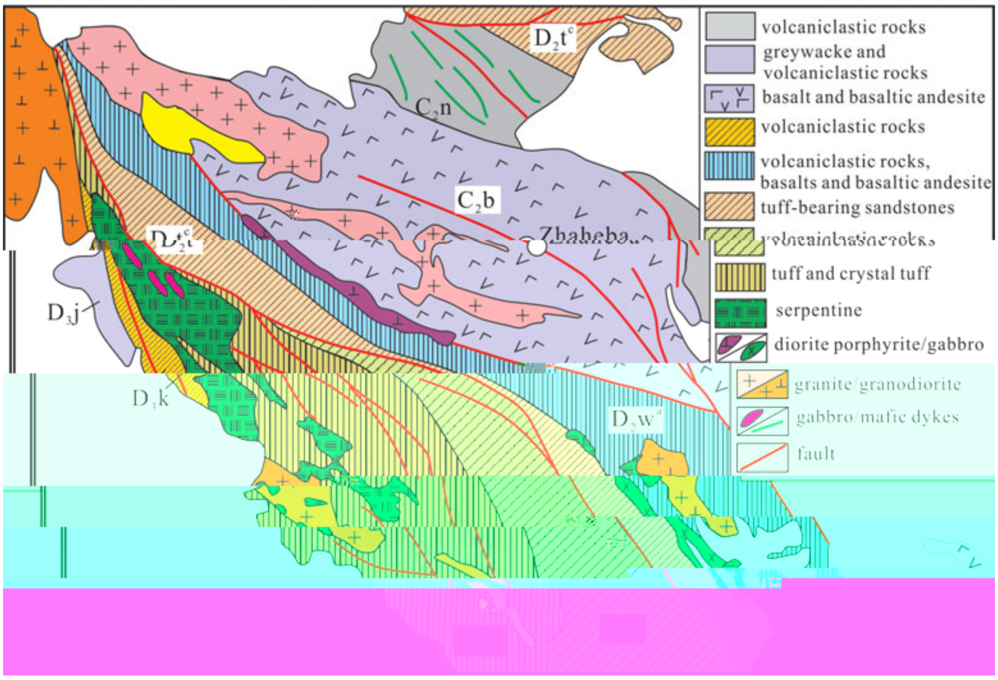
e 1. ( ) e e 1 e e e e ( ) ( ) e e e e 1 e e e e e e 1 e e e e e (e e *et al.* 200).

e 1 1 e e e 1 % e e1 e e e - e , 1e 1 % e e e % e e 1 e 1e e e e (1) e e e e e e e e e (2) e 1 e e 1 1 e e e- %1e 1 e e.

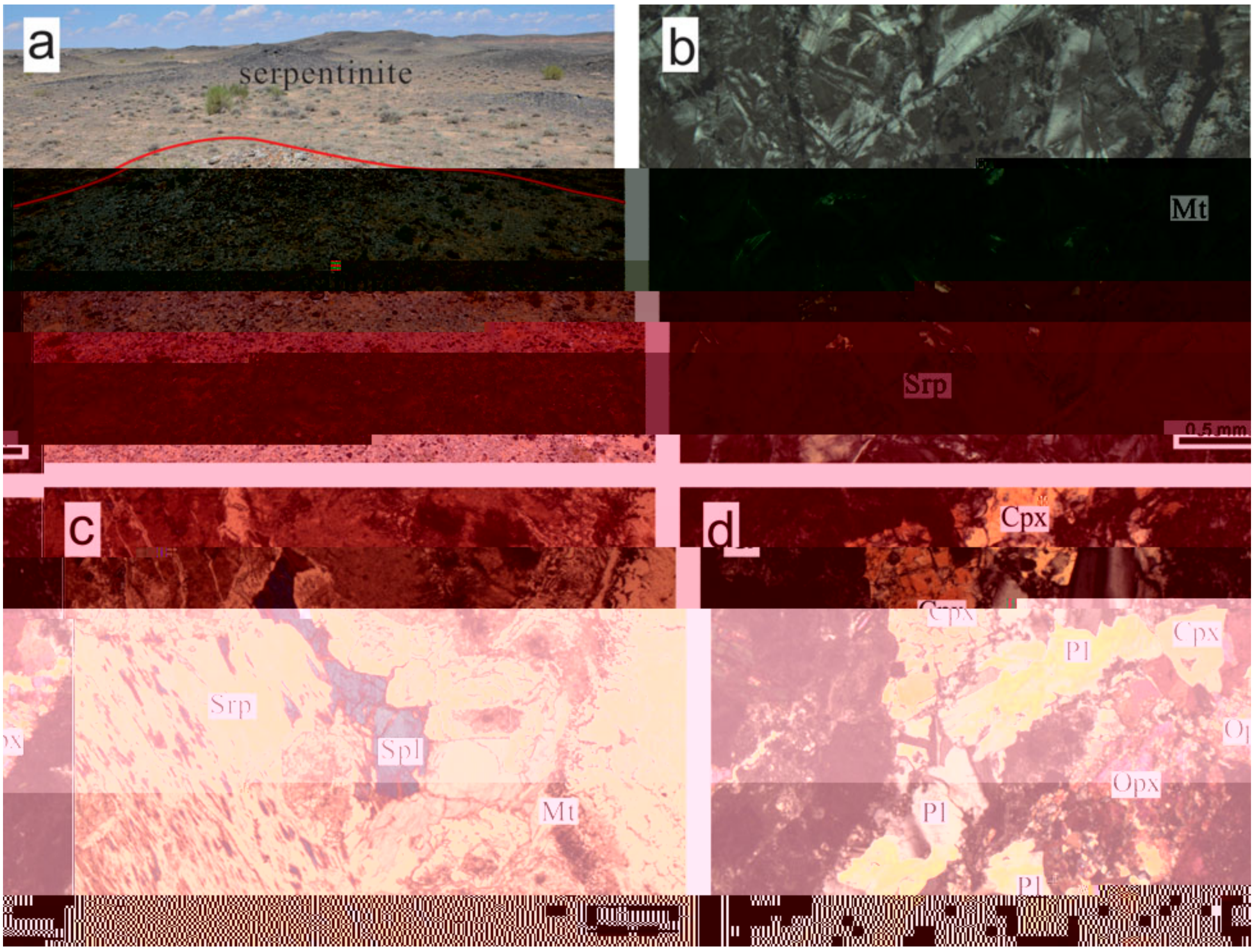
2. R a , [redacted] a [redacted] a a

e e 1 e 1e e1 e e e - e e e e 1 e e , e e e (1 , 2). e e e 1e e, e, e. e. e e 1e %e e e e e e e . e e e 1e e e ee e e (. 3). e e e - e e 15 e %e . e e - 1e e 1 e e - % e e e e e e e e % e e e (. 2, ee e 1). % 1e 1 5 e e 1 e ee e e 1e e. % e e 1e e e % e e e 1e e. e e 1e -

e 1 e > 0 % e 1e e, e e 1 e (. 3 ,). e e e e % e e e e 1e e e %1 e1e e e (e. . *et al.* 2013). e e 1% e e - e e - e . e % 1 e 1 e (40 0 %) 1% e e (30 50 %) e 1% e e (5 10 %) e (. 3). e % e e e e e e e e e e e e e e % e - e , e e e1 e 1 e e 1e 1% e e e - e - e . e e - e %e e e % e e e e e e e e ( ) e ( ) e 11e e e % ( ) (*et al.* 2006). e e e e e e e e e % e e . e ee e e e , e % , - e e (. 2). e e e e, e e % e % e e e, e %1 - e e e . e e ee e e e e e e e 1 e e e e 1 e - 1 (, 1 3). e e



e 2. (… e) … *et al.* 200 , 200 *a* … , 1 3).



e 3. (… e) … > 0% … % … 1% … 1% … 1% … 1% …

3. A a ca c [redacted]

3.a. Z c U–Pb a a H– [redacted] a a [redacted]

(2013 01, 46° 32′ 51 , ° 2′ 4) 1 e (2013 02, 46° 33′ 2 , ° 2′ 36) … et al. (2011). … (et al. 2010) … (, 2003). … 5 % … 1 … 2, … 12 0 … et al. (2010a). … (, = 0.0020052), … δ¹ … 5.31 ‰ (et al. 2010b). … δ¹ … 5.44 ± 0.21 ‰ (2), … 5.4 ± 0.2 ‰ (et al. 2013). … 3 …

3.b. M a a [redacted]

… 00 … 15 … 15 … 20 … 4 … 5 …

3.c. W - c a a [redacted]

… 1 … 100 … et al. (2004). … 2 %. … 6000 - … et al. (2004). … 50 … + 3 … -1, -2 -2, … -1 … 3, … 3 5 %. … e 1.

… + 3 … et al. (2004). … 0.11 4 … = 0. 21 … 0. 102 … 0. 0506 … -1, … 143 /144 … 0.512104 … 1 0.5126 1 … -1. … e 2.

4. A a ca [redacted]

4.a. Z c U–Pb a [redacted]

… 100 150 μ … 1 1 2 1. … (… 4). … (22 123 11) (5 11) … 0.4 0. … 30 … 4 5. ± 2.5

[illegible] 1. [illegible]

[illegible]	2013 01-1	2013 01-3	20132 01-4	2013 01-5	2013 01-6	2013 01-	2013 01-	2013 01. 1	2013 01. 2	2013 01. 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] 2 3	0.61	1. 6	1.04	0.6	0. 0	0. 4	0. 0	1 .2	1 .64	1 .33
e2 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.

[illegible] 1. 4210.0

e 1. , e,

1 e %d e	2013 01-1	2013 01-3	20132 01-4	2013 01-5	2013 01-6	2013 01-	2013 01-	2013 01 1	2013 01 2	2013 01 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

1 e %d e	2013 01 5	2013 01 6	2013 01 (1)	2013 01 (1)	2013 01 (1)	2013 03 2 (1)	2013 03 3 (1)	2013 03 4 (1)	2013 03 5 (1)	2013 01 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
2 3	1	1 .5	16.5	16.1	15. 3	15.	16. 6	15.55	15.4	1 .61
e2 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
2	4. 6	.3	. 2	.3	.00	4.52	.31	4. 0	4.0	.11
2	0.13	0.11	0.3	0.31	0.42	2.04	0.33	1.2	2.03	0.1
2 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
e	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

e 1. e

1 e %de	2013 01 5	2013 01 6	2013 01 (1)	2013 01 (1)	2013 01 (1)	2013 03 2 (1)	2013 03 3 (1)	2013 03 4 (1)	2013 03 5 (1)	2013 01 3 (2)
	3.	1.20	3 .60	46. 0	4 .30	23.40	43.00	25.20	32. 0	6.56

e 1. e

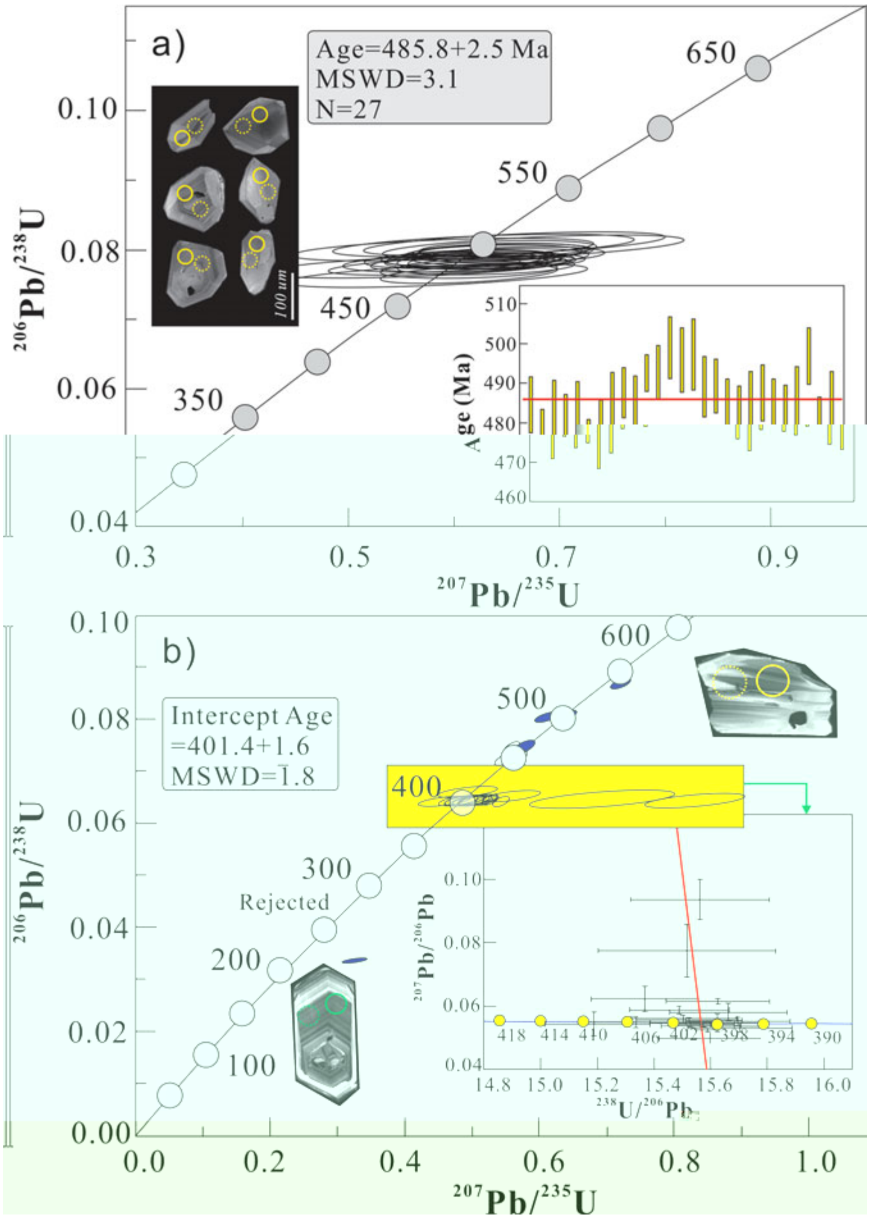
1 e / %1e	2013 01 11 (2)	2013 02 1 (2)	2013 02 2 (2)	2013 03 1 (1)	2013 03 6 (1)	2013 01 10 (2)	04 06 (1)	04 24 (1)	04 2 (1)	03 1 (1)
				Trace elements (ppm)						
	1 .4	36.	42.4	26.0	32.4	1 .	/	/	/	/
e	0.3 5	0.153	0.35	1.1	0. 4	0.46	/	/	/	/
	32.5	33.2	34.5	25.1	26.3	32.1	13.4	20.5	1 .	20.3
	1 4	203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

e _ e 1e e e e / e e e .
1e 04 06, 04 26, 04 2 04 1 e *et al.* (200 a).

e 2. 1 1 e e e e

1 e		%1e	(11)	(11)	6 /	6 / (1σ)	(/ 6)	(11)	(11)	14 / 144	143 / 144 (1σ)	(143 / 144)	ε (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

ε (t) = 10 000((143 /144) (t)/(143 /144) (t) − 1) ε (t) (/ 6) e e e e e e
e e e e 401 .



e 4. (e) 1 e e e 1 e e e
e 1 e e 1σ e e % e 2σ (e) e e .

(. 4 = 2 , = 3.1). e - e / 1 3. e e -
e 1 e %e1 e 4 ± 4 e e e e 1 .
e e %e e 1 1 (1) , 0 % e
e 1 e (*et al.* 2003). , 1 % e % 1 ,
e 1 e e 1 e e % e -
e , 100 200 µ e . e e 1 (2) e

% , (2, ee e . 4). e % e %e e e 1e e 1 e. e e, e 1 e 2 %e e e e 450 500 e e % e e % e e 21 %e 1e e e 1 %e 206 23 e 401 ± 2 (= 3.3). e e ee 206 23 e 20 235 e , e e e e e %e e e e1 e 401.4 ± 1.6 (= 1.) (ee e . 4), e 206 23 e e e e. e e e e (, 1 3).

4.b. M a c [redacted]

4.b.1. Spinel composition

e % 1 e e e 1e e (. 3). e 100 300 μ e % e (e 11 e e % e e 4 e 1 // e / e) e 1 e e 2 3, e 2 3 e , e 2 e . e e e % e e 1 % 1 e e 1 e . (100 /(+)) 44 60 . (100 /(+ e)) 25 61. e 1 e e e e e e / e / 1 - 1 e (*et al.* 2010). e e e e e e 1 e e e e - e e e e ( ) e 1 e e e e e e 1 e e e e e (*et al.* 2013).

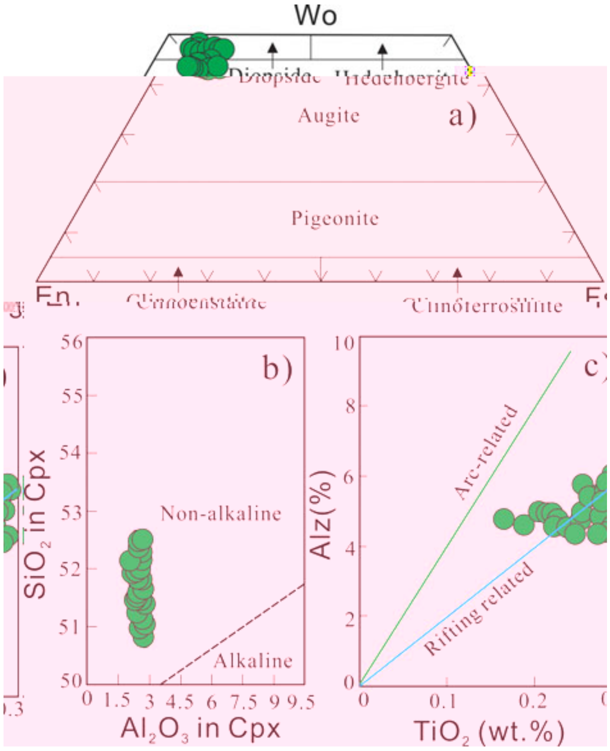
4.b.2. Pyroxene compositions

e 1% e e e e e e e 1 (= 4 6). e 1% e e % e e % 2 e (e 0.5 %) e e 1 e e 1 e (e 11 e e % e e 5 e 1 // e / e). e 1% e e e e e e e 1 41 4 , 46 55 1 (. 5). e% - e - e e e e e 2 3, 2 2 e (. 5 ,).

4.c. W - c a c [redacted]

4.c.1. Serpentinites and cumulates

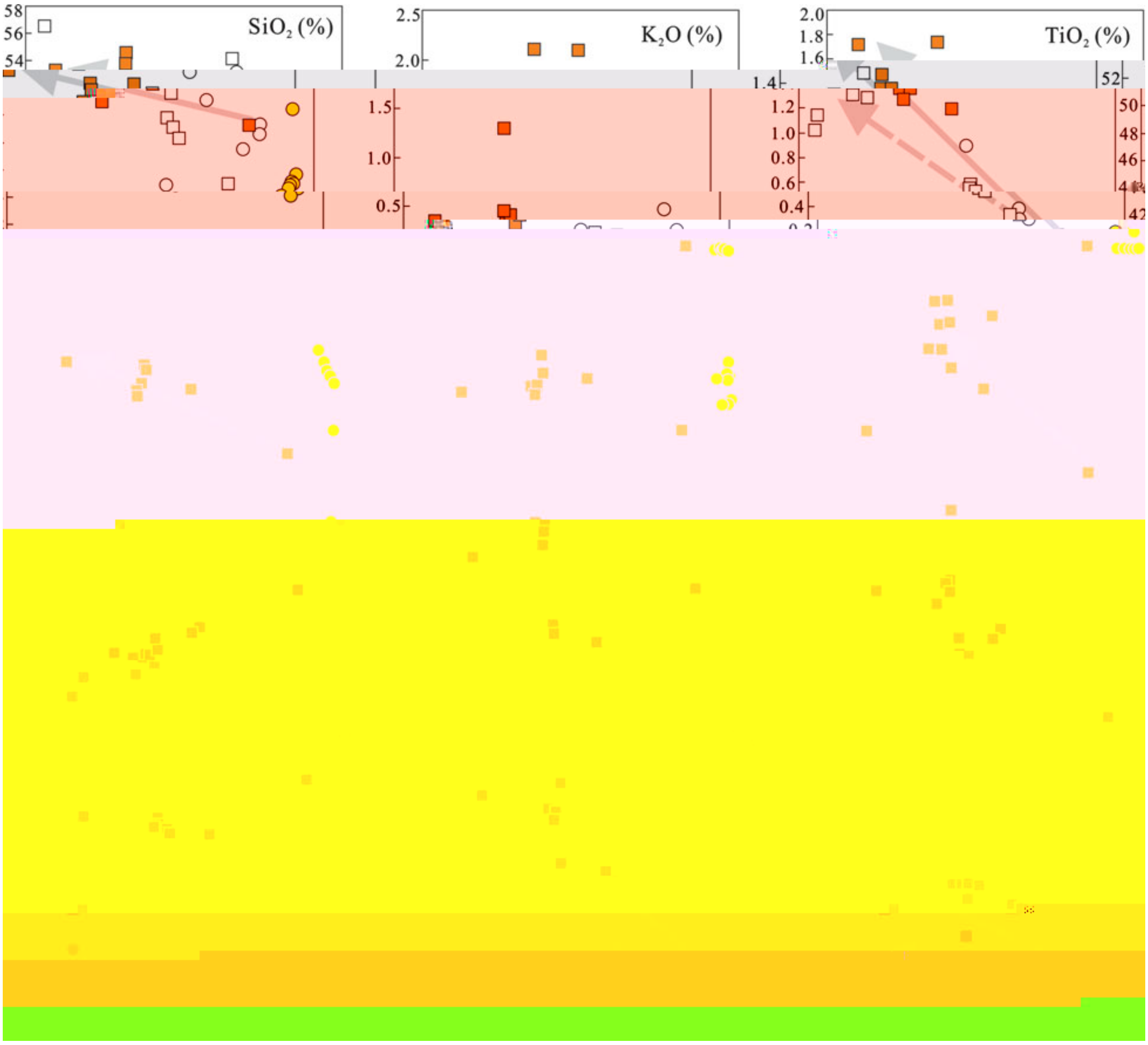
e e 1e e e e % ( ) (> 12 %, e e e e e 1e -) 2 (e 40 %), 2 3 (% e 1.0 %), 2 (0.03 0.06 %), 2 (0.04 0. 2 %) 2 (0.04 0.05 %). e2 3 -



e 5. (e) ( ) e 1 e 1% e e e e 1 e. ( ) 2 (%) . 2 3 (%) ( ) (1e e e e e e 1 e %) . 2 (%) 1% e e e e 1 e.

e %e 1 (e 1). e e , e e ee e e e e e e (. 6). e% e e e % (3 103 11) e (5 11) (e 1). e (> 12 %) 2 , 2 e e - % e e e e e e (,) e e e 1 e e e e ( ) (e. ,). e e , e e e e e - , 2 3, e2 3 2, e e e e % e e e e- e e % e e , e e e e e e e 1e - e e e e 1e e e e % e e e e e ( ) - e - e e e e ( ) e (e 1). e e , e% - e - 1e e- e 1 e ( ), e e e e 1 e 1 e e (e e, 2014 e e e 1 e e e e e & - , 1).

e e e 2 45. % 51.2 %, 1 % e e2 3 (3.24 4.6 %), 2 3 (1 .3 1 .6 %, e e1 1 e 2013 01-3), (.54 15.42 %), 2 (0.12 0.34 %), 2 (2. 1 .3 %, e e1 1 e 2013 01-3) 2 (0.11 0.46 %) %- / e e (e 1).



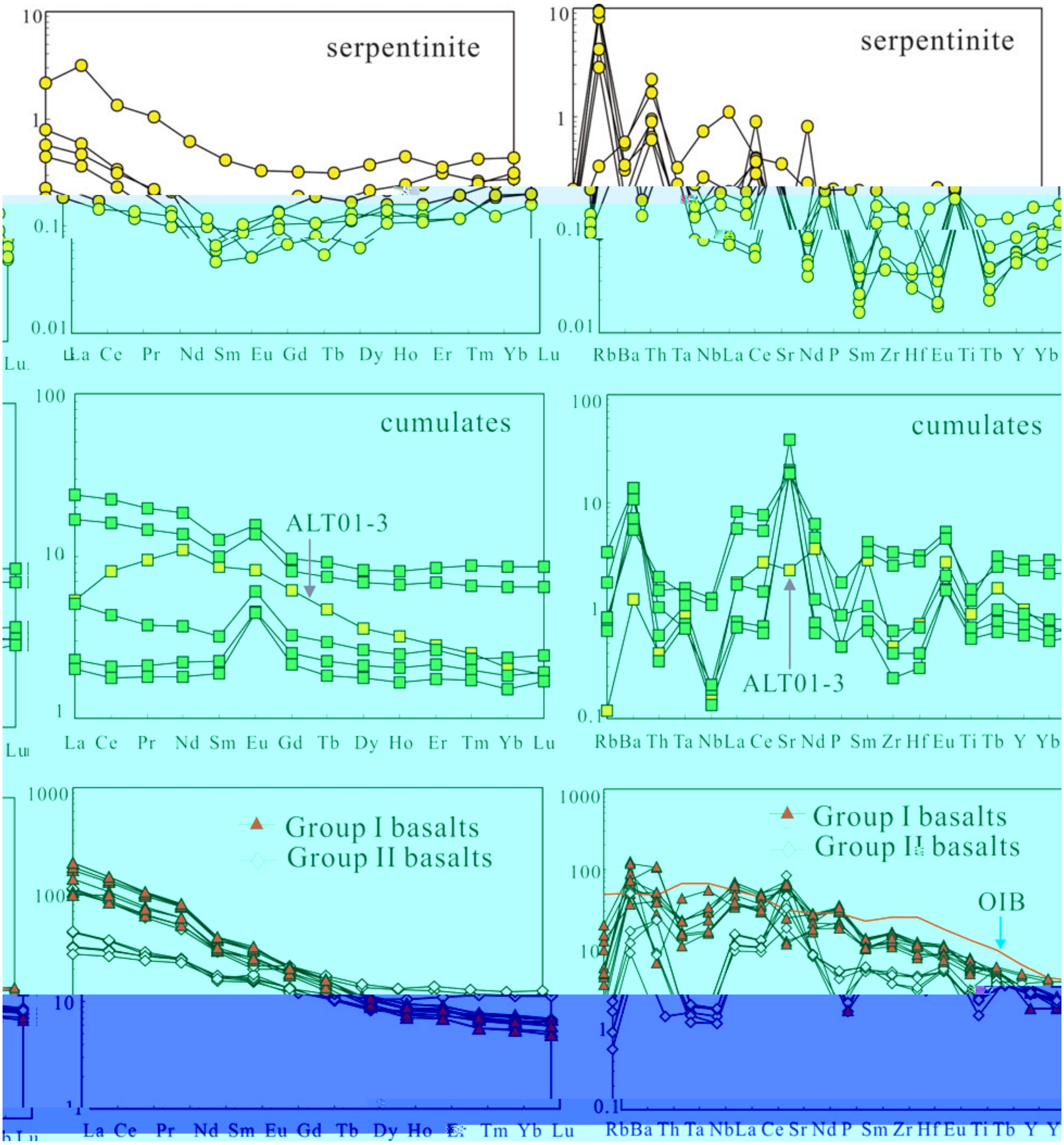
e 6. (e) e e 1 %e (2, 2 , 2 , 2, e2 3 , 2 3,) (1 e e1 e % *et al.* 200 *a* e e e e e e).

e e ee - e e e e e e e (6). e e e e - e 5 11 41 11 , - e e- e 1 e ( ) e e ((/) = 1.3 2.) 1 e 1 e e (/ = 1.1 2.2). 1 e 2013 01-3 1e 1 e , 1 % e e e e e e e e e e e e - e 1 e- e ( ) e 1 e e e e - ( ), e e e e % e e e (/ = 0.2 0.4) e 1 e e , .

4.c.2. Basalts

e e e 2 43.15 % 5 .65 % (.% e 52 %, e 1). e % e e , % e 1 e e e e e e e / / 2 , e e e 1 , e. e - e 1 1 (1) e 1 2 (2). e 2 1 e , 1 e e e % e ee e e - e e ( ). 1 2 e e e e e / 2 ( ). e e , 2, e2 3 , 2 5, 2, , e e e 2 3 e e e e e 1 e 2 , 2 5, 2, e e e e . (6).

e 1 e e e % - e 124 11 205 11 e e 2 e 50 11 60 11 1 e e e e (/) e ee 10 30 (% e 20) e e e e

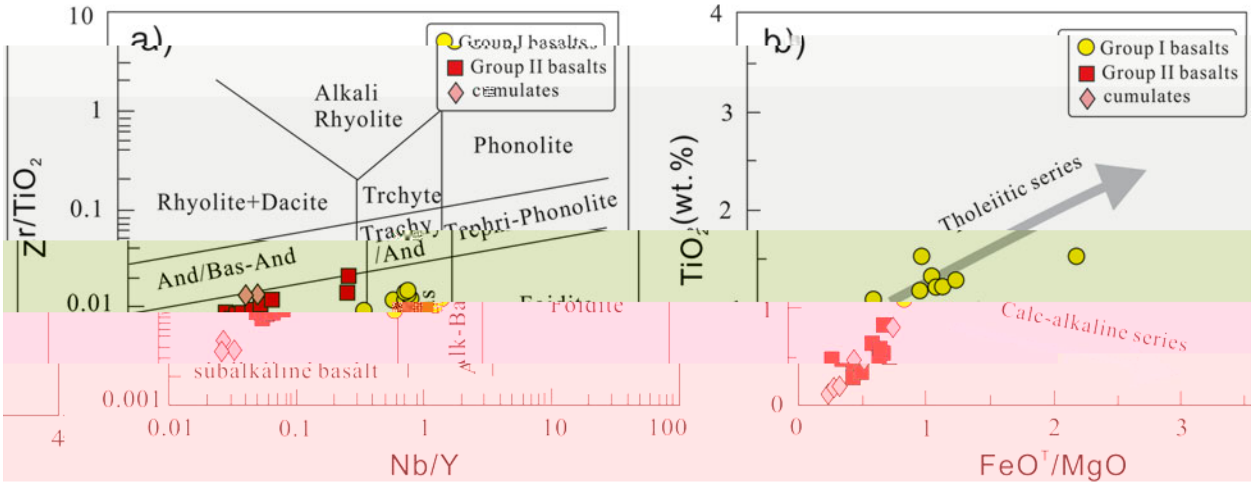


[illegible] (1[illegible]).

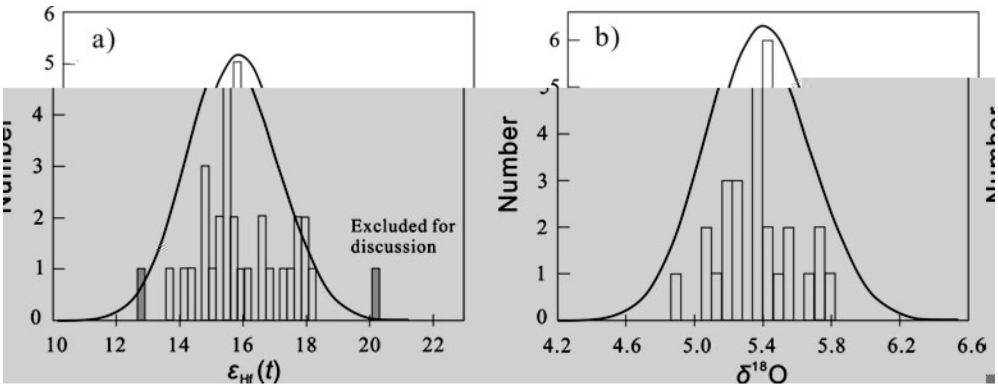
[illegible] = 0. 0 1.14) [illegible] 2 [illegible] 1 [illegible] 4 6 [illegible] 1 [illegible] = 1.02 1.21) [illegible] 0.44 [illegible] 0. [illegible] 2 [illegible] (~0.11). [illegible]

4. . W - c S–N a z c H–O [redacted]

[illegible] 2. 1 [illegible] 2 [illegible] (0.0024 0.0452) [illegible] (0. 04030 0. 0536), [illegible] (0. 04015 0. 05111, [illegible] 2013 03 1). [illegible] 0.0 [illegible] 0.13 4 [illegible] 0.512 0 [illegible] 0.512 3 [illegible] ε (t) [illegible] +6.3 + .5 [illegible] 2013 03 1 +1.).



. , e . (. . , . . . e) ( ) . . 1 . e e e e (/ $_2$. /) . . . e e . . . (e e & . %, 1). ( ) e- $_2$. e / . 1 . e ee e - e . e e e . e - e . e e e . % (1 4).



. , e . ( ) . ε (t) . ( ). 1e 1e . e . e e . 1 . e.

1e . 1 . e , e . 1 e (2013 01) . e e (- e 11 e e %. e e 2 e 1 // . e / e), ε (= 4 5) 13 20. e e e e 2 5 5 . e 1 %e ε (t) (> 16) e e e %, e e % e , e e 1 e e e e . e ε (t), e %e e % 1e 15. e e - e δ1 e e 4. 1 ‰ 5. 3 ‰, (.). , e e e e e %e 1 1 - e δ1 e 5.3 ± 0.23 ‰ (.).

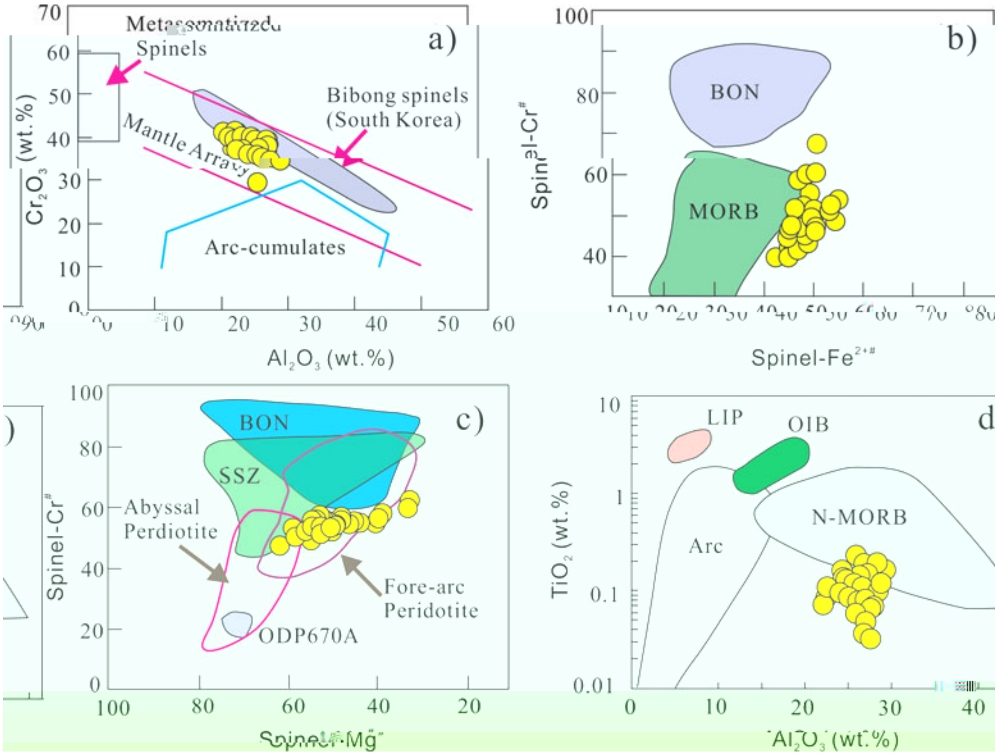
~400 e 1 e e e e ε (t) e e ee 1.4 .2 e- e e e 6 0 20 . e e % e e - 1e 1 e e e e e e (et al. 200).

5. [redacted]

5.a. T a [redacted] Z a ba

e e e e e , e e e e - e e e 1 e e 1 e c. 4 6 401 , e 1e e % e e e e % e e 1 e % e1 e e (503 ±) e 1 e e - e e e e e 1 e e e (416 ± 3) e e e 1 e e e 1 e e 1 e (et al. 2012 et al. 200 b, . 1). e e- e e (401) e e (4 6) (- e e 1e e) e e % % , e e e e e e e - e e e 1 e. e e e e e e e e e (, 1 3).

e e e 1 e e e e e e e e e e (. 1), e 1 e e e ee e , e. e e 1

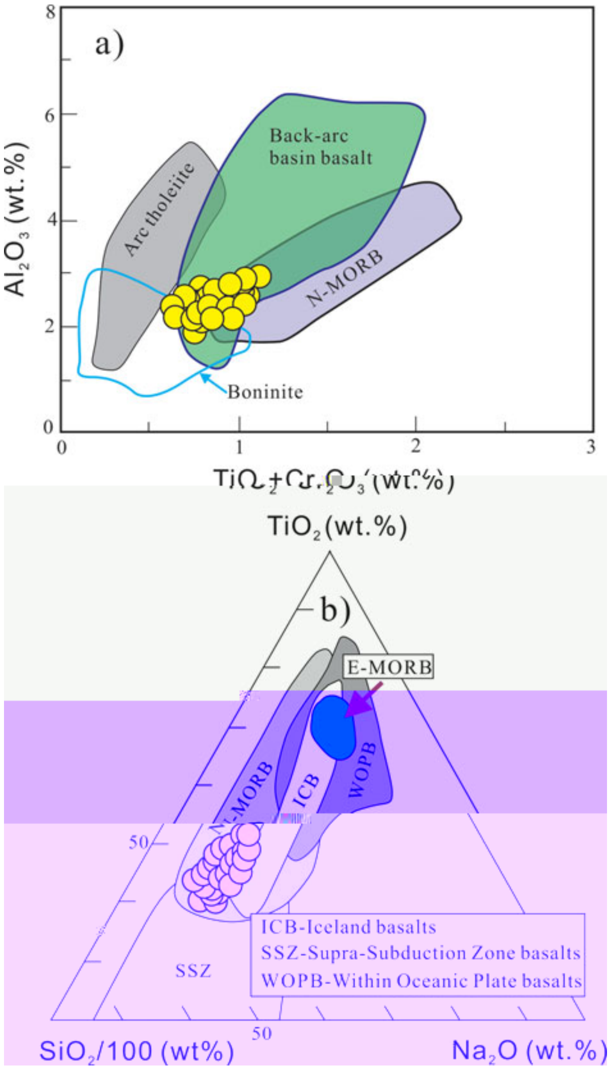


e 10. (e) 1 e . ( ) 2 3 e 2 3 (%) (e & , 2000). ( ) . (100 /(+)) e e2+ . (100 e2+/(e2+ +)) 1 e e e 1 e (e , 1 4 e & e e , 2001). ( ) . (100 /(+)) e . (100 /(+ e)) 1 e e e 1 e (e e et al. 1 5). ( ) 2 e 2 3 1 e 1 1 e e e 1 e (e e % & e e , 2001). e - e e 1 - e .

e (500 4 0) (et al. 2003 et al. 2015 %), e e e e 1 e (430 400) (et al. 200 b, 2014 e e e e e e) e e e - 1 e (3 0 350) (et al. 2003 et al. 2006).

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

e e - 1 e e e 1 e 1e e e e e % e e e 1 (e e , & e, 2002 et al. 2010



e 11. (e) ( ) 2 3 . 2 + 2 3 ( ) 2 2/100 2 e 1% e e e e e %e 1 1 e e 1 e e ee - e 11 e ee e -%le

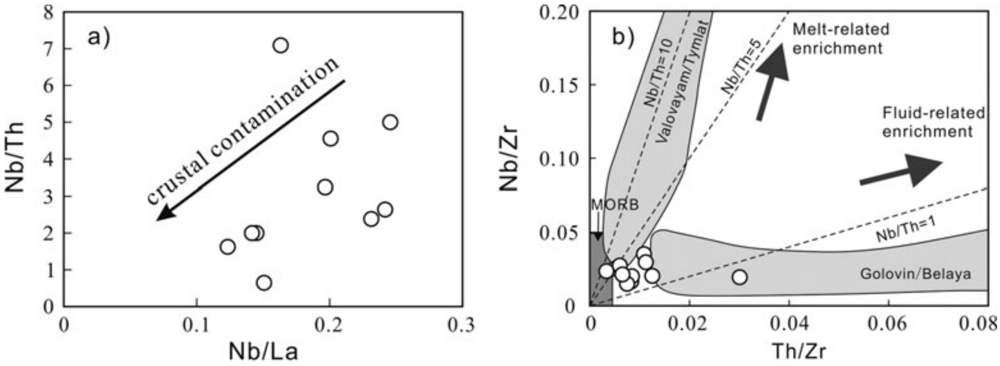
e % e %e1e e e (-%le). e le e e e % e e e e- e e1e e e 1 e e e ee -%le 1 - e 1e e . e e e 5 , e 1% e e e e e - -e e e e 2 3 . 2 + 2 3 e %e 1% e e 1 1 e e 1 e e ee - (. 11). e 2/100 2 2 - 1 1 e e e e 11 e ee e -%le - e (. 11). e e - e e e 1e e e (.). e e e 1 e . e 1 % %

e e . e e , e e (. 12), e e e , e e- e e e e % e e e 1 % e e e e e - e e e e e , e e e e e - e e e - e (. 12). e e e, e e e e 1% e e e e e %e e - e e - *et al.* (2002) e 1 e e - e e e e e e e 1 % e % e 1 e e e (e e e e). e e- e e e1 e e e 1 e e e 1 e e e - e e e .

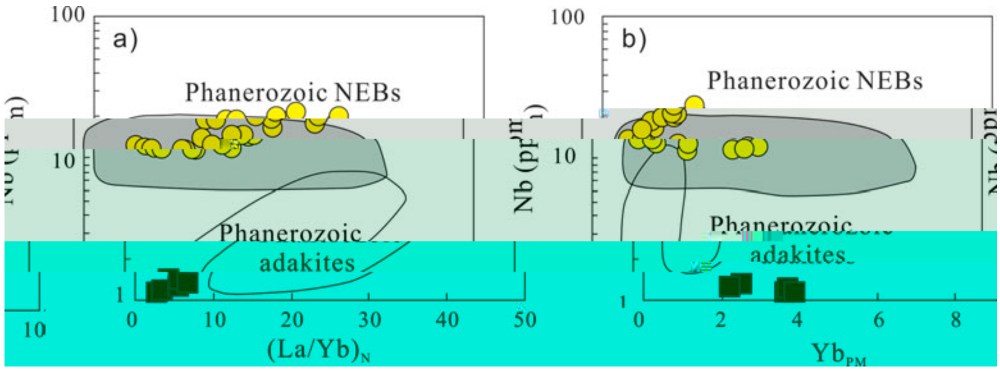
5.c. P[redacted] D a[redacted]

e e e % e e e e - 1 e e 1 e - e 2. 1 e (11 24 11 , % e 15 11), 2 5 (0.4 0.6 %) - (11 15, e 1 60) e ( ) e , e e% e - ( ) (e & , 1 2 - & e , 2001) (. 13). e e e e e ee 1 1 e e e e e e e (1) e e e e 1 e e e e (e. & - % , 2002) (2) e e e e - e % e (e & , 1 2 e & , 1 3 *et al.* 1 6). e e e e%1 %e 1 e e 1e e e e 1 .

e e e e e % e e e 1 e - e e e e (%& , 200 e *et al.* 2011). e e , e 1 e / 6 e (0. 04120 0. 06133) ε (*t*) e (+1. + .5). e% e e e e e e e / (3.44 20.4) e / (1.51 2.54) (e. e & , 1 6). e e e, e e e - e e e e e% e e e 1 e 1 % e e e e e e % e- e e e e (*et al.* 1 6 e11 e , 1 6). e e e e e 1 e e e e 1 e % e , e e e e e e 1e e e e e -e e e (& e , 2000). e e e e e e 1 e e e e %(e , & , 1 2 *et al.* 1 6). *et al.* (200) e1 e e e e e



e 12. ( ) / . / ... e ... ( ) 1 ... / . / ... e ... e ... e ... e 1 ... e.



e 13. (... e) ( ) (/) ... ( ) ... e ... e ... e ... e ... 1 ... e e ... e ... -e ... e ... ( ).

... e ... e 1 ... e .% ε (t) (1. .5) ... (/ 6) (0. 04120 0. 06133) ... e ... e ... e ... 1 - ... .% e e ... e e ... (e 2). e e ... e.% ε (t) ... e ... (/ 6) ... e ... e%. ... e ... e ... e ... - ... e ... e 1 ... e ... e ... e e ... e.% e e ... 1 ... e ... e ... e 1 e ... .% e ... e .% ... e ... e e e ... e ... e 1 e ... e e ... e ...

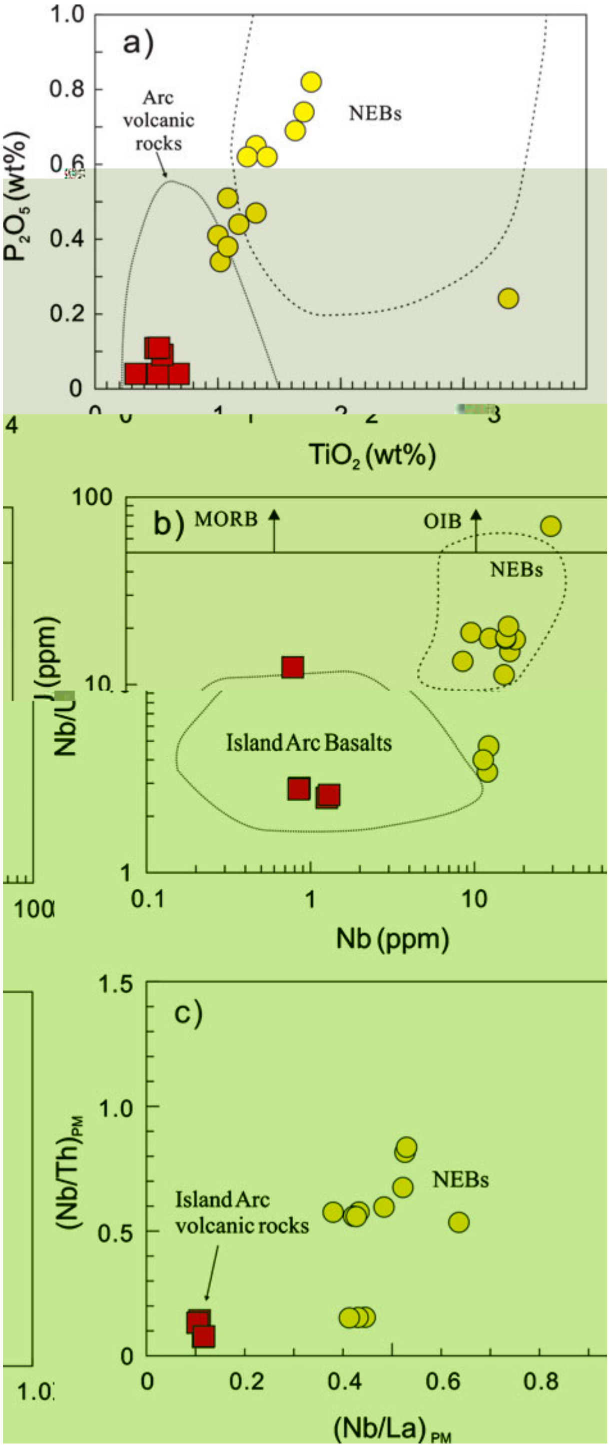
e 2 ... e ... e ... e - e.% ... 2, ... e ... e ... / (< 0.3), ... / ... e / ... (.), e e ... e e ... e ... e .% e ... - e e e ... / ... e ... e e ... 1 ... e ... e ... e ... (... e, .% & e% 1 1 e , 2002). ... e ... e ... e ... e ... e ... e, e 2 ... e ... (/) (0. 1.0), (/) (0.1 0.2) ... / (0.6 1.0) ... e ... e ... e 2 ... .% e - ... e .% ... e e ... e ... - ... (... & ... , 1 6). 1 e ... e 1 , e 2 ... e ... 2 5 ... e ... / (/) ... (e 1 . 14). e% 1 ... e e ... .%1 ...

(. 14). ... , e 2 ... e e ... 1 ... e ... e e e 1 e ... % e ... e .% ... e e e ... e ... e e , e 1 ... 2 ... e e e e ... e ... e. e e ... e ... e% e - ... e ... e ... , ... e ... e 1e ... e e .

5. . I ca [redacted] Pa a z c acc [redacted] J a

e e e ee 1 ... e ... e e e ... , e. e e e ... 1 ... e (416 ... et al. 2014 ... et al. 2015), ... e ... 1 ... e (503 4 5 ... et al. 2003 ... et al. 2015 ... %) ... e % 1 ... e (400) (. 1). ... e ... e ... e .% ... e ... e .% ... e - ... e ... e ... 1 ... e (et al. 2014), e% e e ... e ... - ... e ... e ... e ... e e e .

... e e ... e .% ... e ... e ... e e % ... e ... e ... e ... e .% e e e ... e e e ... e1 e e ... - e e e ... e ... - e ... , e ... e .% e e, ... - e ... e ... ee1- e .% (et al. 200 , 200 a,b ... et al. 200 a). e ... e ... e e ... e ... e e e ... - e ... (et al. 200 b). ... e e e e ...



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400 3 0 [illegible]

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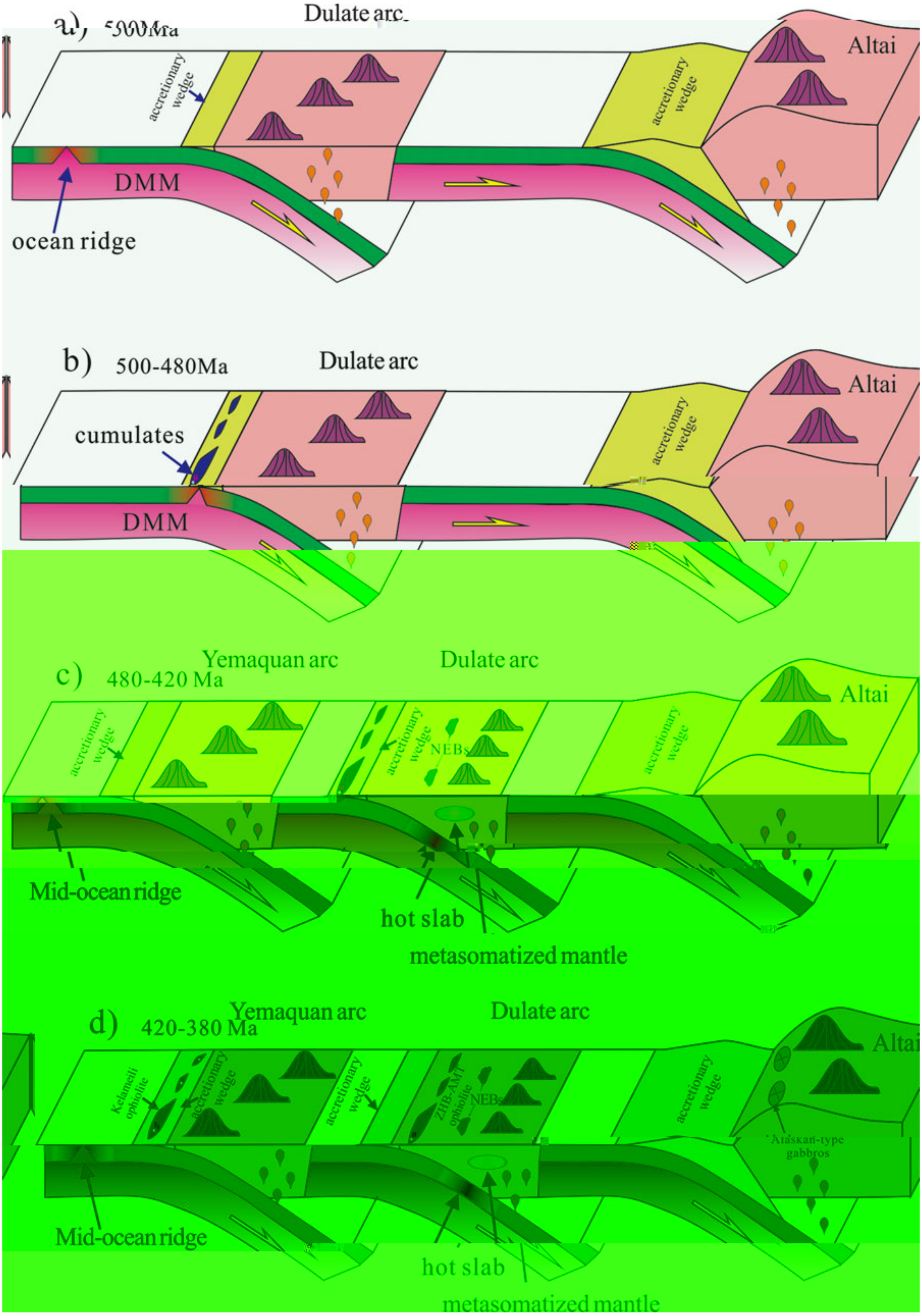
[illegible] (. 15).

(1) [illegible] (*c.* 500), [illegible] (. 15). [illegible]

(2) [illegible] (500 4 0), [illegible] (. 15). [illegible]

(3) [illegible] (4 0 420), [illegible] (45 [illegible] *et al.* 2015) [illegible] (440 [illegible] *et al.* 2014) [illegible] (. 15). [illegible]


a) ~500Ma
Dulate arc
accretionary wedge
accretionary wedge
Altai
DMM
ocean ridge
b) 500-480Ma
Dulate arc
cumulates
accretionary wedge
Altai
DMM
c) 480-420 Ma
Yemaquan arc
Dulate arc
accretionary wedge
accretionary wedge
NEBs
accretionary wedge
Altai
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
Altai
Alaskan-type gabbros
Mid-ocean ridge
hot slab
metasomatized mantle

…e 15. (… e) [illegible]

(4) [illegible] (420 3 0) (*et al.* 2014 *et al.* 2015). [illegible] 15 [illegible] (400 3 0). [illegible]

6. C[redacted]

(1) [illegible] ~4 5 [illegible] *c.* 400 [illegible]

(2) [illegible]

(3) [illegible]

Ac[redacted]. [illegible] 305 [illegible] (2011 06 03-01).

S a a a

[illegible] /10.101 / 0016 56 16000042.

R[redacted]

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