

Partial melting experiments of a MORB at 1.5GPa: constraints on the generation conditions of adakite magmas

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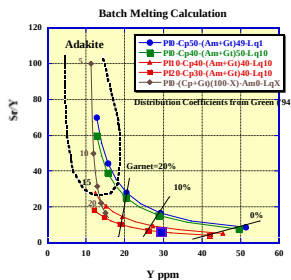


Intention of the work;

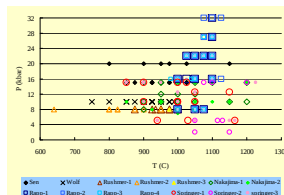
Adakite has high Sr/Y ratio, and is thought to be the partial melts of garnet bearing assemblages. There are two ideas of adakite formation: slab melting and lower crustal melting. Simple calculations suggest that modal contents of the assemblages affect the Sr/Y ratio of the melts, and this experimental work intended to assess the lower crustal melting model through obtaining equilibrium modal composition of MORB assemblages at 1.5 GPa by reversed runs.

Modal constraints of adakite formation from MORB

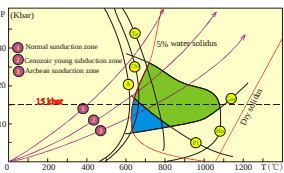
1. Melt < 30wt%
2. Garnet > 30 wt%
3. Plagioclase < 20 wt%



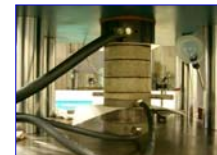
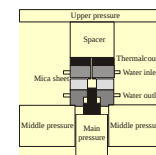
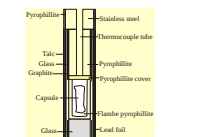
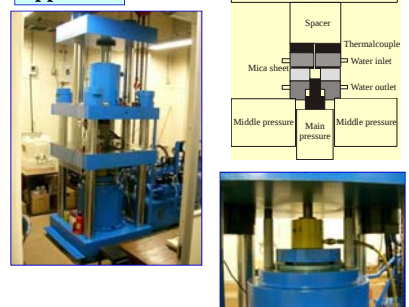
Previous works P-T conditions



Geotherms and melting regime



Apparatus



Starting materials:

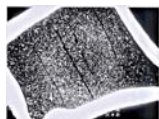
1. Raw MORB sample powder + H₂O
2. Eclogite powder + H₂O (synthesized at 2.5GPa)

SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	H ₂ O ^a	H ₂ O ^b	Total
48.53	1.20	17.00	3.43	4.89	0.13	7.31	11.78	2.49	0.21	0.12	1.40	1.41	99.90
Cr	Ni	Sr	Zr										
326	119	148	74										
Q	Or	Ab	An	Wo	En	Fs	Mt	Ilm	Ap ^c	O-index			
0.42	1.28	21.70	35.62	9.93	18.75	4.54	5.12	2.35	0.29	0.37			

Experimental conditions

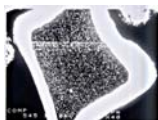
Pressure (kbar)	15					
Temperature (°C)	900			1050		
Duration (h)	30	90	270	15	45	135

Starting material	Temperature (°C)	Duration (h)	Phase assemblages
Basalt	900	30	Gar + Cpx + Pl + Glass
		90	Gar + Cpx + Pl + Sp + Glass
		270	Gar + Cpx + Ky + Sp + Rut + Glass
	1050	15	Gar + Cpx + Glass
		45	Gar + Cpx + Pl + Glass
		135	Gar + Cpx + Ky + Sp + Sp + Glass
Eclogite	900	30	Gar + Cpx + Pl + Glass
		90	Gar + Cpx + Pl + Rut + Sp + Glass
		270	Gar + Cpx + Rut + Glass
	1050	15	Gar + Cpx + Pl + Sp + Glass
		45	Gar + Cpx + Pl + Rut + Glass
		135	Gar + Cpx + Glass



Starting material: **Eclogite**
Temperature: **900°C**

30 h	Duration
90 h	270 h



Starting material: **Eclogite**

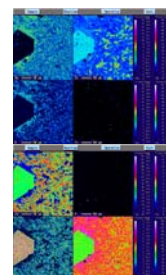
Temperature: **1050°C**

Duration	45 h
15h	135 h



Our experimental results

Starting materials	Temperature (°C)	Duration (h)	Phase assemblages						
			Gar	Cpx	Pl	Ky	Sp	Rut	Glas
Basalt	900	270	17.3	53.1		3.9	1.8	1.2	22.8
	1050	135	17.9	23.0	22.8		1.4		34.9
Eclogite	900	270	21.4	38.4				0.5	41.7
	1050	135	21.5	33.3					45.2

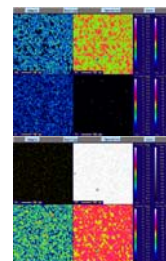


Starting material: **Basalt**

Temperature: **900 °C**

Duration: **270 h**

Gar	Cpx	Rut	Sp	Rut	Glass
17.3	53.1	3.9	1.8	1.2	22.8



Starting material: **Eclogite**

Temperature: **900 °C**

Duration: **270 h**

Gar	Cpx	Rut	Glass
21.4	38.4	0.5	41.7

Conclusions

1. Under hydrous conditions, MORB-like composition may not produce adakite at 1050 C, 1.5 Gpa because of the melting degree in excess of 40%.
2. At 900 C, 1.5 Gpa, MORB-like composition may not generate adakite, because modal content of garnet is less than ca.20wt%.
3. As a whole, lower crustal melting may produce only limited adakitic melt with mildly highSr/Y, but may not generate, very high Sr/Y adakite like those in Daisen volcano.

Plagioclase

T	D	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	G ₂ O ₃	Total
900°C	30h	47.89	0.06	32.54	0.61	0.01	0.26	16.62	2.06	0.02	0.06	99.99
	90h	52.41	0.08	26.38	0.08	0.01	0.46	13.62	3.92	0.04	0.09	100.07
	90h	49.35	0.06	30.20	0.64	0.02	0.30	14.93	2.90	0.03	0.02	98.45
1050°C	45h	55.63	0.10	27.52	0.46	0.01	0.06	10.15	5.57	0.12	0.07	99.60
	135h	48.17	0.03	32.43	0.61	0.02	0.16	16.24	2.37	0.03	0.05	100.11
	135h	55.75	0.04	28.17	0.36	0.01	0.03	10.72	5.51	0.09	0.03	100.71
900°C	30h	55.41	0.03	28.03	0.37	0.02	0.03	9.30	5.64	0.10	0.01	98.94
	90h	57.22	0.41	26.38	0.46	0.01	0.06	8.70	6.10	0.14	0.00	99.56
	135h	54.48	0.08	27.53	0.54	0.02	0.07	10.35	5.26	0.11	0.08	98.52
	45h	55.40	0.05	27.42	0.39	0.02	0.05	9.95	5.56	0.11	0.06	98.99
	90h	55.41	0.03	28.03	0.37	0.02	0.03	9.30	5.64	0.10	0.01	98.94

Clinopyroxene

CmpoXerox													
T	D	SiO ₂	TiO ₂	AlO ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	G ₂ O ₃	Total	
900°C	30h	46.86	1.41	10.28	10.38	0.28	0.28	19.42	1.27	0.02	0.01	99.53	
	90h	48.27	1.14	8.25	8.59	0.17	11.96	18.45	1.15	0.02	0.30	98.30	
	270h	47.69	1.50	9.98	9.45	0.21	9.49	19.60	1.57	0.03	0.33	99.21	
	15h	45.09	1.47	12.64	9.29	0.19	10.45	18.31	1.05	0.01	0.30	98.76	
1050°C	15h	45.46	1.48	13.39	8.10	0.16	9.64	19.50	1.30	0.01	0.30	99.21	
	135h	46.65	1.57	11.46	9.02	0.21	10.04	18.33	1.43	0.01	0.27	98.98	
	900°C	30h	45.32	0.81	15.82	8.20	0.07	7.94	17.62	2.24	0.01	98.46	
	90h	45.75	1.64	14.09	8.26	0.10	8.10	18.39	2.35	0.01	0.07	98.85	
1050°C	15h	45.59	1.42	13.41	8.33	0.03	8.08	20.31	1.26	0.01	0.39	98.28	
	1050°C	15h	45.63	1.25	13.35	7.89	0.09	9.41	19.86	1.42	0.03	0.43	99.35
	45h	46.30	1.53	12.31	7.09	0.11	9.53	19.34	1.77	0.01	0.42	98.40	
	135h	45.02	1.52	13.68	7.07	0.09	9.15	19.93	1.44	0.01	0.31	98.24	

Garnet

T	D	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	G ₂ O ₃	Total
900°C	30h	38.30	1.23	20.64	21.67	1.05	6.54	10.04	0.08	0.01	0.31	99.89
	90h	38.06	1.21	20.38	19.99	0.56	7.68	9.90	0.06	0.01	0.21	98.06
	270h	38.74	1.10	20.77	20.08	0.58	7.81	10.60	0.11	0.00	0.27	100.07
	15h	38.87	1.30	21.02	17.25	0.48	11.09	9.19	0.06	0.00	0.28	99.53
1050°C	15h	38.90	1.50	21.18	17.64	0.40	9.99	10.03	0.08	0.01	0.22	100.00
	135h	38.93	1.51	21.14	19.03	0.45	9.84	8.97	0.11	0.01	0.24	100.23
	900°C	30h	38.66	1.29	20.99	15.52	0.38	10.33	10.82	0.09	0.00	98.48
	90h	39.60	0.78	21.40	16.00	0.39	8.99	11.96	0.12	0.02	0.33	99.59
1050°C	270h	38.82	1.15	21.14	16.06	0.40	9.18	11.83	0.10	0.01	0.32	99.03
	1050°C	15h	38.21	1.30	20.88	15.87	0.41	11.20	11.13	0.11	0.20	99.54
	45h	38.74	1.19	21.01	16.26	0.46	10.70	10.01	0.10	0.01	0.23	98.72
	135h	38.78	1.44	20.89	16.04	0.43	10.78	9.98	0.12	0.01	0.39	98.86