Appendix DR1: Applicability of the plagioclase hygrometer at pressures higher than 3 kbar

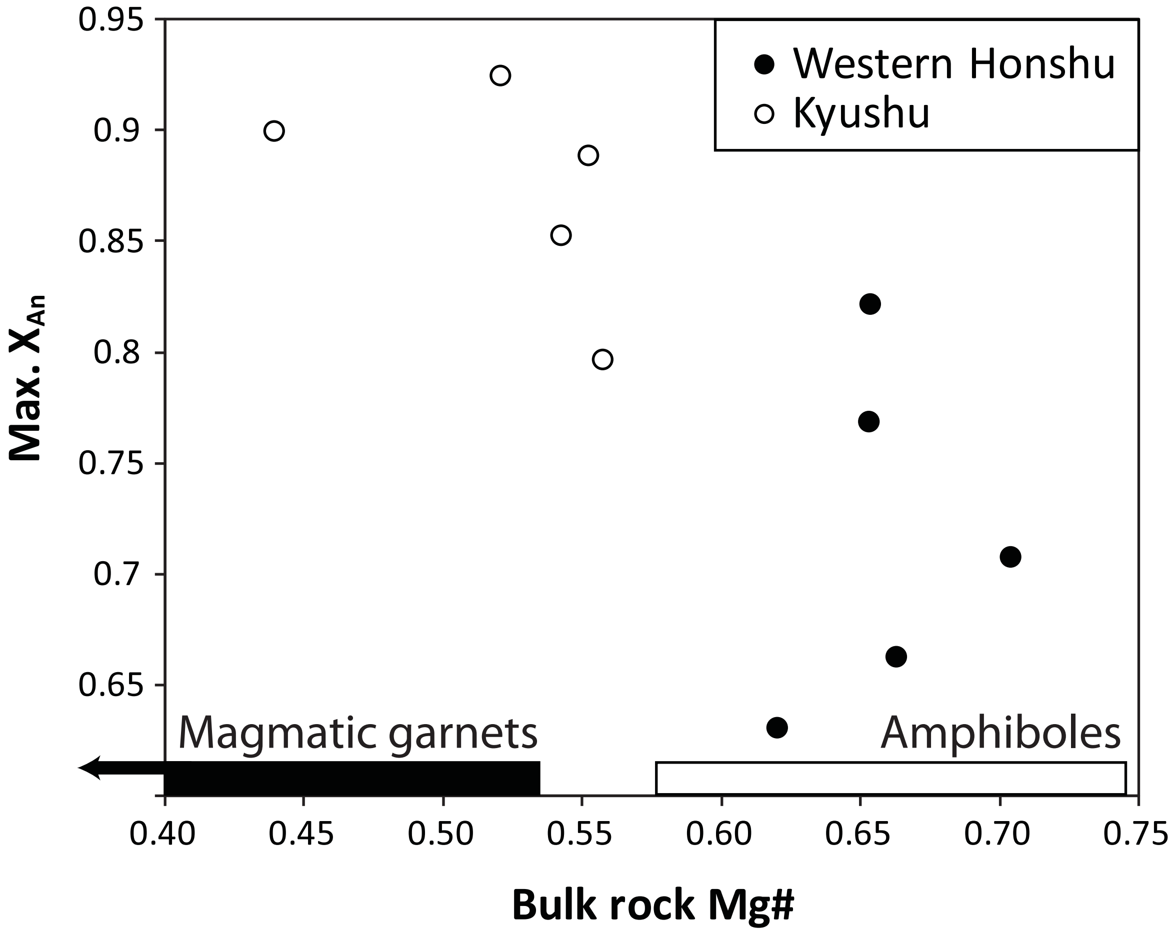
There are two reasons why the hygrometer used in this study can be extrapolated to lower crustal pressures with some confidence. Firstly, the effect of pressure is explicitly included in the hygrometer through the volume terms, which are very well known (the molar volume of the albite and anorthite components in the liquid, along with their respective thermal expansion and compressibility; and the molar volume of crystalline albite and anorthite). So, if composition and temperature are within the range of the experimental calibration, then extrapolating in pressure is unproblematic as the volume terms govern dG/dP on the reaction (Lange et al., 2009) and the volume terms are so well known.

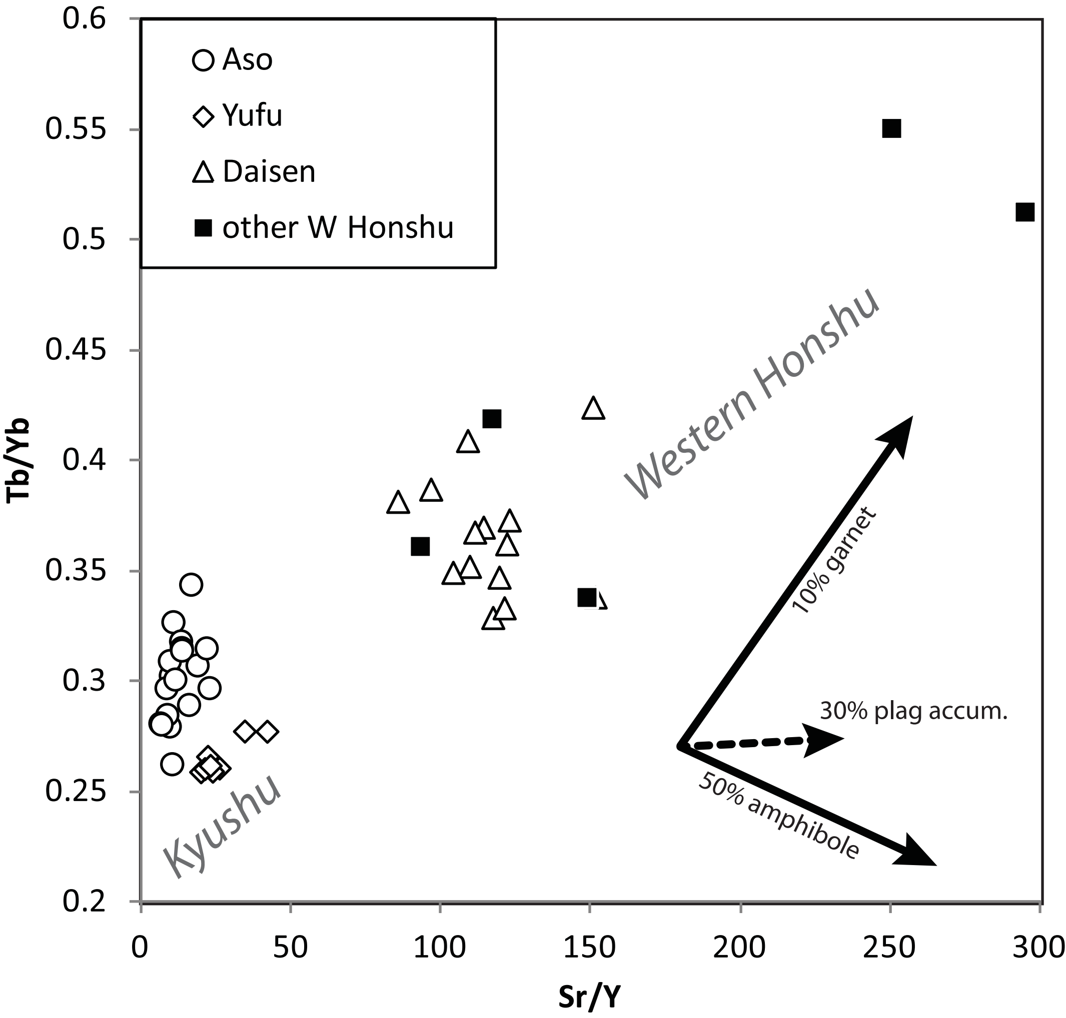
Secondly, the effect of pressure is small compared to the effect of temperature, dissolved H_2O in the melt, and other melt compositional components. The reason is that the delta V of the exchange reaction is quite small (as discussed in Lange et al., 2009).

FIGURE CAPTIONS

Figure DR1. Covariation of maximum observed anorthite contents in plagioclase crystals from mafic samples of southwest Japan with bulk-rock Mg#. Also shown are Mg# ranges for typical igneous garnets and amphiboles (Day et al., 1992).

Figure DR2. MREE/HREE ratios correlate with Sr/Y, pointing to residual garnet as a source for adakitic signatures in SW Japan. Data sources: Aso (Hunter, 1998), Yufu (Sugimoto et al., 2006), Daisen (Kimura et al., 2005, and P. Morris, unpublished data), other W Honshu samples from Sanbe, Oetakayama, Aonoyama and the Shikuma area (P. Morris, unpublished data). Solid arrows indicate the effect of fractional crystallization of garnet and amphibole, and the dashed arrow the effect of accumulation of plagioclase. Partition coefficients for Tb/Yb are taken from McKenzie and O'Nions (1991), and for Sr/Y from Sisson (1994) and averaged from Green et al. (1989) and Dunn and Sen (1994), for amphibole, garnet and plagioclase, respectively.


0.95
0.9
0.85
0.8
0.75
0.7
0.65
Max. X_{An}
Western Honshu
Kyushu
Magmatic garnets
Amphiboles
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
Bulk rock Mg#



Aso
Yufu
Daisen
other W Honshu
Western Honshu
Kyushu
10% garnet
30% plag accum.
50% amphibole
Tb/Yb
Sr/Y
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0
50
100
150
200
250
300

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Table DR1: Sample chemistry, temperature estimates, and plagioclase hygrometry (hygrometry input parameters in italics)

Location	sample	SiO_2	TiO_2	Al_2O_3	FeO^T	MgO	CaO	Na_2O	K_2O	Mg#	Temperatures	X_{An} phenocr.	X_{An} gm.	H_2O (wt %)[7]
Aso	*09ASO01*	*51.65*	*0.92*	*19.36*	*8.66*	*5.27*	*10.35*	*2.24*	*1.17*	0.52	up to 1143 °C[1,2]	*0.925* - 0.501	0.729 - 0.498	4.9
Kuju	*09KUJ01A*	*60.96*	*0.68*	*18.90*	*5.29*	*2.32*	*6.26*	*3.03*	*2.10*	0.44	up to 1105 °C[3,4]	*0.900* - 0.505	0.619 - 0.399	5*
Kuju	09KUJ01B	61.38	0.73	18.68	5.53	2.42	5.93	2.86	2.02	0.44				
Yufu	*09YUF01*	*54.81*	*0.95*	*18.93*	*6.90*	*4.77*	*9.56*	*2.76*	*1.00*	0.55	up to 997 °C[1]	*0.889* - 0.403	0.847 - 0.344	6
Oninomi	09ONI01	52.50	2.14	16.91	8.83	6.23	8.38	2.96	1.34	0.56	n. d.[5]	0.797 - 0.377	0.679 - 0.390	
Oninomi	*09ONI02*	*54.41*	*1.94*	*16.89*	*8.10*	*5.38*	*8.13*	*2.99*	*1.51*	0.54	n. d.[5]	*0.853* - 0.452	0.699 - 0.199	3.6
Abu	09ABU01	49.44	1.59	17.04	8.28	8.74	10.60	2.54	1.14	0.65		0.766 - 0.511	0.769 - 0.354	
Abu	*09ABU02*	*46.40*	*1.77*	*19.46*	*9.92*	*10.48*	*9.30*	*1.39*	*0.68*	0.65		*0.822* - 0.372	n. d.	2
Abu	09ABU03	56.95	1.63	15.77	7.27	5.65	7.75	3.03	1.42	0.58	up to 1095 °C[3]		n. d.	
Abu	09ABU04	55.16	1.65	15.57	7.71	7.05	8.43	2.72	1.24	0.62		0.631 - 0.476	n. d.	
Abu	ABUST10	50.78	2.90	16.17	9.35	5.87	8.81	3.26	1.79	0.53				
Abu	ABUST11	50.54	2.84	16.85	9.78	5.96	8.39	3.00	1.59	0.52				
Menkame	*09MEN01*	*51.86*	*1.02*	*17.51*	*7.03*	*9.37*	*8.63*	*2.83*	*1.30*	0.70	up to 1112 °C[1]	0.510 - 0.137	*0.708* - 0.407	1.8
Menkame	09MEN02	52.60	1.02	18.03	6.71	8.39	8.40	2.96	1.41	0.69	up to 1121 °C[6]			
Daisen	*09DAI01*	*51.45*	*1.24*	*17.38*	*7.61*	*8.39*	*9.24*	*3.03*	*1.19*	0.66	n. d.[5]	n/a	*0.663* - 0.268	1.8
Daisen	09DAI02	51.30	1.21	17.64	7.43	8.09	9.48	3.19	1.18	0.66				
Daisen	09DAI03	51.20	1.30	17.90	7.83	8.32	8.84	2.93	1.21	0.65				
Daisen	09DAI04	51.54	1.27	18.05	7.73	7.54	9.26	3.08	1.05	0.63				
Daisen	09DAI05	51.04	1.28	18.72	8.06	7.95	8.57	2.90	1.01	0.64				

[1]Clinopyroxene thermometry, Lindsley (1983)

[2]up to 1089 °C if two outliers are excluded

[3]Two-pyroxene thermobarometry, Putirka (2008)

[4]Higher temperatures of up to 1175 °C yielded by opx-cpx pairs equilibrated at mantle pressures above 16 kbar, using the parameterization of Putirka (2008)

[5]No suitable mineral phases available for geothermometry

[6]Melt-inclusion-in-olivine thermometry, Putirka (2008)

[7]Calculated using the plagioclase hygrometer of Lange et al. (2009) at 1080 °C and 10 kbar, with a ±30 °C range resulting in an uncertainty of ±0.4 wt%

*This may be a slight overestimate, actual H_2O content in the parental melt may have been about 0.6 wt% lower, see text for discussion.