

SF	Collaborative Research: Volatiles (H ₂ O and CO ₂) in Mariana and Izu Arc Magmas	
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	9/1/2000 – 8/31/2003	OCE 00-01821
<ul style="list-style-type: none"> • We have established the H₂O-saturated phase equilibria for the most mafic lava from the island of Pagan (PAF3B, Woodhead, 1989, Chem Geol 76: 1-24) at 1 atm., 1000 bars and 2000 bars. The results indicate that Pagan lavas had 2-3 wt.% H₂O prior to eruption. • Experiments at 2000 bars, H₂O saturated conditions, have also been run on a low-Fe Pagan composition to understand the effects of FeO on phase relations. It has long been recognized that Mariana lavas have highly variable FeO contents. Our experiments should help understand whether this is a result of varying source composition or an effect of fractionation at lower pressures. • Applying the Pagan phase boundaries to other Mariana lavas suggests that most Mariana lavas had at least 6 wt.% dissolved H₂O prior to eruption. No clear along-arc pattern has been recognized. • The phase diagram for a mafic sample from the island of Hachijo-jima (Izu arc) has been determined at 2000 bars. Comparison of the experiments with the observed liquid lines of descent suggest ~3 wt.% dissolved H₂O in the magmas. This appears to be true for other Izu magmas, indicating that Mariana magmas are in general, wetter than Izu magmas. • In collaboration with Terry Plank, we have doped some of our experiments with trace elements. To grow crystals large enough to be analyzed by laser-ablation ICP-MS, we have been exploring various experimental procedures. By decompressing the experiment by 100-400 bars, we have been able to grow crystals in excess of 100 microns, large enough for trace element analysis. 		

Figures and Captions

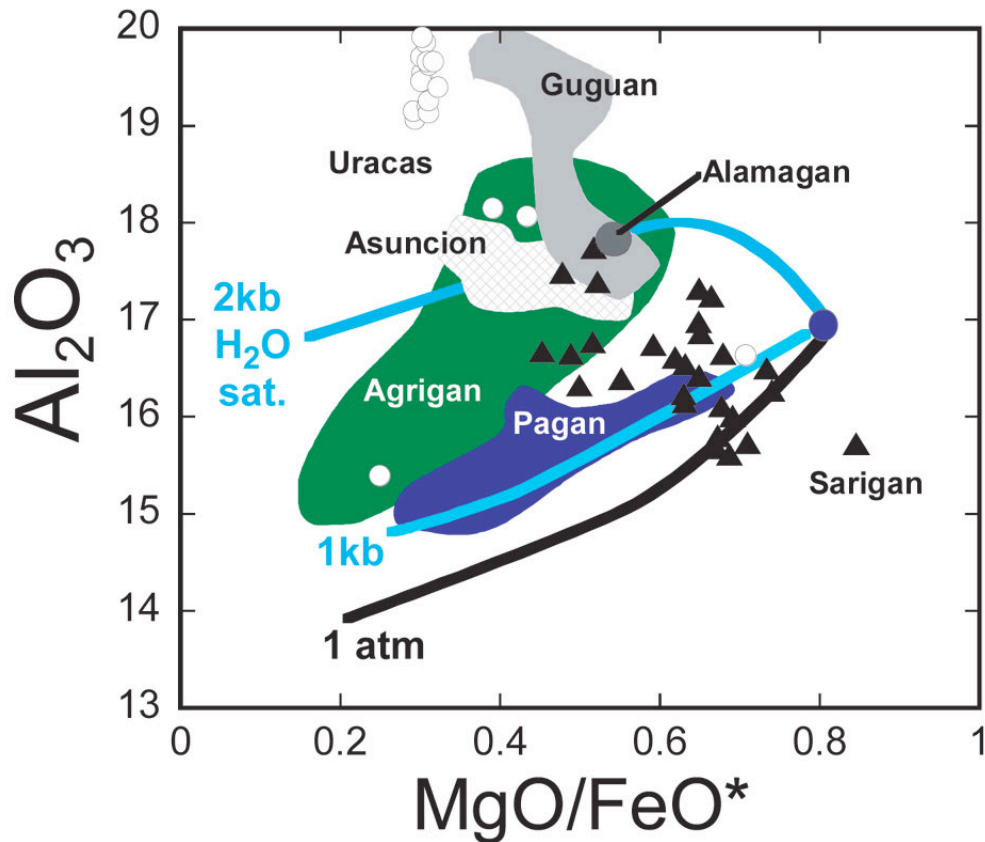


Figure 1: Compositions of Mariana lavas (fields and points) compared to experimentally determined, H₂O-saturated liquid lines of descent (lines) at 1, 1000 and 2000 bars pressure on a mafic Pagan sample composition (blue filled circle). Olivine and pyroxene crystallization lowers the MgO/FeO ratio of the magmas while increasing Al₂O₃, until plagioclase nucleates, at which point Al₂O₃ begins to decrease. H₂O delays plagioclase nucleation and allows magmas to reach higher Al₂O₃ contents (17-18 wt.%), suggesting H₂O contents of at least 6 wt.%. The liquid line of descent data is in good agreement with melt inclusion studies, which indicate 2-3 wt.% H₂O in Pagan magmas with 4-6 wt.% H₂O in Agrigan magmas (Kelley *et al.*, 2003). Lavas from Sarigan show a different liquid line of descent, nearly orthogonal to those of many other islands. This composition is currently being studied experimentally.

Publications and Presentations

Parman SW, Grove TL, Plank T, Estimates of H₂O contents in Mariana and Izu magmas. (State of the Arc – Mt. Hood, Oregon, 2003)

Parman SW, Grove TL, Plank T, Along-arc variations in the H₂O contents of Mariana and Izu magmas. (NSF-IFREE, Hawaii, 2002)

Parman, SW, Grove, TL, and Plank T, Magmatic Water Contents in Mariana and Izu Arc Magmas. *Eos. Trans. AGU 83 (19)*, Spring Meet. Suppl., Abstract V51D-05, 2002