ABSTRACT FINAL ID: T44D-01;

TITLE: Generation of Alkalic Intraplate Basalts via Partial Melting of a Carbonated Mantle *(Invited)*

SESSION TYPE: Oral

SESSION TITLE: T44D. The Origin of Intraplate Volcanism: Hotspots, Nonhotspots, and Large Igneous Provinces II

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ABSTRACT BODY: Generation of intraplate, ocean island basalts continues to be a subject of debate with models invoking partial melting of a volatile-free mantle peridotite, contributions from mafic crustal rocks, melting of a metasomatized mantle, and melt-rock interaction. Models also differ in terms of the proximal melting domain to be in the convecting mantle [e.g., 1, 2] versus the oceanic lithosphere [3]. Evaluating these various scenarios requires detailed knowledge of the compositions of the partial melts that can be derived from plausible mantle lithologies at depths. To add to the growing body of mantle melting studies, here we report new partial melting experiments of carbonated fertile peridotite and discuss the partial melt compositions in the light of genesis of alkalic basalts.
Experiments were conducted using piston cylinder (2 GPa) and a multi-anvil (4 and 5 GPa) devices and Pt/Gr containers between 1300 and 1750 °C. A fertile peridotite, MixKLB-1 with 2.5 wt.% (PERC) and 1 wt.% CO_2 (PERC3) were used as the starting materials. To facilitate comparison, the same aliquot of the starting materials used in our previous 3 GPa experiments [2] were used. The oxygen fugacity during the experiments were estimated to be ΔFMQ of -1.5 to -3.2 based on the assemblage of opx, carbonated melt, olivine, cpx, and graphite/ diamond (inner capsule) and the recent calibration of Stagno and Frost [4]. Olivine, opx, and carbonated melts are present in all the experiments in the presence or absence of garnet and cpx. The key observation of our experiments is that the temperature of onset of carbonated silicate melting, i.e., stabilization of a melt with ≤25 wt.% CO_2, is significantly lower than the solidus of volatile-free peridotite at the pressure range investigated. Our results also demonstrate that the temperature difference between the volatile-free peridotite solidus and 25 wt.% melt-CO_2 isopleth increases with increasing pressure between 2 and 5 GPa. Thus at greater depths, the onset of carbonated silicate melting takes place at progressively lower temperatures with respect to the volatile-free peridotite solidus. With increasing degree of melting, the partial melt compositions, on a volatile-free basis, evolve from nephelinitic to basanitic (37.5 to 45 wt.% SiO_2) at 2 GPa, and melilititic to basanitic (~35 to 45 wt.% SiO_2) at 4 and 5 GPa. Comparison of the major element compositions of carbonated silicate partial melts (5-13 wt.% Al_2O_3, 9.5-13 wt.% FeO*, CaO/Al_2O_3 of 1-5) with natural alkalic OIBs suggest that carbonate-fluxed melting of garnet lherzolite over 70 to 150 km depths can produce partial melts similar to primary alkalic basalts. However, prior enrichment in TiO_2, perhaps through interaction with partial melts of

mafic crustal rocks, is necessary to elevate the concentration of the same to match natural, strongly silica-under saturated basalts.

[1] Dasgupta et al., JPetrol 48, 2093-2124, 2007
[2] Kogiso et al., EPSL 216, 603-617, 2003
[3] Pilet et al., Science 320, 916-919, 2008
[4] Stagno and Frost, EPSL 300, 72-84, 2010

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Additional Details

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