AGU FALL MEETING
San Francisco | 12–16 December 2016

T14C-06: Sr Isotopes in Western Aleutian Seafloor Lavas: Implications for the Source of Fluids and Geochemical Decoupling of Trace Metals from Water

Monday, 12 December 2016
17:15 - 17:30
Moscone South - 304

Sr provides unique constraints on subduction magma source models because it is a fluid-mobile element that is abundant and relatively unradiogenic in arc volcanic rocks. It is common for arc basalts to be 3-4-times more Sr-rich than similarly evolved MORB (Sr/Nd = 30-50 vs 10-15 in MORB) yet Sr isotopes in arc basalts are usually offset from MORB only slightly (^{87}Sr/^{86}Sr ~0.7034 vs 0.7028 for MORB). This is a puzzle because abundant sources of subducted Sr in sediment (GLOSS II ^{87}Sr/^{86}Sr = 0.712) and altered oceanic crust (^{87}Sr/^{86}Sr = 0.704-0.705) are more radiogenic than average arc basalts globally (^{87}Sr/^{86}Sr ~ 0.7034). This is exemplified by lavas in the oceanic Aleutian volcanic arc, where data patterns reveal the need for a source component with ^{87}Sr/^{86}Sr ~0.7028 and Sr/Nd ~100. This component cannot be a fluid produced by dewatering of altered oceanic crust, which should have ^{87}Sr/^{86}Sr >0.704. The likely source is an eclogite melt, which – after reaction with the mantle wedge – is well represented by primitive, high-Sr lavas from the western Aleutians. End-member samples are magnesian rhyodacites (SiO_2~69%, Mg#>0.65) with ~1400 ppm Sr, ^{87}Sr/^{86}Sr <0.7027 and Sr/Nd >100. Formation of this end-member probably involves small degrees of fluid-saturated melting of MORB eclogite, minimally affected by prior seawater alteration. The aqueous fluid flux for melting must have come from a separate source, probably via dewatering of serpentinized peridotite within the mantle section of the subducting plate, which would carry little Sr or other metals, due to their low abundances in serpentinite. This example suggests that Sr, Pb, K, Rb and other incompatible trace elements in Aleutian lavas come primarily from partial melts of subducted basalt and sediment, and so are decoupled from H_2O derived from dehydration of serpentinite at sub-arc depths in subducting oceanic lithosphere. Boron may be an exception, because of its high abundance in serpentinite. These source characteristics may help explain widely variable incompatible trace element abundances together with restricted variability for H_2O inferred from least-degassed melt inclusions in the global arc database (Plank et al., 2013 – EPSL).

Authors

Gene M Yogodzinski *
University of South Carolina Columbia

Peter B Kelemen
Columbia University of New York

Kaj Hoernle
GEOMAR Helmholtz Centre for Ocean Research Kiel

Shaun T Brown
Lawrence Berkeley National Laboratory

Jeffrey D. Vervoort
Washington State University

Maxim Portnyagin
GEOMAR Helmholtz Centre for Ocean Research Kiel

Kenneth W W Sims
University of Wyoming

Find Similar

View Related Events

Session: T14C The Aleutian-Alaska Arc: Volcanic and Tectonic Processes II

Program: Tectonophysics

Day: Monday, 12 December 2016