Slab contributions in the Aleutian arc: A Hf isotopic perspective

S.T. Brown[1], G.M. Yogodzinski[1], M.G. Gerseny[2] and J.D. Vervoort[2]

[1]Dept of Geological Sciences University of South Carolina, Columbia, SC 29208, USA (sbrown@geol.sc.edu, gyogodzin@geol.sc.edu)
[2]Department of Geology Washington State University, Pullman, WA 99163, USA (gersula@wsu.edu, vervoort@wsu.edu)

A study of Hf, Nd and Pb isotopic variations in the Aleutian arc is used to constrain the possible contributions of Hf and other high field strength elements (HFSE) in arc lavas. The systematic along-strike decrease in convergence and sediment flux make the Aleutian arc an ideal natural laboratory for studying the mobility of Hf in subduction zones. The behavior of Hf can be further constrained by across-arc transects where back-arc volcanoes exist at three locations in the eastern Aleutian-Alaskan Peninsula areas. Available data indicate that both εNd and εHf increase along-strike east to west, while Pb isotopes decrease, a trend that is well correlated with the decrease in sediment flux to the trench westward. These observations clearly imply that the subducting material is a source for Hf in Aleutian lavas.

Cross-arc variation of Hf and Nd isotopes in the Cold Bay area (arc front) and at Amak Volcano (back-arc) is small compared to the along strike variation. In light of the along-arc changes, which clearly indicate that Hf is being mobilized out of subducting material, the limited isotopic cross-arc variation at Cold Bay-Amak indicates that slab contributions of Hf in the back-arc are similar to those at the arc front. In contrast, the cross-arc decrease in Pb isotopes at Cold Bay-Amak indicates that the subduction contributions of Pb declines rapidly with distance from the arc-front. Further to the west, arc front samples from Okmok and Islands of Four Mountains have higher εNd and εHf than at Cold Bay. Future analysis of lavas from back-arc volcanoes in this part of the arc (e.g. Bogoslov Volcano) will allow us to further quantify the Hf contribution from the subducting plate.

B and δ^{11}B in Aleutian Island arc basalt track slab and sediment fluid addition to the mantle wedge

B.S. Singer[1], W.P. Leeman[2], M.F. Thirlwall[3], S. Tonarini[4], B.R. Jicha[1] and N.W. Rogers[5]

[1]Department of Geology & Geophysics, University of Wisconsin-Madison, USA (bsinger@geology.wisc.edu)
[2]Department of Earth Science, Rice University, USA (leeman@rice.edu)
[3]Department of Geology, Royal Holloway University of London, UK (m.thirlwall@gl.rhul.ac.uk)
[4]Istituto di Geocronologia e Geochimica Isotopica del CNR, Pisa, Italy (S.Tonarini@iggi.pi.cnr.it)
[5]Department of Earth Sciences, The Open University, UK (n.w.rogers@open.ac.uk)

To evaluate the efficacy of melts vs. aqueous fluids from subducted crust and sediment in transferring elements to the sub-arc mantle, we report trace element, including fluid-mobile B, Be, and Sr, Nd, and Pb isotopic data for >50 basalts from 15 volcanoes along 1700 km of the central and western Aleutian Island arc (Cold Bay to Buldir). These lavas contain <53% SiO_2, have molar Mg#'s of 0.5-0.7, and span the compositional range of Aleutian basalt. Despite large ranges in B (3-32 ppm) and Be (0.4-1.7 ppm), B/Be, B/La, B/Nb correlate positively with $^{87}Sr/^{86}Sr$ and $^{207}Pb/^{204}Pb$ but weakly inversely with $^{143}Nd/^{144}Nd$, implying that B, much of the Sr and Pb, and only some Nd was added to the mantle in a fluid phase. These proxy fluid indicators correlate strongly with down-dip sediment flux which varies 5-fold along the arc due to changes in sediment thickness coupled with an oblique convergence along the curved plate boundary. The highest sediment flux coincides with the subducting Amila Fracture Zone which has channelled unusual crust, presumably serpentinized peridotite, into the mantle wedge beneath the volcanoes of Seguam and Yunaska—where basalts with the largest proportion of fluid have erupted. δ^{11}B measured by TIMS on 11 samples ranges from -0.3 to 3.5‰, with the highest values at Seguam. Mass balance modeling shows that only 25% of the fluid comes from sediment, whereas >75% is from subducted basalt or serpentinite. Melting of sediment following dehydration and B-loss may better explain the relatively low $^{143}Nd/^{144}Nd$ in many basalts. The large amount of fluid released beneath Seguam is reflected in unusually low LILE and HFSE contents and Nb/Zr ratios in its basalt, from which we infer more extensive mantle melting than elsewhere along the arc.