Sources of magmatism at Daisen Volcano, Southwest Japan Arc

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The complex geochemistry of subduction zone lavas reflects the multitude of sources and physical processes contributing to magma generation at convergent margins. Sources of trace element and isotopic signatures include subducted altered oceanic lithosphere and sediments, which combined form the "slab-derived component", the mantle wedge, and in some cases assimilated crustal material. These various contrbutions are altered by the physical processes that deliver them first to the magma source region and ultimately to the surface. The best hope for unlocking the information encoded in the geochemical signatures of arc lavas is the development of comprehensive data sets, including major element, trace element, isotope, volatile, and melt inclusion analyses for individual volcanic centers and lava suites. To this end, we are building a comprehensive data set for Daisen Volcano in the Southwest Japan Arc.

Daisen is a bimodal volcano consisting of primitive basalts and a suite of lavas varying from andesite to dacite, separated from the basalt by a ~8% gap in SiO_2 concentration. Based on the trace element characteristics of the dominant dacitic lavas (high Sr/Y and Sm/Yb, low Y and Yb), Daisen has been characterized as an adakitic volcano. The peculiar trace element geochemistry of the Daisen dacites, combined with the lack of intermediate-depth earthquakes beneath Southwest Japan and the relatively young age of the oceaninc crust being subducted, has led to the proposal that magmatism at Daisen is the result of slab melting. Interestingly, the Daisen basalts, like many basalts in the Southwest Japan Arc, have trace element and isotope characteristics closely resembling ocean island basalt, with only slight enrichment of Ba and Pb and depletion of Nb and Ta to suggest the limited involvement of slab-derived material in the source. This study integrates major element, trace element, phenocryst, and isotope data to determine the physical processes responsible for generating the Daisen basalts, andesites, and dacites, and to elucidate the relationships between these diverse lavas.

Mafic and ultramafic xenoliths from Kanaga and Adak Islands, Central Aleutian Islands, Alaska

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Trace element characteristics of clinopyroxene (cpx) in mafic and ultramafic xenoliths provide insight into the diversity of melt types arising from the mantle beneath Aleutian volcanoes. Abundances of Y, Zr and Nd in cpx of deformed and re-crystallized xenoliths from Kanaga Island, are well correlated with one-another and are inversely correlated with Mg#. Negative Eu anomalies (Eu/Eu*=0.54-0.66) are present in cpx from the most evolved, two-pyroxene samples only (cpx Mg#=0.63-0.73). Concentra-tions of Sr are similar (10-20 ppm) in cpx at all Mg#'s (0.63-0.89). These observations are consistent with an origin for the Kanaga xenoliths as cumulates from a magmatic system that evolved by crystal fractionation at relatively low-pressure and anhydrous conditions, similar to those which are inferred to control melt evolution at Aleutian tholeiitic volcanoes. Trace element concen-trations in hornblende-bearing xenoliths from Mt. Moffett, Adak Island, are similar to those in cpx of the Kanaga xenoliths (e.g., inverse correlation of Y, Zr and Nd with Mg#). These data, combined with a variety of textural criteria (Conrad & Kay, J. Pet., v. 25, 1984) indicate that the Moffett xenoliths are also broadly cumulate in nature. The absence of negative Eu anomalies over a large range of Mg# (Eu/Eu*>0.90 at Mg#=0.74-0.92) indicates however, that plagioclase fractionation was suppressed during formation of the Moffett xenoliths, probably a result of relatively hydrous and high-pressure conditions, similar those that appear to control melt evolution in calc-alkaline volcanoes of the modern Aleutian arc. Moffett xenolith cpx are also distinguished by their high Sr abundances (20-70 ppm), and high Sr/Y and La/Yb. The strong positive correlation with Mg#, indicates that the high Sr/Y (or La/Yb) pattern was a primary characteristic of the melts that produced the xenoliths. These observations, combined with arc-wide variation in lava compositions, suggest that the contrasting styles of tholeiitic and calc-alkaline volcanism result from differences in primitive melts entering the crust, and are not the result of divergent evolution from a common primitive magma due to crustal-level magma systems.