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Along- and Across-Arc Variations in the Southern Volcanic Zone, Chile

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Within Collaborative Research Center (SFB574), we are studying the changes in the chemistry of olivine-bearing volcanic rocks along the volcanic front of the Southern Volcanic Zone (SVZ) in Chile and in the rear and backarc in Argentina.

Samples from the volcanic front (VF) have typical trace element signatures of subduction zone volcanic rocks, characterized, for example, by negative Nb and Ta anomalies and positive Pb, Sr, Cs, Rb, Ba, Th and U anomalies on incompatible element (spider) diagrams. Samples from Longavi in the forearc are distinct in having lower abundances of the HREE's, high Sr/Y and geochemical signatures characteristic of adakitic rocks believed to be derived through melting of the subducting slab. The northern Southern Volcanic Zone (NSVZ) samples from Tupungatito and San José have the most enriched highly to moderately incompatible element ratios, high Rb/Ba and low La/Ta and Ba/La, suggesting involvement of lower crust in the petrogenesis of these rocks. We observe systematic variations in Sr and Nd isotopic compositions along the arc, with Sr isotopes showing a dramatic increase and Nd isotopes showing a dramatic decrease in the NSVZ, which is where the crust begins to thicken significantly. The increase in Sr and decrease in Nd in the VF is coupled with an increase in the degree of differentiation of the Tupungatito and San José (SiO_2 > 58%, MgO = 2-4%) volcanoes. On the Pb isotope diagrams, the VF rocks trend from MORB-like compositions to the field for pelagic sediments, consistent with involvement of subducted sediments in generating the VF rocks. Interestingly, samples from the NSVZ form the lower end of the VF array (have the least radiogenic Pb isotopic compositions) on the uranogenic Pb isotope diagram, but extend to the left of the rest of the VF array on the thorogenic Pb isotope diagram, showing evidence of at least a second enriched component. The presence of the second enriched component could reflect assimilation of lower crust or addition of lower crust through subduction erosion into the manlte wedge.

Quaternary backarc samples in Argentina also show subduction signatures in their incompatible elements but generally show lower fluid signatures than the VF samples. Although the Pb isotopic compositions of backarc rocks are similar to MORB, the low Nd isotopic compositions indicate the presence of enriched material within the backarc. Although no systematic variation is seen in Sr and Nd isotopic composition from north to souths, the Pb isotope ratios show systematic spatial variations with the northern samples having the most enriched Pb isotope ratios. The lower fluid signatures in the backarc volcanoes, coupled with less radiogenic Pb isotopic compositions are consistent with a decreasing influence of the subduction signature into the backarc. With the addition of Hf and O isotope data we should be able to better constrain the different reservoirs involved in generating the diverse geochemical compositions of the SVZ volcanic rocks.