The Ins and Outs along 1100 km of the Southern Chilean Subduction Zone and Argentinian Backarc: From 6000 m below to 6000m above Sea Level

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Within the Collaborative Research Center (SFB574) "Volatiles and Fluids in Subduction Zones: Climate Feedback and Trigger Mechanisms for Natural Disasters", we sampled both the input into the subduction zone, including trench and forearc fluids and sediments at depths up to 6000 m, and the volcanic output from 33 to 43°S latitude, primarily olivine-bearing volcanic rocks from the Chilean Southern Volcanic Zone (SVZ) up to elevations of 6000 m and up to 300 km into the backarc in Argentina. The talk will focus on the causes of geochemical variations along and across the arc and backarc. The most active volcanoes in South America and some of the most hazardous are located in the central SVZ. Our geochemical data (Jacques et al., 2013, GCA 123: 218-243; and in press Chem. Geol.; Wehrmann et al., 2014a, b, in press IJES), integrated with seismic data (Dzierma et al. 2012, EPSL 331-332C: 164-176) also generated in the SFB, show that a higher fluid flux leads to higher degrees of melting and thus greater melt production resulting in higher eruption rates. The source of the excess water appears to be hydrated lower ocean crust and serpentinized upper mantle of the incoming Nazca Plate. Water accessed these reservoirs along multiple large fracture zones and bend faults on the incoming plate. In the northern SVZ, the chemistry of the volcanic rocks becomes more enriched (more similar to continental crust) as the crust thickens from ~30 to ~60 km and the volcanoes reach heights in excess of 6000 m. In their classic MASH (Melting, Assimilation, Storage and Homogenization) model, Hildreth and Moorbath (1988; CMP 98: 455-489) proposed that the change in chemistry reflects increased assimilation of Paleozoic crust as the crust thickens. Alternatively, Stern (1991; Geology 19: 78-81) and Kay et al. (2005; GSA Bulletin 117(1/2): 67-88) argued that the chemical enrichment in the north reflected subduction erosion of Paleozoic crust rather than crustal assimilation. Our new data shows that neither of these models work as proposed, but I will present other alternatives consistent with our new data.