Shallow Melt Eduction and Geochemical Recycling at the Chile Ridge Subduction Zone

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We focus on the geochemical prosesses at a hot subduction zone where spreading centers and fracture zones of the Chile ridge system subducting underneath the South American plate at the latitude of 46°S. The tools we used are Sr-Nd isotopes and abundances and age distributions of recycled zircon hosted in the igneous rocks. L. Miocene-E. Pliocene ridge subduction event resulted in obduction of an ophiolite and contemporaneous fore-arc plutonism in the areas ~30 km southeast of the present Chile triple junction. U-Pb dating on zircons indicate that the Taitao ophiolite–granite complex were formed from ~5.7 to 5.2 Ma. As a result of complex magmatic interactions between the subducting ridge, overlying crust/sediments and mantle, several I-type granitic plutons were formed contemporaneously with the ophiolite. The Sr-Nd isotopes indicate that juvenile magma of calc-alkaline I-type granites formed due to partial melting of hot oceanic crust adjacent to the subducting mid-oceanic ridge that has been contaminated by deep crustal material and/or metasomatized sub-arc mantle. REE concentration and other geochemical signatures indicate that the partial melting took place under garnet-free-amphibolite conditions. Recycled zircon age distributions indicate that the juvenile magmas then incorporated different amount of subducted sediments and/or continental material to form the I-type granites with various compositions. Furthermore, fore-arc region became volcanically active over a period of ~0.4 my after the formation of the Taitao ophiolite-granite complex. The fore-arc volcanism produced ejecta of basaltic to dacitic compositions and migrated from offshore (~5.3 Ma) to inland (~4.6 Ma) along the Chile Margin Unit that trends NE-SW. The volcanism further extended east to produce the dacitic volcanic plug of Pan de Azucar (~4.3 Ma) and lavas in Fjord San Pedro (~2.9 Ma). The migration took place at a rate of ~2.3 cm/y to ~5.3 cm/y. Subduction of fracture zones played an important role in these processes.