Geophysical Research Abstracts
Vol. 18, EGU2016-3116, 2016
EGU General Assembly 2016

Constraints on plateau architecture and assembly from deep crustal xenoliths, northern Altiplano (SE Peru)

Alan Chapman (1,2), Mihai Ducea (2,3), Nadine McQuarrie (4), Matthew Coble (5), Lucian Petrescu (3), and Derek Hoffman (2)

(1) Geology Department, Macalester College, St. Paul, MN, United States (chapman@macalester.edu), (2) Department of Geosciences, University of Arizona, Tucson, AZ, United States, (3) Facultatea de Geologie Geofizica, Universitatea Bucuresti, Bucuresti, Romania, (4) Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA, United States, (5) Department of Geological and Environmental Sciences, Stanford University, Stanford, CA, United States

Newly discovered xenoliths within Pliocene and Quaternary intermediate volcanic rocks from southern Peru permit examination of lithospheric processes by which thick crust (60–70 km) and high average elevations (3–4 km) resulted within the Altiplano, the second most extensive orogenic plateau on Earth. The most common petrographic groups of xenoliths studied here are igneous or meta-igneous rocks with radiogenic isotopic ratios consistent with recent derivation from asthenospheric mantle (87Sr/ 86Sr = 0.704–0.709, 143Nd/144Nd = 0.5126–0.5129). A second group, consisting of felsic granulite xenoliths exhibiting more radiogenic compositions (87Sr/86Sr = 0.711–0.782, 143Nd/144Nd = 0.5121–0.5126), is interpreted as supracrustal rocks that underwent metamorphism at ∼9 kbar (∼30–35 km paleodepth, assuming a mean crustal density of 2.8 g/cm3) and ∼750 °C. These rocks are correlated with nonmetamorphosed rocks of the Mitu Group and assigned a Mesozoic (Upper Triassic or younger) age based on detrital zircon U-Pb ages. A felsic granulite Sm-Nd garnet whole-rock isochron of 42 ± 2 Ma demonstrates that garnet growth took place in Eocene time. Monazite grains associated with quenched anatectic melt networks in the same rocks yield ion microprobe U-Pb ages ranging from 3.2 ± 0.2 to 4.4 ± 0.3 Ma (2σ). These disparate geochronologic data sets are reconciled by a model wherein Mesozoic cover rocks were transferred to >30 km depth beneath the plateau in the Eocene and progressively heated until at least Pliocene time. Isothermal decompression and partial melting ensued as these rocks were entrained as xenoliths in volcanic host magmas and transported toward the surface. Mafic granulites and peridotites from the same xenolith suite comprise the basement of the metasedimentary sequence, exhibiting isotopic characteristics of Central Andean crust. Calculated equilibrium pressures for these basement rocks are >11 kbar, suggesting that the basement-cover interface lies beneath the northernmost Altiplano at ∼30–40 km below the surface. Together, these results indicate that crustal thickening under the northernmost Altiplano started earlier than major latest Oligocene and Miocene uplift episodes affecting the region and was coeval with a flat slab–related regional episode of deformation. Total shortening must have been at least 20% more than previous estimates in order to satisfy the basement to cover depth constraints provided by the xenolith data. Sedimentary rocks at >30 km paleodepth require that Andean basement thrusts decapitated earlier Triassic normal faults, trapping Paleozoic and Mesozoic rocks below the main décollement. Magma loading from intense Cenozoic plutonism within the plateau probably played an additional role in transporting Mesozoic cover rocks to >30 km and thickening the crust beneath the northern Altiplano.