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Pockets, conduits, channels, and plumes: links to volcanism and orogeny in the rollback dominated western Mediterranean

Meghan S. Miller (1), Daoyuan Sun (2), Leland O'Driscoll (1), Thorsten W. Becker (1), Adam Holt (1), Jordi Diaz (3), and Christine Thomas (4)

(1) University of Southern California, Earth Sciences, Los Angeles, United States (msmiller@usc.edu), (2) School of Earth and Space Sciences, University of Science and Technology of China, Hefei, China, (3) ICTJA-CSIC, Barcelona, Spain, (4) University of Münster, Münster, Germany

Detailed mantle and lithospheric structure from the Canary Islands to Iberia have been imaged with data from recent temporary deployments and select permanent stations from over 300 broadband seismometers. The stations extended across Morocco and Spain as part of the PICASSO, IberArray, and Morocco-Münster experiments. We present results from S receiver functions (SRF), shear wave splitting, waveform modeling, and geodynamic models that help constrain the tectonic evolution of the westernmost Mediterranean, including orogenesis of the Atlas Mountains and occurrence of localized alkaline volcanism. Our receiver function images, in agreement with previous geophysical modeling, show that the lithosphere is thin (∼65 km) beneath the Atlas, but thickens (∼100 km) over a very short length scale at the flanks of the mountains. We find that these dramatic changes in lithospheric thickness also correspond to dramatic decreases in delay times inferred from S and SKS splitting observations of seismic anisotropy. Pockets and conduits of low seismic velocity material below the lithosphere extend along much of the Atlas to Southern Spain and correlate with the locations of Pliocene-Quaternary magmatism. Waveform analysis from the USC linear seismic array across the Atlas Mountains constrains the position, shape, and physical characteristics of one localized, low velocity conduit that extends from the uppermost mantle (∼200 km depth) up to the volcanoes in the Middle Atlas. The shape, position and temperature of these seismically imaged low velocity anomalies, topography of the base of the lithosphere, morphology of the subducted slab beneath the Alboran Sea, position of the West African Craton and correlation with mantle flow inferred from shear wave splitting suggest that the unusually high topography of the Atlas Mountains and isolated recent volcanics are due to active mantle support that may be from material channeled from the Canary Island plume.