Geophysical Research Abstracts
Vol. 17, EGU2015-6874, 2015
EGU General Assembly 2015

Subduction-Driven Recycling of Continental Margin Lithosphere

Alan Levander (1), Maximiliano Bezada (2,3), Fenglin Niu (1,4), Imma Palomeras (1), Sally Thurner (1), Eugene Humphreys (2), Ramon Carbonell (5), Josep Gallart (5), Michael Schmitz (6), and Meghan Miller (7)

(1) Department of Earth Science, Rice University, Houston, TX, USA (alan@rice.edu), (2) Department of Geological Sciences, University of Oregon, Eugene, OR, USA , (3) Department of Earth Science, University of Minnesota, Minneapolis, MN, USA , (4) China University of Petroleum at Beijing, Beijing, PRC , (5) Institut de Ciéncies de la Terra Jaume Almera, CSIC, Barcelona, Spain , (6) FUNVISIS, Caracas, Venezuela, (7) Department of Earth Sciences, University of Southern California, Los Angeles, CA, USA

Subduction recycling of oceanic lithosphere, a central theme of plate tectonics, is relatively well understood, whereas recycling continental lithosphere is more difficult to recognize, and appears far more complicated. Delamination and localized convective downwelling are two widely recognized processes invoked to explain the removal of lithospheric mantle under or adjacent to orogenic belts. Here we describe another process that can lead to the loss of continental lithosphere adjacent to a subduction zone: Subducting oceanic plates can entrain and recycle lithospheric mantle from an adjacent continent and disrupt the continental lithosphere far inland from the subduction zone.

Seismic images from recent dense broadband seismograph arrays in northeastern South America (SA) and in the western Mediterranean show higher than expected volumes of positive anomalies identified as the subducted Atlantic slab under northeastern SA, and the Alboran slab beneath the Gibraltar arc region (GA). The positive anomalies lie under and are aligned with the continental margins at depths greater than 200 km. Closer to the surface we find that the continental margin lithospheric mantle is significantly thinner than expected beneath the orogens adjacent to the subduction zones. The thinner than expected lithosphere extends inland as far as the edges of nearby cratonic cores. These observations suggest that subducting oceanic plates viscously entrain and remove continental mantle lithosphere from beneath adjacent continental margins, modulating the surface tectonics and pre-conditioning the margins for further deformation. The latter can include delamination of the entire lithospheric mantle, as around GA, inferred by results from active and passive seismic experiments. Viscous removal of continental margin lithosphere creates lithosphere-asthenosphere boundary (LAB) topography which can give rise to secondary downwellings under the continental interior far inland from the subduction zone: We image one under SA and we infer that one or more have occurred in the past under the western Mediterranean. The process of subduction-driven continental margin lithosphere removal reconciles numerous, sometimes mutually exclusive, geodynamic models proposed to explain the complex oceanic-continental tectonics of these two subduction zones.