Ancient lithosphere domains in ocean basins are key geochemical "reservoirs"

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Refined seismic tomography across the Atlantic Ocean images low-density (high-Vs) regions, embedded within oceanic lithosphere that has the typical low-Vs characteristics of young fertile mantle. These high-Vs regions are seismically similar to deep cratonic roots observed in continental regions and some are continuous with cratonic lithospheric roots beneath western Africa. We interpret these low-density regions as ancient (Archean/Proterozoic) lithospheric mantle relict after thinning and mechanical disruption of continental lithosphere during the rifting episode that formed the Atlantic Ocean. These ancient low-velocity domains commonly extend to ca 250 km depth.

These domains provide a geodynamic explanation for the basaltic geochemical signatures commonly interpreted as contributions from different reservoirs. Such geochemical fingerprints also are found in xenoliths of lithospheric mantle in magmas erupted through the continents (e.g. Zhang et al., 2001). If volumes of ancient lithospheric mantle survive in ocean basins, their interaction with upwelling mantle plumes can "contaminate" oceanic basalts; this mechanism explains the origin and location of different geochemical "reservoirs" seen in OIB magmas. In the Atlantic Ocean, basaltic provinces range from primitive to those with strong "crustal" signatures (EM1 and EM2). Volcanoes (e.g. Trinidade) that lie directly over high-Vs domains have significant EM1 and EM2 components. Volcanoes distant from the high-Vs domains are more primitive. Volcanic systems with a long eruptive history (>100 Myr) may evolve as the eruptive locus moves relative to the ancient high-Vs domains. Crozet basalts, for example, evolve from a strong "crustal" component to "primitive".

Old Re-Os model ages from *in situ* analysis of mantle sulfides in lithospheric peridotitic xenoliths (e.g. Coltorti et al., this conference; Wang et al., 2002) confirm the existence of ancient continental mantle domains at shallow depths beneath thinned or oceanic crust (Cape Verde, Penghu Islands). An understanding of the structure of the suboceanic mantle explains the isotopic variability of OIBs, and offers new insights into the mechanisms of continental breakup and the formation of ocean basins.