Newly discovered mantle province between the Indian and Pacific domains beneath the Southern Ocean

S.-H. PARK[1], C. LANGMUIR[2], S. SCOTT[3], K. SIMS[3], J. LIN[4], S.-S. KIM[5], J. BLICHERT-TOFT[6], H. CHOI[1], Y. YANG[1], AND P. MICHAEL[7]

[1]Korea Polar Research Institute, Incheon, Republic of Korea (shpark314@kopri.re.kr)
[2]Harvard University, Cambridge, MA, USA
[3]University of Wyoming, Laramie, WY, USA
[4]Woods Hole Oceanographic Institution, Woods Hole, MA, USA
[5]Chungnam National University, Daejeon, Republic of Korea
[6]Ecole Normale Supérieure de Lyon, Lyon, France
[7]University of Tulsa, Tulsa, OK, USA

Demarcation of mantle domains is important to understand the distribution and origin of mantle heterogeneities, and has great implications for the patterns of mantle convective flow. It has long been accepted that the Pacific and Indian oceans constitute separate large-scale mantle domains, and that the boundary between these two mantle regions is located at the Australian-Antarctic-Discordance (AAD). We report new isotope data from the Australian-Antarctic Ridge (AAR) which lies between the AAD and the Pacific. The data show the existence of a distinct isotopic domain between the Indian and Pacific mantles, implying that the AAD is no longer the boundary it was thought to be. Furthermore, the AAR data show mixing relationships with Cenozoic volcanism in the West Antarctic Rift System (WARS), including the currently active sub-aerial Erebus volcano in Ross Island and the Balleny and Scott Islands, suggesting that mantle beneath this area is in a state of dynamic mixing. Both enriched and depleted end members of this mixing array are distinct from Indian and Pacific mantles. The mixing may be sustained by a deep plume beneath the WARS, for which there is also evidence from seismic tomography. It is inferred that the mixing zone does not extend to adjacent Marie Byrd Land or east Australia because the Cenozoic volcanism in these regions shows slightly different isotopic trends than the AAR. In multi-dimensional isotopic space, however, these bordering regions share isotopic space with the AAR that is distinct from both the Indian and Pacific mantles. This isotopic evidence suggests the presence of an isotopically distinct mantle province between the Indian and Pacific. The dynamic mixing zone further exhibits a distinct mixing relationship with the Hikurangi seamounts, which were erupted at ~90 Ma, suggesting that the new mantle province in question may be traced back to the Gondwana break-up.