Continuous seismic reflection image of the Lithosphere-Asthenosphere Boundary (LAB) from 2-75 Ma on the African plate in the Equatorial Atlantic Ocean

Pranav Audhkhasi and Satish Singh
Institut de Physique du Globe de Paris, Marine Geosciences, France (pranavaudhkhasi@gmail.com)

Lithosphere-asthenosphere boundary (LAB) has generally been estimated using surface tomography (Priestley and McKenzie, 2006; Auer et al., 2014), surface waves anisotropy (Plomerova et al, 2002; Burgos et al., 2014) and receiver function methods (Kumar and Kawakatsu, 2011; Rychert et al., 2012), indicating a change in the S-wave velocity. Recently, some limited studies have shown that LAB could be imaged using seismic reflection imaging method (Stern et al., 2015; Mehouachi and Singh, 2018), requiring a sharp P-wave velocity contrast. Here, we present a continuous seismic reflection image of the LAB from 2-to-75-Ma in the Equatorial Atlantic Ocean over the African plate along a 1400 km long profile using a 12 km long offset multi-channel multi-component (hydrophone and three component acceleration) seismic data. Optimal de-ghosting by summation of pressure (P) and vertical acceleration (Aₚ) components has improved the bandwidth of the data by removing the notches (Vassallo et al., 2013). Further advanced processing consisted of noise removal in shot and receiver domains followed by low frequency boost-up. Trace interpolation followed by wavenumber filtering was performed in the common-midpoint domain to achieve a higher signal-to-noise ratio and flat events enhancement. Post-stack processing mainly consisted of frequency-space deconvolution, dip filtering and data-adaptive edge-preserving modified Kuwahara filter. We find two prominent reflections: The upper varies from ~12 km (3.5 s) two-way time (TWT) below the seafloor at 2 Myr to ~78 km (20 s) TWT below the seafloor at 75 Myr. For 27-to-47-Myr old lithosphere, we image a second almost flat continuous reflection from 21 s to 22 s TWT below the seafloor (~82 km). This event is not prominent for 49-to-75-Myr old lithosphere, probably due to the influence of the mantle thermal anomalies from St.Helena/Cameroon. There is also evidence of some other reflections between these two reflections, which also dip towards older age. The crust-mantle boundary or the Moho is also fairly imaged throughout the profile with crustal thickness ranging between 1.4 - 2.7 s TWT. We interpret the uppermost reflection as the base of lithosphere, the top of the LAB, and the lower reflection as the base of the LAB, while the reflections between these as sheared melt sheets. Our results provide the very first image of the whole LAB system continuously as it deepens and thins away from the ridge axis. In this presentation, we will discuss different implications of these images and provide a comprehensive model of the oceanic LAB over normal oceanic lithosphere.