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Abyssal peridotites from the Central Indian Ridge: Implications for mantle heterogeneity and oceanic plate formation

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It is generally accepted that abyssal peridotites are formed as residue after partial melting and melt extraction in the adiabatically upwelling mantle beneath the present mid-ocean ridge system. However, Os and some other isotopic characteristics of some abyssal peridotites suggest their ancient residual origin, which might be formed by ancient melting event(s) (Brandon et al., 2000; Standish et al., 2002; Harvey et al., 2006; Liu et al., 2008).

Indian MORBs are well known their distinctive isotopic compositions as compared to other oceans (e.g., Iwamori & Albarede, 2008; Iwamori et al., 2010). Because abyssal peridotites are recovered from the Central Indian Ridge (CIR hereafter) (Hellebrand et al., 2002; Seyler et al., 2003; Morishita et al., 2009, 2014; Zhou and Dick, 2013; Yi et al., 2014) where the spreading rate increases from north to south (DeMets et al., 2010), CIR peridotites would provide spatial information on mid-ocean ridge mantle. Several JAMSTEC cruises succeeded to recover abyssal peridotites from the southern end of the CIR. Abyssal peridotites in the southern end of the CIR are characterized by residues after medium-degree of partial melting followed by chemical modifications from evolved melts, which form gabbroic veins (Morishita et al., 2015). These results combined with previous data from northern part of the CIR suggest that relatively depleted residual peridotites are frequently outcropped in the CIR. Addition to this, orthopyroxene-rich peridotites which have high in Os isotopic compositions are recovered from an oceanic hill on the ocean ridge. These characteristics of the peridotites are expected for those from the mantle wedge. In conclusion, diverse peridotites, which might be formed during or before the formation of the Pangea-Gondwanaland, are now incorporated into asthenospheric mantle beneath the CIR. If this is a case, some peridotites can upwell near the ocean floor without creating thick basaltic crust, followed by faulting and hydration resulting in serpentinized peridotites as a part of oceanic plate. We need to reconsider the formation processes of the oceanic plate based on the heterogeneity of oceanic mantle.

Keywords: Central Indian Ridge, Abyssal peridotite, Mantle heterogeneity, Formation of Oceanic Plate