Role of recycled sediments in the origin of an enriched deep mantle source

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Subducted sediments play a key role in the recycling of incompatible elements into Earth's mantle, and thus contribute to the origin of hidden enriched mantle sources. Geochemical evidence from trace elements and isotopic compositions in rocks from Gaussberg, Samoan and NE China have indicated that recycled sediments were involved in the generation of many enriched lavas (Murphy et al., 2002; Jackson et al., 2007; Wang et al. 2017). Furthermore, the recycled sediment components in these places are thought to have originated from the mantle transition zone. However, experimental evidence about the depth of origin of sediment-related enriched mantle sources is still debated. In this study, a series of experiments were conducted to investigate the partial melting behavior of recycled sediment in hybrid systems at 4–15 GPa and 1200–1800 ^{o}C. In peridotite + sediment and peridotite + K-feldspar mixed systems, the inferred solidi temperatures across the hot mantle geotherm at depths around the *X-discontinuity* (seismic-wave velocity discontinuity, ~300 km depth; e.g., Deuss and Woodhouse, 2004; Schmerr et al., 2013; Shen et al., 2014) in a hot-upwelling mantle. The chemical composition of hybridized melts showed similar trace element patterns and ratios (e.g., Sm/La *vs*. Th/La, and Nb/Yb *vs*. Th/Yb) to those of Samoan basaltic lavas, Gaussberg lamproites and potassic basalts from NE China. Our experimental results demonstrated that an EM-source with sediment signatures may result from partial melting of recycled sediments in a hybrid system in a hot-upwelling mantle, at a depth atop the *X-discontinuity*. Hence, our experimental results indicate that the geophysically observed seismic wave discontinuity (*X-discontinuity*) may be related to the geochemically defined EM-source in the deep mantle.

References

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