Osmium, lead and Neodymium isotope geochemistry of Permian Emeishan continental flood basalts: Insights into the source of a large igneous province.

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Continental flood basalts (CFBs) are commonly thought to represent melting products of mantle plumes. However, the nature of the magmatic source and the processes that produce plume-derived magmas are not well understood. Proposed mantle sources for the CFBs include shallow subcontinental lithospheric mantle (SCLM), asthenospheric mantle, and deep, plume-related mantle. The Os isotopic system is potentially powerful for tracing the source and formation process of magmas in continental settings. One of the reasons is that sub-continental lithospheric mantle typically has lower Os isotopic compositions than primitive upper mantle, while plume-related OIB-type mantle has higher Os isotopic compositions. We report the first Re-Os isotope data for the Late Permian Emeishan large igneous province (LIP) in Southwest China. Twenty one CFB samples including both low- and high- Ti basalts from the Emeishan LIP have been analyzed for Os and Pb isotopic compositions. The low and high Ti basalts yield distinct Os signatures in terms of $^{187}Os/^{188}Os$ and Os content. The low-Ti basalt with highest Os concentration (400 ppt) has a radiogenic Os isotopic composition ($\gamma Os(255Ma)$, +6.5), similar to that of plume-derived OIB. As the Os isotopic composition of basalts with relatively high Os concentrations (typically >50 ppt) likely represent the mantle source Os isotopic composition, this result implies a link to a mantle plume source. On the other hand, the high-Ti basalts with high Os concentration (over 50 ppt) have unradiogenic Os isotopic signatures ($\gamma Os(255Ma)$ values range from –0.8 to –1.4), suggesting that a sub-continental lithospheric mantle (SCLM) most likely contributed to the generation of these magmas. Although crustal assimilation may also be detected in Emeishan basalt samples with low Os concentrations (<50 ppt), its contribution seems to have played an insignificant role in the formation of mantle source of this LIP. Combining Pb and Nd isotopic tracers with the Os data, we demonstrate that the low-Ti basaltic magmas in the LIP were mainly sourced from a mantle plume reservoir, whereas the high-Ti basaltic magmas were most likely derived from a SCLM reservoir or were contaminated by a significant amount of lithospheric mantle material during magma ascent through the SCLM.