The role of the sub-continental lithosphere mantle inferred from Os, Pb, Nd, Sr isotopes and trace element geochemistry of the Paraná Continental Flood Basalts

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Large igneous provinces are the most massive, short-lived igneous events on Earth, producing large volumes of mafic lavas and intrusive rocks. Although some continental flood basalts (CFB) are related to mantle plume activity, others may be more directly linked to heterogeneous sources present in lithospheric mantle. Detailed geochemical and isotopic studies about the genesis of the Mesozoic Gondwana flood basalts, such as Karoo, Paraná and Ferrar, indicate source regions within heterogeneous SCLM characterized by low-$^{143}Nd/^{144}Nd$, high-$^{87}Sr/^{86}Sr$ (>0.7045), and high-$^{207}Pb/^{206}Pb$ at a given $^{206}Pb/^{204}Pb$. In addition, the geographic locations of CFB are not random but invariably associated with ancient mobile belts. This may be considered as an evidence for strong structural control of both the crustal and mantle portions of the lithosphere in channeling the CFB feeding systems. In this way, low-Ti Ribeira magma-type rocks from the northern Paraná Continental Flood Basalts (PCFB) Province were analyzed for their osmium, lead, neodymium, and strontium isotopic compositions, in order to characterize the mantle source involved in their genesis. The rhenium- osmium system may provide new constraints on the relative importance of plume and SCLM in basalt genesis, since samples of SCLM brought to the surface as xenoliths commonly have non-radiogenic $^{187}Os/^{188}Os$ ratios, whereas ocean-island basalts, interpreted by some as caused by plumes, tend to have higher than chondritic $^{187}Os/^{188}Os$, and old continental crust has extremely radiogenic ratios. The initial (back to 134Ma) $^{187}Os/^{188}Os$ ratios of the Ribeira basalts lie within the range recorded for xenoliths, ranging from 0.10660 to 0.12575 (γ_{Os}: -15.5 to -0.3). This result along with the occurrence of negative Nb anomalies in these rocks, low initial $^{87}Sr/^{86}Sr$ ratios between 0.70546 and 0.70593, and extremely unradiogenic Nd isotopic compositions (initial ε_{Nd}: -3.1 to -4.2) suggest that this portion of the PCFB was dominated by an Archean lithospheric mantle source. The initial $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ and $^{208}Pb/204Pb$ ratios of the Ribeira basalts vary between 17.63 and 17.81, 15.50 and 15.54, and 37.86 and 38.15, respectively, which are more radiogenic compared to high-Ti basalts from the northern PCFB. It is worth highlighting that the association of low γ_{Os} with low ε_{Nd} provide compelling evidence of the participation of the SCLM in their genesis. These results, taken together with earlier investigations of the Pitanga, Paranapanema, Urubici and Esmerada magma-types, suggest that much of the PCFB consists dominantly of SCLM-derived material. Additionally, samples of the Tristan da Cunha have initial $^{187}Os/^{188}Os$ ratios varying from 0.1412 to 0.2159 calculated for 2 Ma ($\gamma^{187}Os$: +11 to +70), which are quite radiogenic compared to PCFB. The Os isotopic ratios greater than 0.15 almost certainly require some substantial recycled component (e.g., crust). Therefore, these results can be used to rule out the involvement of the Tristan da Cunha mantle plume in the PCFB generation.

Key words: SCLM; Ribeira magma-type; Os-Pb-Nd-Sr isotopic systems.
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