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The Cretaceous to modern $\mu^{182}W$ and $\mu^{142}Nd$ evolution of the Tristan-Gough mantle plume

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The discovery of seismically distinct reservoirs at Earth's core-mantle boundary (CMB) as large-low velocity provinces (LLVPs) and as ultra-low velocity zones (ULVZs) [1,2] has spurred discussions on the structure and homogeneity of Earth's lower mantle. Geochemical evidence for such distinct lower mantle domains has come from noble gases and radiogenic ^{182}W and ^{142}Nd, the decay products of short-lived ^{182}Hf and ^{146}Sm, which became extinct around 50 and 500 Ma after solar system evolution. Although mantle convection homogenized $\mu^{182}W$ and $\mu^{142}Nd$ compositions through geologic time, in some Phanerozoic OIBs, deficits in $\mu^{182}W$ and $\mu^{142}Nd$ compared to the modern-upper mantle values ($\mu=0$) have been detected [3,4]. Combined $\mu^{182}W$-$\mu^{142}Nd$ anomalies have been explained by plumes tapping Hadean silicate reservoirs that have escaped mantle convection over billions of years, while $\mu^{182}W$ anomalies alone could have also been formed by core-mantle-interaction [3].

One plume for which a CMB source has been inferred [5], and which lies at the margin of the African LLVP, is the Tristan-Gough plume, which erupted to form the Paraná-Etendeka LIPs in Brazil and Namibia and subsequently the Rio Grande Rise, Walvis Ridge, and other volcanic islands in the South Atlantic. This study provides the first combined $\mu^{182}W$-$\mu^{142}Nd$ dataset for the Tristan-Gough plume. Complementary long-lived Sr-Nd-Pb-Hf isotope and trace element data show that some Paraná-Etendeka samples are derived from sources that incorporated recycled (EM1,2) lithospheric material. First data show no anomalous $\mu^{182}W$-$\mu^{142}Nd$ values for the Etendeka province, but a $\mu^{182}W$ anomaly of -6.2 ± 3.3 for a late-stage HIMU-like sample from the Walvis Ridge, similar to a $\mu^{182}W$ of -9 ± 2.7 found in an EM1-like sample from the Discovery Seamounts [6]. This provides evidence for the emergence of $\mu^{182}W$ anomalies between the Lower Cretaceous and Paleogene. Additional $\mu^{182}W$ and $\mu^{142}Nd$ data from Paraná, the Walvis Ridge, as well as the Gough and Shona Tracks will be presented to completely reconstruct the plume sources since the Cretaceous.

[1] Lay and Helmberger, 1983, GJI
[2] Garnero and Helmberger, 1993, JGR
[3] Mundl et al., 2017, Science
[4] Peters et al., 2018, GGG
[5] French and Romanowicz, 2015, Nature
[6] Mundl-Petermeier et al., 2020, GCA