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Tungsten isotope implications for the source of ocean island basalts from the Marquesas Archipelago

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The application of the short-lived radiogenic $^{182}Hf/^{182}W$-system ($t_{1/2}$ = 8.9 Ma [1]) is a good approach to study early differentiation processes or potential involvement of long-term isolated and/or core-influenced mantle domains as components for ocean island basalts (OIB) [2,3].

Several examples of OIB worldwide (e.g., Hawaii, Samoa and Iceland) exhibit a negative He-W correlation [2], possibly connected to the incorporation of primordial material characterized by high $^{3}He/^{4}He$ ratios and negative $\mu^{182}W$ ($^{182}W/^{184}W$ deviation of a sample from laboratory standards in parts per million). Anomalous W isotope compositions in combination with elevated $^{3}He/^{4}He$ ratios have previously been connected to seismically anomalous structures in the lowermost mantle, so-called “(mega) ultra-low velocity zones” [3]. Recently, such a structure was discovered beneath the Marquesas Archipelago [4]. This volcanic island chain is located in the South Pacific, in proximity of the Marquesas Fraction Zone. Its formation process is not yet fully understood. Based on high $^{3}He/^{4}He$ ratios in combination with other geochemical characteristics, such as Sr, Nd and Pb isotopes, a deep-lying mantle source has been suggested [5].

In this study, we have analysed seven samples from two islands of the Marquesas Archipelago, which exhibit $^{3}He/^{4}He$ ratios up to 14.4 Ra [5]. $\mu^{182}W$ ranges from -3.6 ±3.1 to 4.7 ±8.5. Hence, despite elevated $^{3}He/^{4}He$ in some of the samples, none of them display resolved negative ^{182}W anomalies and thus, no negative He-W correlation is observed. Interpretations for the decoupling of He-W systematics in samples from the Marquesas Archipelago will be discussed.

References:

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