Geodynamic implications of He and W isotopes in Iceland hotspot lavas

MATTHEW G JACKSON[1], JANNE BLICHERT-TOFT[2], SAEMUNDUR HALLDORSSON[3], ANDREA MUNDL-PETERMEIER[4], MICHAEL BIZIMIS[5], MARK D. KURZ[6], ALLISON A. PRICE[1], SUNNA HARDARDOTTIR[3], LORI N. WILLHITE[7], KRESTEN BREDDAM[8], THORSTEN W. BECKER[9], REBECCA A. FISCHER[10]

[1] Dept. of Earth Science, UC Santa Barbara, jackson@geol.ucsb.edu
[2] ENS de Lyon and CNRS, Lyon, France
[3] NordVulk, Inst. of Earth Sciences, U. of Iceland
[4] Dept. of Lithospheric Research, University of Vienna
[5] SEOE, University of South Carolina
[6] Woods Hole Oceanographic Institution.
[7] Dept. of Geology, University of Maryland
[8] Danish Health Authority, Copenhagen, Denmark
[9] The Jackson School of Geosciences, UT Austin
[10] Dept. of Earth & Planetary Sciences, Harvard U.

Ocean island basalts (OIB) occasionally erupt lavas with high ^{3}He/^{4}He ratios, a signature that reflects preservation of an ancient domain in the Earth's interior. However, the exact location and origin of this domain is not known. This work focuses on the highest ^{3}He/^{4}He lavas from the highest ^{3}He/^{4}He hotspot, Iceland, to evaluate relationships with long-lived (Sr-Nd-Pb-Hf) and short-lived (^{182}Hf-^{182}W) radiogenic isotope systems. The highest ^{3}He/^{4}He (>25 Ra, ratio to atmosphere) lavas in Iceland are extremely heterogeneous, with ^{206}Pb/^{204}Pb that span ~40% of the global OIB range. The range of Sr-Nd-Pb-Hf isotopic compositions falls outside of the boundaries of the common component in the mantle—sometimes referred to as FOZO or C—which has been suggested to host high ^{3}He/^{4}He in Earth's interior. ^{182}W anomalies are found in high ^{3}He/^{4}He Iceland lavas, and high-^{3}He/^{4}He OIB globally, which is particularly noteworthy; among high ^{3}He/^{4}He lavas, only West Greenland lavas lack ^{182}W anomalies [1], but this may relate to assimilation of continental crust (which has higher W concentrations than Earth's core). In the Phanerozoic, only high-^{3}He/^{4}He lavas have negative ^{182}W anomalies—an ancient signature linked to Earth's core [2,3]—which substantiates prior suggestions that the core hosts high ^{3}He/^{4}He. While ^{182}W anomalies in OIB are linked to Earth's core, it is still not known why most OIB lack ^{182}W anomalies and high ^{3}He/^{4}He, a topic that will be explored here.

[1] Mundl-Petermeier et al. (2019), *Chem. Geol.* 525, 245-259. [2] Mundl-Petermeier et al. (2020), *GCA* 271, 194-211. [3] Rizo et al. (2019), *Geochem. Persp. Lett.* 11, 6-11.