A relationship between sulfur isotopes, $\mu^{182}W$, and $^{3}He/^{4}He$: Evaluating the possibility of S-isotope heterogeneity in a primitive mantle reservoir

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Samoan lavas have been shown to be geochemically hetergeneous as a result of contributions from recycled crustal components and deep primitive reservoirs [1,2]. Resolvable negative $\mu^{182}W$ compositions have been reported for samples from Ofu, which would suggest sampling from a portion of the deep earth that differentiated within the first 60 million years of accretion, allowing for the decay of ^{182}Hf to ^{182}W. The exact process that produced the negative anomalies and sampling location of the plume remains unresolved. The S-isotope composition of mantle reservoirs vary as a function of mixing with recycled components and/or mass dependent fractionation processes [3,4,5]. Here, we present the S-isotope compositions of Samoan basalts that host primitive $\mu^{182}W$ and $^{3}He/^{4}He$, reported in [2]. Bulk rock powders were digested using an HF extraction technique [6] and analyzed as SF_6.

The data yield $\delta^{34}S$ values that range from +0.42 to +2.30‰ and $\Delta^{33}S$ values that range from -0.004‰ to +0.027‰. The S, W and He isotopic ratios show correlated behavior. The samples with negative $\mu^{182}W$ and high $^{3}He/^{4}He$ converge on a near zero $\Delta^{33}S$ and a slightly positive $\delta^{34}S$ (+0.42‰). The $\Delta^{33}S$ values increase as the $\mu^{182}W$ compositions approach ambient mantle values of 0. $\delta^{34}S$ values also rise as $\mu^{182}W$ and $^{3}He/^{4}He$ ratios approach this inferred ambient mantle composition. These observations imply two-component mixing between a primordial (with high $^{3}He/^{4}He$, negative $\mu^{182}W$, and near-zero $\Delta^{33}S$) and a recycled endmember (with low $^{3}He/^{4}He$, near-zero $\mu^{182}W$, and small but resolveable positive $\Delta^{33}S$). [1]Labidi et al., (2015), *EPSL* **417,** 28-39**.** [2]Mundl et al., (2017), *Science* **356** 66-69. [3] Cabral et al., (2013) *Nature* **496**, 490. [4] Labidi et al., (2014) *GCA* **143,** 47-67. [5] Delavault et al., (2016) *PNAS* ***113,*** 12952-12956. [6]Labidi et al., (2012), *Chem. Geol.* **334** 189-198.