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# Preservation of primitive sulfur components among variably metasomatized Kilbourne Hole, NM mantle xenoliths

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Mantle xenoliths exhumed by the Kilbourne Hole (KH), NM diatreme can provide direct information regarding the composition of the convecting upper mantle away from ocean ridges at the time they became part of the sub-continental lithospheric mantle (SLCM). Like many mantle xenoliths that originate at or near the base of the SCLM, KH xenoliths exhibit varying degrees of metasomatism by a fluid agent likely associated with flat slab subduction of the Farallon plate [*1–4*]. Yet, in some cases, the radiogenic isotope compositions of KH xenoliths are identical to that seen in the most primitive Mid-Ocean Ridge Basalt (MORB) samples from the convecting upper mantle [*5*, *6*]. Therefore, it is possible that ancient remnants of fertile or even primitive compositions exist in the mantle beneath KH. Earth's core formation is thought to have isotopically fractionated siderophile elements, like sulfur [e.g., *7*]. MORB samples are mantle derivatives and, to date, are the only sample rock type on Earth to unambiguously record such a fractionation in S isotopes. Using major and trace element compositions, and the isotope compositions of Sr, Nd, Os, and S, we place constraints on the origin of KH mantle xenoliths and whether they retain fingerprints associated with primitive mantle. We also use the S isotope composition of KH samples to determine the various constituents associated with the metasomatizing agent of the KH mantle. Our results indicate that KH xenoliths are associated with an ancient convecting mantle reservoir that stabilized at 1.93 Ga as buoyant SCLM and subsequently experienced metasomatism by a slab component containing non-MIF (e.g., post-Archean) S that was possibly derived from the upper continental crust. In-situ sulfide measurements reveal d$^{34}$S values that are similar to estimates for MORB, and demonstrates that fractionation of $^{34}$S/$^{32}$S on Earth's mantle was widespread and it that occurred prior to 1.93 Ga.

[1] Porecca et al. (2006), Geosphere; [2] Giuliani et al. (2016), EPSL; [3] Harvey et al. (2012), JPET; [4] Byerly and Lassiter (2012), EPSL; [5] Harvey et al., 2011, GCA; [6] Harvey et al. (2010), GCA; [7] Labidi et al. (2013), Nature.