Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15325

Chondritic or solar xenon in the Earth's mantle (?)

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Noble gases are powerful tracers of the origin and evolution of volatile elements in terrestrial planets [*e.g.*, 1]. Isotopic ratios of xenon contained in solar, chondritic, and cometary sources are distinct and allow to re-construct the history of delivery of volatile elements to terrestrial planets. Importantly, the distinction between these sources is not simply related by mass-dependent fractionation, suggesting that under-constrained nucleosynthetic processes are also at play [2]. On Earth, mantle and atmospheric xenon have distinct origin. Atmospheric xenon shows a clear selective depletion of ^{134}Xe and ^{136}Xe relative to solar and chondritic sources, probably because of the addition of cometary xenon depleted in neutron-rich nuclides [3]. Differences are more subtle for xenon contained in the Earth's mantle. Recent studies attributed a chondritic origin to this element [4,5]. A chondritic origin has also been proposed for krypton [6,7] although the most recent krypton data [7] display a puzzling anomaly in ^{83}Kr. In this work, I show that the existing dataset on the isotopic composition of light xenon isotopes measured in mantle-derived gases is of high quality but still does not allow to decrypt the origin of xenon in the Earth's mantle. Taking the most recent and accurate estimate for the $^{124-128}$Xe/^{130}Xe isotopic of solar xenon [8], extrapolation of mantle data to correct for atmospheric contamination (and subduction) yields inconclusive results. Multi-isotope correlations are more helpful but do not allow to firmly conclude. Future analytical improvements might allow to achieve the extreme permil level precisions required for the analyses of mantle derived gases to distinguish between the cosmochemical components mentioned above. However, the origin of the differences between these components remains enigmatic and should also be tackled by noble gas geochemists as a community effort.

[1] Marty (2020), *Geochemical Perspectives* 9, 135-313. [2] Avice et al. (2019), *ApJ* 889, 68. [3] Marty et al. (2017), *Science* 356, 1069-1072. [4] Péron et al. (2018), *Geochem. Persp. Let.* 9, 21-25. [5] Broadley et al. (2020), *PNAS* 202003907, 8. [6] Holland et al. (2013), *Nature* 497, 357-360. [7] Péron et al. (2021), *Nature*600, 462-467. [8] Meshik et al. (2020), *GCA* 276, 289-298.