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The heavy noble gas composition of the martian mantle: implications for accretion of volatiles on Earth and Mars

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The timing and processes leading to the accretion of volatiles on terrestrial planets are still largely debated. Mars, as a planetary embryo, is particularly important in providing information about volatile accretion in the inner Solar System during the early stages of planet formation. Noble gases are invaluable tracers for understanding volatile origin on terrestrial planets. For example, the heavy noble gases, krypton and xenon, have stable, non-radiogenic, radiogenic and fissiogenic isotopes that can provide insightful constraints on the sources as well as on the timing of volatile accretion. However, due to their low abundances and overprinting by cosmogenic gases in meteorites, the krypton and xenon isotopic and elemental compositions of the martian mantle are still poorly determined. Literature xenon data in the martian meteorite Chassigny, which traps martian interior volatiles, were argued to represent a solar origin for these heavy noble gases in the martian mantle [1, 2].

To test whether the Kr and Xe in the martian interior are indeed compatible with a solar origin we focused on obtaining precise Kr isotopic measurements of the martian interior due to the large differences in the Kr isotopic composition between solar and chondritic sources. We used a new protocol of heavy noble gas separation [3] in order to precisely measure Kr in Chassigny via step heating. With these new data, we can clearly identify the source of Kr and Xe for the martian mantle by deconvolution of the cosmogenic component from the trapped component.

In this presentation, these new results will be discussed in comparison with recent data for Kr and Xe for the Earth's mantle [4, 5] to shed light on volatiles accretion in the inner solar system during the early stages of planet formation.

[1] Ott (1988) *Geochem. et Cosmochem. Acta* **52**, 1937-1948. [2] Mathew & Marti (2001) *J. Geophys. Res*. **106**, 1401-1422. [3] Péron et al. (2020) *J. Anal. At. Spectrom.* **35**, 2663-2671. [4] Broadley et al. (2020) *PNAS* **117**, 13997-14004. [5] Péron et al., in revision.