Xenon and krypton in carbon-rich lithologies: isotopic anomalies, present and past atmospheric signatures

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Noble gases are useful tracers to understand the debated origin and evolution of volatile elements on Earth. While recent results from the Rosetta mission suggest that noble gases in the Earth's atmosphere could be derived from cometary sources [1], other studies attribute a chondritic [2] or solar-derived [3] origin to noble gases in the Earth's mantle. Recent studies also confirm that Xenon in the Earth's atmosphere is derived from U-Xe and that the isotopic composition of atmospheric Xe evolved through time [4 and refs. therein].

Altough carbon-rich lithologies, enriched in heavy noble gases, have been dismissed as explanations to the "missing xenon" paradox [5], C-rich phases still have the potential to have recorded the isotopic composition of the Earth's atmosphere through time. In this study we measured the isotope compositions of Xenon and Krypton in a suite of C-rich lithologies, comprising *ca*. 3.4 and 3.0 Ga-old insoluble organic matter samples [6], 1.8 Ga-old shungite [7], and (< 1 Ga) thucholite [8, 9], in order to track the evolution of the isotopic composition of the Earth's atmosphere through time.

Results show that most of Kr and Xe in C-rich lithologies corresponds to adsorbed modern atmosphere released at medium temperatures (< 1000°C). Higher temperature steps released trapped gases. Kr does not show significant isotopic deviation from modern atmospheric Kr. However, Xe isotopes are fractionated in the 3.4 and 3.0 Ga-old samples. No isotopic fractionation was detected in 1.8 Ga-old samples, suggesting the end of isotopic fractionation of atmospheric Xe after *ca*. 2 Ga. Compared to gases trapped in Archean quartz fluid inclusions, Xe in C-rich lithologies also show important spallogenic and fissiogenic excesses. Results on thucholite samples will also be discussed at the meeting.

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