Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20297

Ancient Ne and Xe preserved in a 2.9 Gyr old Greenland anorthosite

SAMUEL PATZKOWSKY AND RITA PARAI
Washington University in St. Louis
Presenting Author: spatzkowsky@wustl.edu

The current deep Earth volatile budget is the time-integrated result of primordial volatile delivery during accretion, radiogenic ingrowth of specific isotopes (*e.g.*, ^{4}He from α-decay of ^{238}U, ^{235}U, and ^{232}Th), volcanic outgassing, and regassing of atmospheric volatiles through subduction. Noble gas isotopes are a powerful tool for tracing the evolution of Earth's volatiles because their isotopic compositions are strongly sensitive to volatile exchange between terrestrial reservoirs. The evolution of the mantle volatile budget is coupled with the atmosphere through continuous degassing and regassing of the mantle (via subduction) over Earth history [1,2]. Archives of ancient atmospheric gases have been used to great effect to constrain the evolution of atmospheric noble gas compositions [3-7] and infer large outgassing fluxes towards the end of the Archean [8]. Given the interconnected histories of these two major volatile reservoirs (*i.e.,* the atmosphere and mantle), it is of vital interest to better constrain past mantle Xe isotopic compositions by seeking magmatic gas signatures preserved within ancient mantle-derived rocks.

We present high precision noble gas isotopes from a mantle-derived 2.9 Gyr old Greenland anorthosite. Neon isotopes show a spallation component but suggest a contribution from a component with elevated ^{20}Ne/^{22}Ne, possibly ancient mantle gas preserved within the sample. Xenon isotopes are clearly resolved from modern atmosphere. We find excesses in ^{128}Xe/^{132}Xe and ^{129}Xe/^{132}Xe compared to modern atmosphere and investigate the origins of this signature. Our noble gas isotopic data highlight the potential to harness archives of ancient mantle gas to test numerical models of mantle isotopic evolution. Characterizing mantle compositions of the past is critical to establish a complete picture of how volatiles were transported among terrestrial reservoirs, which is intimately linked with the evolution of geodynamic processes.

[1] Parai and Mukhopadhyay (2018) *Nature* 560, 223-227; [2] Zhang et al. (in press) *EPSL*; [3] Pujol et al., (2011) *EPSL*, 308, 298-306; [4] Pujol et al. (2013) *Nature*, 498, 87-90; [5] Avice et al. (2017) *Nature Comm.* 8, 15455; [6] Avice et al. (2018) *Geochim. Cosmochim. Acta.* 232, 82-100; [7] Broadley et al. (2022) *EPSL,* 588, 117577; [8] Marty et al. (2019) *Nature*, 575, 485-488.