Noble gas content of HF/HCl-resistant etch residues of ureilites DaG 340 & JaH 422

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Introduction: Ureilites are carbon-rich achondrites that share characteristics with both primitive and and differentiated achondrites. Their noble gas inventory is typically contained in two carbonaceous carrier phases: shock-produced nanodiamonds and, less commonly, unshocked graphite. The shock-produced nanodiamonds in ureilites are of solar composition and are distinct from the presolar nanodiamonds typically found in primitive chondrites. Isotopic ratios of heavy noble gases (Ar, Kr, Xe) in ureilites are similar to those of "phase Q", a HF/HCl-resistant carbonanceous phase that releases its gases when treated with HNO_3. Elemental abundance ratios of ureilite noble gases are distinctly different from those of phase Q and presolar nanodiamond.

Experimental Procedure: A single sample was taken from DaG 340 and JaH 422, respectively. The samples were etched separately using HF, HCl, and $AlCl_3$ at both room temperature and ~60°C in 39 steps over several weeks. Between each step, the solution containing the sample was centrifuged, the waste liquid removed with a pipette, and fresh acid was added. Six washes with acetone and propanol removed the acid. The samples were then wrapped in aluminium foil, and heated in vacuum to 150°C for 24 hours to bake out contamination. We performed stepwise heating at six steps (800°C, 1000°C, 1200°C, 1400°C, 1600°C, and 1740°C) using a resistive furnace and measured the gas released at each step using the noble gas group's magnetic sector field mass spectrometer at the University of Bern.

Results: The etching process removed the vast majority of the sample material (>98% for both DaG 340 and JaH 422), leaving only acid-resistant carbonaceous material. The sample was thus highly enriched in trapped gases, with a neon 3-isotope plot showing very little cosmogenic gas remaining in DaG 340 (<3% of the total ^{21}Ne inventory), with JaH 422 having considerably more gas of cosmogenic origin (~31% of ^{21}Ne).

Measured elemental abundance ratios for DaG 340 generally agree with the the values from [1] for ureilites, while JaH 422 appears depleted in ^{4}He and ^{20}Ne and enriched in ^{36}Ar and ^{84}Kr relative to ^{132}Xe compared to the published ureilite values in [1].

Note: results are preliminary at the time of abstract submission. Complete results will be presented at the conference.

References: [1] Ott U. 2002. *Reviews in mineralogy and geochemistry* 47.1:71-100.