

UREILITE NOBLE GASES MEASURED BY MULTIPLE ION COUNTING MASS SPECTROMETRY

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Introduction: We have upgraded our Noblesse noble gas mass spectrometer with a multi-ion counting detector system (Nu Instruments) equivalent to the one used at Washington University in the study of solar wind noble gases from the Genesis collector [1]. The system consists of eight independent channeltron detectors and a Faraday detector at the high mass end for larger ion beams. Multidetector for various elements as well as different isotope combinations is possible by adjusting the zoom optics between magnet and detectors. First tests were performed by step-heating small samples (few to few hundred microgram) of Murchison meteorite. Here we report on tests performed on carbon-rich ureilite separates (6 and 7 heating steps).

Samples: HF/HCl-resistant residues were prepared from Hajmah (conventional analyses reported in [2]) and from a small fragment of the recent fall Almahata Sitta, stone #1 [3]. Bulk data for the latter have been reported in [4]). Samples were placed into small holes in a molybdenum disk and heated by IR CO₂ laser (Hajmah: 7 steps; Almahata Sitta: 6 steps). Diamond was used as window material, and also for covering the sample holes array.

Mass spectrometer performance: Multidetector ion counting was used for Kr and Xe, as well as in case of Ne for monitoring masses used for interference correction (18, 40, 44). Relative counting efficiencies of the channeltrons determined by running air standards of Xe (2.5×10^{-12} cc ¹³²Xe) range between ~0.75 and 1.17 relative to the central channeltron detector. While these factors became fairly stable during the last few months, for Xe we nevertheless apply a scheme that allows in-measurement cross-calibration of adjacent detectors. Doing so, Xe isotope ratios for standards are measured reproducibly within the analytical error (few ‰ for the major isotopes).

Results: Except for one step with high gas abundance (signal at mass 132 more than 100,000 cps), Xe isotopes for the Hajmah residue agree within uncertainties with our earlier conventional analysis (unpublished), while data for the residue from Almahata Sitta #1 do not support the hint for lighter than typical ureilite Xe seen in the bulk analysis of [4]. Abundances of Ar, Kr and Xe in the Hajmah residue are only ~50 to ~65 % of those seen in our previous analyses (reported in [2] as well as additional unpublished data). A likely reason is that trapped gases in ureilites mostly reside in diamond [5, 6]. In the conventional analysis of the Hajmah residue only ~60 % of Xe was released up to 1850 °C, with the rest released in the last (2030 °C) heating step. Since diamond is mostly transparent to the IR laser, it may not have reached high enough temperature for complete gas release in our exploratory study.

References: [1] Meshik A. P. et al. 2010. *Lunar and Planetary Science* 41:#1876. [2] Jenniskens P. et al. 2009 *Nature* 458:485-488. [3] Ott U. et al. 1985. *Lunar and Planetary Science* 16:639-640. [4] Ott U. et al. 2010. *Lunar and Planetary Science* 41:#1195. [5] Göbel R. et al. 1978. *Journal of Geophysical Research* 83:855-867. [6] Rai V. K. et al. 2003. *Geochimica et Cosmochimica Acta* 67:4435-4456.