Q NOBLE GASES IN THE ORGUEIL HF/HCl RESIDUE: A HIGH-PRESSURE EXPERIMENT

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Introduction: The origin of the planetary noble gases (PNG) carrier (Q) in meteorites remains enigmatic. All attempts to separate Q have been unsuccessful in spite of a number of characteristic distinctive features. It is carbonaceous and accounts for a small (~5%) fraction of the total carbonl in meteorites [1]. Solvation experiments with pyridine [2] suggest that it has an organic structure that can be partially destroyed by the reagent, resulting in a partial loss of PNG. Q is destroyed by oxidizing reagents such as HNO_3, H_2O_2, $HClO_4$ and oxidized in pure oxygen atmosphere at low temperatures (400-600°C). It is more readily transformed into diamond by shock metamorphism than the other organics [3]. On the other hand it is less susceptible to parent body metamorphism than most of the macromolecular material [4]. In the present study we decided to examine how Q reacts to high static pressures. For this purpose a HF/HCl residue from Orgueil has been taken to high pressure and modest temperature in a diamond-anvil cell (DAC). The treated and original samples then were analyzed for C, N, Ar and Xe and by micro-Raman.

Experimental: A small aliquot (~10 ng) of the HF/HCl residue was loaded into a membrane-type DAC containing type II diamonds with 500 μm culets. A rhenium gasket with a 200 μm diameter sample chamber and a preindented thickness of ~50 μm depth was placed between the diamonds to contain the sample. The sample was compressed to 9.7 GPa and heated at 250-300 C for 7 hours, then allowed to cool. Pressure was monitored continuously using the ruby florescence method. [5]

C, N and noble gases have been analysed using mass spectrometric multi-element analyzer Finesse at the Open University. The gases were extracted in three combustion steps – 300, 700 and 1000°C. In the first step most of surface contamination has been removed; at 700°C most of the gases from Q are released, and the last step is required just to confirm that no more gases can be released. Raman spectra have been obtained using the mapping method for areas ~20x20 μm with resolution of 1 μm.

Results and Discussion: The Raman spectra of the original and treated sample are similar. They show usual broad D and G bands characteristics of macromolecular material. No diamond feature is seen in the treated sample, which does not necessarily mean that diamond has not been formed under high pressure, but rather that it is small in size and has low abundance.

The noble gas results indicate that ^{36}Ar and ^{132}Xe have been lost during the high pressure expose: 70% of Ar and 40% of Xe. Since at 300°C no PNG loses are expected from Q the result suggests that it is the pressure that resulted in the noble gas release.

Conclusions: Static high pressure affects the Q resulting in its structural transformation and loss of noble gases. We plan to treat the samples with variable pressure and more detailed investigations of the pressure-treated material in order to understand the observed effects.

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