NOBLE GAS STUDY OF THE SARATOV CHONDRITE (L4)

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Introduction: A noble gas component that is highly enriched in the heavy noble gases is carried by Q, which comprises a very small portion of primitive meteorites. Phase Q is most likely carbonaceous material, but a precise nature has not been determined. It has been known that Q and presolar diamond are closely associated. Although Q and presolar diamond, carrying Xe-HL, decrease with increasing petrologic sub-type among L3 ordinary chondrites, Q is more resistant to thermal metamorphism than presolar diamond [1]. This implies that Q becomes more abundant relative to diamond in meteorites of higher petrologic type, allowing us to analyze Q gases in detail. Here we report high-precision noble gas data of bulk and an HF-HCl residue of the Saratov chondrite (L4).

Sample and Experimental: We prepared an HF-HCl residue using a chemical procedure commonly used to concentrate Q. The HF-HCl residue comprises 0.76% of the bulk meteorite. Elemental and isotopic abundances of the noble gases in the HF-HCl residue and bulk Saratov were measured with the VG5400 sector-type mass spectrometer at Osaka University, using stepwise heating at 600, 800, 1000, 1200, 1400 and 1600ºC.

Results and Discussion: Argon, Kr and Xe concentrations in the HF-HCl residue are two orders of magnitude higher than those in the bulk sample, while He and Ne concentrations are comparable in both samples. However, the residue contains only portions of the heavy noble gases in meteorites; 38% for Ar, 58% for Kr, and 48% for Xe. A substantial portion of the heavy noble gases in meteorites may reside in minerals dissolved with HF and/or HCl. It has also been observed that HF-HCl residues from LL chondrites contain just portions of bulk meteorites [2].

Argon, Kr and Xe concentrations in the HF-HCl residue are low compared with those of L3 ordinary chondrites [1], suggesting that Q gases were partially lost during thermal metamorphism. Helium and Ne in the bulk Saratov are mainly of cosmogenic origin.

Xenon isotopic ratios of the HF-HCl residue indicate that there is no HL component in Saratov. Neon isotopic ratios in the HF-HCl residue show an interesting feature; all data points in a Ne three-isotope plot lie on a straight line connecting the cosmogenic component and a composition between Ne-Q and Ne-A2 ($^{20}Ne/^{22}Ne = 9.6$). This may indicate that Ne isotopic composition of Q has been altered by thermal metamorphism. Neon isotopic compositions that are slightly different from those observed in carbonaceous chondrites are also seen in the residues of Julesburg (L3.6) and Abee (EH4) [1]. Huss et al. [1] discussed the possibility that Q acquired Ne from presolar diamond during thermal metamorphism. However, no correlation between Ne isotopic ratios and metamorphic grade was observed in the residues analyzed with closed-system stepped etching technique [3]. Further investigation is needed.

References: [1] Huss G. R. et al. 1996. *Geochim. Cosmochim. Acta* 60:3311-3340. [2] Alaerts L. et al. 1979, *Geochim. Cosmochim. Acta* 43:1399-1415. [3] Busemann H. et al. 2000. *Meteoritics & Planetary Science* 35:949-973.