# TWO DIFFERENT KINDS OF TRAPPED NOBLE GASES IN THE MOORABIE L3.5 - 3.8 CHONDRITE

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**Introduction:** Fine-grained dark inclusions in Ningqiang carbonaceous chondrite contain primitive solar nebular materials that trapped high concentrations of heavy primordial noble gases [1]. The mineralogical observation and noble gas analysis of dark inclusion help to understand the accretion and evolution process of solar nebular materials [1, 2]. In addition, comparing noble gas compositions in dark inclusion with those in matrix reveals the evolution history of the parent body. We performed laser microprobe noble gas analysis on a dark inclusion and matrix of the Moorabie L3.5 - 3.8 chondrite, which is characterized by the presence of two different kinds of primordial noble gases [3].

**Experimental method:** A polished section (~ 350 µm thick) was made from a chip of the Moorabie chondrite. Scanning electron microscope observation indicates that the section contains the dark inclusion (1 × 0.7 mm size). Noble gases were extracted by heating a small portion with the Nd-YAG laser (50 µm in beam diameter) from the dark inclusion and the adjacent matrix. Fused weights for one analysis are 4 - 13µg. The extracted noble gases were analyzed with a modified VG5400 (MS-II) mass spectrometer at the University of Tokyo. We analyzed 4 sites in the dark inclusion and 7 sites in the matrix.

**Results and discussion:** The dark inclusion consists of micron-sized Fe-rich pyroxene and olivine grains, albite and Fe-Ni metal. The dark inclusion and matrix contain trapped noble gases, though their concentrations and elemental compositions are different from each other. Concentrations of trapped $^{36}$Ar in the dark inclusion (1.9 - 2.5 × $10^{-6}$ cm$^3$STP/g) are more than 20 times higher than those in matrices (4.2 - 9.0 × $10^{-8}$ cm$^3$STP/g). Trapped $^{36}$Ar/$^{132}$Xe and $^{84}$Kr/$^{132}$Xe ratios in the dark inclusion are approximately 70 and 0.8, respectively, which correspond to those of Q noble gases [4]. On the contrary, $^{36}$Ar/$^{132}$Xe ratios in the matrices are 30 - 60, which are lower than those in the dark inclusion. $^{84}$Kr/$^{132}$Xe ratios in the matrices are variable from 0.4 to 1.7. The portions of matrix with $^{84}$Kr/$^{132}$Xe ratio higher than unity might contain fractionated atmosphere. Moreover, the dark inclusion contains higher concentration of excess-$^{129}$Xe (1.6 × $10^{-8}$ cm$^3$STP/g) than those in the matrices (3 - 34 × $10^{-10}$ cm$^3$STP/g). It was revealed that the thermal metamorphism reduces the concentration of Q noble gases accompanying lower $^{36}$Ar/$^{132}$Xe and $^{84}$Kr/$^{132}$Xe ratios than those of Q noble gases in unequilibrated ordinary chondrites [4]. The observed noble gas compositions for our Moorabie matrices are similar to these in [4]. To clarify the relationship between the two different kinds of trapped noble gases in the Moorabie, we will conduct oxygen isotopic analysis for the dark inclusion to see if its oxygen isotopic ratios agree with those of L-chondrites.

**References:** [1] Nakamura T. et al. 2003. *Meteoritics & Planetary Science* 38:243-250. [2] Vogel N. et al. 2003. *Meteoritics & Planetary Science* 38:1399-1418. [3] Yamamoto Y. and Nagao K. 2006. Abstract. Symposium on Antarctic Meteorites, NIPR, Tokyo. XXX, 123-124. [4] Busemann H. et al. 2000. *Meteoritics & Planetary Science* 35: 949-973.