

## IDENTIFICATION OF Q FROM SARATOV (L4).

Sachiko Amari<sup>1</sup>, Scott Messenger<sup>2</sup>, Simon J. Clemett<sup>3</sup> and Alexander Meshik<sup>1</sup>. <sup>1</sup>Physics Department and The McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63130, USA. E-mail: sa@physics.wustl.edu. <sup>2</sup>Robert M Walker Laboratory for Space Science, EISD, ARES, NASA Johnson Space Center, Houston, TX 77058, USA. <sup>3</sup>ERC, Inc. / JACOBS, 2224 Bay Area Boulevard, Houston, TX 77023, USA.

**Introduction:** Heavy noble gases in primitive chondrites are concentrated in a very small portion of meteorites, and the carrier was named Q for quintessence [1]. Q is most likely carbonaceous matter [2, 3] that is readily destroyed by oxidants. However, the exact nature of Q remains enigmatic. In our continuing effort to identify Q [4, 5], we analyzed Q-rich fractions from Saratov (L4) using various types of instruments.

**Experimental Results:** The separation and noble gas analysis were performed at Washington University as described by Amari and Meshik [6]. The fractions Saratov AO and AP have the highest Xe concentrations among the fractions analyzed,  $6.95 \times 10^{-7}$  and  $6.98 \times 10^{-7}$  cm<sup>3</sup>STP/g, respectively. AO and AP were deposited on Au foil and analyzed for organic molecules using microprobe two-step laser mass spectrometry ( $\mu$ -L<sup>2</sup>MS), and C and N isotopic imaging using a NanoSIMS 50L, both at The Johnson Space Center. AO and AP contain aliphatic hydrocarbons, and aromatic hydrocarbons with high-molecular weights, but the amount of organic molecules of AO is 4 to 5 times higher than that of AP. Ammonia (HN<sub>3</sub>) (NH<sub>4</sub>OH was not used during the separation) is a prominent peak in AO and AP. In the total of two  $20 \times 20$   $\mu$ m<sup>2</sup> areas in AO, we found three spots ( $\sim 0.3$   $\mu$ m) with <sup>15</sup>N depletion. The <sup>14</sup>N/<sup>15</sup>N ratios of these spots are  $424 \pm 62$ ,  $417 \pm 53$ ,  $423 \pm 65$ , and are remarkably close to that of the Jupiter ( $435 \pm 57$ ) [7]. The <sup>12</sup>C/<sup>13</sup>C ratios of the spots are  $123 \pm 17$ ,  $104 \pm 6$ , and  $90 \pm 6$ , respectively. The O<sup>-</sup>/C<sup>-</sup> and CN<sup>-</sup>/C<sup>-</sup> ratios are high ( $1.48 \sim 3.99$ , and  $0.80 \sim 2.80$ , respectively), indicating they are organic.

**Discussion:** The affinity of Q and the Q-gases to the primordial component, represented by the composition of Jupiter, has been observed. The <sup>3</sup>He/<sup>4</sup>He ratio of He-Q,  $(1.41 \sim 1.59) \times 10^{-4}$  [8, 9], is very close to the ratio of Jupiter [ $(1.66 \pm 0.05) \times 10^{-4}$ ] [10]. Verchovsky et al. [11] found that Q-gases in CR2 and CR3 chondrites were accompanied by isotopically light N and suggested that Q contained isotopically light N ( $\delta^{15}\text{N} < -140$  ‰) that might be related to solar N. From the fact that these isotopically anomalous 3 spots have the same <sup>14</sup>N/<sup>15</sup>N ratio as that of Jupiter, and are enriched (3 spots in  $\sim 400$   $\mu$ m<sup>2</sup>) in the Q-rich fraction AO, we concluded that these spots represent Q, and that Q acquired its noble gases in the solar nebula.

**References:** [1] Lewis R. S. et al. 1975. *Science*, 190:1251-1262. [2] Reynolds J. H. et al. 1978. *Geochim. Cosmochim. Acta*, 42:1775-1797. [3] Ott U. et al. 1981. *Geochim. Cosmochim. Acta*, 45:1751-1788. [4] Matsuda J. et al. 2010. *Meteorit. Planet. Sci.*, 45:361-372. [5] Amari S. et al. 2013. *Astrophys. J.*, 778:37 (39pp). [6] Amari S. and Meshik A. 2015. *Meteorit. Planet. Sci.*, this issue: [7] Owen T. et al. 2001. *Astrophys. J.*, 553:L77-L79. [8] Wieler R. et al. 1991. *Geochim. Cosmochim. Acta*, 55:1709-1722. [9] Busemann H. et al. 2000. *Meteorit. Planet. Sci.*, 35:949-973. [10] Mahaffy P. R. et al. 1998. *Space Sci. Rev.*, 84:251-263. [11] Verchovsky A. B. et al. 2012. *Lunar & Planet. Sci.*, 43:#2645.