

NITROGEN ISOTOPIC ANOMALIES IN ALHA77307

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Introduction: Nitrogen isotopic anomalies have been associated with high presolar grain abundances in interplanetary dust particles (IDPs) [e.g., 1] and in the CR3 chondrites, QUE 99177 and MET 00426 [2]. The presence of N anomalies indicates the primitive nature of these extraterrestrial materials. The CO3 meteorite ALHA77307 has experienced minimal degrees of processing, evident from the abundance of O-anomalous grains [3, 4]. Here, we report on the N isotopic distributions in this meteorite.

Experimental: The NanoSIMS 50 was used to search for N anomalies in a thin-section of ALHA77307 by rastering a primary Cs^+ beam of ~ 1 pA over $10 \times 10 \mu\text{m}^2$ areas of matrix material, and collecting $^{12}\text{C}^-$, $^{13}\text{C}^-$, $^{12}\text{C}^{14}\text{N}^-$, $^{12}\text{C}^{15}\text{N}^-$ and $^{28}\text{Si}^-$ secondary ions and secondary electrons in multi-collection mode. The Auger Nanoprobe was used to obtain compositional information from areas with anomalous N isotopic compositions.

Results and Discussion: Isotopic imaging of $6700 \mu\text{m}^2$ of matrix area led to the identification of areas with ^{15}N excesses that are heterogeneously distributed in the matrix. The N isotopic anomalies are present as discrete localized hotspots that have $\delta^{15}\text{N}$ excesses up to $\sim 1000\%$, relative to the terrestrial $^{14}\text{N}/^{15}\text{N}$ ratio of 272. The mean $^{14}\text{N}/^{15}\text{N}$ ratio of the N-anomalous areas is 175 ± 2 . Carbon isotopic compositions of most of the N-anomalous hotspots are normal within 2σ . However, two hotspots show enrichments in ^{13}C ($70.0 \pm 0.8\%$ and $43.9 \pm 0.3\%$; relative to $^{12}\text{C}/^{13}\text{C} = 89$), as well as ^{15}N ($441.7 \pm 25.3\%$ and $453.9 \pm 8.2\%$, respectively).

Auger Nanoprobe analyses of the N-anomalous hotspots with an average size of about $0.6 \times 0.6 \mu\text{m}^2$, show predominantly C, suggesting that the carrier is probably carbonaceous matter, which may have formed through low-temperature ion-molecule reactions in cold molecular clouds [e.g., 5]. Presolar SiC can be ruled out as the carrier of the correlated ^{13}C and ^{15}N excesses in the two C-anomalous hotspots based on the high $^{12}\text{C}/^{28}\text{Si}$ ratios (25–38) and presence of only a C peak in their Auger spectra. However, we cannot rule out low-density graphite as a possible carrier.

The abundant N anomalies (about 370 ppm) suggest that interstellar components have been preserved in the matrix of ALHA77307. However, the normal bulk N isotopic composition of its insoluble organic matter [6] and the absence of diffuse N anomalies may suggest some alteration or destruction of pristine organics.

References: [1] Floss C. et al. (2006) *GCA*, 70, 2371. [2] Floss C. and Stadermann F. J. (2009) *ApJ*, 697, 1242. [3] Nguyen A. N. et al. (2008) *LPSC* 39, #2142. [4] Bose M. et al. (2009) *M&PS* 72, 5341. [5] Charnley S. B. and Rodgers S. D. (2002) *ApJ*, 569, L133. [6] Alexander C. M. O'D. et al. (2007) *GCA*, 71, 4380.