SMALL PRESOLAR SI-RICH GRAINS FROM THE QINGZHEN (EH3) METEORITE.

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Introduction: In a previous study, an acid residue of the Qingzhen (EH3) meteorite, consisting mainly of SiC, Si_3N_4 and spinel, was separated into eight size fractions, ranging from 0.05 μm up to >10 μm. Only two of them (QZR4: 0.4-0.8μm, QZR5: 0.8-2.0μm) had been studied previously [1,2]. In this work, we analyzed grains from two other size fractions (QZR2: 0.1-0.2μm, QZR3: 0.2-0.4μm) with the NanoSIMS. We compared the results with those for the larger grain size fractions from the same meteorite and those from the Murchison carbonaceous chondrite [3], in order to explore the distribution of various types of presolar Si-rich grains among size fractions from different chemical groups of chondrites.

Results and discussion: 1501 Si-rich grains from a mount of the 0.1-0.2 μm fraction (labeled as QZR2A) and 1490 Si-rich grains from a mount of the 0.2-0.4 μm fraction (labeled as QZR3A) were analyzed for ^{12}C, ^{13}C, ^{28}Si, ^{29}Si and ^{30}Si by automated ion imaging with the NanoSIMS at MPI for Chemistry [4]. Abundance ratios of SiC/Si_3N_4 are 4.71:1 for QZR2A and 1.35:1 for QZR3A, slightly different from the SEM observation (3.19:1 for QZR2A, 2.03:1 for QZR3A). Twenty supernova (SN) X grains from QZR2A and 19 X grains from QZR3A were identified, representing abundances of 2% and 1.6% of all SiC grains, respectively. Five grains from QZR2A with large ^{29}Si-enrichment, which have a SN origin as well [3], and another 4 from QZR3A were discovered, which gives total SN grain abundances of 2.5% and 2.0%, respectively. These abundances are similar to those inferred for small presolar SiC grains from Murchison [3], but ~8 times as high as for the larger grains from Qingzhen [1]. AB grains are more abundant in both QZR2A (6.1%) and QZR3A (6.7%) in comparison with those from Murchison (3.1-3.7%) [3]. Three Si_3N_4 grains with $^{12}C/^{13}C$ <10 (AB type) and 10 Si_3N_4 grains with $^{12}C/^{13}C$ of 15-24 were identified from QZR3A by ion imaging, whereas only one Si_3N_4 grain with significant ^{13}C excess ($^{12}C/^{13}C$ of 17) from QZR2A was found. These Si_3N_4 grains were relocated in the SEM, and at least for two of them no adjacent SiC grains were evident. Re-analysis of two of the AB-Si_3N_4 grains with the NanoSIMS 50L at IGGCAS showed normal N isotopes, and only slight ^{13}C excesses ($^{12}C/^{13}C$ of 34±14, 25±3), suggesting that the first measurements were probably affected by adjacent SiC AB grains. For grains with X signature, the abundance ratio of Si_3N_4/SiC is between 1:9 in this work and 1:4 in the large size fractions [1]. In contrast, AGB Si_3N_4 grains are comparatively rare compared to SiC. This is consistent with a previous report of only one candidate AGB Si_3N_4 grain from Indarch (EH4) [5].

Acknowledges: This study was supported by Natural Science Foundation of China (40830421).

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