FIRST DISCOVERY OF PRESOLAR GRAPHITE GRAINS FROM THE HIGHLY REDUCED QINGZHEN (EH3) METEORITE: MORPHOLOGY, RAMAN SPECTRUM AND ISOTOPIC COMPOSITIONS

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Introduction: Presolar grains are identified by their large anomalies in isotopic compositions, only likely originated from nuclear reactions. Laboratory studies of presolar grains from various chemical groups and petrographic types of chondrites reflect not only the degree of metamorphism suffered by the host meteorites and chemical and physical properties of the host meteorites, but also the distribution of presolar grains throughout the meteorite-forming regions of the solar nebula [1-3]. Till today, more than 2000 individual presolar graphite grains in total have been studied but limited in carbonaceous chondrites, especially Murchison (CM2) [4-6] and Orgueil (C11) [7-9], which sampled materials from the oxidizing regions in the solar nebula. No any presolar graphite grains have been reported from enstatite chondrites, though presolar SiC grains, as C-rich minerals, have been found in the acid residues from enstatite chondrite of Qingzhen (EH3) [10-11] and Indarch (EH4) [12]. Here, we report the first discovery of presolar graphite grains from the Qingzhen (EH3) enstatite chondrite, which formed under a highly reducing condition.

Experimental: Low-density (1.75 - 1.85 g/cm³) fraction of carbonaceous materials from Qingzhen was studied. Presolar graphite grains were found in two analytical sessions: (1) NanoSIMS mapping for isotopically anomalous presolar graphite grains. (2) SEM searching for graphite spherules. The grains identified by NanoSIMS mapping were observed with SEM, and those graphite spherules found with SEM were analyzed by Raman spectrometer and NanoSIMS.

Results and Discussions: 44 presolar graphite grains have been identified based on their anomalous C-isotopic compositions. The 12C/13C ratios of the grains vary from 7.6 to 755. Eighteen graphite grains show anomalous C isotopic ratios in NanoSIMS mapping. Twenty-three graphite spherules, photo-documented with SEM, show morphology of cauliflower, onion and cauliflower-onion. They show Raman spectra of disordered, glassy and kerogentype, but no ordered ones. Another three grains have been found when NanoSIMS imaging were carried out on graphite spherules. Six grains show 28Si-excesses, suggestive of supernova origins [13, 14], and four grains are 12C- and 29,30Si-rich, consistent with low-metallicity AGB star origins [15-17]. Another two graphite spherules have extremely low 12C/13C ratios with marginal solar Si isotopes. The distribution and correlation of morphology, Raman spectra and isotopic compositions in this study, consistent with those of low-density fraction from Murchison, indicate that the distribution of presolar graphite grains in the solar nebula is homogeneous.

This work was supported by the Natural Science Foundation of China (41503066, 41430105, and 40830421).