SILICON AND CARBON ISOTOPES IN SiC FROM THE QINGZHEN (EH3) CHONDRITE. Gary R. Huss, Albert J. Fahey and G. J. Wasserburg, Lunatic Asylum, Div. of Geol. and Planet. Sci., California Institute of Technology, Pasadena, CA 91125 USA

Presolar SiC is present in primitive EH chondrites in an abundance comparable to those for CI, CM2, and LL3.0-1 chondrites (on a matrix-normalized basis)[1]. The relative abundances of Ne-E(H) and Xe-S in acid residues from Qingzhen and Indarch suggest that the mixture of SiC in these meteorites is similar to those in CI and LL3.0-1 chondrites [1]. (Higher Ne-E(H)/Xe-S ratios in separated SiC from Murchison [2] may reflect loss of small SiC during chemical processing [1]). The literature contains essentially no data on the isotopic compositions of Si, C and trace elements in individual SiC from EH chondrites. In a previous attempt to obtain such data, only one SiC grain was found due to the presence of large amounts of silicon nitride (inferred to be $Si_3N_4$) in the acid residue [3]. In this abstract we report Si and C isotopic data for 23 SiC grains from Qingzhen, including 21 "platy" grains ranging in size from <1 μm to ~3 μm and 2 aggregates of smaller grains. As expected, Qingzhen SiC has the same isotopic characteristics as SiC from other meteorite classes. We also found a Si,N-rich, C-poor grain with isotopically light Si and C similar to grains previously reported from Murchison and Tieschitz [4, 5].

Figure 1 shows the Si isotopic data for Qingzhen SiC on a 3-isotope plot. Within errors, all grains fall in the range previously observed for "mainstream" SiC from Murchison, Orgueil, and unequilibrated ordinary chondrites [5–9]. Silicon isotopic data from "mainstream" SiC define a linear array on a Si 3-isotope plot with a slope of ~2.1 (~1.4 on a delta plot) that does not pass through "solar" Si. The distribution of "platy" Qingzhen SiC along the array is also similar to the distributions of single grains from other classes. However, we did not observe isotopically distinct X, Y, or Z grains, which together make up 2–3% of the SiC grains in CI, CM2, and LL3.0 chondrites [5–9], but this could be due to the relatively small number of grains measured. The two aggregates of small SiC grains fall very close to the terrestrial mass fractionation line ($\delta^{29}Si$ = 11±5‰, 10±3‰; $\delta^{30}Si$ = 15±6‰, 12±5‰, respectively (all errors 2σ)).

Figure 2 shows the C isotopic data. As is typical for SiC grains, all but one of the Qingzhen SiC grains are enriched in $^{13}C$ relative to "solar" C. The range of $^{12}C/^{13}C$ ratios (27–70) lies in the middle of the distributions observed in Orgueil, Murchison, and LL3.0 chondrites (Fig. 2). Spectroscopic measurements of atmospheres of C stars [10] show a similar distribution (Fig. 2), indicating that the SiC in Qingzhen and other chondrites came from a population of C stars similar to that observed today. Carbon isotopes are generally uncorrelated with Si isotopes, consistent with previous observations [5–9]. One grain has a $^{12}C/^{13}C$ ratio of 89±3, identical with the "solar" value, and has a silicon composition within errors of "solar". Contamination with terrestrial SiC is unlikely, although it cannot be completely excluded. This grain may be presolar and its "solar" composition just coincidence. However, it may also have formed in the nebula or in the meteorite under the highly reduced conditions that characterize EH chondrites. SiC grains of apparent solar-system origin have been observed in the anomalous carbonaceous chondrite ALHA85085 in a mineral assemblage typical of enstatite chondrites [11].

We also measured Si and C isotopes in 11 C-poor, N-rich grains. The Si compositions plot in a relatively narrow range along a slope-1/2, mass-fractionation line passing through the "solar" composition and are thus consistent with a solar-system origin. However, one grain has light Si ($\delta^{29}Si$ = -17±13, $\delta^{30}Si$ = -36±11) falling well outside the range previously observed in meteoritic material of solar-system origin [2, 12]. This same grain also has isotopically light C ($^{12}C/^{13}C = 113^{+31}_{-20}$). The $^{12}C^-/^{28}Si^-$ ratio for this grain was 0.0046. This ratio and the C composition are limits on the true values because of contamination with extraneous C during the first few measurement cycles. A carbon-poor grain with very light Si has been reported from Tieschitz [5] and a silicon nitride grain with light Si and C and heavy N was found in Murchison [4] and was inferred to be a presolar grain from a type II supernova. Our grain may be another of

this family of presolar grains. The $^{12}C^-/^{28}Si^-$ of 9 of the other 10 grains varied from 0.004 to 0.27 and decreased by factors of 2 to 10 during the measurement. Thus the measured C compositions, which range from $^{12}C/^{13}C = 43$ to 74, probably reflect C adhering to the grain surfaces or to the gold mount (tiny SiC grains?) rather than indigenous C. One aggregate of small grains exhibited a $^{12}C^-/^{28}Si^-$ ratio of 0.28 which held steady during the run. Its composition is: $^{12}C/^{13}C = 31\pm1$; $\delta^{29}Si = -2\pm4$ and $\delta^{30}Si = -4\pm5$. In appearance and isotopic composition, this grain looks like an aggregate of SiC grains, but the $^{12}C^-/^{28}Si^-$ ratio is too low.

To first order, SiC in Qingzhen seem to be the same as that in other classes of primitive chondrites. The Si and C isotopes of our 23 grains exhibit the same range of compositions as the "mainstream" SiC grains found in other meteorites. This is consistent with the noble gas data obtained on bulk acid residues [1]. We have not yet measured enough grains to address whether small differences exist in the abundance of X, Y, or Z grains or in the distribution of C compositions. We have not yet found large (5–10 μm) grains. However, this cannot be used as evidence that SiC grains in Qingzhen are smaller than in other meteorites because of the steep size distribution of presolar SiC. An absence of large grains can only be demonstrated after several hundred small grains have been characterized and large grains are still absent [e.g., 13]. Qingzhen may contain SiC that formed under reducing conditions in the solar system, but the abundance of such material would appear to be $\lesssim 5\%$ of that of presolar SiC. Qingzhen also contains Si,N-rich, C-poor grains, of probable presolar origin. However, because enstatite chondrites contain large amounts of "local" silicon nitride [2], it will be difficult to pick out the presolar grains for detailed study. Our data indicates an abundance of candidate grains of ~5% of that of presolar SiC.

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