

INTERSTELLAR SiC WITH UNUSUAL ISOTOPIC COMPOSITIONS;

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We continued the search for SiC grains with unusual isotopic compositions by measuring C isotopes in 180 grains from Murchison separate KJG (average size 3.02 μm) and 506 grains from separate KJH (average size 4.57 μm) [1]. In most of these grains we also measured N-isotopes (Fig. 1), in a subset Si isotopes (Fig. 2) and the Al-Mg systematics (Fig. 3). We have previously reported isotopic ratios in a new class of interstellar SiC, named grains X [2]. During the new search we discovered three more grains X (Figs. 1-3). We also found a second class of unusual grains with correlated isotopic compositions in C and Si and baptized them grains Y (Figs. 1-3).

Grains X have light C, heavy N and light Si, the opposite isotopic signature of the bulk of interstellar SiC grains [2-5; Figs. 1-2]. They also have much higher $(^{26}\text{Al}/^{27}\text{Al})_0$ ratios than all other grains. The newly discovered grain X4, an unusually large crystal (Table 1), has extreme isotopic compositions with $^{12}\text{C}/^{13}\text{C} = 2500$, $^{14}\text{N}/^{15}\text{N} = 12.6$ and $(^{26}\text{Al}/^{27}\text{Al})_0 = 0.61$. We have previously reported large ^{44}Ca and ^{49}Ti excesses in X1 [2,6]. The small sizes and/or low concentrations of the other grains (Table 1) did not allow the measurement of all Ca and Ti isotopes (Table 1). No ^{44}Ca excesses were found in grains X1, X4 and X5, but grains X1, X3 and X4 have large ^{49}Ti excesses, reaching 950‰ in grain X4 (Fig. 4). Excesses in ^{44}Ca and ^{49}Ti point toward explosive nucleosynthesis in supernovae [7] as the radioactive precursors of these two isotopes, ^{44}Ti and ^{49}V , have long enough half-lives (44 and 0.9 yrs respectively) for *in situ* decay after grain formation in supernova ejecta. Inferred $^{49}\text{V}/^{51}\text{V}$ ratios vary from 0.11 in X1 to 0.71 in X4. Grain X4 has also an excess at mass 50 (Table 2). We list this excess as an excess of ^{50}Ti , but it could also be an excess in ^{50}V or ^{50}Cr . However, in this case the $^{50}\text{V}/^{51}\text{V}$ ratio would be $119 \times$ solar or the $^{50}\text{Cr}/^{52}\text{Cr}$ ratio $11 \times$ solar. The last possibility is unlikely since the $^{53}\text{Cr}/^{52}\text{Cr}$ ratio is normal. The major problem with a supernova origin is the high $(^{26}\text{Al}/^{27}\text{Al})_0$ ratios in grains X, by far exceeding the production rate of up to 6×10^{-3} expected in supernovae [8]. A possible solution to this problem would be that ^{26}Al had been produced during the AGB phase of a Type I presupernova star. Extensive mixing of material from different shells would be required in any case to explain the isotopic compositions of grains X.

Grains Y have high $^{12}\text{C}/^{13}\text{C}$ ratios (Fig. 1) and Si isotopic ratios that are to the right of the main trend of the bulk of individual SiC grains (Fig. 2). On a Si 3-isotope plot (Fig. 2) they lie on a line that is compatible with the evolution of the Si-isotopic composition by neutron capture in AGB or WR stars [9-11]

REFERENCES: [1] S. Amari *et al.* (1992) *GCA*, in press.; [2] E. Zinner *et al.* (1991) *Meteoritics* **26**, in press; [3] E. Zinner *et al.* (1989) *GCA* **53**, 3273; [4] C. Alexander *et al.* (1990) *LPS* **XXI**, 11; [5] J. Stone *et al.* (1991) *LPS* **XXII**, 1337; [6] T. Ireland *et al.* (1991) *Meteoritics* **26**, in press; [7] S. Woosley (1986) In *Nucleosynthesis and Chemical Evolution*, 1, Observatoire de Geneve; [8] S. Woosley and T. Weaver (1986) In *Nucleosynthesis and its Implications on Nuclear and Particle Physics*, 145; [9] R. Gallino *et al.* (1991), Priv. comm.; [10] Obradovic *et al.* (1991) *Meteoritics* **26**, in press; [11] N. Prantzos *et al.* (1990) *Astron. Astroph.* **234**, 211.

Table 1.

| Gr. | Size μm | Ca ppm | Ti ppm | V ppm | Cr ppm | $\delta^{42}\text{Ca}$ ‰ | $\delta^{43}\text{Ca}$ ‰ | $\delta^{44}\text{Ca}$ ‰ | $\delta^{46}\text{Ti}$ ‰ | $\delta^{47}\text{Ti}$ ‰ | $\delta^{49}\text{Ti}$ ‰ | $\delta^{50}\text{Ti}$ ‰ |
|-----|-----------------------|-----------|-----------|----------|-----------|-----------------------------|-----------------------------|-----------------------------|--|-----------------------------|-----------------------------|-----------------------------|
| X1 | 3×4.5 | 380 | 200 | 140 | - | 57 ± 208 | 276 ± 386 | 48 ± 118 | - | - | 600 ± 300 | - |
| X2 | 4.5×5 | 576 | 360 | 35 | 66 | -167 ± 80 | 390 ± 170 | 3040 ± 237 | 82 ± 48 | 23 ± 50 | 239 ± 58 | -52 ± 38 |
| X3 | 2×2.5 | 68 | 168 | 62 | - | - | - | - | - | - | 473 ± 104 | - |
| X4 | 9×9 | 26 | 67 | 9.6 | 6.5 | 14 ± 200 | 79 ± 356 | -55 ± 78 | 33 ± 66 | -79 ± 62 | 949 ± 88 | 306 ± 59 |
| X5 | 3.5×5 | <22 | <20 | <2.4 | <3.8 | - | - | 174 ± 362 | ----- Normal within ~ 500 ‰ ----- | | | |

