Various graphite morphologies with a diversity of C- and N-isotopic signatures in the highly equilibrated Acapulco meteorite

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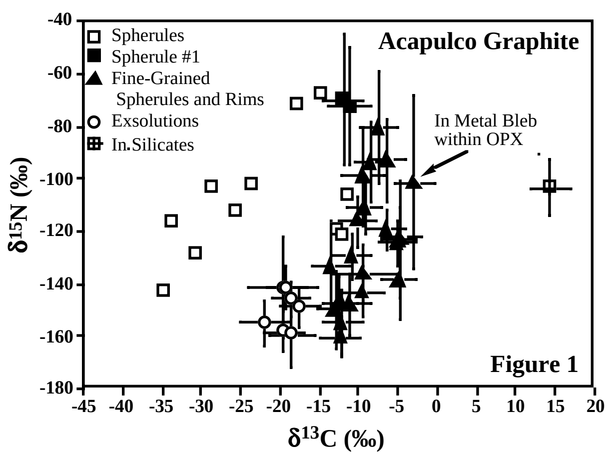
Introduction: Acapulco is a highly equilibrated meteorite and a member of the acapulcoite-lodranite clan with strong chemical affinities to H-chondrites [1]. It has experienced partial melting and pervasive re-crystallization [1], a process expected to erase primordial N-isotopic signatures.

In a detailed petrographic-isotopic study of graphite in this meteorite we encountered eight different graphite morphologies, either in close vicinity or inter-grown with each other. These include spherulitic, feathery, fibrous bands, round fine-grained inclusions, exsolution veneers between kamacite and taenite, and single crystals in the silicate matrix. The C- and N-isotopic ratios ($\delta^{13}C$ versus $\delta^{15}N$) are plotted in Figure 1. Spherulitic graphite plots along a linear array with a slope of 3.25. Graphite exsolution veneers at the kamacite-taenite interface has the lightest C- and N-isotopic compositions ($\delta^{13}C = -23 \rightarrow -18$ ‰, $\delta^{15}N = -159 \rightarrow -141$ ‰). Fibrous graphite band around spherulitic graphite has much lighter N than the spherulitic core ($\delta^{15}N = -145$ ‰ versus $\delta^{15}N = -71$ ‰). A single crystal in the silicate matrix has an C-isotopic ratio completely different from all other graphite grains in Acapulco (Figure 1).



The results indicate that the individual graphite morphologies retained their pristine isotopic signatures, despite the pervasive equilibration and partial melting experienced at T = 1200° C by the Acapulco parent body [1].

References:

[1] Zipfel J. et al., (1995), *GCA*, **59**, 3607-3627.