THE KAIDUN METEORITE: FAST CRYSTALLIZATION OF A FRAGMENT FROM A SUPERHEATED MELT.

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The Kaidun meteorite is characterized by great diversity of lithologies. Here we describe fragment #d3C with rather unusual textural and chemical features related to fast cooling of melt.

The fragment is ~1.0 × 0.28 mm in size and has a subregular rectangular shape. It is found within a carbonaceous matrix. One long side forms an uneven, wave-shaped boundary with the matrix, the other has a smooth, straight boundary with a thin (~30 µm) olivine strip. The fragment shows no visible traces of interaction with the olivine. The fragment's structure is determined by a system of skeletal layered pyroxene crystals growing mostly perpendicularly from the uneven long side, parallel to each other. The crystals are 220–270 µm long and 15–40 µm wide. The intervals between the crystals are 15–45 µm wide and filled with partially devitrified glass. The glass contains faint traces of crystals growing from the side touching the olivine strip.

The skeletal pyroxene crystals show clear zoning and large compositional variations ($En_{50.3–83.9}Fs_{6.9–11.6}Wo_{8.4–41.4}$). The crystals' cores are usually Mg-rich, and the rims Ca-rich. The interstitial glass is almost uniform in composition. In the An-Ol-SiO_2 system it may be represented as $2An·1Ol(Fa_{37})·2SiO_2$. The olivine strip next to the studied fragment has an average composition of $Fa_{7.3±0.4}$.

On a An-Ol-SiO_2 diagram for mole ratio Fe/(Fe+Mg)~0.3 [1] the fragment's bulk and pyroxene compositions fall in the olivine field, while the glass composition falls in the plagioclase field rather far from the Ol-An boundary; thus the fragment was not crystallized under equilibrium conditions. Occurrence of this nonequilibrium phase assemblage may be explained from dynamic crystallization experiments [2]. These authors showed that the change of phase appearance couple with high over-saturating of glasses with plagioclase during fast cooling experiments. The skeletal morphology and high Al_2O_3 content of the pyroxene in the fragment also suggest rapid cooling. From [2], the cooling rate appears to have been several hundred degrees per hour. Phase equilibrium calculations suggest the fragment's glass was annealed at temperatures above 1250°–1270°C [3]. The upper limit of the temperature of the melt is ~1850ºC, as follows from the melting temperature for $Fa_{7.3}$.

We see two possible formation mechanisms for this fragment. In the first the fragment is envisioned as a crystallized splash formed during an impact event on a parent asteroid. However, in such a case it is difficult to imagine the presence in the regolith of a smooth, unaltered strip of olivine. It seems more realistic to suppose the studied fragment and the adjacent olivine strip have a common origin and may be a fragment of a barred chondrule destroyed by a shock and heating event. In this case the basalt-like mesostasis was melted whereas the olivine bar remained unaltered. The unusual composition of the fragment's glass, characterized by almost constant stoichiometric proportions suggests clustering of the melt before crystallization.

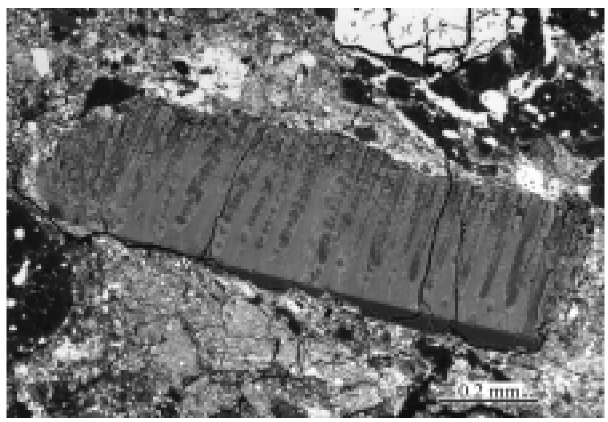

Fig. 1. BSE image of Kaidun fragment #d3C.

References: [1] Walker D. et al. (1972) *Proc. LSC 3rd*, 797–817. [2] Grove T. L. and Bence A. E. (1979) *Proc. LPSC 10th*, 439–478. [3] Ariskin A. A. et al. (1997) *MAPS*, *32*, 123–133.