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SCANNING ELECTRON MICROSCOPY OF CONDENSATION RELATED MINERALS: THE BJURBOLE METEORITE.

Frans J. Rietmeijer and Ian D. R. Mackinnon, SN4 NASA Johnson Space Center, Houston, TX. 77058.

Filamentary single crystals, blades, sheets, euhedral crystals and powders may form by vapor phase condensation depending on the supersaturation conditions in the vapor with respect to the condensing species [1]. Filamentary crystal growth requires the operation of an axial screw dislocation [2]. A Vapor-Liquid-Solid (VLS) mechanism may also produce filamentary single crystals, ribbons and blades. The latter two morphologies are typically twinned. Crystals grown by this mechanism do not require the presence of an axial screw dislocation. Impurities may either promote or inhibit crystal growth [3]. The VLS mechanism allows crystals to grow at small supersaturation of the vapor. Thin enstatite blades, ribbons and sheets have been observed in chondritic porous Interplanetary Dust Particles (IDP's) [4, 5]. The requisite screw dislocation for vapor phase condensation [1] has been observed in these enstatite blades [4]. Bradley et al. [4] suggest that these crystals are primary vapor phase condensates which could have formed either in the solar nebula or in presolar environments. These observations [4, 5] are significant in that they may provide a demonstrable link to theoretical predictions: viz. that in the primordial solar nebula filamentary condensates could cluster into 'lint balls' and form the predecessors to comets [6].

In order to better define the relationship between IDP's and small solar system bodies, we have initiated a study of selected chondrites for which the above criteria are used to infer origins. A few previous studies indicate that crystals with filamentary morphology, blades and sheets do occur in certain meteorites. For example, filamentary crystals of wollastonite occur in white inclusions of Allende [7]; olivine, low-Ca pyroxene, plagioclase and Fe-Ni metal form (thick) blades and needles in vugs of the Farmington ordinary chondrite [8]. These examples are considered vapor phase condensates related to secondary processes after formation of the meteorite [7, 8].

It is probable that other processes will also form vapor phase condensates. For example, upon entry in the earth's atmosphere, temperatures at the surface of a meteorite may become high enough to cause portions to evaporate. Consequently, vapor phase condensates may be present on the fusion crusts of some meteorites.

Fragments of Bjurbole have been investigated using a JSM-35CF scanning electron microscope equipped with a PGT System IV energy dispersive spectrometer for chemical analysis. Alteration is common in parts of the sample but not around the vugs investigated. In addition, evidence of post-fall alteration of the fusion crust is not apparent. Preliminary observations indicate that (a) Blades occur within vug walls in some chondrules. They form sub-equant plates (5.8μm x 3.8μm) or hexagonal shapes and appear to be single crystals. The plates are thin (~59nm). (b) Filamentary crystals and blades are abundant on the fusion crust. Filamentary crystals may be up to 20μm in length and some appear to twist around their long axis (Figure 1). The blades often have a high aspect ratio (e.g. 41μm x 4.3μm) and are also thin (0.08μm to 0.3μm; Figure 2). Semiquantitative chemical analysis indicates the presence of impure wollastonite (Figure 3) and and iron oxide (magnetite? ; Figure 4). Magnetite is known to result from the heating of chondritic material during atmospheric entry [9] and is also believed to form tiny crystallites on silicates in IDP's [10].

Observations on the fusion crust of Bjurbole suggest that vapor phase condensation may occur within and on material entering the earth's atmosphere.

We therefore suggest that this process for the formation of condensates be taken into account in similar studies of all meteorites.

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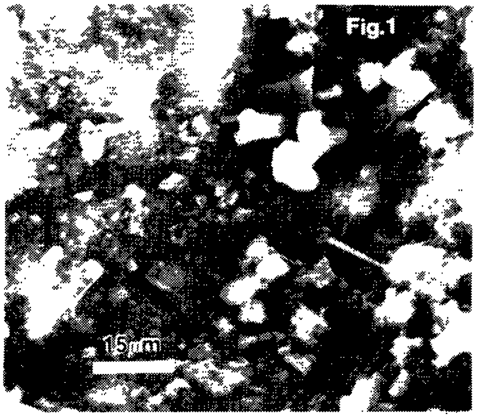
Fig.1

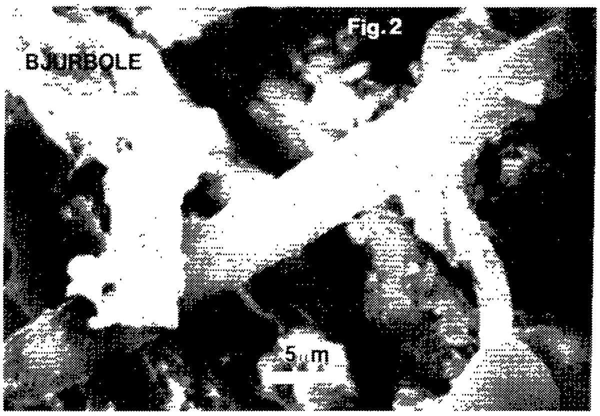
Fig.2

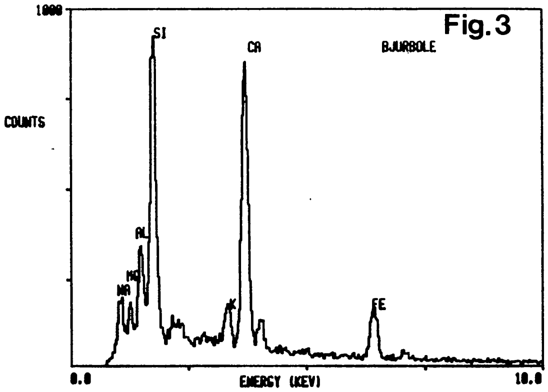
Fig.3

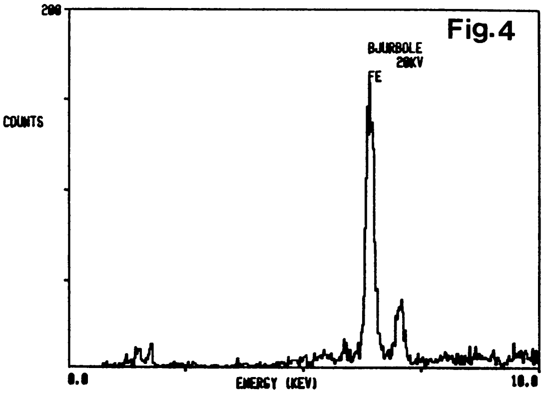
Fig.4