SYNTHESIZED TROILITE MELT MIGRATION INTO ULTRAMAFIC ROCKS: A STUDY FOR ORDINARY CHONDRITE DARKENING BY IRON SULFIDE SHOCK MELTING

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Introduction: This work is a research continuation on shock-darkening of ordinary chondrites by iron sulfide shock melt vein migration into silicate cracks [1-5] and its implication to asteroid spectral properties [4,6]. We aim to study migration of sulfide melt to characterize properties that offer a better insight into shock-darkening through chemical processes and "wetting properties" of iron sulfides to silicates [7].

Method: We use dunite (Tulppio, Finland, [8]) and San Carlos olivine [9] to simulate the silicate portion of ordinary chondrites, and we synthesize meteoritic troilite in ovens at 1325ºC [10] with its pyrrhotite phase intermediate [10]. In the case presented here, sub-cm holes were drilled into a slab of Tulppio dunite, filled with dunite grains and topped with sub-mm pyrrhotite grains (0.0613 g). Then the assemblage was heated to 1325ºC for one hour in nitrogen, retrieved, and analysed using micro X-ray fluorescence (µXRF) analysis and scanning electron microscopy (SEM). As per [10], the pyrrhotite undergoes troilite transformation at such temperature and upon cooling.

Results and Discussion: We show the first glance to our results in Fig. 1 where pyrrhotite grains melted and coated/impregnated the dunite walls and grains, thereby visually darkening the lithology (Fig. 1B). A µXRF element distribution map (Fig. 1C) of the cut drillhole shows sulfur in these areas. SEM images show morphologies of uncoated sulfide-free (Fig. 1D) and sulfide-coated (Fig. 1E) grains. We hypothesize that iron sulfide melted and migrated within the rock as per "wetting properties" or through thermal expansion cracks. Further analyses with different olivine/sulfide configurations will help constraint this peculiar process.

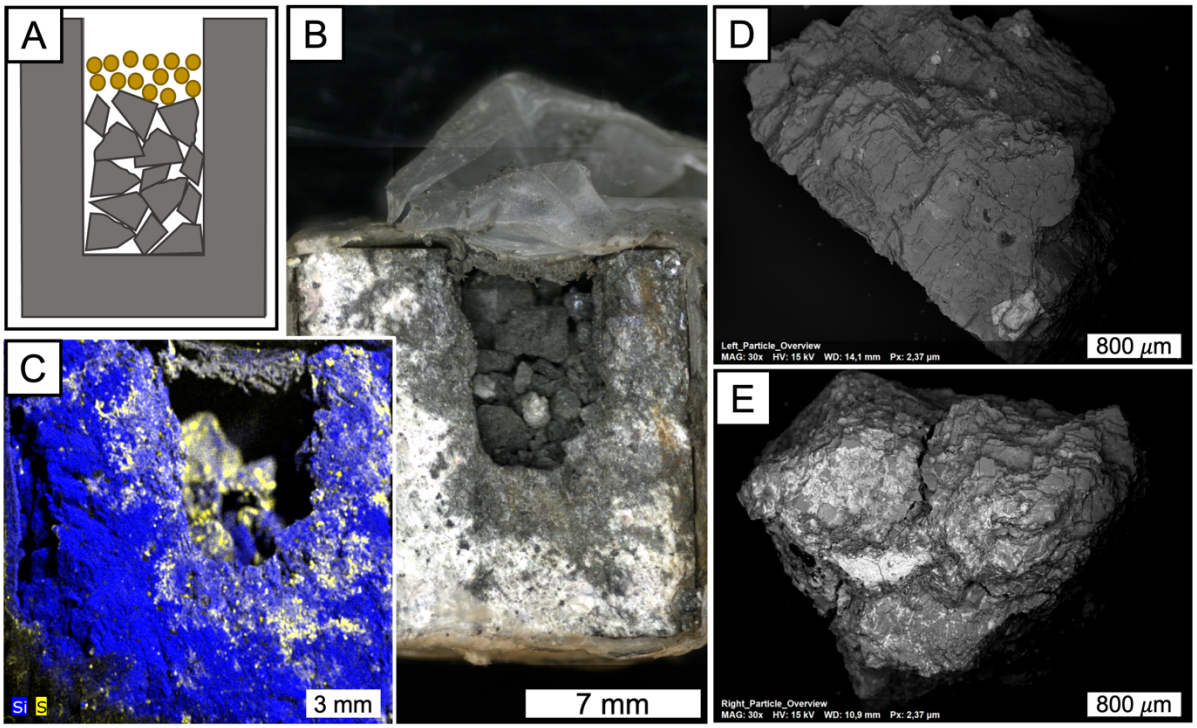

Fig. 1. A) a drilled dunite cube filled with dunite grains, topped with pyrrhotite, is brought to 1325ºC in nitrogen, which leads to B) melting of pyrrhotite (troilite), darkening the dunite grains/walls by possible coating/impregnation of sulfides as seen in C) with a chemical element scan, and D-E) with SEM images of a non-darkened and darkened dunite grain, respectively.

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