FIRST FIND OF WADSLEYITE AND RINGWOODITE IN THE ALFIANELLO L6 ORDINARY CHONDRITE.

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Introduction: Ordinary chondrites (OCs) are the most abundant (>80%) group of meteorites recovered on Earth and also among the most primitive materials in the solar system [1, 2]. They are composed of an assemblage of chondrules (60-80 vol.%) and fine grained matrix [3].

Subjected to collisional processes on small bodies, OCs have suffered variable degrees of shock metamorphism [2, 4]. Olivine, pyroxene and plagioclase might have been transformed into high pressure polymorphs, such as ringwoodite (spinel structure), majorite (hollandite structure) and jadeite, respectively [5], or contain other evidence of shock metamorphism, e.g., planar deformation features, shock darkening, amorphization, etc.

The Alfianello (Brescia, Italy) meteorite is an L6 ordinary chondrite fallen on February 16, 1883. Petrological investigation performed by [6] indicated that it mostly consists of olivine and low Ca pyroxene, while plagioclase, merrillite and apatite occur in minor amounts [7]. Other accessory phases include chromite and ilmenite [6], nickel-iron alloys and sulphides [8]. Plagioclase is commonly transformed into maskelynite and rarely occurs as birefringent crystals [7]. According to the shock classification proposed by [2], the deformation features observed in the investigated sample from the Alfianello meteorite indicate high shock, equivalent to shock degree S5.

Experimental: The sample studied here is a petrographic thin section of a fragment 7 x 10 mm in size displaying no fusion crust from the Alfianello chondrite, kindly provided by the Museo di Storia Naturale of the University of Florence.

The investigated sample has been examined with a variety of analytical techniques: optical microscopy, Field Emission Scanning Electron Microscopy (FE-SEM), Electron MicroProbe Analysis (EMPA) and Raman spectroscopy, with the aim of further characterising shock effects and confirm the classification of this meteorites. Moreover, a portion of an olivine grain displaying a fine microstructure was extracted by FIB obtaining a lamella thin ~100 nm in order to perform further investigation by TEM.

Results: Here we report the first documented occurrence of wadsleyite in an olivine grain in the studied Alfianello meteorite sample, where, recently, also ringwoodite has been reported. Ringwoodite occurs (i) as a core surrounded by olivine, (ii) as a rim around an olivine core, and (iii) as a network of planar lamellae, likely oriented along crystallographic planes within olivine. Ringwoodite lamellae have been only rarely reported in the literature, e.g., in the Sixiangkou L6 chondrite, [9], in Tenham L6 chondrite, [10] and in Yamato 791384 L6 chondrite, [11].

An olivine grain displaying a fine network of randomly oriented contorted lamellae has been also analysed by TEM revealing the presence of a phase with orthorombic simmetry, spatial group Imma, cell parameters a_0=5.86, b_0=11.67, c_0=8.37 which closely matches the symmetry and unit cell parameters of wadsleyite (another high pressure polymorph of olivine). This phase occurs as small domains ca. 200-300 nanometers across and, as for ringwoodite, is probably the result of shock metamorphism of olivine during an impact event [12], similarly to what observed by [13].

Further studies: As the occurrence of ringwoodite in lamellae has been only reported for a few ordinary chondrites, all L6, we are planning further studies by transmission electron microscopy (TEM), to determine the mutual orientation of the ringwoodite lamellae and the host olivine, as well as to understand the mutual crystallographic relationship between wadsleyite and olivine.

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