

PETROLOGY AND BULK COMPOSITION OF THE OUDIYAT SBAA FLUORORICHTERITE-BEARING EH5 CHONDRITE: A WITNESSED FALL FROM EASTERN MOROCCO

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Introduction: On November 18, 2016 a bright fireball was witnessed over southeastern Morocco, and within several days three fusion-crust stones emitting sulfurous odors (total weight 23.8 kilograms) were found near Kdiat Sbaa (“Lion Hill”) at 25.546°N, 12.418°W. Short-lived cosmogenic radionuclide results are reported in [1].



Figure 1. Largest Oudiyat Sbaa stone showing the fresh fusion-crust exterior. White streaks may indicate vaporization of components during atmospheric ablation.

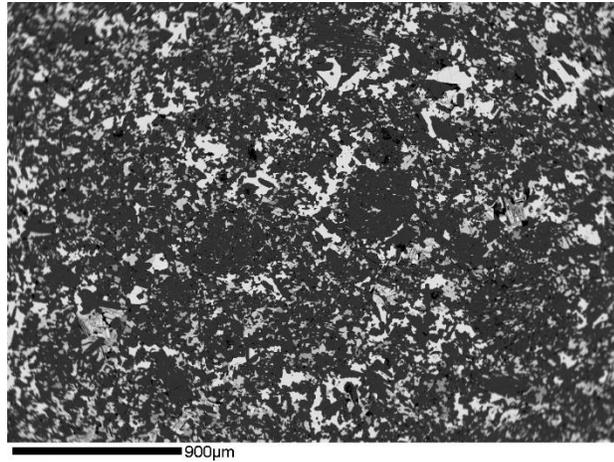


Figure 2. Back-scattered electron image showing sparse enstatite-rich chondrules plus abundant matrix metal and sulfides (bright).

Petrography and Magnetic Susceptibility: The specimen contains some relatively small but well-formed chondrules (mean apparent diameter 300 μm) within a recrystallized matrix containing abundant metal, and is judged to be of petrologic type 5. Accompanying the dominant enstatite ($\text{Fs}_{0.4-0.6}\text{Wo}_{0.1-0.3}$) are alkali feldspar ($\text{Ab}_{88.7-93.1}\text{An}_{1.1-0.9}\text{Or}_{10.2-6.0}$), kamacite (Ni 6.2-6.3 wt.%, Co 0.4 wt.%, Si 3.3 wt.%), niningerite, fresh oldhamite, Cr-bearing troilite and schreibersite. A spherical crystalline object (1.1 mm in diameter) in one studied thin section is composed mainly of fluorrichterite (containing 7 wt.% Na_2O) accompanied by a silica polymorph, enstatite and sulfides. During sample preparation for elemental analysis, black insoluble residue was observed, and is likely graphite. The whole rock magnetic susceptibility measured with an SM30 meter was found to be $5.74 \times 10^{-9} \text{ m}^3/\text{kg}$.

Trace Element Abundances and Si Isotopes: Analysis by ICP-OES and QQQ-ICPMS of powder produced by grinding 2.3 grams of interior material in an alumina mortar gave the following abundances (in wt.%) Fe 28.55, Mg 9.00, Ca 0.73, Na 0.52, S 3.94, Ni 1.97, P 0.14, Cr 0.17, Mn 0.11; (in ppm) V 28, Zn 1.6. In comparison to other enstatite chondrites (notably EH chondrites) analyzed by [2], Oudiyat Sbaa is compositionally very similar but quite poor in Zn. The $\delta^{30}\text{Si}$ isotopic composition is being analyzed for comparison with data for other enstatite chondrites [3].

Discussion: Perhaps the most surprising mineralogical feature in the Oudiyat Sbaa specimen is the presence of fluorrichterite. This amphibole phase has been observed previously as a rare component in EH chondrites such as Abee [4], and fluorphlogopite has been observed in EH chondrite Yamato 82189 [5]. The abundance of halogens and nitrogen in enstatite chondrites has been discussed by [6].

References: [1] Rosén Å. *et al.* (2017) *This conference*. [2] Kallemeyn G. and Wasson J. (1986) *GCA* **50**, 2153-2164. [3] Poitrasson F. (2017) *Rev. Mineral. Geochem.* **82**, 289-344. [4] Olsen E. *et al.* (1973) *Amer. Mineral.* **58**, 869-872. [5] Kimura M. *et al.* (2008) *71st Meteorit. Soc. Mtg., Abstract #5068*. [6] Rubin A. and Choi B.-G. (2009) *Earth Moon Planets* **105**, 41-53.