

A new orthopyroxene-rich diogenite from the Boujdour region, Western Sahara: compositional and textural data. V.Moggi-Cecchi¹, A.Ibhi^{2,3}, H.Nachit^{2,3}, L.Ouknine^{2,3}, G.Pratesi^{4,5}, X.Shehaj⁴, G.S.Senesi⁶, ¹Museo di Storia Naturale “La Specola”-SMA, Università degli Studi di Firenze, Via Romana, 17, I-50125 (FI), Italy, e-mail: vanni.moggicecchi@unifi.it, ²University Museum of Meteorites, 80000, Agadir, Morocco, ³Geoscience and Environment Laboratory, Ibn Zohr University, Agadir, Morocco, ⁴Dipartimento di Scienze della Terra, Università degli Studi di Firenze, Firenze, Italy, ⁵INAF-Istituto di Astrofisica e Planetologia Spaziali, Rome, Italy, ⁶CNR, Istituto per la Scienza e Tecnologia dei Plasmi (ISTP-Bari), Via Amendola 122/D, 70126 Bari, Italy.

Introduction

A complete stone of 14 kg with a moderately fresh fusion crust (Figure 1) was found on March 15, 2023 by the meteorite hunter Ali Lamghari in a flat area called Bir Oued Mounna, about 10 km southeast of the city of Boujdour, Western Sahara (GPS coordinates 26°05.81'N, 14°25.13'W). The area was revisited during a systematic prospecting mission by a team from the University Museum of Meteorites (MUM), Agadir, Morocco (A.Ibhi, L.Ouknine and A. Lamghari) and from the Istituto per la Scienza e Tecnologia dei Plasmi, CNR-ISTP, Bari, Italy (G.S. Senesi) on October 26, 2024, but no further fragments were found. The meteorite is a single stone partly covered with a black and dark brown fusion crust. A broken surface reveals a coarse-grained crystalline texture with mm-sized greenish crystals. The type specimen, weighing 53 g, and one thin section are on deposit at the Museo di Storia Naturale “La Specola” - Sistema Museale di Ateneo of the University of Firenze, Italy (Inv. # I-3745). One polished thin section and a 35 gr chip are deposited at MUM. Ali Lamghari owns the main mass. The meteorite has been submitted for approval to the Nomenclature Committee of the Meteoritical Society with the name Boujdour 001.

Instruments and methods

Optical microscopy was performed at the laboratories of the Dipartimento di Scienze della Terra, Università di Firenze, Italy, using an Axioplan-2 polarizing optical microscope equipped with Axiocam-HR camera. SEM-BSE images have been obtained both at the Scientific Research center of the Ibn Zohr University, Agadir, with a Jeol-JSM IT100 SEM and at the Centro di Servizi di Microscopia Elettronica e Microanalisi (MEMA) of the University of Firenze with a Zeiss EVO-40. Electron microprobe analyzer-wavelength dispersive spectrometry (EMPA-WDS) analyses have been performed at the Firenze laboratories of the IGG – CNR (National Council of Research) with a JEOL-JXA 8230 microprobe.

Experimental results

The SEM-BSE image of polished section of the meteorite shows a granular holocrystalline texture mostly consisting (90%) of very large euhedral orthopyroxene crystals ranging in width from 1 to 5 mm (Figure 2). Few medium grained aggregates,

accounting for 10% of the area and consisting of elongated plagioclase (ranging 400 to 1000 µm in size), olivine, orthopyroxene and diopside crystals, are also visible (Figure 3); other silicate phases include scattered Fe-rich olivine and rare silica grains. Opaque phases are mainly FeNi metal and troilite, with rare ilmenite and chromite grains (up to 400 µm, figure 4).



Figure 1: image of the main mass of the meteorite on the recovery site.

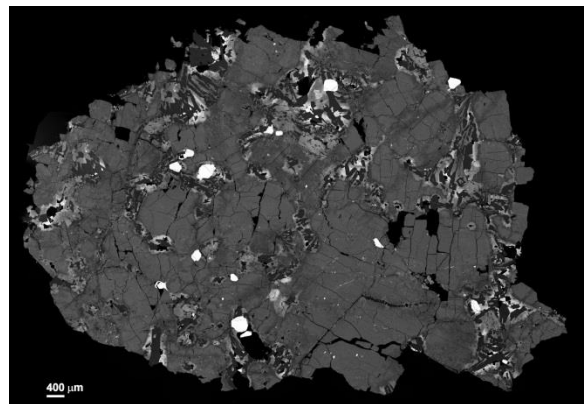


Figure 2: SEM-BSE photomosaic image of a thin section of the meteorite displaying the general texture; scale bar is 400 µm

For classification purposes, the general minerochemical features of the matrix and of selected phases were analyzed by EMPA on both large orthopyroxene grains, as well as olivine, orthopyroxene, diopside and plagioclase crystals of the medium grained aggregates.

As concerns low-Ca pyroxene, both large holocrystalline crystals and the smaller crystals in the aggregates are ferrosilitic ($\text{Fs}_{33.9 \pm 1.5} \text{En}_{61.4 \pm 1.2} \text{Wo}_{4.7 \pm 0.2}$, $N = 12$, $\text{Fe/Mn} = 25.0 \pm 0.2$); High-Ca pyroxene in medium grained aggregates is diopsidic ($\text{Fs}_{59.6 \pm 1.7} \text{En}_{15.8 \pm 1.4} \text{Wo}_{24.6 \pm 2.2}$; $n=6$; $\text{Fe/Mn} = 32.3 \pm 0.3$); scattered olivine crystals among holocrystalline pyroxenes are fayalitic ($\text{Fa}_{94.9 \pm 0.3} \text{Fo}_{5.1 \pm 0.4}$; $n=6$; $\text{Fe/Mn} = 34.9 \pm 0.1$), whereas olivine in aggregates is Fa-poor ($\text{Fa}_{32.3 \pm 1.7} \text{Fs}_{67.7 \pm 1.4}$; $n=6$; $\text{Fe/Mn} = 45.2 \pm 0.2$); $\text{Cr}_2\text{O}_3=0.2$, $\text{CaO}= 0.3$, all in Wt.%). Plagioclase crystals are anorthitic ($\text{An}_{92.0 \pm 0.6} \text{Or}_{0.4 \pm 0.1}$, $n=10$). Chromite grains are Al-rich: $\text{Cr}_2\text{O}_3=54.0$, $\text{FeO}=28.7$, $\text{Al}_2\text{O}_3=9.6$, $\text{MgO}=3.5$, $\text{TiO}_2=2.2$, $\text{V}_2\text{O}_5=0.8$, all in Wt.%.

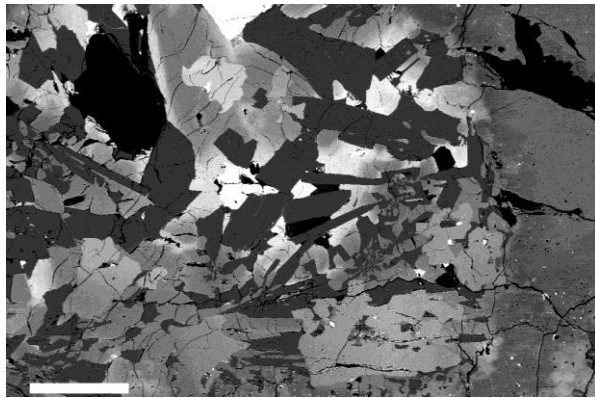


Figure 3: SEM-BSE image of one of the medium grained aggregates of the meteorite; large medium grey euhedral crystals are orthopyroxene; pale to dark grey crystals are olivine, orthopyroxene and diopside; black crystals are plagioclase; white spots are Fa-rich olivine crystals; scale bar is 400 μm .

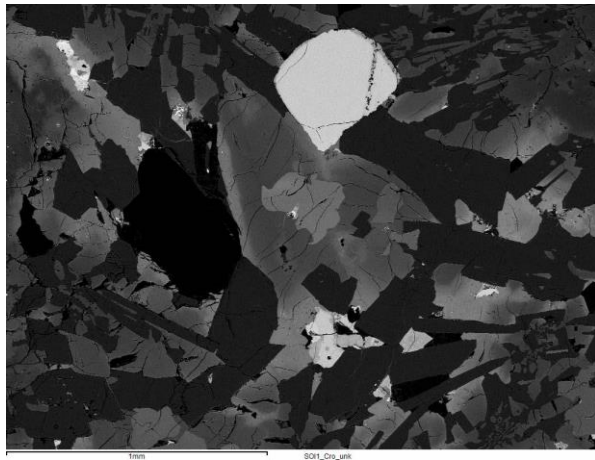


Figure 4: SEM-BSE image of opaque phases of the meteorite; medium grey to black crystals are silicates; pale grey are ilmenite and chromite; white spots are trolite; scale bar is 1 mm:

Discussion and conclusions

According to textural and compositional data, as well as the unbrecciated texture, the meteorite can be classified as a Diogenite, belonging to orthopyroxene-rich subgroup with medium degree of shock and medium degree of weathering [1,2,3].

References:

- [1] Gattacceca, J. et al. (2025) MAPS, in press; [2] Grady M. et al. (2014), Atlas of Meteorites, 1st ed., CUP, Cambridge, pp.350; [3] Scott, E.R.D. et al. (2009), GCA, 73, 5835-5853