Compositional and textural data of Northwest Africa 13599, a new howardite from Sahara. V. Moggi-Cecchi[1], L.Fabrizi[1], G.Pratesi[2], S.Caporali[3], I.A.Franchi[4], R.C.Greenwood[4], [1]Museo di Storia Naturale-SMA, Università degli Studi di Firenze, Via G. La Pira 4, I-5012 (FI), Italy, e-mail: vanni.moggicecchi@unifi.it, [2]Dipartimento di Scienze della Terra, Università degli Studi di Firenze, Via G. La Pira 4, I-50121, Firenze, Italy, [3]Dipartimento Ingegneria Industriale, Università degli Studi di Firenze, Via S. Marta 3, 50139 Firenze, Italy, [4]Planetary and Space Sciences Research Institute, Open University, Walton Hall, Milton Keynes, GB-MK7 6AA United Kingdom

Introduction

This meteorite was purchased by Lucian Cojocaru at the Bologna mineral fair in 2019 (find 2018) from a Moroccan dealer. The main mass, weighing 50 g, displays a partial black, shiny fusion crust with several cracks (figure 1). A sawn surface shows a grey, fine grained, matrix with scattered black clasts up to half centimeter in size. This meteorite has been approved by the Nomenclature Committee of the Meteoritical Society with the name Northwest Africa 13599 [1]. Lucian Cojocaru owns the main mass. The type specimen, weighing 10.0 g, and a thin section is on deposit at the Museo di Storia Naturale – Sistema Museale dell'Università di Firenze (sample # I-3615).

Figure 1: image of the main mass of the meteorite NWA 13599

Instruments and methods

Optical microscopy was undertaken 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 performed at the MEMA Center of the University of Florence with a Zeiss EVO-40. 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 meteorite was investigated by means of optical microscopy, SEM and EMPA techniques. A thin section of the sample was analyzed.

The SEM-BSE image of the thin section shows a polymict breccia (figure 2) with two distinct lithologies: a basaltic lithology and an orthopyroxene-rich lithology with minor olivine and mineral fragments set into a more fine-grained clastic matrix.

Eucrite and diogenite lithologies are found in approximately equal abundances. A large (1 mm) clast consisting of a very fine intergrowth of olivine, silica and plagioclase mixed with larger high-Ca pyroxene is visible (figures 3 and 4). Large orthopyroxene and diopside crystals, ranging in width from 600 to 1000 µm are common, as well as minor olivine crystals and very large (600-1000 µm) clasts of elongated diopside-orthopyroxene crystals.. Scattered low-Ca pyroxene crystals, 400-800 µm in size, with fine (5-10 µm) pigeonite exsolution lamellae are visible. A large (200x800 µm) silica polymorph crystal is also present. Minor phases are FeNi metal and troilite, with rare ilmenite and chromite grains. The thin section displays a moderate weathering and a medium shock stage.

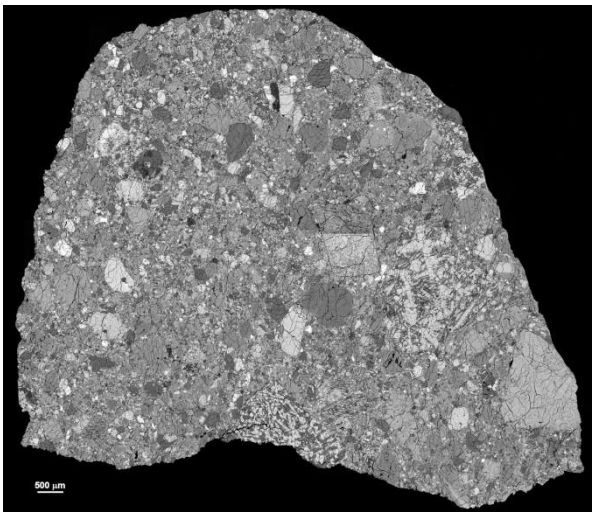

Figure 2: Collage of SEM-BSE images of NWA 13599 displaying the general texture;

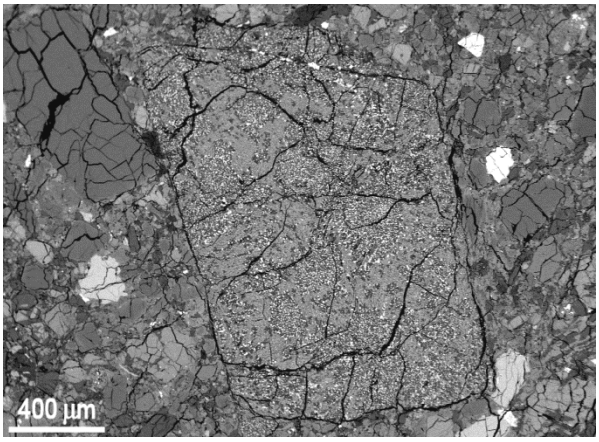

Figure 3: SEM-BSE image of the olivine/silica intergrowth clast of NWA 13599.

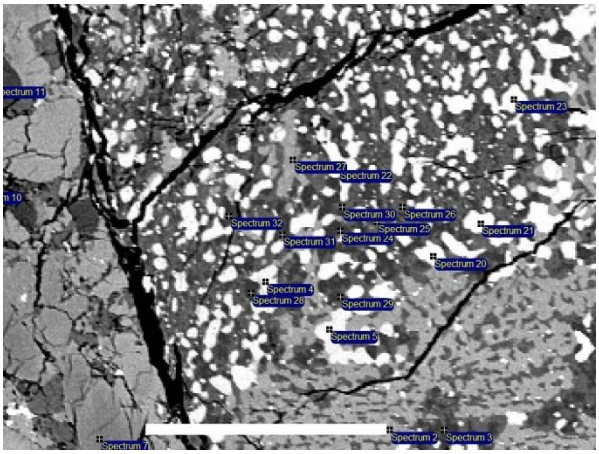

Figure 4: high-contrast blow-up of the previous SEM-BSE image of NWA 13599 with the analyzed points: white spots are olivine; dark grey is silica; pale grey is diopside.

EMPA analyses of individual grains were performed in order to determine the general minerochemical features of the matrix and of single crystals for classification purposes.

The pyroxene host has a ferrosilitic composition ($Fs_{23.3}Wo_{2.6}$, Fe/Mn=29.5), while low-Ca lamellae in exsolved orthopyroxene ($Fs_{55.2}Wo_{4.0}$, Fe/Mn = 28.9) and diopside exsolution lamellae in orthopyroxene are have been also evidenced ($Fs_{29.6}Wo_{41.8}$, Fe/Mn = 27.2); plagioclase is calcic ($An_{86.0}Or_{0.7}$),.

A detailed analysis was performed on olivine. Olivine in Ol/silica intergrowth has an anomalous, markedly fayalitic, composition ($Fa_{75.9}Fo_{24.1}$; n=5; Fe/Mn = 38.3), while olivine crystals outside the intergrowth appear to be more forsteritic ($Fa_{58.4}Fo_{41.6}$; n=8; Fe/Mn = 46.6).

Discussion and conclusions:

The textural and minerochemical data are distinctive and point to a classification as howardite due to the contemporary presence of eucritic and diogenitic lithologies. Oxygen isotopic analyses are planned for this meteorite in order to single out possible deviations from the HED field due to the presence of the olivine/silica clasts [2,3].

References: [1] Gattacceca, J. et al. (2022) *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.