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Petrography and mineral chemistry of the ordinary chondrite NWA 11743: the first meteorite classified in a Greek-based laboratory

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Abstract

We report here on the first meteorite – named NWA 11743 – classified in a Greek-based laboratory. We have observed both porphyritic and non-porphyritic (barred pyroxene; BP) chondrules of type-I. The meteorite matrix, commonly brecciated, is predominantly composed of olivine, low Ca-pyroxene, clinopyroxene, plagioclase, and apatite. The olivine composition ($Fa_{18.6-19.2}$) is typical for H chondrites. The BP-rich chondrules are composed of alternating bars of low- and high-Ca pyroxene. Our detailed petrographic and mineral chemistry investigations suggest that it is an H4 ordinary chondrite with a weathering stage W2.

1. Introduction

We report here on the first petrographic and mineral chemistry results obtained on the ordinary chondrite NWA 11743. The meteorite name was approved by The Meteoritical Society on March 10th, 2018. Standard methods were used to characterize the mineral end-members of the chondrules and matrix of the studied meteorite. We also call attention to the fact that this meteorite represents the first classified meteorite in a laboratory based in Greece.

1.1 Material & Methods

A small meteorite fragment of about 5.0 grams was purchased by I. Baziotis from a dealer in Marrakech, Morocco (in May 2014). The stone is a broken fragment partly covered with fusion crust. A polished thin section was prepared from the fragment and subsequently examined using optical reflected light microscopy to identify the texture and mineralogy.

Major element chemistry and textural characteristics of the matrix, mesostasis, and chondrules were obtained using a JEOL JXA-8900 Superprobe electron probe micro-analyzer at the laboratory of Mineralogy and Geology, Agricultural University of Athens (AUA), Greece. Natural mineral standards were used: quartz (Si), forsterite (Mg), corundum (Al), diopside (Ca), ilmenite (Ti, Mn), K-feldspar (K), albite (Na), fayalite (Fe), and apatite (P), at 15 kV, 15 nA, 20 s on peak counting time and 10 s for each background, and a beam diameter of 3-5 μm.

2. Petrography

Textural observations of the studied thin section in reflected light showed that it is chondritic. Petrographically, partial chondrules are quite common as well as whole chondrules (Fig. 1). The chondrules are both porphyritic and non-porphyritic, and belong to the Type-I [$Mg/(Mg+Fe^{2+})<90$]. The porphyritic olivine (PO) chondrules, rounded to oval in shape, range in size from 300-350 μm to 1200 μm.

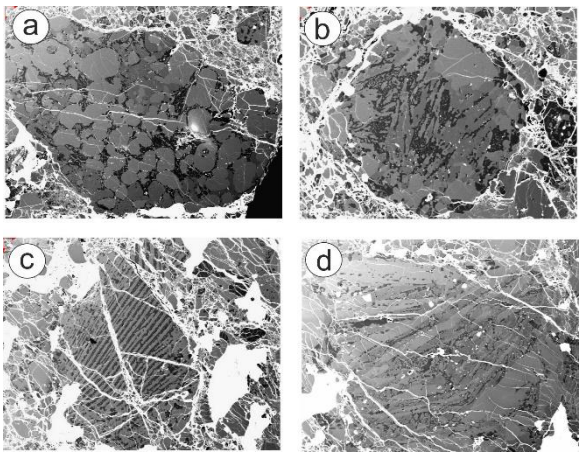

Figure 1: Backscattered electron images of the chondrules and matrix features observed in NWA 11743.

The groundmass consists of olivine (30 vol.%), low Ca-pyroxene (20 vol.%), clinopyroxene (5 vol.%), plagioclase (5 vol.%), and rare phosphate minerals (apatite). In addition, open fractures are filled with

iron oxides (40 vol.%). No shock veins were observed. The rock matrix is commonly brecciated. Black to brown fusion crust partly covers the exterior surface of the sample. Red-brown oxidation is visible on the exterior surface, around metal grains on cut surfaces, and within the matrix.

3. Mineral chemistry

The composition of olivine grains in NWA 11743 is similar to olivine from H chondrites (Fig. 1). NWA 11743 meteorite represents a coarse-grained rock with euhedral to subhedral olivine ($Fa_{18.6\text{-}19.2}$), embedded in a translucent feldspathic ($Ab_{87.6\text{-}82.8}$) glass-rich mesostasis.

The non-porphyritic chondrules are mostly of BP type, showing parallel alternating bars composed of low-Ca pyroxene ($En_{81\text{-}83}Fs_{17\text{-}18}Wo_{1\text{-}2}$) and rare high-Ca pyroxene ($En_{47}Fs_{11}Wo_{42}$) grains.

4. Classification scheme

The NWA 11743 meteorite is classified as an H4 ordinary chondrite. As shown on Fig. 2 it plots in the field of composition typical of H ordinary chondrites.

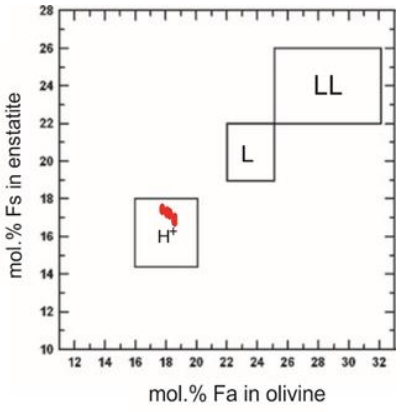

Figure 2: Plot of the chemical composition of olivine and pyroxene grains in NWA 11743. Modified from Brearley and Jones [1].

Here is a summary of the key points allowing its classification (based on [1-3]): a) The meteorite matrix is absent (type 3.2-4), and recrystallized 100% (type 4), b) Olivines with fayalite (Fa) content ranging from 18.6 to 19.2 (type 3.8-4), c). Pyroxenes are low in Ca, with mixed structure (type 4), whereas the ferrosilite (Fs) component displays a narrow range from 17 to 18 (type 4), d) Ca-phosphates (apatite) are present (type 4-6). The weathering stage is minor to slightly moderate oxidized, thus, the rocks was classified at stage W2, with the major silicate minerals being unaffected.

5. Summary and Conclusions

NWA 11743 represents an H4 ordinary chondrite. To our knowledge, it is the first meteorite to be classified in a laboratory based in Greece. The Greek government have announced earlier this year the creation of the Greek Space Agency, and our laboratory at the AUA is in process to establish the first Greek research community in planetary science research. Our main objective is to develop meteoritic science in Greece and to further contribute to the field of planetary research in Europe.

References

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