NWA 4415 AND 4416: Two new enstatite chondrites from northwest Africa

Conference or Workshop Item

NWA 4415 AND 4416: TWO NEW ENSTATITE CHONDRITES FROM NORTHWEST AFRICA. V. Moggi-Cecchi[1], G.Pratesi[2], I.A. Franchi[3], R.C. Greenwood[3], [1]Museo di Scienze Planetarie, Via Galcianese 20/h, I-59100 Prato, Italy, e-mail: v.moggi@pratoricerche.it, [2]Dipartimento di Scienze della Terra dell'Università degli Studi di Firenze, Via G.La Pira 4, I-50123 Firenze, Italy, e-mail: g.pratesi@unifi.it, [3]Planetary and Space Sciences Research Institute, The Open University, Walton Hall, Milton Keynes, MK7 6AA United Kingdom

Introduction

A very small fragment and a small single stone were purchased from a single seller at the Erfoud market by an anonymous collector. Both meteorites have been collected by the seller in the same site and present several similarities that indicate a possible pairing. The fragment (NWA 4415) is a single dark brown 10 g piece with no fusion crust and traces of marked staining, The single stone (NWA 4416) is also dark brown, weighs 259,1 g, lacks fusion crust and shows traces of staining. Both have been approved in 2008 by the Nomenclature Committee of the Meteoritical Society with the names NWA 4415 and 4416, respectively [1]. A cut surface of the bigger stone (NWA 4416) reveals a weakly visible chondritic texture with several metal spots in a dark matrix. The anonymous collector owns both of the main masses. The Museum of Planetary Sciences of Prato (MSP) owns both of the type specimens, weighing 2 and 22 g, respectively, as well as a polished thin sections of each meteorite (inventory #s MSP 5041 and 5042)

Instruments and methods

Optical microscopy and image analysis was undertaken at the laboratories of the Museum of Planetary Sciences of Prato using an Axioplan-2 polarizing optical microscope equipped with Axiocam-HR camera. EMPA-WDS analyses have been performed at the Padova laboratories of the IGG – CNR (National Council of Research) with a Cameca Camebax Microbeam microprobe. Oxygen isotope measurements were undertaken at the Open University by laser-assisted fluorination [2].

Experimental results

The thin sections of NWA 4415 and NWA 4416 show a weakly visible chondritic texture, characterized by rare relic chondrules and chondrule fragments, set in a fine-grained silicate matrix mainly composed of pyroxene (Figure 1). Relic chondrules have dimensions ranging from 200 to 800 µm. Chondrules predominantly display radial pyroxene (RP) textures, with minor porphyritic pyroxene (PP) types. The silicate matrix is mainly composed of enstatite, accounting for about 90 % vol., with rare plagioclase and olivine grains. Opaque phases are mainly altered kamacite and troilite. Alteration products predominantly comprise iron oxides and hydroxides. Schreibersite and daubreelite can be found as accessory phases. The former is associated to kamacite, while the latter can be found as blades intergrown with troilite grains (Figure 2). Multiple thin subparallel and anastomozing veinlets, about 200 µm wide, filled with iron oxides and hydroxides can be easily observed in reflected light (Figure 3). Terrestrial weathering grade is rather high (W3) as can be seen in Figures 2 and 3. The rare olivine grains display a sharp extinction indicating that the meteorite is weakly shocked (S1). The remarkable matrix-chondrules integration suggests a high petrologic type.

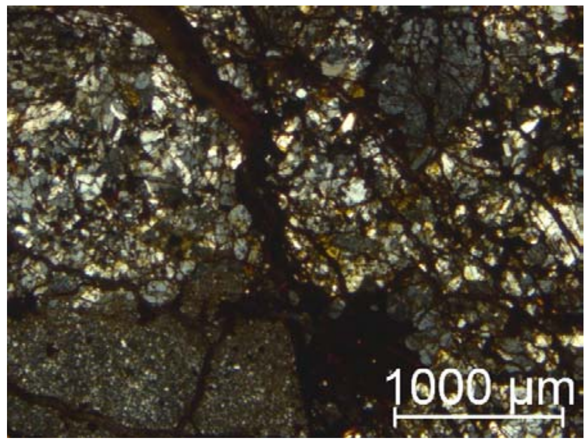

Figure 1: polarizing optical microscope image of a thin section of the enstatite chondrite NWA 4415. Cream-grey areas are enstatite, black areas are metal and troilite; transmitted light, crossed polars.

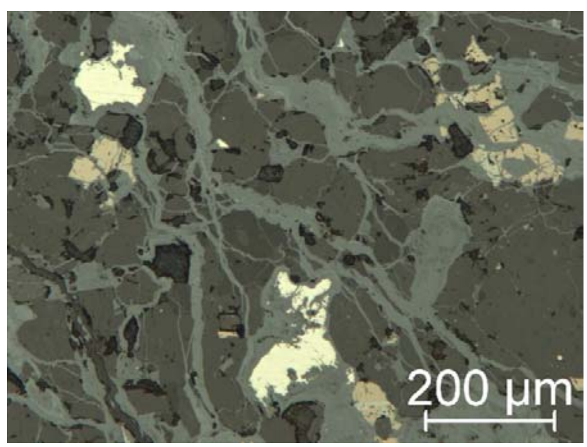

Figure 2: polarizing optical microscope image of a thin section of the enstatite chondrite NWA 4415. Cream-yellow areas are kamacite, bronze areas are troilite, pale-grey areas are iron oxides/hydroxides; reflected light, plane polars.

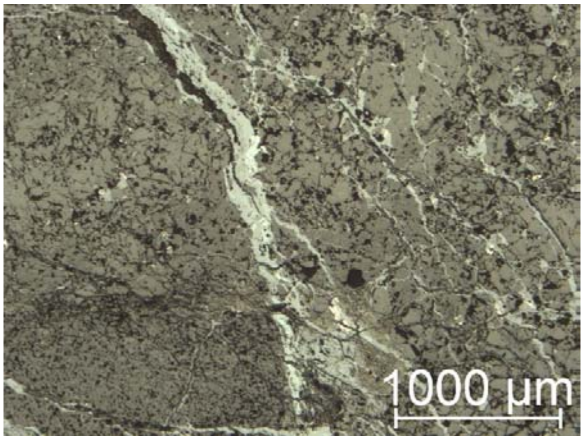

Figure 3: polarizing optical microscope image of a thin section of the enstatite chondrite NWA 4415. Cream-yellow areas are kamacite, bronze areas are troilite, pale-grey areas are iron oxides/hydroxides; reflected light, plane polars.

EMPA analyses of both samples revealed that orthopyroxene in the matrix is rather homogeneous and has a markedly enstatitic composition, ($En_{98}Wo_2$); plagioclase crystal fragments have a homogeneous composition ($An_{15}Or_5$). Opaque phases include kamacite with a rather low Si content (1,5 wt. %). Sulphides are mainly represented by troilite and daubreelite, but extremely rare alabandite [(Mn,Fe)S] grains have also been detected. The oxygen isotope composition of NWA 4415 was $\delta^{17}O$ = 3,34‰; $\delta^{18}O$ = 6,39‰; $\Delta^{17}O$ = - 0,02 ‰. When compared to previous oxygen isotope analyses of enstatite chondrites [3] NWA 4415 has a relatively high $\delta^{18}O$ value consistent with its high terrestrial weathering grade.

Discussion and conclusions

The set of data collected on these enstatite chondrites point to a classification as EL6 chondrites for both meteorites. Oxygen isotope data plot in enstatite chondrite field. The chondrules-matrix ratios suggest a high petrologic type, while the predominance of enstatite and the presence of plagioclase among silicate phases, as well as of schreibersite and daubreelite among opaque phases [4] are distinctive for enstatite chondrites. Other minerochemical characteristics such as the Si amount of kamacite and the presence of alabandite have been previously suggested as being distinctive of the L-group [5]

References: [1] Pratesi G. and Moggi Cecchi V. (2008) *MAPS,* **43**, 1555; [2] Miller M.F. et al. (2000) *Rapid* Commun. Mass Spectrom. **13**, 1211-1217. [3] Newton J. et al. (2000) *MAPS,* **35**, 689-698. [4] Rubin (1997) *MAPS,* **32***,* 231–247. [5] Lin Y. and El Goresy A. (2002) *MAPS,* **37**, 577-599