TEXTURAL AND COMPOSITIONAL FEATURES OF NWA 4222, A NEW MARTIAN METEORITE. 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, Open University, Walton Hall, Milton Keynes, GB-MK7 6AA United Kingdom

Introduction

A single stone weighing 16,5 g was purchased in 2006 at the Erfoud market. The outer surface of the main mass presents a small portion of fusion crust. A cut surface reveals a texture typical of a mafic igneous rock with dark green crystals set in a pale green matrix. Matteo Chinellato owns the main mass, while the type specimen, weighing 3,55 g as well as a polished thin section [1] are on deposit at the Museum of Planetary Sciences (MSP) of Prato, Italy (inventory number MSP 5040).

Instruments and methods

SEM images and EDS analyses have been performed at the MEMA center of the Earth Sciences Department of the University of Florence by means of a Zeiss 515 SEM. 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 have been perfomed at the Planetary and Space Sciences Research Institute Laboratories of the Open University by Richard Greenwood and Ian Franchi.

Experimental results

The thin section of NWA 4222 shows a cumulitic fine-grained porphyritic texture consisting of very large rounded phenocrysts of brown olivine up to 1350 μm in maximum size set in a fine grained basaltic groundmass of twinned tabular pyroxene crystals from 80 to 240 wide and from 130 to 820 large surrounded by an interstitial glassy matrix (Figure 1). Olivine crystals are rather rare and appear to be zoned both in optical and SEM-BSE images. A large area consisting of a homogeneous glassy core surrounded by a inhomogeneous glassy rim is also visible (Figures 2 and 3). Opaque phases are chromite, titanian chromite and ilmenite, up to 100 μm in size, merrillite, and rare pyrrhotite grains up to 50 μm in size (Figure 4). Shock features include strong mosaicism and planar deformation in olivine, undulose extinction and twinning in pyroxene. SEM and EMPA analyses revealed that the large olivine grains are rather inhomogeneous and have, in general, a markedly fayalitic composition, ranging from $Fo_{58,9}$ mol. % in the cores to $Fo_{68,7}$ mol. % in the rims. Pyroxene is primarily pigeonite, ranging in composition from $Fs_{24,1}En_{65,5}Wo_{10,3}$ in the cores to $Fs_{32,62}En_{58,44}Wo_{8,93}$ in the rims, with a FeO/MnO ratio ranging from 32.5 to 46.5. Orthopyroxene is subordinate and ranges from nearly pure enstatite in the cores ($Fs_{17,24}En_{80,35}Wo_{2,41}$) to ferrosilite-enriched terms in the rims ($Fs_{31,41}En_{63,87}Wo_{4,72}$), with a FeO/MnO ratio ranging from 30.2 to 42.4. The matrix is mainly consisting of plagioclasic glass ($An_{61.15}Or_{0,25}$). The glassy area

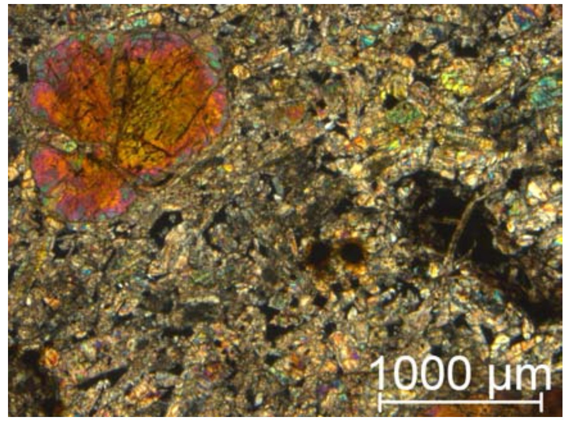

Figure 1: polarizing optical microscope image of a thin section of the martian meteorite NWA 4222 (sample MSP 5040). The rounded orange-pink grain is olivine, elongated yellow crystals are pyroxene; transmitted light, crossed polars.

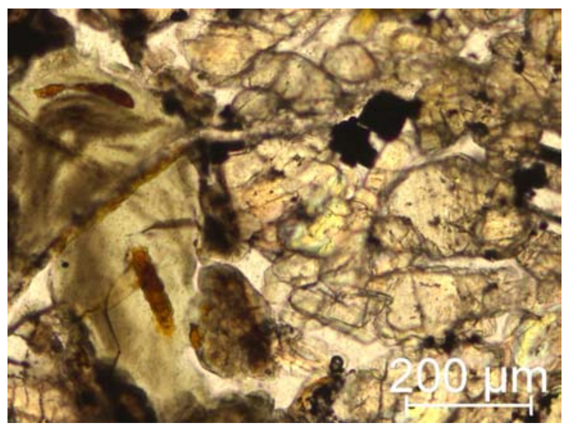

Figure 2: polarizing optical microscope image of a thin polished section of the martian meteorite NWA 4222 (sample MSP 5040). The large dark-brown-green area is glass; transmitted light, plane polars.

represented in Figure 2 and 3 has a variable pigeonitic composition. The inner area (pale grey in figure 3) is homogenous and is enriched in Mg and Al, while the outer area has fringes ranging from a Mg,Al rich pigeonite (dark grey in Figure 3, top left) to a Fe,Al rich one (white areas in Figure 3, top left). Oxygen isotope data (I.A.Franchi, R.C.Greenwood, *OU*) confirm textural and compositional data and are consistent with a classification as martian meteorite: $\delta^{17}O = 2.85$ ‰, $\delta^{18}O = 4.91$ ‰, $\Delta^{17}O = 0.30$ ‰ (mean on 2 analyses).

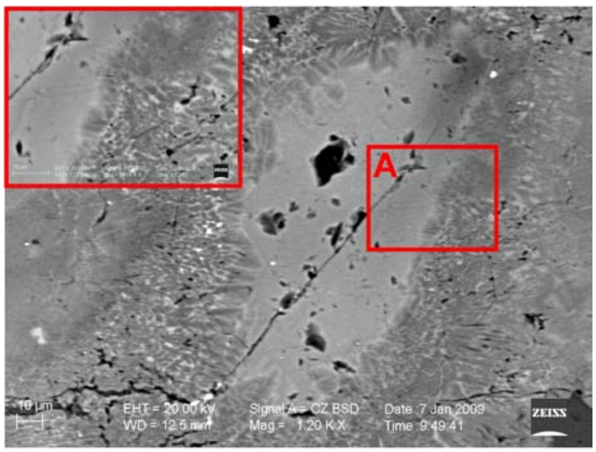

Figure 3: SEM-BSE image of the same area of figure 2; the inner pale grey area is a pigeonitic glass. This area is surrounded by glass fringes; top left: blow up of area A showing the Mg-enriched glass (dark grey) and the Fe-enriched one (white).

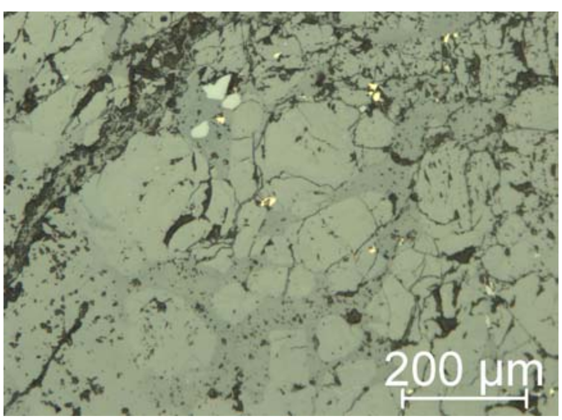

Figure 4: polarizing optical microscope image of a thin polished section of the martian meteorite NWA 4222 (sample MSP 5040). Tiny yellow grains are pyrrhotite; pale grey grains are ilmenite; reflected light, plane polars.

Discussion and conclusions

The set of data collected on this igneous rock point to a classification as martian meteorite. Oxygen isotope data plot in the SNC field. Textural and compositional data, as well as similarities with other martian meteorites from Sahara desert like Dag 476, 489 and 670 [2,3,4] or from Northwest Africa.

References: [1] Weisberg, M.K. et al. (2008) *MAPS,* **43**, 9, 1555; [2] Zipfel J. et al. (2000) *MAPS,* **35***,* 1, 95–106. [3] Folco L. et al. (2000) *MAPS*, **35**, 4, 827-839; [4] Folco L. and Franchi I.A. (2000) *MAPS*, **35**, 5, A54;