A new CO carbonaceous chondrite from Acfer, Algeria

Conference or Workshop Item

A NEW CO CARBONACEOUS CHONDRITE FROM ACFER, ALGERIA. A.Salvadori[1], V. Moggi-Cecchi[1], G.Pratesi[2], I.Franchi[3], R.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

Many small fragments, totally weighing 118 g were found in the Acfer area by an italian dealer. The coordinates of the find are the following: 26°36.52 N - 04°03.18 E. The provisional name Acfer 374 has been assigned to this meteorite by the Meteoritical Society's nomenclature committee. The main mass weighs 100 g and displays a very frail appearance since it looks to be composed by a very dark material, with a low density. The outer surface of the sample is brown-red while the inner part is darker. The Museum of Planetary Sciences of Prato (MSP) owns both the main mass (catalogue number: MSP 2283), weighing 100 g, and the type specimen, weighing 18 g, as well as 2 polished thin sections [1].

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 Philips 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

From a petrographic point of view, both the hand specimens and the thin section of this meteorite have a typical carbonaceous-chondrite appearance, with few chondrules set in a dark matrix.. The thin section displays a chondritic texture, with chondrules' sizes ranging from 30 to 450 µm (mean value on 170 chondrules = 110 µm) A gaussian fit on this sample provided a center value of 80 µm. Chondrules' types are variable, with a predominance of granular olivine (GO, 36 out of 60) type. Minor amounts of porphyritic olivine (PO, 10) and granular olivine pyroxene (GOP, 7) as well as rare radial pyroxene (2), cryptocrystalline (2), porphyritic olivine-pyroxene, barred olivine and recrystallized (all 1) are also present. The meteorite has a matrix-chondrules ratio of about 0.5. Chondrules are set in a very fine-grained matrix composed by olivine, phyllosilicates and pyroxene (Figure 1). GO chondrules are characterized by the presence of a poikilitic texture, with olivine crystals enclosed in large clinoenstatite crystals. Some CAIs and amoeboid olivine inclusions (or aggregates, AOIs or AOAs), accounting for about 10 % of the total volume, can be seen (Figure 2). Opaque phases are diffused as intra- or interchondrules material, mainly as rims outside chondrules, and account for 6-8 % of the total volume (Figure 3). Most of them are represented by Fe-Ni alloys, troilite, pentlandite and pyrrothite. Rare awaruite ($Ni_{2-3}Fe$) and tetrataenite (FeNi) grains, as well as schreibersite and nickelphosphide ones, have been also detected. Terrestrial weathering grade is relatively low (W1). Sharp extinction of olivine indicates that the meteorite is weakly or not shocked

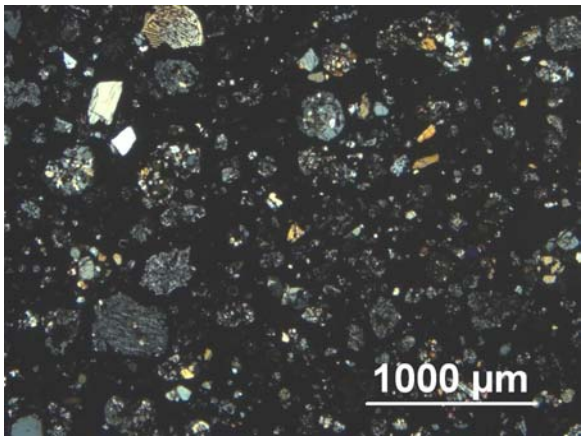

Figure 1: polarizing optical microscope image of a thin section of the CO chondrite sample MSP2283. Light grey and brown grains are olivine, black areas are metal and troilite; transmitted light, crossed polars.

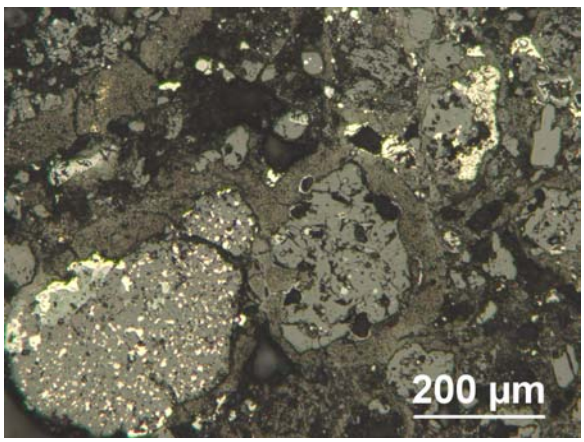

Figure 2: polarizing optical microscope image of a thin polished section of the CO chondrite sample MSP2283. Pale-yellow grains are Fe,Ni alloy, light grey areas are Fe-oxides, brown areas are troilite; reflected light, plane polars.

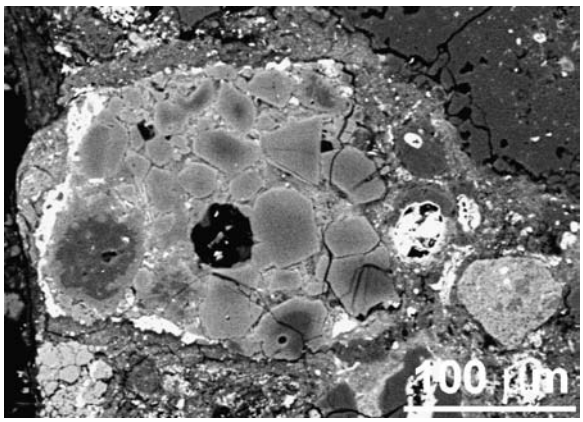

Figure 3: SEM-BSE image of the CO chondrite sample MSP2283. White areas are Fe,Ni alloy and sulphides; grey areas are silicates; a type II chondrule with zoned olivine crystals can be observed.

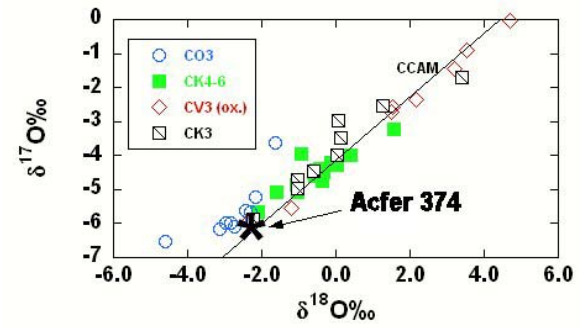

Figure 4: Oxygen isotopes diagram displaying sample MSP 2283 OI data compared with literature data for CO, CK and CV-ox chondrites

(S1).

SEM and EMPA analyses reveal a marked variability of olivine composition, whose Fa values range from 1 to 45 mol. %, with a PMD = 177 (calculated on 26 analyses). Compositional differences between olivine crystals in type I chondrules and those in type II chondrules have been noted. Type I chondrules' olivine displays an extremely narrow compositional range, with Fa values ranging from 0 to 5 mol. % (with a mean value of 2.9 mol.%). These chondrules are predominantly of GO type. According to literature data, which subdivide type I chondrules in metal-rich and metal-poor ones [A], Acfer 374 displays a higher amount of metal-poor types. Olivine in type II chondrules is Fe-enriched and has a variable composition which ranges from 0 to 45 mol. % (Figure 3). Olivine in AOIs displays very low Fa contents ranging from 0 to 4 mol. %. Low-Ca pyroxene are predominantly enstatitic (En = 85-100 mol.). High Ca-pyroxene can be also found in porphyritic chondrules. It displays a diopsidic composition (Fs = 0.90, En = 62.43, Wo = 36.58 mol. %). No plagioclase crystals have been found but a mesostasis of plagioclasic composition is commonly found as interchondrule material. Kamacite composition is rather distinctive, with a Ni contents ranging from 4 to 5 wt. % (mean value 4.61) and a Co contents ranging from 0.1 to 1 wt. % (mean value 0.16). The oxygen isotope analyses plot close to the CCAM line within the CO3 chondrites field and at the edge of the CV3-oxidized and CK chondrites fields ($\delta^{17}O$ = - 6.042‰; $\delta^{18}O$ = - 2.306‰; $\Delta^{17}O$ = - 4.843‰; I.Franchi, R.Greenwood, *Open University*)

Discussion and conclusions:

Petrographic features, like chondrules' dimensions and types (predominance of GO-type), the presence of twinned clinoenstatite and the absence of plagioclase crystals point to a classification as CO carbonaceous chondrite, in agreement with [2]. Chondrules-matrix ratio is also consistent with this classification as indicated by [3] and [4]. Oxygen isotope data (Figure 4) and other minero-chemical data, like the presence of type I and type II chondrules and the bimodal distribution of olivine composition, confirm this hypothesis. The forsteritic coimposition of olivine in AOIs and the low Ni and Co contents of kamacite (Figure 3) suggest for this meteorite a low petrologic type (3.0-3.1) in agreement with [5],[6],[7] and [8].

References: [1] Pratesi G. and Moggi Cecchi V. (2006) *MAPS,* **41**, in press [2] Rubin, A. E. (1989) *MAPS*, **24**, 179 [3] Mc Sween, H. (1977) *GCA,* **41**, 477-491 [4] Mc Sween, H. (1977) *GCA,* **41**, 411-418 [5] Chizmadia, L. (2002) *MAPS*, **33**, 1781-1796 [6] Fuchs, L. and Olsen E. (1973) *EPSL*, **18**, 379-384 [7] Shibata, Y. (1996) *NIPR*, **9**, 79-96 [8] Smith, D. (1993) *EPSL*, **120**, 487-498