Textural and minerochemical features of Dar al Gani 1067, a new CK chondrite from Libya

Conference or Workshop Item

Textural and minerochemical features of Dar al Gani 1067, a new CK chondrite from Libya. S.Caporali[1],V. Moggi-Cecchi[2], G.Pratesi[2,3], I.A.Franchi[4], R.C.Greenwood[4], [1]Dipartimento di Chimica, Università degli Studi di Firenze, Via della Lastruccia 3, 50019, Sesto Fiorentino (FI), Italy, email: stefano.caporali@unifi.it, [2]Museo di Storia Naturale, Università di Firenze, Via G. La Pira 4, I-50121, Firenze, Italy, [3]Dipartimento di Scienze della Terra, Università di Firenze, Via G. La Pira 4, I-50121, Firenze, Italy, [4]Planetary and Space Sciences Research Institute, The Open University, Walton Hall, Milton Keynes, MK7 6AA United Kingdom

Introduction

A single stone weighing 260 g was found in February 2006 by Romano Serra during a meteorite search expedition in the Al Jufrah region of Libya. The coordinates of the find are the following: 27° 23.06' N, 16° 05.77' E. The outer surface is almost completely covered by fusion crust, with several contraction cracks. A cut surface displays a chondritic texture, with several chondrules set in a dark grey matrix. No clear metal spots are visible at the hand specimen scale. The meteorite has been approved by the Nomenclature Committee of the Meteoritical Society with the name Dar al Gani 1067 (DaG 1067) [1]. The Museo del Cielo e della Terra of S. Giovanni in Persiceto owns the main mass. The type specimen, weighing 21 g, and a thin section is on deposit at the Museo di Storia Naturale dell'Università di Firenze (sample N° RI-3226).

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 imaging has been undertaken at the Dipartimento di Chimica, Università degli Studi di Firenze laboratories using a Hitachi S-2300 SEM. EMPA-WDS analyses have been performed at the Firenze laboratories of the IGG – CNR (National Council of Research) with a Jeol Microbeam microprobe. Oxygen isotope measurements were undertaken at the Open University.

Experimental results

The thin section displays a texture composed of separated chondrules containing abundant magnetite in a coarser grained, recrystallized matrix mainly consisting of olivine crystals. Chondrules are not always well defined and are sometimes altered. They have a mean size of 800 μm (on 23 chondrules), with gaussian fit on the sample that provided a center value of 650 μm. Chondrules are of various types: granular olivine (GO) prevailing (16 out of 23), with minor porphyritic-olivine/porphyritic-olivine-pyroxene [2] and granular olivine/pyroxene [2]. Most GO chondrules display a poikilitic texture. The matrix is coarse grained and is formed by devitrified olivine crystals and a mesostasis of plagioclase composition. A matrix/chondrule ratio of about 0.70 has been determined. In the thin section analyzed AOIs are very rare and extremely altered and account for less than 1% of the total volume. A single very large CAI, up to 1.1 mm in size is visible on the upper right border of the section (Figure 1). Fe-Ni metal is extremely rare and altered, while magnetite, present as rounded blebs inside chondrules or as irregular grains outside chondrules, is abundant and accounts for about 7 vol%. Sulphides are also rare (they account for about 1-4 vol%) and are mainly present outside chondrules. The terrestrial weathering grade is moderate (W1).

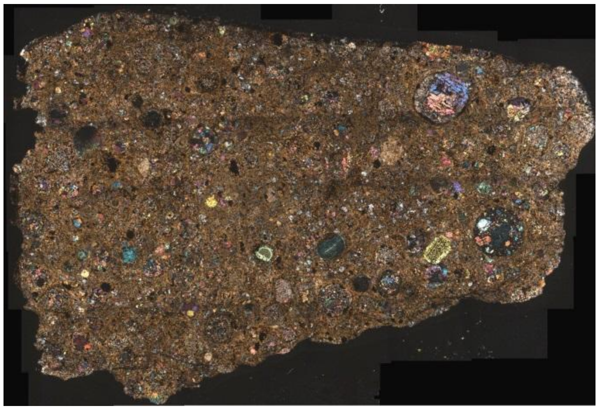

Figure 1: polarizing optical microscope image of a thin section of the CK chondrite DaG 1067. Blue, green and pink grains are olivine, black areas are metal and troilite; transmitted light, crossed polars; f.o.v. 36 mm

SEM and EMPA analyses performed on olivine crystals in the matrix showed a homogeneous composition, with Fa values ranging from 30 to 34 mol. % (mean value $Fa_{33.3\pm1.3}$, Fe/Mn = 158.0±10.1, n = 7). Zoned olivine crystals, with a core-to-rim composition ranging from Fa_9 to Fa_{34}, have been detected in PO chondrules. Low-Ca pyroxenes in GO and GOP chondrules display a homogeneous composition, mainly enstatitic ($En_{90\ 100}$ mol. %). High-Ca pyroxenes in PO and POP chondrules display an augitic composition ($Fs_{10.7\pm0.4}Wo_{45.8\pm1.3}$, Al_2O_3 = 1.06 Wt.%, n = 7). Plagioclase crystals are albitic, with An values ranging from 35 to 50 mol. %. (mean $An_{46.5}Or_{2.6}$). Among opaque phases magnetite is the predominant phase (figure 2) and displays rather high Cr contents (1-2 wt. %). Sulphides mainly consist of troilite, which shows rather high Ni contents (1-2 wt. %). The very rare kamacite grains have a low Ni content.

In terms of its oxygen isotope composition DaG 1067 plots within the CV and CK fields ($\delta^{17}O$ = -4.62‰; $\delta^{18}O$ = -0.70‰; $\Delta^{17}O$ = - 4.26‰.

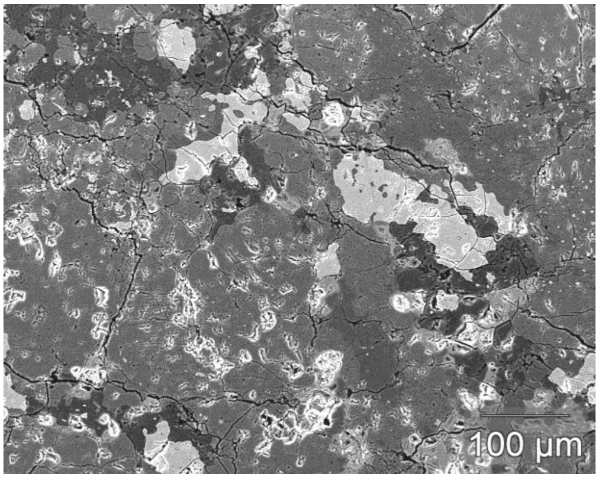

Figure 2: SEM-BSE image of the matrix of the CK chondrite DaG 1067; white areas are magnetite and sulphides; grey areas are silicates.

Discussion and conclusions:

A classification as CK chondrite is suggested by some petrographic features such as the mean chondrules dimensions, the coarse grained matrix and the presence of AOIs and CAIs. The presence of clinoenstatite in poikilitic chondrules, in agreement with [2,3,4,5] and [6], as well as oxygen isotope data [7,8], confirm this hypothesis (figure 3).

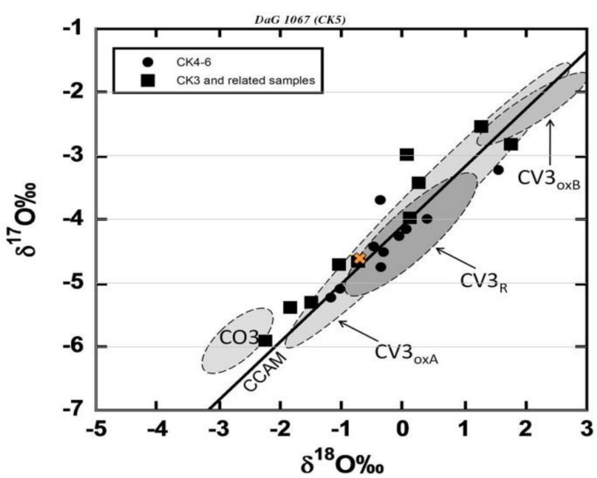

Figure 3: Oxygen isotopes diagram for CO, CK and CV chondrites from literature data. The OI data for DaG 1067 are indicated by an orange cross.

The composition of olivine and pyroxene, as well as the predominance of magnetite among opaque phases are compatible with this classification [3,9].

Chondrules-matrix integration and compositional data suggest a petrologic type 5.

References:

[1] Bouvier, A. et al. (2016) *MAPS*, in press; [2] Rubin A. E. (1991) *Am. Min.*, 76, 1856–1862; [3] Grady M. et al. (2014), *Atlas of Meteorites*, 1st ed., CUP, Cambridge, pp.350; [4] Moggi-Cecchi et al. (2006), *Period. Mineral.*, 75, 217–232; [5] Noguchi P. (1993) *NIPR*, 6, 204-233. [6] Nakamura T. et al. (1993) *NIPR*, ,6 , 171-185; [7] Greenwood R.C.. et al. (2010) *GCA*, 74, 5, 1684-1705; [8] Greenwood R.C.. and Franchi. I.A. (2004) *MAPS*, 39, 11, 1823-1838; [9] Rubin A.E. (1993) *MAPS*, 28, 130-135.