MINERALOGY, PETROGRAPHY AND GEOCHEMISTRY OF CAVEZZO, A "DOUBLE-FACED" CHONDRITE.

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Introduction:

The Cavezzo meteorite, which fell on January 1st 2020, is the first meteorite detected and recovered by the Italian PRISMA Fireball Network [1,2]. Two specimens, weighing 3.12 g (Cavezzo 1) and 52.19 g (Cavezzo 2), were collected three days after the bolide was observed. In the following days, the γ-ray activity was measured on Cavezzo 2 at the INAF Monte dei Cappuccini Laboratory in Torino [3] showing the presence of many cosmogenic radioisotopes including ^{48}V, typical of a recent fall.The type specimen, represented by the whole Cavezzo 1 and a chip from Cavezzo 2, is on deposit at the Natural History Museum of the University of Firenze ((Inv. #s I3557 and I3613). The main mass (Cavezzo 2) is on deposit at the Museum of Planetary Sciences in Prato. Cavezzo 1 (lithology A) shows a very peculiar modal mineralogy such as the relatively high amount of olivine (67 vol%), plagioclase (14.8 vol%), high-Ca pyroxene (9.1 vol%) and chlorapatite (3.1 vol%), low content of low-Ca pyroxene (5.6 vol%), metal (<0.1 vol%) and troilite (< 0.1 vol%) although the compositional values for olivine (Fa 24.24 mol%) and low-Ca pyroxene (Fs 20.41 mol%) are similar to those of the L chondrite group [4]. Cavezzo 2 specimen (main mass – lithology B) has a more typical L ordinary chondrite crystal chemistry and modal mineralogy. As concerns the values of oxygen isotopes, specimen 1 stands at the border between the lower values of the L group and the higher values of the H group (δ^{17}O‰ 3.250; δ^{18}O‰ 4.736; Δ^{17}O‰ 0.788) whereas specimen 2 is at the opposite border of the field (δ^{17}O‰ 3.737; δ^{18}O‰ 4.957; Δ^{17}O‰ 1.159). Even the bulk chemistry confirms a different content of many minor and trace elements (including REE) between the two lithologies.

Instruments and methods:

Optical microscopy was performed at the Museum of Planetary Science in Prato by means of a Zeiss Axioplan II optical microscope. Electron Dispersive X-ray Spectrometry (EDS) microanalyses, major elements bulk chemistry, elemental mapping and modal mineralogy were undertaken at the MEMA laboratories of the University of Firenze using a Zeiss EVO MA15 SEM. Mineral chemistry analyses were performed at the geochemistry laboratories of the Open University using a CAMECA SX-100 Electron Microprobe and at the laboratories of the Università di Firenze Earth Sciences Department using a JEOL JXA-8230 Electron Microprobe both instruments equipped with wavelength dispersive spectrometers (WDS). Trace element concentrations were measured at the Open University using an Agilent 7500a ICP-MS.. Oxygen isotopic analysis was undertaken at the Open University using an infrared laser-assisted fluorination system [5].

Results, discussion and conclusions:

Cavezzo 1 and Cavezzo 2 specimens belong to ordinary L-group of the chondritic class and are characterized by an identical chemistry composition of the main and secondary phases. Nevertheless there are significant differences between them when the textural features, modal mineralogy, geochemistry and oxygen isotopic composition are considered. Cavezzo 1 is characterized by a very low amount of Fe,Ni and sulphides, uncompatible with L-chondrites, contains chlorapatite and shows the occurrence of spinel within the plagioclase veins. Cavezzo 2 has a higher amount of Fe,Ni and sulphides, contains both chlorapatite and merrillite and doesn't show spinel in plagioclase veins. Noteworthy, the oxygen isotope compositions of the two specimens are clearly different each other. In Cavezzo 1 the concentration of almost all elements, both siderophile and chalcophile ones, is higher from that showed by ordinary chondrites. Furthermore, Cavezzo 1 and Cavezzo 2 have very dissimilar REE patterns All these features, together with the fact that the two specimens do not contain fragments of each other, suggest that Cavezzo 1 represents a previously unsampled portion of the L parent body and dictate that this fall be classified as an anomalous L5 ordinary chondrite.

References: [1] Carbognani A. et al., 2020. A case study of the May 30, 2017, Italian fireball. Eur.Phys.J.Plus 135:255. [2] Gardiol D. and the PRISMA-Team. 2019. News from the italian PRISMA fireball network. Proc. 37th Int. Meteor Conf., p. 81-86. [3] Taricco C. et al. 2006. Galactic cosmic ray flux decline and periodicities in the interplanetary space during the last 3 centuries revealed by 44Ti in meteorites. J. Geoph. Res.111, A08102, doi:10.1029/2005JA011459. [4] Grady M.M., Pratesi G., Moggi Cecchi V. 2014. Atlas of Meteorites. Cambridge University Press, Cambridge, p. 384. [5] Greenwood R. C., et al. 2017. Melting and differentiation of early-formed asteroids: The perspective from high precision oxygen isotope studies. Chemie der Erde 27:1–43