Chirfa

THE LARGEST METEORITE SPECIMEN FROM MARS ID #263

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Once Upon a Tine… Martian Meteorites!

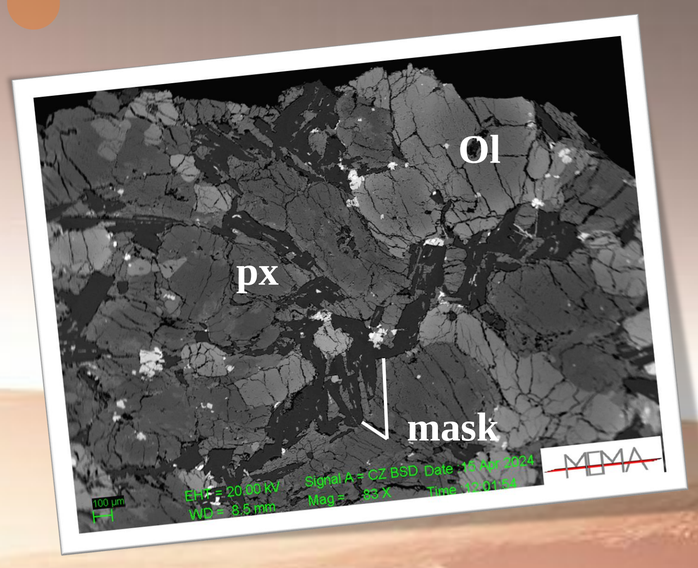
The Martian meteorites (MMs) are peculiar igneous rocks distinguished from other achondrite meteorites based on their different petrography, mineralogy, mineral-chemistry, major and trace elements, and isotopic compositions. To date, MMs are classified into three main groups: Shergottites (basalts), Nakhlites (clinopyroxenites), and Chassignite (dunite). In addition, two unique types of meteorites have been found: ALH84001 (orthopyroxenite) and NWA 7034 (and the related pairs) regolith breccias. The basaltic shergottites, the most abundant MMs (about 90%), can be further subdivided into the following subgroups: basaltic (45%), olivine-phyric (30%), poikilitic (18%), gabbroic (5.5%), augite-rich (0.9%) and pigeonite-rich NWA 10414 (0.5%) (Udry et al., 2020).

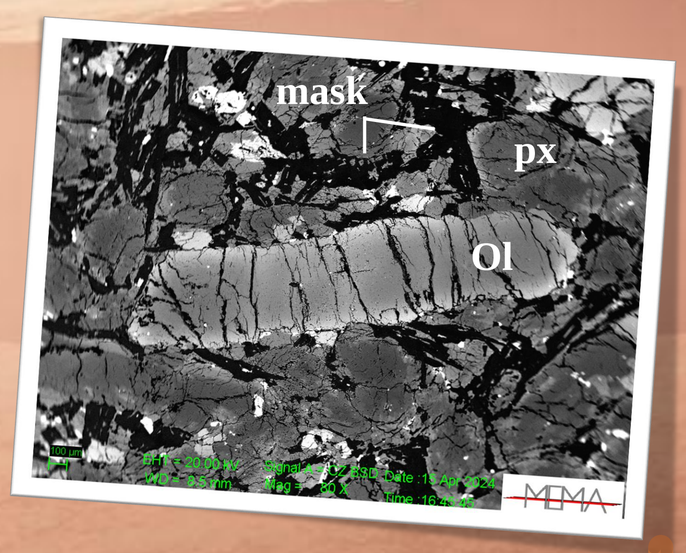
«Chirfa»…Who are you?

In this work, we present the preliminary petrographic results of a new MM found on 18th November 2023 in the Sahara desert near Chirfa, Niger. It represents the largest individual Martian sample hitherto described in the Meteorite Bulletin database — total weight of ~ 24.6 Kg.

I want to know you more…

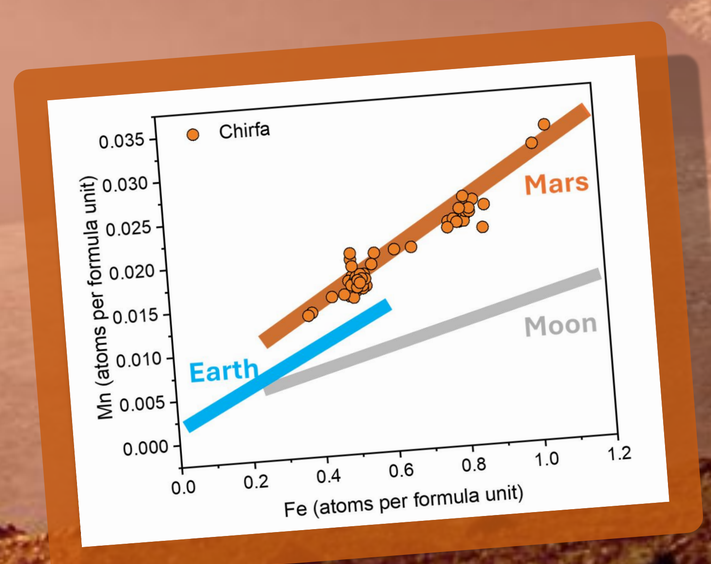
A centimeter-size fragment has been embedded and polished for petrographic investigations. Backscattered images were acquired by scanning electron microscopy (SEM) Zeiss EVO MA15 at the Centro di Servizi di Microscopia Elettronica e Microanalisi (MEMA) Laboratory – Università degli Studi di Firenze. An accelerating voltage of 15-kV and beam current of 10-nA were employed to collect backscattered electron (BSE) images and Energy-Dispersive X-ray Spectroscopy (EDS) analyses. Quantitative mineral analyses with the JEOL JXA 8230 were performed in wavelength-dispersive mode at the Università degli Studi di Firenze. An accelerating potential of 15 kV was used, and ZAF correction was applied to all measurements. Mineral modal abundances were calculated using FIJI and GIMP software.



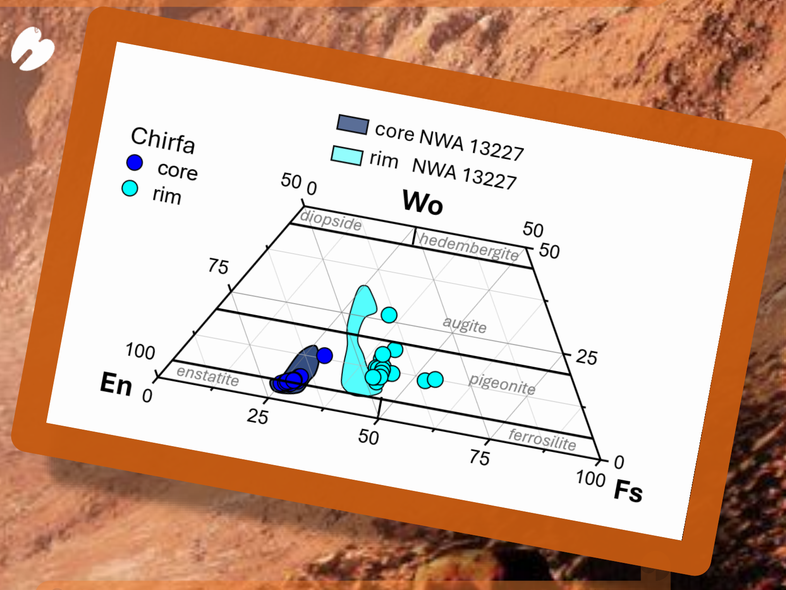


Backscattered images show a coarse-grained texture, dominated by pyroxene (px), olivine (ol), and plagioclase, possibly maskelinite (mask). Oxides, phosphates, and sulfides are present as accessory phases.

Modal Abundace							
minerals	ol	px	mask	phosfates	ilmenite	Fe-Cr-Ti oxides	sulfur
vol. %	15.4	61.0	21.3	1.4	0.5	0.3	0.2



Manganese (Mn) and iron (Fe) concentrations in pyroxene crystals. The orange dots are data from «Chirfa», while the orange line shows the trend of Martian meteorites.



Quadrilateral Classification (Morimoto, 1988) of the studied clinopyroxenes. The core of low-Ca pyroxenes is in agreement with the pyroxene crystals of the olivine gabbroic shergottite NWA 13227 (Benaroya et al., 2024), although the «Chirfa» pyroxenes rim appears slightly enriched in Fe compared to NWA 13227.

Word up!

Olivine gabbroic shergottite, proposed as a link between gabbroic and poikilitic shergottites (Benaroya et al., 2022), are coarse-grained igneous rocks predominantly composed of pyroxene, olivine and maskelinite. Likewise, the poikilitic shergottites contain poikilitic olivine set in a groundmass of smaller olivine, pyroxene, and maskelinite. The coarse grained and poikilitic texture, and the abundance of maskelinite (>10 vol%) found in the «Chirfa» meteorite, suggest more affinities to olivine gabbroic shergottite (e.g., Wu et al., 2023) rather than poikilitic, or other shergottite subtypes. In conclusion, we propose that the «Chirfa» meteorite, the largest Martian specimen, is an olivine gabbroic shergottite.

I would like to see you again…

We believe the 'Chirfa' meteorite holds significant value in furthering our understanding of Martian geological processes. Therefore, we propose to conduct comprehensive petrographic, petrologic, and geochemical analyses. These investigations could potentially enhance our knowledge and shed new light on the geological history of Mars.

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10 cm

The «Chirfa» meteorite