SIRJAN 001: AN UNGROUPED IRON METEORITE FORMED IN A SULFUR-RICH ENVIRONMENT

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Introduction: Sirjan 001 is an iron meteorite weighting ~12.9 kg that was found in March 2018 in Kerman province (Iran). Based on petrographic and bulk-rock elemental composition, we classified it as an ungrouped iron. Considering textural and mineralogical characteristics, Sirjan 001 shows similarities to an unofficial grouplet of meteorites called sulfide-irons, and is by far the largest of this type [1-4]. Studying rare iron meteorite types, such as Sirjan 001, provides valuable information on high-temperature parent body processes. Among such processes are melting and segregation of Fe-Ni-S-rich phases that led to local and/or regional differentiation of parent bodies, and the diversity of the objects in the Solar System.

In this multi-method study, we investigate the origin and petrogenesis of Sirjan 001. Here, we discuss texture, mineralogy, bulk-rock composition, and chromite oxygen isotopic composition. Complementary to this report, we discuss the elemental and isotopic cosmochemistry of siderophile elements of Sirjan 001 in [5].

Methodology: We used a Bruker M4 Tornado µXRF instrument (AMGC, VUB) for mineralogical observations and elemental mapping. High-magnification petrography was performed using a PANalytical (Quanta 200) ESEM equipped with an EDAX (Apollo 10 CDD) EDS at the RBINS. For bulk-rock major and trace elemental analysis, we used Thermo Fisher Scientific iCAP (ICP-OES) and Agilent 7700 Q-ICP-MS at ULB. Samples for this step were prepared based on the method described in [6], which involved using *aqua regia* for dissolution. Oxygen isotopic composition of chromite was measured using a CAMECA SIMS 1270 E7 at CRPG-CNRS.

Results: Sirjan 001 is a single stone with well-preserved regmaglypts showing minimal weathering in cut surface. Cut surface shows a gray metallic interior with metal-sulfide eutectic texture (Fig. 1). Irregular sulfides (troilite) are surrounded by Fe-Ni metal (Ni-rich and Ni-poor). Fe-Ni metal shapes are controlled by troilite outlines. Modal abundances (point counting; n=1000) of Fe-Ni metal and troilite, are 63% and 37%, respectively. Length measurement of 347 troilites yield the following values for mean, mode, and median: 1111±672 µm, 837 µm, and 894 µm, respectively. In addition, schreibersite occurs as an accessory mineral. A few crystals of chromite, graphite, pentlandite, and silicates are observed. Bulk composition concentrations are: Co=0.57, Ni=12.8 (wt%); Cu=320.7, Ga=20.0, Ge=42.4, As=8.4, Mo=4.9, W=0.7, Ir=3.7, Pd=5.6 (µg/g). Average mineral compositions measured by µXRF are (in wt%): Ni-poor metal: Fe=93.6±0.08, Ni=6.11±0.03, Ni/Fe=0.07; Ni-rich metal: Fe=88.0±1.2, Ni=11.4±1.2, Ni/Fe=0.13; sulfide: Fe=80.5±1.7, S=19.6±1.8, Ni=1.9±0.1, S/Fe=0.25. $\Delta^{17}O$ in two measured chromites are: #1: 0.53±0.43, 0.64±0.44 and #2: 0.50±0.45, 0.51±0.51 and fall on terrestrial fractionation line.

Discussions and Conclusions: Based on textural, mineralogical, and chemical characteristics, Sirjan 001 shows similarities to MET 00428, HOW 88403, RBT 04162, RBT 04299, SaW 005, and Sahara 03505 ungrouped irons. These meteorites are known for their relatively high modal troilite contents compared to other irons. Their formation has been suggested to be related to impact melting in chondrite parent bodies [1-4]. We will discuss different scenarios involved in the formation of Sirjan 001 and compare it with similar meteorites and meteoritic components.

References: [1] Clarke R.S. et al. (1990) *Meteoritics* 25: A354. [2] D'Orazio M. et al. (2009) *Meteoritics & Planetary Science* 44:221–231. [3] Schrader D. et al. (2010) *Meteoritics & Planetary Science* 45:743–758. [4] Lunning N.G. et al. (2009) *Geochimica et Cosmochimica Acta* 259:253–269. [5] Tornabene H.A. et al. (2022) *85th MetSoc Meeting*. [6] D'Orazio M. et al. (2003) *Geostandards and Geoanalytical Research* 24:215–225.

Fig. 1: Cut surface of Sirjan 001. Troilite (dark) and Fe-Ni (grey) are the main components of this meteorite.