CHEMICAL AND ISOTOPIC COMPOSITION OF UNGROUPED IRON METEORITE SIRJAN 001

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Introduction: Sirjan 001 is an ungrouped iron meteorite that was found in the Kerman province (Iran) in 2018. An accompanying study [1] reports the textural and mineralogical characteristics of Sirjan 001, where it is determined that Sirjan 001 shares similarities with the unofficial sulfide-rich meteorite grouplet termed "sulfide-irons" [2,3]. Sulfide-iron meteorites are rare in the meteorite collection, even though sulfide-rich melt is predicted to accompany metallic melts formed via fractional crystallization; the paucity of sulfide-rich irons and their relation to magmatic iron meteorites remain a cosmochemical enigma [4]. A study of the elemental and isotopic composition of Sirjan 001 was undertaken to determine its chemical and isotopic composition, age, and how the sample relates to iron meteorites.

Methods: Concentrations for 20 elements were obtained using LA-ICP-MS (*New Wave* UP213 ultraviolet laser coupled to a *Thermo Finnigan Element 2*). Due to the high measured troilite content of ~37% volume [1], LA-ICP-MS analyses were carried out as lines on the metal surfaces and spot analyses on troilite grains. A small piece (~0.06 g) was processed for highly siderophile element isotope dilution using published chemical separation and mass spectrometer techniques [5]. The remaining mass (~3 g) was digested for mass-independent isotopic analyses of Os, Pt, Mo, Ru and W using thermal ionization mass spectrometry (*Thermo Finnigan Triton*) and multi-collector ICP-MS (*Thermo Finnigan Neptune Plus*). All analytical work was carried out at the Isotope Geochemistry and Plasma Laboratories, University of Maryland.

Results: Using the LA-ICP-MS data, a trace element "bulk" composition was calculated that accounts for the relative proportions of metal and sulfides in Sirjan 001. Bulk Ga and Ge concentrations indicate that Sirjan 001 is relatively enriched in volatile elements compared to magmatic iron groups IVA and IVB. On Ni *vs.* Ga, Ge, or Ir plots Sirjan 001 falls within the range of the magmatic IIIAB and the non-magmatic IAB and IIE groups.

Osmium isotope measurements were conducted to determine cosmic ray exposure (CRE) effects, which can lead to the modification of Mo, Ru and W isotopic compositions. The μ^{189}Os value for Sirjan 001 indicates minimal required CRE corrections. The nucleosynthetic ^{183}W isotopic composition for Sirjan 001 is permissive of it being NC type, however, the Mo isotopic composition indicates either NC or a mix of NC-CC compositions. Ruthenium and Pt results will be reported. The ^{182}W isotopic composition for Sirjan 001 corresponds to a metal-silicate segregation age of 5.2 ± 0.4 Myr after CAI formation.

Discussion: Chemically, Sirjan 001 is most similar to the magmatic IIIAB irons and the non-magmatic IAB and IIE groups. To assess if Sirjan 001 is isotopically and/or temporally related to these meteorites, metal-silicate segregation ages and isotopic compositions are contrasted. Sirjan 001 is ~4 Myr younger than reported ages for magmatic iron meteorite groups (e.g., IIIAB) [6]. The ^{182}W isotopic composition of Sirjan 001, however, is consistent with the reported values of several IAB and IIE irons, which have metal-silicate differentiation ages ranging from 4 to 27 Myr after CAI formation [7,8]. These ages likely represent re-equilibration of metal and silicate following modification to the parent bodies via impacts. Sirjan 001 has a mixed NC-CC composition, constrained by Mo isotopic data. This composition is similar to the ungrouped iron (sulfide-poor) Nedagolla, which was proposed to preserve isotopic evidence for early collisional mixing of NC and CC bodies [9]. The chemical and isotopic data suggest that Sirjan 001 is an ungrouped iron meteorite which may preserve early collisional mixing in the Solar System. As noted by [1], Sirjan 001 is chemically, texturally, and mineralogically similar to several ungrouped sulfide-rich meteorites. On-going work investigates the isotopic and temporal relations between Sirjan 001, Nedagolla, and sulfide-rich irons, and how these materials relate to collisional events in the protoplanetary disk.

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