A NEW METEORITE TYPE: FORSTERITE CHONDRITE WITH EH-3 AFFINITY: SAHARA 97158

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Introduction: A large black clast was encountered inside a slab of the EH-3 chondrite Sahara 97158. The clast is poor in metals and sulfides. It has an unusual mineralogy and texture. It is barren of chondrules and depleted in metal-sulfide clasts that are characteristic of unequilibrated EH-3 or EL-3 chondrites. It consists of 40-60 vol.% of large olivine crystals (up to 80 µm in diameter, ($Fo_{0.995}$-$Fa0._{0025}$), up to 25 vol. % prismatic enstatite crystals ($En_{0.99}$-$Fs_{0.003}Wo_{0.001}$), minor contents of glass and some 4-7 vol. % oldhamite, FeNi-metal and other sulfides. The silicate assemblage depicts igneous-like texture and feigns an unusual olivine-rich achondrite but is entirely different from any aubritic meteorite. The sulfide and metal alloy assemblage consists of oldhamite, niningerite, djerfisherite, sphalerite, schreibersite, troilite, caswellsilverite and metallic FeNi. The sulfide-metal inventory is very similar to that of EH-3 chondrites. Djerfisherite is depleted in K (3.36 wt. %) compared to other EH-3s: (8.40 wt. % in Qingzhen). Presence of the clast inside an EH-3 host indicates origin from a chondrule-free proto-asteroid that accreted and was destroyed prior to accretion of the host EH-3 Sahara 97158.

Results and discussion: The clast was subjected to an endogenous heating event, partial melting and melt migration prior to its accretion with the other constituents of the EH-3 Sahara 97158 host. The pre-accretion heating event led to considerable melt migration of sulfides, specifically of troilite along with FeNi metal. There is no evidence of shock features like high-pressure phase transformation of olivine to ringwoodite or wadsleyite and enstatite to majorite or akimotoite so that a dynamic event is not responsible for the partial melting and sulfide-melt migration.

REE abundances were measured by LA-ICPMS in several oldhamite crystals in this clast in conjunction with the REE measurements in oldhamite grains in the Sahara 97158 EH-3 host and in an idiomorphic oldhamite in a chondrule in the same EH-3 host. REE patterns in oldhamite in the clast, in the host EH-3 chondrite and the one idiomorphic oldhamite in a chondrule in the EH-3 host display very similar patterns (e.g. Fig. 6 in [1]). All REE patterns display the mainstream type pattern of Sahara 97158 and Sahara 97072 with positive Eu and Yb anomalies [1].

We consider these findings as a strong hint that all the oldhamite crystals in the EH-3 host, chondrule and in the clast emerged from the same nebular reservoir. Oxygen isotopic investigations are planed and will be conducted after completion of the mineralogical investigations on olivine and enstatite in the clast and enstatite in the host EH-3 chondrite.

References: [1] Gannoun A. et al. 2011. Geochimica and Cosmochimica Acta 75: 3269-3289.