Evidence for change in C/O ratio during evolution of enstatite chondrites

A. El Goresy[1], Y. Lin[2], M. Miyahara[3], A. Gannoun[4], M. Boyet[4], E. Ohtani[5] and M. Trieloff[6]

[1]Bayerisches Geoinstitut, Universitaet Bayreuth, 95447 Bayreuth, Germany, Ahmed.Elgoresy@uni-bayreuth.de
[2]Key Laboratory of Earth and Planetary Sciences. CAS, Beijing, China, LinYT@mail.igcas.ac.cn
[3]Graduate School of Science, Hiroshima University, Higashi-Hiroshima, 739-8526, Hiroshima, Japan.
[4]CNRS, UMR 6524, LMV, F-63038 Clermont-Ferrand, France.
[5]Tohoku University, 980-8578, Sendai, Japan.
[6]Institut für Geowissenschaften, Universität Heidelberg, 69126 Heidelberg, Germany.

Unequilibrated Enstatite Chondrites (EH3&EL3) evolved from a source region with high C/O ratio (> 0.83). The nature of their birth place and mode of formation is controversally debated i. e., either as solar nebula condensates (SCON), or by impact melting (IM) in parental asteroids. These contrasting mechanisms would imply different mineral inventories, cosmochemical signatures, and would leave isotopic signatures undisturbed (in SCON) or alternatively homogenized (IM). We report mineralogical, cosmochemical and nanoSIMS isotopic results from primitive EH3s and the EL3s MS-17 and MS-177 (TC_3 asteroid) fragments. EH3 chondrites contain a menagerie of sulfides consisting of FeS, niningerite (Mg Fe Mn)S, djerfisherite, sphalerite, minor oldhamite (CaS), FeNi metal and graphite. Growth zoning in (Mg Fe Mn)S to contacting FeS reveals a dichotomy of trends: (1) normal (FeS decrease) & (2) reverse (FeS increase) latter attesting thermal events in different asteroids. ^{129}I/^{129}Xe dating of djerfisherite in the most primitive EH3 ALHA77295 indicates an age comparable to oldest age of chondrules in E-chondrites (**4564.2 ± 1.1 M.a**; King et al., 2013). Mineral inventory in EL3, in contrast consists of FeS, alabandite (Mn Fe Mg)S, sphalerite oldhamite. enstatite, FeNi metal and idiomorphic sinoite. Growth sequence of earliest condesates is oldhamite-sinoite-graphite thus indicating increase in C/O ratio after sinoite. REE inventory of CaS in EH3 depicts positive Eu and Yb anomalies. The pattern in EL3 is in contrast, flat with a negative Eu anomaly suggesting a different source region. NanoSIMS study of graphite various morphologies indicates clear dichotomy in δ^{13}C and δ^{15}N signatures in the same EL3 chondrite. Our results clearly negate the (IM) origin for both EH3 and EL3.