SILICA-RICH OBJECTS IN ACFER 182: A NEW VIEW

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Introduction: Acfer 182 is a member of the CH carbonaceous chondrite group [1], and provides direct information concerning the early solar nebula processes. The CH chondrites [2] are a member of the "CR chondrite Clan" [3, 1] that also includes two other chondrite groups: the CR and CB, subdivided in CBa, and CBb [4-5]. These chondrites are very rich in small chondrules (<90 μm) and chondrule fragments (70 vol. %) [e.g., 2]. A few of these objects have very high SiO_2 contents [6, 7]. These silica-rich objects (SRO) are very rare in carbonaceous chondrites [6, 7]. I report the results of major and trace element studies of some SRO in Acfer 182 (PTS M6013, NHM, Vienna) and compared them with previous studies of SRO, Mg-rich cryptocrystalline (CC) and radiating pyroxene (RP) chondrules in CH chondrites [e.g., 7-12].

Results and Discussion: The studied chondrules (Ch III, VI and XV) with apparent diameters ~90 μm, have amoeboid textures (referred as amoeboid–type objects, from here on) made of silica glass (nearly pure SiO_2) within a silicate (hypersthene normative) matrix. They have bulk abundances of Ca, Al and Mg varying from 0.4 to 0.8 x CI with Cr, Mn, Na and Fe contents that decrease with decreasing volatility. Normalized trace element patterns are flat for the ultra-refractory (Zr, Sc,Nb) and REE elements (with abundances ~ 1-3 x CI), with decreasing and increasing abundances of the moderately volatile (V, Cr, Mn) and volatile elements (Rb, K), respectively. Other SRO from Acfer 182 have emulsion-like textures (referred as emulsion–type objects, from here on) dominated by silicate globules in a silica matrix [e.g., 7, 11]. They exhibit low contents of the ultra-refractory and REE elements (~ 0.01-0.1 x CI) with variable abundances of moderately volatile and volatile elements [11]. The texture of amoeboid- and emulsion-type objects points to co-existence of pyroxene- and silica-normative liquids. Their bulk silica-rich composition (from 74.6 to 86.7 wt% SiO_2) indicate that they formed from a highly-fractionated nebular gas (Si/Mg >1) in which a cosmochemical process was involved, as supported by their Yb and La abundances spreading around the solar ratio. Previous studies of several SRO, in addition to amoeboid- and emulsion-type objects, foresee their formation by liquid immiscibility at high temperatures, above 1968 K, with subsequent fast cooling [7]. However, temperatures ~2000 K would cause grains around 0,2 mm in radius to be fully vaporized [12] as well as extremely low REE contents in those that escaped vaporization. The large variation (one/two orders of magnitude) in trace element abundances revealed by amoeboid-and emulsion-type SRO, signals two chondrule forming regions. Similarly to what has been envisaged for the formation of Mg-rich CC and RP chondrules in Acfer 182 [12]. These chondrule forming regions require a sufficiently high dust/gas ratio to allow formation of stable silicate liquids. Full equilibrium condensation calculations show that it is theoretically possible to have enstatite as the stable liquidus phase in an 800×Cl dust-enriched nebular gas at a p^{tot} of 10^{-3} atm, if about 72% of the original Mg is removed (as forsterite?) from the system [13]. Because pyroxene-dominated chondrules need "dust-enriched" regions with similar dust/gas ratios (>500 x CI) as those needed to form BO chondrules (~700 x CI) [14], both objects could have shared the same nebular region. Therefore, formation in the CH chondrule forming region of barred and skeletal olivine (BO, SO) chondrules, as well as Mg-rich CC and RP ones will progressively deplete the gas in Mg and trace element contents, and increase its SiO_2 content. Cooling of such dust-enriched regions, from which Mg and trace elements are gradually removed, might end in the formation of liquids rich in Si and poor in refractory elements (e.g., the SRO precursors).

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