A NEBULAR ORIGIN OF CHLORAPATITE AND SILICATE GLASS IN THE GUIN (UNGR) IRON.

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Silicate inclusions in iron meteorites [e.g., 1] are believed to sample primitive (chondritic) as well as chemically fractionated parent bodies [2]. Inclusions in IIE irons have extreme fractionations, which are commonly considered to be due to impact melting and mixing of feldspars and silica from the surface of a highly differentiated parent body [e.g., 3, 4]. Studies of IIE iron-like inclusions from the Guin (ungr) iron show that they record nebular rather than planetary fractionation processes.

Large silicate inclusions in Guin are common [5] and consist of devitrified siliceous glass with or without augite and phosphates. We investigated an elongated oval (2 x 0.5 cm^2) devitrified glass inclusion consisting of a fine-grained intergrowth of albite, silica and low-Ca pyroxene with accessory ilmenite, rutile, FeNi metal, FeS, Cl-apatite and whitlockite. Albite dominates the chemical composition with (in wt%) 70.3 SiO_2, 16.8 Al_2O_3, 0.04 MgO, 1.4 FeO, 1.3 CaO, 8.5 Na_2O, 0.7 K_2O and 0.17 P_2O_5. Trace element (TE) contents are low (~0.1×CI) except for Ti, Sr, Zr and Nb (~10×CI) and Sc (~1×CI). The REE contents are also low (<0.1×CI) and decreasing from La to Gd (~0.02×CI) and increasing again towards Lu (~0.1×CI). Eu and Yb have positive anomalies. A chlorapatite co-existing with the devitrified glass has low Ti, V, Zr and Nb (<0.1×CI) and high Sr (~20×CI), REE and Y (~70-80×CI) contents with a flat abundance pattern and negative anomalies in Eu and Yb. The complementary TE patterns of Cl-apatite and glass suggest an igneous origin. However, compared to experimental distribution coefficients of TE between apatite and a siliceous liquid [6], the Guin assemblage is far out of equilibrium (e.g., La K_d ~12, but $La_{[ap]}/La_{[gl]}$ ~750!), except for Sr. In addition, the REE abundance pattern of apatite does not follow the distribution coefficients but rather is flat and resembles the group III-pattern of CAIs [7] but at an abundance similar to that in hibonites [e.g., 8] and oldhamites [e.g., 9, 10]. The pattern and abundance level suggest a TE-rich precursor phase for the apatite, oldhamite?, that formed by condensation from nebular gas at low fO_2 [11].

The very low TE content of the glass is similar to those of glasses from other IIE irons [e.g., 4, 12, 13] and does not support a derivation from albite as is widely advertised [3, 4] because it is unfractionated. The positive anomalies of Eu and Yb make the pattern very similar to one reported for a glass from the Colomera IIE iron [12] where the anomalies were considered to be due to "..melting of silicates under highly reducing conditions, similar to those for enstatite chondrites". However, to us the TE pattern of the Guin glass suggests derivation from a nebular reservoir strongly depleted in refractory TE (and Mg!) but not in Eu and Yb. Chlorapatite and devitrified glass in Guin appear to be genetically related but not via an igneous system but via the solar nebula. The precursors could have been oldhamite and a siliceous liquid which subsequently experienced oxidizing conditions that turned oldhamite into chlorapatite [e.g., 14, 15]. Metal trapped the products and preserved this primitive matter [see also 16].

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