GLASSES IN METEORITES: A UNIFICATION MODEL.

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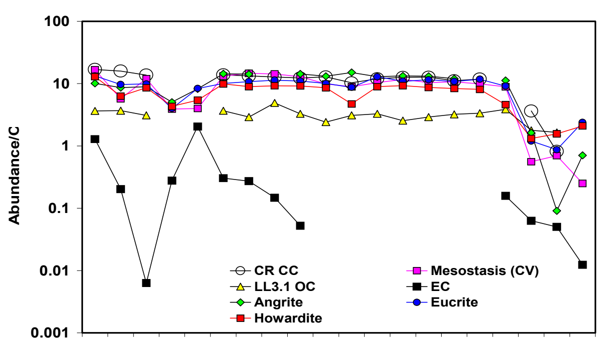
Introduction: Glasses are present in the oldest rocks we know, chondrites, achondrites and iron meteorites. They occur as glass inclusions in olivines and pyroxenes in carbonaceous, ordinary and enstatite chondrites (CC, OC, EC), as mesostasis in chondrules, as glass patches in angrites, as glass spheres and fragments in howardites and iron meteorites or fill open spaces in angrites and eucrites (e.g., hollow spheres, druses and fractures). In chondrites, glasses are widely believed to be the result of igneous processes [1,2]. On the other hand, glasses in achondrites are assumed to have an impact origin, as their major element chemical composition is similar to that of their respective bulk rocks [3,4]. However, according to our data [5-10] we speculate that all glasses are the result of an unique universal process, the nature of which is discussed below.

Results and Discussion: Glasses have a variety of major element chemical composition. They are mostly refractory (Si-Al-Ca-rich) in CV and CR chondrites [5-7] and angrites [8] and grade to less refractory, Si-rich ones, in OC and EC chondrites [11]. Glassy and glass-bearing objects usually have their individual major element chemical composition (e.g., chondrules, objects in howardites) that is variable within narrow limits, suggesting individual formation and processing of each object [8-9]. In contrast to major elements, trace element (TE) abundances of all glasses display the same pattern. They all have unfractionated refractory lithophile TE abundances ~ 10 x CI, with exception of glasses in the EC (Fig.) and iron meteorites, and they are depleted in moderately volatile and volatile elements. This pattern indicates derivation of glasses from a source which had solar relative refractory TE abundances, very likely by condensation. Consequently, all glasses seem to have a common source, the solar nebula, and are related to a common nebular process. We suggest that they are remnants of the liquid that facilitated growth of well-ordered crystals from the gas phase by the VLS growth process [5,7,12]. Such liquid -the glass precursor- is refractory in composition when present in chondrules of CC. It not only could represent the refractory component necessary for chondrule formation [13,14] but an universal nebula liquid. Compositional variations of all other glasses mainly reflect a sub-solidus metasomatic exchange between the refractory glass and an external source: the cooling solar nebula. In this way, more evolved glasses present in EC, iron meteorites and achondrites can be obtained. Chondritic glasses have not been processed the same way and intensity as the achondritic glasses have. However, in most cases, the refractory TE abundances remained unchanged and still testify for a reservoir with relative abundances of condensable elements similar to those in the solar nebular.

Conclusion: As this liquid is preserved in chondrites and achondrites it must have been a crucial partner in their development, a universal liquid that facilitated meteorite formation.



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