A GLASS INCLUSION IN OLIVINE AND MESOSTASIS GLASS OF A KABA (CV3) AGGREGATE ARE SISTERS.
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Introduction: Glasses in minerals and mesostasis of aggregates and chondrules are widely believed to represent residual bulk melts. However, it has been shown that glass inclusions in olivines of carbonaceous chondrites likely represent primitive (condensate) liquids [1-3]. If their chemical composition is not changed by post-formational glass-vapor exchange reactions, they record changing conditions in the solar nebular. The physico-chemical conditions under which silicate liquids can condense in a dust-enriched system were predicted for Ca-rich glasses [4], but not for the Na-rich glasses commonly present in Type I chondrules. Here we report a study of a glass inclusion and glassy mesostasis present in a single aggregate of the Kaba chondrite. The results suggest that both glasses are of similar - and nebular - origin.

Results and Discussion The aggregate in the Kaba PTS L3819 (NHM, Vienna) has a porphyritic texture and consists of olivines with few pyroxenes at its surface. Olivines have FeO and CaO contents varying from 0.66 to 1.5 wt% and 0.22 to 0.48 wt%, respectively. The primary glass inclusion in olivine has a Ca,Al-rich composition with chondritic Ca/Al ratio and is q-normative. The glassy mesostasis is also Al-rich but has low contents of CaO (4 to 6 wt%), high contents of Na_2O (~ 9 wt%) and is ol-normative. Trace element contents of both glasses are high with very similar and unfractionated abundance patterns at ~ 10 x CI (Fig.), similar to Allende chondrules mesostasis [e.g., 5]. Vanadium, Mn, Li and Cr are depleted in all glasses with respect to the refractory trace elements as is Rb in the glass inclusion in olivine but not in the mesostasis glass. This property clearly indicates vapor fractionation and a common origin of both glasses, which are likely condensates – as is the olivine [e.g., 1]. Olivine appears to be in equilibrium with the refractory glass with respect to most elements (distribution coefficients from [6]), including Ca and Al, indicating that it could not have crystallized from a melt with chondritic abundances of these elements. The abundances of Ti, Ho, Er and Yb and Sm in olivine, however, indicate disequilibrium with the glasses as they require a co-existing liquid with ~ 30 x CI and ~ 100 x CI abundances, respectively, compared to ~ 10 x CI as observed. Such disequilibrium could also be indicative of a condensation origin of the co-existing phases. Glass of the aggregate mesostasis differs from the glass inclusion in olivine only in its contents of Ca (which is low) and Na, K and Rb (which are high). Obviously, the mesostasis behaved as an open system and its Ca was exchanged for the alkali elements (making the glass ol-normative), probably in the nebula [e.g., 7], but glass protected by the olivine could not react and thus records the original conditions. We can conclude that aggregate (and chondrule) formation took place during condensation of the major mineral olivine in the solar nebula, in accordance with [7,8].

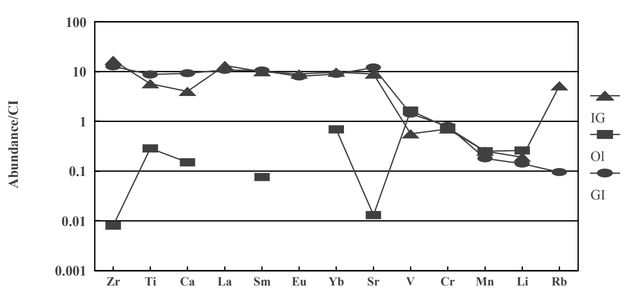

Figure: CI-normalized trace element abundances in glass inclusion (GI), interstitial glass(IG) and olivine of a Kaba aggregate. CI abundances from [9].

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