REE in glass inclusions and their host olivines from type I chondrules: insight on the compostion of a parent planetesimal

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The formation of Mg-rich olivines found in porphyritic chondrules, has long been debated. Glass inclusions trapped in Mg-rich olivines were studied [1]. Their exotic composition was interpreted as the residu of a thin liquid layer allowing the olivine to grow by a Vapor-Liquid-Solid process. However, recent experimental studies on glass inclusions showed that all exotic compositions of glass inclusions were reproducible by slow cristallization of olivine from a CMAS liquid [2,3]. Furthermore, glass inclusions contain high amounts of Na that could not have remained in the liquid in a gaseous environment [4]. These new evidences suggest that Mg-rich olivines from chondrules formed in a planetesimal environment, possibly a magma ocean. Hence, this study focusses on REE in glass inclusions and their host olivines, that can bring insight on process(es) implicated in olivines formation. REE were measured in glass inclusions and hosts olivines from Allende (CV3) meteorite. Analyses were performed with SIMS 1280, with a duoplasmatron source and a high mass resolution (12000). Results show that glass inclsuions and olivines are respectively enriched and depleted in REE by one to two orders of magnitude in regard to CI composition. Both display flat patterns except for Fe and Rb, with a condensation T° below 1350°K. When compared to literature, olivines show similar patterns and values, whereas glass inclusions show lower REE amounts than previously recorded. However, this may be attributed to different analytical conditions. Our results allow to study 8 couples inclusion / host olivine for which partition coefficient were calculated for each element. CI-like and CV-like initial liquids were considered as potential parent magma, from which olivines would cristallize and inclusions would be trapped: high cristallization rates are necessary to obtain such partition coefficients. These rates match the final compositions in major elements observed in glass inclusions and it seems possible to produce every glass inclusion by a slow cristallization of olivine in a parent magma with a CV composition. This suggest that olivines from chondrules could originate from a magma ocean, that is to say a molten planetesimal in course of differentiation. [1] Varela and Kurat (2009) Mitt.österr.Miner.Ges 155, 279-320 [2] Faure et al. (2012) EPSL 319-320, 1-8 [3] Faure et al. (2017) GCA 204, 19-31 [4] Fedkin and Grossman, (2013) GCA 112, 226-250.