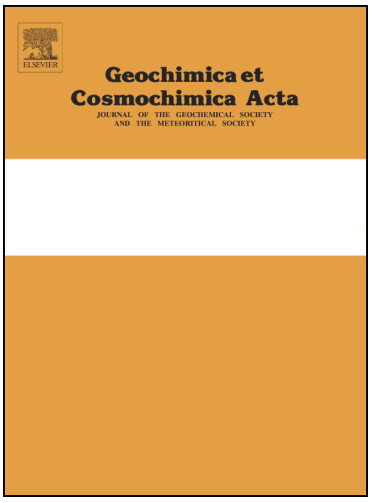

Chemical 3D-imaging of glass inclusions from allende (CV3) olivine via SIMS: A new insight on chondrule formation conditions

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CHEMICAL 3D-IMAGING OF GLASS INCLUSIONS FROM ALLENDE (CV3) OLIVINE via SIMS: A NEW INSIGHT ON CHONDRULE FORMATION CONDITIONS.

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Abstract

Natural glass inclusions - hosted in Mg-rich olivines from Allende (CV3) type I chondrules - and synthetic melt inclusions - trapped in forsterite crystallized from CMAS (CaO-MgO-Al_2O_3-SiO_2) melts - were mapped by Secondary Ion Mass Spectrometry (SIMS) for CMAS major oxides. The first ever 3D chemical images of extra-terrestrial glass inclusions were obtained, along with chemical depth profiles for each oxide. Results show similar patterns for both synthetic glass inclusions (trapped in olivine formed by slow crystallization in a magmatic liquid) and natural inclusions from Allende's olivines. No incompatible-rich boundary layer or diffusion pattern was observed in either case. The absence of an incompatible-rich boundary layer suggests that the olivine overgrowth surrounding glass inclusions in Allende's olivines was formed during slow cooling of the host olivine and likely the surrounding chondrule. This provides new constraints on the cooling rates of type I chondrules.

1. Introduction

Chondrules are silicate blebs embedded, with Ca-Al rich inclusions (CAIs) and metal drops, in a fine-grained matrix of variable porosity. Together, they represent the main components of the undifferentiated meteorites that are chondrites (*Sears and Dodd, 1988; Zanda, 2004, Connolly and Jones, 2016 and references therein*). Chondrules measure between 100 µm and 1 cm in diameter and display a wide range of textures, from glassy to porphyritic. They are thought to have formed by brief and repeated phases of heating (*Hewins and Radomsky, 1990*). Porphyritic chondrules are often studied because they correspond to approximately 85% of all chondrule textural types in ordinary chondrites (*Gooding and Keil, 1981*). They are usually composed of olivines and pyroxenes. They can be classified according to either their redox state or their