HIGH FE CONTENTS IN PRESOLAR SILICATE GRAINS: PRIMARY FEATURE OR THE RESULT OF SECONDARY PROCESSING?

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Introduction: Silicate grains are the newest addition to the collection of presolar minerals found in extraterrestrial materials [1,2]. However, although close to a hundred presolar silicate grains have been found to date, little information exists about the mineralogy and/or elemental compositions of most of them. Such knowledge is crucial for understanding the stellar environments in which these grains formed. Auger spectroscopy is unique in its ability to provide compositional information on a spatial scale of 10s of nanometers without requiring difficult sample preparation [3]. It is, thus, the ideal analytical technique for determining the elemental compositions of presolar silicate grains, which are typically less than half a micron in size.

Experimental and Results: We used scanning Auger spectroscopy to acquire Auger elemental image maps of areas in IDPs and primitive meteorites containing circumstellar silicate and oxide grains [3]. These grains had previously been identified with the NanoSIMS as being presolar, on the basis of their anomalous oxygen isotopic compositions [4,5]. Elemental maps of five presolar silicate grains, ranging in size from ~160 to 350 nm, show that three grains are distinctly enriched in Mg and contain little to no Fe. The remaining two grains are Fe-rich and Mg-poor. Spot analyses, which are planned for the future, will allow us to quantify the elemental compositions and establish the mineralogy of the silicates.

Discussion: Fe-Mg silicates, such as olivine and pyroxene, are expected to have Mg-rich compositions under conditions of equilibrium condensation in the stellar winds of oxygen-rich RGB and AGB stars [6]. The three Mg-rich presolar silicates are consistent with such an origin, but not the two Fe-rich grains. Enrichment of Fe in presolar silicates has been considered to be of secondary origin, due to nebular or parent body processing [e.g., 2], but this could also be a primary feature. Non-equilibrium condensation in stellar outflows is expected to produce silicates with higher Fe contents than equilibrium condensation [7], and amorphous silicates observed around oxygen-rich stars are thought to be Fe-rich in order to explain their higher absorptivity in the near-infrared [8]. Indeed, TEM analysis of a FIB lift-out section of one presolar silicate shows it to be an amorphous silicate containing abundant Fe [9]. One of the Fe-rich grains observed here occurs in an anhydrous IDP, which is unlikely to have experienced significant secondary processing. This grain may represent a primary Fe-rich silicate condensate that formed under non-equilibrium conditions.

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