EVIDENCE FOR PRESOLAR TITANIUM IN SILICATE STARDUST.

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Introduction: Nucleosynthetic titanium isotope anomalies, $\Delta'^{46\text{-}50}$Ti, as defined by mass independent differences from terrestrial values, originate from leftover heterogeneity in the distribution of isotopically distinct presolar material. They provide insights into the nucleosynthetic origins of the Solar System. These anomalies are well represented in chondritic materials which show a strong correlation between mass independent Δ'^{46}Ti and Δ'^{50}Ti [1].

While recent studies suggest that the Ti isotopic composition of the bulk chondrites can be explained by a continuous mixing between a calcium-aluminium-rich inclusion (CAI)-like component and a non-carbonaceous (NC)-like component [2], this is hard to resolve in terms of original presolar carriers or grains. For example, the existence of anomalous refractory hibonite inclusions within chondritic material which do not fall on the designated Δ'^{46}Ti and Δ'^{50}Ti correlation due to a lack of a clear Δ'^{46}Ti anomaly suggest that there must, therefore, be a presolar component of Δ'^{50}Ti decoupled from the Δ'^{46}Ti [3]. In short, the co-variation cannot be explained by just the variable incorporation of a singular presolar carrier, and is more likely explained by multiple carriers that have somehow been incorporated into chondritic material by a process that keeps the Δ'^{46}Ti and Δ'^{50}Ti consistent i.e. thermal/compositional or size discrimination processes. This is supported by nucleosynthetic model data which show that a singular nucleosynthetic environment is hard to assign to the production of both ^{46}Ti and ^{50}Ti in the quantities observed in Solar System material [4], pointing to the necessity of more than one nucleosynthetic carrier.

Previous measurements of Ti in presolar grains utilise techniques involving strong dissolutions of bulk meteorite matter that destroy all but the most acid-resistant mineralogies. The residual presolar material tends to be carbon based e.g. SiC, graphite and nanodiamonds. Some oxides such as spinel and corundum also survive, but these are rarer. The main limitation of leaching bulk meteorite until only the most resistant material is left is that you lose >99% of the sample including all labile minerals such as the silicates. The implication of this is the loss and homogenisation of distinct presolar Ti carriers in the leachate [5]. Indeed, *in situ* oxygen and silicon isotope studies have concluded that presolar silicates are up to 2 orders of magnitude more abundant than SiC grains in some chondrites [6], suggesting they could have an important influence on Ti. Novel *in situ* Ti isotope measurements can provide presolar measurements of Ti in silicates.

Methods: 'Proteus', a prototype collision cell MC-ICPMS with mass pre-filter, allows *in situ* measurements of Ti isotopes by reacting Ti with O_2 gas to form TiO^+, and measuring in a region of the mass spectrum cleared by the mass pre-filter. By virtue of the differential reactivity of ion species with O_2, isobaric interferences on Ti (Ca, V and Cr) are greatly reduced. Combining this with high resolution WDS and EDS microprobe tecniques also allows identification of elemental concentrations highlighting possible mineral characteristics.

Results: We have identified highly anomalous material within the ungrouped carbonaceous chondrite Acfer 094 that is clearly resolved from terrestrial material and possesses a high Si-O and low C bulk composition. This new evidence for highly anomalous Ti in presolar silicate phases offers a fresh exciting enquiry into explaining Ti Solar System isotope trends and possible nucleosynthetic environments of Solar System material.

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