PLANETARY SCIENCE RESEARCH DISCOVERIES
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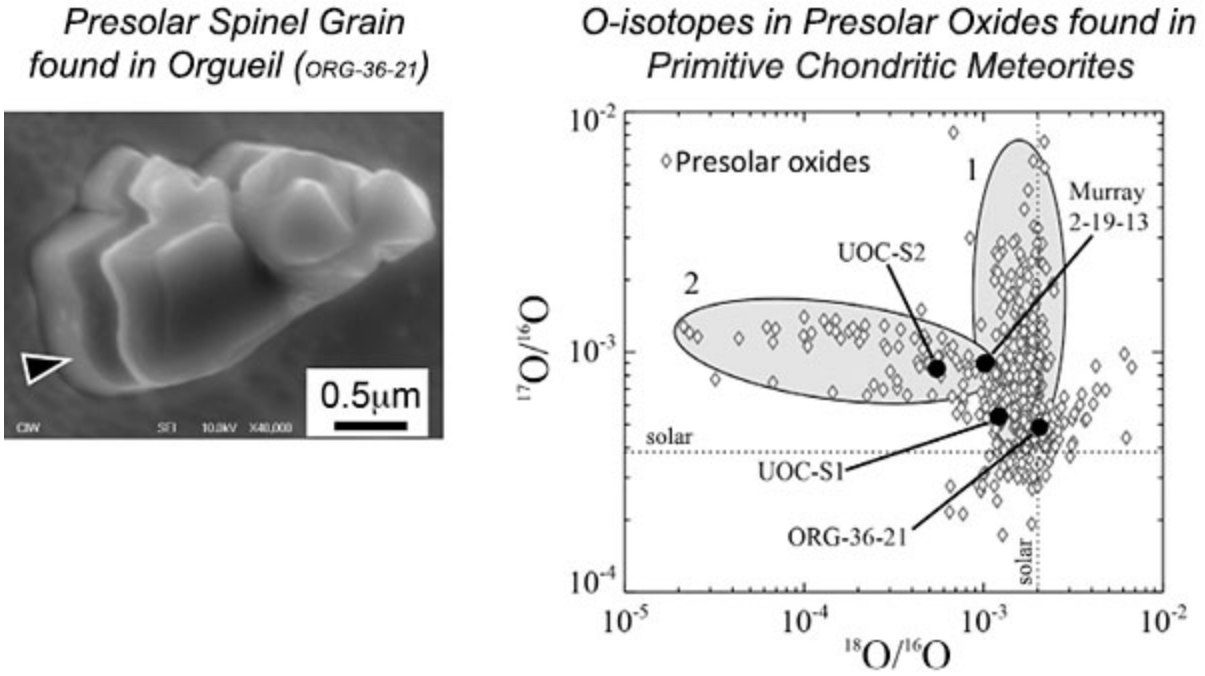
Presolar Oxide Grains: A Study of Spinels

Exquisitely detailed scrutiny and analyses of ***presolar grains***, found in ***primitive meteorites***, are fundamental to building an understanding of the physical and chemical environments surrounding the stars where the minerals condensed. Among the researchers involved in this work, Thomas Zega (University of Arizona) has described his research of the early solar nebula, presolar stardust material, and asteroids as "laboratory-based astronomy at the nanometer scale." Zega, along with colleagues at the Carnegie Institution of Washington, the Naval Research Laboratory, and Washington University in St. Louis recently reported results of elemental, isotopic, and microstructural analyses of four presolar spinel grains from acid-resistant residues of primitive chondritic meteorites.



(From Ziga *et al.*, 2014, *Geochim. et Cosmochim. Acta*, v. 124, p. 152-169, figs. 1, 2.)

[LEFT] Secondary electron image of a Fe-Cr-rich spinel grain from Orgueil [***Data link*** from the Meteoritical Bulletin] acid residue. The arrow indicates an underlying gold surface used during SIMS analysis. **[RIGHT]** Oxygen isotopic compositions of four presolar spinel grains from Zega and colleagues' work (labeled black points) compared with other presolar oxides, mostly Al_2O_3 grains, from previous studies (open diamonds).

Ellipses show compositional fields preciously defined for presolar oxides. The intersection of the dashed lines is average solar system material, where most components in chondritic meteorites plot.

Finding that none of the spinel grains are pure $MgAl_2O_4$, they have made the first identification of presolar Fe- and Cr-rich spinel grains in a primitive meteorite by combining the analytical methods of nanoscale secondary ion mass spectrometry, focused-ion-beam scanning electron microscopy, and transmission electron microscopy. The isotopic data indicate an origin for the presolar grains in low-mass ***AGB stars*** and the microstructural data, so astoundingly detailed, hint

at ancient grain to grain collisions. **PSRD**, since its first year online, has been covering the interdisciplinary research of presolar grains. For examples, take a look at astrophysicist Donald Clayton's 1997 article: ***Moving Stars and Shifting Sands of Presolar History*** and the 2004 article: ***Silicate Stardust in Meteorites***.

See:
Zega, T. J., Nittler, L. R., Gyngard, F., Alexander, C. M. O. 'D., Stroud, R. M., and Zinner, E. K. (2014) A Transmission Electron Microscopy Study of Presolar Spinel, *Geochimica et Cosmochimica Acta,* v. 124, p. 152-169, doi: 10.1016/j.gca.2013.09.010. [***NASA ADS entry***]. Also see **PSRD** articles ***about presolar grains***.

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