Presolar grains in meteorites

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Presolar grains are defined as grains formed in the stellar outflow or ejecta, and were preserved in meteorites. These dust grains retain memory of their birthplaces, exhibiting huge isotopic anomalies that cannot be explained by process occurring in the solar system. Mineral types of presolar grains include diamond (Lewis et al. 1987), SiC (Bernatowicz et al. 1987; Tang & Anders 1988), graphite (Amari et al. 1990), Si_3N_4 (Nittler et al. 1995), oxides (Huss et al. 1994; Hutcheon et al. 1994; Nittler et al. 1994), refractory carbides inside host grains (Bernatowicz et al. 1991; 1996; Croat et al. 2003), and silicates (Messenger et al. 2003; Mostefaoui & Hoppe 2004; Nagashima, Krot, & Yurimoto 2004; Nguyen & Zinner 2004). Their abundances range from a few ppb (Si_3N_4) to a few hundred ppm (diamond and silicates) (Huss & Lewis 1995; Floss & Stadermann 2012). Studies of these grains have yielded a wealth of information about nucleosynthesis in stars, mixing in stellar ejecta, and the Galactic chemical evolution (= temporal variation of isotopic and elemental abundances in the Galaxy).

In this talk, I will review what we have learned from presolar grains, and discuss biases in presolar grain populations in meteorites due to experimental methods of identification and isolation to help better understand differences and similarities of presolar grains and grains from other observations.

References

Amari, S., Anders, E., Virag, A., & Zinner, E. 1990, Nature, 345, 238

Bernatowicz, T., Fraundorf, G., Tang, M., Anders, E., Wopenka, B., Zinner, E., & Fraundorf, P. 1987, Nature, 330, 728

Bernatowicz, T. J., Amari, S., Zinner, E. K., & Lewis, R. S. 1991, Astrophys J, 373, L73

Bernatowicz, T. J., Cowsik, R., Gibbons, P. C., Lodders, K., Fegley, B., Jr., Amari, S., & Lewis, R. S. 1996, Astrophys J, 472, 760

Croat, T. K., Bernatowicz, T., Amari, S., Messenger, S., & Stadermann, F. J. 2003, Geochim Cosmochim Acta, 67, 4705

Floss, C., & Stadermann, F. 2012, Meteorit Planet Sci, 47, 992

Huss, G. R., Fahey, A. J., Gallino, R., & Wasserburg, G. J. 1994, Astrophys J, 430, L81

Huss, G. R., & Lewis, R. S. 1995, Geochim Cosmochim Acta, 59, 115

Hutcheon, I. D., Huss, G. R., Fahey, A. J., & Wasserburg, G. J. 1994, Astrophys J, 425, L97

Lewis, R. S., Tang, M., Wacker, J. F., Anders, E., & Steel, E. 1987, Nature, 326, 160

Messenger, S., Keller, L. P., Stadermann, F. J., Walker, R. M., & Zinner, E. 2003, Science, 300, 105

Mostefaoui, S., & Hoppe, P. 2004, Astrophys J, 613, L149

Nagashima, K., Krot, A. N., & Yurimoto, H. 2004, Nature, 428, 921

Nguyen, A. N., & Zinner, E. 2004, Science, 303, 1496

Nittler, L. R., Alexander, C. M. O'D., Gao, X., Walker, R. M., & Zinner, E. K. 1994, Nature, 370, 443

Nittler, L. R., et al. 1995, Astrophys J, 453, L25

Tang, M., & Anders, E. 1988, Geochim Cosmochim Acta, 52, 1235