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Presolar organic globules in astromaterials

K. NAKAMURA-MESSENGER[1*] S. MESSENGER[2] L.P. KELLER[3] S.J. CLEMETT[4]

[1] ESCG, Jacobs Technology TX 77058 USA (keiko.nakamura-1@nasa.gov)
[2] ARES, NASA Johnson Space Center, Houston, TX 77058
[3] ARES, NASA Johnson Space Center, Houston, TX 77058
[4] ESCG/ ERC, TX 77058

Presolar grains were identified in meteorite residues 20 years ago based on their exotic isotopic compositions [1]. Their study has provide new insights into stellar evolution and the first view of the original building blocks of the solar system. Organic matter in meteorites and IDPs is highly enriched in D/H and $^{15}N/^{14}N$ at μm scales, possibly due to presolar organic grains [2-4]. These anomalies are ascribed to the partial preservation of presolar cold molecular cloud material. Identifying the carriers of these anomalies and elucidating their physical and chemical properties may give new views of interstellar chemistry and better understanding of the original components of the protosolar disk. However, identifying the carriers has been hampered by their small size and the inability to chemically isolate them.

Thanks to major advances in nano-scale analytical techniques and advanced sample preparation, we were able to show that in the Tagish Lake meteorite, the principle carriers of these isotopic anomalies are sub-μm, hollow organic globules [5]. The organic globules likely formed by photochemical processing of organic ices in a cold molecular cloud or the outermost regions of the protosolar disk [5].

Organic globules with similar physical, chemical, and isotopic properties are also recently found from Bells CM2 carbonaceous chondrite, in IDPs [6] and in the comet Wild-2 samples returned by Stardust [7]. These results support the view that microscopic organic grains were widespread constitutents of the protoplanetary disk. Their exotic isotopic compositions trace their origins to the outermost portions of the protosolar disk or a presolar cold molecular cloud.

[1] Zinner E. in *Treatise on Geochemistry* (2004), pp. 17 – 39**.** [2] Messenger S. (2000) *Nature* 404, 968 [3] Busemann H. et al. (2006), *Science* 312, 727 [4] Floss C. et al. (2004) *Science* 303, 1355 [5] Nakamura-Messenger K. et al. (2006) *Science* 314, 1439 [6] Messenger et al. (2008) LPSC XXXIX, #2391 [7] Matrajt et al. (2007) MAPS 42, 5138