Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12291

Understanding Cometary Olivine

MICHAEL ZOLENSKY[1] AND DAVID FRANK[2]

[1]NASA Johnson Space Center
[2]University of Hawaii

Presenting Author: mikezolensky@gmail.com

There is a widespread depletion of Cr from the FeO-rich olivine in comet Wild-2, relative to type IIA chondrules [1], whose degree is akin to that in unequilibrated chondrites such as Krymka (LL3.2) or Rainbow (CO3.2). Since Cr is highly mobile under even mild thermal metamorphism, it is a sensitive indicator of such an event, showing greater depletion in smaller grains (i.e., matrix vs. chondrules) [2]. The distribution of Cr in FeO-rich olivine systematically changes as metamorphism increases between type 3.0 and type 3.2 [2]. Thus, Wild-2 olivine appears to carry evidence of mild thermal metamorphism, ~300°C. It is critical to determine whether there is any evidence for this from samples of other comets, by examining anhydrous chondritic IDPs (some of which must derive from comets). Unfortunately, the data for olivine and pyroxene in IDPs is sparse, mainly decades old and typically lacks useful information on minor elements. Thus, we have begun to collect new compositional data for olivine and pyroxene in chondritic IDPs. A determination that a comet, or its accretion components, had experienced significant thermal metamorphism would greatly alter models of early solar system history.

Thus far, our minor element data for anhydrous IDP olivine, combined with the existing sparse published data for IDPs and Antarctic micrometeorites [3-7], are consistent with Wild 2. Thus, olivine in anhydrous chondritic IDPs and micrometeorites appears to have been heated to a similar degree as comet Wild 2 olivine (~300°C). Did comet materials really experience thermal metamorphism? If so, did this occur on the comet or rather in a prior setting? Alternatively, did this heating occur during atmospheric entry or collection? Additional data are necessary to properly address these questions.

[1] Frank et al. (2014) *GCA* **126**, 284–306; [2] Grossman, Brearley (2005) *MAPS* **40**, 87-122; [3] Christofferson, Buseck (1986) *EPSL* **78**, 53-66; [4] Klöck et al. (1989) *Nature* **339,** 126-128; [5] Zolensky, Barrett (1994) Meteoritics 29, 616-620; [6] Joswiak et al. (2009) *MAPS* **44**, 1561-1588; [7] Dobrica et al. (2009) *MAPS* **44**, 1643-1661.