Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11586

he non-volatile (rocky) components in comet Wild 2

DON BROWNLEE[1], DAVID JOSWIAK[1], NORIKO T. KITA[2] AND MINGMING ZHANG[2]

[1]University of Washington
[2]University of Wisconsin-Madison
Presenting Author: brownlee@astro.washington.edu

Laboratory study of the thousands of comet Wild 2 particles returned by the Stardust mission is providing a uniquely detailed look at the “rocky” contents (probably the major fraction of the comet's mass) of a body that retained ices as volatile as CO. Many solid particles are polymineralic and their microanalysis shows the comet's rocky materials to be a complex grab-bag of nebular solids that assembled in a cold nebular environment where comets could form. The particles include chondrule fragments, CAI's and condensates, all high temperature materials. The comet is an ensemble of unrelated and unequilibrated materials whose mineralogical and isotopic compositions imply formation in numerous nebular environments that existed at the time when chondrules and CAI's formed. Mineralogical and isotopic data on a growing number of 1-100μm particles provides greatly improved statistical ability to compare the comet's diverse building materials with those contained other early SS bodies. Typical Wild 2 rocky components formed in the solar system at incandescent temperatures in environments where icy components could not have existed. The simplest scenario for Wild 2, is that the rocky materials formed first in the inner solar system and were transported to distant cold disk regions where the ice components could exist. The carbon-rich bodies with sample returns are Wild 2 and Ruygu a C-type asteroid sampled by Hayabusa 2. Both are primitive bodies but their contents drastically differ. Ryugu is dominated by secondary alteration products such as phyllosilicates, dolomite, magnetite and phosphates formed in the asteroid. Wild 2 is dominated by diverse materials formed in the nebula. The asteroid previously contained liquid water while the comet contained ice but no water. Although the Wild 2 does contain magnetite and other possible aqueous alteration phases, they are quite rare and plausibly are fragments from bodies where aqueous alteration did occur. The oxygen isotope compositions of Wild 2 olivine with Fe contents ranging from forsterite to Fo_{50} show a good correlation with chondrule olivine in CR chondrites. The Cr and Al contents of Wild 2 pyroxenes show that essentially all of them match patterns seen in the lowest petrographic grade chondrites.