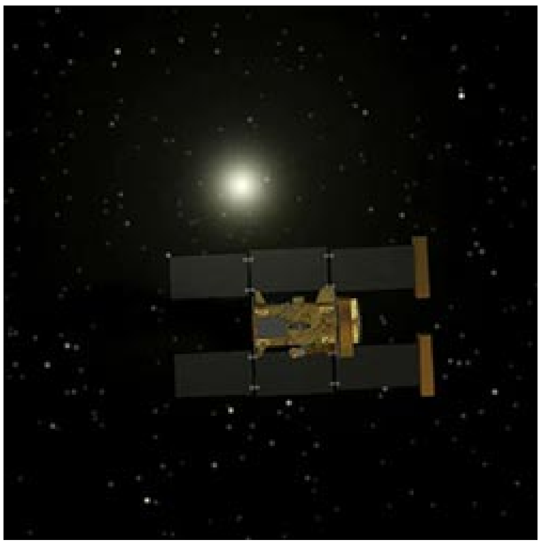
Stardust Analysis Update

May 17 2006



Artist concept of Stardust.

The Stardust Preliminary Examination Team is now in the second half of the six-month period to complete the initial characterization of the returned comet samples. The PET consists of about 200 people around the world organized into sub-teams working on the bulk composition, organics, mineralogy, isotopes, spectroscopy and craters in the aluminum holding frame.

During the first week in May, representatives of each of the six sub-teams met to discuss the state of their findings and began outlining the research papers that they will submit for publication this summer.

The three-day workshop was held at the Timber Cove Inn, a remote seaside location north of San Francisco. The meeting was funded by the University of California's Institute of Geophysics and Planetary Physics and organized by John Bradley, Trish Dobson, Andrew Westphal and Gary Zank.

In addition to the comet research, one of the joys of the meeting was strolling out on the deck to watch grey whales and their newborns migrate up the coast.

The workshop was an opportunity to compare results, dig though the data to see the "big picture" issues that will go into the final research papers and plan out future work.

The analysis results came from a diverse set of instruments ranging from optical microscopes to synchrotrons larger than shopping centers. In addition to presentations of data, numerous discussions focused on what had been learned about the comet.

Everyone was elated to work on ancient materials from the edge of the solar system and there was great anticipation that this work will provide fundamental insights into the origin of the solar system.

There was a general consensus that many of comet particles are built like loose dirt-clods composed both of "large strong rocks" as well as very fine powdery materials.

The fine and coarse materials are only loosely held together and they separated during collection in low-density aerogel to form tracks shaped like ginseng, turnips or carrots. The larger components form root-like holes that lead to the bottoms of the tracks, and the smaller components stopped closer to the tops of the tracks, forming bulbous turnip-like cavities.

The longest tracks are about two centimeters long and up half a centimeter wide. Analysis of material in the bulbs has provided the first information on organic materials in the samples.

Analysis of the large particles that traveled all the way to the button of the tracks has revealed a remarkable range of minerals. Some of these particles contain minerals the form only at extremely high temperatures - temperatures that could not have existed where the comets formed.

Some of these minerals are similar to "refractory" materials that formed in the hottest, innermost regions of the disk of gas and dust that formed the Sun and planets. If these minerals in the comet are from our solar system then they probably formed close to the young Sun and were transported all the way from inside the orbit of Mercury past the orbit of Neptune.

Another option is that these "hottest minerals found in the coldest place" actually formed around other stars. The distinction between solar system and extra-solar origin of these minerals will be determined by measuring their isotopic compositions.

The abundances of the isotopes of elements like oxygen is quite different in true stardust grains, formed around other stars, than it is for materials formed in our solar system. One of the most exciting outcomes of the workshop was preliminary data suggesting that the comet is a mix of both stardust grains from other stars as well as materials formed in the solar system.

As expected, there appears to be true stardust in Stardust.

In addition to Stardust, the sponsors of the workshop also included sessions on past and future missions. Don Burnett of Caltech presented the latest results from the Genesis solar wind mission (a sister mission to

Stardust). Laurie Leshin of Goddard Space Flight Center talked about her work on a Martian sample return mission, using Stardust technology.

Mike Zolensky of Johnson Space Center and Scott Sandford of NASA Ames showed images from the Japanese Hayabusa asteroid sample return mission. Casey Lisse of the University of Maryland presented his latest results from the Deep Impact comet mission.

One of the most interesting findings of Deep Impact was evidence for carbonate minerals and silicate minerals that contain bound water. To date, these materials do not seem to exist or at least be common in comet Wild 2 sampled by Stardust.

Review talks on comet mineralogy, Calcium Aluminum Inclusions and the formation of the solar system were given respectively by Diane Wooden of NASA Ames, Glen McPherson of the Smithsonian Institution, and Doug Lin of the University of California, Santa Cruz.

A highlight of the entire meeting was a panel discussion by several of the above speakers plus Dave Lindstrom of NASA headquarters and Jerry Wasserburg of Caltech. Together, they advised the PET to take care to see the forest through the trees and write meaningful final reports that will be widely read.

Jerry gave great advice and talked about Stardust and its work on the first comet samples in comparison with Apollo 11 and his first look at samples from the Moon, 35 years before.

It was a wonderful meeting and the team left fully charged to complete the rest of its six-month initial examination of the comet samples.