POSSIBLE COMET SAMPLES: THE NASA COSMIC DUST PROGRAM. U.S. Clanton[1], J.L. Gooding[1], D.S. McKay[1], I.D.R. Mackinnon[2], A.M. Isaacs[3], G.A. Nace[3], E.M. Gabel[4], J.L. Warren[4], C.B. Dardano[4].
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Beginning in 1974, a limited effort to collect extraterrestrial dust samples from the stratosphere using impactors mounted on NASA U-2 aircraft was initiated at NASA Ames Research Center (1). Subsequent studies (e.g. 1-9) have clearly established an extraterrestrial origin for some of the material. Attrition of comets is considered to be one of the potential sources of extraterrestrial dust (1,5). Additionally, some of the particles appear to represent a type of primitive material not represented in meteorite collections.

In order to provide a greater availability of these samples to the scientific community, NASA-Johnson Space Center (JSC) began in May of 1981 a program dedicated to the systematic collection and curation of cosmic dust for scientific investigation. Collections were made at 18 to 20 km altitude by means of collectors mounted under the wings of a WB57F. When the aircraft reaches operating altitude, the collector plates (impactors) are extended into the ambient airstream with the collection surface normal to the airflow. To prevent particles from bouncing off the surface, the impactors are coated with a film of high viscosity silicone oil. The impactors are sealed in canisters to minimize contamination when not collecting.

NASA-JSC has now flown three sets of eight collectors with collection intervals of 65, 45 and 35 hours. The total volume swept by these 24 impactors is in excess of two million cubic meters. Calculations indicate that the collection should contain about 2,000 cosmic dust particles larger than 8 micrometers and perhaps 18 to 20 particles almost 50 micrometers in diameter. The larger particles in particular provide a rare opportunity for consortium research.

An ultra-clean (Class 100) facility at JSC is used for pre- and post-flight handling of the collectors and the curation of collected particles. Individual particles in the size range of 6 to 35 micrometers are removed from the silicone oil on the impactors and placed on a Nucleopore substrate that is bonded to a graphite mount. Complete mounts of 16 particles each are washed with hexane to remove the silicone oil. The particles are not stuck to the substrate and can be removed from the mount for further analysis at any later date.

Preliminary examination of the particles has indicated that they represent not only extraterrestrial material but some fraction of terrestrial contamination from both natural and man-made sources. This examination involves a combination of optical microscopy, scanning electron microscopy (SEM) and qualitative bulk elemental analysis using an energy dispersive x-ray spectrometer (EDS) to charaterize each particle. Operating conditions were carefully chosen to minimize particle damage by heating or radiation, contamination or the production of artifacts. The optimum conditions for preliminary examination require uncoated specimens, a 40kV accelerating voltage and a detector take off angle of 35°.

The preliminary information has been compiled into a loose-leaf catalog with all of the data for one particle on a single page. Each page has a SEM micrograph "mug shot" that shows the over-all grain morphology. In addition, optical observations (500X) and EDS spectra are included. The EDS spectrum represents a qualitative bulk elemental analysis of the entire particle. The catalogs are intended only to inform potential investigators as to the types of particles

available for research and should not be considered as anything more than preliminary data which are subject to change.

A preliminary classification of particles was made to assist catalog users in choosing appropriate particles for detailed study. We emphasize that the classification is very tentative and somewhat subjective and is based only on gross morphology and energy dispersive x-ray spectra. Of the 105 particles in the first catalog, 14% are judged to be natural terrestrial contaminants including quartz dust, clay particles, carbonates, and possibly volcanic ash; 42% are judged to be man-made contaminants including rocket exhaust particles and debris from aircraft or spacecraft. The largest group of particles, 43%, are judged to be cosmic dust or meteorite ablation products. This group contains a varied assortment of particle morphologies including aggregates, ablation spheres and massive types. Approximately 1% could not be easily assigned to any category.

The periods flown during the collection coincide with peak periods of several meteor showers. Set one may contain material from the tail of the Eta Aquarid shower from the comet Halley. Set two was flown during the peak of the Delta Aquarid and Draconid showers. Set three should contain samples from the Giacobinid, Orionid and Taurid showers, perhaps providing samples from the Giacobini-Zinner, Halley and Encke comets.

Catalogs of the preliminary SEM/EDS data are available to the scientific community so that interested scientists may request particles for detailed study. In the absence of a comet sample-return mission, the Cosmic Dust Program may provide the best opportunity to study materials from comets.

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