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TARGETED FLIGHT OPPORTUNITIES WITH LARGE AREA COLLECTORS; Ian D. R. Mackinnon, Department of Geology, University of New Mexico, Albuquerque NM 87131.

The collection of stratospheric dust utilising flat plates attached to aircraft wing-pylons currently requires approximately 40 hours of accumulated exposure time [1]. These long exposure times are attained on a relatively ad hoc basis, through the summation of short 4-8 hour flights which are often subject to the demands of other higher priority experiments on the same aircraft. Thus, total collection periods for stratospheric particles at ~20km altitude may range from 3 to 6 months. For example, collection of particles on Flag No. W7029 began on September 21st, 1981 and was completed on November 30th, 1981 [1]. During this collection period, the longest continuous flight time was for ~8 hours on October 15th while several flight times < 2 hours were also recorded [2]. A major factor in the stratospheric collection process is the relative density of particles at the collection altitude. With current collector plate geometry, one potential extraterrestrial particle of about 10μm diameter is collected approximately every hour. However, a new design for the collector plate, termed the "Large Area Collector" (LAC), allows a factor of 10 improvement in collection efficiency over current conventional geometry [3]. The implementation of LAC design on future stratospheric collection flights will provide many opportunities for additional data on both terrestrial and extraterrestrial phenomena.

With a factor of 10 improvement in collection efficiency, LAC's may provide a suitable number of potential extraterrestrial particles in one short flight of between 4 and 8 hours duration. Alternatively, total collection periods of ~40 hours enhances the probability that rare particles (e.g. ~100μm diameter CP aggregates) can be retrieved from the stratosphere. This latter approach is of great value for the cosmochemist who may wish to perform sophisticated analyses on greater than picograms of interplanetary dust. The former approach, involving short duration flights, may also provide invaluable data on the source of many extraterrestrial particles. The time dependance of particle entry to the collection altitude is an important parameter which may be correlated with specific global events (e.g. meteoroid streams) provided the collection time is known to an accuracy of < 2 hours.

Many meteoroid streams occur with predictable regularity, although the relative intensity of a particular event is not always easily determined in advance [4]. Nevertheless, the orbital parameters of many common meteoroid streams are precisely determined and can be readily correlated with the known orbital elements of periodic comets [4]. The components of these meteoroid streams reach a termination height (i.e. the altitude at which the entry velocity vector is zero) between ~55 and 95 km altitude. Thus, after the termination height is reached, particles derived from a meteoroid stream contain a velocity component which is only dependant upon the settling rate of particles through the mesosphere. This region of the Earth's upper atmosphere is relatively quiescent, and, at least at the upper altitudes of the mesosphere, particle transport via transverse winds may not be significant. Experimental data on the settling rate of irregularly shaped particles [5] provides a simple procedure for estimating the settling time for various particle types to fall from an observed termination height to the collection altitude. This settling rate calculation accounts for the viscosity of the medium, particle shape, size and particle density - factors which greatly influence fall time through an atmosphere [5].

Sample calculations for typical particles encountered in the Cosmic Dust Collection [7] indicate that a CP aggregate (with $\sigma = 0.1$ gm.cm^{-3} and effective diameter, d_a, 50µm) can fall from a termination height of 55km to a collection height of 18km in > 80 days. However, if the collection altitude is increased to ~35km, the settling time decreases to ~45 days. A sphere with the same density should fall the 20km column height in ~20 days. These settling time estimates are based upon a simplified, linear extrapolation of Wilson-Huang and Stokes' formulations at higher altitudes [2]. More explicit calculations would provide precisely-defined upper and lower bounds on the lead time available for the collection of stratospheric particles for various combinations of parameters (e.g. sphere vs aggregate; $\sigma \sim 0.1$ gm.cm^{-3} vs 2.5 gm.cm^{-3} etc.). These calculations can be optimised to suit the turn-around time for mission-readiness, the propensity of particles to accumulate in the lower stratosphere and other environmental factors (e.g. shuttle launches, volcanic eruptions). Thus, dust collection missions using an LAC geometry may be targeted towards specific collection altitudes, latitudes and collection times. These space-time points may be defined by the probability that a high flux of incoming extraterrestrial material (e.g. meteoroid streams) will be present. Within a given meteoroid event, it may be possible to obtain separate, short period collections which sample more rapidly settling ablation spheres as well as later settling porous, fluffy and irregularly-shaped particles.

Source-specific data on the micrometeorite flux (commonly misconceived as constant through time) via retrieved samples would provide a significant increase in our understanding of solar system small-body chemistry and mineralogy (e.g. that of comets and asteroids) as well as upper atmosphere dynamics. This type of program is also well-suited to the monitoring of short-term events which may influence the solid particulate environment in the stratosphere. For example, particle debris swarms from the rapid orbital decay of space or near-Earth orbit structures can be assessed. In addition, short-duration collection flights may also provide more timely and precise (experimental) assessments of mans' increased activities in the near-Earth orbital environment [e.g. 6].

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