ACCURATE STRATOSPHERIC PARTICLE SIZE DISTRIBUTIONS FROM TWO SEPARATE FLAT-PLATE COLLECTION SURFACES: CAN WE SEE VARIATIONS WITH TIME?; M.E. Zolensky, SN4, Johnson Space Center, Houston, TX 77058, I.D.R. Mackinnon, Department of Geology, University of New Mexico, Albuquerque, NM 87131, G.A. Robinson, Lockheed, 1830 Nasa Rd. 1, Houston, TX 77058, and D.S. McKay, SN4, Johnson Space Center, Houston, TX 77058.

Over the past two decades, flat-plate particle collections have revealed the presence of a remarkable variety of both terrestrial and extraterrestrial material in the stratosphere [1-6]. The ratio of terrestrial to extraterrestrial material and the nature of material collected may vary over observable time scales. Variations in particle number density can be important since the earth's atmospheric radiation balance, and therefore the earth's climate, can be influenced by particulate absorption and scattering of radiation from the sun and earth [7-9]. In order to assess the number density of solid particles in the stratosphere, we have examined a representative fraction of the solid particles from two flat-plate collection surfaces, whose collection dates are separated in time by 5 years.

Chemical, structural and morphological analyses have been made of a representative fraction of the solid particles from two separate stratospheric collection surfaces. Collection surface W7017 sampled the stratosphere between 17 and 19km in altitude in the summer of 1981, and therefore before the eruptions of El Chichon. The second collection surface examined, designated U2-9, sampled at 19km in the late winter of 1976. This latter collection surface was made available for study by D. Brownlee. Each particle collection surface was washed free of all particles with rinses of freon and hexane, and the resulting wash was directed through a series of Nucleopore filters [5&6]. All particles were examined with a JEOL 35CF Scanning Electron Microscope (SEM) to determine morphology and size. Bulk elemental analyses were obtained with a Princeton Gamma Tech Energy Dispersive Spectrometer (EDS) attached to the SEM. The structures of a small fraction of particles were examined using a JEOL 100CX Transmission Electron Microscope.

All particles were classified using the stratospheric particle classification scheme developed and modified at the Johnson Space Center [6, 10]. Collection surface W7017 contained a large amount of volcanic glass shards (see Table 1), which are considered to be the result of a relatively transient atmospheric phenomenon. Therefore this volcanic material is not included in calculations of the ambient stratospheric particle type distributions shown in Table 2. The total stratospheric number density of particles larger than 1μm in diameter at the collection times is calculated at about 0.58×10^{-1} and 1.0×10^{-1} particles per cubic meter of air for collection surfaces U2-9 and W7017, respectively. Approximately 95% of these particles are smaller than 5μm in diameter.

Since collection surface U2-9 dates to 1976 and W7017 to 1981, these calculated number densities may indicate a net increase in this value over the five year period, neglecting the uncertainties of this analytical procedure. Collection surface W7017 has an increased proportion of low-Z and aluminum-particles, relative to surface U2-9, and may indicate an increased flux of these particles into the lower stratosphere between 1976 and 1981. However, the values for the relative proportion of chondritic material on these collection surfaces are similar (11 and 12%). If the overall flux of this material remains relatively constant with time, the

relative proportion of chondritic material should decrease as additional amounts of low-Z and aluminum-rich material enter the stratosphere. However, there is insufficient precision in the estimates of the earth's annual micrometeorite flux to resolve this question.

With the single exception of the uncommon calcium-aluminum-silicate (CAS) spheres, the number concentrations of all particle types increases logarithmically with decreasing diameter. Aluminum-rich particles show bimodal size distributions which suggest their continual renewal into the stratosphere. Spheres are only a minor fraction of all aluminum-rich materials collected, suggesting that rocket exhaust is probably not the most important source of this material. The micrometeorite flux calculated from surface W7017 is 5×10^{-2} micrometeorites per cubic meter of air. At the collection altitude, the maximum collision frequency of particles >5μm in diameter is estimated to be 6.91×10^{-16} collisions per second. The time constant for this collision frequency indicates that extraterrestrial particles will show negligible contamination by collision with any solid particles (>0.1μm in diameter) in the stratosphere.

References: [1] S.C. Mossop, 1965, Geochim. Cosmochim. Acta, 29, 201-207; [2] D.E. Brownlee et al., 1977, Science, 191, 1270-1271; [3] P. Fraundorf, 1982, Meteoritics, 17, 214-215; [4] I.D.R. Mackinnon et al., 1982, Meteoritics, 17, 245; [5] M.E. Zolensky et al., 1984, LPS XV, 963-964; [6] M.E. Zolensky and I.D.R. Mackinnon, in press, JGR; [7] R.D. Cadle and G.W. Grams, 1975, Rev. Geophys. Space Phys., 13, 475-501; [8] O.B. Toon and J.B. Pollack, 1976, J. Appl. Meteor., 15, 225-246; [9] R.P. Turco et al., 1981, JGR, 86, 1113-1128; [10] K. Kordesh et al., 1983,LPS XIV, 387-388.

Table 1 Stratospheric dust size and type distribution for particle collection surface W7017.

size	chondritic	silicate	volcanic	Al	Al'	Fe-S	Fe+S	CAS	low-Z	other
>10μm	7%	8	21	20	15	5	7	<1	7	10
6-10μm	11%	12	22	26	9	2	3	<1	10	5
1-5μm	4%	9	63	8	3	3	1	<1	4	5
entire surface	4%	9	63	8	3	3	1	<1	4	5

Table 2 Stratospheric dust size and type distribution for particle collection surface W7017, after deletion of volcanic material.

size	chondritic	silicate	Al	Al'	Fe-S	Fe+S	CAS	low-Z	other
>10μm	9%	10	25	19	6	9	<1	9	13
6-10μm	14%	15	34	11	3	4	<1	13	6
1-5μm	11%	23	23	8	8	3	<1	11	13
entire surface	11%	23	23	8	8	3	<1	11	13

Table 3 Stratospheric Particle Size Distribution For Surface U2-9

size	chondritic	silicate	Al	Al'	Fe-S	Fe+S	CAS	low-Z	other
>10μm	17%	24	5	7	10	2	<1	<1	35
6-10μm	<1%	34	24	10	10	3	<1	<1	19
1-5μm	12%	34	5	20	8	6	<1	<1	15
entire surface	12%	34	5	20	8	6	<1	<1	15