66 ACM '91

530853

1P

N91-25992

P/Halley: Spatial distribution and scale lengths for C_2, CN, NH_2, and H_2O

Uwe Fink[1], Michael Combi[2] and Michael A. DiSanti[3]
Lunar and Planetary Laboratory, University of Arizona

Abstract

From P/Halley long slit spectroscopic exposures on 12 dates, extending form 1985 Oct. to 1986 May, spatial profiles were obtained for emissions by C_2, CN, NH_2, and OI (^1D). Haser model scale lengths were fitted to these data. The extended time coverage allowed us to check for consistency between the various dates. Not unexpectedly, the time varying production rate of P/Halley severely affected the profiles after perihelion, which is nicely demonstrated in two profile sequences on adjacent dates, March 01/02 and April 14/15. Because of the time varying production rate, it was not possible to obtain reliable Haser model scale lengths after perihelion. Our pre-perihelion analysis yielded Haser model scale lengths of sufficient consistency that they can be used for production rate determinations, whenever it is necessary to extrapolate from observed column densities within finite observing aperatures. Results of scale lengths reduced to 1 AU are as follows:

	parent (10^3 km)	daughter (10^3 km)
C_2	58±20	58±20
CN	28±15	320+200/-100
NH_2	4.9±1.5	62±20
H_2O	74±60	--

For C_2 a slight flattening of the profile close to the nucleus could not be fitted with a two step Haser model but can be accommodated with a CHON halo model (Combi and Fink 1991). If the inner region is excluded from the fit, the daughter/parent scale length ratio changes from near one to about 6. However, when production rates are sought using a two step Haser algorithm only an equal scale length model comes close to providing an acceptable fit. Only three observations yielded a CN daughter scale lengths because our profiles did not extend sufficiently far. The long daughter of CN also makes this emission very sensitive to production rate variations causing greater scatter in the parent values. A curios asymmetry of the scale lengths for NH_2 was found with the post-perihelion parent being about twice the pre-perihelion value, but the daughter being about half the pre-perihelion number. We have as yet not found a ready explanation for this behavior. Most of the OI ^1D profiles, which effectively map out the comet's H_2O distribution, deviated very little from a $^1/r$ fall off so that it was not possible to obtain a reliable H_2O parent scale length, although consistency with the nominal lifetime of 80×10^3 seconds is quite clearly demonstrated.

This research was supported by NASA grant NAGW 1549.

[1] Uwe Fink: Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721
[2] Michael R. Combi: Space Research Building, University of Michigan, Ann Arbor, MI 48109-2143
[3] Michael A. DiSanti: Infrared & Radio Astronomy Branch, NASA-Goddard, Code 693, Greenbelt, MD 20771

LOW-RESOLUTION SPECTROSCOPY OF D-TYPE ASTEROIDS

A. Fitzsimmons, Queen's University Belfast
P. Magnusson and I.P. Williams, Queen Mary and Westfield College, London
M. Dahlgren and C.-I. Lagerkvist, Uppsala Observatory

We have obtained reflectance spectra of 19 D-type asteroids using the 4.2 m William Herschel Telescope on La Plama. The wavelength coverage of 370 nm to 950 nm has allowed us to measure accurate reflectance slopes for all of these low-albedo objects. A simultaneous search for absorption and emission features has been performed. An initial result is that we have been unable to confirm the existance of absorption bands in 279 Thule as reported by us previously. Preliminary results will be presented and discussed.

LARGE MICROMETEORITES: ATMOSPHERIC ENTRY SURVIVAL, RELATION TO MAIN-BELT ASTEROIDS, AND IMPLICATIONS FOR THE COMETARY DUST FLUX.

G. J. Flynn, SUNY-Plattsburgh, Plattsburgh, NY 12901.

Micrometeors and micrometeorites 50 μm to 1 mm in diameter constitute 80% of all the meteoritic mass (excluding rare, large impactors > 10^{14} grams) accreting onto the Earth [Hughes 1978]. Although small micrometeorites ($\leq$ 50 μm in diameter) have been collected from the Earth's stratosphere since the early-1970's, micrometeorites larger than 100 μm were expected to vaporize on atmospheric entry. Large micrometeorites (>100 μm), partially melted and unmelted, have recently been recovered from the sea floor [Brownlee 1981] and polar ices [Maurette et al. 1986]. IDENTIFICATION AS MICROMETEORITES: High Ne concentrations in several large micrometeorites confirm their extraterrestrial origin, and establish they were individually irradiated by the solar wind as small objects, thus they are not ablation debris or interior parts of a much larger body [Olinger et al. 1989]. Cosmogenic nuclei, ^{10}Be and ^{26}Al, in large micrometeorites also indicate small body or surface exposure [Nishiizumi et al. 1991]. ENTRY HEATING SOURCE IMPLICATIONS: Computer simulations of the atmospheric entry of large micrometeorites show only those with very low geocentric velocities survive without vaporization, indicating the large micrometeorites arrive at Earth by Poynting-Robertson (P-R) orbital evolution from main-belt asteroids [Flynn 1990, 1991; Love and Brownlee 1991] or comets in low inclination, near-circular orbits, like Schwassman-Wachmann 1 [Flynn 1989]. RELATIONSHIPS TO METEORITES AND ASTEROIDS: The most common large micrometeorites are partially melted spheres consisting of olivine grains with minor amounts of magnetite. They have "chondritic" (or solar) abundances of Mg, Al, Si, Mn, and Fe [Maurette et al. 1986]. Sutton et al. [1988] suggest the elemental abundance patterns observed in 3 of 9 melted spheres are more consistent with ordinary chondrite than carbonaceous chondrite composition. Thus S and C type asteroids seem the most likely parent bodies. But high carbon abundances, >10% in 1/3rd of particles examined [Maurette et al. 1987], leave open P or D asteroid parent bodies. IMPLICATIONS FOR FLUX OF COMETARY DUST: The contribution of main-belt asteroids to the flux of large micrometeorites at Earth has previously been assumed to be small [eg, Flynn 1989] because the calculated catastrophic collision lifetimes of these particles (~10^4 to 10^5 years) were substantially shorter than the times required for P-R orbital evolution from the main-belt to Earth (~10^6 years)[eg, Dohanyi 1978]. The space exposure ages of large micrometeorites (10^5 to 10^7 years) measured by Nishiizumi et al. [1991] are consistent with the calculated P-R lifetimes, suggesting the true collisional lifetimes are much longer than those calculated by Dohanyi [Flynn 1990; Nishiizumi et al. 1991]. Since the collisional lifetimes are calculated to be dominated by smaller cometary particles, suggesting the cometary contribution to the interplanetary dust cloud in the 1 μm to 20 μm diameter range (responsible for the fragmentation of the larger particles) is significantly less than previously assumed, consistent with the conclusion that much of the 10 to 20 μm cosmic dust collected at earth is asteroidal [Flynn 1989; Sandford and Bradley 1990].

REFERENCES: Brownlee, D. E. (1981) in The Sea, vol. 7, Wiley, 733-762. Dohanyi, J.S. (1978) in Cosmic Dust (ed. J.A.M. McDonnell) Wiley, 527-605. Flynn, G.J. (1989) Icarus, 77, 287-310. Flynn, G. J. (1990) Meteoritics, 25, 365. Flynn, G. J. (1991) Lunar & Planet. Sci. XXII, 393-394. Hughes, D.W. (1978) in Cosmic Dust (ed. J.A.M. McDonnell), Wiley, 123-185. Love, S.G. and Brownlee, D.E. (1991) Icarus, 89, 26-43. Maurette, M. et al. (1986) Science, 233, 869-872. Maurette, M. et al. (1987) Nature, 328, 699-702. Nishiizumi, K. et al. (1991) Exposure History of Individual Cosmic Particles, Earth Planet. Sci. Lett. (in press). Olinger et al. (1989) Meteoritics, 24, 312. Sandford, S. and Bradley, J.(1990) Icarus, 82, 146-166. Sutton, S.R. et al. (1988) Meteoritics, 23, 304.

C-2

Bulk abundances of the main rock-forming element in the P/Halley dust component

Fomenkova M.N., Evlanov E.N., Mukhin L.M., Prilutsky O.F. (Space Research Insitute, Profsoyuznaya 84/32, Moscow 117810, USSR)

The main data on the chemical composition of P/Halley dust component were obtained after Vega missions from PUMA-1,2 dust-impact mass-spectrometers. Ion ratios of a "compound bulk comet" obtained by different authors (1-3) as the average of the individual grins spectra differ greatly from elemental abundances in carbonaceous chondrites of type CI even for the main rock-forming elements.However, taking into account mass of dust particles brings about a quite satisfactory coincidence of the average ionic composition of comet dust with the solar abundances of these elements.

The procedure of averaging was as follows. First, the sum of all the ions of the main elements in an individual spectrum was assumed to be 100% and the percentage of every element in this spectrum was calculated. The next step was to average the obtained values in all spectra with weighting factors equalling the independently derived mass of dust particles (4). This procedure enables to eliminate uncertainities due to the variations of the ion signal in the spectra of particles of similar mass.

To determine abundances of minor elements as Al, K, Ca, Ti, Cr, Ni we used selected spectra of higher quality, where these elements are surely identified. It is necessary, because noise pulses caused by impacts of very small dust grains can be confused with peaks of minor elements. Results are given in the table for both instruments and for different modes of functioning. Errors have been estimated assuming that individual error of every peak is a square root of its amplitude.

	PUMA1, wide	**PUMA1, narrow**	**PUMA2, wide**	**PUMA2, narrow**
Na	40.8 ± 17.2	29.3 ± 1.7	69.7 ± 5.7	48.2 ± 3.7
Mg	107.7 ±39.6	168.4 ± 5.9	138.7 ± 8.6	177.0 ± 10.8
Al	18.9 ± 6.3	9.0 ± 0.8	23.6 ± 1.6	23.3 ± 1.6
Si	100	100	100	100
S	67.3 ± 23.5	50.3 ± 2.5	74.7 ± 5.3	85.6 ± 5.9
Cl	34.9 ± 10.2	22.1 ± 1.2	3.6 ± 0.2	0.2 ± 0.01
K	0.4 ± 0.2	1.2 ± 0.3	2..6 ± 0.3	2..3 ± 0.2
Ca	7.4 ± 3.0	5.3 ± 0.6	11.6 ± 1.2	12.5 ± 1.1
Ti	0.3 ± 0.15	0.9 ± 0.2	1.1 ± 0.1	0.9 ± 0.1
Cr	1.3 ± 0.6	1.7 ± 0.4	3.0 ± 0.2	3.8 ± 0.3
Fe	92.7 ± 33.4	54.7 ± 3.0	70.9 ± 5.1	49.9 ± 3.2
Ni	4.8 ± 1.5	2..5 ± 0.4	0.6 ± 0.1	< 0.1

REFERENCES

1. Sagdeev, R.Z. et al. Space Research 25, 840-848 (1987).
2. Langevin, Y. et al. Astron. Astrophys. 187, 761-766 (1987).
3. Jessberger, E.K. et al. Nature 332, 691-695 (1988).
4. Fomenkova M.N. et al. Lunar Planet Sci. Conf. 22, 397-398 (1991).

Synthetic mapping for long range integration of Hamiltonian system

Cl. Froeschlé and J.M. Petit

Different types of interpolation are proposed and tested for transforming a non linear differential system, and more particulary Hamitonians one with 2 and three degrees of freedom into maps without having to integrate the whole orbit as in the well known Poincaré return map technique. We construct piecewise polynomial maps by coarse-graining the phase surface of section into parallelograms using values of the Poincaré maps at the vertices to define a polynomial approximation within each cell. The numerical experiments are in good agreement with both the real symplectic and Poincaré maps. The agreement is better when the number of vertices and the order of the polynomial fit increase.

The effect of secular resonances in the asteroid region between 2.1 and 2.4 AU

Ch. Froeschlé, H.Scholl
Observatoire de la Côte d'Azur, Nice, France

The asteroid region between 2.1 and 2.4 AU at inclinations between 10° and 20° is anormally depopulated. This region is surrounded by the principal secular resonances ν_5, ν_6 and ν_{16} and it is crossed by higher order secular resonances. Our aim is to investigate the effect of secular resonances on the orbital evolutions of asteroids in this region. We integrate in the frame of the four-body problem Sun-Jupiter-Saturn-asteroid the orbits of twenty fictitious asteroids with the same initial eccentricity of $e = 0.14$, initial semimajor axes in the range $2.1 \leq a \leq 2.4AU$, and initial inclinations between $12° \leq i \leq 20°$.