Average chemical compositions of minerals in the H6 chondrite (RKP86701) in weight percent

	Olivine(5)	Ortho-pyroxene(5)	Clino-pyroxene(4)	Chromite(4)
SiO_2	38.7 ± 0.3	58.7 ± 0.7	54.0 ± 1.8	na
Al_2O_3	0.04 ± 0.1	0.18 ± 0.02	1.17 ± 0.47	6.56 ± 0.09
Na_2O	0.01 ± 0.004	0.02 ± 0.01	0.79 ± 0.28	na
K_2O	0.01 ± 0.003	0.02 ± 0.01	0.11 ± 0.08	na
TiO_2	0.02 ± 0.02	0.36 ± 0.02	0.85 ± 0.08	2.45 ± 0.15
Cr_2O_3	0.12 ± 0.14	0.17 ± 0.12	0.67 ± 0.12	59.0 ± 0.7
CaO	0.03 ± 0.02	1.55 ± 0.39	20.4 ± 2.8	na
MgO	41.6 ± 1.1	30.7 ± 0.1	17.5 ± 1.8	3.84 ± 0.25
FeO	18.0 ± 0.5	11.3 ± 0.4	4.33 ± 0.93	28.1 ± 1.1
MnO	0.43 ± 0.03	0.50 ± 0.02	0.21 ± 0.02	na
NiO	na	0.08 ± 0.06	na	na
V_2O	na	na	na	1.07 ± 0.06
Sum	99.0	103.5	100.1	101.0
	Taenite(1)	Kamacite(6)	Troilite(6)	
Fe	72.4	90.3 ± 1.1	64.1 ± 0.7	
S	0.01	0.01 ± 0.004	36.4 ± 0.2	
Si	0.01	0.01 ± 0.01	0.01 ± 0.01	
Ni	24.4	6.98 ± 0.10	0.02 ± 0.02	
Co	0.14	0.46 ± 0.05	0.01 ± 0.01	
Cu	0.35	0.06 ± 0.05	0.01 ± 0.01	
Zn	0.06	0.17 ± 0.10	0.06 ± 0.04	
Cr	0.03	0.01 ± 0.01	na	
Mn	0.01	0.03 ± 0.02	na	
Ti	0.00	0.01 ± 0.01	na	
Sum	97.5	98.1	100.7	

na = not analyzed; () number of grains

percent; cpx=0.79 ± 0.28 percent), and calcium oxide (opx=1.55 ± 0.39 percent; cpx=20.4 ± 2.8 percent). However, opx contains more magnesium oxide (30.7 ± 0.1 percent) and ferrous oxide (11.3 ± 0.4 percent) than cpx, which has magnesium oxide=17.5 ± 1.8 percent and FeO=4.33 ± 0.93 percent. The elevated concentrations of aluminum and sodium oxide in cpx are the result of coupled substitution of Al(3+) + Na(1+) for Si(4+), exactly as in terrestrial pyroxenes.

The meteorite from the Reckling moraine contains small grains of chromite composed of the oxides of chromium and iron with small amounts of aluminum, magnesium, titanium, and vanadium.

The metallic iron grains differ in their concentrations of nickel such that taenite contains 24.4 percent, whereas kamacite contains only 6.98 percent. The grains of iron sulfide contain equal molar amounts of iron and sulfur and are identified as triolite, which does not occur in terrestrial rocks.

The silicate minerals as well as chromite contain the correct number of cations compared with the number of oxygen atoms in their respective formulas. Therefore, the minerals in this and other stony meteorites could have crystallized from silicate melts at the time of their formation (4,500 million years ago) in much the same way that they still form on the earth today.

We thank M. L. Lindstrom, meteorite sample curator, for providing the specimen and the thin section of RKP86701. We also thank E. H. Hagen and M. L. Strobel for assistance in the field. This work was supported by National Science Foundation grant 87-14324 and DPP 88-16236.

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Recovery of extraterrestrial particles from the Lewis Cliff Ice Tongue using a passive collection system

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A significant portion of the meteoritic flux to the earth consists of dust-sized micrometeorites and ablation spherules (Nishiizumi et al. 1991). This material has been recovered in notable quantities from supraglacial lakes in Greenland (Maurette et al. 1986) and from tills along the margin of the Transantarctic Mountains (Hagen, Koeberl, and Faure 1990). The recovery of this dust-sized material is challenging because, unlike larger meteorites, micrometeorites are transported by the wind after they ablate from the ice and are only trapped by obstacles in their path (Harvey and Maurette 1990). The recovery of extraterrestrial particles from till is hindered because of the high dilution with terrestrial mineral grains.

The purpose of our field work was to trap spherules in transport after they ablated from the ice to demonstrate that significant quantities of extraterrestrial particles could be trapped with a passive collection system. The experiment was performed during the 1990-1991 field season on the Lewis Cliff Ice Tongue (LCIT) (84° 12' S 161° 10' E) adjacent to Mt. Achernar (figure 1). The LCIT was chosen because it is a well-known meteorite stranding surface with a high ablation rate; the supraglacial tills in the area contain abundant spherules (Hagen, Koeberl, and Faure 1990); and the wind direction along the ice surface remains constant because of the channeling of the wind between adjacent bedrock ridges.

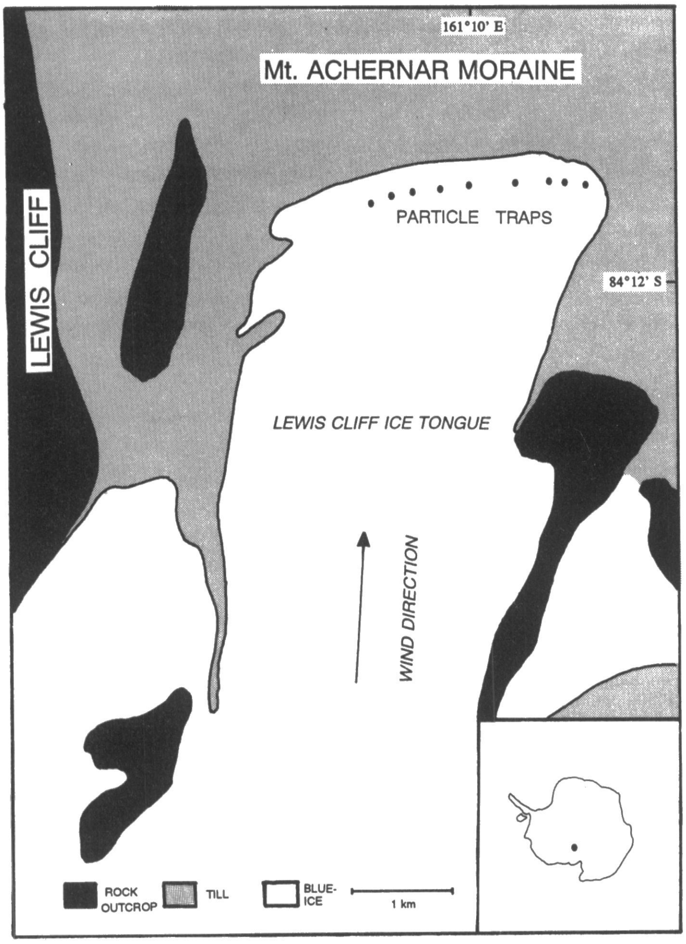

Figure 1. Map showing the Lewis Cliff Ice Tongue and the particle trap locations.

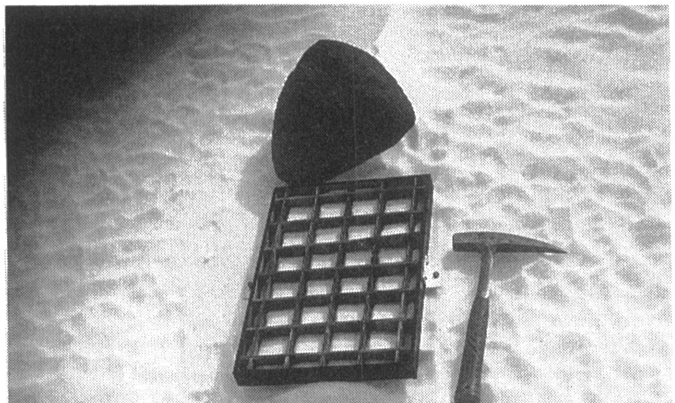

Figure 2. Photograph of a particle trap as emplaced in the field. Each particle trap measures 4.09 centimeters by 6.24 centimeters and is held in place by 2.34-centimeter carpenter nails.

The design of the particle traps used in this experiment is based on devices used to trap particulate emissions from industrial plants in remote areas where no electrical power is available. These traps are designed to effectively catch particles in the fine-sand to silt size ranges (e.g., saltating grains), but they are less effective in collecting smaller particles.

The traps consisted of shallow, open boxes containing a plastic sheet coated with a tacky substance to hold the particles. In addition, a grid constructed of plywood was placed into each box over the plastic sheet. The purpose of the grid was to act as a wind break, thereby increasing the efficiency of the trap. The total surface area of each trap was approximately 1,045 square centimeters (figure 2).

Nine traps were placed on the LCIT at the locations shown in figure 1. The traps were placed approximately 100 meters apart at the terminal end of the LCIT on 9 December 1990 and remained in place to collect continuously until 18 December 1990, when they were recovered prior to a storm. Wind velocity measurements taken 100 centimeters above the ice surface indicate that an average wind speed of 14.5 kilometers per hour prevailed during the collecting period based on measurements with a handheld anemometer having a stated precision of 3.2 kilometers per hour.

Each sediment sample recovered from the traps was searched microscopically for spherules and meteorite fragments. The magnetic and nonmagnetic fractions of the sediment were examined microscopically and spherules were hand-picked using a fine brush.

The number of spherules recovered totaled 899, with a total weight of 6.32 miligrams. Terrestrial sediment was also trapped and had a total weight of 6.136 grams. Figure 3 is a photograph of some typical spherules taken from the particle traps. The size distribution of the spherules recovered from the particle traps was determined by dropping each spherule into a set of sieves. Fifteen size divisions were chosen ranging between 0.600 millimeters to 0.038 millimeters. Spherules recovered from the particle traps follow a natural log grain-size distribution. The mean grain-size of all the spherules trapped was approximately 0.150-0.067 millimeters. The grain-size distribution of the spherules recovered on the LCIT is shown in figure 4.

The results of our experiment show that abundant spherules are ablating out of the LCIT at the present time and that they can be trapped efficiently with a simple passive collector. A benefit of collecting extraterrestrial particles as they ablate from the ice is that they are not diluted with terrestrial mineral grains compared to till.

The authors would like to thank Dave Lape for his assistance in constructing the particle traps. This work was supported by National Science Foundation grant DPP 88-16236.

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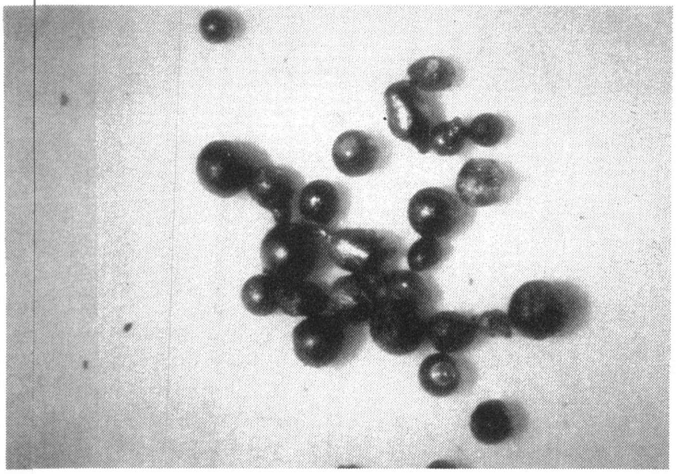

Figure 3. Reflected-light photograph of some typical spherules recovered from the particle traps. Note the irregular shape and vesicular nature of many of the spherules. The average-size spherule is 0.71 millimeters.

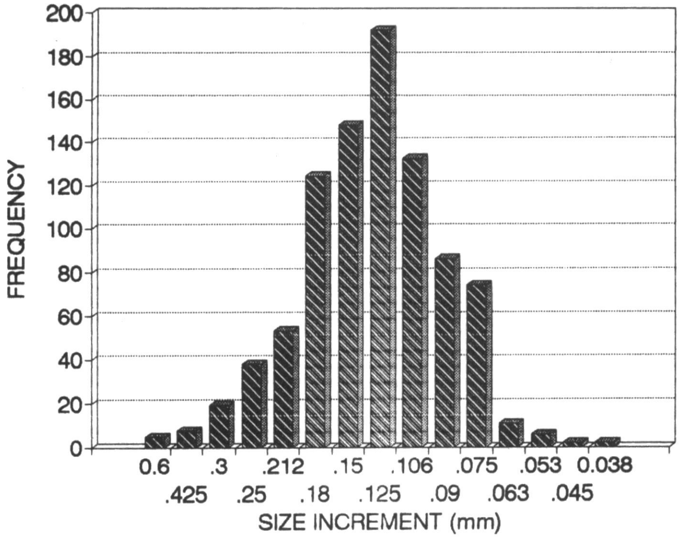

Figure 4. Grain-size distribution of all spherules recovered from the particle traps.