**SAMPLING INTERPLANETARY DUST PARTICLES FROM ANTARCTIC AIR.** S. Taylor[1], J. H. Lever[1], C. M. O'D. Alexander[2], A. Bardyn[2], L. R. Nittler[2], D. E. Brownlee[3], K. Burgess[4], R. M. Stroud[4], K. Farley[5], J. Treffkorn[5]. [1]CRREL, 72 Lyme Road, Hanover NH 03755, Susan.Taylor, James.Lever@erdc.dren.mil; [2] DTM, Carnegie Institution of Washington, 5241 Broad Branch Rd NW,Washington DC, 20015, alexande@dtm.ciw.edu, lnittler@ciw.edu; [3]Dept. of Astronomy, University of Washington, Seattle WA 91195, browlee@astro.washington.edu; [4]Materials Science and Technology Division, Naval Research Laboratory Washington, DC 20375, kate.burgess @nrl.navy.mil, stroud@nrl.navy.mil; [5]Caltech, 1200 E California Blvd, MC 100-23, Pasadena, CA 91125, farley@gps.caltech.edu.

**Introduction:** Analyses of Interplanetary Dust Particles (IDPs) collected in the stratosphere show that these are primitive materials and that a subset have no meteorite counterparts. Evidence of their primitive nature includes their porous, fragile, fine-grained structures [1], highly unequilibrated chemistries and anhydrous mineralogy, high concentrations of presolar grains [2], the presence of glass with embedded metal and sulfides [3], abundant organic matter [4], and H, C, or N isotopic anomalies in the organics [5]. Samples from melted Antarctic snow show that highly primitive materials can be collected on the Earth's surface, including chondritic-porous IDPs [6], particles with affinities to Wild 2 comet grains, and rare ultracarbonaceous particles [7,8].

Filtering clean Antarctic air is potentially a cost-effective way of obtaining these primitive particles. As they are found in Antarctic snow and ice [6,7,8] they must also be present in the near surface air. NASA and NSF funded us to filter large volumes of clean Antarctic air to collect a broad range of cosmic dust. These samples should complement and provide advantages over Stardust Wild 2 samples (collected at hypervelocity into silica aerogel), and stratospheric IDPs (usually collected in silicone oil). Furthermore, air filtering obviates having to collect and melt large volumes of snow, improves temporal resolution, and eliminates particle contact with water during collection, thereby preserving water-soluble or easily altered phases.

**Sampling Strategy:** We built a collector that suctioned and filtered the air stream upwind of South Pole station between Nov. 2016 and Jan. 2019. The air is extremely clean due to factors including no upwind human activity, depression of the tropopause, lack of deep atmospheric convection, and the high altitude of South Pole, which reduces the flux of terrestrial contaminants. Winds were from the "Clean Air Sector" 89% (2017) and 95% (2018) of the time.

A blower continuously suctioned 0.17 $m^3/s$ of air through a 20-cm diameter polycarbonate filter etched with 3-µm pores- $2\times10^6$ pores/$cm^2$. Given a flow velocity of ~6 m/s, ~400,000$m^3$/month, we expected to collect 300 – 900 extraterrestrial (ET) particles larger than 5 µm each month, or 1 – 3 IDPs /$cm^2$/month, based on measured stratospheric IDP concentrations [9,10].

During the two year project, we exposed 41 filters, 13 for month-long intervals, three for three weeks, 11 for two weeks, 12 for a week, and two for a day. Our team used a variety of searching approaches and has examined 55$cm^2$ from eight filters using optical and a complementary suite of electron beam techniques. Also, seven filters from 2017 were analyzed for $^3He$ as per [11] to verify the presence of ET material, provide information on which filters had the most ET material, and look for temporal variation in the small particle ET flux. Except for Al derived from the intake pipe, filters have low terrestrial but high aerosol loads.

**ET Particles:** We have found 14 ET particles, most FeNiS with small amounts of chondritic material attached (Fig.1a) and have identified ~20 candidate ET particles, some that are larger carbonaceous and "chondritic" grains. Only three are fluffy IDP-like grains (Fig.1b) and most are <10µm, smaller than many IDPs collected from the stratosphere (Fig. 2).

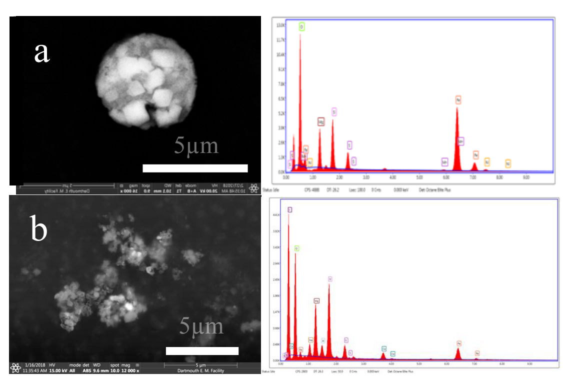


**Fig.1.** Examples of ET particles found. They contain Ni.

ET particles have proved difficult to find, possibly because we lack a quick way to find them on the 300 $cm^2$ filters. As most ET particles appear to be fragments it is possible they dissagregate or partially dissolve by aerosols during collection or as they reside on the filter. The presence of very delicate, 200 × 5µm salt rods suggest they are not broken during collection.

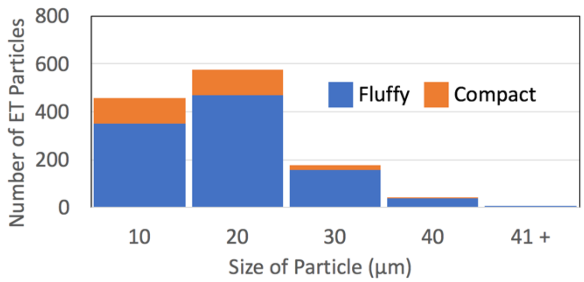


**Fig. 2**. Summary of IDP types and sizes found on 4 IDP flags [12].

**$^3$He Results:** Twenty, 1$cm^2$ subsamples from seven 2017 filters were analyzed to assess heterogeneity and abundance of $^3$He. All 118 subsamples have clearly-detected $^3$He (Fig. 3) and some have isotopic composition and concentrations similar to stratospheric IDPs (Fig.4). While all filters carry some ET helium, filters 17, 10, and 13, from the austral spring, fall and winter, have multiple subsamples with high $^3$He (Fig. 5). The average $^3$He abundance for subsamples from all filters is 48 x$10^{-15}$ cc/$cm^2$/month, equivalent to one 8 µm spherical IDP /$cm^2$/month. Ignoring fragmentation of a single large IDP, the $^3$He results for filter 17 suggests an increase in the ET flux in the austral spring.

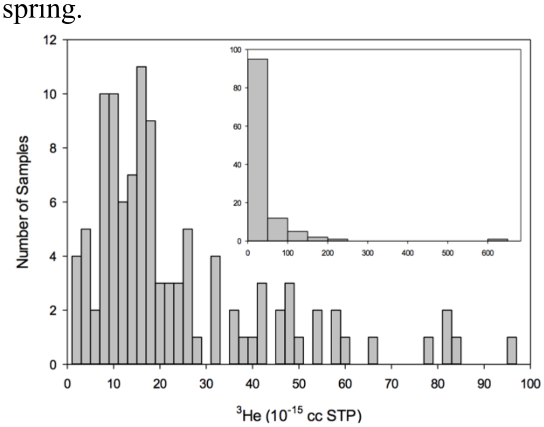


**Fig. 3.** Blank-corrected $^3$He abundances in the 118 filter subsamples. The 2-sigma uncertainty in the blank is comparable to the size of one bar, confirming that essentially every subsample has clearly-detected $^3$He.

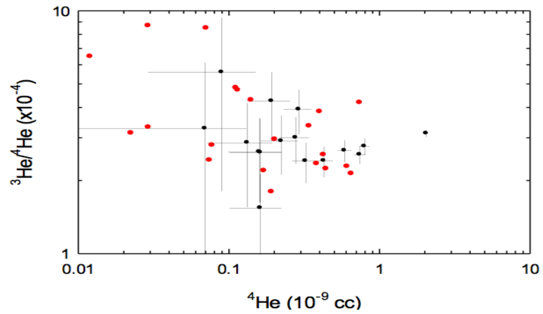


**Fig. 4**. Filter 17 subsample data (black) are comparable to individual ng stratospheric IDPs (red) from [13].

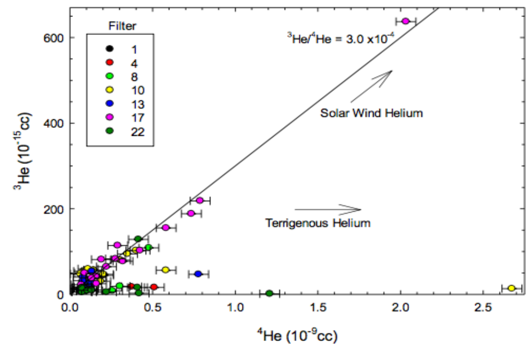


**Fig. 5.** $^3$He vs $^4$He in the 60 subsamples with measurable $^4$He. Colors indicate the filter from which each subsample was taken.

**Conclusions:** The collector ran continuously and well for two years and we collected IDPs from clean air at South Pole. Although few intact IDPs have been found, the overall abundance of cosmic dust, based on the $^3$He data is consistent with stratospheric collections of 1 – 3 IDPs /$cm^2$/month. More work is needed to determine the particle size and composition distribution across the 3 – 100 µm range.

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