A MICROMETEORITE COLLECTOR FOR THE SOUTH POLE WATER WELL. S. Taylor[1], J. Lever[1] and R. Harvey[2]. [1]Cold Regions Research and Engineering Laboratory, Hanover, NH. [2]Department of Geological Sciences, University of Tennessee, Knoxville, TN.

Small extraterrestrial particles are the dominant mass contribution to the present-day Earth, amounting to about one hundred tons each day [1,2]. Although ubiquitous, extraterrestrial materials occur in low concentrations in terrestrial environments and generally weather rapidly. The East Antarctic ice sheet has proven to be an excellent source of well-preserved micrometeorite material [3]. We seek to tap a similar source: the large volume of ice being melted for the drinking water well at the Amundsen-Scott South Pole Station. The well is essentially a melt pocket formed within the ice sheet. Because water velocities are low, the well should concentrate large numbers of micrometeorites into a lag deposit on the well floor. In addition, the well melts progressively older ice as it deepens [4]. Thus, annual particle collection will make it possible to study past variation in the flux of material reaching the Earth over 100-year time scales. In this abstract we describe the design and testing of a collector that we will use to retrieve micrometeorites from the floor of the South Pole water well (SPWW).

The SPWW was constructed by steam drilling a 30-cm-diameter hole through surface snow and firn to a depth of 60–70 m, at which point recirculated hot water melted the impermeable firn to create a pool of water. Over its five-year life, the well will melt progressively older firn and ice (1500 to 400 AD) at about 10 m/year, melting out a cylinder that is 15 m in diameter and 100 m in height (J.H. Rand, personal communication). Because the hot water is injected into the pool roughly 10 m above the well floor, water velocities at the melting front should be very small and should not suspend extraterrestrial particles. Thus, micrometeorites should make up a major part of a lag deposit on the well floor. Calculations based on the number and size distribution of particles found in the Greenland and Antarctic ice [5,6] suggest that we will retrieve about 15,000, 100-μm-

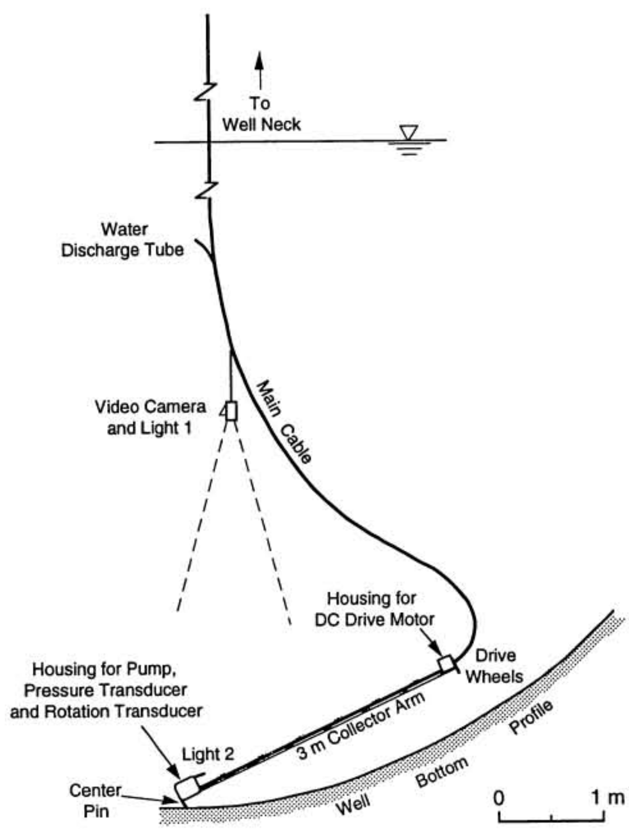

Figure 1. South Pole micrometeorite collector—overall cable and equipment layout.

diameter particles each year. We have designed a collector to suction and retrieve this lag deposit, keeping in mind the essential requirement to preserve water quality.

Our collector consists of a pump, a long collection arm, and an electromechanical cable (Fig. 1). The elongated shape of the collector permits easy entry into the well, yet a single rotation of the collector about the well center allows it to sample a large percentage of the well bottom. The polyethylene collection arm contains a parallel set of filter units each having 30-cm^2 area and 30-, 100- and 250-mm opening Teflon filters. The pump will suction water from the ice/water interface through the filter units and then discharge it above the well bottom to avoid stirring up the deposit. The filter units are easy to replace, in case particulate concentrations are higher than expected. A drive motor will rotate the collection arm around the centrally located pump to sample most of the well bottom. As a backup for magnetic particles, a magnetic strip has been installed along the trailing edge of the collector arm. A pressure transducer will measure filter blockage, and a rotational transducer will measure angular position. An underwater color video camera will document the collection process, look for large particles (mm–cm), and obtain information about the well bottom topography. We will deploy the collector during the annual maintenance period when the well's pump and hoses are removed for servicing. This ensures that the collector cable will not tangle with the well's cable assembly, but it limits our collection time to a few hours.

A key aspect of this program is calibration of the collector, a process now underway at the Cold Regions Research and Engineering Laboratory. We will first determine the collection efficiency of each filter unit using known particle distributions. We will also calibrate the entire collection arm in CRREL's Test Basin under conditions that simulate deployment (a curved floor of ice beneath several meters of water, a long access neck with below-freezing air temperatures, etc.). A curved wooden form, that approximates the shape of the well floor, will be iced and then submerged into the chilled water of the basin. To simulate the long, flexible cabling required to access the well itself, we will suspend our cables from the basin's overhead crane. We will coat the iced surface of the form with a known quantity of particles and use the collector to retrieve them. A good estimate of collector efficiency is particularly important because any particles not collected will be mixed with the following years' collection. The South Pole Water Well has the potential to be the richest and best dated source of micrometeorites ever mined. Our goal is to develop a safe, reliable, and calibrated collector system to capitalize on this source.

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