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Some terrestrial aspects of meteorite accumulations in the Queen Alexandra Range region, Victoria Land

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In this article, we review some of our work involving natural thermoluminescence measurements (TL) on ordinary chondrites (the most common group of meteorites) from blue icefields near the Queen Alexandra Range of East Antarctica (162°E 84°15'S), and in the present instance, we concentrate on the terrestrial implications of these data.

Meteorites obtain high levels of natural TL in space as a result of the interaction of matter with high-energy cosmic rays. On the surface of the Earth, which has a much lower cosmic-ray flux, natural TL levels begin to decay to new, lower levels. The rate of decay and the final "equilibrium" level depend on ambient temperature—the higher the temperature, the faster the rate of decay. In Antarctica, meteorites can be in two distinct thermal environments. They can be buried in the ice and, hence, held at very low temperatures (about -30°C), or they can be on the ice surface at relatively moderate temperatures (about -5°C). The rate of TL decay is negligible at temperatures below -15°C, at least within the time frame of 1 million years or less, which encompasses the terrestrial ages of virtually all antarctic meteorites (Nishiizumi, Elmore, and Kubik 1989). At temperatures of about -5°C or greater, however, TL decay rates are significant on the 100,000-year timescale. Therefore, natural TL levels of meteorites found in Antarctica largely reflect the length of time they have spent on the surface of the ice, or, in other words, their surface exposure age (Benoit in press).

We have collected natural TL data for 129 meteorite fragments collected on blue icefields located near the Queen Alexandra Range and the MacAlpine Hills icefield (*see* Cassidy et al. 1992, for geographic relationships of these fields). In addition, we have previously reported TL data for the more numerous meteorite finds from the nearby Lewis Cliff icefields (Benoit, Sears, and Sears 1992). Full details on our analytical procedure are given in Benoit et al. (1992).

One application of our data, in conjunction with other laboratory and field data, is to determine which meteorite fragments were probably portions of the same body prior to atmospheric entry and terrestrial weathering (*see* Benoit et al., 1992, for details). Among the 61 ordinary chondrite fragments we analyzed from the MacAlpine Hills icefield, we recognize 51 distinct meteorite falls, a relatively high ratio of falls to fragments compared to most antarctic sites. Among the 68 ordinary chondrite fragments we analyzed from the Queen Alexandra Range icefield, however, we recognize only 13 distinct falls, all the redundant fragments being in only two large groups which, in light of their mutual uncommon classification, may actually be a single meteorite. Thus, it appears that the meteorite collection from this icefield is heavily biased by the fragmentation of a single large meteorite.

As part of our standard analysis procedure, we also measure the response of the samples to a unit dose of radiation (referred to as TL sensitivity). We have previously found TL sensitivity decreases as a function of degree of weathering (Benoit, Sears, and Sears 1991) and, thus, can serve as a quantitative measurement of weathering. We find that the TL sensitivity distributions of our samples are generally similar to those of modern falls, indicating that they have experienced only minimal weathering. This is in contrast to meteorites from the Lewis Cliff icefields (Benoit et al. 1992), which are fairly heavily weathered. Although the number of actual samples is small, some evidence points to the existence of a subset of meteorites, which are also heavily weathered, from the MacAlpine Hills icefield.

Additional applications of the natural TL data that are still in progress examine the meteorite accumulation processes, which fall into three broad classes: direct infall on the ice surface, transport in the ice to the ablation zone, and wind transport. Our preliminary results suggest that even in the localized area of the icefields near the Queen Alexandra Range different processes are dominant in different icefields. For example, some fields have been more affected by wind transport than others. These data suggest that certain icefields in the area became active accumulators of meteorites at different periods as a result of the interaction of the ice sheet with the local terrain.

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