THE LEWIS CLIFF METEORITE STRANDING AREA, POLAR ICE CORES, AND WISCONSIN PERIOD IMPACTS; E.L. Fireman, Center for Astrophysics, Cambridge, MA 02138

It is well known that meteorites and volcanic ash-bands have been collected at several Antarctic ice ablation areas. The Antarctic meteorites are being actively studied by members of this conference. This group, however, pays little attention to the ice that surrounds these meteorites, the volcanic ash-bands inbedded in this ice, and to studies on deep ice cores because these subjects are thought to be connected only remotely to the subject of meteoritics. Studies on the Lewis Cliff ice, ash-bands, and deep polar ice cores indicate that these topics are more closely related to meteoritics than is generally thought.

Fig. 1 is a map of the Lewis Cliff meteorite-collecting area showing the locations of five dust-banded ice samples that we received from W. A. Cassidy. We dated the tephra-banded ice samples, 86-3 and 86-4, by a uranium-series method that has been described. The method depends upon either the $^{226}\text{Ra}/^{230}\text{Th}$ or the $^{226}\text{Ra}/^{234}\text{U}$ ratio of the activities dissolved in the ice after the activities are corrected for dissolved $^{238}\text{U}$.

The measured values of the activities with $1\sigma$ errors are the following:

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Ash (g/kg ice)</th>
<th>$^{226}\text{Ra}$ (dpm/kg)</th>
<th>$^{230}\text{Th}$ (dpm/kg)</th>
<th>$^{234}\text{U}$ (dpm/kg)</th>
<th>$^{238}\text{U}$ (dpm/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>86-3</td>
<td>(0.0378)</td>
<td>(0.169 ± 0.004)</td>
<td>(0.064 ± 0.001)</td>
<td>(0.048 ± 0.001)</td>
<td>(0.039 ± 0.001)</td>
</tr>
<tr>
<td>86-4</td>
<td>(0.0967)</td>
<td>(0.403 ± 0.004)</td>
<td>(0.089 ± 0.001)</td>
<td>(0.052 ± 0.001)</td>
<td>(0.037 ± 0.001)</td>
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The activity ratios \(^{238}\text{U corrected}^{*}\) and the ages obtained are show below:

Table 2. \((\text{Ra/Th})^* \leftrightarrow \text{Age(years)}\) \((\text{Ra/U})^* \leftrightarrow \text{Age(years)}\) Ave. Age
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86-3 \((0.130/0.025) \leftrightarrow (26 \pm 2)10^3\) \((0.130/0.009) \leftrightarrow (31 \pm 6)10^3\) \((28 \pm 3)10^3\)
86-4 \((0.366/0.052) \leftrightarrow (19 \pm 1)10^3\) \((0.366/0.015) \leftrightarrow (16.5 \pm 2)10^3\) \((18 \pm 2)10^3\)

The ages are in the Wisconsin glacial period, \(10^4\) to \(7 \times 10^4\) years ago, a period that is well defined in ice cores.

The dust concentrations in ice cores have been measured. During the Wisconsin period, the dust concentration is \(\geq 30\) times higher than during other times. The source of the dust has not been determined. There is only one INAA study\(^4\) of dust in the Camp Century and Byrd cores; from the enhancements of Ir, Sn, Sb, Au and Ag observed\(^4\) in the dust, the author concluded that there was an enormous influx of extraterrestrial material during the Wisconsin period.

There is also only one INAA study\(^1\) on Lewis Cliff dust bands. The elements Ir, Sn, and Ag were not reported in the Lewis Cliff study; however, two of the elements, Sb and Au, found to be enriched during the Wisconsin period according to the core study, were also enriched in the 86-1, 86-3, and 86-4 tephra. For Sb, the enrichment factors (EF), relative to average earth crustal material using Sc as the reference element, are 188, 103, and 766, respectively, for these bands. For Au, EF = 12.2, 19.4, and 211 for these bands. The elemental enrichments in Wisconsin ice need to be more thoroughly studied. We therefore initiated an INAA study of Lewis Cliff ice and ice cores, which will be discussed.

The cause of the Wisconsin climate shift has also puzzled scientists. The number of tephra bands observed in the small Lewis Cliff ablation area leads one to think that there was a high frequency of large volcanos during the Wisconsin period. Benjamin Franklin\(^5\) was one of the first to suggest that large volcanos cause global cooling; others have suggested that large impacts cause increased volcanic activity. These ideas can be tested and quantified by chemical studies on Lewis Cliff ice and on ice cores.

This work was supported by NSF Grant DPP8716835.