Glacial Till Prospecting in Southwest Ohio: Implications for Improved Sampling

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Abstract

Glacial till (drift) prospecting has served a major role in corporate mineral exploration, especially for gold and diamond during the past 30 years. It involves analyzing heavy indicator minerals from bulk sampling of various glacial deposits in order to track up ice flow direction to the potential orebody (such as a kimberlite pipe or Cu-Ni deposit), a technique commonly used in Canada but not in the U.S. Heavy minerals including diamond, gold, and native copper have been found in Ohio glacial till; the provenance of these heavy minerals is the Precambrian bedrock north of Ohio. This study utilized standard procedures in sample collection and analysis (sieving, concentration by gold-panning, heavy liquid separation with lithium metateutagatate [LMT], magnetic separation and microscopy) with seven-samples from a kame of the Late Wisconsinan glaciation in northeastern Greene County, southwest Ohio. Coarse to very coarse sand (2 - 0.5 mm) and fine to medium sand (0.5 - 0.125 mm) fractions from each bulk sample were analyzed for heavy minerals and felsic (quartz and feldspar) concentration. The goal was to determine variability in heavy minerals and felsic component concentrations across samples and between grain-size fractions, in order to suggest improved sampling and analysis techniques.

A variety of heavy minerals, including gold, of igneous and metamorphic provenance were identified in all sample fractions by physical and optical (including fluorescence) properties. Zircon concentration in the fine to medium sand fraction appeared similar across concentrated samples. Statistical analysis showed significant variation of the coarser to finer grain size ratio between samples, displaying the expected variability in sand sizes in a kame deposit; significant differences in the felsic concentration across each grain size fraction were seen between samples and between size fractions within samples. Taken together, results suggest glacial kame deposits can be useful repositories of heavy indicator minerals, yet due to sediment variability extensive sampling is required if kame deposits are to be used as benchmarks in till prospecting en route to an orebody.

Methods and Materials

Sampling and analysis of material was conducted (with slight modifications) after the standard guidelines used by Canadian geologists. Seven 2.5-gallon glacial kame (gravely sand) samples (K1-K7), spaced 5-10 meters apart, were collected from differing heights along a gravel-pit bank. These bulk samples were wet-sieved to separate out the sieve 10-35 (2 - 0.5 mm) and mesh 35-120 (0.5 - 0.125 mm) fractions, which were then dried and massed. Approximately 5 mL samples of each grain size fraction from each site were massed and separated into a sink and float fraction by standard heavy liquid separation techniques (Fig. 1), using lithium metateutagatate (LMT) of 2.74 to 2.75 specific gravity. The float fraction included quartz and feldspars (felsic), along with lighter calcite and limestone grains which were subsequently completely dissolved with 3.0 molar HCI solution. After extracting magnetic grains with a rare-earth magnet, the resulting float (felsic) fraction was massed.

The remaining “bulk” sample fractions were each gold-panned to less than 5 mL. These concentrates were separated into float and sink fractions by heavy liquid separation with LMT of 2.95 (stock) specific gravity. The sieve size 10-35 sink fractions were analyzed and photographed using a Motic BA300 Polarizing Microscope and Helicon Focus 6 image stacking software (Fig. 2 and Table 1). The sieve size 35-120 sink fractions were photographed with a Nikon DS5000 camera under plain and fluorescent light (Figs. 3.4 and Table 1).

Appropriate statistical tests using R statistical software were used on the bulk and 5 mL sample fractions.

High level separation setup, featuring separatory funnel, Buchner flask, and filter funnel and paper. LMT, an iron-free heavy liquid, is diluted with distilled water which can be evaporated off for recovery of the LMT. Note the sink, suspension, and float fractions. The finer the grain size, the longer the settling time.

Table 1. IMPORTANT heavy mineral concentrations of heavy mineral sands, some used to establish reserves in glacial drift prospecting, and of igneous and metamorphic provenance. Note the Description useful for identification under both normal visual light and fluorescent light.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mineral</th>
<th>Color</th>
<th>Size</th>
<th>Density</th>
<th>Flotation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Garnet</td>
<td>Orange</td>
<td>1</td>
<td>2.75</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
<tr>
<td>K2</td>
<td>Tourmaline</td>
<td>Brown</td>
<td>1</td>
<td>2.74</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
<tr>
<td>K3</td>
<td>Zircon</td>
<td>Clear</td>
<td>1</td>
<td>2.74</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
<tr>
<td>K4</td>
<td>Pole</td>
<td>Brown</td>
<td>1</td>
<td>2.74</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
<tr>
<td>K5</td>
<td>Pole</td>
<td>Brown</td>
<td>1</td>
<td>2.74</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
<tr>
<td>K6</td>
<td>Pole</td>
<td>Brown</td>
<td>1</td>
<td>2.74</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
<tr>
<td>K7</td>
<td>Pole</td>
<td>Brown</td>
<td>1</td>
<td>2.74</td>
<td>1</td>
<td>Bipyramidal, brown, glassy, translucent, elongate</td>
</tr>
</tbody>
</table>

Conclusions

The samples contained diverse heavy indicator minerals. Statistical analysis showed significant variation in grain sizes and felsic concentrations across the kame samples. This variability suggests that while kames may serve as repositories for heavy indicator minerals having traveled great distances, extensive sampling is necessary to obtain accurate, representative values of heavy mineral concentrations for tracing up ice-flow to a potential ore deposit. Other types of glacial deposits may display less variability and facilitate less sampling and expense in mineral exploration; future studies like this one on other deposits in southwest Ohio are necessary.

Acknowledgments

Much thanks go to:
- Mr. Al Turner, for allowing sampling from his gravel pit;
- Dr. John H. Whitmore and Professor Thomas Rice, for advising;
- Cedarville University Department of Science and Mathematics, for use of lab equipment and purchasing LMT.

References