INFERENCES OF SUBGLACIAL PROCESSES UNDER THE WEST ANTARCTIC ICE SHEET FROM GRAIN SURFACE TEXTURES

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System of rivers and lakes under the ice sheet, very much like other continents
STUDY AREA

- Subglacial Lake Whillans (indicated by the red star) is located under the West Antarctic Ice Sheet, the UpB site is on a glacial flowline leading into SLW.
- Data from each of the sites was taken at different depths and separated into different size categories.
STUDY SITES

Ice flows from the Upstream (UpB) site toward SLW and SLW fills and drains along the blue line that represents a river flowing under the ice sheet.
BACKGROUND INFORMATION

• Cores and studies conducted by the Whillan’s Ice Stream Subglacial Access Research Drilling (WISSARD)
• Longest trek since the first Polar Expedition
  ▪ 14 days from McMurdo Station
  ▪ 964 km (614 miles)
• Evidence of microbes underneath the ice with low levels of sunlight
COLLECTION METHODS

• Hot water used to drill a ½ mi deep hole through the ice to access the lake

• Launch And Recovery System (LARS) used to collect cores of sediments from the lake bed

• Sediment down a core increases in age
METHODS

• Sand grains indicate subglacial sediment transport
• Scanning Electron Microscope used to identify
  ▪ Surface microtextures
  ▪ Degrees of weathering
• Surface textures used to divide grains into:
  ▪ Glacially transported
  ▪ River transported
• Degrees of weathering grouped into 4 categories
  which were then used to define a 3-phase history during transport
DEGREES OF WEATHERING

Characteristics

(a) **Phase 1**: Weathered surfaces from the original outcrop

(b) **Phase 2**: Previously-weathered glacial transport features superimposed over grains in Phase One

(c) **Phase 3**: Younger weathering overprinted on the glacial transport features. This last phase likely indicates microbiologically-mediated chemical changes.
SITE VS SITE: UpB AND SLW

- Features indicative of glacial transport
- An abundance of grains in Phase 3
- No change in frequency between sites
SLW BY DEPTH

- No change in depth (which is inclusive of all depth data) so we can use SLW data to analyze all depths
- Indicates consistent glacial transport through time
- Lack of river transport and distinctive groupings of weathering features
SIZE COMPARISON AT EACH SITE

- All sizes indicate a lack of river transport and an abundance of glacial transport.

SLW

- No change in frequency among size for either site.
WEATHERING FORMS IN OVERPRINTED SAMPLES

- Isolate overprinted samples
- An abundance of dissolution etching at each site
- Indication of microbiologically-mediated chemical weathering
CONCLUSIONS

1) Surface textures on quartz grains suggest subglacial environments of both UpB and SLW sites have similar sedimentary processes.

2) Quartz grains from the UpB and SLW sites show subglacial sediment transport is in glacial till rather than by the river, both temporally and spatially.

3) Surface textures confirm inferences from other data showing sediment accumulating in SLW is till (like UpB) rather than lake deposits.

4) Large amounts of dissolution etching and precipitation on particles indicate biogeochemical weathering by bacteria previously found by microbiologists.

5) Quartz etching and precipitation features at UpB and SLW infer microbial activity documented in SLW waters and sediments is probably pervasive under the Whillans Ice Stream.
REFERENCES


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