How to Make a Home for a Borehole Seismometer

Because every sensor needs a home



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Overview

- There are a lot of homeless sensors
- ~192 homes are needed
- Varying surface geology
- Remaining seismometers are <6"
- Currently two drill rigs
- Two drilling methods available
- Third option of vault installations (limited geographically)





Surface Geology

Arctic Ocean

Figure 10. Paleozoic and Mesozoic sedimentary rocks are the most widespread rock units in Alaska. Volcanic and intrusive igneous rocks underlie most of the State's major mountain ranges, except for the Brooks Range, which is underlain mostly by Paleozoic sedimentary and metamorphic rocks.



Status of TA Sites

~30% of sites in unconsolidated surface materials

Remainder in weathered or competent surface bedrock

Poor (young) soil development in Alaska, except SE



Why a Borehole?



- Standard TA Vaults won't work....mostly
- Boreholes have a history in AK
- Can get deep but become prohibitively expensive
- New type of borehole, new rig, cost effective





Borehole Sensor Design for AK

- BB Sensor: 3 meters below surface
- Strong Motion Sensor: 1 meter below surface
- Within 8 meters of electronics/power enclosure







Making a Home

The Lund-Drill V1 & V2 is designed for TA in Alaska:

1300 lbs Sling load weight

28% Augering3% Backhoe69% Downhole Hammer

NEED: bedrock or frozen ground borehole, single lift, 3M to 5M.





Drill in Skyvan, bound for Middleton Island





Boring Installation Methods

Augering vs Down-the-Hole Hammer (DTH)AUGERDTH

- Hydraulic system requiring small power pack to spin motor head
- Using continuous flight augers to move cuttings to the surface
- Works well in unconsolidated soils/heavily weathered bedrock
- Relatively low operating cost if dedicated auger
- Poor performance in mixed grains with cobbles
- Poor in bedrock

- Hydraulic system with small power pack, also requires air compressor
- Compressed air serves to actuate the hammer mechanism and clear cuttings
- Pulverizes into fine pieces rather than cutting
- Very efficient in bedrock, frozen soils, and dense compacted soils
- Poor performance in fine soils and saturated soils



DTH Assembly

- Effective in all types of rock, hard packed coarse sediment, frozen
- Low rotation speed, low torque and low down-pressure
- Needs air compressor to run



Casing Advance System

Rotate to lock in place and hold casing



Hard Core Drilling Action





Soft Core Augering Action





For More Information

- On the Web
- EarthScope
 - www.earthscope.org
- USArray www.usarray.org
- PBO
 - pboweb.unavco.org
- National Science Foundation www.nsf.gov

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