A GEOPHYSICAL STUDY OF SNOW IN ANTARCTICA

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During the course of the 1958-59 field season in Antarctica three U.S. International Geophysical Year traverse parties conducted studies over the ice cap. Data taken from the Victoria Land traverse are used in this presentation.

Short refraction profiles and the seismic study of glaciology pits provided detailed pictures of compressional and shear wave velocity variations with depth near the ice cap surface. The relationships between these velocities and other physical properties of the near surface material, especially density and temperature, have been examined.

A seismic study in the glaciology pits using conventional seismic equipment was carried out in an attempt to relate seismic velocities and temperatures. The time interval between geophones with a 50 cm. spacing proved to be too small for an accurate determination of velocities. For low density snow however, (.30 to .42 gm/cc) some correlation between shear wave velocities and temperatures was found. According to these results the temperature coefficient is quite large compared to that found by G. de Q. Robin on P-wave velocities in ice.

Snow density vs. depth curves differ from one region to another. Velocity vs. depth curves also show this regional variation since an empirical relationship exists between velocity and density. This variation is believed to be caused by differences in average annual temperatures and accumulation. Cold plateau temperatures would slow the rate of metamorphism compared with that on warmer ice shelves. Thus, cold areas can in general be expected to have lower near surface densities and velocities than warmer regions.

When plotted on a graph, the relationship between the temperature at a depth of 10 meters (temperature below seasonal changes, i.e. mean annual temperature) and the average density between 3 and 10 meters suggests a quick method for determining annual accumulation. The settlement rate of snow with a given accumulation rate is a function of temperature; therefore, a difference in average density over the same depth interval at two stations having the same mean temperature might be caused by a difference in accumulation. If the accumulations at a number of stations are known, it is possible to approximate the accumulation at an unknown station by plotting its temperature-density value on the graph and noting its position relative to the others.