ZONES OF DEPTH HOAR DEVELOPMENT

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Formation of faceted ice crystals, known as depth hoar, which develop in a snowpack subjected to large temperature gradients are examined. Snow temperature and temperature gradient profiles are generated by use of a heat conduction based on snow density and temperature. The magnitude of the temperature gradient tends to increase as the snow surface is approached, with local minimums through high density snow layers and local maximums above and below these layers.

The development of depth hoar is examined by considering vapor pressure in the pore. A large temperature gradient across the pore will induce a corresponding vapor pressure gradient. By calculating the mean vapor pressure in the pore, the excess vapor density is found to be positive at the top of the pore and negative at the bottom, for the usual direction of gradient encountered in snow. This causes a vapor flux from the bottom to the top of the pore. Depth hoar crystals grow into the pore from the top surface.

It is the vapor density difference, or supersaturation, which determines the rate of crystal growth. The vapor density difference is found to be enhanced at warm temperatures, large temperature gradients, in'low density snow, and above and below layers of high density snow. Because of the strong dependence on temperature, depth hoar growth is generally most prevalent at the base of the snowpack, even though larger temperature gradients may exist elsewhere in the snowpack at a lower temperature. Weakness associated with depth hoar contributes significantly to full depth avalanches. As a result of the development of thin layers of depth hoar in conjunction with high density snow layers, depth hoar may also assist in causing avalanches associated with crusts. This is particular true at warmer temperatures and is enhanced when two high density layers are in a close proximity to each other with a low density layer between them.