SEISMIC MOMENT, STRESS DROP, STRAIN ENERGY, DISLOCATION RADIUS, AND LOCATION OF SEISMIC ACOUSTIC EMISSIONS ASSOCIATED WITH A HIGH ALPINE SNOWPACK AT BERTHOUD PASS, COLORADO, U.S.A.

(Abstract only)

by

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ABSTRACT

The monitoring of the number of acoustic seismic impulses arising from snow instabilities is regarded as a relative indicator of an unstable snow slope but has not yielded a qualitative, predictive indicator. Until now, the source parameters (fracture area and length), seismic moment, energy released, stress drop, and location of acoustic seismic emissions arising from the snowpack have been neglected. A comprehension of these parameters leads to a better understanding of the event and may help in avalanche prediction.

The location of a seismic event is derived from time differences between P-wave arrivals at four sensors located at the snow-ground interface. Three methods confirm the location of an acoustic seismic snow event to within 2 to 4 cm when the event is inside a seismic net.

Spectral analyses of body waves from seismic snow events yield estimates of source parameters, stress drop and energy released. Equivalent dislocation surface radii range from 4.8 to 9.0 cm, which give stress drops of 0.20 to 0.29 bar, with a dissipated energy in the range of 0.0205 to 0.0632 J.

Spectral analysis of the acoustic seismic snow event with application of dislocation theory provides several likely methods to predict avalanches of a climax type.

A CONTRIBUTION TO AVALANCHE DYNAMICS: A FORMAL AND AN EXACT SOLUTION OF THE VOELLMY/PERLA TWO-PARAMETRIC EQUATION OF MOTION

(Abstract only)

by

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ABSTRACT

The two-parameter equation of motion for snow avalanches proposed by Voellmy in 1955 was later formally derived by Perla in 1979. It has been the object of numerous investigations, mainly to its applications. It has been solved for tracks approximated by straight lines, and this solution has, in some countries, been used extensively with a two-segment approximation. Perla and Cheng programmed such a solution for digital computation by matching an arbitrary number of straight line segments. This solution can also include impact losses due to abrupt changes in the track.

In the first part of this paper a formal integration of the Voellmy/Perla equation is carried out for the general case of a track. The averaged values of the different terms are discussed and evaluated as to their relative orders of magnitude. It is shown that the "centrifugal" effect, which is, of course, automatically omitted in the straight-line solution, can be neglected in most cases. As a conclusion it is shown that all avalanche motions governed by the Voellmy/Perla equation will have the same average velocity on all tracks having the same vertical drop H, the same horizontal extension L, and the same set of "friction" parameters, as long as the length S of the track is the same, regardless of the shape of the tracks. The shape will only determine the velocity profile along the track.

The second part of the paper shows the exact solution of the equation for the special case of tracks with constant curvature, i.e. circular arcs. If the conclusion of the first part of the paper holds true, this solution can be used to determine the average velocity on other shaped tracks of the same length, etc.

It is finally shown that a number of well-known avalanches described in the literature can well be approximated by a circular arc. In these cases even the velocity profile is determined by the exact solution.