Geophysical Research Abstracts,
Vol. 11, EGU2009-10769, 2009
EGU General Assembly 2009

Rock fracture by ice segregation: linking laboratory modelling and rock slope erosion

J. Murton
University of Sussex, Geography, Brighton, United Kingdom (j.b.murton@sussex.ac.uk)

It has been unclear until recently if ice can fracture intact bedrock subject to natural freezing regimes, or whether it simply enlarges existing fractures or does both. This question is important, because if ice segregation in bedrock permafrost is widespread, then there may be considerable potential for significantly increased rock slope instability as ice-cemented discontinuities warm and active layers thicken. Laboratory modelling has now begun to elucidate the process of ice segregation in bedrock.

Laboratory experiments indicate that moist, porous rock behaves remarkably like moist, frost-susceptible soil, with both substrates experiencing ice enrichment and fracture / fissuring of near-surface permafrost. It appears that significant concentrations of segregated ice are most likely in the transition zone between the active layer and the permafrost, as a result of downward migration of water in summer and upward advance of freezing at the beginning of the winter.

Laboratory modelling indicates that given adequate water supply, ice segregation produces a zone of ice-bonded fractured bedrock immediately below the permafrost table. In general, the importance of ice segregation relative to in situ volume expansion increases with decreasing thermal gradients and increasing duration of freezing. Recent theoretical developments suggest that the maximum possible disjointing pressure is governed by the temperature depression below the bulk-melting point, even in the absence of large temperature gradients, and therefore slow ice segregation in bedrock may be possible at greater depths where the frozen permeability of rock limits the actual amount of heave produced. Thus, over long timescales, ice segregation may be highly significant in frozen steep bedrock slopes where the presence of ice-rich fractured bedrock may be critically important in releasing rock falls and rock slides during climate-induced warming and permafrost degradation. With recent climate warming predicted to continue during the next century, the warming and thawing of ice-rich bedrock permafrost is likely to destabilize many rock substrates. Such issues will undoubtedly become important to scientists, engineers and inhabitants of permafrost regions.