Geophysical Research Abstracts, Vol. 9, 07977, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07977

Temporal prediction in landslides – understanding the Saito effect

D.N. Petley (1), J. Carey (1, 2), N.J. Rosser (1), S.A. Dunning (1)

(1) International Landslide Centre, Durham University, Durham, United Kingdom, (2) Halcrow, Ltd, United Kingdom, (d.n.petley@durham.ac.uk / Phone: +44-191 3341909)

Of all natural hazards, landslides offer the best potential for prediction of the time of a failure event, and indeed successful predictions of the time of large-scale slope collapse have now been made for real landslides on a number of occasions. In general these predictions are based upon the use of the approach first proposed by Saito, and often named in his honour, in which the inverse of landslide strain rate is plotted against time, and the time of final failure determined by fitting a straight line to the data, and extrapolating the time at which $v^{-1} = 0$.

In the paper, an investigation of Saito linearity is undertaken using a laboratory testing programme. Using undisturbed samples of materials from the basal shear region of a number of landslides, testing has been undertaken using both stress path cells and a novel back-pressured shear box (BPSB) apparatus. In the former, 38 mm diameter samples have been tested using the pore pressure reinflation stress path (sometimes termed the field stress path), in which the deviatoric and the total mean stresses are kept constant, whilst pore pressure is elevated, triggering failure, during which the development of axial strain with time is monitored. The BPSB permits testing in which a 100 x 100 x 25 (high) mm sample, can be subjected to required normal and shear stress states calculated for the landslide. Failure of the sample is induced by increasing pore pressure, and thus reducing the normal effective stress, whilst displacement is precisely monitored.

The results of the research clearly demonstrate that Saito linearity is the result of brittle deformation processes associated with the formation of the shear surface within the landslide mass. The data suggest that the state and rate dependent friction model, which has been implicated as a mechanism in some studies, is not the cause of this

behaviour in landslides. The laboratory tests show that the linear phase of deformation in v^{-1} – time space is associated with stress concentration during the latter stage of shear surface formation. In landslides in which no shear surface forms, the laboratory data clearly show that the linear trend is not observed.

These results provide a greatly enhanced understanding of the processes of shear surface formation, and the circumstances under which Saito linearity can be observed. Thus, the data allow greatly enhanced capabilities to predict the occurrence of final failure events in natural landslide systems.