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Laboratory and field investigations on the long runout of submarine debris flows.

F.V. De Blasio (1), P. Gauer (1),D. Issler (1), T.Ilstad, **A.Elverhoi** (1)and C. B. Harbitz (1)

(1) International Center for Geohazards, Norway

Field observations indicate that subaqueous debris flows can attain surprisingly long runout distances, even on very gentle slopes. In order to understand this increased mobility in subaqueous setting, laboratory experiments simulating debris flows and theoretical investigations have been carried out in parallel, and results are summarized here.

Experiments with clay-rich slurries have demonstrated that the debris flow can be lubricated by a thin water layer, an effect termed hydroplaning. Hydroplaning is a prime candidate mechanism for explaining the extremely long runout distances observed in some natural debris flows.

Subsequent investigations of high-speed video recordings of laboratory debris flows, combined with measurements of total and pore pressure, are pointing towards yet another important role of ambient water: intruding water from the cushion underneath the hydroplaning head and through cracks in the upper surface of the debris flow may drastically soften initially stiff clayey material in the ‘‘neck” of the flow, where some stretching occurs due to the reduced friction at the bottom of the hydroplaning head.

This self-reinforcing process may lead to the head separating from the main body and becoming an ”outrunner” block as clearly observed in several natural debris flows. Comparison of laboratory flows with different material composition indicates that as sand is added to the experimental slurry, a transition occurs in the flow regime. When the slurry contains little sand (sand less than 45%) the flow may be dominated by a hydroplaning plug of stiff soil which is only slightly eroded. When sand is more abundant, grains become strongly agitated, the debris flow is disaggregated and develops a pronounced turbidity current.

Moreover, the high velocities and initial accelerations associated to hydroplaning would imply a high potential for tsunami generation, which fits well with some observations.