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Experimental study on the rheologic behavior of debris flow material in the Campania region, Italy

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The rheologic behavior of the natural material collected in the source area of debris flows occurred in the Campania region has been investigated. Several studies have been carried out on the conditions leading to the triggering of landslides. Less information is available on the transition between soil behavior and fluid behavior.

In this work the rheologic flow behavior of the suspension of these materials in distilled water has been investigated with a standard viscosimeter (AR 2000ex TA Instruments) at different solid volumetric concentrations Cv (20, 30 and 40%).

The materials tested were taken from the source area of three debris flows occurred in the mountainsides of the Northwestern Campania region (Southern Italy):

- Nocera, Salerno (March 2005) material A in the following;
- Monteforte Irpino, Avellino (May 1998) material B;
- Astroni, Naples (December 2005) material C.

The soil type regards the most recent pyroclastic deposits deriving from the volcanic activity of mount Somma/Vesuvius (comprising the Sorrento Penisula and the mountains of Sarno-Quindici) for materials A and B. For material C, the soil type regards the most recent pyroclastic deposits deriving from the volcanic activity of the Phlegrean Fields (part of the city of Naples).

For each solid volumetric concentration Cv, two kinds of tests have been performed:

1. test on fine particle suspension (maximum diameter of 0.1 mm);
2. test on large particle suspension (maximum diameter of 0.5 mm).

The principal result is that the flow behavior is almost the same for all pyroclastic deposits: the materials behave like a Non-Newtonian fluid with a threshold shear stress (yield stress). The shear stress increases with increase of shear strain in the range analyzed ($1 < \dot{\gamma} < 100$ 1/s) thus the viscosity decreases with shear rate.

A clear increase of yield stress with increasing of solid volumetric concentration, Cv, is noted.

Influence of particle size appears when the solid volumetric concentration of large particles (Cv_L) is greater than 10 %.

The rheologic parameters, obtained by fitting the experimental data, are almost the same for all pyroclastic deposits deriving from the volcanic activity of mount Somma/Vesuvius (materials A and B) and quite different for that deriving from the volcanic activity of the Phlegrean Fields (material C).

Experimental activity with new tool that allow testing mixtures with larger grain sizes is being carried out .