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Rheometrical experiments with monitoring of resistivity: for a better understanding of the solid-fluid transition in clayey landslides

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Landslides are natural and complex phenomena which affect all types of geological formations and present a large variety of size, morphology and displacements rates. Among these phenomena, flow-like events in clay-rich formations are particularly complex due to the unpredictable acceleration and fluidization that characterize them. Because of their suddenness, such landslides constitute serious threat for population living in these areas. The forecast and the understanding of these events has then been an active topic of research in the scientific community during the past decades. In that respect, rheometrical experiments in the laboratory bring some insight into the processes occurring during the solid-fluid transition. In creep tests, the evolution of the shear strain rate is measured under constant levels of shear stress, allowing to follow changes in apparent viscosity with time and to observe fluidization. Rheometrical oscillatory tests have been designed to capture the evolution of the elastic shear modulus G (and hence the shear wave velocity Vs) during these creep phases. Previous results have shown that Vs exhibits a drop at the solid-fluid transition, with complex time-dependent effects which could lead, under transient loading, to the occurrence of Vs variations prior to the transition. A complementary way to understand the processes is to measure the electrical resistivity during these rheometrical tests. This parameter, which depends on the water content and salinity, as well as on the amount of clay particles, could also exhibit some changes before or during the solid-fluid transition. For that purpose, the metallic plates of the rotational rheometer have been replaced by new ones made in an electrically insulating material (PVC) with a configuration of four inserted circular electrodes. Rheometrical tests made with this new apparatus provide similar rheological results. For the electrical tests, the geometrical factor has been computed using Finite Element modeling and has also been experimentally measured with water samples of varying and known resistivities. A difference of less than 1% was obtained between the two approaches. First resistivity results obtained on the Trièves clay (French Alps) show a progressive, weak but significant variation in resistivity (5-6 percent) during creep tests. The comparison between the creep and resistivity curves suggests that the resistivity decreases when the apparent viscosity increases. Further experiments are underway on different clays sampled on several flow-like landslides and would allow to have a better insight in the electrical response of such material during the solid-fluid transition.