Micro-seismic monitoring of a shear deformation zone: a laboratory experiment

Cédric Lachaud*[1], David Marsan[2], Maurine Montagnat[3], and Jérôme Weiss[4]

[1]Université Savoie Mont Blanc – ISTerre lab., University Savoie Mont-Blanc - CNRS, Le Bourget-Du-Lac, France – 27, rue Marcoz - 73000 Chambéry, France

[2]Institut des Sciences de la Terre (ISTerre) – Université Savoie Mont Blanc, Université Savoie Mont Blanc – France

[3]Institut des Géosciences de l'Environnement (IGE) – Institut Polytechnique de Grenoble - Grenoble Institute of Technology, Institut national des sciences de lÚnivers, Centre National de la Recherche Scientifique : UMR5001, Université Grenoble Alpes, Institut national des sciences de lÚnivers – UGA - IGECS 4070038 058 Grenoble Cedex 9, France

[4]ISTerre – Institut des Sciences de la Terre, CNRS – 38041 Grenoble Cedex 9, France, France

Abstract

The brittle deformation of ice has important environmental applications, mostly regarding to our understanding at the future evolution of ice sheet, glacier and sea ice. Our work aims at characterizing how a thin layer of ice deforms when subjected to a constant shear rate, over long duration. In particular, we seek how micro-fracturing takes place along a macro-rupture, how it is distributed in energy, time and space distribution, and how much this micro-fracturing contributes to the overall deformation. The experiment set-up involves a thin layer of ice formed on top of a water tank which is mechanically deformed in torsion with a circular Couette-like geometry. Waves propagation is characterized and a micro-seismic monitoring of the fault is performed using accelerometers to investigate the space and time distribution of rupture events according to an imposed loading. We also observe repeating fracture events that give to us an insight on the local slip accommodated by an asperity. Using numerical modelling, we are able to estimate a magnitude for each fracture detected. Then, we combine torque and seismic informations to characterize enery release mechanisms.

*Speaker