Geophysical Research Abstracts
Vol. 12, EGU2010-761, 2010
EGU General Assembly 2010

Compression experiments on artificial, alpine and marine ice: implications for ice-shelf/continental interactions

Marie Dierckx (1), Thomas Goossens (1), Denis Samyn (2), and Jean-Louis Tison (1)

(1) Laboratoire de Glaciologie, Université Libre de Bruxelles, Brussels, Belgium (mdierckx@ulb.ac.be / +32 2 650 22 26), (2) Department of Earth Sciences, Uppsala University, Uppsala, Sweden

Antarctic ice shelves are important components of continental ice dynamics, in that they control grounded ice flow towards the ocean. As such, Antarctic ice shelves are a key parameter to the stability of the Antarctic ice sheet in the context of global change. Marine ice, formed by sea water accretion beneath some ice shelves, displays distinct physical (grain textures, bubble content, ...) and chemical (salinity, isotopic composition, ...) characteristics as compared to glacier ice and sea ice.

The aim is to refine Glen's flow relation (generally used for ice behaviour in deformation) under various parameters (temperature, salinity, debris, grain size ...) to improve deformation laws used in dynamic ice shelf models, which would then give more accurate and / or realistic predictions on ice shelf stability.

To better understand the mechanical properties of natural ice, deformation experiments were performed on ice samples in laboratory, using a pneumatic compression device. To do so, we developed a custom built compression rig operated by pneumatic drives. It has been designed for performing uniaxial compression tests at constant load and under unconfined conditions. The operating pressure ranges from about 0.5 to 10 Bars. This allows modifying the experimental conditions to match the conditions found at the grounding zone (in the 1 Bar range). To maintain the ice at low temperature, the samples are immersed in a Silicone oil bath connected to an external refrigeration system. During the experiments, the vertical displacement of the piston and the applied force is measured by sensors which are connected to a digital acquisition system.

We started our experiments with artificial ice and went on with continental ice samples from glaciers in the Alps. The first results allowed us to acquire realistic mechanical data for natural ice. Ice viscosity was calculated for different types of artificial ice, using Glen's flow law, and showed the importance of impurities content and ice crystallography (grain size, ice fabrics…) on the deformation behaviour. Glacier ice was also used in our experiments. Calculations of the flow parameter A give a value of 3.10e-16 s-1 kPa-3 at a temperature of -10°C. These results are in accordance with previous lab deformation studies.

Compression tests show the effectiveness of the deformation unit for uniaxial strain experiment. In the future, deformation of marine ice and of the ice mélange (consisting of a melange of marine ice, broken blocks of continental ice and blown snow further metamorphosed into firn and then ice) will be studied, to obtain a comprehensive understanding of the parameters that influence the behaviour of both ice types and how they affect the overall flow of the ice shelf and potential future sea level rise.