Geophysical Research Abstracts, Vol. 9, 00567, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00567

Snow metamorphism, firn densification and air content in ice from polar ice core. First results from Dome Concordia Station.

H. Brunjail , L. Arnaud , M. Montagnat, J.M. Barnola and P. Duval

Laboratoire de Glaciologie et Géophysique de l'Environnement, CNRS/UJF, France (maurine@lgge.obs.ujf-grenoble.fr)

Ice formation in polar ice sheet results from densification processes from dry snow and firn. Two stages of densification are generally considered. The first stage consists of snow densification mainly due to structural re-arrangement of grains by grain boundary-sliding. This process would be dominating up to a critical density of about 0.55. The second stage is firn (consolidated snow) which evolution is mainly due to plastic deformation of grains. The average number of bonds per grain increases with density and neck growth is achieved by creep. At the end of this stage, air bubbles are trapped with no contact with the atmosphere. This is the close-off depth, which value depends on the site conditions (temperature, temperature gradients, accumulation). This transition between firn and ice occurs at a density of about 0.84. The age of the air trapped is then different from the age of the ice, difference which has to be taken into account for climatic records analysis.

Furthermore, air content in polar ice depends on air pressure, temperature and pore volume at close-off prevailing at the site of ice formation. Recently, air content in polar ice as measured along polar ice cores has been suggested to be a proxy of local insolation, proxy that could be used to synchronize the ice core climatic record, and to provide an absolute dating of the ice.

In order to understand the mechanisms which would link the insolation to the densification mechanisms and then to the air content, a multi-techniques study of the evolution of snow microstructure around an ice core site has been done, at Dome Concordia Station.

Evolution of density, microstructure, specific surface area, and porosity were measured along 2 meter depth pits. The techniques used to provide the main parameters of snow evolution were optical (Near Infra Red photography, laser transmission), mechanical (Snow micro-penetrometer), and from image analysis (co-axial epitaxy).

We will present preliminary results obtained at Dome Concordia Station during the summer season 2006-2007. We will discuss modeling of snow evolution that can be suggested considering the obtained measurements, and link that can be done with insolation measurements and temperature gradients.