Abstract ID : **204**

Evidence for enhanced density layering at pore close-off in polar firn

Content

Density measurements are standard measurements in Glaciology and have been performed in the past on many snow and firn samples from various polar sites. The measured densities are often mean values of 1m ice core segments ignoring the stratified nature of polar snow and firn. However, for several applications in ice core research the layered character of density becomes one of the controlling factors e. g. for processes at the pore close-off with effects on total air content and several gas and isotope rations in enclosed bubbles. Correlation analysis between air content records (and O2/N2 ratios) with local summer insolation time series suggests a direct link between pore structures and their variability at the surface and those at pore close-off. The understanding of the physical control of this link is poor, mainly due to sparse data sets.
In this contribution we are going to present density profiles (and porosity profiles respectively) with vertical resolution on the sub-millimetre scale using core-scale X-ray scanning techniques on firn samples from 4 polar sites including the Renland site RECAP (East Coast of Greenland), EGRIP (North-East Plateau of Greenland), Kohnen station (Droning Maud Land, Antarctica) and the OIR-Camp site (East Antarctic Plateau close to Dome Fuji). Combining firn core measurements with measurements on snow cores retrieved by carbon-fibre tubes in snow trenches enables us for the first time to derive reliable estimates for both surface layering and the layering down to the pore close-off. At all sites the layering defined by the ratio of standard deviation to the 1m mean value in porosity reaches its maximum in the close-off region. It will be shown that sites of comparable surface variability develop different strengths of layering at pore close-off. Implications for the gas records will be discussed and some explanations will be suggested.

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Track Classi ication: Progress in proxy development and interpretation