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^{10}Be and ^{210}Pb in Antarctic air and firn: A tool for examining the air-firn transfer of sub-micron aerosol

Christoph Elsässer (1), Dietmar Wagenbach (1), Hans Oerter (2), Anna Wegner (1,2), Anton Wallner (3), Susanne Preunkert (4), and Margareta Hansson (5)

(1) Institut für Umweltphysik, University of Heidelberg, Germany (christoph.elsaesser@iup.uni-heidelberg.de), (2) Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, (3) Vienna Environmental Research Accelerator, University of Vienna, Austria, (4) Laboratoire de Glaciologie et Géophysique de l'Environnement, CRNS, St Martin d'Hères, France, (5) Department of Physical Geography and Quaternary Geology, Stockholm University, Sweden

^{10}Be and ^{210}Pb are mainly produced in the atmosphere by cosmic ray interactions and the decay of terrigenous ^{222}Rn, respectively. Being immediately attached to the sub-micron particles they tag the atmospheric cycle of this aerosol body. Moreover, since their sources are relatively well known and expected to show marginal temporal changes in case of ^{210}Pb or less than 30% over a solar cycle in case of ^{10}Be they constitute an ideal tool for studying the air-firn transfer of the sub-micron aerosol over polar ice sheets.

We discuss in this context our firn data of these radioisotopes obtained during several Antarctic traverses and from various ice cores extending from sea level up to 3600m a.s.l. on the central plateau. This spatial distribution is supplemented by our long term atmospheric records of these radionuclides observed at the coastal Neumayer Station and by shorter ones from two inland sites.

While at single sites the relative temporal variability of yearly mean radionuclide levels in firn do not exceed 30%, approximately, we observed systematic, spatial concentration changes by up to a factor of six going from coastal to inland sites. These trends mainly reflect the strong contrast in the glacio-meteorological settings within the covered area (as mainly concerning the scavenging efficiency and particularly the net snow accumulation rate). Even a steady distinct ^{10}Be increase of a factor two is seen over some 100km in the rather homogenous upstream area of the East Antarctic EDML drilling site at Kohnen Station (2890m a.s.l.) suggesting a rather high sensitivity of the air-firn transfer on the accumulation rate in central Antarctica.

We found a uniform, linear relationship between the site specific mean firn concentration and the inverse accumulation rate which surprisingly holds for the entire Antarctic domain studied. This would imply a uniform atmospheric concentration within the Antarctic boundary layer which was indeed fairly corroborated by our atmospheric observations. On the other hand, long term atmospheric monitoring suggests a notable influence of the surface inversion strength on the seasonal, near surface atmospheric levels; an effect which should be more pronounced at inland locations. Using a crude air-firn transfer parameterization of ^{10}Be and ^{210}Pb (i.e. conservative, sub-micron particles) we may infer from our spatial trends among others: a typical dry deposition velocity of 0.12cm/s and dry deposition to total deposition fractions increasing from 60% at coastal to 90% at inland sites. These results will be discussed in terms of implications for the interpretation of glacio-chemical records from deep Antarctic ice cores.