Early Holocene climate variability in the Eastern Ross Sea – Initial Results from the Major Ion Analysis of the RICE Ice Core

Lukas Eling[1,2], Nancy Bertler[1,2], Rob McKay[1,2], Rebecca Pyne[2]

[1]Victoria University Wellington, NZ; lukas.eling@vuw.ac.nz;
[2]GNS Science.

Abstract:

As part of the Roosevelt Island Climate Evolution (RICE-) project, a deep ice core was drilled at Roosevelt Island, an ice rise situated at the northern edge of the Ross Ice Shelf, a major drainage pathway of the marine based West-Antarctic Ice Sheet (WAIS). The RICE records will provide new insights into our understanding of the stability of the Ross Ice Shelf in a warming world and associated sea-level rise contributions of WAIS.
The focus of this PhD project lies on the major ion analysis of the Holocene part of the RICE core comprising measurements of the anions Cl^-, NO_3^-, SO_4^{2-} and MSA^- and the cations Na^+, NH_4^+, K^+, Mg^{2+} and Ca^{2+}. For the reconstruction of sea ice extent and production in the Ross Sea Polynya MSA^- will be used together with the ratio of Na^+/SO_4^{2-} to estimate the frost flower contribution. Important ions to reconstruct atmospheric circulation pattern are K^+, Mg^{2+} and NO_3^-, which have a continental source and are therefore related to katabatic winds, and Na^+, Cl^- and Ca^{2+} which are marine aerosols and thus are associated with cyclonic activity.
As precipitation at Roosevelt Island is heavily influenced by cyclonic storms controlled by the location and depth of the Amundsen Sea Low (ASL) the varying marine aerosol concentrations can be used as a proxy for the ASL. The correlation of associated atmospheric variability changes with temperature proxies such as corrected $\delta^{18}O$ and δD records of the RICE core will provide an opportunity to reconstruct the influence of atmospheric forcing on ocean processes that could influence Ross Ice Shelf grounding line behaviour.
Here we present geochemical data from discrete samples of the RICE core representing the Early Holocene from ~ 10.5 ka BP to ~ 7.5 ka BP in high resolution (subannual to 3-5 years). This time period is particularly interesting as recent results from marine studies, integrated with the latest generation of ice sheet models suggest retreat may have been largely complete by the mid-Holocene. To test the role of atmospheric forcing, the records will be correlated with existing ice core and marine sediment records.

Keywords: Early Holocene, Ice Core Geochemistry, Eastern Ross Sea