



A comprehensive interpretation of the NEEM basal ice build-up using a multi parametric approach

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Basal ice is a common expression to describe debris-laden ice layers found close to the ice-bedrock interface under glaciers and ice sheets. The study of basal ice properties provides us with the unique opportunity of improving our understanding of subglacial environments and processes and refine ice sheet behaviour modelling. Here, we present and discuss the results of water stable isotopes ($\delta^{18}\text{O}$ and δD), ice fabrics, debris weight and gas content of the basal part of the NEEM (North Eemian Ice Drilling Program) ice core. Below 2533.85 m deep, almost 10 m of basal debris-rich material were retrieved from the borehole. The situation at NEEM is different from the previously well-documented GRIP core where the basal ice corresponds to pre ice sheet ice overridden by the growing ice sheet. At NEEM, the basal debris-rich material presents $\delta^{18}\text{O}$ values from -39.89 to -34.36 permil within the range of the above last 300 m of meteoric ice from -44.86 to -30.59 permil. The sequence is however composed of an alternation of three visually contrasting types of ice : clear ice with specks of particulate inclusions, stratified debris-rich layers, and ice containing dispersed debris. Using water stable isotopes ($\delta^{18}\text{O}$ and δD) signatures, each of these ice types are discriminated and clues are given for their conditions of formation and transformation processes. The proposed interpretation is then refined in the light of the other available parameters. While clear basal ice with specks corresponds to altered meteoric glacial ice, stratified debris-rich layer and ice containing dispersed debris present a melting/refreezing signature, somewhat blurred by mixing processes. Based on the identified origins of the different ice types, the present study proposes a first interpretative framework for the build-up of the NEEM basal ice sequence.