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Duplex Structures in the EastGRIP Ice Core - the Loss of Stratigraphic Integrity

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The EastGRIP ice core is drilled through the Northeast Greenland Ice Stream, which has a surface velocity of 55 m/yr towards NNE at the drill site. Deriving a better understanding of internal deformation and the rheology within an ice stream is crucial for ice flow models and projections of future solid ice discharge. We use the line scanner to make the stratigraphy visible and document disturbances in the layering in the depth region from 1375 to 2120 m covering a large part of the Glacial Period. Disturbances are visible in cuts perpendicular to the ice flow direction, and not in cuts parallel to flow. Between these two extremes, we have a gradual change in type and amount of disturbances. As with all other ice cores, the ice in the EastGRIP ice core is thinned vertically. Due to the advanced thinning of layers, it is clear that the visible structures are not the remnants of surface features, such as sastrugi. However, the disturbances, or deformation structures, are the result of strain caused by the stress field at the EastGRIP site, which is described by a compressional component perpendicular to and an extensional component parallel to the ice flow direction. In most samples cut perpendicular to ice flow, i.e. with the compressional setting visible, we find structures, very similar to geological duplex structures. We identify duplex structures extending the width of the core by the sudden change of layer tilt within one bag at a time. Duplex structures are confined by layer parallel shear zones, with tilted layers in between them. The small-scale shear zones only become evident due to the deformation they cause and can extend well beyond these visible structures. We furthermore suggest, that shear zones are present parallel to layering, but do not show up, as a lateral displacement of layers, does not disrupt the vertical profiles. We discuss one example, from a depth of 1651 m (26 ky b2k), in detail. We further investigate approx. 30 m of chemical CFA data, mainly NH_4^+ and Ca^{++}, from the same depth. We find peaks that double, in both the visual stratigraphy as well as the CFA data. These may be a result of the duplex structures that stack the stratigraphy and have the potential to disturb the climate record. Our results display the importance of understanding internal deformation when interpreting the climate record.