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Visual Stratigraphy of the EastGRIP Ice Core

Content

The main goal of the EastGRIP ice core is to increase our understanding of ice flow so that we can make better predictions regarding the contribution of the Greenland ice sheet to sea level rise in the near future. To learn about ice flow, the core is drilled through the fast-moving Northeast Greenland ice stream (NEGIS). We use high-resolution line scan images to investigate small-scale features in the ice cores. The images cover the entire 2120 m of the ice core drilled so far, reaching back to 55,000 years before today. We applied different approaches to visual stratigraphy data throughout the entire core. In the upper 100 m of the ice core we have developed an optical method to find the lock-in depth. This method is independent of other techniques and is based on the refraction of light, created by an increasing number of bubbles being occluded into the ice matrix. Throughout the upper 1100 m of the ice core, we analyze the line scan images to investigate prominent, millimeter-thick melt layers in the ice stratigraphy. These melt layers are caused by melting on the surface of the ice sheet and contain valuable information about extreme warm events. We provide a reconstruction of these melt events on the Greenland ice sheet over the past 10,000 years. To date, all physical-properties image-data were analyzed without knowledge of the orientation of the sample. For an accurate description and analysis of deformation structures in ice, knowledge of the orientation of the sample is crucial. Thus, we have developed a method to reconstruct the orientation of physical properties of image samples. We use this newly won knowledge of ice core orientation in a depth below 1375 m. Here, we analyze and interpret small-scale deformation structures found in the line scan images. We find sudden changes in the tilt of layers and interpret these as duplex structures, where stacks of layers imbricate between shear zones. Understanding the small-scale structures will help advance our knowledge of ice flow and how ice internally deforms. Furthermore, it can help unfold disturbed and folded stratigraphy in the bottom sections of ice cores, and thus extend climate archives even further into the past. The findings presented here are a summary of my PhD work, which greatly expanded the variety of line scan image applications and show the value of this high-resolution dataset for ice coring sciences.

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