

## **A multimillion-year-old record of Greenland vegetation and glacial history preserved in sediment beneath 1.4 km of ice at Camp Century**

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Understanding the history of the Greenland Ice Sheet (GrIS) is critical for determining its sensitivity to warming and contribution to sea level; however, that history is poorly known before the last interglacial. Most knowledge comes from interpretation of marine sediment, an indirect record of past ice-sheet extent and behavior. Subglacial sediment and rock, retrieved at the base of ice cores, provide terrestrial evidence for GrIS behavior during the Pleistocene. Here, we use multiple methods to determine GrIS history from subglacial sediment at the base of the Camp Century ice core collected in 1966. This material contains a stratigraphic record of glaciation and vegetation in northwestern Greenland spanning the Pleistocene. Enriched stable isotopes of pore-ice suggest precipitation at lower elevations implying ice-sheet absence. Plant macrofossils and biomarkers in the sediment indicate that paleo-ecosystems from previous interglacial periods are preserved beneath the GrIS. Cosmogenic  $^{26}\text{Al}/^{10}\text{Be}$  and luminescence data bracket the burial of the lower-most sediment between  $<3.2 \pm 0.4$  Ma and  $>0.7$  to 1.4 Ma. In the upper-most sediment, cosmogenic  $^{26}\text{Al}/^{10}\text{Be}$  data require exposure within the last  $1.0 \pm 0.1$  My. The unique subglacial sedimentary record from Camp Century documents at least two episodes of ice-free, vegetated conditions, each followed by glaciation. The lower sediment derives from an Early Pleistocene GrIS advance.  $^{26}\text{Al}/^{10}\text{Be}$  ratios in the upper-most sediment match those in subglacial bedrock from central Greenland, suggesting similar ice-cover histories across the GrIS. We conclude that the GrIS persisted through much of the Pleistocene but melted and reformed at least once since 1.1 Ma.

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