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# Triple-isotope exposure-burial dating of Greenland subglacial materials: new constraints on ice-sheet history

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## Abstract

With ~7.4 m of sea-level equivalent stored in the Greenland Ice Sheet (GrIS), understanding the sensitivity of distinctive sectors of the GrIS to Quaternary warm interglacials is a forefront challenge for improving sea-level projections. Subglacial materials preserved beneath the GrIS provide rare and direct constraints on past ice-sheet configurations and long-term landscape evolution through cosmogenic nuclide inventories that record complex exposure-burial histories. Existing studies based on paired cosmogenic nuclides (<sup>26</sup>Al/<sup>10</sup>Be) suggest that parts of the GrIS may have experienced periods of reduced ice cover during the Pleistocene, providing key insights into past ice-sheet behaviour and motivating the development of multi-nuclide approaches. Here, we present new *in situ* cosmogenic <sup>36</sup>Cl measurements from subglacial materials beneath the GrIS and combine them with existing <sup>26</sup>Al-<sup>10</sup>Be data within an inversion-based analysis of triple-cosmogenic-nuclide data. The addition of <sup>36</sup>Cl, with its shorter half-life, enhances sensitivity to shorter-timescale burial-exposure cycles and improves the resolution of complex exposure-burial histories. We identify suites of scenarios consistent with the data and provide new constraints on GrIS fluctuations over Quaternary timescales. These results are discussed in the context of existing paleoclimate proxies, ice-sheet reconstructions, and ice-sheet model outputs. Together, this work highlights the potential of combining multiple cosmogenic nuclides to reconstruct complex exposure-burial histories in subglacial and polar environments.

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