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Mio-Pleistocene ice sheet fluctuations from cosmogenic nuclide field constraints in western Dronning Maud Land, Antarctica

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The East Antarctic Ice Sheet (EAIS) is generally assumed to have been relatively insensitive to Quaternary climate change. However, recent studies have shown potential instabilities in coastal, marine sectors of the EAIS. In addition, long-term climate reconstructions and modelling experiments indicate the potential for significant changes in ice volume and ice sheet configuration since the Pliocene. Hence, more empirical evidence for ice surface and ice volume changes is required to discriminate between contrasting inferences.

MAGIC-DML is an ongoing Swedish-US-Norwegian-German-UK collaboration focused on improving ice sheet models by filling critical data gaps that exist in our knowledge of the timing and pattern of ice surface changes along the western Dronning Maud Land (DML) margin and combining this with advances in numerical techniques. As part of the project, field studies in the 2016/17 and 2017/18 austral summers targeted selected sites spanning accessible altitudes in the Heimefrontfjella, Vestfjella, Ahlmannryggen, Borgmassivet, and Kirwanveggen nunatak ranges for *in situ* cosmogenic nuclide sampling. Comparing concentrations of nuclides with widely differing half-lives in bedrock and erratics from a range of altitudes above modern ice surfaces can provide information on ice sheet fluctuations and complex burial and exposure histories, and thus, past configurations of non-erosive ice. Quartz-bearing rock types were sampled and analyzed for ^{10}Be ($t_{1/2}$ 1.4 My), ^{14}C ($t_{1/2}$ 5.7 ky), ^{26}Al ($t_{1/2}$ 705 ky), and ^{21}Ne (stable), and mafic lithologies for ^{36}Cl ($t_{1/2}$ 301 ky).

Results thus far for 32 ^{10}Be and ^{26}Al isotope pairs complemented with seven ^{21}Ne measurements have yielded some consistent patterns of paleoglaciation for the western DML margin. Eight out of fourteen bedrock samples from high-elevation (1700-2238 m a.s.l.) ridges and summits return some of the oldest exposure ages in Antarctica and have consistent ^{10}Be, ^{26}Al, and ^{21}Ne minimum apparent exposure ages of 1.8-4.1 Ma. Initial results therefore indicate that parts of the ice sheet marginal to the Antarctic plateau, along the Heimefrontfjella range, generally have experienced a decrease in ice thickness since the late Miocene. Another six bedrock samples (1556-1732 m a.s.l.) fall in the 300-700 ka range, and they all show significant burial. At face value, perhaps this indicates a regional ice sheet surface above 1700 m a.s.l. for much of the Plio-early Pleistocene. All other samples analyzed to date are erratics from lower elevation and more coastal sites (10 from nunataks at 553-1400 m a.s.l., and 6 from a surface moraine at 1385 m a.s.l.), exhibiting ages between 59 and 275 ka, save for two (4 and 6 ka). Whereas almost all of the nunatak erratics (including the young ones) show significant burial durations, five of the six surface moraine samples do not. These 2016/17 field samples are not yet leading to conclusive age constraints but already start to paint a picture of the western DML margin being relatively stable although there was possibly one or more episodes of relatively limited ice thickening during the last 700 ka.