A 14.5 million-year geologic record of East Antarctic Ice Sheet fluctuations in the central Transantarctic Mountains, constrained with multiple cosmogenic nuclides

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Manuscript open for discussion in *The Cryosphere*: https://www.the-cryosphere-discuss.net/tc-2020-57/

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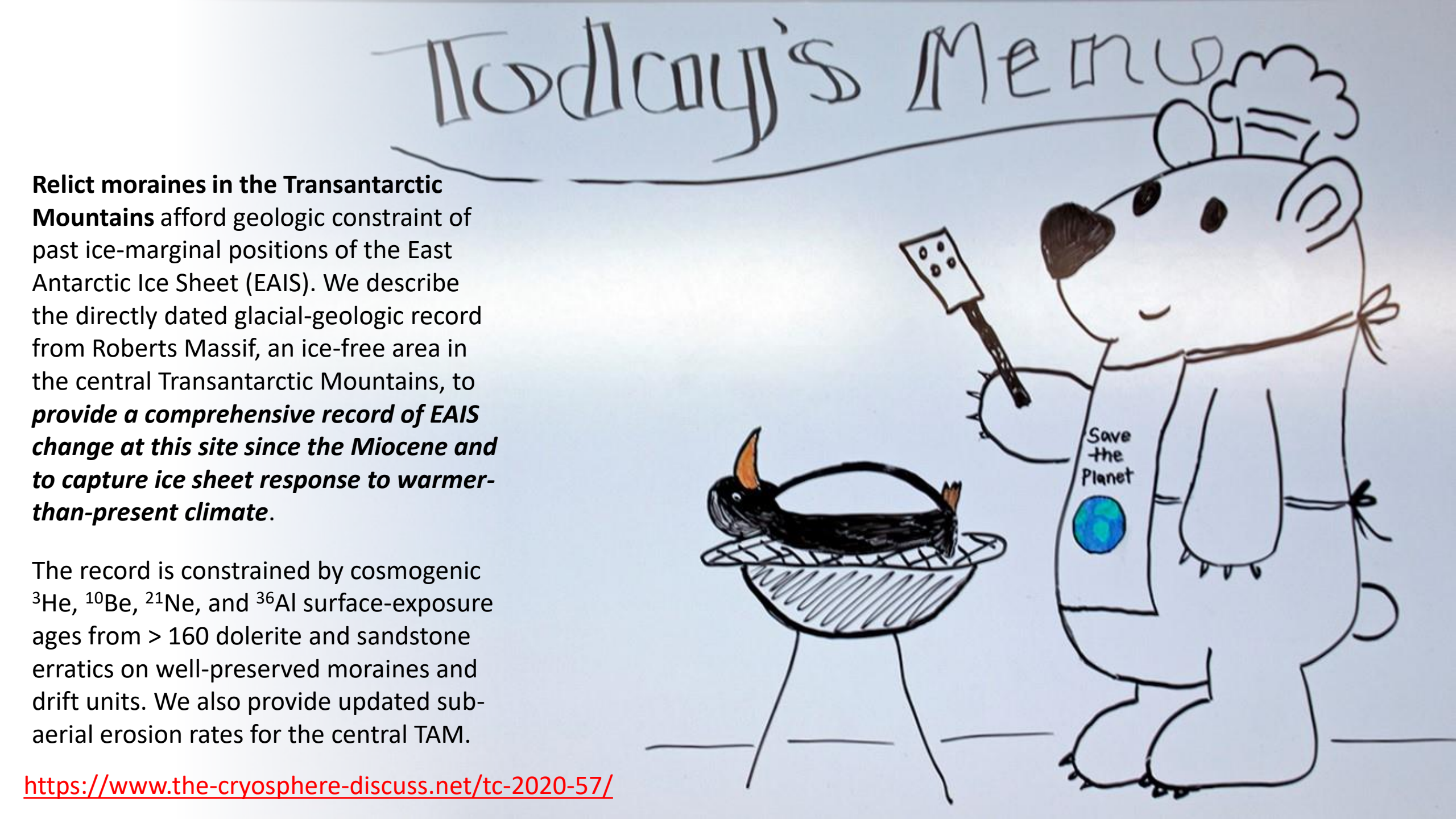
Funded by NSF Office of Polar Programs



Relict moraines in the Transantarctic Mountains afford geologic constraint of past ice-marginal positions of the East Antarctic Ice Sheet (EAIS). We describe the directly dated glacial-geologic record from Roberts Massif, an ice-free area in the central Transantarctic Mountains, to ***provide a comprehensive record of EAIS change at this site since the Miocene and to capture ice sheet response to warmer-than-present climate***.

The record is constrained by cosmogenic ^{3}He, ^{10}Be, ^{21}Ne, and ^{36}Al surface-exposure ages from > 160 dolerite and sandstone erratics on well-preserved moraines and drift units. We also provide updated sub-aerial erosion rates for the central TAM.

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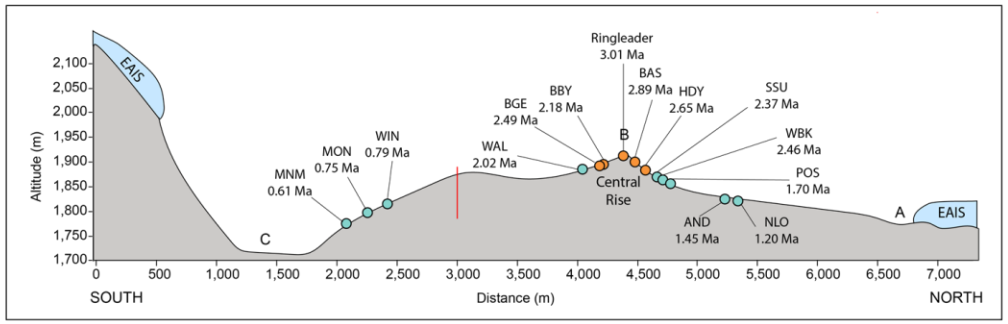
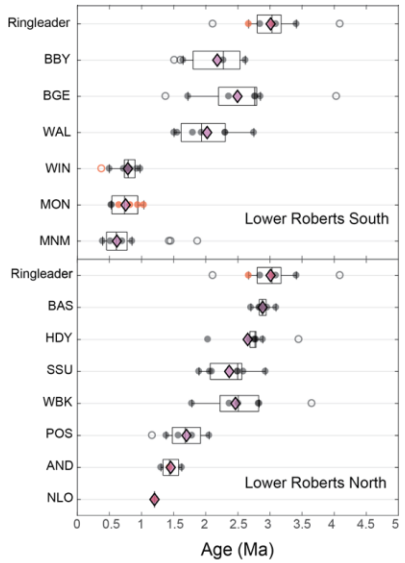
Lower Roberts

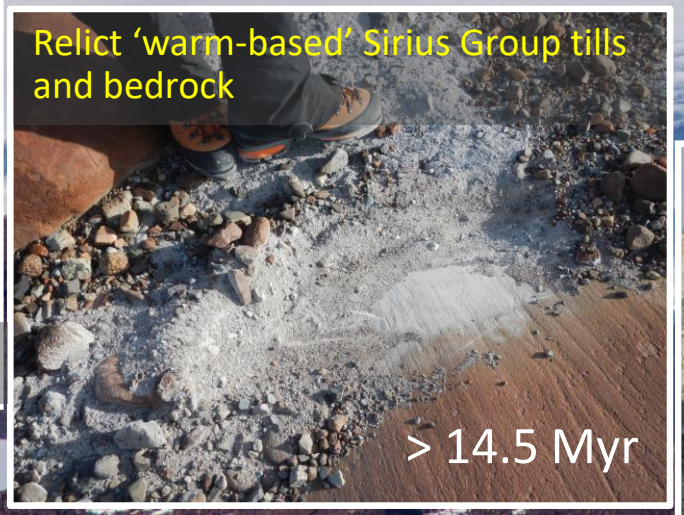
Moraine colour:
Pliocene
Pleistocene





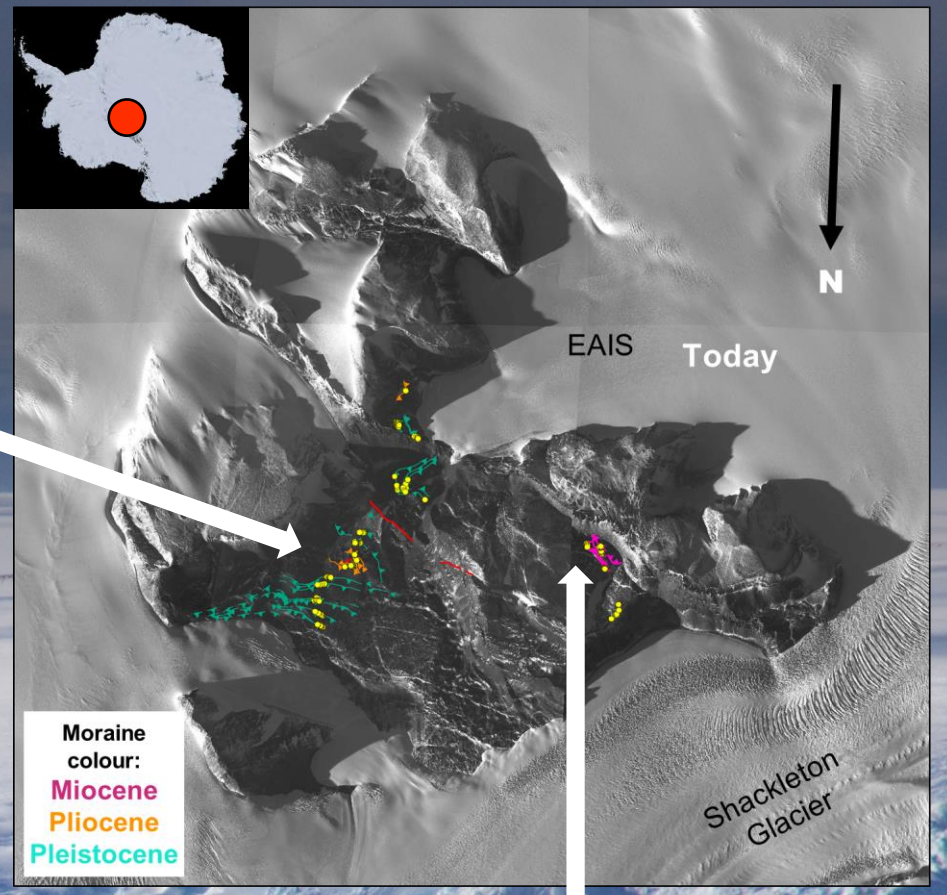
Pliocene/Pleistocene transect of cold-based moraines, Lower Roberts

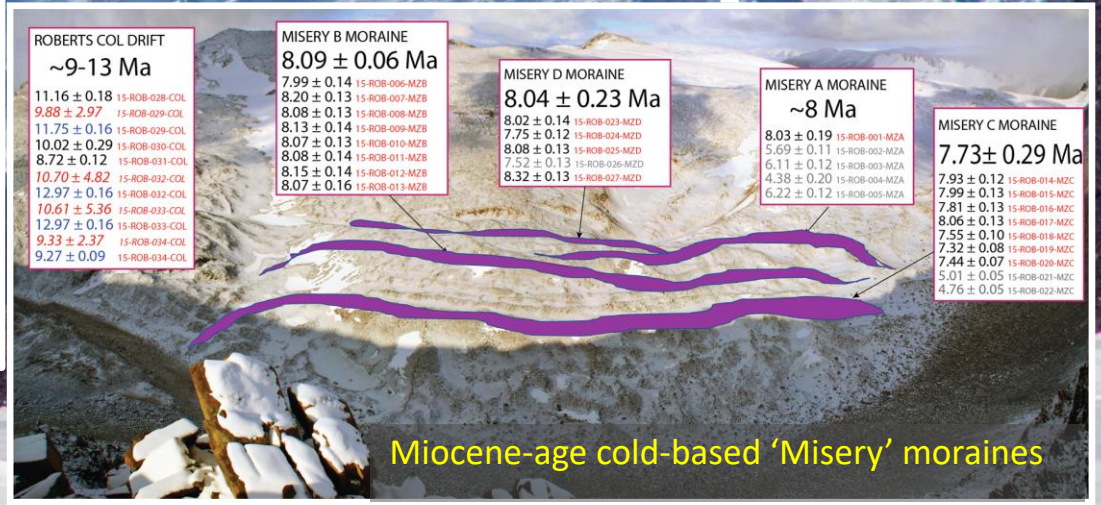
Cold-based ablation moraines, Lower Roberts



Relict 'warm-based' Sirius Group tills and bedrock

> 14.5 Myr





Miocene-age cold-based 'Misery' moraines

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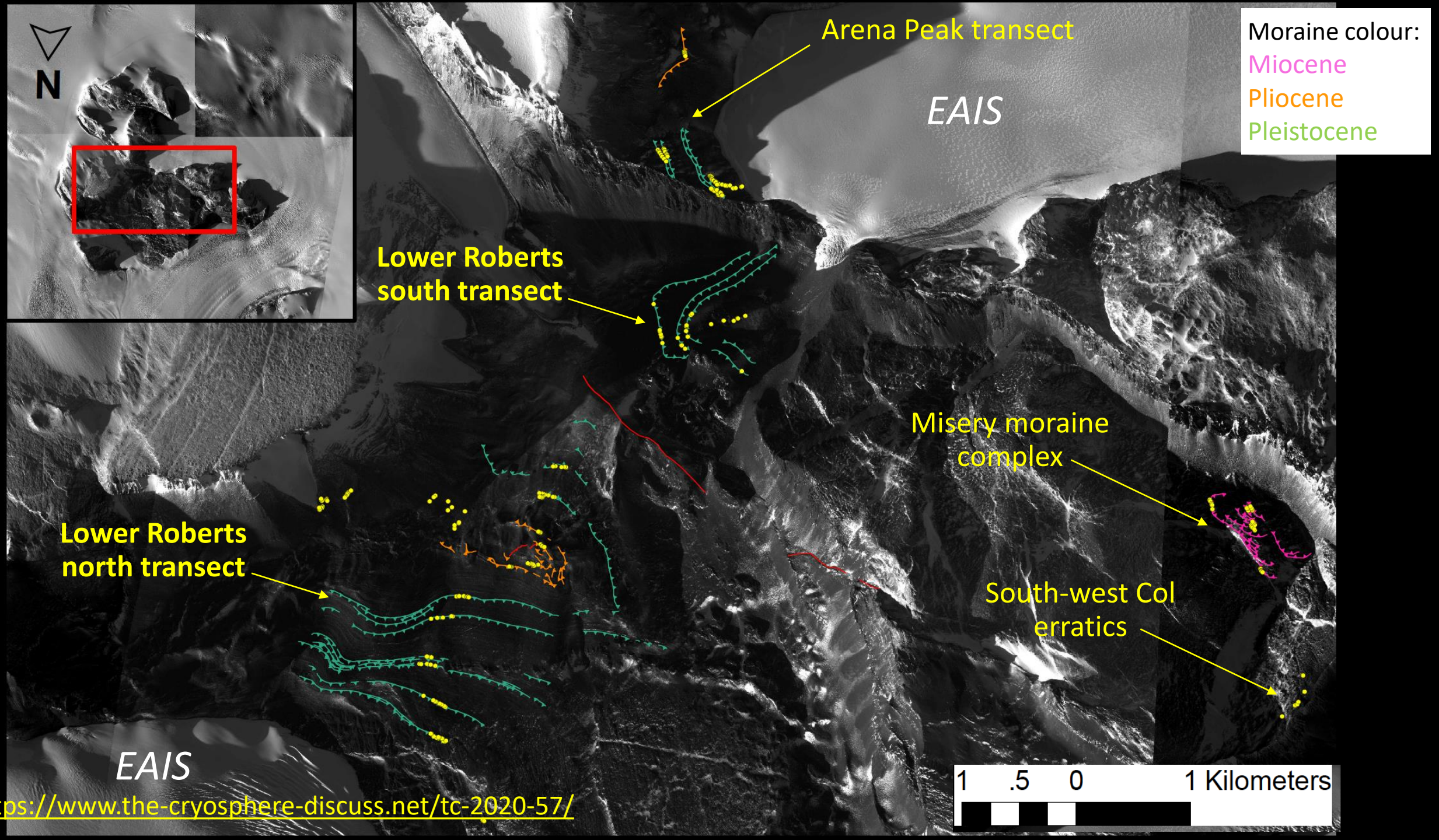

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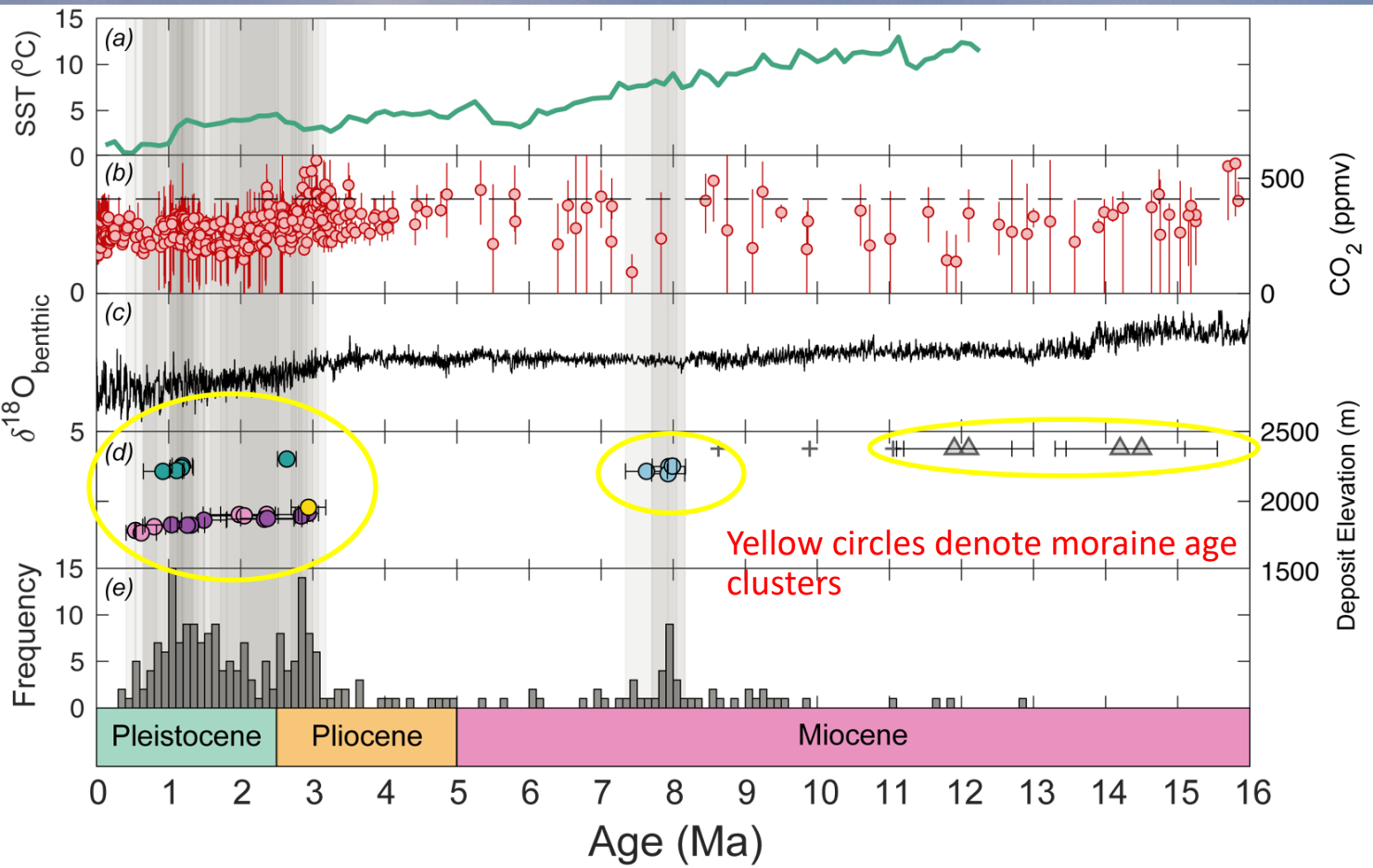

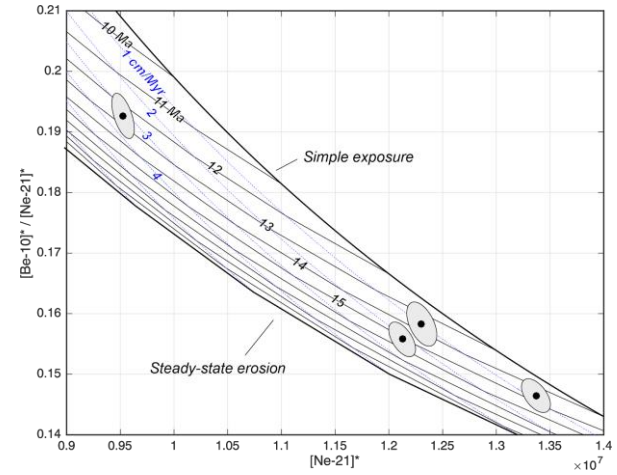

More than 160 cosmogenic nuclide ages from Roberts Massif describe:

- Cold-based glacial regime in the central TAM since ~14.5 Myr
- Warm-based deposits in central TAM are > ~14.5 Myr
- **EAIS has been present in a configuration similar today since at least the middle Miocene**, including periods thought to have been warmer than today *and* with higher atmospheric CO_2 concentrations
- Progressive lowering of ice surface might reflect slow isostatic uplift

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- **Extremely low** sub-aerial erosion rates in central TAM (<< 5 cm/Myr)