Glacial history of Marie Byrd Land - from thousands to millions of years

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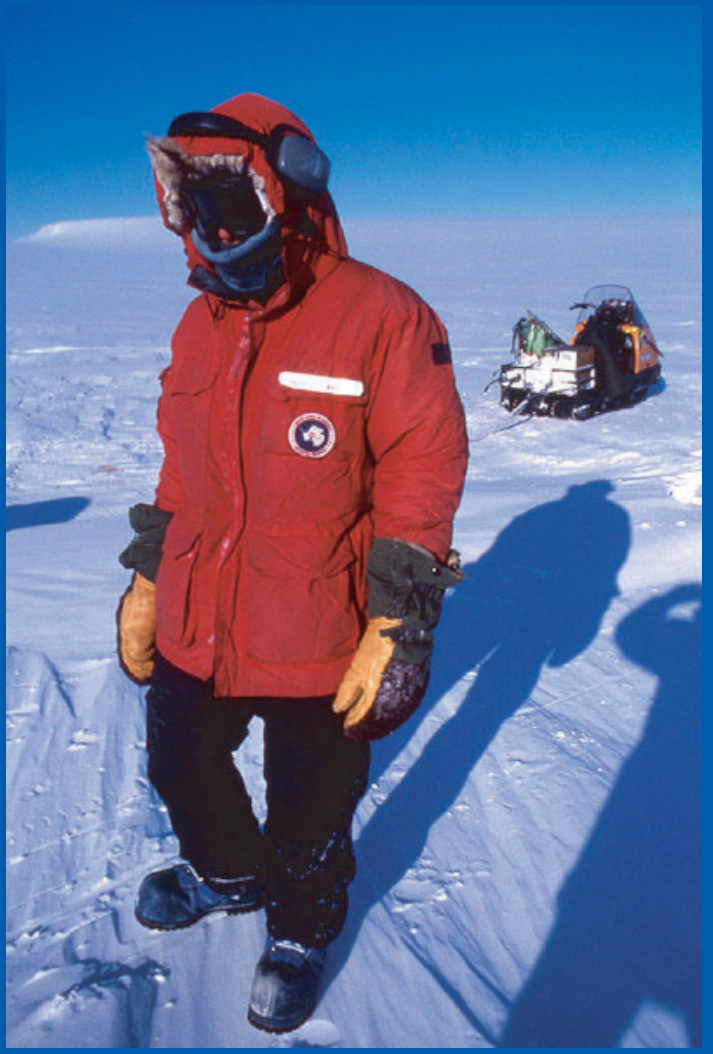

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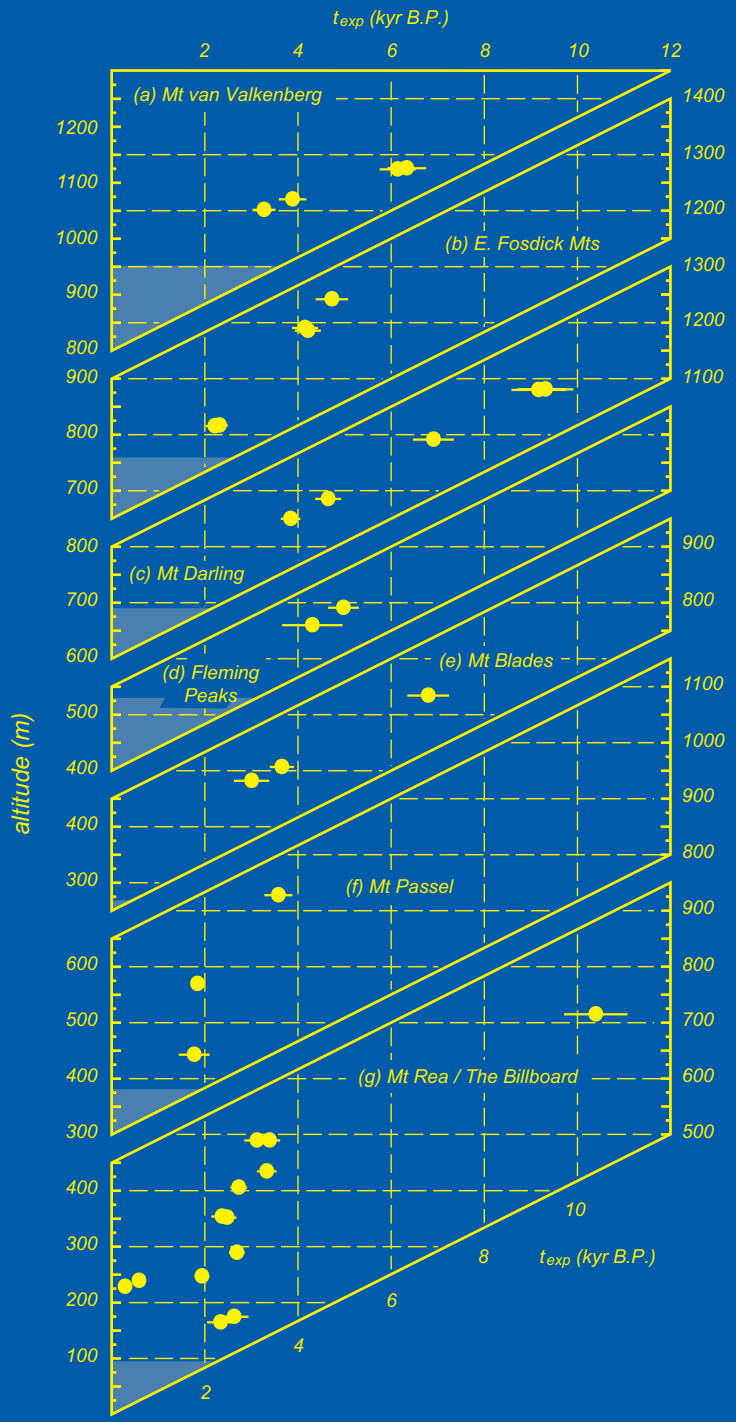
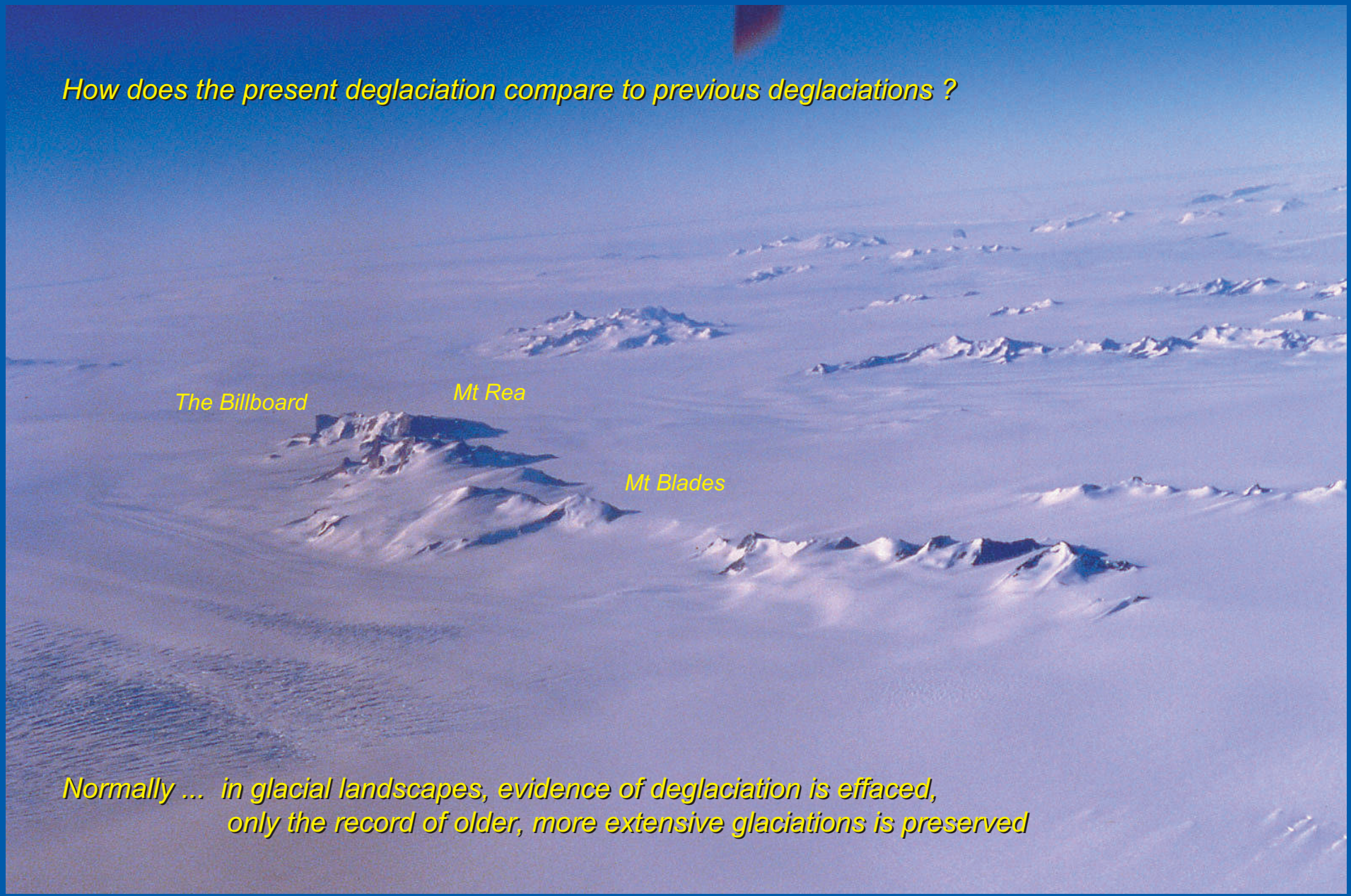
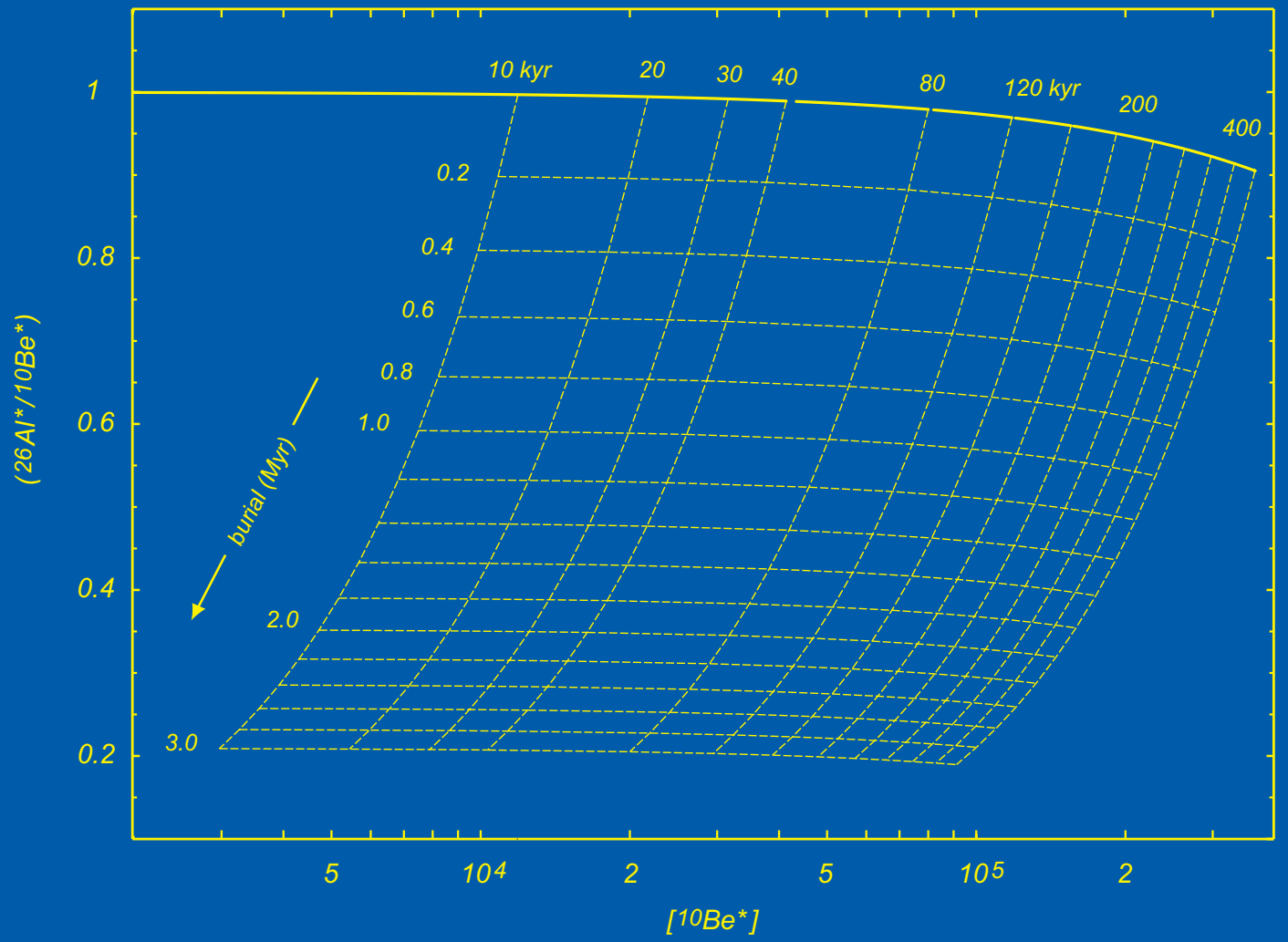


The last deglaciation in the Ford Ranges, Marie Byrd Land

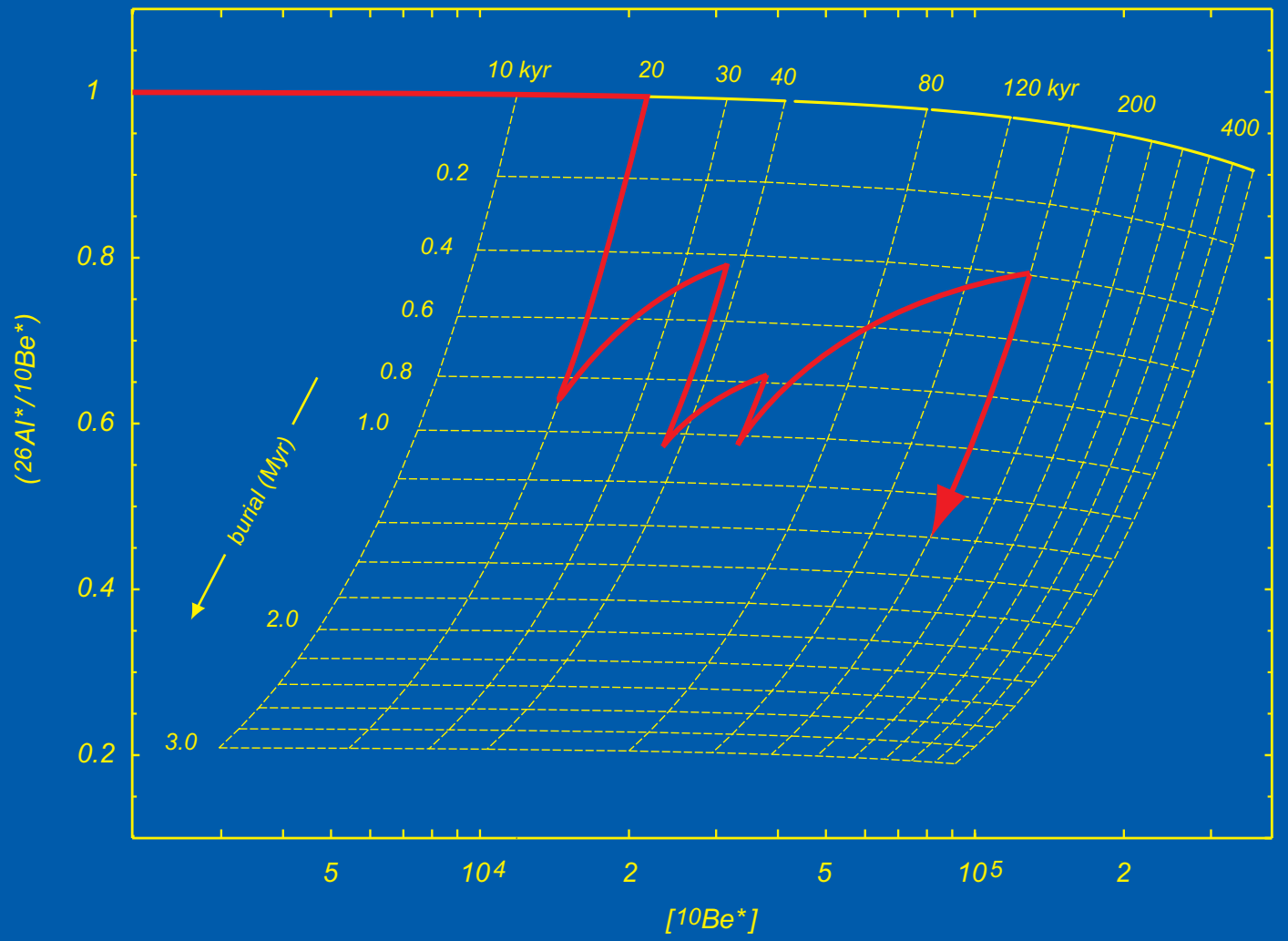
- *Peaks were overrun during the last glaciation.*
- *Summits emerged between 10,400 and 3,800 yrs B.P.*
- *Steady Holocene deglaciation.*


How does the present deglaciation compare to previous deglaciations ?
The Billboard
Mt Rea
Mt Blades
Normally ... in glacial landscapes, evidence of deglaciation is effaced,
only the record of older, more extensive glaciations is preserved


In Marie Byrd Land ... bedrock surfaces retain cosmic-ray exposure histories extending back millions of years

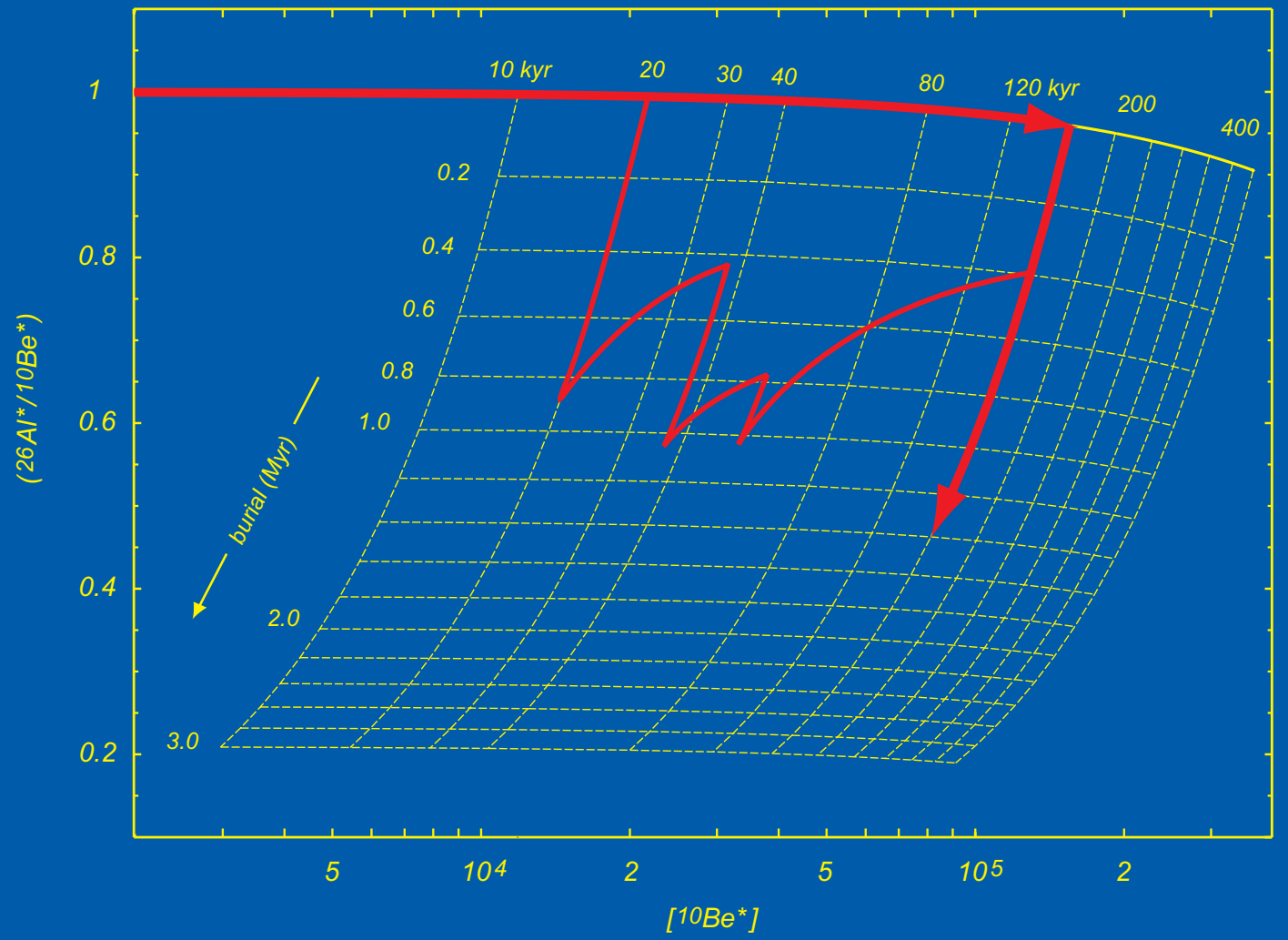


Limits on prior exposure and ice cover from cosmic-ray-produced nuclides



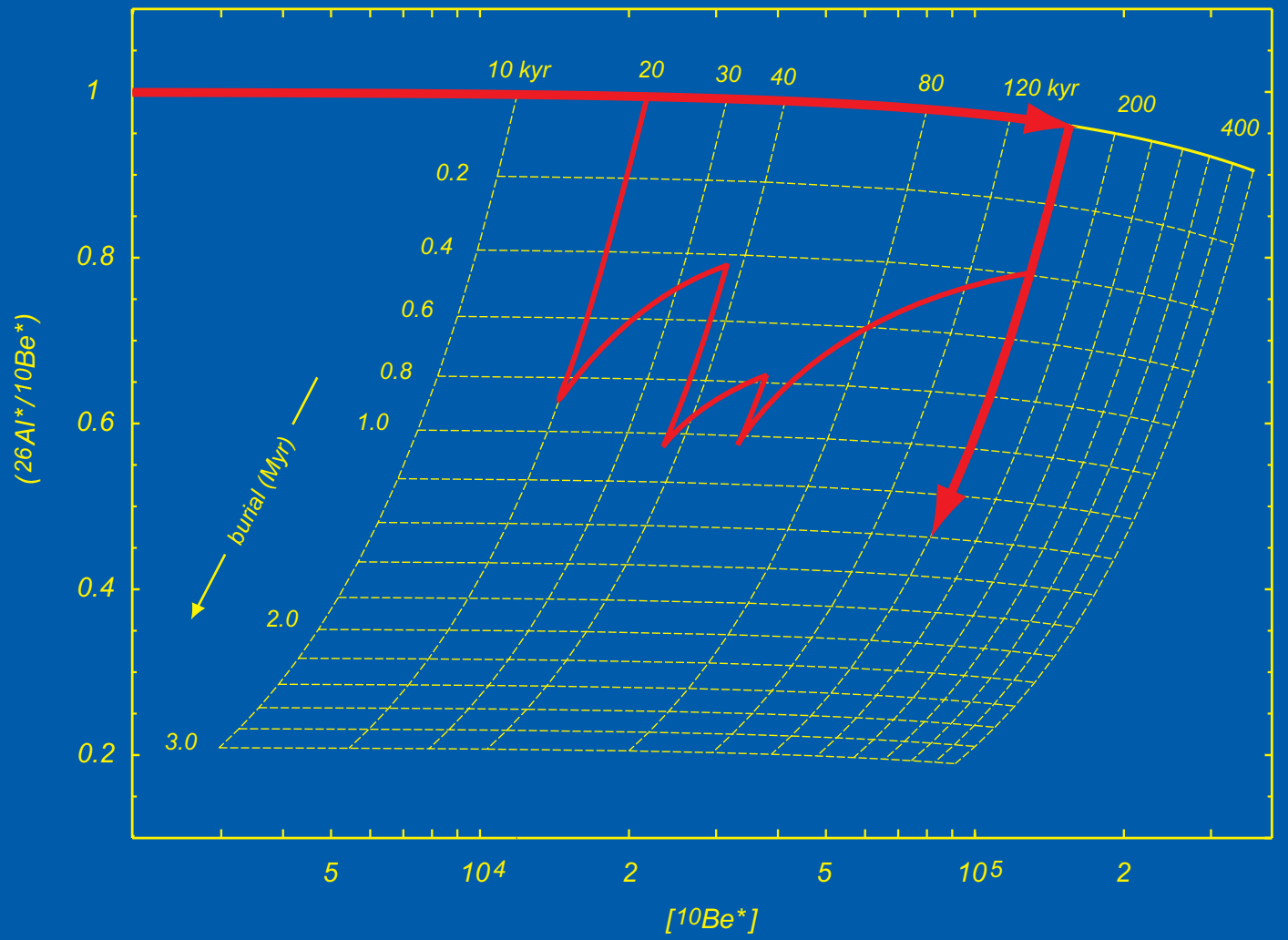
Limits on prior exposure and ice cover from cosmic-ray-produced nuclides

- *Actual exposure histories are complicated, but we can derive some simple limits:*



Limits on prior exposure and ice cover from cosmic-ray-produced nuclides

- *Actual exposure histories are complicated, but we can derive some simple limits:*
- *A lower limit on the cumulative exposure time*



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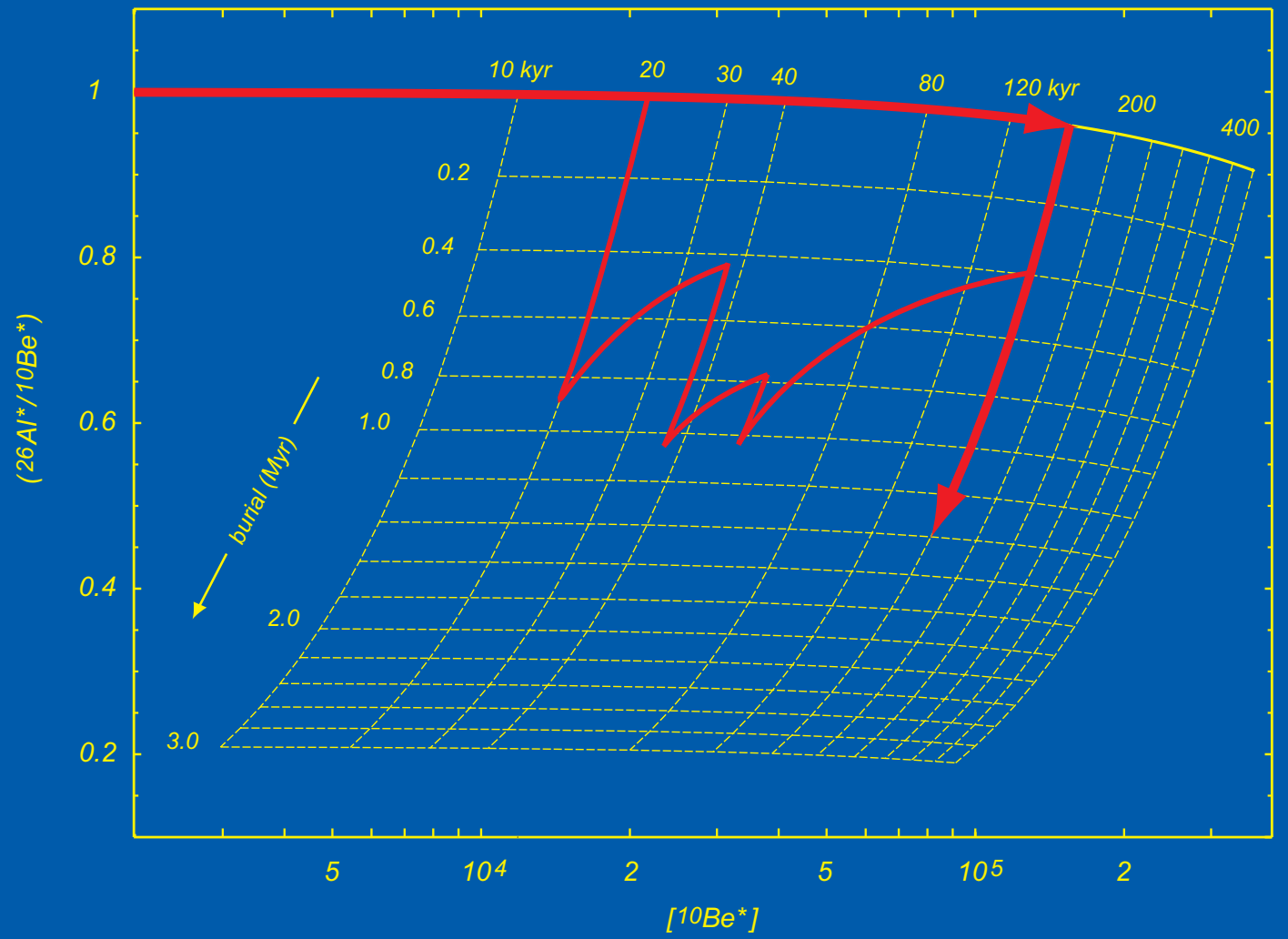
- *A lower limit on the cumulative time covered by ice*



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- *Actual exposure histories are complicated, but we can derive some simple limits:*
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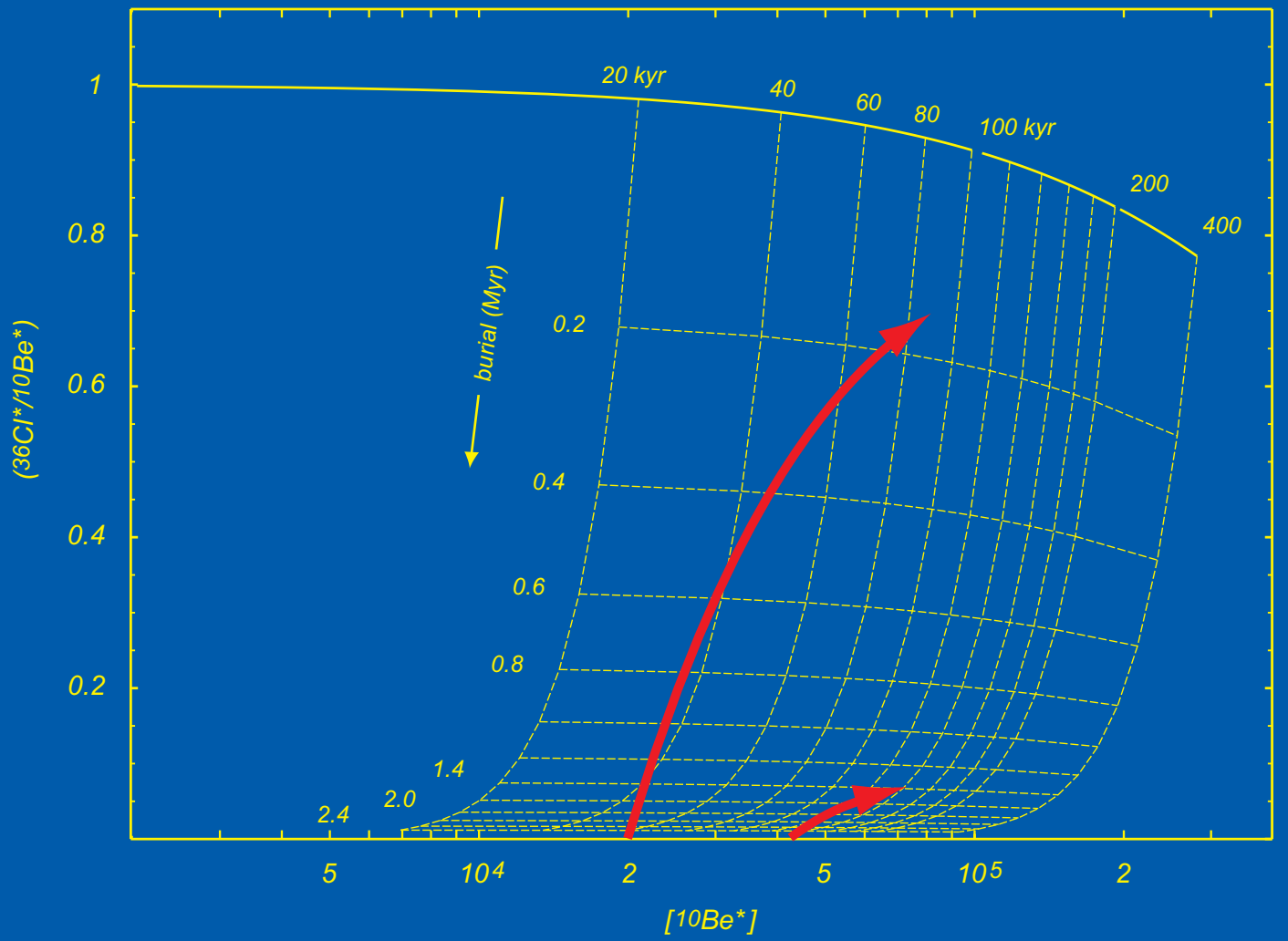
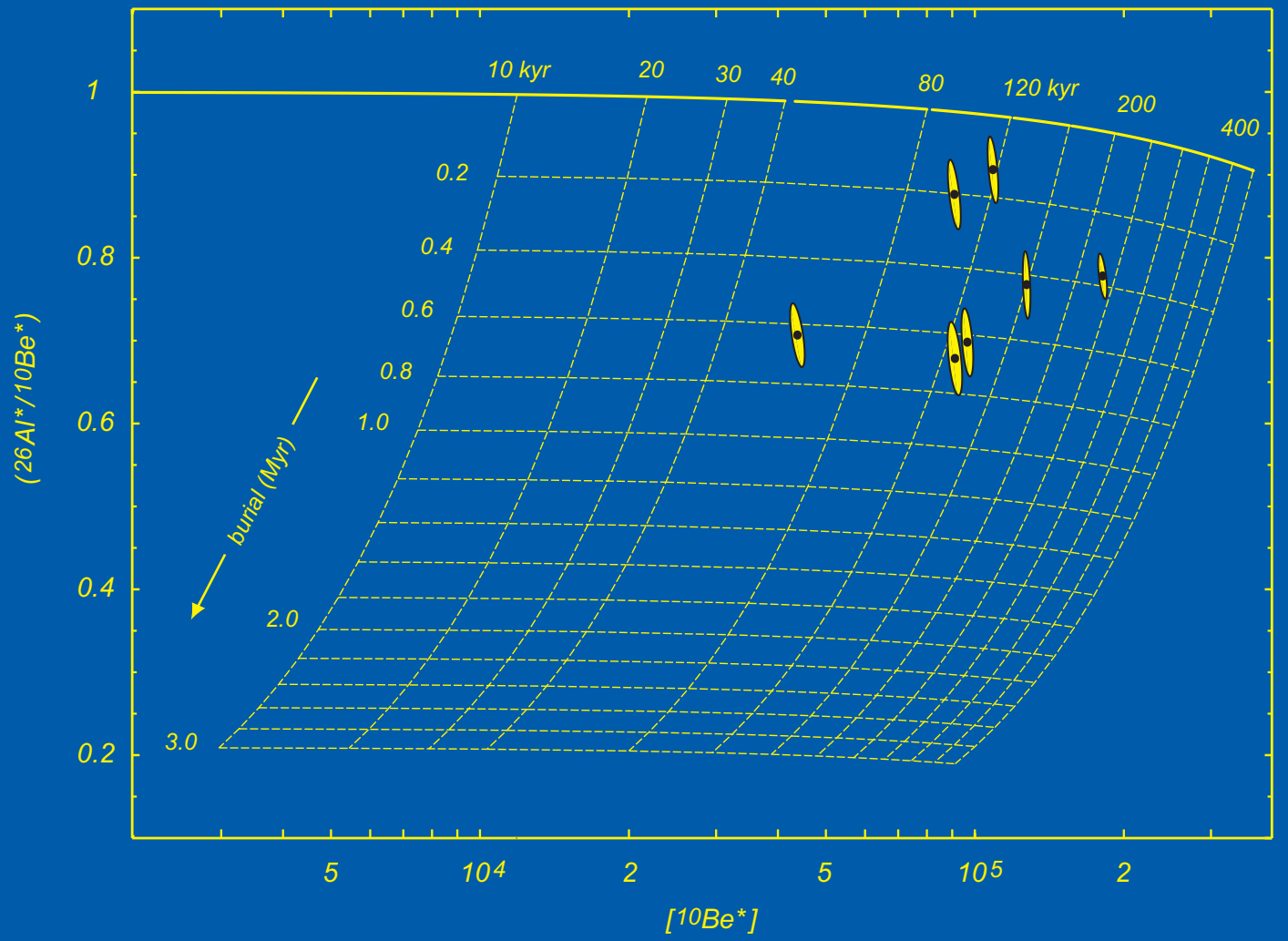
- *An upper limit on the ratio of time-exposed to time covered*



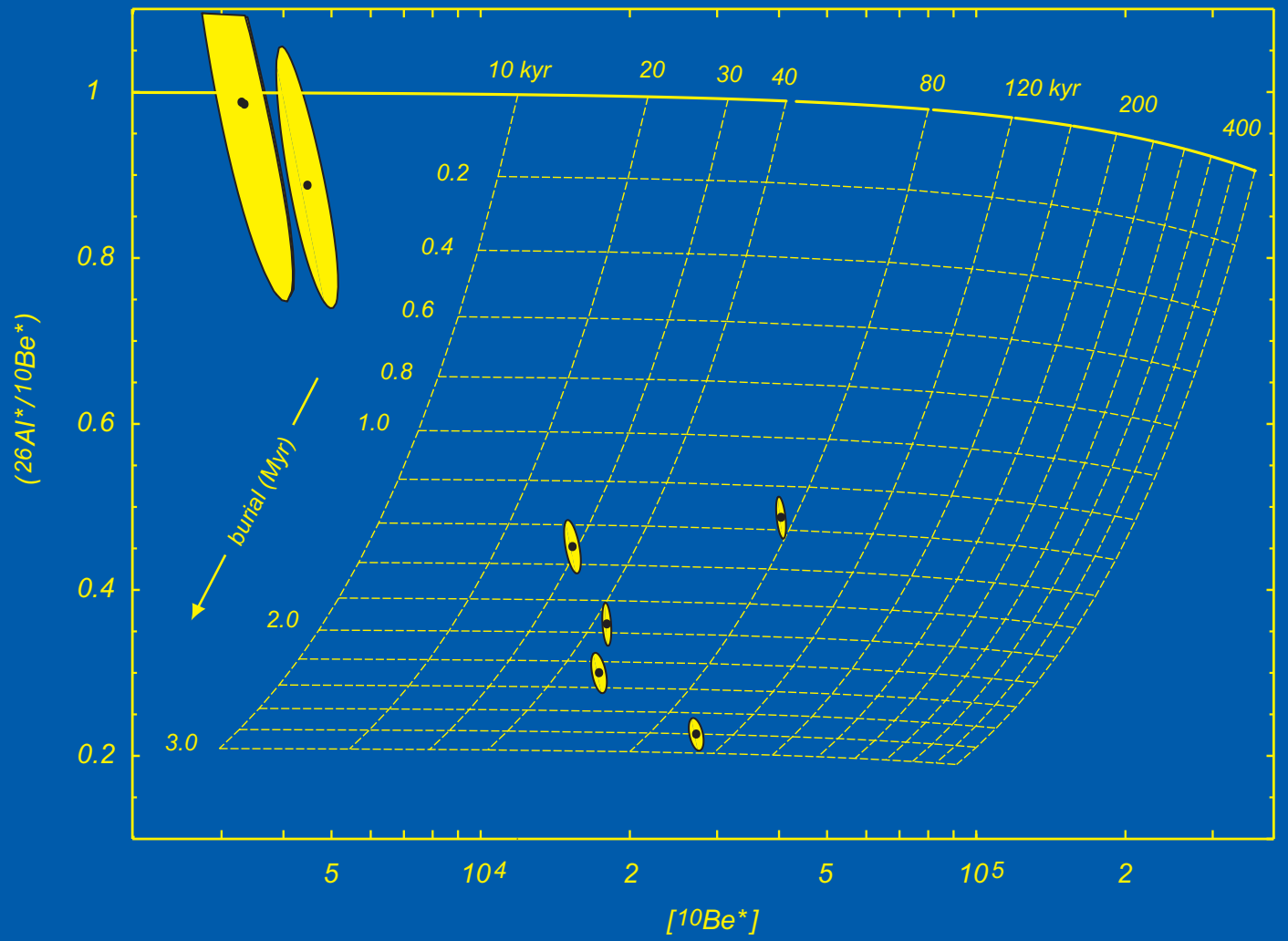
Limits on prior exposure and ice cover from cosmic-ray-produced nuclides

- *Actual exposure histories are complicated, but we can derive some simple limits:*
- *A lower limit on the cumulative exposure time.*
- *A lower limit on the cumulative time covered by ice*
- *An upper limit on the ratio of time-exposed to time covered*
- *Short-lived nuclides provide upper limits on recent exposure*
  (^{26}Al - $t_{1/2}$ = 0.7 Myr, ^{36}Cl - $t_{1/2}$ = 0.3 Myr)



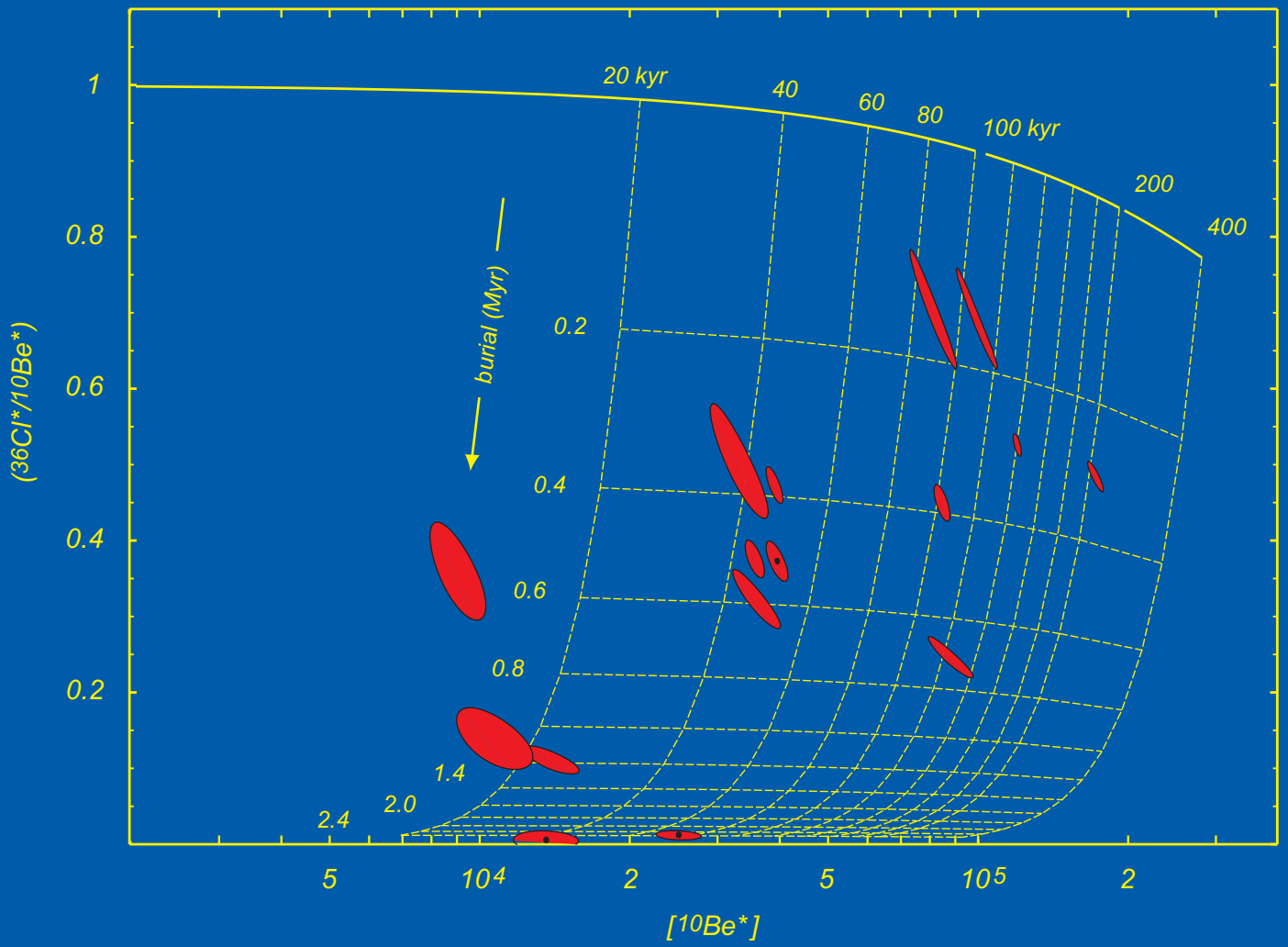
Limits on prior exposure and ice cover from cosmic-ray-produced nuclides

- *Mountain summit surfaces record up to ~ 200 kyr cumulative exposure, and up to ~ 700 kyr cumulative ice cover.*
- *Summits spend > 50% of the time beneath the ice sheet.*



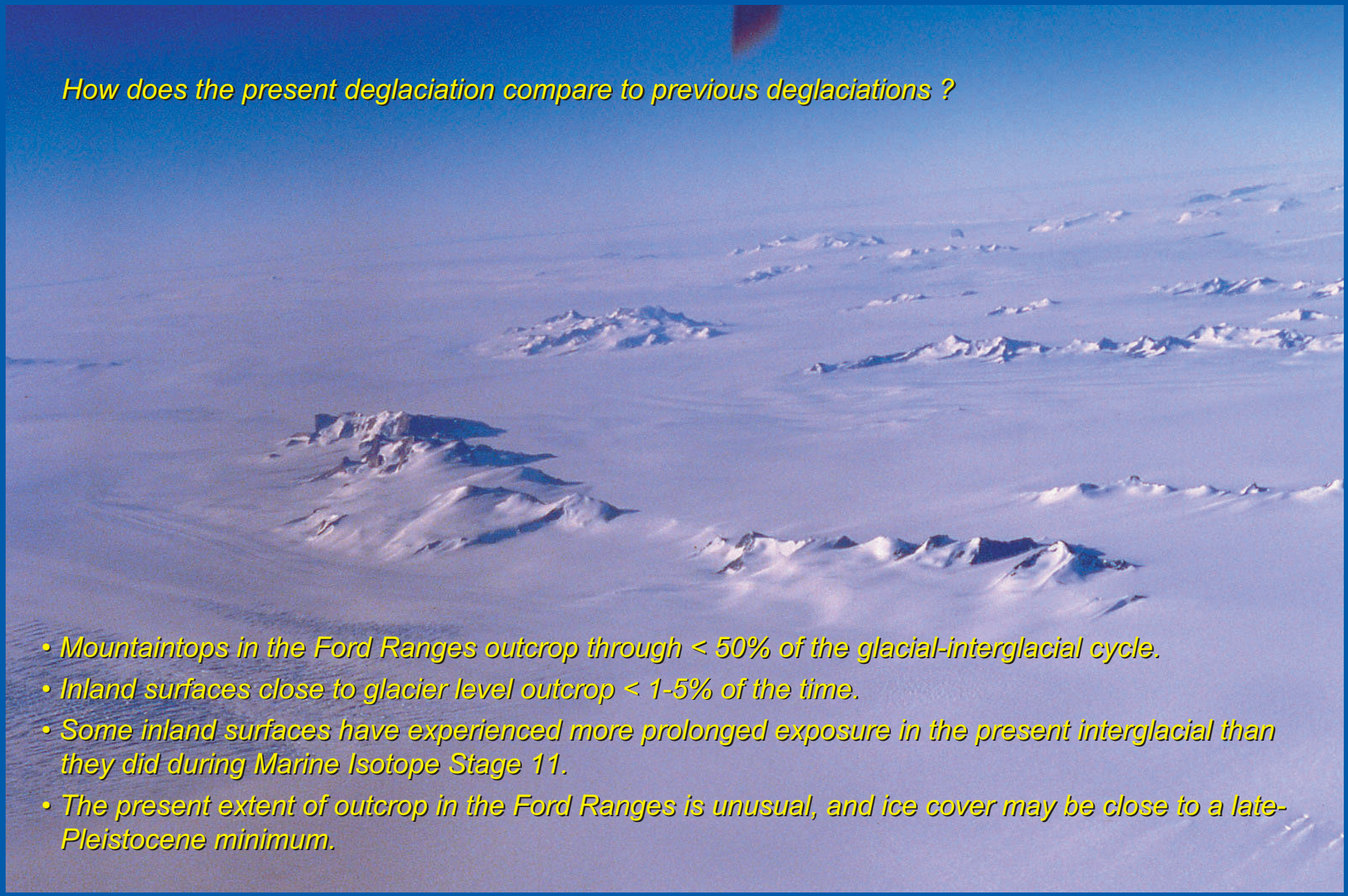
Limits on prior exposure and ice cover from cosmic-ray-produced nuclides

- *Surfaces inland, and close to glacier level, record tens of thousands of years cumulative exposure, and up to ~ 3 Myr cumulative ice cover.*
- *These surfaces seldom outcrop.*
- *The present state of deglaciation in the Ford Ranges is highly unusual.*
- *Lowland surfaces near the coast experience erosive, wet-based glaciation.*



Limits on prior exposure and ice cover from cosmic-ray-produced nuclides

- *Surfaces inland, and close to glacier level, have near-zero concentrations of cosmogenic ^{36}Cl.*
- *These surfaces were exposed for less than:* 0.4 - 2 kyr *during the last interglacial.*
  0.7 - 4 kyr *during Isotope Stage 11 (400 kyr B.P.)*
  ... a total of 3 - 15 kyr *during the past million years.*
- *Present-day ice cover in the Ford Ranges is likely close to a late-Pleistocene minimum.*



How does the present deglaciation compare to previous deglaciations ?

- *Mountaintops in the Ford Ranges outcrop through < 50% of the glacial-interglacial cycle.*
- *Inland surfaces close to glacier level outcrop < 1-5% of the time.*
- *Some inland surfaces have experienced more prolonged exposure in the present interglacial than they did during Marine Isotope Stage 11.*
- *The present extent of outcrop in the Ford Ranges is unusual, and ice cover may be close to a late-Pleistocene minimum.*