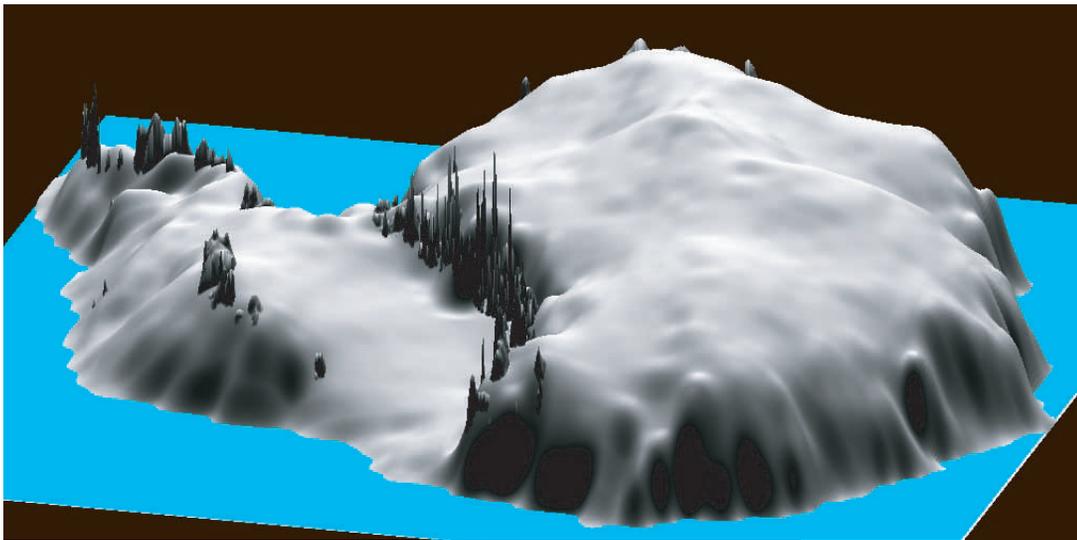


# deglaciation of the Ross embayment

gradual retreat since last glacial maximum

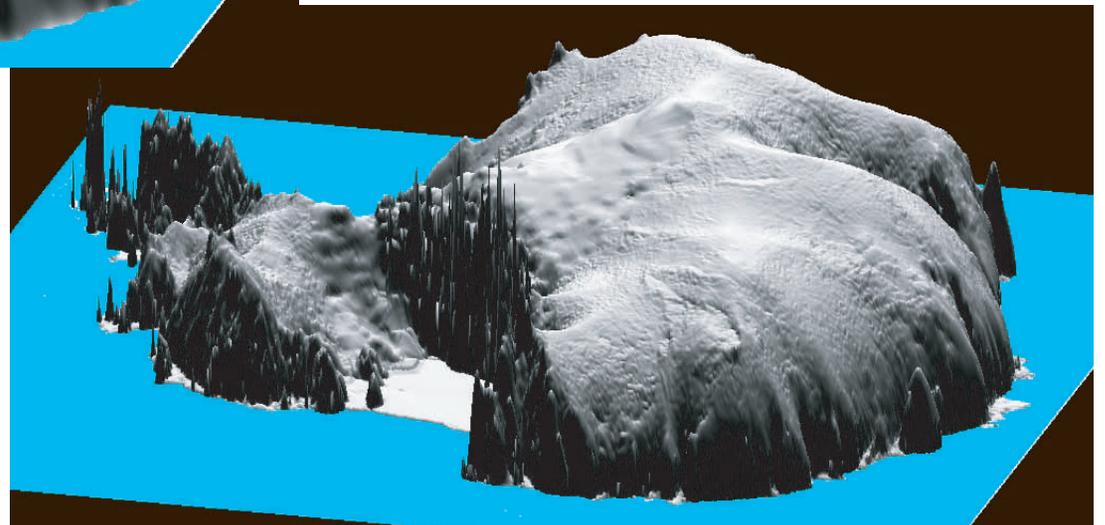
episodic “grounding line” jumps

what governs this behavior?



last glacial maximum  
numerical model reconstruction  
(T. Hughes, *Ice Sheets*)

present  
satellite altimetry  
(J. Bamber)

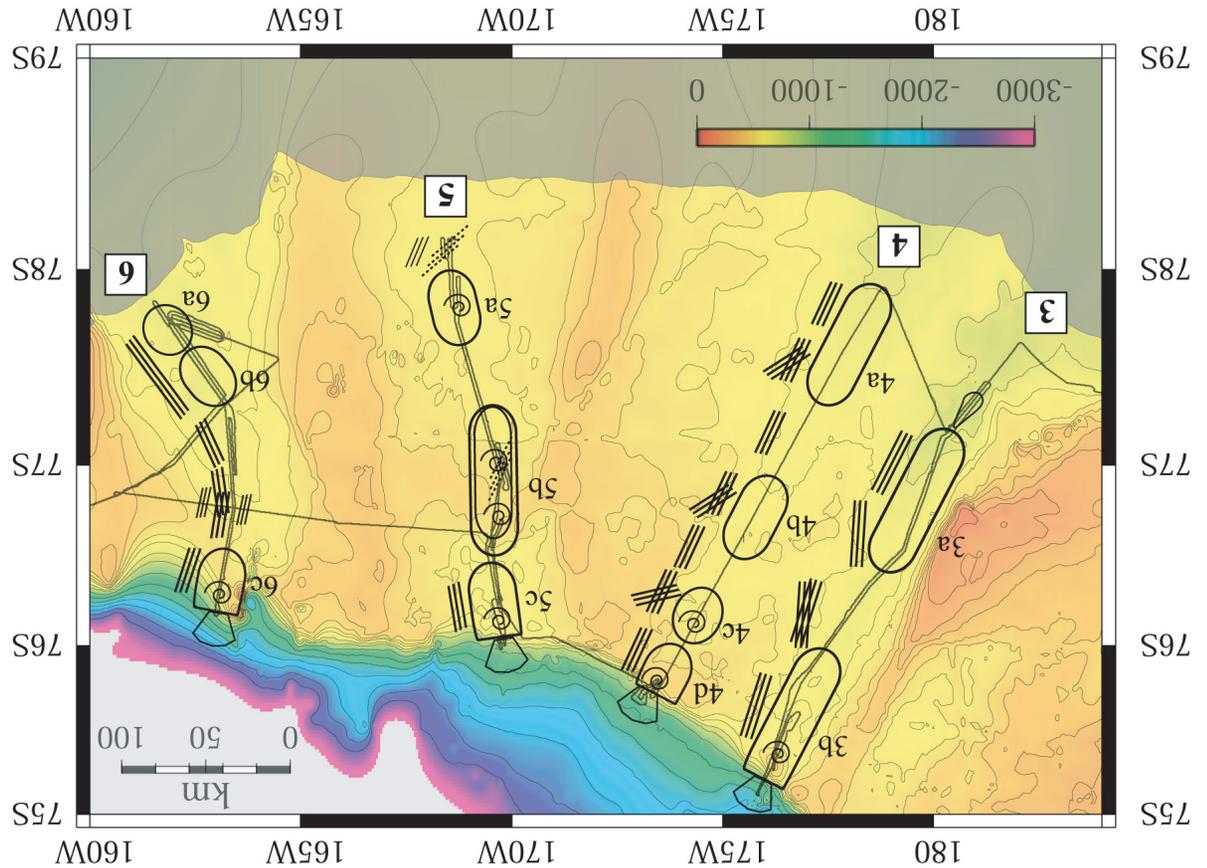


# deglaciation

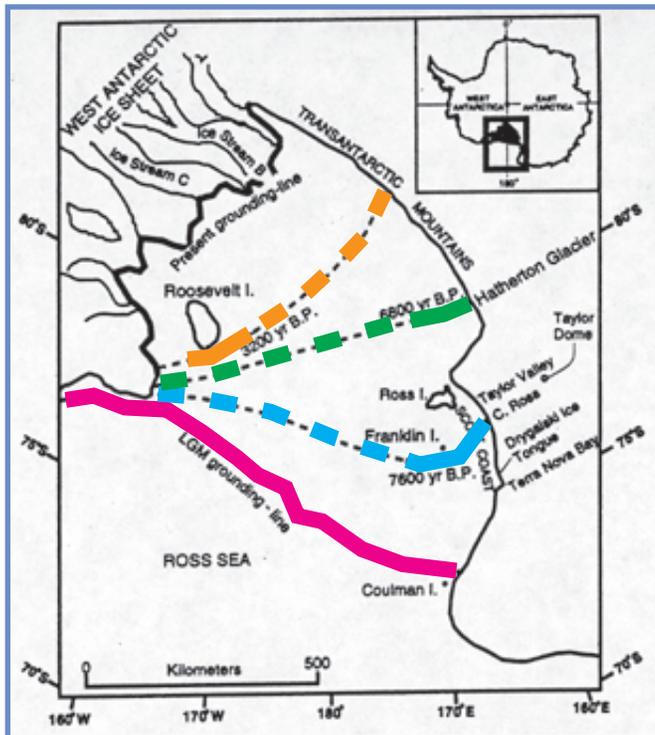
geologic record of retreat

- gradual
- episodic

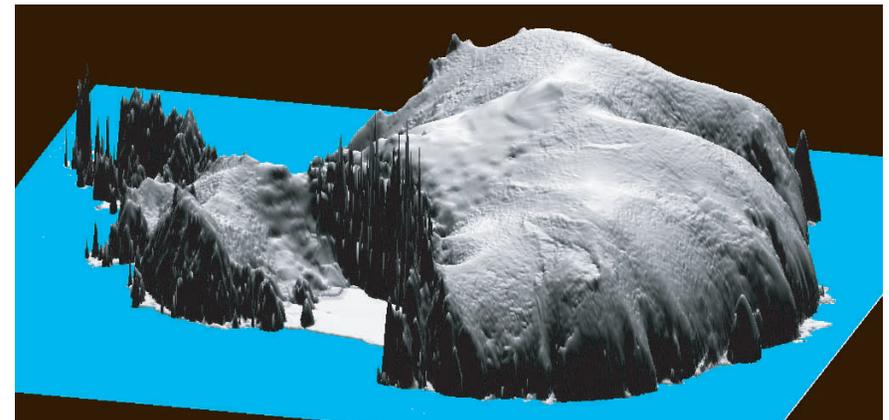
"grounding line wedges"



Mosola & Anderson



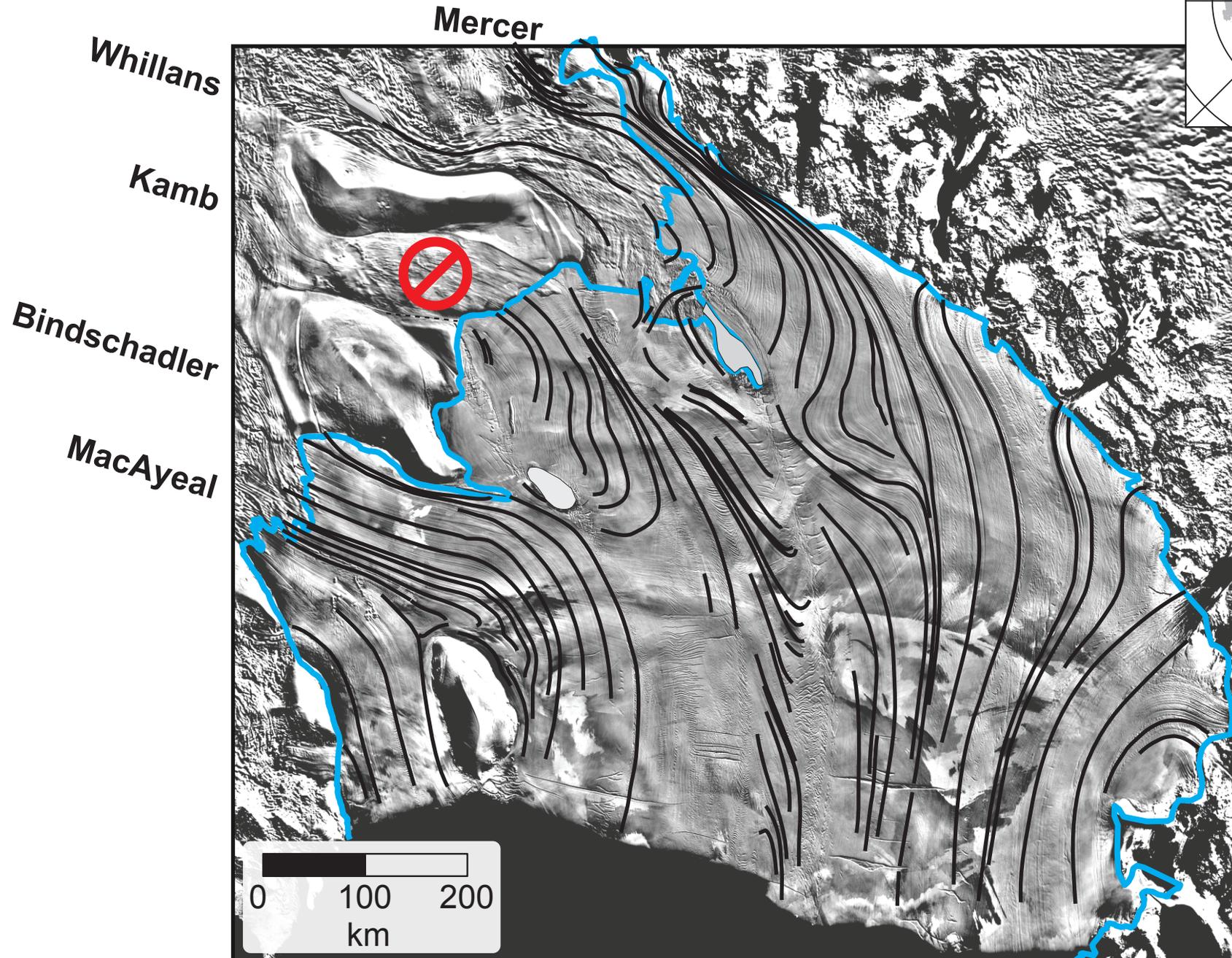
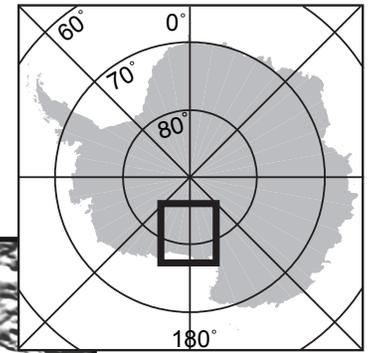
Conway & Hall



present

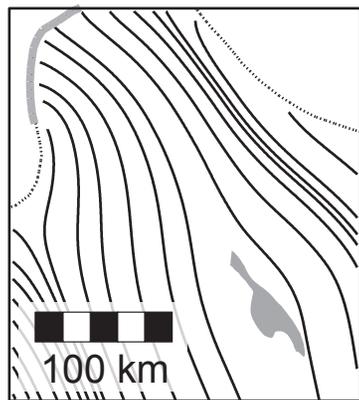
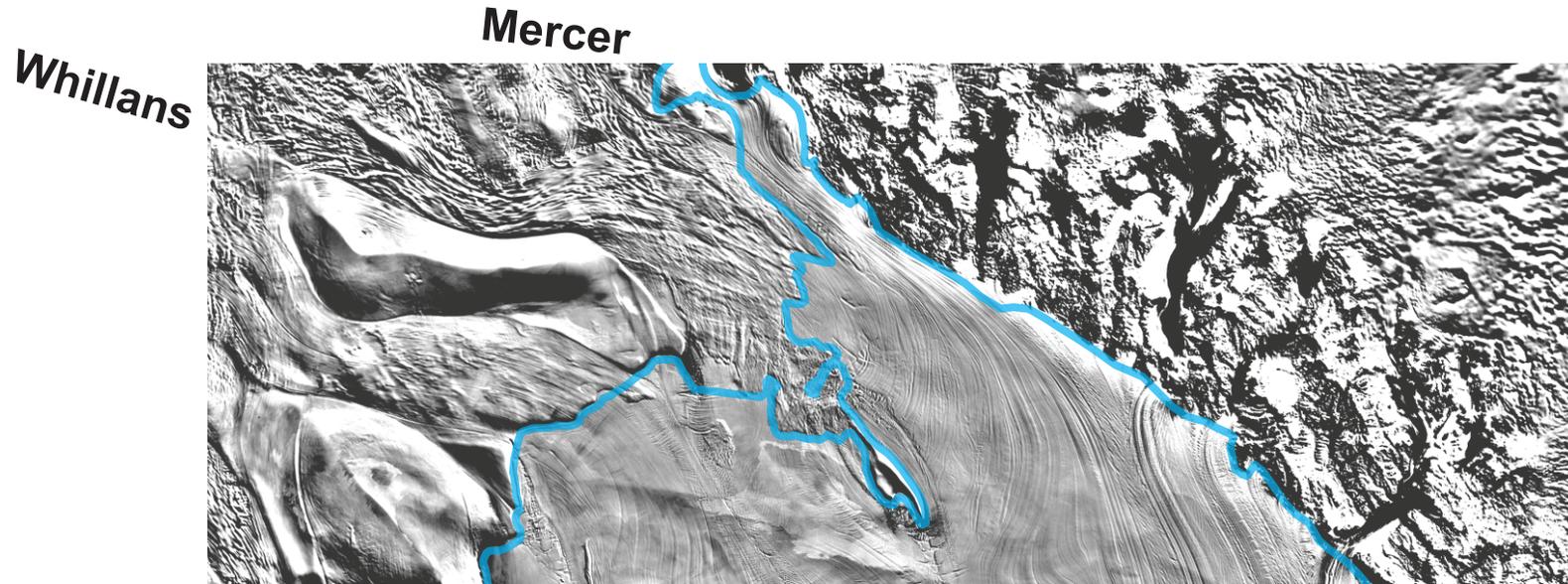
# Ross ice streams

an embayment with a complicated history

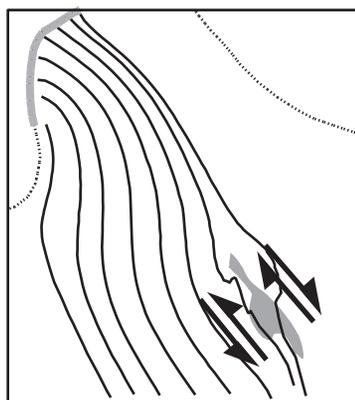


# ice streams stop & start

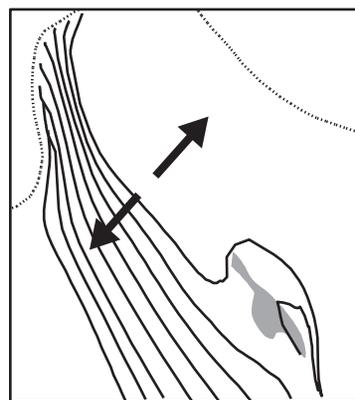
ice shelf/ice plain model used to deduce past events



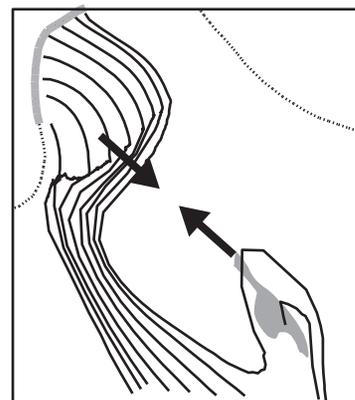
steady state



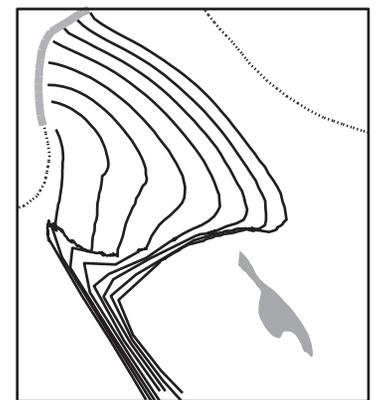
Crary Ice Rise  
stagnates



Whillans IS  
stagnates



Whillans IS  
reactivates

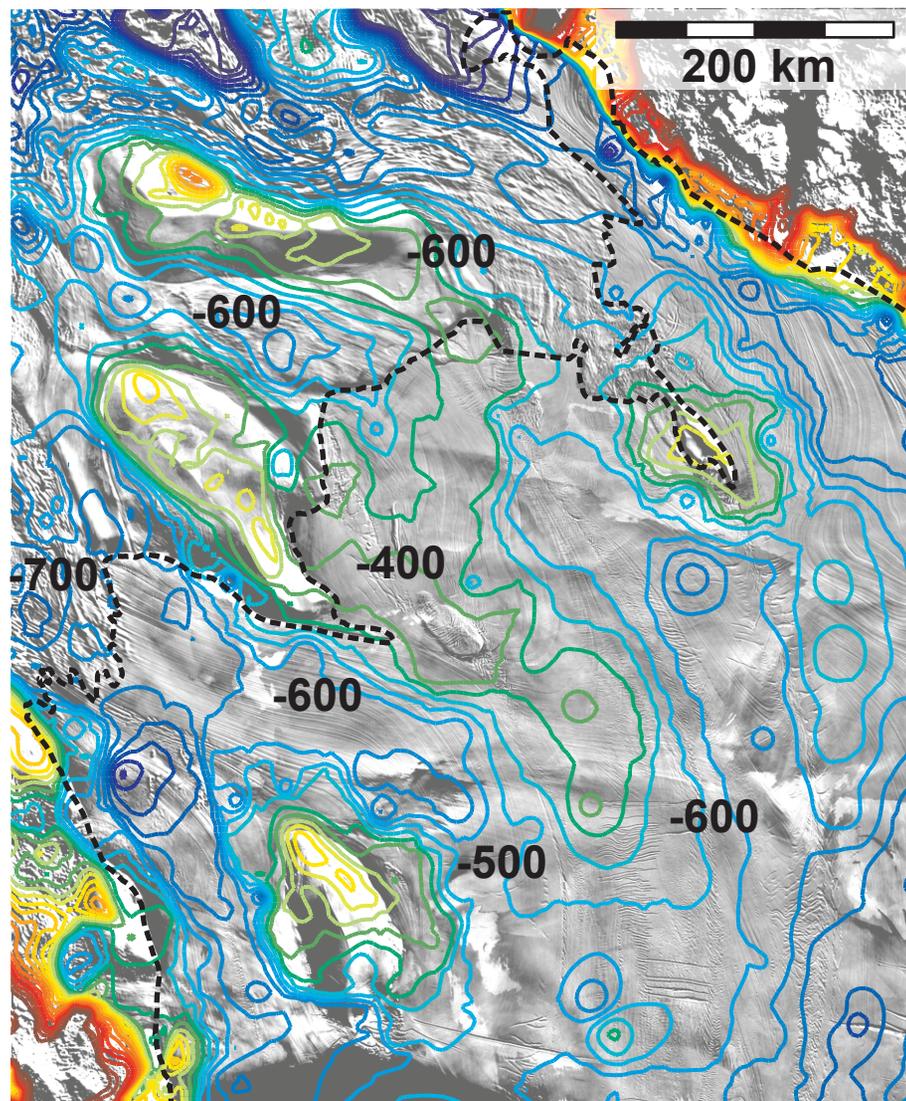


big folds!

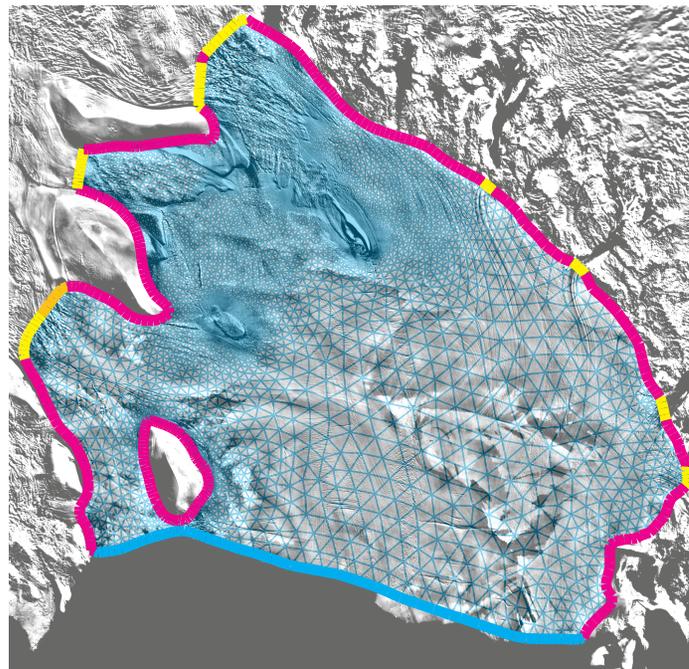
but this is only half of the story

# rapid grounding & ungrounding

discharge variations yield thickness variations



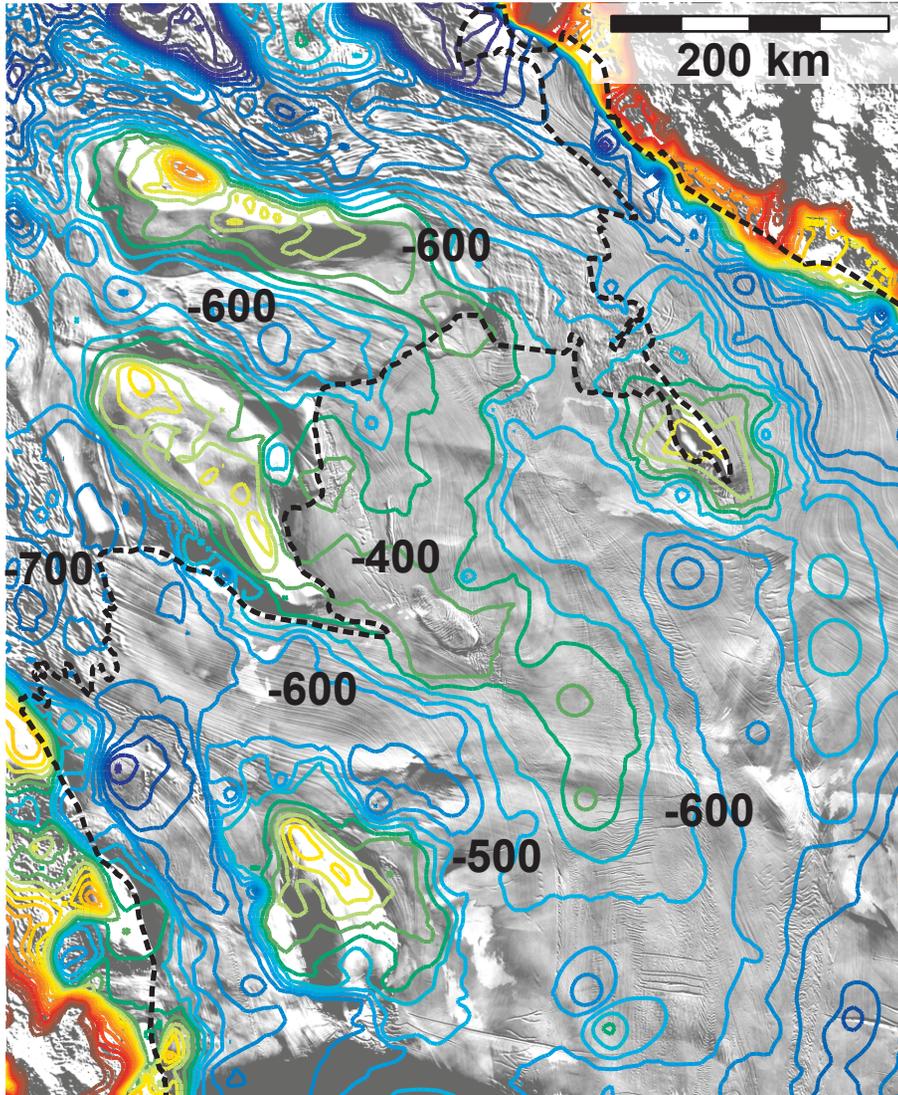
BEDMAP bathymetry



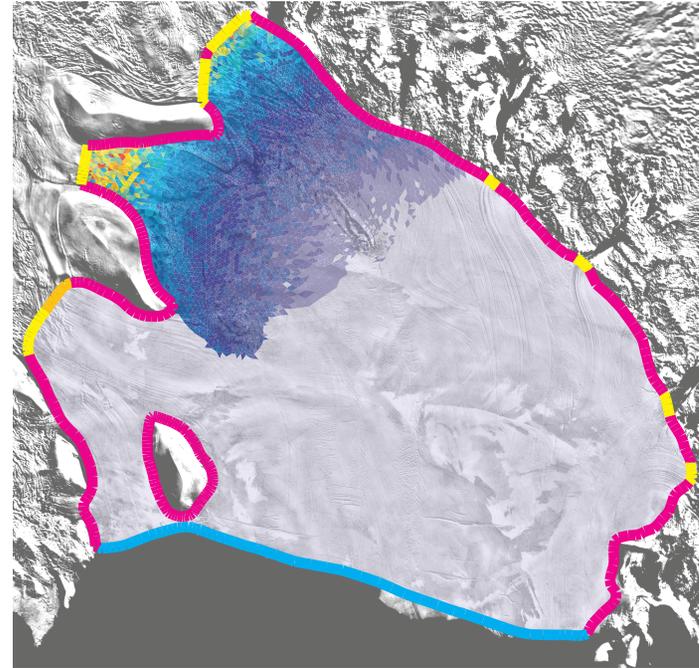
prognostic & diagnostic equations  
ice shelf & ice stream ("reduced")  
grounding according to floatation  
spatially variable basal traction  
fine resolution in transition zone

# rapid grounding & ungrounding

discharge variations yield thickness variations



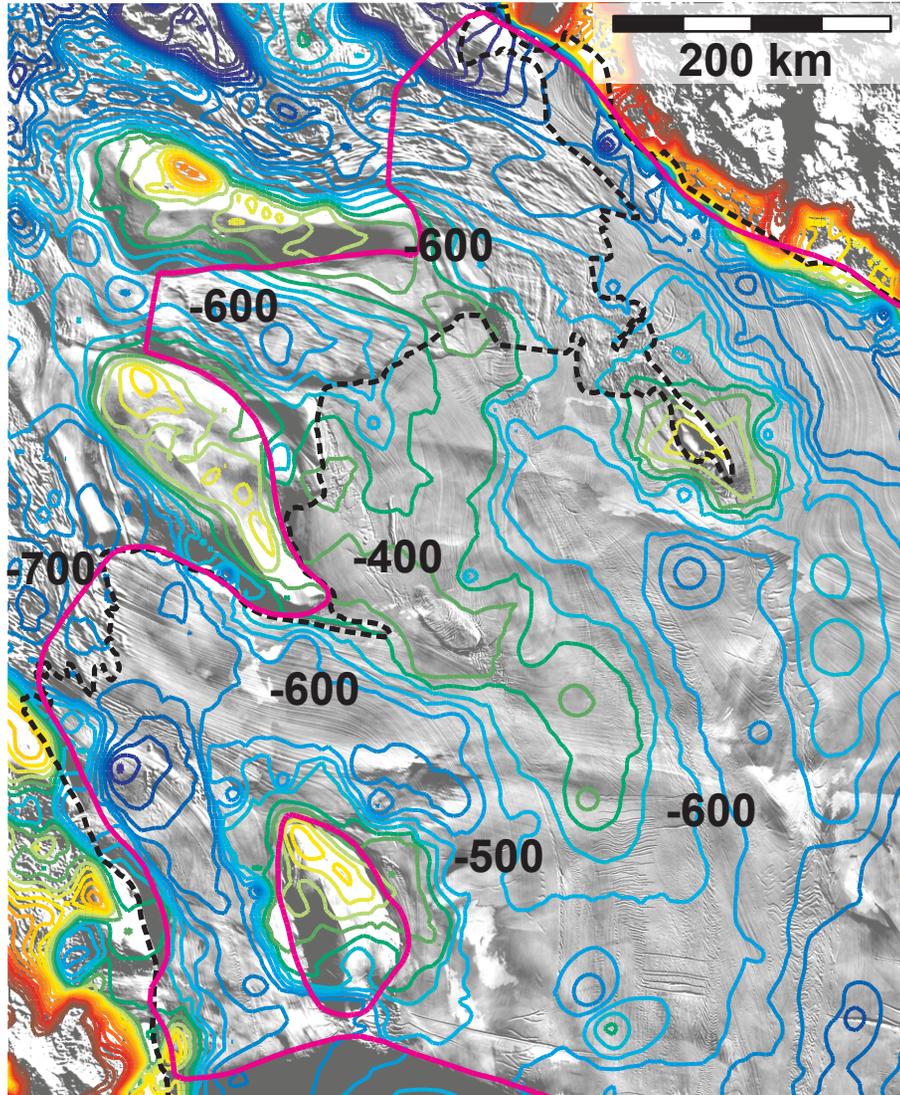
BEDMAP bathymetry



prognostic & diagnostic equations  
ice shelf & ice stream ("reduced")  
grounding according to floatation  
spatially variable basal traction  
fine resolution in transition zone

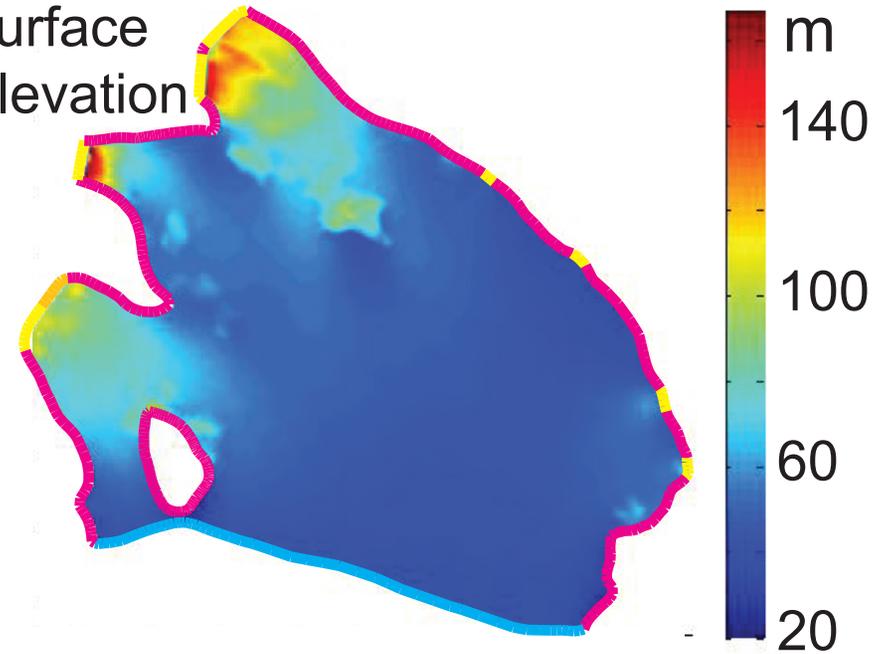
# rapid grounding & ungrounding

model initialization for  
ice rise experiments

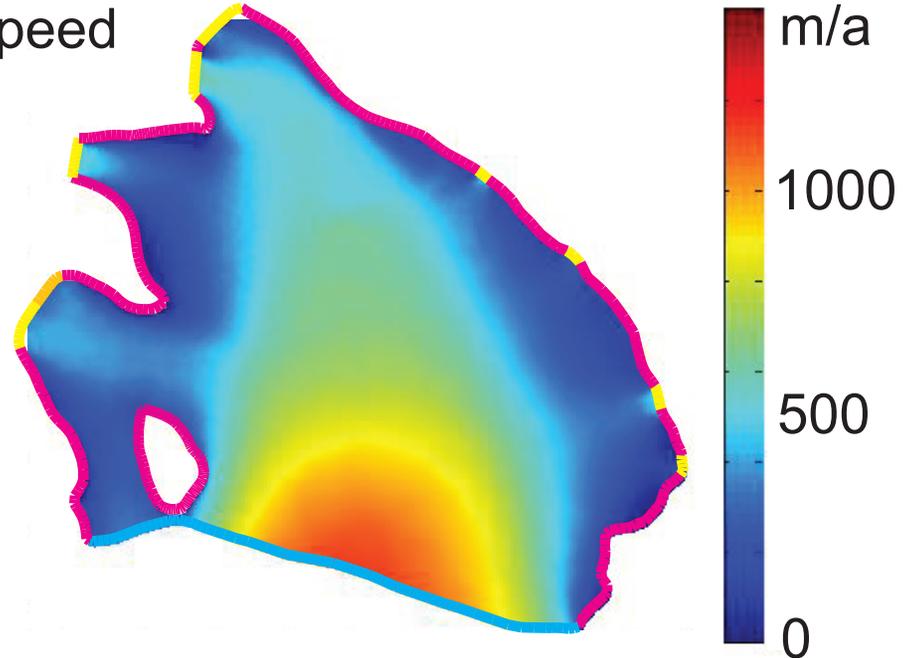


BEDMAP bathymetry

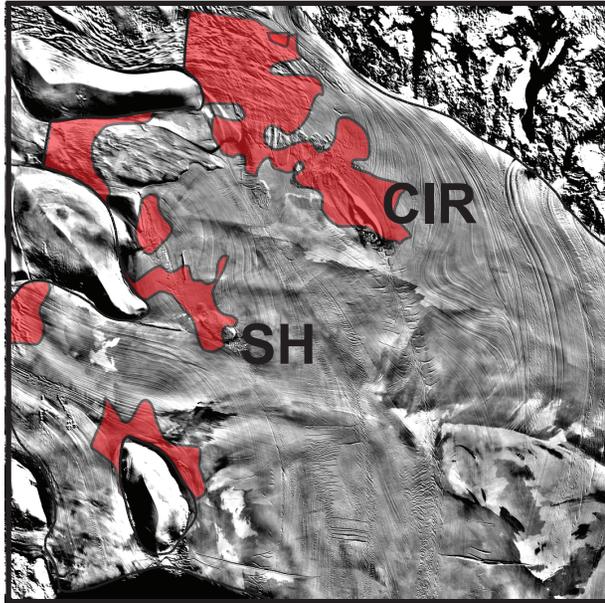
surface  
elevation



speed



# rapid grounding & ungrounding

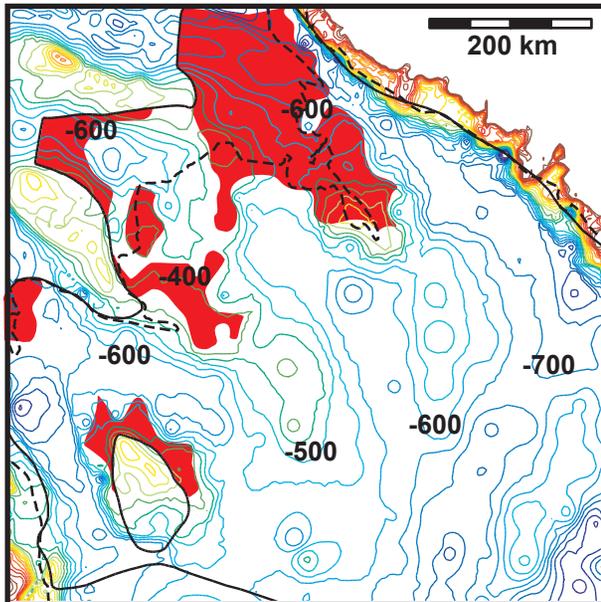


simple experiment:

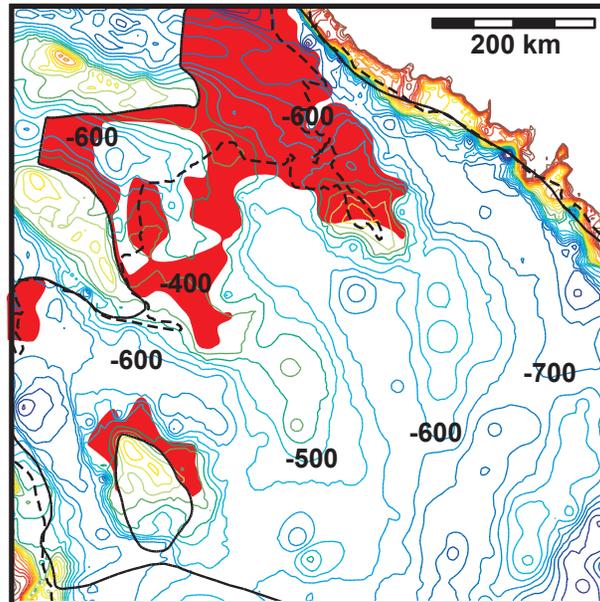
transient response to ice rise stagnation

impose  $u_i = 0$  grounded ice at Crary & Steershead

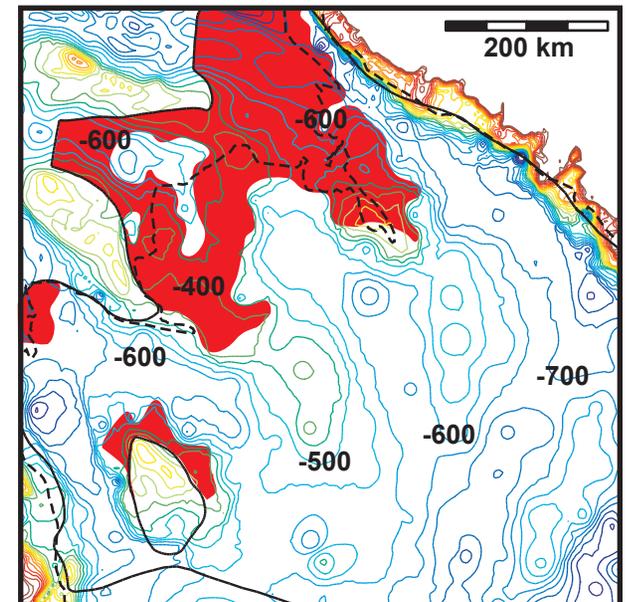
can I validate these types of events?



100 years after  
Crary stagnation

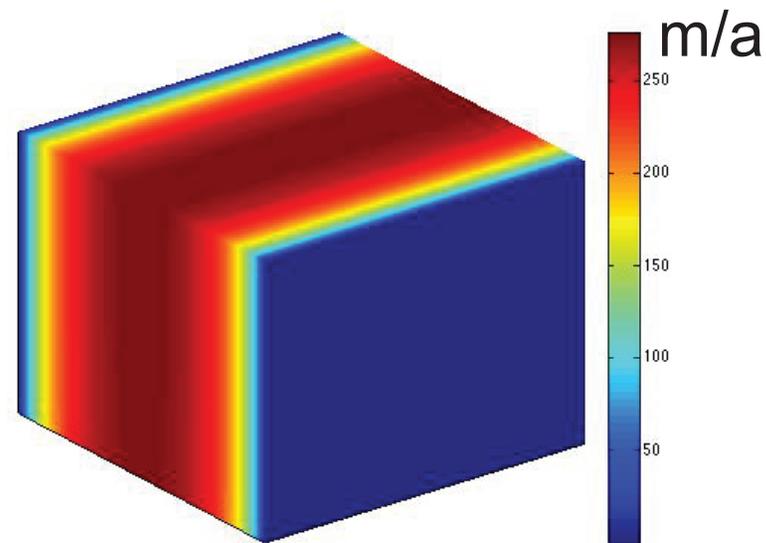
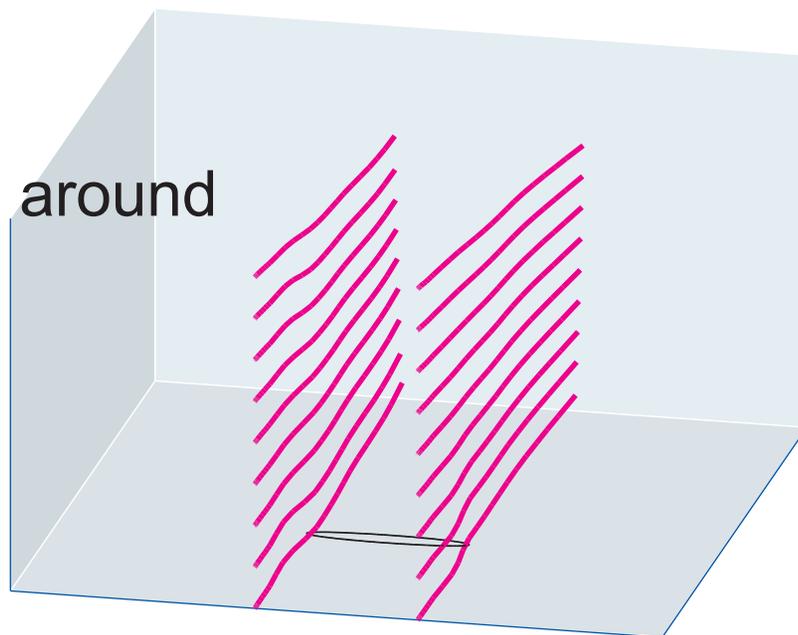
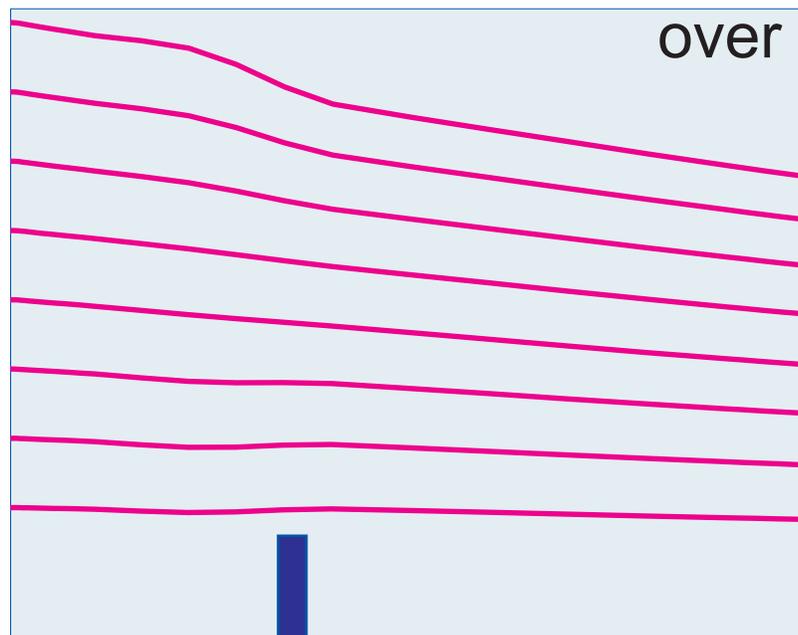


500 years after  
Crary stagnation



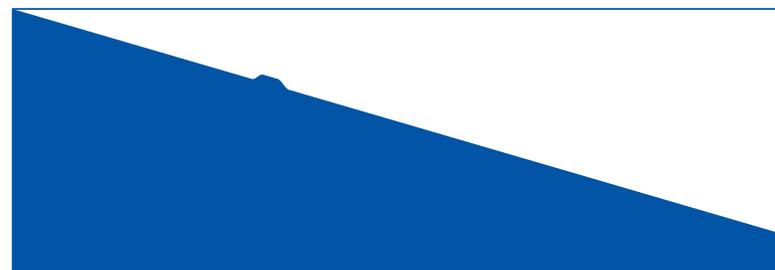
900 years after Crary  
400 after Steershead

# isochrone deformation ideal

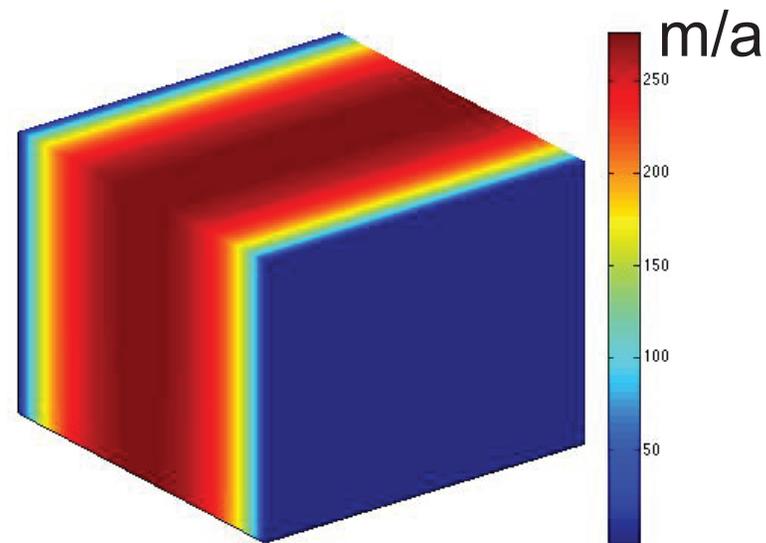
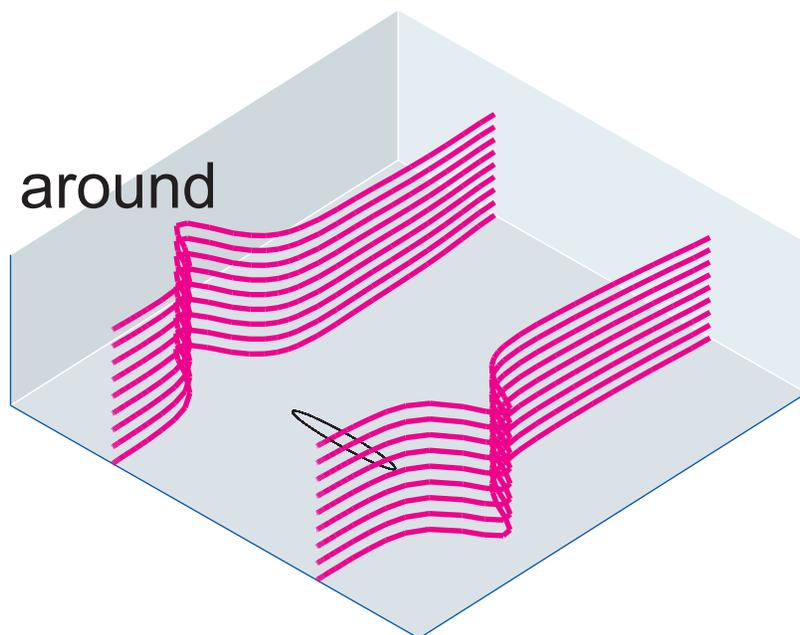
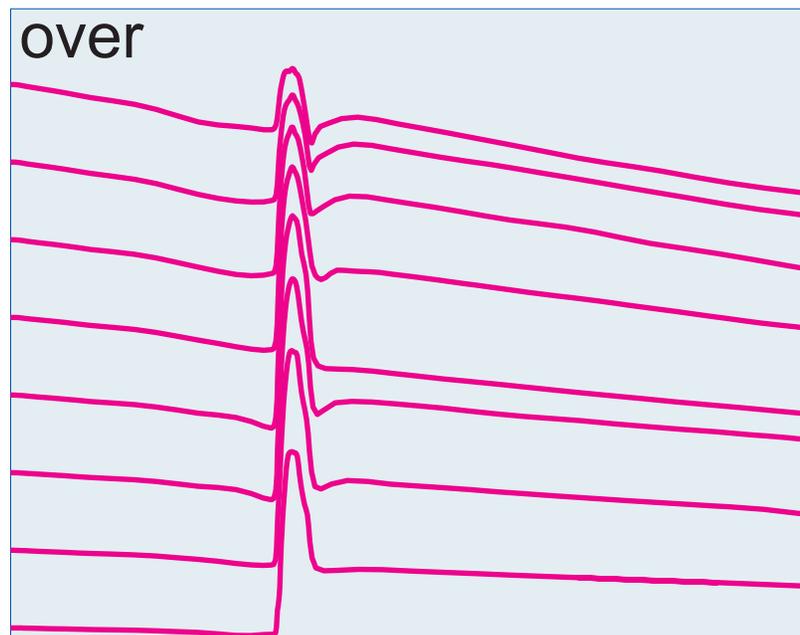


3D flow over weak substrate  
 $1 \times 10^{-3}$  incline

a bump

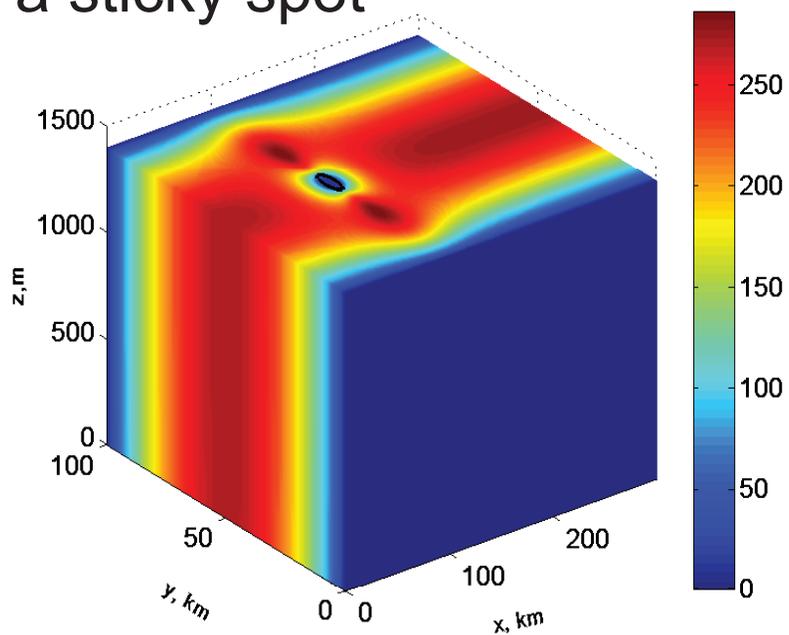


# isochrone deformation ideal

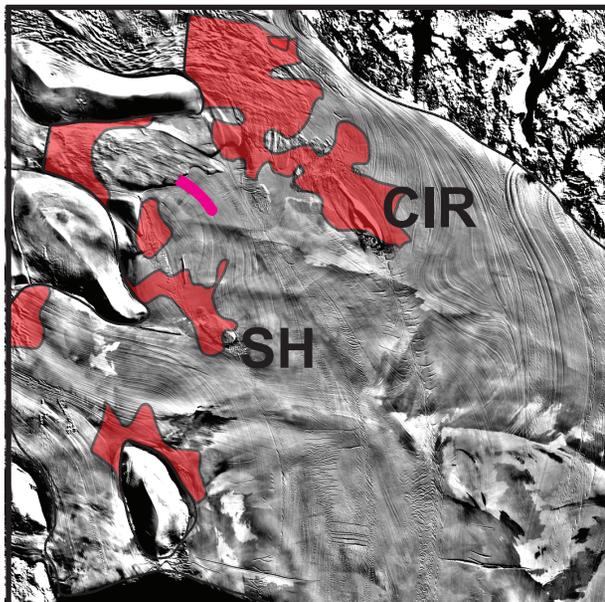


3D flow over weak substrate  
 $1 \times 10^{-3}$  incline

a sticky spot

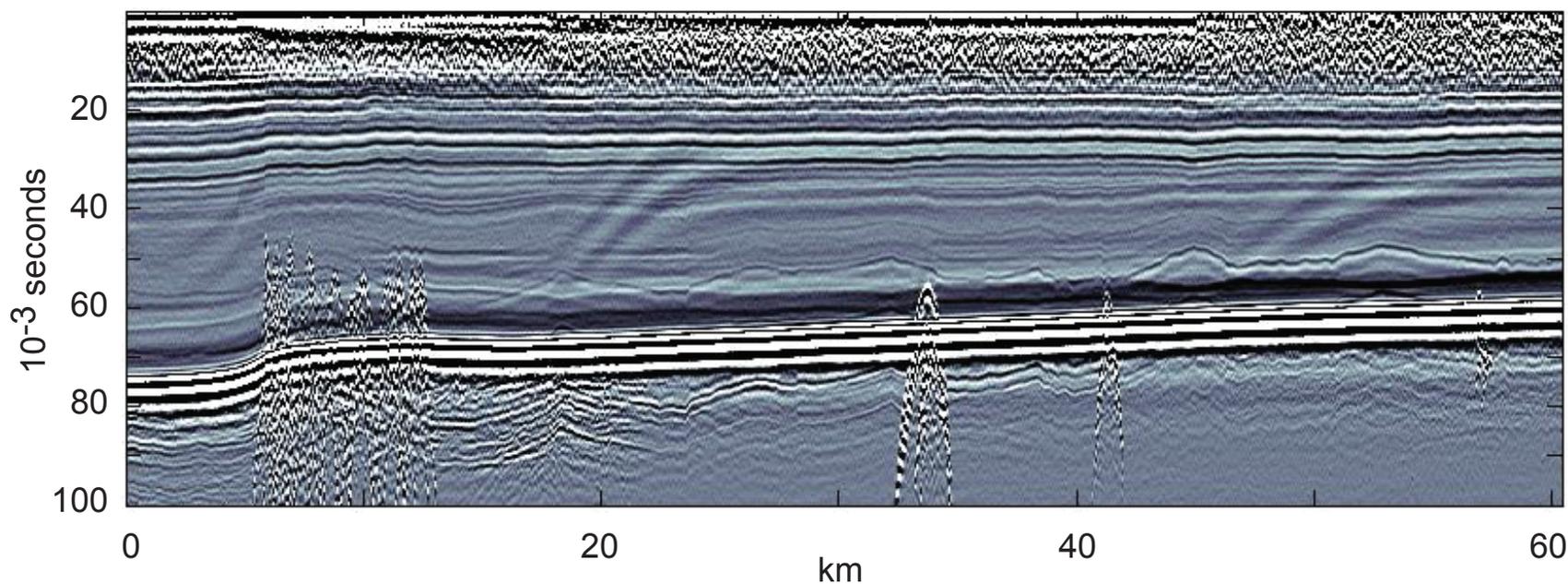


# rapid grounding & ungrounding



OK, suppose I'm a careful driver.  
How do I read the isochrone record?

2 MHz profile across Kamb grounding line



# streaklines in three dimensions

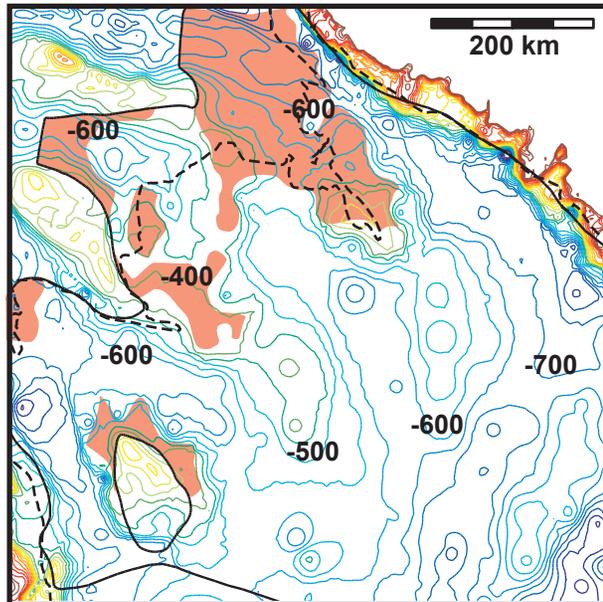
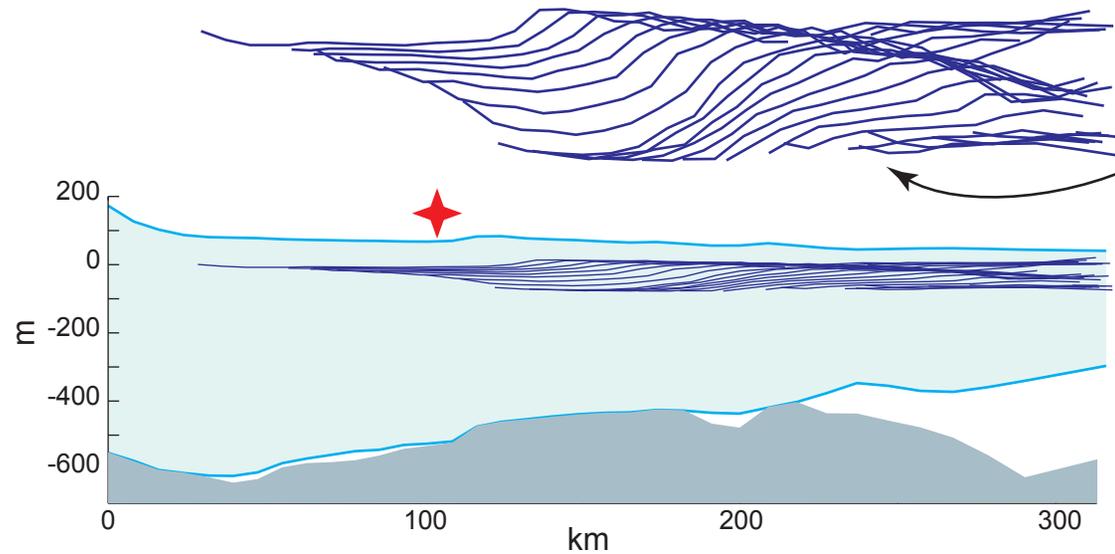
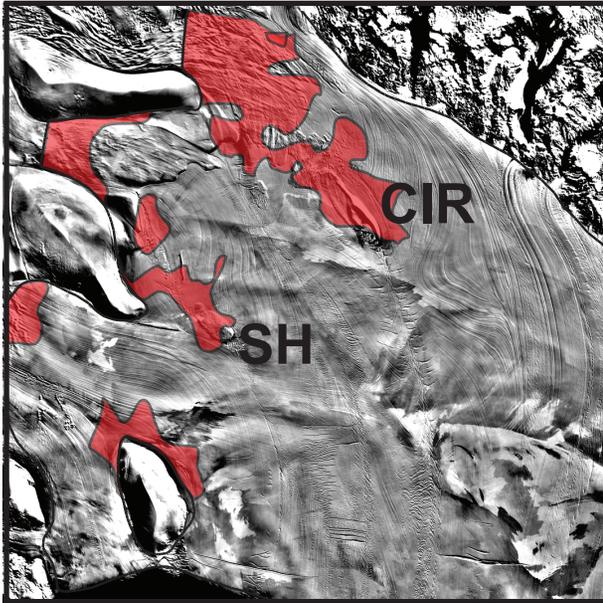
grounding/ungrounding events yield interesting distortions



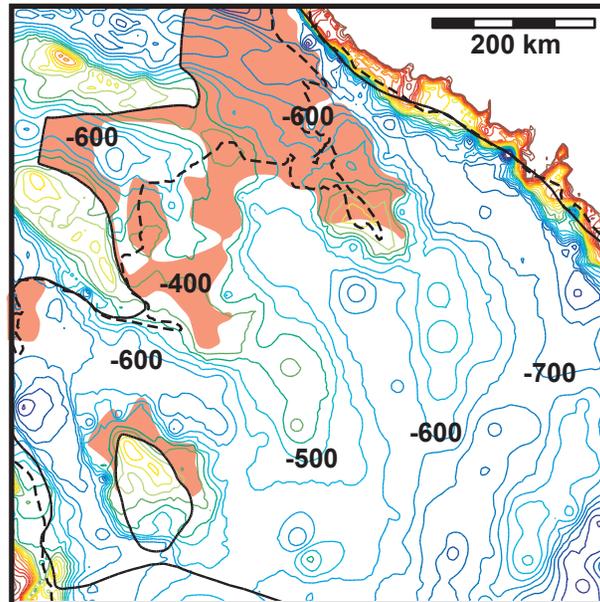
# isochrones from the model

(interesting, maybe useful)

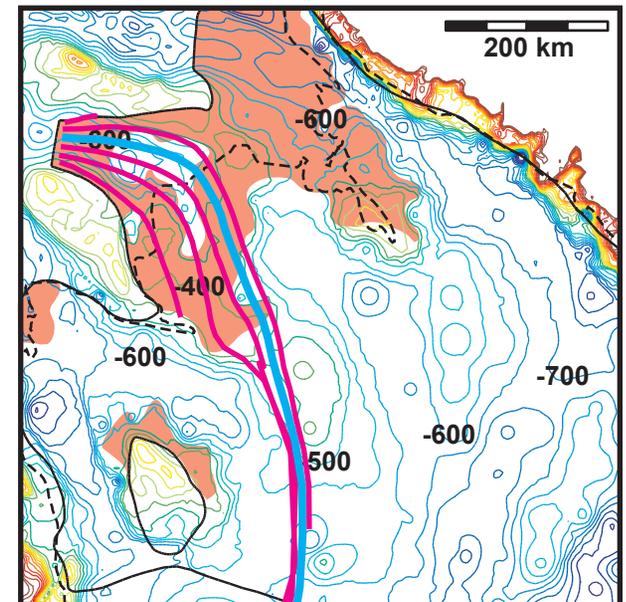
this is old thickening  
from upstream



100 years after  
Crary stagnation



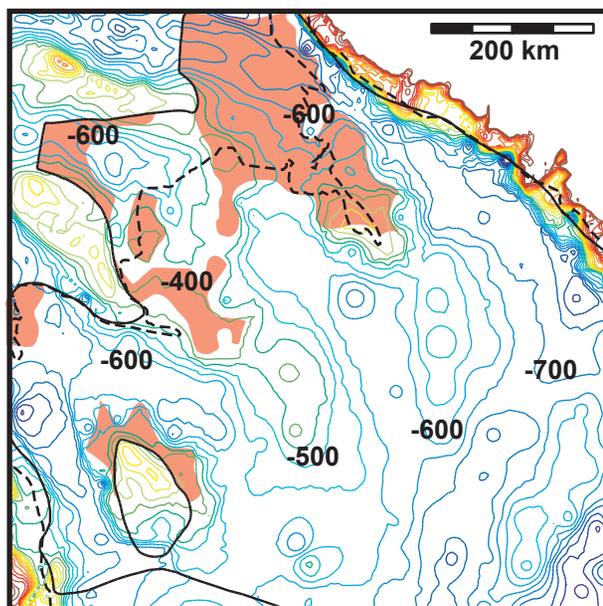
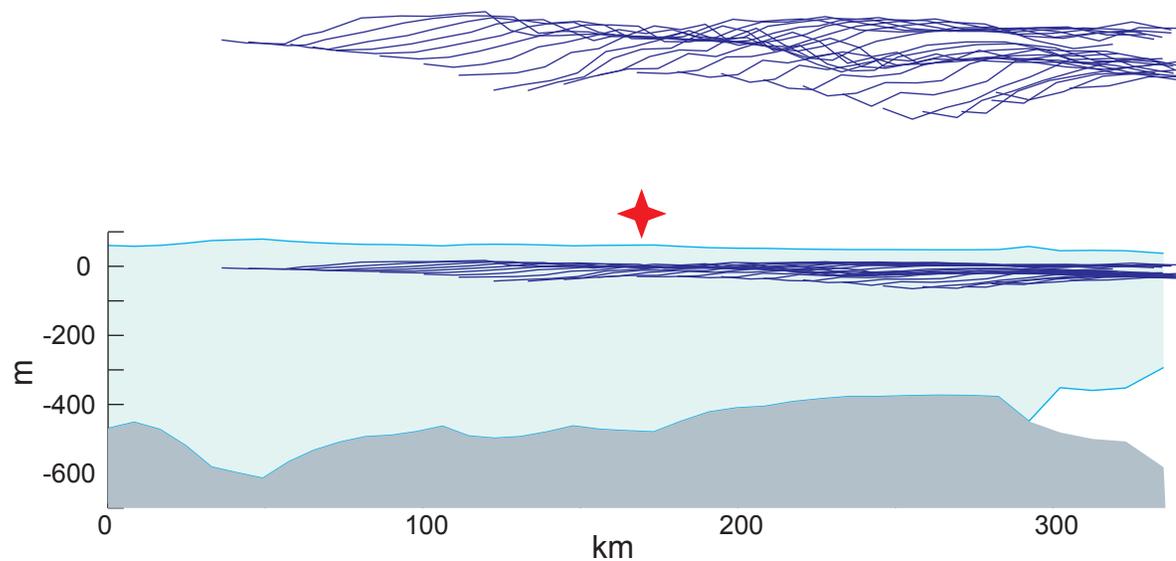
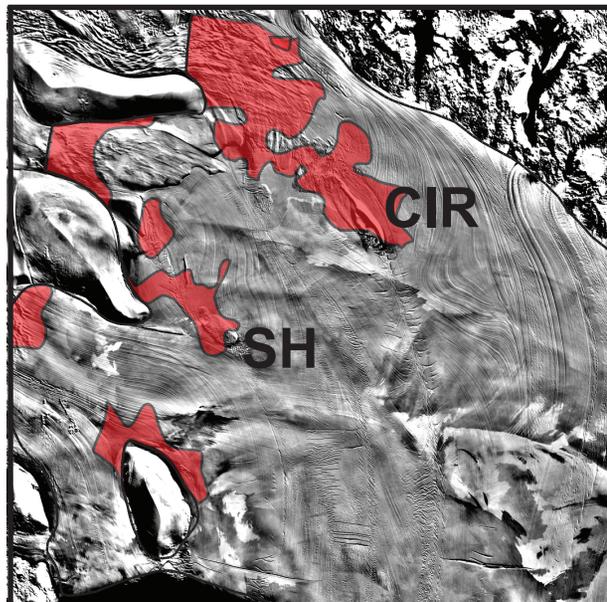
500 years after  
Crary stagnation



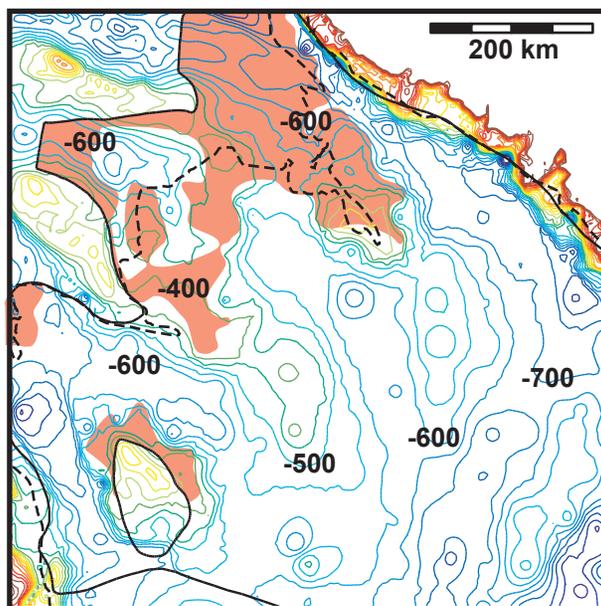
900 years after Crary  
400 after Steershead

# isochrones from the model

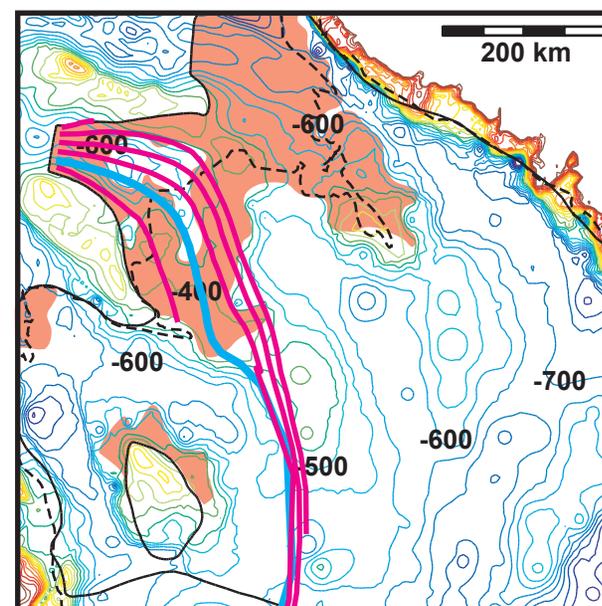
(interesting, maybe useful)



100 years after  
Crary stagnation



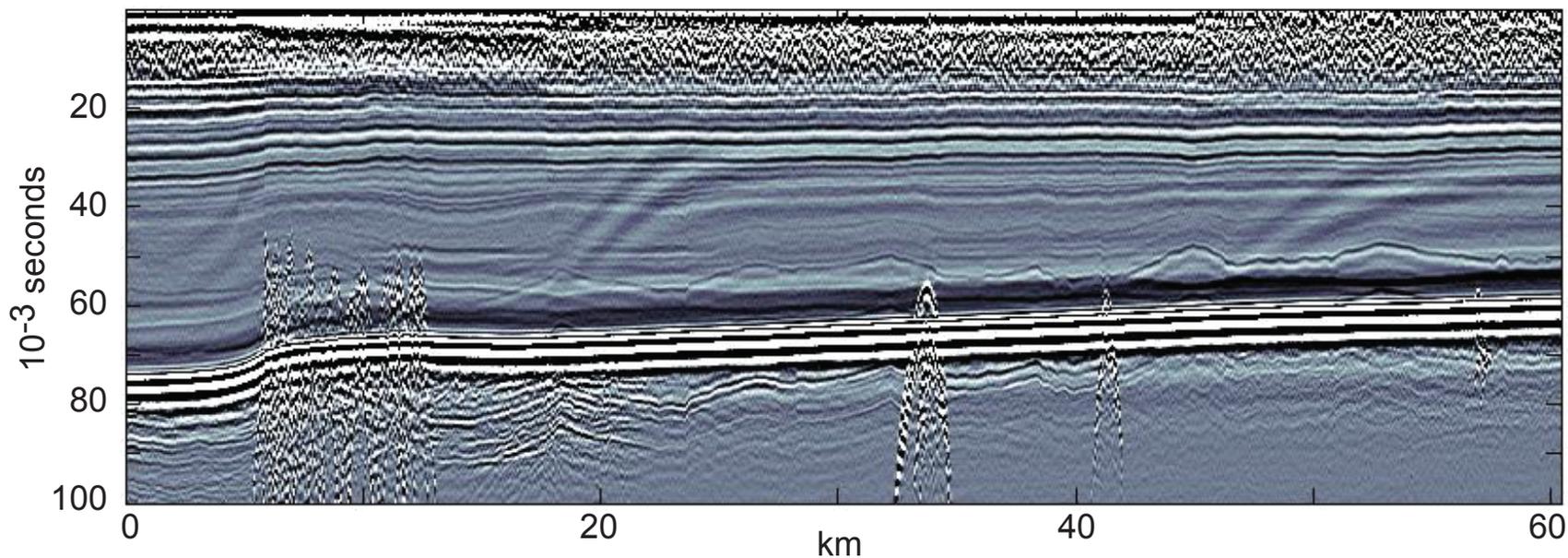
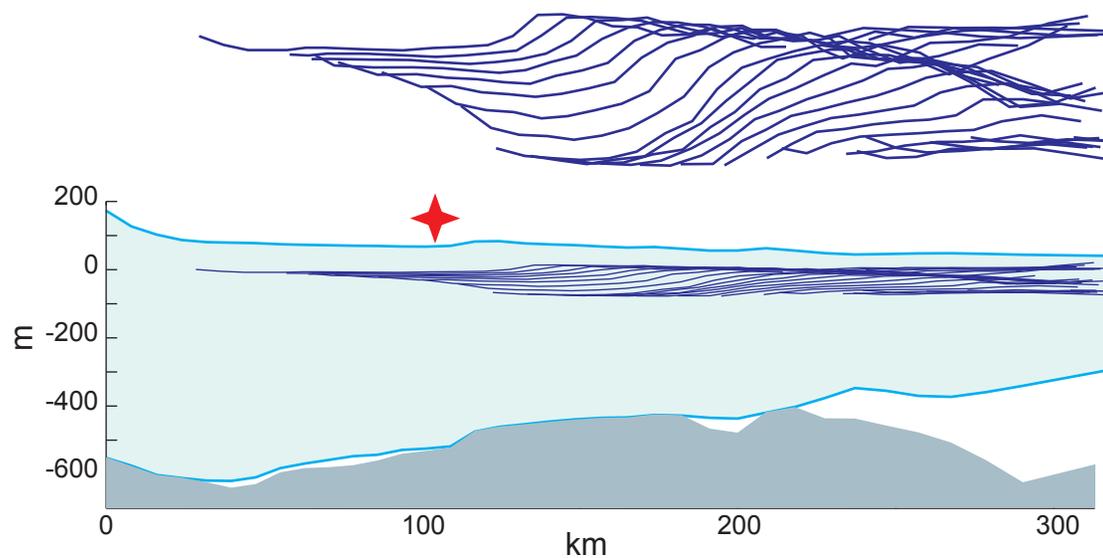
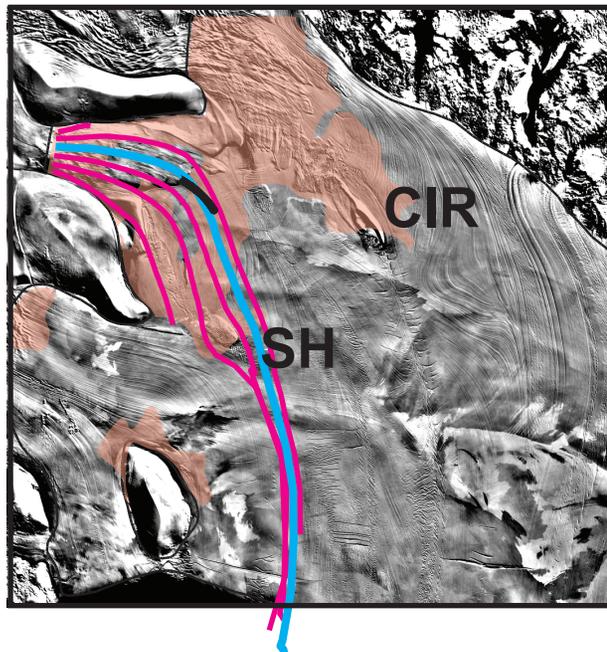
500 years after  
Crary stagnation



900 years after Crary  
400 after Steershead

# isochrones from the model

(interesting, maybe useful)



# isochrones from the model

(interesting, apparently useful)

