INSTITUTE FOR GEOPHYSICS
JACKSON SCHOOL OF GEOSCIENCES
THE UNIVERSITY OF TEXAS AT AUSTIN

Influence of surface processes and sediment flux on subduction cycles and dynamics

Sean P. S. Gulick

in collaboration with

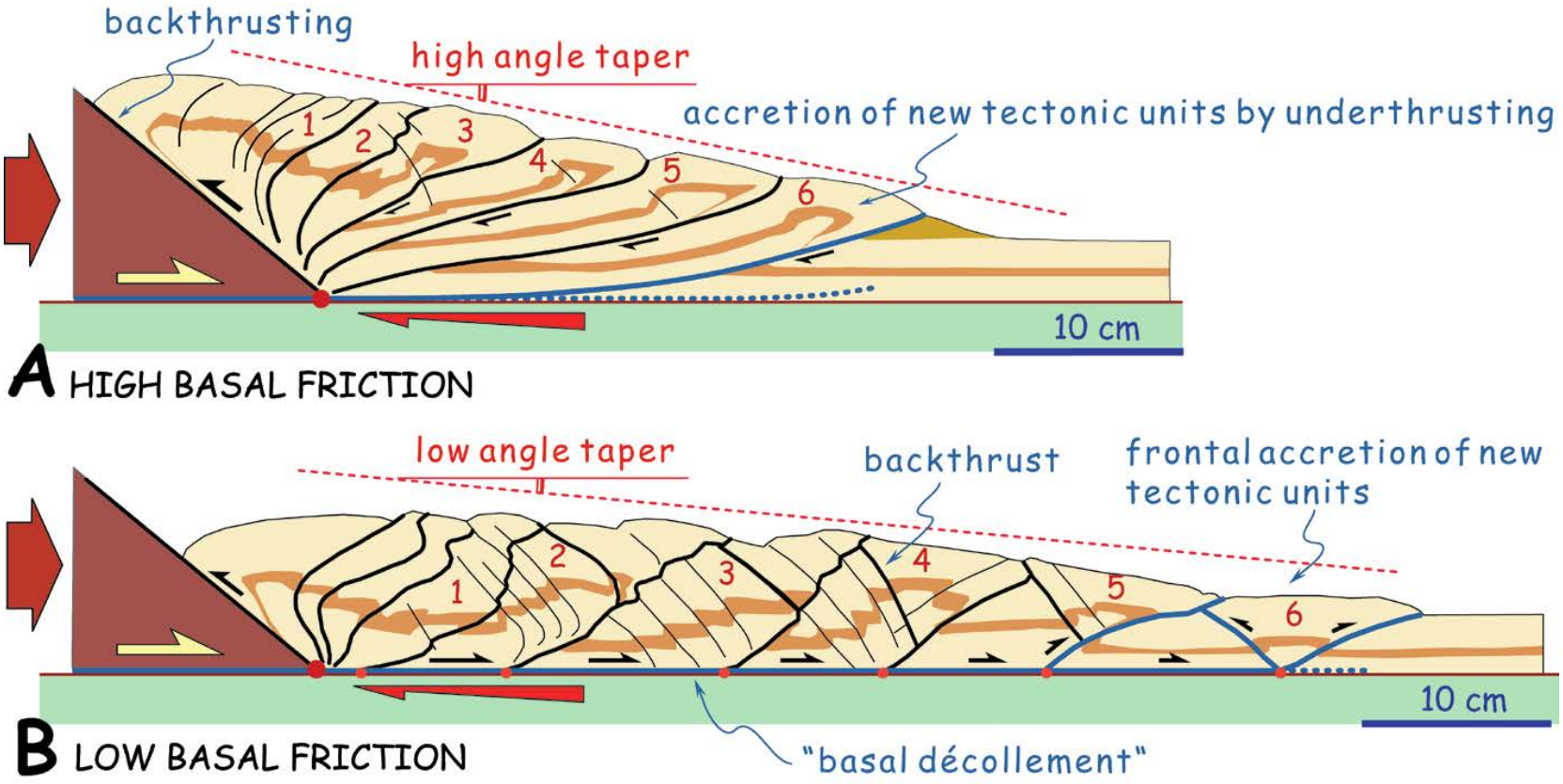
STEEP, USGS, and IODP colleagues

NSF
IODP INTEGRATED OCEAN DRILLING PROGRAM
U.S. Extended Continental Shelf Project
USGS science for a changing world

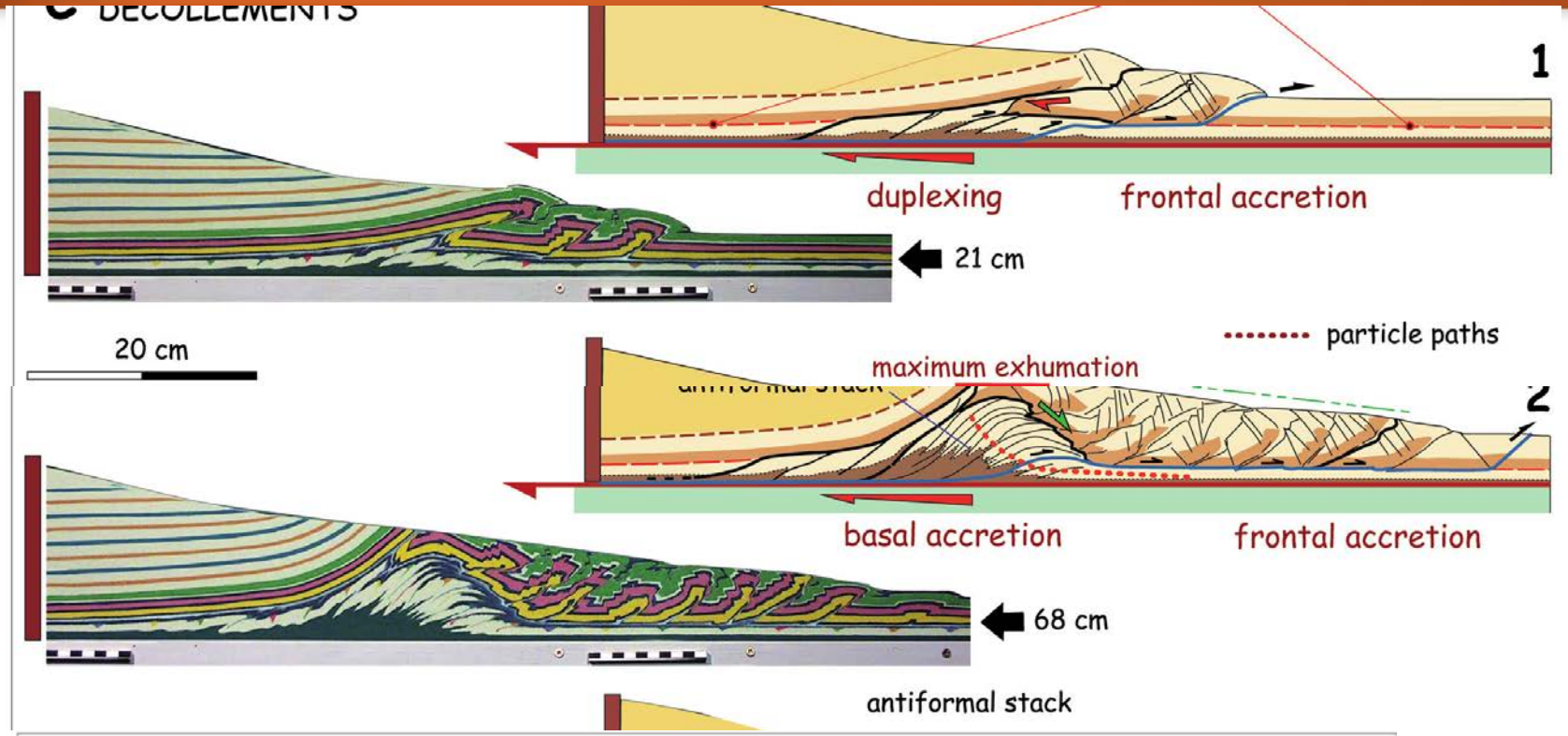
Premise

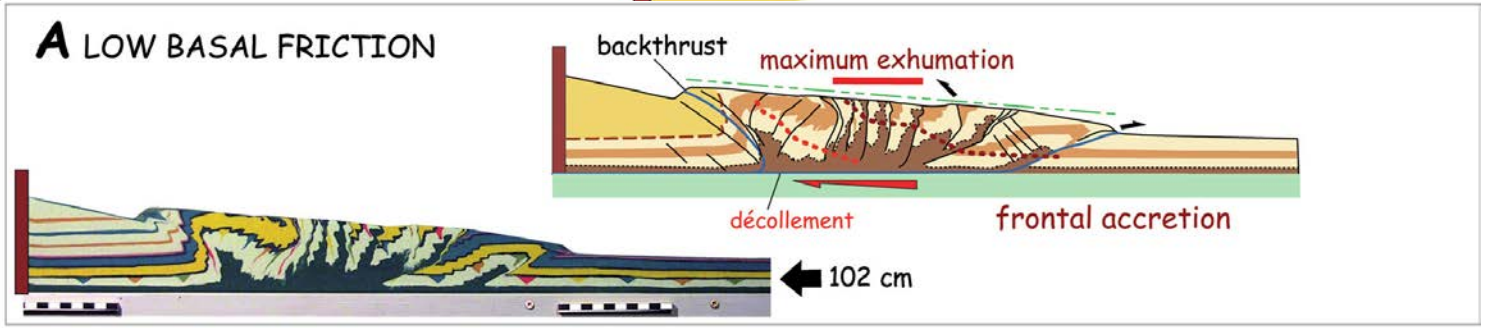
- Consider accretionary subduction settings as a balance of sediment flux, erosion, and deformation within a critical wedge that can be perturbed by tectonic and climatic events

Three questions…

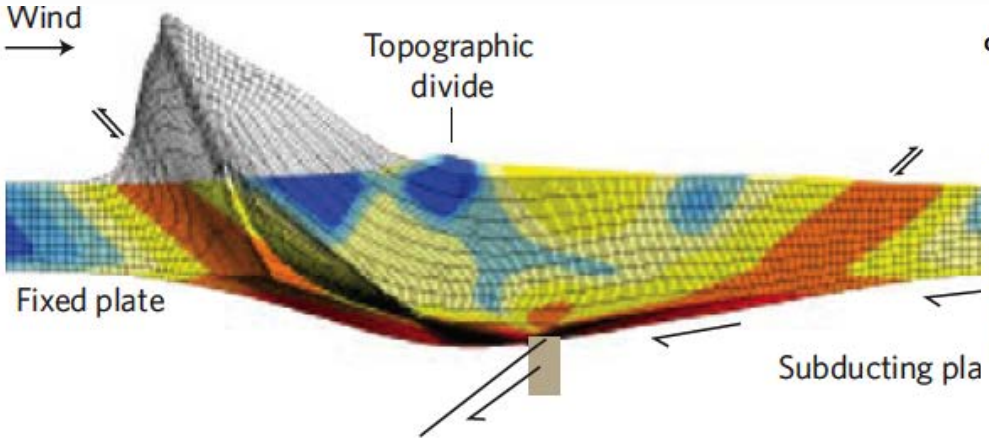


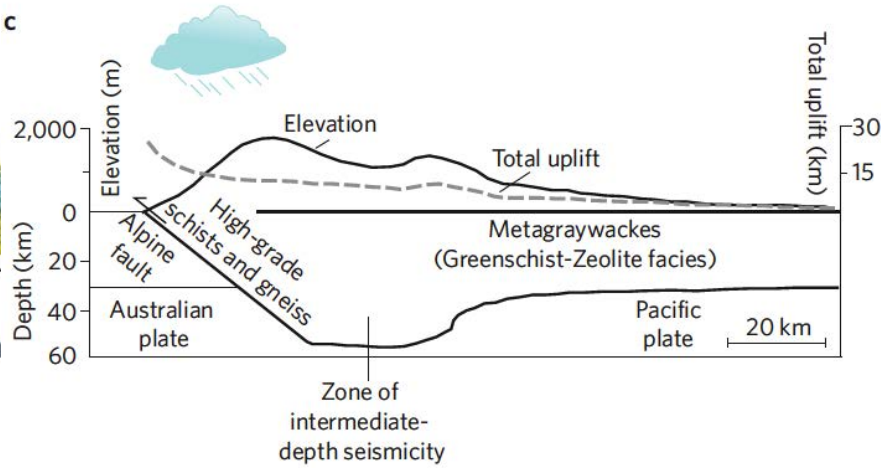
Malavieille, 2010

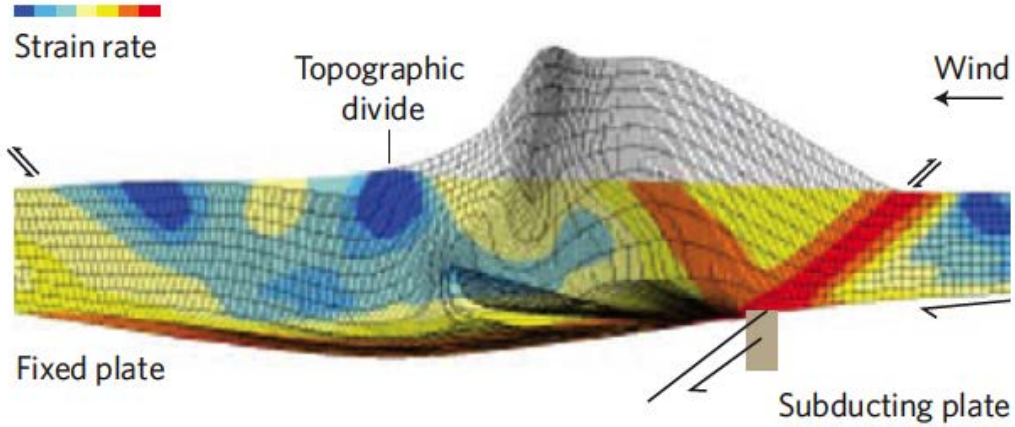




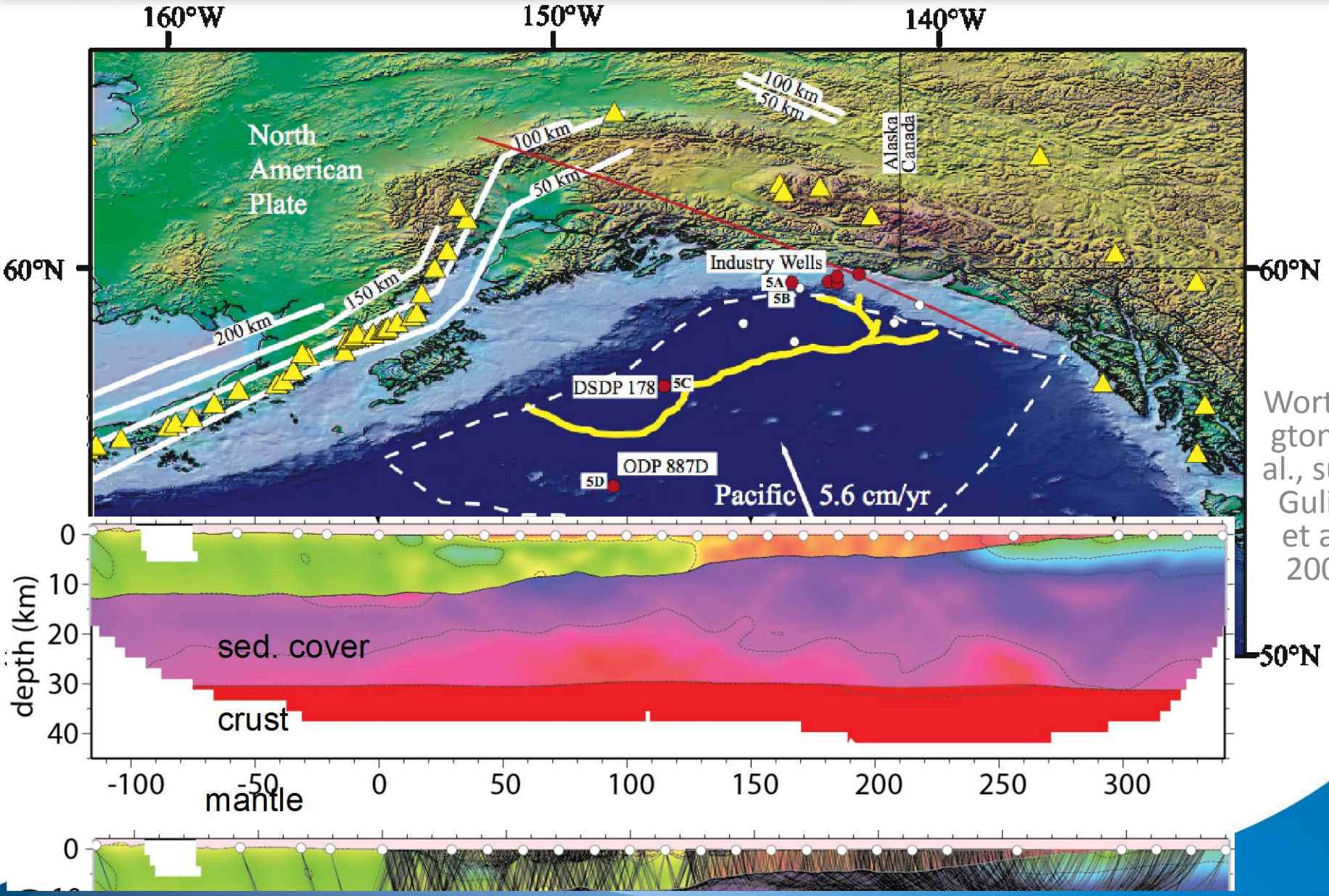
Malavieille, 2010



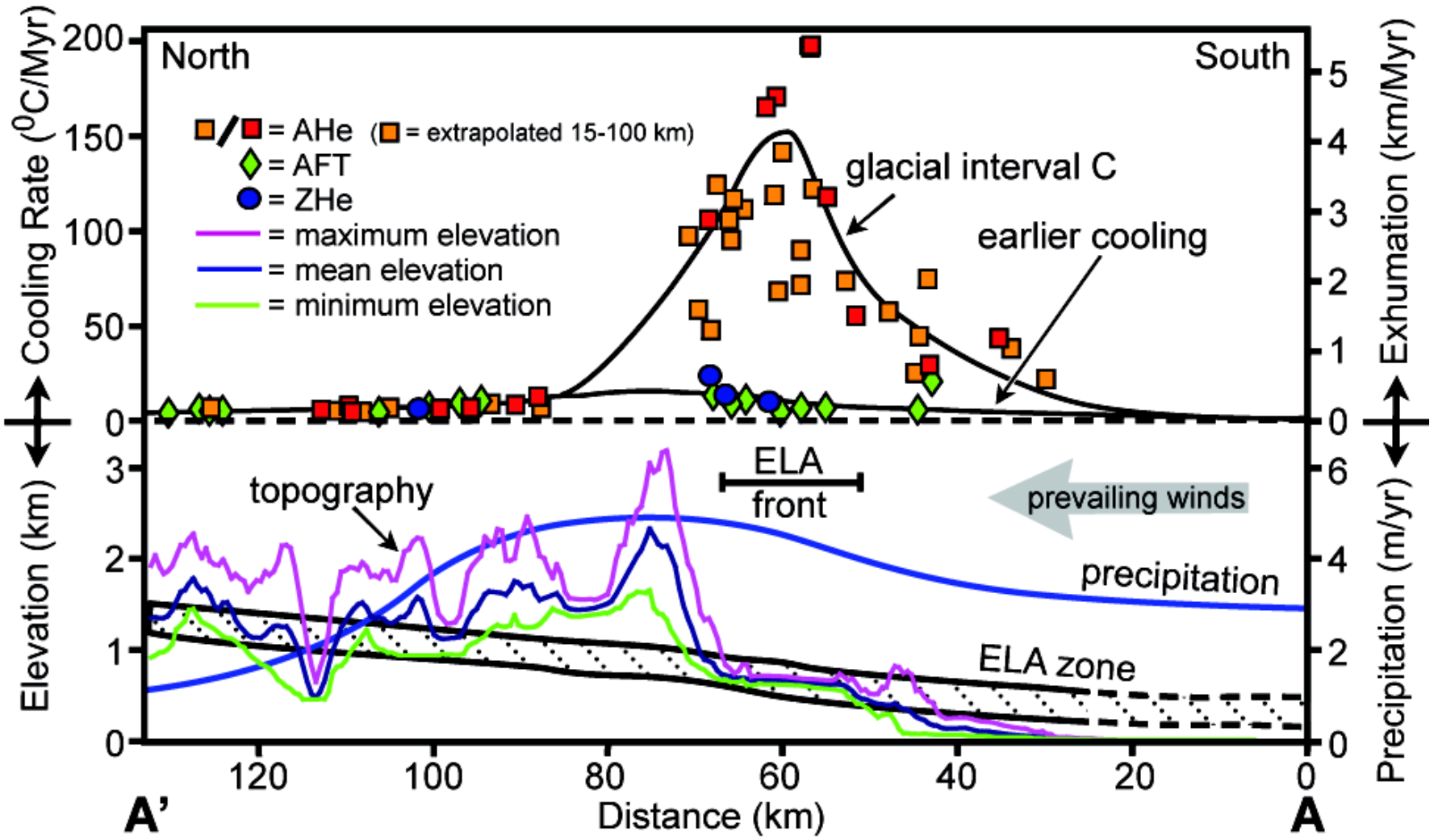




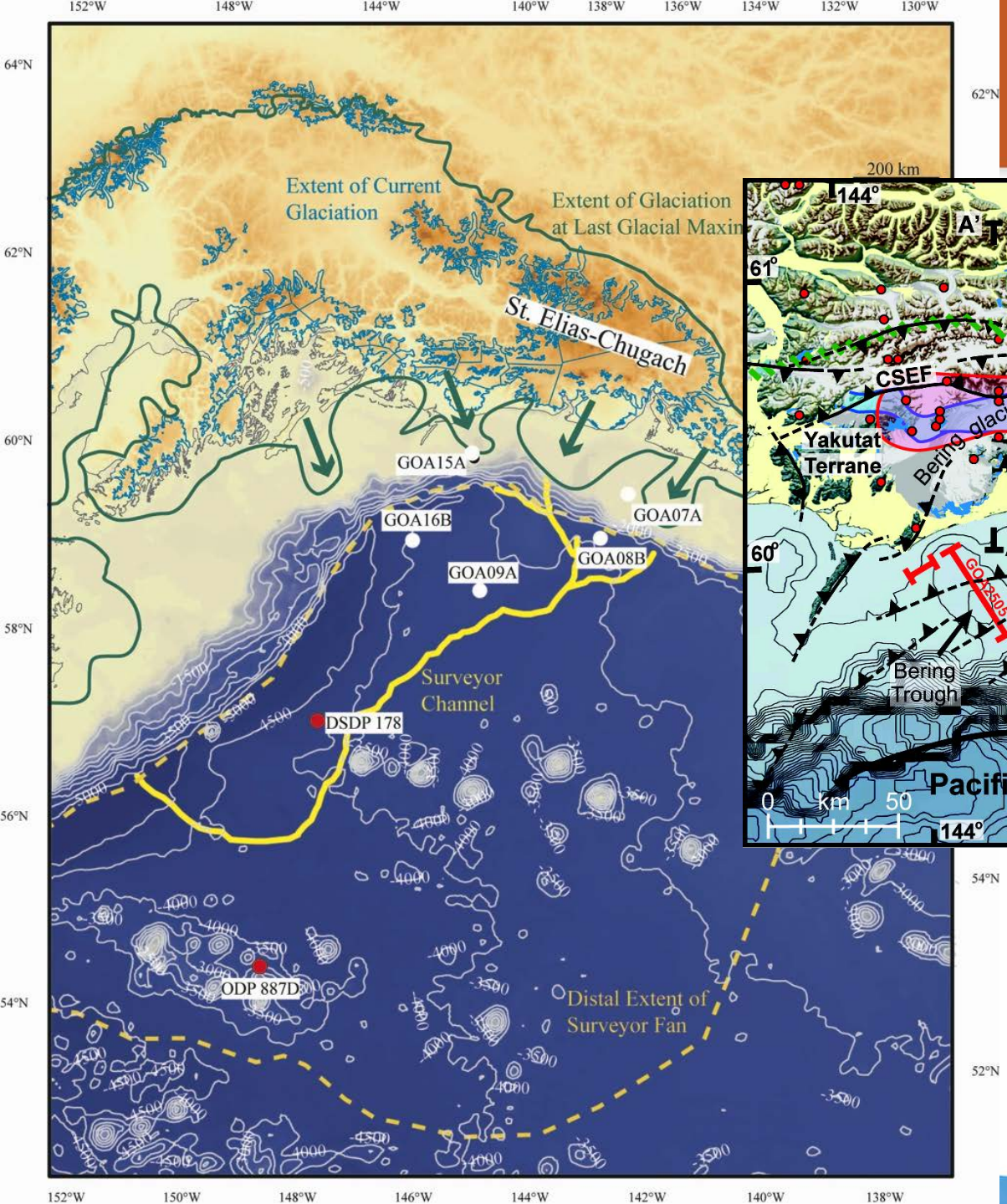
Whipple, 2009;
Willett, 1999;
Koons, 1990

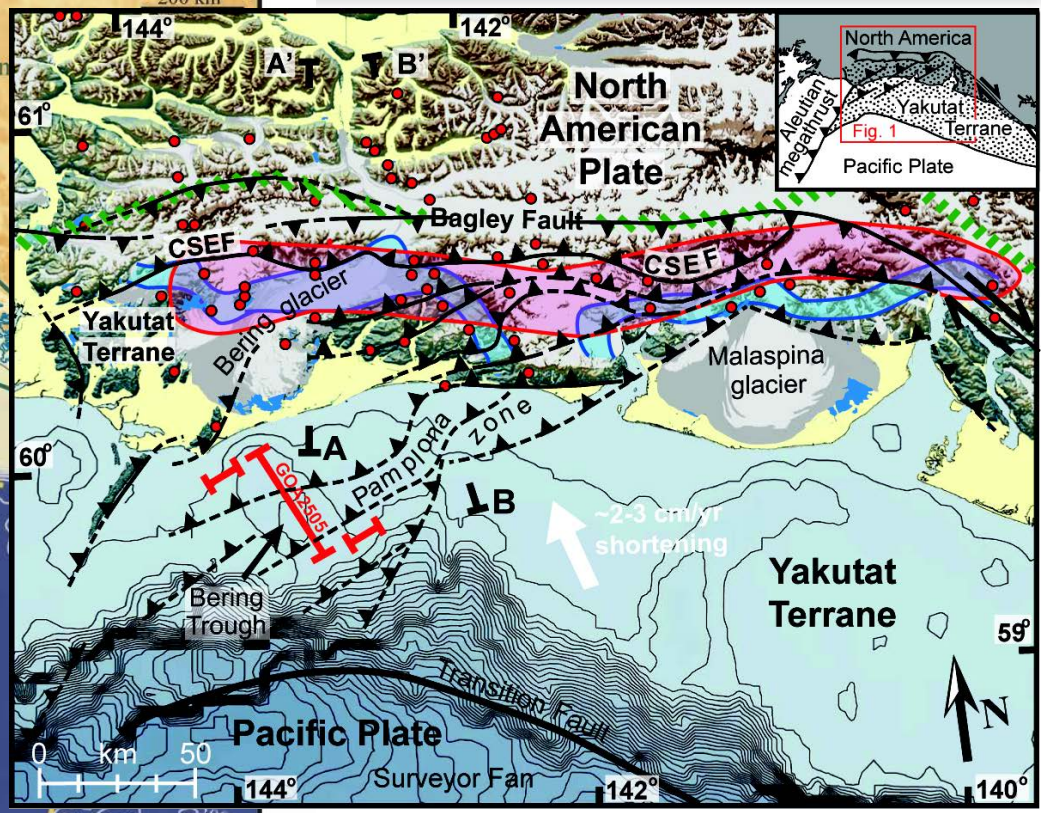


Worthington et al., sub.; Gulick et al., 2007



Berger et al., 2008





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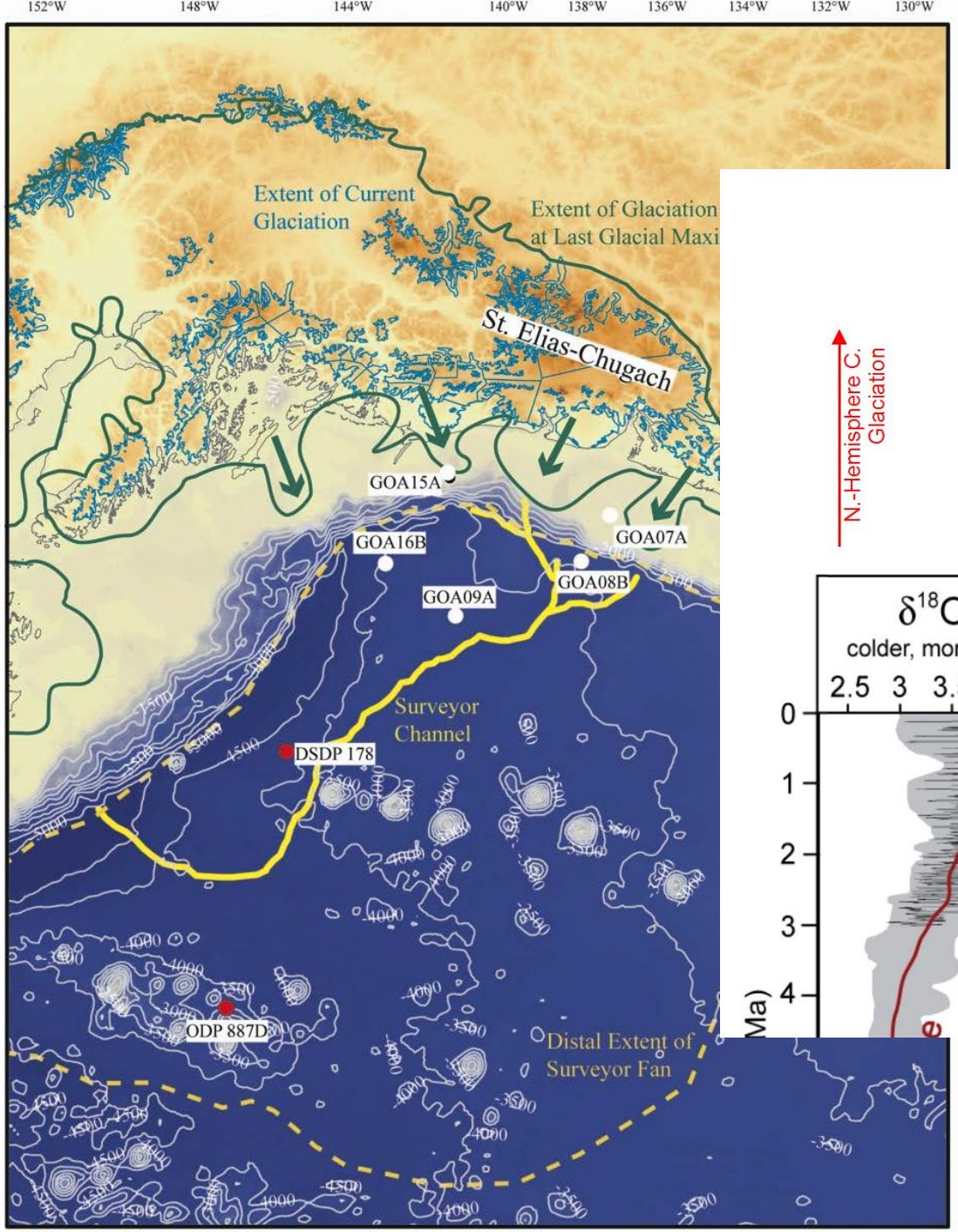
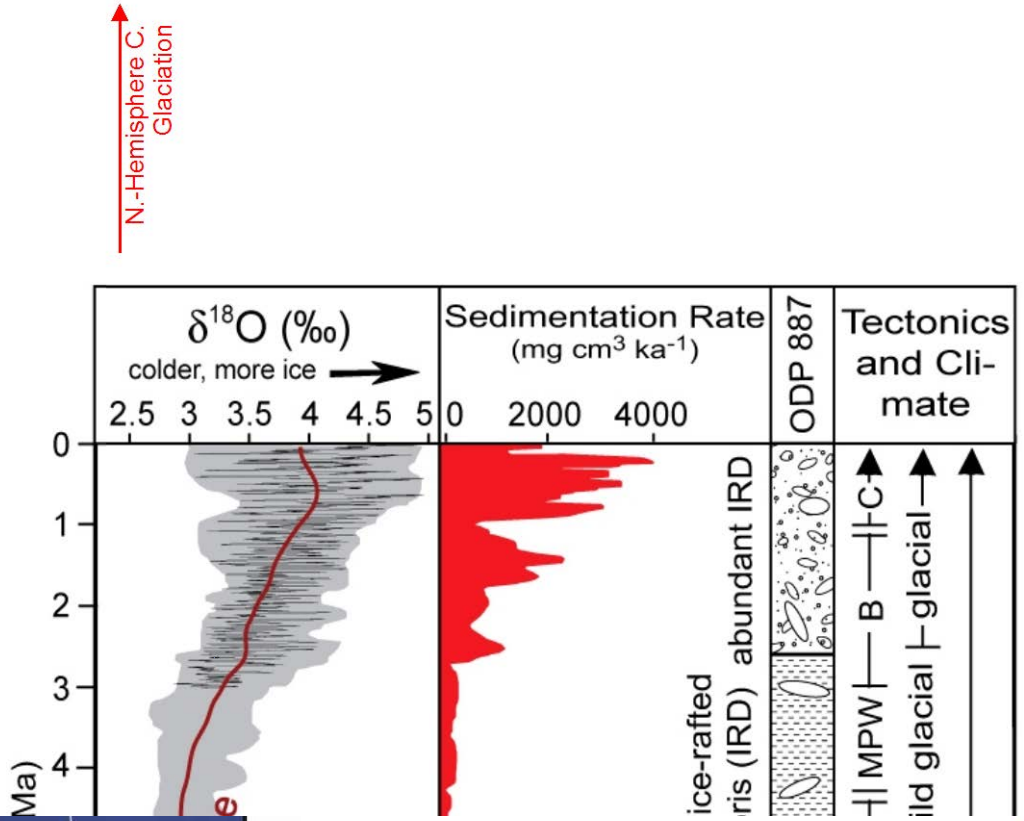
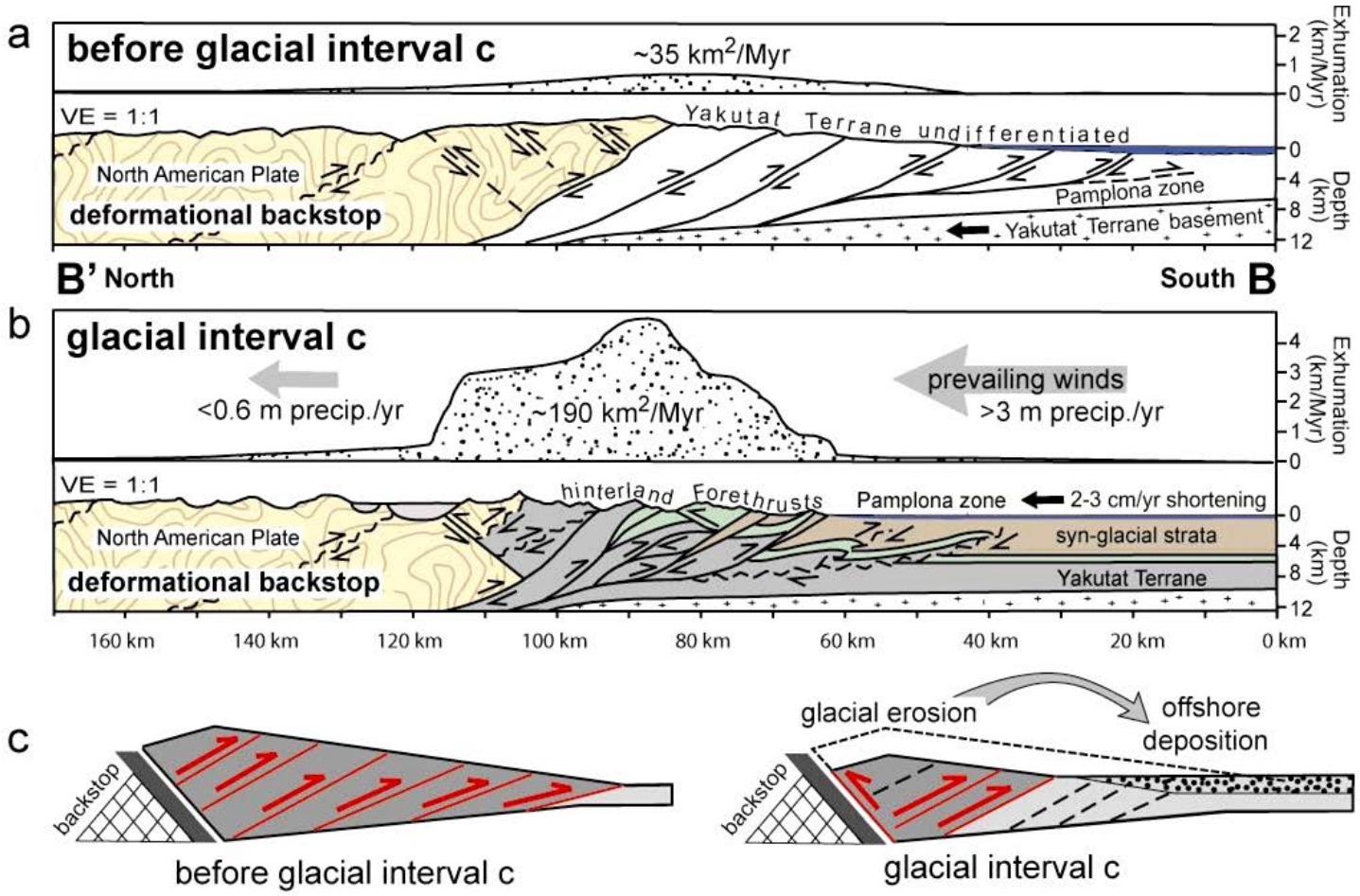
Berger et al., 2008





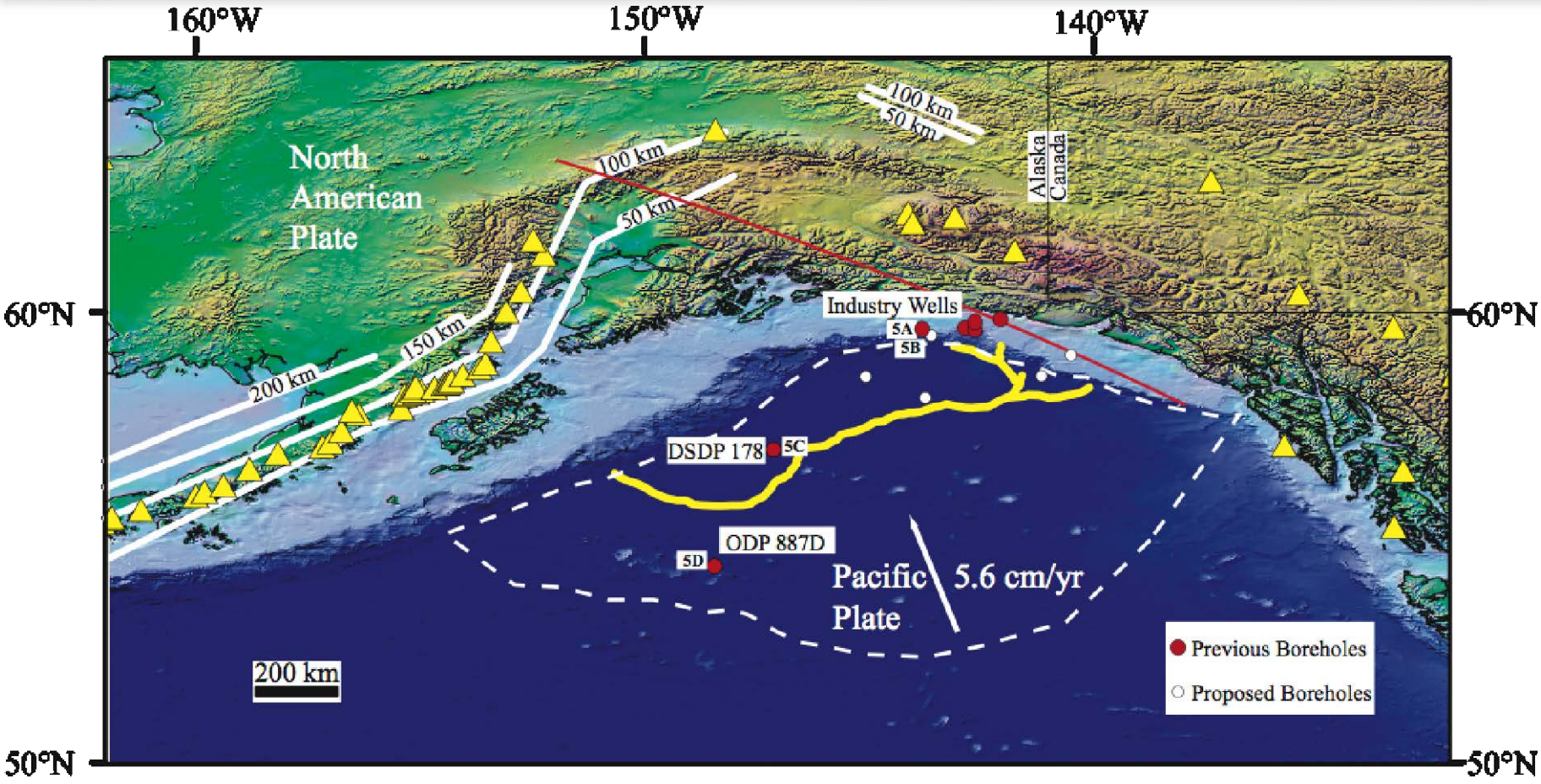
Berger et al., 2008

St. Elias orogen model

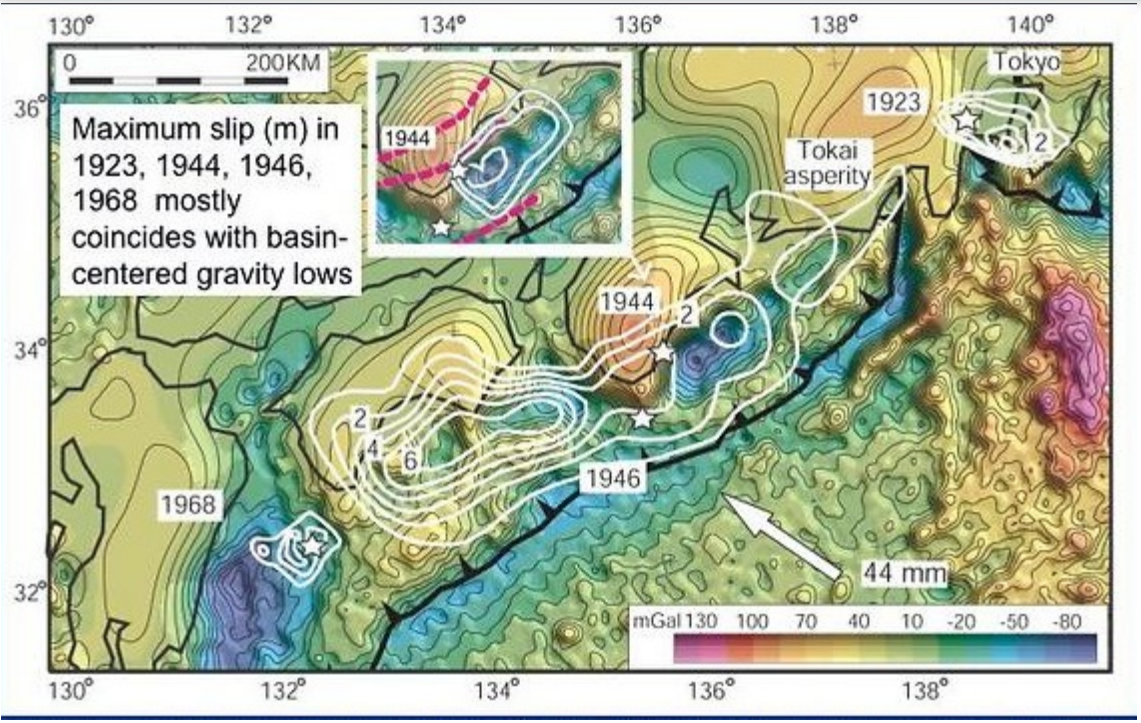


Focused onshore erosion at onset of Glacial Interval 'C'

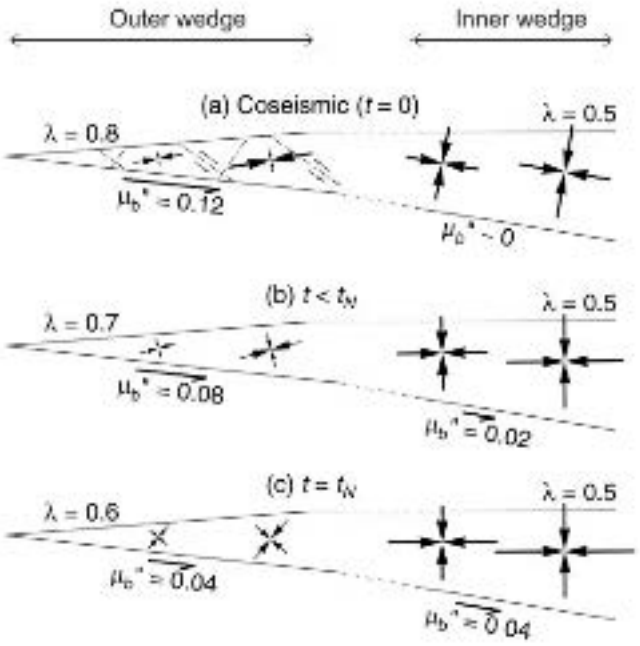
Berger et al, 2008



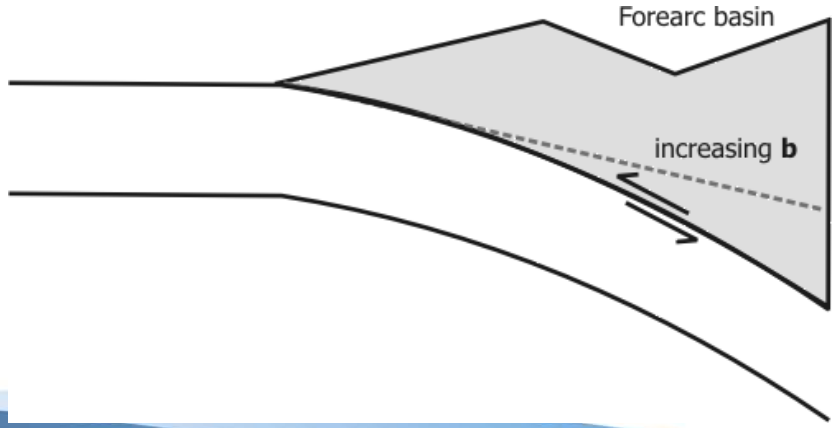
Question 1: Effect of glacial erosion on subduction system from arc to forearc?



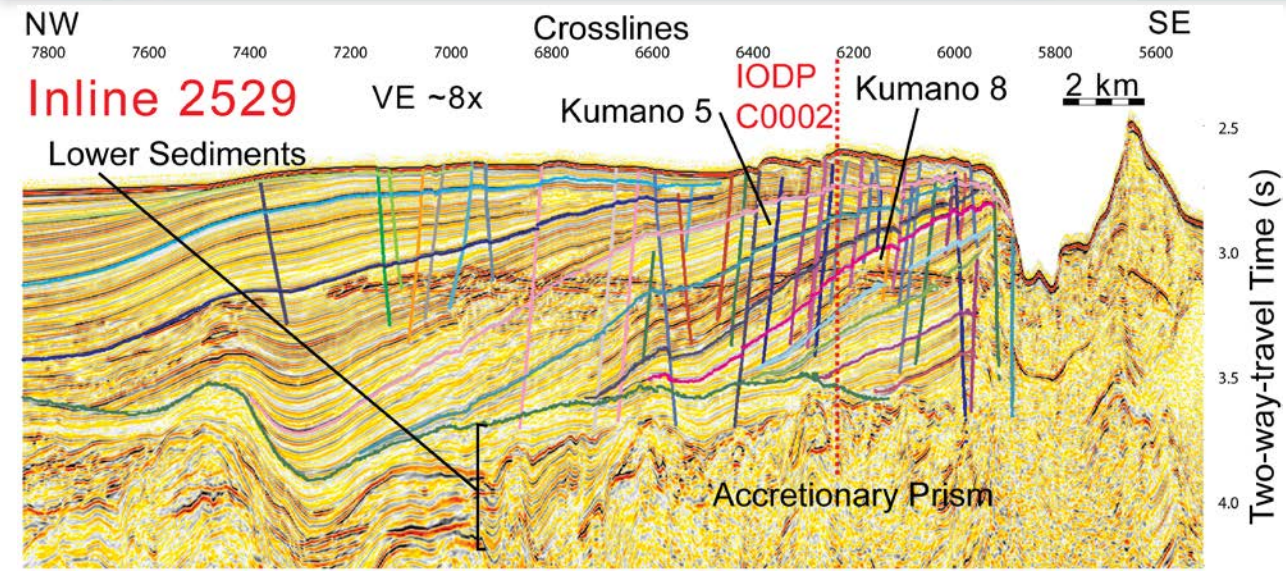
Wells et al., 2003

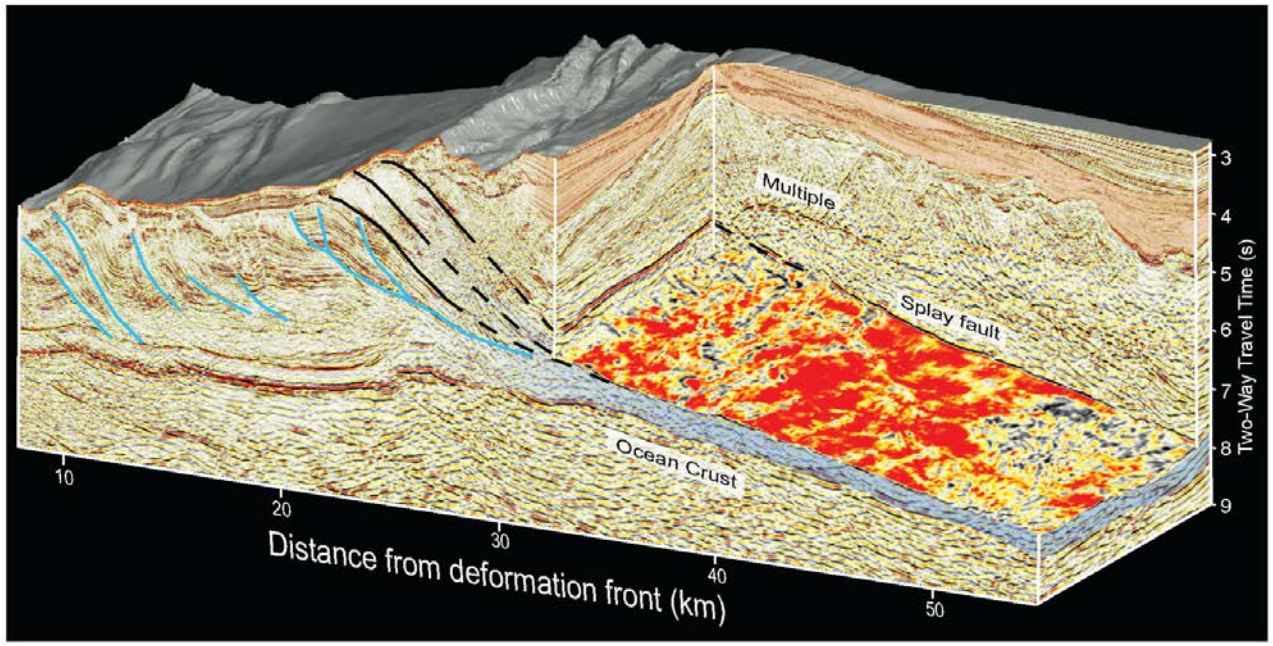


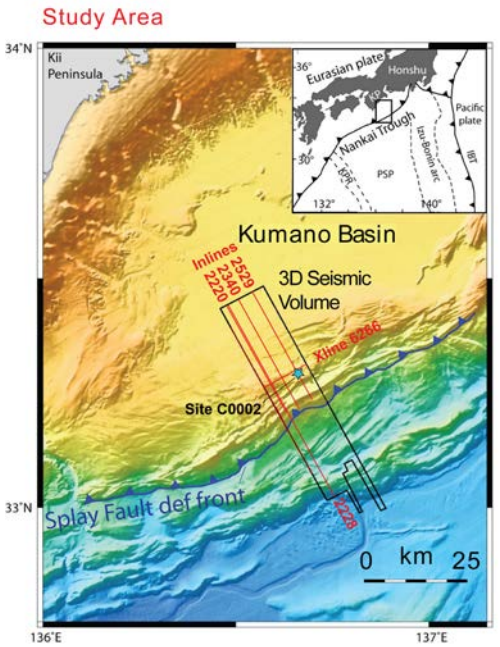
Wang and Hu, 2006



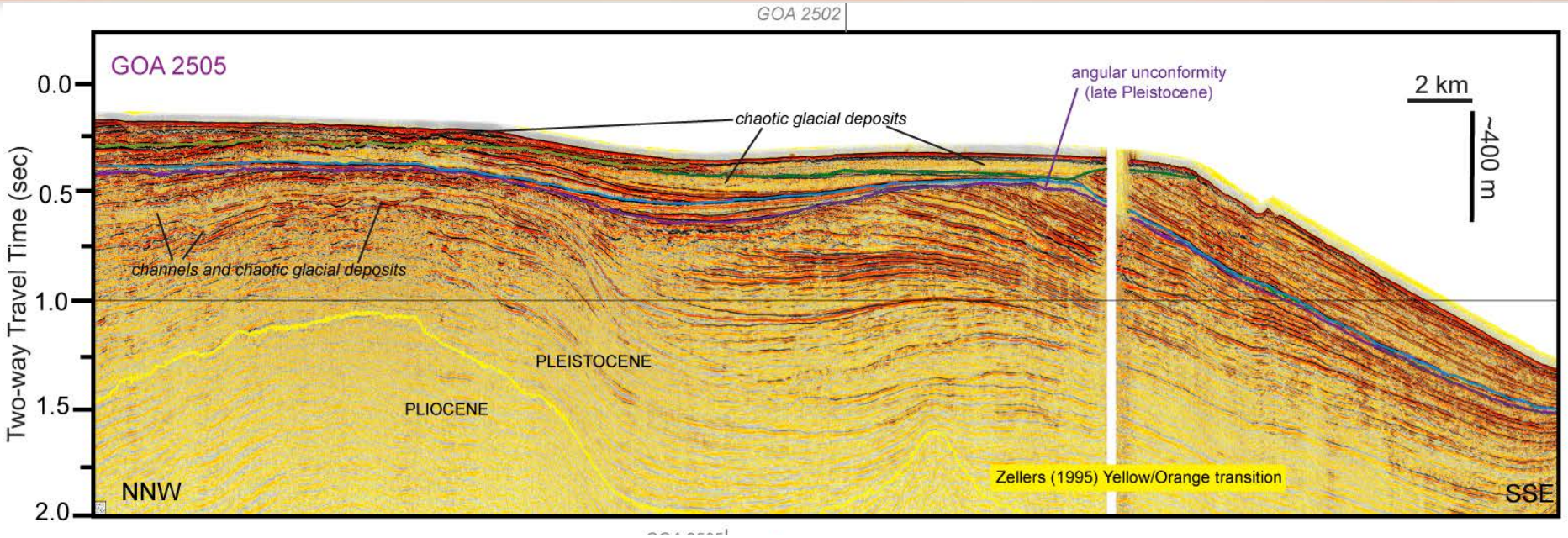
Fuller et al., 2006



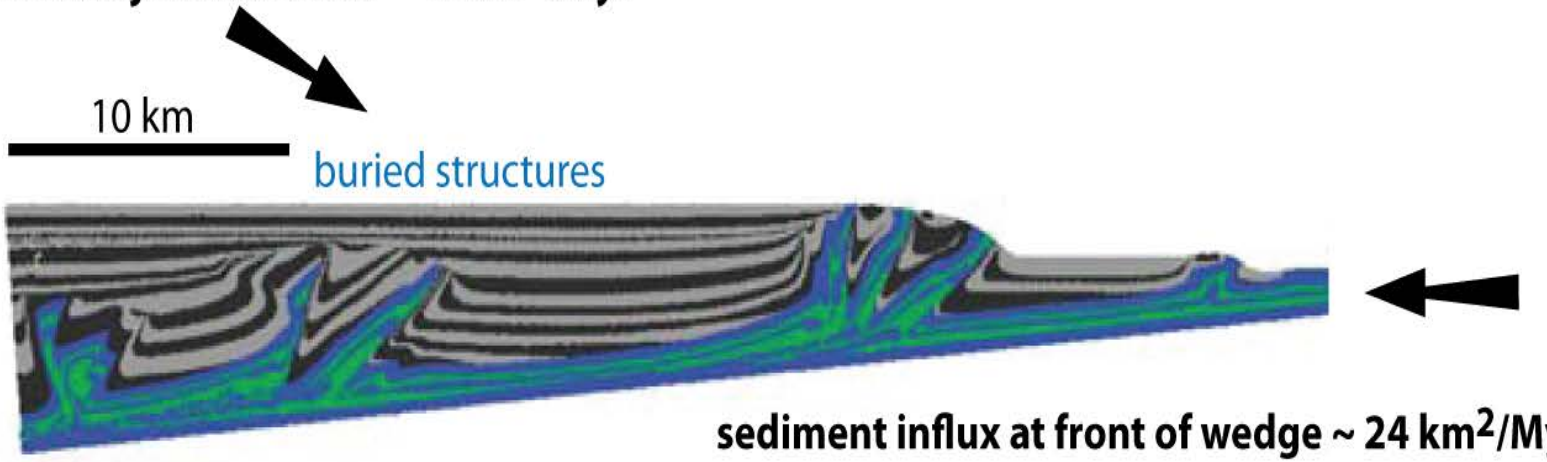




Gulick et al., 2010;
Bangs et al., 2009;
Moore et al., 2007

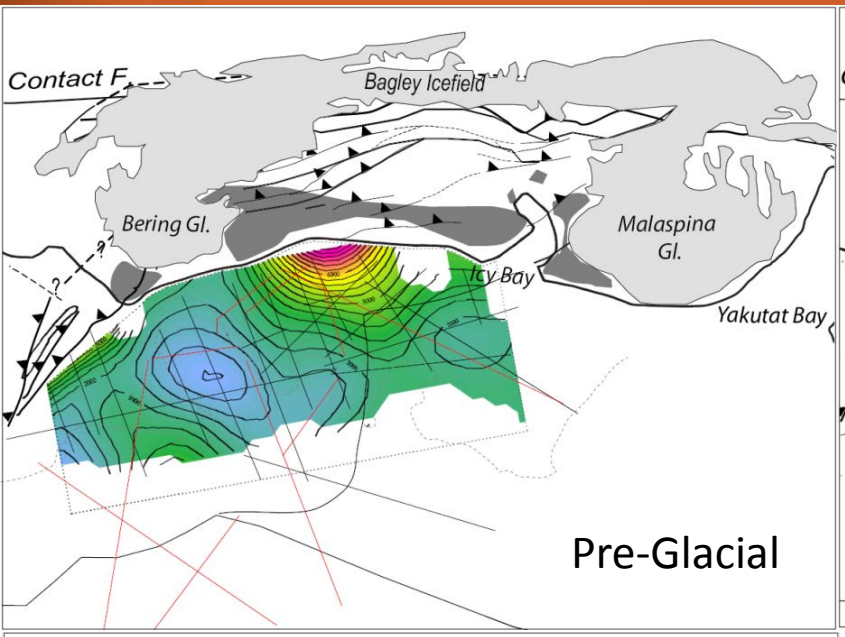


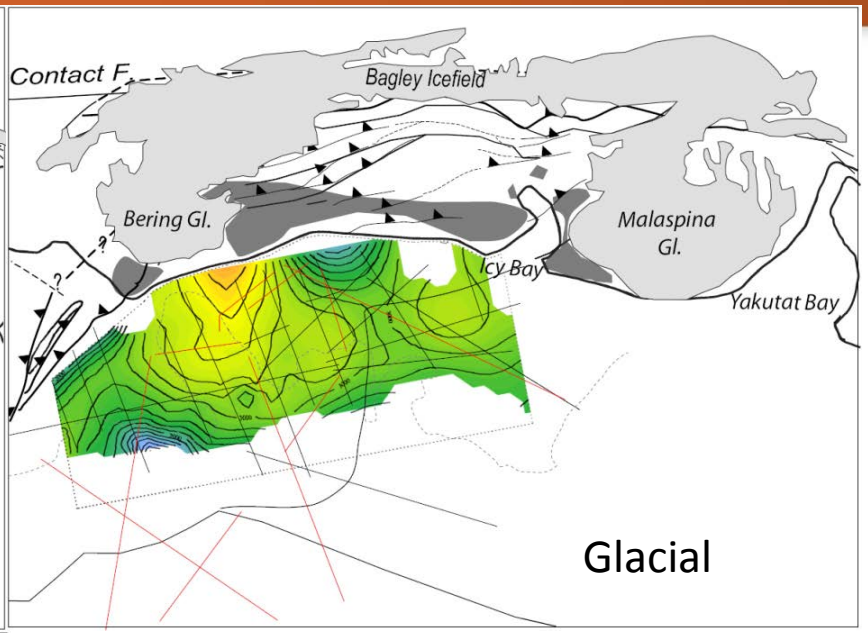
sediment influx from adjacent source ~ 48 km^2/Myr

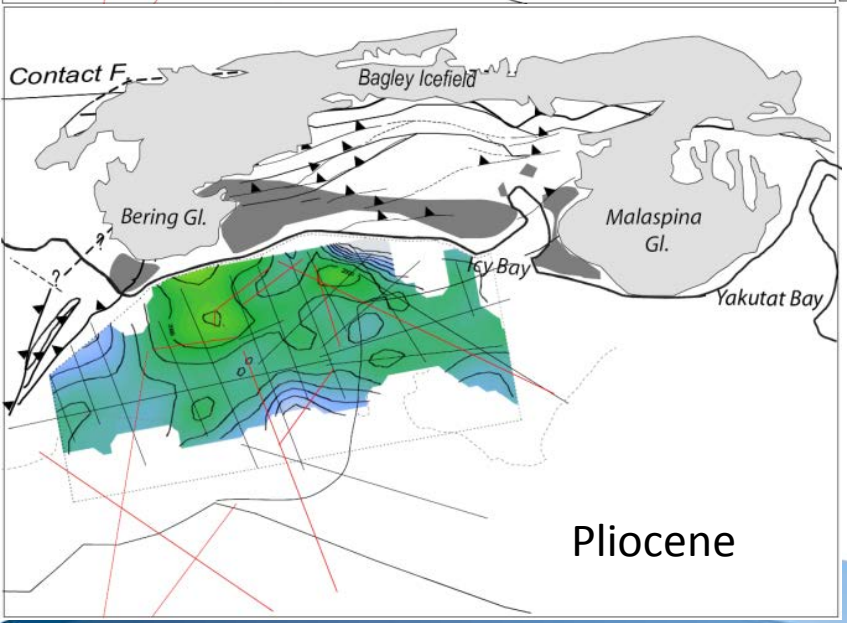


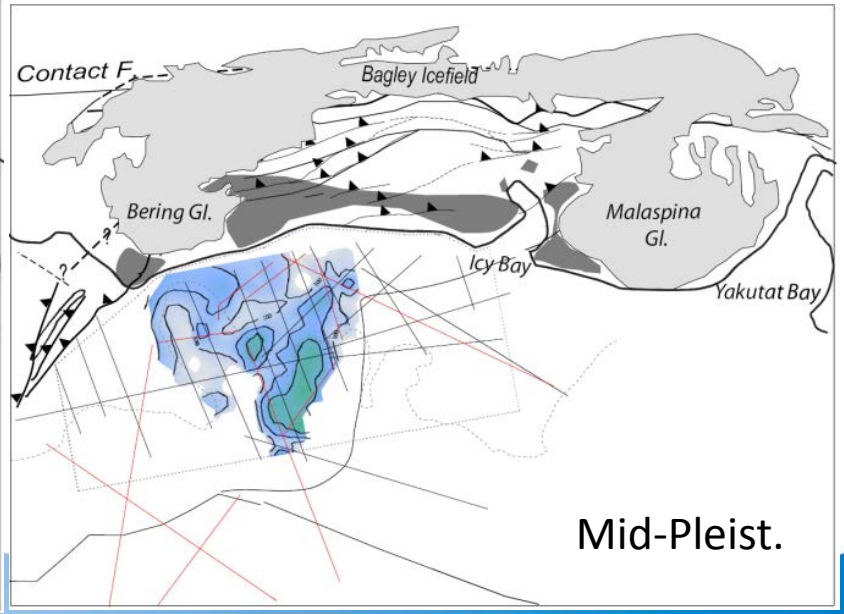
sediment influx at front of wedge ~ 24 km^2/Myr

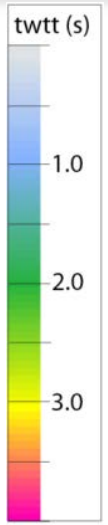
Simpson, 2010



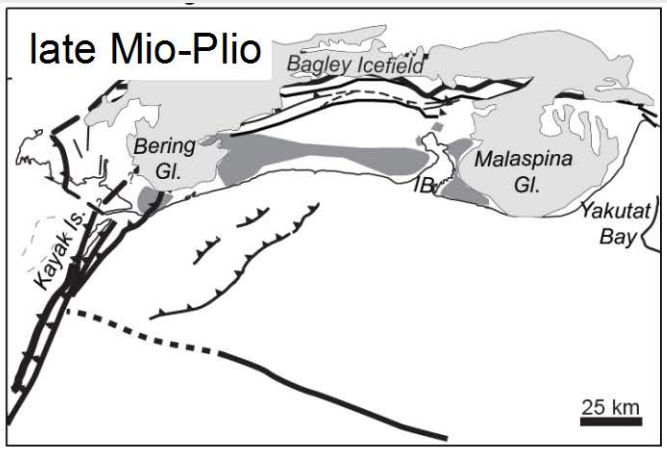


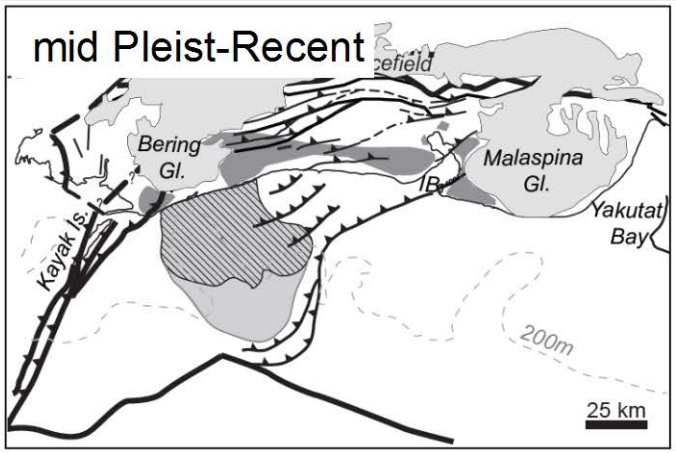




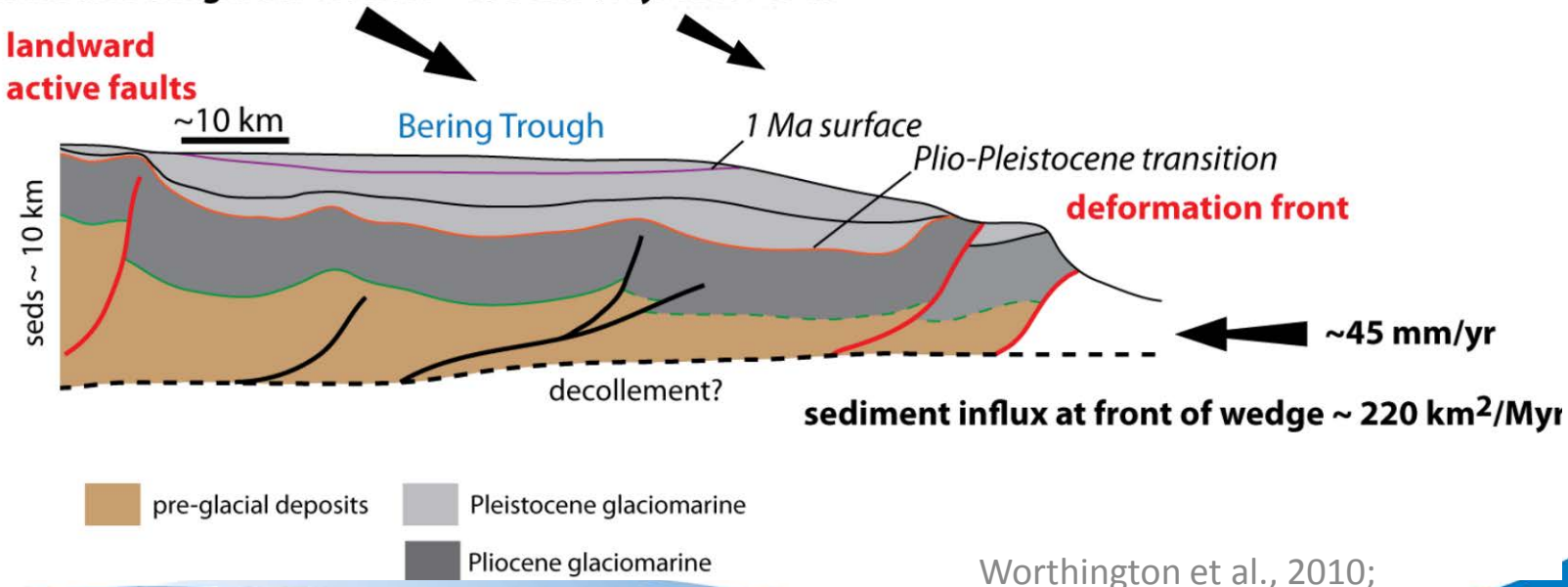


Worthington et al., 2010

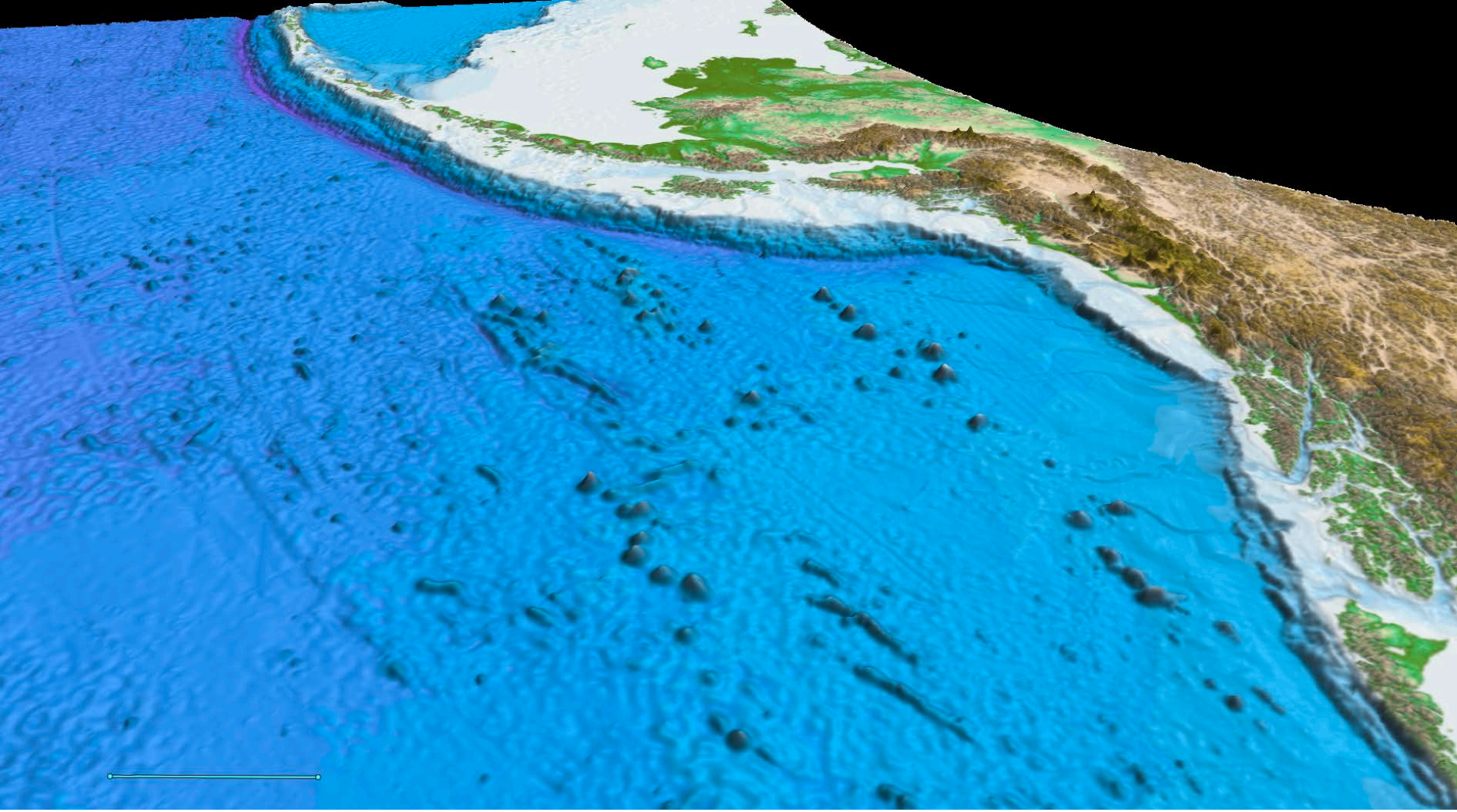




sediment influx from glacial erosion ~ 190 km^2/Myr since 1Ma

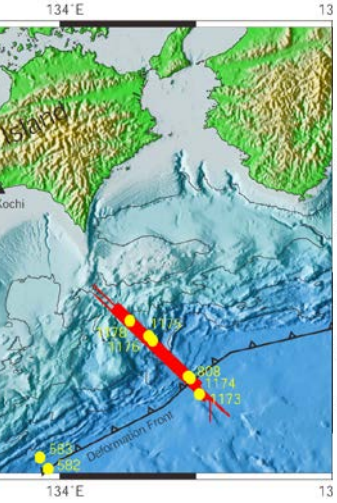


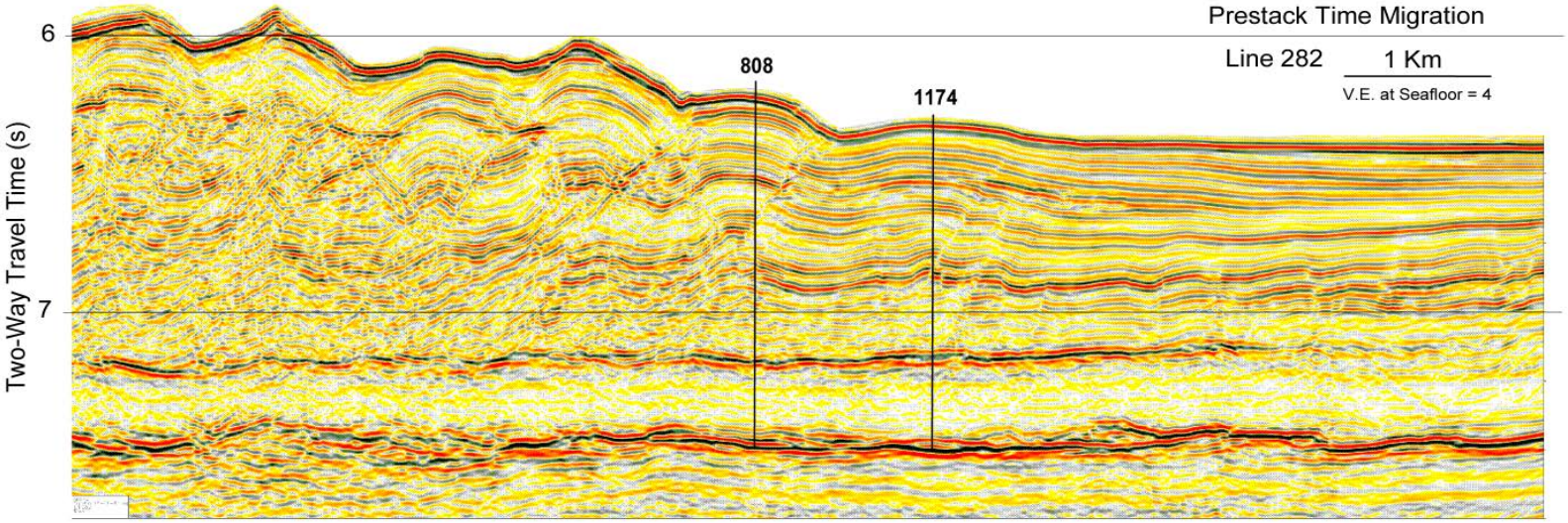
Worthington et al., 2010;

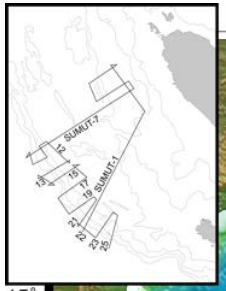


Question 2: How does increasing Plio-Pleistocene mass flux to the forearc shelf effect subduction dynamics?

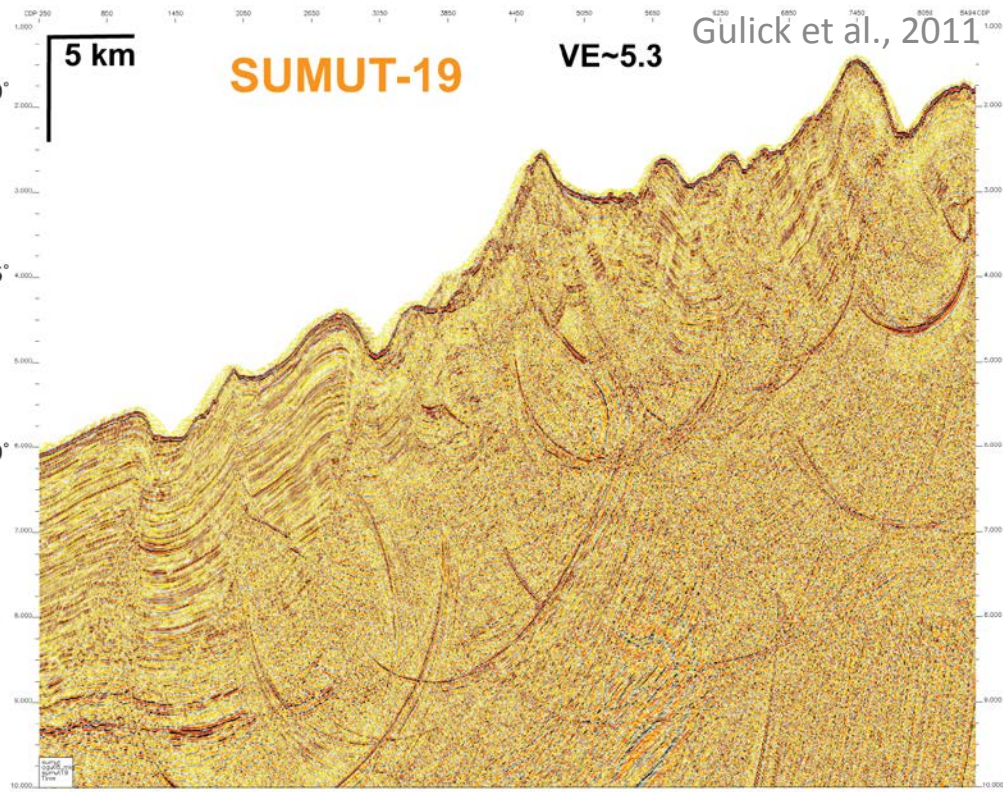
Moore et al., 2001; Bangs et al., 2004; 2006; Gulick et al., 2004

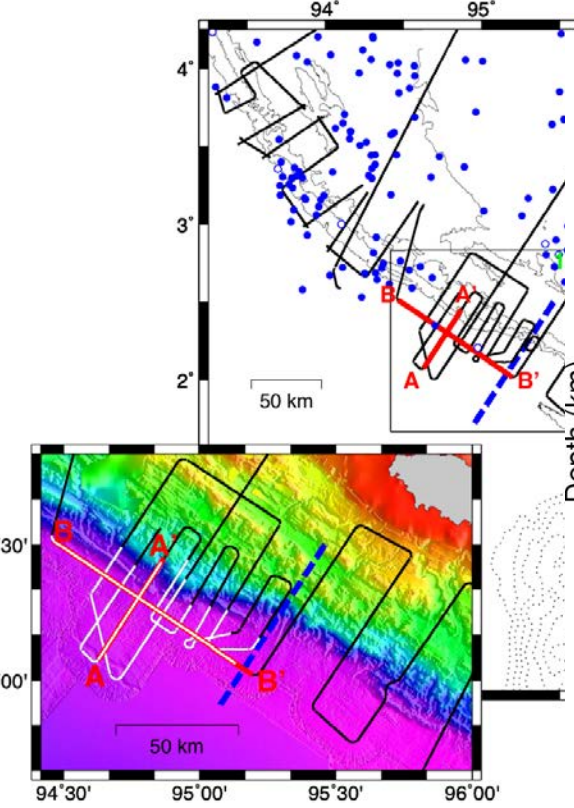




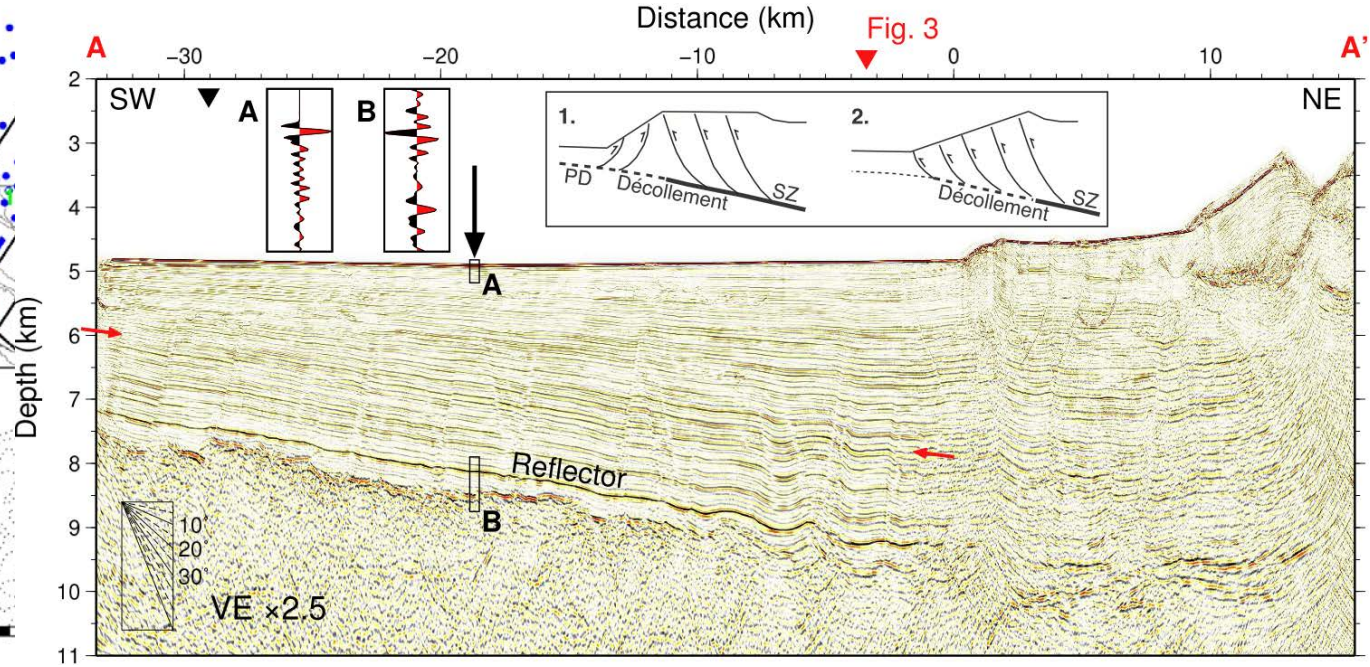


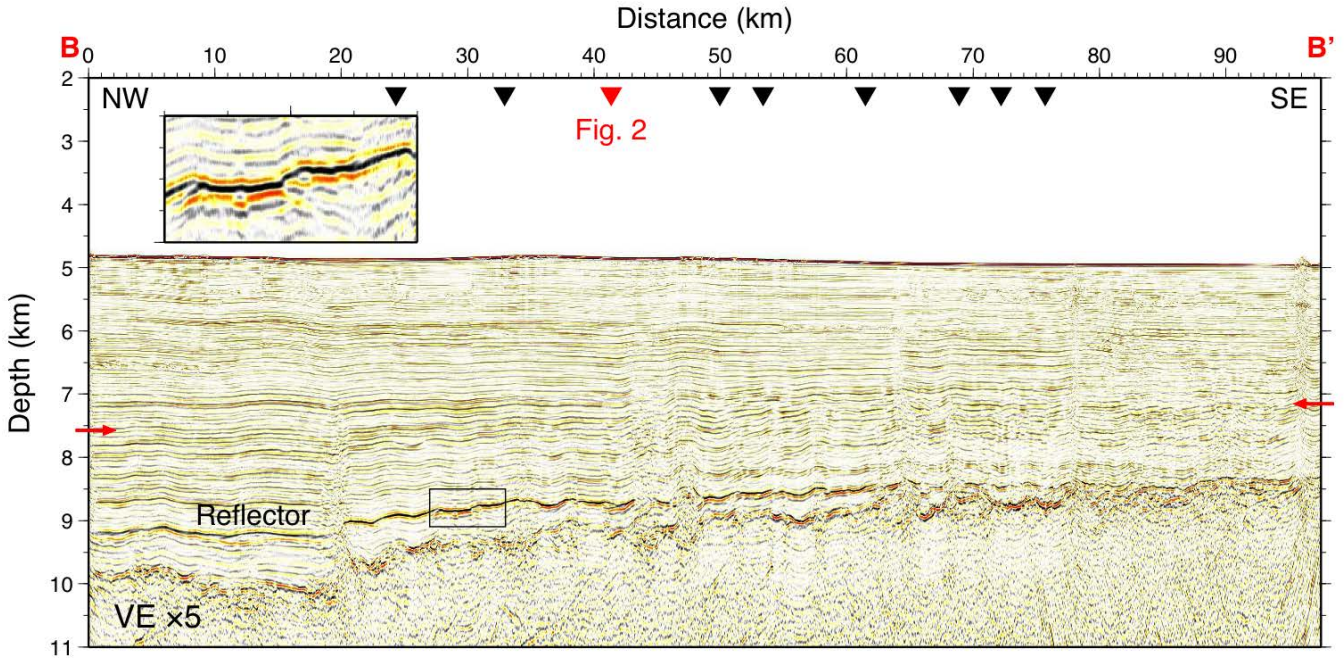
Gulick et al., 2011

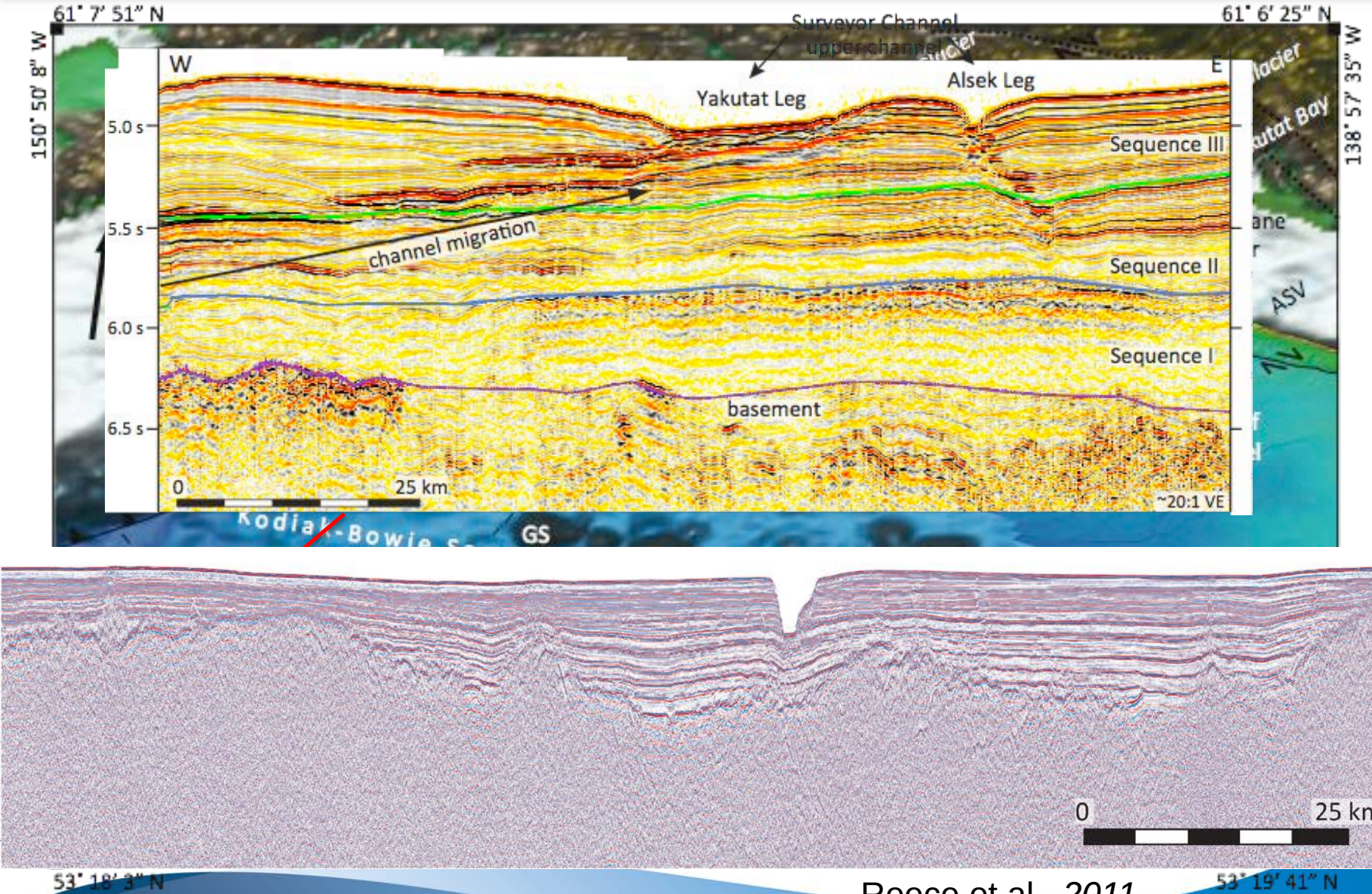




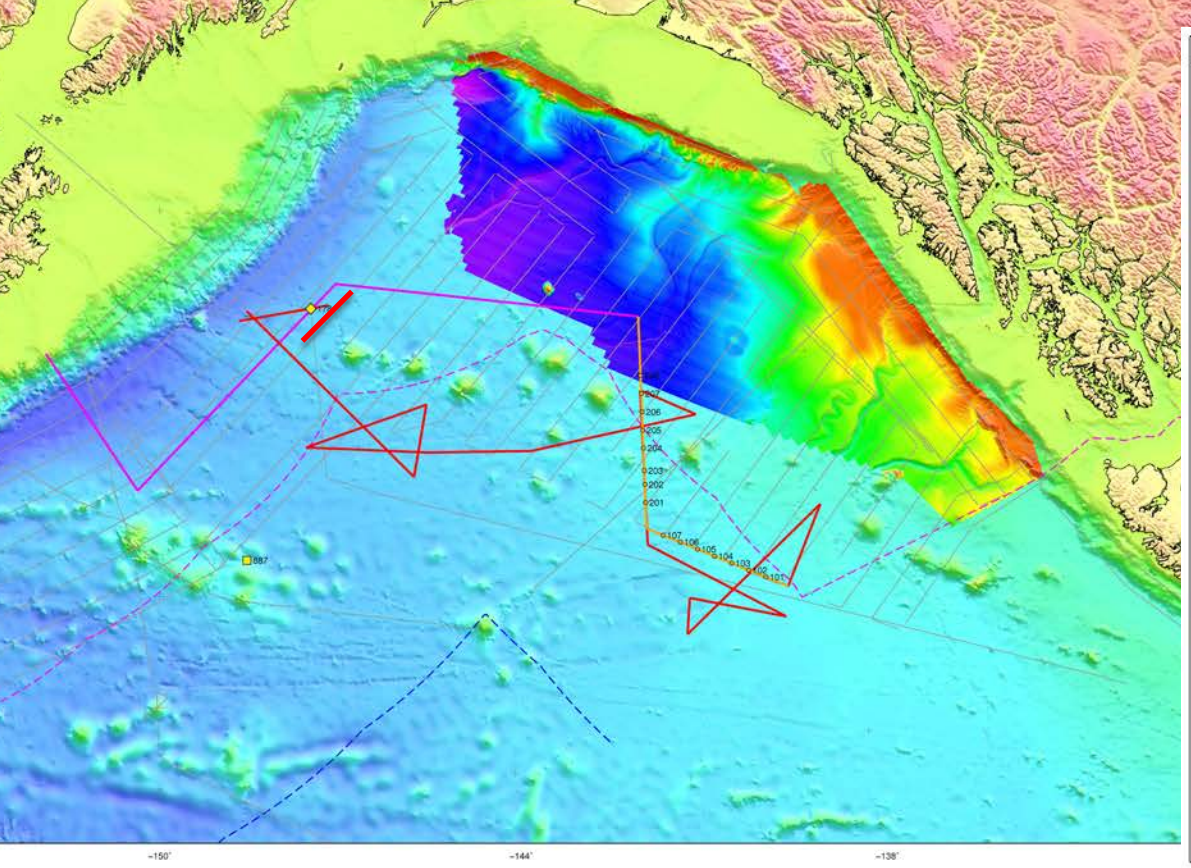
Dean et al., 2010

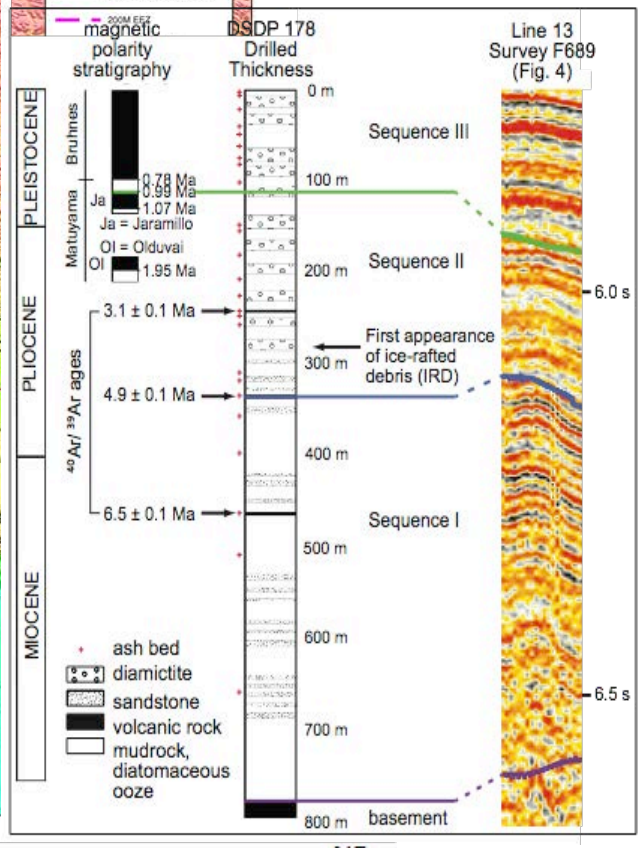


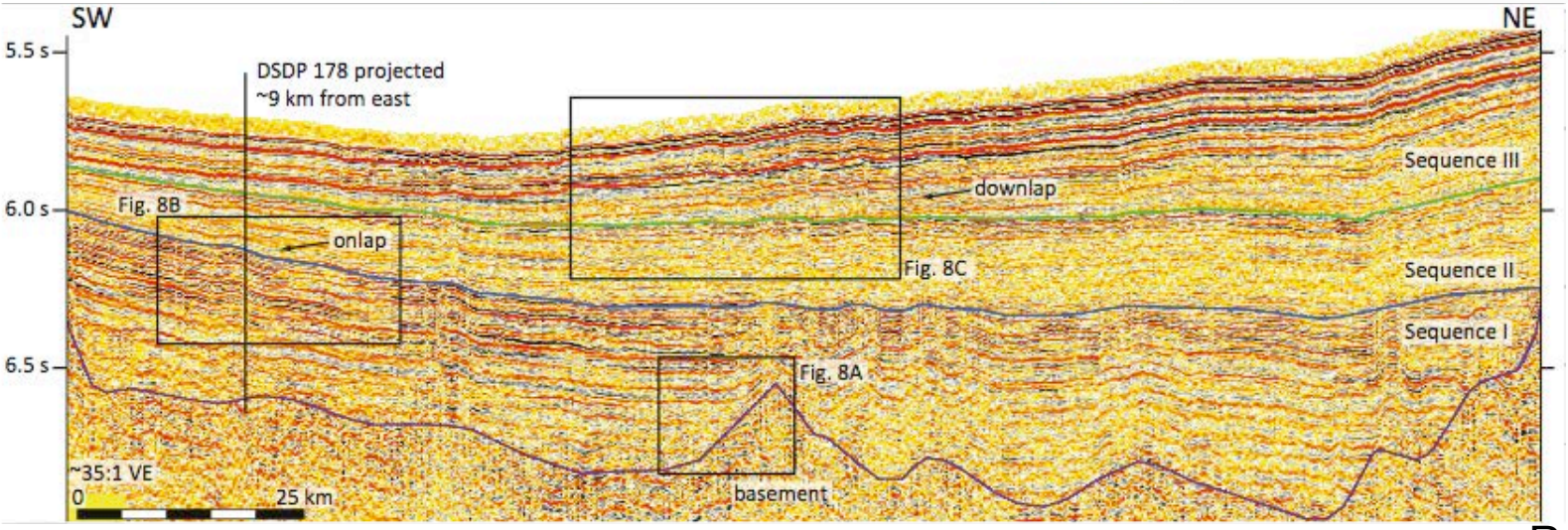




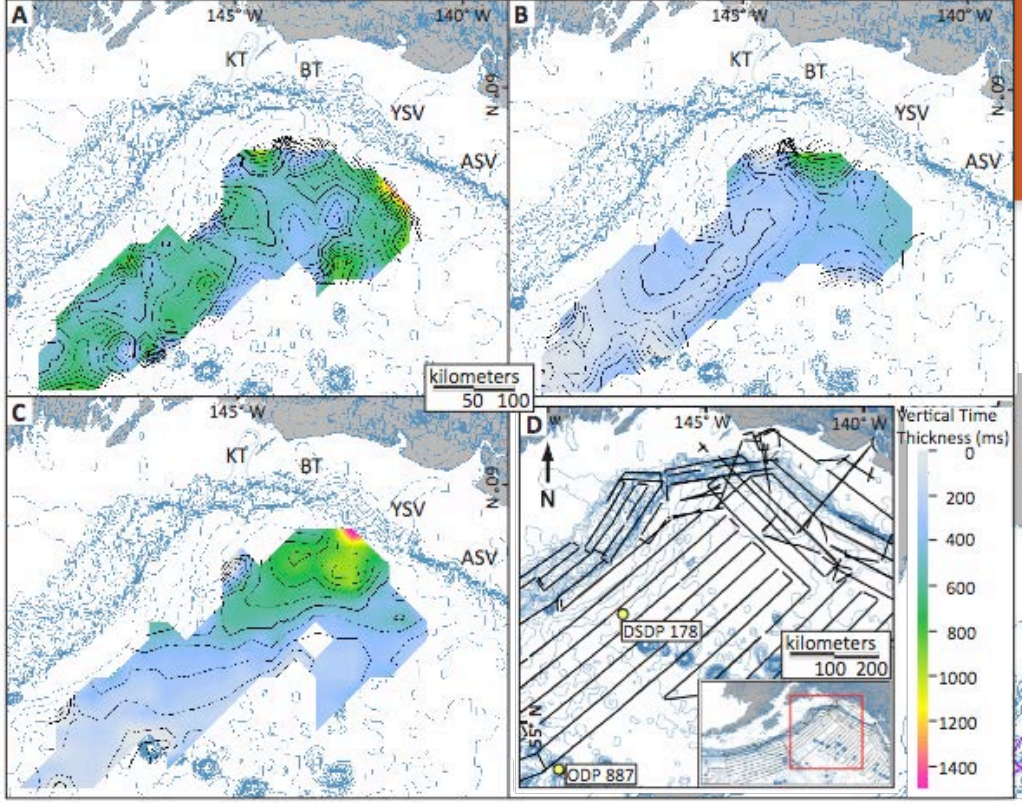
Reece et al., *2011*

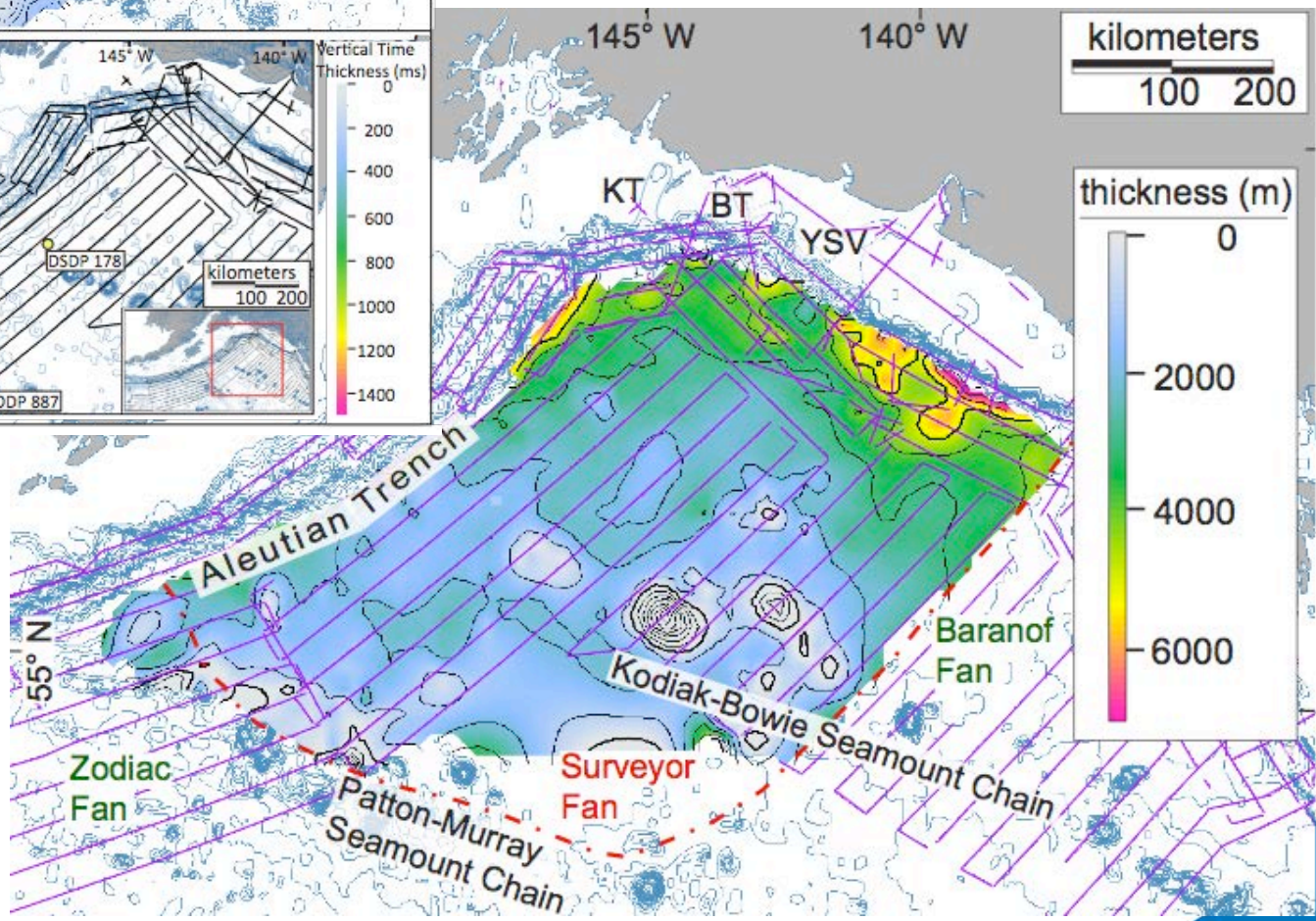






Reece et al., *2011*

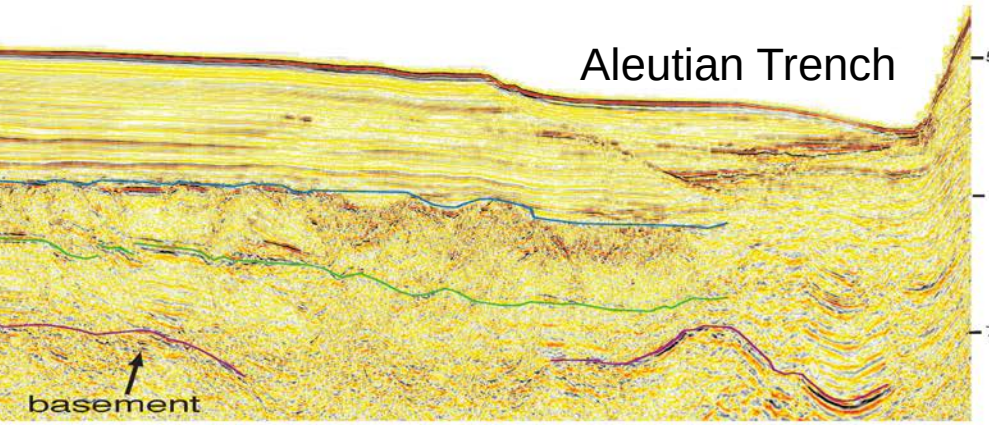


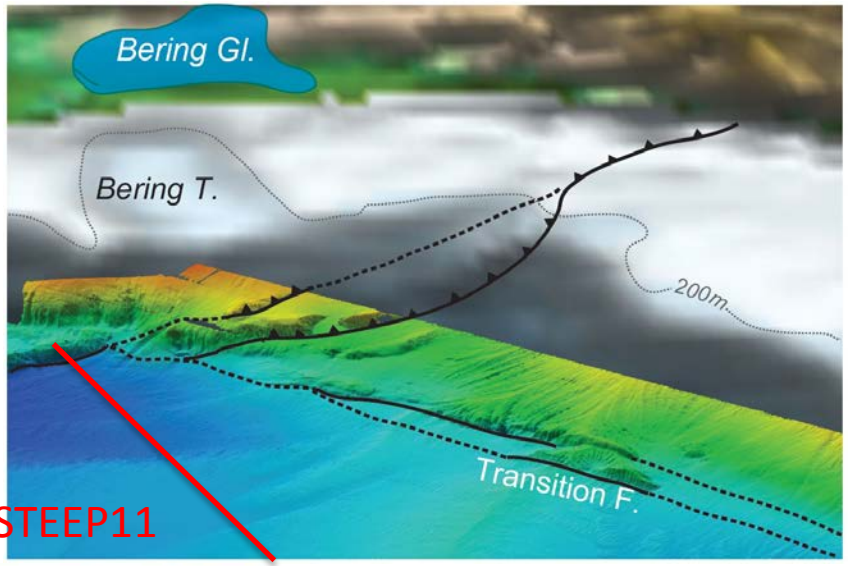


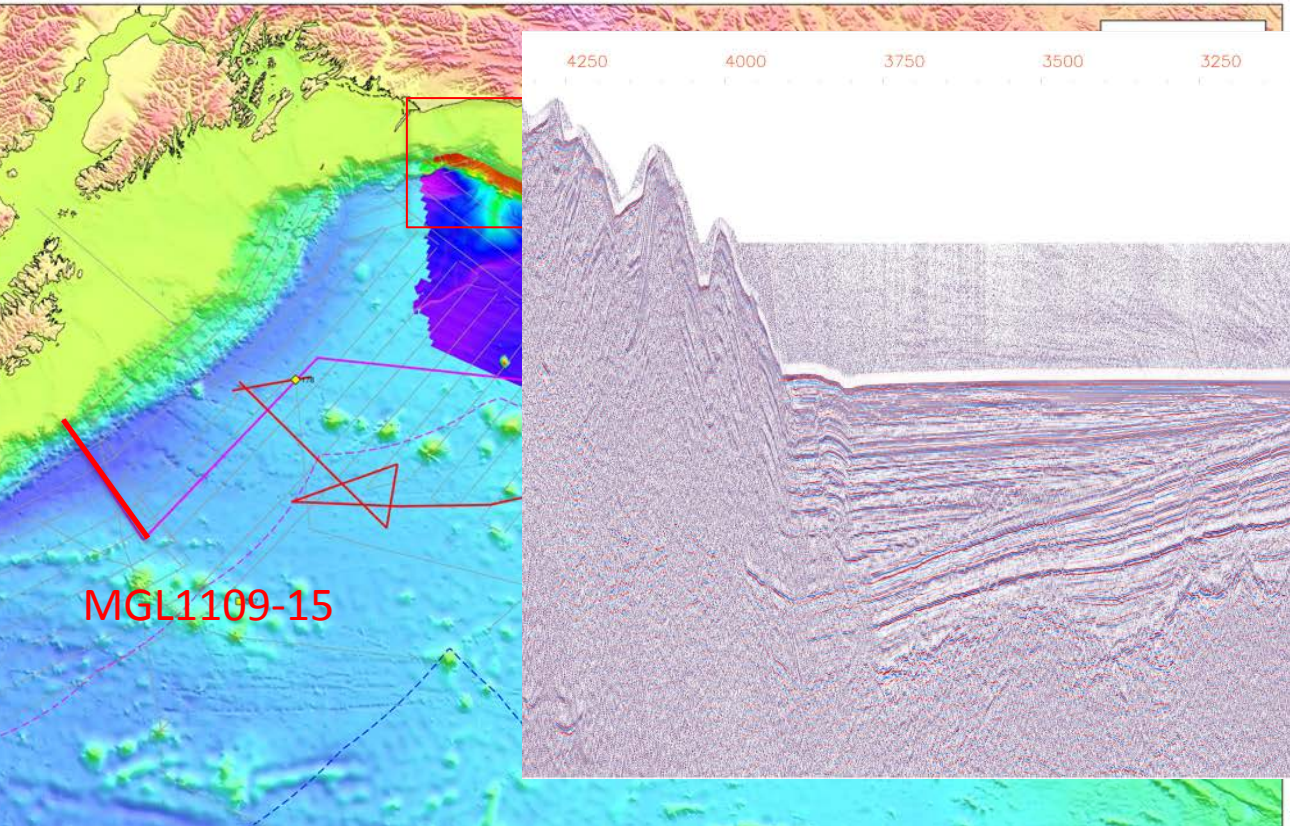
Surveyor Fan is:
341,519 sq km
677,548 cu km

4th largest in the world nearest equivalent is Amazon Fan

Reece et al., *2011*


NE
Aleutian Trench
5 s
6 s
7 s
basement


Bering Gl.
Bering T.
200m
Transition F.
STEEP11


MGL1109-15

4250
4000
3750
3500
3250
3000
2750
2500
2250
5000
6000
7000
8000
9000
1000

Question 3: How does the prism respond over time to variable thickness, age, and rheology of incoming sediments?

Effect on geohazards?