Heat flow measurements and the thermal state of the Alaska subduction zone

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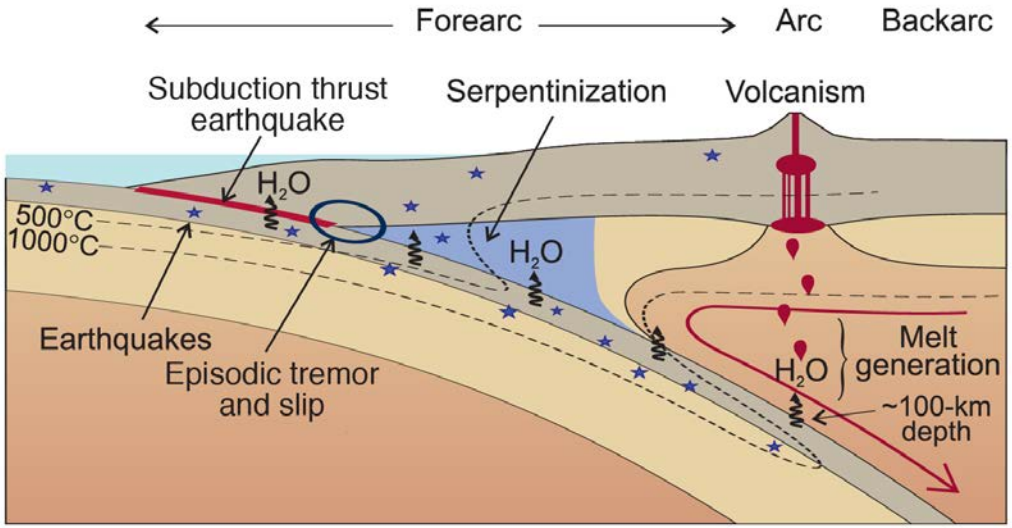
- Updip and downdip limits of seismicity, magnitude of earthquakes
- Plate locking, patterns of deformation
- sediment alteration and dewatering, metamorphic dehydration reactions and patterns of volcanism



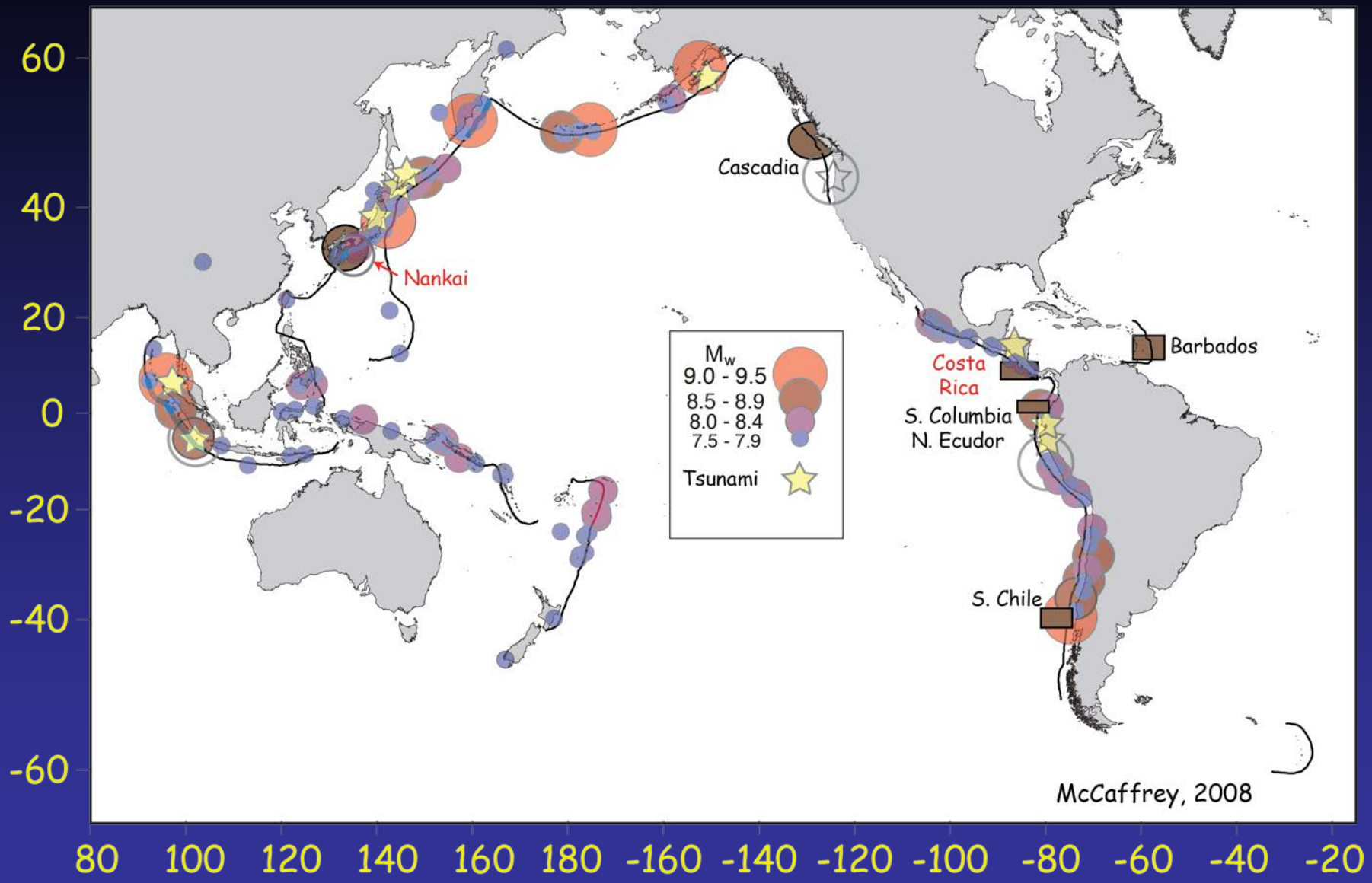
after Hyndman et al., [1997], Wada and Wang [2009]

Alaska Site Planning Meeting

earthscope
www.earthscope.org

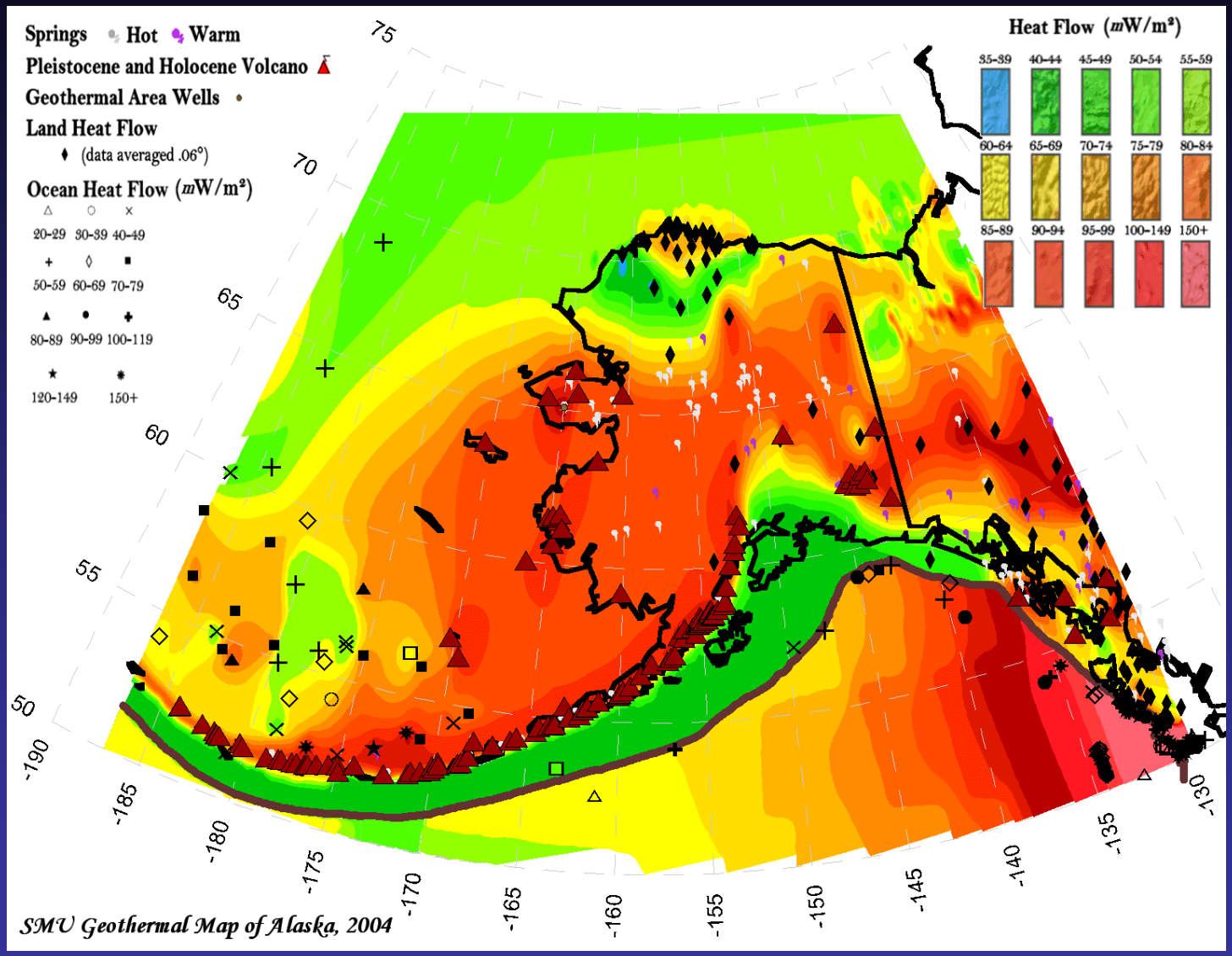
GeoPRISMS
Geodynamic Processes at Rifting and Subducting Margins

Subduction Zones with Well Determined Thermal States

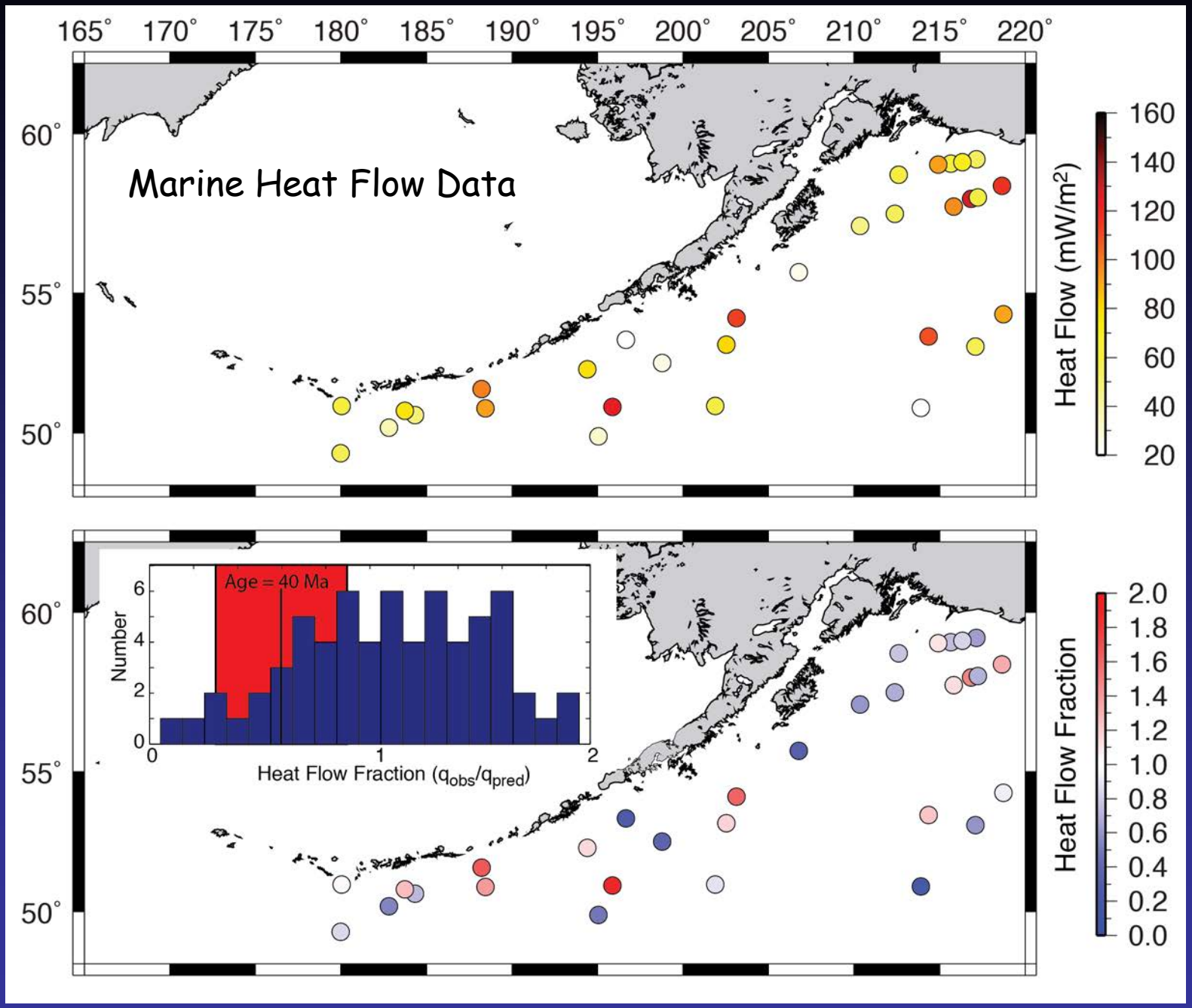


Only a few subduction zones with historical large earthquakes or tsunamis have adequate heat flow constraints

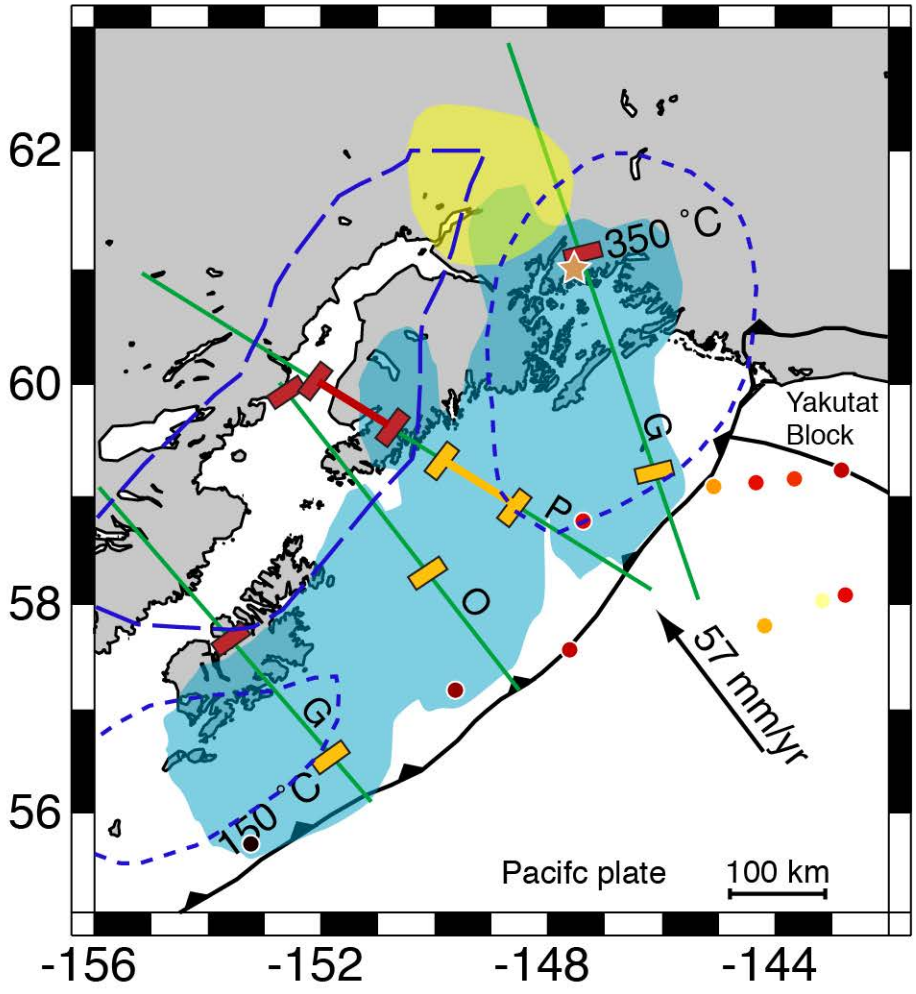
Heat Flow Data in Alaska



SMU Geothermal Map of Alaska, 2004
http://smu.edu/geothermal/heatflow/Alaska_hf.gif


Marine Heat Flow Data
165° 170° 175° 180° 185° 190° 195° 200° 205° 210° 215° 220°
60°
55°
50°
Heat Flow (mW/m²)
160
140
120
100
80
60
40
20
Age = 40 Ma
Number
0
2
4
6
0
1
2
Heat Flow Fraction (qobs/qpred)
Heat Flow Fraction
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0

Previous thermal models



1964 M9.2:
epicenter
rupture area

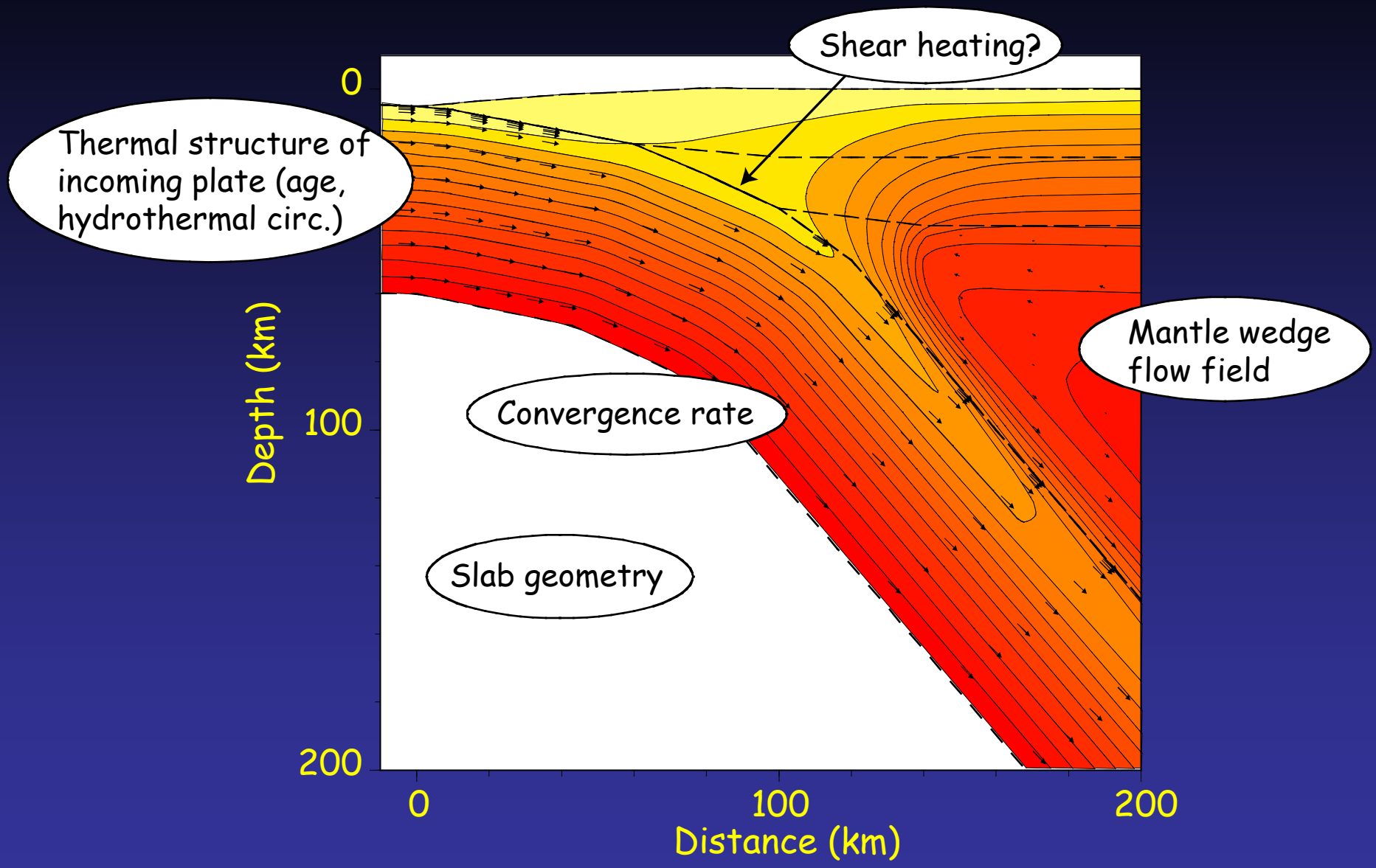
1998-2001 slow slip event area

Geodetically defined:
locked
creeping

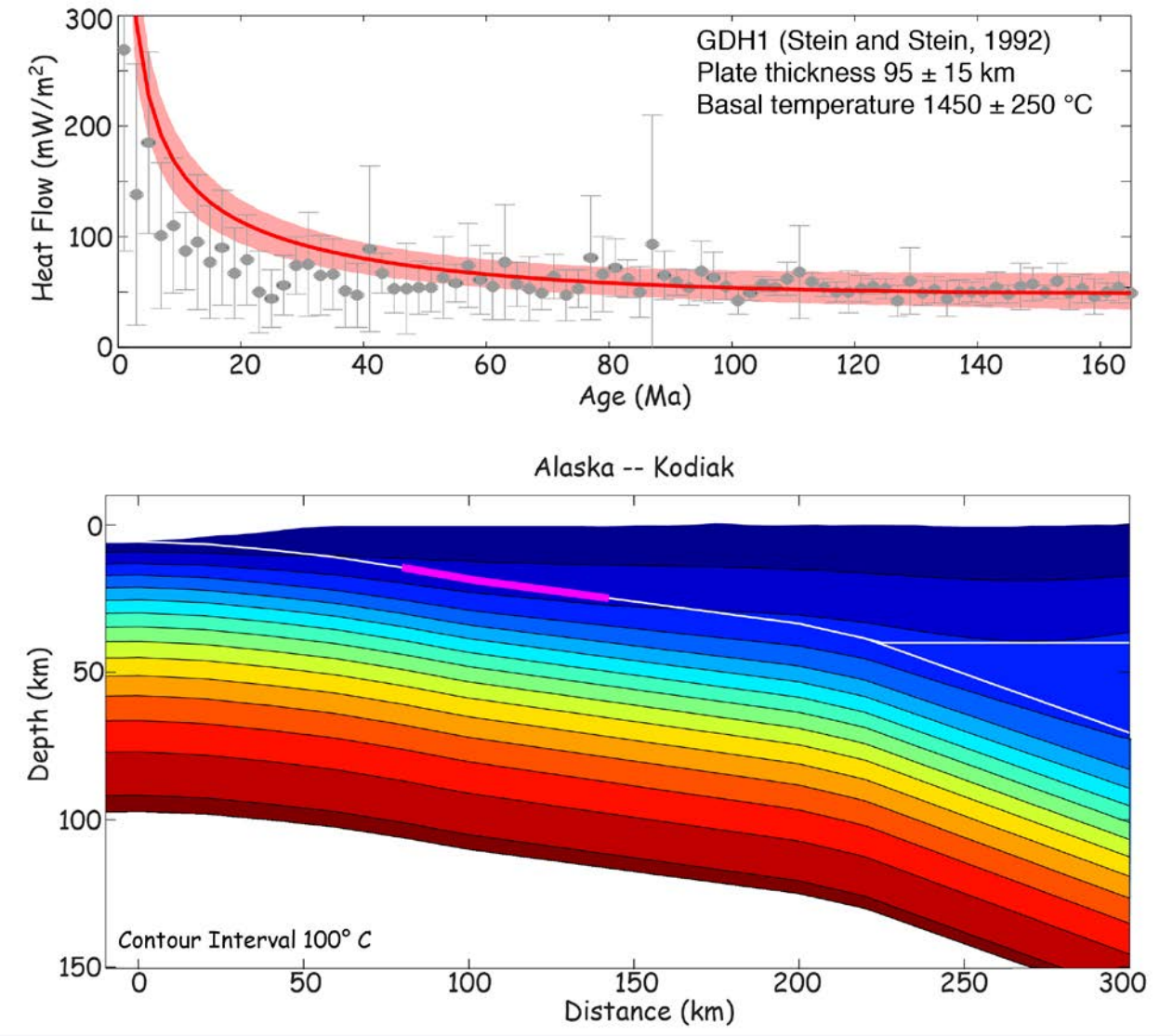
Previous thermal model results:
150 °C
350 °C

P = Ponko and Peacock, 1995
O = Oleskevich et al., 1999
G = Gutscher and Peacock, 2003

Thermal Structure of Subduction



Uncertainty in thermal model for through Kodiak Island due to initial geotherm



Heat Flow Surveys

- Ideally closely spaced heat flow measurements along a transect (1 -2 km spacing)
- Want colocated seismic reflection and heat flow measurements to understand measurement environment
- 4 m 11 thermistor violin bow probe
- Real time telemetry of data and in-situ thermal conductivity

See: http://marine_heatflow.oregonstate.edu

Potential Heat Flow Targets

1. Thermal state of Pacific plate prior to subduction;
2. Estimating fluid flow along plate bending normal faults;
3. Do along strike variations in heat flow correlate to along strike variations in interplate seismicity, SSEs, locking;
4. Fore arc heat flow;
5. Back arc heat flow.