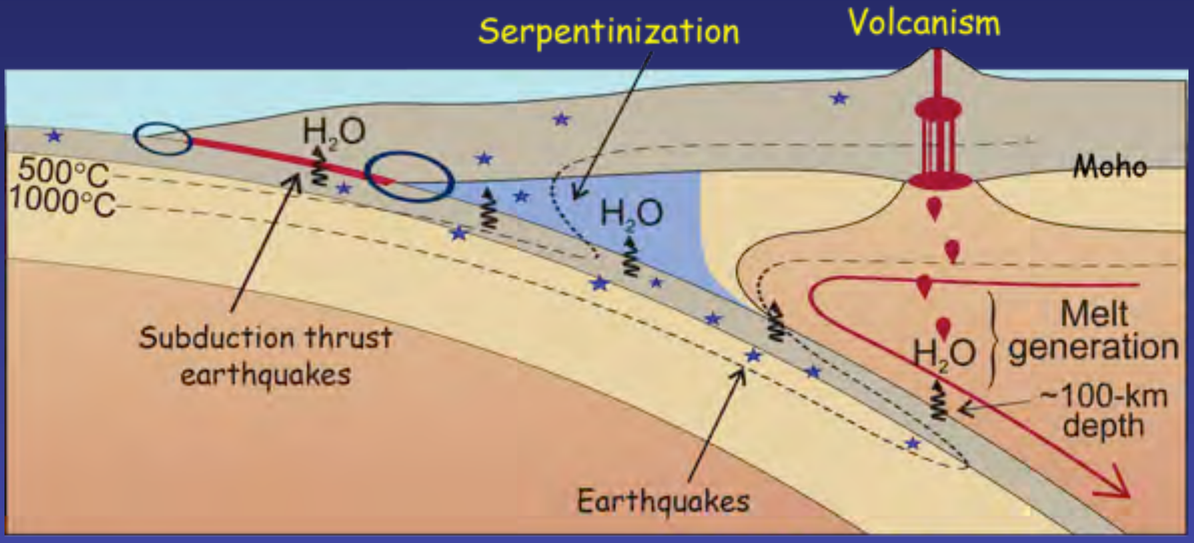
Heat flow along the Hikurangi Margin

Rob Harris, Oregon State University

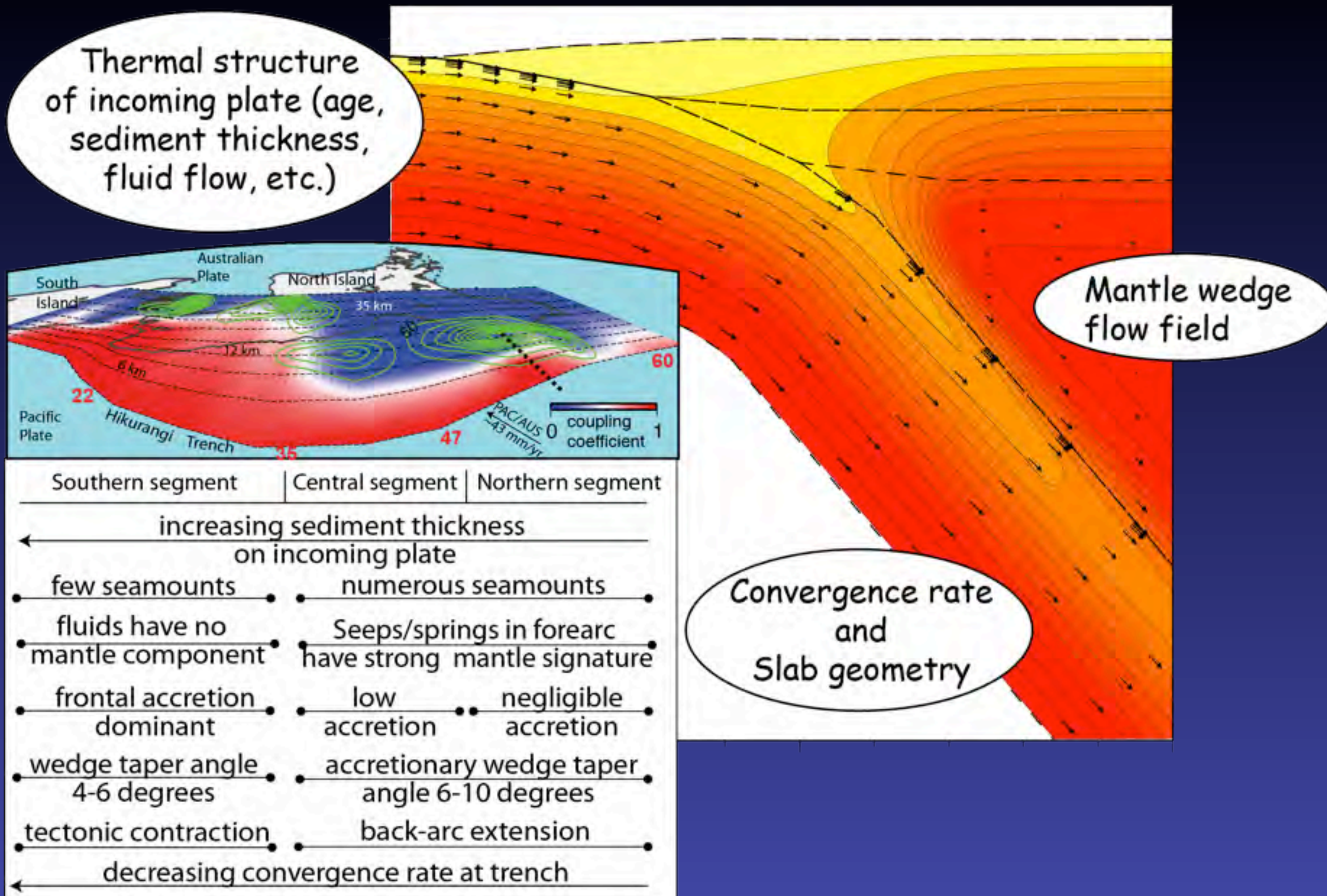
- sediment diagenesis, dehydration, and fluid production
- metamorphic dehydration reactions
- Updip and downdip extents of seismicity, magnitude of earthquakes
- Plate locking, patterns of deformation
- styles fluid flow



Modified from Wada and Wang, 2009

New Zealand Site Meeting

Thermal Structure of Subduction



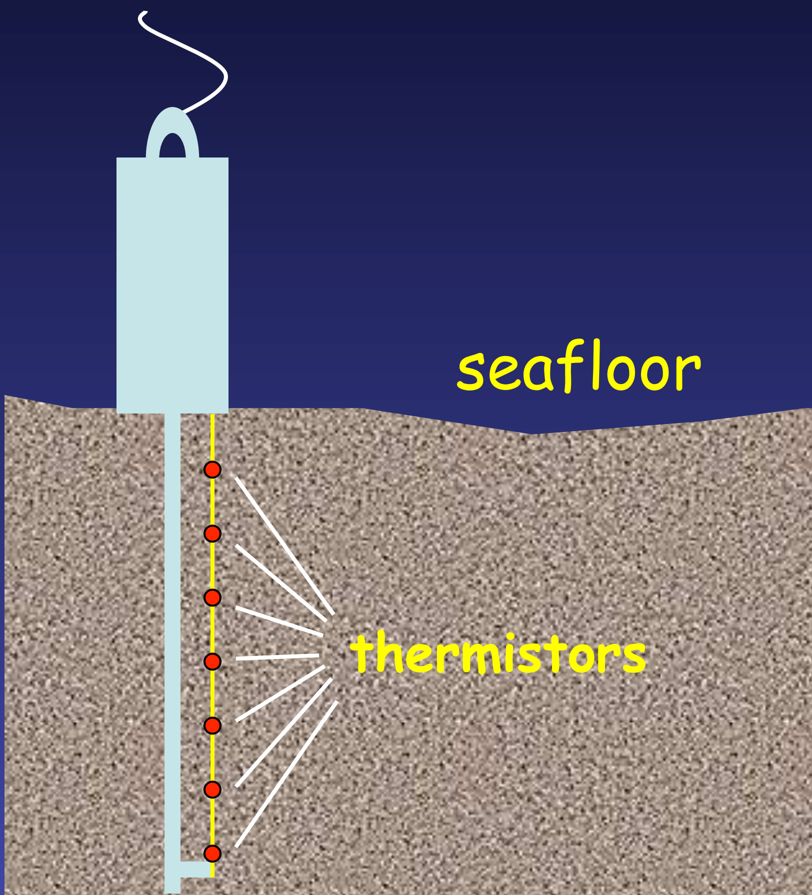
Wallace and Beavan, 2010

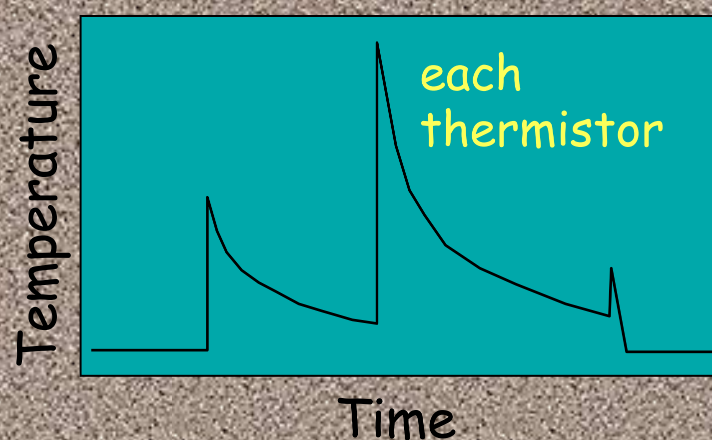
Marine Heat Flow

$q = -k \, dT/dz$

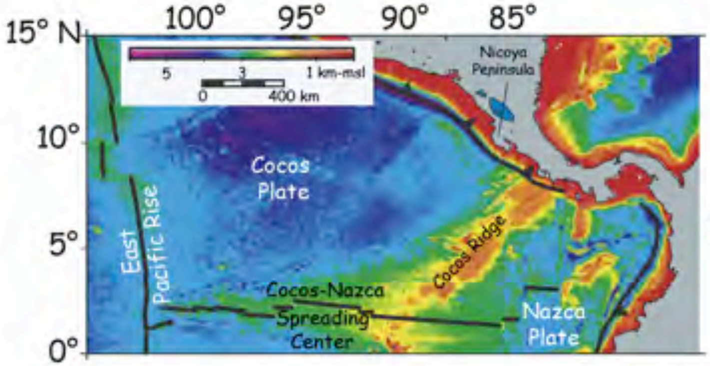
dT/dz = thermal gradient

k = thermal conductivity

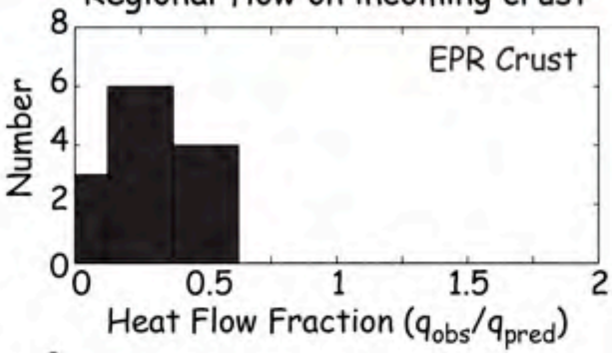


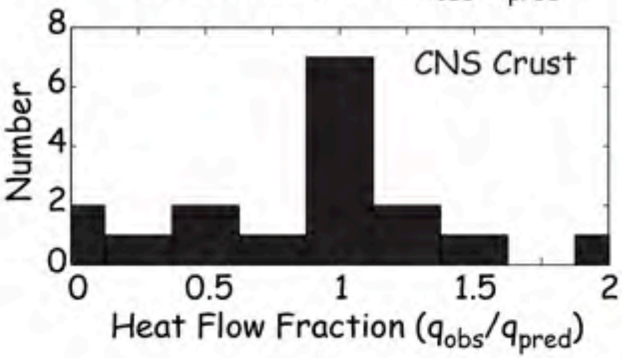


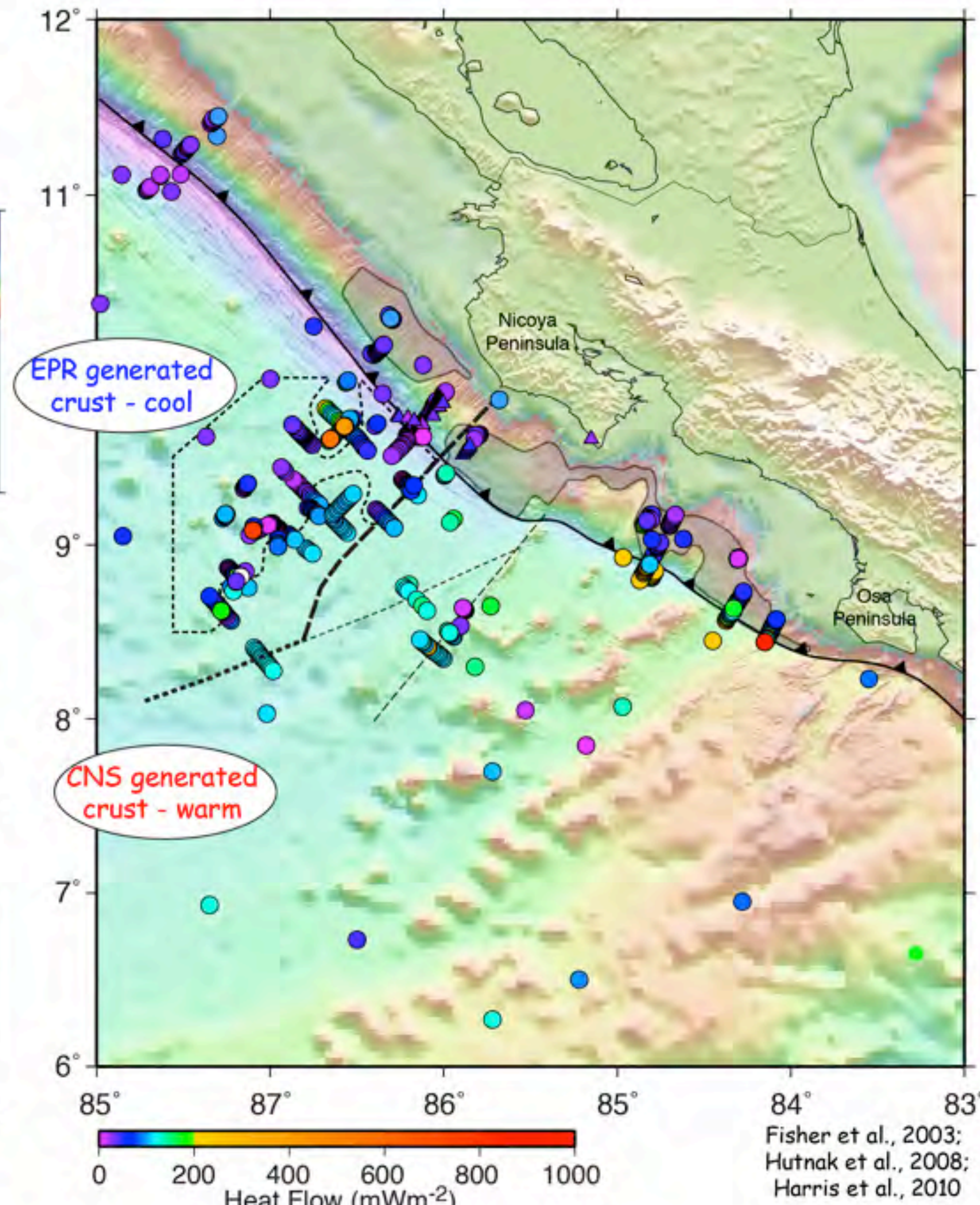
Heat flow data along the Costa Rica Margin



Regional flow on incoming crust

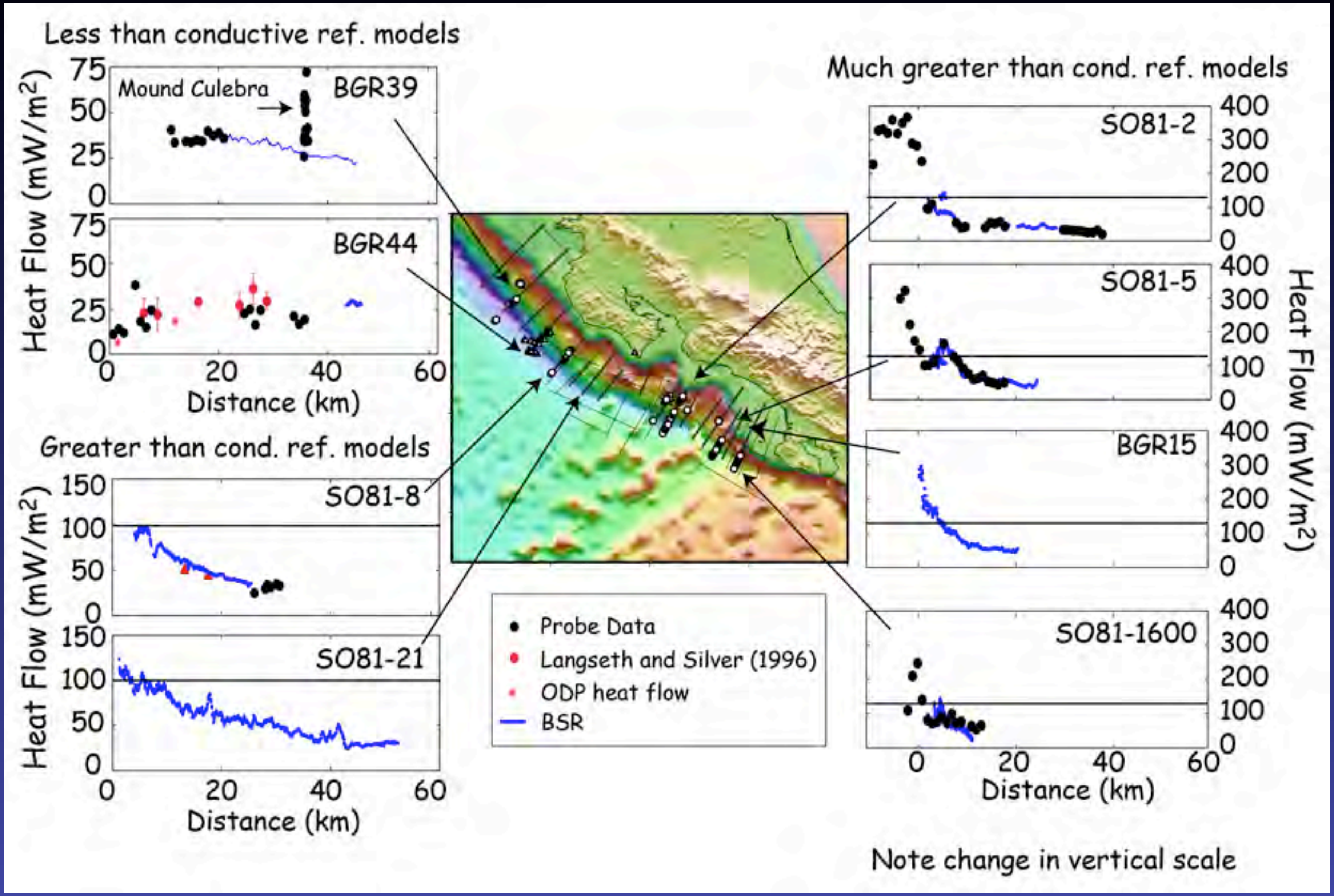






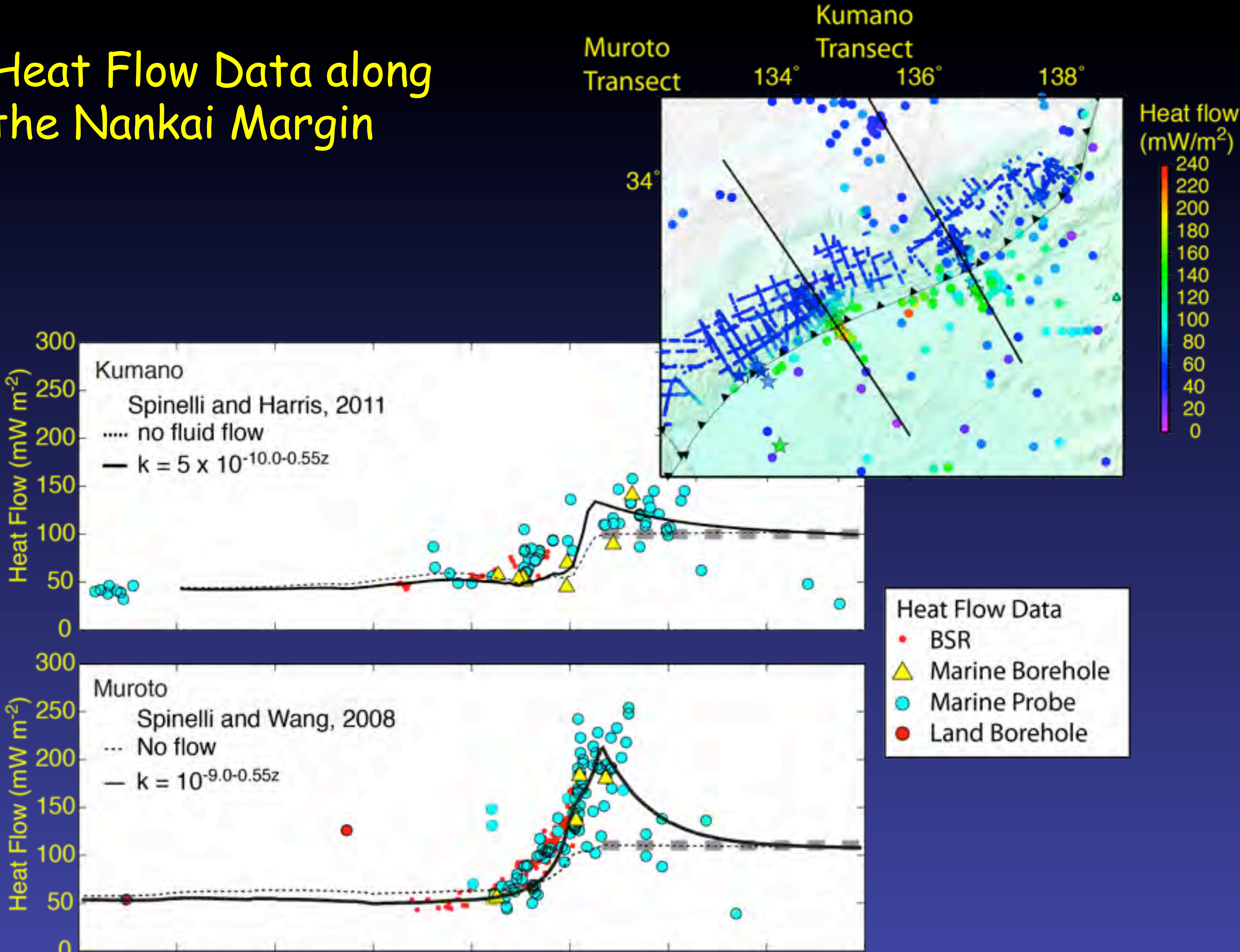
Fisher et al., 2003;
Hutnak et al., 2008;
Harris et al., 2010

Heat Flow Data across the Costa Rica Margin

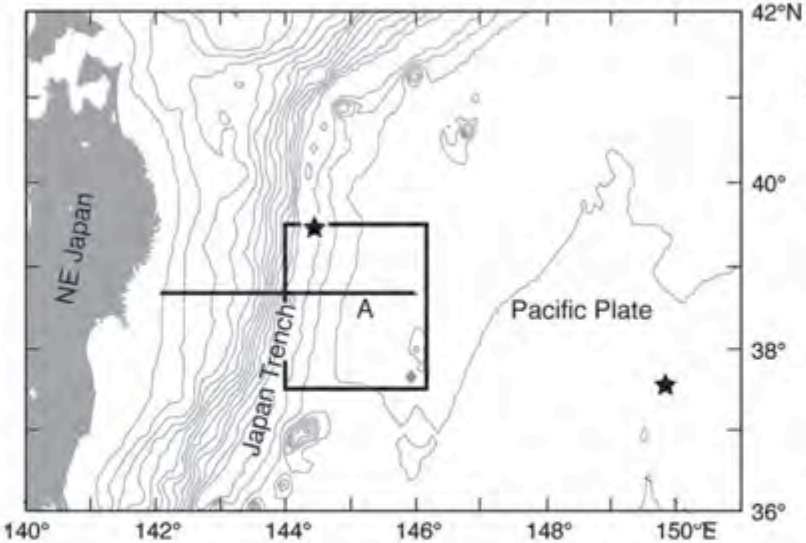


Harris et al., 2010

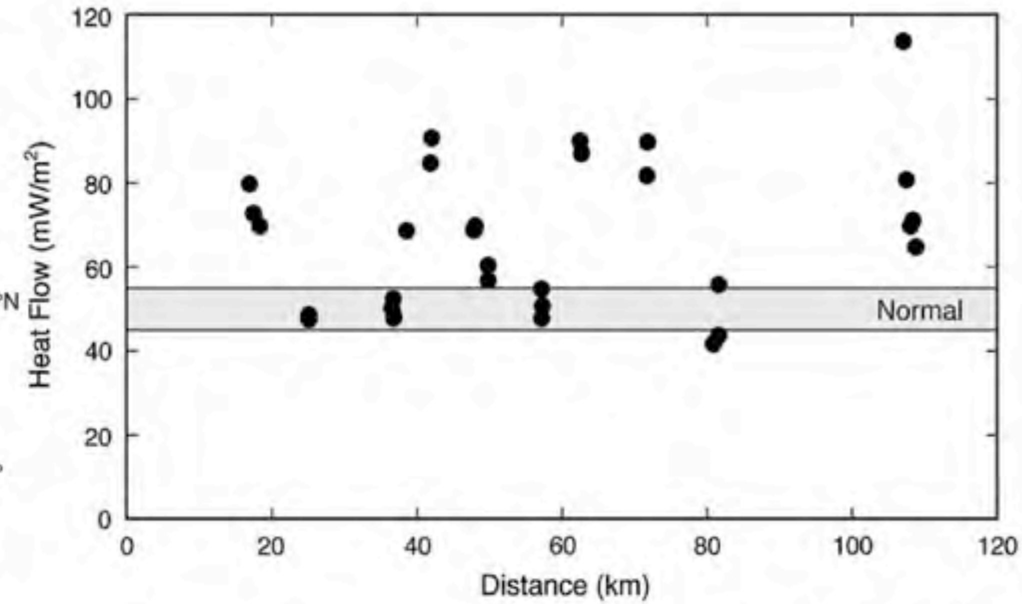
Heat Flow Data along the Nankai Margin

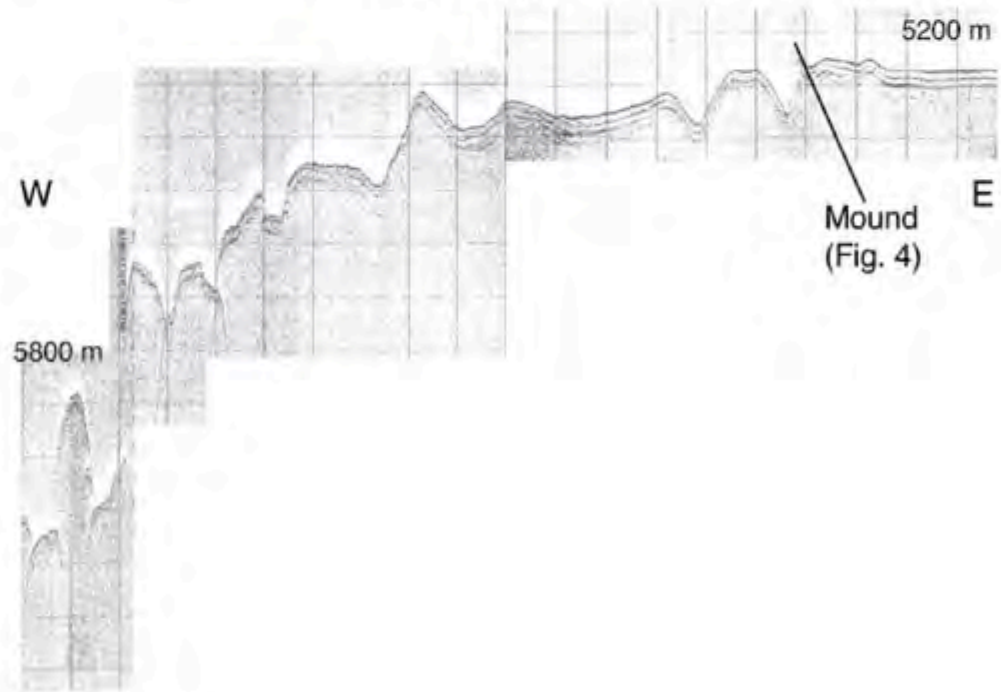


Northern Japan

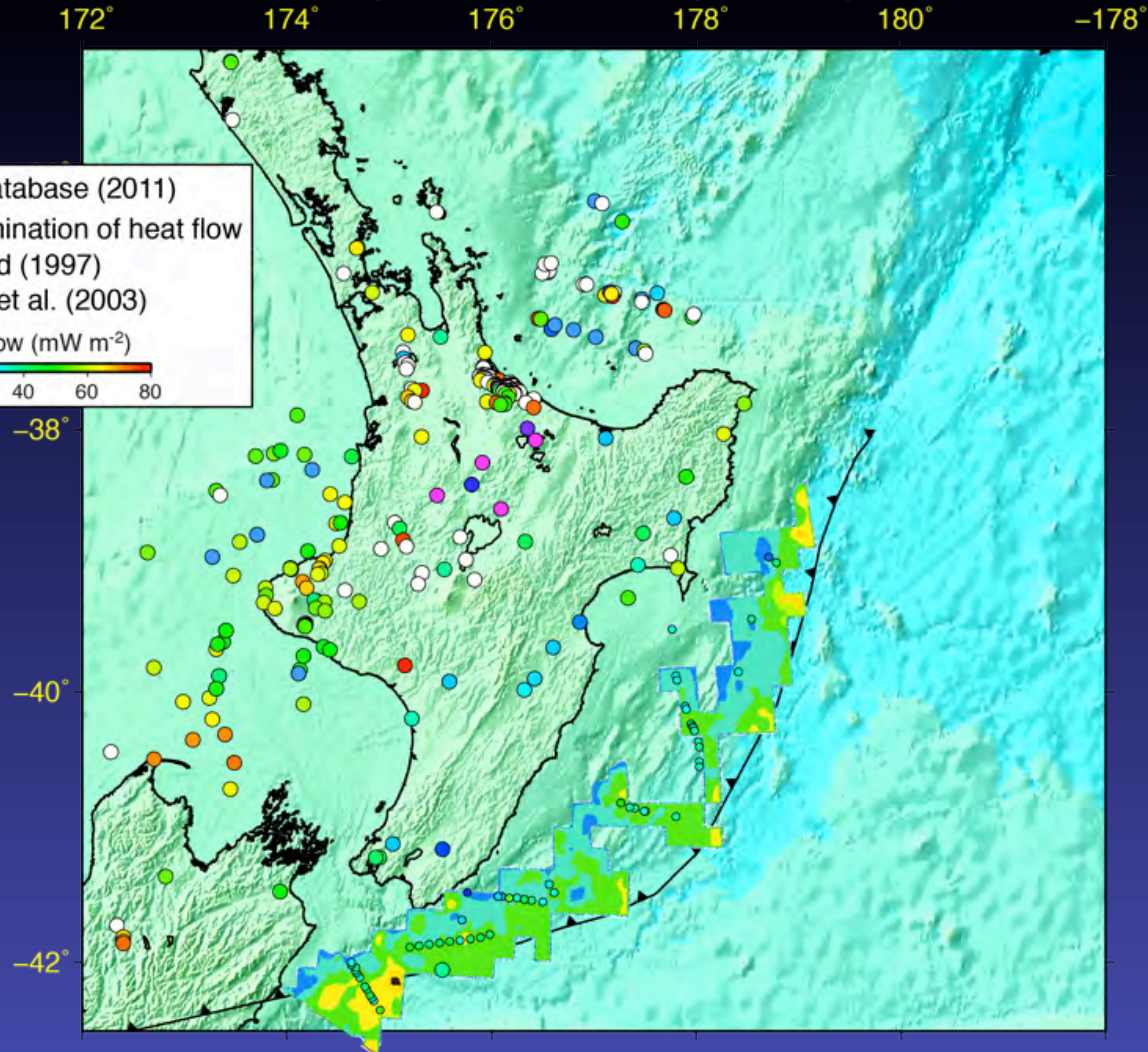


Yamano et al., 2008





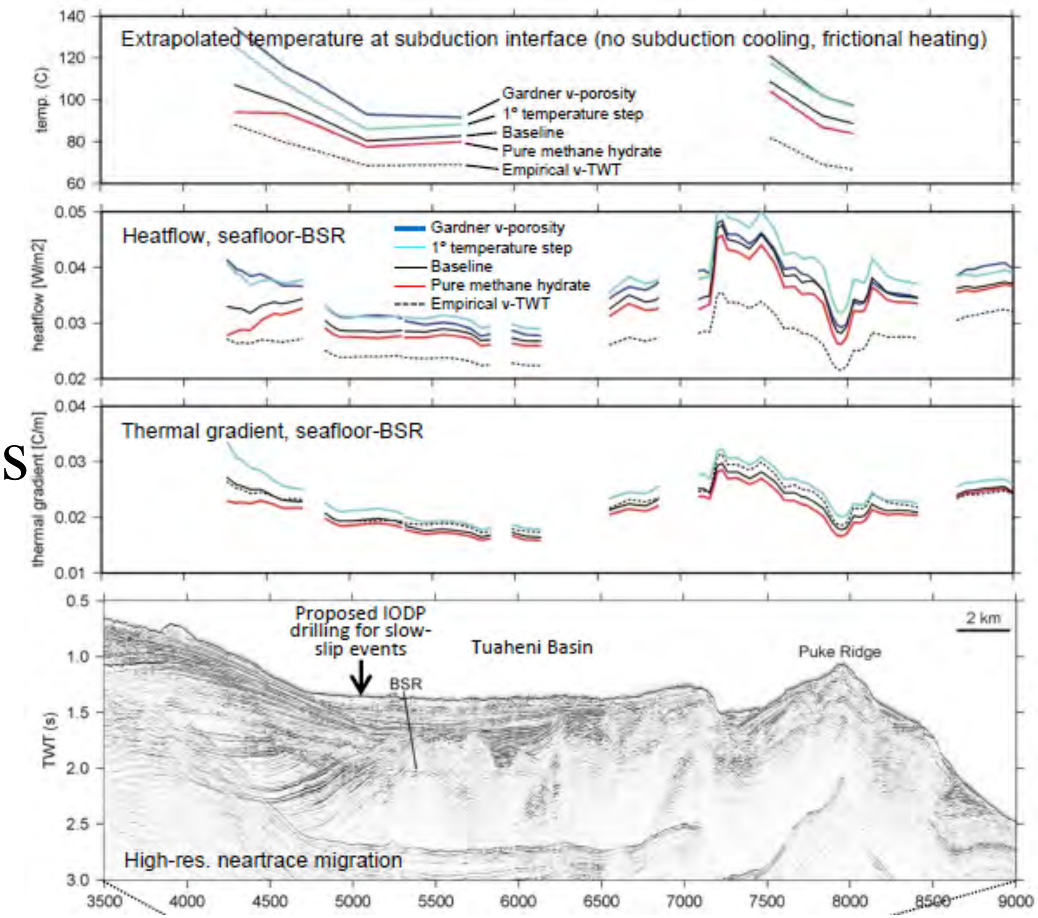
Thermal measurements along the Hikurangi Margin



A Cold Subduction Zone – Heatflow on the Hikurangi Margin (Poster)

Ingo Pecher[1,2], Stuart Henrys[2], and Daniel Barker[2]
[1]University of Auckland, [2]GNS Science, Lower Hutt, New Zealand

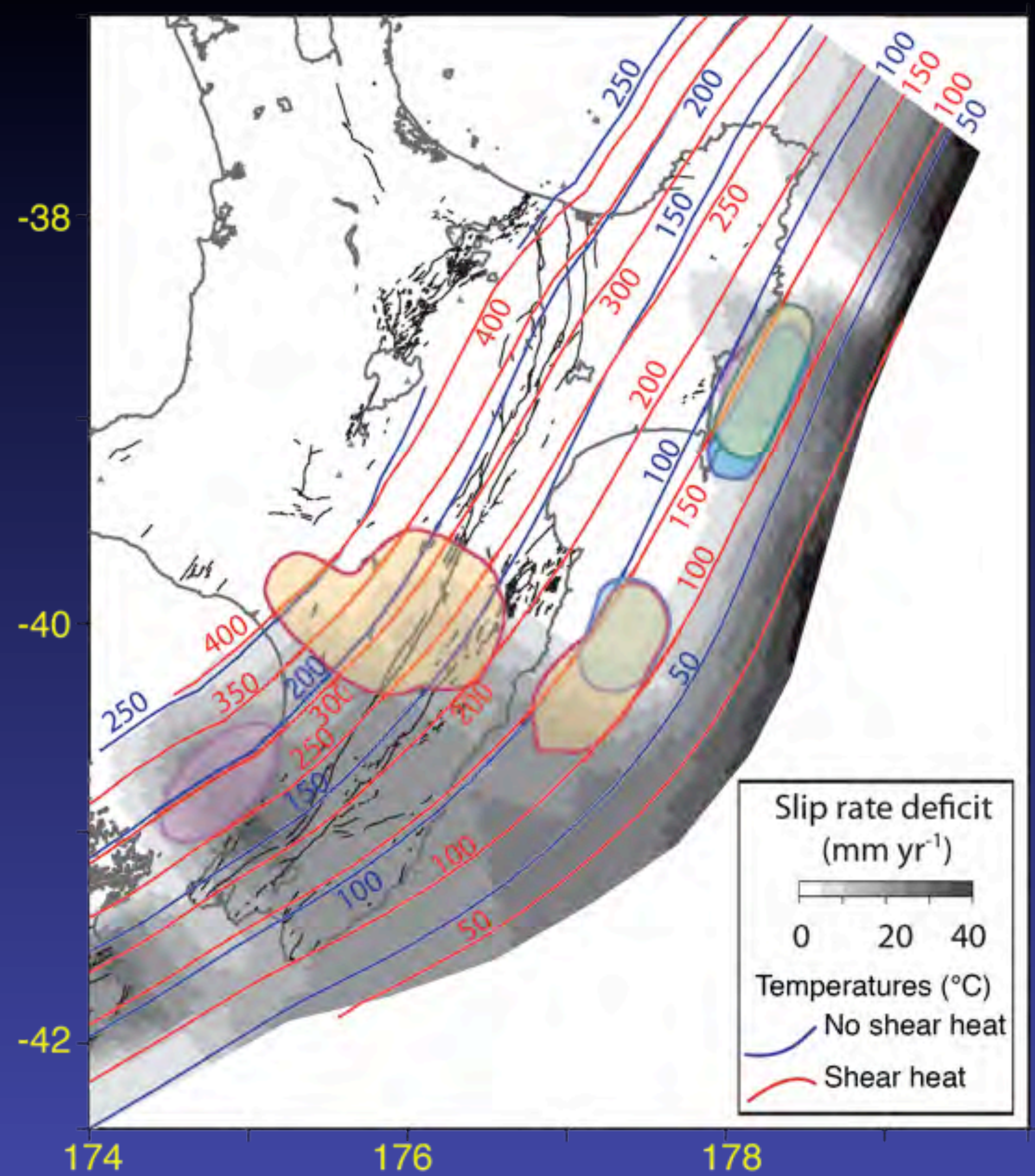
Key findings:
•Low heatflow → deep BSRs (to 700 mbsf)
•Paleo-water temperatures and thermal conductivity among key unknowns



Thermal models across the Hikurangi Margin

Simple thermal advection based on equations from Molnar and England, 1995

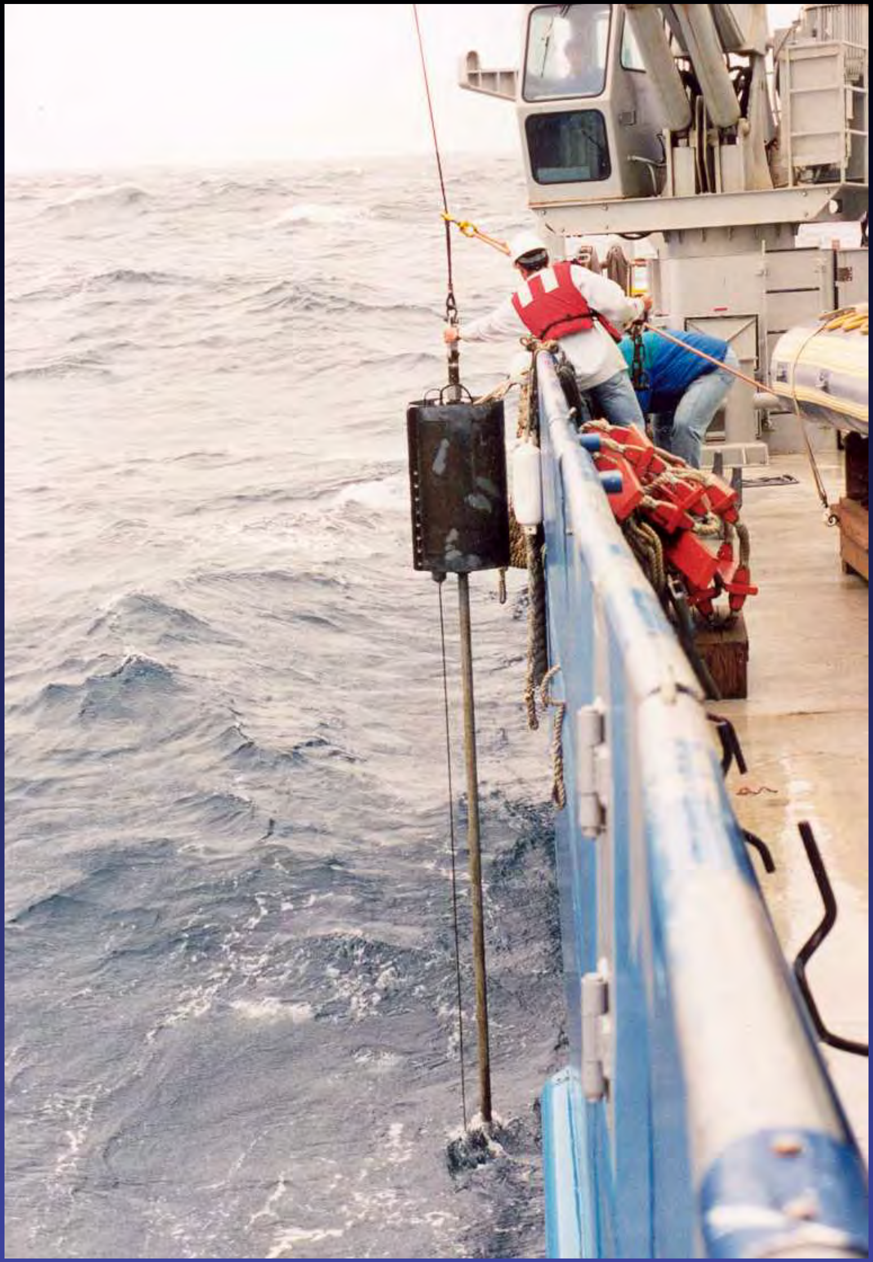
80 My seafloor



McCaffrey et al., 2008

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

Overarching questions for understanding the temperature regime of subduction thrust

1. What is the thermal state of Pacific plate and Hikurangi Plateau prior to subduction?
   Uncertainties in global plate models used to initialize thermal models of subduction are not always appropriate and may lead to large uncertainties.
2. How does the thermal regime change along strike?
   Strong variations in convergence rate, sediment thickness, subduction accretion to subduction erosion.
3. What is the fluid flow regime through the shallow margin, how does it change between subduction erosion and subduction accretion? How do pattern of overpressure development change along strike?

Heat flow transects across both the northern (slow slip area) and southern Hikurangi margin will help address these questions.