Survey of heat and fluid flux of the Cascadia Subduction Zone on the Washington margin

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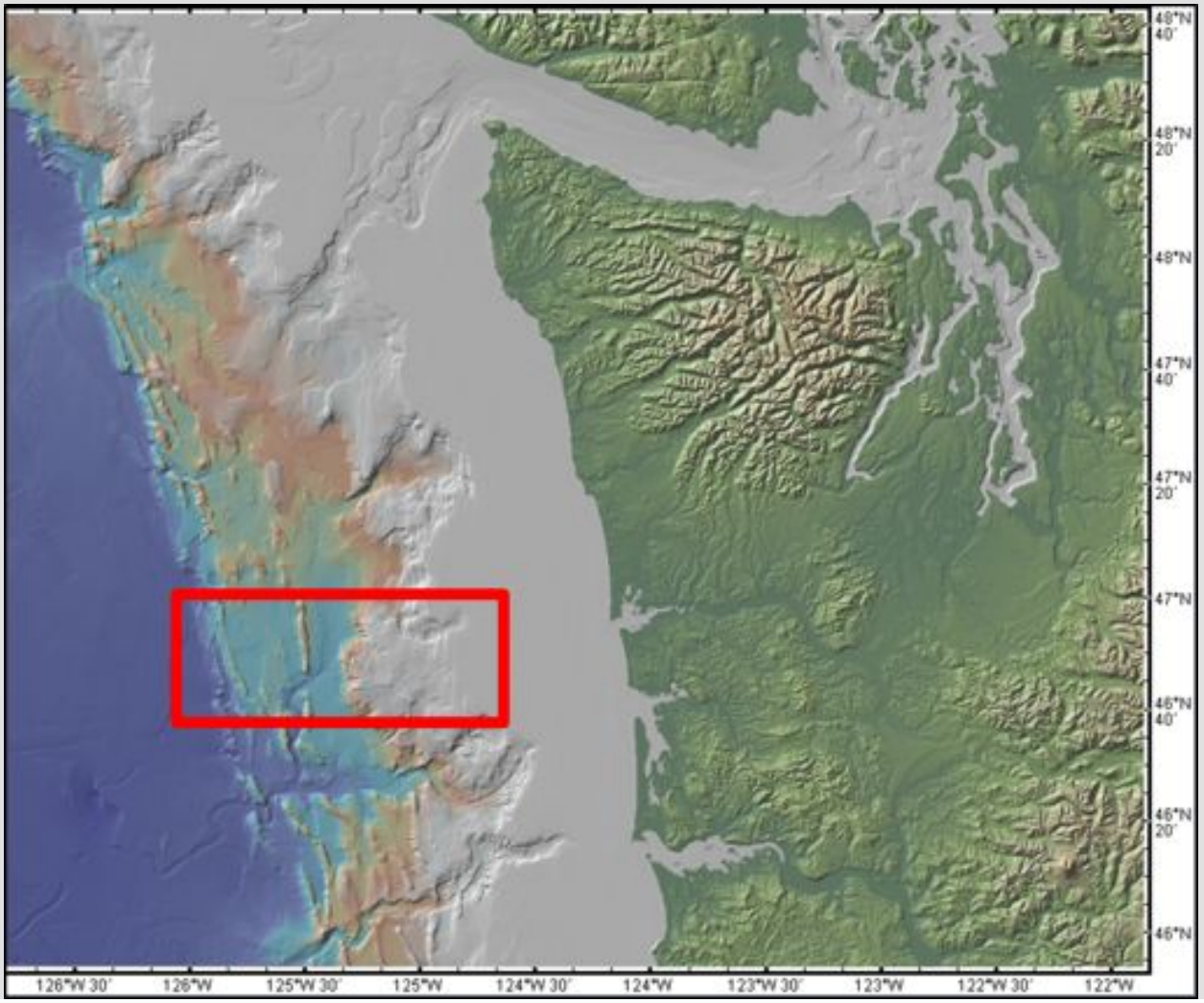
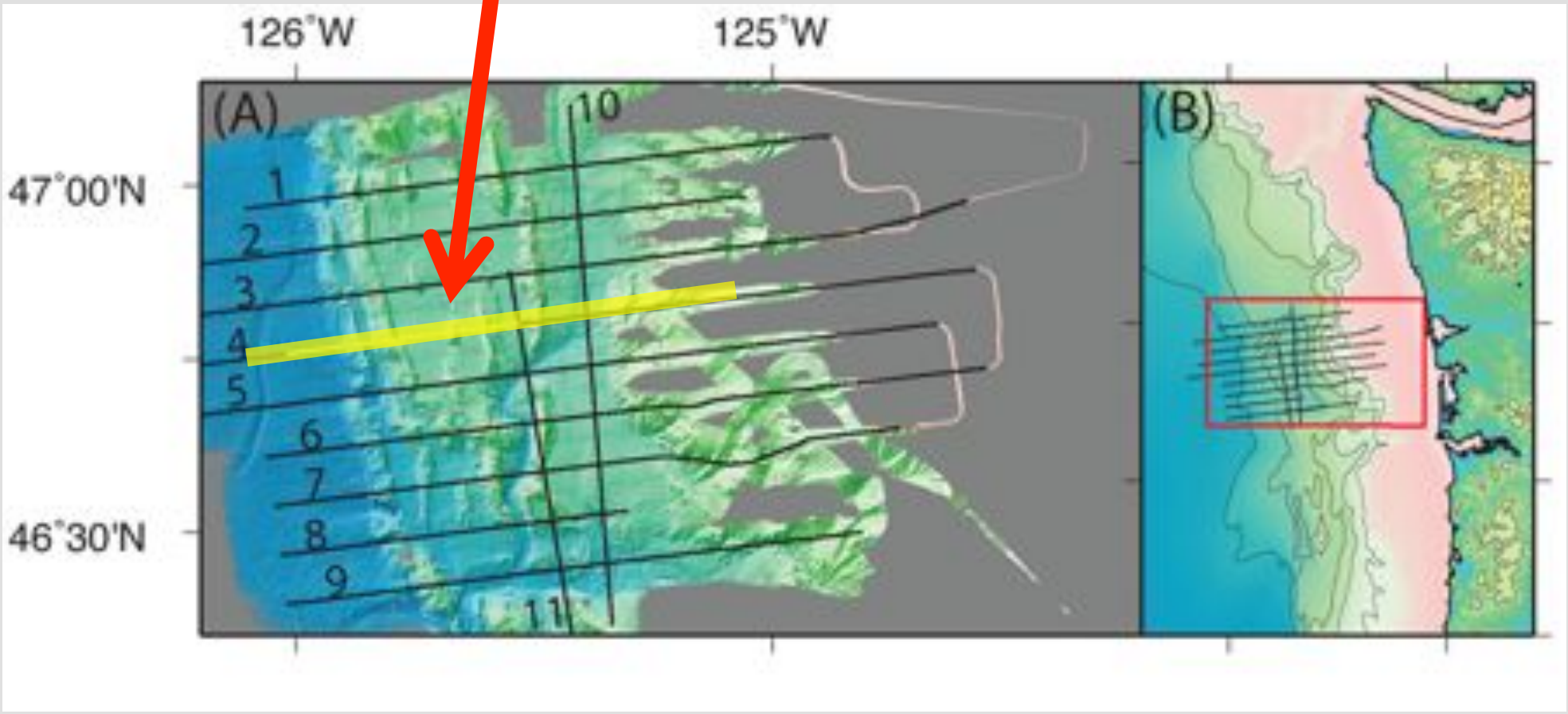
R/V ATLANTIS with ROV JASON II

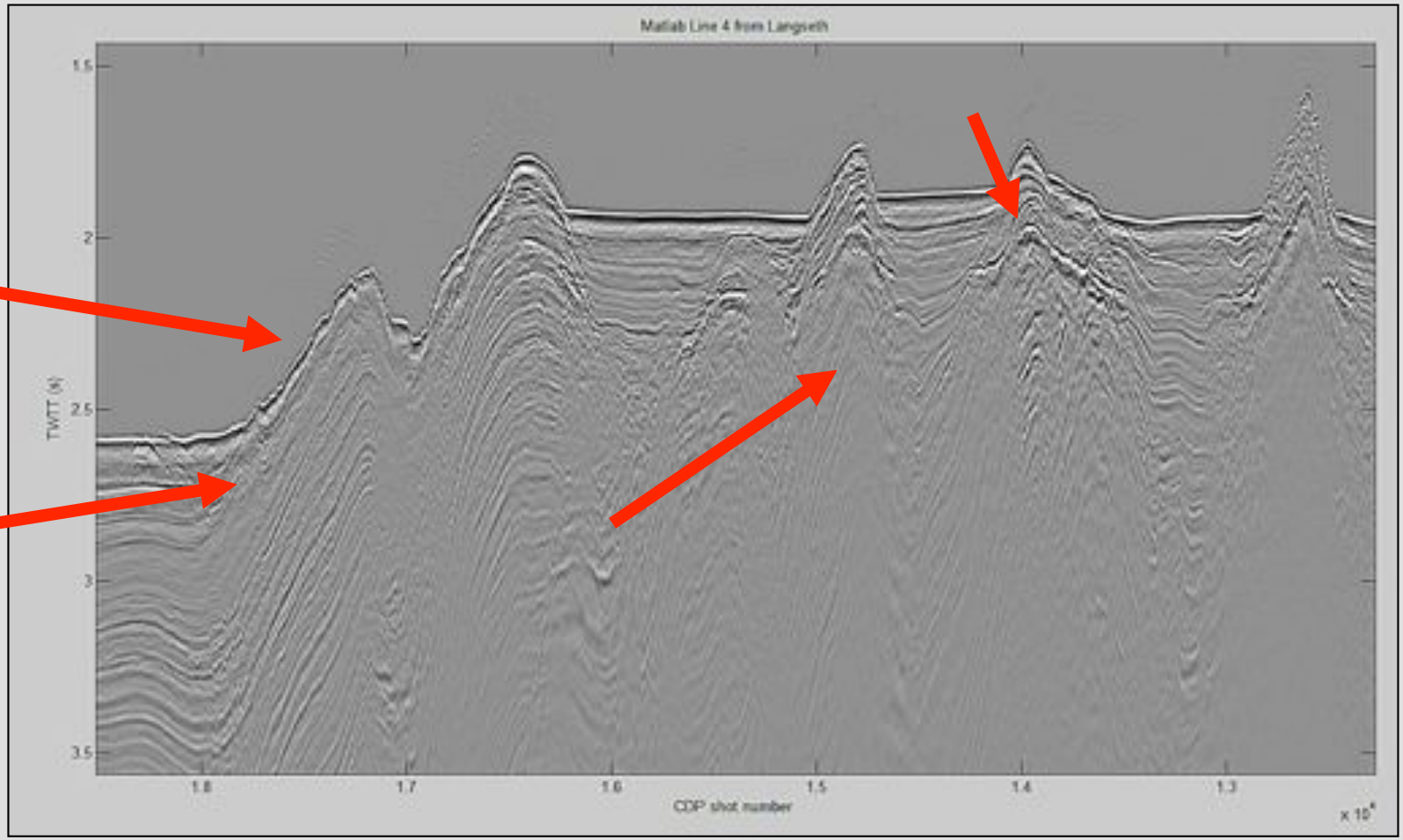


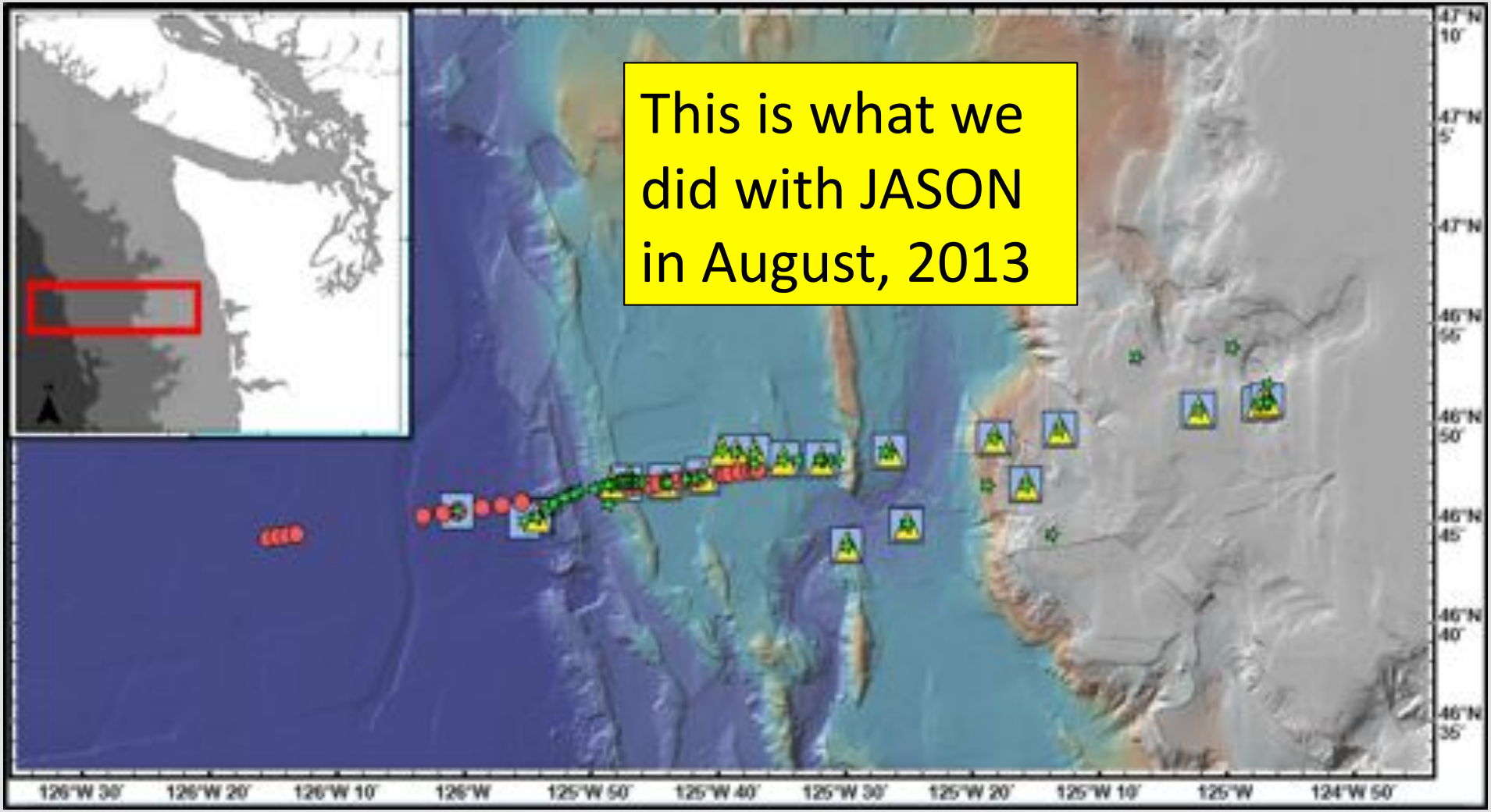
Prior 2012 Cruise – We used the MCS survey done with the R/V LANGSETH, completed in 2012.

Our 2013 profile was on top of the Langseth Line 4



Line 4 of the Langseth data, showing the deformation front, BSRs, seismic wipeouts and landward verging folds.

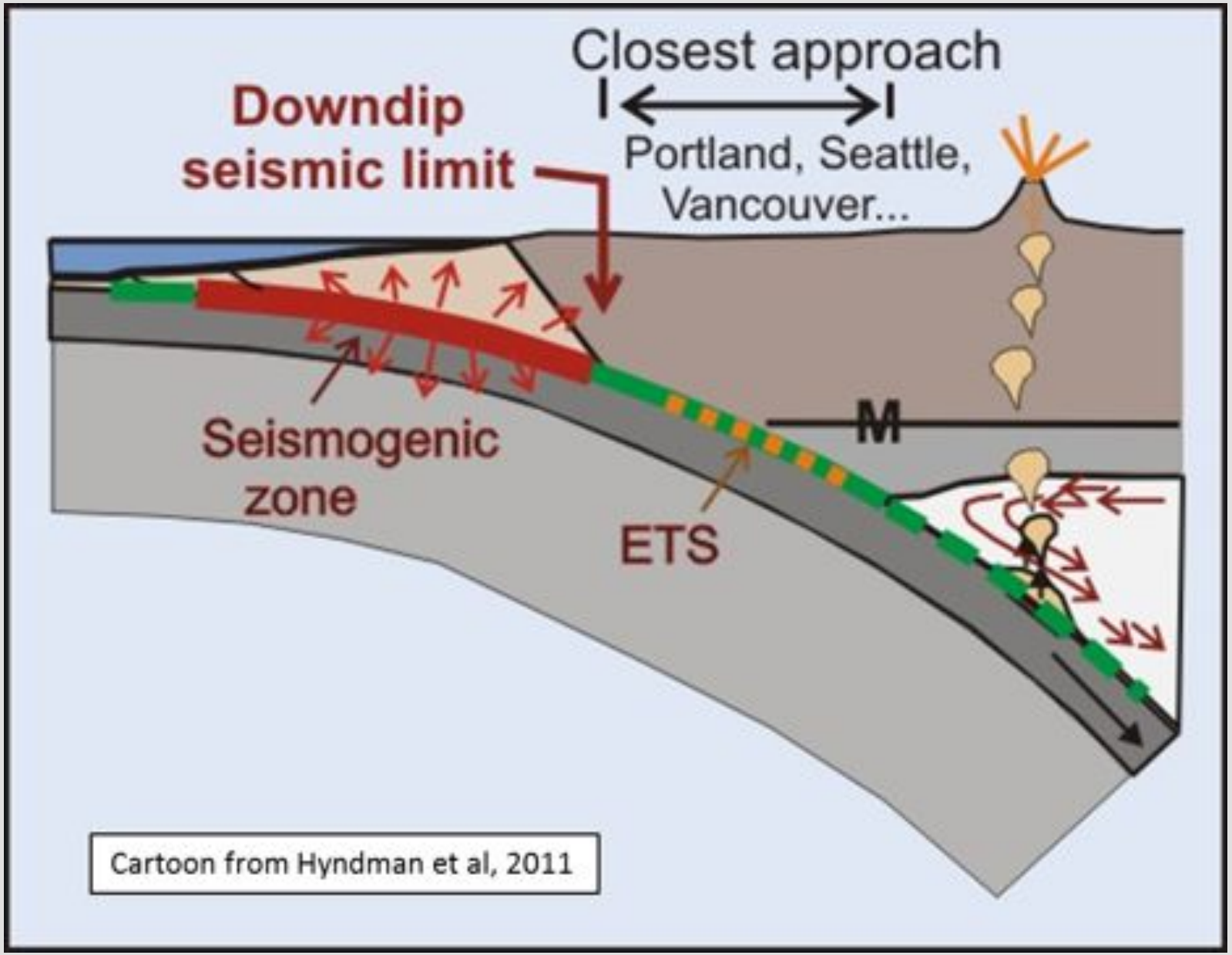




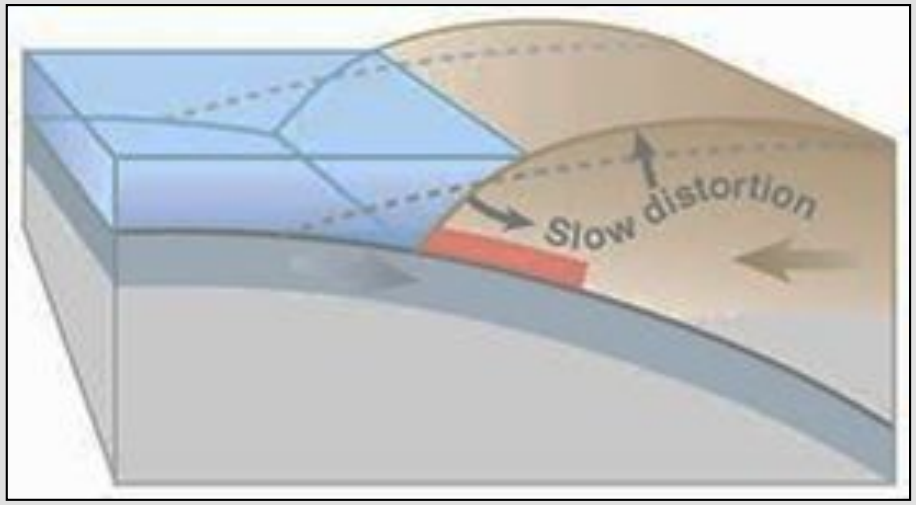
Sampling profile: 28 thermal blankets (blue squares), 23 Mosquito flow meters (yellow triangles), 26 long-probe heat flow (red circles) and **204 Jason heat flow insertions** (green stars).

Not shown: 16 sediment multi-cores, 26 push core recoveries, 9 CTD casts

The primary goal of the cruise was to determine the location of the 'locked segment' of this fault.

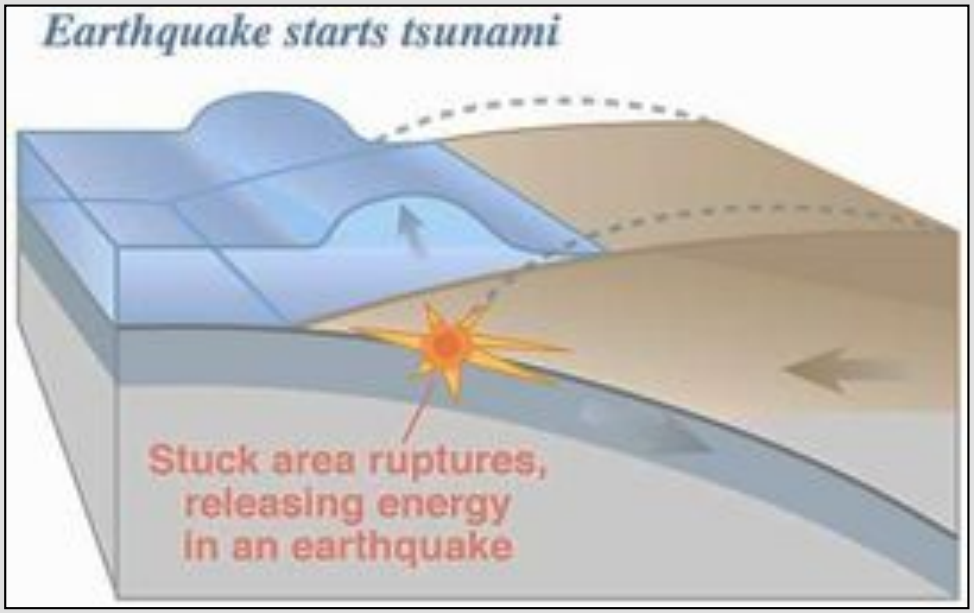


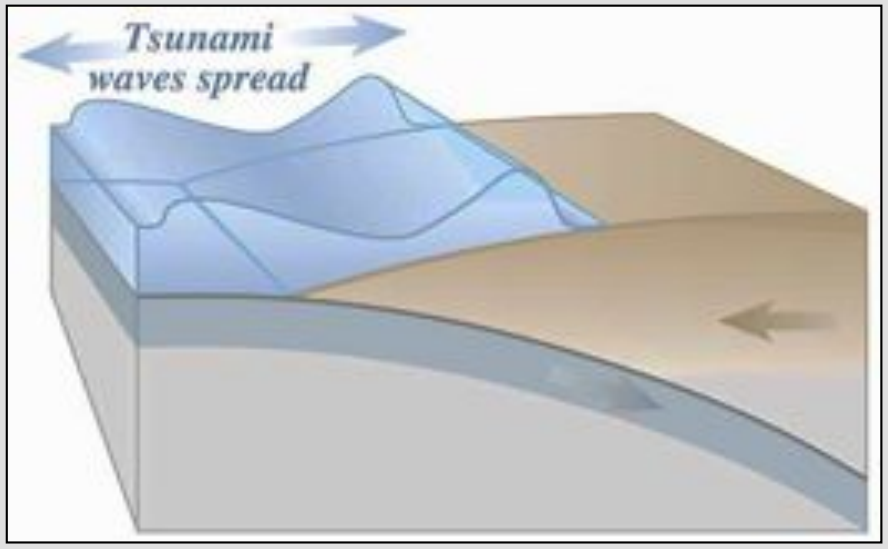
WHY DO WE CARE WHERE THE LOCKED PORTION OF THE CASCADIA SUBDUCTION ZONE IS LOCATED?



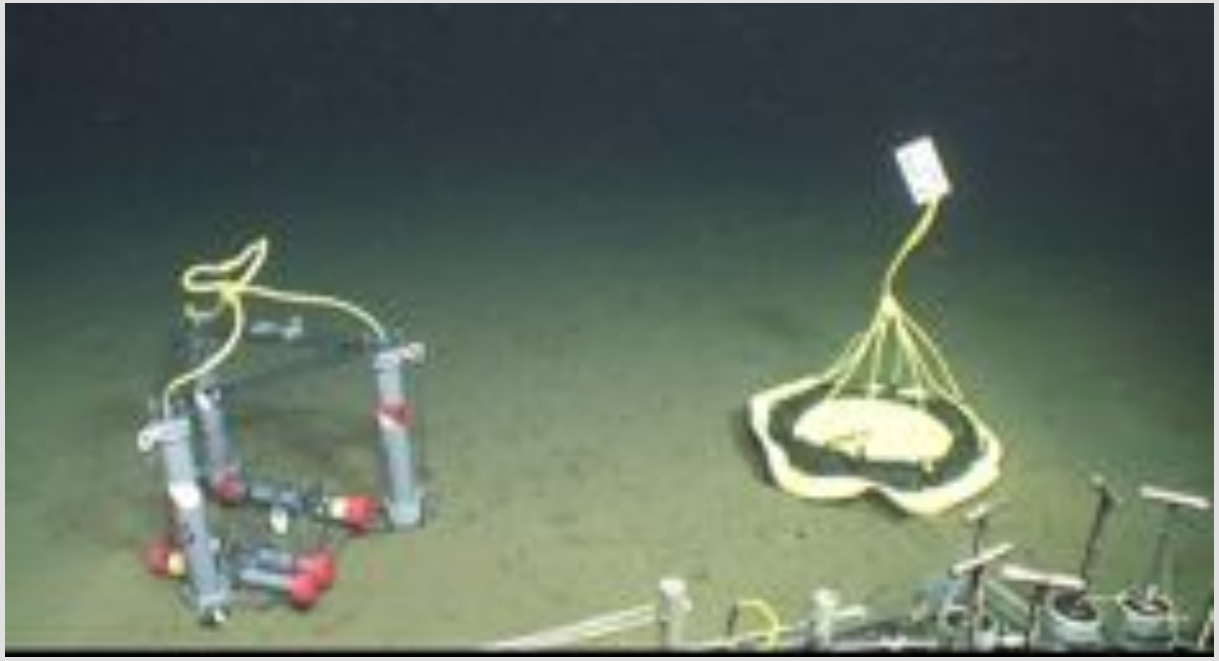
Red band represents 'locked zone'. The area that prevents movement on the fault, but stores compressional energy of the colliding plates.

When locked zone fails, the area directly above it is the line-of-epicenters for the mega-thrust quake.





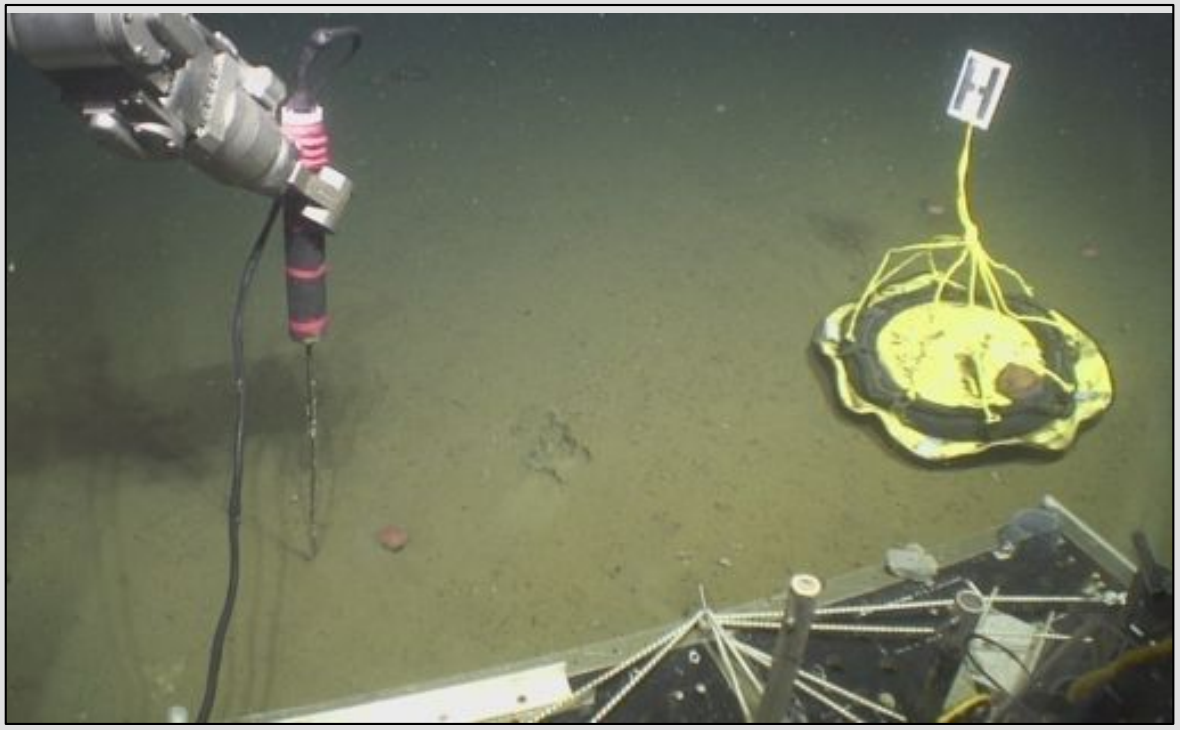
If the locked zone is **off-shore** - in deep water, you get **BIG TSUNAMIS**, and LESS damage on-shore. If it is under the coast, you get MORE shore damage, but **SMALLER tsunamis**.



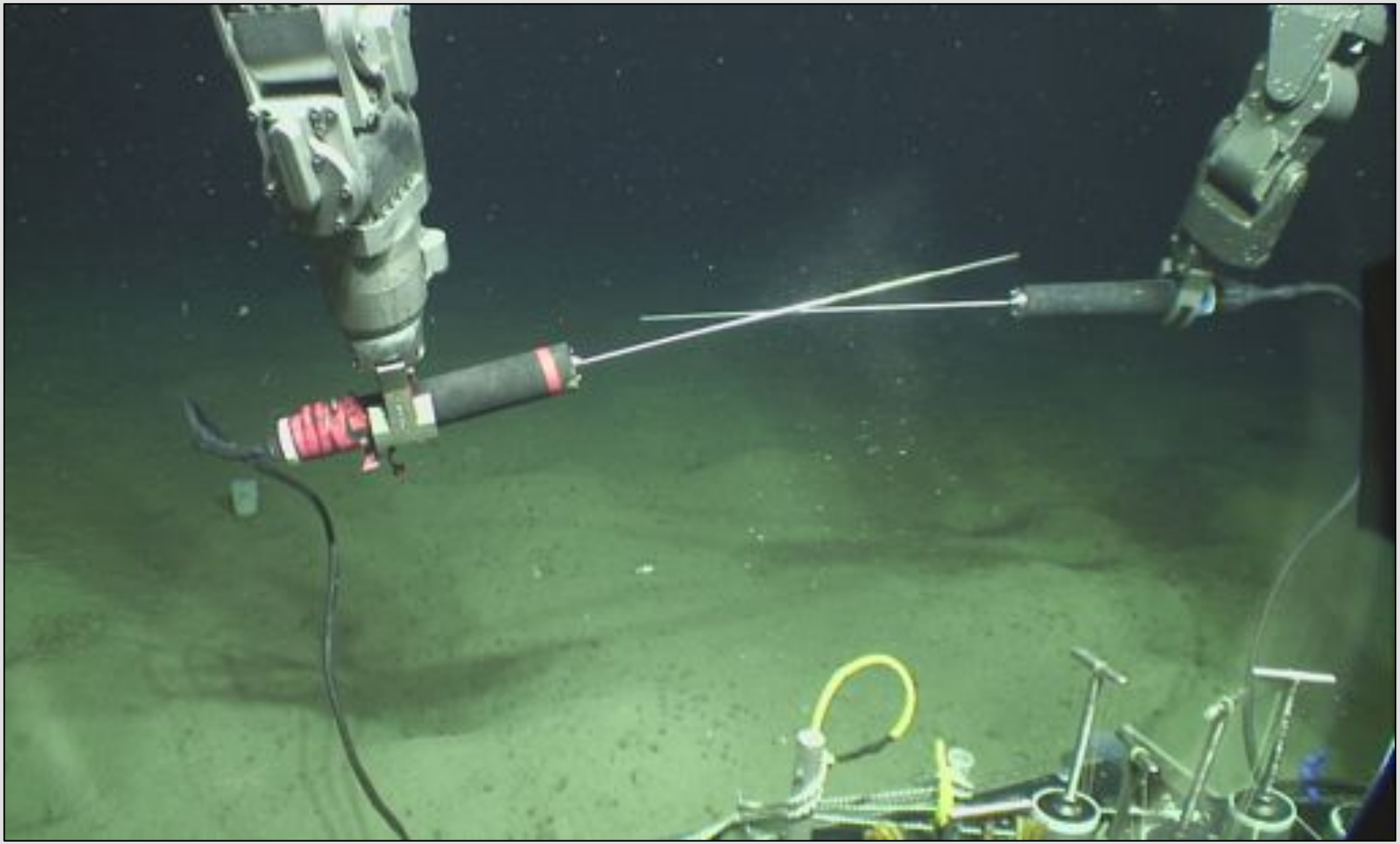
Mosquito on the left, thermal blanket on right

Jason Heat Flow probe on left:

Thermal blanket on the right.

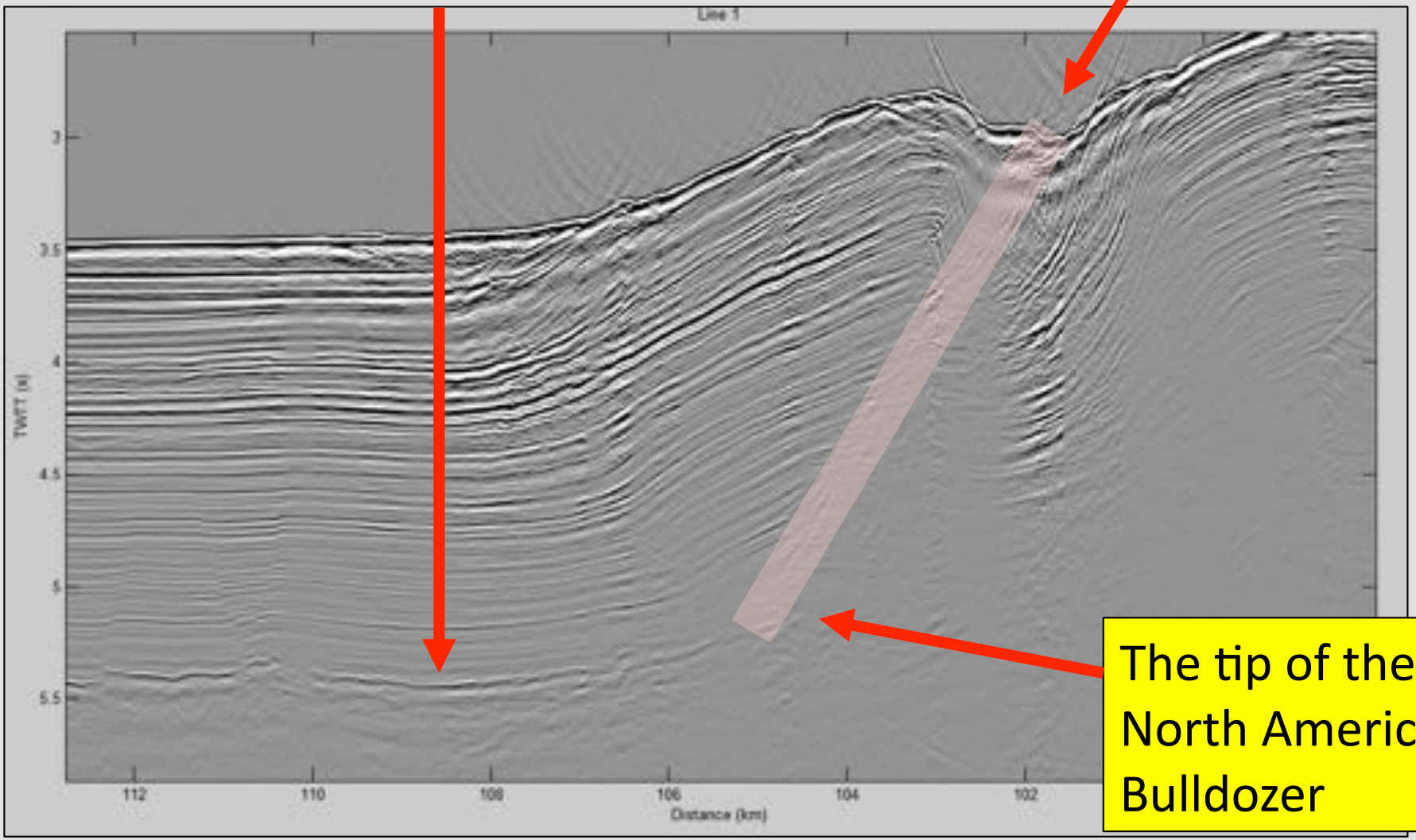


Two Gun Jason – ‘packing heat’ in each manipulator



THE UP-SLOPE LIMIT: First fault that extends from basement through the entire sediment cover.

Basement here is 225°C.



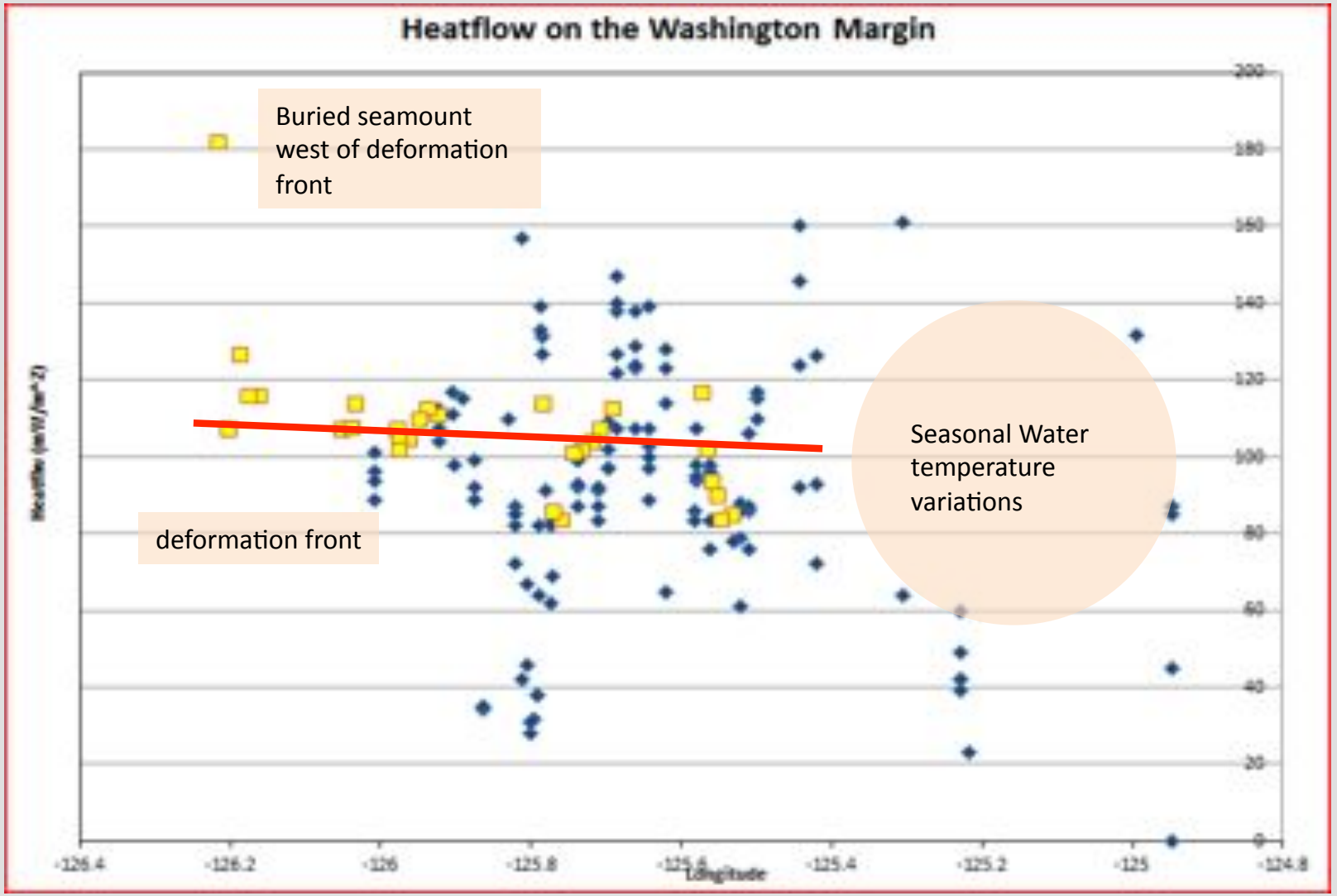
The tip of the North American Bulldozer

NOW, where is the downslope limit of the locked zone?

Where the basement/sediment interface temperature is **350°C**

Heat Flow values: after initial processing and basic QA/QC
Yellow squares are long probe: blue diamonds are Jason short probe.
Red line is my eyeball fit.

Scatter is due to fluid flux in sediments



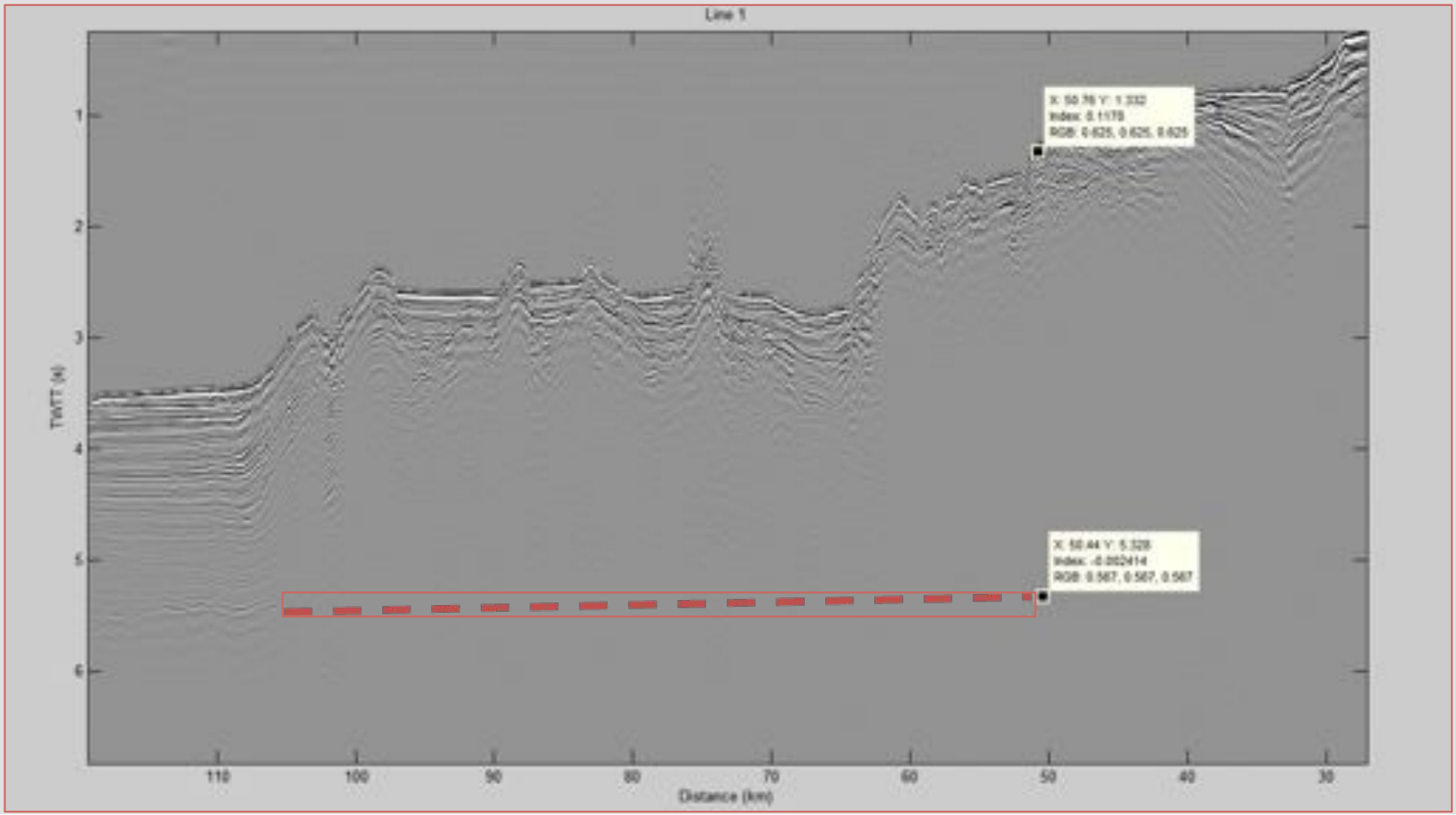
Basement temperature just west of deformation front is **225°C.**

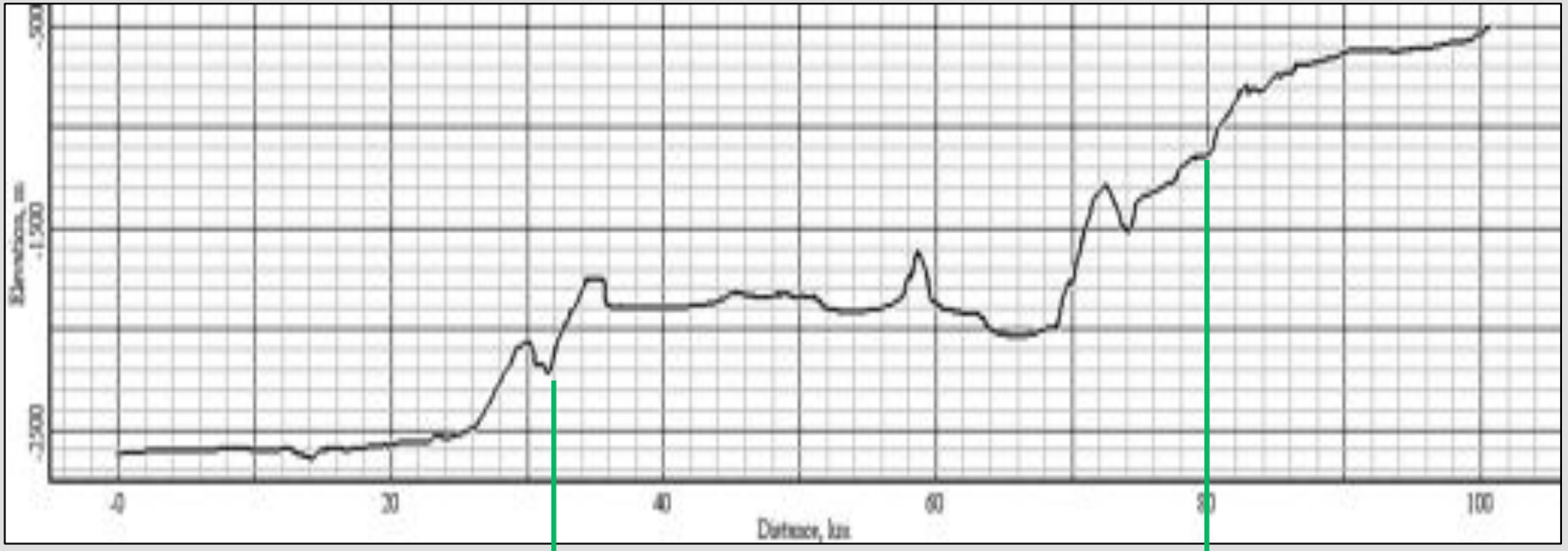
NOT 125°C.

Downslope limit of locked zone: Post-cruise processing puts the basement/sediment interface **temperature of 350°C** beneath the mid-depth section of the continental slope.

At 1000 meters water depth.

NOT beneath the shelf, coast line or under the Olympic Penninsula





The locked zone boundaries are probably here. 50 km wide

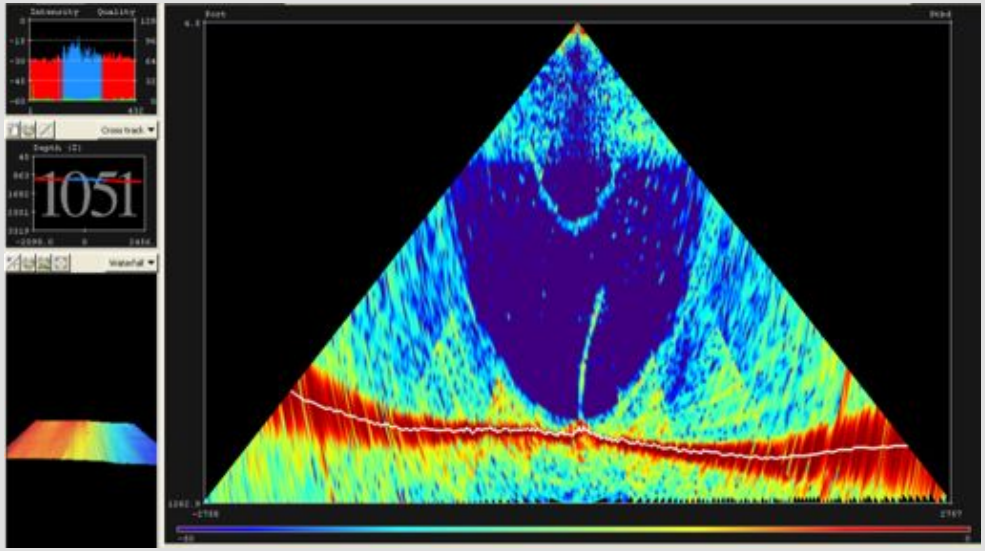
120°C in mid-Cascadia Basin.

No one believes that…

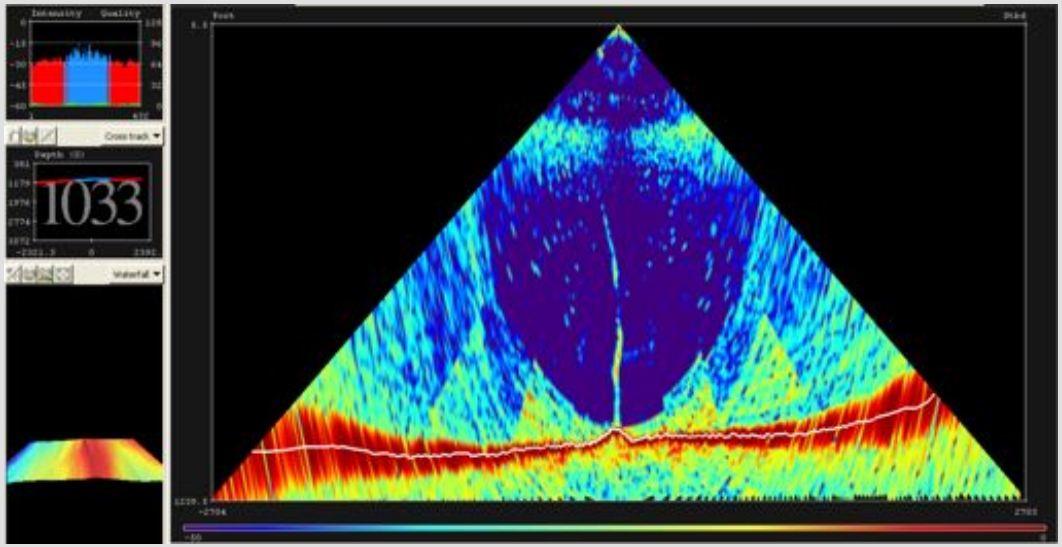
The locked zone boundaries are probably **not** here. 170 km wide from Cozzens and Spinelli, 2012

The 350°C isotherm is **not** beneath the Olympic Peninsula

Distribution and Source of Gas at Seep Sites



Emergent Seep Site – Transient bubble plumes imaged at this site.



Chemoherm Site – Many plumes over a range of depths imaged at this site during the expedition

Mound is ~3 meters high.

Carbonate deposit is several hundreds of meters wide.