

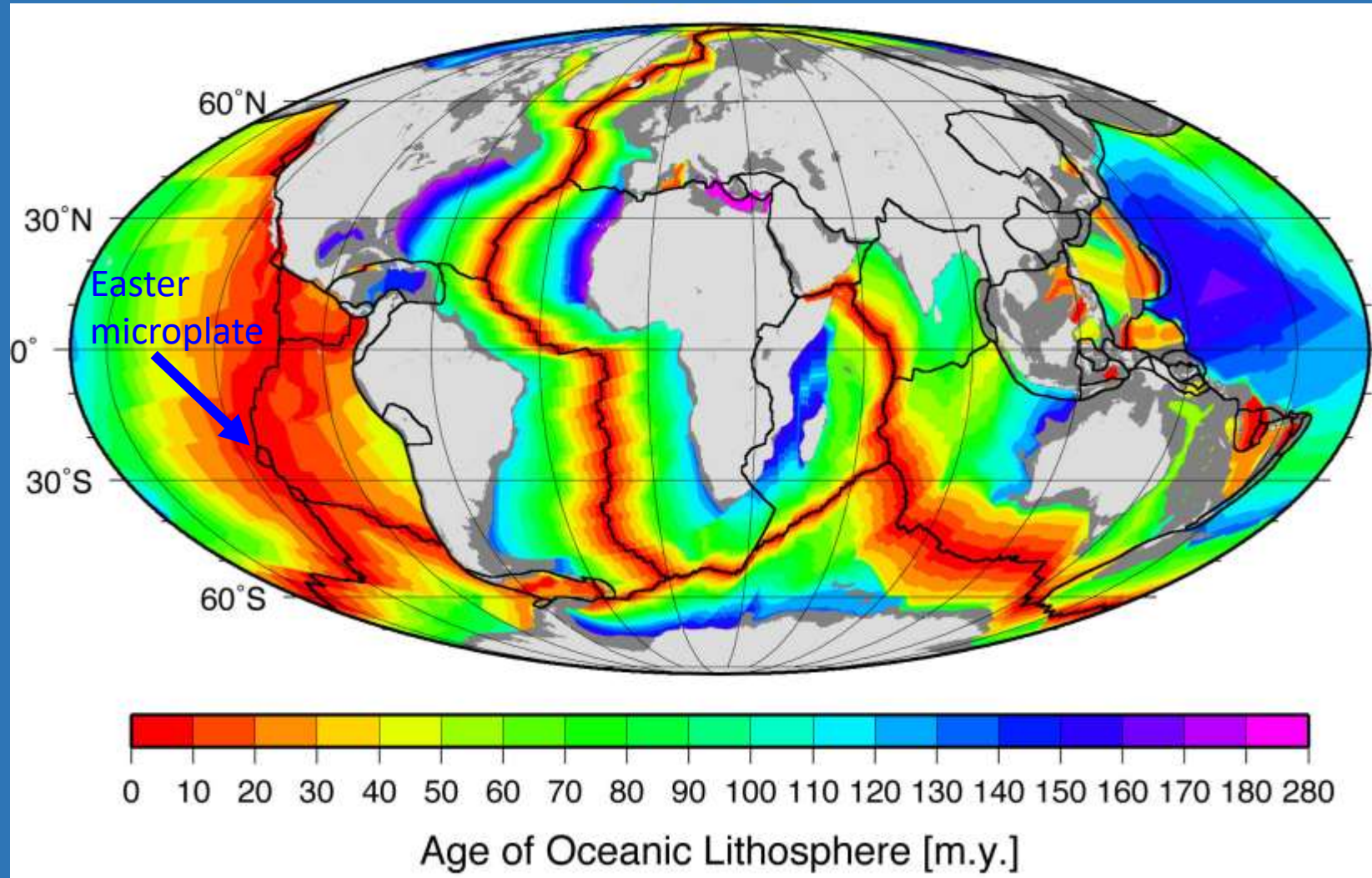
# *Geologic map of lower ocean crust at Pito Deep (S Central Pacific)*



Michelle Gess

Advisors: Drs. Barbara John  
and Michael Cheadle





- mid -ocean ridges (MORs) represent the intersection of two tectonic plates
- new crust is formed at these boundaries

“We know more about the back side of the moon than the oceans.”

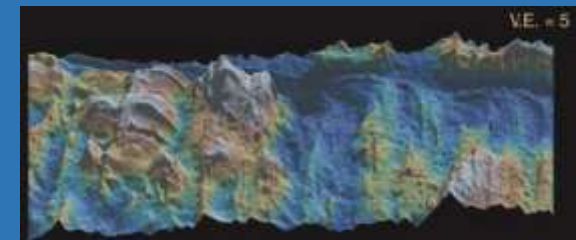
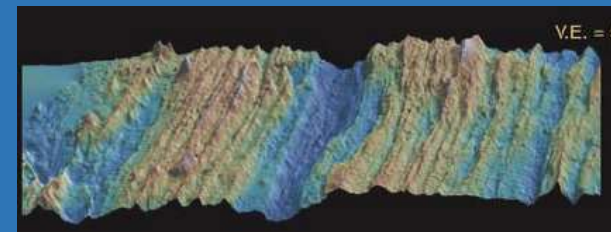
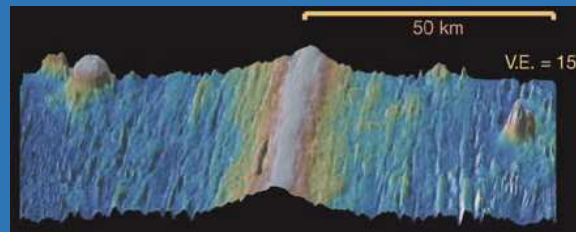
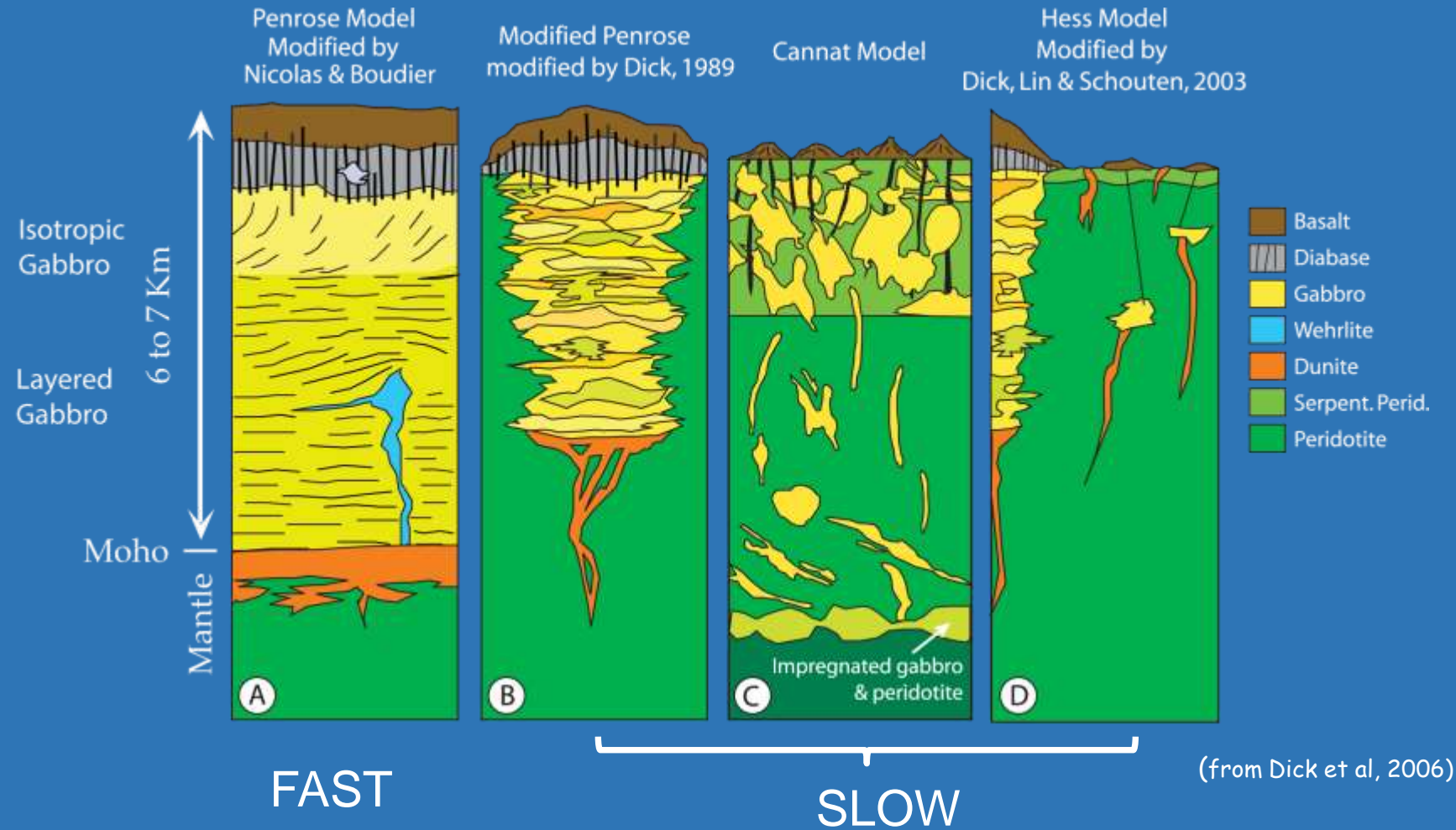
# Two types of MOR (different architecture and bathymetry):

## FAST SPREAD:

- Low relief, with small axial rise
- Layered crust

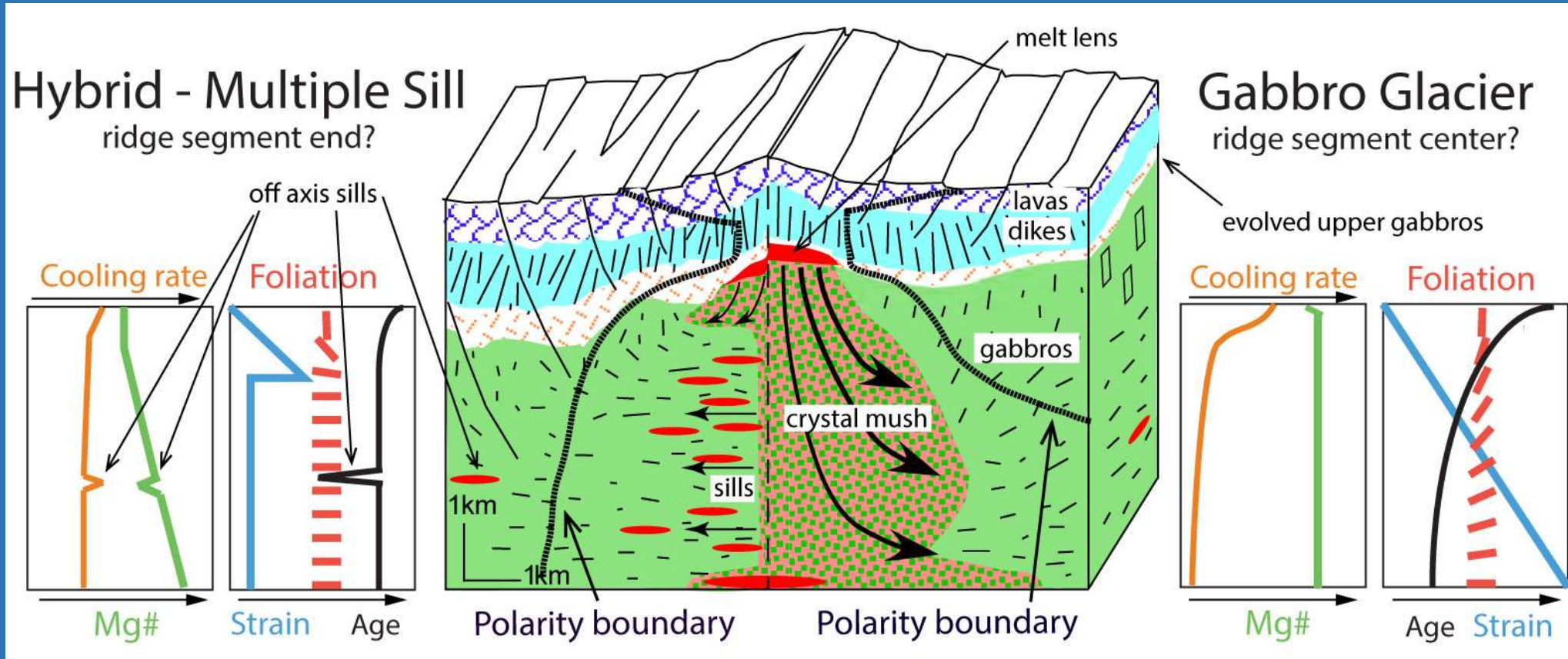
## SLOW SPREAD:

- Extreme topography (up to 6 km relief) w/ axial valleys
- Crust may be absent (mantle exposed at seafloor)



(from Buck et al, 2005)

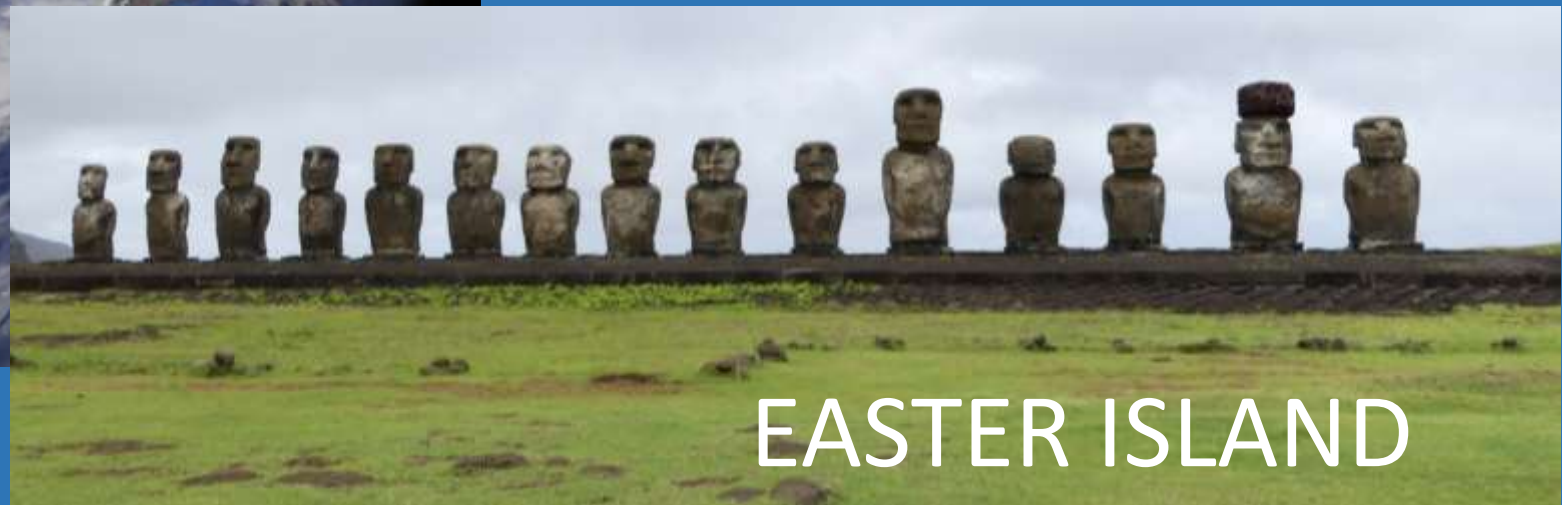
# Accretion models for lower ocean crust at fast spreading MOR



(modified from Coogan, 2014)

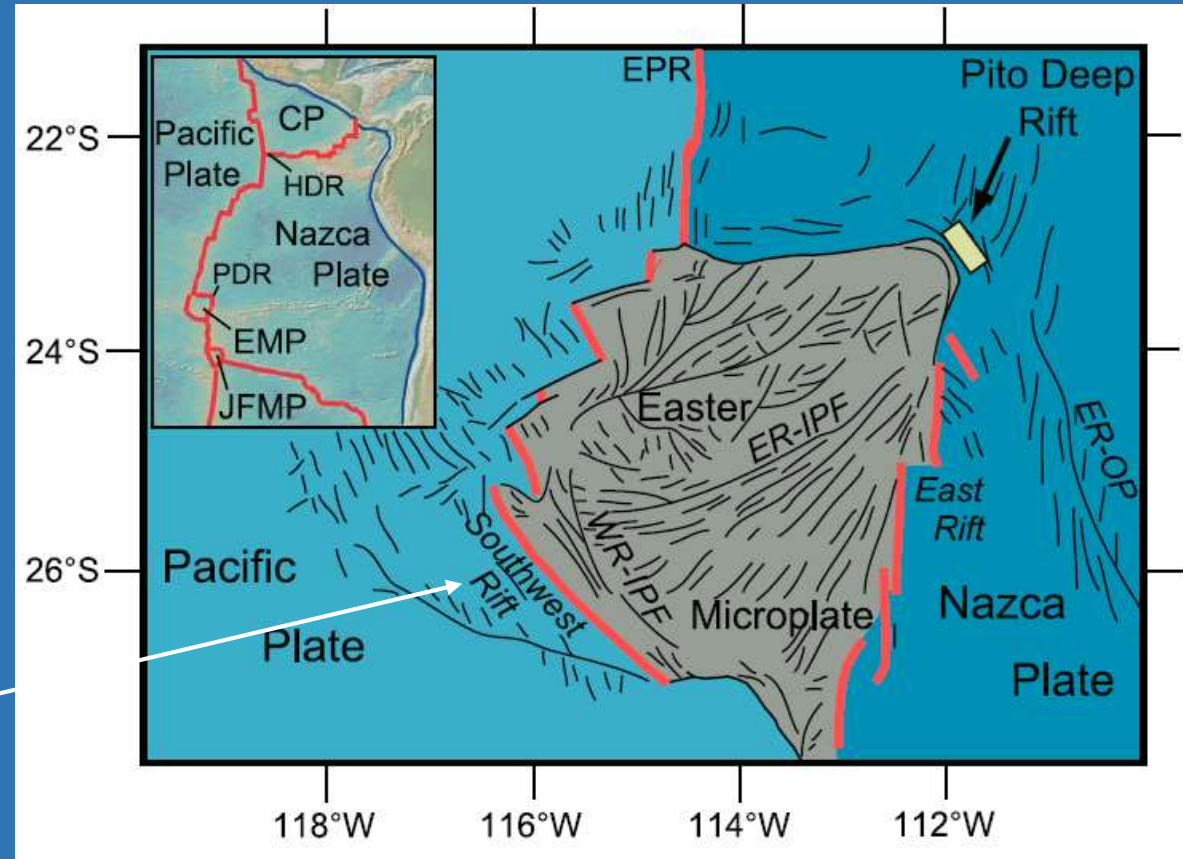
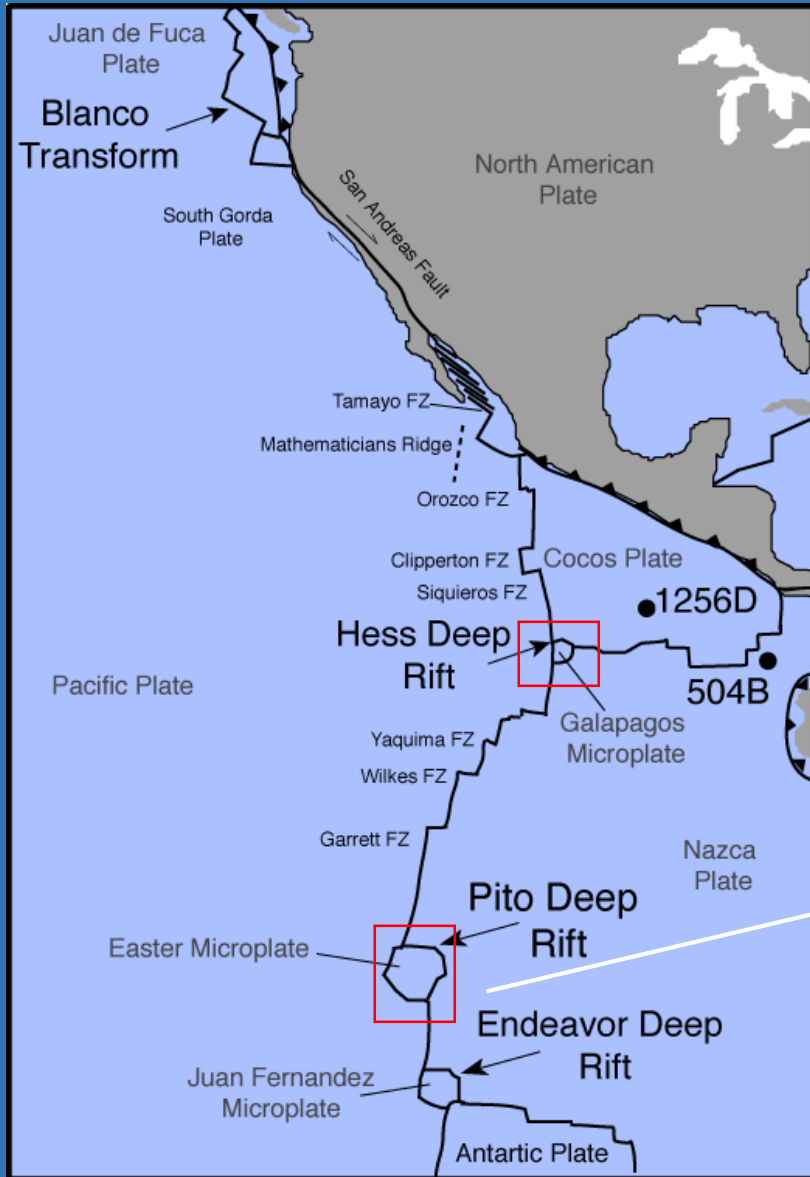


SANTIAGO

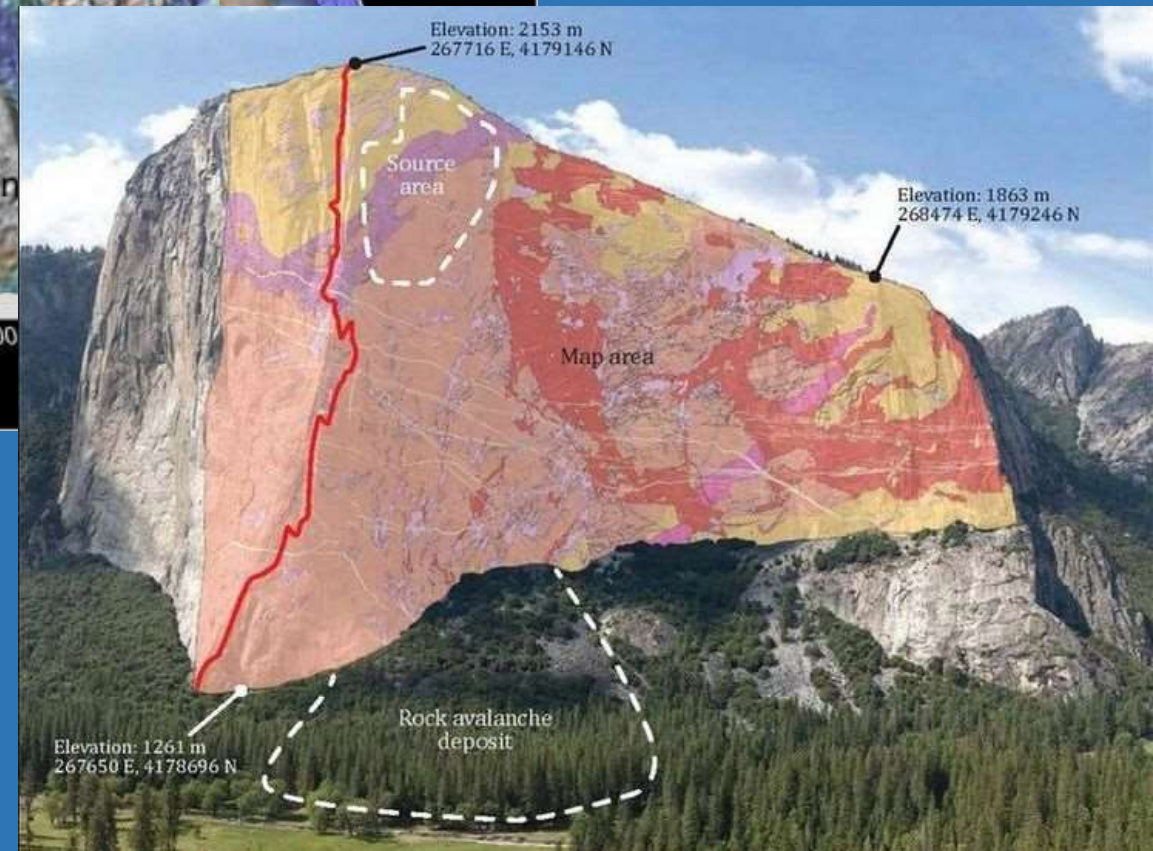
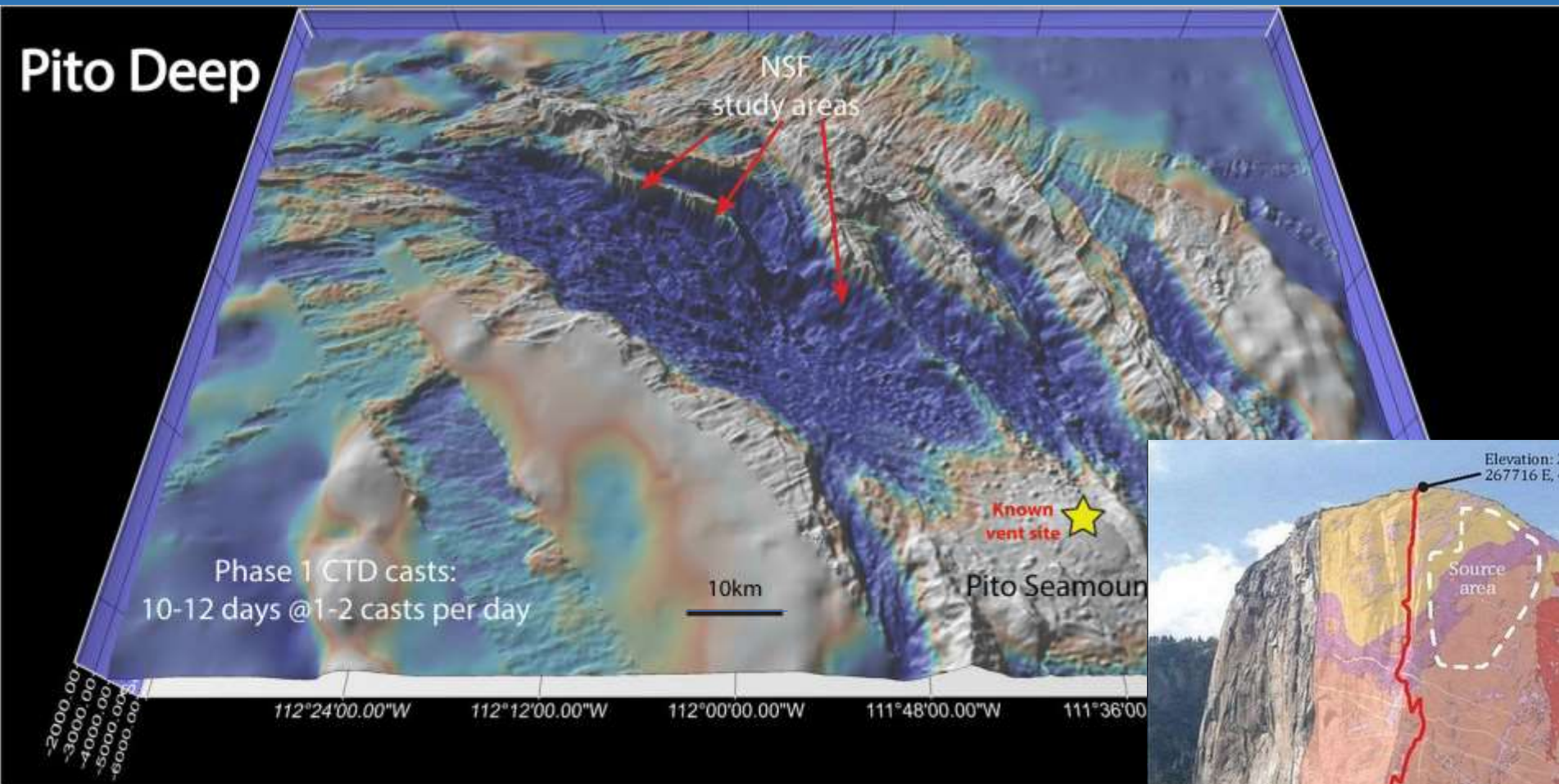


EASTER ISLAND

# PMaG cruise study location



# Pito Deep

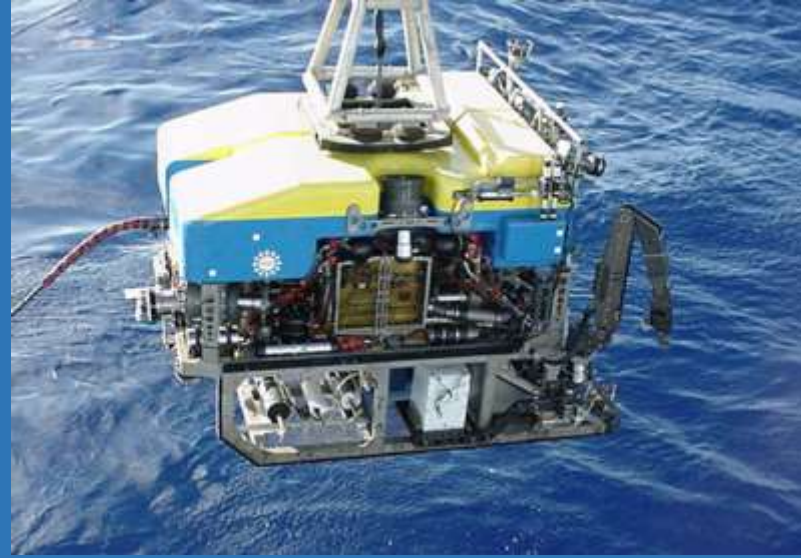


- Pito Deep 3x depth of Grand Canyon
- study area B1 w/ same relief as El Capitan (Yosemite)

# P-MaG Cruise



Atlantis II



Jason II



Jason II's robot arm collecting samples



Sentry



# PMaG Cruise

- Early 2017, 15 scientists spent 42 days at sea\* at Pito Deep Rift
- Purpose to collect *in-situ* samples of lower ocean crust (w/magmatic foliation) to test models of ocean crust accretion
- very successful: detailed mapping of 10's km<sup>2</sup> seafloor (using autonomous robot *SENTRY*), measured seafloor magnetization, collected >400 rock samples (w/ ROV *JASON*), and discovered 5 new hydrothermal vents fields



R/V Atlantis II\*

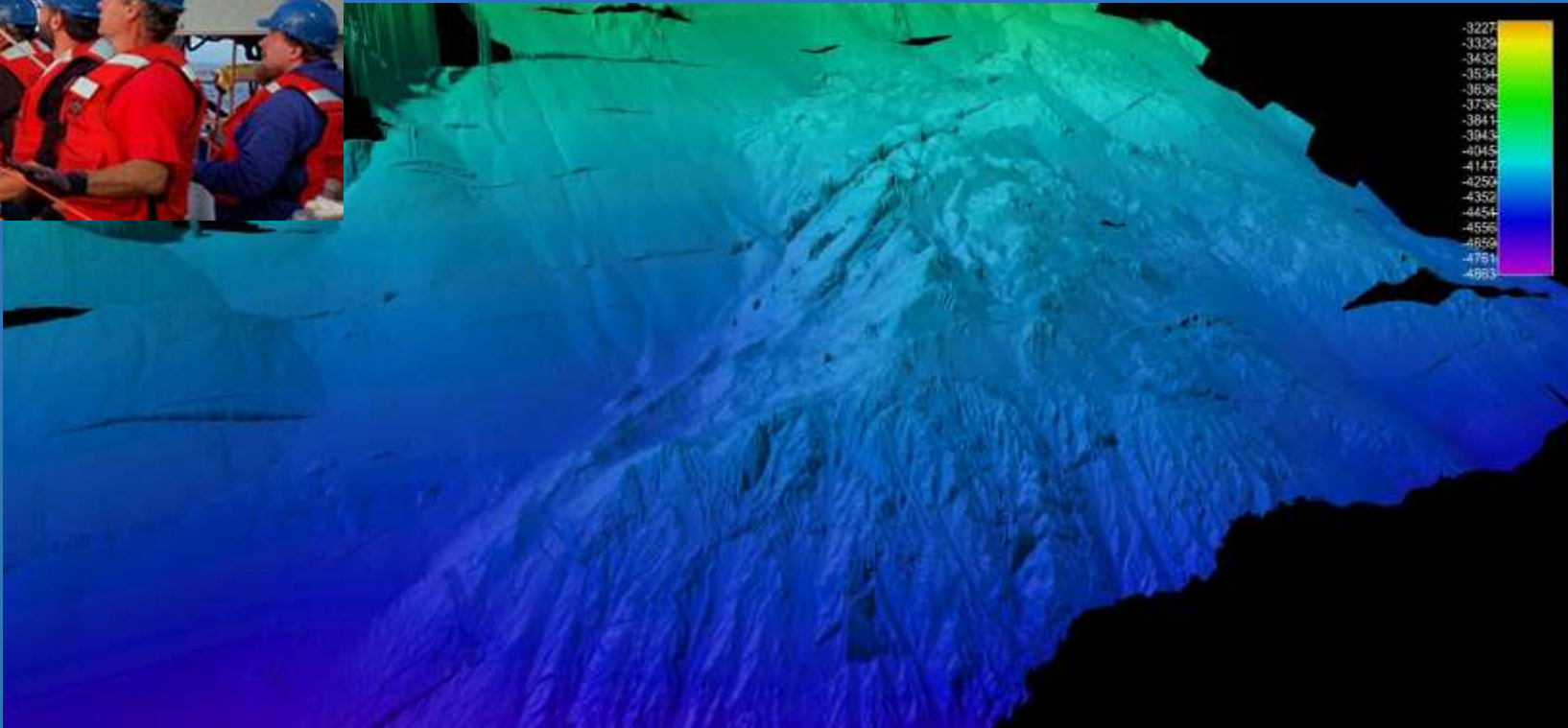
\*our home away from home



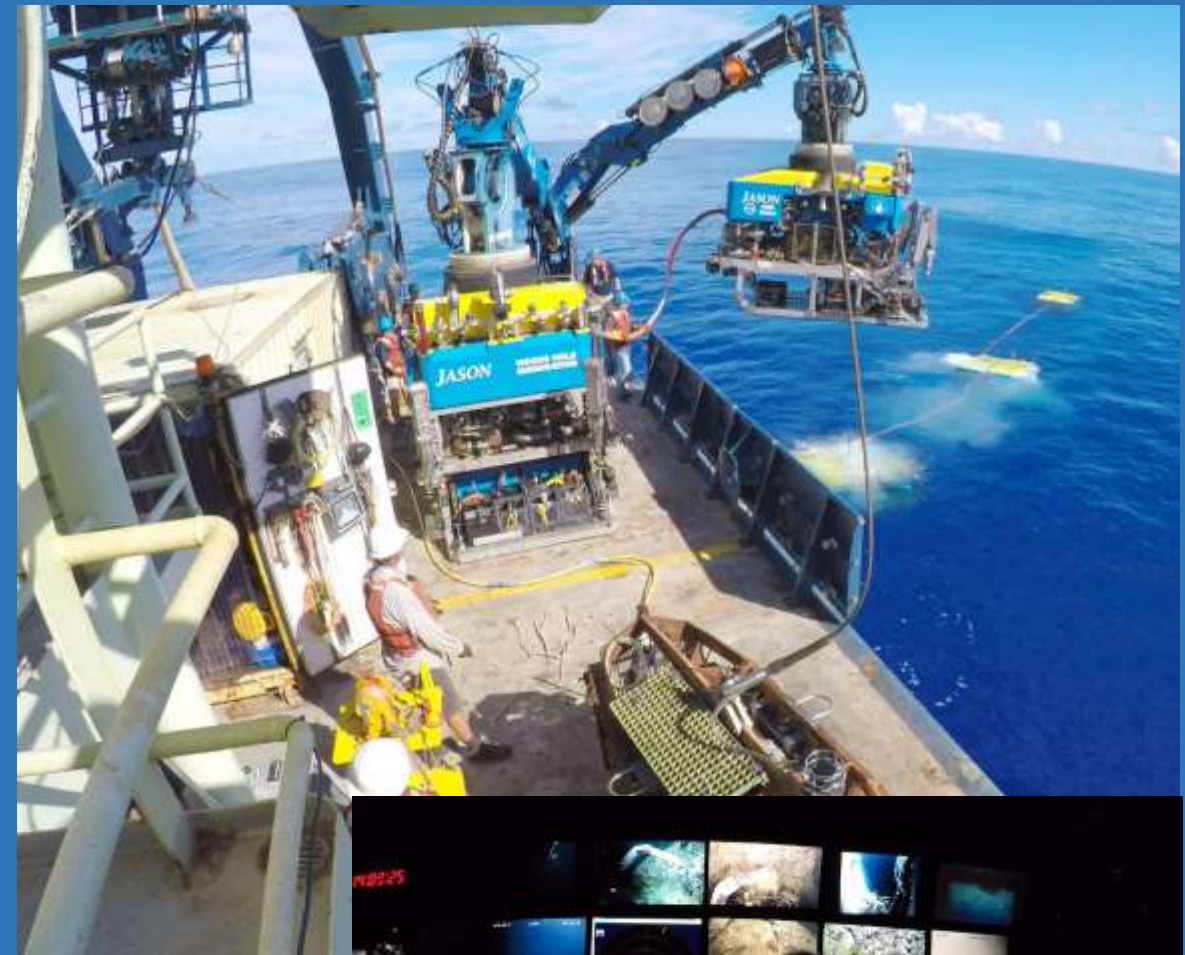
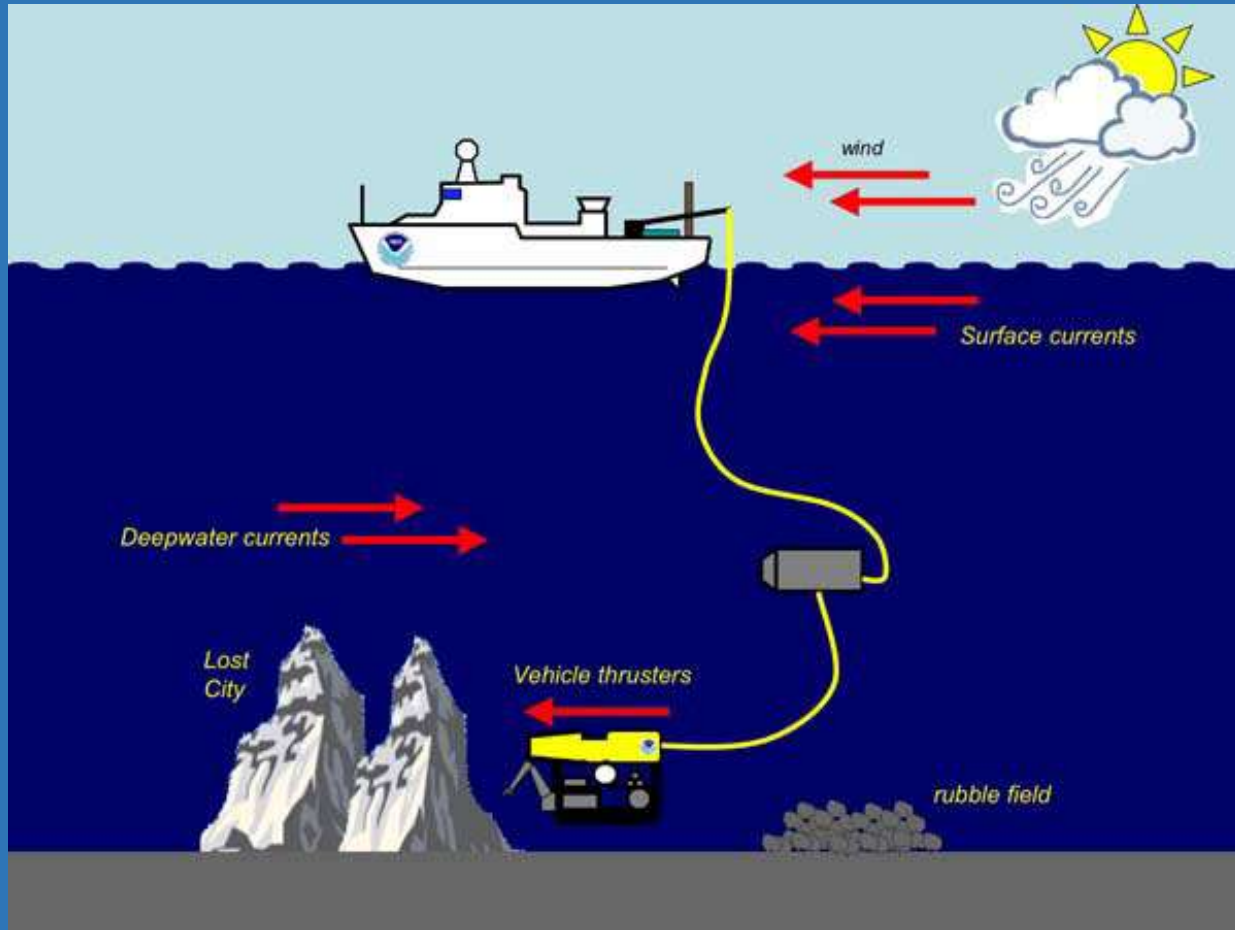


autonomous vehicle SENTRY - used to generate maps of the ocean floor

SENRTY data used to plan ROV "JASON" dives and sample collection



ROV JASON II recovered *in situ* samples from the sea floor, and imaged everything seen while on bottom.



(Lucas Kavanagh)

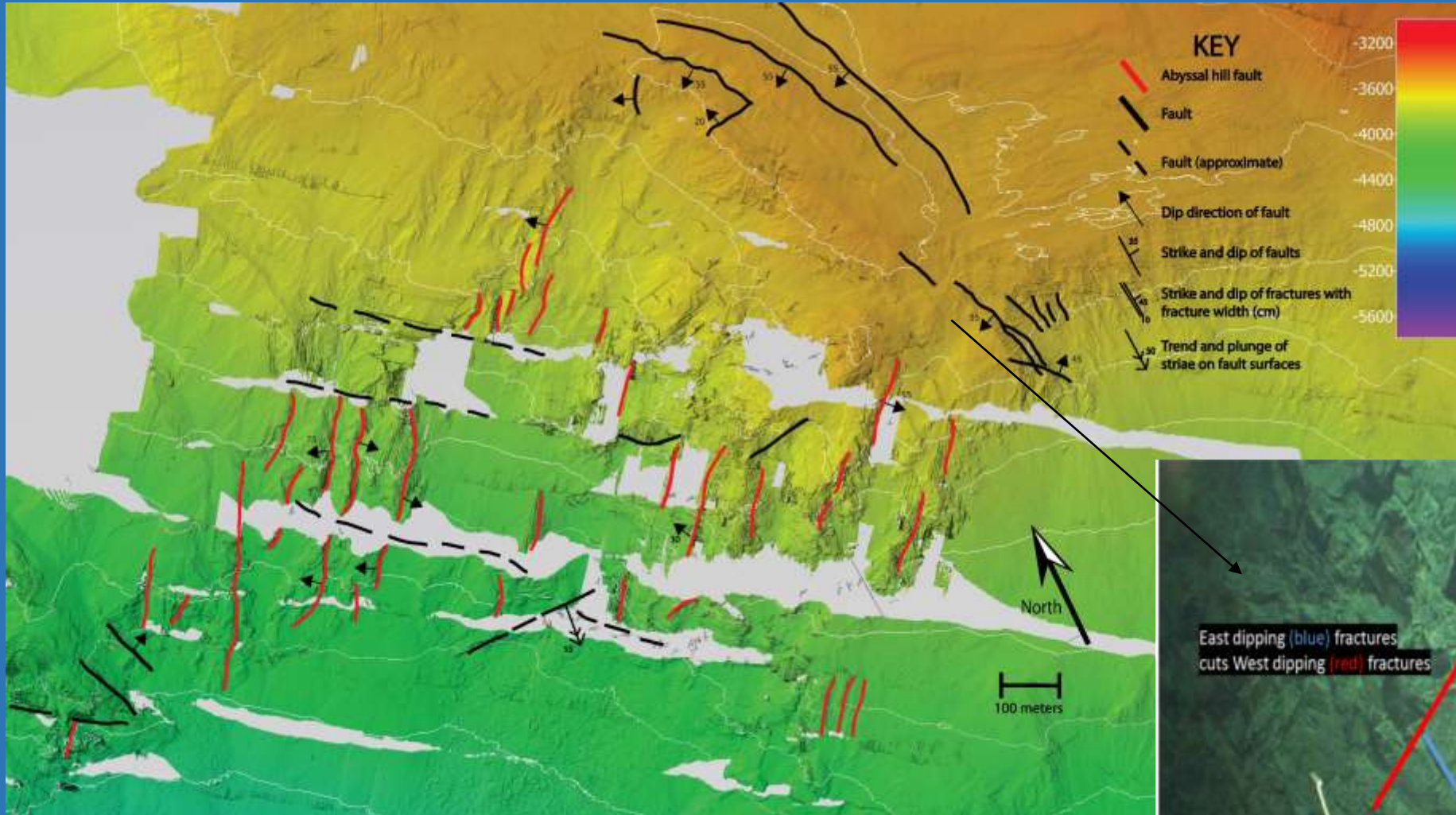


# Post Cruise Research (so far)

- JASON Virtual Van - online database housing all media recorded throughout the cruise. Photos reviewed for the location and orientation of faults, fractures and other structural features
- Key for determining the true orientation of magmatic layering/foliation of the rocks, and for testing the models



# Fault map (area B1, Pito Deep)



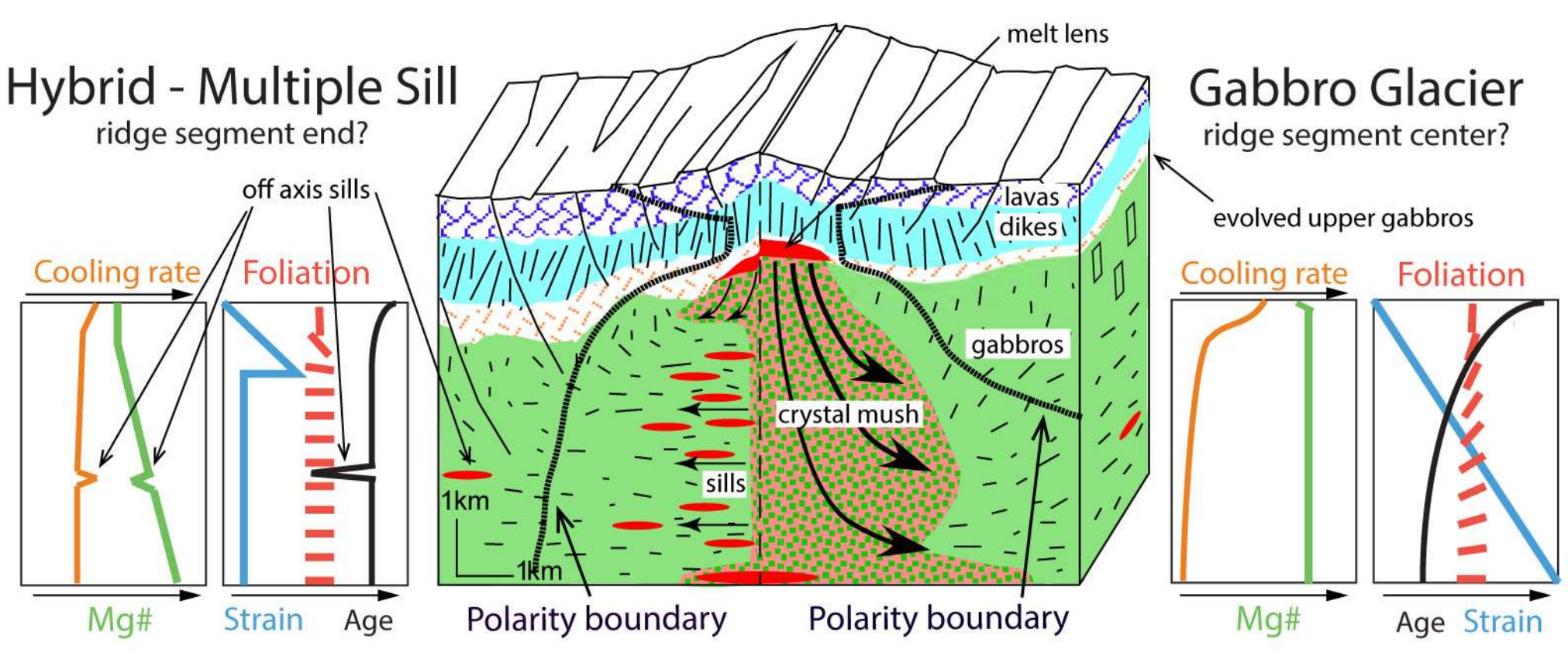
- Abyssal faults, features of all mid ocean ridges, are dominant throughout B1
- Cross cutting relationships can help to determine the deformation history



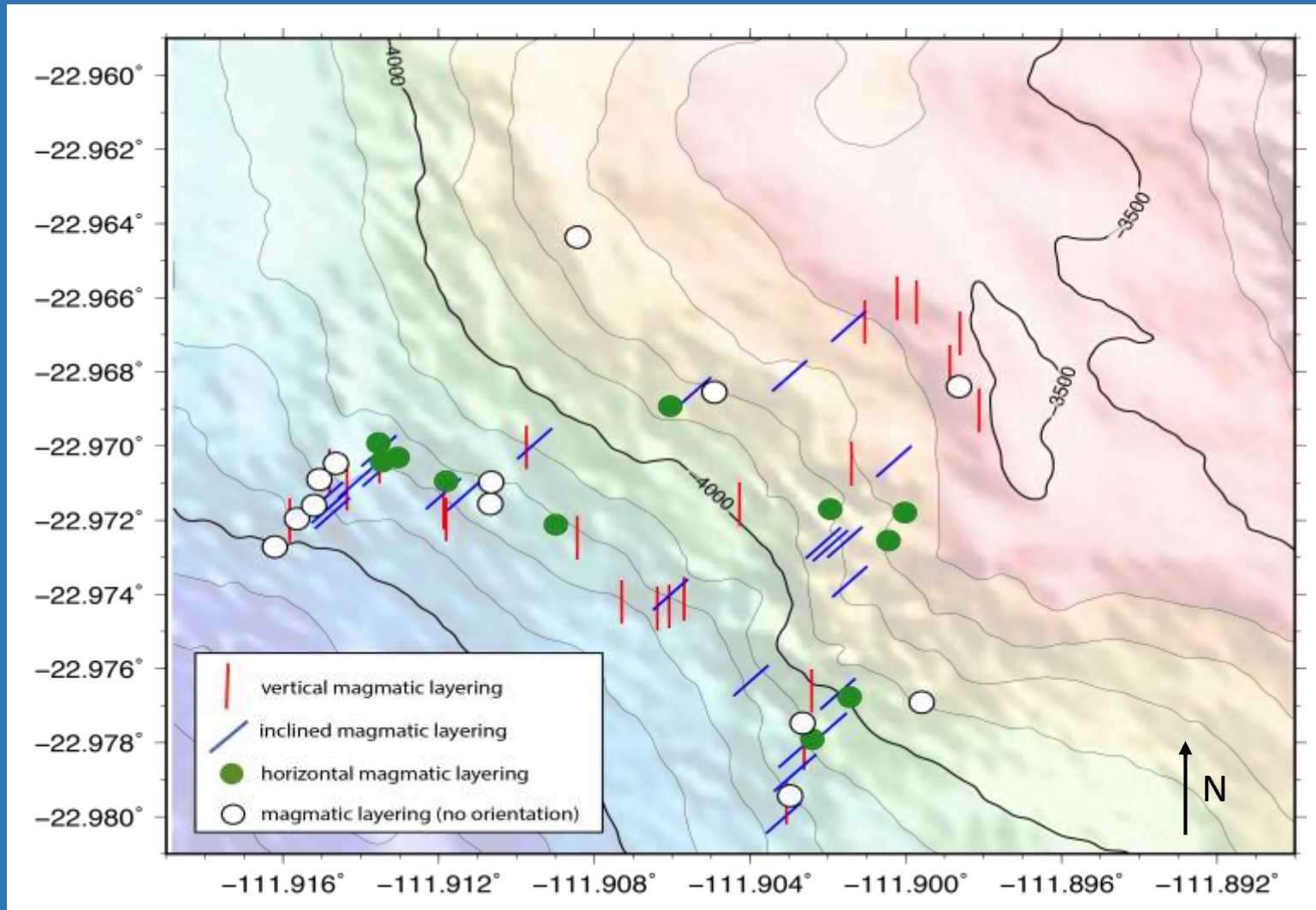
# Magmatic Layering (hand sample and outcrop)



# Magmatic layering at Pito Deep



# Magmatic layering (from reoriented samples, area BI, Pito Deep)





# Conclusions

- There has been intense deformation at Area B1, Pito Deep over time
- A final detailed structural map must be created to have a better understanding of the cross cutting relationships must be completed
- Once the deformation history is understood we can then reorient the magmatic layering to the original layering when formed at the ridge axis
- This information would then be used and tested to determine which of the two models are correct

# Acknowledgements

- Funding to Drs. Michael Cheadle and Barbara John from NSF for the cruise
- Geology & Geophysics Meritorious Undergraduate Research Grant
- Drs. Michael Cheadle and Barbara John for help on completing the research
- Crew and engineers on R/V Atlantis II

Thank you!

Questions ?