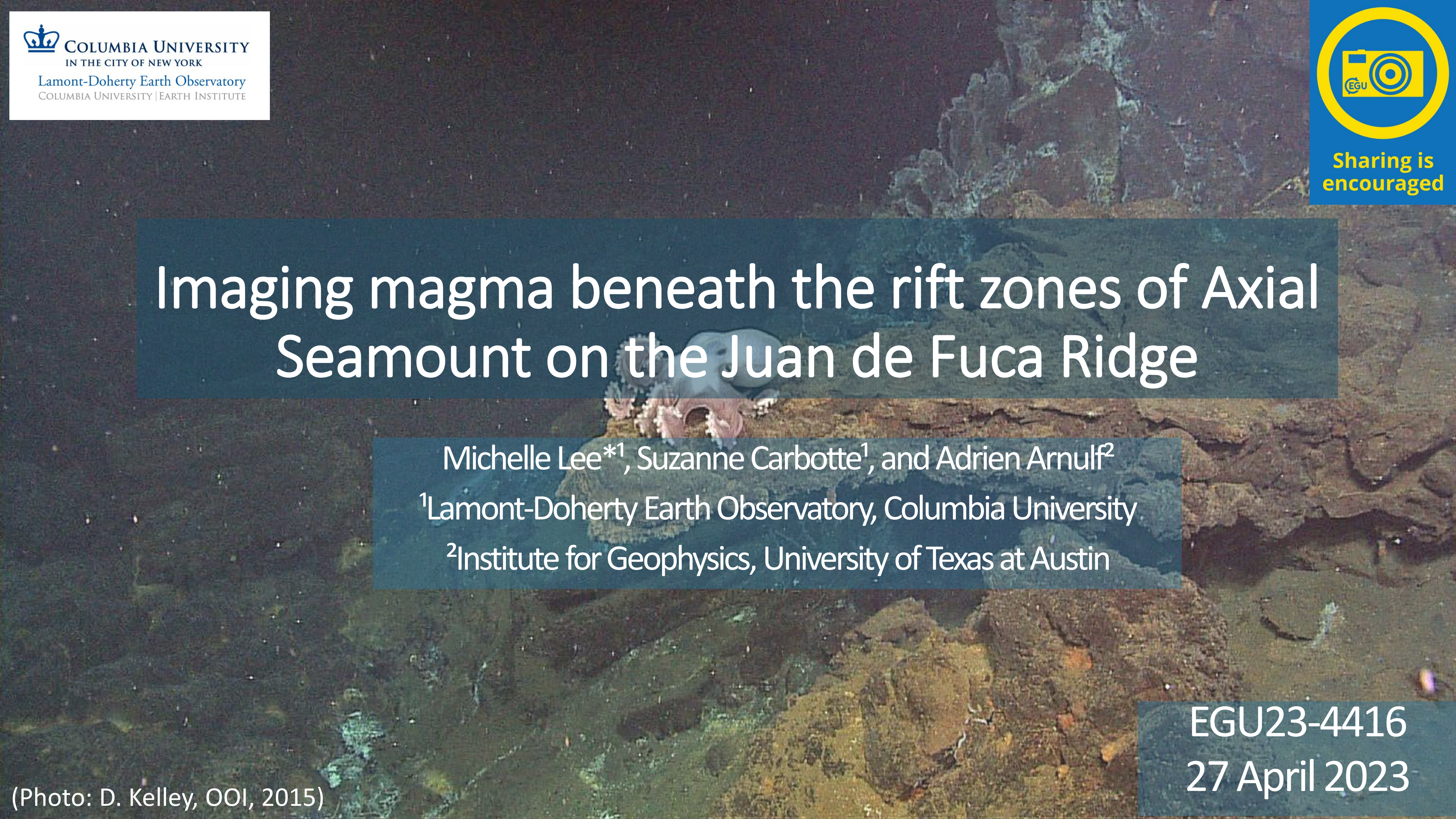


Imaging magma beneath the rift zones of Axial Seamount on the Juan de Fuca Ridge

Michelle Lee*[1], Suzanne Carbotte[1], and Adrien Arnulf[2]

[1]Lamont-Doherty Earth Observatory, Columbia University

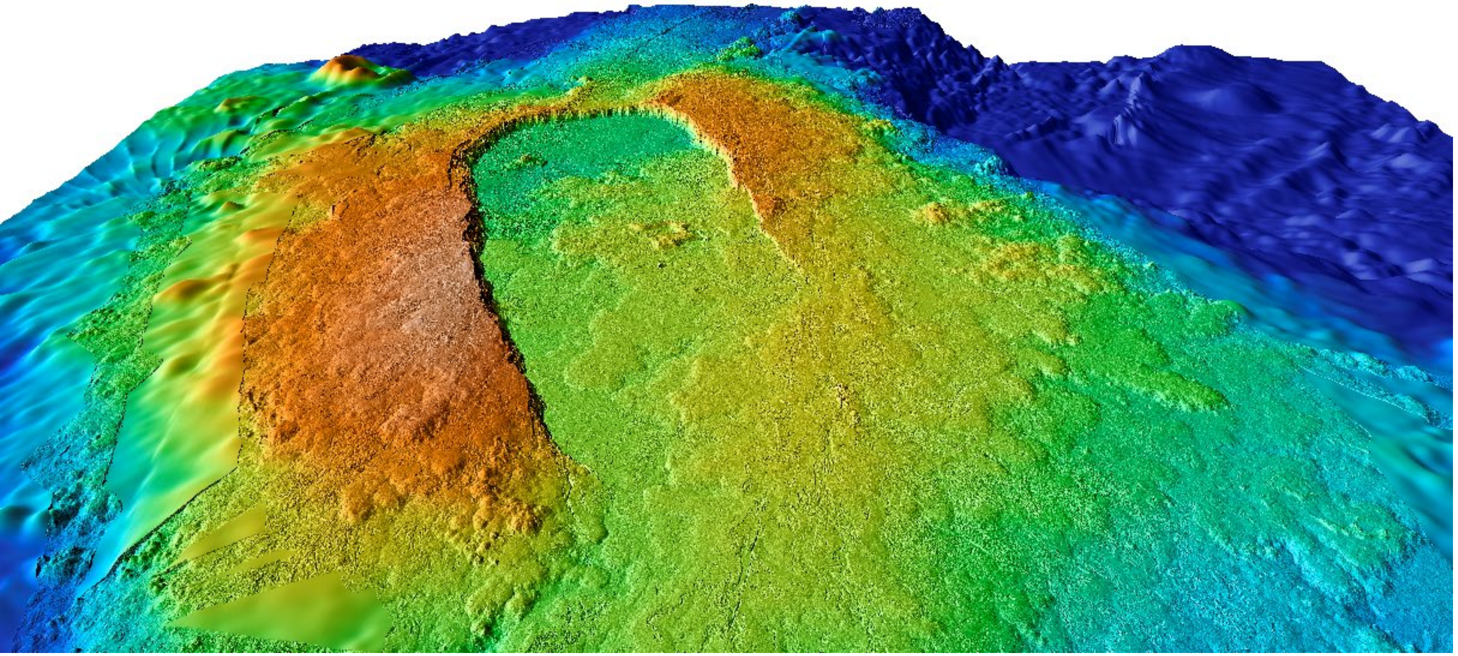
[2]Institute for Geophysics, University of Texas at Austin

EGU23-4416

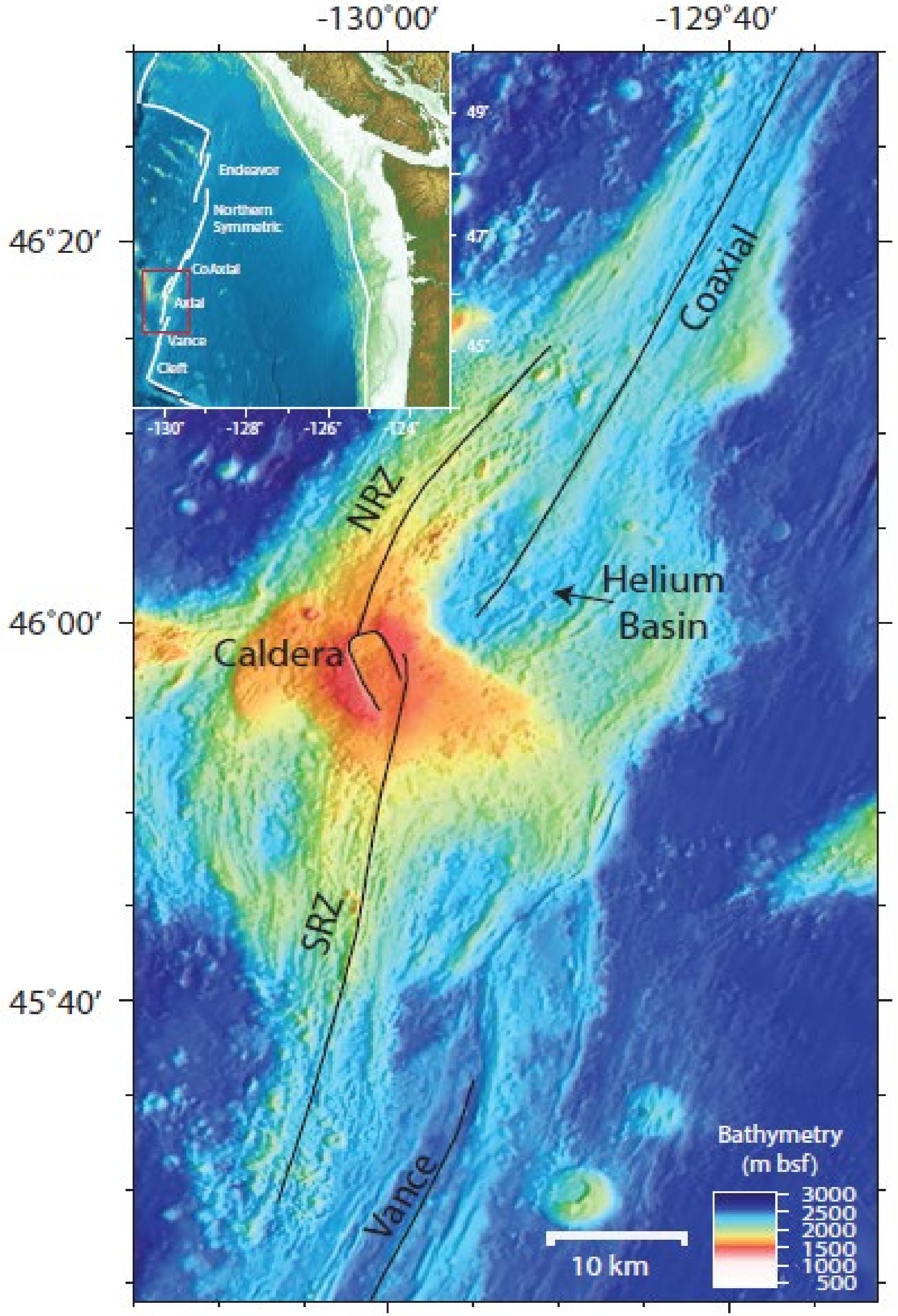
27 April 2023

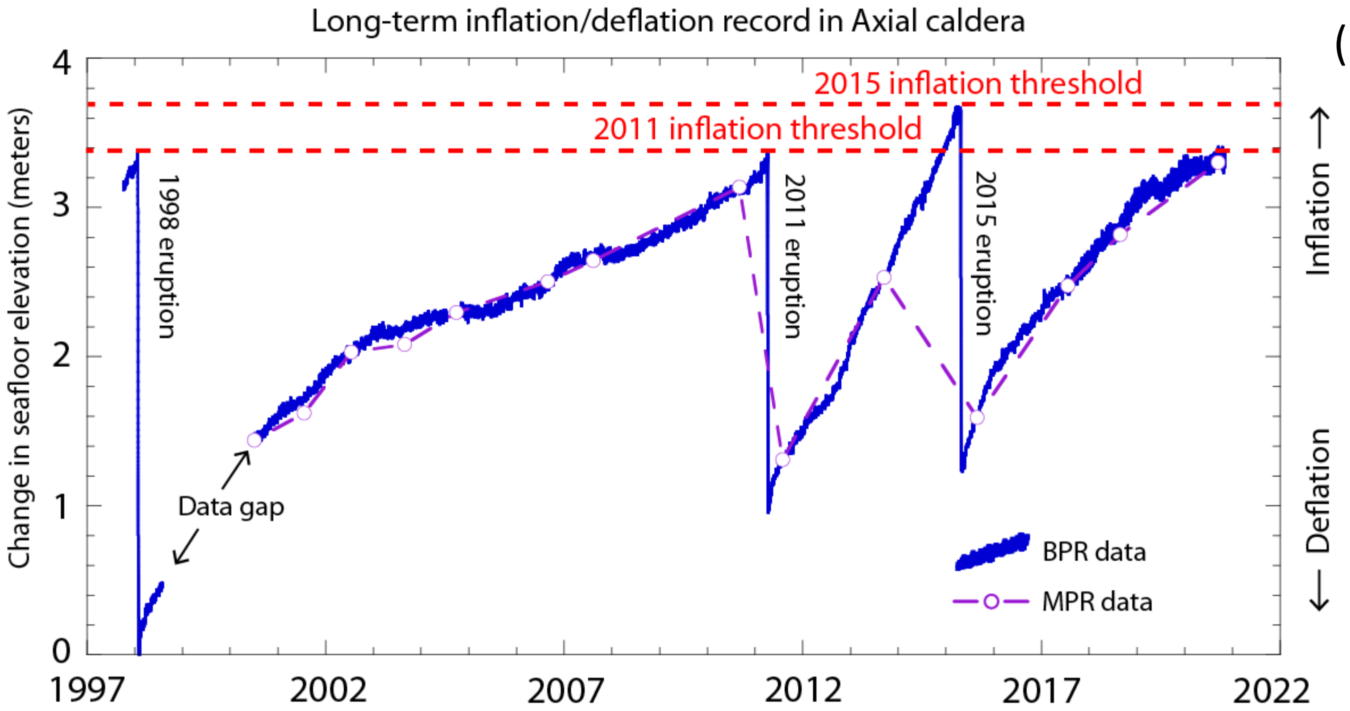
(Photo: D. Kelley, OOI, 2015)

Axial Seamount

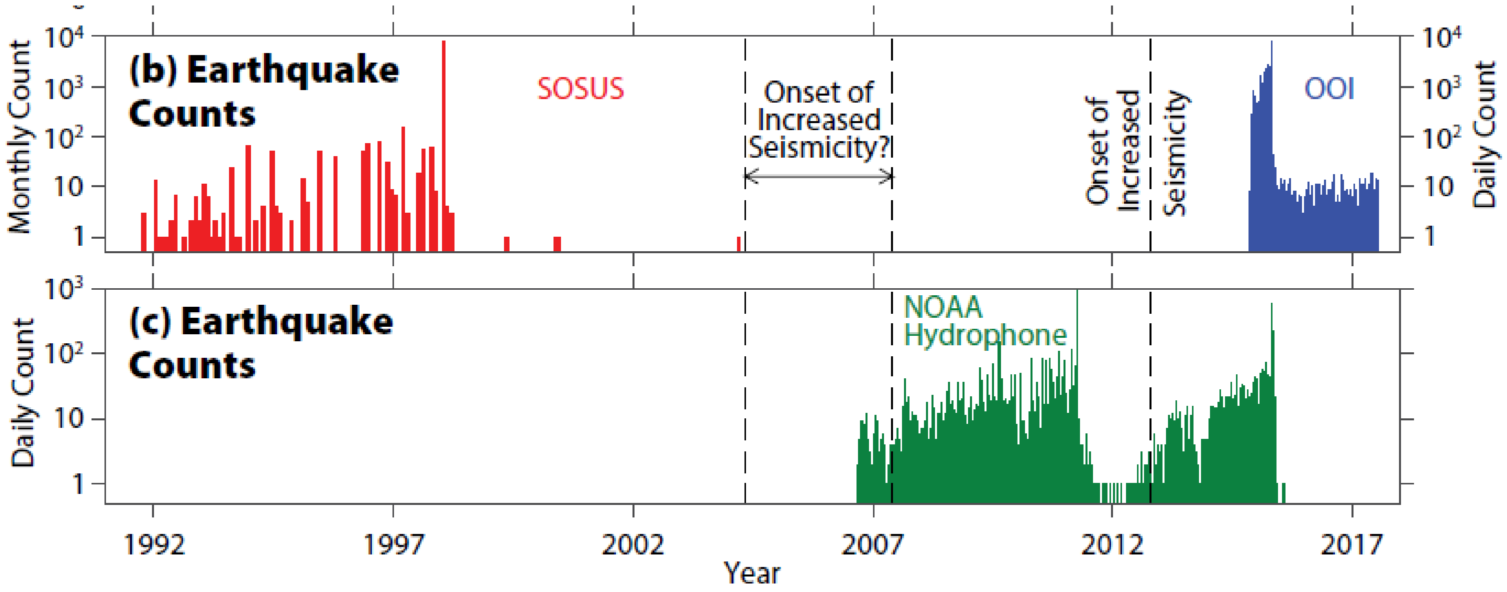


(MBARI)





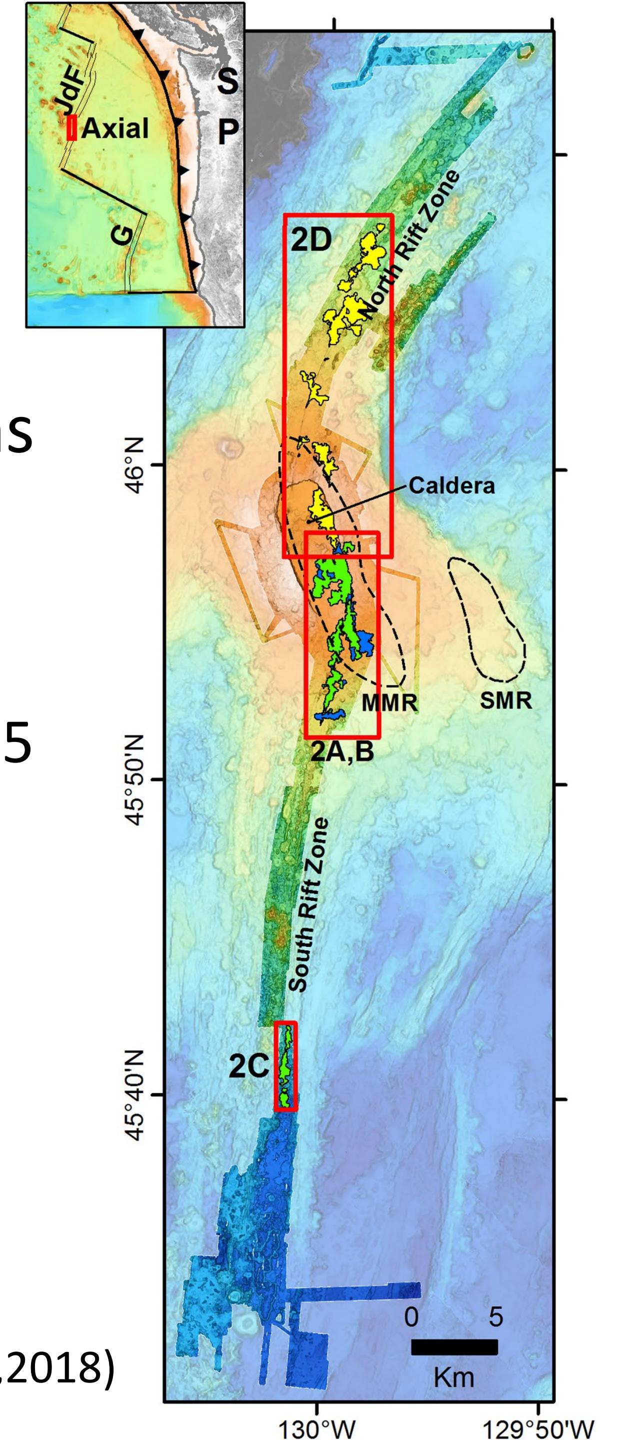
(PMEL)



(Wilcock et al., 2018)

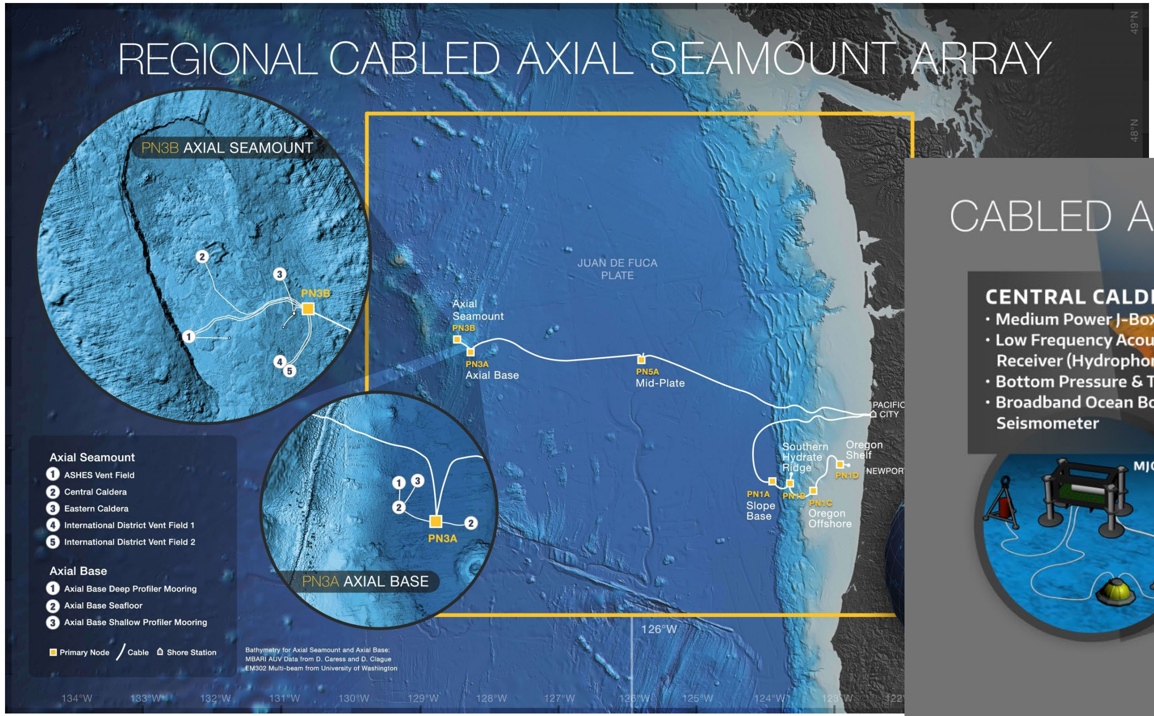
Past Eruptions

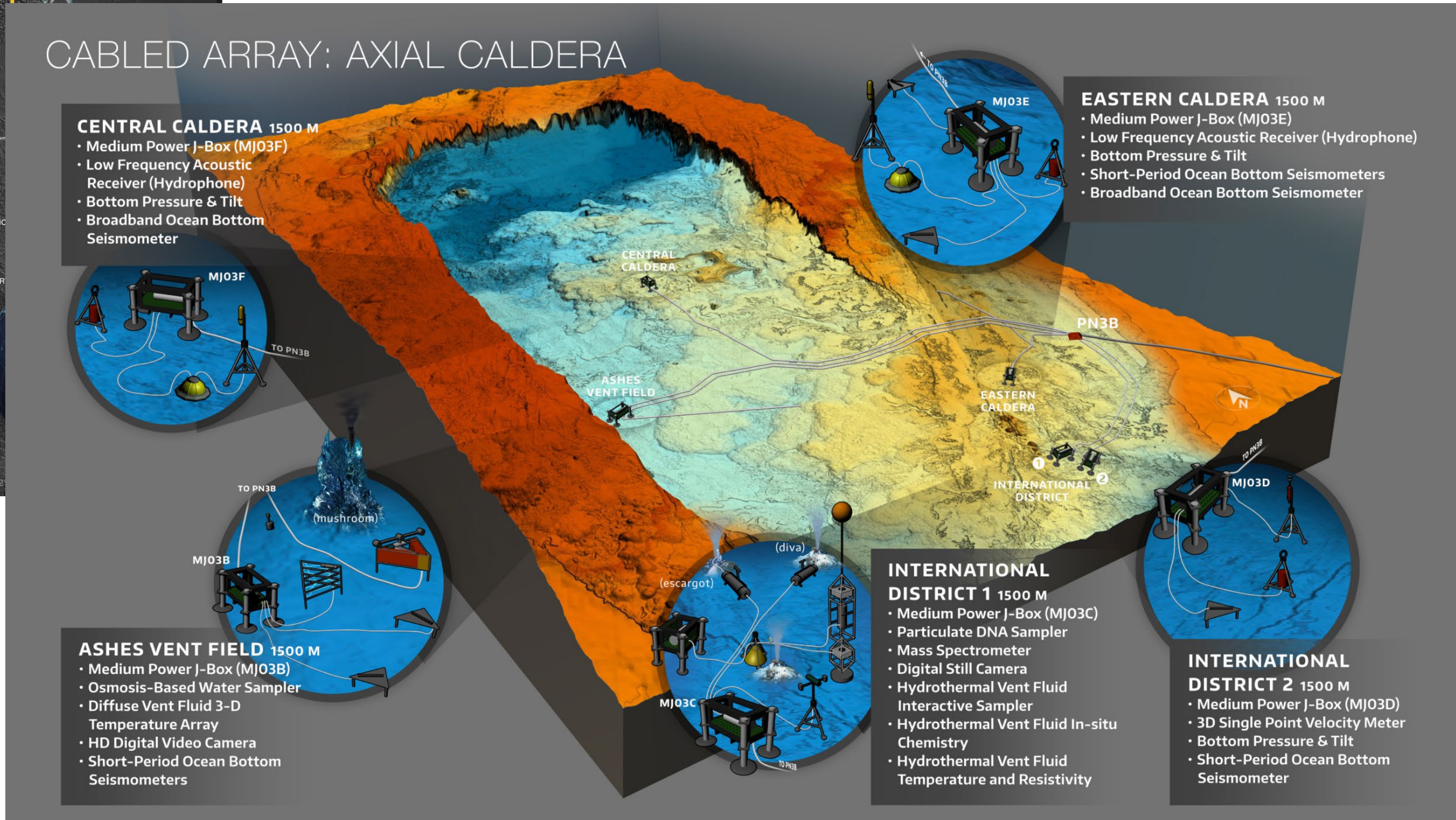
- January 25, 1998
- April 6, 2011
- April 24, 2015



(Clague et al.,2018)

Focus Site for OOI: Real-time Monitoring since 2015

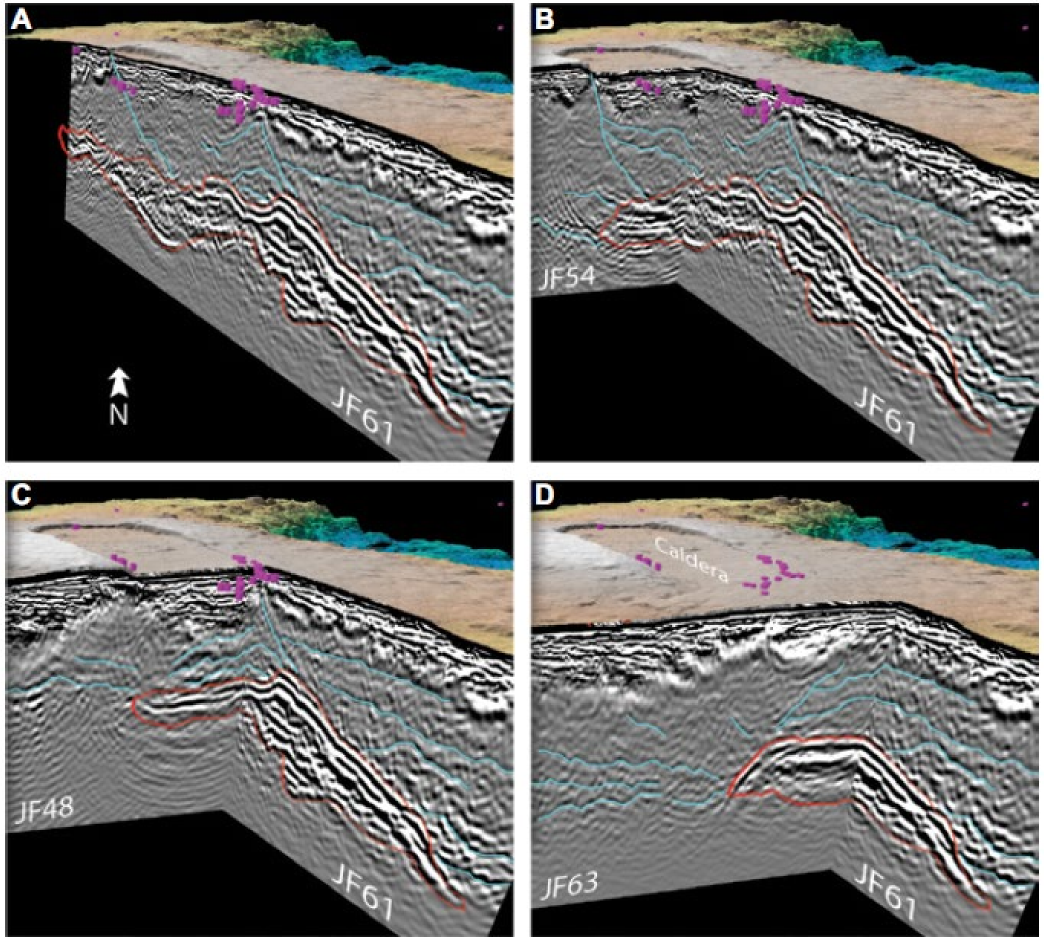




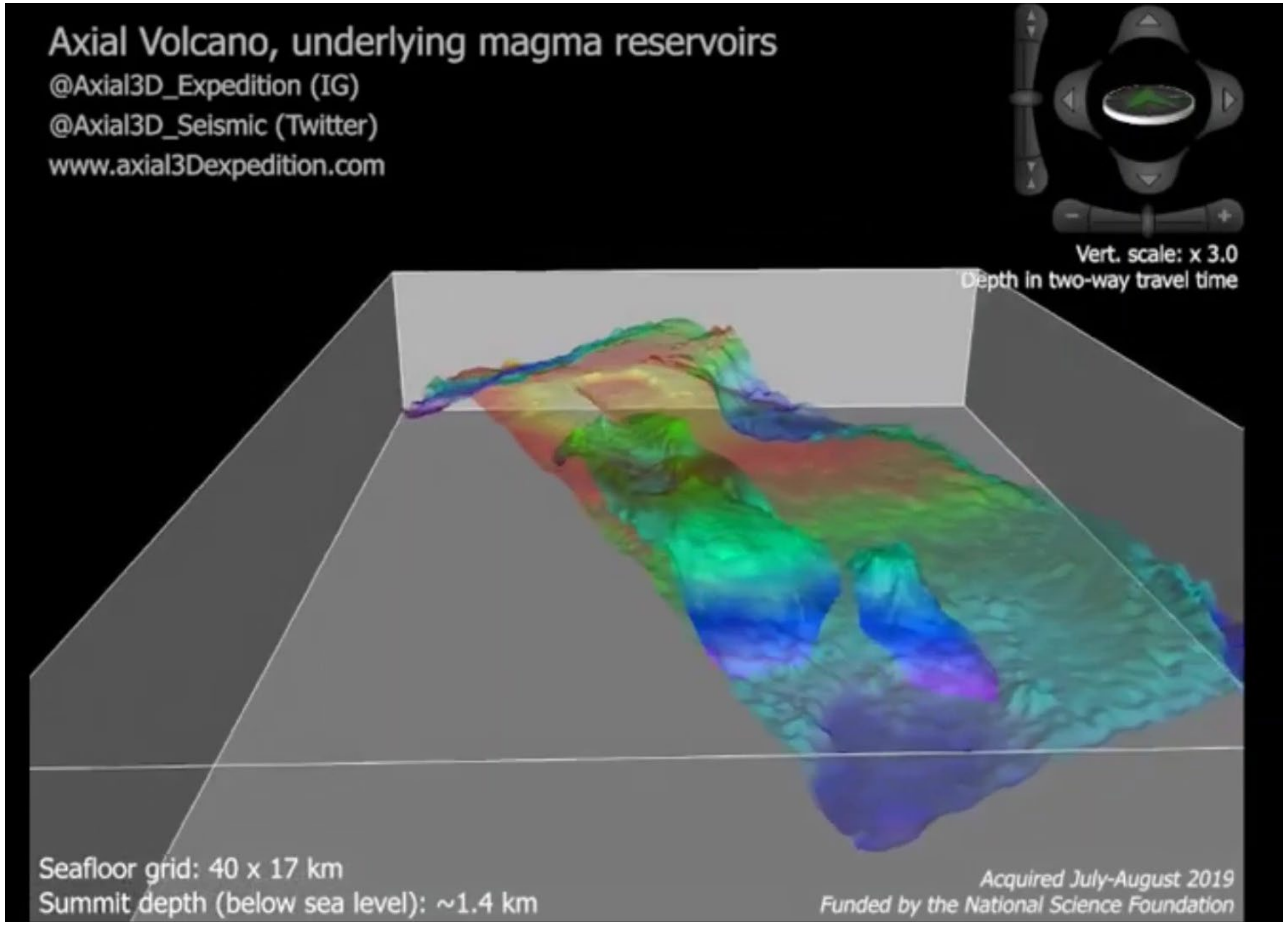
(OOI)

Main Magma Reservoir

Believed to be source of eruption lava with lateral dike intrusion into the rift zones



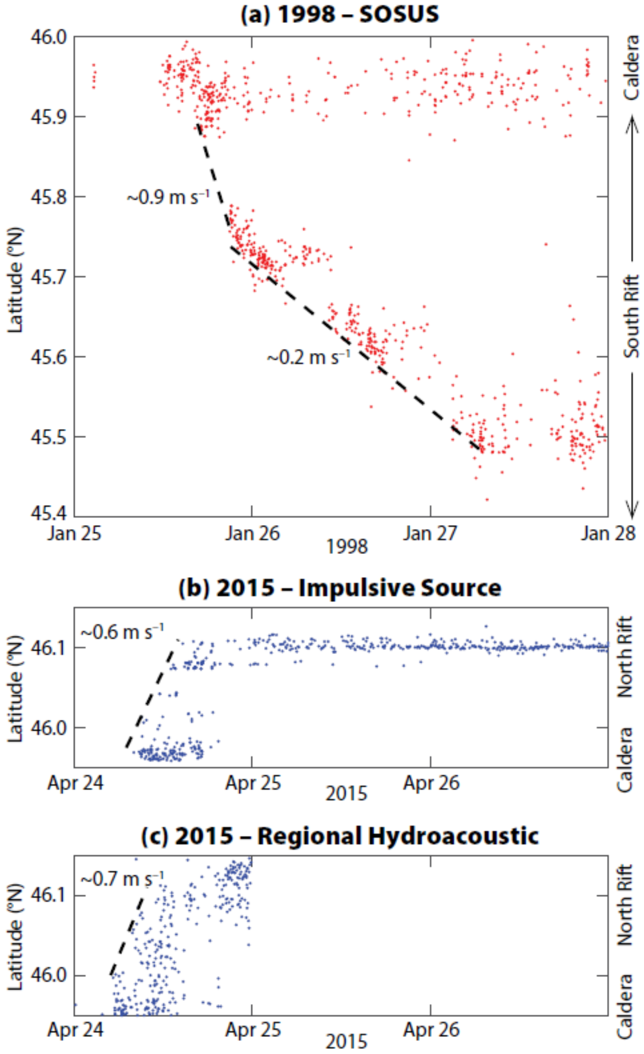
(Arnulf et al., 2014)



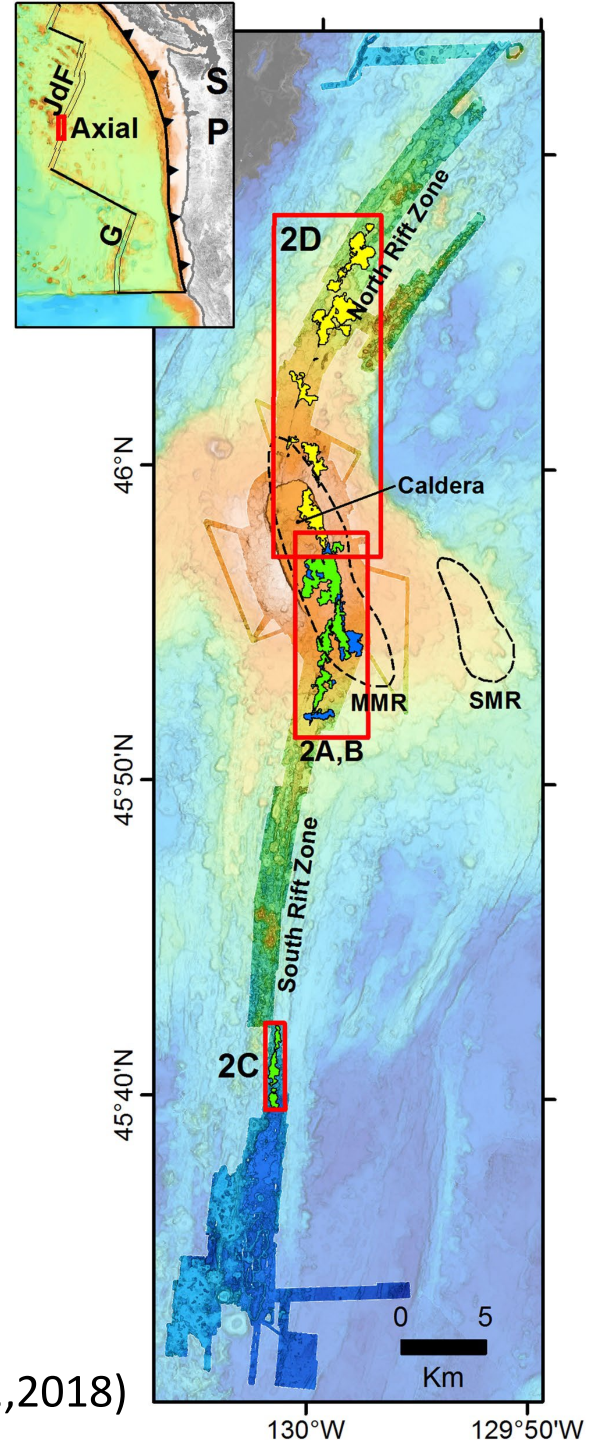
(Axial3DExpedition, 2019)

- Eruptions believed to initiate beneath the caldera with dike propagating into the rift zones
- The main magma reservoir where the eruption and intrusion event initiate has been well imaged but little is known of the internal magmatic structure beyond the caldera
- Prior studies infer that all erupted magma originates from beneath the caldera

❑ Are there magma bodies beneath the rift zones that could be additional magma sources for the eruptions?

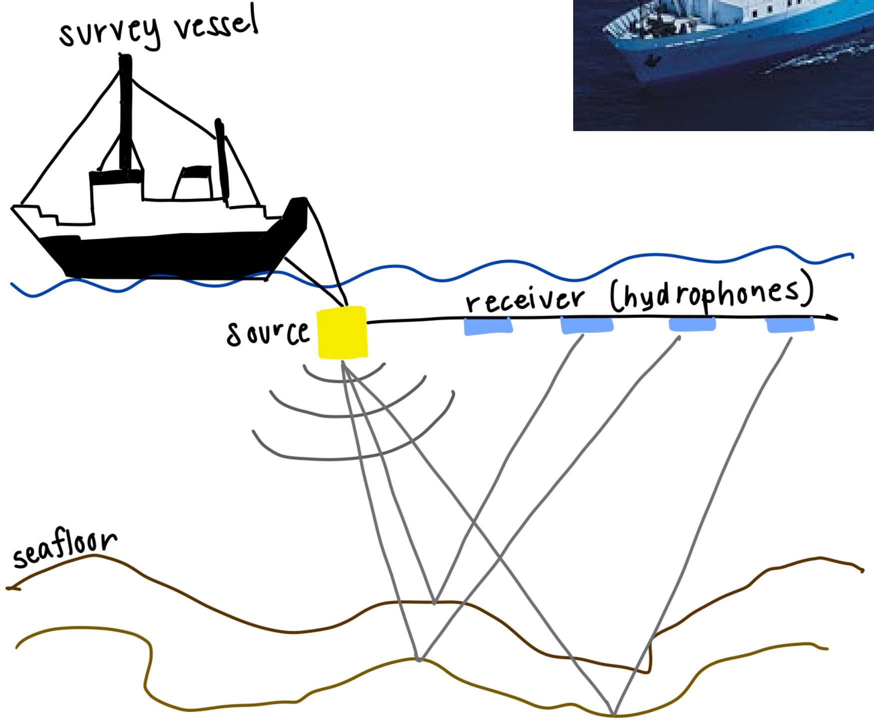


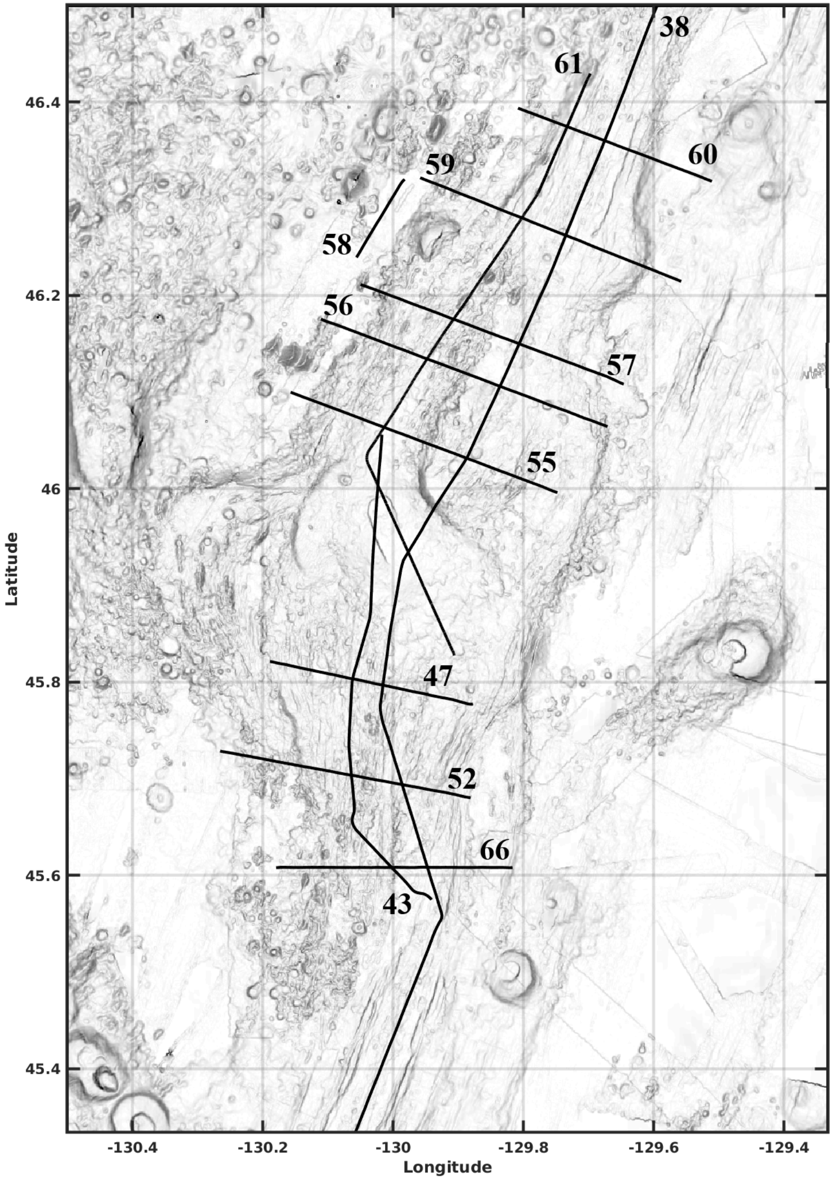
(Wilcock et al.,2018)



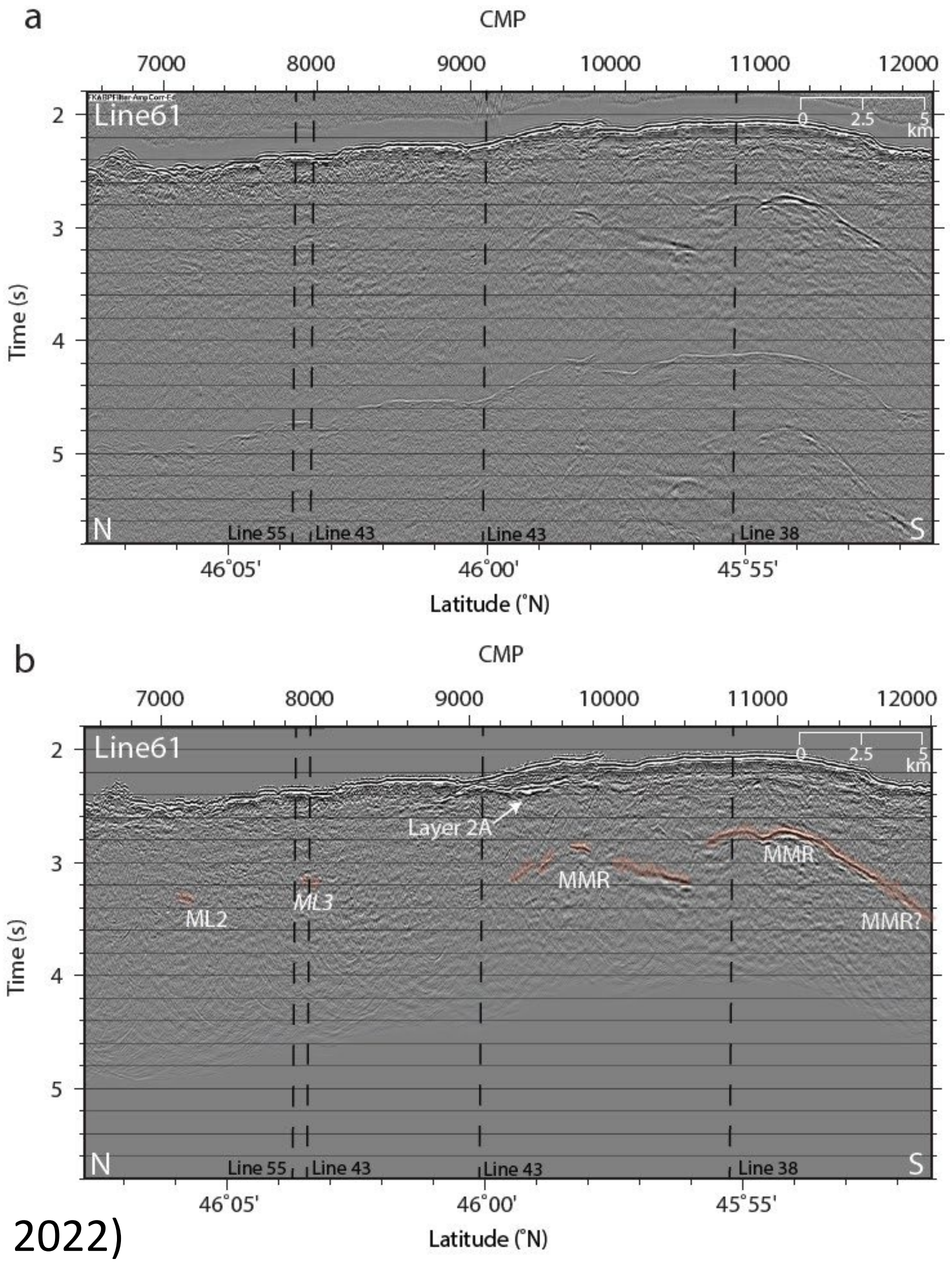
(Clague et al.,2018)

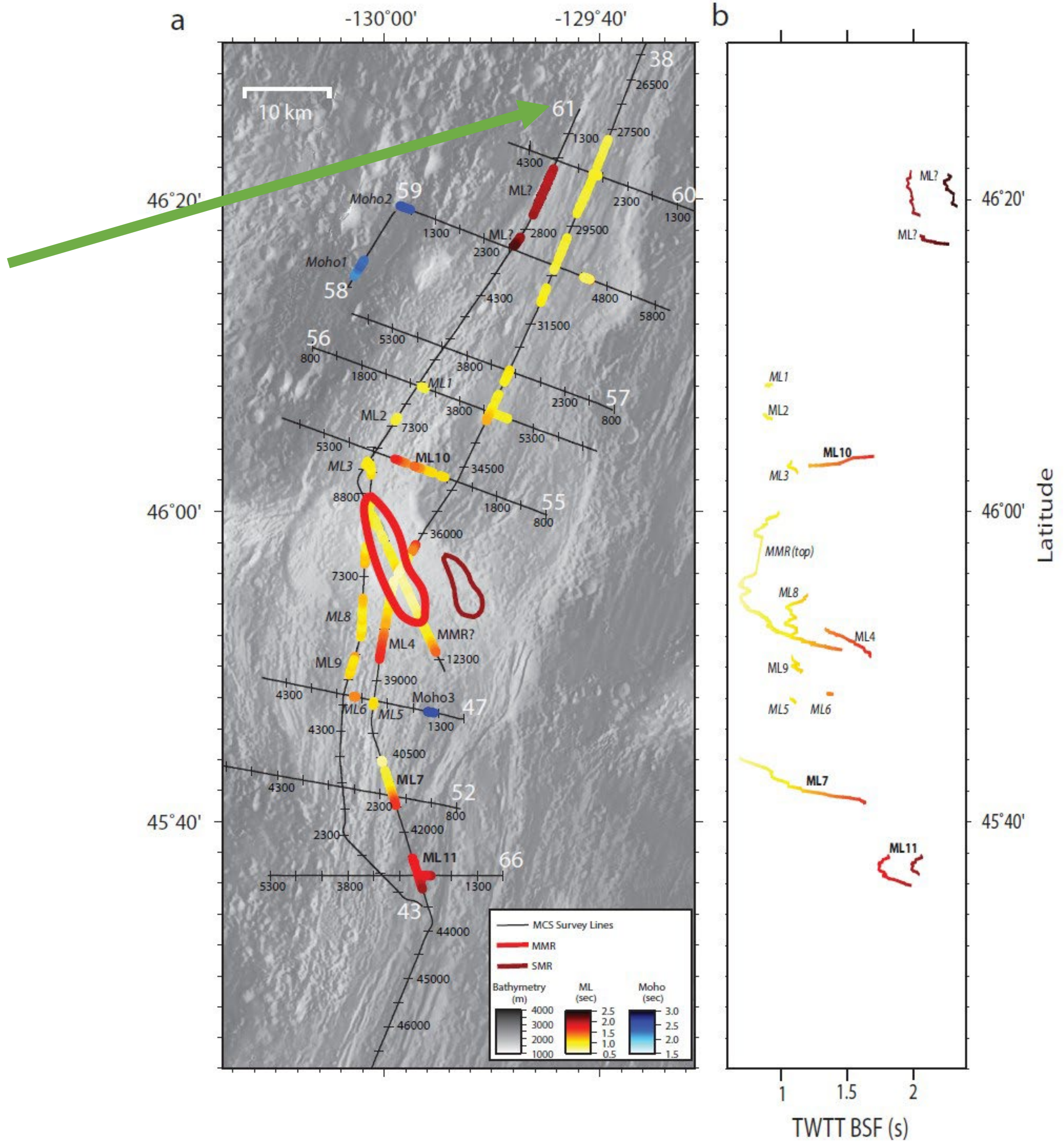
Data


survey vessel
source
receiver (hydrophones)
seafloor


38
61
60
59
58
56
57
55
47
52
66
43
46.4
46.2
46
45.8
45.6
45.4
Latitude
-130.4
-130.2
-130
-129.8
-129.6
-129.4
Longitude

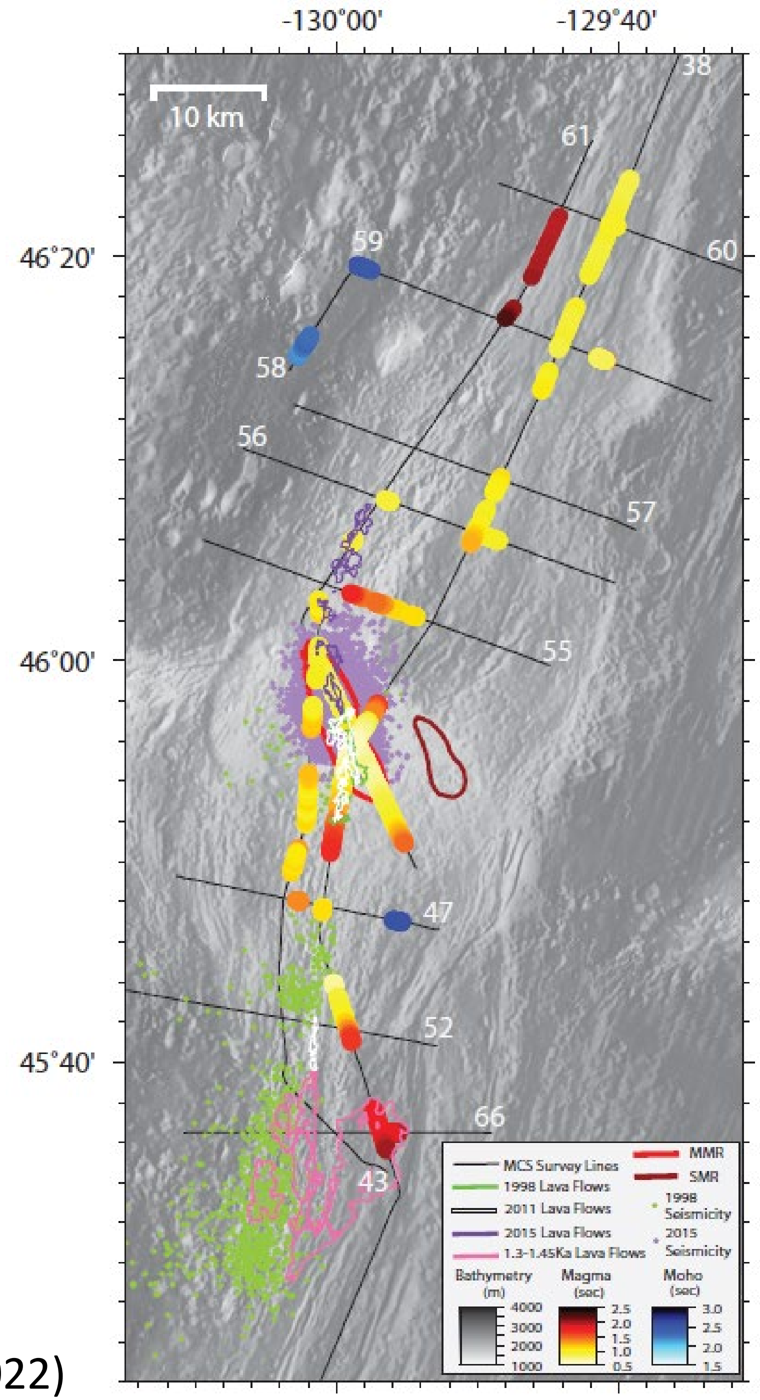
Results





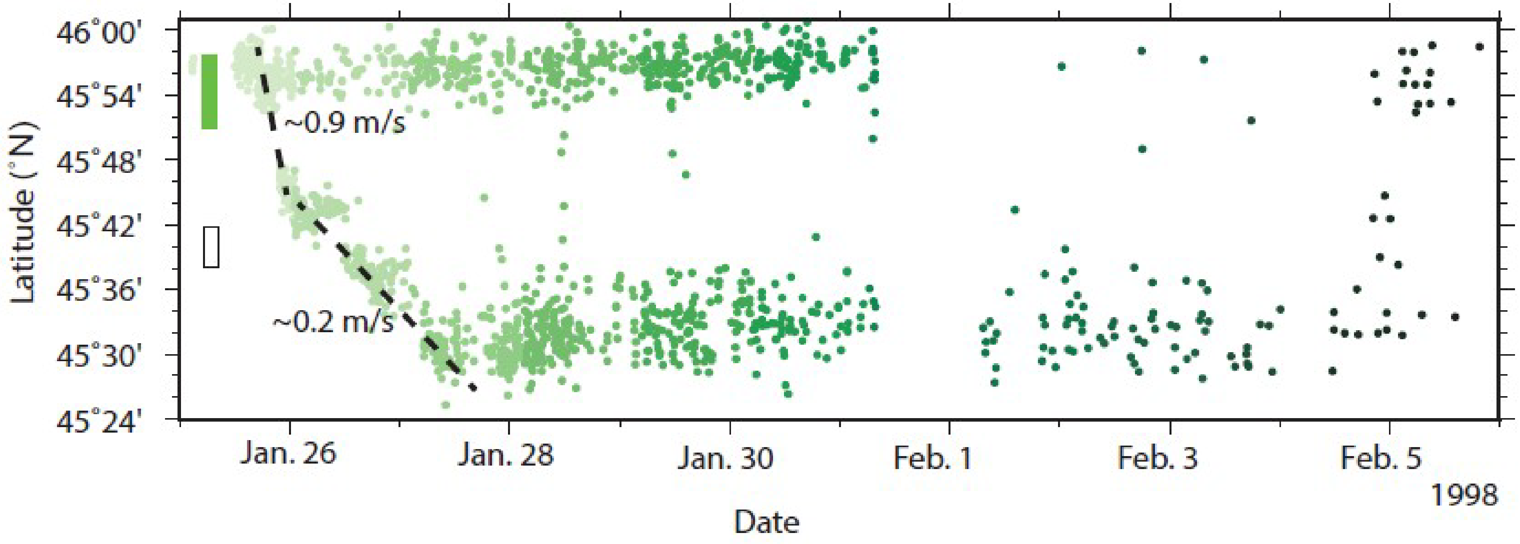
(Lee et al., 2022)

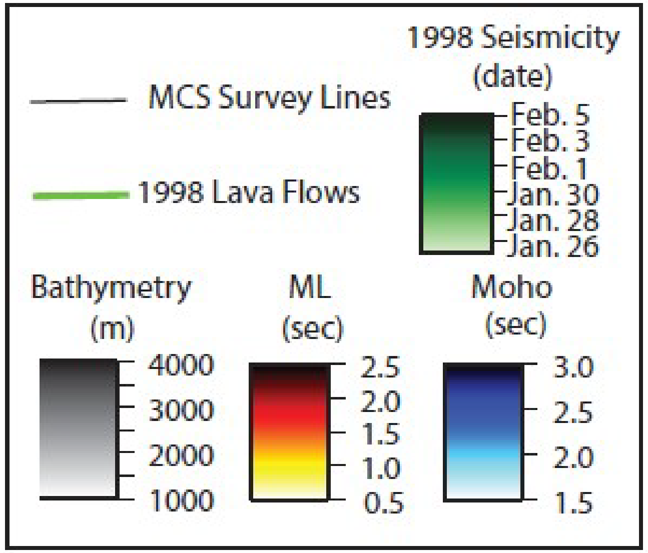
Discussion 1: Magma distribution beneath the SRZ and NRZ and relation to 1998/2011/2015 eruptions

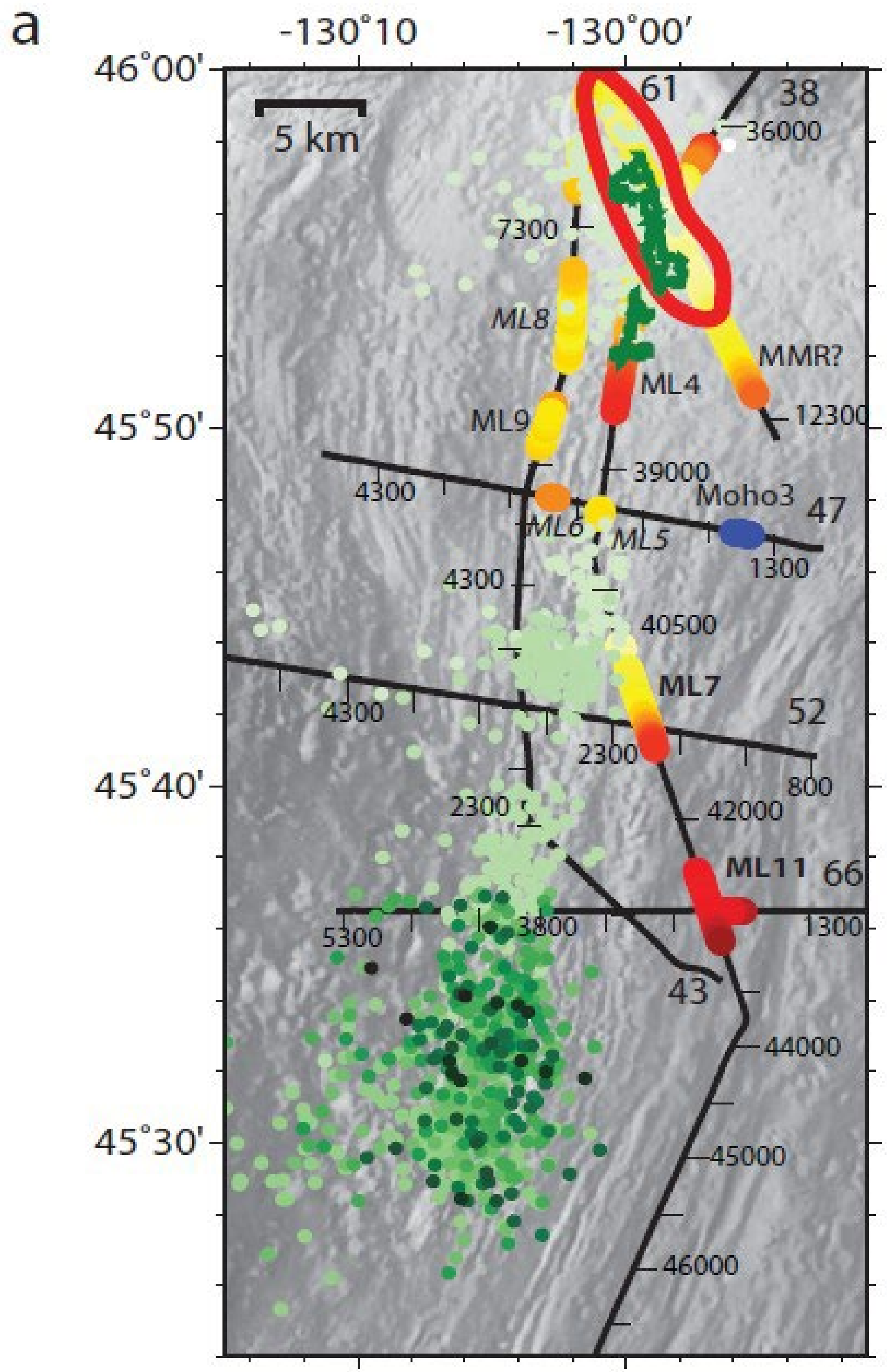


(Lee et al., 2022)

1998 Eruption

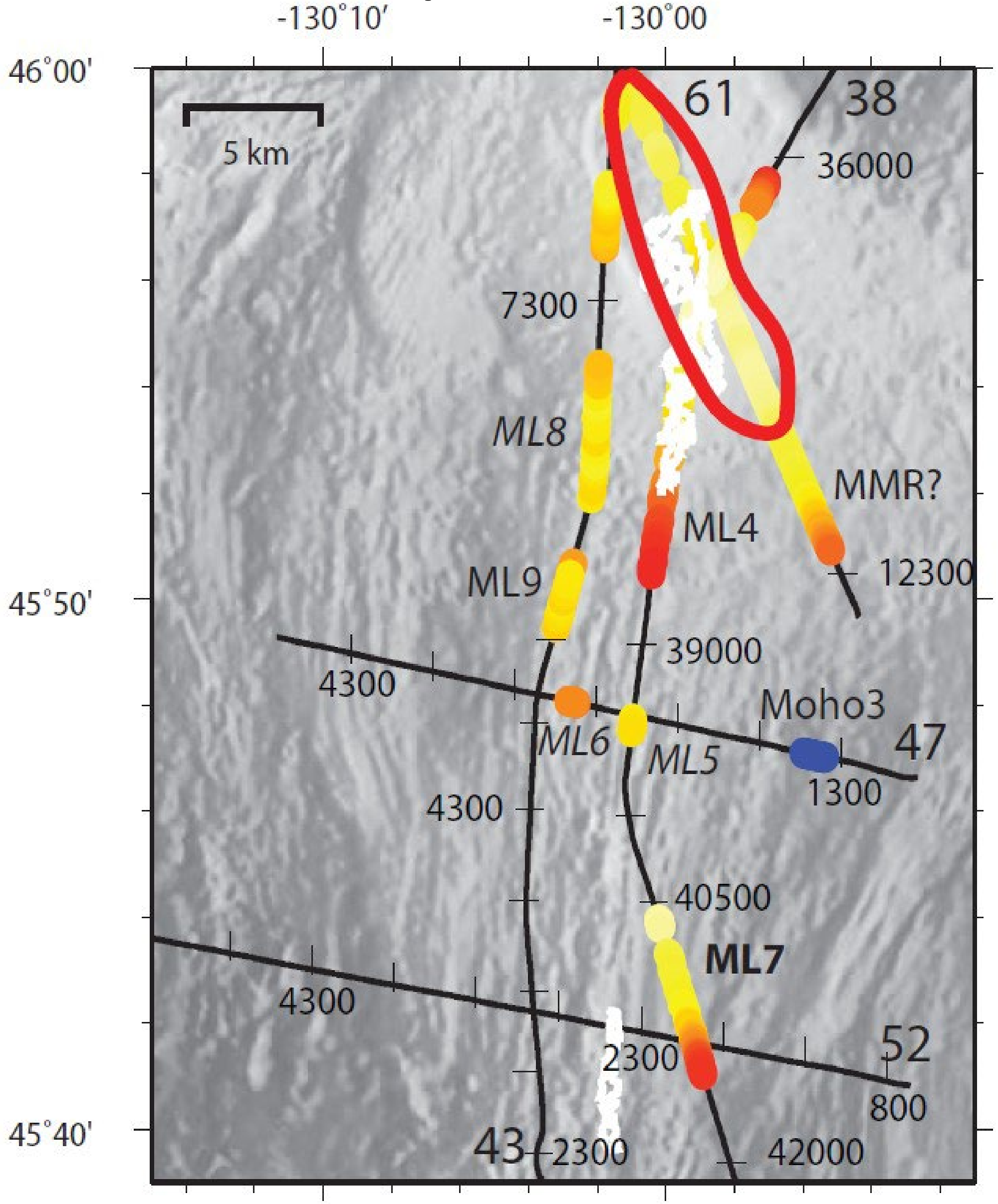




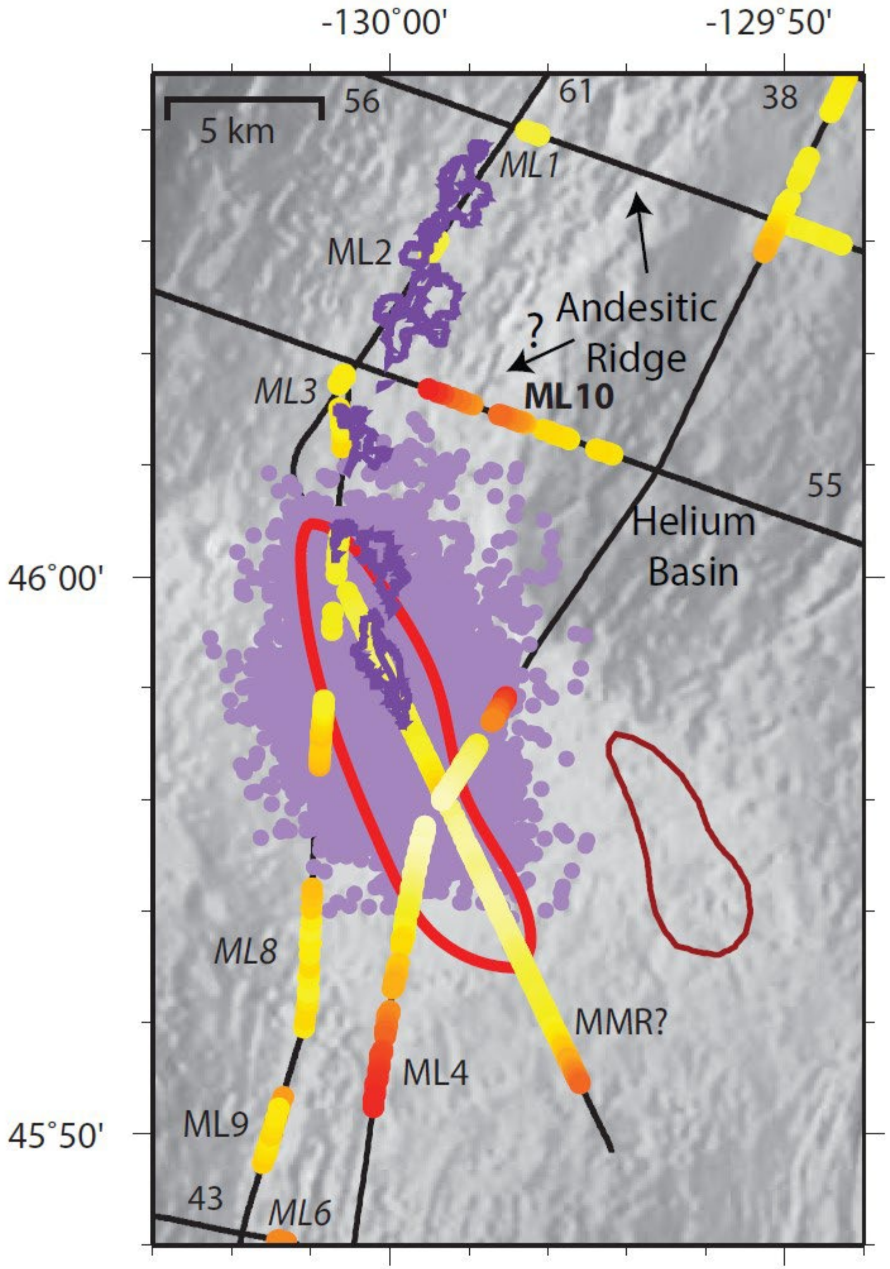


(Lee et al., 2022)

2011 Eruption



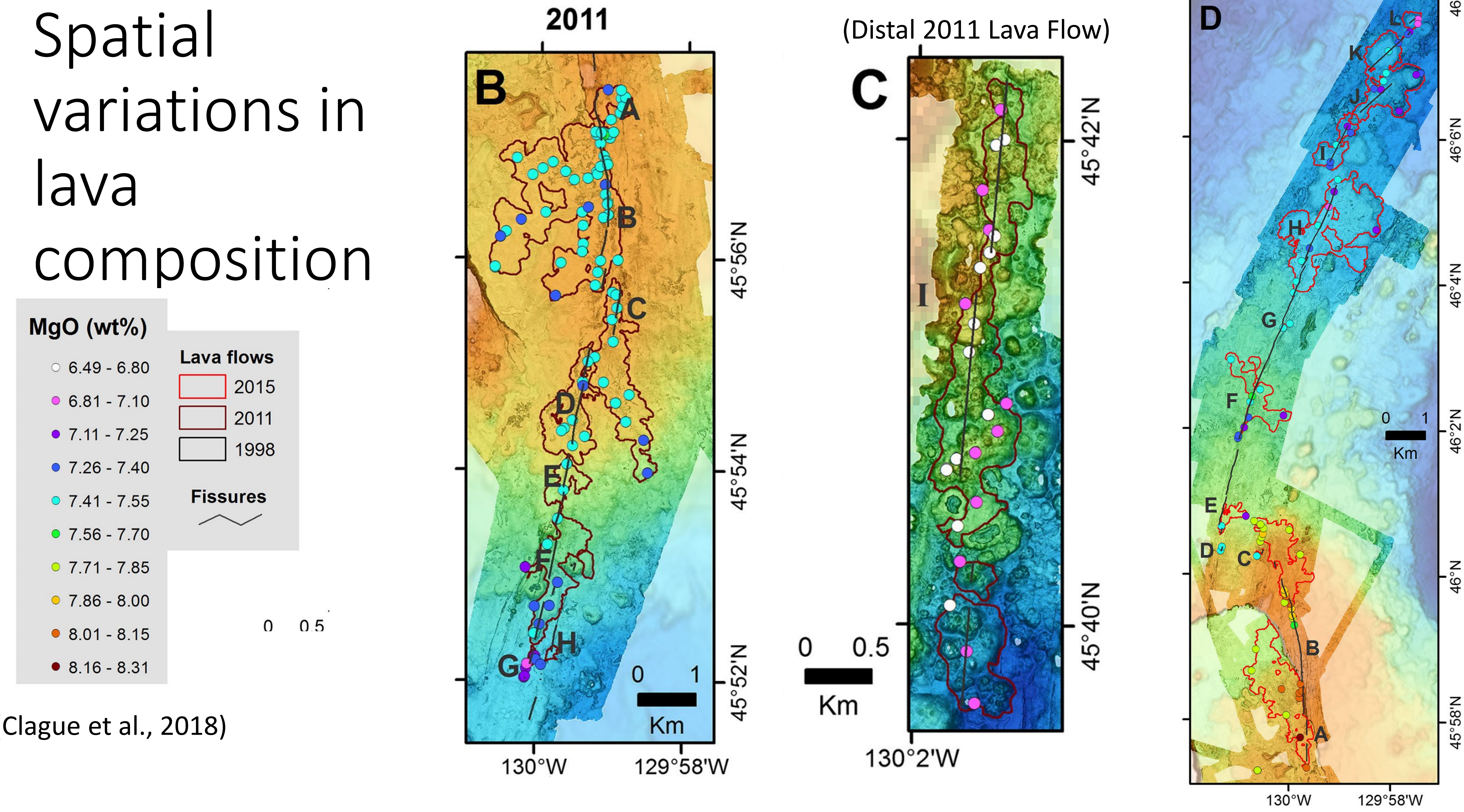
2015 Eruption



(Lee et al., 2022)

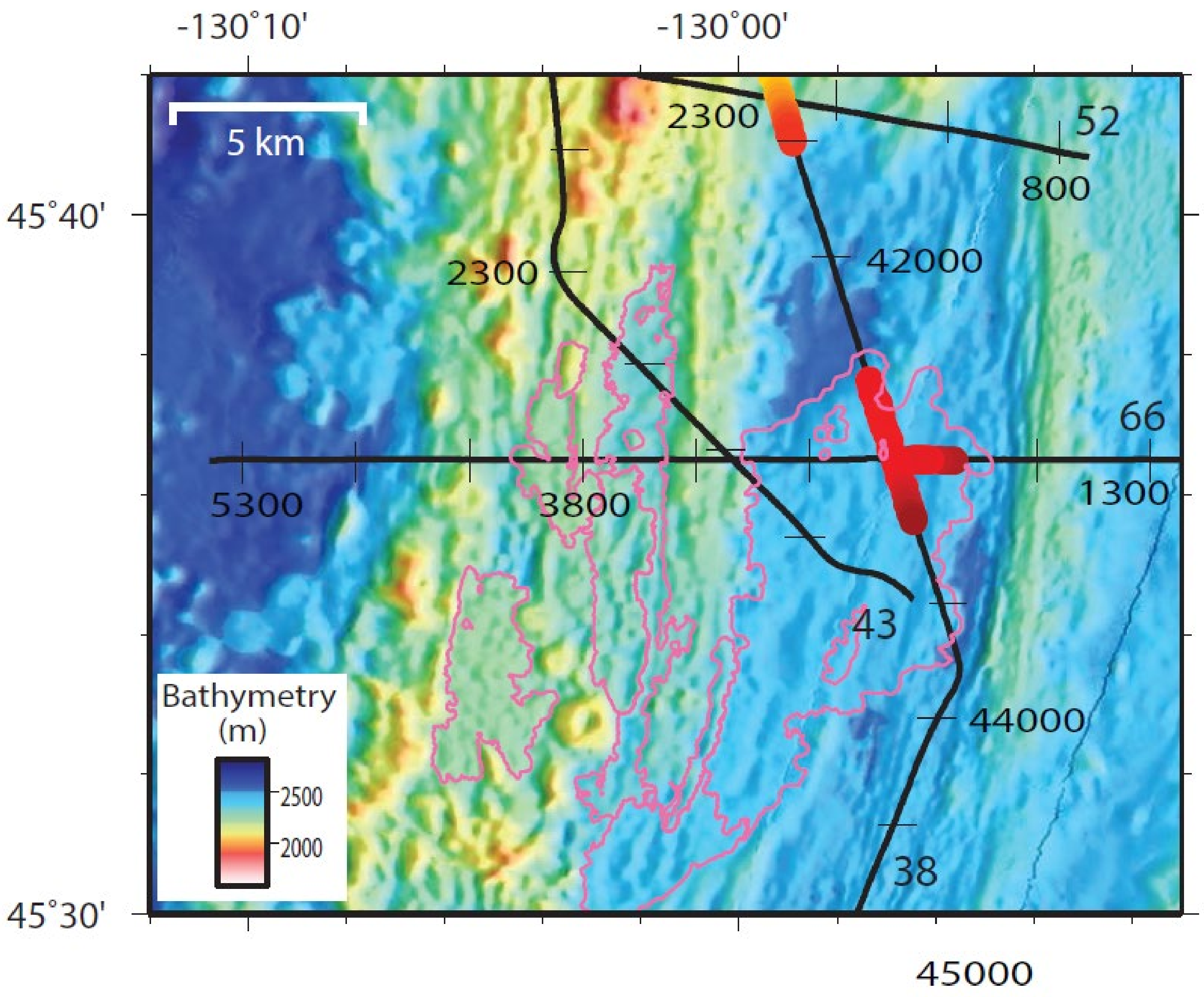
Discussion 2: Magma distribution and insights into chemical variation of erupted lavas

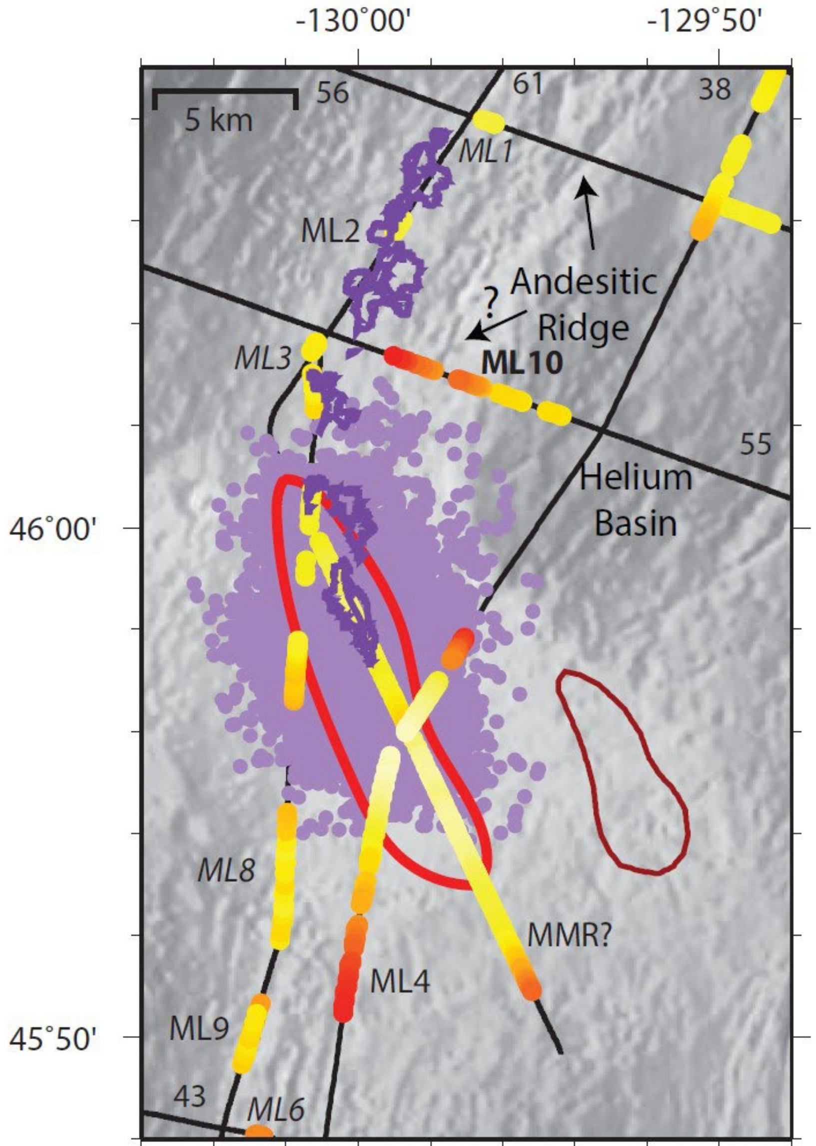
Spatial variations in lava composition



(Clague et al., 2018)

Discussion 3: Magma bodies beneath the rift zone overlap regions with adjoining JDF segments





SRZ and Vance Segment

(Lee et al., 2022)

NRZ and Coaxial
(Helium Basin)

Conclusion

- Small discontinuous magma bodies are imaged beneath the rift zones
  - These bodies could be additional sources of magma during the 1998, 2011, and 2015 eruption and intrusion events
  - These bodies may account for the more evolved composition of the rift zone eruption lavas relative to those within the caldera
    - Supporting model for mixing of caldera magma with other magma sources as the explanation for MgO pattern instead of conductive cooling and crystallization of magma during dike transport which was favored by Clague et al. (2018)
- Larger magma bodies detected beneath the overlapping regions located between Axial and neighboring segments of the JdF ridge
  - Local magma reservoirs for volcanism within these discontinuity zones
  - Potential magma transport between adjoining segments

Thank You!

Please feel free to email me if you have further questions or want to talk more!
Email:
mlee@ldeo.columbia.edu

Geochemistry, Geophysics, Geosystems

Research Article | Open Access

Detection of Magma Beneath the Northern and Southern Rift Zones of Axial Seamount at the Juan de Fuca Ridge

Michelle K. Lee, Suzanne M. Carbotte, Adrien F. Arnulf

National Science Foundation

Columbia University in the City of New York
Lamont-Doherty Earth Observatory
Columbia University | Earth Institute

Questions?