A Plan for Automatic Focal Mechanisms at Axial Seamount

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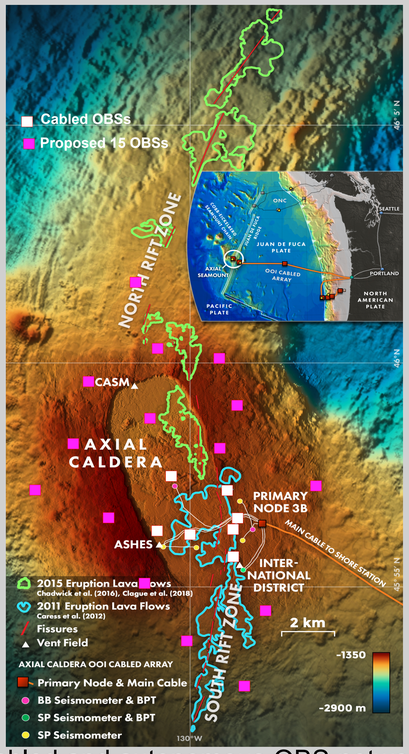
Background

- Axial Seamount is a submarine volcano at the intersection of the Cobb hotspot and the Juan de Fuca ridge that erupted in 1998, 2011 and 2015 (Fig.1). Seven three-component ocean bottom seismometers (OBSs) on the Ocean Observatories Initiative (OOI) Cabled Array in the southern caldera are continuously streaming data in real time.
- Previous research used manual first motion picks and S/P amplitude ratios to obtain focal mechanisms (FMs) for a small subset of earthquakes that spanned the 2015 eruption. This work demonstrated that the inflation and deflation of the underlying magma chamber is accommodated by changes in motion on an outward dipping ring fault.
- We describe a plan for creating focal mechanisms automatically that will be applied to the whole catalog comprising ~150,000 earthquakes and to the data from an expanded network that will be deployed for 2 years starting in September 2022.

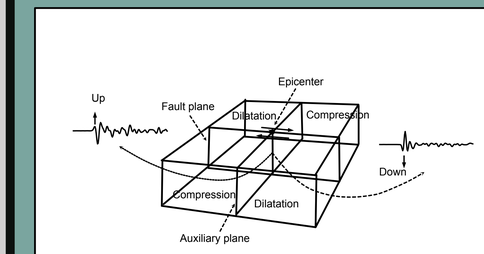


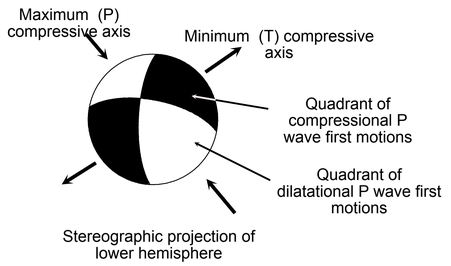
Cabled and autonomous OBS networks at Axial Seamount

Data

- Real-time data from seven three-component seismic stations deployed as part of the OOI Cabled Array from 2015 to 2022.
- Real-time updating double-difference (DD) catalog utilizing waveform cross-correlated difference times(Waldhauser et al., 2020).
- 15 autonomous OBS to be deployed from 2022 to 2024.

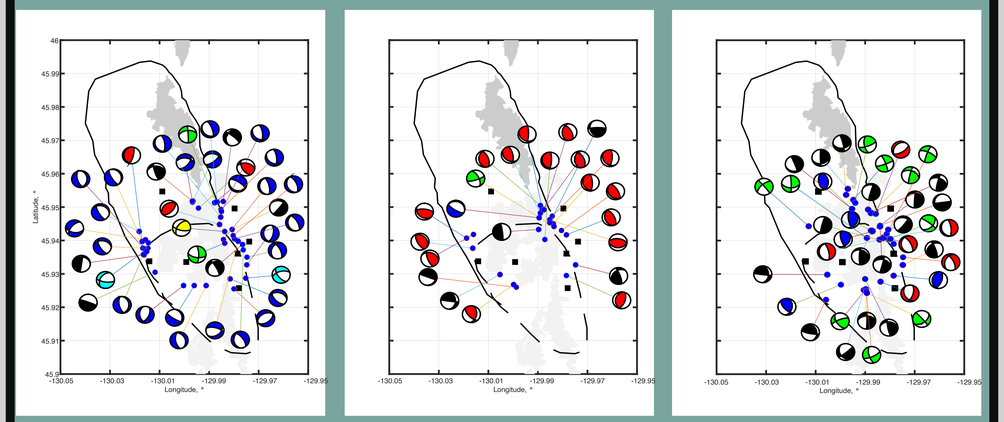
Focal mechanism for the entire catalog will illuminate changes in faulting patterns and stress through the eruptive cycle





Which process drives eruptions at Axial Seamount? Plate extension or magmatic inflation?

Before Eruption | During Eruption | After Eruption



Reverse | Strike-slip | Normal | Oblique-Normal | Oblique-Reverse | Unclassified

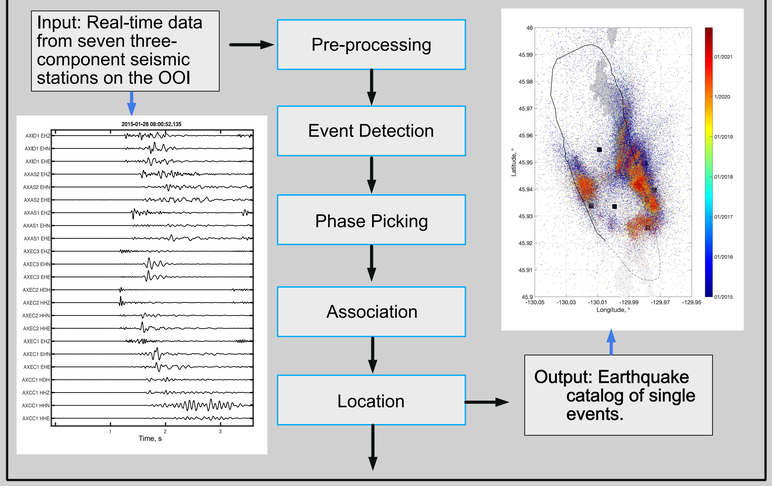
Composite focal mechanisms based on recalculating the solutions from Levy et al (2018) using their first motion picks and our earthquake

Website link

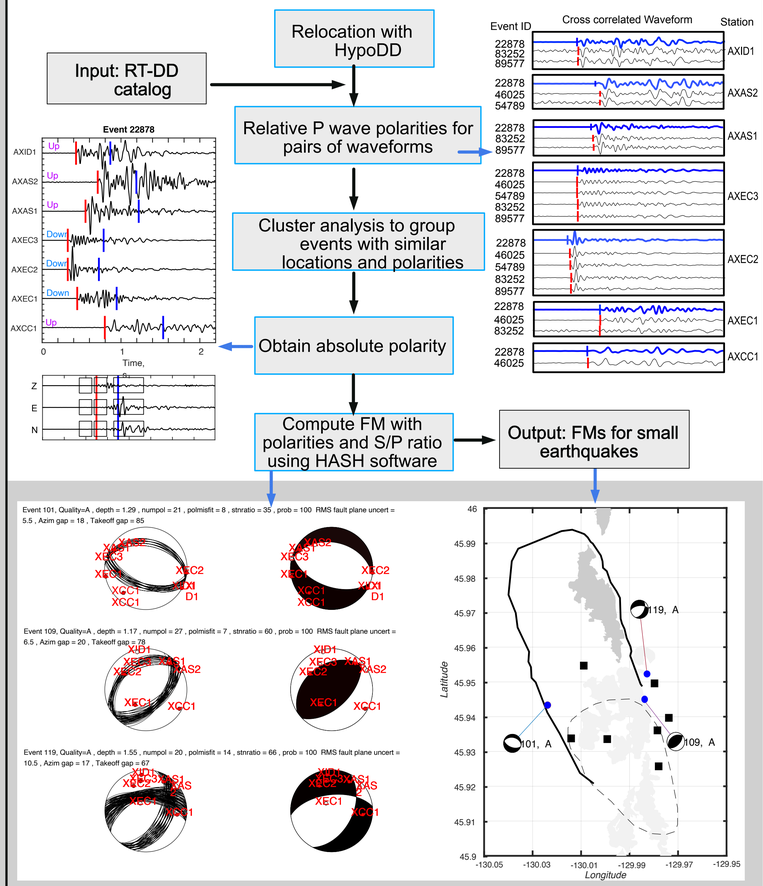
PDF of this poster

Planned Method

- Standard Earthquake Monitoring and Location.



- Determining focal mechanisms automatically



Composite FM from HASH algorithm and their locations

Next Steps and Science Application

- Use S wave polarity to better constrain composite FM
- Stress inversion with FM clusters.

References

- Levy, S., et al. (2018). "Mechanics of fault reactivation before, during, and after the 2015 eruption of Axial Seamount." Geology **46**(5): 447-450.
- Waldhauser, F., et al. (2020). "Precision seismic monitoring and analysis at Axial Seamount using a real-time double-difference system." Journal of Geophysical Research: Solid Earth **125**(5): e2019JB018796.