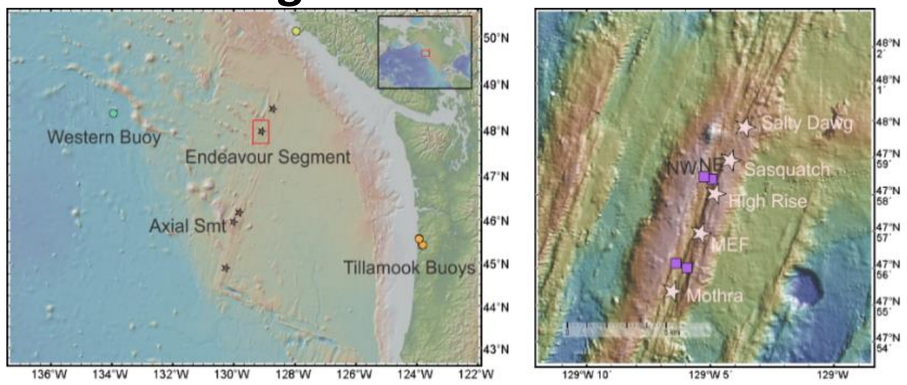
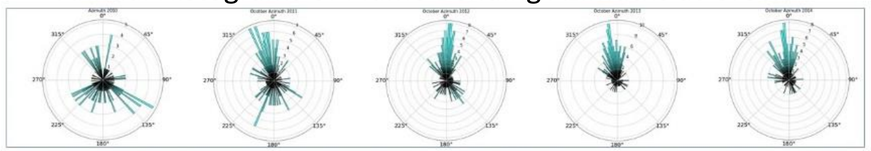
Using acoustic imaging to monitor focused and diffuse hydrothermal venting

Karen G. Bemis (Rutgers) and many, many more
(especially Guangyu Xu (APL-UW), Darrell Jackson (APL-UW), Anatoliy Ivakin (APL-UW), Dax Soule (Queens), Michael Zhao (Rutgers))

Monitoring Grotto Vent on NEPTUNE



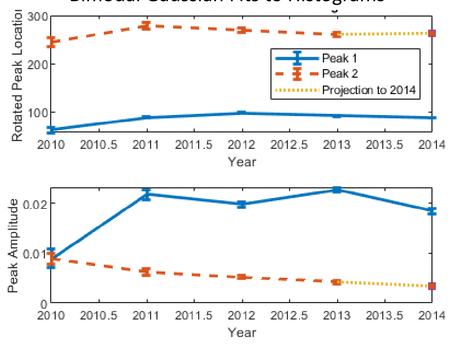
Annual Histograms of Plume Bending Azimuths at Grotto



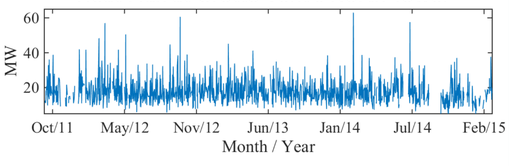
2010 2011 2012 2013 2014

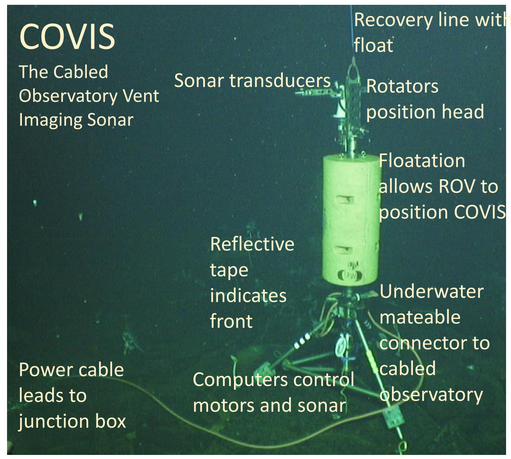
COVIS at Grotto Vent imaged several plumes above the sulfide mound, capturing vertical velocity and heat flux for the largest plume. Recent work tracks changes in the azimuth of plume bending. Bending shifted from balanced N-S bending in 2010-2011 to dominantly N bending in 2013-2014. Increased venting at High Rise and decreased venting in MEF or Mothra seems the most likely explanation.

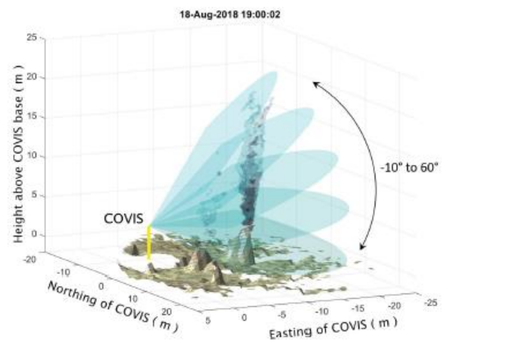
Bimodal Gaussian Fits to Histograms



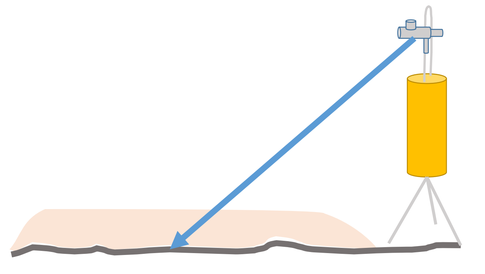
Heat Flux at Grotto Vent's North Tower





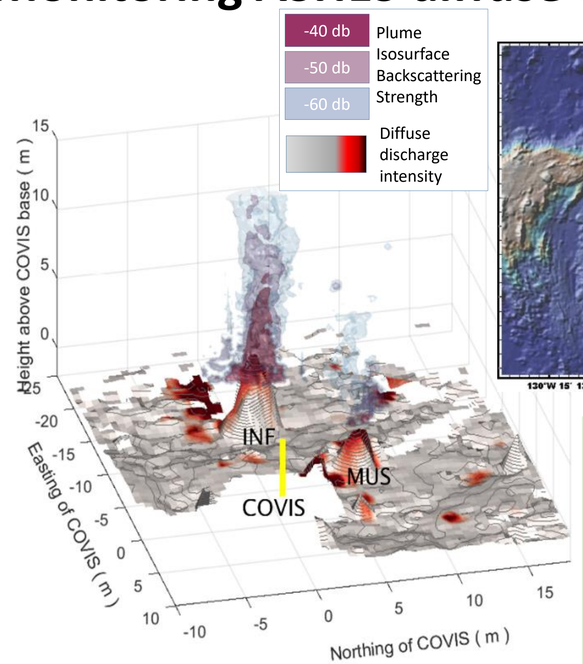


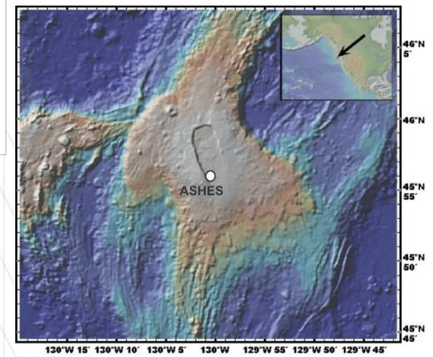
Imaging mode scanning

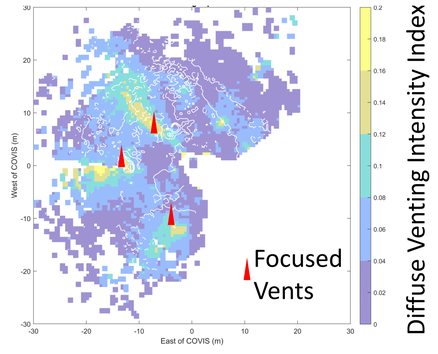


COVIS Diffuse mode

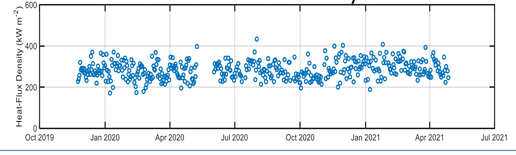
Monitoring ASHES diffuse venting on OOI







ASHES Diffuse Heat Flux Density Constant



COVIS at ASHES has imaged several plumes and detected hydrothermal discharge. We estimate Inferno heat flux as of the order of 10 MW and the diffuse discharge heat flux density as the order of 200-400 kW/m2. Spatial analysis of the diffuse discharge maps suggests aureoles of enhanced diffuse discharge surround focused vents (which in some cases are miniature focused vents with clear discharge).

Supported by NSF NSF OCE 1736702, 1736393, 1834813

Selected Publications:
Bemis, K.G., Zhao, M., Sacker, J., Soule, D. (submitted) Systematic Shift in Plume Bending Direction at Grotto Vent, Main Endeavour Field, Juan de Fuca Implies Change in Venting Output along the Endeavour Segment
Bemis, K. G., Silver, D., Xu, G., Light, R., Jackson, D., Jones, C., Ozer, S. and Liu, L. (2015). The path to COVIS: A review of acoustic imaging of hydrothermal flow regimes. *Deep Sea Research Part II: Topical Studies in Oceanography*, *121*, 159-176.
Xu, G., Bemis, K., Jackson, D., and Ivakin (2021). A. Acoustic and In-situ Observations of Deep Seafloor Hydrothermal Discharge: an OOI Cabled Array ASHES Vent Field Case Study, *Earth and Space Science*, 8(3), e2020EA001269.
Xu, G., Jackson, D. R., Bemis, K. G., and Rona, P. A. (2014). Time-series measurement of hydrothermal heat flux at the Grotto mound, Endeavour Segment, Juan de Fuca Ridge. *Earth and Planetary Science Letters*, *404*, 220-231.