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The Implications of Hydrocarbon Seepage, Gas Migration and Fluid Overpressures to Frontier Exploration and Geohazards

Seeps provide direct samples of the fluids present in a basin without drilling. Where available, we use 3-D seismic to infer subsurface conduits, and seafloor bathymetry and amplitude to identify the surface location of seeps. If 3-D data are not available, we use 2-D seismic combined with hull-mounted multibeam (capable of mapping 400 to 1000 km^2 per day) to identifiy sub-surface conduits and seafloor targets. We utilize a process-oriented approach to interpret the combination of sub-surface, seafloor, and satellite data. Our objective is to identify – and then sample – geologically young features. In deep water, or in areas of strong currents, we use navigated cores to sample the seafloor.

Seafloor seeps also provide direct evidence of fluid overpressuring, which can trigger slope failure. Internally driven slope failures are characterized by a flat base and a steep, amphitheatre-shaped headscarp. If overpressures persist, then failure may recur within the original feature, leading to headward migration and a linear failure morphology. We use the relationship of active seepage to slope failures to evaluate failure mechanisms, interpret subsurface hydrogeology, and constrain geohazards.

We will show examples of seep-based exploration and internally driven slope failure from hydrocarbon prone continental margins, and demonstrate the link between hydrocarbon generation, gas migration, gas hydrate formation, seafloor seeps and slope failure. We will discuss a model for this link, and show seismic (high resolution and exploration), seafloor (multibeam, seismic, and AUV), and borehole data (in situ pore pressure) groundtruthing the model.