High-resolution 3D seismic investigation of fine scale faults and fractures along the Vestnesa Ridge, western Svalbard Margin

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Methane seepage on continental margins derived from shallow gas reserves and gas hydrate stores is significant globally, with initial observations most commonly derived from pockmark expressions on the seafloor. The processes driving fluid flow (liquids and gases) through upper (200m) marine sediments is not well understood. Pockmarks signify present or past seepage events, and are prominent across Vestnesa Ridge. Not all pockmarks are active (venting), suggesting that the mechanism behind fluid flow varies across the ridge. The main structures observed in the seismic are gas chimneys, faults and fractures. Here we study the characteristics of the observed features through attribute analysis at three significant horizons (age estimates: <0.2Ma, ~0.2Ma and ~1.5Ma). We extract fault orientations through the generation of 3D fault attributes and analysis of fault detect volumes. Attribute extracts at horizons, using amplitude and edge detection methods, together with spectral decomposition and RGB blending, have revealed fine-scale (<10m) faults. High amplitude lineaments at multiple depths match fault trends and radial fracturing is observed around gas chimneys. Small faults propagate outwards from gas chimneys and feed into larger tectonically derived faults, suggesting horizontal inter-connectivity at specific depths. Enhanced imaging of gas chimneys and small scale features, contribute to our understanding of how fluids migrate through the sediment column. We hypothesize that the connecting fractures, forming between main fault zones may suggest sediment overpressure and restricted flow through tectonically induced faults resulting in horizontal fluid transport.