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Investigating a dynamic gas hydrate system in disequilibrium in the Danube Delta, Black Sea

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Gas hydrates are known to be extensive across the Danube Delta, as indicated by the presence of bottom simulating reflections (BSRs). The shelf break in this region is characterised by several incised submarine canyons, the largest of which is the Viteaz Canyon, and numerous slope failures. BSRs often coincide with submarine landslides, and it has been proposed that hydrates may play a role in triggering, or facilitating such events. This study focuses on a seafloor canyon (the S2 Canyon) to the north-east of the main Viteaz Canyon, where geophysical survey data and sediment cores were acquired in 2014. Active venting from the seafloor is known to be occurring at this site as multiple flares were been imaged in the water column. The location of these flares coincides with a significant slope failure adjacent to the canyon, and some can be correlated to subsurface gas chimneys, indicating a complex 'plumbing system' of gas migration pathways. This site is of particular interest as the 'present-day' BSR imaged in seismic data is not at equilibrium with the present-day seafloor conditions.

Using high resolution 2D seismic data, a P-cable 3D seismic volume and ocean bottom seismometer data we investigate potential gas migration pathways and the complex gas hydrate system in the vicinity of the S2 Canyon. In addition, we use stratigraphic interpretation based on regional 2D seismic lines to constrain the relative ages of the channel levee systems. Through detailed mapping of the BSR, possible paleo-seafloor surfaces and gas migration features we are able to provide estimates of equilibrium conditions for the hydrate system, and examine the controlling factors affecting gas migration pathways and hydrate formation.

The results of this study provide new insight into a geologically complex setting with a dynamic hydrate system. Characterising the hydrate system here may help to explain why it is in disequilibrium with the present day seafloor, and provide a better understanding of any potential implications for slope stability in the future as the hydrate system moves towards equilibrium.