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Seismic Structure of Shallow Sediments at the Nascent Ridge Vent Site, Makran Deformation Front, Offshore Pakistan

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In fall 2007, a wide range of geophysical and geological data was collected along the Pakistan segment of the Makran accretionary prism. The main scientific goal of the offshore campaign was to identify, map, and characterize recent or presently active fluid vent sites at and beneath the seafloor. The extremely thick sedimentary cover of the subduction complex is hoped to help pin down the influence of sedimentation on the nature of venting and provide a solid basis to compare resulting seepage with other, largely differing vent systems such as in the Black Sea or at the West-African Margin.

We present high-resolution seismo-acoustic data from the vicinity of the proto deformation front in approximately 3500 m water depth. Because of the high sedimentation rates, no trench is visible in the bathymetric data, thus the location of ongoing subduction and deformation is not obvious. Seaward of the first fully-developed accretionary ridge and parallel to it, seafloor topography indicates the onset of deformation in the form of folding, called the Nascent Ridge.

Uniform seismic layering beneath this feature is interpreted to indicate undisturbed hemipelagic, predominantly turbiditic sedimentation. At the estimated depth of the base of gas hydrate stability zone, high reflection amplitudes hint to the presence of trapped gas in the strata. The high-amplitude package is a single clear reflector towards the flanks of the fold, but becomes a set of elevated reflector segments and chaotic high-amplitude patches towards the crest. The depth of the anomaly below seafloor decreases by several hundred meters to a depth which is thought to be within the gas hydrate stability zone. The sediment on top appears to be fractured. Acoustic and visual observations documented free gas in the water column, the existence of which might indicate unknown mechanisms of free gas intrusions into the gas hydrate stability zone. Our data reveal the fine subsurface structure of this rare phenomenon on a few meters' scale, adding to a successful explanation of the feature.