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Evidence of focused fluid flow associated to the gas hydrate wedge on the angolan margin

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The Lower Congo basin, offshore south west Africa, is a prolific petroleum province, which has been extensively investigated and exploited for more than 30 years. The study area is located above a producing oil and gas field, the hydrocarbons being trapped in turbidite channels on a tectonic horst. The work is based on the analysis of 3-D seismic and site survey data (2D AUV, grab samples and ROV photos) above a deeper oil and gas field called Moho. The analysis of this seismic data set reveals numerous evidence of focused fluid flow through the Mio-Pliocene interval, including present-day seafloor seep features and shallow buried paleo-seeps, indicating past activity of the system. The main fluid migration-related structures are the followings:
1. Stacked amplitude anomalies, interpreted as the result of vertical migrations of gas are pervasive. Most of these seep features seem to correspond to fossil events as they are interpreted as successive precipitation at the seafloor of patches of seep carbonates (MDAC, Methane Derived Authigenic Carbonates) stacked during the activity of a seep.
2. Another phenomenon of gas migration through the sediment pile is visible on the seismic data of the Moho area: it is the BSR (Bottom Simulating Reflector) located above a horst. The BSR is formed by 2 patches, which cover a small area about 1.5 km^2 for the largest and 0.5 km2 for the smallest. These two BSRs are located under a depth of water included between 600 and 700 m, into the BSR wedging area.
3. A ‘spider morphology’ is visible on the seafloor. It corresponds to depressions forming variable-sized furrows oriented slightly oblique to the slope dip direction, directly above the upslope limit of the BSR patches. ROV photos and movies from these furrows showed the presence of seep carbonates and of bacterial carpets, linked with methane leak at the seafloor.
A similar ‘spider morphology’ was also identified in subsurface, at 20 ms under the seafloor, further down the slope, in present-day water depth ranging from 750 to 850 m. These buried depressions cover a stripe in that depth range all over the area covered by the 3D seismic data.
These two observations, made both on the seafloor and on it subsurface, seem to correspond to the same phenomenon of fluid expulsion, for the views of the seismic morphology similarities, but in different periods. It is interpreted as a result of a downward migration of the BSR, because of the last sea-level rise, which would have meant an upslope migration of the intersection of the BSR with the seafloor.
Based on the evidence of gas hydrate dissociation phenomenon in the Lower Congo Basin, the pinch-out of the BSR may be considered as a natural laboratory for investigating a possible massive greenhouse gas release due to global warming.