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Fluid-escape structures and slope instabilities along the French Guiana margin

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Many of the world's passive margins are shear margins. Those margins present a very steep ocean-continent boundary which is expressed by high surface-slope gradients. In this type of margins, complex rift structures including wrench and strike-slip faults affect the continental crust. These rift basins usually trap organic matter, hence kerogen that later become hydrocarbons. Along the Guiana margin, late cretaceous black Shales provide additional organic matter.

The French Guiana margin has been recently surveyed (GUYAPLAC cruise, 2003) allowing the discovery of a giant pockmark field likely caused by active degassing of deep reservoirs and expressed at the surface through giant elongated pock-marks. These pockmarks are systematically associated with massive slope instabilities and underlying polygonal fault network. Major seaward collapses seem to have affected the margin, and the breakup unconformity is tilted seaward.

We believe that fluid overpressure above Cretaceous under-consolidated organic rocks may have destabilized part of the sedimentary cover, allowing massive escape of fluids toward the surface, as is suggested further North by geotechnical analyses made after leg ODP 207 (O'Regan & Moran, 2007). A compactional origin of fluids is also possible.

In any case, the specific structural pattern of the Guiana transform margin, with a seaward tilted geometry and no marginal ridge, may favour particularly active fluid releases and slope instabilities (favoured by the decrease in sediment's strength related to high pore-fluid pressure). As suggested by O'Regan & Moran (2007) it is possible also that fluid migration occurs along the break-up unconformity, which crops out along the very steep continental slope. If this is correct, a great part of fossil hydrocarbon resources may escape to the surface along of the Guiana and Surinam continental margins.

References:

O'Regan M. & K. Moran, 2007. Compressibility, permeability and stress history of sediments from Demerara rise. In Mosher, D.C., Erbacher, J. and Malone, M.J. (Eds), Proceedings of the Ocean Drilling Program, Scientific results volume 207.