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Observations on Structures Associated with Mud Diapirism and their Role in Petroleum Charging and Trapping*

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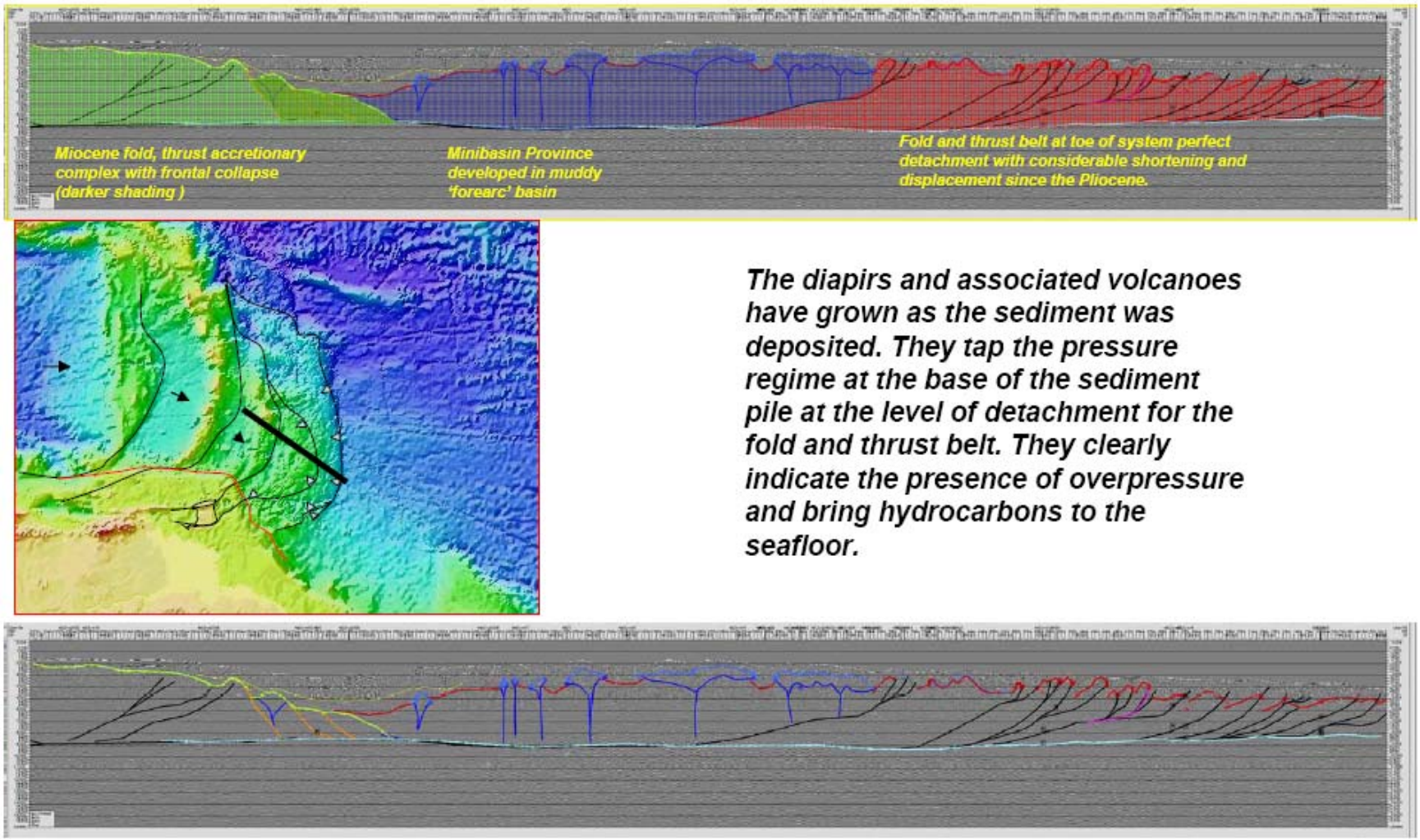
Abstract

There are both geometrical similarities and differences between the structures associated with mobile mud and those associated with salt (perhaps to be expected given the range of mud behavior itself). Throughout the world, but especially in the gravity driven systems of the continental margins, we see anticlines with cores that show the patchy seismic incoherence that we associate with mobile mud. Presumably these structures are fundamentally compressional anticlines, with mud mobility induced as a consequence of the folding process. As such, they are somewhat analogous with the salt-cored compressional folds of the Perdido and Atwater fold belts of the deep water Gulf of Mexico, or the anticlines of the Zagros. Also, like the Zagros anticlines with their local salt diapirs, the mud-cored anticlines are commonly pierced by pipes of diapiric mud which reach to the surface as volcanoes.

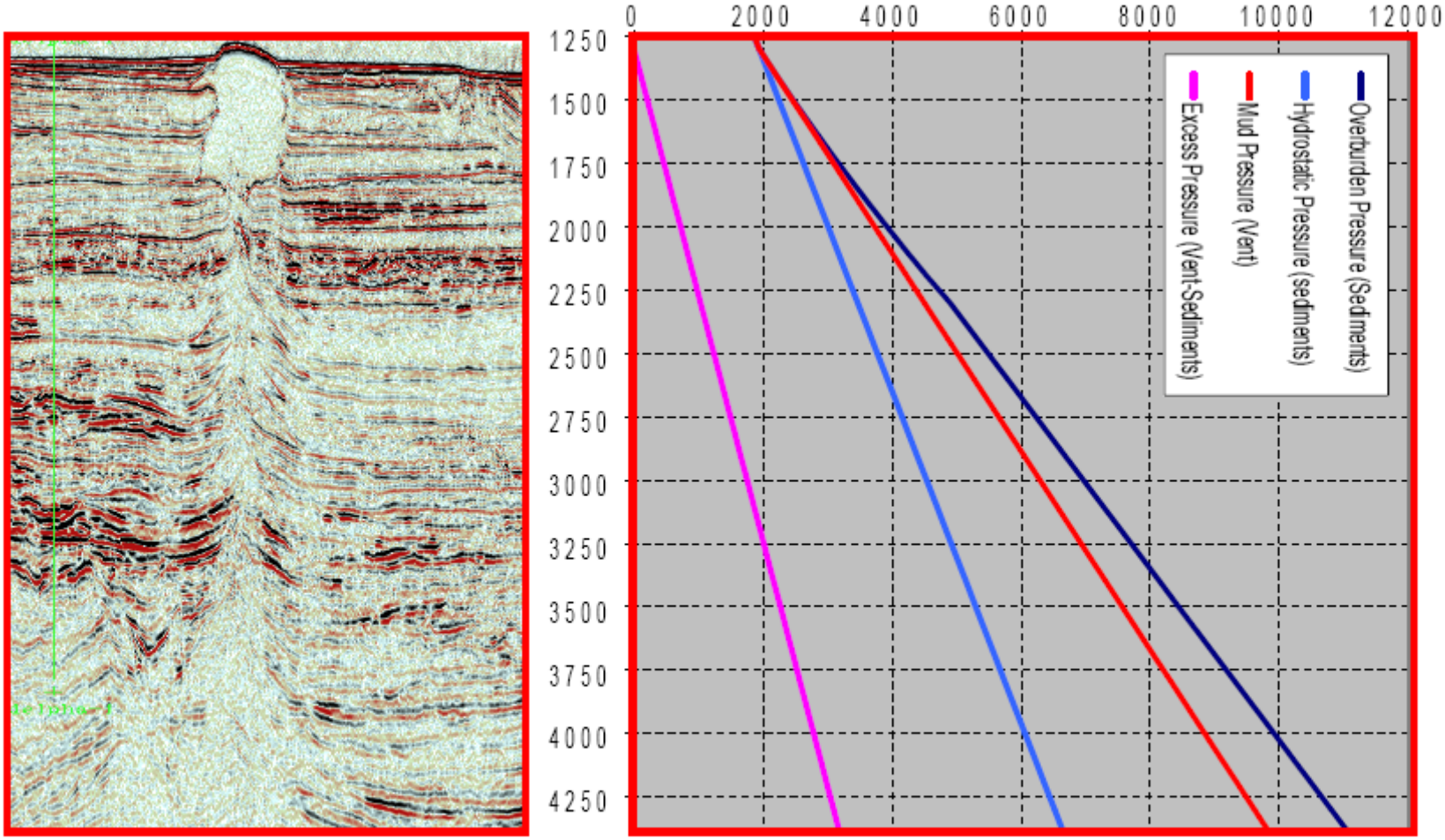
Structures associated with withdrawal and collapse seem to be less commonly associated with mud than they are with salt - we cite examples from the South Caspian but know of few others. We know of only one example of a mud-controlled minibasin province which might be analogous with salt-related minibasin provinces, such as those in the Gulf of Mexico. This is the Trinidad/Barbados forearc basin, a region where we suspect that the petroleum charge-migration story is strongly influenced by the mud tectonics.

As a generality, opinions vary widely on the role of mud diapirs and volcanoes in petroleum charging and entrapment. A discussion of hydrodynamic principles is useful in constraining the possibilities, and therefore predicting the charge mechanisms and column-retention capacities in associated petroleum plays.

Selected Figures



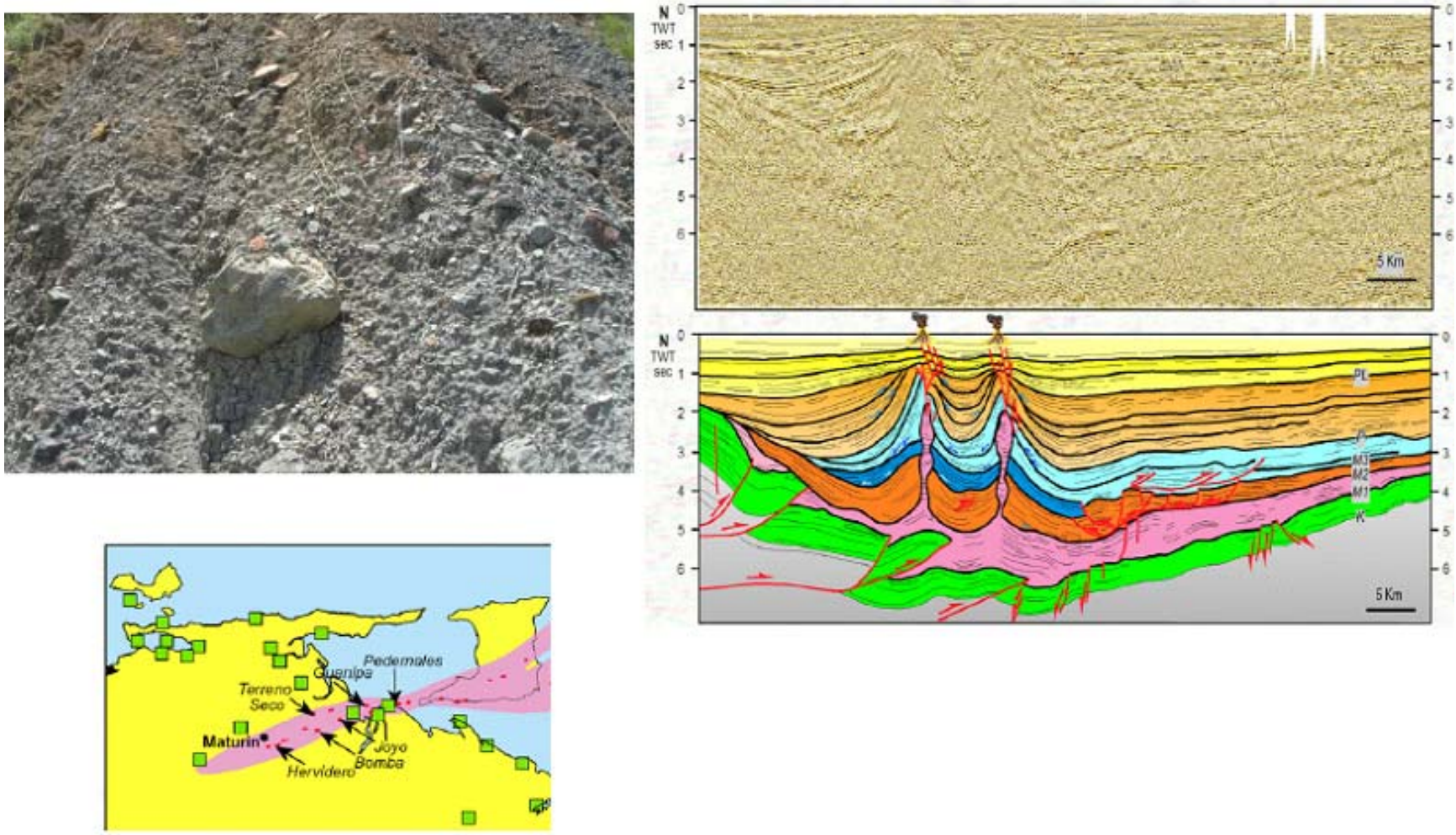
Diapirs and associated mud volcanoes in the Trinidad-Barbados area. Seismic by permission of GX Technology.



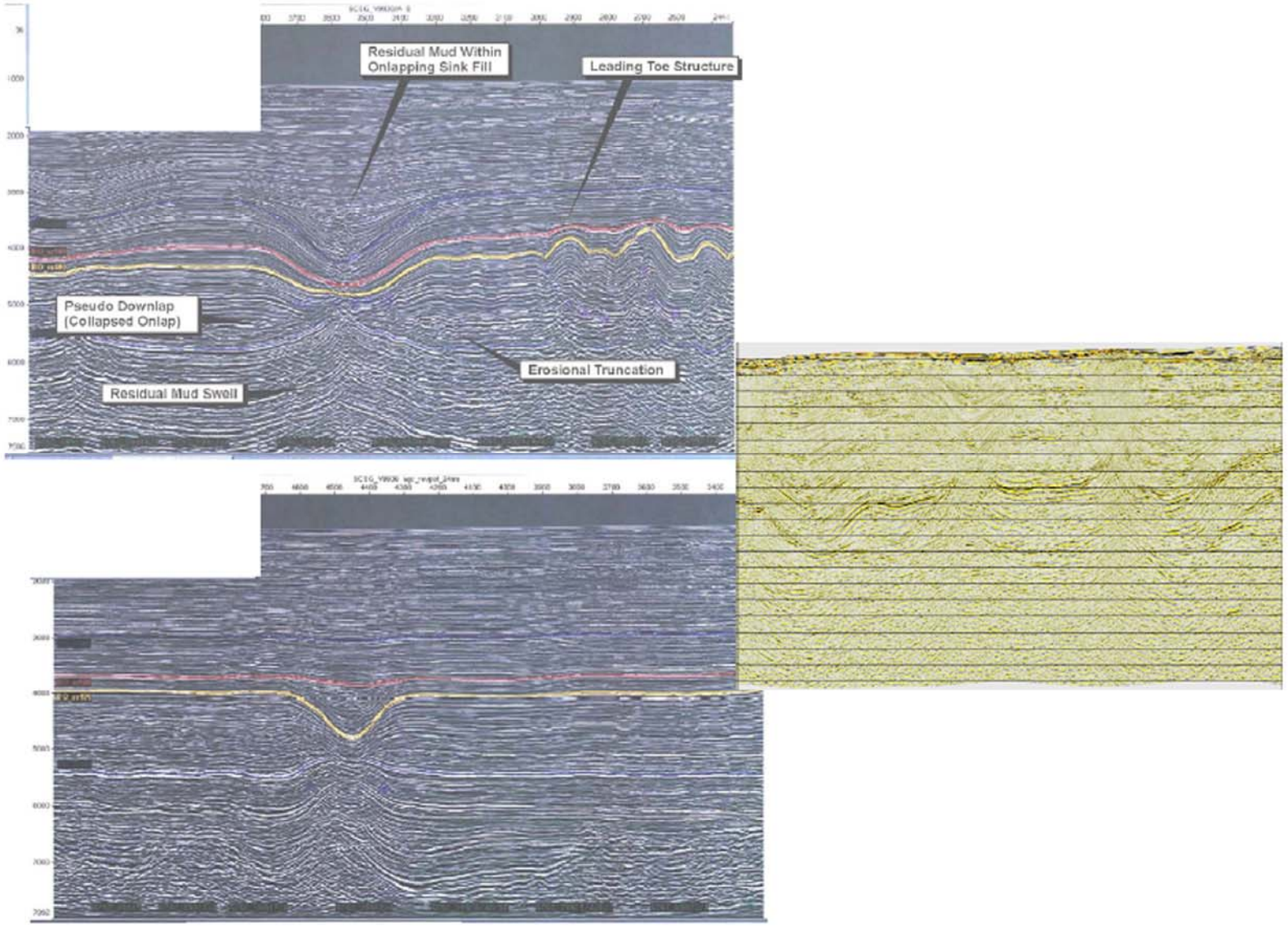
Mud density 1.8 g/cc (15 PPG): vent pressure builds at 2.5 psi/m (0.78 psi/ft)

Vent is overpressured by more than 3000 psi at 3000m below sediment surface

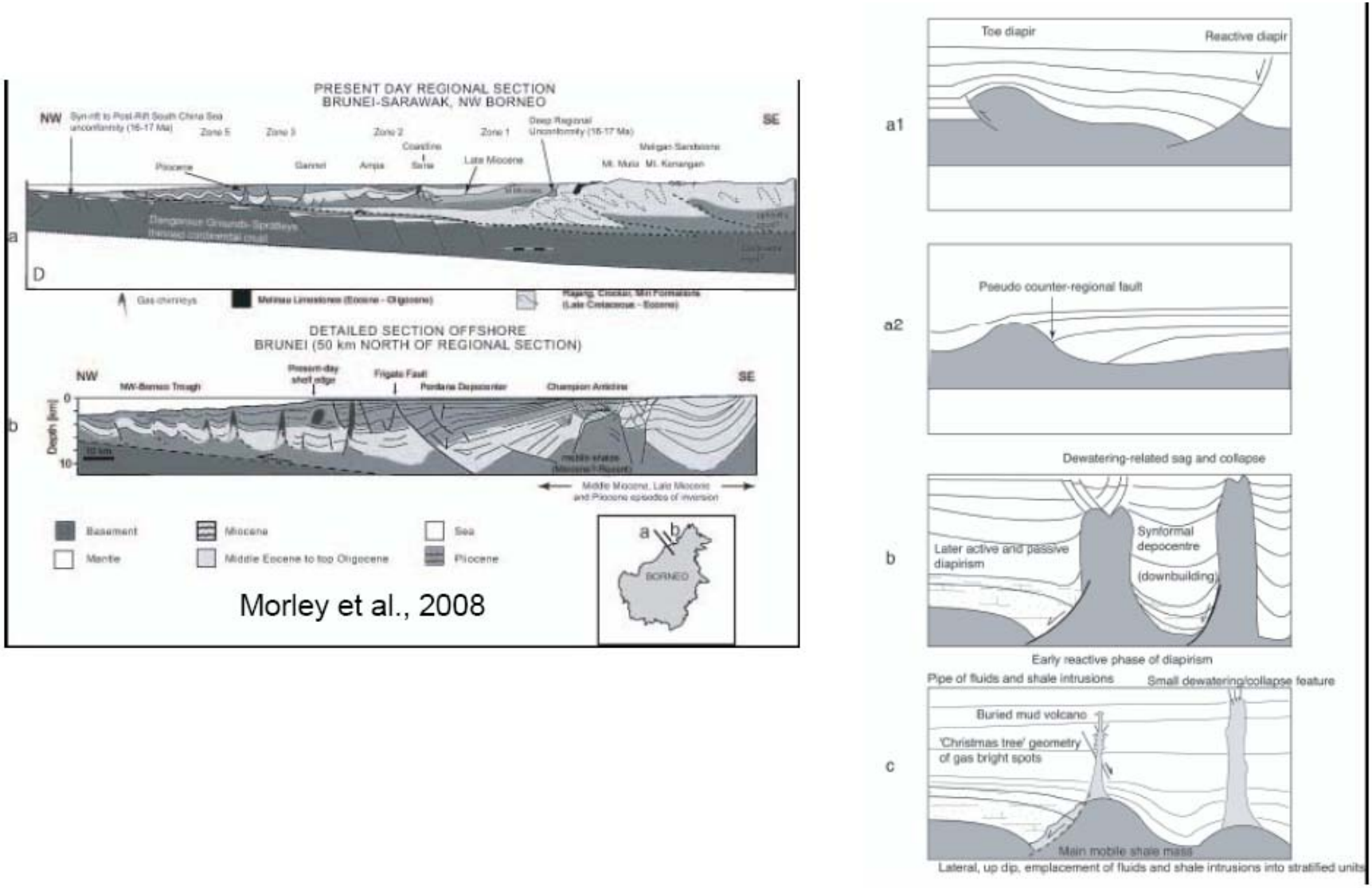
Basin pore pressure - hydrostatic case.



Mud vents in north-south seismic section through Maturin Basin (Duerto and McClay, 2002).



Geologic and seismic sections, Niger Delta.



Cross sections, along with reconstructions, Brunei and Sarawak (northwest part of island of Borneo) (Morley et al., 2008).

References

Corredor, F., J.H. Shaw, and F. Bilotti, 2005, Structural styles in the deep-water fold and thrust belts of the Niger Delta: AAPG Bulletin, v. 89/6, p. 753-780.

Duerto, L. and K. McClay, 2002, 3D Geometry and evolution of shale diapirs in the Eastern Venezuelan Basin: AAPG Search and Discovery article #10026, Web accessed 23 April 2009, http://www.searchanddiscovery.net/documents/duerto/index.htm

Ge, H., B.C. Vendeville, and M.P.A. Jackson, 2003, Analytical modeling of controlling factors for overburden structures in thick-skinned extensional salt tectonics: Acta Petrolei Sinica, v. 24/5, p. 26-31.

Morley, C.K., S. Back, P. Crevello, P. van Rensbergen, and J.J. Lambiase, 2003, Characteristics of repeated, detached, Miocene-Pliocene tectonic inversion events, in a large delta province on an active margin, Brunei-Darussalam, Borneo: Journal of Structural Geology, v. 25, p. 1147-1169.

Vendeville, B.C. and M.P.A. Jackson, 1992a, The rise of diapirs during thin-skinned extension: Marine and Petroleum Geology, v. 9/4, p. 331-353

Vendeville, B.C. and M.P.A. Jackson, 1992b, The fall of diapirs during thin-skinned extension: Marine and Petroleum Geology, v. 9/4, p. 354-371.