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Mechanism of Thin-Skinned Detachment in the Amazon Fan: Assessing the Importance of Fluid Overpressure and Hydrocarbon Generation

Since 10 Ma, continental sediment up to 12 km thick has accumulated at the mouth of the Amazon River, forming the Amazon Fan. Linked extensional and contractional structures root into a common detachment, hundreds of km long. Extensional faults have formed landward of the prograding delta slope and contractional folds and faults have formed seaward of it. By plan-view restoration, we show that extension and contraction balance. We therefore infer that slope instability provided the driving force for thin-skinned deformation.

The detachment is a sharp surface and appears to be stratigraphically controlled. There is no evidence for soft layers, such as evaporites. Abnormal fluid pressure provides a reasonable explanation for detachment. Down to depths of several thousand meters, one deep well indeed encountered fluid pressures near to overburden pressures.

Amongst the possible causes of abnormal fluid pressures is hydrocarbon generation. We have examined all available regional data and have submitted them to a test involving 28 conditions. At a confidence level of more than 90%, we conclude that hydrocarbon generation is a likely cause of fluid overpressure and detachment in the Amazon Fan.

Independently, we have used new techniques of sandbox modeling to investigate the geometries of fault patterns produced by fluid flow through porous media. We have been able to reproduce the structural pattern of the Amazon Fan, on the assumption that fluid overpressures exist beneath the detachment.