Degassing of the Amazon deep-sea fan : new views from the AMAGAS campaign

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Résumé

The submarine fans of large rivers are important sites of long-term carbon storage, but are also settings in which the rapid deposition of organic-rich sediment drives linked processes of gas and gas hydrate formation, fluid expulsion, mass failure and gravity tectonism. The Amazon River culminates in one of the world's largest deep-sea fans, the growth of which since ≈8 Myr has been accompanied by the development of extensional and compressive deformation belts across the shelf and upper slope (< 2250 m). An upper slope gas hydrate system has been identified from a discontinuous bottom-simulating reflection (BSR) that forms elongate patches aligned with the crests of thrust-fold anticlines, suggesting structurally-controlled supply of gas-rich fluids to the gas hydrate stability zone (GHSZ). Multibeam water column imagery acquired in 2016 revealed gas flares rising from small seafloor mounds in parts of the compressive belt, but their wider distribution is unknown. The aim of the AMAGAS campaign (May-June 2023) was to investigate the distribution of gas flares at the scale of the Amazon fan, and the dynamics of the upper slope gas hydrate-fluid-sediment system. The multi-disciplinary campaign acquired acoustic data in water depths of 100-4000 m, and sediment cores for sedimentological, geochemical, geotechnical and geothermal studies in depths of 450-1250 m. Dozens of gas flares were observed above seafloor depths of 2000 m, both within the GHSZ and above its upper limit in ≈550 m water depth, with new flares identified since 2016 and others no longer active. Within the compressive belt, flares rise from small (100s m) features of positive and negative relief shown to be seafloor mud volcanoes, many of which appear to have formed recently. Coupled to preliminary geochemical and geothermal results, these observations suggest a dynamic fluid expulsion system above BSR

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patches, associated with the ongoing formation of new seafloor vents and short-term changes in migration pathways. Analyses of the data are expected to constrain flux rates and the source depths of fluids, as input to modelling of gas hydrate dynamics and slope stability in the context of the ANR project MEGA.

Mots-Clés: Fluid venting, Gas hydrates, slope stability, pockmarks, mud volcanoes