

---

# Insights from measured versus BSR-derived heat flow in an active gas seeping area of the Amazon deep-sea fan

Jeffrey Poort\*<sup>†1</sup>, Aurélien Gay<sup>2</sup>, Daniel Praeg<sup>3</sup>, Frederique Rolandone<sup>4</sup>, Marcelo Ketzer<sup>5</sup>, Kelvin Chima<sup>6</sup>, Cleverson Guizan Silva<sup>7</sup>, A. Tadeu Dos Reis<sup>8</sup>, Sébastien Migeon<sup>3</sup>, and Vikram Unnithan<sup>9</sup>

<sup>1</sup>Institut des Sciences de la Terre de Paris (ISTeP) – Sorbonne Université - Cergy Paris Université - CNRS – France

<sup>2</sup>Géosciences Montpellier – Université de Montpellier - CNRS, Université de Montpellier -CNRS – France

<sup>3</sup>Géoazur – Institut National des Sciences de l’Univers, Observatoire de la Côte d’Azur, Université Côte d’Azur, Centre National de la Recherche Scientifique, Institut de Recherche pour le Développement – France

<sup>4</sup>Institut des Sciences de la Terre de Paris (ISTeP) – Sorbonne Université - Cergy Paris Université - CNRS – France

<sup>5</sup>Linneaus University – Suède

<sup>6</sup>Institut des Sciences de la Terre de Paris (ISTeP) – Sorbonne Université - Cergy Paris Université - CNRS – France

<sup>7</sup>Department of Geology and Geophysics, Fluminense Federal University, Niterói, RJ, Brazil – Brésil

<sup>8</sup>Faculty of Oceanography, Rio de Janeiro State University (UERJ), RJ, Brazil – Brésil

<sup>9</sup>Jacobs University = Constructor University, Bremen, Germany – Allemagne

## Résumé

The Amazon deep-sea fan is one of the largest sedimentary deposits on passive margins. Its rapid growth in response to the supply of organic-rich sediments from the Amazon River has been accompanied by both fan-wide giant landslides and gravitational collapse on shale detachments. The upper slope compressional belt contains a gas hydrate system indicated by bottom simulating reflection (BSR) patches aligned with the crests of thrust-fold anticlines, which in places rise towards seafloor fluid vents. The 2023 AMARYLLIS-AMAGAS I campaign and the ANR MEGA project aim to study the link between the gas hydrate system, seafloor fluid venting and landslide triggering. Here we present a comparison between new seafloor heat flow measurements and BSR-derived heat flow, along two transects crossing different fluid venting structures (seeps, pockmarks and mud volcanoes) at the crest of an anticline. Measured and BSR-derived values concord that conductive heat flow in the Amazon upper slope is low (32-36 mW/m<sup>2</sup>), likely due to sediment blanketing. Above the anticline measured heat flow increases regionally to 41-55 mW/m<sup>2</sup>. Near active venting structures measured surface heat flow increases to values up to 115-185 mW/m<sup>2</sup>. BSR-derived heat

---

\*Intervenant

<sup>†</sup>Auteur correspondant: jeffrey.poort@sorbonne-universite.fr

flow also increases but to a lesser extent. The magnitude and extent of the heat flow anomaly are both fully compatible with a model where fluids bring heat by advection from deeper sedimentary levels to the seafloor along near-vertical conduits. The source depth of the fluid expulsion is likely not very deep (100-200m) and corresponds to the depth of the base of the gas hydrate stability zone (GHSZ) and where gas hydrates may be locally dissociating beneath venting structures. These data and modeling results suggest that deep fluids migrating upwards in the thrust-fold anticlines along faults and/or pinch-out layers are blocked by gas hydrates forming in the stability zone. These warmer fluids will dissociate the hydrates near the base of the GHSZ, elevating the base of the stability zone and locally breaching it towards the seafloor. Normal faults observed above anticline crests indicate extensional stresses that may favor fluid migration to seafloor, consistent with the distribution of fluid venting structures in the study area.

**Mots-Clés:** heat flow, BSR, gas hydrates, fluid, seeps, mud volcanoes, deep, sea fan, Amazon