Seafloor hydrothermal control on ocean dynamics in Enceladus

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Résumé

Cassini observations imply a global ocean underneath Enceladus' ice shell, with hydrothermal seafloor activity. Previous numerical simulations showed that convection in Enceladus' unconsolidated core may produce heterogeneous seafloor heat flux, explaining the South Pole ice thinning and plume activity. While there is evidence for efficient hydrothermal transport from the seafloor to the plumes, the ocean dynamics are still debated. Here, we perform 3-D numerical simulations of the ocean with a very heterogeneous bottom boundary condition from 3-D hydrothermal core simulations. We show that a strong zonal flow diminishes low-latitude heat transfer, while it remains efficient in polar regions, which explains the ice shell variations derived from gravity and topography observations. Using passive tracers, we predict rising times of hours to weeks, compatible with previous predictions. Our simulations confirm that a strong heterogeneous seafloor heat flux concentrates upwellings at the South Pole, efficiently transporting potential bio-signatures from hydrothermal vents to erupting plumes.

Mots-Clés: Lunes glacées, Encelade, Océan

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