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Idealised modelling of ocean circulation driven by geothermal and hydrothermal fluxes at the seabed

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There are two distinct processes by which heat is transferred from the solid Earth into the abyssal ocean. The first is conductive geothermal heating and the second is hydrothermal heating, involving advection of heated water from within the Earth's crust. Here, the noticeably different impacts of these two physical systems on ocean circulation are investigated.

Previous modelling studies have applied geothermal heat fluxes at the seabed and shown discrepancies in circulation compared to cases which neglected heat from the Earth in their boundary conditions. The true heat flux in the ocean, however, is not entirely geothermal. From areas where the crust is younger a significant proportion of the heat input from the Earth could be in the form of fluid flow from hydrothermal vents, introducing forcing to the circulation which has previously been unaccounted for.

In this study a set of idealised modelling experiments are run in order to investigate the effects of changing the balance of the total heat flux from purely geothermal to purely hydrothermal, via intermediate states in which the two boundary conditions are combined in different ratios. By performing such experiments it will be shown which of the two processes is dominant in its effects on circulation driven by heating at the seabed, and whether neglecting the hydrothermal advection in favour of a fully conductive geothermal boundary condition is justifiable.

The results will inform the construction of boundary conditions for future circulation models involving ocean floor heat fluxes, specifically a regional study of geothermal and hydrothermal contributions within the Panama Basin.