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Heat-Flow measurements in the eastern Gulf of Aden: where are the evidences of fluid circulations?

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Active circulations of meteoric fluids have demonstrable effects on the formation of the young oceanic sea-floor in slow and ultra-slow ridges. In the ocean continent transitions (OCT), extreme deformations of the crust and exhumation of continental mantle may have been driven also by such fluids circulations, but this was not yet documented by heat-flow measurements.

Here we present heat-flow measurements along multi-channel seismic (MCS) profiles from the eastern Gulf of Aden, a young oceanic basin formed 18 Ma ago after the break-up of Arabia-Africa, that show contrasted evidences for the presence of fluids. In most cases, the heat-flow is strictly consistent with heat conduction, except near some (but not all) of the basement seamounts where a high amplitude and short width ($\tilde{1}$0 km) anomaly can be detected. Along one specific profile however, a much wider anomaly is observed, affecting OCT and oceanic crust over 40 km. Along the same profile, MCS shows stronger reflexions in the crust than in any other location of the seismic survey. The maximum amplitude of the heat-flow anomaly is observed between this reflector and a seamount where continental mantle is possibly exhumed. Estimates of the necessary fluid flow to explain the surface heat-flow are higher than 2 meters/year, i.e. similar to the estimates in oceanic domains.

The limited observation of heat-flow anomalies with respect to the conductive thermal regime in the Gulf of Aden is interpreted primarily as a consequence of the impermeable hemipelagic sediment cover that prevents penetration of meteoric fluids in the crust, and the rare occurrences of basement seamounts. However, the fact that not all of them are associated with large heat-flow anomalies could be related to the serpentinization process that accompanies this circulation and rapidly decreases the permeability of the host rocks. The absence of generalized circulations at present time does not exclude therefore circulations in the past to drive tectonic process in OCT.