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Systematic Heat Flow Measurements Across the Wagner Basin, Northern Gulf of California

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A primary control on the geodynamics of rifting is the thermal regime. To better understand the geodynamics of rifting in the northern Gulf of California we systematically measured heat-flow across the Wagner Basin, a tectonically active basin that lies near the southern terminus of the Cerro Prieto fault. Seismic reflection profiles show sediment in excess of 5 s two-way travel time, implying a sediment thickness of > 7 km. The heat flow profile is 40 km long, has a nominal measurement spacing of $\sim$ 1 km, and is collocated with a seismic reflection profile. Heat flow measurements were made with a 6.5-m violin-bow probe. Most measurements are of good quality in that the probe fully penetrated sediments and measurements were stable enough to invert for heat flow and thermal properties. We have estimated corrections for environmental perturbations due to changes in bottom water temperature and sedimentation.

The mean and standard deviation of heat flow across the western, central, and eastern parts of the basin are 220$\pm$60, 99$\pm$14, 1058$\pm$519 mW m-2, respectively. Corrections for sedimentation would increase measured heat flow across the central part of basin by 40 to 60%. We interpret the relatively high heat flow and large variability on the western and eastern flanks in terms of upward fluid flow at depth below the seafloor, whereas the lower and more consistent values across the central part of the basin are suggestive of conductive heat transfer. Based on an observed fault depth of 1.75 km we estimated the maximum Darcy velocities through the western and eastern flanks as 3 and 10 cm yr-1, respectively. Heat flow across the central basin is consistent with gabbroic underplating at a depth of 15 km and suggests that continental rupture here has not gone to completion.