

## Slow cooling of the ocean crust, fast spreading benchmarks for slow spreading ridges

### Details

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### Abstract

Understanding the formation and evolution of relatively uniform ocean crust formed at fast spreading rates provides an important benchmark to understand more complex ocean crust formed at slow spreading rates. In this study, the thermal structure of the lower oceanic crust has been investigated at Hess Deep and ODP Hole 1256D using the calcium in olivine geospeedometer. Diffusion rates of calcium in olivine vary significantly with crystallographic axes. In previous studies, the diffusion coefficient for the fastest crystallographic axis has been used and the calculated cooling rates represent the fastest possible cooling, potentially overestimating the cooling rate by up to 50%. To improve upon this, we have used electron backscatter diffraction measurements to determine the orientation of the olivine crystals analysed for Ca diffusion profiles, allowing a profile specific diffusion coefficient to be calculated and used in the cooling rate calculations. The cooling rates through the lower crust at Hess Deep decrease by 1.5 to 2 orders of magnitude from near the dike/gabbro transition to the middle lower crust. Samples from 2 - 4 km show no variation with depth. These cooling rates are one order of magnitude faster than those published for the Wadi Abyad section of the Oman ophiolite (Coogan et al., 2002) but 2 orders of magnitude slower than those from the Wadi Tayan section in Oman (VanTongeren et al., 2008). Cooling rates from gabbros within and below the dike/gabbro boundary at Hole 1256D, Hess Deep and the Oman ophiolite are similar, reflecting the proximity to the upper crustal hydrothermal system that must influence the thermal structure at this key crustal transition.

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