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Heat flow at mid-ocean ridges and ridge flanks: methods and challenges

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Exchange of heat and mass between ocean and oceanic lithosphere is concentrated at mid-ocean ridges and ridge flanks where hydrothermal circulation releases heat and fluids into the ocean and hereby affecting global geochemical budgets in the oceans. Global estimates of these fluxes are well established based on geophysical and geochemical constraints, however, uncertainties remain between the partitioning of fluxes between ridge crest and flanks and focused vs. diffuse flow. The situation may be become even more complicated as new investigations show that seamounts away from a mid-ocean ridge may possibly act as pathways for the exchange of heat and mass between oceanic lithosphere and ocean and hereby contribute significantly to the global oceanic heat and mass exchange budget. The talk will concentrate on the exchange of heat but include findings based on geochemical estimates. The classical method to quantify heat exchange between lithosphere and ocean are seafloor heat flow measurements which allow to map conductive heat flow in sedimented areas close to the ridge but not at the ridge itself due to the lack of sedimentary cover. In bare-rock environments at ridge crests attempts to map conductive heat flow with a thermal blanket had mixed success in the past. Due to the large lateral inhomogeneities in hydrothermal activity at ridge crests and flanks only numerous measurements will provide a realistic estimate of the conductive heat flow. All these measurements, however, can only cover the conductive part of heat transport and miss the advective component. Measuring the advective part of heat flow poses different problems as again, the processes are highly variable in space but also in time so that only integrative investigations over longer periods of time at hydrothermal sources at the seafloor as well as in the water column will allow the estimate of advective heat flow. Methods and challenges will be illustrated by investigations from the southern East Pacific Rise, the eastern flank of

the Juan de Fuca Ridge and Logatchev Hydrothermal Field (MAR).