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Feedbacks of sedimentation on crustal heat flow – New insights from the Vøring Basin, Norwegian Sea

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Information on the nature and origin of rift basins is preserved in the presently observed stratigraphy. Basin modeling aims at recovering this information with the goal of quantifying a basin's structural and thermal evolution. Decompaction and backstripping analysis is a classic and still popular approach to basin reconstruction [Steckler and Watts, 1978]. The total and tectonic subsidences, as well as sedimentation rates are calculated by the consecutive decompaction and removal of individual layers. The thermal history has to be computed separately using forward thermal models. An alternative is coupled forward modeling, where the structural and thermal history is computed simultaneously. A key difference between these reconstruction methods is that feedbacks of sedimentation on crustal heat flow are often neglected in backstripping methods. In this work we use the coupled basin modeling approach presented by Rüpke et al. [2008] to quantify some of the feedbacks between sedimentation and heat flow and to explore the differences between both reconstruction approaches in a case study from the Vøring Basin, Norwegian Sea.
In a series of synthetic model runs we have reviewed the effects of sedimentation on basement heat flow. These example calculations clearly confirm the well-known blanketing effect of sedimentation and show that it is largest for high sedimentation rates. Recovery of sedimentation rates from the stratigraphy is, however, not straightforward. Decompaction-based methods may systematically underestimate sedimentation rates as sediment thickness is assumed to not change/thin during stretching. We present a new method for computing sedimentation rates based on forward modeling and demonstrate the differences between both methods in terms of rates and thermal feedbacks in a reconstruction of the Vøring basin (Euromargin transect 2). We find that sedimentation rates are systematically higher in forward models and heat flow is clearly depressed during times of high sedimentation. In addition, computed subsidence curves can differ significantly between backtripping and forward modeling methods. This shows that integrated basin modeling is important for improved reconstructions of sedimentary basins and passive margins.

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Steckler, M. S., and A. B. Watts (1978), SUBSIDENCE OF ATLANTIC-TYPE CONTINENTAL-MARGIN OFF NEW-YORK, Earth and Planetary Science Letters, 41(1), 1-13.