A Bayesian approach for thermal history reconstruction in basin modeling

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Vitrinite reflectance and apatite fission track) and borehole data (bottom hole temperature and porosity) for thermal history reconstruction in basin modeling. The approach implements a trans-dimensional and hierarchical Bayesian formulation with a reversible jump Markov chain Monte Carlo (rjMCMC) algorithm. The main objective of the inverse problem is to infer the heat flow history below a borehole given the data and a set of geological constraints (e.g. stratigraphy, burial histories and physical properties of the sediments). The algorithm incorporates an adaptive, data-driven parametrization of the heat flow history, and allows for automatic estimation of relative importance of each data type in the inversion and for robust quantification of parameter uncertainties and trade-offs. In addition, the algorithm deals with uncertainties on the imposed geological constraints in two ways. First, the amount of erosion and timing of an erosional event are explicitly treated as independent parameters to be inferred from the data. Second, uncertainties on compaction parameters and surface temperature history are directly propagated into the final probabilistic solution.