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Global paleo heat flow reconstruction using a multi-observable similarity function

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Obtaining an accurate reconstruction of the heat flow variations during the geological past, is still a very difficult task. To predict thermal histories, basin modellers universally use kinetic models calibrated by organic maturation indices such as vitrinite reflectance. However, these inverse models are often poorly constrained and non-unique, and rarely match with thermal histories derived from thermo-mechanical models of rifting. We propose a new approach that allows estimating the regional paleo heat flow in any tectonic setting and at a time interval in the past where the geodynamic paleo context is sufficiently well known. The empirical method is based on a multi-observable similarity function that incorporates a large set of relevant geological and geophysical parameters at present and at past (rift, orogens, plate boundaries, volcanoes,…) and that uses a statistical similarity approach to extrapolate from present-day heat flow examples. The basic idea is that the surface heat flow is directly related to the geodynamical environment, and that the variety of representative environments is well covered by the present-day heat flow data. The predictive capacity of the method has been inferred from present-day blind tests and is satisfactory with global correlation coefficients up to 0.82. For several selected time intervals in the Cenozoic-Mesozoic, we reconstructed and collected a total of 20 paleo observables that allowed creating the first global maps of paleo heat flow estimation. We will discuss the mean observed trends and for a few selected sites we will compare the results with published thermal histories obtained with traditional methods.