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New temperatures for the Paris Basin — results from tectonic-Heat Flow modelling

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Following the work on the temperature in the French sedimentary basins, published in Bonté et al (2010), the objective of this work is to provide a more precise determination and a better understanding of the present-day temperature in the Paris Basin. For this purpose, we use a modelling approach that takes into account: 1) the transient effects of the temperature and 2) the basin layering and the related petrophysical parameters.

Located on the inner part of the Variscan Orogen, the Paris Basin has evolved from the Permian as an intracratonic basin. The tectonic evolution of the basin through time has had a strong influence on the temperature, essentially because of the transient effect on the temperature. The modelling approach that we use takes into account the sedimentation and the tectonic events from the Permian to Present-day. During this period of 250 Ma, the Paris Basin has experienced several events that have influenced either the sedimentation or — in contrast — generated some erosion (e.g., the opening of the Ligurian Tethys during the Lias, and a NW-SE small wavelength compressive phase from the Berriasian to the Late Aptian that developed in relation to the opening of the Bay of Biscay - Guillocheau et al, 2000).

The most important event for the present-day temperature in the Paris Basin, however, is the Miocene uplift of the Vosges-Black Forest (Ziegler, 1990). As the impact on temperature of a tectonic event at the lithospheric scale is considered to last 20 Ma, this Miocene tectonic event still has repercussions on the present-day temperature that we are trying to precisely determine. Using the multi-1D probabilistic tectonic heat flow modelling approach described in Van Wees et al (2009), together with novel 3D modelling mechanisms, we are able to constrain the present-day temperature in the Paris Basin. For this modelling, we take into account the geometry of the layering and the petrophysical parameters (i.e. thermal conductivity, the radiogenic heat production of the sedimentary layers in relation with their facies, and the radiogenic heat production of the basement).

The results of our modelling are verified using two sets of data. For past events, the heat flow is calibrated with Vitrinite Reflectance measurements and for present-day temperature, it is calibrated using BHTs (Bottom Hole Temperature) and DSTs (Drill Stem Test). As a result of this modelling, we are able to present present-day temperature on any required layer within the basin. The result we present is a new precise map temperature at the basement layer.

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