**Supplementary material**

During a first set of inversions, we compared the two different models for He-diffusion kinetics, published by Gautheron *et al.* (2009) and Flowers *et al.* (2009). The results produced by the Flowers *et al.* (2009) model (Fig. 4) predicted T-t paths with higher overall probabilities, which lead us to select them for our geological interpretations. The results using the model of Gautheron *et al.* (2009) are presented in Supplementary Fig. 1. For the three samples, time-temperature paths produced by both models are very similar, both predicting a burial phase from the time of deposition to Miocene-Piocene times, followed by exhumation from that time to the present. However, the inversions using the model of Gautheron *et al.* (2009) predict a younger final phase of exhumation, as low as 1 Ma for sample AN01, as well as a higher T_{max} for all three samples.
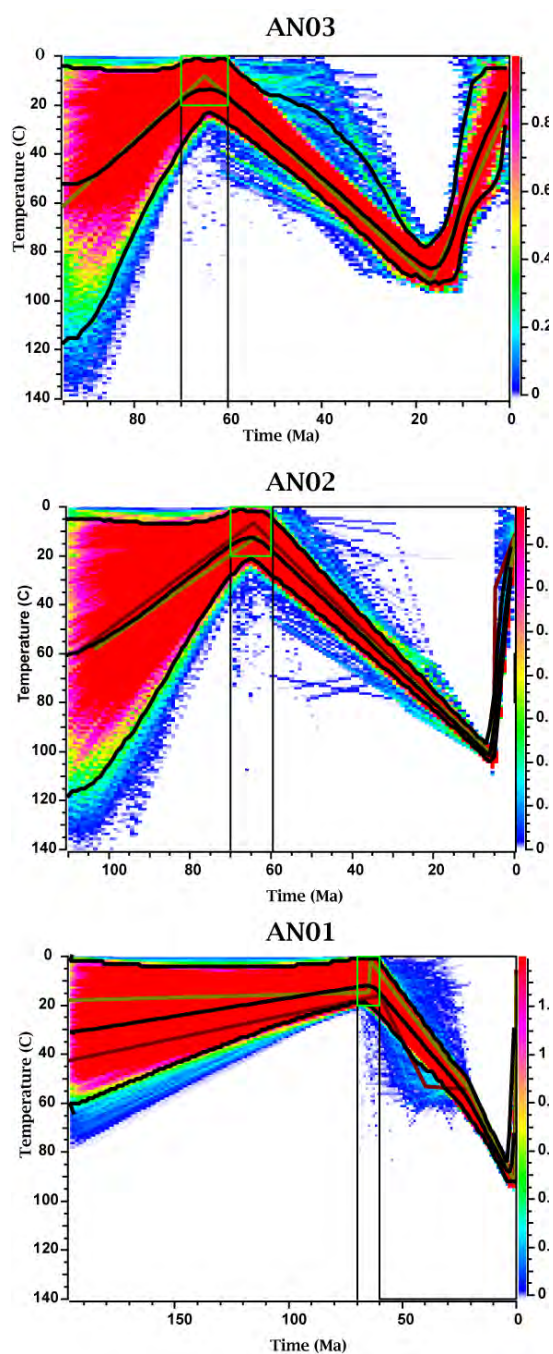
Supplementary Figure 1. Modelled *t-T* paths for samples AN01, 02 and 03 using the He-diffusion model of Gautheron *et al.* (2009). Same legend as for Fig. 4.