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The Thermal History of the Upper Silesia Coal Basin, Poland, Constrained by Apatite Thermochronology

The Carboniferous Upper Silesia Coal Basin (USCB) is one of Europe's largest reserves of coal-bed methane. Reconstruction of the basin's thermal history cannot distinguish between two models: (i) maximum temperatures were reached at the end of the Carboniferous sedimentation, prior to tectonic inversion, and (ii) maximum temperatures were related to Mesozoic-Tertiary thermal pulse. Fission track (FT) and (U+Th)/He ages of detrital apatites from surface exposures and borehole material have been used to elucidate the thermal history of the USCB. AFT ages (266-236 Ma), mean track lengths (13.74-12.06 μm) and unimodal track length distributions of all samples are indicative of a single, rapid Permian-Early Triassic cooling event, consistent with erosion during basin inversion. The post-Triassic thermal history is unresolved by the FT modelling other than constraining further heating to less than 60-70ºC. Apatite He ages (144-108 Ma) cannot be produced by post-inversion cooling or re-heating due to Triassic-Jurassic hydrothermal activity, which is evident from sparse Pb-Zn mineralisation. The He ages track the deposition of more than 1 km midddle Miocene sediments, as predicted from the preservation of small remnants across the basin. Erosion during late Miocene Alpine basin inversion event satisfies constraints from numerical modelling of the He ages. The burial-induced heating was unlikely to play an important role in maturation of organic matter but was likely significant enough to mobilise methane deposits.