Thermochronological evidence on the SE Carpathians Tertiary exhumation and its impact on the orogenic and petroleum systems evolution

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Thermal history and overall kinematics of the SE Carpathians have been reconstructed by means of apatite fission track and (U-Th)/He methods applied along a W-E transect that crosses the internal and external orogenic nappes and the western tilted flank of the foreland basin. This study focuses on the progressive Early Cretaceous-Late Miocene evolution of an accretionary wedge and its impact on petroleum systems.

Internal nappes emplaced during the intra-Albian due to Transylvanides collision underwent rapid burial during the Late Albian-Cenomanian. These nappes and their sedimentary covers experienced continuous reduced cooling during the Late Cretaceous-Paleogene. The internal nappes remained below sea level and were covered by an unconformable Upper Cretaceous-Paleogene flysch sequence, also extending over the locus of the external nappes. The subsidence following Transylvanides collision superposed the flexural subsidence over the subducting Ceahlău-Severin domain. Exhumation of internal nappes started in the Late Oligocene as a result of renewed convergence between the internal nappe indentor and the East European continental passive margin (Moesian Platform), resulting in gradual separation of Transylvanian Basin from Carpathian foreland.

Successive emplacement of external nappes during the Miocene was due to continuous advancement and westward subduction of Moesian Platform towards the internal nappe indentor. The depocentre of flexural subsidence shifted eastward due to progressive nappe emplacement towards the foreland basin. External nappe stacking ended in the Late Miocene due to the final collision with the Moesian Platform. Late Miocene exhumation corresponds to the final separation of Central Paratethys (Pannonian and Transylvanian Basins) from the Eastern branch (Carpathian foreland, Black Sea to Caspian Sea).

Thermal models and burial-cooling curves of external nappes indicate that Oligocene source rocks reached maximal burial of 4-5 km (~110ºC) in the Early Miocene, when they entered the oil window, resulting in hydrocarbon generation during the Late Miocene-Pliocene. Hydrocarbon accumulations are trapped in Paleocene-Eocene, Oligocene and Miocene reservoirs formed during the Miocene stacking of external nappes. Rapid exhumation of ~5 km of these nappes since Late Miocene was due to post-collisional renewed shortening, which might have induced trap breaching, causing hydrocarbon leakage probably due to vertical migration to the surface.