Fission-track dating applied for reconstruction of tectonic processes in the Balkanides

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In the Balkanides region, on the territory of Central Stara Planina Mountain, Bulgaria, several geological structures, since the Variscan orogeny are well preserved. They are related to Alpine (Early and Late) and Neotectonic tectonic stage and can be distinguished on the basis of clear structural features in the field. One of the most prominent of them is the Late Alpine Botev Vrah Thrust – thick-skinned compressional structure that represents northward emplacement of pre-Permian crystalline basement over various by age and lithology rocks.

Low-temperature fission-track (FT) thermochronology combined with detailed structural studies have been applied in order to decipher the Alpine tectonic and thermal evolution of Central Stara Planina Mountain. Seven samples for zircon and apatite FT dating from both hanging wall and footwall of Botev Vrah Thrust were analyzed (Fig. 1). Three samples from the autochthon – Permian volcanics, Triassic sandstones and Paleozoic granitic rocks yield zircon FT ages of 121±6 Ma, 118±10 Ma and 90±7 Ma, respectively. These ages are related to cooling and post-tectonic denudation after the Early Alpine (Austrian) thrusting when the whole unit was at temperatures higher than ~ 250º C. Two detrital populations were statistically separated in the authochthonous Paleocene sandstone sample that yield zircon FT ages of 61±5 Ma and 90±13 Ma. The three samples from the allochthon of the Late Alpine thrust yield zircon FT ages between 82±4 Ma and 54±3 Ma. These ages are younger than the Late Cretaceous magmatic activity (at about 92–91 Ma) in the area where the hanging wall rocks of the Botev Vrah Thrust originated. This suggests that the area was at temperatures higher than ~ 250º C during this magmatic event. The tectonically lowermost sample of Paleozoic granitic rocks yields the youngest zircon FT age of 54±3 Ma. It could be related to the cooling induced by the exhumation during the early stages of Late Alpine thrusting. This age is similar to the age of the younger zircon population from the authochthonous Paleocene sandstones, as well as to the age of their deposition. Thus, it is assumed that the basin was sourced by the advancing to the north allochthon of Botev Vrah Thrust. The existence of a foreland basin is also confirmed by the analysis of

continuous sections of the Upper Cretaceous-Paleocene deposits where data show that deposition and deformation occurred at the same time.

The obtained apatite FT ages of both the hanging wall and footwall samples are between 31±3 Ma and 23±3 Ma. They are all younger than the time of Botev Vrah Thrust emplacement, suggesting that the whole area was at temperatures higher than 120º C during the late Alpine thrusting. These ages are related to syn- to post orogenic denudation and cooling. The ten measured confined tracks in the granitic sample from the hanging wall of the Miocene normal fault give mean track length value of 13.21±0.5 µm that presumes rather slow, probably related to erosion, cooling at about 30 Ma. The apatite FT age-altitude correlation show fast cooling at about 23 Ma for the samples from the footwall. This is probably related to the Miocene faulting and exhumation.

The applied fission-track dating to the region of Central Balkanides, along with the structural data obtained, demonstrate that Botev Vrah Thrust represents a brittle fault structure formed in the upper crustal levels at temperatures 125–250º C. It is suggested that initial thrusting occurred in Late Paleocene. Analysis of the tectonic and thermal evolution of Balkanides from Early Alpine to Neotectonic stage has been performed.

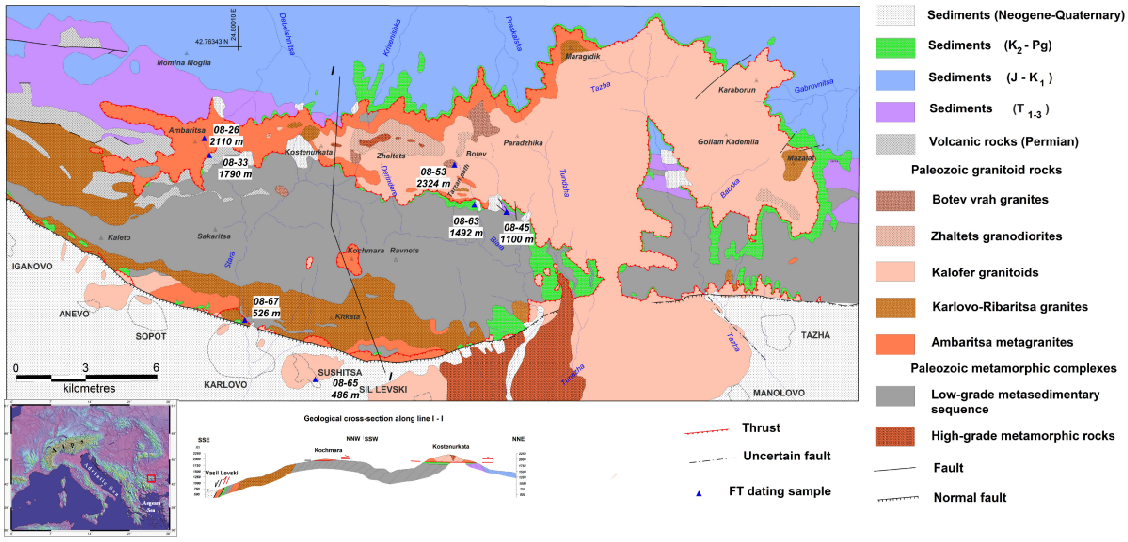

Fig. 1. Geological map of the region studied with sample locations shown