

## Etopole “nappe” or back-thrust/pop-up structure, timing and mechanism of formation, C–W Bulgaria

### Етрополски „навлак“ или обратен възсед/поп-ъп структура, време и механизъм на формиране, Ц–З България

*Dian Vangelov<sup>1</sup>, Yanko Gerdjikov<sup>1</sup>, Alexandre Kunov<sup>2</sup>, Vasil Sirakov<sup>1</sup>*  
*Диан Вангелов<sup>1</sup>, Янко Герджиков<sup>1</sup>, Александър Кунов<sup>2</sup>, Васил Сираков<sup>1</sup>*

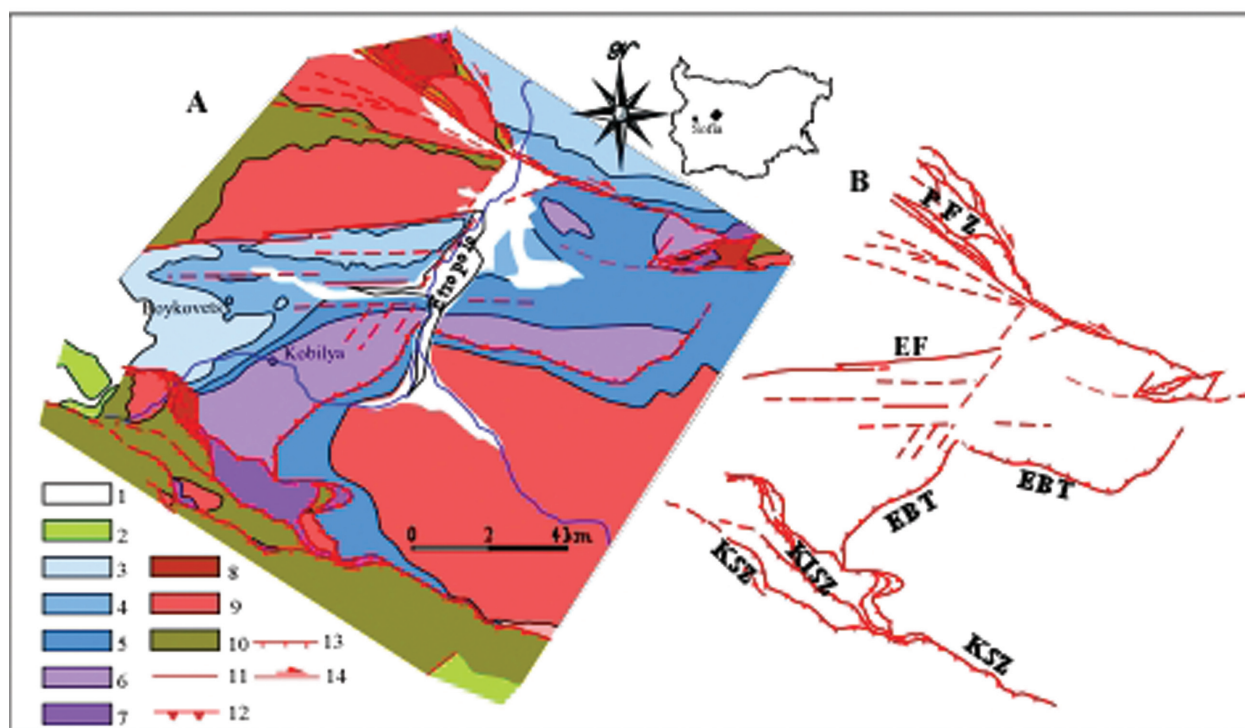
<sup>1</sup> Sofia University “St. Kliment Ohridski”, Department of Geology and Paleontology; E-mail: dedo@gea.uni-sofia.bg

<sup>2</sup> Geological-Paleontological Institute, Department of Earth Sciences, University of Basel; E-mail: a.kounov@unibas.ch

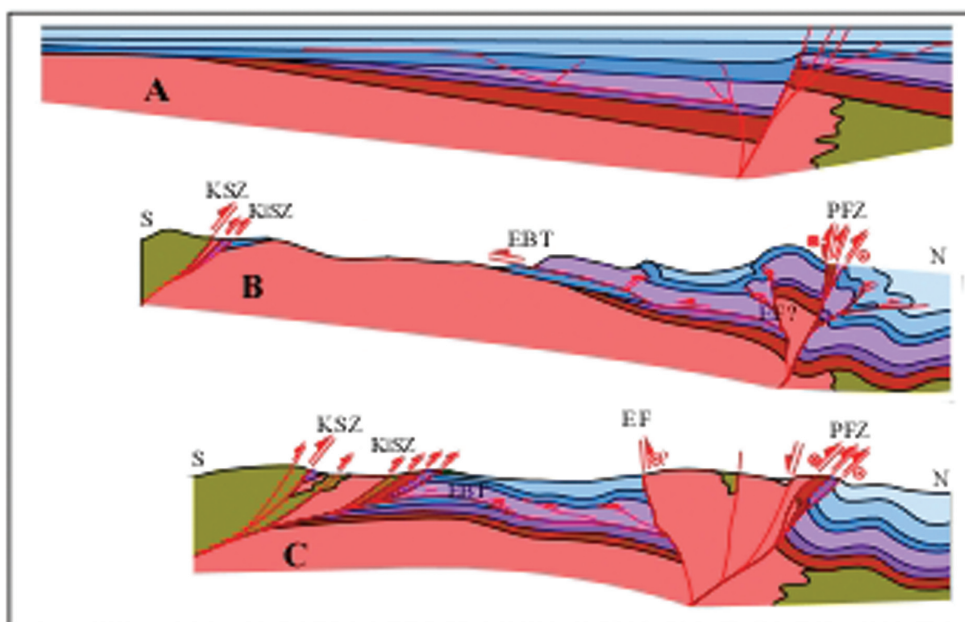
**Key words:** Etopole “nappe”, back-thrust, pop-up, accommodation structure.

The Etopole “nappe” (EN) is located in one of the most complicated parts of the Balkanides with concentration of fault zones, assumed as boundaries of the first-order tectonic units – Plakalnitsa Fault Zone (PFZ), Kashana Shear Zone (KSZ) and Etopole fault (EF). The structural characteristics, boundaries and timing of the main events recorded in the area are still less understood. The EN represents more than 300 m thick

body of Middle-Upper Triassic carbonates that is elongated approximately in E–W direction (Fig. 1A, B). To the south these rocks are tectonically overlaying Lower Jurassic sediments, whereas the northern contact (supposed frontal part) is not clear and is assumed to be marked by regional overturning of Triassic and Jurassic rocks (Antonov, 1976). The only information for EN is provided by Antonov (1976) who character-



**Fig. 1.** A. Schematic geological map of the Etopole area: 1, Quaternary; 2, Upper Cretaceous; 3, Upper Jurassic-Lower Cretaceous; 4, Middle Jurassic; 5, Lower Jurassic; 6, Middle-Upper Triassic; 7, Lower-Middle Triassic; 8, Permian; 9, Upper Paleozoic granitoids; 10, Lower Paleozoic metasediments; B. Sketch map of the faults and fault zones: PFZ, Plakalnitsa fault zone; EF, Etopole fault; EBT, Etopole back thrust; KISZ, Kobilya imbricate subthrust zone; KSZ, Kashana shear zone



**Fig. 2.** A. An explanation of the Jurassic rocks different basement and later shear levels possible position; B. Schematic cross-section across the area central part with the PFZ wrench and EBT back thrust geometry; C. Schematic cross-section across the area western part with possible preliminary EBT back but blind thrust geometry, as part of one triangle zone

ized it as gravity-driven, north-verging nappe with roots in “Back Balkan deep fault” (resp. KSZ), most probably Early Alpine of age.

Our field data suggest complete reevaluation of the Alpine structure of the area. Along the Northwestern part (interpreted as “frontal” part by Antonov, 1976) was established continuous stratification from Triassic carbonates to paracomformably overlaid Jurassic rock, dipping to NW or N of about 30°. The overturned bedding was observed along the western bench of M. Iskar river locally, only for few hundred of meters, southward turning to subvertical and north-deeping. Eastward the bedding is in general subvertical to north-dipping. Structures, typical for the frontal parts of gravity-driven thrusts were not observed, but system of most likely Late Alpine, E-W trending subvertical, dextral strike-slip shearings are common. The southern contact represents a very narrow tectonic boundary (up to tens of cm) with clear south-verging kinematics both in allo- and autochthon blocks – rock-crystallization, imbrication of brecciated zones, series of different scale duplexes etc. The presence of also cm to m scale pop-up structures, back-thrusts, triangle zones and “flower” structures in many outcrops and the clear criteria for southward kinematics are in complete disagreement with assumed north vergency of the EN. To the South the EN is override by Kobylya imbricate

subthrust zone or KSZ. In a more regional frame any tectonic model should take into account the most significant tectonic zone in this part of the Balkanide – PFZ. Taking into account the Late Alpine reactivation of the PFZ, the same age can be assumed for the Etropole “nappe”, formed as shallow accommodation structure, situated in the hanging wall of PFZ and also reflecting the squeezing role played by the rigid body of the Vezhen pluton. In our favorite scenario, the EN can be interpreted as back-thrust (EBT), complicated by “pop-up” zones along the “northern contact”, related or to be a part of PFZ (Fig. 2A, B), or as a blind thrust in the western part, covered by series of imbricated brittle reverse faults, Late Alpine of age (Fig. 2C). To be refined this model it is necessary to be solved many other problems, for example more detail characteristics, interaction and timing of the main structures in the area (Fig. 1B), basin systems evolution, magmatic events etc.

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## References

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