our P-T profile, the mean quartz grain size shows an increase from 63 to 95 microns towards the west. Such grain size variations were also recognised in other parts of the Vepor Unit proposing an existence of similar metamorphic field gradients across the whole studied domain. As a common feature the grain size generally decreases towards the meta-sedimentary cover indicating lower metamorphic conditions in the cover. In selected samples the quartz lattice preferred orientation (LPO) was determined by using electron back-scattered diffraction and computer integration polarization microscopy methods. Both the methods indicate activity of basal a, rhomb and prism a slip systems during the recrystallization, which is in a good agreement with calculated P-T range. The LPO determination revealed single and crossed girdle rotation patterns showing conflicting westward or eastward shear senses detected even in the same thin section. The absence of uniform shear sense during the deformation suggests a pure shear dominated process of ductile thinning operated in the Vepor basement. To explain structural and metamorphic evolution of above described horizontal crustal scale shear zone, we propose that the studied deformation is related to the overthrusting of the southern Gemer Unit upon the Vepor Unit resulting in an orogen parallel extension within the Vepor basement.

Tectonic Control and Basin Evolution of the Northern Transdanubian Eocene Basins (Vértes Hills, Central Hungary)

Zsolt KERCSMÁR[1,2], László FODOR[1] and Sarolta PÁLFALVI[1,2]

[1] Geological Institute of Hungary, 1143 Budapest Stefánia út 14., Hungary
[2] Eötvös University, Department of Palaeontology, 1117 Budapest Pázmány Péter sétány 1/c, Hungary

The Transdanubian Palaeogene Basin was situated behind the active Carpathian thrust front (Tari et al. 1993). Due to the overprinting Neogene tectonic phases and the poor outcrop conditions, the origin of this basin was long-time debated; suggestions include extensional, compressional, and strike-slip settings (Báldi-Beke and Báldi 1985, Fodor et al. 1992, Tari et al. 1993). We used surface mapping, structural measurements, tectono-sedimentary observations and borehole analyses to describe Eocene sediment pattern around the Vértes Hills (northern Transdanubian Range) and to better understand basin evolution.

After Mesozoic carbonate sedimentation, a long period of late Cretaceous to early Eocene terrestrial denudation resulted in a sub-horizontal peneplain and the occurrence of bauxite lenses. The Eocene (late Lutetian–Bartonian) sequence started with a lagunal-marine coal-bearing clastic unit. It is covered with shallow marine marl, than open marine claystone. Sedimentation on basin margins were characterized by the Szőc Limestone Fm. deposited on low-angle, relatively narrow carbonate ramps. The inner ramp is represented by 4 microfacies types, extraclast rudstone to extraclast-bioclast floatstone (basal beds of Szőc Limestone), bioturbated Foraminiferal-Molluscan-Echinoiderm packstone/grainstone (interpreted as sea-grass meadows), skeletal grainstone (bioclastic sand shoals), and Nummulites perforatus rudstone/packstone (Nummulites banks). Mid-ramp is characterized by the predominance of larger Foraminifera under the influence of occasional storms. On the outer ramp glauconitic bioclastic grainstone composed of mainly larger foraminifera, red algae, and bryozoa deposited in current agitated high-energy conditions. The main influencing paleoecological factors were depth, light intensity, hydrodynamic energy, substrate, nutrient content, and sedimentation rates. The inner ramp was characterized by high energy well-lit conditions with the highest nutrient content and highest sedimentation rates. The mid ramp records oligotrophic environment with moderate/low energy and light conditions. The outer ramp is characterized by high hydrodynamic energy with low light intensity and low sedimentation rate (Pálfalvi 2004).

Sediment pattern was determined by two NE striking elevated ridges, (the Dad and Vértes ridges) and two parallel depressions. The development of the Eocene sequence is different on the NW versus SE side of the southerly located Vértes ridge. Thickness is smaller in the NW (Oroszlány depression) than in the SE (Kincses-Magyaralmás depression). The latter was characterized by the deposition of alternating molluscan, Miliolina or Nummulites marl and limestone (Kopek 1980) in a restricted/open lagunal to open marine environments in permanently shallow water conditions.

The Vértes ridge was dissected by NW to W trending syn-sedimentary monoclines, which are frequently breached by syn-sedimentary faults. Major cross-structures include the north–eastern and southern boundary fault of the Tatabánya depression, the Gesztes fault, the Zámoly-Bükk fault, which all have a strike-slip character. The north–eastern margin of the Csákberény trough, and the Nagyegyháza depression seem to be bounded by normal faults. The surface-rupturing faults were mantled with fault-bounded breccia or conglomerate bodies (Bada et al. 1996). Abrasion frequently rounded clasts derived from these scarps. The fault planes themselves or the abrasional gravels on the fault scarps are frequently bioperforated (Kercsmár 2005). The scarp-related limestones were frequently deformed during the diagenesis, due movement of underlying faults. The syn-diagenetic structures include boudinage, intraformational breccias and sedimentary dikes. Sedimentary dikes also occur along major structures. Seismic activity related to faults could induce redeposition of shallow water sediments toward basin centres in form of different cohesive gravity flows and was generated distally

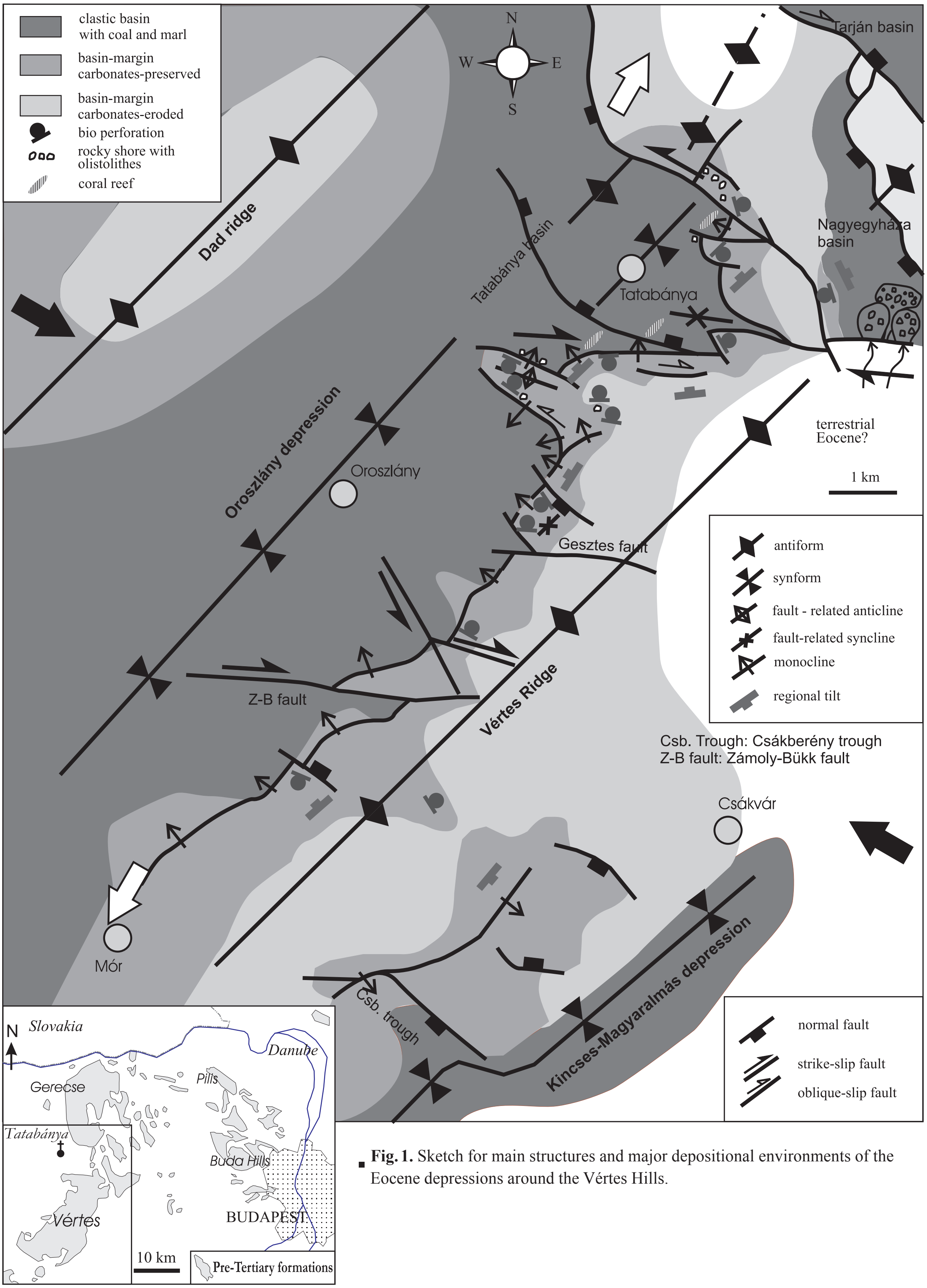

Fig. 1. Sketch for main structures and major depositional environments of the Eocene depressions around the Vértes Hills.

steepened carbonate ramp which developed rimmed carbonate platform on the northern part of the Vértes ridge. Coral reefs were grown on the platform margin dividing the fore and back reef facies.

Syn-sedimentary structures, and the bioperforated fault planes with striae permitted the approximation of middle Eocene stress field. The compression was oriented (W)NW-(E)SE, while the tension was perpendicular. The compression is perpendicular to the general trend of the local paleo-topographic features and might have induced gentle folding of the pre-Tertiary basement. Elevated ridges (antiforms) were colonised by carbonate-producing organism, and carbonate ramps formed on their fringes, along NE-striking monoclines. Depressions (synforms) were covered by slightly deeper water and trapped fine-grained siliciclastic detritus. The orientation some of the normal faults and sedimentary dykes were perpendicular to the compressional direction in the early stage of the middle Eocene tectonic processes. These structures are due to local upwarping and bending of the pre-Tertiary basement during the early stage of folding.

The observations are in agreement with the model of Tari et al (1993) about the compressional (retroarc) origin of the basin. Thickness difference may suggest that the Vértes antiform was slightly asymmetric and had a very minor SE vergency. Such suspected asymmetry is part of the model of Tari et al. (1993) and was documented in the neighbouring Buda Hills (Fodor et al. 1992). On the other hand, the local structural geometry is more complex than a single reverse fault or monocline. The E-W to NW-SE trending strike-slip and normal faults cross-cut the antiforms and seem to be more important in the localisation of the sediment traps. Alternatively, they represent structures post-dating an early phase of folding.

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Do You Separate Sets of Reactivated Faults Manually?

Markéta KERNSTOCKOVÁ and Rostislav MELICHAR

Institute of Geological Sciences, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic

Faults are brittle structures which are formed as the response to stress in the upper crust. Due to variation of the tectonic stress field in time, faults are frequently reactivated in subsequent stress phases. The fault-slip data set is heterogeneous if the slips recorded on the fault planes occured in multiple tectonic phases with different stress fields. The principle of inverse method in paleostress analysis is to find an optimal stress tensor by using fault-slip data measured in deformed rocks. But to use the inverse technique a homogeneous fault-slip data set is required, which means a group of faults activated only in one specific tectonic phase. The stress calculated by applying the inverse method on heterogeneous data does not characterize the real stress situation.

A new computer program was made to identify individual paleostress phases and to determine paleostress tensors from heterogeneous fault-slip data. The possible stress tensor solutions are calculated from the orientation of the fault planes and from the striations and sense of slip. The fault-slip data are combined into four-element groups and the reduced tensor (e.g., shape and orientation of the stress ellipsoid) is calculated for each group. Group with four homogeneous fault-slip data provides the true results wich characterize the real paleostress conditions. The stress tensor calculated for heterogeneous four-fault group is not reliable. These results were visualized using lower hemisphere equal-area projection in which these true and false results can be easily distinguished. Projections of directions calculated from heterogeneous data sets – false results – are dispersed whereas the true results obtained from homogeneous data are grouped in clusters. In case of large number of fault-slip data analysed, the computer program is needed to identify the density of solutions. Density maximum indicates some of possible directions of considered principal stress. The number of such clusters represents a number of paleostress phases. The introduced software has useful application in the study of striated faults. Development of the program was supported by the grant project GA AVČR IAA3013406.