NAT. CROAT. | VOL. 16 | No 2 | 105–120 | ZAGREB | June 30, 2007

original scientific paper/izvorni znanstveni rad

UPPER CRETACEOUS DEPOSITS OF THE POŽEŠKA GORA MT. (CROATIA)

JAMIČIĆ DOMAGOJ

Croatian Geological Survey, Sachsova 2, P.O.Box 268, HR-10 001 Zagreb, Croatia

Jamičić, D.: Upper Cretaceous Deposits of the Požeška gora Mt. (Croatia). Nat. Croat., Vol. 16, No. 2., 105–120, 2007, Zagreb.

Upper Cretaceous deposits of the Požeška gora Mts. (Croatia) formed as the result of interaction between tectonic movements, volcanism and sedimentation in conditions characteristic for moderately deep to deep sea environments. Uninterrupted Santonian-Maastrichtian succession starts with breccias and coarse-grained sandstones which grade into laminated siltstones sandstone and lamellar to thick-bedded limestones. Granite, granophyre and rhyolite fragments are predominant detrital grains in breccias and sandstones all derived from local source-area. The youngest meso to mega-scale folds in Cretaceouss sediments show an E-W strike, although bedding poles are scattered due to older deformations.

Key words: paleostress, resedimentation, granite, rhyolite, Upper Cretaceous deposits, Požeška gora Mt., Croatia

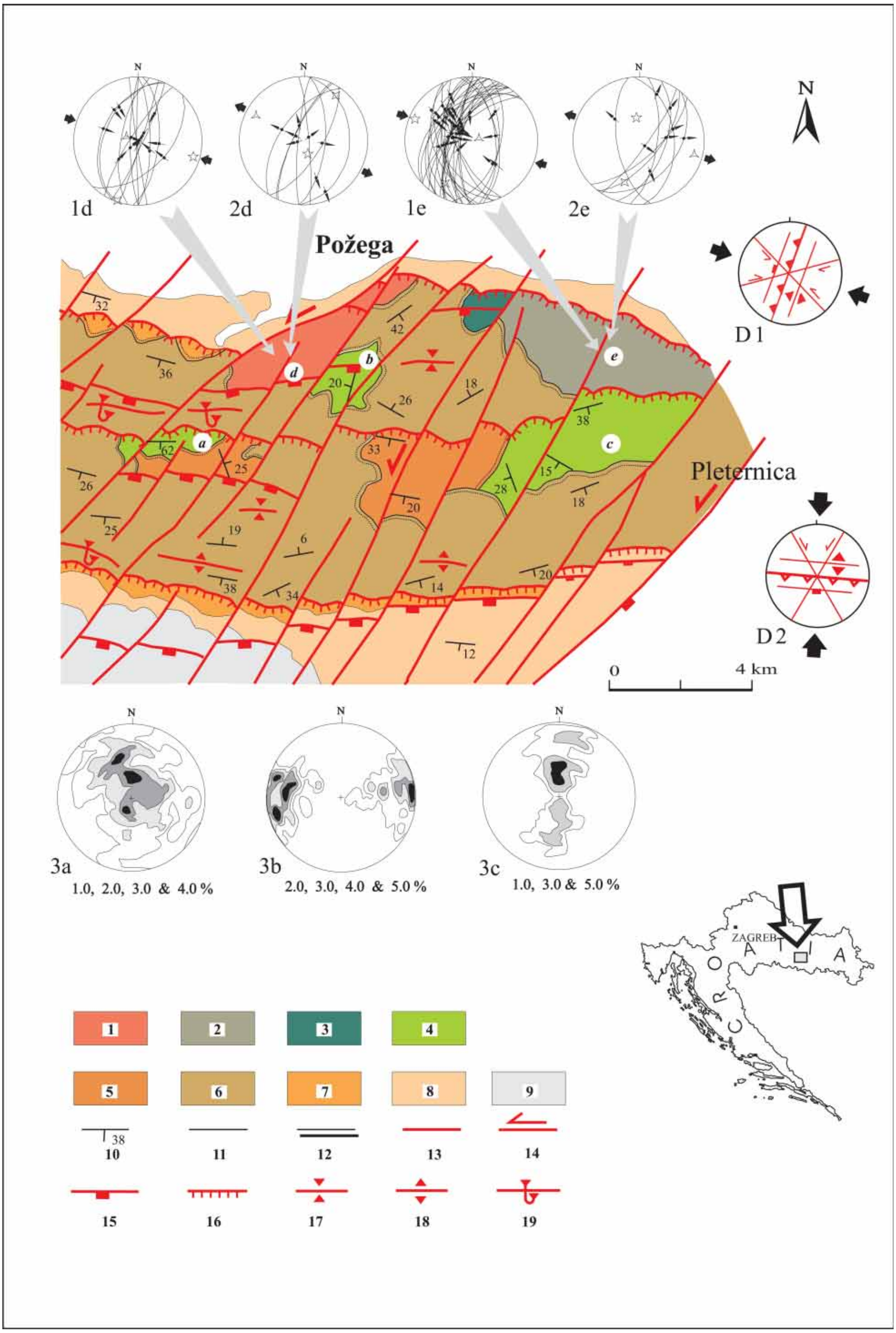
Jamičić, D.: Gornjokredne naslage Požeške gore (Hrvatska). Nat. Croat., Vol. 16, No. 2., 105–120, 2007, Zagreb

Gornjokredni sedimenti Požeške gore (Hrvatska) su nastali kao rezultat uzajamnog djelovanja tektonskih događaja, vulkanizma i sedimentacije u uvjetima karakterističnim za sedimentaciju u umjereno dubokom i dubokom moru. Neprekinuta santonsko-mastrihtska sukcesija počinje s brečama i krupnozrnatim pješčenjacima koji kontinuirano prelaze u siltite i biomikritne vapnence te u pločaste vapnence i debelo slojevite grebenske vapnence. Graniti, granofiri i rioliti su dominantni fragmenti u brečama i pješčenjacima. Borane strukture u krednim sedimentima su pružanja istok-zapad i oko osi ovih bora su stariji strukturni oblici preboravani.

Ključne riječi: paleostres, pretaložavanje, graniti, rioliti, gornjokredni sedimenti, Požeška gora, Hrvatska

INTRODUCTION

Upper Cretaceous deposits of Požeška gora Mt. can be found in tectonically separated blocks, mainly in its central part (Fig. 1). Going from the west they first crop out southwest of Brestovac-Požeški village (Fig. 1. a) in spring flows of Bukovica and Maglaj stream. At this locality they are brought to the north over Ottnangian


1d
2d
1e
2e
N
Požega
Pleternica
D1
D2
0
4 km
3a
1.0, 2.0, 3.0 & 4.0 %
3b
2.0, 3.0, 4.0 & 5.0 %
3c
1.0, 3.0 & 5.0 %
ZAGREB
CROATIA
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

clastic deposits along the south-dipping reverse fault, whereas from the south they are anconformably overlain by the Paleocene (?) conglomerates of Škrabutnik stream. Further to the east, Upper Cretaceous deposits are south of Požega, in the valley of Vučjak stream (Fig. 1, b) and its south tributaries. Here they outcrop in a core of a dome-like structure and are transgressively overlain by Ottnangian deposits. Westward of Pleternica, the Upper Cretaceous sediments build up the wider surroundings of Luke stream (Fig. 1, c), where the complete Upper Cretaceous column is preserved and accessible. To the north they are brought on top of rhyolites and Ottnangian sediments by the south-dippingreverse fault, while from the south and west they are unconformably overlain by Ottnangian and Paleocene (?) Škrabutnik stream sediments, respectively.

KOCH (1919) considered that the Upper Cretaceous sediments in the Vučjak stream are equivalents to Upper Cretaceous deposits of the Žumberak, Samoborsko gorje and Medvednica mountains of NW Croatia. He believed that the volcanic rocks exposed at Požeška gora are the products of post-Cretaceous eruptions, most probably of Late Miocene age. First paleontological data which confirmed Upper Senonian age of marls and limestones of Požeška gora Mt. were given by D. NEDELA--DEVIDE (1957). *Globotruncana lapparenti lapparenti* BROTZEN and *G. l. tricarinata* QUEREAU were found in grey to pinkish limestones (Seoce – Sv. Jelena – Vrhovci profile) and clayey limestones of Luke stream valley, yielding Turonian-Maastrichtian age (POLŠAK, 1971). *G. l. bulloides* VOGLER was determinated in lamellar limestone yielding Campanian-Maastrichtian age while *G. arca* CUSHMAN proved Campanian age of limestones rocks (Grimani in JAMIČIĆ *et al.*, 1985). The top-most member of the Upper Cretaceous column of the Požeška gora Mt. is represented by a thick-bedded limestone deposit. In this limestone, remains of *Hippurites (Orbignia) lapeirousei* GOLDFUS, and sections of *Radiolites* and *Bournonia* were found. Based on these determinations, done by Mamužić (JAMIČIĆ *et al.*, 1985), the reef limestone is also confirmed to belong to Campanian-Maastrichtian. Upper Cretaceous sediments are unconformably overlain by coarse-grained clastic rocks wich are largely expand

⇐

Fig. 1. Geological map of part of the Požeška gora Mt.; 1 – granites, 2 – rhyolites, 3 – basic rocks, 4 – Upper Cretaceous deposits, 5 – conglomerates of Škrabutnik stream, 6 – conglomerates, sandstones, siltstones and marls (Ottnangian), 7 – biocalcarenites, calcarenites, marls, tuffites, sandstones and bituminous marls (Badenian-Sarmatian), 8 – limestones, marls, sandstones, sands and silts (Panonian-Pontian), 9 – sands, silts, gravels, clays and marls (Pliocene), 10 – bed strikes, 11 – normal boundary, 12 – unconformity, 13 – fault, 14 – sinistral fault, 15 – gravity fault, 16 – reverse fault, 17 – syncline, 18 – anticline, 19 – overthrusted syncline. Stereographic projections (lower hemisphere Schmidt net) of fault systems, principal paleostress axes (5-, 4-, 3- stars indicate orientations of, σ_1, σ_2, σ_3 respectively) and main extension/compression as black arrows (values of stress tension are given in Tab. 1). 1d and 2d – granites of Gradski Vrhovci quarry, 1e and 2e – rhyolites on Vesela Dervišaga local road, 3a – bed poles (144 data) of Cretaceous rocks, 3b – poles of axial plane cleavage (67 data) in Upper Cretaceous deposits and 3c – bed poles (120 data) in Tertiary deposits

in the area of Škrabutnik village. Prevailing coarse-grained rocks sandstones with rare occurrences of muscovite siltstones (ŠPARICA *et al.*, 1980). The same authors described the Upper Cretaceous limestones in the Luke stream valley and Golo brdo area but a scarce microfauna did not allow a more detail age determination. Also, in the area of Bukovača they reported about flysch sequences characterised by alternation of marls, sandstones, clayey limestones, calcarenites and conglomerates. PAMIĆ & ŠPARICA (1983) proposed that the volcanic rocks of Požeška gora Mt. are of the same age as the interstratified sediments the being the products of multiphase volcanic activity. Alkali feldspar granites in the area of Požeška gora Mt. are widely discussed by PAMIĆ, (1987); PAMIĆ *et al.*, (1988) and BELAK *et al.*, (1992*). PAMIĆ *et al.* (1988) applied radiometric Rb/Sr method dating on granites and rhyolites and obtained Campanian-Maastrichtian age, 71.5 ± 2.8 Ma for three granite and two rhyolite samples. The same authors suggested that basalts of the Požeška gora Mt. have a different source than that of granites and rhyolites. Later, however, PAMIĆ *et al.* (1989) concluded that mafic and acidic rocks represent a typical bimodal volcanic association made up of the same proportion of alkali feldspar rhyolites and ophitic metabasalts. According to HALAMIĆ *et al.* (1990), HALAMIĆ (1992) Upper Cretaceous sediments and acidic magmatic rocks are cross-cut by diabase veins. HALAMIĆ *et al.* (1993) claimed that coarse-grained clastics of rhyolitic and granitic fragments represent continental sediments deposited in semi-arid conditions. Supposing that such conditions occurred in the area after the Cretaceous time, they assumed that these breccias are of Lower to Middle Oligocene age. BELAK *et al.* (1998) concluded that the mafic of Požeška gora Mt. are of Upper Cretaceous-Paleogene age, being younger than the granite-rhyolite complex and even younger than the Upper Cretaceous deposits.

JAMIČIĆ (1995) gave an overview of the tectonic events for the area of the Slavonian Mts. and based on study of Cretaceous stratigraphic profiles he concluded that acidic volcanic rocks of Požeška gora Mt. are older than Senonian.

METHODOLOGY

On the Luke stream locality, in the left tributary valley and in the local road trench (Fig.1, c), separate geological cross sections were recorded while the rock sampling was completed in order to determine composition of breccias and sandstones and their structural characteristic. Additional sampling and observations were done on other localities as well namely at Brestovac-Požeški and Vučjak, (Figs. 1a and 1b); respectively. At the same time structural measurements and determination

---

* BELAK, M., PAMIĆ, J. & HALAMIĆ, J. (1992): Petrografsko izvješće o magmatskim i sedimentnim stijenama Požeške gore (Petrographic report about magmatic rocks and sedimentary rocks of the Požeška gora Mt. Unpublished report (No.: 68/92) for Geological map 1: 50 000, sheet Nova Kapela).–HGI-CGS.

of structural elements and their classification according to their shape and genesis was completed too. In granites of Gradski Vrhovci village (Fig. 1, d) fault systems with kinematics indicators of tectonic transport direction were recorded. Detailed structural measurements are also performed on outcrops along a local road in rhyolites (Fig. 1, e). Slip directions along fault planes are determined following criteria proposed by HANCOCK (1985) and PETIT (1987). Recorded fault-slip data have been used to calculate orientation of principal stress axes (σ1, σ2, σ3) by means of computer generated statistical analysis. Relative and succession of deformational events were determined based on the presence or absence of particular structural elements in Pre-Tertiary and in Tertiary rocks. Age relations are also confirmed by correlation between recorded structures and structures documented in the surrounding Slavonian Mts. where a sequence deformational event is clearly established (JAMIČIĆ, 1983, 1995a, 1995b; JAMIČIĆ *et al.*, 1985; PRELOGOVIĆ *et al.*, 1995).

RESULTS

Petrographic data

Based on previous investigations, collection and processing on new field structural and petrographic data, the sequence of Upper Cretaceous deposits of Požeška gora Mt. has been reconstructed and presented in a schematic stratigraphic column (Fig. 2). The majority of data refers to the valleys of Luke stream and its left tributary (Fig. 1, c) where the road trench opened a continuous profile throughout the Upper Cretaceous deposits.

The Lower parts of the column are reconstructed based on data collected in the Bukovica stream valley and its right tributary Popova valley (Fig. 1, a), and in the immediate vicinity of Gradski Vrhovci quarry (Fig. 1, d and Fig. 3), located in alkali feldspar granites. Here these granites are unconformable overlain by coarse-grained clast-supported breccias (Fig. 4), which also occur in the area of Bukovica and Vučjak stream, at the very center of the Požega city, as well as on the northern slopes of Požeška gora Mt south-southeast of Požega.

These breccias are composed of sub-angular to sub-rounded fragments of granophyres, alkali-feldspar reddish coloured granites, cherts and rhyloites, up to 10 mm in size. Matrix is semi-coarse-grained sandstone. Thickness of these bressias is not determined due to a strong tectonic reduction.

Also, on most of studied localities, coarse-grained sandstones of the same composition as these breccias are rarely found. However, within the area of Luke stream valley (Fig. 1, c) along the local road, an outcrop of coarse to fine-grained sandstones which grade into, laminated siltstones, lamellar limestone and, finally into thick-bedded limestone of Upper Cretaceous age is visible. This succession is schematically shown in the stratigraphical column of Fig. 2.

Due to the matrix colour, coarse-grained sandstones are light reddish. Microscopic observations showed particles of quartz, K-feldspar, quartzite, fragments of chert, alkali-feldspar granite and granophyre (Fig. 5a) and fragments of rhiolites

(Fig. 5b). Fragments of volcanic glass and clusters of muscovite with sporadic quartz grains are also present. The reddish colour originates from limonite dispersed in matrix. Together with coarse-grained sandstones, fine-grained greyish sandstones occur, which gradually become predominant in the column. Their composition is almost the same as that of the coarse-grained sandstones. Towards the top of this sequence, the ratio of acidic intrusive and effusive rock particles gradually decreases, while quartz, poly-crystalline quartz and sporadically chert fragments prevail. K-feldspar, muscovite, chloritised biotite and some scarce particles of plagioclase occur as well.

Sandstones gradually changes into laminated siltstones of grey to dark grey colour, which in turn grade into laminated limestone. The age of this level is determined on the basis of numerous findings of Globotruncanidae as Campanian-Maastrichtian (PAMIĆ & ŠPARICA, 1983; Grimani in JAMIČIĆ *et al.*, 1985). Lamellar limestone overlies concordantly the siltstones (Fig. 2).The thickness of the limestone beds

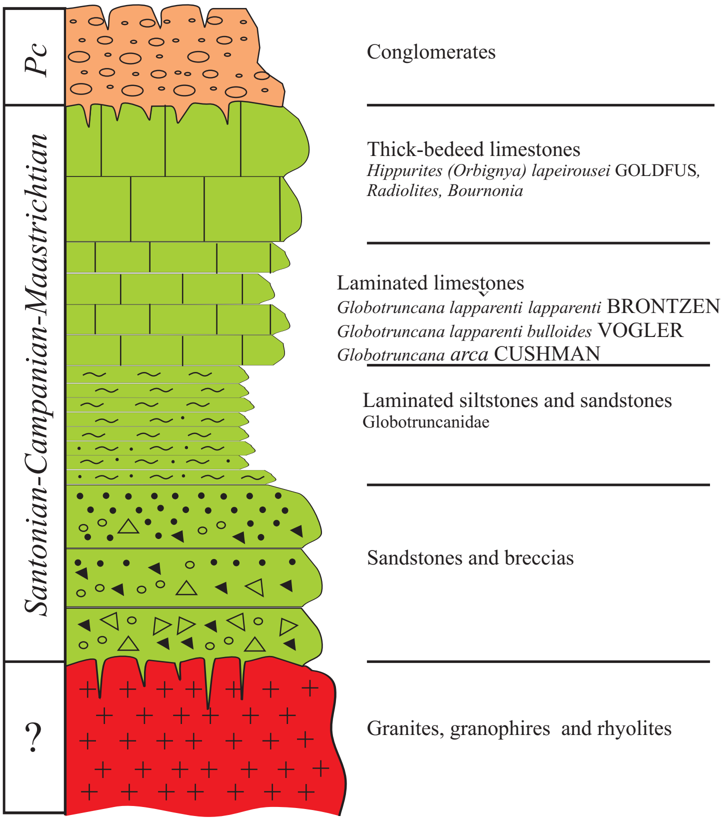


Fig. 2. Schematic lithostratigraphic column of the Upper Cretaceous deposits of the Požeška gora Mt. Biostratigraphic data from JAMIČIĆ *et al.*, 1985.

Fig. 3. Alkali feldspar granites, Gradski Vrhovci quarry.

range from one to five centimetres while the pile thickness is around 80 meters. The top-most member of the Upper Cretaceous column of the Požeška gora Mt. is a thick-bedded limestone deposited. The total thickness of this limestone is approximately 60 meters. In this limestone, the remains of species *Hippurites (Orbignia) lapeirousei* GOLDFUS were found, as well as sections of *Radiolites* and *Bournonia.* According to analysis done by MAMUŽIĆ (JAMIČIĆ *et al.*, 1985), the reef limestone also belongs to Campanian-Maastrichtian, while POLŠAK (1971), on the basis of rudist community, determined Upper Cretaceous age.

Coarse-clastic rocks unconformably overlie the Upper Cretaceous beds (Fig. 2) with their maximal extent west of Škrabutnik village. The prevailing rocks are conglomerates and to a lesser extent sandstones with very rare occurrences of muscovite siltstones (ŠPARICA *et al.*, 1980). These non-carbonate sediments lack fossil re-

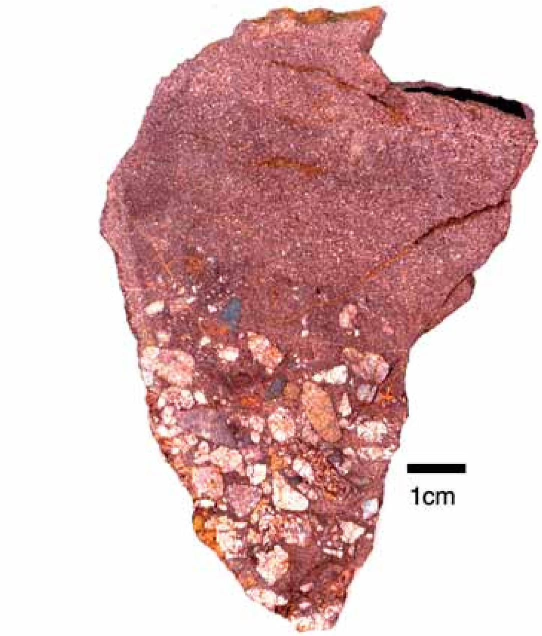


Fig. 4. Normal grading of clast-supported breccia into coarse-grained sandstone.

cords. However, due to their unconformable relationship with Cretaceous rocks and their being surrounded with Middle-Miocene deposits, it is reasonable to expect their age within the Paleocene-Eocene range.

Structural observations

Deformation history of the Požeška gora Mt. is characterised by faulting and folding during the Late Cretaceous and Tertiary times. Based on structural studies the sequence of deformation events and a new perception of tectonic evolution of Požeška gora Mt. area is proposed in this paper.

The recent tectonic setting of the Požeška gora Mt. is characterized by E-W strike of the major stratigraphic unit shaped during the Tertiary and Quaternary times. This resulted from regional stress which, in the southern part of the Pannonian basin was characterised by N-W direction of the greatest principal stress axis (JAMIČIĆ, 1995a, 1995b; PRELOGOVIĆ *et al.*, 1995). Two tectonic events were determined by geological mapping and structural measurements in the Upper Cretaceous rocks of Požeška gora Mt. (Fig. 1, D1 and D2) which were controled by stress fields characterised by almost perpendicular orientation of the greatest principal stress axes ($\sigma 1$).

Succession of tectonic events in the Upper Cretaceous of the Požeška gora Mt. and dating of these events is hereby shown through structural determinations and data obtained from key outcrops.

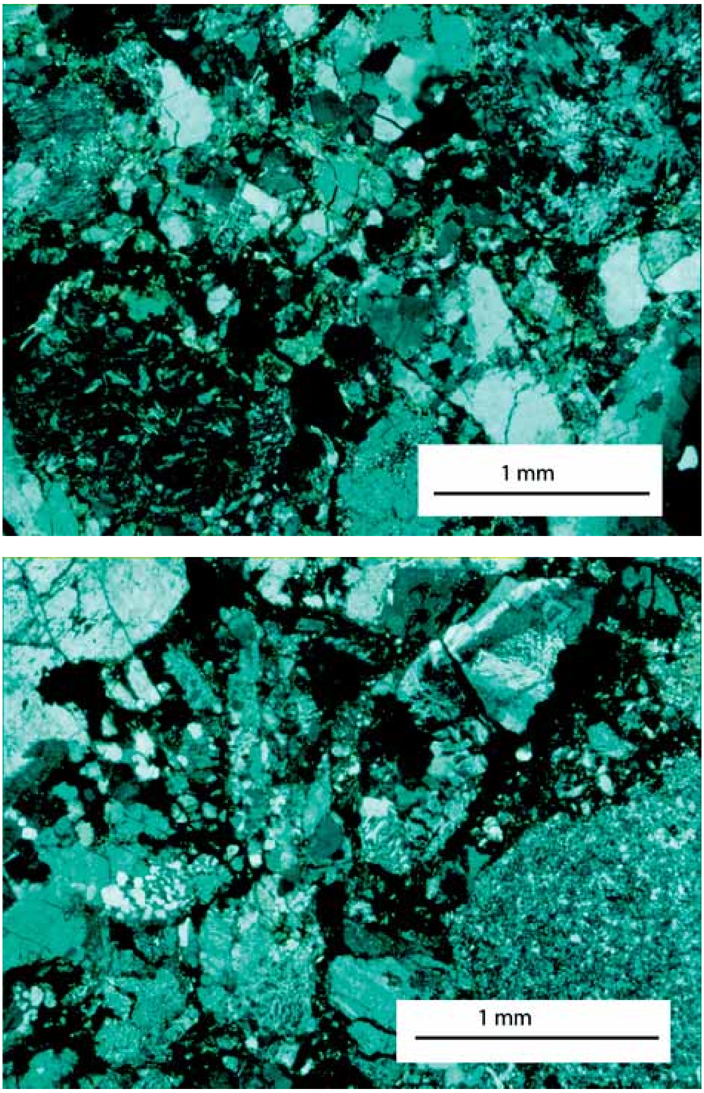


Fig. 5. Micrographs (N+, 5X) of semi coarse-grained sandstones composed of particles of quartz, poly-crystalline quartz, chert, alkali-feldspar granite, granophyre and rhyolite. a) Popova valley locality b) Luke stream locality.

Upper-Cretaceous-Paleogene structures

Older tectonic events (D1) is supposed to be related to the Laramian phase of the Alpine orogeny which in this part of the Pannonian area marks the termination of the Late Cretaceous sedimentary cycle and the Late Cretaceous uplift (JAMIČIĆ, 1985, 1988, 1993, 1995a, 1995b, 2000, 2004; MARINČIĆ, 1995). During this tectonic phase pre-Tertiary rocks of the Požeška gora Mt. were affected by the E-W directed compression, and N-S directed extension.

New paleostress data from the Upper Cretaceous rocks exposed at were obtained the Požeška gora Mt. by measuring orientation of striae lineation on fault planes.

In granitic and rhyolitic rocks of Early Cretaceous (?) age as well as in the Upper Cretaceous deposits (Fig. 1), fault systems were recorded characterized by kinematic indicators that indicate reverse and normal sense of tectonic transport. Due to their brittle characteristics, granitic rocks were heavily crushed into blocks of maximum 1/4 of cubic meter in size. Only one generation of striae has been recorded on fault planes characterised by reverse sense of slip. Two systems of brittle structures were determined in the field. The first one corresponds to reverse faults of approximate N-S strike (NNE-SSW), as a result of E-W directed (Tab. 1), while the other one is represented by faults with normal character of tectonic transport of separated blocks. Data for reverse faults recorded in granites are shown in Fig. 1, 1d and for the consequent normal faults (Fig. 1, 2d). In rhyolitic rocks outcropping in the NE part of the Požeška gora Mt. (Figs. 1, 7), reverse faults prevail (Fig. 1, 1e). These faults indicate a stress field characterized by E-W directed compression (Tab. 1) that resulted in predominantly eastward tectonic transport of rhiolites. In rhyolitic rocks the consequent faults of normal character are present (Fig. 1, 2e).

In the Upper Cretaceous deposits during the Cretaceous and Paleogene tectonic events, monoclinic folds with N-S strike were formed (JAMIČIĆ *et al.*, 1985). The process is often followed by sigmoidal folding of siltstone beds and laminated limestones along the axial plane cleavage (Fig. 6). The strike of the cleavage is N-S with plane inclination in the 20–80° range (Fig. 1, 3b).

Tertiary-Quaternary structures

During the Tertiary to Middle Miocene times, the area of Slavonian Mts. Was affected by the regional extension. During Middle to Late Miocene the same region was affected by a N-S compression. The main structural elements formed during this last deformational event (D2) are reverse faults with E-W strike. In the Cretaceous and Miocene sediments normal, monoclinic, and overturned folds of E-W strike were formed (Fig. 1) with northern vergence, accompanied by a conjugate pair of NE-SE striking sinistral and NW-SE striking dextral faults. Maximal horizontal offset along sinistral faults is maximum 500 meters where this can be seen. Although the bedding poles of the Cretaceous beds of the Požeška gora Mt. are scattered (Fig. 1, 3a) due to older deformation (D1), a folded structure of E-W strike is detectable. Miocene sediments (Fig. 1, 3c) have clear E-W strike with northern vergence.

CONCLUSIONS

Upper Cretaceous deposits of the Požeška gora Mt., on the basis of micro- and macrofossils are of Santonian-Campanian-Maastrichtian age. The continuous sequence

Fig. 6. Lamellar limestones of Campanian-Maastrichtian age, exposed in Luke stream valley. Sygmoidal folding along the axial plane cleavage

of sediments starting from coarse-grained sandstones and breccias, over siltstones and laminated limestones is revealed. Sandstones and breccias contain sub-angular to angular fragments of granites, granophyres and acidic volcanic rocks. They do not contain the fragments of mafic rocks exposed at the Požeška gora Mt., thus indicating that the mafic volcanism was not active during the deposition of the Upper Createceous clastic rocks. Since the acidic magmatic rocks were resedimented into sandstones and breccias, it is certain that they are older than Santonian-Campanian-Maastrichtian. It is hard to establish how much older then the Santonian granites and acidic volcanic

Tab. 1. Paleostress tensors computed from fault-slip data

Locality	Coordinate	Lithology	Age of rocks	Figure	S	N	σ_1		σ_2		σ_3	
Gradski Vrhovci	x=6472321 y=5017743	granite	Lower Cretaceous?	Fig.1, 1d	R	13	108	9	198	2	298	81
Gradski Vrhovci	x=6472321 y=5017743	granite	Lower Cretaceous?	Fig.1, 2d	N	8	171	72	36	13	303	12
Vesela	x=6480423 y=5018679	rhyolites	Lower Cretaceous?	Fig.1, 1e	R	32	292	7	201	6	72	81
Vesela	x=6480423 y=5018679	rhyolites	Lower Cretaceous?	Fig.1, 2e	N	8	356	60	199	28	103	10

S=state of stress (N=normal, R=reverse), N=number of faults used for paleostress calculation. $\sigma_{1,}$ σ_2, $\sigma_{3;}$ trend (as azimuth) and plunge (in degrees) of stress axes.

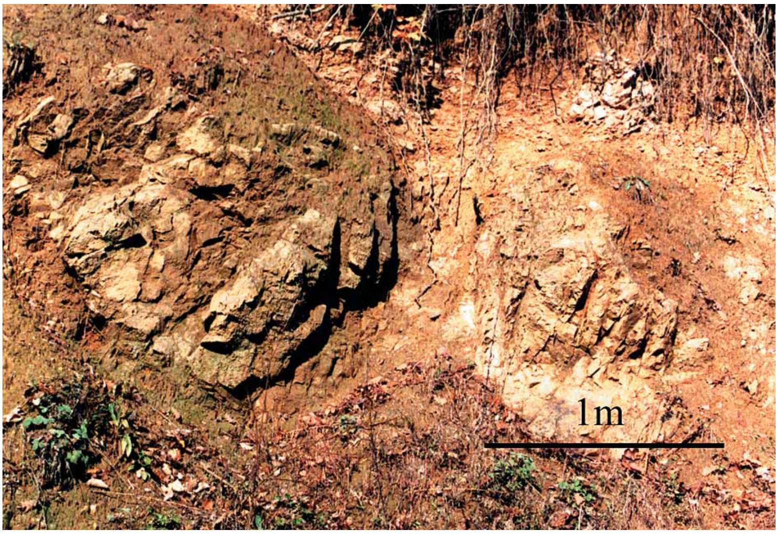


Fig. 7. Tectonized rhyolitic rocks in the footwall of the reverse fault N-S strike (Fig. 1 e)

rocks can be, but it can be said that the radiometric age (PAMIĆ *et al.*, 1988) is a consequence of warming and it is lower than the exact age of their formation. The subsequent warming is the result of tectonic deformational processes that took place at the transition from Upper Cretaceous to Paleogene when this area together with other Slavonian Mts. Experienced compression an E-W directed.

ACKNOWLEDGEMENTS

The paper is a result of continuous investigations on the Tectonic Map of the Republic of Croatia 1:300 000 (project No.: 0181008), financed by the Croatian Ministry of Science, Education and Sport.

Received December 14, 2006

REFERENCES

BELAK, M., HALAMIĆ, J., MARCHIG, V. & TIBLJAŠ, D., 1998: Upper Cretaceous-Paleogene Tholeiitic Basalts of the Southern Margin of the Pannonian Basin: Požeška gora Mt. (Croatia). Geol. Croatica **51**/2, 163–174, Zagreb.

DRAGIČEVIĆ, I. & BLAŠKOVIĆ, I., 2002: Geological grounds of petroleum-geological and geothermal prospectivity in marginal and basinal sections of the Slavonian Mts. area. Nafta 53, 371–376, Zagreb.

HALAMIĆ, J., 1992: Geološki položaj magmatsko-sedimentnog kompleksa Požeške gore (Die geologische Lage des magmatisch-sedimentaren Komplexes des Požega Gebirges – in German). – M.Sc. Thesis, University of Zagreb, 74p. Zagreb.

HALAMIĆ, J., BELAK, M. & JAMIČIĆ, D., 1990: Geološko-petrografski prikaz baznih vulkanskih stijena Požeške gore (Slavonija/Hrvatska) (Geological – petrographical review of the basic volcanic rocks of the Požeška gora Mt. (Slavonia/Croatia) – in Croatian). – XII. kongres geologa Jugoslavije, Ohrid, knj. 2, 456–465, Ohrid.

HALAMIĆ, J., BELAK, M. & PAVELIĆ, D., 1993: The Sedimentological Significance and Stratigraphic Position of Coarse-Grained Red Beds (?Oligocene) of Northwestern Margin of Mt. Požeška Gora (North Croatia). Geol. Croatica **46**/1, 137–143, Zagreb.

HANCOCK, P. L., 1985: Brittle microtectonics: principles and practice. J. Struct. Geology **7**, 437–457.

JAMIČIĆ, D., 1983: Strukturni sklop metamorfnih stijena Krndije i južnih dijelova Papuka [Structural pattern of the metamorphosed rocks of the Mt. Krndija and the southern part of Mt. Papuk – in Croatian].– Geol. vjesnik **36**, 51–72, Zagreb.

JAMIČIĆ, D., 1988: Strukturni sklop slavonskih planina (sjeverni Psunj, Papuk, Krndija) [Structural pattern of the Slavonian Mountains (Northern Psunj, Papuk, Krndija) – in Croatian]. – Unpublished PhD Thesis, University of Zagreb, 152 p., Zagreb.

JAMIČIĆ, D., 1993: Die Anwendung Der β-Diagrame bei Uberfalteten Strukturen [Use of β-diagramme in folded structures – in German].– Geol. Croatica **46**/2, 281–290, Zagreb.

JAMIČIĆ, D., 1995a: Tektonski događaji u južnom dijelu Panonskog područja (sjeverna Hrvatska): pregled i interpretacija [Tectonically events in the south part of the Pannonian area (north Croatia): review and interpretation – in Croatian]. – In: VLAHOVIĆ, I., VELIĆ, I. & ŠPARICA, M. (Eds.): Zbornik radova 1, 1. Hrvatski geološki kongres, Opatija, 215–218, Zagreb.

JAMIČIĆ, D., 1995b: The role of sinistral strike-slip faults in the formation of the structural fabric of the Slavonian Mts. (Eastern Croatia). Geol. Croatica **48**, 155–160, Zagreb.

JAMIČIĆ, D., 2000: Laramijski pokreti u području južnog dijela Panonskog bazena [The Laramian movements in the area of southern parts of the Pannonian basin – in Croatian]. – In: VLAHOVIĆ, I. & BIONDIĆ, R. (Eds.): Zbornik radova, 2. Hrvatski geološki kongres, Cavtat-Dubrovnik, 223–224, Zagreb.

JAMIČIĆ, D., 2004: The »Orešje« Laramian Structure in the NE part of Medvednica Mt. (Croatia). Geologia Croatica 57/1, 87–93, Zagreb.

JAMIČIĆ, D., CRNKO, J., MATIČEC, D. & PRTOLJAN, B., 1985: Strukturni elementi laramijskih pokreta u području Sulkovca (Požeška gora) [Structural elements of the Laramian movements in the area of Sulkovac (Požeška gora) – in Croatian]. – Geol. vjesnik **38**, 149–154, Zagreb.

KOCH, F.,1919: Grundlinien der Geologie von West-Slavonien. Glasnik Hrv. Prir. društva **31**/2, 217–236, Zagreb.

LASKAREV, V., 1931: Prilozi za poznavanje tektonike Požeške gore (Slavonija) [Contributions to knowledge of the Požeška gora Mt. tectonics (Slavonia) – in Croatian]. – Glas. Srp. Kralj. Akad. 141, 103–118 Beograd.

MAJER, V. & TAJDER, M., 1982: Osnovne karakteristike spilit-keratofirskog magmatizma Slavonije [Basic characteristics of the spilite-keratophyre magmatism in Slavonia – in Croatian]. – Acta geologica **12** (1), 1–22, Zagreb.

MARINČIĆ, S., ŠPARICA, M., BENIĆ, J. & KOROLIJA, B., 1995: Sedimenti senona u dolini potoka Mikulića [Sediments of the Senonian in Mikulić stream valley – in Croatian]. – In: ŠIKIĆ, K. (Ed.): Geološki vodič Medvednice, 73–76, Inst. za geol. istraživanja INA – Industrija nafte d.d., Zagreb.

PAMIĆ, J.,1987: Mladoalpinski alkalijsko-feldspatski graniti (aljaskiti) Požeške gore u Slavoniji [Young-Alpine alkali feldspar granites (alaskites) from Mt. Požeška gora in Slavonia, northern Yugoslavia – in Croatian]. – Geologija **30**, 183–205, Ljubljana.

PAMIĆ, J. & ŠPARICA, M., 1983: Starost vulkanita Požeške gore [The age of the volcanic rocks of the Požeška gora Mt. (Croatia, Yugoslavia) – in Croatian]. – Rad Jugos. akad. znan. umjetnosti, knj. 404 (Razr. prir. znan. knj. 19), 183–198. Zagreb.

PAMIĆ, J., INJUK, J. & JAKŠIĆ, M., 1989: Prilog geokemijskom poznavanju gornjokredne bimodalne vulkanske asocijacije Požeške gore u Slavoniji (sjeverna Hrvatska, Jugoslavija) [Some geochemical features of the Upper-Cretaceous bimodal volcanic association from the Požeška gora Mt. in Slavonija (northern Croatia, Yugoslavia) – in Croatia]. – Geologija **31**/**32**, 415–435, Ljubljana.

PAMIĆ, J., LANPHERE, M. & MCKEE, E., 1988: Radiometric ages of metamorphic and associated igneous rocks of the Slavonian Mountains in the southern part of the Pannonian basin. Acta geologica **18**, 13–39. Zagreb.

PETIT, J. P., 1987: Criteria for the sense of movement on fault surfaces in brittle rocks**.** J. Struct. Geol. **9**, 597–608.

POLŠAK, A., 1971: Istraživanje krednih naslaga Požeške gore [Investigations of the Cretaceous deposits of the Požeška gora Mt. – in Croatian]. – Ljetopis Jugosl. Akad. znan. umjetnosti **74**, (1967–68), 473–474, Zagreb.

PRELOGOVIĆ, E., JAMIČIĆ, D., ALJINOVIĆ, B., VELIĆ, J., SAFTIĆ, B. & DRAGAŠ, M., 1995: Dinamika nastanka struktura južnog dijela Panonskog bazena [Dynamic of the structures formation in the south part of the Pannonian basin – in Croatian]. – In: VLAHOVIĆ, I., VELIĆ, I. & ŠPARICA, M. (Eds.): Zbornik radova 2, 1. Hrvatski geološki kongres, Opatija, 482–486. Opatija.

ŠPARICA, M., JURIŠA, M., CRNKO, J., ŠIMUNIĆ, A., JOVANOVIĆ, Č. & ŽIVANOVIĆ, D., 1980: Tumač za list Nova Kapela. Osnovna geološka karta SFRJ 1:100 000 (Explanatory notes for Basic Geological map of SFRY, 1:100 000, sheet Nova Kapela), Inst. Geol. Zagreb, Savezni geol. Zavod Beograd.

ŠPARICA, M. & PAMIĆ, J., 1986: Prilog poznavanju tektonike Požeške gore u Slavoniji [Contribution to the tectonical review of the Požeška gora Mt. in Slavonia – in Croatian]. – Rad Jugos. akad. znan. umjetnosti, knj. 424 (Razred za prirodne znanosti, knj. 21) 85–96. Zagreb.

S A Ž E T A K

Gornjokredne naslage Požeške gore (Hrvatska)

D. Jamičić

U radu se analizira međusobni odnos gornjokrednih naslaga, granitnih i riolitnih stijena. Gornjokredne naslage, kampan-mastrihtske starosti, diskordantno dolaze na granitskim stijenama. Baza gornje krede predstavljena je krupnoklastičnim klastpotpornim brečama čiji fragmenti su poluuglati do poluzaobljeni, a matriks je srednjezrnati pješčenjak crvenkaste boje. Odgovaraju granofiru, alkalijsko-feldspatskom granitu i rožnjaku, a zastupljeni su i fragmenti kiselog vulkanita, riolita. U brečama nisu nađeni fragmenti bazičnih stijena koje nalazimo na Požeškoj gori što znači da bazični vulkanizam nije bio aktivan za vrijeme taloženja gornjokrednih klastičnih stijena.

Na brečama slijede krupnozrnati pješčenjaci koji su zbog veziva svijetlocrvene boje. U njihov sastav ulaze čestice kvarca, K-feldspata, kvarcita, fragmenti rožnjaka,

te čestice kiselih intruziva (alkalijsko-feldspatski granit i granofir) i efuziva (riolit). Zatim, dolaze čestice vulkanskog stakla i nakupine muskovita sa i bez zrna kvarca. Javljaju se i sitnozrnati pješčenjaci sive boje koji u slijedu stupa postupno prevladavaju. Fosilni ostaci nisu zapaženi u ovom nivou gornjokrednih naslaga.

Pješčenjaci postupno prelaze u laminirane siltite sive do tamnosive boje. Unutar njih se javljaju i pelagički biomikriti s laminiranom građom. Starost ovog nivoa je na temelju nalaza brojnih globotrunkanida određena kao kampan-mastriht.

Na siltitima kontinuirano dolaze pločasti vapnenci. Debljina slojeva vapnenaca se kreće od 1 do 5 cm. I u ovom paketu vapnenaca nađene su globotrunkane kampan-mastrihtske starosti.

Završni član, u stupu gornjokrednih naslaga Požeške gore, su debelo uslojeni vapnenci.

Na gornjokrednim naslagama diskordantno naliježu krupnoklastične naslage čije je najveće rasprostranjenje zapadno od sela Škrabutnik. Prevladavajuće stijene su konglomerati, te podređeno pješčenjaci, a vrlo rijetko dolaze i tinjčasti siltiti. To su bezkarbonatne naslage u kojim nisu nađeni fosilni ostaci, ali je zbog njihovog diskordantnog odnosa spram krednih naslaga i položaja u odnosu na okolne srednjomiocenske naslage realno za pretpostaviti da im se starost kreće u rasponu paleocen-eocen.

Današnji strukturno-tektonski sklop Požeške gore oblikovan je tijekom gornje krede i tercijara. Ustanovljena su dva tektonska događaja (D1 i D2) čije glavne osi stresa ($\sigma 1$) su međusobno okomite. Stariji tektonski događaj vezan je za kraj mezozojskog sedimentacijskog ciklusa koji je u ovom dijelu panonskog prostora završio postkrednim izdizanjem u vrijeme laramijske faze alpinske orogeneze. Predtercijarne stijene su pri kraju gornje krede došle pod utjecaj lateralne kompresije, koja djeluje na pravcu istok-zapad, koju prati značajno tektonsko suženje prostora i ekstenzijski procesi u smjeru S-J. U granitnim i riolitnim stijenama te gornjokrednim naslagama su tijekom ovih kompresijskih deformacijskih procesa oblikovani rasjedni sustavi čiji linearni elementi tektonskog transporta ukazuju na reverzno kretanje odvojenih blokova uz pojavu pratećih normalnih rasjeda.

U gornjokrednim naslagama su tijekom kredno-paleogenskih tektonskih događanja oblikovane i bore monoklinalnog tipa čije osi se pružaju S-J. Boranje često prati sigmoidalno svijanje slojeva siltita i pločastih vapnenaca uz plohe klivaža osne ravnine.

Tijekom tercijara do srednjeg miocena je područje slavonskih planina pod utjecajem ekstenzijskih procesa. Evolucija stresa kroz srednji do kasni miocen karakterizirana je S-J kompresijom. Glavni strukturni elementi nastali u ovom deformacijskom događaju (D2) su reverzni rasjedi pružanja Z-I. U krednim i miocenskim sedimentima se zapažaju normalne, kose i prebačene bore pružanja Z-I sjeverne vergencije te lijevi rasjedi pružanja SI-JZ. Konjugirani sustavi desnih rasjeda (SZ-JI) su također zapažani, no u značajno podređenoj mjeri. Horizontalni pomaci uz lijeve rasjede su do maksimalno 500 metara.

Kako su kisele magmatske stijene pretaložene u pješčenjake i breče, to je sigurno da su one starije od razdoblja kampan – mastriht. Koliko su graniti i rioliti stariji od kampana za sada je teško ustanoviti, no može se reći da je radiometrijska starost (71.5 mil. god.) posljedica naknadnih zagrijavanja i s tim u svezi njihovog podmlađivanja.

Naknadno zagrijavanje je uzrokovano snažnim tektonskim deformacijskim procesima na prijelazu gornje krede u paleocen, kada je ovaj prostor, kao i ostale slavonske planine, pod utjecajem kompresije na pravcu Z-I.