STRATIGRAPHY AND PALYNOLOGICAL ASSESSMENTS OF THE UPPER CRETACEOUS SEDIMENTARY AND VOLCANIC FORMATIONS IN THE REGION OF CHELOPECH, CENTRAL SREDNOGORIE ZONE, BULGARIA

Stanislav Stoykov[1] and Polina Pavlishina[2]

[1] University of Mining and Geology "St. Ivan Rilski", Department of Economic Geology, Sofia, Bulgaria, sstoykov@mgu.bg
[2] Sofia University, Department of Geology and Palaeontology, Sofia, Bulgaria, polina@gea.uni-sofia.bg

Introduction

The investigated area is located in the Central Srednogorie volcano-plutonic area, which forms part of the Srednogorie Late Cretaceous island arc system (Dabovski et al., 1991). The Upper Cretaceous sedimentary successions comprise probably continental up to marine deposits intercalated by volcanic, sub volcanic and volcanic-sedimentary complexes. Therefore the stratigraphy of the Upper Cretaceous sediments in the investigated area is of current interest and importance.

The present study provides field revisions and palynological data aiming at age determination of the Upper Cretaceous sediments in the area.

Geological setting of the Chelopech sedimentary and volcanic complex

The basement of the Upper Cretaceous successions consists of high-grade metamorphic rocks (two-mica migmatites with thin intercalations of amphibolites, amphibole-biotite and biotite gneisses), and low metamorphic phyllites and diabases of the Berkovitsa group (Early Paleozoic island-arc volcanic complex, Haydoutov, 2001). These units are in tectonic contact with each other.

The Late Cretaceous succession in the Chelopech region starts transgressively with conglomerates and coarse-grained sandstones intercalated with coal-bearing interbeds (coal-bearing formation, Moev and Antonov, 1978) covered by polymictic, argilleous and arcose sandstones to siltstones (sandstone formation). Collectively, these units have a thickness of less than 500 m. The sedimentary rocks are cut by volcanic bodies and overlain by sedimentary and volcanic rocks of the Chelopech Formation (Moev and Antonov, 1978). It includes the products of the Chelopech volcanic complex, epiclastics, as well as the Vozdol sandstones. These formations have been eroded and transgressively covered by sedimentary rocks of the Upper Senonian-Campanian Mirkovo Formation (reddish limestones and marls), which is in turn overlain by flysch of the Chugovo Formation (Campanian-Maastrichtian in age, Moev and Antonov, 1978).

The Chelopech volcanic complex is located in the Central Srednogorie magmatic zone and hosts one of the largest Au-Cu deposits in Europe. Field observations and sedimentary relationships allow distinguishing of three units of the volcanic complex: (I) dome-like bodies, (II) lava to agglomerate flows, and (III) the Vozdol lava breccias and volcanites (Stoykov et al., 2003). The volcanic rocks are porphyritic with plagioclase and amphibole phenocrysts, while quartz and biotite are rare.

For the timing of the magmatic activity and the mineralisation /alteration products just K-Ar data are available (Lilov and Chipchakova, 1999), which range from 92 to 57 Ma; respectively the magmatism in the Chelopech region was supposed to be prolonged, but mainly Senonian in age.

The first unit is composed of *dome-like volcanic bodies*, which extruded through the unconsolidated Turonian sediments (the sandstone and coal-bearing formation) and through the metamorphic basement. The dome-like bodies mainly have an andesitic and trachydacitic composition. They are highly porphyritic (phenocrysts >40 vol. %). Lilov and Chipchakova (1999) obtained an age of 65-67 Ma for these bodies based on K-Ar dating. The new U-Pb zircon geochronological data define a mean $^{206}Pb/^{238}U$ age of 92.3±0.5 Ma (Stoykov et al., in this volume) which encompasses the Early Turonian.

The second unit is represented by *lava flows*, which grade upwards into agglomerate flows. Borehole data shows that the total thickness of these volcanic products is generally less than 1200 m, but exceeds 2000 m in the region of the Chelopech mine ("within their extrusive center", Popov et al., 2000). The composition of the lava flows varies from latitic-trachydacitic to dacitic. Subsidiary andesites are also present. The lava flows contain fine-grained, fully crystallized enclaves of basaltic andesites to shoshonites. Previous K-Ar dating of non-altered andesite yielded a Turonian age of 91 Ma (Lilov and Chipchakova, 1999). The new U-Pb zircon geochronological data define a mean $^{206}Pb/^{238}U$ age of 91.3±0.3 Ma (Stoykov et al., in this volume) which encompasses the Middle Turonian.

The third unit is represented by *volcanic breccias and volcanites* that formed the so called Vozdol monovolcano (Popov et al., 2000). The volcanic breccias contain fragments within their lava matrix that vary in size between 20 and 80 cm. Brecciated fragments from the andesites of the first unit can be observed in outcrops in the Vozdol river valley. The matrix of the volcanic body in the eastern part hosts small lenses and layers of sedimentary material (sandstones to gravelites), which abundance increases towards the margins of the body. The Vozdol volcanic breccias additionally intercalate and are covered by the Vozdol sandstones, the latter palynologically dated as Turonian in age (Stoykov and Pavlishina, 2003). These features may suggest that the extrusion of the third unit volcanites occurred contemporaneous with the sedimentation processes in the Turonian. The composition of the Vozdol volcanites varies from basaltic andesites and andesites to latites. A biotite $^{40}Ar/^{39}Ar$ age yields a Turonian age of 89.95±0.90 Ma (Velichkova et al., 2001). The new U-Pb zircon geochronological data define a mean $^{206}Pb/^{238}U$ age of 91.3±0.3 Ma (Stoykov et al., in this volume) which also encompasses the Middle Turonian. The K-Ar age

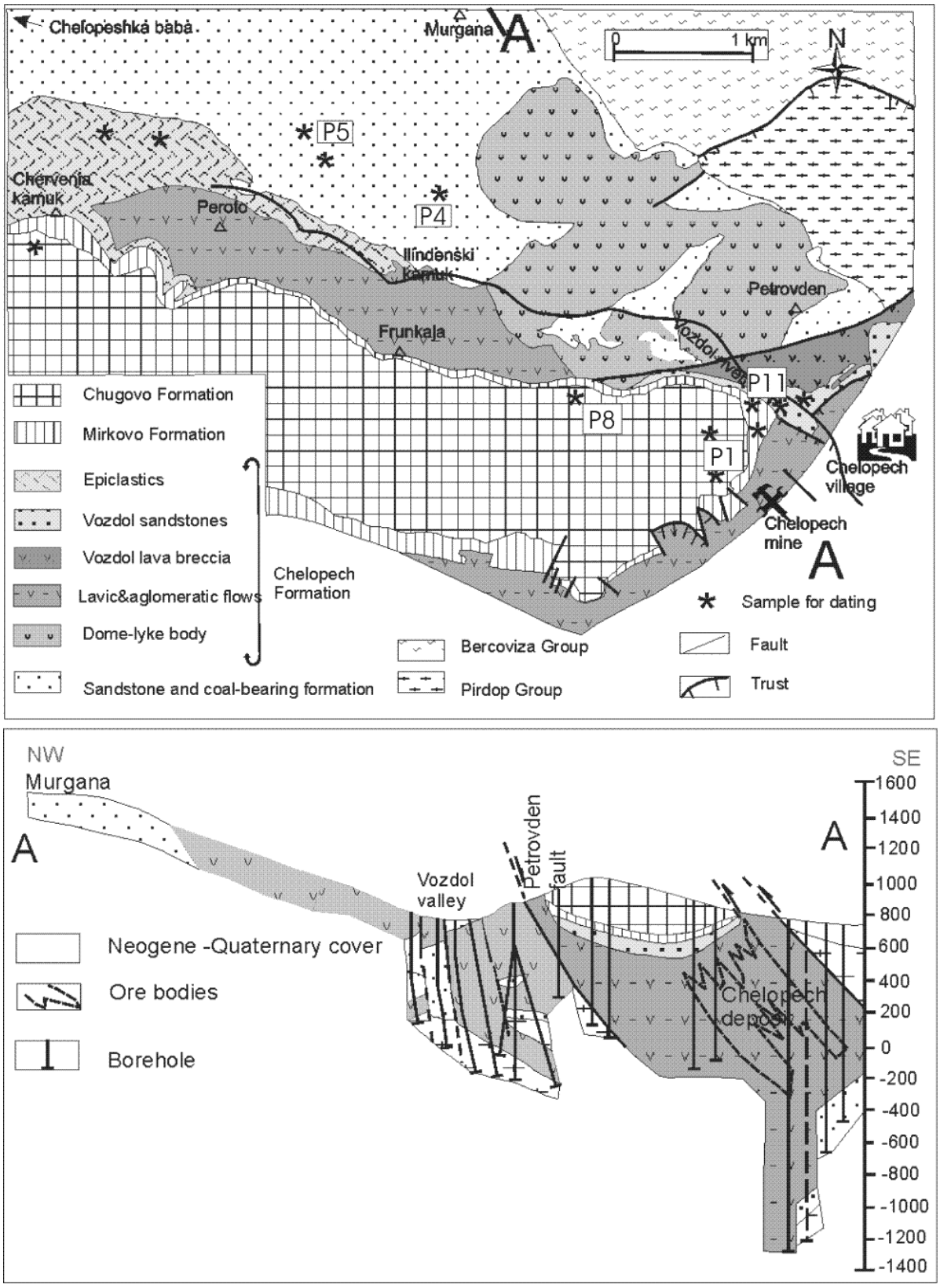

Fig. 1. Geological map (after Stoykov et al., 2003 with additions) of the investigated area and position of the samples.

of 65 Ma obtained by Lilov and Chipchakova (1999) from samples at the same locality reflects a low-temperature overprint.

The cover of the Chelopech volcanic complex is composed of the Vozdol sandstones (to the east), muddy limestones of the Mirkovo Formation (in the center) and sedimentary rocks of the sandstone and coal-bearing formation (to the west).

Palynological data

The palynological investigations have provided new data concerning the age assessment of these formations. Several samples were processed according to standard preparation techniques. Palynologically productive samples were obtained from the sandstone formation, the Vozdol sandstones and the Chugovo Formation. Continental elements predominate in the assemblages, being represented by spores and pollen from the Normapolles group. Dinoflagellate cysts were obtained only from the Chugovo Formation thus, very well confirming the age determination of the pollen taxa.

As it has been already reported (Stoykov and Pavlishina, 2003), samples originating from the sandstone formation and the Vozdol sandstones have yielded palynofloras of similar composition. The forms of the *Complexiopollis* genus are frequent in them with determination of *Complexiopollis christae, Complexiopollis helmigii* and *Complexiopollis* sp. The assemblages are characterized also by the following spore species: *Bikolisporites toratus, Vadaszisporites urkuticus, Cicatricosisporites cuneiformis, Appendicisporites appendicifer.* These new palynological evidences suggest Turonian age for both formations, which is supported by the recent radiometric data of 92.5 Ma (Stoykov et al., in this volume).

Two samples originating from the Chugovo Formation (field reference P1, Chugovo dere valley and P8, Pliasha top) have yielded palynoflora comprising dinoflagellate cysts and Normapolles taxa in equal quantities. The established taxa are as follows: dinoflagellate cysts – *Isabelidinium korojonense, Cerodinium diebelii, Alterbidinium distinctum, Pterodinium cingulatum* and pollen – *Krutzschipollis spatiosus, Suemegipollis germanicus, Semioculopollis croxtoniae, Oculopollis orbicularis, Nudopollis* spp., and *Interporopollenites* spp.

From the point of view of the palynological stratigraphy the encountered dinoflagellate taxa are quite characteristic. Their ranges are well known within the biostratigraphically well controlled dinocyst framework established for Western Europe and especially for the type Maastrichtian area (Wilson, 1974; Kirsch, 1991; Marcheinecke, 1992; Schioler & Wilson, 1993). They indicate *Cerodinium diebelii* Zone (Kirsch, 1991), thus suggesting Early Maastrichtian age for the studied samples. This age assessment is very well confirmed by the encountered Normapolles species. Most of them are known from the latest Cretaceous to the Middle Paleocene. Namely *Suemegipollis germanicus* is well known from the Maastrichtian in Germany, *Semioculopollis croxtoniae* and *Nudopollis* spp. are restricted to the Maastrichtian – Danian interval and *Oculopollis orbicularis* ranges from Santonian to Maastrichtian. The last occurrence of *Krutzschipollis spatiosus* is well documented within the middle part of the Maastrichtian. So, the concurrent ranges of these taxa also indicates an Early Maastrichtian age for the samples.

The new palynological data obtained from samples of the Chugovo Formation are in general agreement with the age assessments of previous authors.

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