THE TRIASSIC AND JURASSIC SEDIMENTS IN EASTERN STARA PLANINA MTS. (BULGARIA) — AN EXAMPLE OF CLASSIFICATION OF GEOSITES IN SEDIMENTARY ROCKS

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Abstract. Two types (basin and shelf) of Triassic and Jurassic Tethyan sediments participate in the structure of eastern Stara Planina Mts. (eastern Bulgaria). A parautochtonous position is assumed for the basin type rocks. The shelf sediments are allochtonous and can be observed as olistolites included in the Lower Jurassic Sini Vir Formation and in the Middle Jurassic Kotel Formation. The parautochtonous sediments take part in the composition of the probable overthrust structures refolded in antiformal and synformal structures, and intensely eroded before Late Cretaceous times. From the geological heritage point of view, the Triassic and Jurassic sediments of the region are included in a large unit — geosites framework — composed of 19 geosites: 10 in the parautochtonous and 9 in the allochtonous sediments. They exhibit different geological (tectonical, stratigraphical, palaeontological, etc.) features.

Key words: geosites framework, geosites, Triassic, Jurassic, eastern Stara Planina Mountains, eastern Bulgaria.

INTRODUCTION

A lively discussion on the units of geological heritage nomenclature (geosites frameworks and geosites) has been lately initiated in the Working Group 1 of ProGEO for south-eastern Europe. Triassic and Jurassic Tethyan formations in the eastern Stara Planina Mountains, eastern Bulgaria, are suitable subjects to expose and illustrate the point of view on this problem. The geosites framework represents rocks deposited in a part of a basin, limited in time, in which the sedimentation, distribution of fauna, depositional sequences, etc. are predestined by the palaeotectonics and the palaeogeography of this basin. In this sense, the Triassic and the Jurassic rocks in the Matoride Basin of eastern Stara Planina Mts. represent an example of geosite framework. These deposits are of Tethyan type in contrast to most of the other deposits of the same age in Bulgaria that possess a Peri-Tethyan character.

The lower boundary of this geosite framework is unknown because the lower boundary of the oldest rocks — the Lower Triassic Mayadere Fm. is not exposed. The upper boundary coincides with the upper boundary of the Kotel Fm. — the youngest age proven in it is the Middle Bathonian (Mid Jurassic).
However, these rocks have suffered erosion, and this boundary coincides probably in time with the Early Callovian when the region was tectonically compressed and the marine sediments were exhumed to the surface.

The type area of the geosites framework is situated in the valley of the Luda Kamchia River (Fig. 2). The aim of the individualisation of the geosites framework is to have the possibility to conform the contemporaneous geosites frameworks from the different parts of one or many sedimentary basins. The geosites framework consists of numerous single geosites that display one or more characteristic features of the exposed sediments. One geosite may demonstrate several features as, e.g. palaeontological (occurrence of fossils), stratigraphical (e.g. the type sections of one stage/substage, or of some lithostratigraphical or biostratigraphical units, etc.), historical (e.g. the locality where a stage/substage has been introduced for the first time in the world or in the country, etc. or the locality where a stratigraphical or tectonical hypothesis was created, etc.), lithological (when a geosite posses some very particular features), geomorphological, etc.
Parautochthonous sediments: 1 — Mayadere Fm. (Spathian), 2 — Gyurgenliya Fm. (Lower Anisian–Lower Carnian), 3 — Glogova Fm. (Upper Carnian–Norian to Rhaetian), 4 — Sini Vir Fm. (Norian–Toarcian), 5 — Balaban Fm. (Toarcian), 6 — Kotel Fm. (Aalenian–Middle Bathonian), 7 — younger sediments (Lower and Upper Cretaceous and Palaeogene); allochthonous sediments (in olistolites): 8 — Triassic and Jurassic rocks, 9 — Middle Jurassic sediments, 10 — overthrust; geosites in allochthonous sediments (noted on the map): Tr, n–r (Orta Kaya type limestones); J, B — Bilka type; J, K — Karaveljovo type; Tr — Lower Triassic marls and limestones; J, D — Djula type, Ajvadzik Dere; J — Cerkoviste type in the locality Ramadan Chair; J, bs — Black shales with Bossistra alpina in the Kotel Fm.; J, Ba — sandstones of Balaban Fm. in the Kotel Fm.
anticline: the Mator–Planina anticline. The allochtonous sediments are exposed as olistolites included in the black shales of the Mid Jurassic Kotel Formation. The olistolites are formed of shelf carbonate Triassic and Jurassic sediments, as well as of smaller blocks coming from the Matoride rifted basin, partly destroyed during the Mid-Jurassic. These sediments take part in the composition of supposed overthrust structures, subject to an intense erosion before the Late Cretaceous and covered transgressively by Upper Cretaceous sediments.

GEOSITES FRAMEWORK AND GEOSITES IN THE TRIASSIC AND JURASSIC ROCKS IN EASTERN STARA PLANINA MTS.

Ten geosites are identified in the parautochtonous Triassic and Jurassic basin rocks. The geosites are of different types: stratigraphical, palaeontological, palaeotectonical, etc. The stratigraphical geosites are represented by the stratotypes of the local lithostratigraphical units and/or some outcrops which show some characteristic features. The palaeontological geosites contain many fossils, and the tectonical geosites exhibit some elements of the Cimmerian and the Alpine structures in the region. In the allochtonous rocks, included into the Jurassic rocks as olistolites, 9 geosites are distinguished.

GEOSITES IN THE PARAUTOCHTONOUS ROCKS

STRATIGRAPHICAL GEOSITES

The Triassic rocks are subdivided (Budurov et al., 1997) in the following formal lithostratigraphical units: Mayadere Fm. (Lower Triassic), Gyurgenliya Fm. (Lower Anisian–Lower Carnian), Glogova Fm. (Upper Carnian–Norian–Rhaetian – p.p.), and the Jurassic rocks (Tchoumatchenco, Černjavska, 1989) are grouped into the Luda Kamchia group and subdivided into Sini Vir Fm. (Rhaetian (p.p.)–Toarcian (p.p.), Balaban Fm. (Toarcian) and Kotel Fm. (Aalenian–Middle Bathonian). The stratotypes of this lithostratigraphical units are designed as stratigraphical geosites.

Geosite 1. (Fig. 1–4). It represents the stratotype of Mayadere Fm. (93.5 m) located parallel to the Maya Dere River, near the village of Vesselinovo, Shumen District (42°57'25'' N and 27°05'20''E) (Budurov et al., 1997). It is built of an irregular, flysch-like alternation of marls, shales, siltstones, sandstones and limestones. The relative volume of shales and siltstones is greater in the basal parts of the section, and is gradually replaced upwards by marls with limestones interbeds. The age corresponds to the upper parts of the Olenekian Stage (Spatian) — conodont zones Neospathodus triangularis–N. homeri, foraminifer zone Meandrospira pusilla, and the palynozones Densoisporites nejburgii and Cyclooverrutiletes presselensis.

Geosite 2. (Fig. 1, 2, 3, 5). This geosite is the stratotype of Gyurgenliya Fm. (29.7 m), located parallel to the Maya Dere River near the village of Vesselinovo (42°57'25'' N and 27°05'20'' E) (Budurov et al., 1997).
It is situated above the stratotype of the Mayadere Fm. and is built up (Fig. 5) of grey, grey-greenish, reddish or yellowish limestones, in the lower part inter-bedded with marls, and locally, with silicates (radiolarites?). The age is determined as Lower Anisian–Lower Carnian, based on rich conodont and foraminifer fauna: conodont zone *Paragondolella timorensis* and lower parts of the foraminifer fauna zone *Pilamina densa Zone* (Aegean Substage), *Paragondolella bulgareka* Zone and parts of *Pilamina densa Zone* (Pelsonian Substage), *Pridaelel constricta Zone* (Illyrian — lower parts of Fassanian Substage), *Paragondolella foliata Zone* and part of *Turriglomina mesotrisiaca Zone* (upper parts of Fassanian–Longobarian Substage), *Paragondolella polygathiformis Zone* and parts of *Paraophthalmidium cardpathicum Zone* (Cordevolian–Julian Substage).

**Geosite 3.** (Fig. 1, 2). The geosite — stratotype of Glogova Fm. (c. 30 m), is situated along the road Kotel–Omourtag, parallel to the Glogova River (Budurov et al., 1997, Pl. I) (42°53′35″N and 26°27′20″E).

The formation is a calciturbidite — irregular alternation of marls (dominating in the lower parts) with thin-bedded limestones, silty limestones, calcareous siltstones and clayey limestones (mainly in the upper parts). The age is determined as Late Carnian–Norian–Rhaetian (?), based on rich macro-fauna as well as on foraminifers — *Paraophthalmidium cardpathicum* and parts of *Miliopora cuvillieri Zone* and newly-found palyynomorphs corresponding to *Vallasportes ignaci–Corollina meyeriana Zone*, thus pointing at Norian age for a part of the section.

**Geosite 4.** (Fig. 1, 2). It is the holostatotype of Sini Vir Fm. (c. 500–800 m.), situated in the valley of Efleshntsa River. It was described by Tchoumatchenko and Černjavska (1989, Pl. I, Figs. 1–3) and re-described in Tchoumatchenko et al. (1992) (42°56′11″N and 27°24′25″E).

The unit is characterised by a turbidite silicoclastic alternation — sandstones to calcareous sandstones, aleurolites and limestones — represented calcareous turbidites, in which many Triassic and Jurassic olistoliths. Some of these olistoliths crowned the heights as Kodha Kaya, Ouch Kaya, Orta Kaya, Orlitsite etc. They add to the formation the aspect of “Wild flysch”. From the Kotel Fm., pollens, spores and dinoflagellata cysts were described (Černjavska, 1962; Tchoumatchenko, Černjavska, 1989, 1990; PeybernPs et al., 1989a, b; Dodekova, Tchoumatchenko, 1989) which characterised the Aalenian, the Bajocian and the Middle Bathonian. Probably the younger parts of the Kotel Fm. were subsequently eroded.

**Geosite 5.** (Fig. 1, 3). The holostatotype of Balaban Fm. (c. 60 m) is described by Tchoumatchenko and Černjavska (1989, Pl. II, Fig. 2) and by Tchoumatchenko et al. (1992). It is located in the Balaban Dere Valley, South of the Dobromir Village (42°56′30″N and 27°18′00″E).

As Balaban Fm. is separated from the upper part (c. 60 m) of the siliciclastic turbidite sequence, started by the Sini Vir Fm. The Balaban Fm. is characterised by thick beds of turbidite sandstones. The collected palyynomorphs *Lycopodiumsporites austroclavatidites*, *Chasmatosporites major*, *Classopolis sp.* represent a large Early and Middle Jurassic section, and the age is attributed to the Toarcian, due to its stratigraphical position.

**Geosite 6.** (Fig. 1, 3). The stratotype of the Kotel formation (c. 1000 m) is situated near the town of Kotel and has an Aalenian–Middle Bathonian section (Tchoumatchenko, Černjavska, 1989) (42°53′35″N and 26°27′25″E).

The Kotel Fm. was introduced into the Bulgarian literature by Nachev et al. (1967) as an Upper Cretaceous lithostratigraphical unit. Later, Tchoumatchenko and Černjavska (1989) returned its Middle Jurassic age, assumed by Černjavska (1962). The Kotel Fm. is build of dark to black shales with rare and thin intercalation of turbidite sandstones; black shales contain many Triassic and Jurassic olistoliths. Some of these olistoliths crowned the heights as Kodha Kaya, Ouch Kaya, Orta Kaya, Orlitsite etc. They add to the formation the aspect of “Wild flysch”. From the Kotel Fm., pollens, spores and dinoflagellata cysts were described (Černjavska, 1962; Tchoumatchenko, Černjavska, 1989, 1990; PeybernPs et al., 1889a, b; Dodekova, Tchoumatchenko, 1989) which characterised the Aalenian, the Bajocian and the Middle Bathonian. Probably the younger parts of the Kotel Fm. were subsequently eroded.

**PALAEOONTOLOGICAL GEOSITE**

**Geosite 7.** (Fig. 1, 2). The outcrop of Sini Vir Fm., from vicinity of the former village Emirovo (near the village Dobromir), (42°56′25″ N and 27°16′05″E) provided Tchoumatchenko and Uchman (1999) with a rich collection of ichnofossils and made an important contribution to the knowledge of the evolution of Mesozoic ichnodiversity.

**TECTONICAL GEOSITES**

**Geosite 8.** (Fig. 1, 2, 6, 7). The outcrop situated along the forest road in the region of Cheshme Bair Hill (in the upper valley of Balaban Dere River) represents a palaeontotectonic geosite in which two limbs and the core of the Late Cimmerian Mator–Planina anticline are preserved (Tchoumatchenko, Černjavska, 1990). The core (Fig. 2, cross-section E–F) is represented by the calciturbidites of the Glogova Fm. (Fig. 5) in the topmost parts of Cheshme Bair Hill; the southern anticlinal limb is build up by the rocks of the Sini Vir Fm., Balaban Fm. and Kotel Fm. and crops out in the Balaban Dere Valley. The Glogova Fm. (Fig. 6) is build up of alternation of elastic limestones and marls — represented calcareous turbidites, in which
the Bouma rhythms Ta, Tb, Tc, and Td can often be observed; the Sinivir Fm (Fig. 7) is structured predominantly by siliciclastic turbidite. The lower boundary coincides with the first siliciclastic turbidite bed situated over the calciturbidite of the Glogova Fm. The basal part of the Sini Vir Fm. is build of alternation of marls to calcareous shales, and aleurolites and sandstones. This is a section with a progressive transition from aleuritic and aleuritic-sandy limestones (Glogova Fm.) up to sandy, two components hyposediments (sandy limestones up to limy sandstones (Sini Vir Fm.). In the lower part of the section predominate calcareous rocks with aleuritic admixture (the Glogova Fm.), and upwards increases progressively the quantity and dimension of the terrigenous component (the Sini Vir Fm.). The terrigenous component is formed in the basal part predominantly of rock pieces and micas, which diminish upwards and are replaced by quartz particles. All these features show that there is common source of the two lithostratigraphical formations alimentation, and they differ by deepening of the rocks erosion, only.

**Geosite 9.** (Fig. 2, section A–B). The northern limb of the Late Cimmerian Mator Planina anticline is overturned (Fig. 3, cross-section C–D) and crops out in the vicinities of the former Emirovo Village (Sini Vir Fm.), and in the area of the railway station and the village Strouya (27°28′25″ E and 42°57′30″ N).

The anticlinal core was eroded there during the Late Jurassic and the Early Cretaceous, and is filled by Upper Cretaceous sediments, structuring the superimposed Turnak alpine synclinal. To the West, in the valley of Maya Dere, the core of the Late Cimmerian Mator Planina Anticline is thrusted over its northern limb, represented by shales of the Mid Jurassic Kotel Fm.

**Geosite 10.** (Fig. 1, 3, 8). This geosite represents the outcrops of the Luda Kamchia Group on the Vratnik Pass, at the road to village Dobrevtsi (26°08′40″ E and 42°54′50″ N) (Tchoumatchenco, Ėernjavska, 1989).

The siliciclastic turbidites of the Sini Vir Fm. from the southern limb of the Mator Planina anticline are thrusted over the Lower Cretaceous siliciclastic turbidites of the Cherni Osum Fm. Also sandstones of the Balaban Fm. well crop out (Fig. 8).

**GEOSITES IN THE ALLOCHTONOUS TRIASSIC AND JURASSIC SEDIMENTS**

The allochthonous Triassic and Jurassic sediments, within the Lower and Middle Jurassic rocks, are selected as 8 geosites. They are derived from the destructed southern palaeosshelf of the Exotic Range of Zlatarski (Tchoumatchenco, 1988; Tchoumatchenco and Ėernjavska, 1990; Tchoumatchenco et al., 1992), as well as of parts of the southern slope of the Matoride (Tethyan) basin. Enormous Triassic olistolites build up the tops of Kayite Heights in the Luda Kamchia
Gorge, the Orlitsite Hills, etc. The Lower Jurassic blocks are subdivided into 4 types, to which Tchoumatchenco (1988) gave different local names; they reflect their primary sedimentation position on the palaeoshelf.

**Geosite 11.** (Fig. 1). This geosite crops out south of the Kotel town and represents an allochtonous block, build up of alternation of limestones and marls, regarded as the Upper Triassic Glogova Fm., included into the black shales of the Mid Jurassic Kotel Fm.

**Geosite 12.** (Fig. 1, 2, 3, 9). The geosite represents the summits of Kodzha Kaya, Orta Kaya, Ouch Kaya heights (Fig. 9) (42°55′10″ N and 27°14′35″ E).

They are build of the Upper Triassic platform bioclastic limestones (rudstones). The bioclasts are of crinoids, fragments of corals, etc. The limestones form beds of 10–50 cm, some time thicker, in which corals form irregular stocks (patch reefs). Berndt (1934) compared these limestones with the German Dachstein limestones. The limestones contain foraminifers *Tolypammina discoidea*, *Trochammina balcanica*, *T. sp.*, *Variostoma sp.*, *Glomospirella sp.*, *Miliolipora cuvilieri*, *Variostoma/Diplotremina*, *Tubiphytes sp.*; Ganev (1961) collected also *Cyrtina uncinata*, *Rhaetina gregaria*, "Rhynchonella" aff. *fissicostata*, *Nautilus sp.* nov.; Budurov et al. (1997) described these limestones as Orta Kaya type Upper Triassic limestones. They are included into the Middle Jurassic Kotel Fm.

**Geosite 13.** (Fig. 1, 2, 10). The geosite is situated south of Bilka Village and demonstrate the transgressive contact of the Lower Jurassic sediment, described as Bilka type (Tchoumatchenco, 1988), overlaying the Orta Kaya type Upper Triassic limestones (Fig. 10) (42°55′09″ N and 27°14′36″ E).

Jurassic sediments begin with sandstones or with calcareous breccia (built predominantly of Ostridents and brachiopods (*Lobothyris* sp. indet.) fragments, corals and rare ammonites (*Coroniceras* sp. indet.). They pass into reddish micritic limestones, from which brachiopods *Spiriferina alpina alpina*, *Cirra cf. langi*, *C. borissiaki*, *Capillirostra sp.*, *Lobothyris subpunctata*, *Zeilleria waterhousii*, as well as rare corals were collected along the road between Aytos and Provadia, near the bridge on the Koru Dere. Tchoumatchenco (1988) and J. Stephanov (in collection) determined ammonites *Amaltheus evolutus* and *A. subnodosus*; on the upper surface of the Triassic limestones, below the Jurassic sediments, there are many *Trypanites* type borings.

**Geosite 14.** (Fig. 1, 2, 3, 11). It is situated up to 1 km SW of the railway station Turnak, within the railway cutting in the locality Kazaldza Kaya (Fig. 11) (42°55′50″ N and 27°13′55″ E).

It is built up of reddish micritic limestones (with Pliensbachian brachiopods as *Lobothyris subpunctata* and *Cirra langi*). In these limestones intercalations of irregular shapes exist, interpreted as neptunian dykes with brachiopods of Toarcian to Bathonian age: *Homoeorychyncha cymocephala* (Toarcian), *Aulacothyris blakei*, *Dundrothyris perovalis*, *Kalirhynchia platiloba* (Mid Jurassic), etc. (Tchoumatchenco, 1988, 1989, 1990). These dykes filled palaeokarstic forms and are build up of oolitic limestones and/or conglomerates.

*Fig. 9. Geosite 12. General view of Ouch, Orta and Kodzha Kaya heights — olistolite of Ortha Kaya type in the Kotel Formation*

Near the village of Bilka, Luda Kamchia valley, Burgas District

*Fig. 10. Geosite 13. Transgressive contact between Bilka type Lower Jurassic and the Upper Triassic Orta Kaya type near the Bilka Village*

Burgas District (on the southern slope of the Kodzha Kaya height)

*Fig. 11. Geosite 14. Neptunian dyke*

Toarcian to Lower Bathonian in the Bilka type sediment, in the vicinity of Kazaldza Kaya, near the village of Turnak, Burgas District
Geosite 15. (Fig. 1, 2, 3). The geosite is situated on the railway cutting, North of Karaveljovo railway station (42°55’45” N and 27°10’35” E).

It contains the Karaveljovo type Lower Jurassic (Domerian — the lowest parts of Toarcian) sediments (Tchoumatchenco, 1988, 1989, 1990); the outcrop is build up of grey-greenish limestones and marls in alternation with thin beds of grey-pinkish limestones; they are bioclastic, made of numerous fragments of crinoids, echinoids, belemnites and brachiopods: Spiriferina alpina falloti, S. alpina alpina, S. haueri, Homocerhynchia almaensis, Zeilleria quadrifida, indicating the lower part of the Domerian Substage.

Geosite 16. (Fig. 1, 2). The rocks of this geosite crop out in the Ajvadjik Dere valley, confluence of the Luda Kamchia River (Tchoumatchenco, 1988, Pl. II, Fig. 2)(42°54’40” N and 27°09’20” E).

It consists of Triassic and Lower Jurassic sediments. The Triassic is represented by the Olenekian Mayadere Fm. and the Mid Triassic Gyurgenliya Fm. The Mayadere Fm. is build up of thinly bedded limestones (4–10 cm thick), grey, in alternation with marls. The marly intercalations upwards became thinner; the limestones are with irregular bedding surfaces, compared by Berndt (1934) with the German Wellenkalk. Ganev (1961) collected from them “Terebratula” margaritovi, Eumorphotheca iberi, E. telleri, Hoernesia socialis, Gervillia incurvata, Anodontophora (Myacites) fassaensis, Pleurotomaria sansonii, Naticella costata, Tirolites cf. spinosus, Dinarites dalmatinus, Arianites (Meropella) plejanae. The sediments of the Mayadere Fm. are connected upwards, in a progressive transition, with limestones of the Gyurgenliya Fm. At the base, they contain (1) a packet of thinly bedded (8–12 cm thick) grey limestones, up to 20 m thick, with numerous small Spiriferinids; (2) above them the section continues with thickly bedded (30–60 cm), dark-grey limestones, thick up to 8–10 m; (3) alternation between grey limestones and grey-greenish marls — thickness c. 15 m. Ganev (1961) collected from them Tetractinella trigonella and Aulacothyris angusta; (4) the Triassic part of the section ends with thickly bedded (1–2 m) grey and reddish limestones — c. 20–25 m thick. These Triassic rocks were described by Berndt (1934) as “grey limestones of Ajvadjikdere”.

Different parts of the Triassic rocks are transgressively covered by the Djula type Sinemurian–Carixian (Lower Jurassic) sediments (Tchoumatchenco, 1988). The Djula type sediments begin with (5) 4–8 m thick sandstones, over which the section continues with (6) c. 17 m thick, predominantly bioclastic, reddish to greenish, thinly bedded (5–10 cm) limestones, with many fragments of crinoids and Ostracods; (7) limestones, reddish to violet, lithoclastic; the lithoclasts are represented by reddish micritic limestones with irregular rounded shapes of up to 5–7 cm in diameter; the matrix is formed by fragments of crinoids and bivalves. Lobothyris subovoides and the Upper Sinemurian ammonite Xipheroceras cf. Zhiphus were collected from the packet; (8) limestones (2.0 m) grey-greenish, micritic, with Aegoceras sp. indet.; (9) lithoclastic limestones (1.40 m) grey-greenish; the clasts are of micritic grey-beige limestones (2x6 cm up to 10x10 cm), and the matrix is of aleuritic lime-marl, with many large Belemnites; (10) limestones (0.50 m) red-violet, granular, with many large Belemnites; (11) limestones (0.50 m) grey-greenish, granular, biodetritic, with many foraminifers: Involutina liassica, I. turgida, Cornuspira orbiculare, Ophialmidium carinatum, Lenticulina polymorpha, etc.

Geosite 17. (Fig. 1, 12). The geosite represents the Cerkiniste type Lower Jurassic, in the locality Cerkiniste (42°53’00” N and 26°26’30” E), town Kotel (Tchoumatchenco, 1988, Pl. II, Fig. 1).

The Cerkiniste type is build of isolated blocs of red, ferriferous, clayey limestones, with crinoid bioclasts, to red marls (Sinemurian in age), included into the black shales of the Kotel Fm. (Fig. 12). Many geologists have collected rich ammonite and brachiopod fauna from these blocs; ammonites: Sulciferites sp. (Lower Sinemurian), Coroniceras sp. indet. (upper parts of the Lower Sinemurian), Oxynoticeras sp. (Upper Sinemurian), Charmasseiceras sp. (Upper Sinemurian); brachiopods: Spiriferina haueri, Gibbirhynchia amalthei, Piarorhynchia juvenis, Prionorrhynchia greppini, Nuclea bosrakensis, Lobothyris subovoides, Zeilleria numismalis, Z. subdigona, etc. (Tchoumatchenco, 1988). Limestones of these blocks are used for the building decorative walls in some houses in Kotel.

Geosite 18. (Fig. 1). Geosite of ”Black shales with Bositra alpina”, near Strouya Village, Varna district (42°57’10” N and 27°8’30” E).

It is build of black aleuritic shales, sometime rich in ammonites (facies common in other parts of Bulgaria and known as Etropole Fm.). This block is of shelf genesis and is included in the black shales of the Kotel Fm. as olistolite. The same rocks can be observed also in the Bedzene Dere, East of Orta Kaya Hill.
Fig. 13. Geosite 19. Olistolite of Toarcian Balaban Fm. (coarse siliciclastic turbidite) included into the Mid Jurassic Kotel Fm.

Geosite 19. (Fig. 1, 13). The geosite is located near the railway station Strouya, District Varna (42°57'30'' N and 27°28'25'' E).

It represents exposures of sandstones blocks (3–5 m) — coarse siliciclastic turbidite of the basinal Balaban Fm. (Toarcian), included as olistolites in the black shales of the Middle Jurassic Kotel Fm. (Fig. 13).

CONCLUSIONS

The list of the Triassic and the Jurassic geosites in eastern Stara Planina Mts., presented above, is not closed and will be continuously improved during future work within the project NZ-1310/03 of the Bulgarian NCSR.

The biggest problem, connected with the Triassic and Jurassic sediments in eastern Stara Planina Mts., concerns connections with the contemporaneous rocks: in the eastern direction — with the North Dobrogean Tulcea Zone and southern Crimea (?), and in the western direction — with the areas of Kazanluk, Teteven, and the Izdrimets Palaeograben and, probably, with the Sinaia Rift in the southern and eastern Carpathians, etc.

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