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ABSTRACTS

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SEDIMENTOLOGY OF JURASSIC AND CRETACEOUS BOUNDARY DEPOSITS IN THE FEODOSIYA REGION (EASTERN CRIMEA)

E.J. BARABOSHKIN[1], S.V. RUDKO[2], V.K. PISKUNOV[1], A.J. GUSZHIKOV[3], V.V. ARKAD'EV[4], M.I. BAGAEVA[3], V.A. PERMINOV[5], A.G. MANIKIN[3]

[1]Moscow State University, Geological Faculty, Moscow
[2]Geological Institute RAS, Moscow, E-mail: rudserega@yandex.ru
[3]Saratov State University Geological Faculty, Saratov
[4]St. Peterbourg State University,Geological Faculty, St. Peterbourg
[5]Centre of Ecological-Naturalistic Art of Youth "Intellect", Ukraine, Crimea, Feodosiya

Keywords: *Crimea, biostratigraphy, sedimentology, ichnofacies, Jurassic, Cretaceous*

The section of Jurassic / Cretaceous boundary beds in Feodosiya City region (Fig. 1) has been known since the XIX century. However, so far nobody has studied its sedimentology. Therefore, in 2010 complex research was carried out on this section (about 300 m), including biostratigraphic (Moscow State University, St. Petersburg University), paleomagnetic (Saratov State University) and sedimentologic studies (MSU, GIN RAS).

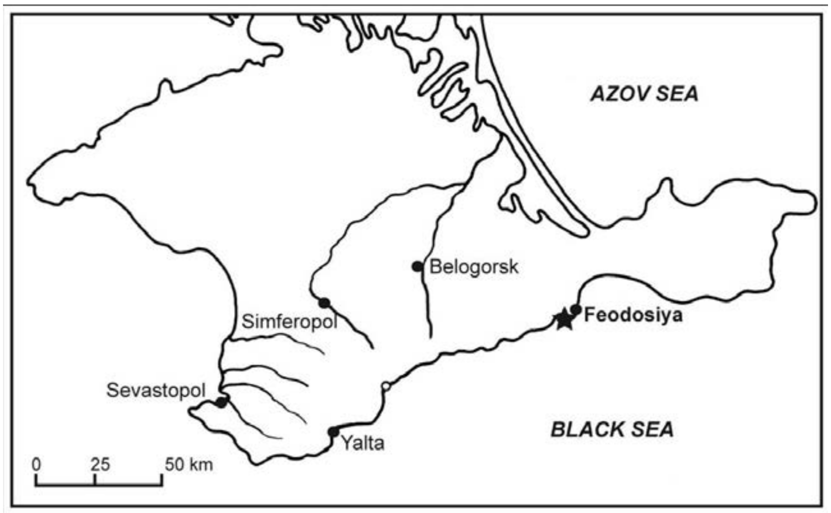

Figure 1. The position of the studied section.

During the latest Tithonian-earliest Berriasian, the region was a part of a distally-steepened ramp of shoal-rimmed platform, covered by hemipelagic and gravitational deposits of a considerable thickness (Baraboshkin, 2005). Several types of deposits could be distinguished:
Calciturbidites comprise facies of channel, distributive channels and interchannel deposits.

Channel turbidites are lenticular in shape, represented by rudstones and grainstones of variable thickness (40-300 cm). In cross-section they consist of several channel cycles, which include erosional surface and graded interval with the top burrowed by *Ophiomorpha annulata* (Ksiaz). Thickest channel turbidite is situated just above the base of Berriassian. Small amount of channel facies and several levels of ophiomorph burrows in it suggest rarity of turbidite source-channels, deficit of coarse material and predominance of hemipelagic sedimentation.

Distributive channel facies are thinner and composed of graded limestones. Their texture varies from rudstones to coarse grainstones. The erosional base is commonly smooth, occasionally with sole marks, in particular of the traces of ammonite rolling. The top might be also disturbed by *Ophiomorpha annulata* (Ksiaz.), though the structure of the section indicates one-act descent of the turbidite.

Interchannel facies is formed by alternating of calcareous hemipelagic clay and grainstones. The thickness of the latter varies from cm to mm scale. They have the normal gradation and rarely, mm-scale cross-lamination. The top might be penetrated by *Ophiomorpha* burrows. Intervals in frequent alternation of clays and grainstones may be interpreted as levee facies. Coarse material and incomplete Bouma sequence show some resemblance to coarse-grained high-density turbidites. Interturbidite clay is horizontally-laminated, but often burrowed by *Phycosiphon*, which indirectly suggests rather shallow depth.

Hemipelagites are represented by laminated or bioturbated clay (in the Tithonian succession) or carbonate clay and marl (in the Berriassian succession). The carbonate content of hemipelagites increases upward from (5-15% to 30-85% $CaCO_3$), along with appearance of channel turbidites and their complete disappearance near the Tithonian – Berriassian boundary. Probably this is related to the termination of turbidite sedimentation and start of pelagic sedimentation, being accompanied by a decrease of sedimentation rate and growth of bioproductivity, which was confirmed by the carbonate nanoplankton data (Matveev, 2010).

Jurassic and Cretaceous **trace fossil** assemblages are different. Tithonian turbidite deposits contain worm burrows *Phycosiphon incertum* Fischer-Ooster, *Zoophycos insignis* Squinabol, *Flexorhaphe miocenica* (Sacco), *Chondrites* isp., *Planolites* isp., ?*Petalloglyphus* isp., *Taenidium* isp. and crustacean tunnels *Ophiomorpha annulata* (Ksiaz.). The latter are abundant and assigned both to the base of turbidites and to the top of channel turbidites, reflecting pre- and post-turbidite events (Seilacher, 2007).

Berriasian trace fossils are more diverse: worm burrows *Nereites missouriensis* (Weller), *Chondrites intricatus* (Brongniart), *Ch.* isp., *Planolites* isp., *Rhizocorallium* isp., *Glockeria parvula* Ksiaz.; rest traces *Bergaueria perata* Prant; farmer structures of *Cosmorhaphe lobata* Seilacher; crustacean burrows *Ophiomorpha annulata* (Ksiaz.). Ophiomorphs occur at the base of the sequence and associate with channel turbidites. Other types of burrows are also mentioned here: farmer structures *Paleodictyon* isp., worm burrows *Taenidium* isp., *Petaloglyphus* isp., *Stelloglyphus* isp., *Haentzschelinia* isp., *Spirorhaphe* isp., *Zoophycos* isp. (Yanin & Baraboshkin, 2010).

Both ichno-assemblages characterize the **Nereites ichnofacies** of slope – to bottom environments. It is deeper-water for Jurassic and shallower for the Cretaceous part of the succession (Seilacher, 2007), which is confirmed by the presence shallow-water elements of Cruziana ichnofacies in the Berriasian. However, Zoophycos ichnofacies was not recognized.

Therefore, **two stages** of the ramp development were identified in the studied section. The first one coincides with the Tithonian part of the section, when turbidite and hemipelagic sedimentation has prevailed during basin subsidence. The second one corresponds to the terminal Tithonian - Early Berriasian, when the turbidite sedimentation breaks into pelagic to hemipelagic sedimentation.

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THE NAPPED STRUCTURE OF THE ISTRANCA CRYSTALLİNE COMPLEX İN NW TURKEY AND SE BULGARİA

Yavuz BEDI[1], Emil VASILEV[2], Christo DABOVSKI[2], Ali ERGEN[1], Adil DOĞAN[1], Cengiz OKUYUCU[1] , Iliana BONCHEVA[2], Valeri SACHANSKI[2], Iskra LAKOVA[2], Daria IVANOVA[2], M.Cemal GÖNCÜOĞLU[3]

[1]General Directorate of Mineral Research and Exploration (MTA),
Department of Geological Research, Ankara, y.bedi@mta.gov.tr
[2]Bulgarian Academy of Sciences, Institute of Geology, Sofia, cdabovski@yahoo.com
[3]Middle East Technical University, Department of Geological Engineering, Ankara, mcgoncu@metu.edu.tr

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The Istranca Crystalline Complex is made of several nappes, collectively named as the "Istranca Nappes". They are classified according to differences in their basements, Triassic lithostratigraphy and metamorphism. From bottom to the top they are named as Sarpdere (with Subbalkanide-type Triassic), Mahyadag (with Istranca-type Triassic) and Doğanköy (with Sakar-type Triassic) nappes, which were thrust onto the Subbalkanide Autochthonous. The autochthonous occurs mainly in the Bulgarian area and comprises a basement of Precambrian? high-grade metamorphic rocks, intruded by Late Paleozoic granitoids, and Paleozoic greenschist facies metasediments and felsic metavolcanics. The unconformably overlying succession includes Lower Triassic metaclastics, Middle Triassic carbonates and Middle to Upper Triassic olistostromes with olistoliths. The Upper Triassic comprises massive carbonates, overlain by an alternation of carbonates and fine-grained clastics. In the Turkish area, no pre-Triassic rocks were observed and the Subbalkanide type Triassic of Sarpdere Nappe is overthrust by Mahyadağ Nappe. The basement of the Mahyadağ Nappe comprises a low-grade metamorphic succession of Devonian siltstones and carbonates, an alternation of Devonian-Permian carbonates and quartzites and latest Permian- earliest Induan pelecypod-bearing carbonates. This basement is disconformably overlain by conglomerates, quartzites and siltstones, that grade into Lower-Middle Triassic carbonates. The Middle Triassic is characterized by limestones and dolomites. The upper part of the Mahyadağ Nappe consists of ammonite and crinoid-rich Middle-Upper Triassic carbonates with clayey and sandy interlayers. The Doğanköy Nappe, representing originally the uppermost Cimmerian nappe, comprises a crystalline basement complex of Precambrian-Early Paleozoic metasedimentary rocks and orthoamphibolites, intruded by pre-Carboniferous felsic and mafic intrusions. Variably

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SEDIMENTOLOGY AND STRUCTURE OF UPPER JURASSIC CLASTIC AND CARBONATE DEPOSITS OF DEMEDZI PLATEAU (SW CRIMEA)

Vladimir PISKUNOV[1], Sergey RUDKO[2], Evgenij BARABOSHKIN[1]

1 - Dept. Regional Geology and Earth History, Geological Faculty, M.V.Lomonosov Moscow State University, 119991, Leninskie Gory, Moscow, Russian Federation. E-mail: vkpiskunov@gmail.com
2 - Geological Institute RAS, 119017, Pyzhevsky lane 7, Moscow, Russian Federation

Keywords: *Crimea, structure, sedimentology, carbonate microfacies.*

Demerdzi Plateau located in the central part of First range of Mountain Crimea between Mts. Chatyrdag, South Demerdzi and Dolgorukovskaya Plateau. The geology of the area is a subject of strong debates [7], but the structure and sedimentology of the Upper Jurassic were not re-studied for a long time. The aim of this investigation is to discuss the structure, stratigraphy and sedimentology of the region on the base of the new data, we have received in 2008-2010 [2].

Geological structure of the area has been mapped in the field using aerophotos 1:50 000 scale. The region has been divided into 4 structural units (fig. 1). The first three unites are separated by bedding thrusts marked by brecciated zones and thick calcite veins. The units are represented by (from a base to a top): I – conglomerate member (330°∠30), II – limestone member (IIa, 330°∠25) and conglomerate-breccia member (IIb), which unconformable overlay IIa limestone member and wedge-out to the north (330°∠25), III – carbonate breccia member (340°∠20 - 145°∠5). The unit IV is presented by thick member of bedded limestones (310°∠35-65), separating by subvertical (?) left strike-slip fault. The bedding thrust between members I and II cuts their contact regularly, so they probably had primary stratigraphic contact. Member II is splitted by overthrusts dipping to the north. Boundary between members II and III is covered, dips to the north being probably overthrusted. Members I (275°∠30°) and II (IIa – 255°∠25, IIб – 355°∠15) are outcropped in Mt. Pahka-Kaya too, which separated from Demerdzi Plateau by subvertical subvertical (?) strike-slip fault.

Member's age is: I - Oxfordian [4, 8], II – Kimmeridgian – Tithonian, dated by brachiopods and gastropods, III – Late Kimmeridgian, dated by ammonite *Discophinctoides* cf. *modestus* (Schneid, 1915). The age of the member IV is Middle – Late Tithonian [1].

Detailed study of outcrops of Demerdzi Plateau and Mt. Pahkal-Kaya allows make the following conclusions.

Conglomerate member I. Thick series of roughly graded clast-supported conglomerates with large-scale pebbles (cm - m) and cross-bedding (10s m) were deposited in conditions of (?) large graben-related Gilbert delta type. The slope was probably controlled by faults [3]. Thin lenses of cross-bedded gravelstones and sandstones with fine pebbles and clayey cement are debris flow and foreset slump in origin. Many geologists follow V. Chernov [4] and accept the south position of the sourceland for the conglomerates. But NW dipping of oncoid limestones of member IV, primary horizontal, suggests that other members were rotated. Thus original dipping of cross-bedding series was probably turned to the SE, and sourceland was situated to the NW. This hypothesis is, however was already discussed before [6].

Carbonate member IIa is occurred in tectonic lenses and consists of horizontally-bedded limestones, carbonate breccias with polymictic pebbles and conglomerate. It is represented by the following standard microfacies (SMF, [5]): 16-Non-laminated, 21, 22, 13, 16-Laminated, 17, 11, 10, 8, 9. SMF 22, 21 and 16-Non-laminated are most common: oncoid floatstone, fenestral pack- and bindstones, peloidal packstones. Distribution of SMF on the rimmed carbonate platform model corresponds to the facies zones: brackish, restricted, open-marine and sand shoals. Temporary clastic sedimentation was occurred.

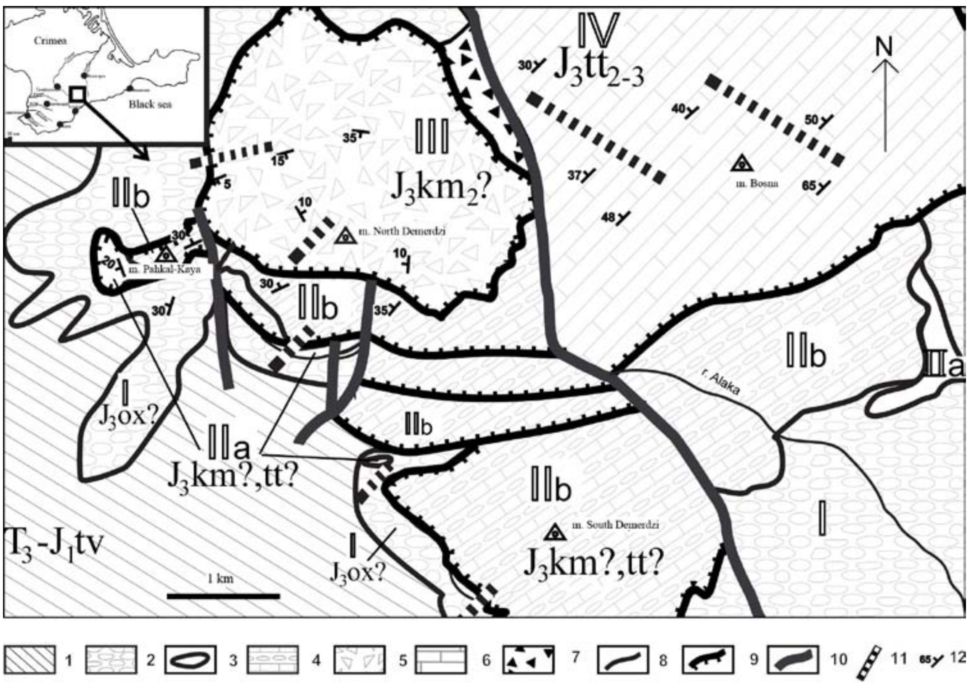

Figure 1. Structure of Demerdzi Plateau: 1) Taurik Formation (T_3-J_1tv) 2) conglomerate member I (J_1ox); 3) carbonate member IIa (J_3km?-tt?); 4) conglomerate-breccia member IIb (J_3km?-tt?); 5) carbonate breccia III (J_3km_2); 6) carbonate member IV (J_3tt_{2-3}); 7) fault breccias; 8) geological boundaries; 9) thrusts; 10) subvertical faults; 11) studied outcrops; 12) dips.

Conglomerate-breccia member (IIb) consists of carbonate breccias and polymictic conglomerates. The sourceland of angular clasts was situated inside the basin, rounded pebbles indicate its transportation. The member has been deposited in the conditions similar to Gilbert delta with steep slope, that probably controlled by faults. SMFs of carbonate clasts are identical to the member IIa. It is the evidence that member IIb is a product of re-deposition of member IIa, resulted from temporary exposures of the carbonate platform. The platform was controlled by faults, trigged clastic influx and deposition on the Gilbert delta's slope, below the wave base.

Breccia member III consists of pink and grey parallel bedded breccias in reddish carbonate matrix. The SMFs of clasts correspond to brackish, restricted and open-marine facial zones. The sedimentation of the member is similar to that of IIb, and differs by lack of clastic input. The reddish color of the breccias is a result of iron diagenetic oxidation. Since conglomerate-breccias of member IIb are grey, the alteration of member III took place in the other location or during overthrusting.

Carbonate member IV consists of parallel bedded limestones. It was sedimented in shallow water above the wave base on rimmed platform or distally-steepened ramp. SMFs 22, 18, 16-Non-laminated, 13, 21, 11, 12, 9 were recognized for it. The most common are SMFs 22, 18, 16-Non-laminated and 13: oncoid floatstones, grain- and packstones with abundant foraminifera and green alga, peloid packstones and oncoid rudstones. The distribution of SMF types in the rimmed carbonate platform corresponds to the brackish, restricted and open-marine facies zones [5], but their analogues could correspond to facial zones of the inner distally-steepened ramp: lagoon, sand shoals, restricted and open-marine.

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GROUND SURFACE DEFORMATION MONITORING OF THE DANUBE DELTA USING INTERFEROMETRIC SYNTHETIC APERTURE RADAR TECHNIQUES

Valentin PONCOS[1], Delia TELEAGĂ[1], Gheorghe OAIE[2]

[1]Advanced Studies and Research Center Ltd., 19 Ion Luca Caragiale St., Bucharest, Romania, delia.teleaga@asrc.ro
[2]National Institute of Marine Geology and Geoecology – GeoEcoMar, 23-25 Dimitrie Onciul St., 024053 Bucharest, Romania

Keywords: *radar interferometry, deformation maps, ground displacement, Danube Delta*

Synthetic Aperture Radars (SAR) are space-borne instruments that emit electromagnetic radiation and then record the strength and time delay of the returning signal to produce images of the ground. Thus, SAR Differential Interferometry (DInSAR) is a remote sensing technique which uses SAR detected images from consecutive passes of the satellite to map and monitor centimetric or even millimetric ground surface deformations with an accuracy up to millimeters.