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Stratigraphy

Stratigraphical Correlation of the Barremian-Aptian Sedimentary Sequences of the Okriba-Khreiti and Dzirula Tectonic Subzones (Georgia)

Mikheil Kakabadze[*], Irakli Kakabadze[**], Mevlud Sharikadze[§]

[*] *Academy Member, A. Janelidze Institute of Geology, I. Javakhishvili Tbilisi State Univerity*
[**] *A. Janelidze Institute of Geology, I. Javakhishvili Tbilisi State University*
[§] *Faculty of Mining and Geology, Technical University of Georgia*

ABSTRACT. The question of correlation of the Barremian-Aptian (Lower Cretaceous) sedimentary sequences, represented in the Okriba-Khreiti and its adjacent Dzirula tectonic subzones (Georgia), is studied. Selection of the considered territory as object for sequence stratigraphic correlation was conditioned by facial variety, existence of rich fossil composition and frequent alternation of sedimentation cycles during the Barremian-Aptian. On the basis of studying of unconformable surfaces, as well as of alternation of the comparatively deep and shallow sea facies of the Barremian-Aptian of the Dzirula subzone 5 sedimentary sequences (Br_1^1-Br_1^3, Br_2^1-A_1^1, A_1^2-A_1^4, A_2^1-A_2^2, A_3^1-Al_1^1), corresponding to those established earlier in Okriba-Khreiti subzone, are revealed. Biostratigraphic frames of these sequences are specified, as well as their variable litho- and biofacial features in time and space are analysed. In most cases sequence boundaries are characterized by erosion surfaces, but in those sections where sequences represent comparatively deeper shelf setting facies, sequence boundaries are conformable. In all cases when boundaries between two sequences are represented by stratigraphical gap, beds of adjacent sequences are characterized by same dip azimuth and dip angle. Accordingly, each such boundary represents typical disconformity and the chronostratigraphic range of its degradation vacuity is variable in the considered region. *© 2013 Bull. Georg. Natl. Acad. Sci.*

Key words: *Lower Cretaceous, Barremian, Aptian, Georgia, sequences, biostratigraphy, correlation.*

Sequence stratigraphic method is successfully used in exploration of the mineral deposits (especially of oil and gas) in many countries of the world since the 1980s [1]. In Georgia the first special sequence stratigrapghic investigations started only fifteen years ago in the Lower Cretaceous deposits of the middle part of the Rioni basin [2-6].

Distribution area of the considered Lower Cretaceous (Barremian-Aptian) deposits belongs to the Central Uplift zone of the Transcaucasian Intermontane area according to the scheme of Tectonic zoning of Georgia [7]. On the basis of the litho- and biostratigraphical analyses the question of sequential correlation of the Barremian-Aptian outcropped deposits (Fig. 1, sections 1-9) of the Okriba-Khreiti subzone with the southern (Chkheri anticline, Ghoresha-Kharagouli and Moliti synclines) and eastern peripheral (monocline) parts (Fig. 1, sec-

Fig. 1. Schematic map of Lower Cretaceous outcrops (shaded) in western Georgia with locations (circles) of the studied Barremian-Aptian sections: Znakva (1), Nikortsminda (2), Bethlevi (3), Tvishi (4), Dzedzileti (5), Gordi (6), Kumistavi (7), Gumbra (8), Godogani (9), Lashisghele (10), Gverki (11), Goresha (12), Skhliti (13), Moliti (14), Nebodziri (15), Tsipa (16).

tions 10-16) of the Dzirula subzone is considered. Biostratigraphic frames of these sequences are specified, as well as their variable litho- and biofacial features in time and space are analysed.

Selection of the considered territory as object for bio- and sequence stratigraphic correlation was conditioned by facial variety, existence of rich fossil composition and frequent alternation of the sedimentation cycles during the Barremian-Aptian.

In the studied area within the Barremian-Aptian interval the following 5 sequences are revealed: Lower Barremian (Br_1^1-Br_1^3), Upper Barremian-Lowermost Aptian (Br_2^1-A_1^1), Lower Aptian (A_1^2-A_1^4), Midlle Aptian (A_2^1-A_2^2) and Upper Aptian-Lowermost Albian (A_3^1-Al_1^1).

Lower Barremian sequence (Br_1^1-Br_1^3)

In the Okriba-Khreiti subzone transgressive tract of the Br_1^1- Br_1^3 sequence is represented (sections: Nikortsminda, Khonchiori) by clayey and sandy limestones of the *Taveraidiscus hugii* Zone, which replaces Upper Hauterivian limestones with characteristic of shallow-water thick-walled bivalves (*Amphidonta*). Upwards conformably follow sandy and clayey limestones containing, besides the gastropods (*Tylostoma* sp.) and bivalves (*Panope* sp.), ammonites (*Taveraididscus* ex gr. *hugii*), *Spididiscus* cf. *seunesi*, *Barremites cassidoides*, *Protetragonites crebrisulcatus*), belemnites (*Hibolites* sp., *Mesohibolites* sp.) and foraminifers of the Lower Barremian *Taveraidiscus hugii* Zone, which points to the beginning of deepening of the sea in this area. Stratigraphically higher follow limestones (without sandy material) and marls with characteristic ammonite association of the *Kotetishvilia compressissima* Zone.

Br_1^1-Br_1^3 sequence is more clearly distinguished in the southern and eastern peripheries of the Dzirula massif, where Lower Barremian dolomitic and organogenic (Urgonian) limestones transgressively lie on the Bajosian porphyrites or on the Paleozoic granitoids. The transgressive basal formation consists of reworked material of porphyrites and granitoids respectively, with reduction of thickness of this formation, as well as of size of breccia-conglomerate material (from 5-6 m to 0.2 – 0.3 m) to eastwards. Stratigraphically upwards there follow brecciate and pelitomorphic limestones, containing gastropods (*Nerinea eristavii* Dvali, *Ampullospira mediara* Dvali, *Ampullina* aff. *pictetti* Kar.) and

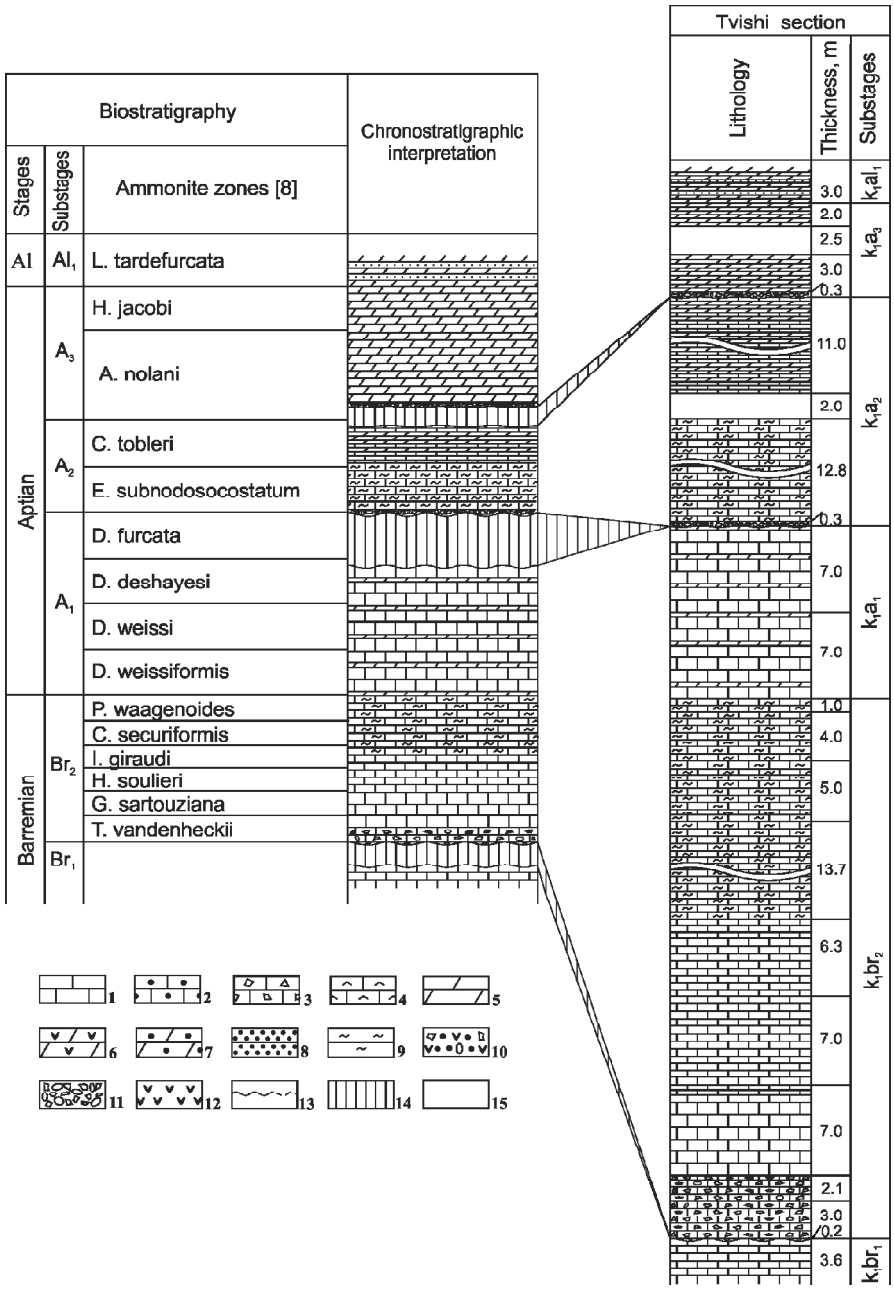

Fig. 2. Biostratigraphy and chronostratigraphic interpretation of the Upper Barremian–Aptian deposits in the environs of village Tvishi. Key (applies also to Fig. 3): 1- limestone; 2 - sandy limestone and/or glauconite limestone; 3 - brecciate limestone; 4 - dolomitic and/or biogenic limestone; 5 – marly limestone; 6 - marl; 7 – tuffaceous marl; 8 - sandy and/or glauconite marl; 9 - sandstone; 10 - sedimentary volcanic rock (tuff, tuff-breccia, tuff-conglomerate); 11 - breccia-conglomerate; 12 - porphyrite; 13 - unconformity; 14 – hiatus; 15 – break in exposure.

foraminifers (*Textularia* sp., *Quinqueloculina* sp.).Transgression reached its maximum in the second half of the Early Barremian, when the peneplaned massif almost completely was covered by sea and favorable conditions for formation of the Urgonian facies (with *Requenia* sp.sp. and representatives of *Miliolidae, Textularidae,* etc.) were established [8].

Regressive tract of the Br_1^1-Br_1^3 sequence starts at the end of the Early Barremian. In the Okriba-Khreiti subzone area to regressive tract corresponds the upper part of the *Holcodiscus caillaudianus* Zone, represented by comparatively shallow-sea type

brecciate limestones with *Amphidonta subsinuata* Leym., *Paracrioceras rondishiense* Kakab., etc. On the erosion uneven surface of these brecciate limestones transgressively is deposited the next Upper Barremian-Lowermost Aptian (Br_2^1-A_1^1) sequence [4].

In the area of the Dzirula subzone, to wit in the Goresha-Kharagouli syncline in the upper part of the Lower Barremian, gradual increase of the terrigene material occurs. In some places, e.g. in the environs of the villages Goresha (in the gorge of the river Kvadaura) and Skhliti at the top of the clayey marls (with *Requienia*) of the uppermost Lower Barremian the uneven erosion suface is traced, pointing out that at the end of the Early Barremian regression these Urgoniam limestones (with *Requienia* sp., as well as with foraminifers) were exposed and then partly washed away. On the noted erosion surface of these limestones unconformably lie the breccia-conglomerates (0.3 m), which represent the basal part of the next Upper Barremian transgressive tract. It should be noted that within the periphery of the Dzirula massif the Lower Barremian sequence is not possible to divide into biozones.

In the eastern part of the territory of the Dzirula subzone, in the sections: Moliti, Nebodziri, Tsipa, etc. the Upper Barremian deposits are totally absent and on the Lower Barremian biogenic limestones (with *Requienia*) unconformably, with basal formation lie the Lower Aptian deposits. Thus, the interrelation between the Lower- and Upper Barremian in this area is unclear.

Upper Barremian-Lowermost Aptian sequence (Br_2^1-A_1^1)

In the area of Okriba-Khreiti subzone Br_2^1-A_1^1 sequence is well distinguished in Tvishi section, where on the erosion surface of the Lower Barremian limestones unconformably lies breccia-conglomerate layer (0.2-0.5 m). Higher up follow fine-grained brecciate limestones containing - *Phyllopachyceras* sp., *Acrioceras* sp., *Barremites* sp., *Toxancyloceras* cf. *vandenheckii* Ast., *Pseudocrioceras* sp., *Eulytoceras* sp., *Mesohibolites garschini* St.-Verg., *Dzirulina znakvensis* Kvakh.). In this section all Upper Barremian biostratigraphical zones – beginning from *Toxancyloceras vandenheckii* and ending with *Pseudocrioceras waagenoides* - are established (Fig. 2). It is remarkable that in the northern located Nikortsminda section transition between the Lower and Upper Barremian is conformable, but lithologically Upper Berremian at the base contains sandy material. In the neighbouring Znakva section the lower *Toxancyloceras vandenheckii* Zone is lacking, but in the southern situated sections the interval of the truncation is enlarged; e.g., in the sections: Godogani, Kumistavi, Semi, Gumbra the *Toxancyloceras vandenheckii* and *Gerhardtia sartousiana* Zones are lacking and on the uneven eroded surface of the Lower Barremian limestones unconformably lie limestones of the *Hemihoplites soulieri* Zones, with breccia-conglomerate layer (0.2-0.7 m) at the basis. Higher up follow fine-grained and pelitomorphic limestones and marls, abundant in ammonites (*Gerhardtia* sp.sp., *Heinzia* sp. sp., *Barremites* sp.sp., *Lytoceras* sp. sp., *Hemihoplites* sp.sp., *Imerites* sp. sp., *Eristavia* sp.sp., *Colchidites* sp.sp., *Pseudocrioceras* sp.sp. etc.), belemnites (*Mesohibolites* sp. sp.) and foraminifers. Thus, in most sections of the Okriba-Khreiti subzone the lower boundary of the Br_2^1-A_1^1 sequence is characterized by clearly distinguished uneven erosion surface and corresponding interval of the truncation is rather variable. As to the peak of the Late Barremian transgressive subcycle, as it turns out, is revealed in the *Colchidites securiformis* Chrone [4].

In the area of the Dzirula subzone, specifically in the Goresha-Kharagouli syncline, in the gorge of the river Kvadaura on the uneven surface of the Upper Barremian limestones (with *Requienia*) lies a breccia-conglomerate layer (0.3 m) abundantly containing shells of bivalve molluscs – *Tethironia* and *Flaventia.* Analysis of this and other sections of the Goresha-Kharagouli syncline shows that at the beginning of the Late Barremian formation of the carbonate-

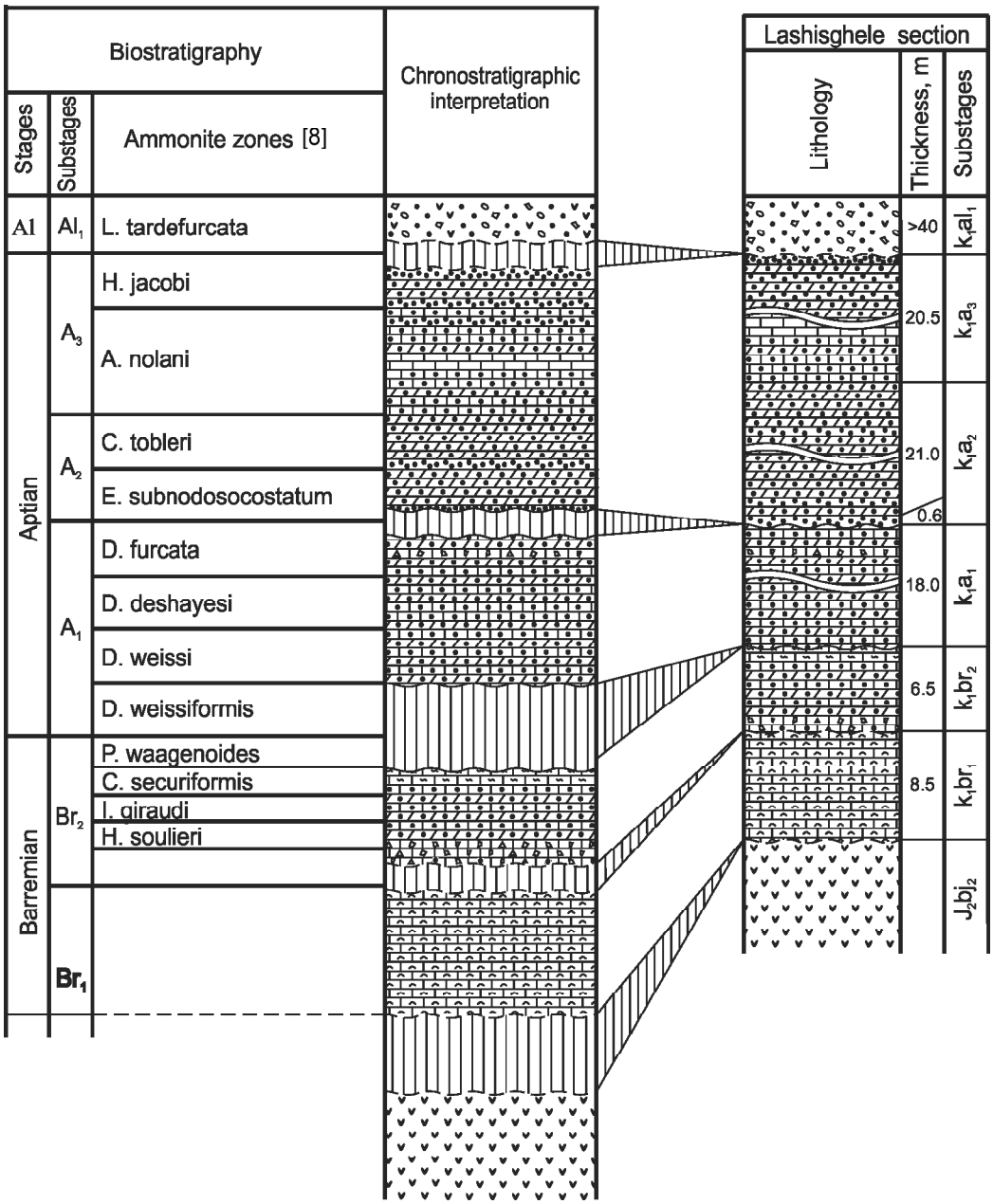

Fig. 3. Biostratigraphy and chronostratigraphic interpretation of the Upper Barremian–Aptian deposits in the gorge of the river Lashisghele.

terrigenous deposits, containing big-sized shells of the thick-walled bivalves (socalled "*Exogyra* horizon"), were carried out. These sediments are built up with brecciate marly and sandy limestones (2-3 m) and together with the noted bivalve shells they contain reworked pieces (max. d= 30 cm) of the underlying whitish compact limestones, as well as slightly reworked and weathered grains of porphyrite. It is remarkable that the chronostratigraphic boundaries of the "Exogyre horizon" in the southern periphery of the Dzirula massif "creeps" from the lowermost Upper Barremian to the lowermost Aptian. Viz, in the Goresha-Kharagouli syncline this horizon corresponds to the lower part of the Upper Barremian [8] and apparently embraces *Toxancyloceras vandenheckii* and *Gerhardtia sartusiana* Zones,

though sole shells of *Amphidonta* stratigraphically are distributed higher up to the top of the Upper Barremian. As to the northern limb of the Moliti syncline, the sandy limestones with abundant shells of *Amphidonta* are distributed also in the Lower Aptian. It is worth noting that within the southern periphery of the Dzirula massif Upper Barremian shallow-marine "*Exogyra*" facies is replaced by relatively deep marine ammonite facies, indicating the strengthening of the Late Barremian transgression. In this area the ammonites appear for the first time in the *Hemihoplites soulieri* Zone, represented by limestones with glauconite grains on some levels. In some places, e.g. in the Lashisghele section (Fig. 3) in the lower part of the *Hemihoplites soulieri* Zone there are layers of brecciate sandy limestones (3 m), which unconformably overly the Lower Barremian Urgonian limestones. In the gorge of the river Jonjoura (environs of village Skhliti) on the Lower Barremian Urgonian limestones unconformably, with thin (0.3m) breccia-conglomerate bed in the basis, lie brecciate limestones (2.5 m), containing ammonites of the *Hemihoplites soulieri* Zone. In other sections in the lower part of the noted Zone often there are inclusions of slightly reworked porphyrite pieces (d=1-4 mm). Transgression in the Dzirula area, as it appears, reached its maximum in the *Colchidites securiformis* Chrone.

Regressive tract of the Br_2^1-A_1^1 sequence in the Okriba-Khreiti subzone is well distinguished in the sections Kumistavi, Gumbra and Godogani, where beginning from the *Pseudocrioceras waagenoides* Zone there is an increase of the terrigene material and beside the coarse-sculptured and big-sized heteromorph ammonites of the genus *Pseudocrioceras*, representatives of the typical habitant of the shallow-sea bivalves (*Amphidonta*) also appear.

In the Dzirula subzone the regressive tract of the Br_2^1-A_1^1 sequence is relatively well distinguished in the environs of the river Lashighele and village Skhliti, where after marly limestones of the *Colchidites securiformis* Zone appreciable increase of the terrigene (sandy-clayey) material and domination in the ammonite associations of representatives of very specialized, coarse-sculptured genus *Pseudocrioceras* are obvious. As to the area of the Moliti syncline and eastern peripheral part of the Dzirula massif, the uppermost Barremian and lowermost Aptian sediments (including *Deshayesites weissi* Zone) either are not deposited at all or were washed away by the Early Aptian transgression [9, 10].

Lower Aptian sequence (A_1^2-A_1^4)

Within the Okriba-Khreiti subzone lower boundary of the Lower Aptian sequence is heterogenous. In the Godogani section the transgressive tract is well distinguished by unconformity; in this section the upper part of the Upper Barremian *Colchidites securiformis* Zone, *Pseudocrioceras waagenoides* Zone completely and Lower Aptian *Deshayesites weissiformis* Biohorizont (Bh) are absent. Particularly, on the erosion surface of the clayey limestones of the *Colchidites securiformis* Zone lie breccia-conglomerate layer (0.25 m). Upwards follow thin-bedded clayey limestones and slightly sandy glauconite limestones of the Lower Aptian *Deshayesites weissi* Zone, which, besides the ammonites (*Deshayesites weissi* (Neum. & Uhl.), *Procheloniceras* sp., *Macroscaphites* cf. *striatisulcatus* (d'Orb.) etc.)) contains bivalves (*Opis rionensis* Rouch.) and foraminifers. Higher up conformably follow sandy limestones of the *Deshayesites deshayesi* Zone, containing ammonites (*Deshayesites deshayesi* (Leym.), *Cheloniceras seminodosum* (Sinz.), *Ch. cornuelianum* (d'Orb.), *Pseudohaploceras* sp. sp., etc.)) and bivalves (*Opis rionensis* Rouch.). As to northern disposed sections (Gumbra, Kumistavi, Tvishi, Znakva), everywhere the lower boundary of the A_1^2-A_1^4 sequence (as noted above) is conformable.

In the Dzirula subzone, to wit in the Goresha-Kharagouli syncline (sections: Khoriti, Ghverki,

Uchameti, Gabourasghele, Korneba) the Lower Aptian sequence begins with a transgressive tract of the *Deshayesites weissi* Zone. In this area sandy marls and limestones of this Zone lie on the erosion surface of the marly limestones of *Colchidites securiformis* Zone. At the base there is a layer of greenish-grayish sandy-glauconitic marls (0.2-0.7 m), which together with remnants of belemnites, bivalves and gastropods contain more or less reworked shells of the representatives of Late Barremian genus *Colchidites* and those of similar to representatives of the genus *Turkmeniceras* [10]. Stratigraphically higher about 0.4-0.7m in the section there appear *Procheloniceras albrechtiaustriae* Hoh. and *Deshayesites* ex. gr. *weissi* Neum. et Uhl. In this area transgression attains its maximum in the *Deshayesites deshayesi* Chrone. As to the environs of Moliti syncline and eastern periphery of the Dzirula massif (Moliti, Tsipa, Chumateleti, Bijnisi, Tsivtskaro, Tskhetisjvari) the synchronous Lower Aptian sediments unconformably, with breccia-conglomerates in the basis (0.2-0.3 m) lie either on the massive biogenic limestones or on the brecciate limestones with *Amphidonta*. In the noted breccia-conglomerate layer together with Early Aptian ammonites of the *Deshayesites weissi* and *Deshayesites deshayesi* Chrones (e.g. *Deshayesites deshayesi* Leym., *D. dechyi* Papp., *D.* cf. *weissi* Neum. & Uhl., *Procheloniceras albrechtiaustriae* Hoh., *Cheloniceras cornuelianum pygmaea* Niksch., *Ch. seminodosum* Sinz., *Pseudohaploceras douvillei* Fall.) there are also the Late Barremian species (*Pseudocrioceras orbigyi* Math., *Macroscaphites* cf. *recticostatus* d'Orb., *Colchidites* sp., *Mesohibolites uhligi* Schwetz.) [9, 11-15].

Early Aptian regressive subcycle in the area of the Okriba-Khreiti subzone started in *Dufrenoyia furcata* Chrone; several existing submarine elevations (e.g. Godogani, Kumistavi, Gumbra, Tvishi) turned into subaerial exposures and then began their erosion. Marks of subaerial processes are well expressed by erosion pockets and rust-caloured limestones at the top of the compact, pelitomorphic limestones of the *Deshayesites deshayesi* Zone; the erosion pockets are filled with broken, reworked shell fragments of belemnites, ammonites, bivalves. The boundary with the next Middle Aptian sequence is traced through this erosion surface (see below).

Within the Dzirula subzone the Lower Aptian sequence is terminated by a regressive tract of the *Dufrenoyia furcata* Zone. This is proved in the sections (Lashisghele, Skhliti, Nebodziri, Tsipa, etc.) by increase of the glauconite and sandy material (in some places by the existence of brecciate limestons), as well as by dominance of comparatively more coarsly sculptured ammonites of the genera *Dufrenoyia* and *Cheloniceras* (Group of *Cheloniceras cornuelianum* d'Orbigny).

Middle Aptian sequence (A_2^1-A_2^2)

Transgressive tract of the Middle Aptian sequence within the Okriba-Khreiti subzone is well distinguished in many sections (Godogani, Kumistavi, Tvishi, etc.) by unconformable disposition of the *Epicheloniceras subnodosocostatum* Zone (with breccia-conglomerates at the basis) on the erosional surface of the *Deshayesites deshayesi* Zone or of older deposits [16, 4]. In some places (e.g. village Gumbra) transgression reached later - in the *Colombiceras tobleri* Chrone. Middle Aptian of this area besides ammonites (representatives of genera – *Epicheloniceras, Colombiceras, Macroscaphites, Haploceras*, *Euphylloceras*, etc.) contains belemnites (*Mesoghibolites minareticus* Krimh., *M. moderatus* Schwetz., *M. elegans* Schwetz., etc.), bivalves (*Aucellina caucasica* (Buch)) and foraminifers. It is remarkable that within the northern Znakva-Bethlevi area, which was deeper part of the shelf, there is conformable transition between Lower and Middle Aptian.

Within the Dzirula subzone the transgressive tract of the Middle Aptian corresponds to the lower part of the *Epicheloniceras subnodosocostatum* Zone and most clearly it is revealed in some areas of

Goresha-Kharagouli and Moliti synclines, where it is distinguished by unconformable disposition of the *Epicheloniceras subnodosocostatum* Zone on the *Dufrenoyia furcata* Zone. E.g. in the sections of Moliti and Nebodziri the Middle Aptian glauconite marly sandstones (2.0 m) transgressively, with marks of washing away, lie on the Lower Aptian sandy limestones, but in some places they overlie (with breccia-conglomerate layer (0.2 m) at the basis)) the Lower Aptian brecciate limestones. They contain abundantly the following fossils - *Epicheloniceras martini orientalis* Jac., *E.* cf. *tschernyschewi* Sinz., *E.* cf. *subnodosocostatum* Sinz., *Colombiceras discoidalis* Sinz., *C.* cf. *tobleri* Jac. & Tobl., *Euphylloceras* sp. ind., *Eodouvilleiceras* sp., *Ammonitoceras* sp. ind., *Mesohibolites moderatus* Schwetz., *Plicatula placunea* Lam., *Grammatodon securis* Leym., *Dzirulina dzirulensis* Anth., *Lamellaerhynchia* sp. Some shells have reworked marks. In this respect interesting is the section of Lashisghele (Fig. 3). Particularly, in the middle part of the river Lashisghele on the Lower Aptian sandy marls and limestones (*Dufrenoyia furcata* Zone) lie the greenish-gray glauconite sandstones (0.6 m) containing - *Epicheloniceras martini orientalis* Jac., *E. subnodosocostatum* Sinz., *Colombiceras discoidalis* Sinz., *Mesohibolites moderatus* Schw., *Neohibolites* sp., *Solarium dentatum* d'Orb., *Perissoptera* sp., *Chlamys* sp., *Amphidonta* sp. and many shells of brachiopods. These sediments contain reworked shells of ammonites, as well as rounded marl pebbles and inclusions of charred plants. Higher up in the section, sandstones gradually are replaced by sandy-glauconite marls (21 m), in the lower part of which *Epicheloniceras* sp., but in the middle part – *Colombiceras* sp., *Zuercherella* sp., *Solarium dentatum* d'Orb. - of the *Epicheloniceras subnodosocostatum* Zone are collected. It should be noted that in some sections (e.g. Amashuketi, Goresha, Lashe) of the Dzirula subzone there is conformable transition between these sequences [17 - 19]. In the studied territory Middle Aptian transgression lasted up to the first half of the *Colombiceras tobleri* Chrone and then it was replaced by regression. In the Okriba-Khreiti subzone beginning from the second half of the *Colombiceras tobleri* Chrone the sea gradually grew shallow, and then there appeared several (in Tvishi, Znakva, Nikortsminda, Dzedzileti, Gordi) temporary islands, the disappearance of which was connected with the followed Late Aptian transgressive subcycle [5].

Within the Dzirula subzone the regressive tract of the Middle Aptian sequence is well distinguished in many sections, particularly in the sections of the southern periphery of the Dzirula massif, where facial changes are expressed by dominance of coarse-sculptured ammonites of the genus *Protacanthoplites*, as well as by increase of the sandy material in the marly-limestony deposits. In some places (sections: Ghverki, Uchameti, Moliti, Nebodziri, Tsipa) they are replaced by marly glauconite sandstones. The sandstones contain poorly reworked pebbles of porphyrites (d = 2-5 mm) and inclusions of charred plants.

Upper Aptian-Lowermost Albian sequence (A_3^1-Al_1^1)

It is remarkable that in the south-western part of the Okriba-Khreiti subzone, viz, in the sections of the villages Kumistavi, Dzedzileti and Gordi Upper Aptian marls with brerccia-conglomerate layer in the basis unconformably lie on the Lower Aptian *Deshayesites deshayesi* Zone [16]. However, in some sections of the Okriba-Khreiti subzone the boundary between the *Colombiceras tobleri* and *Acanthohoplites nolani* Zones is traced through the erosion surface of the Middle Aptian limestones; e.g. in Tvishi section Upper Aptian *Acanthohoplites nolani* Zone with breccia-conglomerate layer in the basis, lies on the Middle Aptian *Colombiceras tobleri* Zone [20,21]. Similar situation is in the environs of Nikortsminda [22] and Znakva villages [4]. On the same level slight marks of washing away are also seen in the village Godogani, but in the northern sections (villages:

Alpana, Bethlevi) Middle/Upper Aptian transition is conformable [23].

Within the frames of the Dzirula subzone the transgressive tract of the A_3^1-Al_1^1 sequence most clearly is distinguished in its southern periphery, in the northern slope of the Moliti syncline; viz.in the sections of the village of Vakhani and river Kvebisghele, where *Acanthohoplites nolani* Zone unconformably overlies the Barremian limestones. Both sections are almost similarly constructed; in the basis of the Upper Aptian there is a breccia-conglomerate layer (1-2 m), which consists of rounded and reworked pieces of limestones, cemented by sandy limestones and marls. This layer also contains shards and partly reworked shell pieces of bivalves *(Amphidonta, Alectrionia, Pterotrigonia, Neithea)* and it unconformably lies on the Barremian (presumably Upper Barremian) brecciate-sandy limestones. Stratigraphically higher up follow greenish-grey glauconite-sandy marls (0.6-1.8 m), which in the lower part contain - *Acanthohoplites* cf. *trautscholdi* Sim., Bac., Sor., *A.* sp. ind., *Mesohibolites moderatus* Schw., *Neohibolites clava* Stoll., *N. inflexus* Stoll., *Plicatula inflate* Sow. This layer upwards is replaced by gray sandy marls and limestones (12 m) containing - *Aucellina caucasica* Buch, *A. aptiensis* d'Orb., *Plicatula inflata* Sow., *Panope gurgitis* Pict. et Roux [9,10]. The described sediments belong to the lower part of the *Acanthohoplites nolani* Zone. Clearly, deepening of this basin occurred in the second half of the *Acanthohoplites nolani* Chrone. Such conclusion is proved by the existence of litho- and biofacial changeabilitry: almost everywhere in the sections the noted sandy marls and limestones are replaced by pelitic-aleuritic limestones and simultaneously, coarse-sculptured ammonites of the genera *Diadochoceras* and *Paracanthoplites* are replaced by smooth-sculptured ammonites of *Acanthohoplites nolani* group.

Regressive tract of the A_3^1-Al_1^1 sequence within the Okriba-Khreiti subzone is revealed in the *Hypacanthoplites jacobi* Zone and it embraces the lowermost part of the *Leymeriella tardefurcata* Zone too. To this phenomenon points the appearance of marly limestones and marls beginning from the uppermost part of the *Hypacanthoplites jacobi* Zone (e.g. sections Nikortsminda, Tvishi) and afterwards their replacement by glauconite limestones with numerous representatives of the genus *Aucellina* [24, 25].

As to the Dzirula subzone, in many sections in the upper part of the Upper Aptian composition of the aleurite-psammitic material increases, and ammonites of *Acanthohoplites nolani* group are replaced by coarse-sculptured representatives of the genus *Hypacanthoplites*; e.g. in the sections of Tsipa village and river Suramula sandy limestones and marls of the *Acanthohoplites nolani* Zone stratigraphically higher up are replaced by glauconite sandstones or by glauconite marly sandstones, but higher (section Suramula), there are glauconite tuffites containing stones of sandy marls and porphyritic rocks. Regression, which started in the *Hypacanthoplites jacobi* Chrone has lasted for a short time in the Early Albian *Leymeriella tardefurcata* Chrone, and then, the next deepening of the sea (sections: Lashe, Suramula) took place in the late interval of the *Leymeriella tardefurcata* Chrone.

Conclusions

Thus, on the basis of a study of unconformable surfaces, as well as of alternation of the comparatively deep and shallow sea facies of the Barremian-Aptian of the Dzirula subzone 5 sedimentary sequences (Br_1^1-Br_1^3, Br_2^1-A_1^1, A_1^2-A_1^4, A_2^1-A_2^2, A_3^1-Al_1^1), corresponding to those established in Okriba-Khreiti subzone [4], are revealed.

In the localities where thickness of the Barremian-Aptian sequences is considerably reduced, in most cases sequence boundaries are characterized by erosion surfaces, but in those sections where the thickness of sequences is comparatively increased and they represent the comparatively deeper shelf setting facies, sequence boundaries are conformable. In

all cases when boundaries between two sequences are represented by stratigraphical gap, beds of adjacent sequences are characterized by same dip azimuth and dip angle. Accordingly, each such boundary represents typical disconformity and the chronostratigraphic range of its degradation vacuity is variable in the considered region.

Data of facial and biostratigraphical analyses of the revealed transgressive and regressive tracts, facially in more or less different Barremian-Aptian deposits of the Okriba-Khreiti and Dzirula tectonic subzones, represent one of the sound grounds for their detailed stratigraphical correlation, as well as for study of the Barremian-Aptian palaeogeographic evolution of this territory with precision of the time-intervals corresponding to the Subage.

Taking into account the great practical and theoretical significance of sequence stratigraphic analysis, it became obvious that in the near future special sequence stratigraphic investigations on the territory of Georgia should embrace not only the Cretaceous but the whole Mesozoic-Cenozoic as well.

სტრატიგრაფია

ოკრიბა-ხრეითისა და ძირულის ტექტონიკური ქვეზონების (საქართველო) ბარემულ-აპტური სედიმენტური სექვენსების სტრატიგრაფიული კორელაცია

მ. კაკაბაძე[*], ი. კაკაბაძე[**], მ. შარიქაძე[§]

[*] *აკადემიის წევრი, ი. ჯავახიშვილის თბილისის სახელმწიფო უნივერსიტეტი, ა. ჯანელიძის გეოლოგიის ინსტიტუტი, თბილისი*

[**] *ი. ჯავახიშვილის თბილისის სახელმწიფო უნივერსიტეტი, ა. ჯანელიძის გეოლოგიის ინსტიტუტი, თბილისი*

[§] *საქართველოს ტექნიკური უნივერსიტეტი, სამთო-გეოლოგიური ფაკულტეტი, თბილისი*

განხილულია ოკრიბა-ხრეითისა და ძირულის ტექტონიკური ქვეზონების (საქართველო) ბარემულ-აპტური სექვენსების შეპირისპირების საკითხი. აღნიშნული ტერიტორიის ბიო- და სექვენს-სტრატიგრაფიული კვლევების ობიექტად არჩევა განაპირობა აქ გავრცელებული ბარემულაპტური ნალექების ფაციესურმა მრავალფეროვნებამ, მდიდარი ფაუნისტური კომპლექსების არსებობამ და სედიმენტაციური ციკლების ხშირმა მონაცვლეობამ. ძირულის ქვეზონის ფარგლებში ბარემულ-აპტურ ნალექებში უთანხმო ზედაპირების, აგრეთვე ზღვის შედარებით ღრმა და მარჩხი ფაციესების მონაცვლეობის შესწავლის საფუძველზე გამოიყოფა 5 სედიმენტაციური სექვენსი (Br_1^1-Br_1^3, Br_2^1-A_1^1, A_1^2-A_1^4, A_2^1-A_2^2, A_3^1-Al_1^1), რომლებიც ოკრიბა-ხრეითის ქვეზონაში ადრე გამოყოფილ ბარემულ-აპტურ სექვენსებს შეესაბამებიან. დაზუსტებულია ამ სექვენსების ბიო-სტრატიგრაფიული ჩარჩოები და შესწავლილია მათი ლითო- და ბიოფაციესური ცვალებადობის ხასიათი სივრცესა და დროში. უმეტეს შემთხვევაში სექვენსებს შორის საზღვრები ეროზიული ზედაპირებით არის გამოხატული, ხოლო იმ ჭრილებში, სადაც სექვენსები ზღვის შელფის შედარებით

უფრო ღრმა ფაციესით არიან წარმოდგენილი, სექვენსებს შორის საზღვარი თანხმობითია. იმ შემთხვევაში, როდესაც სექვენსის საზღვარი სტრატიგრაფიული ხარვეზით არის წარმოდგენილი, ორივე მოსაზღვრე სექვენსის ამგები ქანების დაქანების აზიმუტი და დახრის კუთხე ერთნაირია. შესაბამისად, ყოველი ასეთი საზღვარი წარმოადგენს ტიპიურ პარალელურ უთანხმოებას და ირკვევა, რომ მისი დეგრადაციული სიცარიელის ქრონოსტრატიგრაფიული ამპლიტუდა შესწავლილ რეგიონში ცვალებადია.

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