

# The Lower Aptian of the Mangyshlak Mountains

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**Abstract**—In the Mangyshlak Mountains, the lower Aptian deposits are represented by thin beds (0.5–1.5 m) of sandstone and conglomerate, and in the Kugusem anticline, this time range spans two conglomerate beds incorporating an intermediate clay member (up to 15 m thick). The lower Aptian beds rest with a hiatus on different horizons of the Cretaceous (Berriasian-Barremian), or on the Middle Jurassic rocks. The beds yielded diverse assemblages of various faunal groups: ammonites, belemnites, bivalves, brachiopods, Echinoidea, and others. The beds represent a condensed sedimentary sequence of the shallow-shelf type and are divisible into the lower Aptian *Deshayesites weissi*, *Deshayesites deshayesi*, and *Dufrenoya furcata* ammonite zones. The lower Aptian ammonite assemblages include 21 species from genera *Deshayesites*, *Dufrenoya*, and *Cheloniceras*, two of which (*Deshayesites semenovi* and *Cheloniceras sinzowi*) are new and described in the paper. The paper also presents images of 16 other species, including 11 forms discovered for the first time in the Mangyshlak Mountains.

**Key words:** *Transcaspian region, Mangyshlak, northern Caucasus, southern England, lower Aptian, ammonites, zone, correlation, condensed beds.*

In many Transcaspian areas (Kopetdag, Greater and Lesser Balkhany, Kubadag, and Tuarkyr), the lower Aptian deposits are represented by marine sediments, whose beds are 40 to 650 m thick and span the *Deshayesites tuarkyricus*, *D. weissi*, *D. deshayesi*, and *Dufrenoya furcata* zones<sup>1</sup> of the ammonite scale (*Resh-eniya ...*, 1977; Bogdanova, 1978). Sections of the Mangyshlak Mountains, where fossils of three ammonite zones are encountered in a bed less than 1.5 m in thickness, are unique in the stratigraphic aspect. This bed of massive calcareous sandstone incorporates pebbles and gravel of underlying rocks and phosphorites. It is a basal one in a rather thick sequence of clay with septarian concretions (the Septarium Clay of the Aptian after N.I. Andrusov).

The majority of researchers, who studied the Lower Cretaceous in the Mangyshlak Mountains, believe that the bed of calcareous sandstone or conglomerate (it was frequently referred to as "plate" in publications) spans the total range of the lower Aptian Substage (Luppov, 1932; Savel'ev and Vasilenko, 1963; *Melovye otlozheniya ...*, 1980). On the basis of ammonites represented by index species of different zones, Savel'ev and Vasilenko (1963, p. 271) arrived at the conclusion that the rocks of the "plate" represent the "typical condensed sequence." The lithologic composition of the "plate" was studied by Klycheva and Yakunitskaya

(1963), who argued that, in some sections of the Karatau Range, the basal part of the septarium clay above the "plate" may also belong to the lower Aptian.

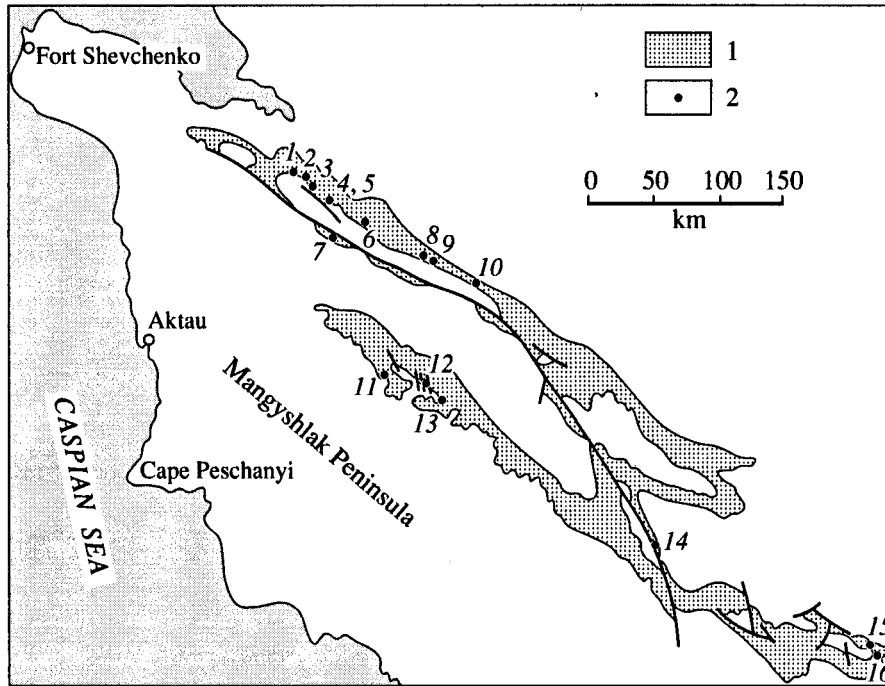
In 1971 and 1973, Luppov, Bogdanova, and Lobacheva studied 17 exposures of the lower Aptian deposits in the western and eastern Karatau Range, and also in the Karasyaz', Turgashi, and Kugusem structures (Fig. 1). They outlined the relations of the bed in question with the overlying and underlying deposits, and showed a possibility to subdivide it into the lithologic units in certain localities. Applying in addition the bed-by-bed distribution analysis, Bogdanova identified ammonites and bivalves of the bed, and Lobacheva studied brachiopods<sup>2</sup> and sea-urchins from this unit.

Figs. 2–6 illustrate principal structural features, lithological composition, and distribution of paleontological remains that have been detected in various exposures of the Aptian "plate" within the Karatau and Kugusem structural zones. In all the sections studied, the lower Aptian deposits overlie the uneven erosion surface of underlying deposits ranging in age from the Middle Jurassic (Besokty Formation) to the Hauterivian and Barremian (Kugusem Formation of variegated lagoonal-marine sediments).

In the Chirchili section (near the synonymous well in the westernmost piedmonts of the Karatau Range), the "plate" rests on the dark-gray massive Hauterivian sandstones (*Trigonia* Formation) and represents a gray 0.5-m-thick sandstone bed bearing abundant phosphorite nodules and pebbles variable in size. In addition to

<sup>1</sup> In 1979, Plenum of the Cretaceous Commission of the Interdepartmental Stratigraphic Committee (ISC) added to the lower Aptian the *Turkmeniceras turkmenicum* Zone formerly attributed to the Barremian (*Postanovleniya ...*, 1981; see for my own opinion on the issue at p. 65, point 5).

<sup>2</sup> Brachiopods are described in a separate paper by Lobacheva.



**Fig. 1.** Geographic scheme of the Mangyshlak Peninsula with outcrops of Lower Cretaceous deposits (1) and the sites studied (2): 1, Chirchili; 2, Sorbulak; 3, Karashimrau; 4, 5, Shair; 6, Kogozbulak; 7, Tushchibek; 8, Doshchan; 9, Dzharmysh; 10, Kurkruk, 11, 12, Karasyaz'; 13, Sarmurun; 14, Besokty; 15, 16, Kugusem.

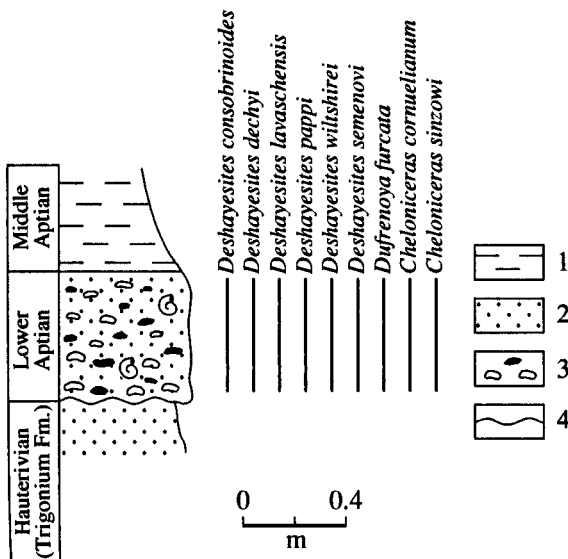
ammonites indicated in Fig. 2, the bed yielded plentiful remains of bivalves (*Cucullaea*, *Lima* s. str., *Grenella*, *Thetironia*, *Arctica*, and *Opis*) and brachiopod shells. All fossil remains occur in a form of phosphorite casts or their fragments. The bed is overlain by black smeary clay of the middle Aptian age.

This type of appearance is characteristic of the "plate" under consideration in the Sorbulak, Shair,

Tushchibek, Doshchan, Karasyaz', Sarmurun, and Besokty localities.

In the Karashimrau section (Fig. 3) (7 km to the east from the synonymous wells, the western Karatau Range), the "plate" consists of two beds and overlies the light-green silty clay of the Kugusem Formation. The lower bed of fine-grained rocks incorporates pebbles in its basal horizon only. The calcareous sandstone of the upper bed is intercalated with frequent gravel and conglomerate lentils. Both beds yielded well-preserved fossils. Ammonites of the upper zone of the lower Aptian are recovered from the upper bed only. Both beds are correlative in age with the conglomerate bed of the Chirchili locality.

In the Kogozbulak section (western wall of the Kogozbulak Canyon in the western Karatau Ridge), the "plate" is divisible by lithological features into four beds (Fig. 4). The lower bed of conglomerate with well-rounded pebbles of phosphorite and glauconite rocks is barren of fossils and overlies the erosion surface of grayish green Hauterivian shales. The second bed yielded rare fragments of degesitid shells. Beds 1 and 2 seem to be accumulated earlier than the "plate" rocks in the Chirchili and Karashimrau sections. Beds 3 and 4 include the mixed fauna of all lower Aptian zones and correspond in their formation time to the entire Karashimrau section. Sandstone of Bed 4 grades upward first into its silty variety, and then into the dark, almost black foliate clay enclosing an interlayer with septarium con-



**Fig. 2.** Chirchili section: (1) clay; (2) sand or sandstone; (3) conglomerate; (4) erosion surface.

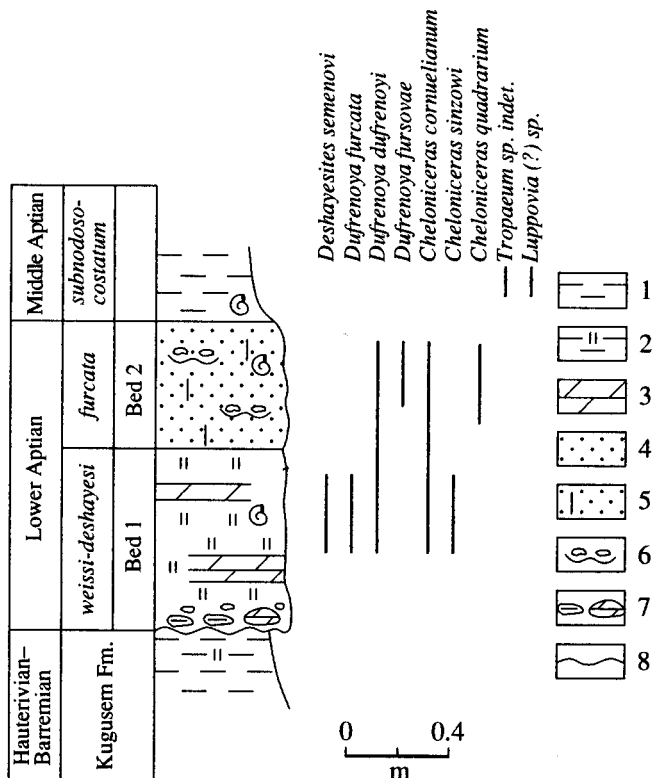


Fig. 3. Karashimrau section: (1) clay; (2) silty clay; (3) marl; (4) sand or sandstone; (5) calcareous sandstone; (6) conglomerate; (7) pebbles of clay and marl; (8) erosion surface.

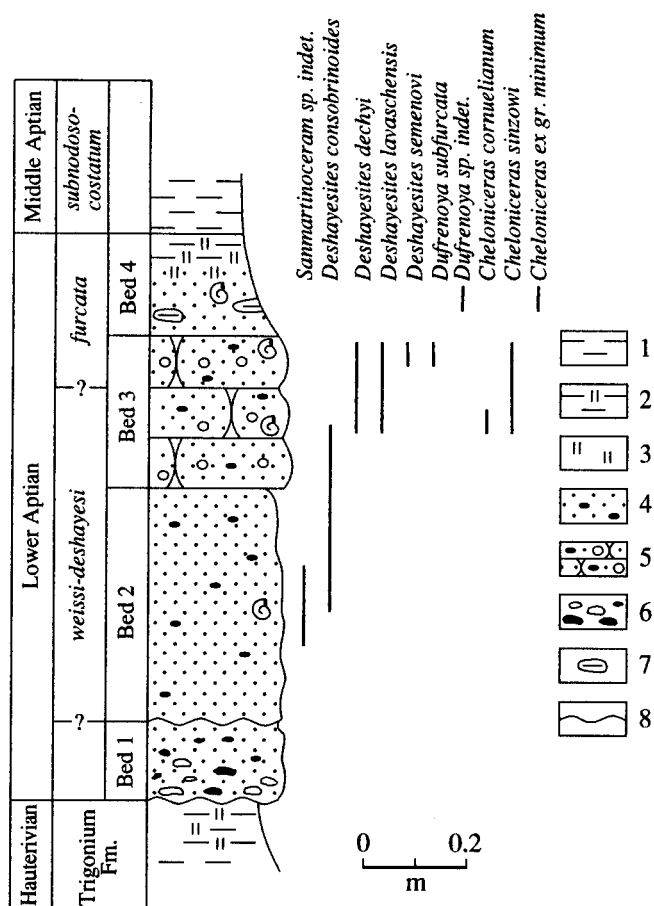


Fig. 4. Kogozbulak section: (1) clay; (2) clayey siltstone; (3) siltstone; (4) sandstone with phosphorite grains; (5) massive oolitic sandstone with phosphorite grains; (6) conglomerate; (7) pebbles of clay rocks; (8) erosion surface.

cretions at the top. The clay yielded remains of the middle Aptian ammonite *Epicheloniceras tchernyschewi* Sinz.

In this section, the lower-middle Aptian boundary does not coincide with the "plate" top and is located above it in the nonconsolidated clay, because the sandstone Bed 4 overlying the "plate" proper bears still the early Aptian ammonites. Since the middle Aptian *Epicheloniceras* forms always occur in Mangyshlak only in the septarium clay and never below it. I place the lower-middle Aptian boundary at the level of 0.5 m above the "plate" top, where the clay is already free of silty or sandy admixture.

In the Dishchan-Dzharmysh section situated between the Doshchan Cemetery in the west and the village of Dzharmysh in the east (the eastern Karatau Ridge), the upper part of the Kugusem Formation (up to 7 m thick) is composed of grayish yellow sandstones cross-bedded at the base and incorporating large concretions (up to 2 m in diameter) of massive calcareous sandstone (Fig. 5). Lentils of conglomerate and gravelstone with frequent phosphorite grains occur everywhere in this member. At the top of the member, there

is a bed 1 m thick, and precisely this part of the member is usually considered as a stratigraphic analogue of the Aptian "plate." The bed is composed of yellowish gray, locally bleached sandstone incorporating pebbles and gravel at the base. Only this bed yielded the early Aptian ammonites associated with poorly preserved bivalves of genera *Glycymeris*, *Aucellina*, *Chlamys*, *Camptonectes*, *Lima* s. str., *Exogyra*, *Thetironia*, and *Opis*, and also with remains of brachiopods and sea-urchins. In the Doshchan Cemetery area 5-6 km to the west from this section, it is evident that the described bed discordantly overlies the various members of the Kugusem Formation. In this case, the "plate" has a sharp contact with overlying black clay.

In the Kugusem section (Fig. 6) studied in a ravine extending westward from the Kugusem Well, the upper beds of the Kugusem Formation (about 17 m thick in total) are composed, like in the Doshchan-Dzharmysh locality, of sandstones displaying frequently the cross-bedding and enclosing lenses and interlayers of fine-pebble conglomerate and gravelstone. By analogy with many sections of the Karatau Ridge and with the Dosh-

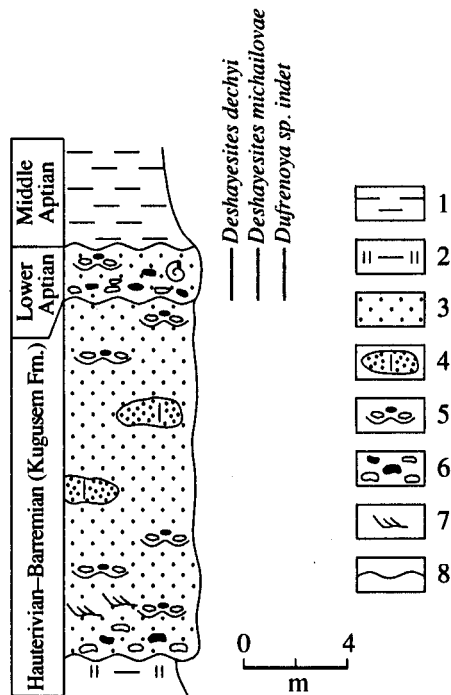


Fig. 5. Doshchan section: (1) clay; (2) clayey siltstone; (3) sand or sandstone; (4) nodules of calcareous sandstone; (5) gravel and conglomerate lentils; (6) conglomerate; (7) cross-bedding; (8) erosion surface.

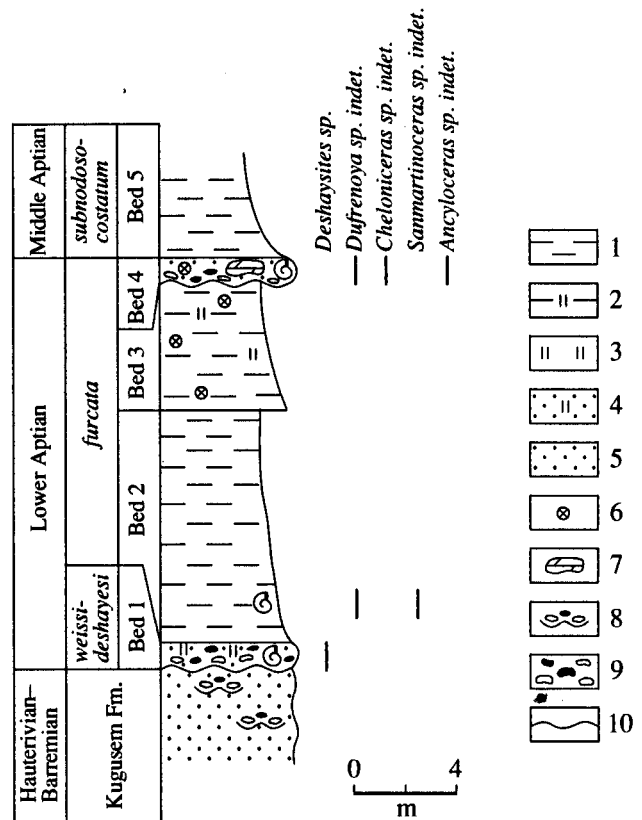


Fig. 6. Kugusem section: (1) clay; (2) silty clay; (3) siltstone; (4) silty sandstone; (5) sand or sandstone; (6) septarium nodules; (7) marl nodules; (8) gravel and conglomerate lentils; (9) conglomerate; (10) erosion surface.

chan-Dzharmysh locality, in particular, the conglomerate Bed 1 at the top of this sandstone sequence is accepted for the basal lower Aptian unit. From this bed, Klycheva and Yakunitskaya (1963) recovered ammonites of the genus *Deshayesites*. In contrast to many other sites, however, the bed does not exhaust here the total range of the lower Aptian. The clay Bed 2 above it yielded the early Aptian *Dufrenoya* forms (Plate II, images 12 and 13; Plate III, image 7). Above the Bed 3 of clayey siltstone barren of fossils, there is another conglomerate bed similar in composition and structure to the lower one and bearing casts of *Dufrenoya* and *Chelonicerias* species. Accordingly, this bed should also be considered as a constituent of the "plate" looking like it is split in two parts by the clay and siltstone interlayers.

By analogy with other sections, the lower-middle Aptian boundary is placed here at the base of the clay Bed 5. This decision is still arbitrary, because the middle Aptian ammonites are extremely rare in the Kugusem area and completely missing from the section in question.

The presented brief description shows that the Aptian "plate" and units below and above it are variable in structure. In the majority of localities however, the lower Aptian interval of the section is represented by either the sandstone, or most frequently, by conglomerate

ate bed up to 1.5 m in thickness, and only in the Kugusem area, this interval includes the 15-m-thick clay unit occurring between two conglomerate beds.

As is already mentioned, Klycheva and Yakunitskaya (1963) additionally attributed to the lower Aptian the basal beds of the septarium clay overlying the "plate." Amid three localities they described, the Chirchili section situated in the southern slope of the eastern Karatau Range is most intriguing. In this section, Klycheva and Yakunitskaya attributed to the lower Aptian the 76-m-thick unit of black clay with remains of *Chelonicerias* sp., *Deshayesites* sp., and *Nuculana pseudomariae* J. Nik., but they did not indicate the position of ammonite remains in the unit. In two other cases (the Keriz and Karakuduk sections), the clay units were dated on the basis of bivalve remains, and such a situation is insufficient to substantiate the early Aptian age of the enclosing rocks. Savel'ev and Vasilenko (1963) also argued that this age suggested for a thick sequence of septarium clay is doubtful and inadequately grounded from the paleontological viewpoint.

The ammonite assemblage from the Mangyshlak Mountains, which was studied in this work, includes 21 species of genera *Deshayesites*, *Dufrenoya*, and *Chelonicerias*. They occur together with shell fragments of

Table 1. Distribution of ammonites in the lower Aptian section of the Mangyshlak Mountains and other regions

Ammonite species (species marked with asterisk are pictured in Plates I-III)	Mangyshlak Mountains											Turkmenistan						Northern Caucasus					Southern England					
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5	
<i>Deshayesites babaschensis</i> *					7										+													
<i>D. consobrinoides</i> *	1			4	15									+	+												+	
<i>D. dechyi</i> *	17			7	19		4		3	2				+	+						+							
<i>D. euglyphus</i> *				2									+	+											+			
<i>D. kudrjavzevi</i> *				7										+	+													
<i>D. lavaschensis</i> *	20		1	16	54																+							
<i>D. levigatus</i>			2												+													
<i>D. luppovi</i> *					1				1	1			+	+														
<i>D. michailovae</i> *				1										+	+													
<i>D. pappi</i> *	2													+														
<i>D. robustocostatus</i>				1																	+							
<i>D. semenovi</i> sp. nov.*	1		3	13	29	2																						
<i>D. terminalis</i>		1													+													
<i>D. cf. wiltshirei</i> *	8	1								1																	+	
<i>Dufrenoya furcata</i> *	3		2	4						1						+						+						+
<i>Dufrenoya dufrenoyi</i> *	9		4	10												+												
<i>D. subfurcata</i> *				15	2											+						+						
<i>D. fursovae</i> *			1													+												
<i>Chelonicerias cornuelianum</i> *	10		23	5	13		4	1						+	+	+										+		
<i>Ch. quadrarium</i> *			1							1																	+	+
<i>Ch. sinzowi</i> sp. nov.*	15		4	10	7			3	3																			
<i>Sanmartinoceras</i> sp.					1																							
<i>Tropaeum</i> sp. indet.					1																							

Mangyshlak sections: (1) Chirchili; (2) Sorbulak; (3) Karashimrau (western); (4) Shair; (5) Kogozbulak; (6) Airakty; (7) Karashimrau (eastern); (8) Tushchibek; (9) Karaduan; (10) Ondy; (11) Karasyaz'; figures in each column indicate amount of collected specimens. Ammonite zones in Turkmenistan (Bogdanova, 1978): (1) *Turkmeniceras turkmenicum*, upper Barremian; (2) *Deshayesites tuarkyricus*; (3) *D. weissii*; (4) *D. deshayesi*; (5) *Dufrenoya furcata*, lower Aptian zones 2-5; (6) *Epicheloniceras subnodosocostatum*, middle Aptian. Ammonite zones of northern Caucasus (Drushchits and Mikhailova, 1966): (1) *Heteroceras astierianum-Imerites giraudi-Colchidites securiformis*, upper Barremian; (2) *Deshayesites weissii-Procheloniceras albrechtiaustriacae*; (3) *D. dechyi-D. deshayesi*; (4) *Dufrenoya furcata-D. subfurcata*, lower Aptian zones 2-4; (5) *Chelonicerias subnodosocostatum-Colombiceras crassicosostatum*, upper Aptian. Ammonite zones of southern England (Casey, 1961): (1) *Prodeshayesites fissicosostatus*; (2) *Deshayesites forbesi*; (3) *D. deshayesi*; (4) *Tropaeum bower banki*, lower Aptian zones 1-4; (5) *Chelonicerias martinoides*, upper Aptian.

Table 2. Correlated lower Aptian ammonite zonations

Stage, substage	England (Casey, 1961)		Northern Caucasus (Drushchits <i>et al.</i> , 1986)	Mangyshlak	Turkmenistan (Bogdanova, 1978)
Lower Aptian	<i>Tropaeum bowerbanki</i>	<i>Cheloniceras meyendorfi</i>	<i>Dufrenoya furcata</i>	<i>Dufrenoya furcata</i>	<i>Dufrenoya furcata</i>
		<i>Dufrenoya transitoria</i>			
	<i>Deshayesites deshayesi</i>	<i>Deshayesites grandis</i>	<i>Deshayesites deshayesi</i>	<i>Deshayesites deshayesi</i>	<i>Deshayesites deshayesi</i>
		<i>Cheloniceras parinodum</i>			
	<i>Deshayesites forbesi</i>	<i>Deshayesites callidiscus</i>	<i>Deshayesites weissi</i> – <i>Procheloniceras alb-rechti-austriae</i>	<i>Deshayesites weissi</i>	<i>Deshayesites weissi</i>
		<i>Deshayesites kiliani</i>			
<i>Deshayesites fittoni</i>					
<i>Prodeshayesites fissiocostatus</i>	<i>Prodeshayesites obsoletus</i>		Kugusem Formation	<i>Deshayesites tuarkyricus</i>	
	<i>Prodeshayesites bodei</i>				
Barremian	Weld		<i>Turkmeniceras turkmenicum</i> – <i>Matheronites ridzewsky</i>		<i>Turkmeniceras turkmenicum</i>

*Tropaeum*, *Toxoceratoides*, and *Ancyloceras* forms undeterminable at the species level. In many sections of the Aptian “plate” of the Karatau Range, the distribution of zonal index species is indistinct. Nonetheless, when the “plate” is divisible into several beds, one may observe the following distribution patterns: the basal conglomerate is always barren of ammonites (Karashimrau and Kogozbulak localities); the bed above it includes rare degesitid forms (Kogozbulak locality, Bed 2); genera *Deshayesites* and *Dufrenoya* coexist in the middle bed, and the uppermost bed bears the assemblage of *Dufrenoya* and *Cheloniceras* species (Kogozbulak locality, Bed 4; Kugusem locality, beds 2 and 4).

The studied ammonite assemblage and lower Aptian faunas from Turkmenistan (Bogdanova, 1979, 1991) include many species in common. The lower *Deshayesites tuarkyricus* Zone of the Mangyshlak plate yielded both *Deshayesites luppovi* and *D. euglyphus*, whose stratigraphic range in Turkmenistan is wider than this zone. *D. oylanensis* and index species *D. tuarkyricus*, occurring within the zone only, have not been encountered in the Mangyshlak Mountains, and it is unclear whether this lower Aptian zone is present here or not. It appears that the onset of marine sedimentation in the Mangyshlak region was after the earliest Aptian time. The *Deshayesites wiltshirei* species characteristic of the *grandis* Subzone of the *D. deshayesi* Zone in southern England (Casey, 1964) is established to occur also in Mangyshlak. This fact is of particular interest, because in the Transcaspian areas located southward (Tuarkyr, Greater Balkhan, Kubadag) this part of the Aptian sequence is usually eroded. Other ammonites from Mangyshlak, except local species *Deshayesites semenovi* and *Cheloniceras sinzowi*, are well-known and widespread in many distribution areas of the lower Aptian deposits.

At present, there are two schemes of the lower Aptian ammonite zonation in the Boreal and Tethyan provinces (Table 2). The scheme elaborated by Casey (1961) for southern England exemplifies the boreal zonations, whereas the scheme established in Turkmenistan is accepted as a standard of ammonite zonations in Tethyan regions (Bogdanova, 1978; Hoedemaeker *et al.*, 1993). The lower Aptian ammonite zonation suggested for Mangyshlak (Table 2) is very tentative, because the proper zonal assemblages have not been identified here. Many species available in the Mangyshlak “plate” allow me to believe that they characterize here the zonal units of Turkmenistan and northern Caucasus. At the same time, the lack of the majority of species typical of southern England exclude any chance to apply zonations of the boreal type in the study region. Only two common species, *D. wiltshirei* and *Ch. quadrarium*, both missing from the Transcaspian sections probably because of erosion, characterize the *deshayesi* Zone in both the Mangyshlak region and southern England. The ammonite assemblages of the *furcata* time were very different in the Mangyshlak and England basins. The heteromorphic ammonites, for instance, the genus *Tropaeum*, were dominant at that time in the latter, whereas their abundance in the Mangyshlak and Transcaspian areas is extremely low. The *Tropaeum* remains from basal beds of the septarium clay represent most likely the middle Aptian species of the genus, since they coexist with ammonites of the genus *Luppovia* characteristic of this stratigraphic level in Transcaspian areas.

Judging from the structure of the Aptian “plate” and its faunal remains, there was the following succession of events responsible for the “plate” formation. After the accumulation of the Kugusem Formation in the Hauterivian–Barremian freshwater basin that periodically experienced salinization (Klycheva and













