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GEOLOGY, STRATIGRAPHY AND PALAEONTOLOGY OF THE EOCENE SHYNZHYLY LOCALITY (EASTERN KAZAKHSTAN) AND COMPARISON WITH THE CONTINENTAL EOCENE OF ITALY

GEOLOGIA, STRATIGRAFIA E PALEONTOLOGIA DEI DEPOSITI EOCENICI DI SHYNZHYLY (KAZAKHSTAN ORIENTALE) E CONFRONTO CON L'EOCENE CONTINENTALE IN ITALIA

Abstract - Thanks to its geological peculiarities, Kazakhstan turned out to be extremely rich in fossil deposits which have returned a very rich collection of finds dating from the Paleogene to the Pleistocene. In this respect one of the most important paleogenic deposits is that of Shynzhyly on the right bank of the river of the same name (formerly known as Chinzhaly) in SE Kazakhstan where an abundant Eocene fauna has been found. Previously these deposits were attributed to the Kolpak Formation (Eocene).
At least three distinct genera belonging to the Tapiroidea superfamily have been found here: *Eoletes gracilis*, *Eoletes* sp. and *Schlosseria* sp. (family Lophialetidae) and *Teleolophus medius* (family Deperetellidae). There are also remains of two primitive rhinocerotoids *Forstercooperia minuta* and *Rhodopagus* sp., of micro-mammals (*Saykanomys bohlini*, *Saykanomys* sp., *Aksyiromys dalos, Pappocricetodon kazakhstanicus, Zhungaromys gromovi*, *Zhungaromys* sp., of turtles belonging to the family Trydionidae), of bony fish of the genus *Amia* (order Amiiformes). Based on these fossils, the Shynzhyly deposits have recently been dated to the middle Eocene. Five species of carophytes (phylum Charophyta, family Characeae) have also been identified genera *Sphaerochara*, *Psilochara* and *Stephanochara*. The carophytes come from levels stratigraphically above those that have provided bone remains and therefore more recent if compared with the remaining of the fossil material. The association of Shynzhyly carophytes shows affinity with that of the Awate Formation (which emerges in the northern part of the Tarim basin in NW China; association *Stephanochara yengisuensis - Sphaerochara chinensis - Tolypella rugulosa rugulosa*) dated to the late Eocene-early Oligocene.
Finally, the deposits described are compared with the contemporary continental deposits of NE Italy: no similarities have been found between the faunal associations of the two territories.
Key words: Paleogene, Eocene, Palaeontology, Stratigraphy, Vertebrate fauna, Charophyte, Kazakhstan, NE Italy.

Riassunto breve - *Grazie alle sue peculiarità geologiche, il Kazakstan si è rivelato estremamente ricco di depositi fossiliferi che hanno restituito una ricchissima collezione di reperti databili dal Paleogene al Pleistocene. Uno dei depositi paleogenici più importanti sotto questo profilo è quello di Shynzhyly, sulla riva destra del fiume omonimo (già noto come Chinzhaly) nel SE Kazakhstan, dove è stata rinvenuta un'abbondante fauna eocenica. In precedenza questi depositi erano attribuiti alla "Formazione Kolpak" (Eocene).*
Sono stati qui rinvenuti almeno tre generi distinti appartenenti alla superfamiglia Tapiroidea: Eoletes gracilis, Eoletes *sp. e* Schlosseria *sp. (famiglia Lophialetidae) e* Teleolophus medius *(famiglia Deperetellidae). Sono presenti anche resti di due rinocerotoidei molto primitivi,* Forstercooperia minuta *e* Rhodopagus *sp., di micro-mammiferi (*Saykanomys bohlini, Saykanomys *sp.,* Aksyiromys dalos, Pappocricetodon kazakhstanicus, Zhungaromys gromovi, Zhungaromys *sp., di tartarughe (ordine Testudinata) appartenenti alle famiglie Trionychidae ed Emydidae, di pesci ossei del genere* Amia *(ordine Amiiformes). Sulla base di questi fossili, i depositi di Shynzhyly sono stati di recente datati all'Eocene medio. Sono anche state identificate cinque specie di carofite (phylum Charophyta, famiglia Characeae) dei generi* Sphaerochara, Psilochara *e* Stephanochara. *Le carofite provengono da livelli posti stratigraficamente al di sopra di quelli che hanno fornito resti ossei e quindi più recenti rispetto a questi ultimi. L'associazione di carofite di Shynzhyly mostra affinità con quella della Formazione Awate (che affiora nella parte settentrionale del bacino di Tarim in NW Cina; associazione* Stephanochara yengisuensis - Sphaerochara chinensis - Tolypella rugulosa rugulosa*) datata al tardo Eocene-Oligocene iniziale.*
I depositi descritti vengono infine confrontati con i coevi depositi continentali dell'Italia Nordorientale: non vi sono similitudini far le associazioni faunistiche dei due territori.
Parole chiave: *Paleogene, Eocene, Paleontologia, Stratigrafia, Fauna a vertebrati, Charophyta, Kazakhstan, Italia Nord-orientale.*

1. Introduction

The most important aspect of modern stratigraphy is the problem of correlating the stratigraphic scale based on plankton (planktonic foraminifers, nanoplankton, phytoplankton), benthic foraminifera, mollusks, and other invertebrates found in marine and shallow-coastal marine deposits with the continental deposits containing the remains of terrestrial plants and animals only. Kazakhstan occupies a peculiar position since within the same territory there is a junction of various Cenozoic structural and facies zones. This particular situation allows correlating marine sections of the Paleogene of the Mediterranean belt (Tethys), which covers territory of western Kazakhstan, with continental deposits of central and Eastern Kazakhstan (*Vostochno Kazakhstanskaya Oblast'* (Eastern Kazakhstan Oblast').

On the other hand, within Kazakhstan there is a transition between the Paleogene deposits that accumulate in the sub-tropical basins of southern Kazakhstan with the boreal basins of northern Kazakhstan. Therefore, the Kazakhstan Paleogene sections are fundamental for the correlation of marine and continental layers.

The grant project of the Ministry of Science and Education ARO5134621 "Comprehensive study of supporting stratigraphic sections of the Cenozoic of southeast Kazakhstan to develop an improved stratigraphic diagram of sedimentary deposits of Central Asia" is aimed at a detailed study of unique Cenozoic sections of southeastern Kazakhstan, which is rich in fossils and minerals. Such project began in the late '90s of the last century.

On southeastern Kazakhstan there are many supporting and stratotype sections representing the most complete sections containing both the upper and lower boundaries of the geological units.

The palaeontological sections with a significative palaeontological content are important for the development of stratigraphic correlations as well as objects of geological heritage that need to be studied and preserved for the future generations.

The scientific research and the consequent knowledge is needed to attract economical investment in order to exploit the mineral resource and develop the geo-tourism.

One of the most characteristic Kazakh Paleogene sections is that of the Shynzhyly River, which is located about 7-8 km north-west of the village of Kabanbai in the Almaty Oblast' (Fig. 1). The Shynzhyly locality undoubtedly represents a unique Eocene section in southeastern Kazakhstan.

2. About the studied section

The outer depressions of Northern Dzungaria are stratotypic localities for the allocation of the Paleocene and Eocene suites. The most complete section crops out in the Kolpak Depression (Fig. 2). The outcrop presents a width of 5-7 km and an extension of 72 km, breaking east of Alakol-Dzungar fault. To the south - at the foot of the Besbokan and Kara-Almaly mountains - lies the southern fault of the Kolpak Depression. This fault delimits the central part of the Shet-Tentek river valley with a series of mud volcanoes produced by the swelling of the Eocene clays.

The section which is the subject of this study is situated in the Shynzhyly riverbed near the right bank of the river within the Kolpak Depression, about 7-8 km northwest of Kabanbay village (known as Andreevka when Kazakhstan was a republic of URSS), Alakol District, Taldy-Kurgan Region, Northern Dzungarya, Almaty Oblast', southeastern Kazakhstan).

Fig. 1 - The geographical localisation of the Shynzhyly area (red square) in Eastern Kazakhstan.
- *La posizione geografica dell'area di Shynzhyly (quadratino rosso) nel Kazakistan Orientale.*

3. History of the studies

The deposits containing the Eocene fauna crops out on the right bank of a small tributary brook of the Shinzhaly river informally named "Teply" and located north of the Kabanbay village. These deposits were first reported by the geologist L.K. Didenko-Kislitsina of the Southern Kazakhstan Geological Administration in 1958 (Didenko-Kislitsina 1965). They belong to the Eocene Kolpak Formation. Didenko-Kislitsina collected fossil mammal and fish remains in 1958 and 1964. Those specimens were later determined by M.D. Biryukov, V.V. Kuznetsov, and G.D. Khisarova (Didenko-Kislitsina 1965, 1999).

During the field work carried out in 1968-69 by the staff of the palaeobiological laboratory of the Institute of Zoology of the Academy of Sciences of the Kazakh Soviet Socialist Republic [at present, National Academy of Sciences of the Republic of Kazakhstan], further bones were collected, mainly belonging to Eocene tapiroids.

According to Didenko-Kislitsina (1965), the faunal remains collected in 1958 and 1964 came mainly from the upper part of the Kolpak Formation section. However, in the Didenko-Kislitsina's description of this section only a general analysis of the stratigraphy was provided but a faunal lists was not given.

The Cenozoic section of the area was briefly described in a volume about the geology of the northeastern part of the Dzungarian Alatau (Didenko-Kislitsina 1965). From the top to the bottom, the section is as follow:

Shynzhyly Formation - sand and gravel (upper Anthropogene, Ag_{III}-Q_{III});

Dzerzhinsk Formation - loam-boulder-pebble (upper middle Anthropogene, Ag_{II}^{2}-Q_{II}^{2});

Baskan Formation - loam-boulder-pebble (lower middle Anthropogene, Ag_{II}^{1}-Q_{II}^{1});

Koturbulak Formation - it is similar to the Baskan suite and developed in depressions on local river watersheds and on the flanks of the mountains (lower Anthropogene, Ag_{II}-Q_{I}^{2});

Khorgos Formation - small pebble-conglomerate, developed on local watersheds of rivers in the Kolpak Depression and on the northern slopes of the Saykan mountains (upper Pliocene, N_2^{3});

Enbekshi Formation - represented by loam, sandy loam with interbeds of rubbles; it is analogue to the Ily Formation (lower Pliocene, N_2^{2-3});

Alakol Formation - red clay, which is layered in the lower part (upper Miocene/lower Pliocene, N_1^{2-3}+N_2^{1-2});

Aktau Formation - multicoloured-layered, gray clay occurs in the lower part (Oligocene, Pg_3). According to new data, the Aktau unit at the Aktau area is presently considered to belong to the lower Miocene (Nigmatova et al. 2018), while it was previously referred to the Oligocene/lower Miocene;

Kolpak Formation - red clay, which are layered and mottled in the lower part (middle-late Eocene, Pg_2^{2-3});

Tunkuruz Formation - ash-gray bentonite (lower-middle Eocene, Pg_2^{1-2});

Jamantin Formation - variegated clay, sands, and sandstones (Paleocene, Pg_1 ?);

The Kolpak Formation ranges 10 to 200 m in thickness. The lower part of the formation consists mainly of sand with gravel lenses. In the upper part, the sand is replaced in some places by lenses of brown and red-brown clay

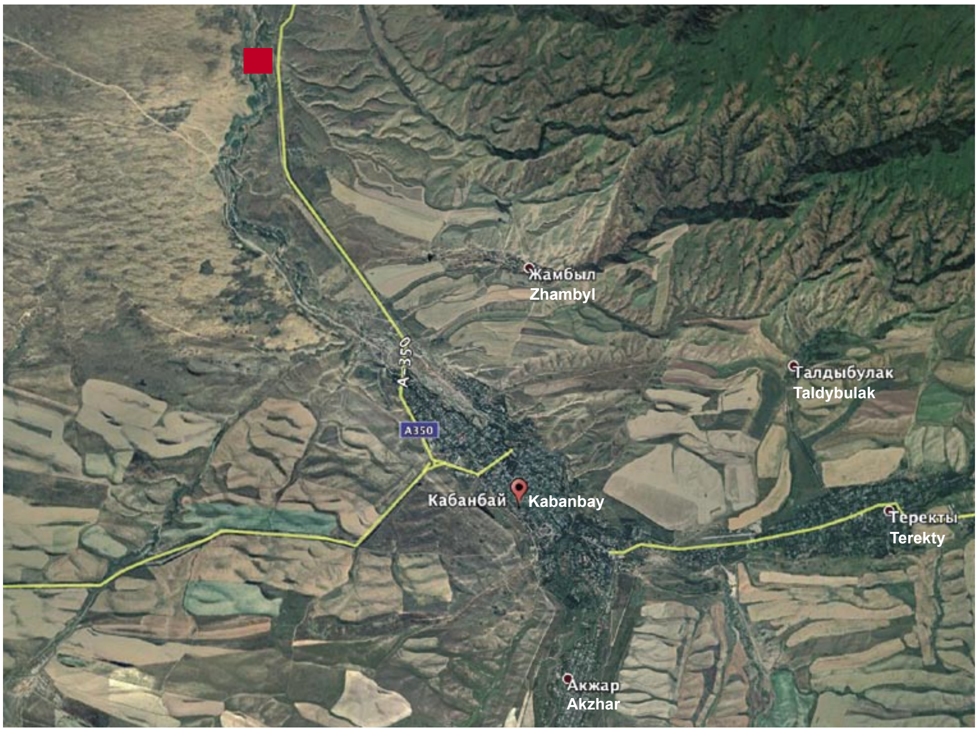


Fig 2 - Map of the Kolpak Depression with the localisation (red square) of the Shynzhyly riverbed section (from Google Earth).
- *Mappa della Depressione di Kolpalkov. Il quadratino rosso indica la posizione della sezione che affiora nell'alveo del fiume Shynzhyly.*

Fig. 3 - The Kolpak Formation on the right bank of the Shynzhyly River.
- *La Formazione di Kolpak sulla riva destra del fiume Shynzhyly.*

Fig. 4 - A panoramic view of the field work at the site near the spring of the "Teply" brook.
- *Vista generale dello scavo presso la sorgente del corso d'acqua denominato "Teply".*

Fig. 5 - A panoramic view of the site of the leaching surface near the spring of the "Teply" brook.
- *Vista generale del sito corrispondente alla superficie di dilavamento presso la sorgente del corso d'acqua denominato "Teply".*

and siltstone, in other by thin layers of green clay. The Fig. 3 shows the bone-bearing section of the Kolpak Formation along the right bank of the Shynzhyly River (in the left bank of a the "Teply" brook). The detailed descriptions of this section is reported below.

4. The palaeontological content

In Kazakhstan, vertebrate-bearing deposits of Eocene age are rare. They are mainly concentrated in the Zaysan Depression, an intramontane basin in the Eastern Kazakhstan, south-east of the Shynzhyly area, and not far from the Zaysan lake.

Thus, the Shynzhyly locality represents a unique case in southeastern Kazakhstan.

The mammalian bone remains collected by L. K. Didenko-Kislitsina in 1958 and 1964 have previously been determined by M. D. Biryukov as belonging to a tapiroid (*Schlosseria* sp.) and to a rhinocerotoid (the rhino-like *Prochyracodon* sp.), while the fish remains have been referred to *Amia* sp. by G. D. Khisarova (Khisarova in Didenko-Kislitsina 1965, 1999). The turtle remains have been referred to the Trionychidae (Kuznetsov & Chkhikvadze 1974). *Schlosseria* sp. was the first tapiroids to be found in Kazakhstan. Until that date, tapiroids had been found only in the Eocene deposits of China and Mongolia. Later, tapiroids have been discovered also in the Zaysan Depression (Eastern Kazakhstan Oblast'). As a result of the 1968-69 field work by the Palaeobiological Laboratory of the Institute of Zoology of the Academy of Sciences of Kazakhstan, further bones of tapir-like mammals were collected at the Shynzhyly locality. At first, these tapiroids were identified as *Lophialetes* sp., *Schlosseria* sp., and *Teleolophus* sp. by M. D. Biryukov (Didenko-Kislitsina 1971). Later they were described by Biryukov (1974a, 1974b) as a new genus and new species, *Eoletes gracilis* Birjukov, 1974, and a new species, *Teleolophus beliajevi* Birjukov, 1974. Several years later, a new family - Eoletidae Schoch, 1989 - was established for the first species (Prothero & Schoch, 1989). A few years later, the second species - *Teleolophus beliajevi* - was recognised to be a junior synonym of *Teleolophus medius* Matthew & Granger, 1925 (Lucas et al., 1997). A cladistic analysis performed by Lucas et al. (1997) did not find support for a clade Eoletidae because *Eoletes*, *Lophialetes* and *Schlosseria* form a trichotomy. The fish remains previously referred to *Amia* sp. by G. D. Khisarova were later attributed partly to *Amia chinzhalensis* Sytchevskaja, 1986 and partly to *Amia* sp. A part of the turtle sample was ascribed to the geoemidid *Echmatemys chingaliensis* Kuznetsov & Chkhikvadze, 1974. The remaining turtle remains were referred to indeterminate Emydidae and Trionychidae. Finally, some artiodactyl remains were assigned to *Archeomeryx* sp. (Kozhamkulova, 1974; Kuznetsov & Chkhikvadze 1974).

According to the results of the study by the 1994 Kazakh-American expedition team, the rhinoceros remains belonging to *Forstercooperia minuta* Lucas, Schoch & Manning, 1981 (probably the rhinoceros remains previously identified as *Prochyracodon* sp.), and the small mammals *Saykanomys bohlini* Dawson, 1964 (synonym of *Saykanomys chalchae* Shevyreva, 1972), *Saykanomys* sp., *Aksyiromys dalos* Shevyreva, 1984, *Pappocricetodon kazakstanicus* Emry et al., 1998, *Zhungaromys gromovi* Emry et al., 1998, and *Zhungaromys* sp. (Lucas et al. 1997; Emry et al. 1998; Tyutkova 2009) were also found. Excavations by

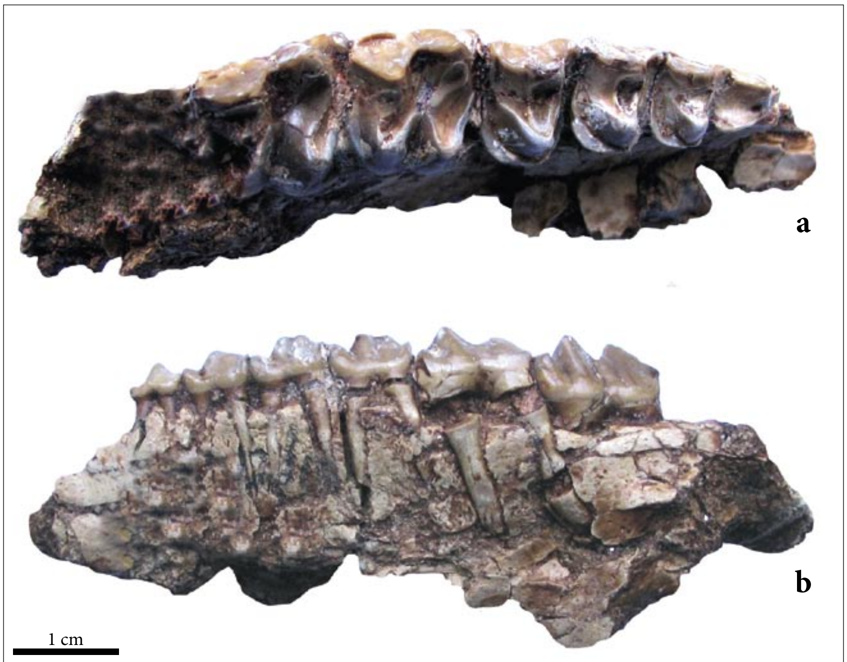


Fig. 6 - *Eoletes gracilis*; the fragment of the [1]36/2-08 upper jaw with P2 ÷ M3 teeth; a) occlusal view, b) buccal view.
- Eoletes gracilis; *frammento [1]36/2-08 di mascellare con i denti P2 ÷ M3; a) norma occlusale, b) norma buccale.*

B.U. Bayshashov and L.A. Tyutkova carried out in two sites in 2008-2009: the main site near the spring of the Teplybrook (Fig. 4; coordinates: 45°53'60.4" N - 80°34'56.2" E) and the site of the leaching surface near the spring of the Teply brook for the small mammals; (Fig. 5; coordinates: 45°53'63.5" N - 80°34'64.5" E) yielded a variety of species that added to the list of tapiroid and rodent species already found in this formation.

The comparison between the new material and that previously found revealed the presence of at least three genera belonging to the Tapiroidea including the taxa *Eoletes gracilis* (Fig. 6), *Eoletes* sp., and *Schlosseria* sp. belonging to the Lophialetidae Matthew & Granger, 1925, *Teleolophus medius* Matthew & Granger, 1925 belonging to the Deperetellidae Radinsky, 1965.

Furthermore, remains of *Rhodopagus* sp. were also recovered (Reshetov, 1975; Bayshashov & Billia 2011; Bayshashov 2012). In this context, the *Rhodopagus* Radinsky, 1965 genus as well as its systematic position deserve a separate mention.

In the past, *Rhodopagus* was classed as a tapiroid of the Lophialetidae family (Matthew & Granger 1925, 1926; Simpson 1945, *inter alios*). At that time, Zdansky (1930: 40) ascribed two lower jaw fragments to "Hyracodontidae gen. and species indet." For his part, Radinsky (1965: 207-214) when assigning *Rhodopagus* dubiously to a lophialetid tapiroid (by using the material previously described by Zdansky) did not escape the fact that Rhodopagus showed some dental characters highlighting that "peculiar upper cusp pattern of Rhodopagus ... set this genus apart from all other previously described tapiroids" (just as in Radinsky, 1965: 207). These characters were able to corroborate the thesis that *Rhodopagus* was a tapiroid with a characteristic dentition "probably due to convergence" (Radinsky, 1965: 214).

For this genus, Reshetov even established the new Rhodopagidae Reshetov, 1975 family (Reshetov 1979). A decade later, Lucas & Schoch (1981) carefully investigated the Rhodopagus dentition concluding that the genus - because of its peculiar odonto-morphological traits - must be included in the hyracodontid family (Lucas & Schoch 1981: 50) Finally, in compliance with the criteria proposed first by Lucas & Schoch (1981), Prothero & Schoch (1989), and later by McKenna & Bell (1997) *Rhodopagus* falls into the Hyracodontidae Cope, 1879 family, Rhinocerotoidea Gray, 1925 superfamily.

Taking up the topic concerning the aforementioned tapiroids (*Eoletes gracilis*, *Eoletes* sp., *Schlosseria* sp., and *Teleolophus medius*). These taxa are rarely found together at the same locality. The dating of the fossil-bearing section was based on tapiroids and rodents biostratigraphy.

In China, these genera/species are known from the middle Eocene deposits of the Arshanto, Irdin Manha and Shara Murun localities (Inner Mongolia Autonomous Region) (Matthew & Granger 1925; Radinsky 1965).

The tapiroid *Teleolophus medius* has been reported also from the early Eocene Andarak-2 locality of Kyr-

Fig. 7 - The geographical location of the middle Eocene section in the Shynzhyly riverbed. Base and top of the section (1 and 2, marked with red squares), the Shynzhyly river (left side) as well as the A-350 Kabanbay-Usharal Highway (right side) are visible (from Google Earth).
- *Localizzazione geografica della sezione (Eocene medio) dell'alveo del fiume Shynzhyly. Sono identificabili i due quadrati rossi (1 e 2) che indicano la base e il tetto della sezione, il fiume Shynzhyly (riva sinistra) e la superstrada A-350 Kabanbay-Usharal (lato destro).*

gyzstan together with *Eoletes tianshanicus* Averianov & Godinot, 2005 and the marsh rhinoceros *Sharamynodon kirghisensis* (Belyaeva, 1971) (Aver'yanov & Godinot 2005). Fossils and facies show that the southeastern part of Kazakhstan was then occupied by lakes and the climate was subtropical and humid. Tapirs dwelled the near-water environments and spent most of their time immersed in water. The bone accumulation of various tapiriforms and fishes testifies the lake-coastal landscape of territory.

Based on the archaic characters of *Eoletes*, Biryukov (1974a) suggested that the Shynzhyly deposits dated to the end of the early Eocene or to the beginning of the middle Eocene.

The hare-like and rodent mammals show affinities with the Obaylin Formation (middle Eocene) of the Zaysan Depression (Tyutkova 2009).

The fossil microflora of the Shynzhyly locality is represented by gyrogonites of charophytes. Zhamangara & Lucas (1988) identified five species of charophytes belonging to the family Characeae and the genera *Sphaerochara, Psilochara* and *Stephanochara*. Based on more detailed studies performed on the morphological and morphometric characteristics of the gyrogonites, it is now possible to revise the taxonomic status of the species of *Stephanochara*. The specimens previously referred to *Stephanochara kazakhstanica* Zhamangara & Lucas, 1988 and *Stephanochara shinzhalyensis* Zhamangara & Lucas, 1988 are currently assigned to the genus *Lychnothamnus* following a revision of this genus (Soulie-Märsche 1989).

Based on the vertebrate remains, the Shynzhyly deposits are dated to the middle Eocene. The charophytes were collected stratigraphically above the vertebrate-bearing layers; therefore, they may give a somewhat younger dating respect to the vertebrate remains. In Europe, the genus *Psilochara* appears in the *Maedleriella embergeri* zone (lower part of the early Lutetian-middle Lutetian; Riveline et al. 1996) *Sphaerochara hirmeri* (Rasky, 1945) Mädler, 1952 and *Psilochara conspicua*

Fig. 8 - A: a section of the bone layer with the indication of the bone remains location; B: rear-roots of tapiroform teeth; C: large cranial fish bones.
- *A: sezione del livello con ossa con la posizione di alcuni frammenti ossei; B: radici posteriore di denti di tapiriforme; C: osso craniale di pesce.*

Grambast, 1958 (late Eocene-early Oligocene, the north-western European basins) are known in Europe, but they are not associated in the lower Headon beds of England (Rivelinex 1986). *Lychnothamnus:* is an Eurasian genus (*Lychnothamnus stockmansii* ranges from the Upper Eocene (middle Priabonian) to the Lower Oligocene (lower Rupelian) of Asia and Europe) that appeared in the Upper Eocene and is still present.

Correlation of the Shynzhyly charophyte association indicates similarities with that of the Awate Formation of the northern part of the Tarim Basin (northwestern China) which is dated to the late Eocene-early Oligocene (Lu & Luo 1990). The charophytes from the Awate Formation of the Tarim Basin belong to the *Stephanochara yengisuensis-Spharochara chinensis-Tolypella rugulosa* association.

5. The section and its stratigraphy

In 2017-2018, studies on the Shynzhyly section were carried out. A great attention was paid for the first time to the analysis of the biofacies in order to determine the dynamic habitat conditions of biota and the mode of burial of the organic remains in the clay.

The location of the basal (red square 1) and top (red square 2) parts of the Shynzhyly section is shown in Fig. 7.

The base of the section (Fig. 7, red square 1) is located 115 m east-north-east of the Shynzhyly river bed and 200 m west of the A-350 Kabanbay-Usharal Highway. It is made of loose deposits of middle Eocene age.

The top of the section (Fig. 7, red square 2) is located 102 m south-west of the beginning one and 205 m east-north-east of the Kabanbay-Alakol Highway on the right bank of the Shynzhyly river.

A detailed description of the section is presented below, divided into two paragraphs respectively referring to the base of the section and to its top.

5.1. The base of the section

The basal part of the section is 2.59 m-thick. From the base to the top, it is subdivided into eight beds.

Bed 1. The first layer is made of dirty pinkish and spotted clay with thin veins (up to 10 mm thick) which are not parallel to bedding. These veins are located parallel to each other and filled with iron hydroxides. Rare medium-fine-grained quartz grains are found in clays. When drying the clay, shrinks, swells and breaks in small fragments. The thickness of this layer is 15-18 cm;

Bed 2. Quartz sand and bluish-gray montmorillonite clay characterise this layer. When wet, it can be easily broken with fingers becoming sticky. The color of deposits appears to be uniform. The sand is not cemented. Quartz grains are rounded, semi-rounded, or angular, having a generally elongated shape. Sand grain size ranges from coarse to fine. Within the sand, small lenses (1x2 to 2.5 cm in size) of bluish-gray clay are rarely found. Dispersed in the bed and parallel to its bedding plane, there are numerous large bone remains of the mudfish *Amia* Linnaeus, 1766 (Family Amiidae Bonaparte, 1838) (determination by G. D. Khisarova, in Didenko-Kislitsina 1965, 1999). Their opercular elements are up to 5-6 cm in size, with their convex side facing upwards. The boundary with the overlying bed is irregular, wavy. The thickness of bed 2 is 18 cm;

Bed 3. This layer is characterised by reddish-pink mudstone with elongated lenses of light olive clays. On the bedding planes, fragmentary remains of *Amia* are present. In the upper part of the bed, the reddish-pink-red clay sands contain elliptical lenses of light olive clays 0.5 x 1.0 cm and 0.5 x 0.2 cm in size. Uneven bands of reddish-pink sandy clay and pinkish-gray clay layers are also present. The vertical thicknesses of the layers of pinkish-gray clay are variable with mudstone layers whose bedding surfaces are uneven, wavy. In the upper part of the bed, among reddish-pink mudstone, irregularly rounded inclusions of pinkish clay are found, which are mostly arranged randomly. This bed is relatively well exposed along the strike and is 15 cm-thick;

Bed 4. This layer is made of bluish-gray montmorillonite clay containing rare quartz grains of medium and small size. The quartz grains are usually uneven and sometimes form small lenses (mostly 1x2-3 cm in size). The bluish-gray clay includes bone fragments of vertebrates. They are essentially small operculars and vertebrae of *Amia*. They are distributed unevenly in the bed, in the form of separate and randomly arranged clusters or just as scattered fragments. Tapiroid bones were also found in this bed. Since bones were unearthed mainly in the lower part of the bed, this has been dated as middle Eocene (Biryukov 1974a, Biryukov 1974b; Bayshashov 2012).

The sediment was burrowed by mollusks (thus, it is bioturbated), and is brick-red or dark-cherry in colour. The boundary with the underlying bed, is uneven, wavy, sometimes pocket-like.

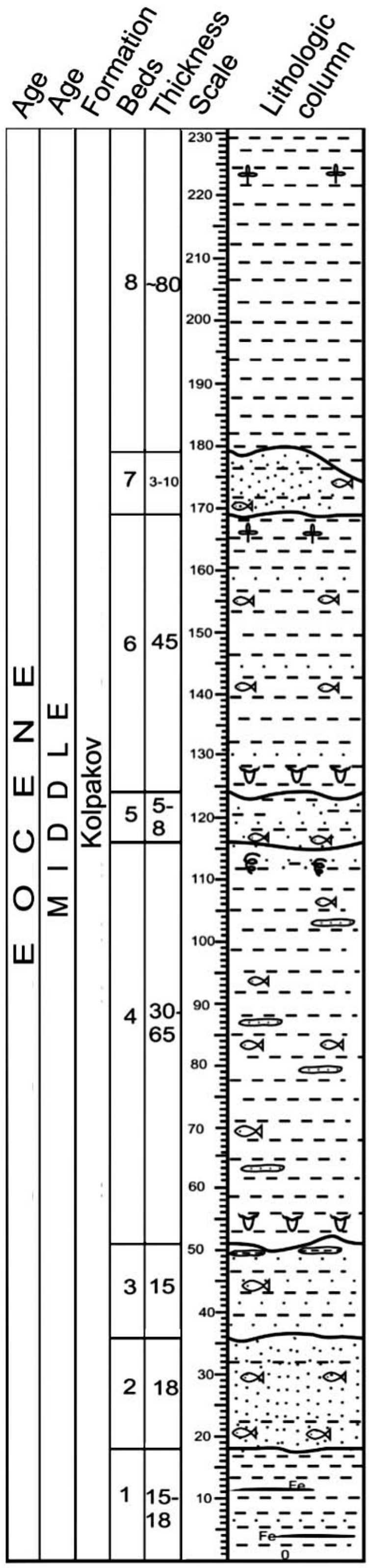
In the upper part of the bed, there is a thin layer of dirty pink clay with irregular and rounded-angular silty inclusions with size ranging from 1x1.5 to 5x8 cm).

Along the strike, the bed gradually wedges out. The thickness of the bed 4 ranges from 30 to 65 cm.

Bed 5. This layer is characterised mainly by medium-grained quartz sand and bluish-gray montmorillonite clay (quartz sands in prevailng). Like bed 2, rare large remains of the opercular bones of amiid fishes are preserved. The remains of fish bones are mostly fragmentary. The boundary with the upper and lower beds is uneven and wavy. The bed changes in thickness laterally and gradually wedges out. Its length is approximately 1.5 m. The surface has a curved outline. The thickness of this bed ranges from 5 to 8 cm;

Bed 6. This layer is an uneven alternation of dirty-pink clay and bluish-pinkish-gray and sandy clay. The base of the bed is composed of dirty-pink clay with admixture of quartz sand causing a change in color intensity from the bottom to the top. In other words, the color is more saturated at the base and gradually gets lighter moving toward the top (~ up to 13 cm). This bed contains skeletal remains of small-sized amiid fishes, which are arranged horizontally on the bedding surface. In some places - especially in the lower part of the bed - there are rounded nodules (size 0.5 x1 cm or less) of olive-gray unaltered clays. Above the bed, the light-pink sandy clay (which is parallel to the bedding) contains bone fragments of amiid fishes, mainly large and small opercular shields and vertebrae. The thickness of bed 6 ranges from 5 to 8 cm. Above the sands, spotty-light-pink clay with rare bone remains of amiid fishes and fragmentary remains belonging to tapiroids (isolated teeth and small bones) are confined to the lower part of the bed. Above the bed 6 there are spotty pinkish-blue and clayey sands with bone fragments of amiid fishes. The interlayer is not conituous laterally: it often breaks, and its surface is irregular. The thickness of the interlayer varies on average from 2 to 3 cm. In the clay sand, small bone fragments of amiid fishes lie horizontally along the bedding planes. The boundary with the lower and overlying layers is uneven and wavy. Moving from the bottom to the top of the bed, the colour intensity changes from light pink tones to dark pink. The thickness of this bed ranges up to 45 cm;

Bed 7. This layer is composed of brick-red clay sand with large rounded to rounded-elongated inclusions of light olive-gray clay sand (varying in sizes: 2x1.5, 3x2.5, 3x1.5, and 1x1 cm). The brick-red color is most likely secondary as there are inclusions with primary unchanged color. Quartz grains are sparse in the clay. In most inclusions, the central part is sandy with a thin clay cortex. The quartz grains of the sand are of medium and coarse size, both rounded and semi-



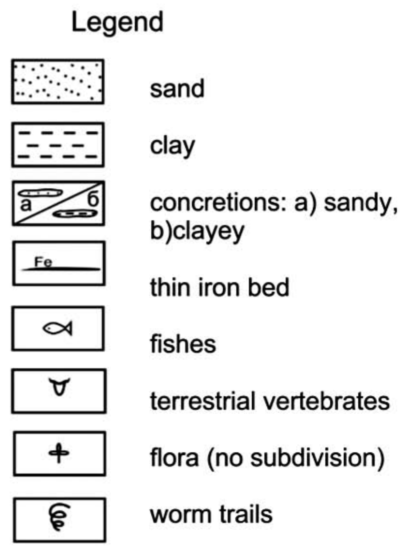


Fig. 9 - Stratigraphic column of the Shynzhyly section (drawn by P.E. Pirogova).
- *Colonna stratigrafica schematica della sezione Shynzhyly (disegno di P.E. Pirogova).*

Fig. 10 - Bed 1. A round-elongated inclusion with primary, not altered, red colour is clearly visible in the lower part of the bed.
- *Strato 1. Inclusione allungata-arrotondata con colorazione primaria, ben visibile nella parte inferiore dello strato.*

rounded. Throughout the whole bed, the skeletal remains of amiid fishes are highly fragmented, sparse within the bed, often randomly but sometimes parallel to the bedding planes. The boundary with the lower and overlying beds is uneven and wavy. The thickness of this bed along the strike is rather variable, ranging from 3 to 10 cm.

Bed 8. This last layer of the basal section is characterised by dirty clay covered with olive gray clay. Due to clay alteration processes, it is very difficult to describe this bed. In its upper part, rare spots of carbonate composition are irregularly found, but they can be clearly traced along the strike. This bed lacks bone remains. The exposed part of this bed has a thickness of 80 cm.

The stratgraphic column of the Shynzhyly section is shown in Figs 8 and 9.

5.2. The top of the section

The top of the section measures 3.43 m in thickness. From the base to the top, it is subdivided into five beds.

Bed 1. The base of this layer is covered by water till to a depth of about 1 m. The bed is composed of pink-red clay. Closer to the top of the bed, rare, large and roundly elongated inclusions of light olive-gray clay are distinctly visible along the strike (Fig. 10).

On average, their size varies between 5x5 and 3.5x4 and less centimetres. The inclusion have a rim of brick-red and dark-pink color (mainly 2-3 cm thick). These colours gradually merge with the colour of the surrounding rock (there are no clear boundaries among them). From the bottom to the top, there is a change in the colour ranging from pink to light-olive. The boundary with the overlying bed is uneven and wavy. The thickness of this bed is ~1.2 m;

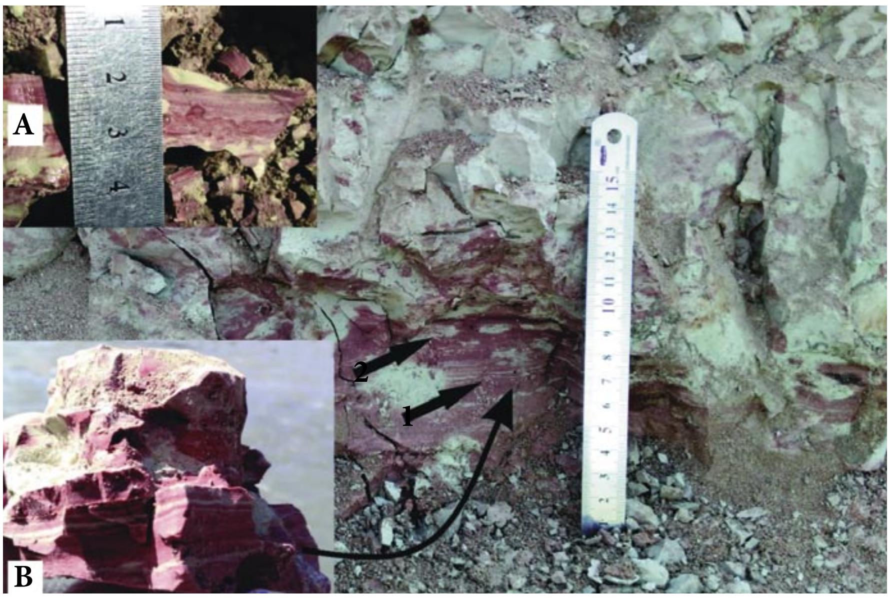


Fig. 11 - Bed 3. The layered clay in the lower part of the bed: A) partial texture disturbance and erosion in the lower part of the bed; B) layered clay fragment: the arrow shows its sampling place in the outcrop; the lenticular-elongated inclusions of light-olive clay inside the cherry-red clay.
- *Strato 3. Argille laminate nella parte inferiore dello strato: A) disturbo ed erosione parziale della laminazione nella parte inferiore dello strato; B) frammento di argilla laminata: la freccia indica il luogo campionamento nell'affioramento; inclusioni allungate lenticolari di argilla verde-oliva in argilla rosso-ciliegia.*

Bed 2. This layer is composed of light olive clay with spots of pink and light-pink clay. In places, the clay is highly fractured due to its shrinking and swelling (size of fragments varies from 2 to 5 cm). A few carbonate spots can be also observed, which are unevenly distributed within the clay. The thickness of this bed is ~60 cm;

Bed 3. This bed consists of a laminated and thin clay layers with colors ranging from dark-pink to brick-red and a prevailing thin, plane-parallel and gently wavy layering. The thickness of the laminae ranges from 1 to 3 mm. The colour of the laminae is most likely secondary. Upwards in the bed, the stratification disappears. In cherry-red clay, horizontally arranged and lenticular-elongated inclusions of light-olive clay are clearly visible (Fig. 11, B). Rare, small fragments of bones of amiid fishes were found in the layered clays. The boundary with the underlying and overlying beds is uneven and wavy. In the lower part of the bed, erosion and partial texture disturbance are observed (Fig. 11, A). There are also rare carbonate concretions, often located parallel to the bedding planes. The thickness of this bed is ~18 cm;

Bed 4. This layer is composed of pale-pink and silty clay that is highly fractured due to its shrinking and swelling. The fragments are of different sizes, from 3-5 to 10 cm or more. The thickness of this bed is 105 cm.

Bed 5. This layer is composed of medium-grained sand and spotty, light-olive clay. On the weathered surface, spots of ?gypsum or salt are clearly visible. The bed is well-traced along the flank of the right bank of the Shynzhyly river. The thickness of this bed is 40 cm.

The section is overlain by the brick-red and weathered ?Oligocene deposits.

6. The terrigenous sedimentation in the Kolpak Depression

The analysis of the composition of the sediments of the Shynzhyly section and their grain size distribution suggests that they represent lacustrine facies close to the central part of the lake. This is suggested by the absence of wave ripples on the surface between the beds as well as by the absence of coarse clastic deposits (pebbles, coarse-grained sands). In accordance with the scheme proposed by Twenhofel (1936), the composition of the sediments described above for both the basal and the top sections is confined to the inner zone of the basin. In the central part, the section is composed of coarse quartz sands, silts and montmorillonite clay (bentonite), corresponding to the hydrodynamic zonality referred to the zone below the wave base with a shallow coast (at the base of the section there is a sandy silt layer and there is no coarse clastic material). The filling of the central part of the lake is made up of clay deposits and - to a lesser extent - with sand transported into the lake by one or more rivers. It is also possible that the sediment deposition was due to collapse and erosion along the coast and transport by the currents of the river(s) to the deeper waters of the lake.

Based on the orientation of the organic remains in the sediments, we may identify the direction of the water current that transported them to the deeper parts of the lake. In field studies, it was noted that the opercular elements of the fishes are asymmetrical and conical in shape, slightly widened. In the clay beds, they have the convex side directed upward and the pointed part that is presumably parallel to the direction of the water current. Following Reinek & Singh (1981), it can be assumed that the pointed end is directed against the current flow. The tapir bones found in the clays of the beds 5 and 7 also have a directional arrangement that coincides with the direction of the water flow, as for the bed 2; it is only noted that the thinner end is directed forward and the long side is parallel to the direction of the flow. Because of the presence of small aggregates of gypsum and anhydrite in the clay and, conversely, the scarcity of organic matter in it, it can be assumed that the water of the lake was hypersaline. Clay deposits are spotty in colour: the primary colour appears to be olive-gray, whereas the secondary one (which is predominant) is reddish with different shades. This is due to the presence of iron minerals.

In the middle Eocene, the Kolpak Depression region was characterised by a basically humid and temperate-subtropical climate with abundant rainfall and an extensive development of the vegetation. Because of washout, clay sediments where transported and deposited into the sedimentation basin from adjacent areas. The wet climate of the region is also attested by the presence of coalified plant debris in the sediments of the section, i.e., the organic matter in the weakly drained sediments did not have time to decompose and was replaced by black iron sulfides, as it was observed in the bed 8 of the section along the "Teply" brook. Olive-gray (primary) color and its different shades are due to ferrous iron (Fe_2) contained in the nontronite, which formed in a reducing environment with a high content of organic matter and a low sedimentation rate.

Furthermore, small and thin (up to 2-3 cm) parallel veins of diagenetic pyrite are present in the lower part of the section (beds 1 and 2) in clay sands of the excavation on the bank of the "Teply" brook. The red colours of the deposits and its various shades contain oxide iron (Fe_3) formed in an oxidizing environment. The secondary red color of deposits and its different shades may indicate the conditions of gradual climate change (a drying up) in the region as a whole. The iron minerals underwent secondary changes during alternating periods with abundant tropical rains and warm and dry climate, with the formation of a spotty red colour in the deposits.

Montmorillonite, the formation of which occurs only in an arid and temperate climate, is also the main mineral indicator of the arid climate of the region (Reinek & Singh 1981: 131).

Quartzite, biotite, feldspars, and other minerals typical of tuffs and volcanic rocks are found from clastic grains. This is due to weathering which, in some cases, interfere in the formation of montmorillonite clays. Usually, montmorillonite clays are the product of underwater ash alteration in marine settings, but they also occur on land in the weathering crust of the exposed primary rocks and as a product of resedimentation.

Nontronite clays are characteristic only of the weathering crust of the exposed igneous rocks. Their significant accumulations in other deposits are still unknown. A different framework is observed in the section on the right bank of the Shynzhyly river: any organic residues are practically absent in the sediments, the spotty color is also practically absent. However there is a gentle and shallow horizontal stratification consisting of red-brick and olive-gray layers with further layers of agglomeration and partial creep. It can be assumed that puffs with red clays were formed as a consequence of the introduction of currents from the adjacent upper sections into deeper ones, so that organic substances were mixed in silt in various quantities, and iron oxides could be reduced and converted to sulfate salts with a consequent loss of red colour and turning it greenish-gray colours.

In accordance with the composition of sediments and the presence of organic residues in them, it can be assumed that the deposits at the excavation site (section 1) have formed in a shallower part (there is more coarse clastic material, the layers are unstable, wedge-shaped along the strike in the lower part of the section). Otherwise, the deposits of section 2 would have formed in the deepest part of the basin (there is a gently wavy and superficial horizontal stratification, no presence of organic matter).

The selection of the beds along the sections 1 and 2 is based on their cyclical formation, which was determined during field studies. Relatively clear interlayer boundaries are noted for the different colours of each bed. The comparison with the modern conditions shows that the temperature of the river water is lower than that of the lake water and - therefore - more severe.

During precipitations, the transported detrital material was divided into fractions: the coarser and heavier one - in this case, the quartz sand - for first settled to the bottom, that light one - silts and clays - for some time remained in suspension, then precipitated. The presence of bottom currents associated with the underwater activities of the rivers can be attested by the presence of sediment agitation textures and interlayer shallow ripples which is clearly observed in the beds 5-8 of the "Teply" spring excavation.

On average, the height of the ripples varies between 2.5-3.5 cm and its length may reach 10 cm. The density currents of the underwater channels were active as also evidenced by the presence of a small quantity of sand fraction in the overlying clay deposits transported by the streams to the lower parts of the basin. Here, in the description of the section the texture features are given starting from the bed 5. Depending on the dynamics of the water flow and the organic matter washed away from the coastal part of the lake and transported to the lower parts of the basin, the following distribution can be observed: it can be assumed that - according to the data relating to the local precipitation and humidification regime - in the middle Eocene within the development of the Kolpak Depression, there was a region with a variable-humid climate possibly with a partial drying up. This is indicated by the presence of layers of well-rounded and sorted quartz sand in the terrigenous part of the section.

Moreover, the red clay is mixed with plant detritus and interspersed with carbonaceous clay in sandy-clay sediments. In addition, the presence in the region of an alternating humid climate is testified by a reduced amount of carbonate content of sandy-clay continental sediments by an increase in the amount of clay from the bottom to the top, and by an increase in iron content. Hydroxides are found in different shades of red although carbonate red-flowers are more common in a dry climate. Delta and continental facies are also present, as it attested by the charophytes and vertebral remains (fragmentary remains of fishes and tapiroids).

In the southeastern Kazakhstan depressions, the continental sedimentation dominated throughout the Paleogene. A long stage of accumulation of red and variegated sediments preceded the late Eocene.

Beginning in the Late Cretaceous, this stage continued almost to the end of the middle Eocene. It was characterised by an extremely passive tectonic regime and powerful chemical weathering. The result of these processes was the accumulation in the erosive-tectonic depressions of the Kazakh Shield (the Altay and the Tien' Shan Depressions) of a relatively thin stratum - intensively transformed by weathering - of red-variegated sediments covering a wide age range.

It is important to note that in Eastern Kazakhstan - even before the beginning of the Late Eocene - the boundary of the ancient climatic section, passing approximately between 47°-48° N, was already clearly outlined. To the north of this border - in a certain number of areas - humid kaolin motley flowers were formed enclosing leaf prints, spores, and pollen of a moisture-loving flora.

To the south of the above mentioned boundary, typical arid montmorillonite motley flowers with gypsum and carbonates accumulate. Thus, at the beginning of the late Eocene two palaeoclimatic zones were present in Kazakhstan: an arid southern one and a humid northern one. The boundary between these zones is well-traced in the upper Eocene and lower Oligocene.

It should be noted that the Eocene-Oligocene boundary was not marked by any drastic geological changes in the Kazakh Shield as well as the adjacent mountains. At the Eocene-Oligocene boundary, no large tectonic movements are recorded. Thus, more or less large-scale activation of tectonic movements in vast areas of northwestern Asia occurred somewhat earlier, at the end of the early middle Eocene-beginning of the late Eocene. In Kazakhstan, this produced a sharp change in lithology in those areas characterised by continental sedimentation: the accumulation of kaolin varieties ceased everywhere in the wet palaeoclimate zone. During the late Eocene and under subtropical and warm climate conditions, a coloured pyritic-carbonate sequence began to deposit. Further south of this area, carbonate red layers accumulated in the arid palaeoclimate zone. During the early Paleogene, the climate separation line ran approximately in latitudinal direction within 47°-48° N.

A change in the composition from the upper Eocene deposition - coarser and more dynamic in the facies profile - to the early Oligocene one - with thinner and more persistent clay deposits - indicates a gradual decrease in the intensity of tectonic movements and the beginning of leveling of denudation areas. The progressive global cooling of the climate, which began at the end of the late Eocene, markedly increased in the early Oligocene. The spread of the Turgai temperate broadleaf flora began during the earliest Oligocene in Kazakhstan, reaching its full expression during the late Oligocene.

7. Taphonomical remarks

The biofacial analysis of sections in the area of the right bank of the Shynzhyly river is based on the presence in the section of organic remains. Charophyts apart, they are mainly represented by sparse bones referred to amiid fish and tapiroids. Bone remains are mainly found in the section of the "Teply" brook. In the section on the right bank of the Shynzhyly river, only small fragments of fish bones are occasionally found. At the base of the section along the "Teply" brook, fossil macroremains are completely absent. Higher in the section, they are unevenly distributed.

In the lower part of the section, bone fragments and large opercular bones of amiid fish are common. The middle part of the section contains tapiroid remains (small osteo-joints and teeth) as well as small fish vertebrae. In the upper part of the section, fragmentary fish vertebrae are practically absent. In the uppermost portion of this last part, a layer of indeterminate small and coalifie plant remains is exposed along the strike.

Thus, the structure of the vertebrate-bearing beds and the sedimentology of the Eocene deposits from the northwestern foothills of the Dzungarian Alatau show that lacustrine basins occupied a larger area at that time. By the end of the Eocene, the deposition of variegated and red-coloured clays increased, testifying a gradual climate drying up and a shallowing of the lakes.

Therefore, the climate and the kind of sedimentation changed at the Eocene-Oligocene boundary in Kazakhstan.

During the Oligocene, the climate became more and more arid, as evidenced by the widespread prevalence of red-coloured clays with gypsum, an increase in coarse-grained sediments and an almost complete absence of finely dispersed clays. In the Miocene and Pliocene, the colour of the rock changed to predominantly fawn. This is one of the signs of the drying out and cooling of the climate. During the Oligocene, the landscape of Kazakhstan became savannah-like as a consequence of the climate change.

8. Correlations with the Eocene of Friuli Venezia Giulia and Italy

During Eocene the current Kazakhstan area appears as an emerged land, bordered to the south by coastal and lake areas that lead to a shallow basin, predominantly terrigenous, which extends east-west, up to the Iberian area, to pass up to the deeper sea areas with carbonate platforms, witnesses of the gradual closure of the Tethysian ocean, and which extended to the current Anatolian-Balkan and Italian area.

In detail, at the edge of these "Mediterranean" marine areas, conditions similar to those described in this note have developed, in areas such as the north of today's Tunisia, France and the Iberian Peninsula, as well as emerged areas - albeit not clearly continental - are also present in part of Northern Italy.

It is interesting to compare the faunas of two sectors that until the beginning of the Mesozoic were at the northern edge of the great Tethysian Ocean, the closure of which involved, while remaining at similar latitudes, an obvious and clear differentiation in the fauna.

The Eocene of the Friuli Venezia Giulia Autonomous Region of northeastern Italy is exclusively marine and dominated by carbonate platform deposits and silicoclastic units (the basinal turbidites of the Flysch and the non-turbiditic final filling of the flysch basin) (Carulli 2006). The only evidences of terrestrial life are scattered plant remains transported into the sea by the rivers and winds (Muscio G., pers. comm.). Therefore, correlation with continental sections of Central Asia is not directly possible. The only taxon shared by the Friulian palaeontological record with the Kazakh site here reported is the fish of Amiidae family. However, the amiid from Friuli (*Amiopsis prisca*) is Barremian (Cretaceous) in age and is preserved into marine deposits (Dalla Vecchia et al. 2008; Dalla Vecchia 2008).

In Italy, Eocene rocks of continental origin crop out in Veneto and Sardegna regions (Kotsakis et al. 2005).

The main Veneto locality is that one of the Purga di Bolca-Vegroni in the Alpone Brook valley of the Lessini Mountains in the Verona province. At the Monte Purga (near the famed village of Bolca), a section 10-20 m-thick of rocks originated in a freshwater-brackish environment crops out, which contain fossil-bearing horizons and coal seams. Barbieri & Medizza (1969) dated the volcanic neck of Monte Purga to "post-Cuisian" times, and got a radiometric age of 36 Ma (i.e., Priabonian, late Eocene). This locality yielded plants remains (including the palm trees *Eolatanites* and *Hemiphoenicites*), fresh water turtles (*Neochelys capellinii* (De Zigno, 1889) and *Trionyx* (*Amyda*) *capellinii* Negri, 1892), crocodiles (*Crocodylus vicetinus* Lioy, 1865; *Asiatosuchus*, *Hassiacosucus, Pristichampsus* and *Diplocynodon*), a snake ('*Coluber*' *ombonii*), insects and fresh water and terrestrial mollusks (e.g., *Helix damnata*, *Cyclotus obtusicosta*, *Melanopsis vicetina* and *Planorbis muzzolonicus*), but not mammals (Giusberti et al. 2014). Fossiliferous transitional deposits of 'middle' Eocene age with terrestrial plants, reptiles (small crocodiles) and invertebrates (including insects) had been found in other localities of western part of the Veneto region during the 19th century (Monte Pulli, Fosse di Novale), but unfortunately their fossil content has not been recently revised. However, a maxillar fragment of the anthracotherid *Prominatherium* cf. *dalmatinum* has been reported from Grancona locality (Vicenza) by Bona & Grandi (2014), who suggested a late Eocene age for it. The oldest Anthracotherids are from the uppermost middle Eocene of Asia (Ghezzo & Giusberti 2016), but they are not reported in the Kazakh association that is the object of this paper.

In Sardegna, Eocene mammals are known from two localities of the Sulcis area, Terras de Collu and Bacu Abis coal mine (Kotsakis et al. 2005). The first one yielded two endemic perissodactyls (*Paralophiodon sardus* and *Atalonodon monterini*) whereas the second yielded teeth of the large marsupial *Amphiperatherium* (Kotsakis et al. 2005). *Paralophiodon sardus* and *Amphiperatherium* specimens were found within coal-bearing (lignite) sections of middle Eocene age, whereas *Atalonodon monterini* is from lower Eocene marine limestones (Kotsakis et al. 2005). Although endemic species, these taxa have a European affinity (Kotsakis et al. 2005), therefore comparisons with the Kazakh mammals is not possible.

The most important locality for Paleogene mammals in northeastern Italy is that of Monteviale, near the town of Vicenza in the Veneto region. Also in this case, the specimens were found within a coal-bearing (lignite) section, which is placed in the lower Oligocene close to the Eocene-Oligocene boundary (lowermost Rupelian, MP21 Mammalian Paleogene Zone) (Kotsakis et al. 2005; Pandolfi et al. 2016; Ghezzo & Giusberti 2016).

The relatively rich mammalian association is dominated by endemic taxa, which probably lived on a short-lived volcanic island emergent from a lagoon between the land (located to north) and the coral reef (located to south) (Ghezzo & Giusberti 2016; Pandolfi et al. 2016). It includes Dugongidae, the ?pantolestan *Epapheliscus italicus* Van Valen, 1966 and ?*Pantolesta* incertae sedis, the large bats *Archaeopteropus transiens* Meschinelli, 1903, the basal rhinocerotid *Epiaceratherium bolcense* Abel, 1910, the anthracotheriid *Anthracotherium monsvialense* De Zigno, 1888, *Anthracochoerus stehlini* Dal Piaz, 1931, *Anthracochoerus fabianii* Dal Piaz, 1931 and the palaeochoerid ?*Propalaeochoerus paronae* Dal Piaz, 1930. (Pandolfi et al. 2016; Ghezzo & Giusberti 2016). The occurrence of *Epiaceratherium*, *Anthracotherium* and ?*Propalaeocherus* in the NE Italy fauna shows its affinity with late Eocene faunas of southern and western Asia. It is indicative of a land connection via an island chain between southern Europe and Asia at the beginning of the Oligocene (Pandolfi et al. 2016; Ghezzo & Giusberti 2016). However, no affinity exists with the Kazakh mammal association here described.

Reptiles are represented at Monteviale by the crocodylian *Diplocynodon* cf. *D. muelleri* (see Macaluso et al. 2019), the trionychid turtle *Trionyx italicus* von Schauroth, 1865 and the geoemydid turtle *Bergouniouxchelys vallesnerii* (Bergounioux, 1954) (Pandolfi et al. 2016; Ghezzo & Giusberti 2016). The amphibians are represented by tadpoles of the anuran *Palaeobatrachus* sp. and fish by the small osteichthyan '*Lepidocottus*' *papyraceous* (Agassiz, 1832) (Pandolfi et al. 2016). Also in this case, no taxa are shared with the Kazakh association here described.

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Аннотация: На территории восточной части Казахстана уже с конца палеозоя - мезозоя установился континентальный режим. В кайнозое на этой территории существовало большое количество крупных и мелких озер и рек, что способствовало сохранению большого количества остатков фауны и, в меньшей степени, флоры от палеогена до плейстоцена. Эти палеонтологические материалы имеют чрезвычайно важное значение для стратиграфии и реконструкции палеоландшафтов Юго-Восточного Казахстана. В этом отношении одна из важнейших палеогеновых отложений - это местонахождения Шынжылы (ранее Чинжалы), на правом берегу одноименной реки, недалеко от пос. Кабанбай (Юго-Восточный Казахстан), где была обнаружена многочисленная фауна эоцена. Отложения описано как среднеэоценовая «калпаковская свита». Здесь было обнаружено по крайней мере три различных рода, принадлежащих к надсемейству Tapiroida: *Eoletes gracilis, Eoletes sp.* и *Schlosseria sp.* (семейство Lophialetidae) и *Teleolophus medius* (семейство Deperetellidae). Есть также останки двух примитивных носорогов *Forstercooperia minuta* и *Rhodopagus sp.*, микро-млекопитающих (*Saykanomys bohlini, Saykanomys sp., Aksyiromys dalos, Pappocricetodon kazakhstanicus, Zhungaromys gromovi, Zhungaromys sp.*, черепах, относящихся к семейству Trionychidae, костистых рыб рода *Amia* (отряд Amiiformes). По этим окаменелостям шынжылинские отложения был датирован средним эоценом. Пять видов харофитов (филум Charophyta, семейство Characeae) идентифицированы родам *Sphaerochara, Psilochara и Stephanochara*. Харофиты происходят из уровней стратиграфически выше тех, из которых происходят остатки костей и, следовательно, более молодые по сравнению с остатками ископаемых животных.
Ассоциация шынжылинских харофитов сходна с ассоциацией аватской свиты (залегающей в северной части бассейна Тарим, на северо-западе Китая; ассоциация *Stephanochara yengisuensis - Sphaerochara chinensis - Tolypella rugulosa*) датируется поздним эоценом - ранним олигоценом. Наконец, описанное местонахождения сравниваются с современными континентальными отложениями северо-восточной Италии.
Ключевые слова: палеоген, эоцен, палеонтология, стратиграфия, фауна позвоночных, харофиты.

Tu'jyrym: Geologialyq ereksheli'kteri'ne bailanysty, Qazaqstan paleogennen pleistotsenge deii'ngi tabylg'an qazba januarlar qaldyqtaryna o'te bai. Osyg'an bailanysty, man'yzdylarynyn' bi'ri' - bu'l Shynjyly (bu'ryng'y Chinjaly), attas o'zennin' on' jag'alauynda, Qabanbai auylyna jaqyn jerde ornalasqan paleogen (eotsen) sho'gi'ndi'leri'. Sho'gi'ndi' qabattary orta eotsenni'n' kalpakov svitasy reti'nde sipattalg'an. Mu'nda Tapiroida tu'qymdastaryna jatatyn, kem degende y'sh tu'qym ty'rleri' tabyldy: *Eoletes gracilis, Eoletes sp.* ja'ne *Schlosseria sp.* (Lophialetidae tu'qymdasy) ja'ne *Teleolophus medius* (Deperetellidae tu'qymdasy). Sondai-aq, my'ii'ztu'msyqtardyn' eki' ty'ri'ni'n' *Forstercooperia minuta* ja'ne *Rhodopagus sp.*, u'saq-sy'tqorektilerdi'n' *Saykanomys bohlini, Saykanomys sp., Aksyiromys dalos, Pappocricetodon kazakhstanicus, Zhungaromys gromovi, Zhungaromys sp.*, tasbaqalardyn' Trionychidae tu'qymdastary, balyqtardyn' *Amia* ty'rleri'ni'n' qaldyqtary tabyldy. Osy qazba qaldyqtaryna bailanysty Shynjyly sho'gindileri orta eotsenge jatqyzyldy. Tabylgan harofittedrdi'n' *Sphaerochara, Psilochara* ja'ne *Stephanochara* tu'qymdastaryna jatatyn bes ty'ri' anyqtaldy. Qazba januarlarynyn' qaldyqtarymen salystyrg'anda harofitter tabylg'an qabat jog'ary ornalasqan. Shynjyly harofitter qauymdastyg'y Qytaidyn' solty'sti'k-batysyndag'y (Tarim oipatynyn' solty'styk bo'li'gi'ndegi') eotsenni'n' son'y, oligotsennin' basyna jatatyn avat formatsiasynyn' (*Stephanochara yengisuensis* - *Sphaerochara chinensis* - *Tolypella rugulosa* qauymdastyg'y) qauymdastyg'yna u'qsas. Ty'nba qabattardyn' ornalasuy Italianyn' solty'sti'k shyg'ysyndag'y qazirgi kontinentaldy sho'gindileri'men salystyrylady.

Ty'ii'n so'zder: Paleogen, Eotsen, Paleontologija, Stratigrafija, Omyrtqalylar faunasy, Harofitter.

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