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LATE MIOCENE *INDARCTOS* (CARNIVORA: URSIDAE) FROM THE KARABULAK FORMATION OF THE KALMAKPAI RIVER (ZAISAN DEPRESSION, EASTERN KAZAKHSTAN)

G.F. Baryshnikov^{1*} and P.A. Tleuberdina²

¹Zoological Institute of the Russian Academy of Science, Universitetskaya Emb. 1, 199034 Saint Petersburg, Russia; e-mail: ursus@zin.ru;

²Museum of Nature of "Gylym ordasy" Republican State Organization of Science Committee, MES RK, Shevchenko ul. 28, 050010 Almaty, Kazakhstan; e-mail: p.tleuberdina@gmail.com

ABSTRACT

The big bear from the genus *Indarctos* is studied for the Neogene fauna of Kazakhstan for the first time. Material is represented by the isolated M1 found at the Late Miocene deposits (MN13) of the Karabulak Formation of the Kalmakpai River (Zaisan Depression, Eastern Kazakhstan). Tooth size and its morphology suggest this finding to be referred to *I. punjabiensis*, which was widely distributed in Eurasia.

Key words: biostratigraphy, *Indarctos*, Kazakhstan, Late Miocene

ПОЗДНЕМИОЦЕНОВЫЙ *INDARCTOS* (CARNIVORA: URSIDAE) ИЗ ФОРМАЦИИ КАРАБУЛАК НА РЕКЕ КАЛМАКПАЙ (ЗАЙСАНСКАЯ КОТЛОВИНА, ВОСТОЧНЫЙ КАЗАХСТАН)

Г.Ф. Барышников^{1*} и П.А. Тлеубердина²

¹Зоологический институт, Российская академия наук, Университетская наб. 1, 199034 Санкт-Петербург, Россия; e-mail: ursus@zin.ru;

²Музей природы, РГП «Гылым ордасы» КН МОН РК, Шевченко 28, 050010 Алматы, Казахстан; e-mail: p.tleuberdina@gmail.com

РЕЗЮМЕ

Впервые для неогеновой фауны Казахстана изучен крупный медведь из рода *Indarctos*. Материал представлен изолированным M1, найденным в позднемиоценовых отложениях (MN13) формации Карабулак на реке Калмакпай (Зайсанская котловина, Восточный Казахстан). Размеров и зубная морфология позволяет отнести находку к *I. punjabiensis*, широко распространенному в Евразии.

Ключевые слова: биостратиграфия, *Indarctos*, Казахстан, поздний миоцен

INTRODUCTION

Fossil bears belonging to the genus *Indarctos* Pilgrim, 1913 are characterized by Eurasian-North American distribution. Their bone remains are known from the Late Miocene localities of Europe, Northern Africa, Asia, and North America. However

these findings are scant, which results in the insufficient knowledge of morphology, taxonomy, and paleoecology of the representatives of this genus.

One of the problems of their study is a large size as well as scarcity and specificity of findings, which has led to descriptions of new taxa of the species rank, many of them being known by a single specimen. Meanwhile the sexual, individual, and geographical variability were not taken into account. At present

* Corresponding author / Автор-корреспондент

time, the genus *Indarctos* is considered to include from 5 to 2 species (Roth and Morlo 1997; Baryshnikov 2007). Two species are recognized for Eurasia (Petter and Thomas 1986; Baryshnikov 2007): *I. arctoides* (Depéret, 1895) (including *vireti* Villalta et Crusafont Pairó, 1943 as a subspecies) from the early Late Miocene of Europe (Vallesian) and Asia Minor (MN9-11) and *I. punjabiensis* (Lydekker, 1884) (= *atticus* Weithofer, 1888; *anthracitis* Weithofer, 1888; *salmontanus* Pilgrim, 1913; *ponticus* Kormos, 1914; *lagrelii* Zdansky, 1924; *sinensis* Zdansky, 1924; *maraghamus* de Mecquenens, 1925; *bakalovi* Kovačev, 1988; *zdanskyi* Qui et Tedford, 2003) from the late Late Miocene of Europe (Turolian), Western, Southern, and Eastern Asia (MN11-13 or MN10-13, see Roth and Morlo 1997).

In Asia, fossil remains of big *I. punjabiensis* were recorded in Iran (Maragha), Indo-Pakistan (Dhon Pathan Formation, Siwaliks), and China (Lufeng, Baode, Songshan) (Zdansky 1924; Mecquenens 1925; Matthew 1929; Zheng 1982; Qiu and Tedford 2003). Two non-described findings are known in Kazakhstan: from Pavlodar (Gusinyi Perelet) and Kalmakpai (Tleuberdina et al. 1990; Baryshnikov 2002). In present communication, we characterize for the first time the fossil material, referred to this species, which was recovered at the Kalmakpai locality and is kept in the collection of Museum of Nature in Almaty, Kazakhstan (MNA).

LOCALITY AND MATERIAL

The locality of Kalmakpai (47°26'01N, 85°17'46E) is situated in Zaisan depression on the right bank of Kalmakpai River, 60 km south-eastwards of Zaisan City, Eastern Kazakhstan (Fig. 1). The burial was recovered in the deposits of Karabulak Formation, which is characterized by two lithologically different packs of rocks (Borisov 1963). Bone bearing horizon is confined to the upper pack (layer 356) and is formed by alternating brown and yellow-gray arenaceous loams, sands, and conglomerates. The age of fauna was provisionally ascertained as Early or Middle Pliocene (Tleuberdina 1988). Later the taxonomic composition of fauna was defined more precisely, being represented now by following taxa: *Martes* sp., *Promeles* sp., *Plesiogulo crassa* Teilhard, *Adcrocuta eximia* (Roth et Wagner), *Hyaenictitherium hyaenoides orlovi* Semenov, *Machairodus kurteni* Sotnikova, *Hipparion hippidioides* Sefve, *H. elegans* Gromova,

Chilotherium sp., *Sinootherium zaisanensis* Bayshashov, *Cervavitus novorossiae* Chomenko, *Procapreolus latifrons* Schlosser, *Samotherium* cf. *irtyshense* Godina, *Paleotragus (Yuurlovvia) asiaticus* Godina, *Tragoportax* sp., *Gazella dorcadooides* Schlosser (Dmitrieva 1977; Zhegallo 1978; Godina 1979; Bayshashov 1986; Semenov 1989; Sotnikova 1992). The analysis of this complex points out the predominance of Turolian species, whereas the evolutionary level of the representatives of genera *Machairodus*, *Adcrocuta*, *Hyaenictitherium*, *Samotherium*, *Tragoportax* assigns the Kalmakpai fauna to the late Turolian (Vangengeim et al. 1993). It was revealed that the Kalmakpai deposits have alternating magnetization (Pevzner et al. 1982), which makes it possible, in addition to faunal composition, to date this locality as the Late Miocene (near 6.3–6.5 Ma, upper of MN13) (Pevzner et al. 1982; Forsten and Tleuberdina 2001; Vislobokova et al. 2001; Tleuberdina 2005).

The examined material is represented by the single isolated left upper molar M1 (MNA 1839/km-83), which was tentatively referred to *Indarctos* sp. (Tleuberdina 1988). Terminology of elements of masticatory surface of M1 has been published by Baryshnikov and Lavrov (2015). Measurements of the tooth were carried out using the scheme elaborated earlier (Baryshnikov 2006).

Institutional abbreviations. CBUL, Claude Bernard University Lyon 1, Villeurbanne, France; MEU, Museum of Evolution, Uppsala, Sweden; MNA, Museum of Nature, MES RK, Almaty, Kazakhstan; NHMW, Natural History Museum, Wien, Austria; PIN, Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow, Russia.

Measurement abbreviations. *L*, greatest length, *Lant*, length of anterior part, *Lme*, length of metacone, *Lpa*, length of paracone, *Lpost*, length of posterior part, *W*, greatest width (see Table 1).

SYSTEMATICS

Order Carnivora Bowdich, 1821

Family Ursidae Fischer von Waldheim, 1814

Genus *Indarctos* Pilgrim, 1913

Indarctos punjabiensis (Lydekker, 1884)

Description and comparisons. M1 (MNA 1839/km-83; Fig. 2A) is represented only by the enamel crown, which is somewhat broken at the posterior



Fig. 1. Location of *Indarctos* localities in Kazakhstan. 1 – Pavlodar (Gusinyi Perelet), 2 – Kalmakpai.

margin. The tooth is assigned to a young individual and seems to be only beginning to erupt. This is confirmed not only by the absence of roots but also by numerous enamel folds of the masticatory surface, which are absent or inconspicuous on teeth, which began to wear.

The dimensions of MNA 1839/km-83 are large, corresponding to those of M1 in *I. punjabiensis* and markedly exceeding parameters of this tooth in *I. arctoides* (Table 1). The crown, in a view from the masticatory surface, is nearly square. Its outer length only slightly surpasses the inner length. The anterior part of tooth crown (from the anterior margin to the carnassial notch) is as long as posterior part (from the carnassial notch to the posterior margin), in spite of *I. punjabiensis* is commonly characterized by posterior part of this tooth longer than anterior one. Probably, this is a result of partial damage of the examined crown.

Paracone and metacone are robust, three-edged; they are placed along the same line. The paracone is longer than metacone. Parastyle and metastyle are not developed, being marked only by inconspicuous cingulum elevations separating main cusps corre-

spondingly from the anterior and posterior margins of the tooth crown. Protocone is large and ridge-like. An uninterrupted praeprotocrista is extended forwards from this cusp, reaching the paracone. Paraconule is bob-developed. Metaconule is noticeably smaller than protocone and is separated from it by a distinctive transverse groove. There is a large basin of trigon, which is closed anterior by the praeprotocrista and posterior by the inner ridges of metacone and metaconule, which run towards one another. The platform located behind these ridges is rather small. Postprotocrista is not developed. Labial cingulum slender; it is less distinctive in comparison with other examined specimens of *I. punjabiensis*. The lingual ridge is short and does not exceeds forwards beyond the level of the protocone apex, despite it occasionally can reach the anterior-inner part of the crown (Fig. 2D).

Judging from its measurements, the tooth MNA 1839/km-83 seems to be one of the largest for *I. punjabiensis* in Eurasia (Table 1). The size variation observed in this species, presumably, is associated with the sexual dimorphism, since males of bears are markedly larger than females. Therefore, the tooth from Kalmakpai may be referred to a male.

Table 1. Measurements (mm) of upper molar M1 in *Indarctos* and *Agriotherium*

| Taxon and Locality | Measurements | | | | | |
|---|--------------|------|-------|------|------|------------|
| | L | Lant | Lpost | Lpa | Lme | W |
| <i>Indarctos arctoides</i> | | | | | | |
| Montredon, France, UCBL 210184 (type <i>arctoides</i>) | >24.1 | | | 11.8 | 9.3 | 22.8 |
| Montredon, France (Crusafont Pairó, Kurtén 1976) | 22.2 | | | | | 24.0 |
| Orignac, France (Helbing 1929) | – | | | | | 24.6 |
| Can Llobateres, Spain (Crusafont Pairó, Kurtén 1976) | 19.5, 19.6 | | | | | 24.5, 22.4 |
| Otovaska, Moldova (Lungu, Chemyrtan 1996, type <i>sarmaticum</i>) | 22.3 | | | | | 20.0 |
| <i>I. punjabiensis</i> | | | | | | |
| Kalmakpai, Kazakhstan, MNA 1839/km-83 | 29.6 | 14.6 | 14.6 | 11.6 | 10.4 | 27.0 |
| Paote, China, MEU M3845a (type <i>lagrelii</i>) | 27.3 | 13.4 | 13.7 | | | 25.1 |
| Baode, China (Qiu, Tedford 2003, type <i>zdanskyi</i>), tooth have very wear | 27.0 | | | | | 25.0 |
| Near Hasnot, Dhok Pathan zone, Siwaliks, Pakistan (Colbert 1935) | 29.0 | | | | | 28.0 |
| Ananiev, Ukraine, PIN 355-92 | 31.6 | 15.5 | 16.0 | 11.1 | 10.4 | 27.7 |
| Dorn-Dürkheim 1, Germany (Roth, Morlo 1997) | 29.2 | | | | | ca25.1 |
| Kalimanci, Bulgaria (Kovačev 1988, type <i>bokalovi</i>) | 31.0 | | | | | 29.0 |
| Samos, Greek, NHMW A4731 | 28.2 | 13.8 | 14.1 | 11.6 | 11.9 | 26.1 |
| Samos, Greek (Helbing 1932) | 29.0 | | | | | 26.0 |
| Samos II, Greek (Thenius 1957) | 29.0 | | | | | 28.5 |
| Crevilente 2, Spain (Montoya et al. 2001) | 27.7, 27.9 | | | | | 24.9, 25.2 |
| <i>Agriotherium sivalensis</i> | | | | | | |
| Siwaliks, Indo-Pakistan, NHM 39721 (type <i>sivalensis</i>) | 28.4 | 14.4 | 14.6 | 14.4 | 13.0 | 29.5 |
| <i>A. africanum</i> | | | | | | |
| Langebaanweg, South Africa, CBUL 212814, cast | 29.4 | 15.7 | 14.1 | 12.1 | 12.7 | 28.2 |

Shape of the masticatory surface of M1 in *I. punjabiensis* from various localities is quite uniform, differing only by details (Fig. 2). This variation is associated, probably, with the individual variability, which is pronounced in omnivorous bears (e.g., in the recent brown bear *Ursus arctos* L., 1758). So there is no basis for the assignment of the examined teeth M1 (MNA 841/km-84) to different taxa of the species rank.

Distinctions from *Agriotherium*. The size and shape of M1 in *Indarctos* are similar to those in the genus *Agriotherium*. Therefore we give characters distinguishing these genera. These are as follows (Petter and Thomas 1986; Qiu and Smidt-Kittler 1983): the tooth crown is square in *Indarctos* and trapezoid in *Agriotherium*; there is a very inconspicuously developed metastyle in *Agriotherium* and no linking ridge between metacone and metaconule (in *Indarctos* this

ridge is present and the metastylar cuspid is distinctive). These characters can be supplemented by the wider crown of M1 in *Agriotherium*, whereas its paracone and metacone are larger (with respect to the tooth greatest width) in comparison with *Indarctos* (Table 1).

Aforementioned characters testify attribution of the upper molar MNA 1839/km-83 to *Indarctos punjabiensis*. In addition, the tooth from Kalmakpai is also slightly pyramidal.

CONCLUSION

Records of *Indarctos punjabiensis* are known from Western Europe to China and from Northern Kazakhstan to Pakistan, which indicates a wide distribution of this species in the Late Miocene of Eurasia.

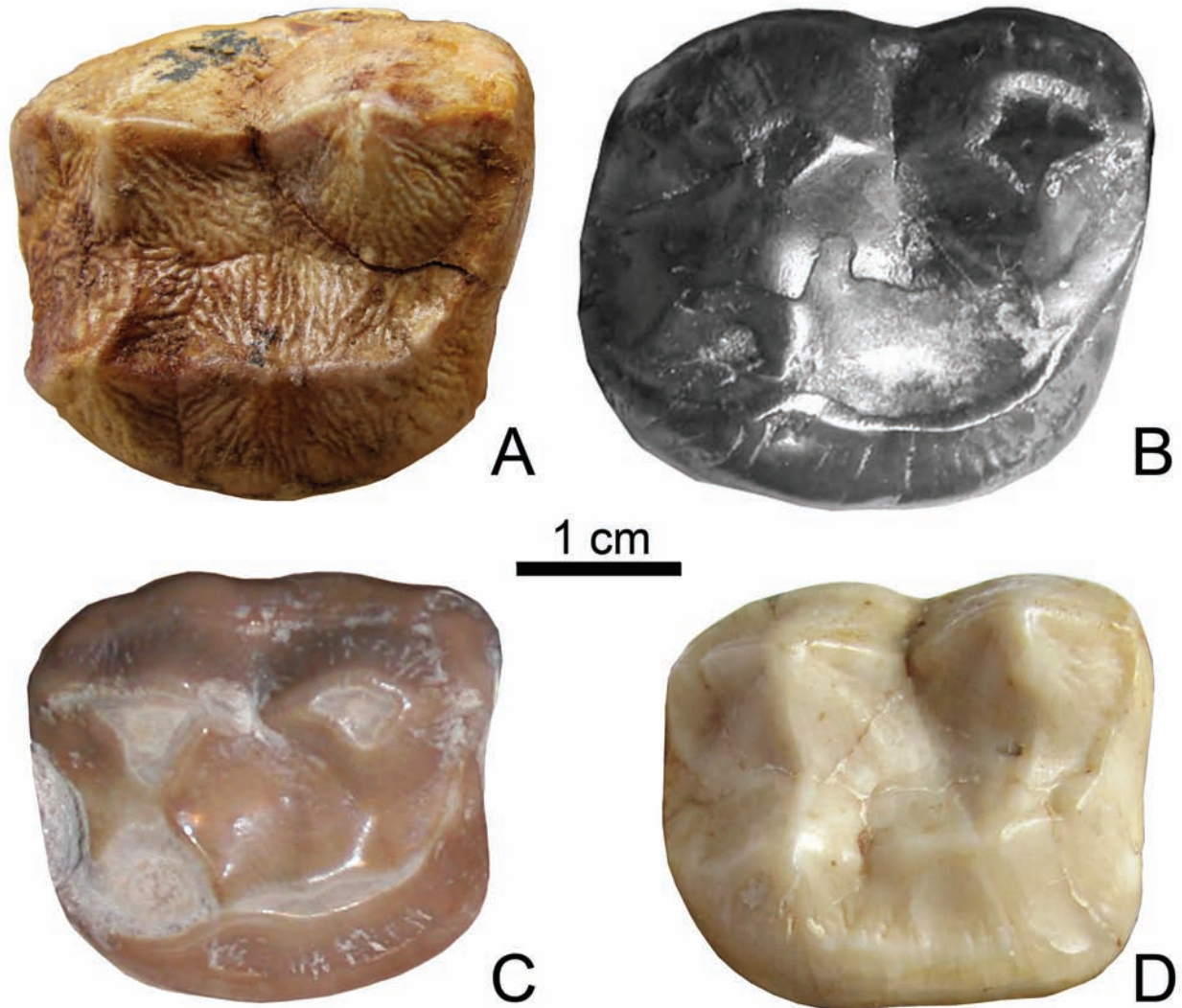


Fig. 2. *Indarctos punjabiensis*, left upper molar M1, occlusal view. A – MNA 1839/km-83, Kalmakpai, Kazakhstan; B – PIN 355-92, Ananiev, Ukraine; C – NHMW A4731, Samos, Greece; D – MEU M3845a, Baode, China (type *lagrelii*).

This is associated with the large size of animals and their omnivorous diet (Viranta 2004). They might inhabit various biotopes, including those with arid climate and open landscapes characteristic of the fauna of Kalmakpai.

Climate in a lifetime of Kalmakpai fauna was relatively mild and arid. It is ascertained by paleontological remains and litho-chemical composition of red carbonate-rock formations. Fuscous color of sediment as well as marked content of pelitomorph carbonate in it also point to the aridity of climate (Erofeev 1969). Spore-pollen spectrums show

predominance of steppe xerophytic herbaceous forms (*Chenopodiaceae*, cereals, reeds, fabaceans, asteraceans, wormwoods, etc.). The pollen of angiosperm trees (poplar, elm, nut-tree, and alder) is also recorded as an admixture. This composition indicates a presence of arid steppes with open reservoirs, small steppe rivers, and rare lakes associated with complexes of riparian plantations (Rzhanikova 1968).

The small *I. arctoides* is regarded to have more herbivorous diet (Abella et al. 2015) in comparison with its descendant *I. punjabiensis*, which has enlarged its size and become omnivorous. Its resemblance by the

bones of front limb with the recent brown bear *Ursus arctos* (Roussiakis 2001) testifies similarity of their locomotor adaptations. These progressive evolutionary features increased the ability of this species to disperse, which led to coming of *Indarctos*-like bears to the North America.

In Eurasia, *I. punjabiensis*, presumably was extinct in the end of Miocene (Late Turolian). The finding from Kalmakpai appears to be one of the lattermost.

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