ISSN 0869-5938, Stratigraphy and Geological Correlation, 2011, Vol. 19, No. 2, pp. 238–242. © Pleiades Publishing, Ltd., 2011.
Original Russian Text © V.V. Arkadiev, 2011, published in Stratigrafiya. Geologicheskaya Korrelyatsiya, 2011, Vol. 19, No. 2, pp. 120–124.

BRIEF COMMUNICATIONS

New Data on Ammonoids of the Genus *Paraulacosphinctes* from the Upper Tithonian of the Mountainous Crimea

V. V. Arkadiev

St. Petersburg State University, Universitetskaya nab. 7-9, St. Petersburg, 199034 Russia
e-mail: arkad@GG2686.spb.edu

Received March 17, 2010
Revised text received April 14, 2010

Abstract—The Late Tithonian ammonites *Paraulacosphinctes* cf. *transitorius* (Oppel) and *P.* cf. *senoides* Tavera from the Feodosiya section boundary Tithonian-Berriasian beds of the Crimea are described. These species allow the correlation of the beds with *P.* cf. *transitorius* recognized in the Crimea with the Upper Tithonian Substage of the Western European scale. Based on magnetostratigraphic data, these beds supposedly correlate with the *Durangites* Zone.

Keywords: ammonites, Upper Tithonian, biostratigraphy, correlation, Mountainous Crimea.

DOI: 10.1134/S086959381102002X

INTRODUCTION

The biostratigraphy of the Tithonian Stage of the Mountainous Crimea is poorly studied. The existing zonal schemes of the Tithonian of this region are preliminary and are based on isolated ammonite occurrences. The history of studies of the Tithonian Stage in the Crimea has been discussed in detail by Arkadiev and Rogov (2006). Characteristic Tithonian ammonites were until recently only described and figured in a few publications (Ovechkin, 1956; Khimshiashvili, 1967; Arkadiev, 2004; Arkadiev and Rogov, 2006; Arkadiev et al., 2006). Hence, any new discovery of Tithonian ammonites is of significant interest for biostratigraphy because it can allow refinement of the Jurassic–Cretaceous boundary and facilitate a more precise correlation.

For many years I have been studying the Jurassic–Cretaceous boundary beds of the Mountainous Crimea. In 2002, a Late Tithonian ammonite *Oloriziceras* cf. *schneidi* Tavera was found for the first time in the Feodosiya section of the Eastern Crimea (Arkadiev, 2004). Later, *Paraulacosphinctes* cf. *transitorius* (Oppel) (Plate, fig. 4) was identified from the section near the village of Yuzhnoe (Sultanovka) (Arkadiev and Rogov, 2006). Based on these ammonites, Beds with *Oloriziceras* cf. *schneidi* and Beds with *Paraulacosphinctes* cf. *transitorius* were recognized in the Upper Tithonian of the Eastern Crimea (from bottom to top) (Arkadiev and Rogov, 2006). However, it should be noted that these stratigraphic units were recognized in separate sections.

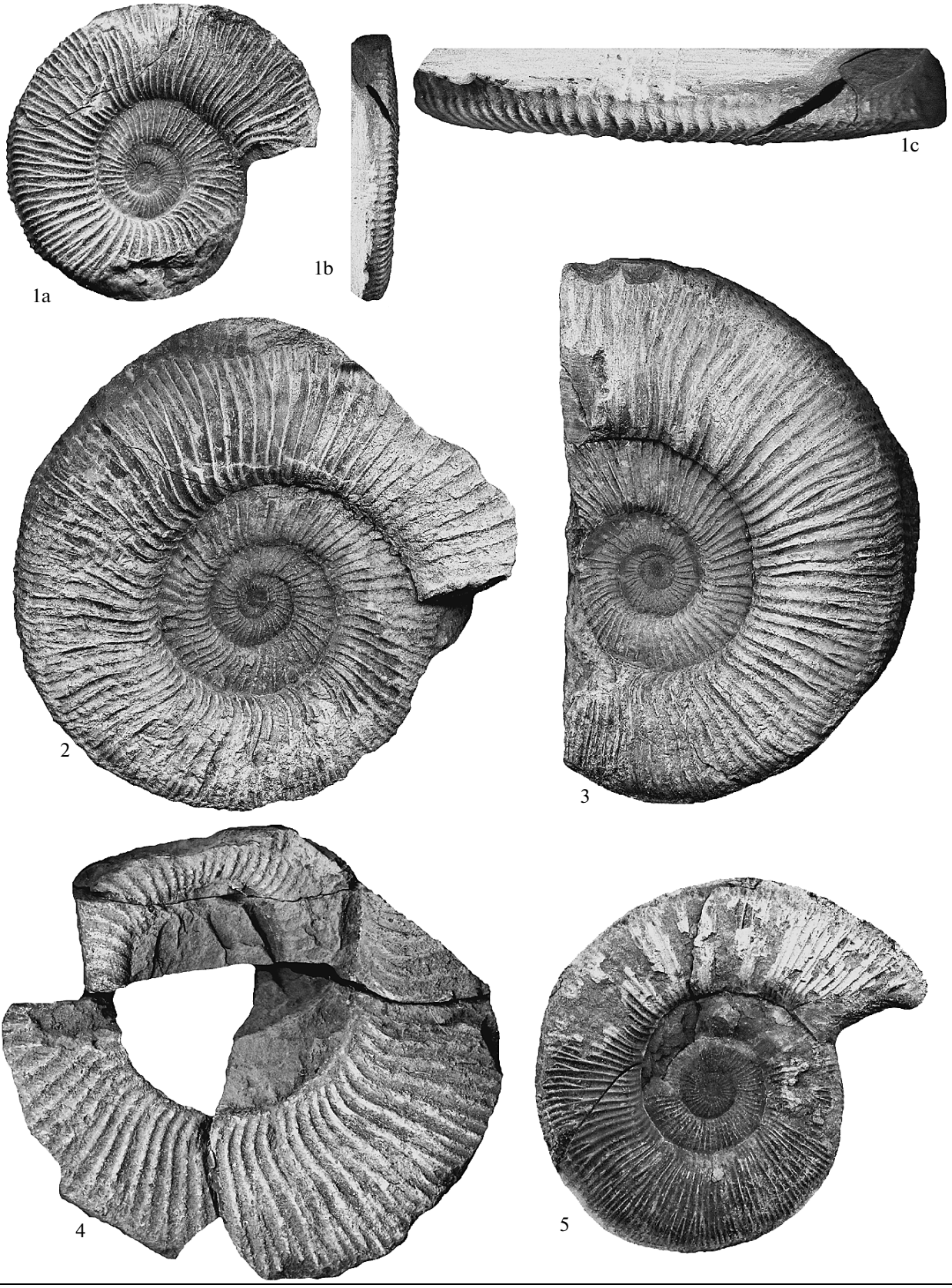
All known and previously figured specimens of *P. transitorius* from the Mountainous Crimea (there are only two) are poorly preserved, which casts some doubt on their usefulness for the refined Tithonian stratigraphy. In 2009, in the course of work on magnetostratigraphic studies of the Jurassic–Cretaceous boundary in the Eastern Crimea I, together with geologists A.Yu. Guzhikov and A.G. Manikin from Saratov University, and V.A. Perminov, a geologist from Feodosiya, re-examined the Upper Tithonian section in the Dvuyakornaya Bay for paleomagnetic probes. The section is composed of clay with thin interbeds of detrital limestones (Dvuyakornaya Formation) and was described previously by Arkadiev et al. (2006) (figure). In the lower part of this section, small poorly preserved ammonites were found, *Haploceras* sp., *Lytoceras* sp., *Holcophylloceras* sp., and *Ptychophylloceras*

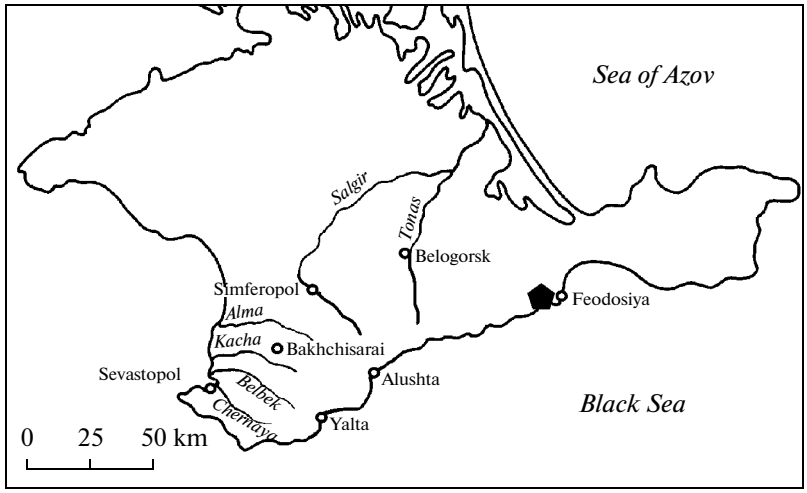
Late Tithonian ammonites of the genus *Paraulacosphinctes* from the Eastern Crimea.

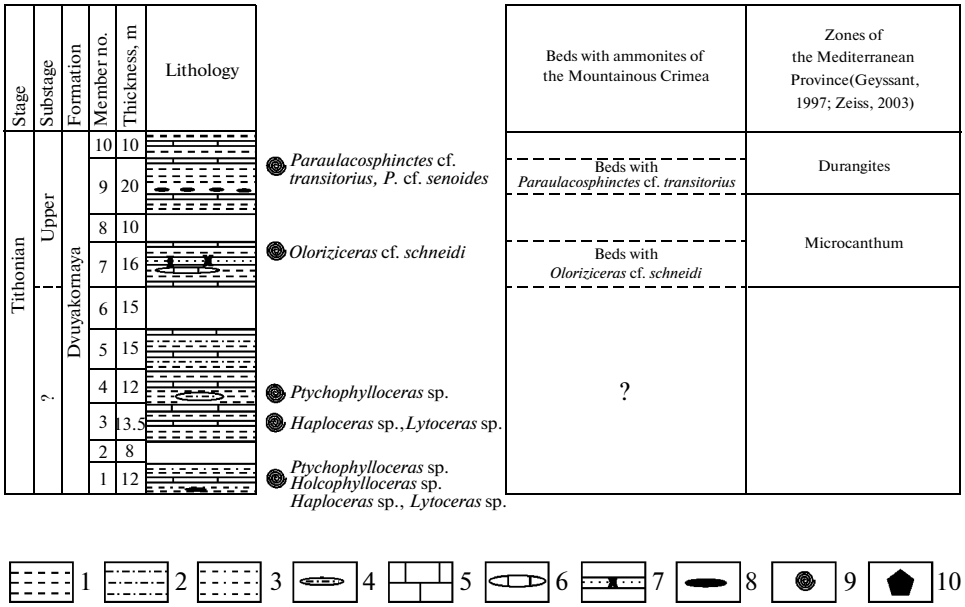
Figs 1–4. *Paraulacosphinctes* cf. *transitorius* (Oppel). (1) specimen no. 3/382: (1a) lateral view, ×1, (1b) ventral view, ×1, (1c) the same, ×2; (2) specimen no. 1/382, lateral view, ×1; (3) specimen no. 2/382, lateral view, ×1; Eastern Crimea, Dvuyakornaya Bay, Upper Tithonian, Beds with *P.* cf. *transitorius*; coll. V.V. Arkadiev; (4) specimen no. 3/378, lateral view, ×1; Eastern Crimea, vicinity of the village of Ordzhonikidze, 1 km southeast of the village of Yuzhnoe; Upper Tithonian, beds with *P.* cf. *transitorius*; coll. V.V. Arkadiev.

Fig. 5. *Paraulacosphinctes* cf. *senoides* Tavera, specimen no. 5/382, lateral view, ×1, Eastern Crimea, Dvuyakornaya Bay, Upper Tithonian, Beds with *P.* cf. *transitorius*, coll. V.V. Arkadiev.

Plate







Dvuyakornaya Formation section (Upper Tithonian) in the Dvuyakornaya Bay of the Eastern Crimea.
1) clay, 2) siltstone, 3) sandy clay, 4) siltstone lenses, 5) limestones, 6) limestone lenses, 7) calcareous sandstones, 8) siderite concretions, 9) ammonite occurrences, 10) location of the section examined.

sp., which do not provide precise dating. Possibly, Members 1–6 correspond to the Middle Tithonian. The upper Tithonian ammonite *Oloriziceras* cf. *schneidi* was identified from 2 m below the top of Member 7 (Arkadiev, 2004). In 2009, several specimens of *Paraulacosphinctes* cf. *transitorius* (Oppel) and *P.* cf. *senoides* Tavera were found in the upper part of Member 9. Therefore, for the first time the succession of the Late Tithonian ammonite taxa was preliminarily recognized. The beds with *P.* cf. *transitorius* in the section Dvuyakornaya Bay, apparently correlate with the equivalent beds near the village of Yuzhnoe recognized previously (Arkadiev and Rogov, 2006). This allows the refinement of the generalized Tithonian–Berriasian section of the Feodosiya area.

MATERIAL

Ammonites described in this paper are housed in the Museum of Paleontology and Stratigraphy of the Department of Dynamic and Historical Geology of St. Petersburg State University (coll. no. 382).

SYSTEMATIC PALEONTOLOGY

Family Perisphinctidae Steinmann, 1890

Genus *Paraulacosphinctes* Schindewolf, 1925

Paraulacosphinctes cf. *transitorius* (Oppel)

Plate, figs. 1–4

Paraulacosphinctes cf. *transitorius*: Zeiss, 2001, p. 62, fig. 22; pl. 19, figs 1, 1a; Arkadiev and Rogov, 2006, p. 95, pl. 1, fig. 10.

Shell shape. The shell is large, discoidal, evolute, with flattened flanks. The adult whorls are more strongly evolute. The venter is rounded. The cross-section is highly oval. The umbilicus is wide, shallow, with a steep wall.

Ornamentation. The flanks of adult whorls possess coarse bipartite ribs. The ribs begin near the umbilical seam are rursiradiate before the umbilical shoulder, later bending and at a small angle running across the flank. In the middle of the whorl the ribs are very slightly prorsiradiate. In the upper third of the whorl each rib dichotomizes into two equal branches, with the posterior branch slightly inclined backward. Singular ribs are very uncommon (one–two per whorl). The ornamentation of young whorls (Dm to 25–30 mm) differs in the ribs being less bent. On the venter, the ribs are interrupted by a distinct smooth ventral band.

Dimensions in mm and ratios, number of ribs:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per 1/2 whorl	
								Internal	External
2/382	95.0	31.5	?	39.5	33	?	42	39	78
1/382	87.0?	30.0?	?	39.0	34	?	45	37	74
3/382	55.0	20.5	?	22.0	37	?	40	35	69
4/382	41.8	14.5	?	16.7	35	?	40	28	54

Comparison. The specimens described are most similar to those figured by Tavera (1985, pl. 11, figs. 1–5) from the Upper Tithonian of Spain.

Remarks. This species is distinguished from species of a similar genus *Oloriziceras* by finer ornamentation and by the presence of the ventral band. It is distinguished from the Late Tithonian genus *Zittelia* by the lack of constrictions.

Occurrence. Upper Tithonian, *Simplisphinctes Zone–Microcanthum* Zone, *transitorius* Subzone Morocco; *Microcanthum* Zone, *transitorius* Subzone–*Durangites* Zone (?) of Spain; *Microcanthum* Zone, *transitorius* Subzone of Czech Republic, Bulgaria and Northern Caucasus. Upper Tithonian, Beds with *P.* cf. *transitorius* of the Mountainous Crimea.

Material. 4 specimens (no. 1–4/382) from the Eastern Crimea (vicinity of the village of Ordzhonikidze, Dvuyakornaya Bay).

Paraulacosphinctes cf. *senoides* Tavera
Plate, fig. 5

Shell shape. The shell is large, evolute, discoidal, with flattened flanks. The shape of the venter is unknown. The umbilicus is wide, shallow, with a steep wall.

Ornamentation. The flanks possess thin bipartite ribs. The ribs begin near the umbilical seam are rursiradiate before crossing the umbilical shoulder, later bending and are slightly inclined forward across the flank. In the upper third of the whorl each rib is divided into two equal branches. A few singular ribs are present (one–two per whorl).

Dimensions in mm and ratios, number of ribs:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per 1/2 whorl	
								Internal	External
5/382	69.0	24.0	?	29.5	35	?	43	50	98

Comparison. The specimens described are most similar to the holotype of *P. senoides* figured by Tavera (1985, pl. 13, fig. 1) from the Upper Tithonian of Spain. This species differs from *P. transitorius* in the finer and more densely spaced ribbing.

Occurrence. Upper Tithonian, *Microcanthum* Zone, *transitorius* Subzone–*Durangites* Zone of Spain. Upper Tithonian, Beds with *P.* cf. *transitorius*, Mountainous Crimea.

Material. 2 specimens (no. 5–6/382) from the Eastern Crimea (vicinity of the village of Ordzhonikidze, Dvuyakornaya Bay).

DISCUSSION

Stratigraphic Distribution of Ammonites

Presence of the genus *Paraulacosphinctes* in the section studied suggests the Late Tithonian age of the host beds. However, it is impossible to judge upon the correlation of the host rocks to any zone of the standard Tithonian succession based solely on ammonites. The stratigraphic distribution of *P. transitorius* (Oppel) is mainly restricted to the transitorius Subzone of the *Microcanthum* Zone. However, in Morocco this species was recorded in the *Simplisphinctes* Zone (Benzaggagh, 2000), and in open nomenclature, this species was recorded in the *Durangites* Zone of Spain (Enay and Geyssant, 1975). *P. senoides* Tavera was previously described from the *transitorius* Subzone and the *Durangites* Zone of Spain (Tavera, 1985). It is noteworthy that the Late Tithonian perisphinctids (genera *Paraulacosphinctes, Oloriziceras*, and *Zittelia*) are very similar, and their identification is very difficult when the material is poorly preserved.

Magnetostratigraphic data obtained by A.Yu.Guzhikov and A.G. Manikin can be used to refine the stratigraphy of the Beds with *P.* cf. *transitorius*. In the Dvuyakornaya Bay Section, the Beds with *P.* cf. *transitorius* correspond to the magnetozone of mainly

reversed polarity which can only be an equivalent of the chrone M19r (Arkadiev et al., 2010). Other large magnetozones in the upper part of the Tithonian are unknown, hence, the beds can be only correlated with the *Durangites* Zone in the Spanish section Puerto Escano (Pruner et al., 2010).

Thus, taking into account a combination of existing bio- and magnetostratigraphic data, the recognized beds with *P.* cf. *transitorius* can tentatively be correlated with the *Durangites* Zone of the standard scale (Geyssant, 1997; Zeiss, 2003).

CONCLUSIONS

(1) Species of the genus *Paraulacosphinctes* (*P.* cf. *transitorius* (Oppel) and *P.* cf. *senoides* Tavera) are identified and described from the Dvuyakornaya Formation of the Eastern Crimea.

(2) For the first time, the succession of the Late Tithonian ammonites is established in a single section (bottom *Oloriziceras*, top *Paraulacosphinctes*). Beds with *Oloriziceras* cf. *schneidi* and beds with *Paraulacosphinctes* cf. *transitorius* are recognized. These new units are recognized as "Beds" because they do not have paleontologically-based boundaries with the underlying and overlying strata.

(3) Based on ammonites, the recognized beds can be correlated only with the Upper Tithonian (*transitorius Subzone–Durangites* Zone).

(4) Based on magnetostratigraphic data, beds with *Paraulacosphinctes* cf. *transitorius* of the Eastern Crimea correlate with the Upper Tithonian *Durangites* Zone.

Further studies in this region will allow more precise age determination and the recognition of the Jurassic–Cretaceous boundary.

ACKNOWLEDGMENTS

I am grateful to M.A. Rogov (Geological Institute, Russian Academy of Sciences, Moscow) for consultations on ammonite identifications.

Reviewers M.A. Rogov, V.A. Zakharov

REFERENCES

Arkadiev, V.V., The First Record of the Late Tithonian Ammonite in the Feodosiya Section of the Eastern Crimea, *Paleontol. Zh.*, 2004, no. 3, pp. 39–45 [*Paleontol. J.* (Engl. Transl.), no. 3, pp. 265–267].

Arkadiev, V.V. and Rogov, M.A., New Data on Upper Kimmeridgian-Tithonian Biostratigraphy and Ammonites of the Eastern Crimea, *Stratigr. Geol. Korrelyatsiya*,, 2006, vol. 14, no. 2, pp. 90–104 [*Stratigr. Geol. Correlation* (Engl. Transl.), vol. 14, no. 2, pp. 185–199].

Arkadiev, V.V., Bagaeva, M.I., and Guzhikov, A.Yu., et al.,. New Data on the Tithonian–Berriasian Bio- and Magnetostratigraphy of the Feodosiya section, Mountainous Crimea, in *Materialy Pyatogo Vserossiiskogo soveshchaniya "Melovaya sistema Rossii i blizhnego zarubezh'ya: problemy stratigrafii i paleogeografii". 23–28 avgusta 2010 g.*, Baraboshkin, E.Yu. and Blagoveshchensky, I.V,, Eds., Ul'yanovsk: UlGU, 2010, pp. 49–53.

Arkadiev, V.V., Fedorova, A.A., Savel'eva, Yu.N., and Tesakova, E.M., 2006. Biostratigraphy of the Jurassic–Cretaceous Boundary Sediments in the Eastern Crimea, *Stratigr. Geol. Korrelyatsiya*,, vol. 14, no. 3, pp. 84–112 [*Stratigr. Geol. Correlation* (Engl. Transl.), vol. 14, no. 3, pp. 302–330].

Benzaggagh, M., Le Malm supérieur et le Berriasien dans le Prérif interne et le Mésorif (Rif, Maroc): Biostratigraphic, lithostratigraphic, paléogéographic et evolution tectonosédimentaire. *Doc. Lab. Géol. Lyon*, 2000, no. 152, pp. 1–347.

Enay, R. and Geyssant, J.R., Faunes tithoniques des chaînes bétiques (Espagne méridionale). Colloque sur la limite Jurassique–Crétacé, Lyon, Neuchâtel, September 1973, *Mém. Bur. Rech. Géol. et Miniéres*, 1975, vol. 86, pp. 39–55.

Geyssant, J.R., Tithonien, Biostratigraphie du Jurassique Ouest-Européen et Méditerranéen, *Bull. Centre Rech. Elf Explor. Prod. Mém.,* 1997, 17, pp. 97–102.

Khimshiashvili, N.G., *Pozdneyurskaya fauna mollyuskov Krymsko-Kavkazskoi oblasti* (Late Jurassic Molluskan Fauna of the Crimean-Caucasian Region), Tbilisi: Metsniereba, 1967.

Ovechkin, N.K., Stratigrafiya i fauna ammonitov verkhneyurskikh otlozhenii yugo-zapadnogo Kryma, *Vestn. Leningr. Univ.*, 1956, no. 6, pp. 12–29.

Pruner P., Housa V., Oloriz F., et al., High-resolution Magnetostratigraphy and Biostratigraphic Zonation of the Jurassic–Cretaceous Boundary Strata in the Puerto Escano Section (Southern Spain). *Cretaceous Res.*, 2010, vol. 31, pp. 192–206.

Tavera, J.M., *Los ammonites del tithonico superior-berriasense de la zona Subbetica (Cordilleras Beticas*). Granada: Universidad de Granada, 1985, 381 p.

Zeiss, A., Die Ammonitenfauna der Tithonklippen von Emstbrunn, Niederösterreich. *Neue Denk-Schriften des Naturhistorischen Museums in Wien*, 2001, vol. 6, pp. 8–117.

Zeiss, A., The Upper Jurassic of Europe: Its Subdivision and Correlation. *Bull. Geol. Sur. Denmark and Greenland*, 2003, no. 1, pp. 75–114.