



Fossil records of Rhinoceroses (Rhinoceroidea Gray, 1821), Chalicotheres (Chalicotherioidea Gill, 1872) and Brontotheres (Brontotherioidea (Marsh, 1873) (Peryssodactyla Owen, 1848 - Mammalia Linnaeus, 1758) in Bulgaria

Zlatozar N. Boev*

National Museum of Natural History, Bulgarian Academy of Sciences,
1 Blvd. Tsar Osvoboditel, 1000 Sofia, BULGARIA

* Corresponding author: boev@nmnhs.com; zlatozarboev@gmail.com

Abstract. The fossil record of the Rhinoceroses, Chalicotheres and Brontotheres in Bulgaria covers 34 taxa from a total of 53 localities dated from the Oligocene to the Late Pleistocene: Rhinoceroidea (27 taxa), Chalicotherioidea (5), and Brontotherioidea (2). Most widely spread were *Aceratherium incisivum* (established in 15 localities), *Dihoplus schleiermachersi* (13), *Coelodonta antiquitatis* (6), and *Ancylotherium pentelicum* (5). The majority of the localities (27) are concentrated along the largest Bulgarian rivers - Struma (14 localities), Iskar (6), Maritsa (5), and Mesta (2), as well as the Sofia Valley (9) and the Burgas lowland (3).

Key words: Fossil, perissodactyls, Neogene, Miocene.

Introduction

Chalicotheres (Chalicotherioidea Gill, 1872) and Brontotheres (Brontotherioidea (Marsh, 1873) are fossil group of perysodactyls, while Rhinoceroidea (Gray, 1821) survived through rhinoceroses (Rhinocerotidae Gray, 1820) with 4 genera and 5 species (DINERSTEIN, 2011): white rhinoceros *Ceratotherium simum* Burchell, 1817), black rhinoceros *Diceros bicornis* (Linnaeus, 1758), Sumatran rhinoceros *Dicerorhinus sumatrensis* (Fischer, 1814)[3], Javan rhinoceros *Rhinoceros sondaicus* Desmarest, 1822[3], and Indian rhinoceros *Rhinoceros unicornis* Linnaeus, 1758. All they have Old World subtropical and tropical distribution in Africa and Asia.

Territory of Bulgaria, Balkans and all Europe lies on out of the recent range of Rhinocerotidae. Although many records of fossil rhinoceroses from Europe documented very well the former distribution of these perissodactyls in the Western Palearctic in the Paleogene (Oligocene)

and Neogene (Miocene and Pliocene), data from Bulgaria and Balkans complete the information on their final former presence in Europe before the drastic range restriction to Southern regions of Africa and Asia today (Rhinocerotidae), or total extinction (Chalicotheriidae and Brontotheriidae). Present study aims to gather all scattered information on the fossil history of these three superfamilies of Peryssodactyla in Bulgaria.

Material and Methods

For the goal of the study, i. e. gathering the numerous scattered published (and unpublished) data for the fossil remains of these three superfamilies of Peryssodactyla throughout all the country, we have checked many sources as scientific publications, popular-science publications, and museum collections. Sometimes a collected specimen was published in several publications under different names,

but we accepted the last identification or the newest taxonomical referring.

Results and Discussion

Taxa account

Superfamily RHINOCEROTOIDEA Gray, 1821

Family AMYNODONTIDAE Scott & Osborn, 1883

1. *Cadurcodon ardynensis* Osborn, 1924: Kameno (Burgas region). Oligocene. Sand quarry (NIKOLOV, 1963, 1977a).

Family HYRACODONTIDAE Cope, 1879

2. *Paraceratherium bugtiense* Pilgrim, 1908: Dobrinishte (Blagoevgrad Region): Oligocene (NIKOLOV, 1985). Listed as *Indricotherium transouralicum* Pavlova, 1922

Family RHINOCEROTIDAE Gray, 1821

Subfamily Aceratheriinae Dollo, 1885

3. *Aceratherium incisivum* (Cuvier, 1822): Merichleri (Haskovo Region): Lower Pliocene (BAKALOV & NIKOLOV, 1962); Oligocene (NIKOLOV, 1985); Ezerovo (Plovdiv Region): Maeotian - Pontian (NIKOLOV, 1985) – Late Miocene; Ahmatovo (Plovdiv Region): Pontian (NIKOLOV, 1985); Dimitrovgrad (Haskovo Region) – Durhan quarry near town. Oligocene (BAKALOV & NIKOLOV, 1962); Oligocene-Miocene (NIKOLOV, 1985); Troyanovo – 1 (Haskovo Region). Coal mine. Oligocene-Miocene (NIKOLOV, 1985); Dobrich (Haskovo Region): Oligocene-Miocene (NIKOLOV, 1985); Burgas (Burgas Region): Maeotian - Pontian (NIKOLOV, 1985). Precise locality unknown. Maeotian and Pontian, probably mixed fauna from different beds (Miocene; NIKOLOV, 1977a): (BAKALOV & NIKOLOV, 1962) (BAKALOV, 1927); Hrabarsko (Sofia Region). Late Miocene (Pontian; BAKALOV & NIKOLOV, 1962). Abandoned coal mines; Gnilyanska formation (NIKOLOV, 1985). Cranial fragment with right maxilla and teeth; Aldomirovtsi (Sofia Region): Pontian (NIKOLOV, 1985) – Late Miocene; Gaber – 1. (Sofia Region). Coal mine Beli Breg (former Bolshevik) near the Gaber village. (Pontian; NIKOLOV, 1985). Oligocene –

Lower Pliocene (BAKALOV & NIKOLOV, 1962); Gaber – 2. (Sofia Region). Coal mine Garmen. Oligocene – Lower Pliocene (BAKALOV & NIKOLOV, 1962); Gaber – 3. (Sofia Region). Coal mine Oreshets Oligocene – Lower Pliocene (BAKALOV & NIKOLOV, 1962); Stanyantsi (Sofia Region): Maeotian (NIKOLOV, 1985) – Late Miocene. Late Miocene (Turolian, 5.80-5.35 Mya /Miocene-Pliocene boundary/) (BOHME *et al.*, 2013). Undescribed and unpublished finds (GERAADS *et al.*, 2011); Oreshets (Vidin Region): Oligocene-Miocene (NIKOLOV, 1985); Dolni Izvor (Haskovo Region): Oligocene (NIKOLOV, 1963).

4. *Aceratherium* sp.: Noevtsi (Pernik Region): Maeotian (NIKOLOV, 1985) – Late Miocene; Kromidovo (Blagoevgrad Region): Late Miocene (NIKOLOV, 1985); Slatino – 1. (Blagoevgrad Region). Quarry (SPASSOV *et al.*, 2006). Lower part of the Upper Miocene (GERAADS & SPASSOV, 2009).

5. *Chilotherium zernovi* (Borissiak, 1915): Kalimantsi (Blagoevgrad Region) NH 59: Pontian (BAKALOV & NIKOLOV, 1962), Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2002, 2009). Listed as *Aceratherium zernovi* Borissiak, 1911 (BAKALOV & NIKOLOV, 1962, SPASSOV, 2002).

6. *Chilotherium* cf. *sarmaticum* Korotkevich, 1970: Oranovo - pr. quartrer Oranovo of town of Simitli (Blagoevgrad Region). Quarry (SPASSOV *et al.*, 2006; GERAADS & SPASSOV, 2009).

7. *Chilotherium* (*Eochilotherium*) cf. *kiliasi* Geraads, Koufos, 1990: Kromidovo (Blagoevgrad Region). Late Miocene (GERAADS & SPASSOV, 2009).

8. *Chilotherium* cf. *konvalenski* Pavlow, 1913: Yambol (Yambol Region). Maeotian to Dacian-Romanian, Late Miocene (GERAADS & SPASSOV, 2009).

9. *Chilotherium* sp.: Ahmatovo (Plovdiv Region). Second half/the end of the middle Turolian (MN12) – Late Miocene (GERAADS & SPASSOV, 2009); Stanyantsi (Sofia Region). Late Miocene (Turolian, 5.80-5.35 Mya /Miocene-Pliocene boundary/) (BOHME *et al.*, 2013); Sarafovo (Burgas region). Miocene (JAKUBOWSKI & KARASZEWSKI, 1972).

10. *Acerorhinus* sp.: Kalimantsi (Blagoevgrad Region). Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2009).

11. *Brachypotherium* sp.: Ahmatovo (GERAADS & SPASSOV, 2009); Kalimantsi

Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2009).

Subfamily Rhinocerotinae Owen, 1845

12. *Dicerorhinus kirschbergensis* (Jäger, 1839): Dobroslavtsi (Sofia Region): Pleistocene. Listed as *Rhinoceros mercki* Jäger, 1839 (BAKALOV & NIKOLOV, 1962); Mladenova cave near Chiren village (Vratsa Region). Listed as *Rhinoceros mercki* Jäger, 1839 (NIKOLOV, 1977b; 1983).

13. *Rhinoceros* sp.: Nova cave (near Lyuti Brod village; Pleven Region): Pleistocene (NIKOLOV, 1983).

14. *Coelodonta antiquitatis* (Blumenbach, 1807): Temnata Dupka cave (Lovech Region): Late Pleistocene 1,6 Mya (VASIL POPOV – unpubl. data). Listed as *Rhinoceros tichorhinus* (POPOV, 1936); Bacho Kiro cave (Gabrovo Region): final of Late Pleistocene (50 000-10 000 BP; BOCHENSKI, 1982). Listed as *Rhinoceros tichorhinus* Cuvier, 1812 from Malkata cave (NIKOLOV, 1977b; 1983); Unknown site – 1. (Lovech Region). Listed as “one of the Karlukovo caves”. Listed as *Rhinoceros tichorhinus* Cuvier, 1812 (NIKOLOV, 1983); Unknown site – 2. Pirgovo (Ruse Region). Caves near Pirgovo village. Pleistocene (KOVACHEV, 1906; NIKOLOV, 1977). Listed as *Rhinoceros tichorhinus* Cuvier, 1812 (KOVACHEV, 1906); Mirizlivka cave (Vidin Region) FP 43. Wurmian – Late Pleistocene (POPOV, 1933). Listed as *Rhinoceros tichorhinus* (POPOV, 1936). POPOV (1983) proved Early Pleistocene deposits.

15. *Dicerorhinus megarhinus* De Christol, 1834: Dorkovo (Pazardzhik Region): Ruscinian, Early Pliocene (THOMAS *et al.*, 1986). Listed as *Stephanorhinus megarhinus* (de Christol, 1834) (SPASSOV, 2003; DELSON *et al.*, 2005).

16. *Stephanorhinus elatus* (Croizet, Jobert, 1828): Muselievo (Pleven Region): Final Ruscinian (SPASSOV, 2003), Early Pliocene - 2nd half of the Middle Ruscinian, MN 15 (3.3-3.1 Ma). Listed as *Stephanorhinus jeanvireti* Guérin, 1972. (SPASSOV, 2003).

17. *Dicerorhinus* sp. – 1: Dorkovo (Pazardzhik Region): Ruscinian, Early Pliocene (NIKOLOV *et al.*, 1986).

18. *Dicerorhinus* sp. – 2: Kalimantsi – 3 (Blagoevgrad Region): MN11-12, most probably MN 12 (SPASSOV, 2002).

19. *Dicerorhinus* sp. – 3: Kalimantsi – 4 (Blagoevgrad Region): MN11-12, most probably MN 12 (SPASSOV, 2002).

20. *Diboplos schleiermacheri* (Kaup 1832): Kalimantsi (Blagoevgrad Region) NH 59: Lower Miocene – Pontian (BAKALOV & NIKOLOV, 1962); Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2009). Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Hrabarsko (Sofia Region). Upper Pliocene – Lavant (BAKALOV & NIKOLOV, 1962); Late Miocene (Pontian; BAKALOV & NIKOLOV, 1962). Abandoned coal mines; Gnilyanska formation (NIKOLOV, 1985). Cranial fragment with right maxilla and teeth. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Katina (Sofia Region): Pontian (NIKOLOV, 1985) – Late Miocene. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Dragovishtitsa (Sofia Region): Upper Pliocene – Lavant (BAKALOV & NIKOLOV, 1962); Oligocene. Exact locality unknown. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834. (NIKOLOV, 1985; Prolesha (Sofia Region): Upper Pliocene – Lavant (BAKALOV & NIKOLOV, 1962); Dacian (NIKOLOV, 1985) – Late Miocene; Byala Slatina (Vratsa Region): Upper Pliocene – Lavant (BAKALOV & NIKOLOV, 1962); Pliocene (NIKOLOV, 1985). Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Kula (Vidin Region): Upper Pliocene (BAKALOV & NIKOLOV, 1962); Maeotian (NIKOLOV, 1985) – Late Miocene. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Altimir (Vratsa Region): Upper Pliocene (BAKALOV & NIKOLOV, 1962); Pliocene (NIKOLOV, 1985). Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Cherkezitsa (Plovdiv Region) – river between villages Ahmatovo and Popovitsa: Maeotian - Pontian (NIKOLOV, 1985) – Late Miocene. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Gorna Gradeshnitsa (Blagoevgrad Region): Maeotian (NIKOLOV, 1985) – Late Miocene. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Ezerovo (Plovdiv Region): Maeotian - Pontian (NIKOLOV, 1985) – Late Miocene. Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Oranovo (Blagoevgrad Region). Quarry. Upper Miocene (SPASSOV *et al.*, 2006). Listed as *Dicerorhinus schleiermacheri* Kaup, 1834; Slatino – 2. (Blagoevgrad Region) (GERAADS & SPASSOV, 2009).

21. *Diboplos pikermiensis* Toulou 1906: Hadzhidimovo – 1. (Blagoevgrad Region): Listed as *Dicerorhinus pikermiensis* Gloger, 1841 (SPASSOV, 2000); Slatino - 2. (Blagoevgrad Region): Upper Miocene (SPASSOV *et al.*, 2006); Strumyani – 2. (Blagoevgrad Region): Upper

Miocene (GERAADS & SPASSOV, 2009). Listed as cf. *Dicerorhinus* sp. (SPASSOV *et al.*, 2006); Kalimantsi (Blagoevgrad Region): Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2009).

22. *Dicerorhinus* sp.: Kocherinovo – 1. (Kyustendil Region): Maeotian (NIKOLOV, 1985). - Late Miocene; Kocherinovo – 1. (Kyustendil Region): Late Miocene (SPASSOV *et al.*, 2006); Strumyani – 2. (Blagoevgrad Region). Later part of MN 11? (SPASSOV *et al.*, 2006); Dorkovo (Pazardzhik Region): Pontian (NIKOLOV, 1985; NIKOLOV *et al.*, 1986).

23. *Stephanorhinus etruscus* (Falconer, 1868): Varshets (Montana Region; FN 89): MN 17/MNQ17, 2.4 - 2.1 Ma (SPASSOV 2003).

24. *Ceratotherium neumayeri* Osborn, 1900: Stanyantsi (Sofia Region). Late Miocene (Turolian, 5.80-5.35 Mya /Miocene-Pliocene boundary/) (BOHME *et al.*, 2013). Udescribed and unpublished finds (GERAADS *et al.*, 2011); Hadzhidimovo – 1. (Blagoevgrad Region): SPASSOV (2000); Kalimantsi (Blagoevgrad Region) Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2009).

25. *Ceratotherium* sp.: Strumyani – 1. (Blagoevgrad Region). Later part of MN 11? MN 11 (SPASSOV *et al.*, 2006). MN 11 (SPASSOV *et al.*, 2006); Strumyani – 2. (Blagoevgrad Region). Later part of MN 11? (SPASSOV *et al.*, 2006).

26. Dicerorhinae gen.: Kozarnika Cave (Vidin Region) B2-2 B2-1 (Guadelli *et al.*, 1995, 2005). Early Pleistocene. GUADELLI *et al.* (2005) dated finds as B2-2 (i. e. 1.4-0.9 Ma), but SIRAKOV *et al.* (2010) dated them as B2-2 – B2-1. After POPOV & MARINSKA (2007) the upper boundary of the B-s zone is placed 0.75-0.9 Mya.

27. Rhinocerotinae gen.: Kalimantsi – 4. MN 12 (SPASSOV *et al.*, 2006). Middle Turolian – Late Miocene (GERAADS & SPASSOV, 2009).

Superfamily CHALICOTHERIOIDEA Gill, 1872

Family CHALICOTHERIIDAE Gill, 1872

28. *Ancylotherium pentelicum* Gaudry and Lartet, 1856: Kalimantsi (Blagoevgrad Region): Lower Pliocene – Pontian (BAKALOV & NIKOLOV, 1962); Sarmatian - Maeotian (NIKOLOV, 1985) – Late Miocene; middle Turolian – Late Miocene, NH 59 (GERAADS *et al.*, 2006); Kalimantsi – 2. MN 12 (SPASSOV *et al.*,

2006); Gorna Sushitsa (Blagoevgrad Region): Lower Pliocene – Pontian (BAKALOV & NIKOLOV, 1962); Maeotian (NIKOLOV, 1985) – Late Miocene. MN 22-12 (SPASSOV *et al.*, 2006); Hadzhidimovo – 1. (Blagoevgrad Region): SPASSOV (2000); Strumyani – 1. (Blagoevgrad Region). Later part of MN 11? MN 11 (SPASSOV *et al.*, 2006).

29. *Chalicotherium goldfussi* J. J. Kaup, 1833: Gorna Sushitsa (Blagoevgrad Region): Lower Pliocene – Pontian (BAKALOV & NIKOLOV, 1962); Maeotian (NIKOLOV, 1985) – Late Miocene. MN 22-12 (SPASSOV *et al.*, 2006); Batishnitsa (Ruse Region): Maeotian (NIKOLOV, 1985) – Late Miocene; Kromidovo (Blagoevgrad Region): Maeotian (NIKOLOV, 1985) – Late Miocene; Dolna Sushitsa (Blagoevgrad Region): Maeotian (NIKOLOV, 1985) – Late Miocene.

30. *Metaschizotherium fraasi* Marsh 1877: Kalimantsi. MN 11-12 (GERAADS *et al.*, 2001; SPASSOV, 2002).

31. *Kalimantsia bulgarica* GERAADS & SPASSOV & Kovachev, 2001: Kalimantsi. MN 11-12 (GERAADS *et al.*, 2001).

32. Chalicotheriinae gen.: Hadzhidimovo – 1. (Blagoevgrad Region): SPASSOV (2000).

Superfamily BRONTOTHERIOIDEA (Marsh, 1873)

Family BRONTOTHERIIDAE Marsh, 1873

33. *Brontotherium rumelicum* Toulou, 1892: Kameno (Burgas region). Oligocene. Sand quarry (NIKOLOV, 1977a).

34. Brontotheriidae gen.: Kameno (Burgas region). Oligocene. Sand quarry (NIKOLOV, 1963, 1977a).

Conclusions

Fossil and subfossil record of the three superfamilies of peryssodactyls is surprisingly reach. A total of 34 taxa (10 of them unspecified and identified up to generic level) have been established in the fossil record of the country: Rhinocerotidae (27 taxa) - Amynodontidae (1), Hyracodontidae (1), Rhinocerotidae (25: Aceratheriinae /9/ and Rhinocerotinae /16/); Chalicotherioidea (5 taxa) - Chalicotheriidae (5), and Brontotherioidea (2 taxa) - Brontotheriidae (2). Their numerous fossils came from a total of 53 localities dated from the Oligocene to the Late Pleistocene. The true rhinoceroses

(Rhinocerotidae) were most varied in the paleontological context, reaching up to 25 taxa. Most widely spread were *Aceratherium incisivum* (established in 15 localities), *Diboplos schleiermacheri* (13), *Coelodonta antiquitatis* (6), and *Ancyloterium pentelicum* (5).

The majority of the localities (27) are concentrated along the largest Bulgarian rivers - Struma (14 localities), Iskar (6), Maritsa (5), and

Mesta (2), as well as the Sofia Valley (9) and the Burgas lowland (3) (Fig. 1). On the other hand, only 14 of the total of 53 localities are situated in the Eastern Bulgaria, i. e. ca. 74 % of the localities are placed in the western part of the country.

Although a small country, Bulgaria possesses a surprisingly reach fossil record of these three groups of large perysodactyls, an important source for their examination.

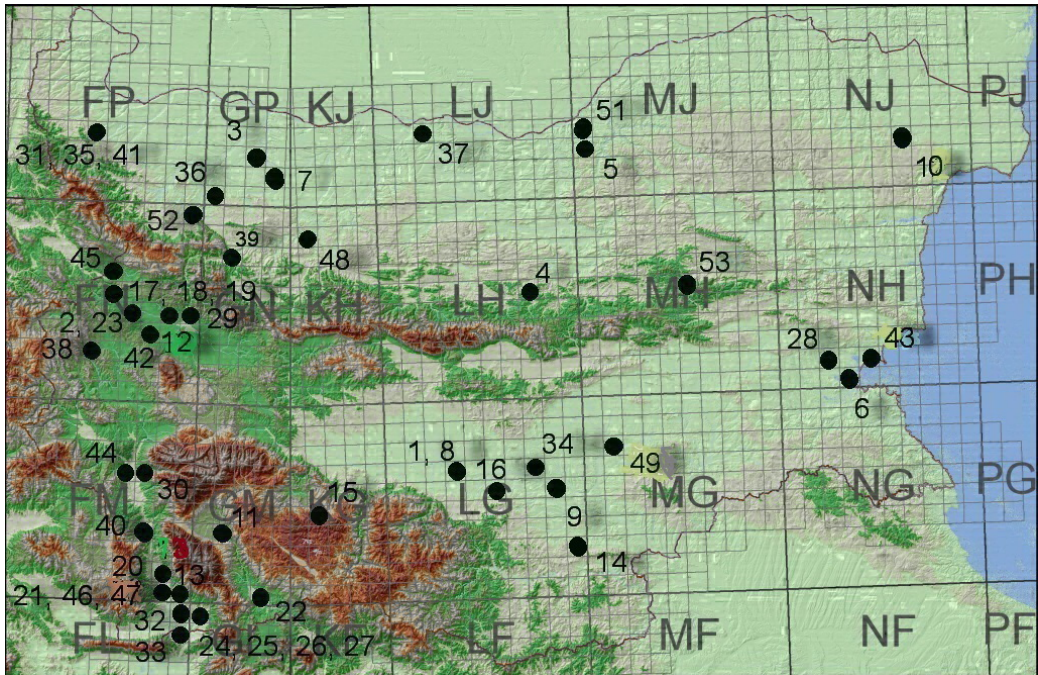


Fig. 1. Localities of fossil rhinoceroses, chalicotheres and brontotheres in Bulgaria: Ahmatovo (1), Aldmirovtsi (2), Altimir (3), Bacho Kiro cave (4) Batishnitsa (5), Burgas (6), Byala Slatina (7), Cherkhezitsa (8), Dimitrovgrad (9), Dobrich (10), Dobrinishte (11), Dobroslavtsi (12), Dolna Sushitsa (13), Dolni Izvor (14), Dorkovo (15), Ezerovo (16), Gaber – 1 (17), Gaber – 2 (18), Gaber – 3 (19), Gorna Gradeshnitsa (20), Gorna Sushitsa (21), Hadzhidimovo – 1 (22), Hrabarsko (23), Kalimantsi (24), Kalimantsi – 2 (25), Kalimantsi – 3 (26), Kalimantsi – 4 (27), Kameno (28), Katina (29), Kocherinovo – 1 (30), Kozarnika Cave (31), Kromidovo (32), Kula (33), Merichleri (34), Mirizlivka cave (35), Mladenova cave (36), Muselievo (37), Noevtsi (38), Nova cave (39), Oranovo (40), Orshets (41), Prolesha (42), Sarafovo (43), Slatino – 1 (44), Stanyantsi (45), Strumyani – 1 (46), Strumyani – 2 (47), Temnata Dupka cave (48), Troyanovo – 1 (49), Unknown site – 1 (not marked on the map - 50), Unknown site – 2 (51), Varshets (52), Yambol (53).

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