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A hominid tooth from Bulgaria: The last pre-human hominid of continental Europe

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ABSTRACT

A hominid upper premolar was discovered in the Azmaka quarry, near Chirpan (Bulgaria). The associated fauna, especially the co-occurrence of *Choerolophodon* and *Anancus* among the proboscideans, and *Cremolophippus matthewi* and *Hippotherium brachypus* among the hipparions, constrains the age of the locality to the second half of the middle Turolian (ca. 7 Ma), making it the latest pre-human hominid of continental Europe and Asia Minor. The available morphological and metric data are more similar to those of *Ouranopithecus* from the Vallesian of Greece than to those of the early to middle Turolian hominids of Turkey and Georgia, but the time gap speaks against a direct phyletic link, and Turolian migration from the east cannot be rejected.

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Introduction

Several late Miocene hominids are documented from the Balkano–Anatolian area. Until recently, it was thought that like the Spanish and central European forms (but unlike the insular, isolated *Oreopithecus*), the youngest of them are Vallesian (first part of the late Miocene) in age. *Ouranopithecus macedoniensis* (Northern Greece) and *Ankarapithecus metei* (Sinap, Anatolia) are dated to 9.6–8.7 Ma (millions of years ago) and about 9.9–9.6 Ma, respectively (Kappelman et al., 2003; Koufos, 2007) (it is possible that at Nikiti-1, *O. macedoniensis* reaches the Vallesian/Turolian boundary: see Casanovas-Vilar et al., 2011). Recently, a new hominid was described from Anatolia as *Ouranopithecus turkae* (Güleç et al., 2007) of early Turolian age, and more precisely MN11 of the mammalian biozonation (Ünay et al., 2006) (but a somewhat younger age cannot be discarded for this species: Casanovas-Vilar et al., 2011), confirming that in this region hominids survived the Vallesian/Turolian boundary. An age close to the Vallesian/Turolian boundary could be proposed after the different investigations for

the '*Dryopithecus*' from Udabno (Georgia) (Gabunia et al., 2001; Casanovas-Vilar et al., 2011). Last, *Graecopithecus freybergi* from Attica, Greece, is associated with a fauna tentatively assigned to the Turolian, but its precise age remains unclear (Koufos and Bonis, 2005). The stratigraphic and biochronological context of an upper premolar from southern Bulgaria, described below, suggest that it represents the last pre-human hominid of continental Europe and of the Balkano–Iranian province.

The locality of Azmaka: geological background

The hominid tooth originates from an old sand quarry called Azmaka (AZM), 2.5 km NNE of the town of Chirpan in southern Bulgaria (Fig. 1). It cuts through a limited exposure of Neogene alluvial deposits of the Maritsa river basin, unrecorded on the geologic map of Bulgaria (Boyakov et al., 1993). The abandoned quarry in AZM has a total surface of about 1 km² and consists of separate sub-quarries, which were assigned different locality names ('AZM 1', 'AZM 2', etc.) (Fig. 2). The deposits gently dip toward the NE, but they can be correlated in the various parts of AZM, in spite of a few faults of minor vertical amplitude of no more than a few meters. Two genetic lithocomplexes can be recognized in

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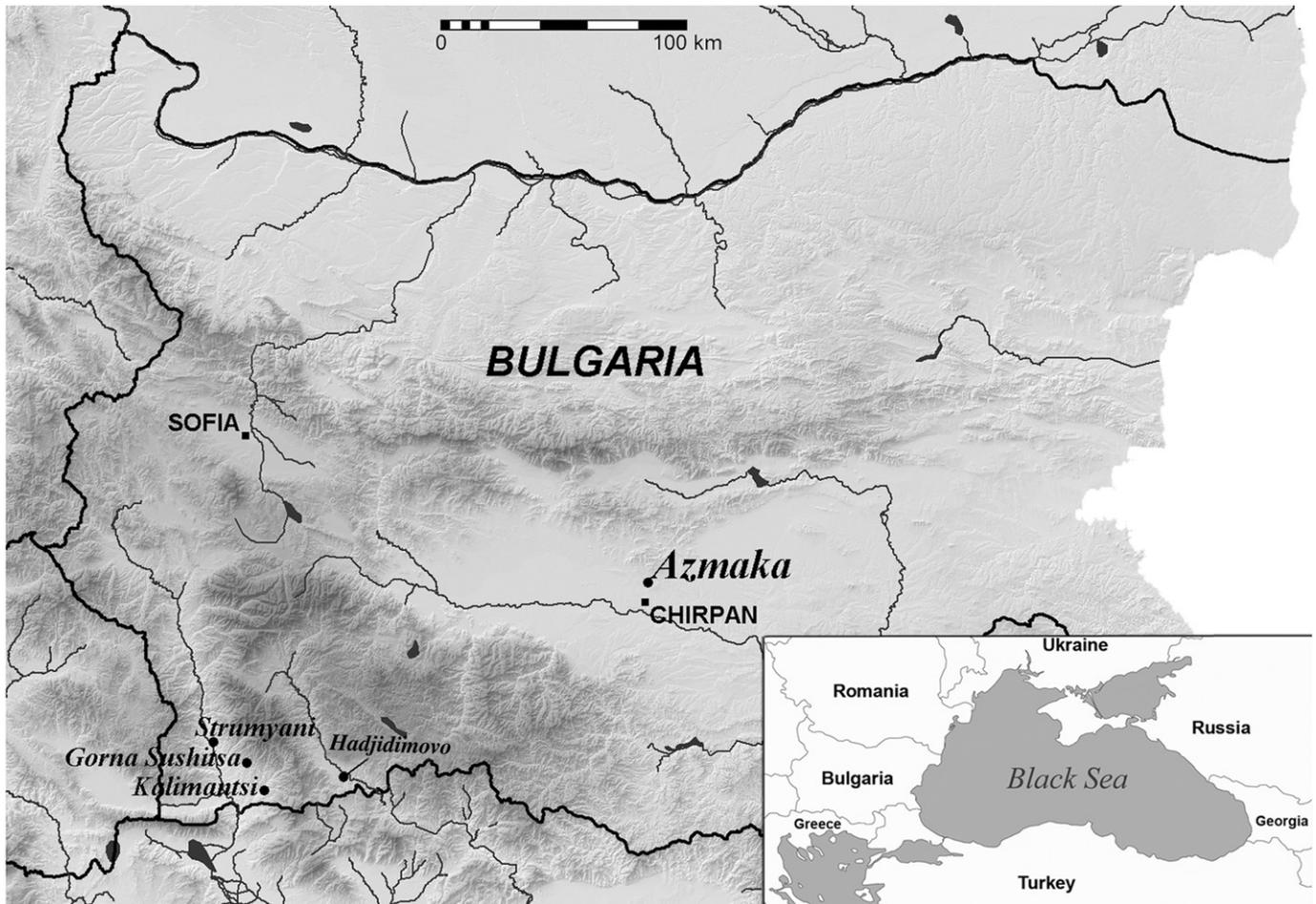


Figure 1. Map of Bulgaria with indication of the locality of Azmaka.

the AZM deposits that unconformably overlay marine Upper Eocene limestones. The lower complex, which crops out in AZM 3 (AZM 3L), consists of alternated compact brackish clays and fine overlying continental (?) sands. It yielded two teeth of the anthracothere *Brachyodus*, showing that this lower complex documents, at least in part, the early Miocene, but the occurrence of the brackish mollusk *Corbula helmersenii* suggests that its lower boundary could be in the late Oligocene (Kalmykian regional stage of the Eastern Paratethys). An upper continental lithocomplex (AZM 3U) represents a variegated group of alluvial strata (with a thickness of about 20 m), consisting of a number of alternating layers of fawn-brownish and reddish clayey sands, and conglomerates of greenish clays and paleosols. They unconformably overlie the lower complex (Fig. 3). The facies of this upper lithocomplex strongly resemble those of the deposits that outcrop at the sand quarry of Ahmatovo, also localized in the Maritsa river Neogene deposits (the stratotype of the Ahmatovska Formation: Popov, 1993). The Ahmatovo locality is located about 20–25 km from Azmaka, and yields a middle Turolian fauna (Geraads and Spassov, 2009) that is similar in its species composition to the fauna of the upper lithocomplex in Azmaka, of which two collections were made (Table 1): one was collected by the amateur paleontologist P. Popdimitrov in the period 1985–2005 from AZM 1–4 (see: fossil fauna from the old collections – Table 1). The second collection was made by us in 2008–2009, mainly from a new fossiliferous spot, AZM 6. According to P. Popdimitrov, the hominid tooth described below was discovered in AZM 4b in the fawn-reddish sands of the upper lithocomplex.

The sedimentary structure of the upper lithocomplex indicates that these upper Miocene levels are homogenous and accumulated by the activity of braided rivers in a relatively short time span, which is also confirmed by the fauna (see below). Deposition of the upper Miocene sediments started with a fining-upward sequence of boulders, conglomerates, sands (all in reddish matrix) and silty, green-red mottled paleosols in Azmaka 3 (AZM 3U; Fig. 3). On top of the conglomerates of AZM 3U, we discovered a cranium of *Anancus* sp. Above the cranium are sandy layers with paleosols, most probably older than the sandy layers with paleosols that crop out in the middle section of AZM 2 and in AZM 6, where we discovered a rich fauna (Table 1). The noted layers in AZM 6 and AZM 2 are probably equivalent to cross-bedded fawn-reddish sands and silty clays (reworked paleosols) of the fossiliferous layers in AZM 4b, where the hominid tooth was discovered. The correlation suggests that the hominid-bearing level is stratigraphically located above the reddish conglomerates with the *Anancus* skull and near (or slightly below) the level of the layers with fauna in AZM 6 (Fig. 3).

The associated fauna: composition and biochronology

The preliminary list of the large mammal fauna of the Popdimitrov collection is mostly composed of artiodactyls, perissodactyls, carnivores and proboscideans, which are also found in the classic Turolian localities of the Balkano-Iranian province (Table 1 – the old collections). The presence of the rhino *Acerorhinus* and of a chalicotheriine (cf. *Anisodon*), both rare in Greece, is similar to other Bulgarian, Macedonian and Turkish sites, while

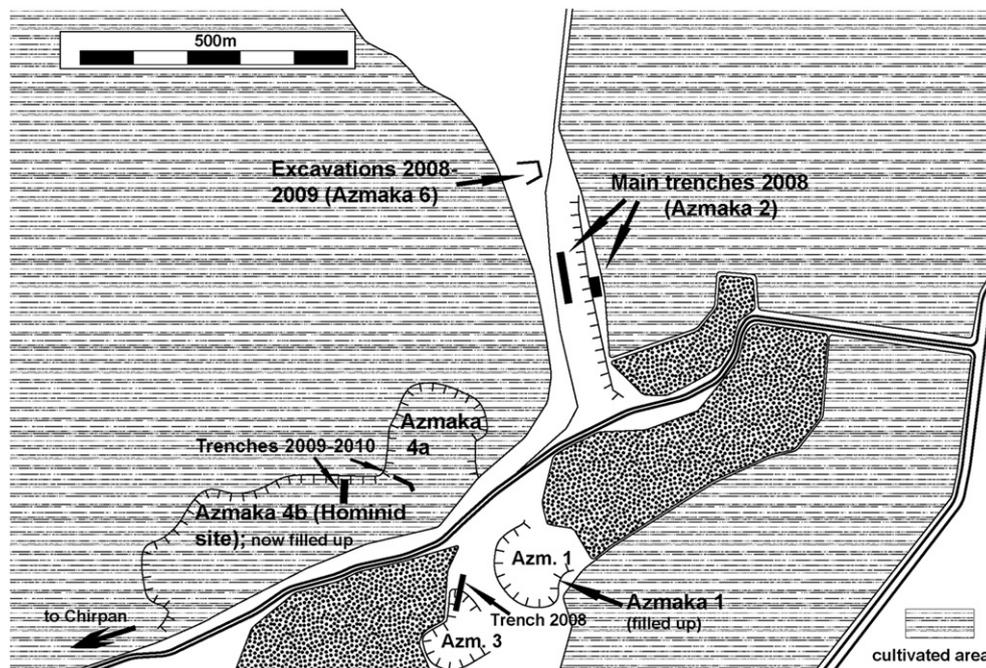


Figure 2. Sketch of the Azmaka quarry.

Dorcatherium is not a rare find in the southern Balkans. We may note that no taxon is suggestive of a Vallesian age, that the single specimen of the tragulid *Dorcatherium* is large, and that the *Protragelaphus* is even larger than *Protragelaphus theodori* from the late Turolian of Dytiko (Bouvrain, 1978), although the morphology of its horn cores is that of the middle Turolian *Protragelaphus skouzesi*. Many species identified in the old collections were also sampled from AZM 6, which provides biochronological indications similar to those of the Popdimitrov collection. The entire fauna of Azmaka indicates a middle Turolian association (Table 1). The proboscidean taxa present at Azmaka are part of a specific faunal association that is also known from other Bulgarian localities in the Maritsa river basin from the second half of the Turolian (e.g., the localities of Ahmatovo and Ezerovo: Markov, 2008). Isolated *Anancus* teeth are available in the old collections from AZM 1. Our excavations at AZM 3U recovered an incomplete cranium with M2–M3. The M3 shows a primitive morphology, namely an absence of posterior posttrite conules, and an anancoid contact involving the mesoconelet (see Metz-Muller, 2000). The co-occurrence of *Choerolophodon pentelici* and *Anancus* sp. indicates a post-Pikermian age for AZM. Typical for the Turolian faunas of SE Europe, *C. pentelici* is known until MN13 (Dytiko, Greece: Bonis et al., 1988; Tassy, 1990). *Anancus*, on the other hand, seems to appear in late MN12 (Tassy, 1986; Metz-Muller, 2000) and is absent from Pikermi and the pre-Pikermian European localities. In its primitive tooth morphology, the AZM *Anancus* is similar to finds from Ahmatovo and Ezerovo, and to the anancine from the Turolian locality of Dorn-Dürkheim 1, *Anancus lehmanni* (see Markov, 2008). Proboscideans from Dorn-Dürkheim 1 have been correlated to 'MN12-13' by Gaziry (1997), an estimation with which we agree, although Dorn-Dürkheim 1 is generally considered an early Turolian locality, because its fauna seems to be mixed and to contain reworked fossils (Spassov et al., 2006; Markov, 2008). *Cremohipparion matthewi* also indicates a late middle Turolian to late Turolian age, but the co-occurrence of *Hippotherium brachypus* (a complete skull from AZM 6), a species not found in the late Turolian restricts the time range to the second half of the MN12 (Vlachou and Koufos, 2009). *C. matthewi* is represented by a cranium (also from AZM 6: FM2860) of small size.

The preorbital bar is short (24.3 mm), the preorbital fossa is shallow, and subtriangularly shaped. The ventral and dorsal rims are moderately delineated. The main differences with the earlier *Cremohipparion macedonicum* are the less developed preorbital

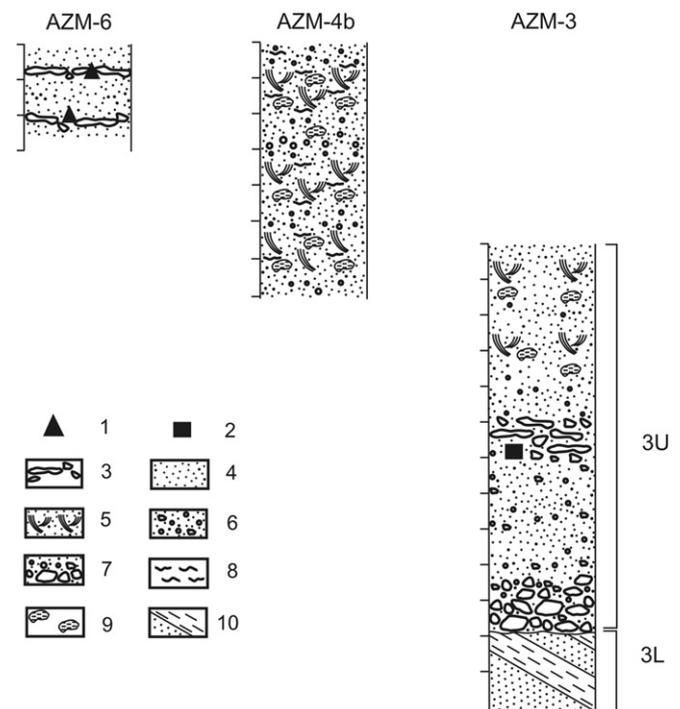


Figure 3. Profiles of Azmaka sandpit with lithostratigraphic correlation of fossil-bearing sections: 1. Fossil fauna. 2. *Anancus* find. 3. Paleosols. 4. Unsorted sands (fine to coarse) with gravels with variegated coloration. 5. Unsustained sands with cross-striation with variegated coloration. 6. Conglomerates with clayey-sandy cement. 7. Boulders, cobbles and pebbles. 8. Reddish to black thin sandy layers. 9. Gray-green aleurolite-sandy clays boulders. 10. Lower Oligocene – lower Miocene alternated clays and sands of the lower lithocomplex (AZM 3L). The column scale is 1 m.

Table 1
Preliminary check-list of the Middle Turolian fauna of Azmaka locality.

Azmaka (AZM) localities	AZM 1–4	AZM 6
<i>Hystrix primigenia</i>		+
<i>Mesopithecus pentelicus</i>		+
Proboscidea indet.		+
<i>Deinotherium gigantissimum</i>	+	
<i>Choerolophodon pentelici</i>	+	
<i>Tetralophodon atticus</i>	+	
<i>Anancus</i> sp.	+	
<i>Hippotherium brachypus</i>	cf.	+
<i>Creomhipparion</i> cf. <i>mediterraneum</i>	+	+
<i>Creomhipparion matthewi</i>	cf.	+
<i>Ancylotherium</i> sp.		+
cf. <i>Anisodon</i> sp.	+	
<i>Chilotherium</i> sp.		+
<i>Acerorhinus</i> sp.	+	
cf. <i>Ceratotherium</i> sp.	+	+
Hyracoidea indet.	+	
<i>Palaeotragus</i> sp.		+
<i>Bohlinia attica</i>	+	
<i>Helladotherium</i> sp.	+	+
<i>Dorcatherium</i> sp.	+	
cf. <i>Pliocervus/Procacpreolus</i> sp.	+	+
<i>Microstonyx major</i>	cf.	+
<i>Gazella</i> sp.	+	+
cf. <i>Protoryx</i> sp.	+	
<i>Prostrepsiceros zitteli</i>	+	
<i>Prostrepsiceros</i> sp.	+	
<i>Protragelaphus</i> cf. <i>skouzesi</i>	+	
? <i>Miotragocerus</i> (<i>P.</i>) <i>gaudryi</i>	+	+
<i>Tragoportax</i> sp.	+	+
Mustelidae indet.	+	
<i>Adcrocuta eximia</i>	+	+
<i>Ictitherium</i> sp.	+	+
<i>Plioviverrops orbigny</i>		+
<i>Paramachaerodus</i> sp.		+
cf. <i>Metailurus major</i>		+
<i>Machairodus</i> sp.	+	+
<i>Testudo marmorum</i>	cf.	+
Aves indet.		+

The fauna from locality AZM 1–4 after fossils from the 'old collections: 1985–2006' of P. Popdimitrov (Chirpan private paleontological museum); AZM 6 – after our excavations (2009–2010).

fossa, which is identical with that of the type specimen from Samos, and the less plicated teeth (Koufos, 1987; Vlachou and Koufos, 2000). The comparison of the tooth dimensions of a male cranium of the primate *Mesopithecus pentelicus* from AZM 6 (L P3–M3 – 32.8; L M1–M3 – 22.9 and 23.0; L C1–M3 – 40.1) with the *Mesopithecus* tooth size (males) from the other early to late Turolian localities from the Balkans (Bonis et al., 1990a,b; Zapfe, 1991; Koufos et al., 2003, 2004; and Personal Data) leads to the following conclusions: Tooth measurements of *Mesopithecus* are smaller than those from the first part of the Turolian (late MN 11 to early MN 12: Hadjidimovo (Spassov, 2002); Vathylakkos (Koufos et al., 2006)), referred to the large chronoform *M.* cf. '*delsoni*' and larger than those of the late Turolian (Dytiko: Bonis et al., 1990a) but closer to those from the middle to late MN 12: Kalimantsi (Geraads and Spassov, 2009); Pikerimi (Koufos et al., 2006; Kostopoulos, 2009). Thus, the *Mesopithecus* biometrics are in agreement with the data provided by the proboscideans and hipparions, suggesting a middle Turolian age (more precisely, the second half of MN 12). This is also corroborated by the only fossil reptile, the tortoise *Testudo marmorum*, previously known only from its type locality Pikerimi.

We conclude that the AZM biostratigraphic likely age is restricted to the post-Pikerimi middle Turolian. The absolute age of the reference locality of Pikerimi has recently been estimated at ca 7.2 Ma (Kostopoulos, 2009), hence that of the Azmaka fauna could be close to 7 Ma.

Description of the hominid tooth

The Azmaka hominid tooth (Regional Historical Museum of Stara Zagora, coll. No. RIM 438/387) is a strongly worn upper premolar (Fig. 4). It is elongated labio-lingually, like hominid premolars. The sub-oval shape in occlusal view, with rounded rectangular outline, the rather symmetric lingual and labial surfaces, which are sub-equal in length, the lack of salient mesio-labial angle, unlike hominid P3s where it is related to the distinct wear facet, all distinguish the tooth from a P3 but correspond instead to the shape of P4. Three relatively small mesio-distally compressed roots are present: one, the most robust one, on the lingual side and two on the labial side. The labial ones are close in

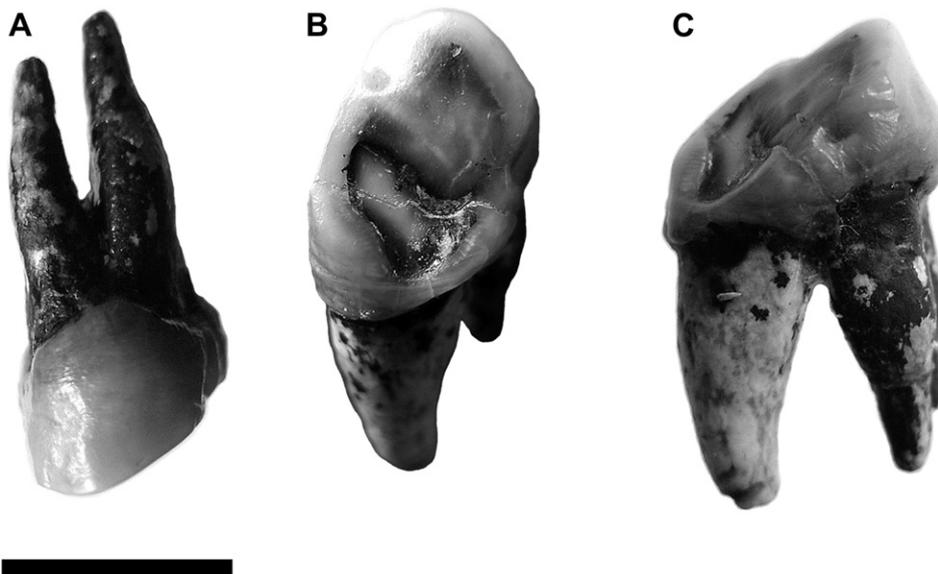


Figure 4. The hominid left upper premolar (P4) from Azmaka (AZM 4b) (RIM, No. 438/387). 4-A: in labial view; 4-B: in occlusal view; 4-C: in distal view. Scale – 1 cm.

size and fused only at their bases. One of them is a bit shorter but slightly more robust and somewhat displaced labially. Thus, it can be accepted as the mesial one and these root features, together with several others, such as the mode of wear, the trace of the mesial fovea, etc., suggest that the premolar is from the left side.

The occlusal surface is more expanded than the cervix, the labial crown profile being especially bulging. The enamel is thick, especially on the occlusal surface. At approximately the same stage of wear, on the upper premolars of the *A. metei* specimen MTA 2125 (comparison from photos and a cast) the dentin occupies most of the occlusal surface whereas it is exposed only on a small part of the occlusal surface of the Azmaka P4 (see below). The crown is worn flat, showing an advanced individual age, with no crown relief of the paracone, protocone, or foveae, except for a small trace of the mesial fovea. The main occlusal surface is strongly slanted lingually. A tiny dentin pit typical of worn upper premolars opens in the area of the missing paracone apex. A much larger mesio-distally elongated dentin pit is exposed in the area of the missing protocone apex, occupying most of the surface of the lingual part. The contacts with P3 and M1 are marked by interstitial wear facets. There are no visible traces of cingula but an enamel hypoplasia (with clear evidence of 'perikymata' lines) is expressed on the crown surface. This defect is reported for some fossil hominid teeth (Brunet et al., 2002). Measurements: comparative crown measurements of the Azmaka P4 are given in millimeters (mm) in Table 2: lingual root (at base): 5.1×5.6 , maximum length (H) = 12; mesio-labial root: 2.9×4.8 , H = 11.4; distal labial root: 2.8×4.4 , H = 11.9.

Comparisons

Late Miocene hominids are known from several genera from Africa and Eurasia. Some of them preserve the P4, which can be compared with that of the Azmaka hominid.

Samburupithecus kiptalami (Ishida and Pickford, 1997) from the late Miocene (9.5 Ma) of the Samburu Hills, Kenya, is based on a maxilla with cheek dentition (KNM SH 8531). The P4 from Azmaka differs from its P4 in being more rectangular, slightly broader, and much shorter mesio-distally (Table 2).

The P4 of *Nakalipithecus nakayamai* (KNM-NA46430) from the late Miocene (9.74–9.88 Ma) of the Nakali Formation, Kenya (Kunimatsu et al., 2007), is similar in size to that of the Azmaka hominid, but is also more rounded and longer relative to its breadth (Table 2).

Direct comparison with the *Sahelanthropus tchadensis* P4 from Chad (Brunet et al., 2002), dated to ca. 7 Ma (Vignaud et al., 2002; Lebatard et al., 2008), is impossible as the P4 is unknown in the Chadian form, but its teeth, premolars included, are too small to match those of the Azmaka hominid.

Lufengpithecus is known from southern China with two or three late Miocene species (~9–7 Ma) (Harrison et al., 2002; Kelley, 2002). Its P4 average dimensions are considerably smaller (Table 2) and demonstrate (observations on casts) a different wear mode, which is stronger on the paracone. The protocone is only slightly worn when the paracone is in advanced stage of wear, thus the occlusal surface in mesial/distal view is concave. It is likely that this profile with more raised paraconal part would persist even in the stage of wear of the AZM tooth, which is flat instead.

Three species of *Sivapithecus* are accepted in the recent revision of the genus (Kelley, 2002), but even the youngest species, *Sivapithecus sivalensis* from the Siwaliks of India and Pakistan is older (9.5–8.5 Ma) (Kelley, 2002) than the Azmaka hominid. The mean values of its P4 are smaller than the AZM tooth (see Table 2; the Potwar skull GSP15000 is close in size ~ 8×12 mm: Pilbeam, 1982) but its crown shape is more piriform in occlusal view.

Table 2

Comparative measurements of the Azmaka P4 and of other Upper Miocene Hominoids.

	Length (mesio-distal)	Width (labio-lingual)
Azmaka (RIM 438/387)	8.2	12.3
<i>Ouranopithecus macedoniensis</i> ^a		
R.PI. 193 ♂	8.6	13.6
R.PI. 120 ♂ (mean)	9	14.55
NKT 89 ♀ (mean)	7.25	12.6
Range	7.25–9.2	12.6–14.6
<i>'Ouranopithecus' turkae</i> CO-205 ^b	9.9	14.7
<i>Ankarapithecus metei</i>		
AS 95-500 ^c	7.5	11.8
MTA 2125 ^d	7.8	12.4
<i>Rudapithecus hungaricus</i> ^a	5.2–6.5	9.5–11.5
<i>'Udabnopithecus' garedziensis</i> ^e	6.5	10.1
<i>Samburupithecus kiptalami</i> SH 8531 ^a	9.1	12.5
<i>Nakalipithecus nakayamai</i> NA 46430 ^a	9.6	11.7
<i>Sivapithecus indicus</i> ^f	7.6	12
<i>S. sivalensis</i> ^f	7.2	10.9
<i>S. parvada</i> GSP 20450 ^g	9.2	14.9
<i>Lufengpithecus lufengensis</i> ^h	7.7 (6.5–8.8)	11.6 (9.8–13.6)
<i>Lufengpithecus keiyuanensis</i> ⁱ	7.3 (5.6–9.1)	10.9 (8.3–13.3)
<i>Oreopithecus bambolii</i> ^j	6.2 (5–5.7)	8.8 (7.7–9.4)

For the nomenclature and taxonomy, see the text and the literature cited there. When both the right and left P4s are preserved, mean measurements are given.

^a Original measurements.

^b Güleç et al., 2007.

^c Alpagut et al., 1996.

^d Begun and Güleç, 1998.

^e Gabunia et al., 2001.

^f Kay, 1982, mean.

^g Kelley, 1988.

^h Wood and Xu, 1991, mean (minimum–maximum).

ⁱ Liu et al., 2000, mean (minimum–maximum).

^j T. Harrison, Personal Communication.

The Dryopithecina (sensu Begun, 2009) have smaller and more ellipsoid/piriform (less rectangular) P4s in occlusal view. The youngest of them is *Rudapithecus* from Rudabánya (ca. 10–9.5 Ma) and the '*Dryopithecus*' from Udabno, a site assigned to the Vallesian/Turolian boundary (Gabunia et al., 2001; Begun, 2002; Casanovas-Vilar et al., 2011). Dryopithecina P4s are smaller than that of the Azmaka hominid (Table 2). The enamel layer in the Azmaka hominid P4 is also thicker, as in the much less worn P4 from Udabno where the paracone enamel is already abraded (Gabunia et al., 2001: Fig. 14-2-14-3), unlike that of the Azmaka tooth.

The P4 of the endemic, insular *Oreopithecus* from Tuscany and Sardinia, with an age between 8.7 and 6.7 Ma (Rook et al., 2000, 2011), is also much smaller (Table 2) and more ellipsoid, with a less angular contour in occlusal view.

Two partial skulls with teeth of *A. metei* are known from the Sinap Formation, Ankara region, Turkey (Kappelman et al., 2003). The P4 from Azmaka is relatively close in its general morphology, size and proportions to that of the *Ankarapithecus* male MTA 2125, which is only slightly shorter (Table 2), but with an occlusal crown contour that is more piriform, with slightly longer lingual side and shorter buccal one. The enamel of the Azmaka tooth is also thicker. At the same stage of wear (the lingual and labial crown height of the P4s are virtually the same) the enamel is erased on the lingual half of the occlusal surface as well on the apex of the paracone of the *Ankarapithecus* specimen.

The P4 of '*Ouranopithecus' turkae* from the early Turolian of Çorakyerler in Turkey (Güleç et al., 2007) is significantly larger (Table 2), more rounded and more piriform in occlusal view, as in *Ankarapithecus*, but unlike *O. macedoniensis* and the Azmaka tooth.

O. macedoniensis is known from three late Vallesian localities in northern Greece: Ravin de la Pluie, Xirochori-1 and Nikiti-1 (Bonis

et al., 1990b; Koufos, 2007). The morphology of the Azmaka P4 is very close to that of specimens at the same wear stage and has the size of a female individual of this species (Table 2), but its roots are smaller.

Direct comparison with *G. freybergi* from Pyrgos Vassilissis, near Athens (Greece) is impossible because this species is known only by a mandible. However, the corpus is smaller than that of female *O. macedoniensis*, and it is small in comparison to that of the molar's crown (Koufos and Bonis, 2005). Recent studies indicate that *Ouranopithecus* and *Graecopithecus* are not identical (Begun, 2002, 2009; Koufos and Bonis, 2004, 2005).

Taxonomic and paleoecological discussion

The P4 from Azmaka differs from the known forms, including those described from the early Turolian of Çorakyerler (Turkey) and from Udabno (Georgia) and resembles *O. macedoniensis* in morphology and crown size, although the smaller roots, the geologic age differences, and inadequacy of the material prevents referral of this tooth to the latter species. The small size of the roots may indicate a similarity in size to *G. freybergi*, an identification that would be supported by the possible Turolian age of this form, but more definitive conclusions remain impossible. For the time being, the tooth could be provisionally assigned to cf. *Ouranopithecus* sp. or aff. *G. freybergi*.

According to the recent paleogeographic and paleoecologic data, an open biome had developed in the Turolian in Western Eurasia and a decrease of precipitation had taken place in its core area south of the Paratethys sea. This process climaxed at about 8–7 million years ago (Eronen et al., 2009). The presence of browsers, mixed feeders, grazers, and also bark-eaters among herbivorous mammals, as well as the typical Pliocene tortoise, leads us to conclude that the Azmaka environments provided open areas with a rich herbaceous layer (including C₃ graminoids and forbs) in combination with bushland and woodland vegetation. This is supported by the presence of mottled paleosols, indicating seasonality in precipitation. It reveals a forest-savannah/open woodland mosaic, considered as typical after faunal (mammals and birds) and botanical data for the Pliocene biome (described initially as seasonal sclerophyllous evergreen woodlands: Solounias et al., 1999; Bernor, 2007) of the Middle Turolian of the central Balkan regions (Spassov, 2002; Ivanov, 2003; Spassov and Geraads, 2004; Merceron et al., 2006; Spassov et al., 2006; Boev and Spassov, 2009; Geraads et al., 2011).

Following the procedures described in Merceron et al. (2005; see also Calandra et al., 2008; Merceron et al., 2009, 2010; Peigné et al., 2009; Ramdarshan et al., 2010), the dental microwear pattern of the Azmaka premolar is quantified using both shearing and crushing facets (Fig. 5). These data are compared with premolars of Northern Greek *O. macedoniensis*. The comparative dataset of premolars of *O. macedoniensis* is composed of the following specimens: RPL117- RPL118- RPL128- RPL193- RPL198- RPL207- RPL631- RPL71- RPL75- RPL78- RPL85-XIR1. Comparing the Azmaka premolar dental microwear pattern with molars could result in misinterpretations due to their more posterior position (Gordon, 1988). Also, unworn and deeply worn premolars were removed from this comparative dataset. Considering the similarities with the data collected from the Greek ape, the Azmaka hominid was obviously a so-called 'hard-object feeder'. Indeed, both shearing and crushing facets of the Azmaka individual display high pitting patterns, whereas the shearing facet displays more scratches than the crushing one. Based on a microwear analysis applied to molars, Merceron et al. (2005) emphasize the similarities between extant baboons and *Ouranopithecus* and conclude that the Balkan ape may have fed on items ranging from abrasive material

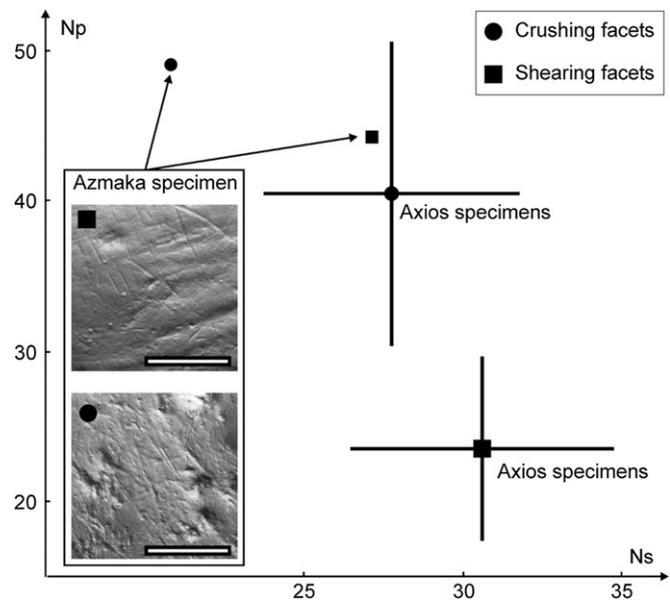


Figure 5. Bivariate plots of the number of pits (Np) and scratches (Ns) on the shearing (square) and crushing (circle) dental facets on premolars of *Ouranopithecus macedoniensis* (from Axios localities in Greece) and of the Azmaka hominid (Maritsa river basin, Bulgaria). The Greek sample is here represented by the mean and the confidence interval at 95%. Scale bars = 500 μ m.

(silica-bearing graminoids) to hard/brittle elements (seeds, nuts). Such feeding habits related to the consumption of food that is rich in grasses has also been highlighted from microwear and isotopic analyses for early African hominines (Ungar et al., 2010; Cerling et al., 2011).

Conclusions

The latest data have shown that contrary to the hominids in Western and Central Europe (with the exception of the insular *Oreopithecus*), hominids from the Eastern Mediterranean may have lived up to 8–7.5 Ma, preadapted to the more open biotopes of the Balkan–Iranian zoogeographic province (Casanovas-Vilar et al., 2011). The Azmaka hominid is probably about 1.5 million years younger than *O. macedoniensis*, as well as the dryopithecine from Udabno ('*Udabnopithecus*'), and most probably almost one million year younger than '*Ouranopithecus turkae*', and could be regarded as the latest known occurrence of a pre-human hominid in continental Europe and Asia Minor. The Azmaka tooth gives considerable ground to accept the presence of hominids in the Balkans during the second half of the Turolian, and falsifies the hypothesis that in the Turolian of Europe they were replaced, under new environment conditions, by new primate competitors such as the cercopithecoid *Mesopithecus* (Agusti et al., 2003; Merceron et al., 2010). We may hypothesize that the Turolian hominid is a survivor from the Vallesian. The fact that it has not been found so far in the rich Turolian sites of the area is no certain proof of hominid extinction in Europe at the end of the Vallesian. In any case, this hominid must have been a rare element in the paleobiocoenosis and its discovery depends heavily on chance.

Alternatively, we may propose that, given the absence of hominids from the abundant Balkan fossil record from the first half of the Turolian, the Azmaka locality may document instead a new westward dispersal via Asia Minor toward the Balkans. Considering the Çorakyerler and Udabno's discoveries, we suggest that an origin from Asia Minor is more likely, yet this does not exclude the possibility of African influence. The exchange with African fauna at

the time became intensive, a number of Pliocene taxa migrated to Africa, yet nevertheless there were reverse migration processes (Bernor, 2007). This hypothesis receives some support in the discoveries in localities near Ahmatovo village (that are close geographically and biochronologically to Azmaka: see above) of the rhinoceros *Brachypotherium* and of a trilophodont gomphothere, which probably attest a late Middle Turolian dispersal of East African faunal elements toward the Balkans (Markov, 2007; Geraads and Spassov, 2009).

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