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CURRENT RESEARCH ON THE HOMINID SITE OF DMANISI

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Geology and Geochronology

The early Paleolithic site of Dmanisi is in the province of Kvemo-Kartli (East Georgia), on the territory of the medieval town of Dmanisi.

Dmanisi is located about 85 km southwest of Tbilisi (44° 20' N, 41°) in the Mashavera River Valley, which drains the Javaheti volcanic chain to the west of the site (fig. 1).

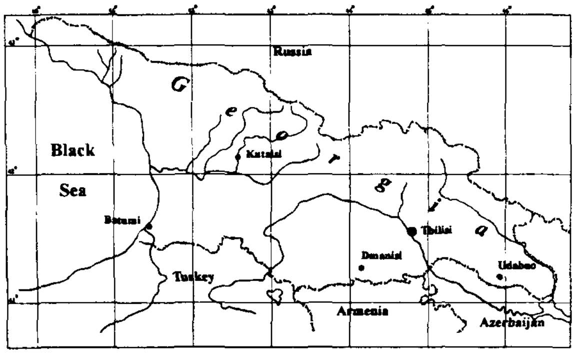


Figure 1. Map.

The site is situated on a promontory elevated about 80 m above the confluence of the Mashavera and Pinezouri valleys (fig. 2). The hominid and artifact-bearing deposits, the full extension of which is unknown, cover the original surface of Mashavera basalt. The age of Mashavera lava flow is 1.85 ± 0.01 MA. The lavas are normally magnetized and clearly correspond to the Olduvai paleomagnetic event. These lavas fill the Mashavera valley and also extended into the Pinesouri valley. The Paleolithic site had accumulated in direct association with a lake, which was formed when a lava stream blocked one of the Dmanisi rivers (fig. 3).

Today, the Dmanisi bone deposits lie over almost unweathered basalts, which extend over an area of some 5,000 sq.m. Up to date 150 m^2 was excavated (fig. 4).

The fossiliferous deposits are up to 4 m. in thickness and are covered by the remains of a medieval town and middens.

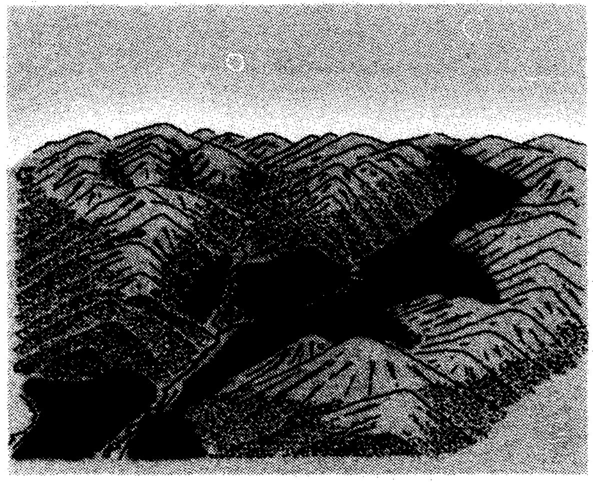


Figure 2. The site of Dmanisi today.

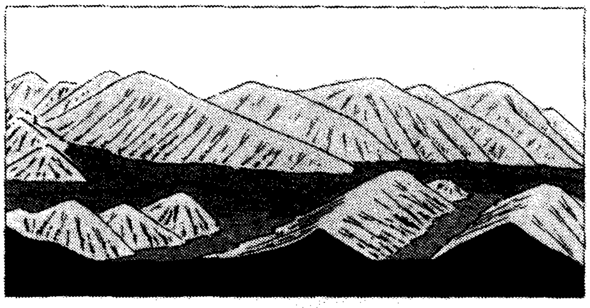


Figure 3. The site of Dmanisi 1.7-1.8 Ma ago.

We can distinguish the following three main stratigraphic units in the sections (fig. 5, by Gabunia *et al.*, 1999). The lowest one (layers V and IV), contains volcanic ash as well as colluvial and fluvio-lacustrine sediments. The lowest layer corresponds to the formerly defined Layer VI (Djaparidze *et al.*, 1989). This basal deposit is a black, basaltic, tuffaceous loamy sand, comprised mainly of pumaceous glass, plagioclase and associated mafics. The tuff is up to almost 50 cm thick, variably filling crevasses and low areas on the irregular, unweathered surface of the Masavera Basalt.

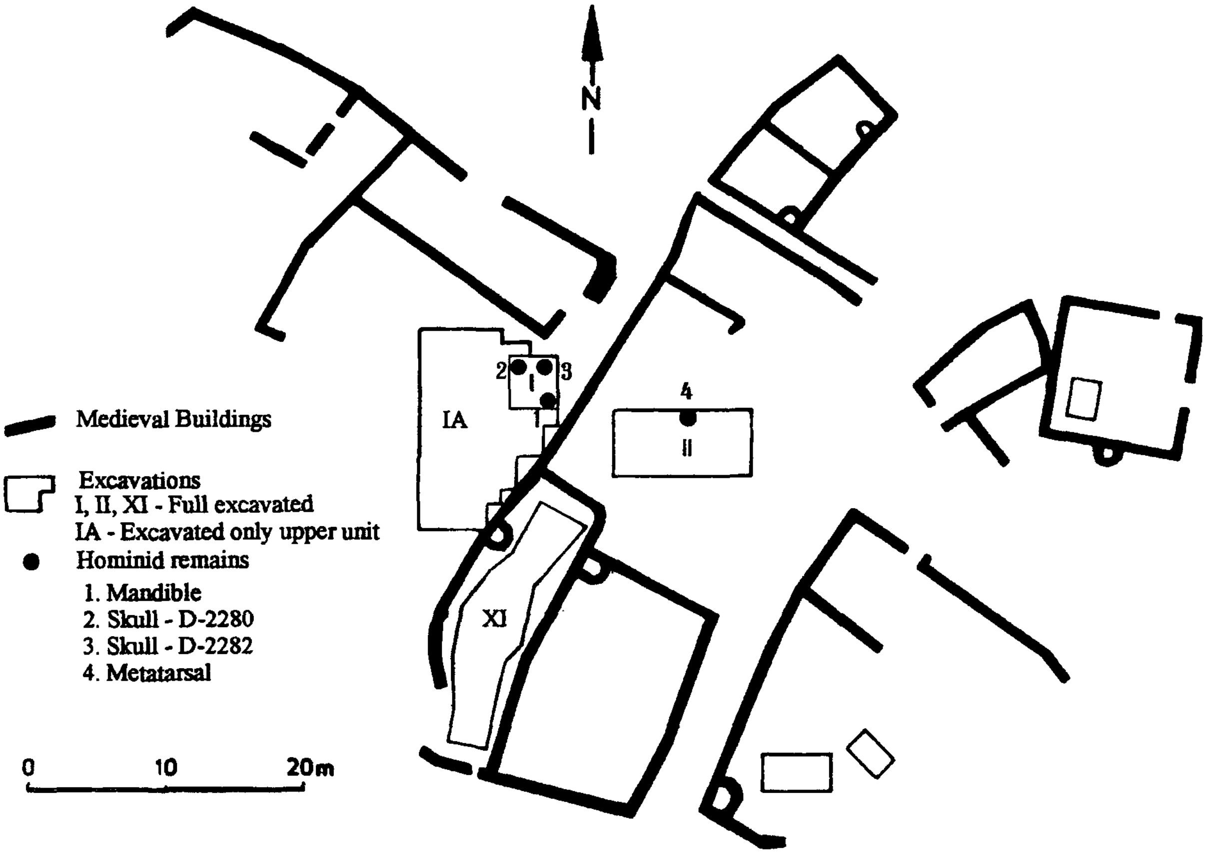
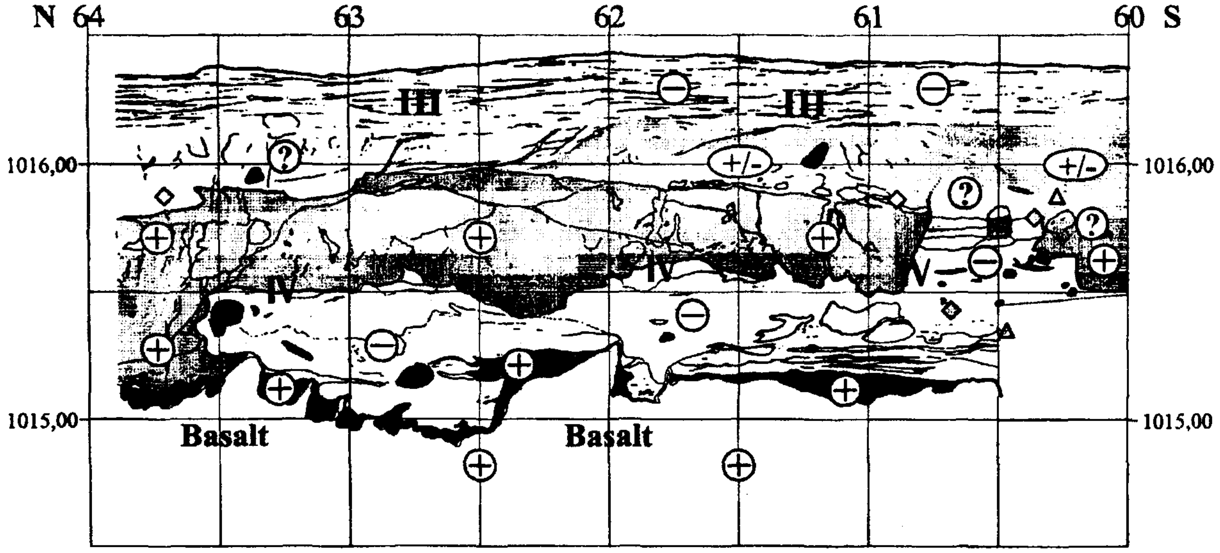


Figure 4. Plan of excavations.



Section by

Gabunia et al 1999

± - Polarity

III, IV – number of layer

Figure 5. The section by Gabunia *et al.*, 1999.

Level IV is up to 2,5 m. thickness its corresponds contains former levels IV and V (Djaparidze *et al.*, 1989).

The unit is a massive to thinly bedded, very dark grayish-brown tuffaceous loamy sand that grades upward to a calcareous, dark yellowish-brown tuffaceous fine loamy sand; this unit has weak angular blocky structure, many carbonate veins and cavity linings, and is weakly indurated by 5-13% secondary carbonate.

This unit includes numerous remains of large mammals as well as some stone tools. In this unit we have samples with normal magnetization as well as samples with reverse polarity. The fossil remains come from nestlike lenses, which include whole crania as well as postcranial elements. The positions of the bones as well as the presence of the axial skeletons indicate that post-depositional movements have not affected them. All hominid remains recovered to date were found in this unit.

The Second unit Level III is represented by an indurate carbonate crust. This crust also contains fossilized fauna and stone tools. It covers the entire area of the site and serves as an important stratigraphic marker bed. The presence of this crust precluded any displacement of the bones or of stone tools from higher levels into the lower part of the section. This very hard carbonate zone must have contributed to the remarkable bone preservation in the underlying sediments. There is no evidence that the carbonate zone was broken or penetrated until the Medieval period. This unit has reverse polarity.

The upper unit (level II and I) contains mostly colluvial pebbles. This stratum has yielded the largest number of stone artifacts and few bones. This unit has reverse polarity.

The lower part is a massive, dark yellowish brown tuffaceous loamy sand, ca. 1.2 m thick. The upper 50 cm of this unit is a yellowish brown pedogenic calcrete, with laminar, massive and nodular fabrics. This soil, roughly the equivalent of Layer I (Djaparidze *et al.*, 1989), formed during a long period of surface stability.

Accumulation of the bone deposits directly above the Mashavera lava does not seem to have been separated by a geologically perceptible interval, as the surface of the basalt has no noticeable signs of erosion. Additionally, there are no traces of pedogenesis between the lavas and the observable cultural layers. Our observations suggest that this interval lasted no longer than the period between the dated Mashavera flow and the Olduvai-Matuyama boundary.

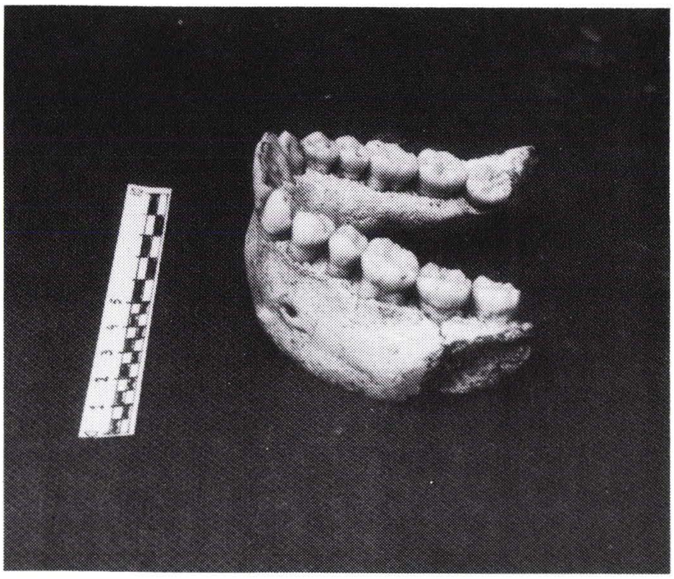
Dmanisi hominids

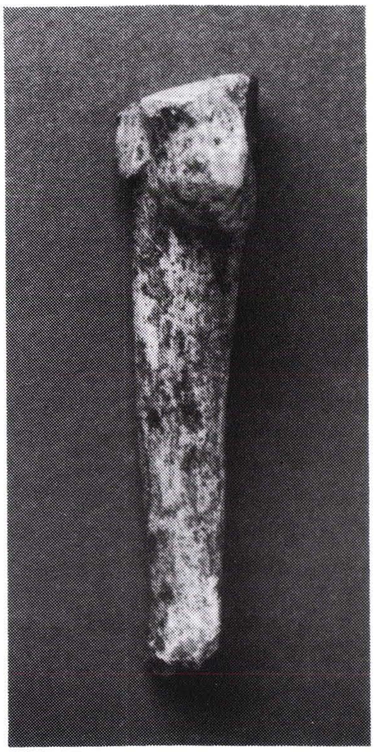
To date we have recovered four hominid remains in Dmanisi (fig. 4). This includes a mandible, (found in 1991), third metatarsal bone (found in 1997) and two hominid skulls in summer 1999 from the same level that produced the mandible.

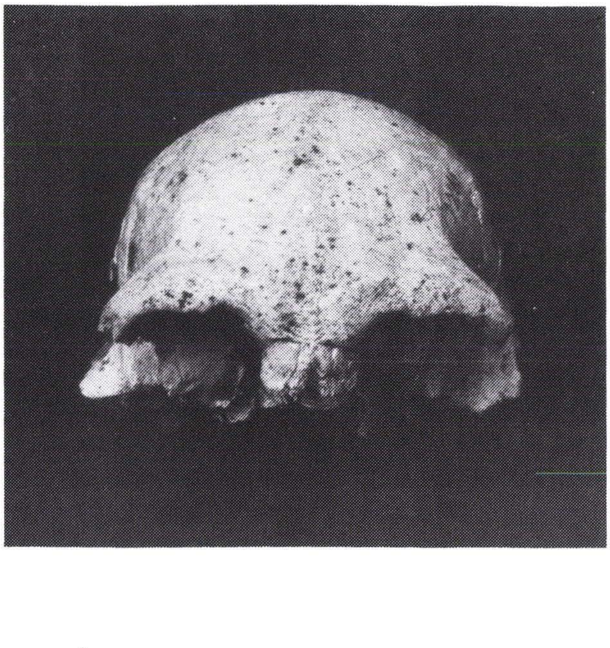
When we attributed the Dmanisi mandible to *Homo erectus*, we noted that some of its characteristics are remarkable and unique (Gabunia and Vekua, 1993 and 1995). The mandible is different from all known *Homo erectus* specimens, but at the same time displays a certain similarity to several African fossils from Koobi Fora and Ileret (e.g., ER 992, and ER 730). It resembles these specimens in the general form and robustness of the jaw (fig. 6), in the anterior position of the ascending ramus which includes the edge of the retromolar space; in the absence of trigonum mentale, and in some other particularities. At the same time, it differs from those specimens in some important features. In particular the molars decreased in size from M^1 to M^3, P^2 is very small and the anterior surface of the symphysis is less receding among other features. One may suggest that the clear apomorphic character of these distinctive traits point to its possible affinity to the later *Homo erectus* (Brauer and Schulz, 1996). However, we think that these characteristics, which are generally considered as signifying advanced evolution, should be regarded in some cases as kinds of traits of accelerated development, whose phylogenetic significance is not always clear.

It is noticeable that such early representatives of genus *Homo* like *Homo rudolfensis* have a clear evidence of a trigonum mentale (Schrenk *et al.*, 1993). If we attribute a decisive systematic importance to the presence of chin triangle, then we should regard, *e.g.*, the *Homo erectus* from Tighenif as *Homo sapiens*. The weak mental protuberance is also marked on *H. erectus* from Koobi-Fora (ER 730), which has a trait of tuberculum marginales anterius. This feature is well developed on Sangiran 9, an archaic *H. erectus* from Java.

As to the distal molar reduction, which is generally regarded as a progressive trait, it might have appeared independently and at different times by various hominids. We would remind the reader that







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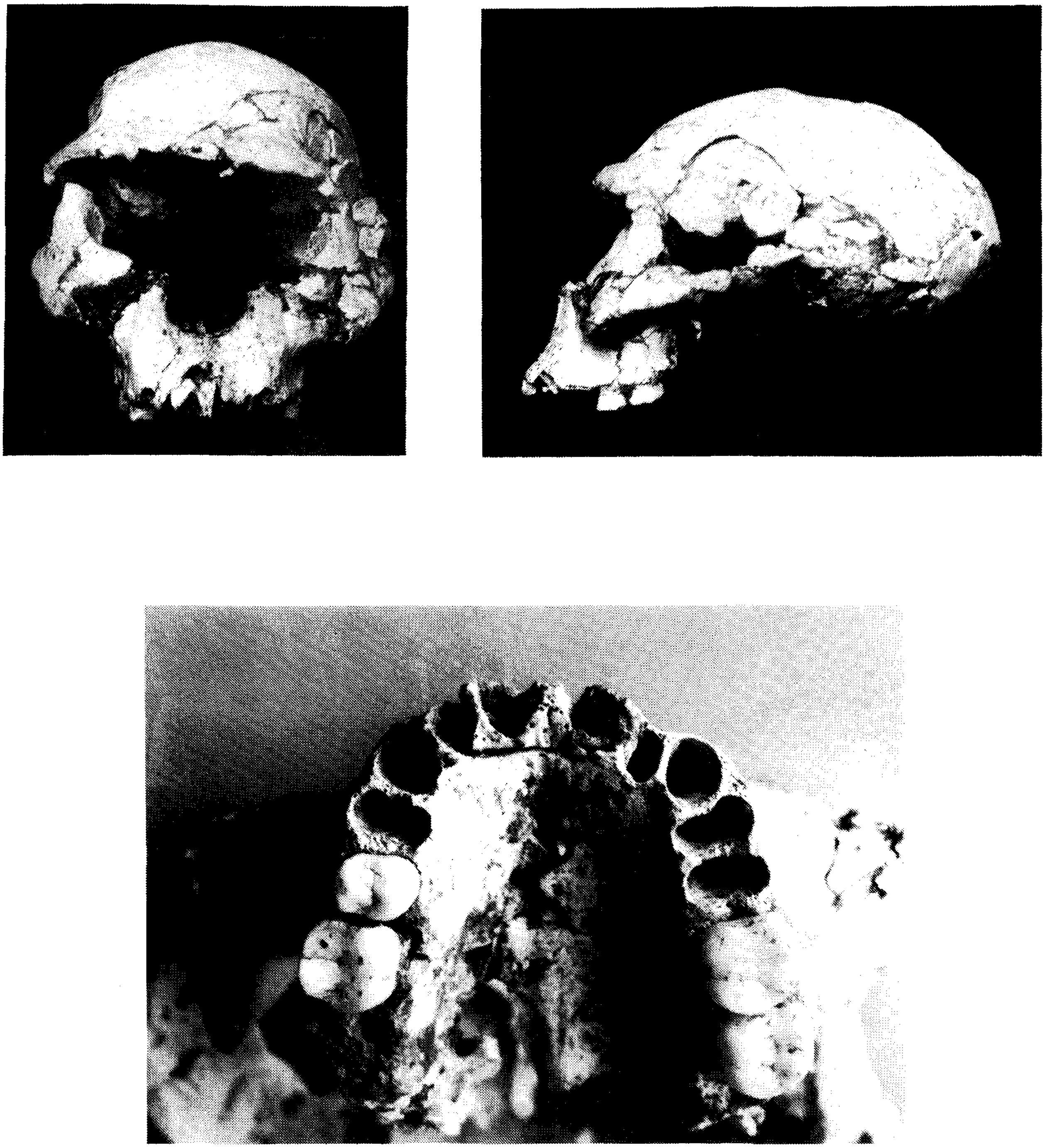
Figures 6. Hominid Mandible; 7. Hominid Metatarsal; 8. D-2280 frontal view; 9. D-2280 lateral view.



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12 Figures 10. D-2282 frontal view; 11. D-2282 lateral view; 12. D-2282 dentition.

early *H. erectus* from Koobi Fora (ER730) and from Nariokotome (WT 15000) have M^1 and M^2 approximately of the same-size, and the reduction of M^2 to M^3 is evident not only in the above mentioned forms but also in ER 992 from Koobi Fora, KGA 10-1 from Konso-Gardula (Asfaw *et al.,* 1992).

The distal molar reduction and other progressive characteristics are combined in the Dmanisi specimen, which also possesses archaic features in the structure of the jaw and even in its teeth. The reduction in the size of M^2 and M^3 could be linked with the anterior-posterior compression of the jaw. M^3 shows not only a notable decrease in size but is also slightly shifted medially, giving the impression that there is no room for it in the jaw.

We consider that the Dmanisi mandible is close to *Homo ergaster* group e.g., ER 992, ER 730,and WT 1500. Some scholars agree with this conclusion (Rosas and Bermudes-Castro, 1998), while others see the Dmanisi specimen as a very developed form linked to the late *Homo erectus* group (Brauer and Shulz, 1996).

The find of a hominid III metatarsal in Dmanisi (fig. 7) in Layer 4 does not contradict to its closeness with the early representatives of the *Homo erectus* group of Africa. According to its size and ratio (proximal and lat/med. breadth 12.1 mm, dorso-planter depth 18.1 mm., lat/med. breadth 6.1 mm. dorso-planter depth 8.7 mm.). it reveals close similarity to metatarsals 803 j and 1500 M from Kenya (Gabunia *et al.*, this volume).

In the summer 1999, the same level that produced the mandible also yielded two hominid skulls. The first specimen (D-2280) represents an almost complete cranial vault while the second (D-2282) is a cranium vault and a fragment of the maxilla (fig.8-12).

The first fossil specimen, D2280 (fig. 8-9), is an almost complete calvaria including a partial cranial base retaining slightly damaged nuchal and basilar portions of the occipital, parts of the greater wing of the sphenoid, and most of the left mandibular fossa of the temporal. The second and more complete cranium, D2282 (fig. 9-12), retains much of the face and cranial vault but has undergone lateral and dorso-ventral post-mortem deformation. The occipital and temporal regions are crushed on the left side, as are the zygomatic bones. The base is largely absent. Much of the median upper facial skeleton is missing including the supraorbital torus at glabella, nasal bones, and frontal processes of the maxillae. However, the maxillae are well-preserved laterally and inferiorly and retain the slightly worn right P^4-M^2, the left M^1 and M^2, and the alveoli of all other adult teeth including those of M^3 which are visible on radiograph. D2282 is the smaller of the two crania and based on gracile muscle attachment areas, less well-developed cranial superstructures, light dental wear, and well-demarcated cranial sutures may be either an older subadult or young adult and possibly a female.

Both crania are small with endocranial volumes below 800 cm^3. A direct measurement using seeds yielded an endocranial volume of 775 cm^3 for D2280. The cranial capacity calculated from the length, breadth, and cranial index of D2282 is about 650 cm^3.

Cranial shape is similar in both specimens, spheroidal in superior view and relatively low and angular in lateral view. Greatest cranial breadth is low at the level of the well-pneumatized mastoid processes. The occipitals are relatively narrow and angular. The occipital angle in D2280 is 108°. A continuous occipital torus is present in each specimen, and D2280 exhibits a larger torus and more rugose nuchal muscle markings than does D2282. A pronounced occipital crest extends from the external occipital protuberance to the foramen magnum in D2280. The frontal sinus and ethmoid pneumatization are visible in D2280. A wide supratoral sulcus is present in D2282 where it is less developed in D2280. Postorbital constriction is significant. Cranial bones are moderately thick and no cranial cresting is present (the temporal lines are separated by at least 23 mm in D2280). Traces of an angular torus are present in both specimens and a small sagittal keel is present in D2282. An apparent metopic eminence and sagittal keel on D2280 is likely pathological. The glenoid fossae of the temporal are mediolaterally and anteroposteriorly long and relatively deep. The entoarticular process in D2282 is projecting and formed by both temporal and sphenoidal contributions as is foramen spinosum. Temporal squamae are moderately long and low, although somewhat taller in D2282 than in D2280.

The D2282 facial skeleton is well-preserved at Estimates of the facial, orbital, and zygomatic heights and orbital breadths are comparable to those of the Koobi Fora specimens assigned to *H. ergaster*. The pyriform aperture is comparatively narrow, blunt sided, and has a small pre-nasal fossa. The naso-alveolar clivus is wide and somewhat flattened, forming an angle close to 46° to the alveolar plane. The jugum alveolare canini is well developed, forming a distinctly flattened convexity, rising over the lower edge of the pyriform aperture. The palate is moderately long, narrow and deep. The tooth rows diverge minimally from one another. The anterior zygomatic is positioned at M^1.

The maxillary dentition of D2282 is similar in size and morphology to that of KNM-ER 3733 and KNM-WT 15000. The P^4 is single-rooted and narrow crowned. Molar crown area is larger in M^1 than in M^2.

The combination of the features of the Dmanisi hominids appear more similar to *H. ergaster* than to *H. erectus sensu stricto* (or to any of the habilines). This conclusion is consistent with our studies of the Dmanisi mandible. We thus assign the Dmanisi hominids to *Homo ex gr. ergaster.*

The Biostratigraphy of the Vertebrate Faunas

The Dmanisi faunal assemblage consists mainly of Villafranchian mammals, the majority of which can be attributed to the top of Middle Villafranchian or Villanyan and to the Lower Biharian (fig. 13). The inventory includes: *Megantereon megantereon, Homotherium crenatidens, Pantera gomgaszoegensis, Ursus etruscus, Equus stenonis, Dicerorhinus etruscus* and several others which are found throughout the entire Villafranchian and therefore cannot provide an accurate geological age for the Dmanisi complex (Turner, 1994). Instead, we consider the following species as better chronological markers: (1) the very large ostrich - *Struthio dmanisensis*, which is similar in size to *S. transcaucasicus* from Kvabebi (Vekua, 1972), and is also reminiscent of the gigantic ostrich *Struthio oldwaji* from Olduvai I (Leakey, 1967), (2) *Mimomys tornensis, (3) Mimomys ostramosensis, (4) Kowalskia sp., (5) Pachycrocuta perrieri, (6) Cervus perrieri and Cervidae cf. Arvernoceros, (7) Gazella cf. borbonica and finally, (8) Giraffidae cf. Paleotraginae.*

These species are widely represented in the layer 4. In Layer 2, to date, we found only *Pachycrocuta perrieri, Cervus perrier, and Giraffidae cf. Paleotraginae.* These data, as discussed below, indicate that the Dmanisi fauna is older than the end of the Late Villafranchian (fig. 13).

It should be noted that in the East Paratethys region ostriches are not known from deposits younger than the Pliocene (Dubrovo and Kapelist, 1979). In the Caucasus their late representatives - namely, the large type of *Struthio* - are found in Lower Apsheronian of Taribana (correlated with the Dmanisi horizon) and of Palan - Tukan in west Azerbaijan (Burchak-Abramovich, 1953).

The discovery at Dmanisi of *Mimomys tornensis* and *Mimomys ostramosensis* indicates that the Dmanisi fauna cannot be younger than basal Biharian.

The genus *Kowalskia* is known mainly from the late Miocene and the Lower Pliocene (Mein, 1989). It occurs less commonly in the late Pliocene (Zheng, 1984) and has not been found to date in the Pleistocene. The discovery of this species at Dmanisi clearly supports the antiquity of the Dmanisi complex.

The remains of giraffes at Dmanisi were also unexpected because, in Georgia, late representatives of this taxon are known from the lower part of the Upper Pliocene (Gabunia and Buachidze, 1970).

Pachycrocuta perrieri and *Cervus perrieri,* characteristic of the early and middle Villafranchian faunas of western Europe, and middle-sized deer, reminiscent of *Arvernoceros ardei*, all also indicate affinities with middle Villafranchian and basal late Villafranchian faunas (Turner, 1994).

Our recovery of *Gazella cf. borbonica* is significant because in western Europe this taxon is not found in deposits younger than the Middle Villafranchian (Agusti and Moya-Sola, 1992).

The archaic faunal component at Dmanisi also includes *Archidoskodon meridionalis taribanensis*, a southern elephant who possibly requires a new species designation (Alekseeva, 1977).

Comparatively younger forms are also present at Dmanisi, such as *Soergelia*, which first appears in the Upper Villafranchian and lasts through the Middle Pleistocene. It is important to note, however, that the palaeontological history of this species has been poorly studied to date, and it may have been present earlier than has previously been thought. One form was recently identified in Venta-Micena (Spain) in the context of Early Pleistocene fauna (Agusti and Moya-Sola,1992).

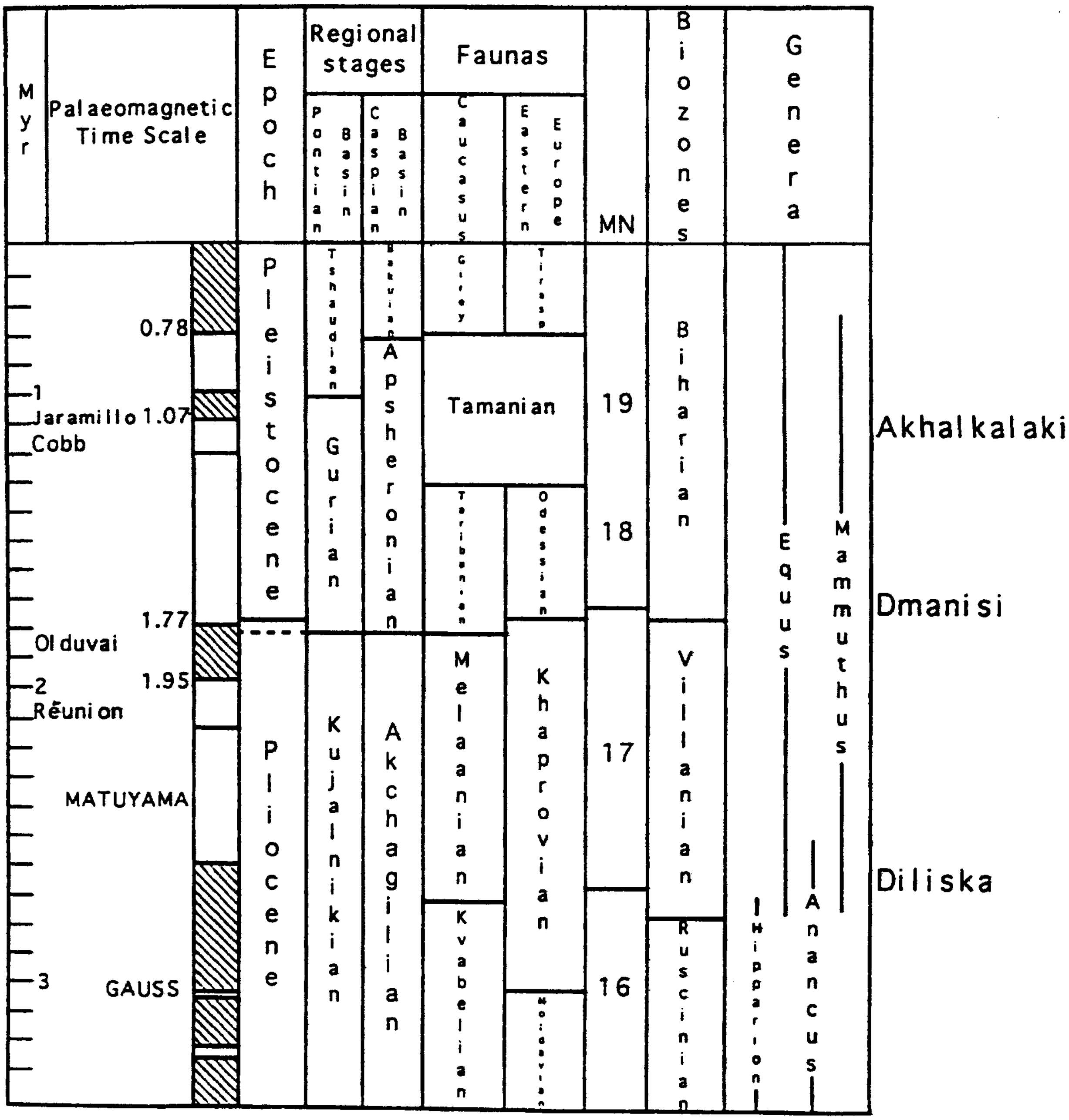

Figure 13. Stratigraphical shema.

Considering that *Soergelia* is probably of Asian origin and that its migration required some time, the appearance of early representatives of this genus in Transcaucasia at the beginning of the Pleistocene or even at the end of the Pliocene is not surprising.

In Europe the first appearance of *Pantera gomgaszoegensis* coincides with the disappearance of *Pachycrocuta perrieri* (Turner, 1994). In Dmanisi both species coexisted. It is possible that *P. Gomgaszoegensis* as well as *Canis etruscus* dispersed here from the East. Traces of *P. gomgaszoegensis* in Transcaucasus are older than those from western Europe, where the earliest appearance of this species are reported from Olivola and Tegelen (Turner, 1994) and where they are found together with *Pachycrocuta brevirostris*.

In western Europe, *Dama nesti* is limited mainly to the Late Villafranchian (Azzaroli *et al.*, 1988) but its presence in Transcaucasia at the beginning by this time or even at the end of the Middle Villafranchian cannot be excluded. It seems that at Dmanisi it is present at the beginning of Apsheronian, (the basal part of the Lower Pleistocene) (fig. 13). The same can be said for some other members of the Dmanisi fauna with comparably broad stratigraphical spread (*Hypolagus brachygnathus, Apodemus cf. dominans, Megantereon megantereon, Canis etruscus, Ursus etruscus* and others).

The Dmanisi bovid is a new genus and species that was named, *Dmanisibos georgicus* (Burchak-Abramovich and Vekua, 1992). It is difficult to assess its bio-stratigraphic implications. However, such features as the flatness of its forehead, an occiput notably stretched in length, and a distinctive position of the horn pivot, place it in an intermediate position between the *Tshaudian Eobison* (Flerov, 1979) and the more archaic *Adjiderobos* (Dubrovo and Burchak Abramovich, 1984) from the Late Akchagylian. This nicely correlates the chronological horizon of the Taribana-Dmanisi fauna.

A small complex of vertebrates from the Lowest Apsheronian of Taribana (Kotsakhuri region) consists of *Testudo sp., Emys orbicularis, Struthio sp., Archidiskodon meridionalis taribanensis, Equus stenosis stenosis, Dicerorhinus cf. etruscus, Camelus sp., Protoryx sp., Leptobos sp.* and others (Gabunia and Vekua, 1981; Vekua and Kvavadze, 1981). The Dmanisi fauna is very close to that of Taribana and may date to the basal part of the Apsheronian. These two faunal localities are geographically quite close to each other and, as discussed below, represent the same paleoenvironment.

The small faunal collection from Tsalka is also assigned to the Dmanisi-Taribana complex. It contains *Homotherium cf. crenatidens, Dama cf. nesti, Eucladoceros sp., Leptobos sp.* (Vekua *et al.*, 1985). Long-range comparisons extend through Europe and the Near East. When the Dmanisi complex is compared to Eastern Europe, it corresponds to the late phase of the Khaprov faunal complex (Alekseeva, 1977), where Hipparion and Annancus are already absent. However, the presence of *Ellasmotherium, Paracamelus* and some other species separates them from the Dmanisi complex and reflect the more severe climate that prevailed in Kharpov. The Dacic basin (Romania) is of special interest because its Tatou complex is close to the Dmanisi fauna (Radulescu and Samson, 1990) and also contains artifacts. The fauna includes *Archidiskodon meridionalis, Ursus etruscus, Pachycrocuta perrieri, Homotherium crenatidens, Megantereon megantereon, Equus stenonis, girafid Mitilanotherium.* Another site, Shandalia (former Yugoslavia), is also similar to Dmanisi in terms of the mammalian fauna and the remains of a lithic inventory (Malez, 1975). These examples offer evidence that at the beginning of the Pleistocene, Transcaucasia was more closely linked with the Dacian-Balkan region than with Eastern Europe.

In spite of the absence of good faunal correlations with western Europe, the assemblages of Le-Coupet, Olivola, Seneze, and Tasso are generally comparable as they all contain typical forms of *Archidiskodon meridionalis, Equus stenonis, Ursus etruscus* and other taxa (Guerin, 1982; Bonadonna and Alberdi, 1987; Azzaroli *et al.*, 1988). These complexes are also characterized by other species which reflect regional specificities in western Mediterranean and, in some cases, differences in the geological ages. They are dated to the Middle Upper Villafranchian, from the upper part of Zone 17 and Zone 18 as defined by Guerin (1982). Among the Late Villafranichian western European mammalian faunas of western Europe, the Venta-Micena complex is more similar to Dmanisi (Martinez, 1992). It differs from Dmanisi in its regional characteristics but may represent the comparatively advanced evolution of representatives of some common forms.

The Dmanisi fauna bear a distant resemblance to Ubeidya (Israel) which contains different forms of fossil vertebrates, rare remains of *Homo sp.* and rich lithic assemblages (Tchernov *et al.*, 1986). Ubeidya, however, is not only younger than Dmanisi, but also differs from it by the presence of *Archidskodon meridionalis tamanensis, Hippopotamus* and other taxa which indicate different ecological conditions. At the same time, both sites contain several common species: *Hypolagus brachygnatus, Canis etruscus, Ursus etruscus, Dicerorhinus etruscus.* The discovery of *Parameriones cf. obedediensesis* at Dmanisi is of special interest. Tchernov and colleagues (1986) consider this taxon as endemic to the Ubeidiya region.

Overall, the Dmanisi fauna contain species with diverse points of origin where Palearctic elements prevail over Paleotropical ones. Although it is difficult to assign specific origins to the Palearctic species, most of them likely dispersed here from Asia. The origin of *Megantereon* remains moot. Some researchers argue that this taxon belongs to the African *Megantereon whitei* (Martinez-Navarro and Palmkvist, 1996). We remain to be convinced. The sum of these data, however, do indicate that during the Plio-Pleistocene, extensive faunal interchanges occurred via the territory of Transcaucasus.

The Paleoecology of Dmanisi

It is important to note that our excavations at Dmanisi are still in progress. Although we do not have complete information about the ecological structure of this fauna, a preliminary analysis is currently underway.

Figure 14 shows that the fauna from Layer 2, which is separated from Layers 4-5 by a calcareous crust, substantially differs from that recovered from the lower part of the section.

Figure also shows that layer 4 contains substantially more bones and more species than do layers 2 and 3. No rodents or reptiles have been recovered from the upper layers. The almost complete absence of carnivores from the upper layers does not seem accidental but likely reflects paleoecological changes. While acknowledging taphonomic factors, we suggest that the observed decreases in species richness towards the upper levels likely also reflects a climatic changes which correlates with the general trend to aridisation of eastern Georgia in the Lower Pleistocene (Shatilova and Ramishvili, 1990).

The Dmanisi faunal assemblage contains representatives of different habitats. Denizens of the forest-steppe ecosystem predominate, while *Struthio, Ochotona*, and some other taxa indicate the importance of steppic conditions. The presence of xerophytic plant communities is also reflected in Dmanisi reptiles in such forms as *Coluber najadum* (Chkhikvadze and Kharabadze, 1995), *Gerbillus* sp., *Hypolagus brachygnathus* and *Archidiskodon*, etc. Steppic conditions are also evident in the preliminary data on terrestrial gastropods, the following species of which have been identified to date: *Helicopsis sp., Pseudochondrula tuberifera, Helix aff. pomatia, Jaminia sp.*, etc. (I. Taktakishvili, personal communication 1998).

At the same time, the abundance of deer at Dmanisi, where they represent >80% of Artiodactyla, points to the important role played by forested areas. The abundance of *Cervids* distinguishes Dmanisi from coterminous faunal complexes of the Paleotropical realms as well as from some Palearctic ones. *Cervids*, for example, are absent from such nearby sites as Taribana (Kotsakhuri). We believe that at Dmanisi the richness of the *Cervid* fauna partially reflects the vertical zonality of the nearby forested mountainous areas. *Dama cf. nesti*, like the modern *Dama dama*, could have preferred open landscapes and forest edges (Pidoplichko, 1954). *Cervus perrieri* and *Cervidae cf. Arvenoceros* likely favored foothills and the lowest parts of the forest zone. *Eucladocerus cf. senesensis*, like *Cervus elaphus* which today inhabits the southern slope of the Major Caucasus and inhabits the Lagodekhi region some 70 km north of Dmanisi, possibly preferred the middle range of mountainous forests. Such *Caprinis* as *Soergilia* could be lived in middle and high mountainous forests. Other indicators of forests include *Sorex sp.*, and possibly wild cattle *(Dmanisibos georgicus).*

The co-occurrence of such different large carnivores as *Pachycrocuta perrieri, Pantera gombaszoegensis, Megantereon megantereon, and Homotherium crenatidens* in Layers 4 and 5 at Dmanisi indicates the diversity of the landscapes in this region.

The sum of these data show that when Layer 4 accumulated, Dmanisi was located in a mixed mosaic environment of open landscapes, gallery forests along the river valleys and forested mountains. Forested areas were reduced in size during the formation of Layers 3 and 2.

The Dmanisi community structure differs somewhat from those identified at other early hominid sites. In contrast to Olduvai, Dmanisi has no Suids but does have a large number of *Cervids*. Ubeidiya, likewise, contains few *Cervids*. The closest counterpart to the Dmanisi mammalian community is to be found at the Early Pleistocene site of Orce (Palmqvist and Martinez-Navarro, 1996).

The validity of our reconstructions of the Dmanisi paleoenvironments can be independently tested with floral data.

New pollen studies done at Dmanisi only partially corroborate the earlier floral evidence retrieved from the coprolite which indicated rich forest spectra (Klopotovskaja *et al.*, 1989). In a sample from Layer 4, shrub and herb elements predominate (*Chenopodiaceae, Artemisia, Ephedra* and others). Arboreal vegetation is represented by mostly single pollen grains of *Betula and Pinus*, and only one sample produced the pollen of *Tilia.*

At the same time, thousands of seeds of *Borraginaceae*, *Anchusa, Lycopsis, Lithosprmum* and of other species were present in all cultural

Species in ***Dmanisi***	**Level 2**	**Level 3**	**Level 4**
Erix sp.			**X**
Natrix sp.			**X**
Coluber najadum			**X**
Coluber robertmertensi			**X**
Elaphe aff. dione			**X**
Pelias sp.			**X**
Daboia cf.raddei			**X**
Struthio dmanisensis			1\1
Ochotona cf.lagreli			2\1
Hypolagus brachyagnatus	1\1		70\4
Apodemus dominans			9\3
Kowalskia sp			1\1
Cricetus sp.			1\1
Mimomys tornensis			2\1
Mimomys ostramonensis			2\1
Parameriones cf.obeidiensis			10\3
Gerbillus sp.			1\1
Marmota sp.			1\1
Canis etruscus	7\3	2\1	127\9
Ursus etruscus	7\2		66\5
Martes sp.			1\1
Megantereon megantereon			43\4
Homotherium crenatidens			17\3
Panthera gombaszoegensis			31\1
Pachycrocuta perrieri	1\1		7\2
Archidiskodon meridionalis	4\1	4\1	44\9
Equus stenonis	38\5	4\1	260\23
Dicerorhinus etruscus etruscus	5\1	2\1	76\9
Gazella borbonica			24\7
Soergelia sp.	7\2		66\9
Dmanisibos georgicus	9\3	2\1	131\23
Cervus perieri	19\4	5\2	256\11
Eucladocerus aff.senezensis	5\1		82\8
Cervidae cf. Arvernoceros			22\5
Dama nesti	2\1		291\18
Paleotragus sp.	1\1		5\2
Homo sp.			4\2

Figure 14. Fauna of Dmanisi.

layers. While a great number of seeds from the beetroot family found at Dmanisi are inedible, such edible species as hackberry (*Celtis*) are rather frequent. Although these taxa are characteristic of savanna flora (Leme, 1974), today they also grow in the woodlands of the Caucasus and of central Asia (Gulisashvili, 1980). We suggest that hackberries and, perhaps, the fruits of *Ephedra* were consumed by Dmanisi hominids. Seeds of *Celtis* are frequent in other early Paleolithic sites - e.g. at Zhoukoudian (Dohnal, 1961), Lazaret, Terra-Amata, Tautavel and others (Bahn, 1984) - and may represent components of hominid diets.

The abundance of *Borraginaceae* seeds at Dmanisi merits special attention. These xerophytes are anthropophites, often found in archaeological sites of later time periods. In the Near East these taxa are seen as indicators of human occupation (van Zeist, 1991). Their presence at Dmanisi may indicate that already at this early a time hominids had an impact on local plant associations which resulted in the increased reproduction of weeds and pioneer vegetation.

The presence of the pollen of *Abies, Pinus, Alnus* and, less frequently, of *Ulmus* and *Salix* (Klopotovskaja *et al.*, 1989; Kvavadze, 1997) at Dmanisi reflects a considerable variety of vegetation and possibly some vertical zonality. The predominance of herbs here, like at Taribana, of grass forms is in good accord with the herpeto assemblages as well as with the associations of certain mammals and birds. Forests probably covered the middle mountain ranges as well as grew along river channels while the flat river valleys were covered by savanna vegetation.

We can summarize the above data by arguing that warm climatic conditions prevailed at Dmanisi during the Lower Paleolithic. The climate was warmer and dryer than the present day one and corresponded to the Mediterranean type of climate. This paleoclimatic reconstruction is in good accord with evidence for a general aridisation of east Georgia landscapes at the end of the Pliocene (Late Akchagylian-Early Apsheronian). This increased aridity resulted in a considerable reduction of wooded areas and in the spreading of open vegetation (Shatilova and Ramishvili, 1990). Pollen data from Taribana support this interpretation and indicate more arid conditions than existed during the preceding periods (Vekua, 1972). At Taribana the rich NAP component is dominated by *Poaceas* (about 47%) along with pollen of *Chenopodiaceae* and *Artemisia* (Vekua and Kvavadze, 1981). Arboreal elements include *Platanus orientalis, Alnus,* and *Pinus*. This paleofloristic spectrum indicates a mixed forest-steppe environment, one which perhaps resembles a modern savanna. While steppes spread in the lowlands, forests grew in the river valleys and at higher elevations. During this time, one corresponding to the Olduvai paleomagnetic subchron, warm climates predominated almost everywhere in Europe (De Jong, 1988).

Lithic Artifacts

Lithic artifacts are present in all horizons. To day over 800 stone artifacts have been recovered. Lithic artifacts are particularly common in Layer II (more than 90 % of all quantity) but are also present in Layers III and IV. It is still not possible to recognize differences in the typology or technology of the various layers.

The artifacts are mainly manufactured from silicified volcanic tuffs and are occasionally of quartz. Petrographic analyses of the recovered stone tools show that hominids here exploited the pebbles and cobbles available in a gorge near the site (Tvalchrelidze and Lordkipanidze, 1998). They are struck from cobbles which occur in the valleys of the Mashavera and Pinezaouri.

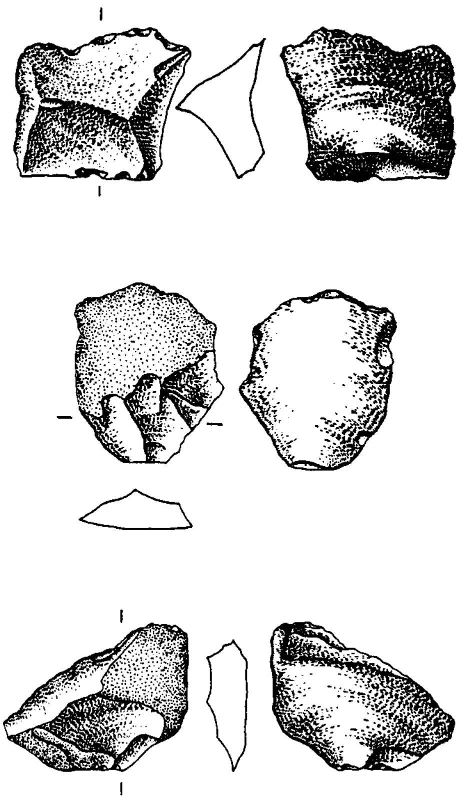

Figure 15. Stone tools.

Flakes make up the majority of the artifacts (fig. 15-16). A number of the smaller flakes are struck from more highly silicified flint-like tuffs, which are only rarely found in the river gravels.

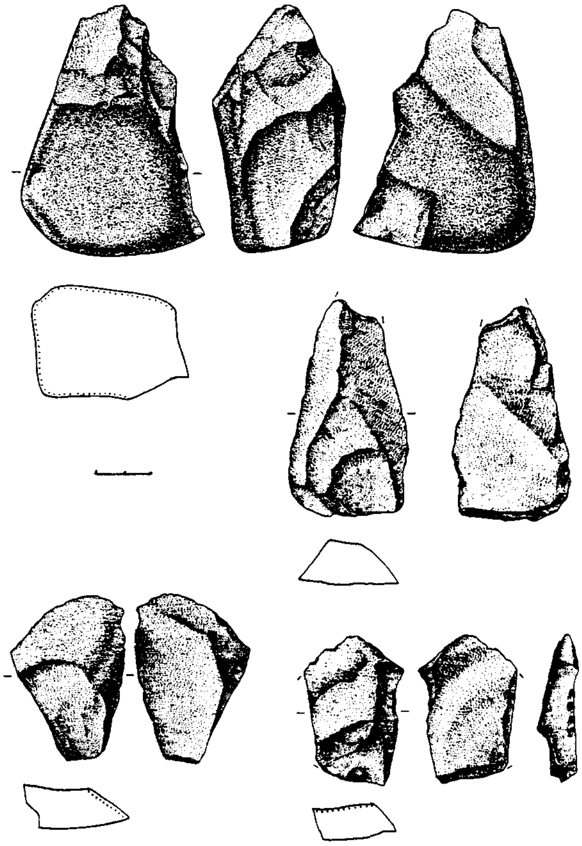

Figure 16. Stone tools.

The dorsal surfaces of the flakes normally have flake scars which are usually struck from the same direction as the flake itself and show serial knapping of flakes. The flakes edge commonly show definite use wear (marginal retouch, splintering, small notches).

Retouched flakes (fig. 16) are rare, but present in the form of edge retouch and stepped retouch. A multiple burin is present, manufactured on a large flake with an edge retouched ventral face.

Cores are mainly spherical/polyhedric and struck from several directions (fig. 16-17). There are also conical cores whose striking platform is formed by one or, at most, a few blows. Pebble tools are both unifacially and bifacially worked and show a great overlap with the category of cores (fig. 18-19).

No bifaces or developed Oldowan artifacts have been found. Most of the artifacts retain sharp edges suggesting little transport and no refits of flakes or tools were observed. By the basic knapping technique Dmanisi lithic complex clearly belongs to the Oldowan or mode 1 industries. The Dmanisi artifacts are compatible with pre-Acheulean assemblages of East Africa.

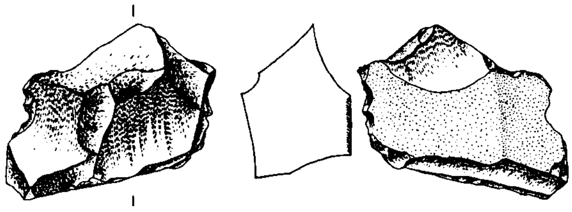

Figure 17. Stone tools.

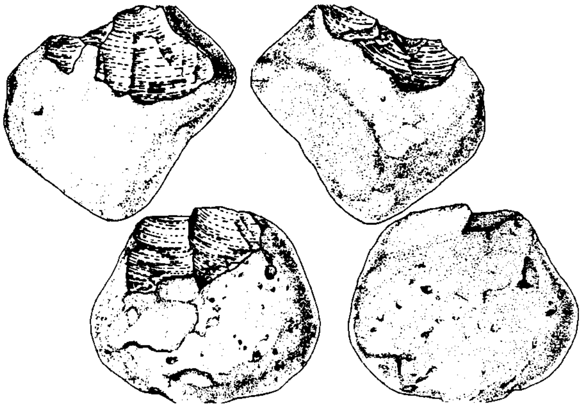

Figure 18. Stone tools.

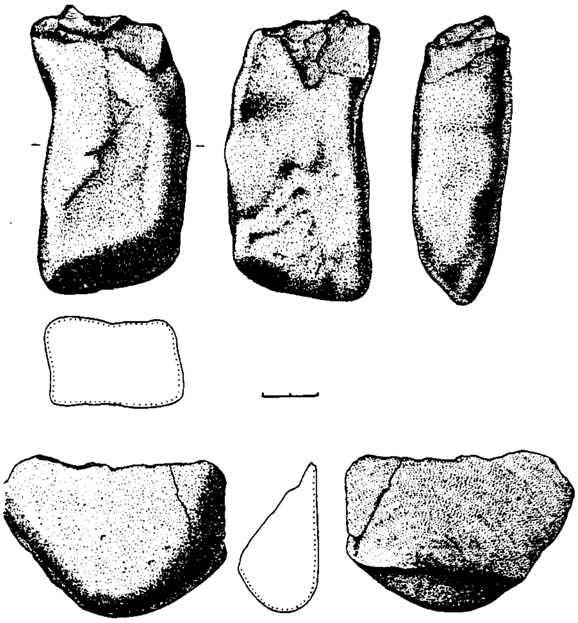

Figure 19. Stone tools.

Conclusions

Dmanisi is the oldest hominid site found in western Eurasia to date. The geological age of the Dmanisi fauna corresponds to an early phase of the Upper Villafranchian (Upper Villanyan or Lower Biharian, transition MN 17 to MN 18).

Paleontological, archeological, geochronological, and paleomagnetic data from Dmanisi all indicate an earliest Pleistocene age of about 1.7 MA.

The Dmanisi fauna reflect quite diverse landscapes - an interpretation supported by paleobotanical evidence. The data from Dmanisi reflect the prevalence of a moderately dry climate and the presence of fairly extensive open landscapes.

The hominid site itself was likely located near a lake or pond, rich in lacustrine resources. This biome, together with the adjacent forest-steppe formations, created a highly productive ecotone rich in animal and plant resources. The nearby river gravels provided hominids with extensive lithic resources (pebbles and cobbles) used for tool production.

The Dmanisi hominid remains are the first hominids discovered outside of Africa to show clear affinities to African *H. ergaster* rather than to more typical Asian *H. erectus* or to any European hominid.

Further research at Dmanisi will enable us to refine the geologic age of site as well as to retrieve new data which will enrich our understanding of the Dmanisi hominids and their way of life.

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