Current knowledge about the Dmanisi site (Georgia).

David O. Lordkipanidze
General Director Georgian National Museum, Georgia.
dlordkipanidze@museum.ge

Abstract

Our excavations of the site of Dmanisi, Georgia, bring new knowledge about evolutionary history of early Homo. Over the past decade, this site has yielded a treasure of a unique series of 1.8 million year old cranial and postcranial hominin fossils. Along with many well-preserved animal fossils and quantities of primitive stone artifacts this is the richest and most complete collection of indisputable early Homo remains from any single site with a comparable stratigraphic context. The discoveries document the first expansions of hominins out of Africa and into Eurasia, and demonstrate that this was neither due to increased brain size, nor to improved technology. Dmanisi re-shaped many hypotheses on early hominin phylogeny, palaeoecology and biogeography. Despite certain anatomical differences between the Dmanisi specimens, we do not presently see sufficient grounds to assign them to more than one hominid taxon. Thus, the Dmanisi assemblage offers a unique opportunity to study variability within an early Homo population the research presented new evidence on the evolutionary biology of early Homo and challenges the existence of different Homo linages in Africa.

Introduction

For a long time, scientists thought that the first hominid out-of-Africa migrants were Homo erectus, a species with large brains and a stature approaching human dimensions. The species was widely assumed to have stepped out in the world once they evolved their greater intelligence, modern human like body proportions and invented more advanced stone tools.

Our excavations of the extraordinary palaeoanthropological site of Dmanisi, Georgia, bring new knowledge about first evolutionary history of early Homo. Over the past decade, this site has yielded a treasure of a unique series of 1.8 million year old cranial and postcranial hominin fossils. Few palaeoanthropological research projects have had such a great impact on our thinking about human evolution. The discoveries document the first expansions of hominins out of Africa and into Eurasia, and demonstrate that this was neither due to increased brain size, nor to improved technology. The scientific work at Dmanisi re-shaped many hypotheses on early hominin phylogeny, palaeoecology and biogeography. The research presented new evidence on the evolutionary biology of early Homo and challenges the existence of different Homo linages in Africa.

Dmanisi is in Southern Georgia about 85 km from the capital Tbilisi, and was a medieval city situated on a hilltop. In 1983, archaeological excavations in the ruins of the old city led to the fortuitous discovery of Plio-Pleistocene sediments containing animal bones. Following this, stone tools and hominin remains were recovered from the site.

The archeological site is on a promontory overlooking the confluence of the Pinazauri and Mashavera Rivers. These rivers eroded through 80-100 meters of basalt beginning in the early Pleistocene, leaving the site high above the rivers today. Scientists dated the age of the fossils using radiometric techniques from deposits directly atop a thick layer of volcanic rock dating from 1.85 ma. The fresh, unweathered contours of the basalt indicate that little time had passed before the fossil-bearing sediments blanketed it. Paleo-magnetic analyses show that sedimentation occurred around 1.77 ma, when the earth's magnetic polarity reversed, a phenomenon called the "Matuyama Reversal".

Remains of known prehistoric animals accompany the hominin fossils found here a rodent called Mimomys, for instance, only lived between 1.6 and 2.0 ma. The 1.76-million-year-old layer of basalt at a nearby site caps the same stratigraphy. Dmanisi is a snapshot of time, like a time capsule.

The Paleolithic site had accumulated in direct association with a lake, which was formed when a lava stream blocked one of the Dmanisi Rivers. Today, the Dmanisi bone deposits lie over almost unweathered basalts, which extend over an area of some 5,000 square meters. Up to date, less than 10 percent of site has been excavated. The fossiliferous deposits are up to 4 m. in thickness and are covered by the remains of a medieval town and middens.

Geology and dating

On top of basalt that dates to within the Olduvai subchron, there are two main strata, A and B. In the stratigraphic sequence developed by Prof. Reid Ferring, several profiles have been exposed at the promontory, showing the presence of sediment following by volcanic ashes (Ferring *et al.* 2011).

The A layers are normal polarity and from within the Olduvai subchron, and the B layers were deposited immediately after this; they have reversed polarity and so post-date 1.78 ma. . Between the layers there is an indurate crust of groundwater carbonates. This crust also contains fossilized fauna and stone tools. Its covers the entire area of the site and can explain the good preservation of bones and precluded any displacement of the bones or of stone tools from higher levels. Bones are accumulated in especially dense concentrations where the basalt is low lying.

Figure 1: *Dmanisi skull D4500 (N5). Photo by Guram Bumbiashvili*

Hominids

The Dmanisi site has offered up the remains of several hominid individuals (5 skulls, 4 with maxillas; 4 mandibles and 100 post-cranial remains). This is the richest and most complete collection of indisputable early Homo remains from any single site with a comparable stratigraphic context. The Dmanisi sample comprises variations according to age: sub-adult D2700/D2735 with erupting M3s. Adults D2280, D2282/D211, D4500/D2600; old individuals D3444/D3900 and sexual dimorphism. Despite certain anatomical differences between the Dmanisi specimens, we do not presently see sufficient grounds to assign them to more than one hominid taxon. Thus, the Dmanisi assemblage offers a unique opportunity to study variability within an early Homo population (Gabunia *et al.* 2000, Vekua *et al.* 2002, Rightmire, Lordkipanidze 2009).

Our analyses show that the Dmanisi people were small (ca. 150 cm). Related to body size, their brains were smaller (545-760 cubic centimeters) than those of “classic” Homo erectus from Africa and Asia (800-1000 cubic centimeters). In this respect, they are closer to the very first representatives of the genus Homo (Homo habilis from Africa, ca. 2 ma) than to their later conspecifics. Dmanisi people were almost modern in their body proportions, and were highly efficient walkers and runners, but their brains were tiny compared to ours, and their arms moved in a different way (Lordkipanidze et al 2007).

The "Skull 5" cranium with its mandible, found earlier, represents the world's first completely preserved adult hominid skull from the early Pleistocene. It has the smallest braincase of the Dmanisi individuals (546 cm^3 - or about one third that of a modern human), but the largest face and teeth - a combination previously unknown for early Homo. The skull's face, large teeth, and small brain size resemble those of earlier fossil humans, but the detailed anatomy of its braincase - which gives clues to the “wiring” of the brain - is similar to that of the more recent early human species, *Homo erectus*. The Dmanisi site has fueled an ongoing discussion over whether the Dmanisi humans were an early form of Homo erectus, a distinct species called *Homo georgicus*, or something else (Lordkipanidze *et al.* 2013).

Paleo-environment

Faunal and paleobotanical evidence makes it possible to reconstruct the ecology of the Dmanisi hominins. At the time of occupation, the site was near a lake shore that formed when the Masavera lava flow dammed the Masavera and Pinasaouri Rivers. At the Dmanisi site more than 50 groups of animals have been identified; faunal remains include several large carnivores, bovids, an equid, and other open- steppe and gallery-forest taxa. In Dmanisi we found bones of saber-tooth cats, giraffes, rhinos, elephants and other extinct animals. The data reflect a paleo-environment that spread like a mosaic over a large area around the site: woodland and gallery forests, bush land, tree savannahs, open grasslands and semi-desert-like rocky terrains with shrub vegetation. Generally, Dmanisi was a forested, relatively humid habitat in a temperate zone, with cool winters. In contrast, East Africa had a relatively dry and hot steppic environment (Lordkipanidze *et al* 2007).

Stone tools

The Dmanisi site is very rich archaeologically, where more than 10,000 stone tools have been discovered. The site preserves a complex archaeological record of numerous re-occupations, measured by both stratigraphic and spatial concentrations of artifacts and faunal remains across all areas of the site.

While flakes comprise the majority of tools recovered, some cores and choppers have also been found. The raw materials for lithic artifacts come from nearby rivers. The differences in technology are not only observed in the changes in the material composition of the assemblages, but also the techniques. Before the Dmanisi finds, experts believed that humans could not have left Africa before having developed an advanced technology such as Acheulean types of tools that were symmetrically shaped, manufactured and standardized. The tools found at Dmanisi, however, are simple flakes and choppers, much the same as the primitive Oldowan tradition that hominids in Africa practiced nearly a million years earlier (Mgeladze *et al.* 2010).

Figure 2: *Dmanisi Archeological Museum-Reserve. Photo by Fernando Javier Urquijo*

We found many unmodified stones at the site originating from elsewhere; there was no possible way they could have arrived there naturally. The larger rocks were likely used as tools for pounding flesh, cutting meat, or smashing bones, while certain smaller stones might have served different purposes such as enabling aggressive scavenging. Small hominins who lived there stuck together for protection and perhaps threw rocks to pilfer food from carnivores.

Evidence including lithics and fossil human anatomy supports the hypothesis that the initial evolution of “elite human throwing” arose as part of power-scavenging and/or hunting adaptation. The capacity to throw with elite skill is expected to have had important social consequences and to have driven the evolution of a uniquely human type of kinship-dependent social cooperation

Other indirect evidence of social cooperation comes from the human skull D-3444 cranium and jaw. These fossils belonged to an individual who had lost all but one of his teeth before he died. How could a toothless person survive for years in a cold environment, without using fire to cook food? The consumption of soft animal tissues such as marrow and brains is indicated by associated mammal bones and pounding tools. Even more compelling is the possibility that he was cared for (Lordkipanidze *et al.* 2005).

Conclusions

Best hard evidence we have about early Homo comes from Dmanisi. We have never had such accurately dated material, so many well preserved human fossils - both cranial and post cranial - or such a rich fauna and thousands of stone tools from any other single site.

Here we discovered Skull 5-the world's first completely preserved adult hominid skull from the early Pleistocene. It has a small braincase of 546 cm^3 - (about one third of a modern human’s), but the largest face and teeth, a combination previously unknown for early *Homo*. Dmanisi has indeed yielded multiple fossils of the same geological age and from a single locality. This provides the first opportunity to actually quantify and test hypotheses about intra- and inter-specific variation in early *Homo*. Skull 5 is a key to these analyses because it unites features that have been used to define different species of early Homo. In other words, had the braincase and the face of Skull 5 been found as separate fossils in Africa, they might have been attributed to different species.

Comparing variations in the Dmanisi sample with variations in modern human and chimpanzee populations now shows that all the Dmanisi individuals belong to a population of a single early Homo species. Indeed, the five Dmanisi individuals are conspicuously different from each other, but not more different than any five modern human individuals, or five chimpanzee individuals from a given population. Dmanisi has let us capture a clear snapshot of the evolution of early *Homo*.

Dmanisi draws one of the most complete pictures of Early *Homo*. We have a group of creatures with small brains, small stature, with very developed lower limbs, highly efficient walkers and runners with almost modern body proportions; and though their arms moved in a different way, they use primitive stone tools and have a social system; also, they live in a temperate environment, very different from Africa.

Yet, in spite of these exciting discoveries, the early evolution of the genus *Homo* and the number of species is still shrouded in mystery. The hypothesis that early *Homo* represents one variable species versus multiple species is still in progress. We are not rejecting the possibility that a number of *Homo* species, but I don't think this issue should be considered a simple discussion between "splitters" and "lumpers". Indeed, the senior authors of our article on Skull 5 (Lordkipanidze, *et al.* 2013 and Zollikofer e*t al.* 2014), which is considered an additional "lumping" paper, were among the first to show - through quantitative data - that Neanderthals and modern humans are two separate species.

The extraordinary preservation of Dmanisi specimens from different biological ages has enabled us to use approaches from population biology. Thus the Dmanisi finds have brought new standards to these discussions. I am sure that the discovery of new fossils and the further development of scientific methods will shed more light on why and how both of these seemingly divergent approaches to taxonomy - and perhaps uniquely new paradigms - will contribute to understanding the history of our species.

References

Vekua A., Lordkipanidze D., Rightmire G.P., Agusti J., Ferring R., Maisuradze G., Mouskhelishvili A., Nioradze M., Ponce de León M.S., Tappen M., Tvalchrelidze M., Zollikofer C.P.E. (2002) - A new skull of early Homo from Dmanisi, Georgia. *Science* 297(5578):85-89.

Rightmire G.P., Lordkipanidze D. (2009) - Comparisons of Early Pleistocene Skulls from East Africa and the Georgian Caucasus: Evidence Bearing on the Origin and Systematics of Genus Homo. In: F.E. Grine, J.G. Fleagle, R.E. Leakey (eds.), *The First Humans: Origin and Early Evolution of the Genus Homo.* Vertebrate Paleontology and Paleoanthropology Series, Dordrecht, Netherlands, Springer, p. 39-48.

Ferring R., Oms O., Agusti J., Bernad F., Nioradze M., Shelia T., Tappen M., Vekua A., Zhvania D., Lordkipanidze D. (2011) - Earliest human occupations at Dmanisi (Georgian Caucasus) dated to 1.85-1.78 Ma. *Proceedings of the National Academy of Sciences* 108:10432-10436.

Lordkipanidze D., Ponce de León M.S., Margvelashvili A., Rak Y., Rightmire P., Vekua A., Zollikofer C.P.E. (2013) - A complete skull from Dmanisi, Georgia, and the evolutionary biology of early Homo. *Science* 342:326-331.

Lordkipanidze D., Jashashvili T., Vekua A., Ponce de León M.S., Zollikofer C.P.E., Rightmire G.P., Pontzer H., Ferring R., Oms O., Tappen M., Bukhsianidze M., Agusti J., Kahlke R., Kiladze G., Martinez-Navarro B., Mouskhelishvili A., Nioradze M., Rook L. (2007) - Postcranial evidence from early Homo from Dmanisi, Georgia. *Nature* 449:305-310.

Gabunia L., Vekua A., Lordkipanidze D., Swisher A.A., Ferring R., Justus A., Nioradze M., Tvalchrelidze M., Anton S.C., Bosinski G., Jöris O., Lumley M.-A. de, Majsuradze G., Mouskhelishvili A. (2000) - Early Pleistocene Hominid Cranial Remains from Dmanisi, Republic of Georgia: Taxonomy, Geological Setting and Age. *Science* 288:1019-1025.

Lordkipanidze D.,Vekua A., Ferring R., Rightmire G.P., Agusti J., Kiladze G., Mouskhelishvili A., Nioradze M., Ponce de León M.S., Tappen M., Zollikofer C.P.E. (2005) - The earliest toothless hominin skull. *Nature.* 434:717-718.

Mgeladze A., Lordkipanidze D., Moncel M.-H., Despriee J., Chagelishvili R., Nioradze M., Nioradze G. (2010) - Hominin occupations at the Dmanisi site, Georgia, Southern Caucasus: Raw materials and technical behaviours of Europe's first hominins. *Journal of Human Evolution* 60:571-596.

Zollikofer C., Ponce de Leon M.S., Margvelashvili A. (2014) - Response to Comment on "A Complete Skull from Dmanisi, Georgia, and the Evolutionary Biology of Early Homo". *Science* 344:360.