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SHORT NOTE

On the earliest human occupation in Europe: Paleomagnetic constraints

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RESUMEN

Se ha realizado un estudio paleomagnético detallado en el sitio arqueológico de Dmanissi (República de Georgia, Caúcaso) con el fin de esclarecer la posición relativa del sitio en el marco cronológico del Plio-Pleistoceno. Un total de 27 núcleos paleomagnéticos fueron obtenidos a lo largo de un perfil en la localidad donde una mandíbula humana fue encontrada. Quince direcciones características de magnetización remanente (ChRM) fueron utilizadas para determinar la polaridad magnética de las unidades estudiadas. En la mayoría de las muestras es evidente la presencia de una fuerte magnetización secundaria de polaridad normal, que es removida usualmente a los 250 grados Celsius. Del análisis paleomagnético, parece que los sedimentos que contienen el homínido y herramientas de piedra, todos presentan polaridad reversa. Lo anterior indica Edad Matuyama (post-Olduvai) para el sitio, en discordancia con estudios previos.

PALABRAS CLAVE: Paleomagnetismo, hominidus, antropología, Europa.

ABSTRACT

We carried out a detailed paleomagnetic survey at the Dmanissi archeological site (Republic of Georgia, Caucasus) in order to clarify the relative position of the site in the Plio-Pleistocene chronologic framework. In total, 27 standard paleomagnetic cores were obtained across the profile at the locality where the human mandible was found. Fifteen characteristic remanent magnetization directions have been used to determine the magnetic polarity of the studied units. The presence of a strong normal overprint is evident in most of the samples and is usually removed at about 250 degrees Celsius. Judging from the paleomagnetic analysis, it seems that the sediments containing the hominid and stone tools all show reverse polarity magnetization. This points to Matuyama age (post-Olduvai) for the site, in disagreement with previous studies.

KEY WORDS: Paleomagnetism, hominids, anthropology, Europe.

BACKGROUND

The genus *Homo* evolved in Africa about 2.0-2.5 Ma (Thomas *et al*., 1988). However, the question of when humans first dispersed out of Africa is highly controversial. Gabunia and Vekua (1995) provided radiometric dates of a human mandible and lithic artifacts from Dmanissi, Georgia. Gabunia *et al*. (2000) redated the basalts at the site and obtained an Olduvai age. Two sites in Asia, Longgupo and Java, had previously yielded the oldest evidence for hominids dispersals from Africa. Previously, there has been no clear evidence for human occupation older than 0.5 Ma in Europe (Roebroeks and Van Kolfschoten, 1995; Dennell and Roebroeks, 1996). With the discovery of the Dmanissi fossils, with a claimed age of 1.8 Ma, the dates of human dispersal to western Europe had to be reconsidered (Dean and Delson, 1995). The TD6 level in Atapuerca was claimed as the oldest site in southern Europe. The age of the Atapuerca site (~0.78 Ma) is constrained by paleomagnetism (Parés and Pérez-González, 1999) and Electron Spin Resonance (Falgueres *et al*., 1999), and is supported by biochronology (Cuenca-Bescos *et al*., 1999). A site in southern Spain, in the Guadix-Baza Basin, seems to contain lithic artifacts slightly older than Atapuerca (Martínez *et al*., 1997), though there is no clear evidence for human bones so far (e.g. Moya-Sola and Kohler, 1997).

In this note, we present a dissenting view based on our own paleomagnetic results at the Dmanissi site, which yield Matuyama age.

THE DMANISSI MANDIBLE

In Dmanissi, hominid remains and lithic artifacts were found in a stratigraphic section of alluvial and lacustrine

sediments. Below the sediments there is a basalt layer that has yielded two different ages. Rubinshtein *et al*., (1972) claimed an age of 0.56 ± 0.1 Ma by using K-Ar dating. Later, Majsuradze *et al*. (1995) used Ar-Ar dating and obtained an age of 1.8 ± 0.1 Ma. Thus the sediments overlying the basalt must be younger than 1.8 Ma, although no definitive agreement exists on the exact emplacement time (Majsuradze and Tvalchrelidze, 1995). Gabunia and Vekua (1995) referred to a paleomagnetic study by Sologashvili *et al*. (1995), who reported normal magnetization in samples from the basalt and from the overlying sediments containing the human remains. As the normal polarity Olduvai Chron is 1.95- 1.77 Ma old (Cande and Kent, 1995), and since the host rock yielded normal polarity (Sologashvili *et al*., 1995), a conservative explanation held that the archaeological level V must be between around 1.8 Ma old. A faunal association suggests an Villafranchian age (Upper Pliocene-Lower Pleistocene) for the Dmanissi site (Gabunia and Vekua, 1993; Dzaparidze, 1995). Gabunia *et al*., (2000) report both reverse and normal polarities for the sedimentary units; However, the 'near Olduvai' (~1.7 Ma) age, first suggested by Sologashvili *et al*., (1995) was maintained. A date of about 1.8 Ma for the Dmanissi mandible has generally been adopted (e.g. Roebroeks, W. and Van Kolfschoten, T., 1995, Dean and Delson, 1995; Klein, 1995; Dennell and Roebroeks, 1996, Gabunia *et al*., 2000).

However, the relatively evolved morphology of the Dmanissi mandible is striking (Dean and Delson, 1995, Klein, 1995, Brauer and Schultz, 1996; Rosas and Bermúdez de Castro, 1998). Dates as late as 1 have been mentioned (Klein, 1995). Rosas and Bermúdez de Castro (1998) attributed the mandible to *Homo sp. indet.* (*aff. ergaster*). They noted the similarity of the Dmanissi mandible with the Asian *Homo erectus*, based on aspects of dentition. Could the Dmanissi be younger than 1.8 Ma?

PALEOMAGNETIC SURVEY OF DMANISSI SEDIMENTS

We carried out an independent magnetic survey at the Dmanissi site, in order to clarify the relative position of the site within the Plio-Pleistocene chronologic framework. We collected 27 samples along a profile at the locality where the mandible was found. Samples were carefully oriented in the field and imbibed with a sodium silicate solution. Paleomagnetic analysis was carried out at the University of Michigan. Oriented samples were measured with a shielded three-axes SQUID magnetometer with a noise level of 8E-6 A/m, well below the natural remanent magnetization (NRM) intensity of the samples. Stepwise thermal demagnetization was used to eliminate the overprint of the present day magnetic field. The characteristic remanent magnetization (ChRM) was used to find (Figure 1) the Virtual Geomagnetic Polar (VGP) latitudes along the stratigraphic sections. A total of 21 samples were analyzed, and 15 ChRM directions have were used to determine the magnetic polarity. A strong normal overprint was found in most samples but it was usually removed at about 200 degrees Celsius.

DISCUSSION

Paleomagnetic analysis indicates that the sediments containing the hominid and stone tool remains have dominantly reversed and not normal polarity. The reversed magnetization is partially overprinted by the present-day normal field from a low unblocking-temperature-component, probably goethite because of the thermal demagnetization. Hence, the alternating field demagnetization technique is not suited to isolate the primary magnetization. We suggest that this may be the reason why some normal magnetization has been previously reported for that site (Sologashvili *et al*., 1995).

The reversed polarity of the Dmanissi sediments suggests a Matuyama date for the site. It could be as young as 1.07 Ma. The faunal assemblage at Dmanissi indicates a Lower Pleistocene age for the site (Gabunia and Vekua 1993; Vekua 1995). In order to agree with our measurements, this faunal association may not be much older than Venta Micena or Fuente Nueva-3, dated as around 1 Ma (Martínez *et al*., 1997; Oms, 1999).

While the age of the underlying basalt in Dmanissi might still be correct as reported by Sologashvili *et al*., (1995), our paleomagnetic analysis yields reverse magnetization for the overlying sediments (Units V to II) in quite good agreement with Gabunia *et al*., (2000), who reported a normal polarity magnetization at only one site. No normal polarity magnetization was detected in our study.

The base of the Pleistocene at Dmanissi is found to be barely younger than the end of the Olduvai Chron. Our data does not support an Olduvai age for the human remains. Age comprised between 1.77 to 1.07 Ma - latest Pliocene / early Pleistocene-fits the current absolute and relative dates at the site. Our results do not purport to represent a new dating for the Dmanissi mandible, but rather a cautionary note on the eventual use of this archaeological site as evidence for 1.8 Ma old human presence in Europe. Magnetic stratigraphy may yield new possibilities for the chronology of the Dmanissi site.

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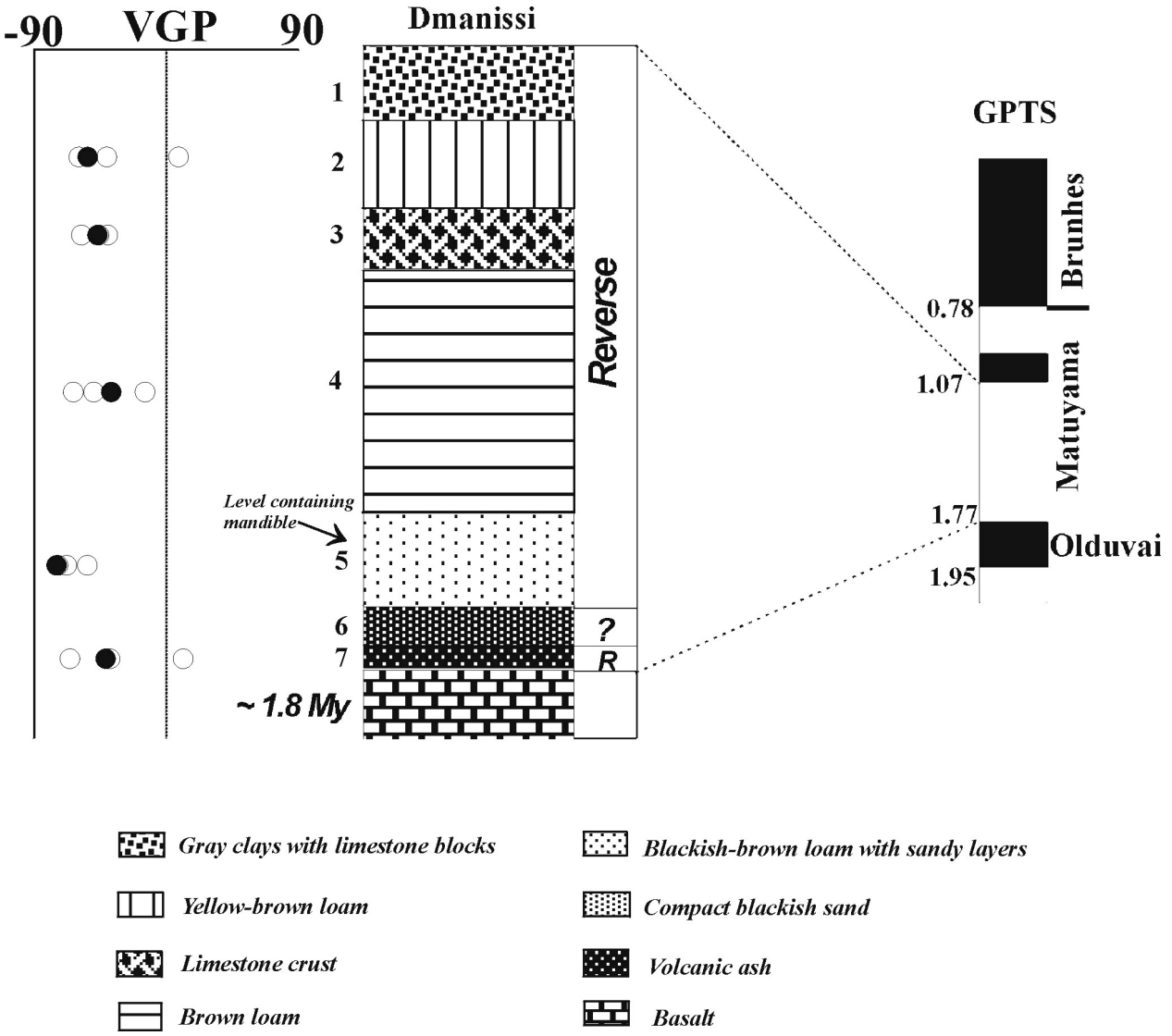

Fig. 1. Stratigraphic section of the Dmanissi site (modified from Dzaparidze, 1995 and Goguitchaichvili and Parés, 2000). Lithostratigraphic units 1 to 4 appear as in Gabunia and Vekua (1995, Fig. 1). The mandible was found in level 5, along with many fossil vertebrates (Dzaparidze, 1995). Right part of the figure shows the magnetic polarity chrons (Cande and Kent, 1995) for the last 1.95 Ma for reference. On the left side, the corresponding Virtual Geomagnetic polar (VGP) latitudes are also shown for each lithostratigraphic unit. Dots represent the Fisherian mean VGP Latitude for three samples (circles) per sampling site.

* Note - Representative demagnetization diagrams are available on request.

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