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The Omo Mursi Formation: A window into the East African Pliocene

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ABSTRACT

Dating to more than four million years ago (Ma), the Mursi Formation is among the oldest of the Plio-Pleistocene Omo Group deposits in the lower Omo Valley of southwestern Ethiopia. The sedimentary sequence is exposed along a strip ~35 km by 4 km, but it has received relatively little attention due to the difficult access to this area. Although expeditions to the lower Omo Valley between 1968 and 1973 focused primarily on the Usno and Shungura Formations, survey of the Mursi Formation produced a faunal collection of about 250 specimens deriving exclusively from the Yellow Sands area at the southern extent of the exposures. In 2009, we reinitiated an investigation of the formation by focusing on the most northern exposures, and a new fossil site, Cholo, was identified. Cholo is depositionally similar to the lowermost exposures at the Yellow Sands, although no stratigraphic correlation between the two localities has yet been made. The fossiliferous sediments at Cholo are capped by a prominent vitric tuff that is compositionally distinct from any other known tephra preserved in East African rift basins, including the only known vitric tuff at the Yellow Sands. The faunal assemblage of the Yellow Sands area presents interesting characteristics: the fossils generally show little weathering and include a large proportion of suids (44% of the mammalian fauna) and a small proportion of bovids (14%) compared with other Pliocene African sites. The sample is also unusual in the high frequency of deinotheres (7%). Taxon-specific stable carbon isotopic composition of the Mursi mammals tends to show generally higher proportions of C_3 diets compared with other Pliocene sites in East Africa and Chad. This and the particular faunal proportions suggest that the environments represented by the Mursi Formation were more closed than those of other Pliocene sites.

Introduction

The lower Omo Valley of southern Ethiopia has played a central role in our understanding of vertebrate evolution in eastern Africa (Coppens et al., 1976; Howell, 1978). Pliocene and Pleistocene strata in this area constitute part of the Omo Group, which includes the Shungura, Usno, Nkalabong, and Mursi Formations in Ethiopia, and the Nachukui and Koobi Fora Formations along the shores of Lake Turkana in Kenya (Brown et al., 1970; Butzer, 1976; de Heinzelin, 1983, Fig. 1). The lower Omo Valley deposits have been the object of intensive research and numerous publications since the 1960s, but the Mursi Formation, despite its estimated age of more than four million years (Ma), has remained relatively understudied. In fact, there is no single publication documenting the geology and entire faunal record derived from the Mursi Formation, although some of the Mursi mammals have been described by researchers primarily interested in taxonomy (e.g., Maglio, 1973; Beden, 1976; Gentry, 1985).

The period prior to 4 Ma is important in hominin evolution because it marks the transition from *Ardipithecus* to *Australopithecus*. The latter is the oldest taxon with well-documented, habitual bipedal locomotion and one of its species is likely to be

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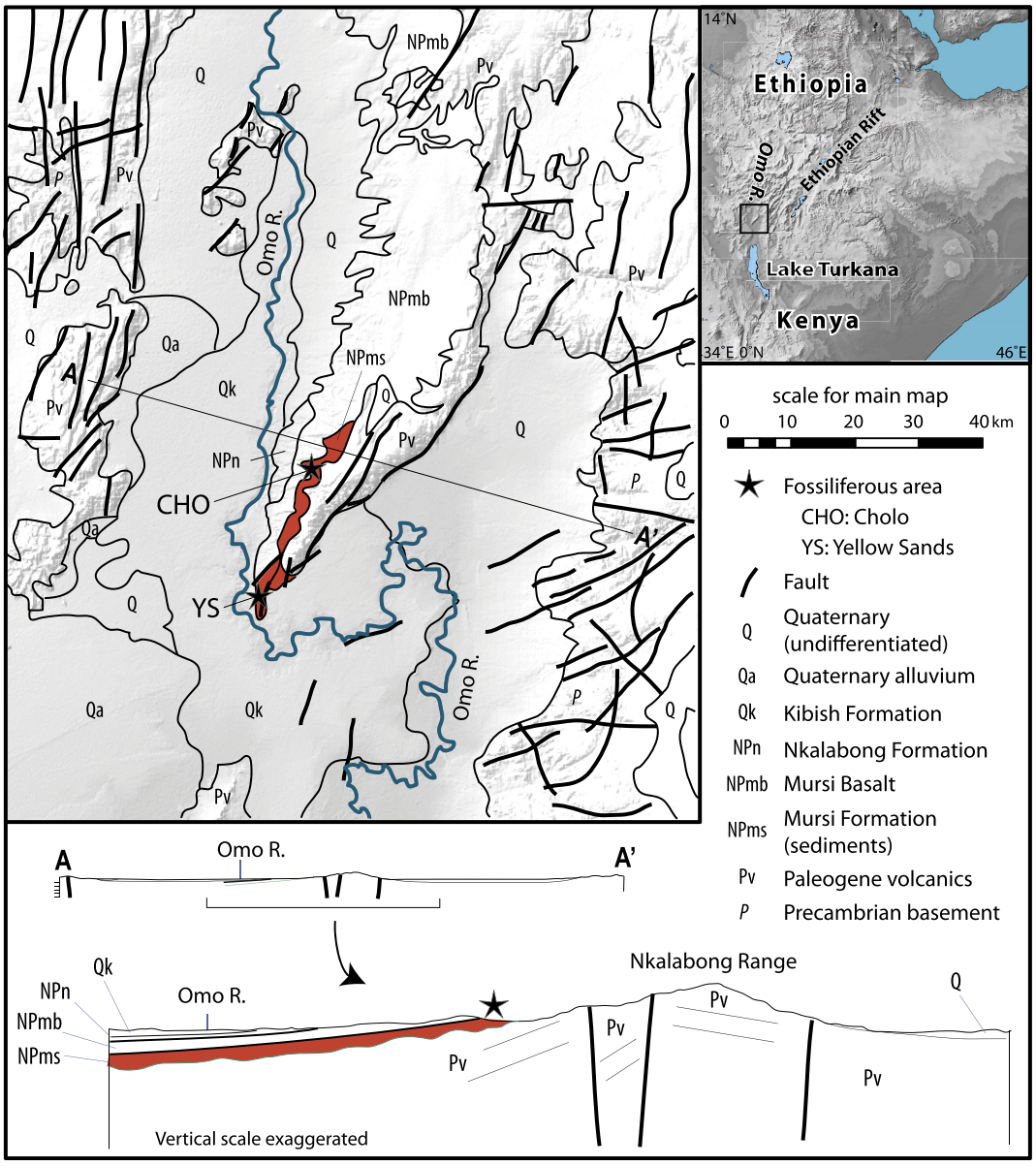

Figure 1. Geological map of the area surrounding the Mursi Formation sediments, overlain on digital elevation data (90 m Shuttle Radar Topography Mission data). Location of cross section A–A′ is indicated on the map; note expansion of vertical scale in detailed cross section. Geology adapted from Davidson (1983).

the immediate ancestor to the genus *Homo*. If *Ardipithecus ramidus* is directly ancestral to *Australopithecus anamensis* (Haile-Selassie, 2001; Haile-Selassie et al., 2004; White et al., 2006, 2009a), this implies a rapid speciation event between 4.4 and 4.2 Ma that included a major modification of locomotion and significant changes in jaw and tooth morphology (Suwa et al., 2009a, b) despite similarities in their enamel stable isotope composition (Sponheimer et al., 2013). However, if *Ardipithecus* and *Australopithecus* are two distinct lineages (Senut et al., 2001; White et al., 2006, 2009a), it remains important to document the period during which they may have occupied East Africa contemporaneously. Despite the importance of this time period for our understanding of how the genus *Australopithecus* arose, very few localities of pertinent age are identified in East Africa (Aramis [White et al., 1994], Asa Issie [White et al., 2006] and Galili [Macchiarelli et al., 2004] in Ethiopia, Kanapoi [Patterson, 1966], Lothagam [Patterson et al., 1970], and Tabarin [Hill, 1985] in Kenya, Manonga Valley [Harrison, 1991] in Tanzania). The Mursi Formation provides an opportunity to document this critical interval. Renewed fieldwork in the Mursi Formation by our team in 2009, 2011, and 2012 endeavored to increase our understanding of the biogeography and habitats of the greater Turkana Basin during the early Pliocene and provide data for meaningful comparisons with the preceding and subsequent period.

In this paper, we present an overview of previous and current field research in the Mursi Formation, describe the geological context of the formation, and provide a geological description of a new site found by our team, which includes a new tuff. We also present a revised study of the entire collection of fossil vertebrates available at the National Museum of Ethiopia (NME) in Addis Ababa and at the National Museums of Kenya (KNM) in Nairobi collected from previous expeditions. This included an evaluation of the