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Reassessing the sedimentary deposits and vertebrate assemblages from Ponte Galeria area (Rome, central Italy): An archive for the Middle Pleistocene faunas of Europe

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ABSTRACT

The Ponte Galeria area is part of the larger "Campagna Romana" and hosted the inner delta of the Tiber River since the beginning of the Middle Pleistocene, allowing the deposition of a series of glacio-eustatically controlled fluvial–lacustrine sedimentary successions very rich in fossil mammal remains. Due to its richness of fossiliferous sites, this area represents an exceptional archive for the study and understanding of the biochronological, paleobiogeographical and paleoenvironmental evolution during the Middle Pleistocene in Europe. A series of recent studies, using the $^{40}Ar/^{39}Ar$ ages of tephra intercalated within the sedimentary deposits, provided a large amount of geochronological data linking these aggradational successions to the different Marine Isotopic Stages. In the present paper we present a complete review of the faunal assemblages identified so far in the Ponte Galeria area, and we constrain the ages of the faunal units by placing them within the new chronostratigraphic scheme. By means of this interdisciplinary approach, we re-calibrate the mammal assemblages collected in this area and reconstruct a new biochronological and paleobiogeographic framework for the Italian peninsula during the Middle Pleistocene.

In particular, we distinguish six well-defined biochronological units (Slivia, Ponte Galeria, Isernia, Fontana Ranuccio, Torre in Pietra, and Vitinia) in the studied area covering a time span of ca 0.6 Myr, from the Early to Middle Pleistocene transition to at least marine isotope stage 7. This period is characterized in Europe by the Mid-Pleistocene Revolution (global climate change) and by the transition at first between Villafranchian and Galerian taxa and later between the Galerian and Aurelian ones. According to the reviewed data, the persistence of Villafranchian taxa is recorded in Italy at the beginning of the Middle Pleistocene probably due to favorable climatic conditions or delay in dispersal of competitive species, while the faunal turnover between the Villafranchian and Galerian species was completed around 0.6–0.5 Ma. During this time, *Bos primigenius* and other temperate-warm taxa were widespread in the Peninsula earlier than in Western Europe. In contrast, typical Aurelian taxa, usually related with temperate-cold climatic conditions (*Ursus spelaeus*, *Megaloceros giganteus*), occurred later in Italy than in other Western European areas.

Contents

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1. Introduction

The transition between the Villafranchian and Galerian faunas was a gradual phenomenon that lasted over a time span of about 0.5 Myr. During this period, new species reached Western Europe joining the Villafranchian ones such as *Pachycrocuta brevirostris*, *Panthera gombaszoegensis* and *Homotherium* among the carnivores, and *Axis eurygonos*, *Equus altidens*, *Hippopotamus antiquus* and *Mammuthus meridionalis* among the herbivores, which progressively disappeared. During the time span between the latest Early and the early Middle Pleistocene (corresponding to the Matuyama–Brunhes geomagnetic event), the most remarkable faunal renewal occurred with the appearance, among others, of the Galerian species *Cervus elaphus*, *Sus scrofa*, *Bison schoetensacki*, *Palaeoloxodon antiquus*, *Crocuta crocuta* and *Mammuthus trogontherii* (Gliozzi et al., 1997; Petronio and Sardella, 1999; Martinez-Navarro et al., 2009; Kahlke et al., 2011; Petronio et al., 2011; Magri and Palombo, 2013).

The occurrence of the large-sized cervid *Praemegaceros verticornis*, represented by an early form also known as *Praemegaceros pliotarandoides*, has been chosen as the bioevent marking the beginning of the Galerian Land Mammal Age (LMA) (latest Early Pleistocene; Gliozzi et al., 1997). In Italy, this species was reported for the first time in the Colle Curti local fauna (LF) (Marche region) (Ficcarelli and Mazza, 1990; Coltorti et al., 1998), correlated to the base of the Jaramillo subchron (about 1.1 Ma). This period is well-known through the marine isotopic record and through continental pollen diagrams because it represents an important point of radical transformation of the climatic and vegetational cycles ("Mid-Pleistocene Revolution"), coincident with the passage to a phase characterized by 100-kyr glacial cycles (e.g., Pisias and Moore, 1981; Maasch, 1988; Park and Maasch, 1993; Saltzman and Verbitsky, 1993; Berger and Jansen, 1994; Mudelsee and Schulz, 1997; Mildenhall et al., 2004; Head and Gibbard, 2005; Leroy, 2007; Crundwell et al., 2008; Marino et al., 2008; Bertini, 2010; Alonso-Garcia et al., 2011; Joannin et al., 2011; Leroy et al., 2011; McClymont et al., 2013; Magri and Palombo, 2013 and references therein). During the Late Galerian, when climatic conditions were more stable, the faunal renewal was completed and at the beginning of the Aurelian LMA (late Middle Pleistocene), taxa that represent the core of the present-day mammal fauna appeared (Petronio et al., 2007, 2011).

In the Ponte Galeria area, the faunal renewal during the Galerian and the Aurelian LMA is well documented, since several faunal assemblages spanning the latest Early Pleistocene to the latest Middle Pleistocene have been described (Gliozzi et al., 1997; Petronio and Sardella, 1999; Petronio et al., 2011).

In this work we provide a complete review of the faunal assemblages identified so far in the Ponte Galeria area, and we constrain the ages of the LF by placing them within the new chronostratigraphic scheme, which identifies a series of glacio-eustatically forced aggradational successions correlated to the Middle Pleistocene marine isotopic stages (MIS) (Marra et al., 2008 and references therein). Thus, the first and last occurrences of several taxa are re-calibrated and discussed.

2. Regional setting

The Ponte Galeria area (Fig. 1) lies in the central portion of the Latium coast, just north-east of the mouth of the Tiber River (about 15 km W of Rome's center, Italy). This area, part of the larger "Campagna Romana", hosted the inner delta of the Tiber River since the beginning of the Middle Pleistocene, allowing the deposition of a series of glacio-eustatically controlled fluvial–lacustrine sedimentary successions, very rich in mammalian faunas. Continued uplift of this area since 0.8 Ma, concurrent to the development of the volcanic districts of Monti Sabatini and Alban Hills, provided partial erosion and exposure of these sedimentary successions.

This area is presently a plateau, slightly uplifted with respect to the south- and west-bounding fluvial and deltaic plains of the Tiber River. The top surface is around 60 m a.s.l. and spreads over more than 50 km^2. The plateau is crossed by long, narrow and relatively steep-walled valleys of the NNW–SSE directed Fosso Magliana and Fosso Galeria streams, western tributaries of the Tiber River.

A lithostratigraphic scheme for the overall Ponte Galeria area, including the facies analyses of nine constituent members and a tentative correlation with the MIS was proposed by Conato et al. (1980). This work introduced several new formations spanning the late Middle Pleistocene to Late Pleistocene (e.g., the San Cosimato, Aurelia, Vitinia, and Duna Rossa formations), disconformably overlaying the early Middle Pleistocene Ponte Galeria Formation, previously described by Ambrosetti and Bonadonna (1967).

New schemes were successively proposed, either based on sequence stratigraphy (Milli, 1997; Milli et al., 2004, 2008) or on the introduction of "aggradational sections" (Karner and Marra, 1998; Marra et al., 1998), which represent a hybrid approach to the definition of glacio-eustatically forced sedimentary successions, partly based on the concept of unconformity bounded stratigraphic units. Both types of scheme derive from the lithostratigraphic one and refine the link between the stratigraphic units and the MIS. Here we adopt the chronostratigraphy based on the definition of aggradational section introduced by Karner and Marra (1998) and developed in a number of papers that, thanks to the datings of volcanic layers interbedded with the sedimentary deposits and to magnetostratigraphic analyses carried out on clay deposits, introduced 10 glacio-eustatically forced sedimentary units corresponding to as many aggradational successions deposited during MIS 22–21 through MIS 2–1 (Figs. 2 and 3, Marra et al., 1998; Karner et al., 2001a; Florindo et al., 2007; Marra et al., 2008; Marra and Florindo, 2014). The correlation of these glacio-eustatic forced aggradational successions with the fourth-order depositional sequences described in the sequence-stratigraphic studies (Milli, 1997; Milli et al., 2008) is provided in Fig. 3 and discussed in Section 5.1.

In the Ponte Galeria area, abundant remains of vertebrates have been found in different sites since the early 60s of the last century (Ambrosetti and Bonadonna, 1967; Ambrosetti et al., 1972). In more recent work (Petronio and Sardella, 1999; Petronio et al., 2011), the findings of numerous faunal assemblages referable to the Galerian and Aurelian were mentioned for the first time (Fig. 2). The name Galerian was used at first by Ambrosetti et al. (1972) to define the sedimentary deposits cropping out in the Ponte Galeria area. The name Galerian was later used as LMA to identify Middle Pleistocene mammal faunas previously related with the Cromerian (Azzaroli et al., 1982, 1988; Gliozzi et al., 1997). The name Aurelian was used by Gliozzi et al. (1997) as LMA and it derived from Via Aurelia (Rome), the road crossing the area where a large number of Middle Pleistocene vertebrate assemblages was collected.

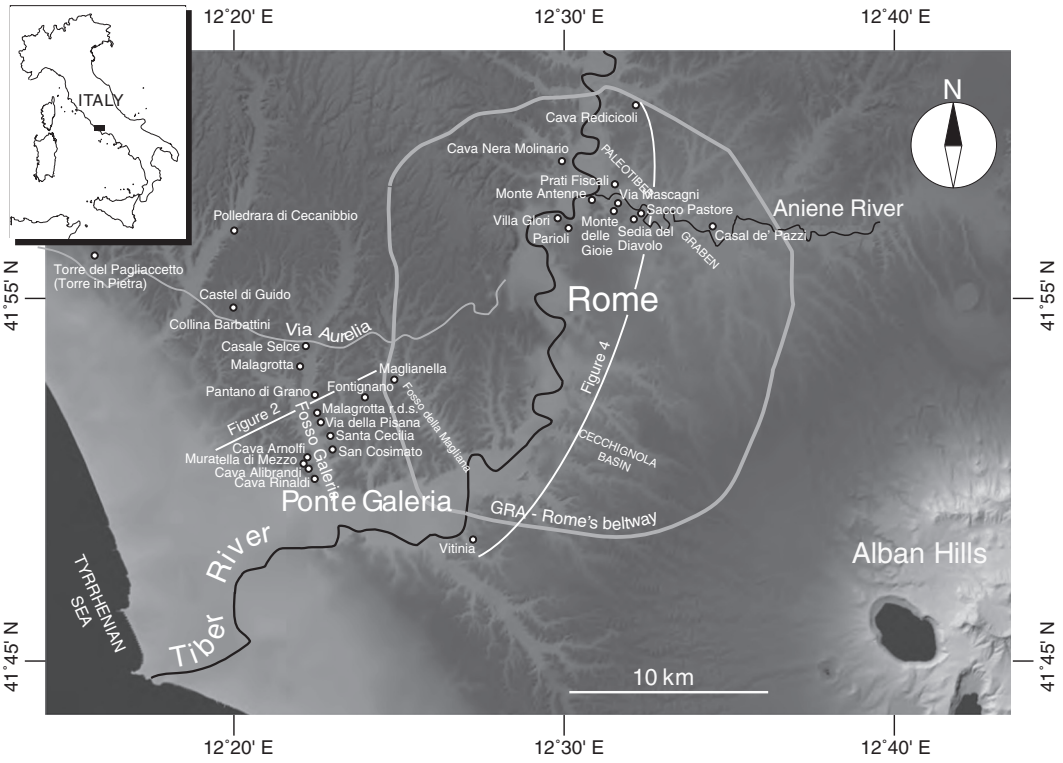

Fig. 1. Shaded relief image of the area of Rome, showing location of the fossiliferous localities and of the geologic type-localities mentioned in the text. Location of the cross-sections of Figs. 2 and 4 is also shown.

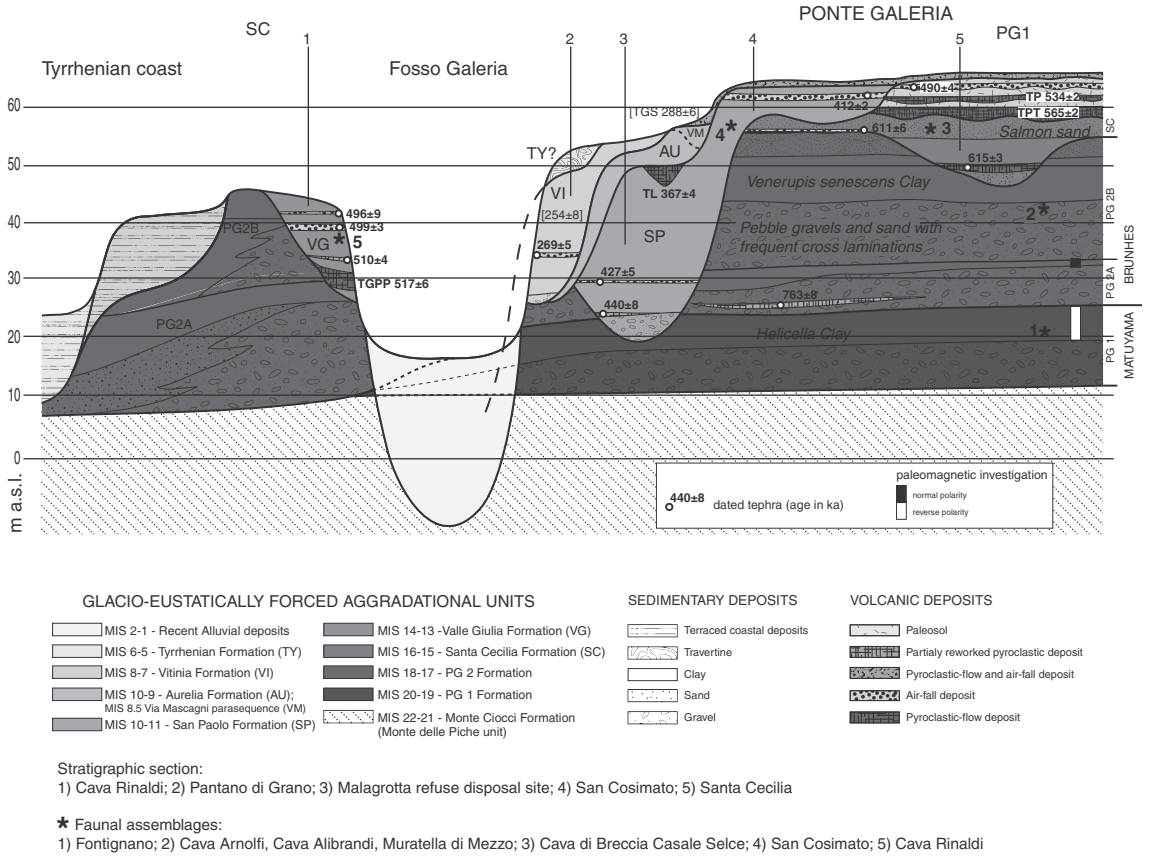

Fig. 2. Schematic, composite geologic section (horizontal not to scale) showing the lithostratigraphic features of the aggradational deposits of the paleo-Tiber River and the position of dated volcanic layers used to correlate the aggradational units to the $\delta^{18}O$ isotopic record. The stratigraphic position of the faunal units described in the text is also shown. Location of the section is shown in Fig. 1.