



## A new primate assemblage from La Verrerie de Roches (Middle Eocene, Switzerland)



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### ABSTRACT

Primates reached a great abundance and diversity during the Eocene, favored by warm temperatures and by the development of dense forests throughout the Northern Hemisphere. Here we describe new primate material from La Verrerie de Roches, a Middle Eocene karstic infill situated in the Jura Region (Switzerland), consisting of more than 80 dental remains. The primate assemblage from La Verrerie de Roches includes five different taxa. The best represented primate is *Necrolemur* aff. *anadoni*, similar in size and overall morphology to *Necrolemur anadoni* but resembling in some features the younger species *Necrolemur antiquus*. Microchoerines are also represented by two species of *Pseudoloris*, *P. pyrenaicus* and *Pseudoloris parvulus*, constituting the unique joint record of these two species known up to now. Remains of Adapiformes are limited to one isolated tooth of a large anchomomyin and another tooth belonging to the small adapine *Microadapis* cf. *sciureus*. The studied primate association allows assigning La Verrerie de Roches to the Robiacian Land Mammal Age. More specifically, this site can be confidently situated between the MP15 and MP16 reference levels, although the primate assemblage probably indicates some degree of temporal mixing. This is the first record of *P. pyrenaicus* and a form closely related to *N. anadoni* out of the Iberian Peninsula. The identification of these microchoerines in Switzerland gives further support to the connection of NE Spain and Central Europe during the Middle Eocene.

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### 1. Introduction

The origin of Euprimates dates back to the beginning of the Eocene, a moment marked by high temperatures and followed by sustained global warmth (Shackleton and Boersma, 1981; Zachos et al., 2001, 2008). During this epoch, the development of dense forests allowed the radiation of primates throughout the Northern Hemisphere. Two main groups of Euprimates became abundant and diverse during the Eocene: the larger-sized adapiforms and the small-bodied omomyiforms (Rose et al., 1994; Covert, 2002; Gebo, 2002; Gunnell and Rose, 2002; Gilbert, 2005; Gingerich, 2012; Godinot, 2015), which are related to the main clades of living primates (strepsirrhines and haplorrhines, respectively).

The Robiacian European Land Mammal Age ranges approximately between 43.5 and 37.8 Ma (Vandenbergh et al., 2012). Primates of this age are well known through the abundant and well-preserved material from classical localities such as Egerkingen and Mormont (Switzerland), Creechbarrow (England), Sant Jaume de Frontanya (Spain) and, especially, from numerous French fossil sites, including Lissieu, Robiac, Grisolles and several levels in the Quercy phosphorites such as Le Bretou and Lavergne (Godinot, 1983, 1985, 2015; Hooker, 1986; Aguilar et al., 1997; Legendre et al., 1997; Hooker and Weidmann, 2000). During the Robiacian, Omomyiformes are represented by the genus *Nannopithecus* and its putative descendant *Necrolemur* (Minwer-Barakat et al., 2015a), as well as the small-sized and rather diverse genus *Pseudoloris*. *Microchoerus* has also been reported from some Robiacian localities, although this genus has recently been suggested to be a paraphyletic group, and the taxonomic allocation of some Middle Eocene forms must be reconsidered (Minwer-Barakat et al., 2017). Regarding the adapiforms, during the Robiacian they are represented in Europe by the anchomomyins *Anchomomys* cf. *quercyi*

Abbreviations: BFI, La Bouffie; IPS, Institut de Paleontologia de Sabadell (former name of the Institut Català de Paleontologia Miquel Crusafont); NMB, Natural History Museum of Basel; SJF, Sant Jaume de Frontanya; VDR, La Verrerie de Roches.

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from Le Bretou (Godinot, 1988a) and *Anchomomys frontanyensis* from Sant Jaume de Frontanya 3 (Marigó et al., 2011), as well as the genus *Mazateronodon* in Mazaterón (Marigó et al., 2010). Other cercamoniines include the genus *Europolemur* from Creechbarrow Hill (Hooker, 1986). Adapines are represented by the genera *Lep-tadapis* found in Creechbarrow Hill, as well as *Adapis* from the same site (Hooker, 1986), the latter also recovered from different French (Robiac, Castrais, Grissoles; Louis and Sudre, 1975; Sudre, 1978), Spanish (Mazaterón and Sant Jaume de Frontanya; Moyà-Solà and Köhler, 1993; Marigó et al., 2014) and Swiss localities (Mormont-Éclépens; Sudre, 1978).

La Verrerie de Roches, an Eocene site in Switzerland, is rather poorly known despite the fact that it was first mentioned more than a hundred years ago (Stehlin, 1910, 1916). It is a classical network of “siderolithic” fissure fillings like the much better known European reference locality of Egerkingen, also in Switzerland. It is located in the Canton Jura, a few kilometers southeast of the canton’s main city, Delémont (Fig. 1). Some material was sampled from karstic fissure fillings at the beginning of the 20th century, leading to an interesting description of some artiodactyl teeth (Stehlin, 1910) and of a single primate fragmentary hemimandible of unknown affinities (Stehlin, 1916). In total about 40 mostly undescribed specimens comprised the historical collection of the Natural History Museum of Basel (NMB). Many karstic fissure fillings within the Late Jurassic basement are known over a rather limited surface, and no reference to what fissure filling was sampled was previously given, so that little information on the precise location of the previously described material can be given. About a hundred years later, new sampling carried out in 2006 in the context of the paleontological investigations along the A16 motorway (Transjurane) led to several hundred kilograms of material being screen washed, ultimately leading to the description of 20 teeth belonging to eight mammalian taxa, all coming from the same karstic fissure filling (Becker et al., 2013). The authors described a rather diverse fauna, which includes rodents (*Sciuroides* cf. *romani*, *Paradelomys crusafonti*, *Paradelomys ruetimeyeri*, *Elfomys* cf. *tobieni*, *Elfomys egnesseri*), a marsupial (Herpetheriinae indet.), a carnivore (Carnivora indet.), a mixtotherid (*Mixtotherium lavergnense*), as well as two different primates, assigned to *Adapis* aff. *sudrei* and *Necrolemur* aff. *antiquus*, each one represented by a single isolated tooth.

Between the historical publications and the recently published work, more excavations were carried out in the 1970s and early 1980s by the NMB. This material was never mentioned in any publication and was stored in the collections of the Museum. It

represents the largest collection of teeth from this locality, with more than a thousand specimens representing a large faunal spectrum of mammals and lower vertebrates, making this locality one of the richest for the Middle Eocene of Switzerland and perhaps, once its full potential is assessed, of Europe too. Unfortunately, the precise location of the sampled fissure fillings was not noted on a map of the outcrop and only collection years are available. To date, the outcrop represents a surface of about 50 m in length over 15 m in height and at least 36 fissure fillings with reddish sediment are still visible. We know that 10 fossiliferous fissure fillings were sampled back in the 1970s and 1980s; seven others were sampled in 2006 by the new paleontological investigations along the A16 motorway, which could partly, at least, be the same as those of the collection under study here.

In this work we describe in detail the primate specimens from La Verrerie de Roches housed in the collections of the NMB, consisting of more than 80 dental remains. The primate assemblage from La Verrerie de Roches includes five different taxa, three microchoerines and two adapiforms, thus representing one of the most diverse primate associations of the European Middle Eocene.

## 2. Material and methods

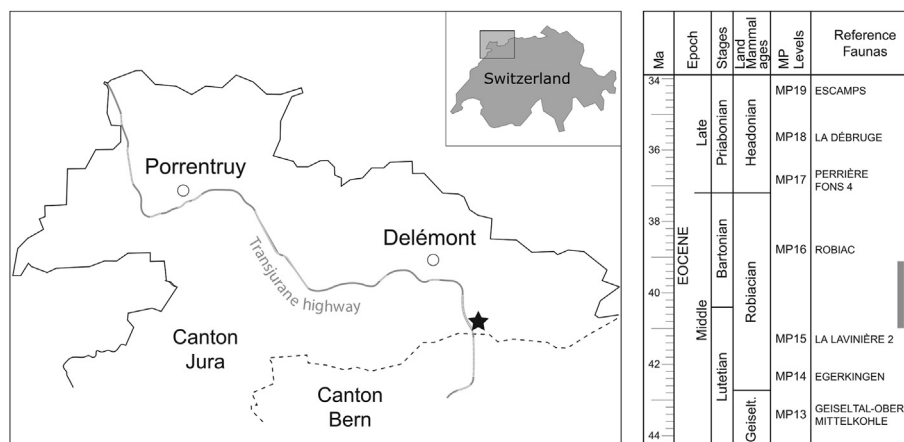
The studied material is housed in the collections of the Natural History Museum of Basel. The nomenclature used in the descriptions of the teeth is that described in Minwer-Barakat et al. (2015b). The first and second upper molars of *Necrolemur* and *Pseudoloris*, as well as the first and second lower molars of *Pseudoloris*, have been described together because of the difficulty of distinguishing them when they are found in isolation (they are referred to as  $M^{1-2}$  and  $M_{1-2}$ ). Following Hooker and Harrison (2008), the terms “anterior” and “posterior” are used specifically for the descriptions of the incisors because, whereas the posterior direction equates to distal, the anterior does not equate with mesial. Measurements have been taken using an optic caliper “Nikon measuroscope 10” connected to a monitor “Nikon SC112”, as defined by Godinot (2003). Micrographs were taken using the Environmental Scanning Electron Microscope (ESEM) of the Universitat de Barcelona.

## 3. Systematic paleontology

Order PRIMATES Linnaeus, 1758

Suborder HAPLORHINI Pocock, 1918

Infraorder OMOMYIFORMES Schmid, 1982



**Figure 1.** Location map and biochronological position of the site of La Verrerie de Roches (courtesy Becker et al., 2013). Location on map is indicated by the black star. The gray bar indicates uncertainty of the age within the late Lutetian and Bartonian stages, or Robiacian Land Mammal Age.

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