

# New data on the Early Villafranchian fauna from Vialette (Haute-Loire, France) based on the collection of the Crozatier Museum (Le Puy-en-Velay, Haute-Loire, France)

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## Abstract

Vialette (3.14 Ma), like Senèze, Chillac, Sainzelles, Ceysseguet or Soleilhac, is one of the historical sites located in Haute-Loire (France). The lacustrine sediments of Vialette are the result of a dammed lake formed by a basalt flow above Oligocene layers, and show a geological setting typical for this area, where many localities are connected with maar structures that have allowed intra-cratonic lacustrine deposits to accumulate. Based on previous studies and this work, a faunal list of 17 species of large mammals has been established. Eight species, typical of this time period and well known, occur in the collection of the Crozatier Museum of Le Puy-en-Velay: *Pliocrocota perrieri*, *Lynx issiodorensis*, *Mammuth borsoni*, *Anancus arvernensis*, *Stephanorhinus jeanvireti*, *Tapirus arvernensis*, *Cervus pardinensis* and *Crozetoceros ramosus*. The presence of *Gazella* cf. *G. borbonica* is newly established, in addition to which the oldest known occurrences of *Canis* sp., cf. *Eucladoceros* sp. and of the genus *Equus* in Western Europe are also described. These are the new data which pushed back the age of the arrival of the genus *Equus*, cf. *Eucladoceros* and *Canis* in Western Europe. Five taxa are not found in the Crozatier collection: Primates indet., *Agriotherium* sp., *Ursus* gr. *minimus-thibetanus*, Bovidae middle-sized (?*Pliotragus ardei* or ?*Gallogoral meneghinii*), ?*Procapreolus* cf. *cusanus*.

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## 1. Introduction

Vialette is located in France near the city of Le Puy-en-Velay (Fig. 1) within the department of Haute-Loire in the

large volcanic area called Velay, which has provided many Plio-Pleistocene paleontological localities such as Sainzelles, Ceysseguet or Soleilhac. The site was excavated from the beginning of the 19th century by many researchers from different European institutions, and the fossil material from Vialette is therefore scattered in many museums and institutions all over the continent, but the collection stored in the Crozatier Museum was only partially included in previous works. Based on previous studies by Aymard (several short notes in the 19th century), Boule (1892), Bout (1960), Heintz (1970), Heintz et al. (1974), Guérin (1972) and this present study a faunal list of 17 species of large mammals has been established. Only the oldest items,

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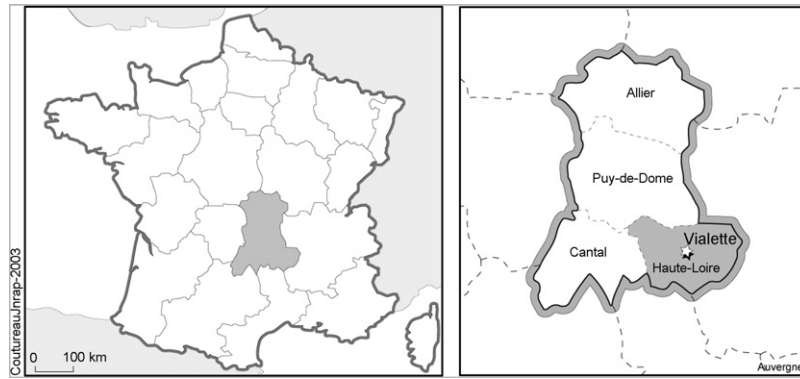


Fig. 1. Location of the site of Viallette (modified after Biquand et al., 1981; Thouveny and Bonifay, 1984).

those resulting from the two first fossil collections of Aymard and Robert in the 19th century, are stored in the Crozatier Museum, and represent nearly 1500 specimens.

In this study only the specimens undeniably coming from Viallette have been taken into account. The species known to be typical of Viallette will first be described before presentation of the new results and discussion of their implications.

## 2. General context

The geological setting of Viallette is quite particular for this volcanic area where many paleontological localities are connected to maar structures that have allowed the accumulation of intra-crateric lacustrine deposits. The fossiliferous lacustrine deposit of Viallette is the result of a dammed lake (Couthures, 1979) formed by the lower basaltic flow lying above Oligocene clays. The deposits were covered by the upper basaltic flow which is now partially eroded.

The fossiliferous layer is ascribed to the normal magnetised lower part of the Gauss magnetochron, confirmed by a fission track date of  $3.14 \pm 0.6$  Ma (Biquand et al., 1981; Thouveny and Bonifay, 1984). It corresponds to the Triversa Faunal Unit (MN16a; Fig. 2) in the first half of the Early Villafranchian Land Mammal Age.

## 3. Typical species

Many studies on the fauna discovered in Viallette during the different excavations have been published in the 19th and 20th centuries but none of them has taken into account the whole collection of the Crozatier Museum. In many papers some species, such as *Machairodus* sp. and *Capra* sp. (Boule, 1892), *Gazellospira torticornis* (Guérin, 1965) and *Homotherium crenatidens* (Guérin, 1972) were cited without any further details and disappeared from the later faunal lists. The last complete listing was given by Heintz et al. (1974), but some of the species cited in this work are not present in the collection of Le Puy-en-Velay, and we begin with those.

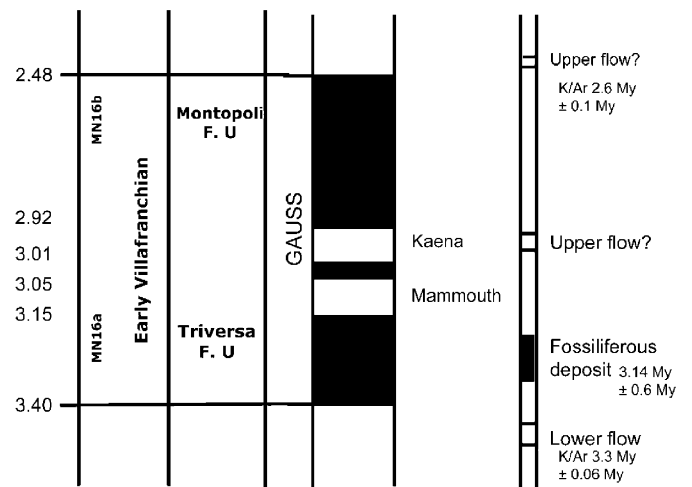


Fig. 2. Geochronology, magnetostratigraphy, chronostratigraphy and biochronology (Mammal Age and Faunal Unit) of the Middle Pliocene locality of Viallette.

### 3.1. Material in other collections

- The presence of '*Dolichopithecus arvernensis*' is based on a primate molar found in the collection of the Naturhistorisches Museum, Basel (NHMB), and identified by Heintz et al. (1974). However, the attribution of this primate should be used carefully and requires a revision, since the authors admit that the molar features are very different from those seen in *Paradolichopithecus arvernensis* from Senèze, and we suggest allocation simply to Primates indet.
- *Agriotherium* sp. was described and figured by Helbing (1932) based on one upper M2 stored in the NHMB.
- One single canine stored in the collection at the NHMB (Heintz et al., 1974) has been recently attributed to *Ursus* gr. *minimus-thibetanus* (Wagner, 2006). It was previously assigned to *Ursus etruscus* by Heintz et al. (1974).
- Two specimens, a tooth and a calcaneus, stored respectively in the Museum national d'Histoire naturelle de Paris (MNHN) and in the University of Sciences of

Lyon (FSL) are attributed by Heintz et al. (1974) to *Pliotragus ardei* or *Gallogoral meneghini*.

- Two remains stored in the NHMB are attributed by Heintz (1967, 1970), with reservations to *Procapreolus cusanus*.

### 3.2. Crozatier Museum specimens

#### 3.2.1. *Pliocrocuta perrieri*

It is represented by three specimens: a fragmented maxilla with P1 and P2 (2003-5-374-VIA), a semi-complete ulna (2003-5-545-VIA) and a complete second metacarpal (2003-5-1455-VIA). Two lower teeth are also recorded by Heintz et al. (1974) from the collections of the Guimet Museum of Lyon (MGL). The occurrence of a hyena in Vialette was reported by Depéret et al. (1823) as *Hyaena vialetti* (nomen nudum, created by Aymard) and by Guérin as *Hyaena arvernensis* (Boule, 1892; Guérin, 1972), now considered as synonyms of *P. perrieri* (discussion on the nomenclature in Werdelin and Solounias, 1991). This hyena, close to the living brown hyena (Turner, 1990), shows morphological differences (e.g. the maximal breadth of the upper P2 is distal in *P. perrieri* whereas it is in a mesial location in *Pachycrocuta brevirostris*) and is smaller and more slender than the widespread Eurasian latest Pliocene and Early Pleistocene *P. brevirostris* (Turner and Antón, 1996). The occurrence of *P. perrieri* at Vialette is one of the first occurrences of this species in Western Europe, where it held the role of large bone destroyer until being replaced by *P. brevirostris* in the Early Pleistocene (Turner, 1995).

#### 3.2.2. *Lynx issiodorensis*

The only two remains known, so far, of this species from Vialette are a mandible with P3 and P4 (2003-5-407-VIA) and a lower canine (2003-5-406-VIA). On the lower P3 the paraconid is not well developed and the protoconid is spearlike while the talonid carries a developed central cuspid. The lower P4 shows a developed paraconid, a spearlike protoconid and an elongated talonid. This felid, occurring from the Early Pliocene (MN 14; Agustí et al., 2001a, b) to the Early Pleistocene, is larger than the Pleistocene *Lynx spelaeus*. We note that a recent paper Morales et al. (2003) describes a new species of small- to middle-sized felid from the Early Pliocene site of Layna (Spain), and call it *Caracal depereti*. In the same paper, these authors also include all the Plio-Pleistocene material ascribed to the species *L. issiodorensis* in the genus *Caracal*, and classify it as *C. issiodorensis*.

#### 3.2.3. *Mammuth borsoni* and *Anancus arvernensis*

Both species of ‘mastodonts’ are found together at Vialette. This is a common association of the Early Pliocene of Europe but it is much less frequent in the Middle Pliocene. This association of *M. borsoni* plus

*A. arvernensis* is one of the last known, in Europe, before the extinction of *M. borsoni* at the end of the Triversa Faunal Unit, possibly linked to the climatic cooling and the withdrawal of forested habitat. *A. arvernensis*, on the other hand, survived in Europe until the end of the Pliocene (Palombo and Ferretti, 2005). The mammutid molars from Vialette are characterised by a broad crown, a high loph(id) base, and a weak pretrite central conule (crescentoid crests), all diagnostic features of *M. borsoni* (Tassy, 1985). The size of the molars is also comparable to that of specimens from the type locality. A noteworthy feature of the studied sample is the occurrence of an atlas, given that this element is poorly known in *M. borsoni*. The Vialette atlas resembles that of *M. americanum* in having a thick and dorsally convex neural arch, differing in this respect from the gomphothere *A. arvernensis* that possesses a more slender and flat arch. Two nearly complete lower third molars (2003-5-756-VIA and 2003-5-755-VIA) of *A. arvernensis* are formed by five lophids and a posterior heel. Alternation of pretrite and posttrite half-lophids is marked and the cement is poorly developed, and the morphology and size of the teeth are well within the range of variability of the species. The remainder of the material is also fully comparable with that known from Pliocene *A. arvernensis* samples from Europe.

#### 3.2.4. *Stephanorhinus jeanvireti*

Vialette is the type locality of this species (Guérin, 1972). The holotype is stored in the Basel museum. *Stephanorhinus elatus*, created by Croizet and Jobert (1828) is also used in recent papers but without any proper and detailed clarification of the nomenclature we will use *S. jeanvireti*, species recognised by the ICZN. This species, a slender, medium- to large-sized rhinoceros, is only found, so far, in the MN16 of Europe. It shows primitive features, such as developed premolars, and could, based on morphology and proportions, be a possible relative of the Early Pleistocene *Stephanorhinus hundsheimensis* (Fortelius et al., 1993; Lacombat, 2005a).

#### 3.2.5. *Tapirus arvernensis*

It is one of the most common species at Vialette. This is a small and slender tapir characteristic of the Ruscinian and the Early Villafranchian. The species is also reported in few Late Pliocene localities such as Le Coupet (Haute-Loire, France), but without any certainty about the stratigraphic position regarding the main fossiliferous layer dated around ~2 Ma, Heintz et al. (1974) and Tegelen in the Netherlands (Guérin and Einsenmann, 1982; Azzaroli et al., 1988; Rustioni et al., 1995) but in fact the latter remains come from Maalbeek which is correlated to the Early Villafranchian (Braber et al., 1999; Kolfsochten, 2001). This species is well adapted to a closed and humid environment, as shown by its typical morphology with slender long bones with broad and concave articulations. The teeth show also primitive features like

the size of the premolars which are quite similar to the size of the molars.

3.2.6. ‘*Cervus*’ *pardinensis*

It is the most frequently occurring taxon in Vialette, although the generic assignation of this species, and the question of allocation to either *Pseudodama* or *Metacervoceros*, is the topic of controversy (see Azzaroli, 1992; Valli, 2001; Di Stefano and Petronio, 2002; Croitor, 2006). We will simply follow the nomenclature of Heintz (1970) and use the genus ‘*Cervus*’ s. l. This cervid is characterised by a three-tined antler with a basal tine near to the burr and a broad and developed cingulum that spreads all around the collar of the lower and upper teeth. All the upper premolars possess a postero-lingual wing which is, in comparison with specimens from younger localities (e.g. St Vallier [Valli, 2001] or Étouaires [Poidevin et al., 1984; Pastre, 2004]), considered as a primitive character (Valli and Lacombat, 2005) and all the lower P4 are unmolarised.

3.2.7. *Croizetoceros ramosus*

It is a small-sized cervid showing a circular section of its antler with a high basal tine. The cingulum of the teeth is reduced but present. The population of *Croizetoceros* from Vialette shows primitive characters such as the early stage of molarisation of the lower P4, usually completely molarised in the Middle Villafranchian populations (Valli, 2005). This species (divided into several subspecies by Heintz, 1970) occurs over the whole Early and Middle Villafranchian time span.

4. New results from the Crozatier collection

4.1. *Canis* sp.

Members of this genus are generally considered to make their first appearance in Europe in the Late Pliocene (Martinez-Navarro and Rook, 2003). However, Heintz et al. (1974), in their revision of the Villafranchian of France, pointed out a potential presence of *Canis* in Vialette without any description or picture of the remains and attributed the ‘probable’ canid of Vialette to *Canis* aff. *etruscus*. We accept that the genus *Canis* is present at Vialette and identify six remains (2003-5-401-VIA: a mandible with M1 and M2 [Fig. 3], 2003-5-402-VIA: a mandible with P3, 2003-5-403-VIA a mandible with CP1P2P3P4 [Fig. 3], 2003-5-404-VIA: a lower I2, 2003-5-405-VIA: a lower I3 and 2003-5-541-VIA: a tibia). The morphology, the size and the proportions of these remains allow us to exclude genera occurring in the Early Pliocene, such as *Eucyon* as well as the very common racoon dog *Nyctereutes* (Monguillon, 2005). This is therefore probably the earliest occurrence of the genus *Canis* in Europe, although at this stage we refrain from an allocation to species.

4.2. *Equus* sp.

*Equus stenorhis* was reported at Vialette by Bout (1960), based on three specimens in the NHMB, but this was rejected by Heintz (1970) and Heintz et al. (1974). However, three equid remains (2003-5-689-VIA—a complete

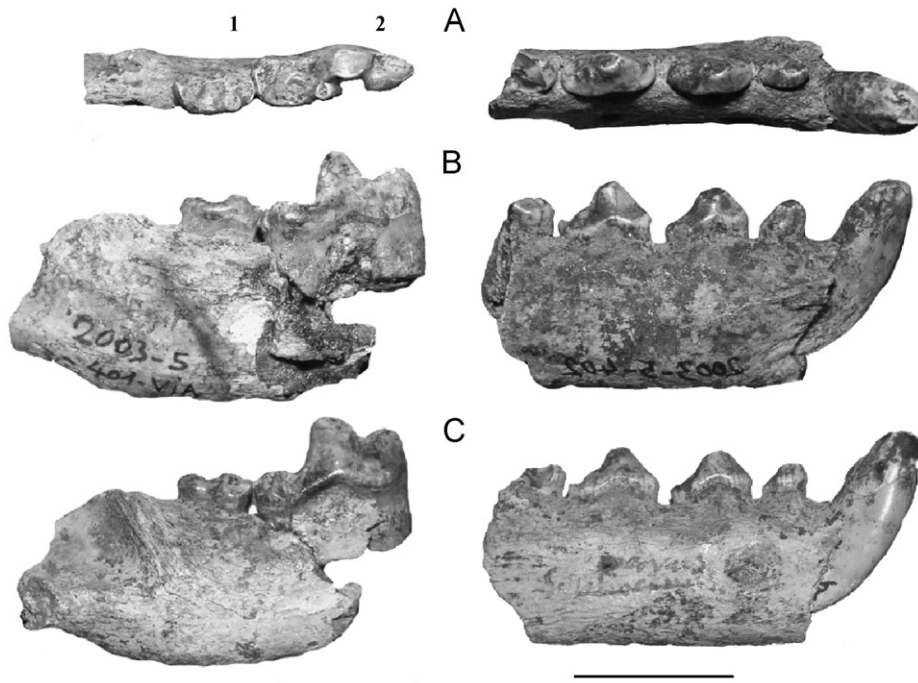


Fig. 3. *Canis* sp. of Vialette—1: Mandible with M1 and M2 (2003-5-401-VIA), 2: Mandible with C, P1, P2, P3 and P4 (2003-5-403-VIA); (A) occlusal view, (B) lingual view, and (C) buccal view. Scale = 2 cm.

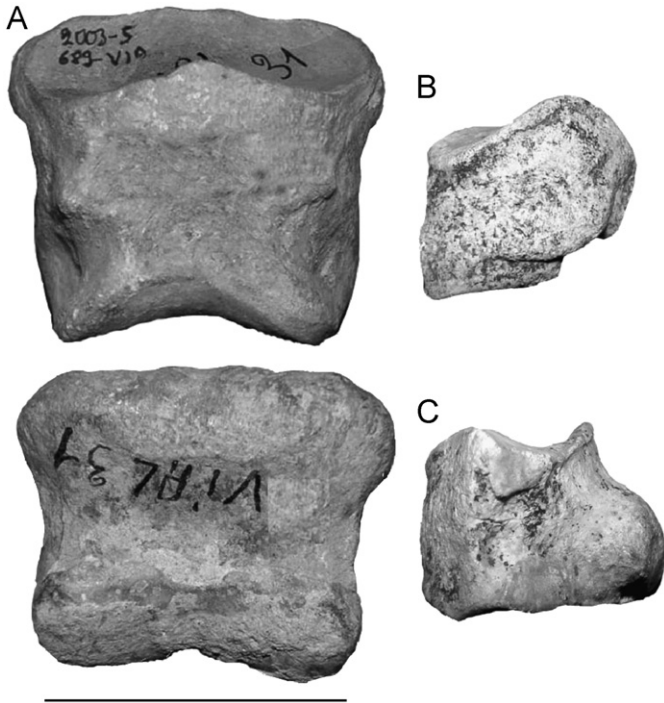


Fig. 4. *Equus* sp. of Vielette—(A) 2nd phalange (2003-5-689-VIA) caudal and cranial view, (B) lateral view of the pyramidal (2003-5-973-VIA), and (C) lateral view of the lunatum (2003-5-975-VIA). Scale = 5 cm.

second phalange; 2003-5-973-VIA—a pyramidal and 2003-5-975-VIA—a lunatum; Fig. 4) in the Crozatier Museum collection labelled in the 19th century as coming from the site were found to have the peculiar Vielette fossilisation and are attributed here to *Equus* sp. The first appearance of *Equus* in Western Europe, *Equus livenzovenssis*, is quoted near 2.5 Ma (Azzaroli et al., 1988; Rustioni et al., 1995; Alberdi et al., 1998; Agusti and Oms, 2001), but it is also cited as *Equus* sp. in Eastern Europe: in Romania (Groserea and Covrigi, MN16a, Samson, 1975; Radulescu and Samson, 2001; Radulescu et al., 2003), in Lebyash'e 1 and Esekartkan (MN16a, Kazakhstan, Vislobokova et al., 2001; Vislobokova, 2005) and in France: Crouzas (Haute-Loire; MN16a, Lacombat, 2005b). We can now confirm that the genus *Equus* was present in the Early Villafranchian in Western Europe. Unfortunately, these remains are not enough to allow a specific attribution, despite the fact that the size of the second phalange (2003-5-689-VIA) is one of the largest when compared with the data on stenoid horses of Prat (1980), and is in agreement with the large size of the earliest forms of *Equus* in Europe (Alberdi et al., 1998).

#### 4.3. *Gazella* cf. *Gazella borbonica*

An upper M3 (2003-5-1000-VIA; Fig. 5), attributed to *Gazella*, shows convergent labial and vestibular outlines. A small development of the sharp mesostyle and a rounded parastyle and the absence of an anterior fold are typical of *G. borbonica*. The small size of the specimen and its



Fig. 5. *Gazella* cf. *borbonica* of Vielette. Upper M3 (2003-5-1000-VIA), occlusal, buccal and lingual view.

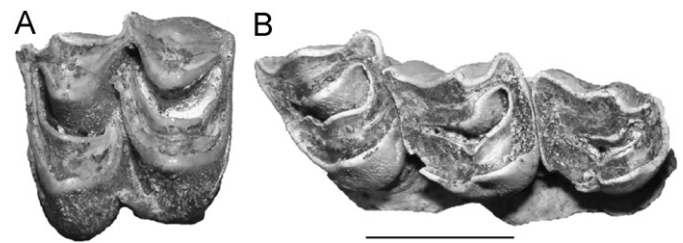


Fig. 6. cf. *Eucladoceros* of Vielette. Occlusal view of: (A) upper M2 (2003-5-1097-VIA); and (B) Maxilla with P2, P3 and P4 (2003-5-343-VIA). Scale = 3 cm.

morphology, easily distinguish it from larger bovids such as the goral *G. meneghini*, *P. ardei* or *Gazellospira torticornis* (Guérin, 1965; Heintz, 1966). Even if *G. borbonica* occurs in the Ruscinian (Heintz, 1969, 1975; Aguirre and Morales, 1990; Kostopoulos and Athanassiou, 1997), this is the first citation of the species in Vielette.

#### 4.4. cf. *Eucladoceros* sp.

The scanty large cervid remains from Vielette only allow us to attribute them to a form of cf. *Eucladoceros*. Only two specimens of large cervid from the site have been previously described in the collection of the NHMB and Natural History Museum of London (NHM) by Heintz (1967, 1970), who suggested that they might be either '*Cervus* perrieri or *Arvernoceros ardei*. The size of the large

cervid specimens from Vialette (30% bigger than '*Cervus perrieri*') rules out the former species and the morphology of the teeth (without any developed cingulum; Fig. 6) allow us to exclude *A. ardei* as well, whereas both features correspond to *Eucladoceros* (Valli et al., 2005). If this generic attribution is confirmed, the collection from Vialette, with 20 specimens, represents one of the earliest occurrences of the genus *Eucladoceros* in Europe.

## 5. Discussion

The material from Vialette provides the earliest known European occurrences of *Canis*, of the genus *Equus* and, possibly, of the genus *Eucladoceros*, and establishes the lowest appearances of two and perhaps all three of these genera in the Early Villafranchian. The Crozatier Museum collection is also now seen to contain *Gazella* cf. *G. borbonica*. These results therefore carry new biochronological and paleoecological implications.

The first occurrence of *Eucladoceros* in Western Europe has conventionally been taken to be in the second half of the Early Villafranchian in the Montopoli Faunal Unit (Italy; MN16b, Azzaroli et al., 1988; Gliozzi et al., 1997; Palombo, 2005) dated near 2.5 Ma. However, an earlier record of this genus is demonstrated in Kvabeby (Georgia; MN16a, Vekua, 1972; Hemmer et al., 2004; Vekua et al., 2005; Vislobokova, 2005) in the Eastern part of Europe. A similar time difference in recorded appearance is true for the genus *Equus*, again recorded in the Montopoli Faunal Unit (Lindsay et al., 1980; Azzaroli et al., 1988; Rustioni et al., 1995; Alberdi et al., 1998; Agusti and Oms, 2001). However early occurrences of *Equus* sp. in Groserea and Covrigi (Romania; MN16a, Samson, 1975; Radulescu and Samson, 2001; Radulescu et al., 2003) together with *M. borsoni*, *A. arvernensis*, *S. jeanvireti* and *C. pardinensis* among others, showing a perfect correlation with Vialette, and in Lebyash'e 1 and Esekartkan (MN16a, Kazakhstan, Vislobokova et al., 2001; Vislobokova, 2005), have been clearly demonstrated.

The record of one of the first unequivocal *Canis* occurrences in Vialette (so far, in the Early Villafranchian, *Canis* sp. is only cited in Kvabeby [Georgia; Hemmer et al., 2004] but is considered as doubtful for Spassov and Rook, 2006) is an isolated appearance of this genus in the Early Villafranchian of Europe. However, other occurrences are reported in the Middle Villafranchian and at the end of the Pliocene (Martinez-Navarro and Rook, 2003; Arribas et al., 2004; Palombo, 2005; Sardella and Palombo, 2007), confirming that the so-called 'Wolf Event' (Azzaroli, 1983; Azzaroli et al., 1988; Rook and Torre, 1996) was already completed before the beginning of the Pleistocene (see Sardella and Palombo, 2007, for a discussion).

The climatic degradation that reduced the 'pre-Villafranchian' forest (Méon-Vilain, 1972; Suc et al., 1995; Azanza et al., 2004; Palombo, 2004 and references therein), the typical biotope of some of the species recorded at Vialette such as *M. borsoni* and *T. arvernensis* (Azzaroli

et al., 1988; Gliozzi et al., 1997), is underlined by the occurrence of *Equus* sp. and *Gazella* cf. *G. borbonica*. These two species are likely to have preferred dryer conditions and a more open landscape of the kind indicated by the aridity peak signalled at 3.2 Ma by Shackleton et al. (1984), Shackleton (1995) and Agusti et al. (2001a, b) among others.

Based on definition of the Italian Faunal Units (Azzaroli, 1977), Vialette can be correlated to the Triversa Faunal Unit (MN16a). This Unit is characterised by an important faunal turnover where survivors of the Ruscinian (*Agriotherium* sp., *L. issiodorensis*, *A. arvernensis*, *M. borsoni*, *T. arvernensis*) are found together with newcomers showing more advanced features (*P. perrieri*, *C. pardinensis*, *S. jeanvireti*; Azzaroli et al., 1988). The first appearance of *Leptobos* (the '*Leptobos* event' of Azzaroli et al., 1988), *Acinonyx*, *Megantereon* and *Homotherium* are also a part of the definition of this Faunal Unit (Gliozzi et al., 1997). These later species are not found, so far, in Vialette. However, we have demonstrated that *Canis*, *Equus* and cf. *Eucladoceros* occur not only in this locality but also in several other sites in Europe and they should therefore also be included in the characterisation of the Triversa Faunal Unit.

## 6. Conclusion

The fauna of Vialette is a well-dated Early Villafranchian (MN16a, Triversa FU) assemblage showing a mixture of taxa inhabiting different environments. A number of species, notably forest dwellers such as *M. borsoni* and *T. arvernensis*, were present in the Early Pliocene or earlier, and some of them make among their last appearances here, presumably unable to survive the cooling of the climate and the progressive dismantling of the forest habitat that followed. Other, perhaps more tolerant species, such as *A. arvernensis* survived, while others such as *P. perrieri*, *S. jeanvireti* and *C. pardinensis* appeared at the beginning of the Early Villafranchian and are characteristic of this time slice. Among these latter taxa some newcomers, such as *Canis*, *Equus* and *Eucladoceros*, were previously considered to appear later in the Middle Villafranchian (MN16b, Montopoli FU) or even later. This assemblage therefore shows an almost perfect and consistent picture of the cooling of the climate that occurs during this period underlined by the presence of taxa inhabiting or preferring more or less open environments such as *Equus* and *Gazella*.

The following revised faunal list is here proposed for the Vialette site: Primates indet., *Agriotherium* sp., *Ursus* gr. *minimus-thibetanus*, *Canis* sp., *P. perrieri*, *L. issiodorensis*, *M. borsoni*, *A. arvernensis*, *S. jeanvireti*, *Equus* sp., *T. arvernensis*, Bovidae middle-sized (?*P. ardei* or ?*G. meneghini*), *Gazella* cf. *G. borbonica*, cf. *Eucladoceros* sp., *C. pardinensis*, ?*Procapreolus cusanus* and *C. ramosus*. Moreover, *Equus*, *Canis* and, perhaps, *Eucladoceros* might be added to the early Villafranchian faunal complex.

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