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Short Communication

Sciurids (Rodentia, Mammalia) from Höll (Middle Miocene, Bavaria)

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The locality Höll is exceptional because of its location at the southernmost margin of the Upper Freshwater Molasse (Fig. 1A). It is exposed along the Argen stream, to the west of the Höll farm near Gestratz, southwest of Isny (TK 25: Blatt 8325 Wangen in Allgäu Ost; R.357210, H.527905; Scholz 1986). The vertebrate fauna consists of reptiles, birds and large mammals (Scholz 1986). The diversified small-mammal assemblage comprises marsupials, Erinaceomorpha, Soricomorpha, pikas and the cricetid rodents, including rare taxa such as *Karydomys* (Prieto & Scholz, 2013). The locality is preliminary correlated to the local unit OSM F (Fig. 1B; Prieto & Scholz 2013, Prieto & Rummel 2016).

Among the small mammals, the squirrels are a rarity in Höll, and only four fossils are available to science. In sharp contrast, the species diversity is relatively high and at least three species are recognized. All of them belong to the tribes Marmotini Pomel, 1853 and Xerini Murray, 1866.

The species *Palaeosciurus sutteri* Ziegler & Fahlbusch, 1986 is documented by a right fragmentary mandible with p4-m1 (measurements, see Fig. 1 C; all measures are given in mm): p4: L1: 1.92-L2: 2.09 x W1: 1.83-W2: 1.69; m1: L1: 2.26-L2: 2.35xW1: 2.41-W2: 2.25; Fig. 2A). Both teeth which show the morphological characters of *P. sutteri* (see Ziegler & Fahlbusch (1986) and Ziegler (2005) for details). In addition, a m2? (Fig. 2B; L1: 2.55-L2: 2.91xW1: 3.57-W2: 2.83) is characterized by its large size, especially in width, and a very high metaconid. The mesoconid is strong and the entoconid small. Ginsburg & Mein (2012) report a large indeterminate sciurid from Sansan, but the species is only represented by a single p4, and thus the comparison with Höll is not possible. The monospecific genus *Lagrivea* from La Grive does not have m2 with enlarged width (Mein & Ginsburg 2002: fig. 17). Although some doubt remain concerning the taxonomical assignment of this lower molar, we consider at present that it is an aberrant *Palaeosciurus sutteri* specimen.

The second species, *Heteroxerus* aff. *rubricati* Crusafont, Villalta & Truyols, 1955, is present at Höll with a left mandible fragment with p4-m3 (Fig. 2C; p4: L1: 1.39-L2: 1.48 x W1: 1.34-W2: 1.27; m1: L1: 1.68-L2: 1.74 x W1: 1.72-W2: 1.58; m2: L1: 1.77-L2: 1.90xW1: 2.03-W2: 1.75; m3: L1: 1.66-L2: 1.82 x W1: 1.75- W2: 1.65). On the p4, the anterior wall of the protoconid is outlined by a plunging crest. On m1-m3, this crest is well expressed and connects to the anteroconulid. The m1 anterior cingulum is broad, but relatively short. It ends abruptly. In contrast, on the m2, the crest descends more regularly and is thus longer. It ends somewhat at the half of the height of the anterior wall of the protoconid. The m3 shows only a thin anterior cingulid running along the anterior wall of the anteroconulid. The metalophid is variable in morphology along the dental elements: in the p4 it is high and continuous, while a thin interruption is observed in the m1. The crest is completely interrupted in the m2, but already continuous when dealing with the last molar. Similarly, the entolophid is better developed in the p4 and m1 where it is a broad crest connecting the rounded entoconid to the hypoconulid. The m2 shows a light thickening of the crest shortly before the hypoconulid, and the m3 the connection is not achieved. In all teeth but the m3, the posterolophid does not reach the ento-

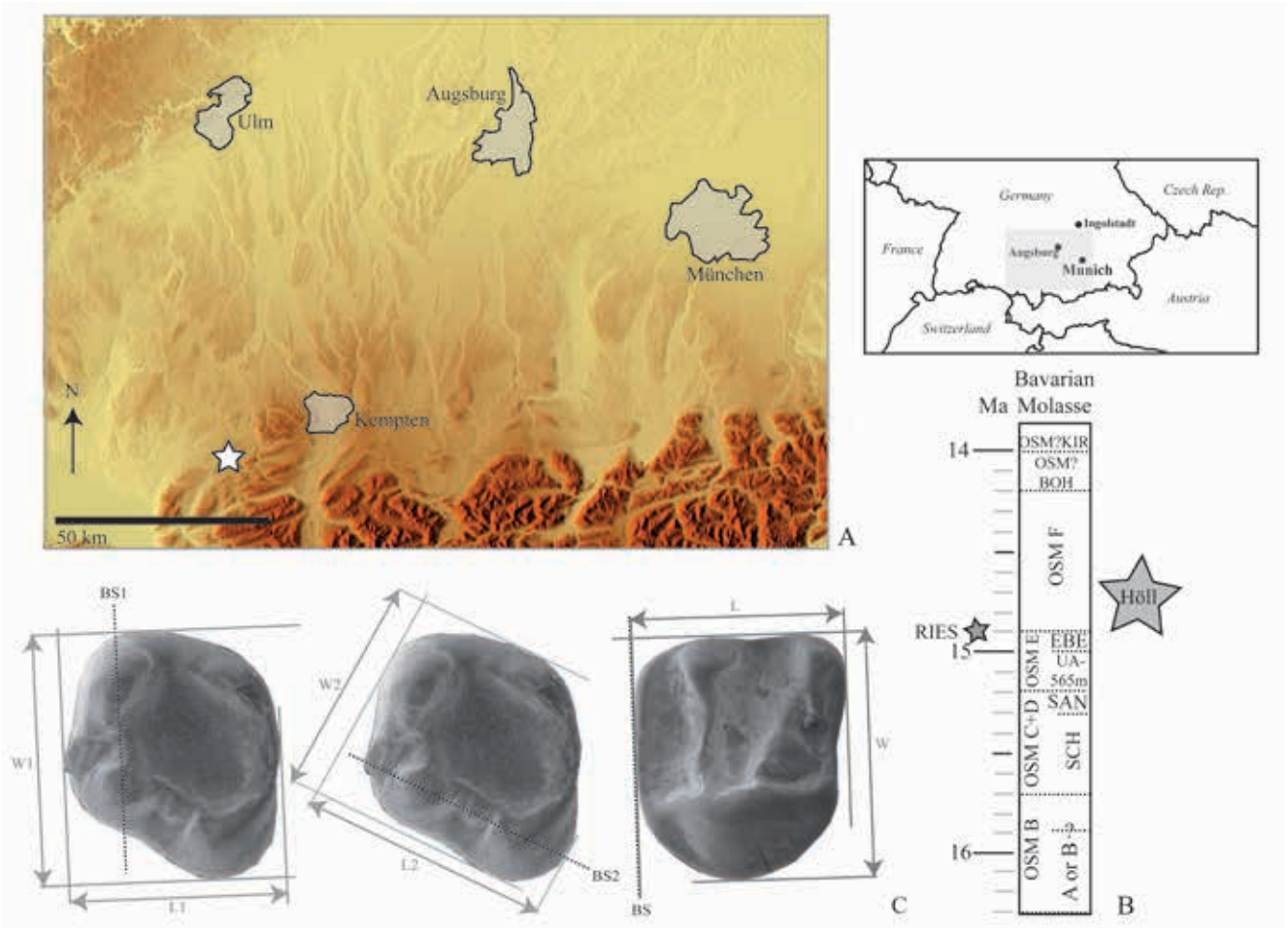

Figure 1: **(A)** Geographic situation of the fossil site Höll (star). **(B)** Preliminary chronostratigraphic position of Höll (after Prieto & Rummel 2016). **(C)** Measurement methods applied to the Sciurids.

conid. A crest is always present between metaconid and entoconid and, in spite of the development of a cingulid, the sinus is never completely closed. The validity of *Heteroxerus huerzeleri* is a matter of debates. While Kälin (1993) and De Bruijn (1999) still consider *H. huerzeleri* to represent a valid species, Ziegler (2005: 295) in contrast follows Cuenca Bescós (1988: 33, 54) and considers the species as junior synonym of *H. grivensis*. In addition, in her work on the sciurids of the Ramblian and Aragonian of the Calatayud-Montalbán basin, Cuenca Bescós considers the *Heteroxerus* remains from Vieux-Collonges (originally assigned to *H. huerzeleri* by Stehlin & Schaub (1951)) as to belonging to *H. rubricati*. The main argumentation allowing Ziegler (2005) to justify the synonymy is, beside the interruption of the metalophid in m1, the close biostratigraphic correlation of La Grive and Vermes 2. Preliminary studies on *Heteroxerus* (in progress by both two first authors) tend to show different evolutionary pathway between the Iberian Peninsula and Central Europe. Hence, it is preferred in this paper to consider *H. huerzeleri* as valid species but further investigation is needed. However, Ziegler (2005: 295-296) discusses intensively the assignment of some *Heteroxerus* samples from the lower and middle Miocene from Germany. While a revision of these forms is in progress but not achieved, we prefer to follow this author regarding the Bavarian collections and refer similar species from the North Alpine Foreland Basin to *H.* aff. *rubricati*.

Finally, the third species, *Spermophilinus besana* Cuenca, 1988 (Fig. 2D), is a common taxon of the Upper Freshwater Molasse. Kretzoi & Fejfar (2005: 117) intensively discussed the synonymy *Spermophilinus-Csakvaromys* Kretzoi, 1951. Like in Hír et al. (2011: appendix), this synonymy is herein not followed because, we did not see the original material of *Csakvaromys.* In addition, all studies based on sciurid material from the Miocene of the North Alpine Foreland Basin use the term *Spermophilinus*. Therefore, in order to homogenise and to clarify the understanding of fossil record of these forms in this and in the surrounding areas, we continue to recognize *Spermophilinus,* and follow thus the point of view of De Bruijn and Bosma (2012). Ruiz-Sánchez et al. (2013: 142) comment the changing of the original naming of the species, *Spermophilinus besana*, into *S. besanus* by several authors. They conclude that "besana" derives from the Spanish substantive and thus valid as such. The specimen from Höll is excep-

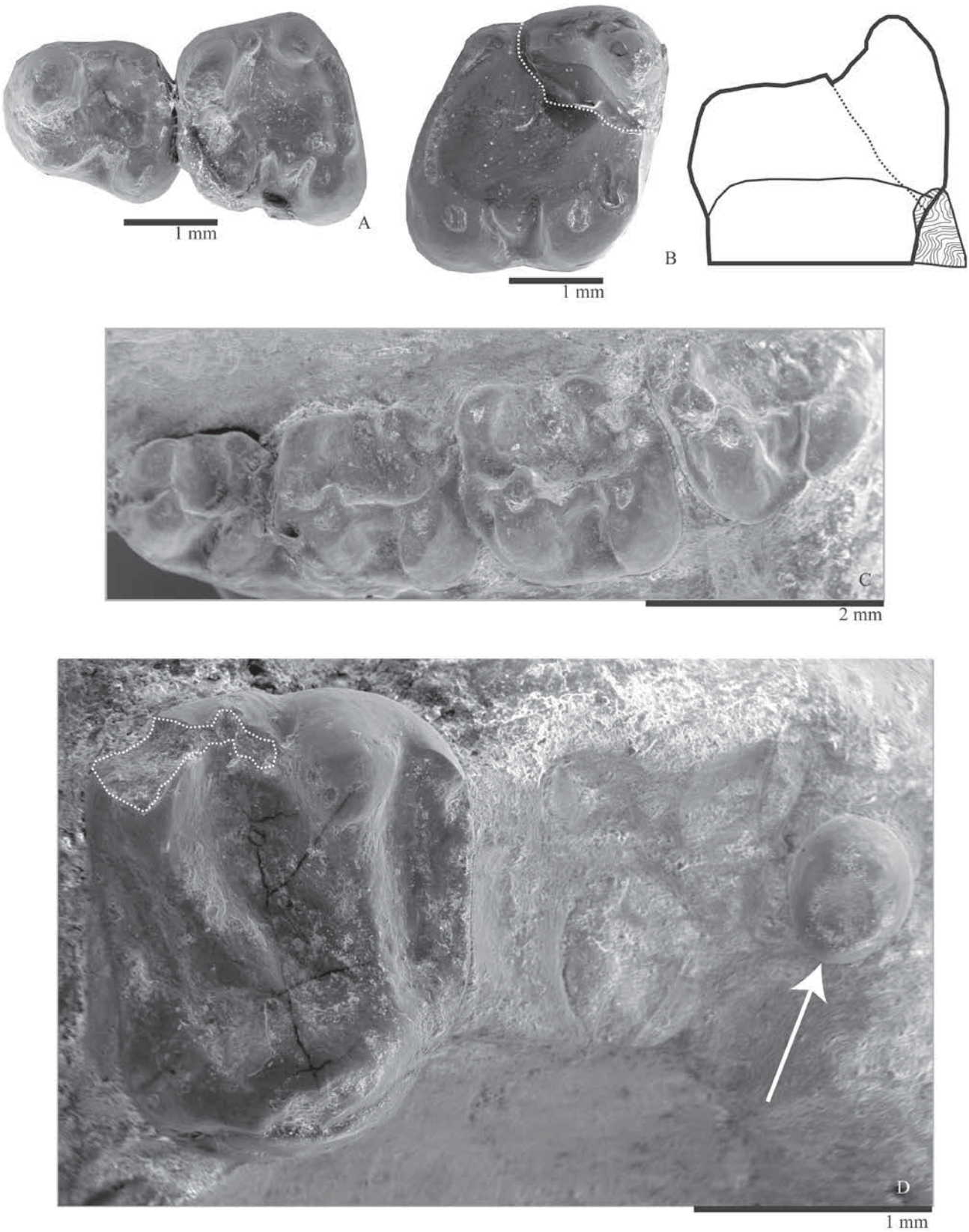

Figure 2: **(A)** *Palaeosciurus sutteri* Ziegler & Fahlbusch, 1986; left mandible fragment with p4-m3. **(B)** ?*P. sutteri*; right m1 (left: occlusal view; right: drawing from anterior view showing the high metaconid). **(C)** *Heteroxerus* aff. *rubricati* Crusafont, Villalta & Truyols, 1955: left mandible fragment with p4-m3. **(D)** *Spermophilinus besana* Cuenca, 1988: right maxillary fragment with P3 (arrow) and M1.

tional because it preserves the P3 (Fig. 2D, arrow), a tooth rarely documented in the fossil record of the genus. The right maxillary fragment with P3 and M1 (M1: L: 1.60 x W:~1.95) Is imbedded in sediment.

The molar shows the typical characteristic of *Spermophilinus*. In size, the M1 falls within the range of the M1,2 molar collection from Sandelzhausen, the most common sciurid of the locality (Ziegler 2005). Originally most of the Early and Middle Miocene *Spermophilinus* samples from the Upper Freshwater Molasse were assigned to *S.* aff. *bredai* (older and middle series) or *S. bredai* for the younger series (e.g., Ziegler and Fahlbusch 1986, Kälin 1993). Ziegler (2005) follows De Bruijn (1995) and considers the smaller species of the older and middle series to belong to *S. besana*.

Evidences of the presence of a P3 by *Spermophilinus* are rarities. Forsyth Major (1893: 191) indicates that a minute alveole anterior to P4 exists by *Sciurus spermophilinus*, unfortunately not visible on the Plate X, fig. 4. De Bruijn & Mein (1968: Plate II, figs. 11a, 11b) figure a fragmentary skull of *S. bredai* from La Grive but the presence of a P3 cannot be deduced from the drawing, nor from the text. Ginsburg & Mein (2012) report a maxillary from Sansan that still have the P3-M2, and figure one other maxilla with damage alveole of P3. The P3 is in situ in the specimen from Höll. This very small tooth is placed antero-lingually from the anterior root of the P4.

The sciurid association from Höll is, with regard to the few available fossils, relatively diverse. It completely lacks gliding forms (*Miopetaurista*, *Blackia*, etc). These taxa are generally more rare than the tree and ground squirrels in Southern Germany (see for instance Heissig 1989, 2006; Boon 1991; Ziegler 2005), and their missing in this site from Allgäu is probably the result of sampling biais.

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