



**Palaeozoological Investigations  
from the Early Miocene Lignite Opencast Mine Oberdorf  
(N Voitsberg, Styria, Austria)**

GUDRUN DAXNER-HÖCK\*)

1 Text-Figure and 2 Tables

*Styria  
Pannonian Basin  
Styrian Basin  
Lignite  
Palaeozoology  
Mammals*

*Österreichische Karte 1 : 50.000  
Blatt 163*

**Contents**

|   |     |
|---|-----|
| Zusammenfassung .....                         | 477 |
| Abstract .....                                | 477 |
| 1. Introduction .....                         | 477 |
| 2. The Vertebrate Fauna .....                 | 478 |
| 2.1. Palaeoenvironmental Interpretation ..... | 480 |
| 2.2. Biostratigraphic Results .....           | 480 |
| Acknowledgements .....                        | 480 |
| References .....                              | 480 |

**Paläozoologische Untersuchungen aus dem untermiozänen Braunkohlentagebau Oberdorf  
(N Voitsberg, Steiermark, Österreich)**

**Zusammenfassung**

Zwei Wirbeltierfaunen aus den basalen Bereichen von zwei Lignitlagen (O3 und O4) aus der Hangendabfolge von Oberdorf sind in Zusammensetzung und Entwicklungsgrad der Wirbeltiere fast ident. Deshalb werden die beiden Fossilhorizonte als zeitgleich angesehen, und die Faunen als eine Einheit behandelt. Sie umfassen zusammen 56 Säugetierarten und über 30 Arten von Amphibien, Reptilien und Vögeln. Nagetiere und Insektenfresser dominieren unter den Säugetieren. Die Wirbeltiere repräsentieren fast ausschließlich Waldbewohner. Die Säugetiere ergeben eine zeitliche Einstufung in die Säugetierzone MN4 des Unter-Miozäns.

**Abstract**

The two vertebrate faunas from the basal parts of two lignite-bearing layers (O3 and O4) of the hanging wall sequence in Oberdorf are almost identical in their compositions and stage of vertebrate evolution. These two horizons are therefore treated as one contemporaneous vertebrate unit. Together they contain 56 species of mammals and more than 30 species of amphibians, reptiles and birds. Rodents and insectivores dominate among the mammals. The recorded vertebrates represent almost exclusively inhabitants of forest biotopes. The mammals indicate an Early Miocene age, Mammal-Zone MN4.

**1. Introduction**

In the course of project "Kleinsäugetiere" of the Geological Survey Vienna, palaeozoological investigations in the opencast mine Oberdorf were carried out by Dr. Hans DE BRUIJN (Utrecht) and the author from 1989 to 1993. These activities were continued from 1995 to 1997, supported by the FWF-project P-10338-GEO.

The Oberdorf basin is situated in the northwestern part of the Styrian Basin. It is divided into a western and an

eastern subbasin. Although palaeozoological prospectings were done in both areas, the findings of vertebrate fossils were restricted to the hanging wall sediments of the eastern subbasin. The fossils were concentrated in carbonaceous clay sediments and silts at the basal parts of two lignite-bearing layers (O3 and O4; see standardprofile: meter 100 and 110 in DAXNER-HÖCK et al. [1998a, Text-Fig. 5] and HAAS et al. [Text-Fig. 3, this volume]). Besides

\*) Author's adress: GUDRUN DAXNER-HÖCK: Geological-Palaeontological Department, Natural History Museum, Burgring 7; A-1014 Vienna, Austria.

plant and gastropod remains, the fossil content was rich in small mammal teeth and various small vertebrate bones. Jaws and skull fragments of small vertebrates occurred sporadically along with large mammal remains. No articulated skeletons were found. After washing equal quantities of coal-bearing clay from the two horizons (1.5 tons each) the fossil content was three times higher in O4 than in O3. These differences are interpreted as the result of different sampling methods (DAXNER-HÖCK et al., 1998a).

Gastropods are recorded from various horizons of the hanging wall but their study remains to be completed.

## 2. The Vertebrate Fauna

The vertebrate fauna is rich in amphibians, lizards, snakes and small mammals, while large mammals and birds are only represented by a few fossils. These recently collected fossils have been studied and published by an international team of specialists. The results are summarized in short comments and the following faunal list (see also DAXNER-HÖCK et al., 1998).

Table 1.  
List of recently collected vertebrates from the two fossil horizons O3 and O4 in the opencast mine of Oberdorf. In parenthesis the contributors' names.  
Vertebrates from old collections (see MÖTTL, 1970) from the Köflach-Voitsberg region are not included.

| Vertebrate fauna from Oberdorf       | O3 | O4 |
|--------------------------------------|----|----|
| <b>AMPHIBIA</b> (see SANCHIZ 1998)   |    |    |
| Allocaudata                          |    |    |
| Albanerpetontidae                    |    |    |
| <i>Albanerpeton inexpectatum</i>     | x  | x  |
| Caudata                              |    |    |
| Salamandridae                        |    |    |
| <i>Chelotriton</i> sp.               | x  | x  |
| cf. <i>Chioglossa</i>                |    | x  |
| <i>Salamandra sansaniensis</i>       | x  | x  |
| <i>Triturus roehrsi</i>              | x  | x  |
| Salamandridae indet.                 | x  | x  |
| Anura                                |    |    |
| Discoglossidae                       |    |    |
| <i>Latonia ragei</i>                 | x  | x  |
| Palaeobatrachidae                    |    |    |
| <i>Palaeobatrachus</i> sp.           | x  | x  |
| Pelodytidae                          |    |    |
| <i>Pelodytes</i> sp.                 | x  | x  |
| Hylidae                              |    |    |
| <i>Hyla</i> sp.                      |    | x  |
| Ranidae                              |    |    |
| <i>Rana (ridibunda)</i> sp.          | x  | x  |
| Anura indet.                         | x  | x  |
| <b>REPTILIA</b>                      |    |    |
| Serpentes (see SZYNDLAR 1998)        |    |    |
| Boidae                               |    |    |
| cf. <i>Bavarioboa</i> sp.            |    | x  |
| Colubridae                           |    |    |
| <i>Coluber</i> cf. <i>caspioides</i> | x  | x  |
| <i>Palaeonatrix</i> sp.              |    | x  |
| cf. <i>Neonatrix</i> sp.             |    | x  |
| Colubridae indet. A                  |    | x  |
| Colubridae indet. B                  |    | x  |
| Natricinae or Elapidae indet.        |    | x  |
| Viperidae                            |    |    |
| <i>Vipera</i> sp.                    | x  | x  |
| Serpentes indet.                     | x  | x  |
| <b>Aves</b> (see MLIKOVSKY 1998)     |    |    |
| Anatidae indet.                      |    | x  |
| Passeriformes indet.                 |    | x  |
| <b>MAMMALIA</b>                      |    |    |
| Marsupialia (see ZIEGLER 1998)       |    |    |
| Didelphidae                          |    |    |
| <i>Amphiperatherium frequens</i>     | x  | x  |
| Insectivora (see ZIEGLER 1998)       |    |    |

|   |  |   |
|---|--|---|
| <b>Erinaceidae</b>                                      |  |   |
| <i>Galerix symeonidisi</i>                              |  | x |
| <i>Galerix aurelianus</i>                               |  | x |
| <b>Metacodontidae</b>                                   |  |   |
| <i>Plesiosorex</i> aff. <i>germanicus</i>               |  | x |
| <i>Plesiosorex</i> cf. <i>styriacus</i>                 |  | x |
| <b>Talpidae</b>   |  |   |
| <i>Desmanella</i> aff. <i>engesseri</i>                 |  | x |
| <i>Desmanodon</i> sp.                                   |  | x |
| <i>Proscapanus</i> aff. <i>sansaniensis</i>             |  | x |
| <i>Talpa minuta</i>                                     |  | x |
| <i>Myxomygale hutchisoni</i>                            |  | x |
| Talpidae gen. et sp. indet. 1                           |  | x |
| Talpidae gen. et sp. indet. 2                           |  | x |
| <b>Dimylidae</b>  |  |   |
| <i>Plesiodimylus</i> aff. <i>chantrei</i>               |  | x |
| <i>Chainodus intercedens</i>                            |  | x |
| <b>Soricidae</b>  |  |   |
| <i>Heterosorex neumayrianus</i> aff. <i>subsequens</i>  |  | x |
| <i>Miosorex</i> sp.                                     |  | x |
| <i>Lartetium</i> cf. <i>petersbuchense</i>              |  | x |
| <i>Florinia stehlini</i>                                |  | x |
| <i>Allosorex gracilidens</i>                            |  | x |
| Soricidae gen. et sp. indet.                            |  | x |
| <b>Chiroptera</b> (see ZIEGLER 1998)                    |  |   |
| Vespertilionidae  |  |   |
| Vespertilionide 1: <i>Myotis</i> aff. <i>murinoides</i> |  | x |
| Vespertilionide 2: cf. <i>Myotis antiquus</i>           |  | x |
| Vespertilionide 3+4                                     |  | x |
| Vespertilionide 5                                       |  | x |
| Rhinolophidae   |  |   |
| Rhinolophide 1: cf. <i>Rhinolophus lemanensis</i>       |  | x |
| Rhinolophide 2: cf. <i>Rhinolophus grivensis</i>        |  | x |
| Molossidae  |  |   |
| <i>Mormopterus helveticus</i>                           |  | x |
| <b>Rodentia</b>   |  |   |
| Sciuridae (see DE BRUIJN 1998)                          |  |   |
| <i>Palaeosciurus sulteri</i>                            |  | x |
| <i>Spermophilinus besanus</i>                           |  | x |
| <i>Ratufa</i> n. sp.                                    |  | x |
| Petauristidae (see DE BRUIJN 1998)                      |  |   |
| <i>Miopetaurista dehmi</i>                              |  | x |
| <i>Blackia miocaenica</i>                               |  | x |
| <i>Hylopetes hoeckarum</i> n. sp.                       |  | x |
| Gliridae (see DE BRUIJN 1998)                           |  |   |
| <i>Glis minor complicatus</i> n. ssp.                   |  | x |
| <i>Seorsumuscardinus alpinus</i> n. g. n. sp.           |  | x |
| <i>Glirudinus minutus</i>                               |  | x |
| <i>Glirulus (Glirulus) lissiensis</i>                   |  | x |
| <i>Glirulus (Paraglirulus) sp.</i>                      |  | x |
| <i>Peridyromys murinus</i>                              |  | x |
| <i>Microdyromys</i> cf. <i>legidensis</i>               |  | x |
| <i>Microdyromys</i> cf. <i>hildebrandti</i>             |  | x |
| <i>Bransatoglis fugax</i>                               |  | x |
| <i>Bransatoglis</i> cf. <i>astaracensis</i>             |  | x |
| Cricetidae (see DAXNER-HÖCK 1998a)                      |  |   |
| <i>Democricetodon gracilis</i>                          |  | x |
| <i>Eumyarion</i> aff. <i>weinfurteri</i>                |  | x |
| Anomalomyinae (see DAXNER-HÖCK 1998a)                   |  |   |
| <i>Anomalomys minor</i>                                 |  | x |
| <i>Anomalomys</i> sp.                                   |  | x |
| Platacanthomyinae (see DAXNER-HÖCK 1998a)               |  |   |
| <i>Neocometes similis</i>                               |  | x |
| Eomyidae (see DAXNER-HÖCK 1998a)                        |  |   |
| <i>Ligerimys antiquus</i>                               |  | x |
| <b>Lagomorpha</b> (see DAXNER-HÖCK 1998a)               |  |   |
| Ochotonidae   |  |   |
| <i>Prolagus</i> sp.                                     |  | x |
| <b>Artiodactyla</b>                                     |  |   |
| Tragulidae (see RÖSSNER 1998)                           |  |   |
| <i>Dorcatherium</i> sp.                                 |  | x |
| <i>Dorcatherium nawi</i>                                |  | x |
| Cervidae (see RÖSSNER 1998)                             |  |   |
| <i>Lagomeryx parvulus</i>                               |  | x |
| <i>Lagomeryx ruetimayeri</i>                            |  | x |
| <i>Procervulus dichotomus</i>                           |  | x |
| Suidae (see VAN DER MADE 1998b)                         |  |   |
| <i>Aureliachoerus minus</i>                             |  | x |
| <b>Perissodactyla</b> (see VAN DER MADE 1998a)          |  |   |
| Rhinocerotidae  |  |   |
| Rhinocerotidae indet.                                   |  | x |



Text-Fig. 1.  
Reconstruction of an Early Miocene swamp forest habitat from Oberdorf.  
In front the cervids *Lagomeryx* and *Procervulus*, the small pig *Aureliachoerus* and a rhinoceros. In the background the flying squirrel *Miopetaurista*.  
Artist: Pavel MAJOR, Prague.  
Scientific instructor: Oldřich FEJFAR, Prague

Although different in abundance of specimens, both fossil layers (O3 and O4) show an almost equal species composition representing the same stage of evolution. Therefore both faunas are considered to be coeval and are treated as one unit. While small mammals, amphibians and lizards are represented quite well in fossil remains as well as in species numbers, the record of large mammals, birds and lagomorphs is rather poor. Nevertheless, two bird remains provide evidence of a large passerine bird and the first record of an Early Miocene duck from non-palustrine deposits in Europe (MLIKOVSKY, 1998). The ophidian fauna consists of Colubridae, Boidae and two different poisonous snakes; one of them is a viper, the second is a questionable relative of a cobra (SZYNDLAR, 1998). Lizards are very abundant in Oberdorf but their study remains to be completed. The amphibian fauna (SANCHIZ, 1998) is composed of Anura, Caudata and Allocaudata, in total at least ten species. In Oberdorf, *Triturus roehrsi* and *Latonina ragei* – two amphibian species that are rare elsewhere – are dominant.

Among the mammals a small pig, *Aureliachoerus minus*, and a rhino were recorded based on a few teeth (MADE, 1998a, 1998b). About 140 postcranial bones, teeth and antlers from cervids and tragulids were studied and assigned to six species of ruminants by RÖSSNER (1998). Two groups of small mammals, the rodents and insectivores, are very diverse. ZIEGLER (1998) determined 19 species of insectivores, one representative of marsupials and 7 species of bats. The rodent families Gliridae, Sciuridae, Petauristidae (studied by BRUIJN, 1998), Cricetidae, Eomyidae, Platanthomyinae and Anomalomyinae (studied by DAXNER-HÖCK, 1998a) are represented by 85 % of the mammal fossils and are attributed to 22 species.

DAXNER-HÖCK et al. (1998; Tab. 2) break the mammal species down as follows (n = numbers of species):

Table 2.  
Distribution of mammal species from Oberdorf.

| Mammals<br>(n = 56) | Small Mammals<br>(n = 49) | Rodents<br>(n = 22)   |
|---------------------|---------------------------|-----------------------|
| 12 % large mammals  | 2 % Lagomorpha            | 4.5 % Platanthomyinae |
| 88 % small mammals  | 2 % Marsupialia           | 4.5 % Eomyidae        |
|                     | 14 % Chiroptera           | 9 % Anomalomyinae     |
|                     | 37 % Insectivora          | 9 % Cricetidae        |
|                     | 45 % Rodentia             | 13.5 % Petauristidae  |
|                     |                           | 13.5 % Sciuridae      |
|                     |                           | 46 % Gliridae         |

### 2.1. Palaeoenvironmental Interpretation

The majority of the small mammals lived in burrows underground, or in bushes, under rotting logs or fallen trees. We assume that tree squirrels, flying squirrels and dormice were arboricolous, using hollow trees for shelter and for their nests as their extant relatives do. The flying squirrels are represented by three species. They needed high trees for gliding from one tree to the next. Although partly omnivorous or insectivorous, most of the observed small mammals were plant eaters using the forest biotopes as a habitat and their rich supply of fruits, berries, seeds, nuts, twigs, leaves and roots for food. The variety of snakes, lizards and amphibians including Caudata, Allocaudata and Anura fit in forest environments as well. There is no record of any inhabitant of open country except for a few teeth of a lagomorph; these teeth are interpreted as belonging to prey.

The large mammal association consists of cervids, tragulids and one species of rhino and pig. All of them re-

quire forest biotopes and we assume that they would also accept a swampy environment close to a river system (see DAXNER-HÖCK et al., 1998 and HAAS et al., this volume).

### 2.2. Biostratigraphic Results

The majority of determined small mammal species from Oberdorf range from Mammal-Zone MN3 to MN4, others are restricted to MN4, and a small group ranges to MN5 or to the Middle Miocene. In contrast to the primitive small mammals *Ligerimys antiquus*, *Bransatoglis fugax*, *Microdyromys cf. legidensis*, *Peridyromys murinus*, *Myxomygale hutchisoni*, *Chainodus intercedens* and others, the existence of *Democricetodon gracilis*, *Eumyarion aff. weinfurteri*, *Anomalomys minor* and *Neocometes similis*, who invaded Europe in MN4, indicates a maximum age of MN4 for Oberdorf. On the other hand the more modern species (*Keramidomys thaleri*, *Democricetodon mutillus*, *Microdyromys koenigswaldi*, *Prodryomys satus*) which first occurred in Europe in MN5 are not known from Oberdorf. This indicates a minimum age of MN4.

Oberdorf is correlative with the Central European faunas of the early to middle part of Mammal-Zone MN4 (DAXNER-HÖCK et al., 1998). It is situated between Petersbuch 2 (Germany; MN4a; compare WU 1993), Dolnice 1, 2 (Czech Republic; MN4a; compare FEJFAR, 1989) and Forsthart, Rembach, Rauscheröd (Germany; MN4b; compare ZIEGLER & FAHLBUSCH, 1986), Tägernastraße (Schweiz; MN4b; compare KALIN, 1997), Dolnice 3, Orechov (Czech Republic; MN4b; compare FEJFAR, 1989) and La Romieu, which is the reference locality for MN4 (France; MN4b). In MN4a the vertebrate faunas contain the eomyid species *Ligerimys antiquus*, which is replaced by the large *Ligerimys florancei* in MN4b. In MN5 the eomyid genus *Ligerimys* itself is replaced by *Keramidomys*.

In Austria the vertebrate fauna from Oberdorf is stratigraphically placed between Maigen (Eggenburgian, MN3; MEIN, 1989b) and Teiritzberg and Obergänsersdorf (Karpatian, MN5; DAXNER-HÖCK, 1998b).

In conformity with all the authors who studied the different vertebrate groups (DE BRUIJN, 1998; DAXNER-HÖCK, 1998a; ZIEGLER, 1998; RÖSSNER, 1998; SZYNDLAR, 1998; VAN DER MADE, 1998a,b; SANCHIZ, 1998; MLIKOVSKY, 1998), the Oberdorf fauna is thought to be of Early Miocene age. Following MEIN's (1975, 1989a) biozonation the mammals indicate Mammal-Zone MN4. The mammal fossil layers are situated within a normal polarity interval, which can be correlated by this fauna with Chron C5Dn, indicating an age of 17.2–17.6 Ma (see MAURITSCH & SCHOLGER, this volume; and STEININGER et al., this volume).

### Acknowledgements

These investigations are financially supported by the Austrian Science Fund, Project P 10338-GEO and the Geological Survey Vienna, Project "Kleinsäugetiere" and were made possible by the courtesy of the Graz-Köflach-Eisenbahn- und Bergbaugesellschaft (GKB). H. and J. DE BRUIJN, E. and A. KRISTKOIZ, B. MELLER, several students and my three daughters, helped to sample and collect fossils. I gratefully acknowledge the support of persons and institutions listed above.

### References

- BRUIJN DE, H. (1998): Vertebrates from the Early Miocene lignite deposits of the opencast mine Oberdorf (Western Styria Basin, Austria). 6. Rodentia 1 (Mammalia). – Ann. Naturhist. Mus. **99A**, 99–137, Wien.

- DAXNER-HÖCK, G. (1998a): Wirbeltiere aus dem Unter-Miozän des Lignit-Tagebaues Oberdorf (Weststeirisches Becken, Österreich). 7. Rodentia 2 und Lagomorpha (Mammalia). – Ann. Nat. Hist. Mus. Wien, **99A**, 139–162, Wien.
- DAXNER-HÖCK, G. (1998b): Säugetiere (Mammalia) aus dem Karpat des Korneuburger Beckens. 1. Rodentia und Carnivora. – Beitr. Paläont., **23**, 367–407, Wien.
- DAXNER-HÖCK, G., HAAS, M., MELLER, B., STEININGER, F.F. (1998): Wirbeltiere aus dem Unter-Miozän des Lignit-Tagebaues Oberdorf (Weststeirisches Becken, Österreich). 10. Palökologie, Sedimentologie und Stratigraphie. – Ann. Nat. Hist. Mus. Wien, **99A**, 195–224, Wien.
- FEJFAR, O. (1989): The Neogen VP Sites of Czechoslovakia: A contribution to the Neogene terrestrial Biostratigraphy of Europe based on Rodents. – In: LINDSAY, E.H., FAHLBUSCH, V., MEIN, P. (eds.): European Neogene Mammal Chronology, 211–236, Plenum Press, New York.
- HAAS, M., DAXNER-HÖCK, G., DECKER, K., KOLCON, I., KOVAR-EDER, J., MELLER, B. & SACHSENHOFER, R.F. (1998, this volume): Palaeoenvironmental Studies in the Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria). – In: STEININGER, F.F. (ed.): The Early Miocene Lignite Deposit of Oberdorf N Voitsberg (Styria, Austria), Jb. Geol. B.-A., **140/4**, 483–490, Wien.
- KÄLIN, D. (1997): New magnetostratigraphic calibration of Early to Middle Miocene mammal biozones of the North Alpine foreland basin. – Mém. Trav. E.P.H.E., **21**, 515–535, Montpellier.
- MADE VAN DER, J. (1998a): Vertebrates from the Early Miocene lignite deposits of the opencast mine Oberdorf (Western Styria Basin, Austria). 8. Rhinocerotidae (Mammalia). – Ann. Naturhist. Mus. **99A**, 163–168, Wien.
- MADE VAN DER, J. (1998b): *Aureliachoerus* from Oberdorf and other Aragonian pigs from Austria. – Ann. Naturhist. Mus. **99A**, 225–277, Wien.
- MAURITSCH, H.J. & SCHOLGER, R. (1998, this volume): Palaeomagnetism and Magnetostratigraphy from the Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria). – In: STEININGER, F.F. (ed.): The Early Miocene Lignite Deposit of Oberdorf N Voitsberg (Styria, Austria), Jb. Geol. B.-A., **140/4**, 429–432, Wien.
- MEIN, P. (1975): Résultats du Groupe de Travail des Vertébrés. – In: SENES, J. (ed.): Report on Activity of R.C.M.N.S. Working Groups, 6. Congress of the Regional Committee of Mediterranean Neogene Stratigraphy, Proc. **1**, 78–81, Bratislava.
- MEIN, P. (1989a): Updating of MN Zones. – In: LINDSAY, E.H., FAHLBUSCH, V. & P. MEIN (eds.): European Neogene Mammal Chronology, NATO ASI series A 180 (Plenum), 73–90, New York.
- MEIN, P. (1989b): Die Kleinsäugerfauna des Untermiozäns (Eggenburgien) von Maigen, Niederösterreich. – Ann. Naturhist. Mus. Wien, **90A**, 49–58, Wien.
- MLIKOVSKY, J. (1998): Vertebrates from the Early Miocene lignite deposits of the opencast mine Oberdorf (Western Styria Basin, Austria). 4. Aves. – Ann. Naturhist. Mus. **99A**, 39–42, Wien.
- MOTTL, M. (1970): Die jungtertiären Säugetierfaunen der Steiermark, Südost-Österreichs. – Mitteilungen des Museums für Bergbau, Geologie und Technik am Landesmuseum Joanneum, **31**, 3–92, Graz.
- RÖSSNER, G.E. (1998): Wirbeltiere aus dem Unter-Miozän des Lignit-Tagebaues Oberdorf (Weststeirisches Becken, Österreich). 9. Ruminantia (Mammalia). – Ann. Naturhist. Mus. **99A**, 169–193, Wien.
- SANCHIZ, B. (1998): Vertebrates from the Early Miocene lignite deposits of the opencast mine Oberdorf (Western Styria Basin, Austria). 2. Amphibia. – Ann. Naturhist. Mus., **99A**, 13–29, Wien.
- STEININGER, F.F. DAXNER-HÖCK, G., HAAS, M., KOVAR-EDER, J., MAURITSCH, H.J., MELLER, B. & SCHOLGER, R.M. (1998, this volume): Stratigraphy of the “Basin Fill” in the Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria). – In: STEININGER, F.F. (ed.): The Early Miocene Lignite Deposit of Oberdorf N Voitsberg (Styria, Austria), Jb. Geol. B.-A., **140/4**, 491–496, Wien.
- SZYNDLAR, Z. (1998): Vertebrates from the Early Miocene lignite deposits of the opencast mine Oberdorf (Western Styria Basin, Austria). 3. Serpentes (Reptilia). – Ann. Naturhist. Mus. **99A**, 31–38, Wien.
- ZIEGLER, R. (1998): Wirbeltiere aus dem Unter-Miozän des Lignit-Tagebaues Oberdorf (Weststeirisches Becken, Österreich). 5. Marsupialia, Insectivora und Chiroptera (Mammalia). – Ann. Naturhist. Mus. **99A**, 4–97, Wien.
- ZIEGLER, R. & FAHLBUSCH, V. (1986): Kleinsäuger-Fauna aus der basalen Oberen Süßwasser-Molasse Niederbayerns. – Zitteliana, **14**, 3–80, München.