Early and Late Miocene correlation (Central Paratethys)

Gudrun DAXNER-HÖCK

Geologisch-Paläontologische Abteilung, Naturhistorisches Museum Wien, Burgring 7, A-1014 Wien, Austria

Correlation of marine and continental sequences from different countries is still far from being understood. In addition, there are major differences in correlation of the MN-zones (MN3-6) and the Geomagnetic Polarity Time Scale (GPTS) between SW-Europe and Central Europe (Tab.1 and DAAMS et al. (1999, Fig. 9)).

Therefore, in Austria we primarily concentrate on a few vertebrate faunas, which were deposited in marine or brackish sediments of the Paratethys. Localities which yielded mammal fossils and marine fauna likewise serve as correlation tie points between MN-zones and the marine biozones (based on molluscs, planktonic foraminifera or/and calcareous nannoplankton). For correlation of marine biozones and the Geomagnetic Polarity Time Scale of CANDE & KENT (1995) we follow BERGGREN et al. (1995). This correlation allows us to give a numerical age estimation of marine faunas, and of time equivalent terrestrial faunas, which were brought into the sea and were deposited together with marine animals and nannoplankton in the marine sediments.

Some Austrian vertebrate localities (Figs. 1, 2) focus on correlation in the high-resolution intervals **HRI 3** (13 - 17 Ma) and **HRI 2** (8.5 - 11.5 Ma):

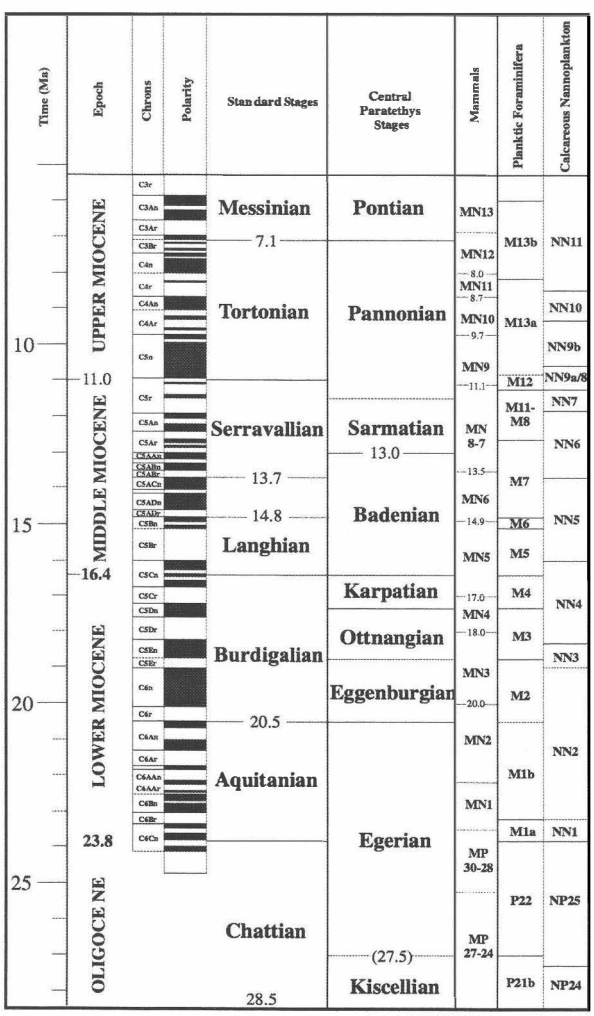

Fig. 1: Correlation chart compiled by HARZHAUSER, RÖGL, DAXNER-HÖCK.

1. The small mammal fauna from **Maigen** (MEIN 1989) in Lower Austria was recovered from marine sediments. It is associated with marine fauna of the lower part of the Upper Eggenburgian. The presence of the small mammals *Ligerimys antiquus, L. lophidens*, *Melissiodon dominans* and the absence of modern cricetids and glirids confirm the Mammal Zone MN3. Correlation: Upper Eggenburgian and lower-middle part of MN3, respectively.

2. From the hanging wall of the opencast pit of **Oberdorf** in Styria two mammal faunas were recovered (DAXNER-HÖCK et al. 1998). The Mammal Zone MN4 is evidenced by the cricetids *Democricetodon gracilis*, *Eumyarion* aff. *weinfurteri*, *Anomalomys minor* which first occurred in Central Europe in MN4, and by *Ligerimys antiquus*, which was replaced by *Keramidomys thaleri* in MN5. The section shows from bottom to top only one change of magnetic polarity. This change from a reversed (below) to a normal polarity interval (above) occurs approximately 10 meters above the main coal seam. The whole sediment pile above the seam, i.e. the hanging wall (including the two mammal bearing horizons) shows normal polarity (MAURITSCH & SCHOLGER 1998). This normal interval is thought to be Chron C5Dn, because as shown below (3.) the next higher normal interval C5Cn3n corresponds with the lower MN5 and the uppermost part of the Karpatian, respectively. The next lower normal interval C5En corresponds with lower Ottnangian and the higher MN3, respectively. The estimated age of the Oberdorf fauna is 17.3 - 17.6 Ma.

HRI 3: 13-17 Ma

3. The continental vertebrate faunas (terrestrial and aquatic fauna) of **Obergänserndorf** and **Teiritzberg** in Lower Austria were deposited in marine-brackish sediments of the Karpatian sea and therefore were mixed up with marine fauna. Karpatian sedimentation was before the FAD of *Praeorbulina*, which evidences the beginning of the Badenian (Lower Lagenid Zone). The mammal fauna (DAXNER-HÖCK 1998) indicates the lower MN5 by the presence of *Keramidomys thaleri* (being the most abundant fossil), *Democricetodon mutilus, Microdyromys koenigswaldi, Prodryomys satus,* and the absence of *Ligerimys*. Magnetostratigraphic investigations (SCHOLGER 1998) from the very sections with mammal bearing layers (MN5) showed normal magnetic polarity, only. According to BERGGREN et al. (1995) there is only one normal polarity interval Chron C5Cn3n which corresponds with the Karpatian. The following higher Chron C5Cn2n is correlative with the beginning of the Badenian (=Lower Lagenid Zone). The next lower Chron C5Dn corresponds with the Mammal Zone MN4, as demonstrated above (Oberdorf fauna). The estimated age of the vertebrate faunas Teiritzberg and Obergänserndorf is 16.5 - 16.7 Ma.

4. Two mammal faunas from the localities **Grund** and **Mühlbach a. M.** in Lower Austria were recovered from Lower Badenian marine sediments. Although not yet described in detail, we recognized the rodents from Grund and Mühlbach as being more advanced than those from Obergänserndorf and Teiritzberg, i.e. middle-late MN5. Magnetostratigraphic investigations showed normal polarity (SCHOLGER - oral communication), and the marine fauna indicates the Lower Lagenid Zone. The estimated correlation is Chron C5Cn1.

5. The locality **Apfelberg** from the Fohnsdorf Basin in Styria yielded a very small mammal fauna which includes the cricetids *Eumyarion medius, E. bifidus* and *Democricetodon crassus* (STRAUSS, DAXNER-HÖCK & WAGREICH, submitted paper). We correlate the faunula with Sansan in France which is the reference fauna of Mammal Zone MN6.

HRI 2: 8.5 - 11.5 Ma

The HRI 2 corresponds with the Pannonian sedimentation in the Vienna Basin and the Austrian part of the Pannonian Basin. Successive changing of salinity and finally the disappearing of the brackish Pannonian Lake from the eastern part of Austria reflects significant changing of fauna. The Pannonian succession was subdivided by PAPP (1948) into a series of letter-stages, the "zones" A-H, marked by certain mollusc and ostracod taxa .
Some mollusc-ostracod faunas are associated with mammals. They allow correlation of the Pannnian mollusc-"zones" (A-H) and the Mammal Zones MN9-11 (DAXNER-HÖCK 1996). The estimated ages of mammal faunas and the boundaries drawn between MN-zones correspond with Spain. Compare Tab. 1, 2 and VAN DAM (1997, Fig. 2.7).

6. The fauna of **Bullendorf** in Lower Austria yielded molluscs of the lower Pannonian A/B. The associated mammals are very rare and do not include "*Hippotherium primigenium*". Thus, per definition it is no Vallesian, but late Astaracian (MN8) .

7. From the localities **Vösendorf, Inzersdorf** and **Hennersdorf** in Lower Austria rich vertebrate and mollusc faunas indicate the mammal Zone MN9 and the Pannonian "zones" D/E. Magnetostratigraphic investigations in Hennersdorf showed normal polarity. It is the long normal Chron C5n2n.

8. The localities **Götzendorf** and **Stixneusiedl** yielded no murids but mammals indicating late MN9, and molluscs of "zone" F. Normal magnetisation with a low signal of reversed magnetisation at the basal part of the Götzendorf section points to Chron C5n 1n (SCHOLGER - oral communication).

9. The first occurrences of murids in the faunas of **Richardhof** and **Neusiedl a. S**. signalise the beginning of MN10. The freshwater and terrestric gastropods indicate the Pannonian "zone" G/H. Normal polarity of the sediments (SCHOLGER - oral communication) is thought to correspond to Chron C4Ar1n or C4Ar2n.

10. **Kohfidisch** is a fissure filling. The rich small mammal fauna is almost identical with the Turolian Eichkogel-fauna (MN11), but *Progonomys woelferi* was thought to indicate MN10. Discussion is still going on.

11. **Schernham** is a new and so far not described rich vertebrate fauna from the Molasse Basin. It yielded large and small mammals which point to MN10-11.

12. The small mammals from **Eichkogel**, i.e. *Parapodemus lugdunensis, Kowalskia skofleki, Pliopetaurista bressana, Epimeriones austriacus, Collimys primus* and others indicate MN11 (DAXNER HÖCK 1980, 1996), and the according gastropods allow correlation with the mollusc "zone" H. The top of the locality Eichkogel represents the youngest Pannonian small mammal fauna from Austria.

Conclusion: All the biostratigraphic and magnetostratigraphic data from Austrian vertebrate localities (Fig. 2) are brought into line with the correlation chart for GPTS, and marine and continental biozonations (STEININGER 1999, Fig.1.1) which is commonly used in Central Europe (REICHENBACHER et al. 1998 and other authors). But this opinion differs in many respects from the correlation of MN-zones and GPTS data, which is used in Spain. (DAAMS et al. 1999, AGUSTI et al. 2001). There are discrepancies concerning duration and boundaries of MN-zones of the Early and Middle Miocene, but not of the Late Miocene (Tab. 1).

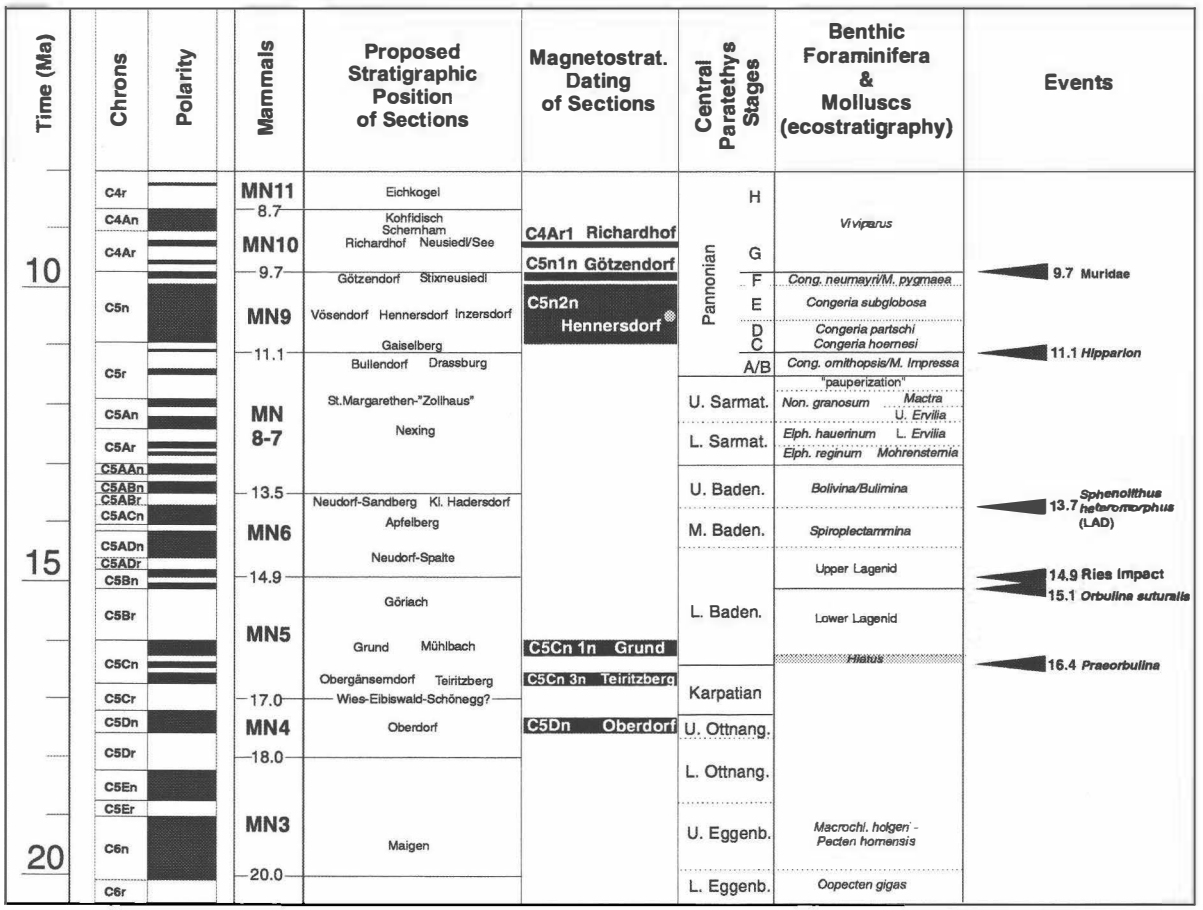

Fig. 2: Correlation of sections and vertebrate localities from Austria (Maigen – Eichkogel) with marine and continental biozonations and the Geomagnetic Polarity Time Scale (GPTS). Compiled by DAXNER-HÖCK, HARZHAUSER and RÖGL.

Lower boundaries of MN-zones:	Numerical ages for MN - boundaries:		
	Steininger 1999	Daams et al. 1999	Agusti et al. 2001
MN4	18.00	17.00	16.60 (17.00)
MN5	17.00	16.00	16.00
MN6	15.00	13.75	13.80
MN7-8	13.50	12.50 (13.00)	12.50 (13.00)
MN9	11.10	11.10	11.10 (11.50)
MN10	9.70		9.70
MN11	8.70		8.70

Tab. 1: Numerical ages for MN-boundaries.

According to different correlation charts the lower boundaries of MN-zones (MN4-8) differ from each other by 1 to 1.25 million years. All these charts are based on very rich data, and the correlation is well proved and confirmed. But, to my opinion the MN-zones are not yet defined clearly. Additional problems arise from endemic faunas which have only a few or no species in common with faunas to compare. Thus, the understanding of MN-zones and their usage is not the same for different authors from distant areas.

My proposal would be to update the MN-zones constantly. It is necessary to give clear information about most abundant and characteristic taxa, the beginning and duration, and the variation of included taxa due to different geographic areas. We should start with certain

faunas, which are proved by radiometric, and/or palaeomagnetic, and/or other biostratigraphic data to be of the same age. It is necessary to prove the species determinations of these selected test faunas. If certain taxa are confirmed to be identical they may be used to characterise the very MN-zone.

References

AGUSTÌ, J., CABRERA, L., GARCÉS, M., KRIJGSMAN, W., OMS, O. & PARÉS, J.M., 2001: A calibrated mammal scale for the Neogene of Western Europe. State of the art. - Earth-Sci. Rev., 52, 247-260, Amsterdam.

BERGGREN , W.A., KENT, D.V., SWISHER, C.C. & AUBRY, M.-P., 1995: A revised Cenozoic Geochronology and Chronostratigraphy. - In: BERGGREN, W.A., KENT, D.V. & HARDENBOL, J. (eds.): Geochronology, Time Scales and Global Stratigraphic Correlations: A Unified Temporal Framework for a Historical Geology. - SEPM Special. Publ., 54, 129-212, Tulsa.

CANDE, S.C. & KENT, D.V., 1995: Revised calibration of the geomagnetic polarity time scale for the Late Cretaceous and Cenozoic. - Journal of Geophysical Research, 100, 6093-6095, Washington D.C.

DAAMS, R., MEULEN, A. VAN DER, ALVAREZ SIERRA, M., PELAEZ-CAMPOMANES, P., CALVO, J.P., ALONSO ZARZA, M.A. & KRIJGSMAN, W., 1999: Stratigraphy and sedimentology of the Aragonian (Early to Middle Miocene) in its type area (North-Central Spain). - Newsletter Stratigr., 37, 103-139, Berlin-Stuttgart.

DAXNER-HÖCK, G., 1980: Rodentia (Mammalia) des Eichkogels bei Mödling (Niederösterreich). 1. Spalacinae und Castoridae. 2. Übersicht über die gesamte Nagetierfauna. - Ann. Naturhist. Mus., 83, 135-152, Wien.

DAXNER-HÖCK, G., 1996: Faunenwandel im Obermiozän und Korrelation der MN-"Zonen" mit den Biozonen des Pannons der Zentralen Paratethys. – Beitr. Paläont., 21, 1-9, Wien.

DAXNER-HÖCK, G., 1998: Säugetiere (Mammalia) aus dem Karpat des Korneuburger Beckens. 3. 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. Naturhist. Mus., Wien, 99A, 195-224, Wien.

MAURITSCH, H. J. & SCHOLGER, R., 1998: Palaeomagnetism and Magnetostratigraphy from the Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria). - In: STEININGER, F. F. (ed.): The Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria). – Jb. Geol.B.-A., 140/4, 429-432, Wien.

MEIN, P., 1989: Die Kleinsäugerfauna des Untermiozäns (Eggenburgien) von Maigen, Niederösterreich. – Ann. Naturhist. Mus., Wien, 90, 49-58, Wien.

REICHENBACHER, B., BÖTTCHER, R., BRACHER, H., DOPPLER, G., ENGELHART, W.V., GREGOR, J.-J., HEISSIG, K., HEIZMANN, E. P. J., HOFMANN, F., KÄLIN, D., LEMKE, K., LUTERBACHER, H., MARTIN, E., PFEIL, F., REIF, W., SCHREINER, A. & STEININGER, F. F., 1998: Graupensandrinne - Ries-Impakt: Zur Stratigraphie der Grimmelfinger Schichten, Kirchberger Schichten und Oberen Süßwassermolasse (nördliche Vorlandmolasse, Süddeutschland). – Z. dt. geol. Ges., 149/1, 127-161, Stuttgart.

SCHOLGER, R., 1998: Magnetostratigraphic and palaeomagnetic analysis from the Early Miocene (Karpatian) deposits Teiritzberg and Obergänserndorf (Korneuburg Basin, Lower Austria). – Beitr. Paläont., 23, 25-26, Wien.

STEININGER, F. F., 1999: The Continental European Miocene. Chronostratigraphy, Geochronology and Biostratigraphy of the Miocene "European Land Mammal Mega-

Zones" (ELMMZ) and the Miocene "Mammal-Zones (MN-Zones)". - In: RÖSSNER, G. E. & HEISSIG, K. (eds): Land Mammals of Europe, 9-24, Verlag Dr. Friedrich Pfeil, München.
STRAUSS, P.E., DAXNER-HÖCK, G. & WAGREICH, M., (submitted): Lithostratigraphie, Biostratigraphie und Sedimentologie des Miozäns im Fohnsdorfer Becken (Österreich). – Mitt. Österr. Geol. Ges., Wien.
VAN DAM, J.A., 1997: The Small Mammals from the Upper Miocene of the Teruel-Alfambra Region (Spain): Paleobiology and Paleoclimatic Reconstructions. - Geologica Ultraiectina, Med. Fac. Aardwet.Univ., 156, 1-204, Utrecht.

Correlation of Turkish and Greek mammal localities and magnetostratigraphic data

Sevket SEN

Laboratoire de Paléontologie du Muséum, UMR 8569 du CNRS, 8 rue Buffon, F-75005 Paris, France

The two countries of the Aegean area, Greece and Turkey, have large Neogene basins covering more than 50% of their land surface by continental deposits. About 400 Neogene mammal localities are listed in Turkey, and a hundred in Greece. The Greek Neogene mammalian faunas are reasonably well documented thanks to efforts of old and young paleontologists on more than one and half centuries. This is not the case in Turkey; most of mammal localities are known with preliminary lists, although some reliable efforts have been done since three decades. However, detailed systematic studies on Turkish Neogene mammals exist on some key localities and taxonomic groups (rodents, insectivores, carnivores, proboscideans, etc.), allowing to bring in light some key mammalian events.

The present data show that the correlation of the Aegean mammalian faunal successions with the European Neogene Mammal Chronology (ELMA-ages and MN-zones) remains unsatisfactory. For many intervals of the Neogene, the first and last occurrence datums of taxa are not well documented yet because of insufficient systematic studies and/or radiometric and magnetostratigraphic datings. Moreover, the faunal communities from this area are merely different from that of western Europe, except a few elements in common at genus and species level. This makes the identification of HRI intervals suggested by the EEDEN Committee complicated as well as to use the western European criteria to enlighten the time resolution of mammalian events included in these intervals.

When complete faunas are studied, it is generally observed that the correlation with MN-zones remains a problem, because there are no key elements recognizable. Thus, in the Eastern Mediterranean area it is difficult to use accurately the European zonation; on the other hand there is no other mammal zonation to correlate. Magnetostratigraphic work should help to solve these problems.

Some key localities were pointed out (Fig. 1):
Chios (early Middle Miocene): MN5 faunas from three successive horizons and magnetostratigraphic correlation to C5Br.
Sinap: the lower part of the section is without *Hipparion* which first occurs near the base of C5n at ca. 10.6 Ma.
Igbek: a late Vallesian fauna.