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DEUQUA EXCURSIONS

Edited by Ludwig Zöller and Andreas Peterek

From Paleozoic to Quaternary

A field trip from the Franconian Alb to Bohemia

GEOZON

River history of the Upper Main River area from Tertiary to Holocene

Flussgeschichte des Obermain-Gebietes vom Tertiär bis zum Holozän

Wolfgang Schirmer, with contributions of Michael Friedrich, Maria Knipping, Bernd Kromer and Uwe Abramowski

Itinerary / *Exkursionsroute*

Fig. 0.1: Location map of the excursion points. Map basis: Top 50 Bayern, Landesamt für Vermessung und Geoinformation, Version 5.

Abb. 0.1: Karte der Exkursions-Stops. Grundlage: Top 50 Bayern, Landesamt für Vermessung und Geoinformation, Version 5.

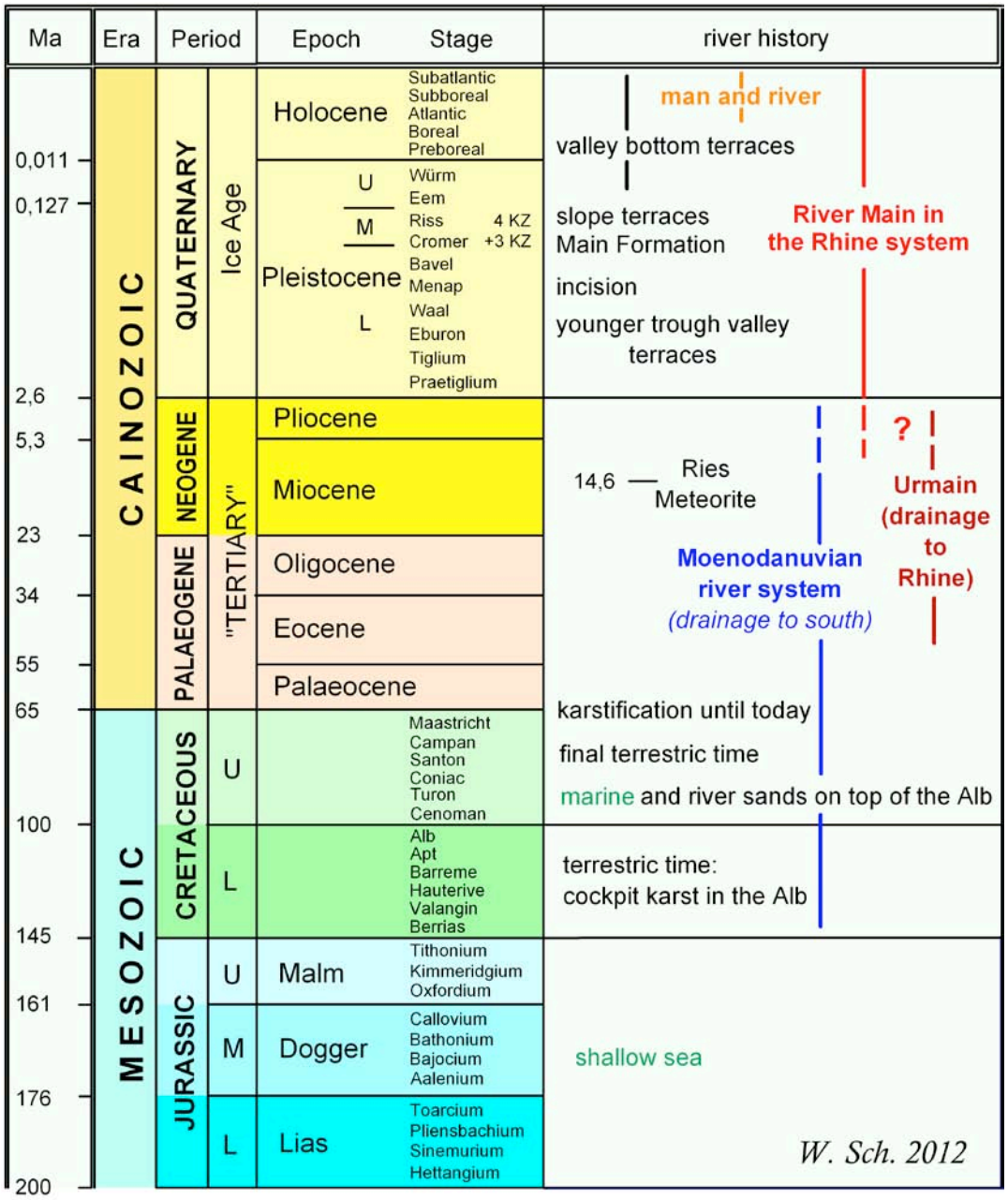

Fig. 0.3: Stratigraphic table for the Moenodanuvius and Main River (Schirmer 2010, modified).

Abb. 0.3: Stratigraphische Tabelle für den Moenodanuvius und Main (Schirmer 2010, geändert).

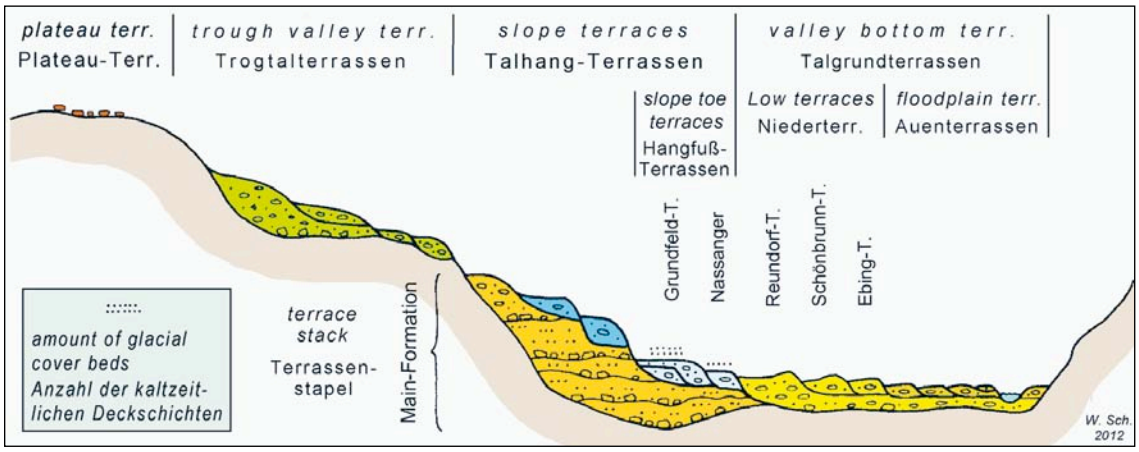

Fig. 0.4: Scheme of terrace flight of the Main River and other tributaries of the Upper Rhine (from Schirmer 2010, slightly modified).

Abb. 0.4: Schema der Terrassentreppe des Mains und anderer Oberrheinzuflüsse (aus Schirmer 2010, leicht verändert).

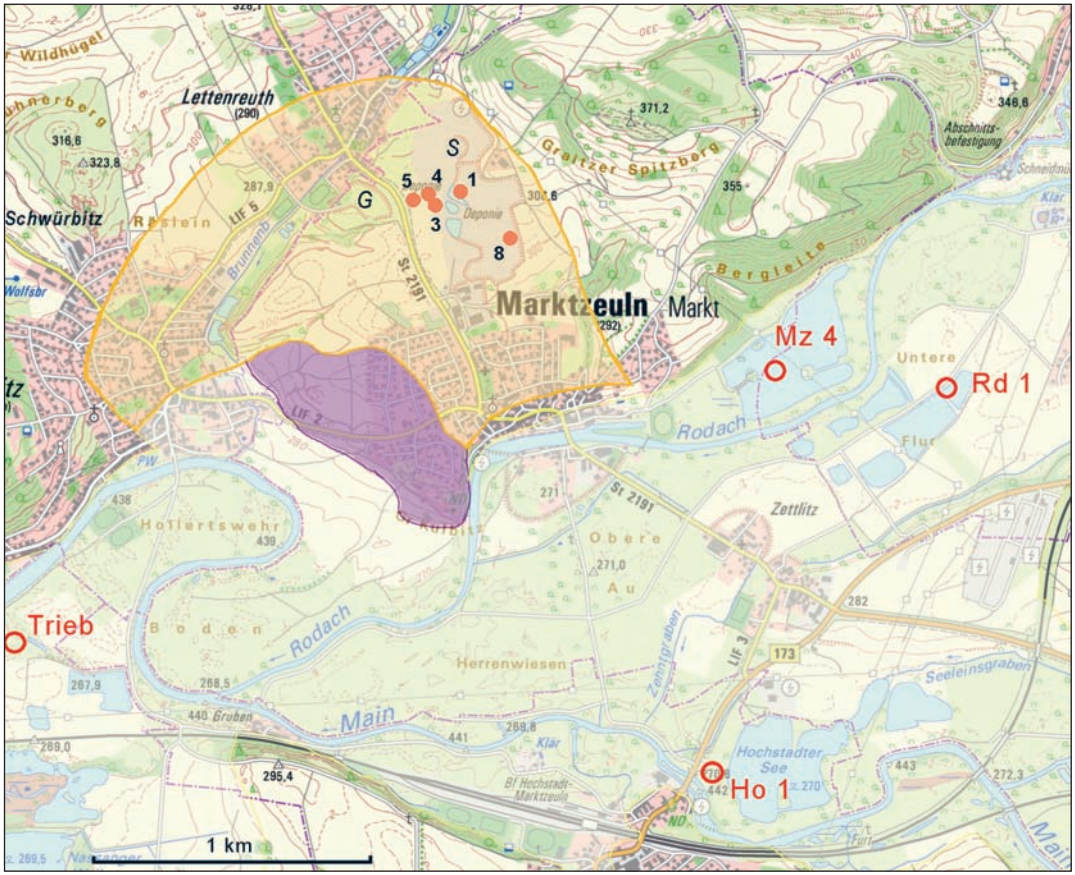

Fig. 2.1: Location map of the Marktzeuln Palaeomeander and the river junction of Rodach and Main. Orange = Marktzeuln Palaeomeander (early middle-Pleistocene Main Formation). Violet = Kulbitz cut-off meander spur (Upper Triassic Burgsandstein). Map area lightened up = late middle-Pleistocene to Holocene river deposits. Red dots within the the Main Formation: Profiles of the gravel pit Lettenreuth. G = pit "Grasiger Weg". S = pit "Schallhölzer". Red circles in the floodplain: Ho 1 = gravel analysis Hochstadt 1, Mz 4 = gravel analysis Marktzeuln "Oberes Wehr" 4, Rd 1 = profile Redwitz "Untere Flur" 1. Map basis: Top 25 Bayerische Vermessungsverwaltung 2010.

Abb. 2.1: Karte des Marktzeulner Paläomäanders und der Mündung von Rodach und Main. Orange = Marktzeulner Paläomäander (frühmittelpleistozäne Main-Formation). Violett = Kulbitz-Umlaufberg (Burgsandstein). Aufgehellter Kartenteil = Spätmittelpleistozäne bis holozäne Flussablagerungen. Rote Punkte in der Main-Formation: Profile der Grube Lettenreuth. G = Grube „Grasiger Weg". S = Grube „Schallhölzer". Rote Kreise in der Aue: Ho 1 = Schotteranalyse Hochstadt 1, Mz 4 = Schotteranalyse Marktzeuln-„Oberes Wehr" 4, Rd 1 = Profil Redwitz-„Untere Flur" 1. Kartengrundlage: Top 25 Bayerische Vermessungsverwaltung 2010.

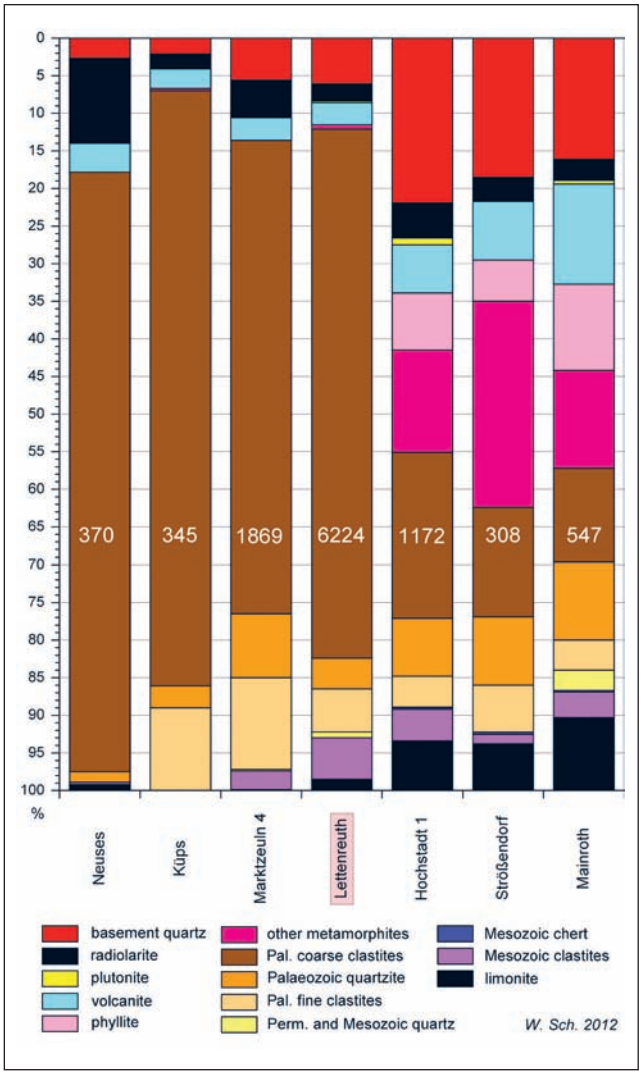

Fig. 2.5: Gravel spectrum Lettenreuth in comparison to spectra of the Burgkunstadt Upper Main River (Mainroth, Strößendorf, Hochstadt 1) and the Rodach River (Neuses, Küps, Marktzeuln "Oberes Wehr" 4). White numbers = total amount of analysed pebbles.

Abb. 2.5: Geröllspektrum Lettenreuth im Vergleich zu Spektren des Burgkunstadter Obermains (Mainroth, Strößendorf, Hochstadt 1) und der Rodach (Neuses, Küps, Marktzeuln-„Oberes Wehr" 4). Weiße Zahlen = analysierte Gesamtgeröllzahl.

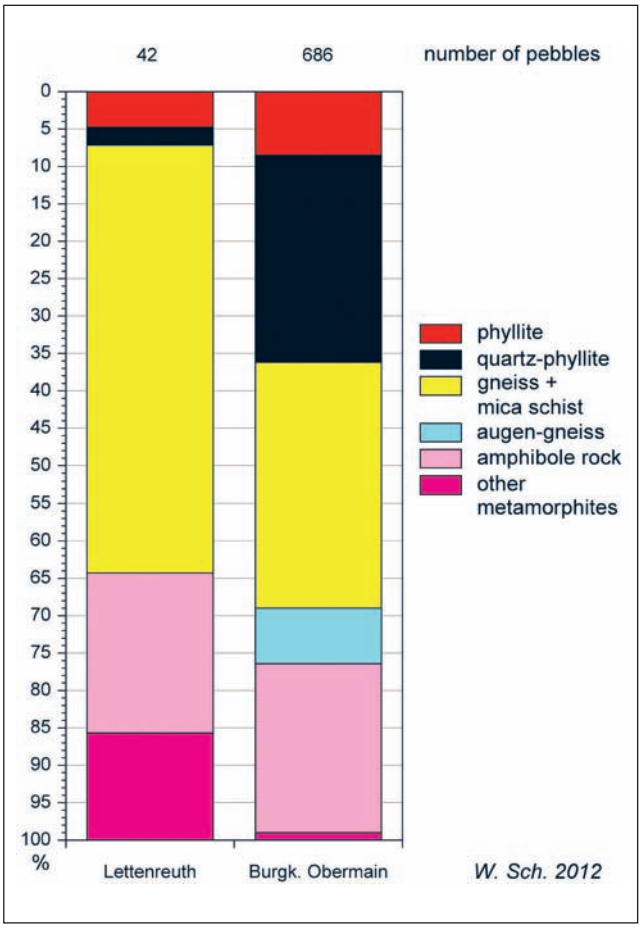

Fig. 2.6: Comparison of gravel spectra of metamorphite pebbles of the Burgkunstadt Upper Main valley ground with the Main-Formation in Lettenreuth.

Abb. 2.6: Vergleich der Metamorphit-Geröllspektren des Burgkunstadter Obermain-Talgrundes mit dem der Main-Formation in Lettenreuth.

Stop 3 Late Glacial Ebing Terrace in the Rodach valley ground near Redwitz

[Wolfgang Schirmer, Michael Friedrich, Maria Knipping, Bernd Kromer & Uwe Abramowski]

R 444226, H 555935, 273 m a.s.l. Topographical TK and geological map GK 25 5833 Burgkunstadt

Geological and geomorphological setting

Location 3, Redwitz-Untere Flur 1, is situated within the Rodach floodplain (Figs. 0.1 and 2.1), 1.3 km upstream from the Main floodplain respectively 3.0 km upstream of the junction with the Main River. Valley and joining versants are formed by Upper Triassic Lower Sandsteinkeuper (Blasensandstein, Coburg-Sandstein, Burgsandstein). The floodplain is 900 m wide, 600 m width are of Holocene age, 300 m width of Latest Weichselian age (Weichsel-Spätglazial) represented by the Ebing Terrace.

The valley ground of the Main River and tributaries embraces three terraces of Last Glacial age, besides the Holocene terraces (Tab. 3.1, see also Fig. 0.4).

The Ebing Terrace is the youngest of them and morphologically the lowest and rises above some decimeters over the Holocene terraces.

Vertical valley section

The profile Redwitz-Untere Flur 1 provides a vertical section through the whole valley fill from the floodplain top down to the bedrock (Fig. 3.1). The bedrock is sandstone and red and green marl of the lower Sandsteinkeuper. Above the bedrock follow four fluviatile series, three light coloured lower series and one dark coloured upper series, the Ebing Terrace.

The three lower series

1. The first and lowest one is preserved by a 0.3 m thick sandy lag facies of a vertical accumulated gravel (V gravel).

2. The second one above it is 0.8 m thick and represents a typical lateral accretion gravel (L gravel) with typical skeleton gravel near the base of the diagonal bedding planes. It indicates a meandering river.

3. The third fluviatile series, 1.8 m thick preserved, is again a sandy V gravel. An OSL age from the upper sandy layer (Fig. 3.2) yielded 24.3±2.0 ka (Abramowski et al., in prep.), a Weichselian Upper Pleniglacial age. It is the socle of the Reundorf Terrace.

The disconformable upper boundary of the third fluviatile series is the boundary between the light coloured lower channel deposits and the darker upper channel deposits (Fig. 3.3), i.e. between the Weichselian Upper Pleniglacial deposits (Jüngeres Hochglazial) and the Latest Weichselian deposits (Spätglazial), the Ebing Terrace. This boundary sometimes is lying even within the outcrop (as in Fig. 3.3), sometimes also channel-like.

Upper series, the Ebing Terrace

1. *Hippophaë* channel: The Upper series starts with a floodplain channel cut 1.6 m deep into the third series, the Reundorf Terrace. The basal channel fill is a 0.4 m thick loam, at its very base silty, weakly clayey, above it fine sandy, silty (Fig. 3.4). In the deepest part of the fine sandy layer a wood remnant (sample Main 3295) gave a ^{14}C age of 12,127±34 BP (14,035–13,895 calBP using IntCal 09); that points to the early Late Glacial period.
A column of six samples from this 0.4 m flooplain loam has been palynologically analysed by Maria Knipping (Tab. 3.2). The pollen spectra show a lot of reworked palynomorphs of pre-Quaternary and Quaternary types. Beside this reworked badly preserved taxa autochthonous pollen could be separated; they show a quite better preservation. Pollen of Poaceae, Cyperaceae are frequent and *Salix*, *Pinus*, *Hippophaë* and *Betula* occur regularly in the pollen spectra. Though the samples are contaminated with a lot of reworked taxa it seems likely that the sediment was built during the *Hippophaë* phase in the early Late Glacial.

Tab. 3.1: Last Glacial terraces of the valley ground in central Europe.

Tab. 3.1: Letztglaziale Terrassen des Talgrundes in Mitteleuropa.

Terrace name	Synonym	Age
Reundorf Terrace	Niederterrasse 1	30,000–24,000 years BP, Upper Pleniglacial
Schönbrunn Terrace	Niederterrasse 2	23,000–14,500 years BP, late Upper Pleniglacial
Ebing Terrace	Niederterrasse 3	(14,500-) 12,800–11,560 years BP, Late Glacial

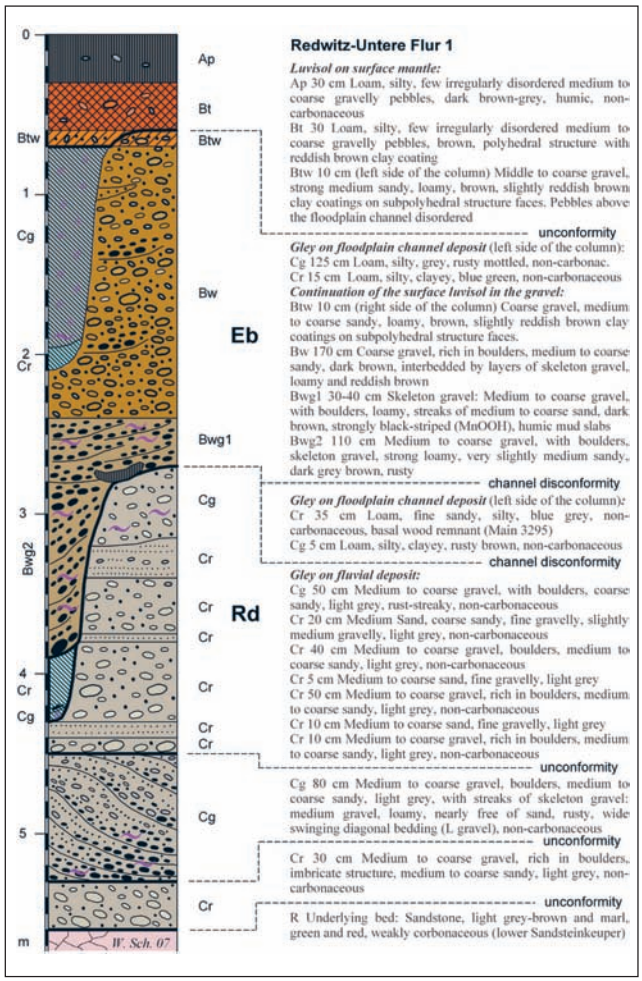

Fig. 3.1: Profile Redwitz–Untere Flur 1. Soil horizon designations after FAO-UNESCO (1990). Eb = Ebing Terrace, Rd = socle of the Reundorf-Terrace.

Abb. 3.1: Profil Redwitz–Untere Flur 1. Boden-Horizontbezeichnungen nach FAO-UNESCO (1990). Eb = Ebing-Terrasse, Rd = Sockel der Reundorf-Terrasse.

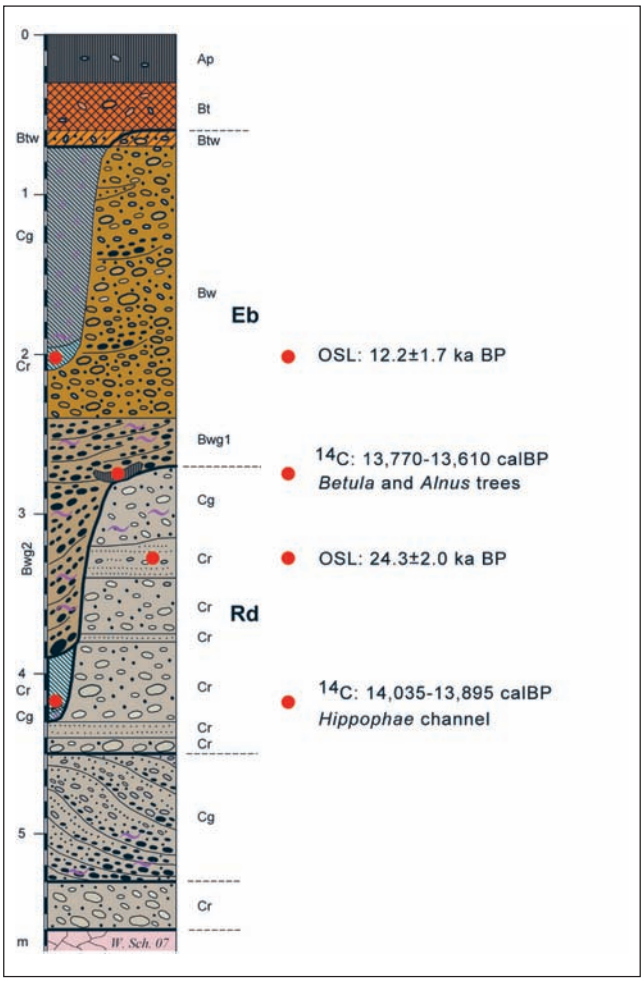

Fig. 3.2: Profile Redwitz–Untere Flur 1 with finds and ages. Eb = Ebing Terrace, Rd = socle of the Reundorf-Terrace.

Abb. 3.2: Profil Redwitz–Untere Flur 1 mit Funden und Altersangaben. Eb = Ebing-Terrasse, Rd = Sockel der Reundorf-Terrasse.

Thus, the channel cutting into the Reundorf Terrace happened in the late Upper Pleniglacial or at the transition to the Late Glacial forming in this lower level an early Late Glacial floodplain with the *Hippophaë* channel.

2. The higher part of the channel fill and the base layer of the darker gravel outside the channel fill is a skeleton gravel of 1.5 m in thickness. It bears smaller and larger slabs up to 50 cm thick of black humic mud (Fig. 3.3). Some of these mud slabs contained wood remnants. A ^{14}C age of one of this wood remnants is 11,820±25 BP (13,770–13,610 calBP). Among these remnants were 26 trunk pieces of alder (*Alnus* c.f. *viridis*) and birch (*Betula* c.f. *pendula* / *pubescens*) (Fig. 3.5), the largest one 60 cm long and 30 cm in diameter with well preserved bark. Preliminary dendrochronological studies on 16 of those birch and alder trees revealed that it is possible to cross-match most of the birch series and construct birch tree-ring chronologies. At most other sites with Late Glacial wood remnants, pine (*Pinus sylvestris*) is the most frequent tree species with preserved wood. Therefore a number of Late Glacial–Early Holocene tree-ring chronologies of pine exist in Central Europe and northern Italy (Friedrich et al. 1999, 2004, 2010, Kaiser et al. 2012). In contrast to pine, which is a well suitable species for tree-ring analysis, for hardwood species like birch, poplar, or alder only a very few and short tree-ring series of subfossil wood exist in Central Europe (i. e. Friedrich et al. 1999, Friedrich et al. 2010). Additionally, chronology construction is more elaborate, as the individual series of those species are short, the wood is poorly preserved and absent rings frequently occur. So far 10 birch trees could be combined to form a 81-year floating tree-ring width chronology that can be predated by ^{14}C to 13,770–13,610 calBP. Another single tree is predated to 12,127±34 BP (14,040–13,890 calBP). According to these dates the trunks are remnants of a Bølling-Allerød birch (-alder) forest. According to the ^{14}C date it could correlate to the Greenland Isotope Interstadial 1c in mid-Late Glacial (Björck et al. 1998).
   For more than 40 years most of the gravel pits in the Main catchment area has been observed intensively and more than 3000 trees and tree remnants have been sampled and studied dendrochronologically. 2750 oak trees have been combined to form the major oak chronology for Central Europe (Becker 1993, Friedrich et al. 2004) (Fig. 3.6). But in contrast to the other river valleys Rhine and Danube where Late Glacial/Early Holocene (pine) wood is found frequently, no tree trunks older than 10,350 calBP could be found through all these years in the Main catchment.
   Therefore this new site with Late Glacial tree remnants is of special interest. This birch forest turnes out to be the oldest forest within the floodplain of the Main catchment area.

3. Above this basal skeleton gravel follows 1.8 m thick dark brown, slightly reddish, coarse and loamy gravel, badly sorted and irregularly orientated, with interbedded skeleton gravel streaks, the main corpus of the Ebing Terrace.

Fig. 3.3: Gravel pit Redwitz-Untere Flur 1. Unconformity between the light coloured lower channel deposits (Weichselian Upper Pleniglacial) and the darker upper channel deposits (Late Glacial Ebing Terrace). At its base occur reworked dark blue mud slabs containing wood fragments. Photo: W. Schirmer 11. 07. 2009.

Abb. 3.3: Kiesgrube Redwitz-Untere Flur 1. Diskordanz zwischen dem hellen unteren Flussbettsediment (Jüngeres Hochglazial) und dem dunkleren oberen (spätglaziale Ebing-Terrasse). An deren Basis sind umgelagerte dunkelblaue Muddeschollen eingearbeitet, die Holzreste enthalten. Foto: W. Schirmer 11. 07. 2009.

Fig. 3.4: Gravel pit Redwitz-Untere Flur 1. At the base of the darker coloured Ebing Terrace an orange arrow marks the early Late Glacial mud channel (Hippophaë channel). Photo: W. Schirmer 14. 09. 2007.

Abb. 3.4: Kiesgrube Redwitz-Untere Flur 1. An der Basis der dunkler gefärbten Ebing Terrasse liegt eine Früh-Spätglaziale Mudderinne (Hippophaë-Rinne), markiert durch einen orangen Pfeil. Foto: W. Schirmer 14. 09. 2007.

4. This gravel again is cut by a 1.5 m deep floodplain channel filled with blue green and grey silty loam of a gley soil. An OSL dating from the base of this gley channel yielded an age of 12.2±1.7 ka (Abramowski et al., in prep.). That means a Younger Dryas age (Greenland Isotope Stadial 1 = GS1).

5. A silty loam bed of 0.6 m in thickness is overlaying the gravel bed as well as the floodplain channel. It is the floodplain deposit of the Ebing Terrace ending at the recent surface of the valley bottom. A luvisol has developed on this surface, in some depressions also a stagnic luvisol.

Conclusion

The vertical valley section is covered by the Late Glacial Ebing Terrace. At its base the socle of the Reundorf Terrace has been preserved. The L gravel below it might belong to

Tab. 3.2: Gravel pit Redwitz-Untere Flur 1. Pollen analysis from the Hippophaë channel (M. Knipping).

Tab. 3.2: Kiesgrube Redwitz-Untere Flur 1. Pollenanalyse aus der Hippophaë-Rinne (M. Knipping).

Redwitz-Untere Flur 1 Pollen analysis: M. Knipping																													
Pollen grains:	arboreal pollen							nonarboreal pollen																	reworked taxa					
sample	Pinus	Betula	Salix	Juniperus	Hippophae	Ephedra fragilis type	Ephedra distachya type	Poaceae	Cyperaceae	Artemisia	Chenopodiaceae	Thalictrum	Epilobium	Rubiaceae	Cichoriaceae	Apiaceae	Brassicaceae	Varia	Pediastrum	Botryococcus	monolete Spore	Botrychium	Ophioglossum	Equisetum	Indeterminata	corroded [reworked]	sum prequaternary taxa	sum arboreal pollen	sum arboreal + nonarboreal	total sum
M 3288	3		6		4			12	15						2	2	1	1	2		1			1	64	32	48	14	47	194
M 3290	7		15	4	3			44	34	1	1	6		10				3	1	2		1		2	77	103	42	29	128	356
M 3291	5	1	1		1	1		42	16	1		1	1	1	1			1	2	1					49	19	51	10	74	196
M 3292	6	1	4		2			48	34	1		5		5				7	1					1	90	37	25	13	113	267
M 3293	15	3	26	7	11			62	61	3		4		15	1		1	9	2	3		2		1	142	97	29	64	222	496
M 3294	11	1	6	1	9		1	50	41	1					4	1	1	3	2	2	5		1		143	36	39	30	131	359
Pollen percentages:																														
M 3288	6,4		12,8		8,5			25,5	31,9						4,3	4,3	2,1	2,1	4,3		2,1			2,1	136,2	68,1	102,1	29,8	100	412,8
M 3290	5,5		11,7	3,1	2,3			34,4	26,6	0,8	0,8	4,7		7,8				2,3	0,8	1,6		0,8		1,6	60,2	80,5	32,8	22,7	100	278,1
M 3291	6,8	1,4	1,4		1,4	1,4		56,8	21,6	1,4		1,4	1,4	1,4	1,4			1,4	2,7	1,4					66,2	25,7	68,9	13,5	100	264,9
M 3292	5,3	0,9	3,5		1,8			42,5	30,1	0,9		4,4		4,4				6,2	0,9					0,9	79,6	32,7	22,1	11,5	100	236,3
M 3293	6,8	1,4	11,7	3,2	5,0			27,9	27,5	1,4		1,8		6,8	0,5		0,5	4,1	0,9	1,4		0,9		0,5	64,0	43,7	13,1	28,8	100	223,4
M 3294	8,4	0,8	4,6	0,8	6,9		0,8	38,2	31,3	0,8					3,1	0,8	0,8	2,3	1,5	1,5	3,8		0,8		109,2	27,5	29,8	22,9	100	274,0

fluvial deposits of the Middle Pleniglacial period (MIS 3), the basal gravel to older Weichselian deposits.

The Ebing Terrace indicates by the *Hippophaë* channel that its age starts with the beginning of the very early Late Glacial (about 14,035–13,895 calBP) within a lower level than that of the ending Reundorf Terrace. During the deposition of its thick gravel accumulation the river passed a floodplain with floodplain channels of middle Late Glacial age (about 14,000–13,600 calBP). In this floodplain grew a birch and alder forest, the oldest forest hence found in the Main catchment area. By eroding this floodplain the river incorporated into its gravel mud slabs of this floodplain together with the tree remnants of its forest — possibly in frozen state (gelisolum slabs). It follows that the lowest gravel in the channel between 3.9 and 2.8 m depth should be older than 14,000–13,600 calBP. The gravel above the slabs is younger than mid-Late Glacial and older than Holocene owing to the Younger Dryas age of the OSL-dated gley channel on top of the gravel. Thus, the main gravel bed is of Younger Dryas age (Greenland Isotope Stadial 1). Along the lower Rhine River this gravel deposition has Laacher See pumice of 12,900 aBP (GI 1a/b) as indicator constituent. The Redwitz Younger Dryas gravel again is cut by a 1.5 m deep floodplain channel of Younger Dryas (GS1) age. This phenomenon was likeweise found at the locus typicus of the Ebing Terrace downstream close to Bamberg (U. Schirmer & W. Schirmer 1988). It shows that the gravel deposition of the Ebing Terrace tapered off distinctly before the end of the Younger Dryas. It happens likewise to the gravel accumulation along the River Rhein (Schirmer 1990a: 28).

Thus, the Ebing Terrace starts with the beginning of the Late Glacial, but the bulk of gravel layer was deposited during the earlier Younger Dryas (GS1) cooling period (Schirmer 2010: 20). This by the way corresponds to results from the Danube area (Schellmann 2010, Gesslein & Schellmann, 2011: 408).

Fig. 3.5: Birch trunc from the gravel pit Redwitz-Untere Flur 1, deposited within a reworked mud slab at the base of the Ebing Terrace. Its age is about 13.5 ka, i.e. middle Late Glacial. Photo: W. Schirmer, 02. 06. 2007.

Abb. 3.5: Birkenstammstück aus der Kiesgrube Redwitz-Untere Flur 1. Es stammt aus einer in die tiefsten Teile der Ebing-Terrasse umgelagerten Muddescholle. Alter: ca. 13,5 ka, mittleres Spätglazial. Foto: W. Schirmer, 02. 06. 2007.

Stop 4 Holocene terraces in the Main valley ground at Trieb

R 44386/7, H 55582, 268 m a.s.l. Topographical map TK 25 5832 Lichtenfels.

Geological setting

The River Main valley adjoining to Trieb was often subject to intensive research of the valley ground (Becker & Schirmer 1977, Schirmer 1978, 1979, 1980, 1983, 1990b, 1991, 1995a, 2007d). It offers the favour that here the gravel pits in the valley ground are pumped out to be excavated down to the gravel sole, to the bedrock. The bedrock here is the Upper Triassic Feuerletten, a deeply red clay. Above it the pits exhibit complete vertical sections of the valley fill. These sections show mostly two fluviatile series: the socle of the Upper Pleniglacial Reundorf Terrace unconformably superimposed by any of the nine floodplain terraces shown in Fig. 4.1. At Stop 3 the Reundorf Terrace was superimposed by the Ebing Terrace. In the Trieb valley stretch the Reundorf Terrace is superimposed by Holocene terraces. In this context some important phenomena can be studied:

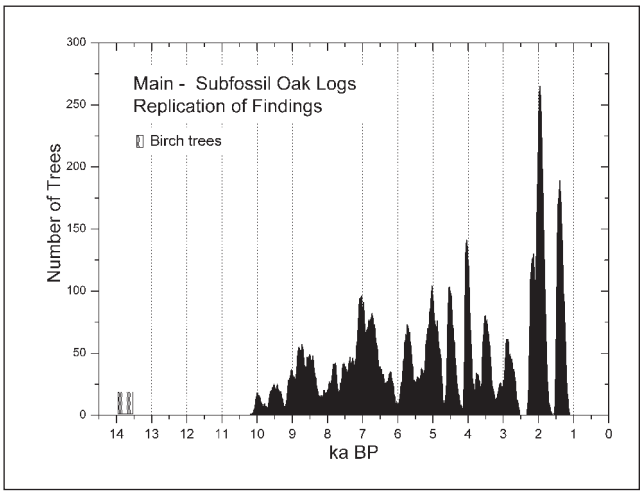

Fig. 3.6: Replication (number of trees through time) of the oak chronology from the River Main and tributaries (Friedrich et al. 2004). The white bar indicates the time range of the new birch chronologies from Redwitz/Rodach.

Abb. 3.6: Belegung der Eichenchronologie des Mains und seiner Nebenflüsse (Friedrich et al. 2004). Der weiße Balken gibt den Zeitraum der neuen Birkenchronologie von Redwitz/Rodach an.

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