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One River, Two Valleys

WOLFGANG SCHIRMER [1]

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Abstract

In the Upper Main area the river flument of the antepenultimate glacial period (Gundfeld Flument, MIS 8) was deposited under a longer equilibrium period of the Main River. This equilibrium stage gave first the Main River enough time for lateral erosion that resulted in a thalweg shift to the northwest to develop a new stream bed. The shift was triggered by augmented debris input from the high slope of the Franconian Alb down to the Main Valley. The thalweg shift is dated to late MIS 10 or to MIS 9 at about 340-270 ka BP.

Secondly, the equilibrium period resulted in overlapping of the youngest part of the Grundfeld Flument upon an older flument torso, which is a degradation terrace of the older Middle Pleistocene Main Formation. The overlapping flument is subdivided into four small sub-fluments. These are glacial deposits with cold climate indicators each separated by fossil soils of warm climate type as Luvisols and Cambisols of advanced stage. Thus, this overlap part can be compared to the well-known MIS 7 with its three pronounced interglacial periods separated by breviglacial periods. (Details are given in German in SCHIRMER 2020a.)

Thirdly, the incision after the equilibrium period MIS 8 and 7 and prior to the aggradation period MIS 6 took place at the boundary MIS 7/MIS 6 that is between interglacial and glacial.

Key words: Main River, thalweg shift, antepenultimate glacial, equilibrium stage

Kurzfassung

Ein Fluss, zwei Täler

Der Obermain im Kontakt zur Fränkischen Alb nutzte eine längere Zeit fluvialen Gleichgewichts entlang des Mains zu einem Talwechsel Richtung Nordwest. Es ist dies der Talwechsel vom Albmain-Tal zum Banzmain-Tal. Auslösender Faktor war der erhöhte Schuttandrang von der Fränkischen Alb her. Der Zeitpunkt des Talwechsels war vor dem drittletztglazialen Grundfeld-Flument im Zeitraum zwischen spätem MIS 10 und MIS 9, etwa 340–270 ka BP. Die Gleichgewichtslage des damaligen Tals erlaubte auch nur eine klimatisch bedingte geringe Eintiefung zur Basis des Grundfeld-Fluments, das deshalb bei

Address of the author:

1) Prof. Dr. Wolfgang Schirmer, 91320 Wolkenstein 24, schirmer@uni-duesseldorf.de

der folgenden Aufschüttung im Banzmain-Tal in das bereits verlassene Albmaintal hinüberlappte. Dieser nun von späterer Abtragung geschützte jüngste Überlappteil des Grundfeld-Fluments zeigt eine vierfache Aufteilung in schmale glaziale Lagen getrennt durch kräftige fossile Parabraunerden und Braunerden. Diese Abfolge bietet eine Parallelisierung mit dem weltweiten Interglazialkomplex MIS 7 an, der durch ausgeprägte Breviglaziale gegliedert ist (Ausführlicheres dazu in SCHIRMER 2020a). Der Zeitpunkt der nachfolgenden Eintiefung zwischen Grundfeld- und Nassanger Flument lag im Wechsel MIS 7/MIS 6, also zwischen Interglazial und Glazial.

Schlüsselwörter: Main, Thalweg-Wechsel, Albmain, Banzmain

1. Albmain and Banzmain — a short survey

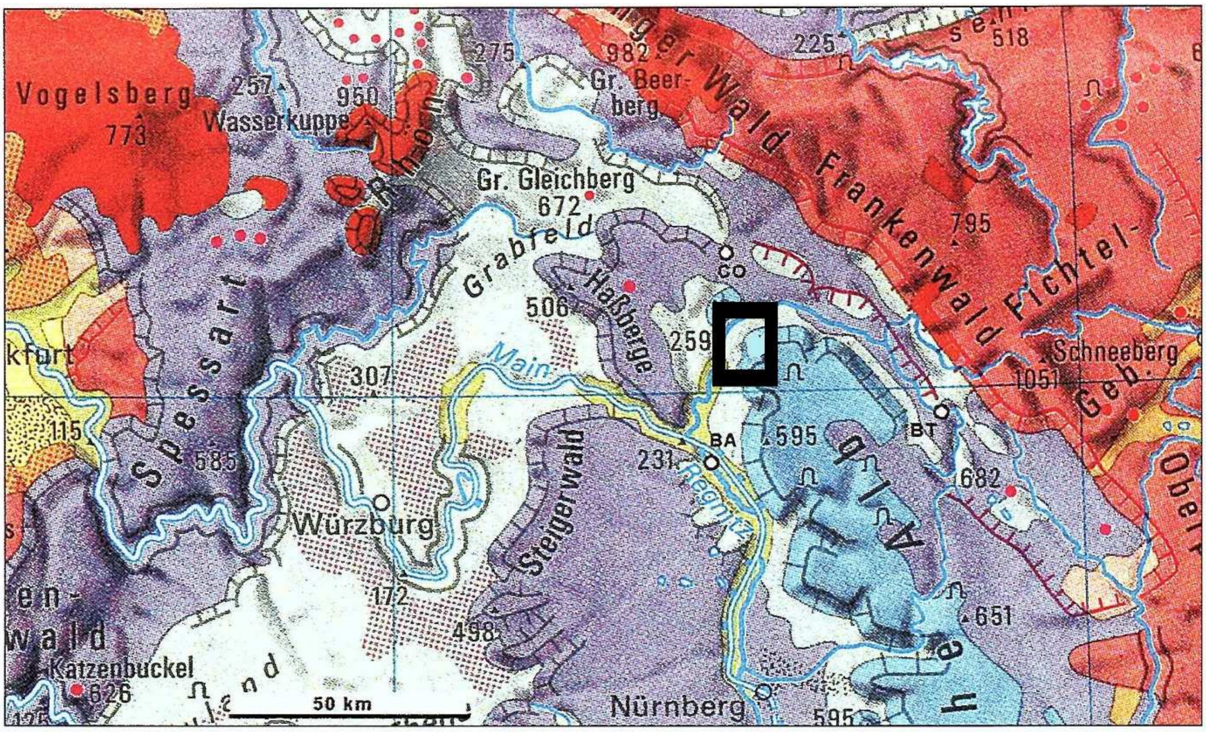

Fig. 1 Geological map of northern Bavaria with black quadrangle of the location of Fig. 2. BA = Bamberg, CO = Coburg (from Alexander-Weltatlas 1982: 105, with additions).

The upper Main River in northern Bavaria tightly followed along the toe of the Northern Franconian Alb (light blue in Fig. 1). This thalweg was called „Albmain“ (SCHIRMER 2018: 176). The difference in elevation between the last river bed of the Albmain and the top of the escarpment was measured to be 210 m by a distance of 2 km. During a stage of equilibrium of the River Main combined with increasing glacial frost activity during the Middle Pleistocene, the debris input from higher elevations into the Albmain Valley augmented in a way that the Main River moved aside to make way for the debris masses. By its shifting the river found a softer bedrock and cut in deeper than before to scour out a new thalweg, the „Banzmain“ (Fig. 2 and 3.3). Today, the Banzmain Valley base (pelma) lies 17 m deeper than the base of the Albmain River before the thalweg shift. However, this short survey is much more complex and is presented herein with more detail.

2. Setting of the story

The Main River flanks the hard and highly elevated Franconian Alb on its northwestern side running tightly at its toe (Figs. 1 and 2). The reason this Albmain thalweg is located next to the mountain may be caused by the tectonic dip of the Jurassic beds toward the Franconian Alb (Figs. 3.2–3.4). This bed was scoured out during the declining Early Pleistocene (~1.7 Ma), when the Upper Rhine Graben (Fig. 1) started to subside more strongly. Thus, the Main River had to incise deeply to level with the receiving water of the Rhine River. When the downward movement of the Upper Rhine Graben tapered off around 1 Ma, the Main River with its clayey-sandy hinterland could form the rhythmical aggradation of a 32 m thick stack of the Main Formation (Fig. 3.1). By further uplift of Southern Central Europe (~0.5 Ma), the stack was cut to continue the terrace flight until today (SCHIRMER 2020b) (Figs. 3.2–3.4).

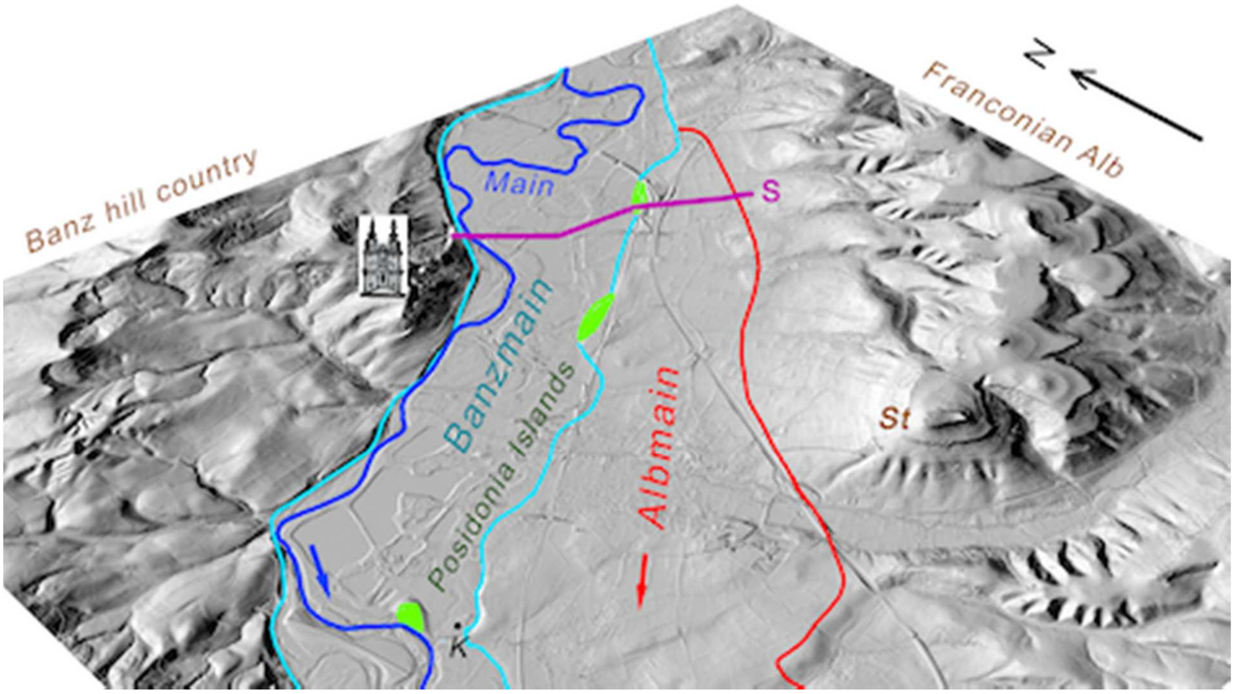

Fig. 2 Hill-shade map of the investigation area called „Garden of God". Main Valley flanked to right by the Franconian Alb, to left by the rolling Banz hill country crowned by the monastery of Banz. The river valley is bipartite into the Albmain Valley (red) and the Banzmain Valley (light blue). The latter is undercutting the Banz hill country due to debris input from the Franconian Alb. Between both valleys three Posidonia Islands (light green) rise up. K = Sewage Unterzettlitz, S = Grundfeld cross section through both river beds (violet), drawn in elevation in Fig. 3. St = Staffelberg (539 m a.s.l.). Background Map: © Bayerische Vermessungsverwaltung.

However, during the degradation of the Main Formation a big event during which the Main River was shoved over the northwestern flank of its bed off the slope toe of the Franconian Alb occured. In the valley section depicted in Figs. 3.2–3.4 this flank was formed by a bituminous limestone bed inserted into a thick shale sequence of Lower Jurassic age, called Posidonienschiefer (Posidonia Shale). Consequently, the river shifted its thalweg beyond the limestone ridge to incise into the weak mudstone sequence. This new thalweg was called Banzmain according to the monastery of Banz crowning the crest of the mountain opposite the Franconian Alb. The limestone ridge called Posidonia Island was the former right flank of the Albmain (Fig. 3.2) and is now the left flank of the Banzmain (Fig. 3.3. and 3.4).

Fig. 3 Cross sections through the Main River Valley with the story of the Albmain and Banzmain Valleys.

Fig. 3.1 Scheme of the Main Valley around probably MIS 10 (~380–340 ka): The Main Formation (Fluments A–E) is on the way being dissected by the Main River as consequence of land uplift. An climatic interruption was given by aggradation of the Schney Flument. Afterwards the degradation of the Main Formation continued.

Beginning with Fig. 3.2 the valley story is shown on the basis of the Grundfeld Cross Section the location of which is drawn in Fig. 2 (S).

Fig. 3.2 MIS 8+7 stage: The Main Formation originally up to 32 m in thickness has been degraded down to a thickness of 15.4 m representing a degradation terrace. Then the Main River moved its thalweg toward northwest cutting there into Lower Jurassic shale and leaving a small bituminous limestone ridge within the Posidonia Shale, the Posidonia Island (Fig. 3.2–3.4). Now, this ridge separated the Albmain River bed from the new Banzmain River bed. However, by aggrading its new river deposit (Grundfeld Flument) the river overlapped on its old bed depositing four thin sub-fluments that were preserved ideally in this outlying position until today.

Fig. 3.3 MIS 6+5 stage: During the next glaciation period the Main River scoured completely away the Grundfeld deposits within the Banzmain Valley and deposited there the Nassanger Flument (MIS 6, light blue). Some fluments of MiS 5 age (darker blue) were added, the basal parts of which were exposed as lateral accretion deposit 5,4 km down-valley from the section, indicated in Fig. 2 as K (sewage Unterzettlitz), described in SCHIRMER (2019).

Fig. 3.4 Recent stage: The Nassanger Flument (MIS 6) was reduced to a small seam at the valley edge of the Banzmain Valley. Deposits of the last glaciation and the Holocene occupy the bulk of the Banzmain Valley.

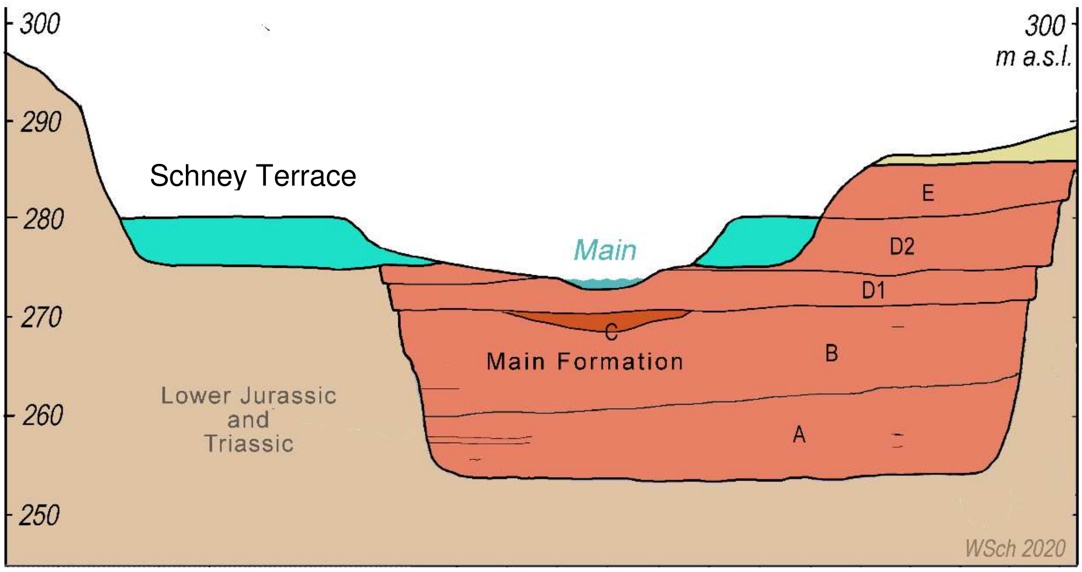

Fig. 3.1

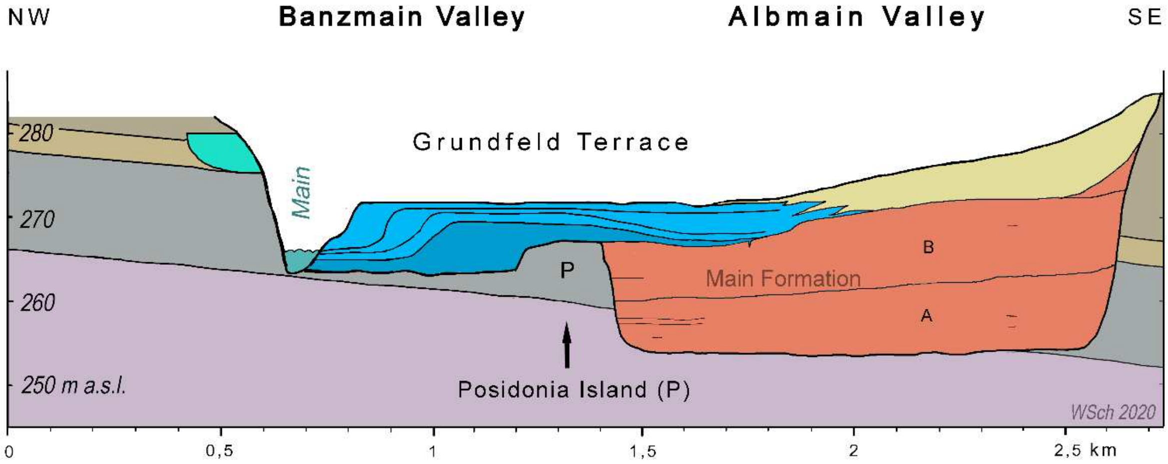

Fig. 3.2

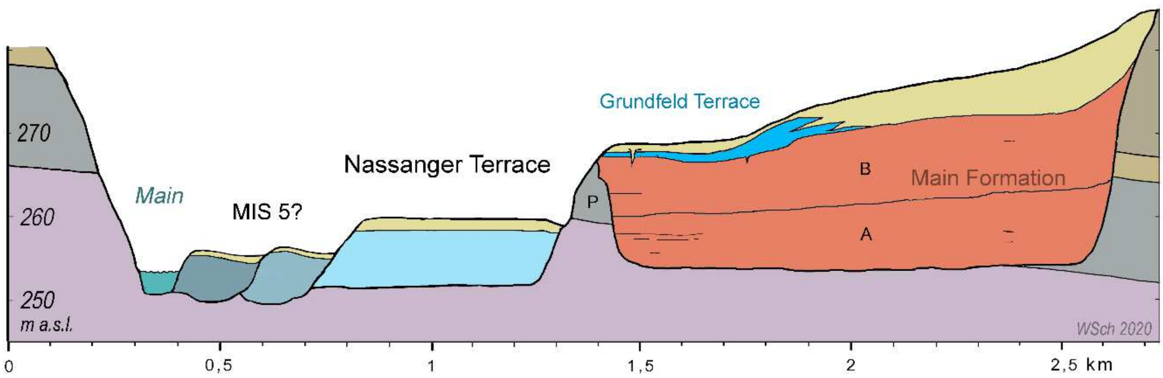

Fig. 3.3

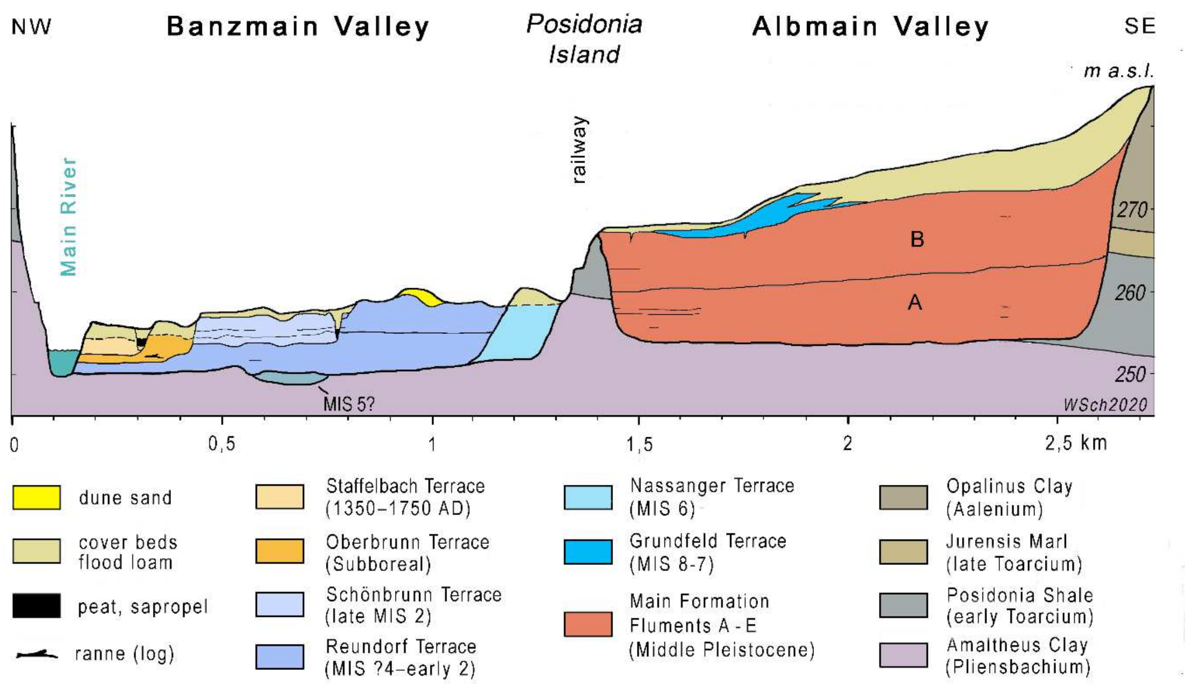

Fig. 3.4

The reasoning for the shift is both, lateral erosion during a longer period of equilibrium in the Main Valley and augmentation of slope debris from the Franconian Alb during increasing periglacial erosion. A tectonic reason for the shift of the thalweg is considered to be unlikely. The thalweg shift moved against the tectonic dip that is 0.4° along the direction drawn in Fig. 3.2–3.4. Though a tectonic shift may reverse for a while there is no geological evidence for such a reversal. Moreover, the same shift is documented by the Regnitz River running parallel to the Franconian Alb 35 km to the south (SCHIRMER 2018).

A further interesting point is, that after shifting of the River Main from the Albmain bed into the Banzmain bed the Main River came back to the Albmain bed overlapping its degradational terrace prevoiusly left. The reason for this overlapping was: The incision of the Banzmain bed was more shallow than the following aggradation of the Grundfeld flument (Fig. 3.2). Consequently, the river overlapped its previously deosited relict terrace.

The thickness of the overlap deposit was up to 3.3 meter. Moreover, this overlap deposits offer three stories:

1. The aggradational Grundfeld flument that overlapped with its uppermost part was completely eroded in the Banzmain Valley within in the valley reach of Fig. 3.3. Thus, the Grundfeld deposits are preserved by their overlapping deposits only. Fortunately, 8 km upstream, the pelma of the Grundfeld flument is preserved. It allows us to calculate a cutting rate of 3-5 m below the degraded Albmain Valley bed.

2. The overlap part of the Grundfeld Flument lying in the old abandoned Albmain Valley was deposited beyond the influence of the later Main River. Fortunately, it is preserved with four small sub-fluments each separated by fossil soils (Luvisols and Cambisols) that indicate warmer periods between the sub-fluments, which contain cold climate indicators (cryoturbations and drop soils) (cf. SCHIRMER 2020a). The repeated cold-warm sequence is reflected in the MIS 7 sediment complexes of loess sections, deep sea cores and ice cores (e.g. SARTORI 2000, LISIECKI et al 2005, JOUZEL et al. (2007), PIVA et al. 2008, BUGGLE et al. 2011, 2014, VOELKER et al. 2011, FITZSIMMONS et al. 2012, RAILSBACK et al. 2015, SCHIRMER 2017, ZEEDEN et al. 2018, WAGNER et al. 2019, CHOUDHURY et al. 2020) (Fig. 4).

3. The next incision after the deposition of the five Grundfeld Fluments and prior to the aggradation of the Nassanger Flument took place with the decline of MIS 7 or the beginning of MIS 6.

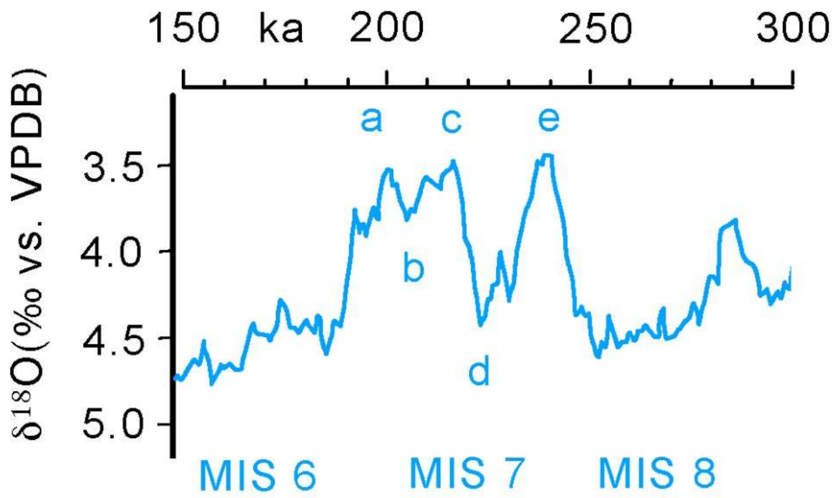

Fig. 4 MIS 7 Interglacial Complex with three interglacial periods (7a, 7c and 7e). LR05 curve after LISIECKI & RAYMO (2005) redrawn from RAILSBACK et al. (2015). VPDB = Vienna PeeDee Belemnite.

3. Dating the valley shift

The time of the shift was before or with the beginning of the aggradation of the Grundfeld Flument (MIS 8) at about 340–270 ka BP. The time when the overlap from the Banzmain Valley on to the Albmain Valley ceased was during or shortly after the deposition of the youngest Grundfeld Flument (MIS 7b) at around 200–190 ka BP (Fig. 4).

4. Recent conditions of the two valleys (Fig. 3.4)

The abandoned Albmain Valley to date is slanting down from the slope toe of the Franconian Alb toward the Posidonia Islands respectively toward the Banzmain Valley. It was successively filled up by slope deposits from tributary creeks and soil creep.

The Banzmain Valley experienced a continued river history of further river cuttings and aggradations until today: The Nassanger Terrace during MIS 6 and possibly row terraces of MIS 5 age (Fig. 3.3), the Reundorf Terrace during MIS 4 to early 2, the Schönbrunn Terrace during late MIS 2, the Ebing Terrace during the Younger Dryas Period (14.4-11.7 ka) and seven Holocene accretional row terraces (Fig. 5, SCHIRMER 2020b: 8).

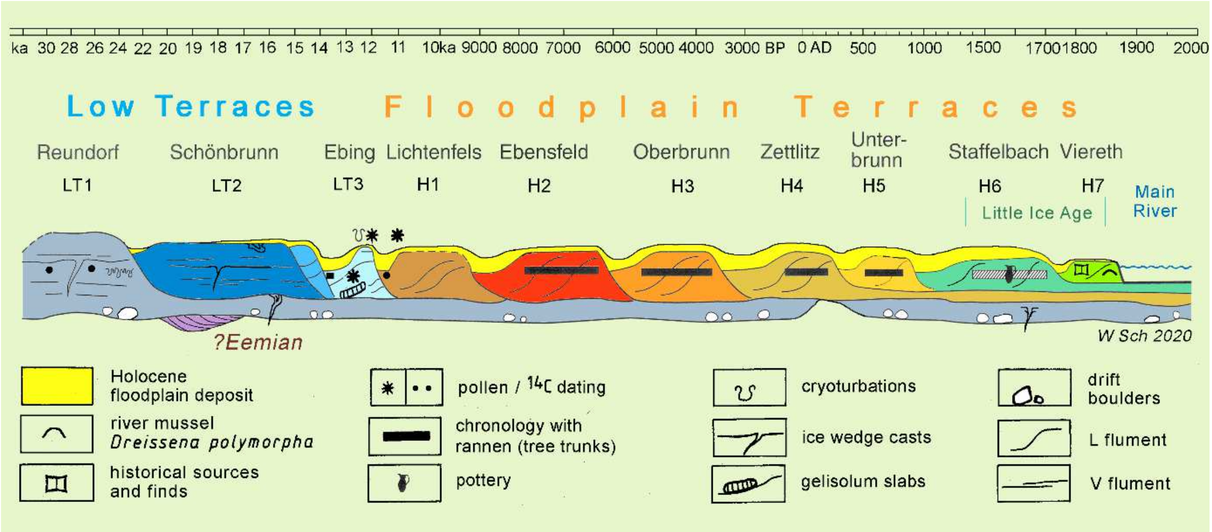

Fig. 5 Terrace/flument row. Scheme along the Main River. From the Low Terrace 2 (LT 2) on, the river terraces of the valley floor form a terrace row. Occasionally, they get flooded (yellow), and therefore were called floodplain terraces. H = Holocene (from SCHIRMER 2020a: 8).

5. Acknowledgements

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