OSL-Dating of Floodplain Sediments from the rivers Danube (Austria), Ebro (Spain) and Elbe (Germany)

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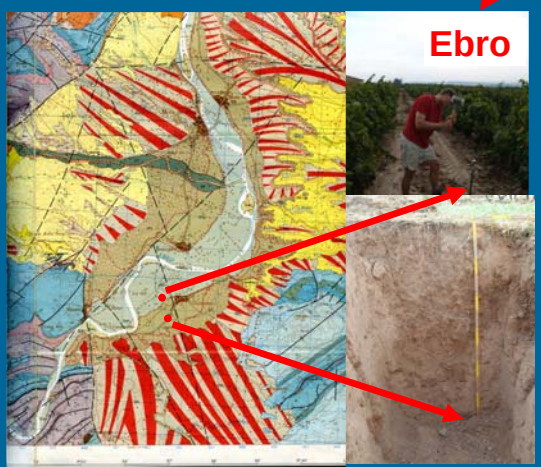
Objective

The objective of this study in the AQUATERRA project was to investigate the development of floodplains in different European rivers systems. Samples came from the Elbe, Ebro and Danube system. For chronological control dating by optically stimulated luminescence (OSL) was undertaken.

Details of OSL-Dating

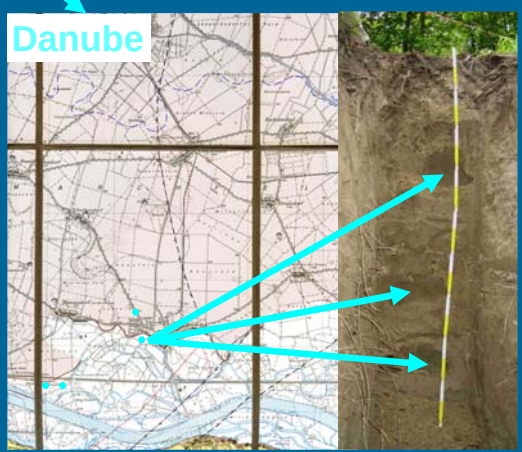
OSL measurements were made using a Risø TL/OSL DA-15C/D automatic reader with a calibrated 90Sr/90Y beta source. The luminescence purity of the quartz extracts was checked using infra-red stimulation. Blue light-emitting diodes (LEDs) were used for the optical stimulation of quartz for 40s, at 125ºC. Preheat temperature was 260ºC to empty any shallow traps which may be unstable during the burial period of the sediment. A Single-Aliquot Regenerative-dose (SAR) protocol was used to estimate equivalent doses. The last step of each cycle was illumination for 40s, at 280ºC. Dose recovery tests, dose response grow curve and thermal transfer tests were measured for each sample, and a preheat plateau test on one sample. Equivalent doses (De) are based on between 97-99 aliquots per sample. The dose rates were calculated based on laboratory high-resolution gamma spectrometry analyses on bulk samples from the sediment surrounding the OSL sample. The current and saturated water content of the samples was measured and the medium content calculated.

Local setting of samples



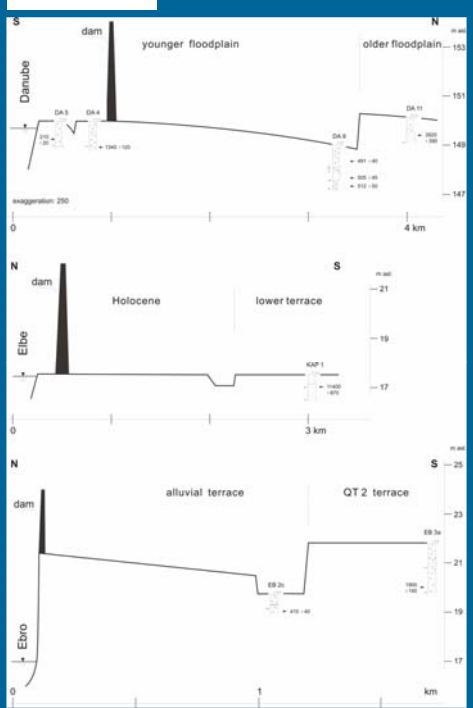
The Mora basin is a small Tertiary basin inside of the Iberian coastal range, with huge Pleistocene fan sediments (red strips) and terrace accumulations of the river Ebro (brown and grey colour on the Geol. map of Orche et al. 1981). We toke a sample from the older alluvial terrace (grey, QAL1) and several samples from the next higher terrace level (brown, QT2). In a small pit (foto) we found in 1,2 m depth pottery fragments which were classified by Thermoluminescence (TL) to the Greek/Early Roman period.

The Elbe valley does not display a terrace staircase but a flat valley bottom. Since the 13. century the local population tries to prevent the valley from flooding and fluvial erosion by artificial dam constructions. The border between Pleistocene (green colour) and Holocene accumulations (in grey) is visible on soil maps (eg. Schwartz 2001 & Weissermel 1898). In a drilling we extracted an OSL-sample from the Pleistocene surface. Samples from the Holocene area have been taken but not jet dated.



The sampling sites at the river Danube are located on postglacial terraces (higher surface in grey, lower surface in white) inside of the historically documented maximum border of flooding (blue interrupted line on the Geol. map of Fuchs & Grill, 1984). We toke three samples in one small pit on the lower terrace (photo). Close to this pit a medieval wooden harbour, dated archeologically to the 16th century, was digged out below a flood loam cover. Two additional samples from the lower (white) terrace and one sample from the higher (grey) terrace have been taken.

Results



Location Sample depth	east (°, min., sec.) date WGS 84	north (°, min., sec.)	*surface elevation a.s.l (m)	*sample elevation a.s.l (m)	Medium water content %	OSL-age (a = years)
DA4 – 1,1m	16° 39' 39''	48° 08' 05''	150	148,9	35	1340 +/- 120
DA5- 0,7m	16° 39' 47''	48° 08' 03''	150	149,3	34,5	210 +/- 20
DA9 – 0,65m DA9 – 1,3m DA9 – 1,65m	16° 41' 43''	48° 08' 42''	149	148,35 147,7 147,35	21,6 19,5 27,7	491 +/- 40 505 +/- 45 512 +/- 50
DA11 – 0,7m	16° 41' 32''	48° 09' 14''	150	149,3	15,5	3920 +/- 390
EL3 – 0,5m	11° 31' 33''	53° 01' 26''	17,5	17	15,4	11400 +/- 870
EB2c – 0,7m	00° 37' 32''	41° 02' 38''	19,8	19,2	14,1	410 +/-40
EB3a – 1,3m EB 3a – 1,3m	00° 37' 49''	41° 02' 23''	21,8	20,3 20,3	14,2 12	1900 +/- 140 1900 +/-140

Considering a regulary flooding of the valley bottom we assumed that the medium water content was the average water saturation in the past and used this value for calculation of the ages.
All calculated ages from samples in superposition (eg. BGS) show plausible values. Samples extracted from the same horizon give similar ages (eg. EB 3c). The information from different methological approaches (eg. TL-daing and archeological information) fits very well with the sedimention age by OSL (Da = Danube, EL = Elbe, EB = Ebro).

Conclusion

OSL-dating of a sample from the lower terrace of the Elbe confirms the (late) glacial age of this terrace unit. The sampled fine sediment cover of the Ebro QT 2-terrace, which was previously considered older then Holocene (= not alluvial), is OSL- and TL-dated to the Roman period. In the Danube area the two fold subdivision of the postglacial accumulations can be subdivided into modern, late medieval, late roman and bronze age accumulations.
The used approach to date flooding sediments with OSL brought reasonable results and is capable to solve archaeological and geomorphological question in river environments.