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Pitfalls in estimating past sedimentation rate in floodplains of aggrading rivers

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In some recent studies of flood plains of European aggrading rivers, facial and architectural dependences of apparent sedimentation rates in have been underestimated. The facial dependence is either a consequence of slower and finer sedimentation in a distal floodplain or coarser and faster sedimentation in the closer vicinity of a river channel. This basic knowledge is not considered if sediment samples are obtained from drill cores and cannot be evaluated by a sedimentologist, or a large number of ^{14}C data is statistically processed while the depositional environment of each individual dated material is not adequately considered.

We have studied sediments from about 1/3 of the total width of the floodplain of the lower course of the Morava River near Straznice in the south-eastern part of the Czech Republic (upstream watershed 9146 km^2). We collected samples from up to 5 m thick floodplain sediments in the river erosional banks and up to 4 m long drill cores in the floodplain, and subjected them to geochemical and granulometric analyses. Their absolute dating was performed by ^{14}C analysis of wood debris or charcoal (Middle and Upper Holocene) and the sediment from the last century was identified due to its regional industrial contamination by Pb and Zn and magnetic particles. The apparent aggradation rate was calculated to range from 0.2 to 0.6 cm/y and we spot that it has been indirectly proportional to the sediment clay content. As the younger sediments were coarser than older ones in the studied part of the floodplain area, our results "pretended" an increase of the sedimentation rate during the last millennium. This bias became obvious after evaluation of the change in the Morava River channel system in the last approximately five centuries according to the sediment record, of which the final stage has been depicted in historical maps from the last two centuries (reliable older maps are not available). Instead of accelerated aggradation, we have in fact revealed a gradual change of the Morava River from a complex system of several, probably meandering branches during the last several centuries to the actual single channel passing through the area we have studied recently.

Another systematic change of floodplain sediments, which we revealed in the studied area of Morava River, seems to have proceeded during the last 4 millennia: coarse, mostly sandy sediments found on the base of studied profiles are usually older than 4 ky BP; poorly sorted sandy-silty-clayey sediment is dated to 4 to 2 ky BP; and up to 4 m of better sorted top sediments have been deposited in the last about 1500 y. Because these sediments point to a different structure of the former Morava River, we cannot unequivocally conclude that the loam deposition has started just during the last 1 to 3 ky, as it is almost conventionally stated for many similar European floodplains on the base of similar results. It is hard to exclude two alternative explanations: 1) removal of the older loamy sediments by plain lateral movement of meandering river channels and 2) different floodplain architecture of our studied part of the floodplain in comparison with the entire past floodplain. Both these alternative explanations seem sound for the studied Morava River floodplain.

Therefore we show that the evaluation of sedimentation rate in the floodplain of an aggrading river must be done with a great care to avoid erroneous description of the past erosion in the watershed and the subsequent deposition in floodplains.