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Floodplain sediment phosphorus concentrations related to long-term trends in population, landscape dynamics and river eutrophication

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Soil phosphorus (P) levels can reflect the population density in a catchment. In this vein, the historical evolution of floodplain soil P content could identify the anthropogenic effects on the fluvial P and, reconstruct pre-human P concentrations, which are considered the basis for setting environmental P limits. We combined soil chemistry with pollen data and settlement history to relate changes in land cover, paleo demography, and river P concentrations over the past 7,500 years. We sampled floodplain sediment cores of 5 m depth from three locations in the Dyle river catchment (BE). Those cores were time dated with radiocarbon and analysed on two human impact proxies (1) the sediment degree of P saturation (DPS), calculated as the ratio of molar concentration of extractable P over Aluminium and Iron (2) the Human impact score based on pollen data from earlier research. We appended the biochemical data with (3) the archaeological evidence summarised to reflect regional population dynamics.

Comparing these three proxies allowed assessing the potential of floodplain sediment DPS analysis as a proxy for human impact and identify the natural background of P. The three proxies correlated significantly for all three locations, confirming the application of sediment DPS as proxy for human presence in a catchment. The first settlements had a limited impact on the sediment DPS. During the Roman period (2,000 BP), the sediment DPS peaked downstream in the catchment, suggesting a large environmental impact. During the Middle Ages, DPS levels rose slowly for all sites to peak again in recent times. Based on the sorption relationship between sediments and surface water, the natural background of P in the Dyle river was estimated from a period with low human impact at 41 [95% CI: 16, 78] µg TP L^{-1} or 27 [95% CI: 3; 54] µg PO_4-P L^{-1}, almost a factor of ten below current levels. The results suggest floodplain sediment DPS analysis and geoarchaeological evidence could assess past environmental impact linked to population dynamics, and illustrate that dated floodplain sediment sequences can identify historical periods of intensive occupation within a catchment.