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Anthropogenic stratigraphic signals downstream a metropolis: Extracting Vienna's signature from Danube river plain archives

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Among tectonics, lithology, and climate, human impact has become an external forcing control on Earth's environmental and geological processes, leaving its traces in geological archives. Even though this anthropogenic influence can be seen on a global scale, regional studies characterizing the scope and growth of anthropogenic influence centers, such as major cities, are scarce, especially for urban or peri-urban environments.
In this study, we investigate the anthropogenic impact of the metropolis Vienna on its peri-urban environment, and correlate and evaluate the main geological signals for a potential Holocene-Anthropocene transformation in the 1950s during the so-called "Great Acceleration" of Earth System Sciences (Steffen et al., 2015) by applying sedimentological and geochemical methods.
The human influence in urban sedimentary archives of Vienna has already been detected in previous studies by Wagreich et al. (2022) using artificial isotopes and trace metals as stratigraphic markers on urban coarse artificial ground. Here, the study area is set further downstream of Vienna, in the National Park Donau-Auen, where direct human intervention into the archived Danube river sediments is currently nil and floodplain archives allow to trace and quantify the human stratigraphic fingerprint and test dating techniques using (artificial) radionuclides in an alluvial setting.
Within the proximal floodplain sediments of the Danube, i.e. erosional profiles and sediment cores, sedimentological, geochronological and chemostratigraphic markers are applied to characterize and date the anthropogenic strata in this area. First observations indicate three periods of distinct sedimentation patterns, potentially corresponding to the natural state prior to significant human intervention, the river system's reaction to the first extensive river channelization in the 1870s CE, and its following response to the construction of hydropower stations (1956-1998 CE) and second river regulation (1990s). The lowermost section is characterised by clay- and organic-rich thin layers (few cm to mm) being suddenly replaced by alternating silt and sand packages of 5 to 20 cm beds. The uppermost silt to fine-sand dominated section is massive and shows almost no sediment structures, unlike the other sections, and exhibits a uniform light grey colour distinct from the light beige and dark brown colour of the underlying deposits.
The archive of natural Danube deposits is further analysed for artificial radiogenic isotopes, trace metals, and (micro-)plastics with the aim (i) to disentangle the anthropogenic fingerprint of Vienna from the sediment and characterise the interplay between upstream human interventions and local river dynamics, (ii) to identify and evaluate the geological signal of the Great Acceleration of Earth System Sciences around the 1950s, and (iii) to evaluate markers for a potential Holocene-Anthropocene transformation downstream of Vienna.

References:

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