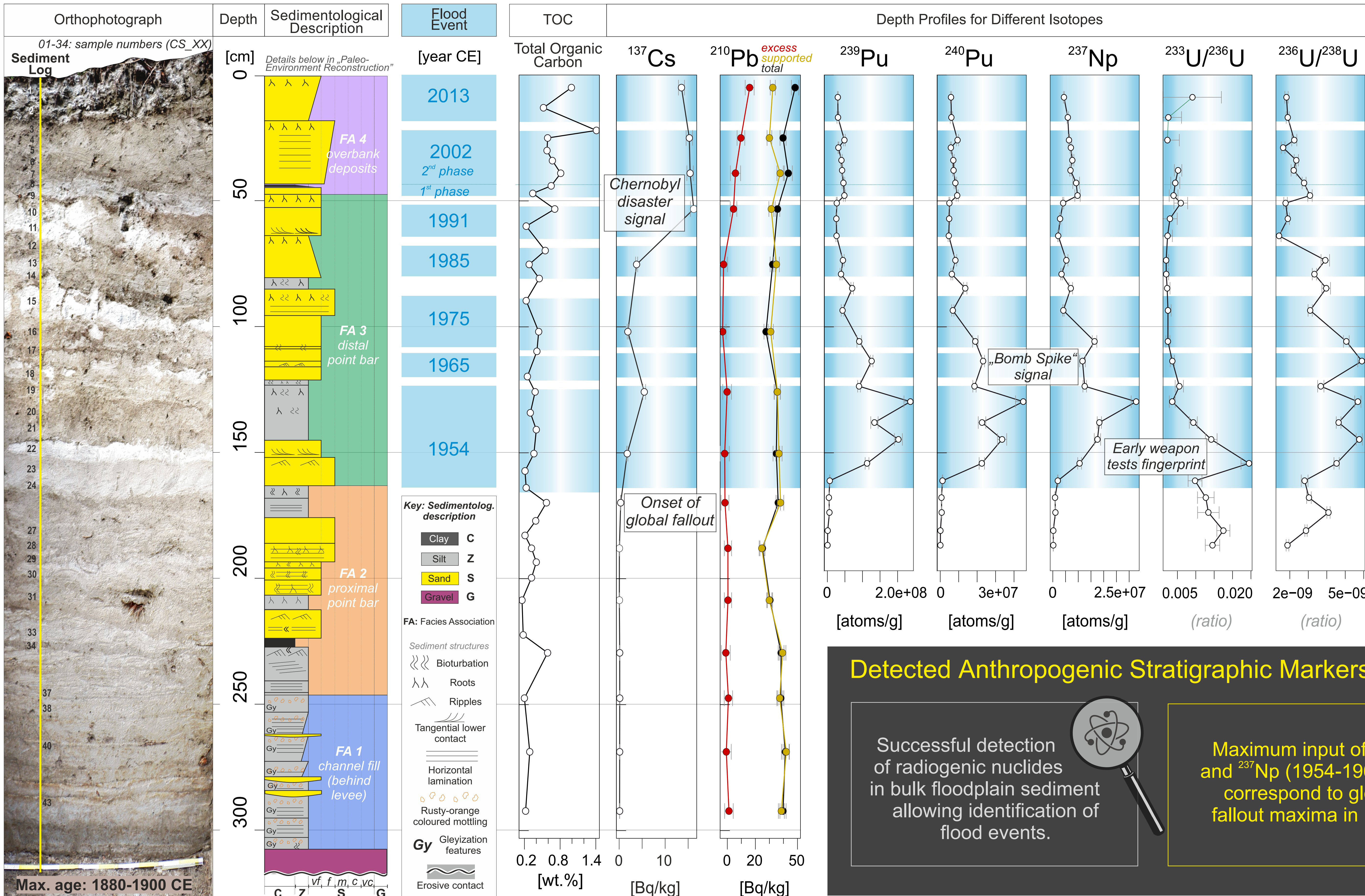
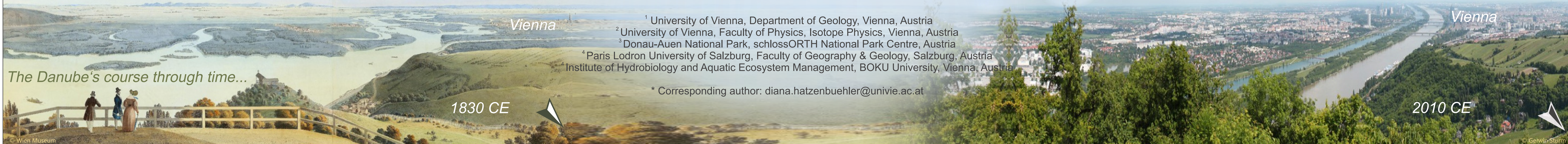


# From Floodplains to Fallout:

## Anthropogenic stratigraphic signals in Danube floodplain archives downstream of Vienna

Diana Hatzenbühler<sup>1\*</sup>, Michael Weißl<sup>1</sup>, Karin Hain<sup>2</sup>, Christian Baumgartner<sup>3</sup>, Alexander Hubmer<sup>4</sup>, Andreas Lang<sup>4</sup>, Ronald Pöppl<sup>5</sup>, Michael Wagreich<sup>1</sup>



### Introduction and Study Area

The **Danube river** has been an essential part of Vienna since the first settlements. Being located along the river, Vienna profits from the constant water access.

However, floods had presented a constant threat to the inhabitants, and as a consequence, construction measures were implemented to gain control over the highly dynamic river.

These measures are concentrated in and upstream of Vienna, while the area downstream, the nature reserve „Donau-Auen“ remained far less impacted.

For our project, this area presents a natural laboratory to investigate the anthropogenic impact of the metropolis Vienna on ist peri-urban environment.

Can we detect the anthropogenic fingerprint in the natural sediments of peri-urban floodplain archives?



### Dating Floodplain Sediments

#### The Challenge: Young age of deposits

Dating of very young deposits (e.g. last 10-100 years) presents a challenge to geoscientific methods. While <sup>210</sup>Pb is commonly applied for dating such ages, it is more appropriate for environments with constant sedimentation rates and absence of sediment reworking, conditions atypical for active floodplains.

#### The Approach: Event-based dating

Thermonuclear weapon tests from 1952 to 1963 CE generated a global signal of anthropogenic radionuclides, reaching its peak in the early 1960s, the so-called „bomb-spike“ of <sup>239</sup>Pu, excess <sup>14</sup>C and other isotopes (Waters et al.,

2016). Similar events were created in nuclear power plant disasters such as Chernobyl in 1986, though their impact is more regional.

Our study integrates multiple analytical methods, such as sedimentological analysis, historical reports and fingerprinting of radiogenic nuclides, to identify and date flood events of the last 80 years. Bulk sediment composition for <sup>137</sup>Cs and <sup>210</sup>Pb using gamma spectrometry. <sup>39</sup>Pu, <sup>240</sup>Pu, <sup>237</sup>Np, and ratios for <sup>233</sup>U/<sup>236</sup>U and <sup>236</sup>U/<sup>238</sup>U were measured with Accelerator Mass Spectrometry (AMS), after extraction chromatography with TEVA® and UTEVA® Resin cartridges (Eichrom Technologies®) to isolate actinide fractions and remove matrix interference.

### Detected Anthropogenic Stratigraphic Markers

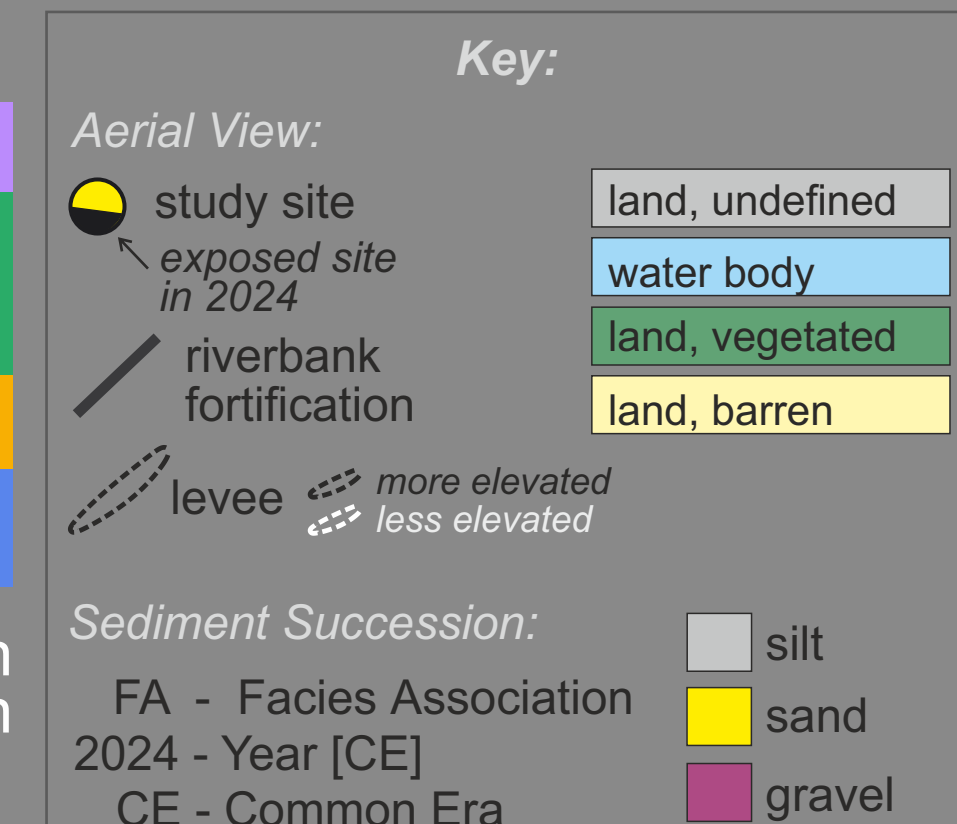
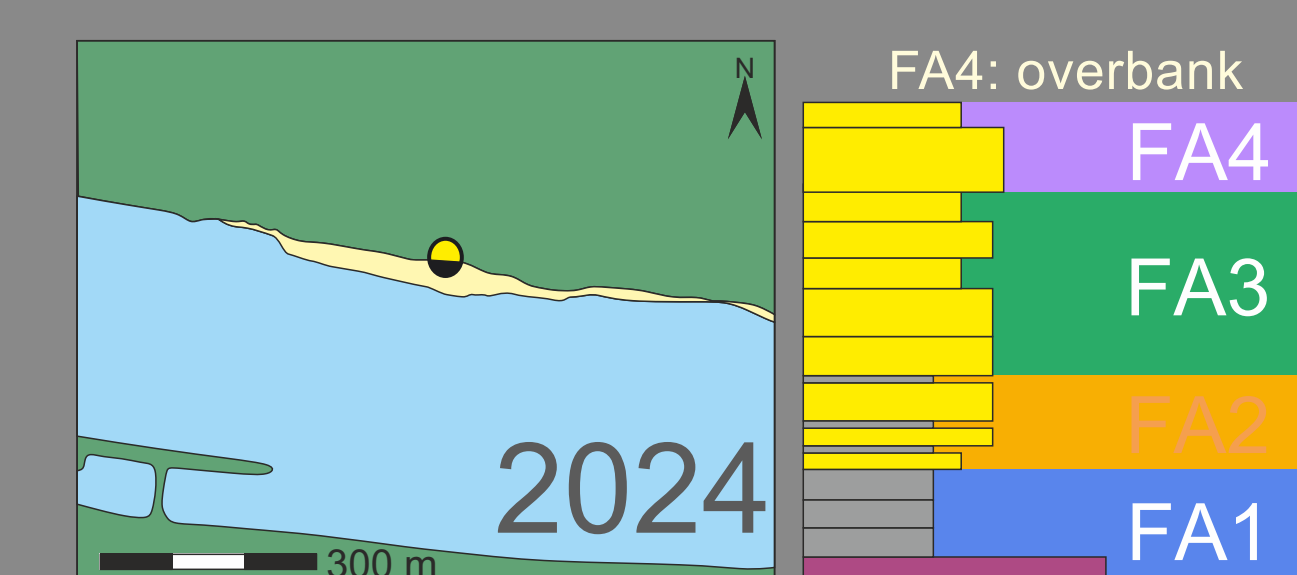
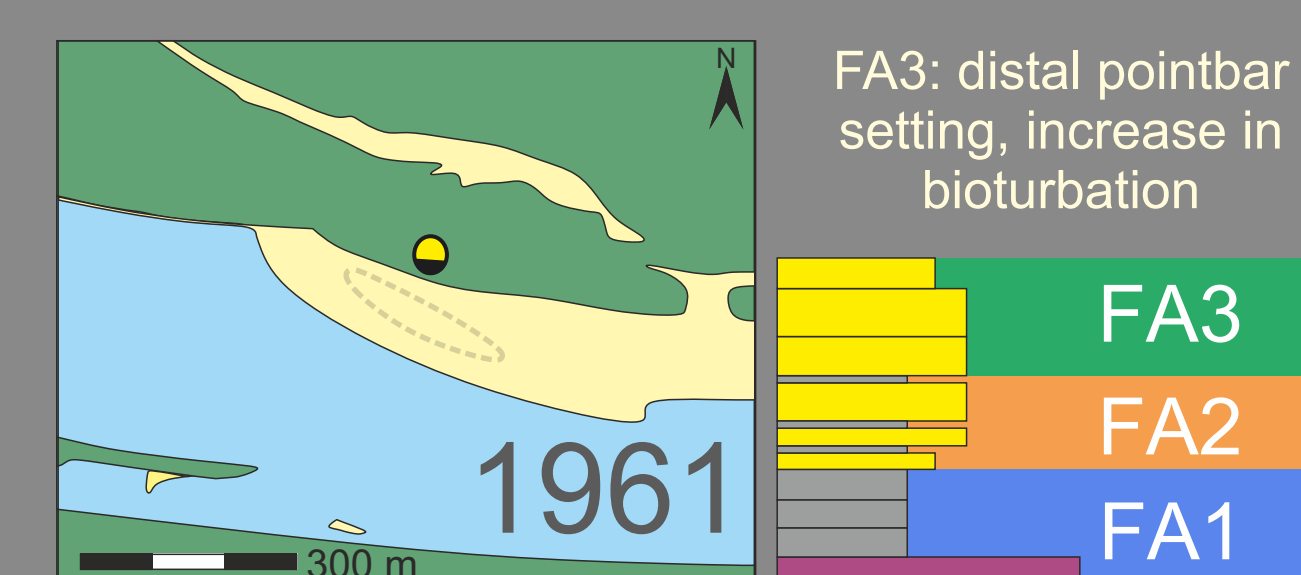
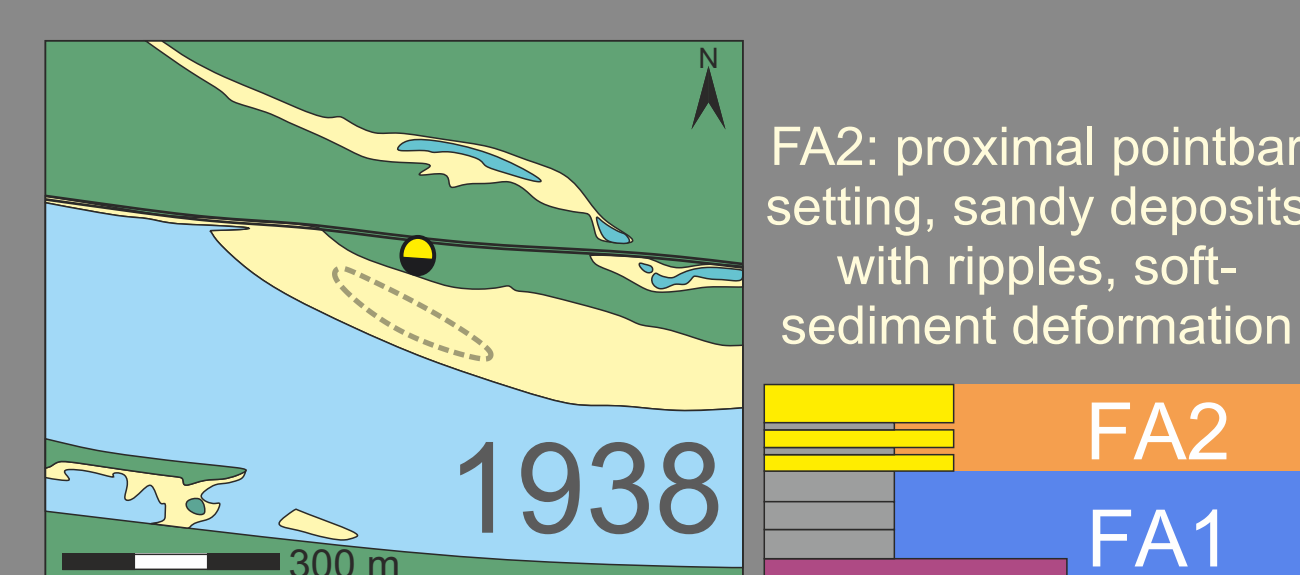
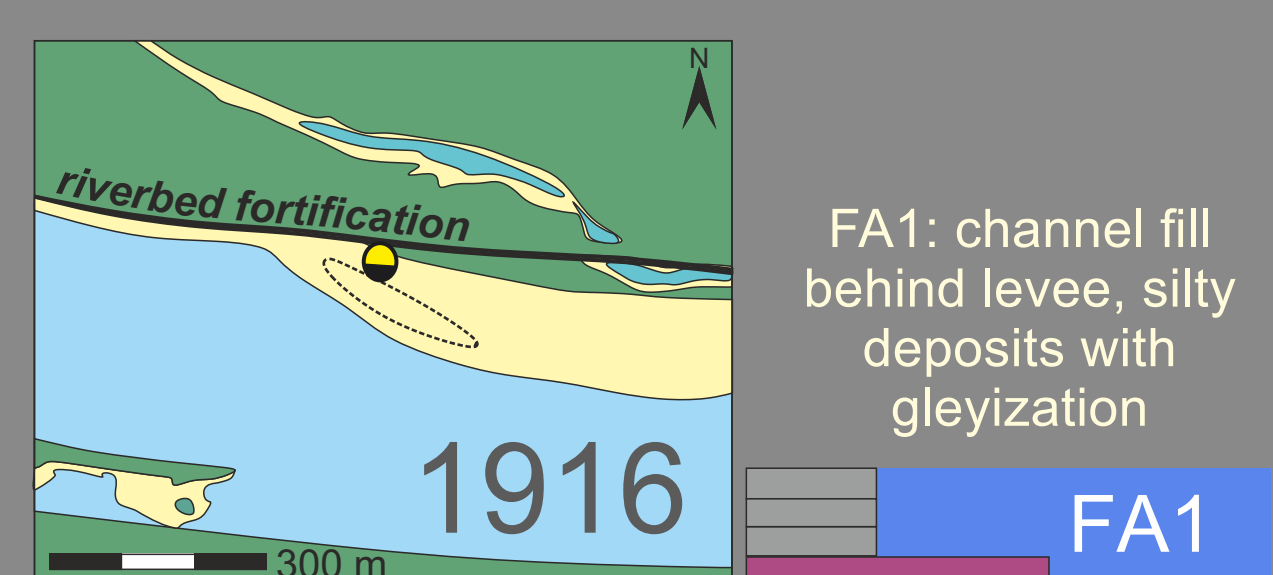
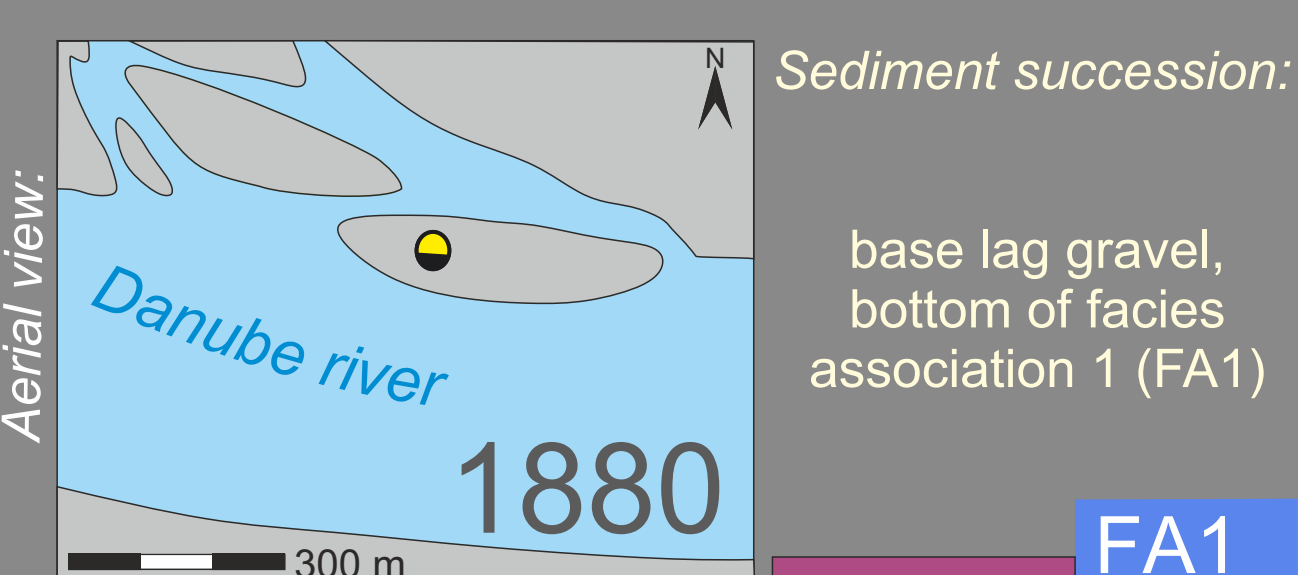
Successful detection of radiogenic nuclides in bulk floodplain sediment allowing identification of flood events.

Maximum input of <sup>239</sup>Pu and <sup>237</sup>Np (1954-1965 CE) correspond to global fallout maxima in 1963.

<sup>233</sup>U/<sup>236</sup>U peak prior to <sup>239</sup>Pu, <sup>237</sup>Np peak reflecting changes in isotopes used as fuel in nuclear weapon tests.

Detection of Chernobyl disaster (1986 CE) signal solely in <sup>137</sup>Cs. Being highly volatile, this radionuclide was transported across Europe, while Pu, Np, or U where deposited in the proximity of the reactor.

### Paleo-Environment Reconstruction: Based on Facies Analysis and Historical Mapping



Natural state prior to river straightening: Meandering river with abundant gravel bars and frequent river bank reworking.

River straightening in 1880/1890 CE: Onset of continuous aggradation triggered by construction of riverbed fortification.

Coarsening upward of mean grain size and sediment structures of the lower to medium flow regime.

First appearance of dm-thick flood deposits with internal grain size fractionation (sandy vs silty beds). Progressively less defined towards the top.

Onset of massive, uniform flood deposits in an overbank setting. Beginn of lateral erosion opening-up the studied section.

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Cooperation with:

Nationalpark Donau Auen

References:

Waters, C.N., Zalasiewicz, J., Summerhayes, C., et al., 2016. The Anthropocene is functionally and stratigraphically distinct from the Holocene. Science 351, a2622.