

4. Summary

Landslide fens are a type of mountain minerogenic mires that develop in landslide depressions. Comparing to the typical lowland mires they are characterized by a more variable hydrological regime and a greater dynamics of minerogenic material delivery to the sedimentary basin. Owing to such conditions, in the sediments of landslide mires, as well as landslide lakes, changes in the late glacial and Holocene palaeoclimate and palaeoenvironment could be recorded in a great detail. Two landslide fens, Kotoń and Klaklowo in the Beskid Makowski Mountains (the Western Carpathians), are particularly interesting due to the unique sequences of rarely documented late glacial and Holocene sediments of great thicknesses. The aim of the study of sediments from these landslide fens was to: i) compare the record of late glacial and Holocene climate changes, taking into account the influence of the different topographical position of these sites, ii) determine changes in the composition of plant macrofossils within two profiles collected from different zones of the same landslide fen, iii) determine local and regional vegetation changes during the Older Dryas climatic oscillation. Additionally, the aim of the doctoral thesis was to: iv) verify the occurrence of thermophilous plant refugia in the Kotoń landslide area during the late glacial, and v) identify tephra (volcanic ash) levels associated with volcanic eruptions during the late glacial.

Main cores of fen sediments were collected from the spots characterised by deposits of the greatest thicknesses, 500 and 367 cm for the Kotoń and Klaklowo sites, respectively. Two lateral cores were also collected from each of the landslide depression marginal zones (lateral cores Klaklowo B1 and B2, lateral cores Kotoń B1 and Kotoń B2). The sediment cores were then sampled and the obtained material was subjected to plant macrofossil analysis, pollen analysis, radiocarbon dating, loss on ignition, grain size and geochemical analysis.

The study showed that (with some exceptions) the expansion and/or disappearance of dominant plant taxa (*Pinus*, *Betula* sect. *Albae*, *Carex*, Bryopsida) and changes in the supply of minerogenic matter caused by global climate shifts (according to Greenland ice cores absolute chronology): Allerød warming (GI-1a–c, 13,904–12,846 years BP), Younger Dryas cooling (GS-1, 12,846–11,653 years BP) and Holocene warming (<11,653 years BP), occurred at approximately the same time in the Klaklowo and Kotoń landslide fens and were not conditioned by the exposure and/or altitude of the sites. On the other hand, during shorter climatic oscillations, Gerzensee cooling (GI-1b, 13,261–13,049 years BP) and the cold Preboreal oscillation (ca. 11,400–11,100 years BP), a much more pronounced lithological record (increased supply of minerogenic material) was observed within the Krakow fen than in the sedimentary sequence of the Kotoń site, which could be conditioned by the characteristics

of the Klaklowo fen catchment, including its area, shape, slope morphology, bedrock geology and specific local landforms.

In the case of both sites, it was found that the main sediment profiles collected in the central part of the fens are not only representative of the entire sedimentary basin, but also allow for the reconstruction of more stages of peatland development with more clearly defined stage boundaries than for the Klaklowo B1 and Kotoń B1 cores drilled in the marginal zones of the fens.

The Older Dryas climatic oscillation (GI-1d, 14,025–13,904 years BP), associated with the influence of a cold and dry continental climate, is represented in the sedimentary sequences of both Kotoń and Klaklowo fens by plant macrofossil assemblages which indicate the occurrence of steppe-tundra and prevalence of Arctic/alpine climatic conditions at that time. In the case of local vegetation and palaeohydrological changes, the GI-1d/Older Dryas climatic oscillation was recorded similarly at both sites, as a shallowing of existing palaeo-waterbodies.

Based on the results of pollen analyses conducted for the main and marginal cores, it was demonstrated that pollen of thermophilous plants (*Corylus*, *Ulmus*, *Quercus*, *Tilia*, *Carpinus betulus*) in the late glacial sediments of the Kotoń and Klaklowo fens is redeposited from the older slope covers. The plant macrofossil records also did not contain seeds, fruits, or vegetative parts of plants, indicating the local occurrence of these taxa. Therefore, the hypothesis of the occurrence of thermophilous plants refugia at the Kotoń site in the late glacial has not been confirmed by the current research results.

In the depth ranges selected (based on the modeled age) for the analysis of potential tephra horizons, the Neapolitan Yellow Tuff (NYT) and Laacher See Tephra (LST), both in the Klaklowo and Kotoń sites, numerous grains with tephra characteristics were found, however, detailed geochemical analyses are necessary to confirm their origin from the particular eruptions: NYT and LST.

The results of the conducted research make a significant contribution to the state of knowledge about local and regional changes in vegetation cover, chronostratigraphy and climatostratigraphy of the late glacial and provide a solid basis for further extended multi-proxy studies of the sediments of landslide fens in the Western Carpathians.