

ABSTRACT

This thesis aims to characterize the relict thermokarst features, compare them with the recent forms, delineate their locations, determine the paleoenvironmental conditions based on their morphology and distribution.

Approximately 530,000 km² of the European territory was surveyed for the evidence of paleo-thermokarst. The study identified 2,173 circular depressions, with detailed morphological characteristics collected for 528 of them. Based on their morphology and environmental characteristics, a hypothesis regarding their genesis was proposed. This hypothesis was subsequently refined through the review of literature and the comparison with other studies. As a result, 286 circular depressions were attributed to the remnants of paleo-pingos, 21 depressions were classified as paleo-thermokarst lakes, and the remaining depressions in Serbia were excluded from the paleo-thermokarst origin hypothesis.

The detected depressions vary in area from 1.5 to 8.7 ha. The assumed relict pingos mostly range between 0.6 and 5.2 ha. Most depressions have the major axis length between 50 and 500 m, while relict pingos range from 90 to 280 m. The rampart height ranges from 2 to 7.8 m, with the central 50% of measures between 1 and 2.3 m. The depth of depressions generally range from 0.5 to 1.5 m, and from 0.4 to 1.3 m for the detected pingo depressions.

The statistical analysis of the depression morphology revealed correlations such as the increase in depression size towards the southeast and the decrease of area with the increasing altitude. Additional relationships were found between the area of depressions, their depth, the height of the rampart, and their slope. The comparative analysis between the original dataset and the refined dataset that excludes non-paleo-thermokarst depressions showed neglectable differences.

Based on the detected paleo-thermokarst depressions, an alternative paleo-permafrost boundary was suggested. Compared to other studies, this boundary extends across the center of the Pannonian Basin, leaving the southern territories uncovered. For these areas, were proposed possible paleoclimatic conditions that are based on the detected paleo-thermokarst depressions. The mean annual air temperature (MAAT) of approximately -1°C to -6°C was proposed. The mean annual precipitation (MAP) was estimated to have been between 100 mm and 425 mm. The depth of paleo-permafrost in the Pannonian Basin, could have reached up to 600 m.

This study highlights the significance of relict thermokarst features as geoindicators for understanding the past climatic conditions and contributes to the broader field of paleoclimate reconstruction.

Key words: thermokarst, paleo-thermokarst, pingo, relict pingo, paleo-lake basin, morphology, LGM, Last Glaciation, permafrost, paleo-permafrost