# The landslide susceptibility assessment for application in the spatial planning system: from national to local scale

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# THE LANDSLIDE SUSCEPTIBILITY ASSESSMENT FOR APPLICATION IN THE SPATIAL PLANNING SYSTEM: FROM NATIONAL TO LOCAL SCALE

# PROCJENA PODLOŽNOSTI NA KLIZANJE ZA PRIMJENU U SUSTAVU PROSTORNOG PLANIRANJA: OD DRŽAVNOG DO LOKALNOG MJERILA

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Keywords: *landslides, landslide susceptibility assessment, Croatia*

The main motivation to research the landslide susceptibility assessment for application in land use planning arises from the national landslide risk assessment (BERNAT GAZIBARA *et al.*, 2019) which recognised landslides as a second natural risk in Croatia (CNPDRR, 2019). Furthermore, the preliminary regional landslide susceptibility analysis showed that approx. 20 % of the Republic of Croatia area is potentially prone to sliding. Therefore, landslide susceptibility assessment for national, county and local levels was carried out in the frame of two scientific projects Methodology development for landslide susceptibility assessment for land-use planning based on LiDAR technology (LandSlidePlan, HRZZ IP-2019-04-9900) (BERNAT GAZIBARA *et al.*, 2022) and project Applied landslide research for the development of risk mitigation and prevention measures (PRI-MJER, KK.05.1.1.02.0020). The national landslide susceptibility map at a small scale is created to give a general overview of critical areas for an entire country, and its purpose is to inform policymakers and the general public (MIHALIĆ ARBANAS *et al.*, 2022). County-level landslide susceptibility assessment on a medium scale synthesizes available data and identifies wider areas with landslide problems and can be used to define areas for more detailed research on a local level. The third level is the local-scale landslide mapping and zonation that includes specific areas of local administrative units (municipality or city) or complex critical areas. The results were landslide susceptibility maps for seven study areas: (i) the Republic of Croatia; (ii) City of Zagreb, Karlovac County and Primorje–Gorski Kotar County; and (iii) the study areas in the Zagreb City (BERNAT GAZIBARA *et al.*, 2023), Hrvatsko Zagorje (SINČIĆ *et al.*, 2022a), Karlovac City (SINČIĆ *et al.*, 2022b) and Istria.

Methodology development for landslide susceptibility assessment on national and county scales was carried out using a heuristic approach, i.e. Fuzzy Logic method, and available topographical and geological data. Given that the validation of the final landslide susceptibility map is mandatory, and systematic landslide inventories at the national or county level do not exist, we used the landslide database conducted by the University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering. The database consists of 2,186 landslides with the exact location of the occurrence. All landslide susceptibility maps showed high accuracy and were classified into three susceptibility zones, considering The Area Under the Receiver Operating Characteristic Curve ($AUC_{ROC}$).

Methodology development for landslide susceptibility assessment on a local scale was carried out using different mapping units and statistical methods (e.g. Information Value method, Weights of Evidence method, Logistic Regression and Discriminant Analysis, and machine learning methods, including Support Vector Machine, Artificial Neural Network and Random Forest). Moreover, landslide susceptibility models were computed using different scenarios of high-resolution input data, i.e. geometrical types of LiDAR-based inventory and variations of causal factors. Finally, all landslide susceptibility models were evaluated based on model fitting performance, model prediction performance, and model uncertainty. The purpose of comparing landslide susceptibility models is to define the most suitable maps for application in spatial planning at national, regional, and local levels. The research was based on innovative technologies, limitations related to the availability of spatial data in Croatia (limited amount of geological data), and urgent needs for efficient solutions applicable in the Croatian spatial planning system in line with European and global requirements related to sustainable development, human and environmental protection.

This work has been partially supported by University of Rijeka (project Uniri-tehnic 18-97 and Uniri-tehnic 18-298).

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# PETROGRAPHIC, MINERALOGICAL AND CHEMICAL CHARACTERISTICS OF BAUXITE FROM POSUŠJE DEPOSITS, BOSNIA AND HERZEGOVINA – AGEMERA PROJECT RESEARCH

# PETROGRAFSKE, MINERALOŠKE I KEMIJSKE KARAKTERISTIKE BOKSITA IZ LEŽIŠTA U POSUŠJU, BOSNA I HERCEGOVINA – AGEMERA PROJEKT ISTRAŽIVANJA

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Keywords: *bauxite deposit, karst bauxite, Posušje, petrography, AGEMERA*

The exploitation of bauxite in the wider area of Posušje in Bosnia and Herzegovina has been known since the first half of the 20th century, and to date more than 1100 deposits or occurrences of various sizes and structures have been discovered. Bauxite deposits of Posušje represent typical karst bauxites, formed during the emersion phase between Upper Cretaceous rudist limestones in the footwall and various carbonate and clastic rocks of Paleocene/Eocene and Oligocene ages in the hanging wall. The most intensive mineralogical and geochemical bauxite research in these areas was carried out during the 70s and 80s. Afterwards, despite numerous newly discovered deposits, no petrographic, mineralogical and geochemical analysis on the bauxites has been published. The present study is focused on recently discovered bauxite deposits in Posušje and their petrographic and mineralogical description. The bauxites show ooidic to pelitomorphic, but in places also clastic textures. Micro-ooids and spheroids are mostly smaller than 0.1 mm, and in places fragments of the former ooid can be found. In some bauxites, pebbles of resedimented bauxite prevail, mostly larger than 2 mm but sometimes larger than 1 cm, which define their conglomerate texture. Gibbsite and boehmite are the main Al-bearing minerals of the bauxites, and diaspore has not been observed. The ratio of gibbsite to boehmite varies between deposits, and in some deposits boehmite is the only aluminium phase present. Where present, the gibbsite is developed into relatively large hypidiomorphic crystals larger than 0.25 mm, with clearly defined polysynthetic lamellae. Hematite is the dominant Fe-phase in all deposits. Although rarely, goethite-rich bauxites can be found in the form of isolated layers, with just traces or no hematite. Zircon, apatite and calcite are minor and ac-