

# Cartographic and GIS aspects of geosite assessment: a case study in the Gerecse Hills, Hungary

Edina Hajdú <sup>a,\*</sup>, Márton Pál <sup>a,b</sup>

<sup>a</sup> ELTE Eötvös Loránd University, Institute of Cartography and Geoinformatics, hajdu.edina@inf.elte.hu

<sup>b</sup> ELTE Eötvös Loránd University, Doctoral School of Earth Sciences, pal.marton@inf.elte.hu

\* Corresponding author

**Keywords:** geosite, GIS, quantitative assessment, Gerecse Hills, geoheritage

## Abstract:

Geoheritage is a relatively new field of geosciences that is becoming widely known among scientists and tourists too. It is built on the diversity of earth scientific values of the abiotic nature (geodiversity). This concept is organically linked to geoparks, where the preservation and promotion of abiotic natural heritage is one of the key objectives. These are open and visitable areas with rich geoscientific heritage. The foundation and management of geoparks are based on the identification of geosites and their assessment. Geosites are the most spectacular and scientifically interesting objects in a given area: e.g. caves, rocks, key sections, cliffs or spectacular outcrops. Their geological, geomorphological, hydrographical and pedological properties are of high importance for experts, and they also may generate tourism interest. The geo-attributions are often complemented by cultural, and educational values. The connection of these different additional properties makes a site suitable for geotourism purposes. This branch of tourism is about sustainable development: visitors of geosites or geoparks are provided with relevant scientific information with cultural-historic aspects.

Cartography and GIS are closely linked to this discipline, as their data analysis methods and visualization techniques help to identify, manage, and promote geosites. This research was conducted to identify and evaluate potential geosites in the Northern Gerecse Hills, Hungary. The area's high geodiversity was recognised earlier with the GIS-based methodology of Pál & Albert (2021): this gave the basis for designating and assessing potential sites for geotourism utilisation. As geotourism infrastructure and geoconservation management are not yet established in the Gerecse Hills, this explorational research opened new perspectives using the toolset of cartography and GIS.

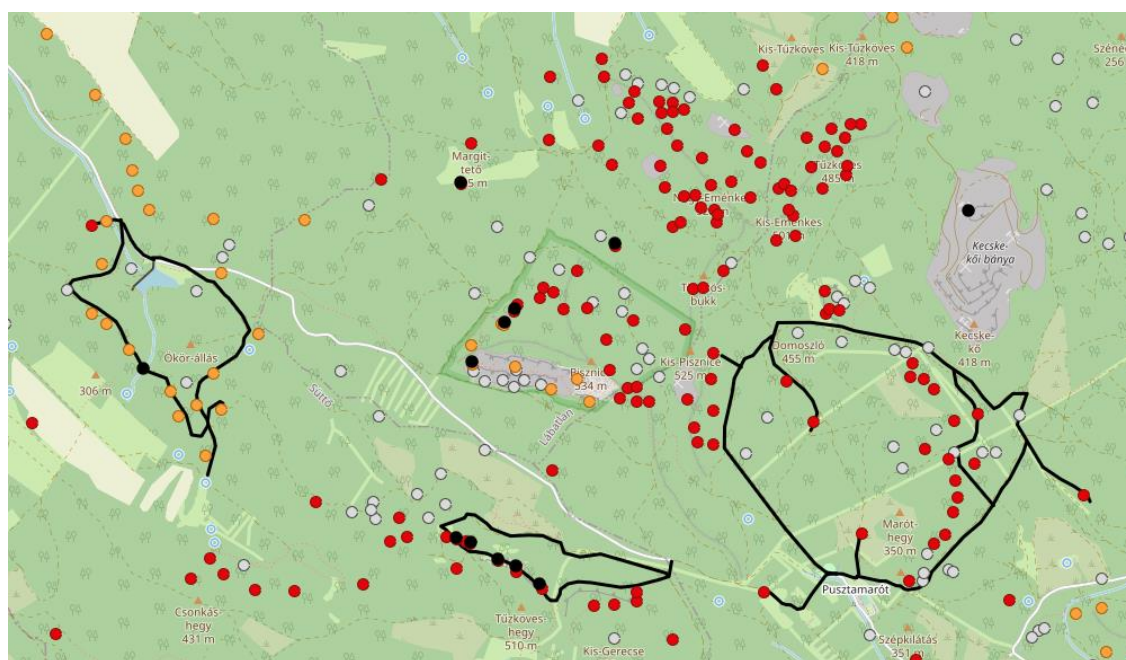


Figure 1. An excerpt of the Leaflet-based field map. The black point featured are the key sections, the red ones are the important ones, the orange dots are the moderately important formations while the grey points were only visited if the planned route went nearby them. The black lines are planned field tracks to be followed.

The identification and evaluation took place in a GIS-based workflow built up by the search for potential geosites, which was later supplemented by fieldwork and the evaluation (based on cartographic and field data). We used national topographic maps as a base material to look for potential geosites based on various relief forms (e.g. cliffs, gullies, holes, pits, caves, or rocks). In parallel to this analysis, we created a database in a GIS environment, marking each selected topographic symbol with a point feature. The selected potential geosites were classified into 3 categories based on their geological formation (that was noted from the 1:100,000 geological map of the area): important, moderately important, and not important category. The important category was formed by the rarest formations of the sample area: Triassic, Jurassic, and Cretaceous rocks. The least important category included topographic elements with lithology originating from the Quaternary. In addition, the geological key sections (the most important, spectacular and preserved examples of each rock type) formed a separate group due to their significance – all of them were visited on the field. The field survey followed the identification of potential geotopes. In all cases, we planned a route right before this, which basically went on trails, touching all the points that were considered important, as well as many less important points too.

Based on our field maps (a Lefalet-based smartphone app containing the categorised points and analogue topographic maps – Fig. 1), we could more easily identify potential sites, and we could also add comments to them that made desktop evaluation easier. This online map included every categorised topographic point and the planned routes for each day. The field evaluation of potential geosites was determined by their distance from the hiking trail system and settlements: only the sites in the 1 km buffer zone of these objects were marked as ‘must-to-visit’. This was because tourists usually do not visit sites that are not easy to access even by foot. Photos were also taken and used during the evaluation process. Field evaluation, notes and photos were organised into a database and prepared for desktop evaluation: the quantification of tourism and scientific values of each potential geosite.



Figure 2. The most important identified geosites of the Gerecse Hills. This database may contribute to the geotourism and geoconservation development of the area.

Two quantitative geosite evaluation methods were used during the evaluation: the Geosite Assessment Model (GAM – Vujčić et al., 2011) and the Modified Geosite Assessment Model (M-GAM – Tomić & Božić, 2014). Both evaluation methods were aided by GIS workflows and functions. For example, the 100k geological map of Hungary was analysed

to determine the rarity of each formation, while topographic and tourist datasets were evaluated to find the nearest restaurant, hotel, important road or visitors' centre to the potential site. By summing up the points given to these criteria, we get the geotourism potential score of each site. Nearly 400 potential geotopes were collected during the identification process: ~50 of them were found to be suitable for geotourism utilisation based on this method. By applying the 'natural breaks' method of Jenks, the most important sites were clustered and noted on a map (Fig. 2).

We got a comprehensive database of the geotourism value of the area and the evaluated geosites as a result. Objects with the highest geotourism potential (e.g. Vöröshid Key Section, Kópité Hill, Bersek Hill) may be the bases and core of further infrastructural developments and sustainable tourism utilisation. This database contributes to the establishment of the Hungarian National Geosite Inventory that incorporates all evaluated and important geosites of Hungary.

### Acknowledgements

EH was supported by the ÚNKP-21-2 New National Excellence Program of the Ministry for Innovation and Technology, Hungary.

MP was supported by the ÚNKP-21-3 New National Excellence Program of the Ministry for Innovation and Technology, Hungary.

### References

- Pál, M., & Albert, G. (2021). Refinement proposals for geodiversity assessment—a case study in the Bakony–Balaton UNESCO Global Geopark, Hungary. *ISPRS International Journal of Geo-Information*, 10(8). <https://doi.org/10.3390/ijgi10080566>
- Tomić, N. & Božić, S. (2014) A modified geosite assessment model (M-GAM) and its application on the Lazar Canyon area (Serbia). *Int J Environ Res* 8(4):1041–1052. <https://doi.org/10.22059/ijer.2014.798>
- Vujičić, M.D., Vasiljević, D.A., Marković, S.B., Hose, T.A., Lukić, T, Hadžić, O. & Janićević, S. (2011). Preliminary geosite assessment model (GAM) and its application on Fruška Gora Mountain, potential geotourism destination of Serbia. *Acta Geogr Slovenica* 51(2):361–377. <https://doi.org/10.3986/AGS51303>