

Relief and Landscapes

Landform Evolution

Topography is one of the most important factors in the geographical environment. Its configuration, origin, as well as past, present and future development is decisive for the character and course of the evolution of drainage, soils, flora, fauna and human settlements.

The Carpathian (Pannonian) Basin configuration is emphasised by the Alps, Carpathians and Dinaric mountain ranges that provide a frame for the depression, which is still in the stage of subsidence (*Figure 20*).

The primary characteristic features of the country's topography are low relief and poor vertical dissection. Hungary's lowest point is in the vicinity of Szeged (79 metres above sea level), whereas the highest one is in the Mátra Mountains (1014 m a.s.l.).

The Carpathian Basin is oval-shaped when viewed in plan and of relatively recent origin, developing mainly in the middle and late Tertiary as a result of the folding of the surrounding framework of mountains.

At that time, the uplift of the 1,500 km long range of Carpathians began, adjoining to the Alps in the west, and to the Dinaric ranges in the south. Also, the subsidence of the Alföld (Great Hungarian Plain) started ca 7–10 million years ago.

The relief of the interior of the Carpathian Basin, formed during the last transgression, is constituted by filled-up depressions, basins, plains, dissected hills, foothills and medium-height mountains dissected into horsts. Earlier (even during the Upper Miocene), medium-height mountains were found over huge areas, in locations where nowadays only basins and hills are to be found.

The present-day medium-height mountains (e.g. parts of the Vértes, Gerecse, Mecsek or Buda Mountains) were lower and sometimes covered with Pannonian marine deposits. Intense volcanic activity commenced in the north and north-western areas of the Carpathian

Basin, being at that time one of the 'hot spots' of the globe. The first rock to have formed as a result of these Miocene volcanic eruptions was the rhyolitic tuff, which covered the famous marine and terrestrial fossils of the Ipolytarnóc Nature Reserve.

Most of the mountains forming the inner Carpathian volcanic belt in Hungary were brought into existence by andesite volcanism during the Middle Miocene (e.g. the Visegrád, Börzsöny, Cserhát and Mátra Mountains) and Upper Miocene (e.g. Tokaj/Zemplén Mountains).

The surface is built of young marine, alluvial and eolian deposits and, to a lesser extent, by volcanic rocks; they disguise the events of the previous geological epochs. 73% of the country consists of lowlands and plains (up to 200 m a.s.l.), 20% of hills or foothills (mostly up to 350 m a.s.l.) and 7% of the territory is occupied by medium-height mountains (lower uplands to 750 m a.s.l. and mountains up to 1,014 m a.s.l.) and their valleys.

The present configuration of the topography was shaped during the past five and a half million years, and mostly in the Quaternary. More than three-quarters of Hungary is built up of loess and loess-like deposits, alluvial fans, talus cones, fluvial gravel and thick sand sequences; all related to the Pliocene and Pleistocene climate changes.

The travertines and landforms in karstifying rocks (e.g. caves in the Bükk Mountains, Aggtelek Karst in north-east Hungary or in the north-eastern part of the Transdanubian Mountains) developed mainly during these times.

In the middle of the Pleistocene (350–400 thousand years ago), during the Lower Paleolithic the first groups of the prehistoric people appeared in these areas (e.g. in the village of Vértesszőlős, on the Castle Hill of Buda and on the Kender Hill in Pilis Mountains).

Major Landscape Units

The present-day territory is divided into six physiographic macroregions: the Alföld (Great Hungarian Plain), the Kisalföld (Little Hungarian Plain), the West Hungarian Borderland, the Transdanubian Hills, the Transdanubian Mountains and the North Hungarian Mountains with its inter- and intramontane basins (Figure 21).

The largest landscape unit of the Carpathian Basin is the *Alföld* with a total territory of 100,000 km² of which 52,000 km² belong to Hungary. Its surface is made up of wide flood plains and alluvial fans of the interfluves. From the latter the Nyírség, the Maros Plain and the sandy plain on the *Danube–Tisza Interfluve* are the most important. Among them, the latter is the largest mesoregion of the country, where the landscapes were mainly formed by wind-blown sand. Here the deep subsurface sediments are the (100–800 m thick) deposits of the Danube. Out of these alluvial fans the *Nyírség* is the most diversified in terms of landforms, where the windblown sand was stabilised by the planting of acacias, fruit trees and tobacco.

The sandy plains merge into fertile loessic regions with chernozem soils, highly suitable for agricultural production. One of them is the *Hajdúság*, extending in a north to south direction and lying 30–50 m higher than the neighbouring grassy steppe of Hortobágy. The greatest extent of loess cover is to be found on the *Bácska* plateau in the South Alföld. In the Transdanubian part of the Alföld lies the *Mezőföld*, a plain thickly covered by loess, which rises 50–60 m above the Danube floodplain. Here one can find the famous loess exposure at Paks, which is a record of the climate changes during the Pleistocene.

The *Kisalföld* depression is bordered by the Transdanubian Mountains, the North-Western Carpathians and the Eastern Alps. Its territory is divided by the main branch of the Danube. The greater part of it (north of the river as *Danubian Lowland*) belongs to Slovakia, the rest (5,500 km²) is situated in Hungary. Its basin-like features are: a flat, plain-like character; unconsolidated deposits of gravel, clay and sand; centripetal drainage in relation to the Danube; broad flood-plains; and the groundwater table lying near the surface. Between Bratislava

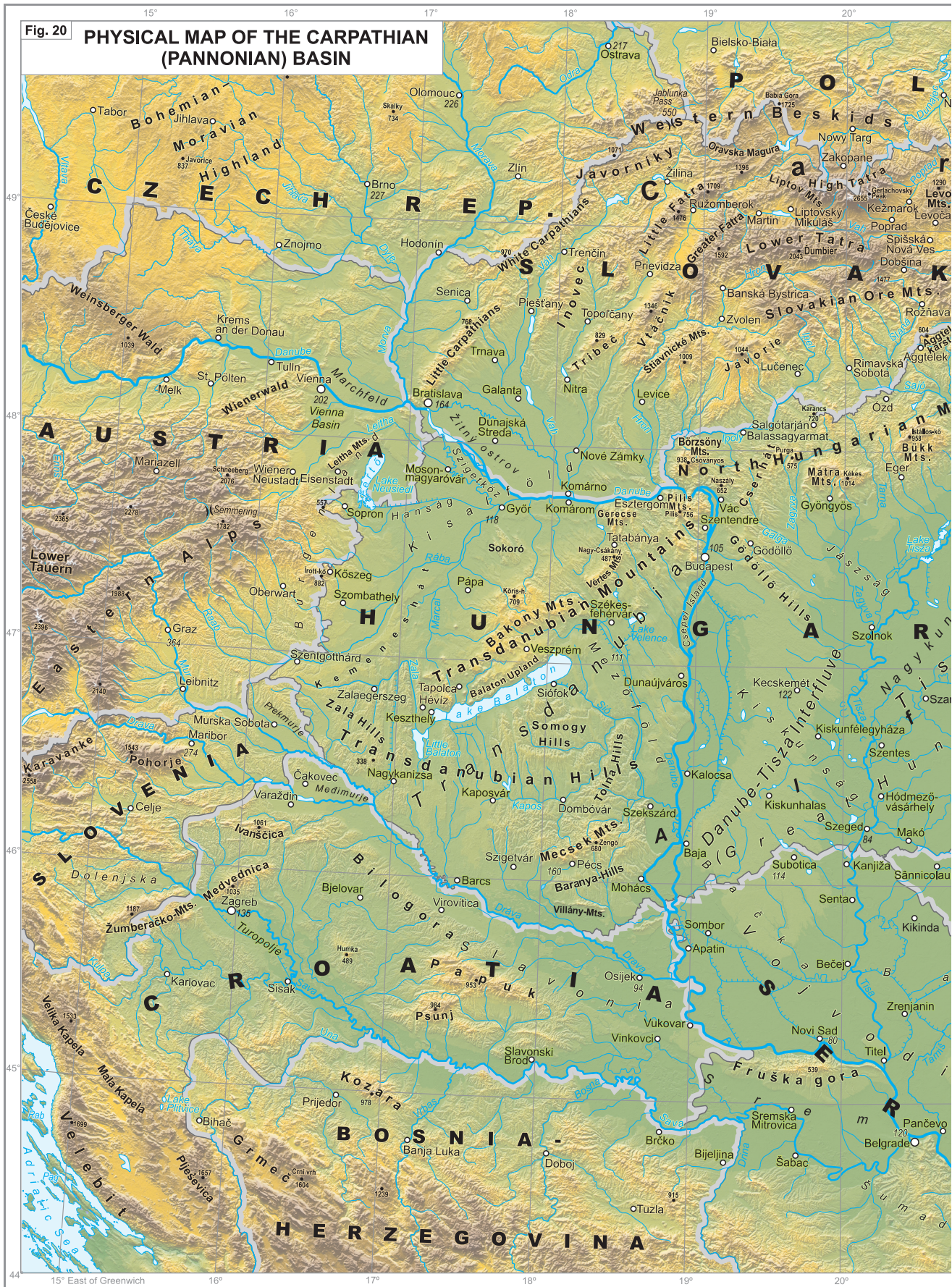
(Pozsony) and Komárom (Komárno) alluvial gravel and sandy deposits from the Danube accumulated in a thickness of between 1,000 and 2,000 m, and they serve as an abundant source of potable water. The flood-plain accumulated by the Danube and its tributaries turns into slightly dissected, eroded lowlands and plains of medium elevation with terraces and outlier towards the marginal regions of the Kisalföld.

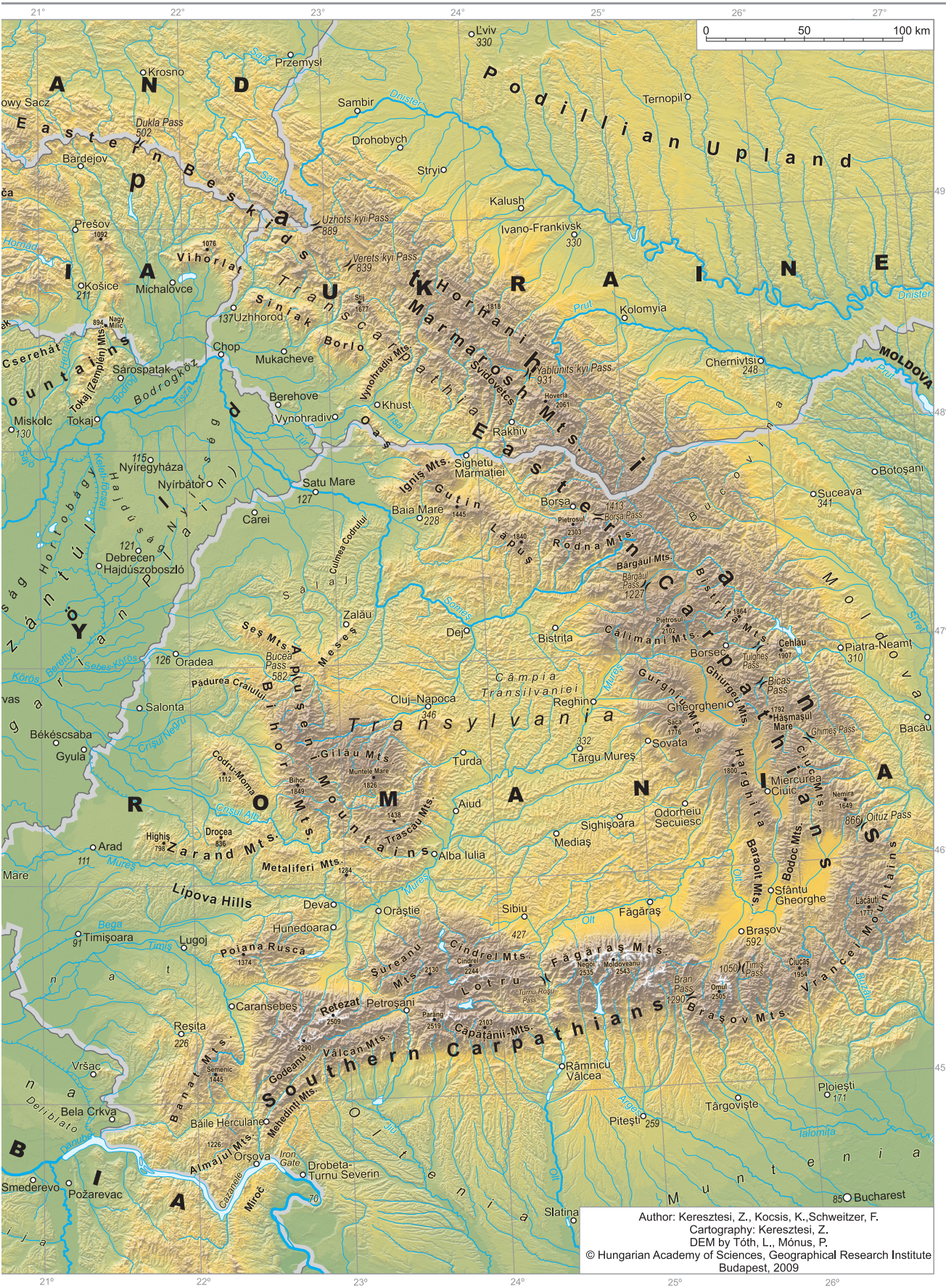
The Kisalföld is bounded to the west by the *West Hungarian Borderland* physiographic macroregion, including the isolated blocks of the crystalline range of the Eastern Alps: the *Sopron/Ödenburg Mountains*, the *Kószeg/Güns Mountains* (with the highest peak in Transdanubia, Írott-kő/Geschriebenstein, 882 m a.s.l.) and *Vas Hill/Eisenberg*. The 'Hungarian Alps' descend to the gravel-covered alluvial plain of Vas-Sopron through foothill slopes.

The 200 km long and 30–50 km wide *Transdanubian Mountains*, a block-faulted range of south-west–north-east strike, consists mostly of Mesozoic limestone and dolomite rocks, and a series of karstic horsts. This upland covering 7,000 km² between the depressions of the Kisalföld and the Alföld, is generally of low elevation, averaging between 400 and 500 m a.s.l.

Between the chain of horsts of the Transdanubian Mountains, hills and intermontane basins covered by Tertiary deposits are to be found. The former tropical peneplanes, faulted and broken up by tectonic movements and covered with thick laterite debris, bauxite and karstic formations, were uplifted to different heights. During this period horsts, graben structures and basins were formed partly by deflation, which also shaped the famous basalt-capped buttes of the Tapolca Basin (e.g. Badacsony and Szentgyörgy-hegy).

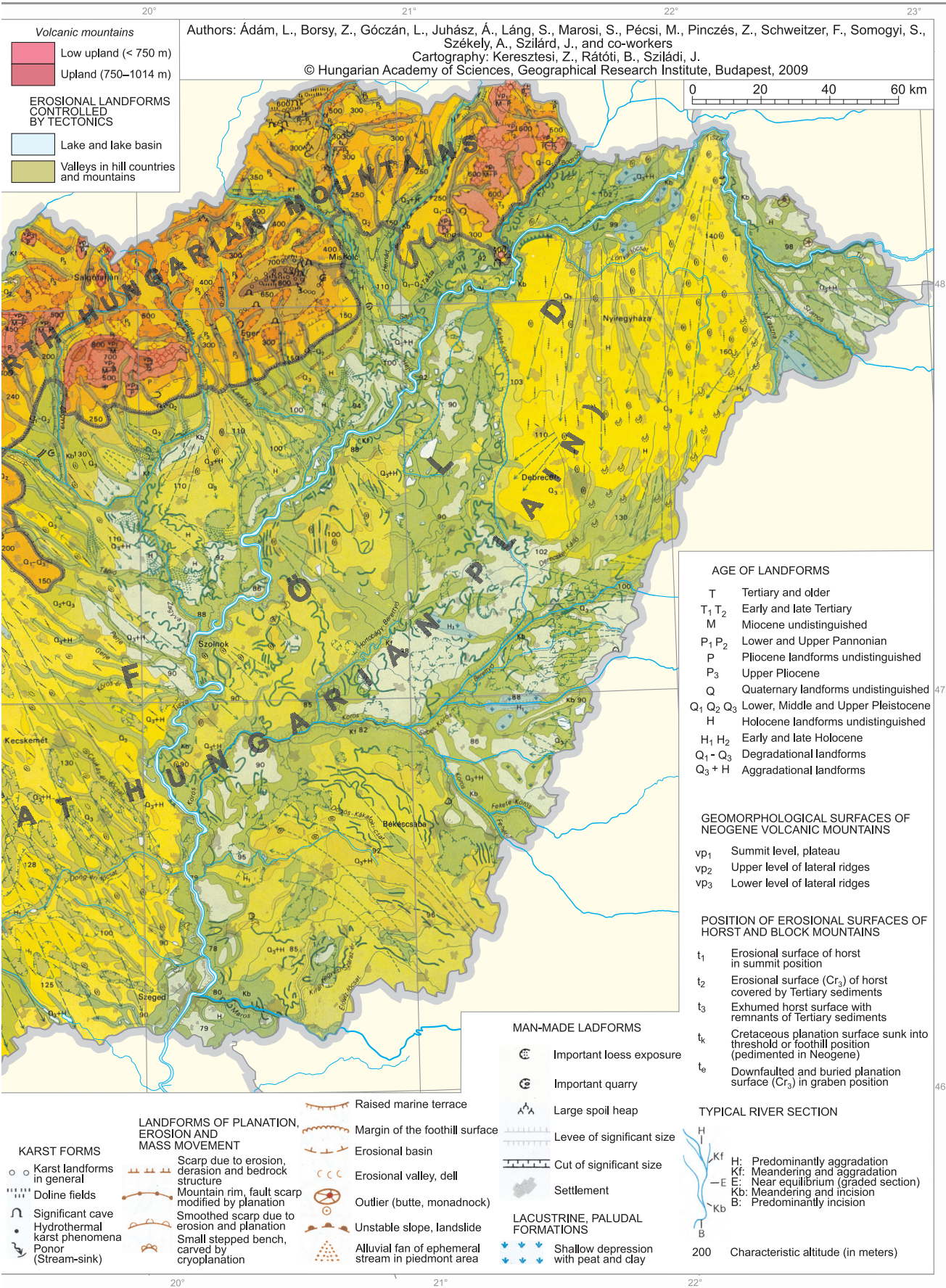
The *Bakony* is the highest group of the Transdanubian Mountains between Lake Balaton and the Kisalföld. It consists of flat-topped fragments elevated to a level of 200–700 m. Other important units of this mountain chain are the *Vértes* (480 m), the *Gerecse* (634 m), the *Pilis* (756 m) and the *Buda Mountains* (527 m). The most important mineral resources of this area are bauxite, brown coal and the thermal waters.





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 Cartography: Keresztesi, Z., Rátóti, B., Sziládi, J.
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Volcanic mountains
 Low upland (< 750 m)
 Upland (750–1014 m)

EROSIONAL LANDFORMS CONTROLLED BY TECTONICS
 Lake and lake basin
 Valleys in hill countries and mountains

AGE OF LANDFORMS

- T Tertiary and older
- T₁ T₂ Early and late Tertiary
- M Miocene undistinguished
- P₁ P₂ Lower and Upper Pannonian
- P Pliocene landforms undistinguished
- P₃ Upper Pliocene
- Q Quaternary landforms undistinguished
- Q₁ Q₂ Q₃ Lower, Middle and Upper Pleistocene
- H Holocene landforms undistinguished
- H₁ H₂ Early and late Holocene
- Q₁ - Q₃ Degradational landforms
- Q₃ + H Aggradational landforms

GEOMORPHOLOGICAL SURFACES OF NEOGENE VOLCANIC MOUNTAINS

- vp₁ Summit level, plateau
- vp₂ Upper level of lateral ridges
- vp₃ Lower level of lateral ridges

POSITION OF EROSIONAL SURFACES OF HORST AND BLOCK MOUNTAINS

- t₁ Erosional surface of horst in summit position
- t₂ Erosional surface (Cr₃) of horst covered by Tertiary sediments
- t₃ Exhumed horst surface with remnants of Tertiary sediments
- t_k Cretaceous planation surface sunk into threshold or foothill position (pedimented in Neogene)
- t_e Downfaulted and buried planation surface (Cr₃) in graben position

MAN-MADE LANDFORMS

- ☉ Important loess exposure
- ☼ Important quarry
- ▲▲ Large spoil heap
- ▬ Levee of significant size
- ▬ Cut of significant size
- ☐ Settlement

LACUSTRINE, PALUDAL FORMATIONS

- ☼ Shallow depression with peat and clay

KARST FORMS

- Karst landforms in general
- ⋯ Doline fields
- ∩ Significant cave
- Hydrothermal karst phenomena
- ⊖ Ponor (Stream-sink)

LANDFORMS OF PLANATION, EROSION AND MASS MOVEMENT

- Raised marine terrace
- Margin of the foothill surface
- Erosional basin
- Erosional valley, dell
- Outlier (butte, monadnock)
- Unstable slope, landslide
- Alluvial fan of ephemeral stream in piedmont area
- Scarp due to erosion, deration and bedrock structure
- Mountain rim, fault scarp modified by planation
- Smoothed scarp due to erosion and planation
- Small stepped bench, carved by cryoplanation

TYPICAL RIVER SECTION

200 Characteristic altitude (in meters)

The latter are common at Hévíz, Zalakaros, Tapolca, Balatonfüred in the Balaton region, and in Budapest.

The *North Hungarian Mountains*, the country's most diversified and highest upland mainly constitute a part of the inner volcanic belt of the Western Carpathians. The majority of their territory (10,000 km²) comprises remnants of Miocene strato-volcanoes, while the remainder belong to Mesozoic block mountains. The volcanic mountains around the Danube Bend – *Visegrád Mountains* (reaching 700 m) and the *Börzsöny* (elevating above 900 m) – lifted up in the Middle Miocene, whilst in the east the *Tokaj/Zemplén Mountains* (800 m) resulted from Upper Miocene volcanism. The *Börzsöny*, *Cserhát* and *Mátra* (with the highest Hungarian peak, the Kékes, 1014 m) consist mostly of andesite and tuffs. Along the southern foothills of the Bükk Mountains and in the Tokaj/Zemplén Mountains rhyolite gradually gains in proportion.

Between the volcanic mountains, the faulted and folded Mesozoic block mountains developed, which constitute the most typical karstic landforms of Hungary, e.g. the *Aggtelek (or Gömör-Torna) Karst* and the Bükk Mountains. The nearly 24 km long system of caves of the Aggtelek and Slovak Karst were added to the UNESCO World Heritage List in 1995. In the

Bükk 1,115 caves have been discovered, including István-lápa (the deepest cave in Hungary, 254 m), the archaeologically important Szeleta and Subalyuk caves, and the Cave Baths (a prominent tourist attraction of Miskolc-Tapolca). The central core of the Bükk, a heavily faulted and folded block range is the largest and most beautiful limestone table of the country.

The *Transdanubian Hills* are situated between Lake Balaton, the Alföld, and Dráva and Mura rivers. These hills reach an average height of 200 to 300 m a.s.l. and have subsurface deposits of Quaternary fluvial gravel and sand, which are in turn covered with a blanket of Pleistocene loess with a thickness of 10–50 m. Below this, Pannonian marine clay and sand (2,000–3,000 m thick in some places) can be found, covering a crystalline and Mesozoic rock basement. The western part of this hilly region features parallel ridges and meridional (north to south) valleys. In the east the surface is articulated by faults running north–northwest, south–southeast; along these structural lines valleys have developed. From this hilly environment rise the mostly Mesozoic, karstic limestone mountains and horsts ('inselbergs'): the *Mecsek* (682 m a.s.l.) and the *Villány Mountains* (442 m a.s.l.). In the southern foreland of the eastern Mecsek is situated the loess covered granite block of *Mórággy Hills*.