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# The Badenian flora and the palaeoclimate interpretation of the locality Nováky, Slovak Republic

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**Abstract. The results of a study of macroscopic plant fossils from the locality Nováky (Hornonitrianska Kotlina Depression, Slovakia) are presented. The fossil remains have been identified on the basis of comparative morphology. The determined flora consists of 38 determined taxa. The characteristics of the flora have been studied (Nearest Living Relatives, NLR) and palaeoclimatic estimates with using the leaf physiognomy (Climate Leaf Analysis Multivariate Program, CLAMP) were obtained. The vegetation corresponds to broad-leaved forest suggesting subtropical humid conditions.**
**Key words. plant fossils, palaeoclimate reconstruction, Climate Leaf Analysis Multivariate Program (CLAMP), Badenian, Slovakia**

## INTRODUCTION

Land plants are an ideal climate proxy for non-marine environments because their morphology and distribution is strongly climate dependent. Palaeoclimate proxies based on fossil leaves and pollen can be divided into two types: those based on aspects of plant architecture constrained by environmental conditions (physiognomic approaches) and those based on the environmental tolerances of assumed living relatives (nearest living relative approaches). I used the physiognomic approach to reconstruct the palaeoclimate at the Badenian (middle Miocene) locality Nováky.

The palaeontological locality Nováky is situated in the Hornonitrianska Kotlina Depression in the middle of the Central West Carpathians. Fossil flora from this depression was studied by several authors (e.g. Němejc 1959, Takáč 1966, Sitár 1976). These studies focused on the macroflora, microflora and the Diatomaceae.

## MATERIAL AND METHODS

Studied palaeobotanical material, deposited in the Hornonitrianske múzeum in Prievidza, Slovak Republic, originated from the Koš Formation (late Badenian; Šimon et al. 1997). This formation is built of a monotonous complex of gray clays which are a product of a swamp sedimentation alternated in time with lacustrine sedimentation (Hók et al.

1995). A total of 202 samples of fossil plants were studied. The systematic determinations were provided by Mikuláš Takáč with further revisions by the author. Revisions of the fossil impressions were based on morphological features alone due to restrictions of the Museum, which does not permit the use of cuticular analysis. Only dicots were taken into consideration. They were sorted into morpho-species and examined for the presence or absence of each of the 31 morphological characters used after CLAMP categorization. Climate characteristics were calculated using the Climate Leaf Analysis Multivariate Program (CLAMP; Wolfe 1993, 1995), which is the most comprehensive foliar physiognomic technique currently available.

## RESULTS

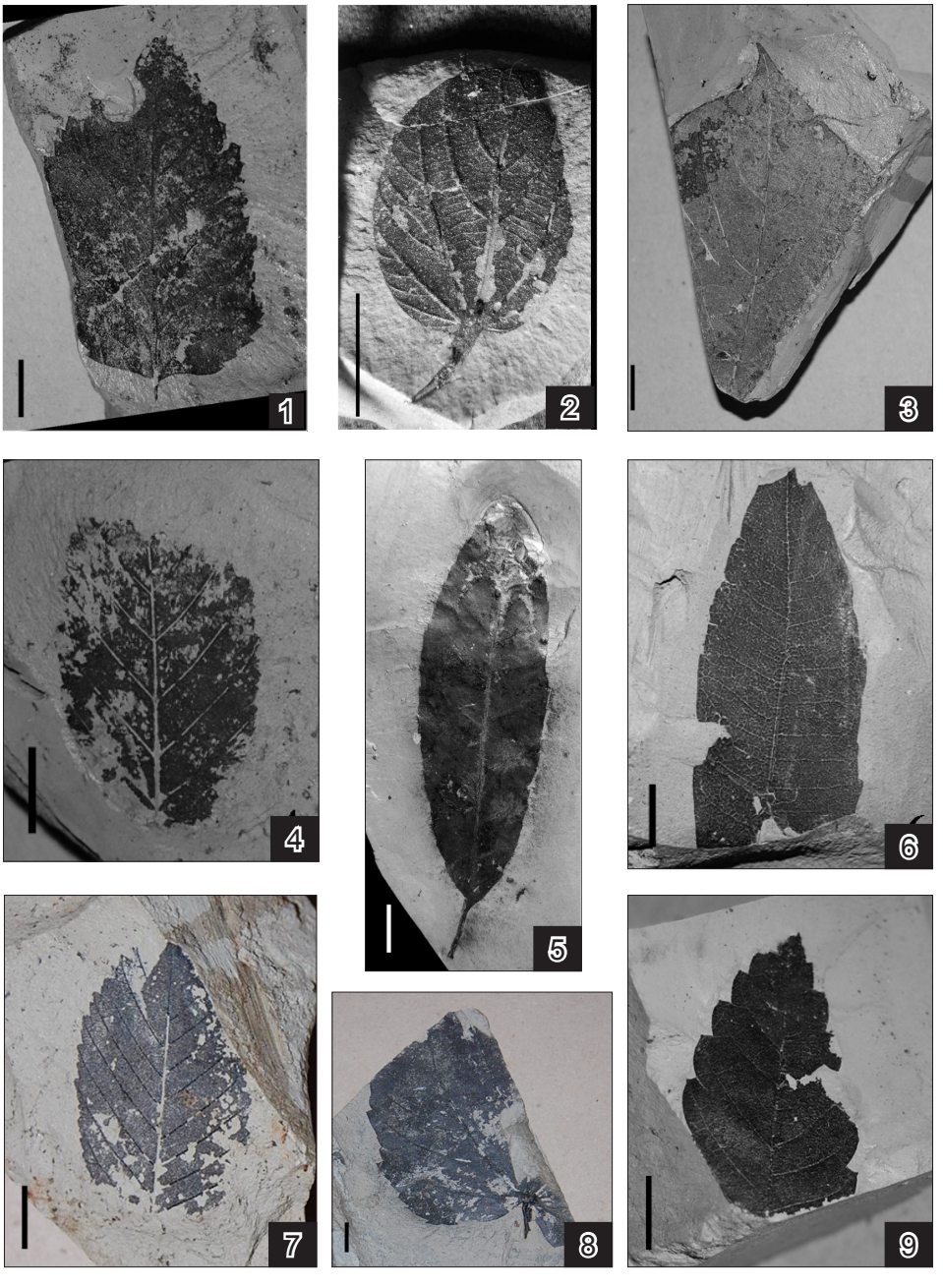
The following taxa were recorded from Nováky: *Acer tricuspidatum*, *Ailanthus confucii*, *Alnus gaudinii*, *Alnus julianiformis*, *Berberis* sp., *Betula* sp., *Betula macrophylla*, *Betula subpubescens*, *Byttneriophyllum tiliaefolium*, *Carpinus grandis*, "*Castanea*" sp., "*Castanea*" *kubinyi*, *Cercidiphyllum crenatum*, *Daphnogene polymorpha*, *Diospyros anceps*, *Engelhardia orsbergensis*, *Engelhardia macroptera*, *Fagus* sp., "*Ficus*" *truncata*, *Fraxinus* sp., *Glyptostrobus europaeus*, *Juglans* sp., *Laurophyllum* sp. div., *Liquidamabar* sp., *Magnolia* sp., *Myrica* sp., *Myrica lignitum*, *Nelumbo protospeciosa*, *Pinus* sp., *Platanus* sp., *Populus populina*, *Quercus pseudocastanea*, *Salix varians*, cf. *Sapindus falcifolius*, *Tilia* sp., *Ulmus* sp., *Vitis stricta* and *Zelkova zelkovifolia*.

Three partial ecological associations representing different habitats were distinguished. Slope association is represented by *Ailanthus confucii*, *Daphnogene polymorpha*, *Carpinus grandis*, *Zelkova zelkovifolia*, *Betula* sp. and *Vitis strictum*. Back swamp association includes *Glyptostrobus europaeus*, *Acer tricuspidatum*, *Salix varians* and *Myrica* sp. Wet soil association is represented by *Ulmus* sp, *Alnus julianiformis*, *Fagus* sp, *Fraxinus* sp., *Populus populina*, *Byttneriophyllum tiliaefolium*, *Liquidambar* sp. and *Cercidiphyllum crenatum*.

The CLAMP analysis predicted climate parameters for the locality Nováky as follows: mean annual temperature (MAT): 14.47 °C, warm month mean temperature (WMMT): 21.88 °C, cold month mean temperature (CMMT): 7.87 °C, length of the growing season (GROWSEAS): 8.27 months, mean growing season precipitation (MGSP): 165.43 mm, mean monthly growing season precipitation (MMGSP): 18.82 mm, precipitation during the three wettest months (3WET): 89.37 mm, precipitation during the three driest months (3DRY): 22.51 mm, specific humidity (SH): 9.93 g/kg, relative humidity (RH): 77.73 %, Enthalpy (ENTHAL): 32.65 kJ/kg.

## DISCUSSION

I compared the results presented above with my preliminary results for the localities Cigeľ and Lehota from the Hornonitrianska kotlina Depression. Both belong to the same Formation and their floras are very similar. The temperature variables (MAT, WMMT, CMMT) did not differ more than by 0,7 °C and precipitation variables (GSP, MMGSP, 3DRY, 3WET) differ maximally about 200 mm per month for each value.




**Figs. 1-9. Leaf impressions from the Badenian of Nováky. Scale = 1 cm.**
**1 – *Betula* sp. (VII-4648), 2 – *Byttneriophyllum tiliaefolium* (Al. Braun) Knobloch et Kvaček (VII-4556), 3 – *Byttneriophyllum tiliaefolium* (Al. Braun) Knobloch et Kvaček (VII-4810), 4 – *Carpinus grandis* Unger emend. Heer (VII-4604), 5 – *Fraxinus* sp. (VII-4559), 6 – *Myrica* sp., 7 (VII-4480), 7 – *Ulmus* sp. (VII-4550), 8 – *Vitis stricta* (Goeppert) Knobloch (VII-5680), 9 – *Zelkova zelkovifolia* (Unger) Bůžek et Kotlaba (VII-3989).**

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REFERENCES

Hók J., Šimon L., Kováč P., Elečko M., Vass D., Halmo J. & Verbich F., 1995: Tectonics of the Hornonitrianska Kotlina Depression in the Neogene. – Geologica Carpathica 46: 191-196.

Němejc F. 1959: Zpráva o stratigrafickém hodnocení fosilních květen handlovské a kremnicko-štiavnické oblasti. [A report on the stratigraphical evaluation of the fossil flora from the Handlová and Kremnica-Štiavnica regions]. – Zprávy o Geologických Výzkumech v Roce 1957: 163-164. [In Czech.]

Šimon L., Elečko M., Lexa J., Kohút M., Halouzka R., Gross P., Pristaš J., Konečný V., Mello J., Polák M., Vozárová A., Vozár J., Havrila M., Köhlerová M., Stolár M., Jánová V., Marcin D. & Szalaiová V., 1997: Vysvetlivky ku geologickej mape Vtáčnika a Hornonitrianskej kotliny. [Explanation to the geological map of the Vtáčnik Mts. and Hornonitrianska Kotlina Depression]. – Bratislava: Vydavateľstvo Dionýza Štúra, 281 pp. [In Slovak.]

Sitár V., 1976: Neue Erkenntnisse űber die fossile Flora aus Tertiärsedimenten der Slowakei. – Acta Geologica et Geographica Universitatis Comenianae 30: 91-103.

Takáč M., 1966: Výskum treťohorného rastlinstva v nováckych uhoľných baniach. [Research of the Tertiary flora of the Nováky coal mines]. – Horná Nitra 3: 219-226. [In Slovak.]

Wolfe J.A., 1993: A method of obtaining climatic parameters from leaf assemblages. – United States Geological Survey of the Territories, Bulletin 2040: 1-73.

Wolfe J.A., 1995: Paleoclimatic estimates from Tertiary leaf assemblages. – Annual Review of Earth and Planetary Science 23: 119-142.