

Geochemical Atlas of Slovak Republic at a Scale 1:1 000 000 An Introduction

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Introduction

Most geological results are valuable for environmental studies. This is due to the fact that the natural environment is strongly determined by geological conditions. At the present time there is a strong need to carry out comprehensive and complex geological programmes oriented to ecology because, so far, existing geological data are dispersed and often not fully suitable for ecological studies. Moreover, new and more precise data and complex geological information are needed for ecological studies. That is why the Dionýz Štúr Institute of Geology in Bratislava (since January 1, 1996, a part of the new Geological Survey of the Slovak Republic), in collaboration with 10 other institutions, started an extensive project in 1991 entitled "Investigation of the geological factors in the environment".

The project was covered by two partial tasks. The first of these tasks was aimed at the compilation during the 1991-1995 of the Geochemical Atlas of Slovak Republic at a scale of 1:1 000 000. This map was supplemented by maps of associated geochemical and ecological features at a scale of 1:200 000. Investigations were directed to the evaluation of concentrations and distributions of chemical elements, including the toxic ones (single chemical elements and components maps) in groundwater, stream sediments, rocks, soils and forest biomass. The evaluation also covered the total radioactivity of Slovakia and that of individual elements producing that radioactivity. The result of the first task is the subject of this monothematic volume of the Slovak Geological Magazine.

In the frame of the second task, a set of maps representing geological factors of the environment in Slovakia was compiled based on regional geological

maps at a scale of 1:50 000. The set includes maps of geology, mineral resources and forecasts; natural radioactivity of rocks (K, U, Th, U_{Tot} , dose rate), radon risk and in water (U_{nat} , ^{226}Ra , ^{222}Rn); pedology, geochemical reactivity of rocks; hydrogeological map; groundwater quality; geochemical map and a multicomponent engineering geology map showing the complex interactions of the technogenetic sphere and that of the geological environment. In the first stage of the completion of the second task (1991-1993) the compilation concentrated on regions: Upper Nitra river area, Low Tatra Mts., Hornád river Basin with the Eastern Slovak Ore Mts., Košice Basin and Slánske Vrchy Mts., Žiar Basin with the Banská Štiavnica area, Malá Fatra Mts. with the surrounding basins. Together, these areas cover about 9 000 km² (fig.1).



Fig. 1: Regions, studied at scale 1 : 50 000 (I - Upper Nitra river, II - Low Tatra Mts., III - Hornád river Basin with the Eastern Slovak Ore Mts., IV - Košice Basin and Slánske vrchy Mts., V - Žiar Basin with the Banská Štiavnica area, VI - Malá Fatra Mts. with the surrounding basins)

A geochemical atlas of Slovakia is being prepared by the Geological Survey of Slovak Republic mainly in

co-operation with the Comenius University, Slovak Academy of Science in Bratislava, INGENO Žilina, the Soil Fertility Research Institute in Bratislava, the For-

estry Research Institute in Zvolen and the URANPRES Spišská Nová Ves and with other institutes in lesser ways.

Methodology

a) Sampled media, sampling density

Sampled media	Sampling density	Number of samples	Note
Groundwater	1 sample/3 km ²	16 359	Mostly springs and dug wells; some hydrogeological bore holes
Stream sediments	1 sample/2 km ²	24 422	Active stream sediments <0.125 mm
Rocks	irregular grid	3 839	"main rock types"
Soils	1 profile/10 km ²	9 892	1 profile = 2 samples (A and C horizons)
Forest biomass	1 sample/16 km ²	3 063	Composite sample
Radioactivity	1 point/10 km ²	4 900 (points recorded)	- Total natural radioactivity - individual components of natural radioactivity K, U, Th, Rn

b) Analysed elements, components, measured parameters:

Stream sediments (soils, rocks - modified)

Al, As, Ba, Be, Ca, Ce, Co, Cd, Cs, Cr, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, Sb, Se, Sn, Sr, Th, U, V, W, Y, Zn, Zr

Groundwater:

Temperature, pH, conductivity, dissolved O₂, acidity, alkalinity (field measurements)

Na, K, Mg, Ca, SiO₂, NH₄, F, Cl, NO₃, SO₄, HCO₃, HPO₄, COD-Mn, Fe, Mn, Li, Sr, Zn, Cu, Cd, Pb, Cr, Hg, As, Se, Tl, Sb, Al, Ba, aggr.CO₂
(metals: filtration – 0.45 µm)

Forest biomass:

Al, As, Ba, Be, Ca, Cd, Ce, Co, Cr, Cu, F, Fe, Hg, K, Li, Mg, Mn, N, Na, Ni, Pb, Rb, S, Sb, Sr, V, Zn, (Ba, Ce, Rb - in some samples only)

Radioactivity:

Total natural radioactivity, K, U, Th, Rn

These elements were analysed by following analytical techniques (more in detail see in the following articles).

FAAS: atomic absorption spectrophotometry, flame atomization

GAAS: atomic absorption spectrophotometry, electrothermal atomization

CVAAS: atomic absorption spectrophotometry, atomization by cold vapor generation

HGAAS: atomic absorption spectrophotometry - hydride-generation method

ICP- OES: inductively coupled plasma optical emission spectrometry

ICP - AES: inductively coupled plasma atomic emission spectrometry

XRF: x-ray fluorescence spectrometry

ISE: ionselective methods

TMA: trace mercury analyzer (AAS)

ITPH: isotachopheresis

T: acidobasic titrations

Control of analytical processing has been accomplished by an independent group of scientists using internationally acknowledged criteria for the control of analytical results.

The analyses of stream sediment samples collected in the period 1991 – 1994 are incomplete by this time.

The presentation of the more recent data, statistical analysis of all the data, and the interpretation of all these results will be completed by 1998 when this part of the Geochemical Atlas is to be published.

Use of results - environmental aspects

The complex geochemical data obtained on the basic components of the environment are indispensable for the Administration and its Ecology Institutes in their planning for environment protection, urban development, water management, agriculture, food industry, hygiene and other fields. The special goals are:

- Background values and distribution in Slovakia of chemical element concentrations will be established for the main components of the environment.

- Results provide accurate values of contamination of important single-element environmental components.

- Results of geochemical mapping will allow a more effective evaluation of the results in geomedical or geohygienical sciences (regional occurrence of diseases in relation to geochemical provinces or contamination zones), in agriculture and food production (soil fertility and protection, trace elements in the food chain etc.), forestry (establishment of causes of forest and forest soil degradation), as well as in water management (regional distribution of significant features in groundwater for water management).

- Results allow a more efficient establishment of tasks for newly realized research in the indicated scientific areas.

- The results of geochemical mapping of stream sediments and groundwater will be valuable for mineral prospecting that it provides an exact metallogenetic characterization of Slovakia.

The results of geochemical mapping will also be useful in evaluation of Slovak territory in terms of the results of international geochemical mapping project (IGCP No 360, etc.)

Present state of the Geochemical Atlas of Slovak Republic

In 1997 three parts (groundwater, forest biomass, radioactivity) of the Geochemical Atlas of Slovakia will be issued separately. In 1998 other three parts (rocks, soils and stream sediments) will be published, including the compilation of maps focused on anomalous concentrations of the ecologically most important elements at a scale of 1 : 200 000.