SLOVAK GEOLOGICAL MAGAZINE

Radon in the geological medium

JOZEF HRICKO

GEOCOMPLEX, a.s., Geologická 21, 822 07 Bratislava

Abstract: During last 6 years, the distribution of radioactive gas Rn-222 in soil air of the subsurface layer is among important objectives of the environmental projects in city agglomerations of Slovakia. The largest ones, covered by radon survey, are Bratislava and Košice regions.

On the radon survey results, a radon risk maps on 1:25 000 and 1:50 000 scales have been compiled in Bratislava region, while on 1:10 000 scale in Košice region.

The paper presented deals with main results of radon survey in a/m areas.

Key words: radon in soil air, radon risk maps

Introduction

The distribution of Rn-222 in the sub-surface layer of the geological medium is the current task of environmental projects in regions of city agglomerations in Slovakia.

The compilation of a radon risk map is, for example, among the sub-projects within the framework of the projects Bratislava - abiotic component of the environment (1990-1993) and Košice - abiotic component of the environment (1994-1999?).

The presented paper deals with the behaviour of radon in the geological medium and with some results of the radon survey in the Bratislava and Košice regions.

General informations

Rn-222 penetrates very easily through permeable rock complexes and active faults to a distance of a few kilometres from the source. The content of radon in soil air depends on the Ra-226 content in the rocks, the emanation ability of minerals and rocks, the permeability of rock formations in respect to water and gas.

Radon spreads in rocks and neotectonic zones by diffusion and convection. The diffusion movement is affected by physical properties of the geological medium, while convection flow is a consequence of changes in the physical properties, mainly temperature and pressure. Radon is transported by convection in greater quantities than by diffusion.

The distribution of radon and the values of its volume activity (a_v) in the sub-surface layer are influenced by climatic changes. The amount of radon rising up from the soil air to the surface increases with increased air temperature and decreases with high air pressure, humidity of the atmosphere and precipitation. The a_v values are low in a dry period and vice versa.

The risk of radon penetrating from the sub-surface layer to houses depends on the a_v value in the soil air and on structural-mechanical properties of the foundation soils.

The assessment of the radon risk in Bratislava and Košice regions is based on the methodology applied in the Czech Republic and on the Notice of the Ministry of Health of the Slovak Republic No. 406/92. The assessment of the soil gas permeability is in accordance with the former Czechoslovak standard No. 73 1001 (see table below).

Radon risk category	Volume radon activity (kBq.m^{-3})		
	soil permeability		
	low	medium	good
low – I	< 30	< 20	< 10
medium – II	30 – 100	20 – 70	10 – 30
high – III	> 100	> 70	> 30

Radon risk maps

1. Bratislava region

The a_v was determined in 0.80 m deep holes. The density of observations was 3 reference areas (each representing 20 stations) per km^2. The radon risk maps have been compiled on the scales 1 : 25 000 and 1 : 50 000. 56.8 % of the area under study is lying in the low radon risk area, 37.6 % in the medium radon risk area and 5.6 % in the high radon risk area (see Fig. 1). Follow-up monitoring of the equivalent volume radon activity (EVRA) in apartments located in areas with high radon risk in the surface layer has shown

MINISTRY OF ENVIRONMENT OF THE SLOVAK REPUBLIC
DIVISION OF GEOLOGY AND NATURAL RESOURCES

GEOCOMPLEX, a. s., Bratislava

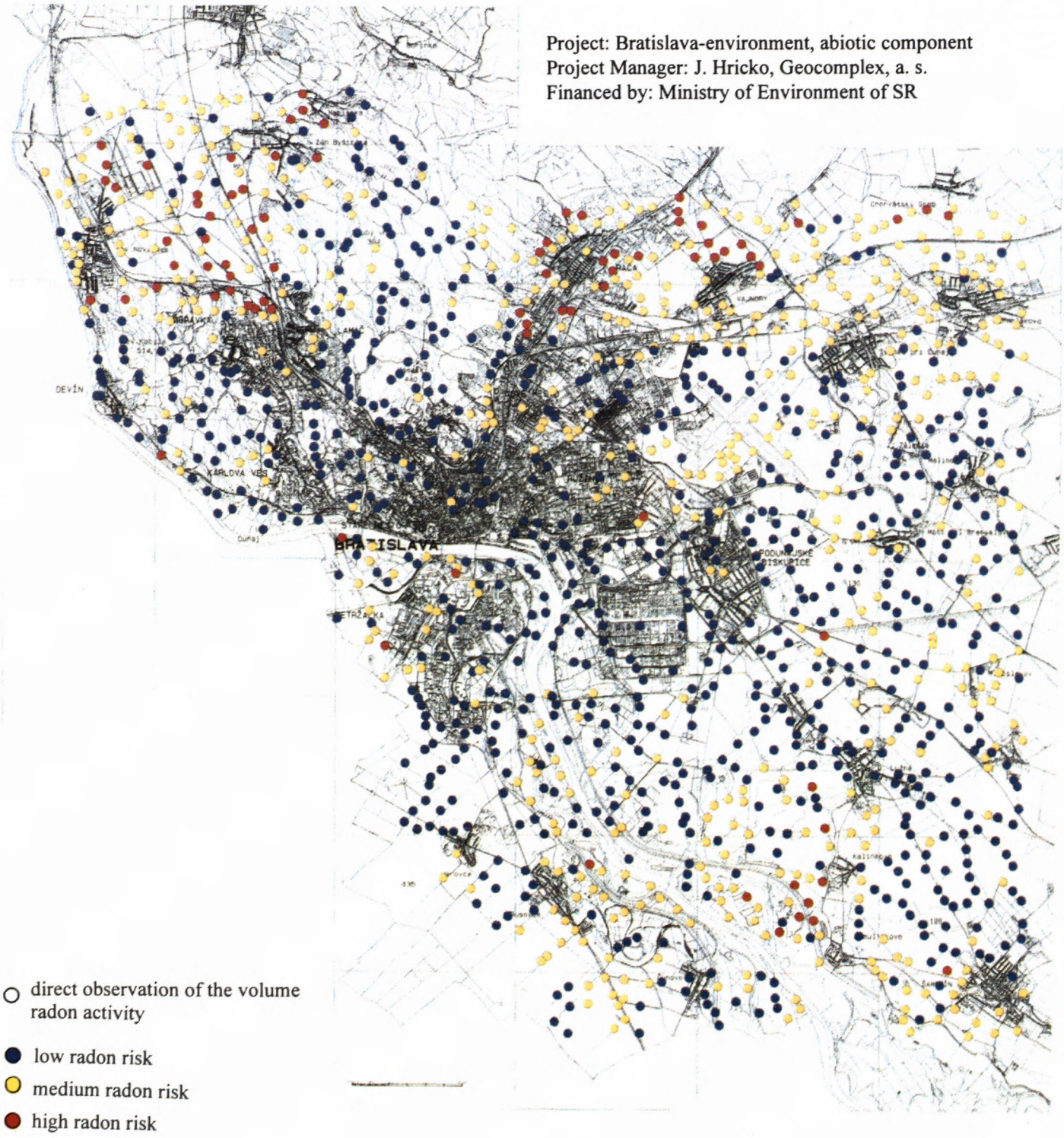


Fig. 1 Radon risk map of the Great Bratislava region (by ČÍŽEK, SMOLÁROVÁ 1992, HRICKO, 1993)

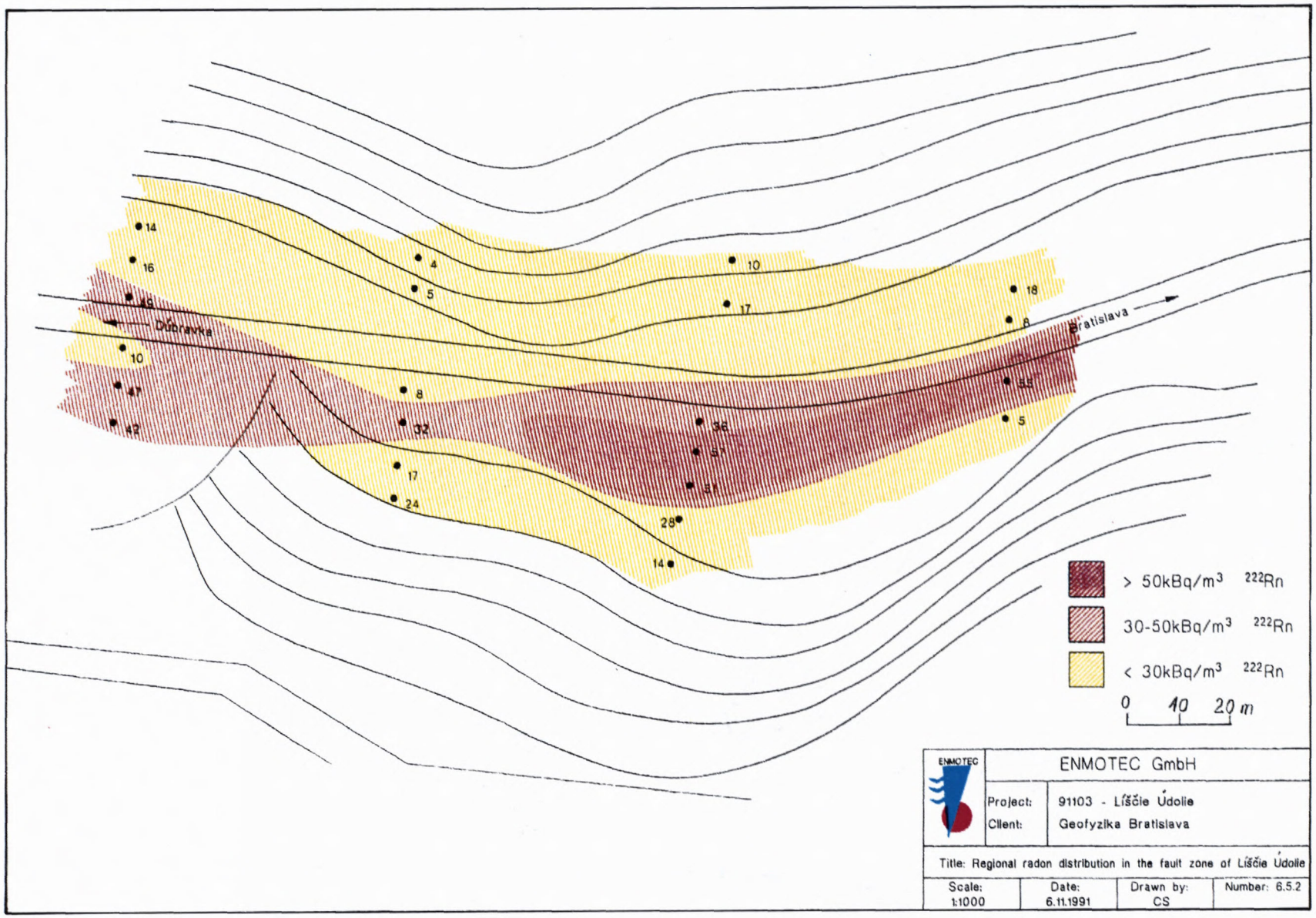
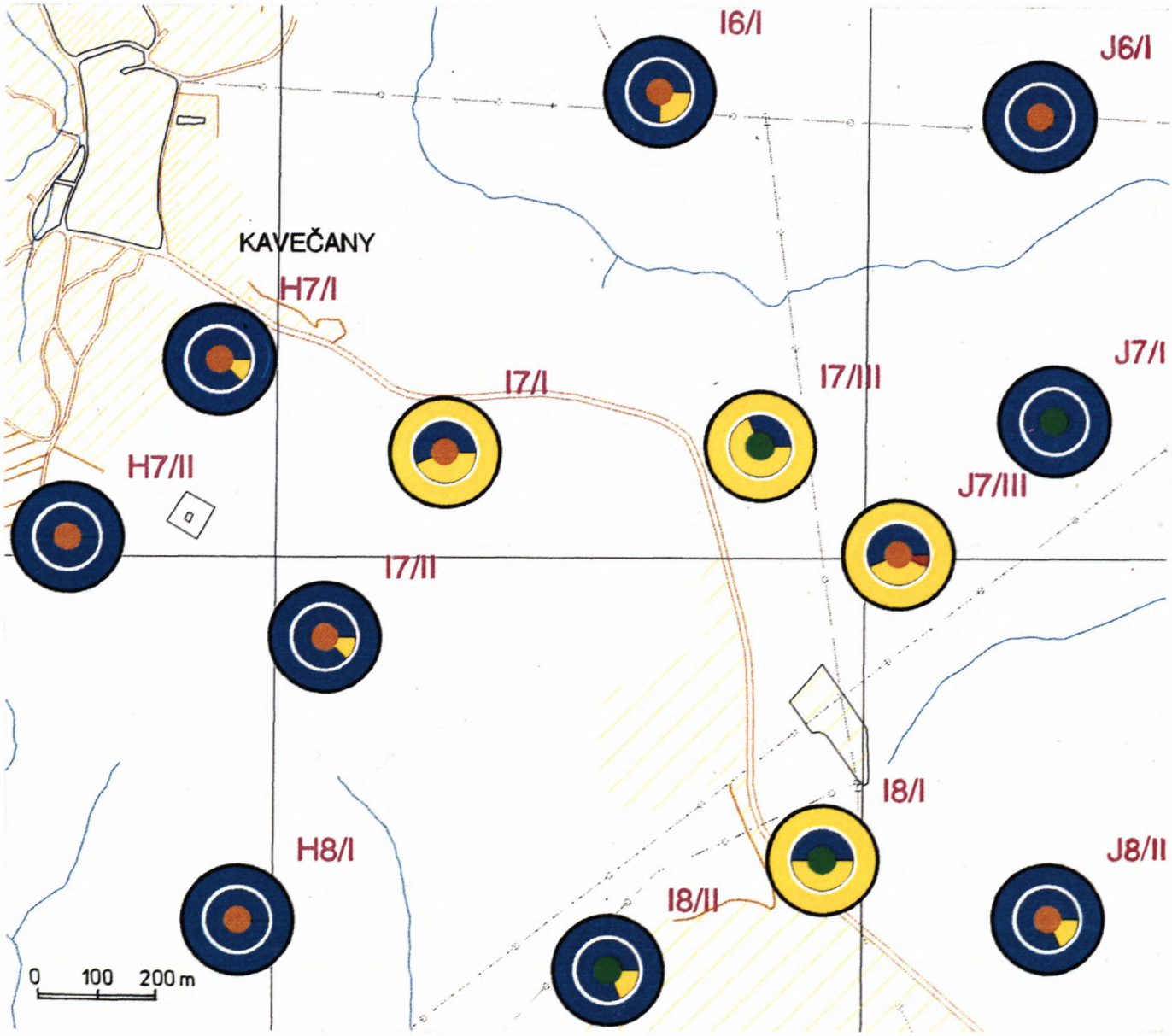


Fig. 2 Regional radon distribution in the fault zone of Líščie údolie valley (Bratislava-Karlova Ves)



RADÓNOVÉ RIZIKO RADON RISK

nízke low

stredné medium

vysoké high

SOIL PERMEABILITY

PRIEPUSTNOSŤ

nízka low

stredná medium

vysoká high

Fig. 3 Radon risk map from northern part of Košice region (by SUCHÝ, DANIEL, 1995)

values several times exceeding the Slovak limits (Marianka, Rača, Vajnory).

Evidence of neotectonic features being an excellent medium for radon emanation rising up to the subsurface layer is shown in Fig. 2. The tectonic zone of Líščie údolie valley in the Bratislava-Karlova Ves area has been clearly detected by the radon profile survey.

2. Košice region

At present, the northern half of the area in question has been covered by the radon survey. Low and medium radon risks have been observed here, while localities with a high radon risk are small in extent.

A part of the radon risk and soil permeability map from the northern Košice area is shown in Fig. 3.

References

HRICKO, J., MARTINOVIĆ, M., ŠEFARA, J., VRANA, K., 1993: Bratislava – environment, abiotic component: Final report, Manuscript, Geofond Bratislava.

HRICKO, J., 1995: Košice – abiotic component of environment: Progress report, Manuscript, Geocomplex, a.s., Bratislava