



Hazards and risks in karst terrains – definitions and classification

V. Andrejchuk, A. Tyc

Department of Geomorphology, University of Silesia, Poland (atyc@us.edu.pl / Fax: +48 32 2915865 / Phone: +48 32 3689289)

Natural and man-induced hazards in karst terrains can be fully understood only through a multi-disciplinary approach, combining expertise from different fields of geosciences. There is motto of the symposium held in Vienna. The aim is to improve the exchange of knowledge and experiences between specialists, but one of main difficulty in their communication is lack of defined terminology as well as scope of hazards in karst and related terms. Despite very rich literature of the problem there are no defined and discussed main terms and notions (also their scope) in this geoscience's domain, (e.g. main terms – hazard and risk, terrain stability or threat and danger of karst terrains). This circumstance considerably makes difficult cooperation of specialist from different countries, based often on different scientific and practical schools. It limits soundly exchange of experiences between experts from countries of Western Europe, United States and former Soviet Union, where there are spread researches on hazards.

Unquestionably, *threat*, *hazards* and *risk* in karst terrains there are key terms in the range of notions in applied karst research domain. As *threat of karst* authors understand *potential threat* for life, health or welfare of people and economic objects, subsequent directly from specificity of geological structure and functioning of karst massif. This notion indicates static and dynamic features of karst environments, which are potential carriers of *hazard in karst*. For example, presence of underground cavities in karst massif (*potential threat*) hides in hazard of collapse formation. It means that in some instances potential threat of karst, which are inherent feature of karst environment, become hazards. They proceed from potential to real category. In this context *hazards in karst* there are processes (including activation) which can cause negative results for people, economy or environment.

Threats and hazards in karst are of natural and man-induced origin. Underground cavities can be result of natural karst processes as well as emerge in result of human activity. Interfering to karst environment, e.g. through underground exploitation, quarries man creates potential threats and real hazards.

Hazards in karst terrains understanding as fastly getting processes (realization of threat) can be classified by different factors. According to essence getting process it is possible to differ two main groups of hazards: *gravodynamic hazards* (wide group of gravitational processes in karst) and *hydrodynamic hazards* (relate with violent changes of regimes of karst waters). Both kinds of hazards can manifests on surface and underground.

Natural or man-induced collapses and subsidences, as well as landslides often accompanying these processes are examples of superficial gravodynamic hazards. Cave or cavity roof breakdown and collapse of consolidated internal cave sediments or invasion to cavity of unconsolidated sediments represents underground gravodynamic hazards. Hydrodynamic hazards connected with surface of karst terrains are represented by floods (e.g. in poljes), submergence of karst springs or by opposite processes of lakes and reservoir emptying. Rapid water intrusion to mine galleries and rising of karst waters in caves (e.g. hazard for cave exploration and show caves) are examples of underground hydrodynamic hazards.

Hazards in karst terrains are usually of rapid even of catastrophic course, but there is a group of evolutionary, slow processes in category of hazards, e.g. salt water intrusions or karst water contamination.

With discussed terms are very connected two other, used mostly in terms of engineering geology and other applied geosciences – *risk* and *mitigation*. Risk can be understand as probability of occurrence and consequential damage of processes defined as hazards. The reduction of risk to life and environment by reducing the severity of collapse, building subsidence-resistant constructions, restricting land use, etc. can be defined as mitigation.

Examples from different karst regions will illustrate proposed term's classification and definition.