Published in: Proceedings of the 12th International Congress of Speleology (1997), vol. 5, pp. 13-14.
Status: Postprint (Author's version)

The dynamics of the karstic features of Sprimont (Belgium) and its consequences on the land-use planning
Preliminary note

La dynamique des processus karstiques à Sprimont (Belgique) et ses conséquences sur la planification d'aménagement du territoire. Note préliminaire.

Camille EK[1], Raymond MICHEL[2], Vincent MOUSNY[1] & Damien CLOSSON[1]

(1) Department of Physical Geography and Quaternary, University of Liège, B.11, Sart Tilman, 4000 Liège, Belgium
(2) Direction Générale de l'Aménagement, Ministère de la Région Wallonne, 5100 Namur, Belgique

Abstract

The Department of Physical Geography of the University of Liège (Belgium) was in charge of updating the physical factors of the regional land management map for Sprimont, a karstic municipality of Belgium. The influence of floods, karst processes, landslides, and other physical factors were evaluated.

The karst features and karst-related events have been mapped three times with accuracy in this area during the last century (in 1898, 1971 and 1996). The data provided the basis for a study of the rates and dynamics of the karst processes and permitted the forecasting of hazards on a secular basis.

A map of karstic areas, karst features and karst dynamics was prepared. Some systematic trends of the evolution of karst features were noted. A map of risks and land-use constraints was derived from the first map and from the observed trends. Rules were induced from these data and were proposed to control building and other activities in clearly defined areas.

Résumé

Le Département de Géographie physique de l'Université de Liège a été chargé d'établir les facteurs physiques susceptibles d'influencer le plan d'aménagement de Sprimont, une commune karstique de Belgique. L'influence des inondations, des phénomènes karstiques, des glissements de terrain et d'autres facteurs physiques a été prise en considération.

Les phénomènes karstiques ont été cartographies, à Sprimont, en 1898 puis en 1971 et enfin en 1996. Ceci a permis d'évaluer la vitesse de certains processus et d'établir, sur une base séculaire, une prospective des risques.

Une carte des zones karstiques, des phénomènes karstiques et de la dynamique du karst fut élaborée. Une carte des risques et des contraintes en fut dérivée. Des règles de sécurité en ont été déduites et ont été élaborées en un projet de décret régissant les activités de construction et de génie civil dans des secteurs karstiques définis.

INTRODUCTION

The updating of the management plans

In the Walloon region (Southern Belgium), the land management is ruled by plans, schemes and regulations. Land-use planning divides the territory into land-use zones.

It was recently decided to update the management plans, and firstly the criteria of these plans. These criteria include physical ones and human ones.

The Physical Geography Department of the University of Liège was in charge to carry on "the restatement of the criteria of a right management with regards to physical constraints". The task had to be carried out in the

Published in: Proceedings of the 12th International Congress of Speleology (1997), vol. 5, pp. 13-14.
Status: Postprint (Author's version)

municipality of Sprimont, considered as typical and set as such as test-place.

The municipality of Sprimont

Sprimont is a municipality of some 74 km" in the folded area of Southern Belgium : the so-called Ardennes, in the broad meaning of this term. The area was folded by Hercynian movements, and the municipality territory includes Devonian and Carboniferous (= Mississippian) formations with thin remnants of a Post-Hercynian, Tertiary cover.

The morphology is typically Appalachian : the ridges consist of Devonian sandstones levelled by an old peneplain, and the valleys are hollowed out in Devonian and Carboniferous limestones.

Mapping the natural constraints

The natural constraints considered and mapped included flood hazard, slopes (including rockfall and slide hazard, influence on motorized cultivation, solar energy balance...), karst, protection of water catchment zones, sewage constraints, soil fertility, etc... A general map was presented including all the contraints. In the present paper, we shall deal with the karst hazard map only.

KARST FEATURES OF SPRIMONT

Present-day morphology of the Sprimont syncline

The structural geology of Sprimont is complex; we shall here consider only the Carboniferous Limestone syncline crossing the built-up center of the municipality. This syncline is edged on both sides (north and south) by Devonian sandstone anticlines, between which it is depressed, and shelters a dry valley.

The dry valley is pitted by dolines and swallowholes. All the streamlets are intermittent or episodic. Some swallowholes are cave entrances, but more caves are scattered on the steep slopes of the valley. The main resurgence, "le Trou Bleu" (The Blue Hole), lies in the alluvial plain of the Ourthe valley and is the outlet of almost all the valley waters, however some resurgences have been detected in the bottom of the Ourthe bed.

Recent history of the karst landscape

The drainage is presently disorganized, no stream flows in the axis of the valley, and the few streamlets of the tributary dales run only during a few days after the rainfalls (MICHEL, 1971).

The synclinal valley was carefully studied and mapped in 1898 by E. MARTEL, E. VAN DEN BROECK and E. RAHIR. They published a map and a detailed description of the karstic features of the valley (E. VAN DEN BROECK, E. MARTEL, and E. RAHIR, 1910). In two different sites they referred to "ancient sinkholes downward the present ones". During a second visit to the region, in 1909. they noted that "as in most swallowhole areas changes had occured in the interval" (p. 1401 and p. 1411).

Later on, between 1960 and 1970, one of us (C.E.) noted a lot of new modifications and suggested to map the valley anew. The changes appeared to be drastic on an unpublished survey in 1971. At least three swallowholes had moved backward by 400 m or more, and among 22 holes, 8 had moved in the same direction, on a mean distance of 270 m (MICHEL, 1971).

In 1995 one of us (V.M.) revisiting the region, noted new changes in the last 24 years.

The swallowholes move normally upwards along the valley axis. But when man blocks an inlet, waters run downwards and can open or re-open a lower sink. The result is then visible on the map as a recent swallowhole situated downward of an older one. This is an exception. The rule is the move upward, i.e. up-stream.

STATING AND MAPPING KARST CONSTRAINTS

The map here presented (Fig. 1) is the result of three successive surveys (1898, 1971, 1995).

The purpose of the concerned work was to find out a methodology to identify the physical constraints important for a good land-use planning (EK. & GRIMBÉRIEUX, 1985; MICHEL, 1996; PISSART & CLOSSON, 1996).

Published in: Proceedings of the 12th International Congress of Speleology (1997), vol. 5, pp. 13-14.
Status: Postprint (Author's version)

With this aim in sight, a first descriptive map of the present situation has first been drawn from aerial photographs and field observations in 1995. This map was then compared to the two older ones. The resulting figure is presented in this paper (Fig. 1).

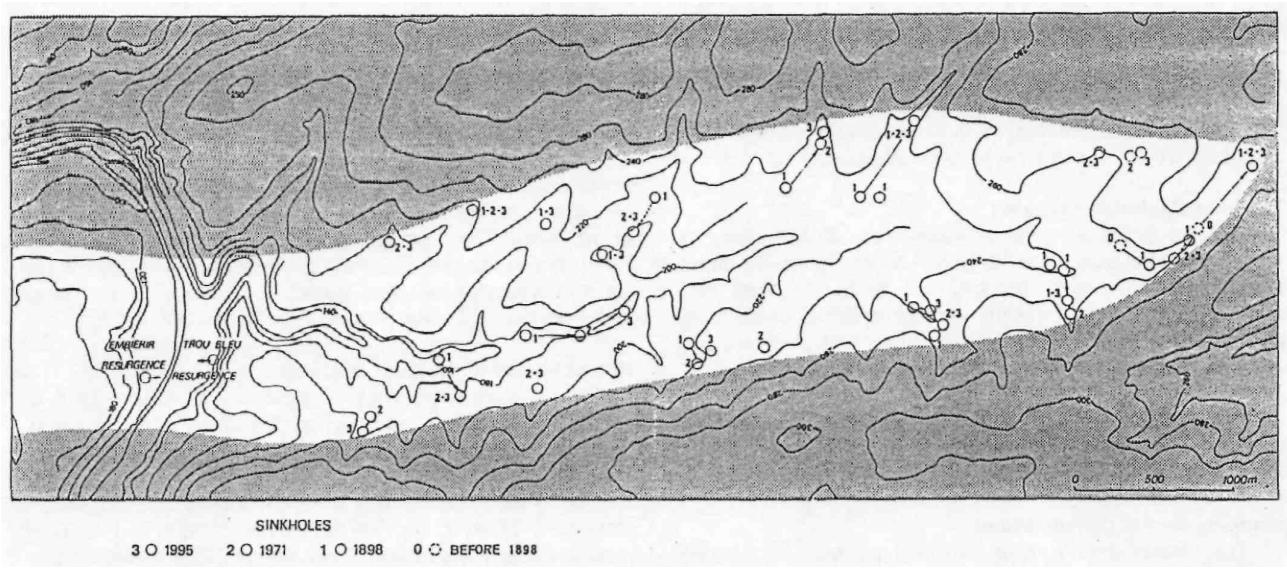
From the compilation of all present and past field data, we derived a map called *Karst-related constraints.* On this map were distinguished :

1. Non building areas, at least 30 diameter around the dolines;
2. Restricted building areas, at least 60 m diameter around the dolines, and, around the swallowholes, extended to 100 m upstream;
3. Karstic substratum areas where a lot of activities are restricted.

This map was eventually combined with the other constraint-maps to produce a *Synthetic map of physical constraints.*

The analysis of these maps by the Direction Générale de l'Aménagement du territoire lead to a new article in the Walloon Code of Land Management : "Article 46 : When activities or works are to be carried out in an area prone to karst hazard, the works or activities can be forbidden or submitted to special requirement to protect people and the environment".

Figure 1: *Sprimont carboniferous syncline: evolution of sinkholes between 1898 and 1995.*



References

EK, C. & GRIMBERIEUX, J., 1985. Comptes rendus du Colloque international de karstologie appliquée. *Annales de la Société Géologique de Belgique,* 108 : 308 p.

MICHEL, R., 1971. *Le vallon de Sprimont à Chanxhe.* Mémoire de licence en Sc. géographiques, Université de Liège, inédit, 172 p.

MICHEL, R., 1996. *Le karst, une contrainte physique pour l'aménagement du territoire.* Direction Générale de l'Aménagement du territoire (DGATLP). Rapport interne, inédit, 3 p.

PISSART, A. & CLOSSON, D., 1996. The importance and problems of cartography. An example : the cartography of natural constraints on a territory of 74 sq. Km in Belgium (the Sprimont territory). *Proceedings of the European School on Floods an Landslides Integrated Risk Assessment, Orvieto,* pre-print, 7 p.

VANDENBROECK, E., MARTEL, E. & RAHIR, E., 1910. *Les cavernes et les eaux souterraines de la Belgique,* 2 vol., Brussels, 1592 + 92 + LXVI p.