Geophysical Research Abstracts, Vol. 9, 08499, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08499

Cave gypsum an indicator for early speleogenetical processes?

M. Filipponi (1) and P.Y. Jeannin (2)

1. Laboratoire de géologie de l'ingénieur et de l'environnement (GEOLEP), Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland
2. Swiss Institute of Speleology and Karstology (SISKA), Switzerland

(marco.filipponi@epfl.ch / Phone: +41 21 693 23 55)

Karst terrains are one of the most intricate grounds to be assessed for civil engineering purposes. It induces economic, social, security and environment problems. The main problems are due to unpredictable location, dimensions and geometry of karst structure voids.

GEOLEP and SISKA started a project aiming to improve the prediction of the position and characteristics of karst conduits within the scale of the karst massif. The 3D analysis of the geometry of large cave systems in close relation with their geological context as well as hydrogeological boundary conditions makes it possible to better assess parameters controlling the speleogenesis, and to provide better predictability of dissolution voids.

So far we analysed more than 15 large cave systems in limestone and dolostone from all over the world (in all more than 1500km of conduits). We could show for these examples, that the spatial distribution of karst conduits is guided at regional scale by only a restricted number of bedding planes (in most cases between two and five bedding planes in a carbonate sequence that control the position of around 80% of the phreatic conduits) and the hydrogeological boundary conditions.

To better understand the reasons why only some bedding planes are particularly favourable to the karstification, a detailed study of this bedding planes as well as the cave conduits developed along those was designed. Within this context one question was: can cave gypsum deposits be used as indicator for early speleogenetical pro-

cesses?

One of our study sites is the Siebenhengste region north of Interlaken (Switzerland), one of the most significant cave areas in the world with in total almost 300 km of mapped cave conduits. The main part of the caves evolved in the massive Urgonian limestone of the Schrattenkalk-Formation, with a thickness of around 180m. The limestone dips 10-30° towards the southeast as large slab, cut by a series of faults. The cave system consists of a 3D labyrinth of shafts and horizontal conduits, whereof almost 85 % of the phreatic conduits developed along five bedding planes. In the cave conduits around 260m below the surface, which developed along such a favourable bedding plane, we found a lot of gypsum flowers and needles.

We can distinguish four different kinds of gypsum by the provenience of the sulphur and relat them to different speleogenetical processes:

- **Re-precipitation of sedimentary gypsum** that has been previously dissolved in the rock mass. The speleogenetical indication of this kind of cave gypsum is that the primary gypsum is easy soluble relatively to the surrounding rock mass and causes an elevated ratio of secondary porosity that would favour the evolution of the karstification.
- Reaction between the host limestone and **sulphates** (including sulphuric acid) **derived from oxidized sulphide minerals** (e.g. pyrite). The weathering of sulphide minerals can produce acidic solutions, which can at least locally increase the dissolution capacity and cause an elevated ratio of secondary porosity.
- Reaction between the host limestone and **sulphates** (including sulphuric acid) **derived from hydrothermal sources**. This kind of cave gypsum indicates that speleogenesis took place under hypogenic conditions with a minor role for the karstification of meteoric percolation water.
- Reaction between the host limestone and **sulphates derived from decomposition of organic material in the soil**, and transported by seepage water into the cave. Although the dissolution capacity of the strong acidity is depleted after relative short flow path (order of some metres) so that the influence to the karstification of the whole rock mass is very restricted.

To work out the origin of the sulphur we measured the sulphur isotope composition δ^{34}S of gypsum samples from the Siebenhengste cave system as well as pyrite from the Schrattenkalk-Formation. The results indicated that the sulphur of the gypsum comes from the oxidation of pyrite. This let us conclude that the karstification along this particular bedding plane has been favoured by the weathering of pyrite and the related production of acidic solutions, which could at least locally increase the dissolution capacity. Such an additional acidic dissolution has a minimal effect on the context of the later passages, but its contribution to the porosity development into the bedding plane can be significant.