



## **Gypsum karst in Lower Austria - distribution, features, and hazards**

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In the Eastern Alps gypsum occurs in a number of tectonic units but is only distributed locally, in rather small patches. The most important evaporitic units in Lower Austria lie within the Northern Calcareous Alps (NCA; part of the Upper Austroalpine) in the Upper Permian Haselgebirge Formation, the Lower Triassic Werfen Fm., and to a smaller extent in the Upper Triassic Oponitz Fm. The low grade metamorphic stratigraphic sequence of the Lower Austroalpine Semmering area also contains evaporates („Bunter Keuper“; Upper Triassic).

However, in detail (i) the spatial distribution, (ii) the surface morphology and (iii) the consequences for society are poorly known. This comprehensive study aims to shed light on these aspects. Based on geological maps, the mining register, and field studies including morphologic mapping occurrences of gypsum are located. In addition, water analysis concerning enhanced electric conductivity (0.6 to 2.7 mS/cm) and sulphate content (up to 1.3 g/l SO<sub>4</sub>) are utilised to testify dissolved gypsum.

Due to the stratigraphic position and the fact that the comparatively soft gypsum and associated silt- and sandstones are prone to erosion, most gypsum occurs on mountain slopes and in valleys. The most common landforms of gypsum karst in Lower Austria are dolines. Most of them are particularly round and funnel shaped, develop on steep slopes, and can reach diameters of several tens of metres. In limestone, dolines of these sizes only occur on elevated karst plateaus but rarely show round outlines. Some of the dolines in gypsum karst, especially at the contact with non-karstic rock, act as ponors and show an asymmetric shape. Due to the location on steep slopes and the high solubility, subsurface gypsum bodies are often associated with landslides and it is often hard to distinguish the dominant process for the development of depressions (i.e. dissolution or landslide). The interplay of both processes results in asymmetrically shaped dolines. Natural outcrops of gypsum are rare but in most cases at least small karren features were detected. Among ca. 4000 registered caves in Lower Austria, only five are related to gypsum dissolution. They are relatively small, unstable and change their shape quite rapidly.

There were numerous smaller and bigger gypsum mines and quarries but only one of them is still active. As a result of mining, artificially induced sinkholes above mines have developed and are hard to distinguish from natural ones. Despite its high importance as a natural resource, gypsum can cause hazards to infrastructure. The constant and rapid dissolution by natural or human induced water (mining waters, emptying of swimming pools etc.) can cause fast-developing cavities and subsequently collapse features. In some regions reports of fresh sinkholes are frequent and sometimes infrastructure is damaged. In these areas special protective measures are necessary for construction sites etc.