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Development and evolution of an Alpine sulphuric acid cave: Kraushoehle (Austria)

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The number of known active and fossil hypogene cave systems is increasing rapidly thanks to recent advances in our understanding of this type of karst. Many cave systems previously thought to be of epigene origin have undergone more or less important phases of hypogene development. Epigene overprinting tends to obliterate hypogene features rendering identification of caves of multiphase speleogenesis a challenge.
Among hypogene caves the sulphuric acid ones are the most interesting for a number of reasons: they host important bacterial and arthropod communities, they have peculiar and typical morphologies, and contain a variety of mineralisations.
Sulphuric acid caves have been described from the Americas (Lechuguilla and Carlsbad in New Mexico, Cueva de Villa Luz in Mexico, Kane caves in Wyoming), but examples are also known in Europe (Movile cave in Romania, Frasassi and Monte Cucco in Italy). Until recently, the Serpents cave (Aix-les-Bains, northern Prealps) was the only sulphuric acid cave described in the international literature from the Alpine belt.
Kraushöhle located near Gams (Styria, Austria), the world's first show cave equipped with electric lights in 1883, is the only currently known sulphuric acid cave in the Eastern Alps. Thick, partly eroded gypsum deposits in the subhorizontal passages formed by the replacement of the limestone bedrock by upwelling H2S-rich waters. A detailed morphological and mineralogical study has been carried out in this cave in order to study its development.
Cupolas are the most striking morphological features, but ceiling partings and portals, ceiling channels, replacement pockets, horizontal corrosion/convection notches, sulphuric acid karren, blind chimneys, incomplete dissolution walls, drip holes and floor cusps are also present. There is only minor evidence of an epigenic (vadose) overprint in some parts of the cave system.
In addition to calcite (derived from the host limestone) and gypsum (product of the acid corrosion of the host rock), gibbsite ($Al(OH)_3$), opaline ($SiO_2.xH_2O$), jarosite ($KFe_3(SO_4)_2(OH)_6$), metalunogene ($Al_2(SO_4)3.12H_2O$), hydroxylapatite ($Ca_5(PO_4)_3(OH)$) and alunite ($KAl_3(SO_4)_3(OH)_6$) were identified. Alunite is of special interest because it is a datable mineral, and with our interpretation of alunite as a product of acid limestone weathering, it is possible to determine the timing of speleogenesis using the K-Ar decay scheme ($^{40}Ar/^{39}Ar$ method of dating).
Further studies of the stable isotope composition and speleothem chronology are in progress to better understand the evolution of this exceptional cave.