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Stratigraphic Proxy Records for the Marine Evaporite Deposit of Hallstatt (Austria)

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The marine evaporate deposit of Hallstatt was formed during the Upper Permian and partly Lower Triassic (Scythian) in shallow lagoons of the Tethys. The apparent mélange of minerals and rock fragments, so-called Haselgebirge, represents a main part of the East Alpine evaporates. The primary sedimentary structures are highly overprinted by complex fold and fault structures caused by alpine orogenesis events and high plasticity of salt minerals like halite. Thus recovering of evaporite sequences and stratigraphic records is highly challenging and still a matter of debate.

The present study is focused on the distribution of Br^-, Sr^{2+} and $^{34/32}S$ isotopes in salt minerals as well as on the microstructure through the evaporite deposit ($\approx$ 600 m drill core) to decipher potential stratigraphic records and primary versus secondary sequences. Thin slides were obtained by dry preparation, and microdrilling was used for sample separation. XRD, optical microscopy and electron microprobe analyses are used to study mineralogy and microstructure and to obtain the spatial distribution of elemental ratios such as Sr^{2+}/Ca^{2+}. Mechanically separated samples were suspended in MilliQ water for analyzing soluble ions by ion chromatography. For selected samples $\delta^{34}S$ values of sulfate minerals are analyzed using isotope-ratio mass spectrometry.

XRD pattern reveal the predominance of halite, anhydrite, polyhalite, calcite and dolomite with an accumulation of e.g. halite and anhydrite/polyhalite as well as clay minerals in local horizons. SEM images display a secondary formation of polyhalite via the consumption of anhydrite. Among others, the mineral kalistrontite ($\approx$ 100 μm in diameter) is associated to anhydrite which has to be considered for individual Sr^{2+}/Ca^{2+}ratios of calcium sulfate horizons.

From the dissolution data the Br^- content in halite, the only present mineral for Br^- incorporation, can be estimated. The potential impact of fluid inclusions - identified by thin section analyses in several samples - on Br^- concentrations are considered by pre-treatment of the samples with ethanol before treatment with MilliQ water. Preliminary results of halite analyses show Br^- concentrations varying within the range of 86 - 124 $\mu g\ g^{-1}$. In principle Br^- content in halite can be used as a stratigraphic proxy e.g. by discovering evaporation degrees during primary halite formation, where the discrimination of Br^- versus Cl^- for halite crystallization is given by the distribution coefficient: D_{Br}(halite) < 1. Sulfur isotope distribution of sulfate minerals records the isotopic composition of the precipitating solution (seawater), but may be affected e.g. by microbial activities. Preliminary results with respect to elemental and isotopic data as well as microstructures will be discussed.