5.2. Short notes on the Hallstatt salt rock - the "Haselgebirge"

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The salt-bearing rocks of the Northern Calcareous Alps are summarized under the term „Haselgebirge", a term of old miner´s language origin, which means salt rock. The term has been introduced into the geological literature by L. v. BUCH (1802).
Nowadays the geological term Haselgebirge comprises variegated claystones, gypsum, anhydrite, halite and accessoric evaporitic minerals. Breccia structure is prevailing, undisturbed sedimentary successions are mostly preserved in some „inclusions", huge rock bodies within the breccia.
Haselgebirge in a strict sense, as it is used by miners, is a breccia with a matrix of salt and components of clay/siltstone, gypsum, anhydrite and rare dolomite.
The origin of the brecciation was a matter of long lasting discussions - synsedimentary versus tectonical brecciation. Both factors seem to be of importance.
Fluidal tectonical processes accompanied the diapiric ascent of the evaporites, starting in the Mid-Triassic. Due to its position near the basal detachment plane of the NCA sedimentary sequence the Haselgebirge underwent additionally strong shearing during alpine orogeny. On the other hand, however, marker beds visible within some breccias point at a synsedimentary origin.
Based on detailed mapping inside the salt mines SCHAUBERGER developed a subdivision of the Haselgebirge according to colour and mineralogical composition, summarized in SCHAUBERGER (1986):

„Rotsalzgebirge" - reddish/grey salt, anhydrite, polyhalite, glauberite, Na/Mg-sulphates, red and black claystone, grey/brown sandstone.

„Grüntongebirge" - white salt, muriazite, rare K/Mg/Na-sulphates, green claystone, greygreen sandstone, rare Fe/Cu-ores.

„Bunttongebirge" - brown salt, black, green, grey and red claystone, accessoric local volcanites („Melaphyr") and volcanic tuffites.

„Grausalzgebirge" - grey/white salt, cherty anhydrite, dolomitic anhydrite, grey claystone, accessoric magnesite.

The sedimentary environment is interpreted as shallow depressions within a Graben system. Occasionally marine ingressions from the open Tethys led to hypersalinar conditions, causing evaporitic mineral deposition. Alluvial fans from the hinterland and sand/mud flats bordered gypsum flats of a sabkha facies and a central „basin" with halite precipitation.
Evaporitc „shoaling upward" sequences have been demonstrated by SPÖTL (1988) a,b - see Fig. 5.2.2. The so called Northern Inclusion of the Hallstatt salt mine represents a clastic/evaporitic red-bed succession, which is thought to represent the transitional facies between the depositional realm of the Haselgebirge and the siliciclastic hinterland - SPÖTL (1987).
Due to the lack of macrofossils and the tectonically disturbed contact to the surrounding rocks also the age of the Haselgebirge was uncertain for a long time. KLAUS (1953, 1955, 1963, 1974) established an Upper Permian age, based on palynology. Characteristic taxa are *Nuskoisporites*, *Gigantosporites*, *Lueckisporites* and *Klausipollenites schaubergeri.*

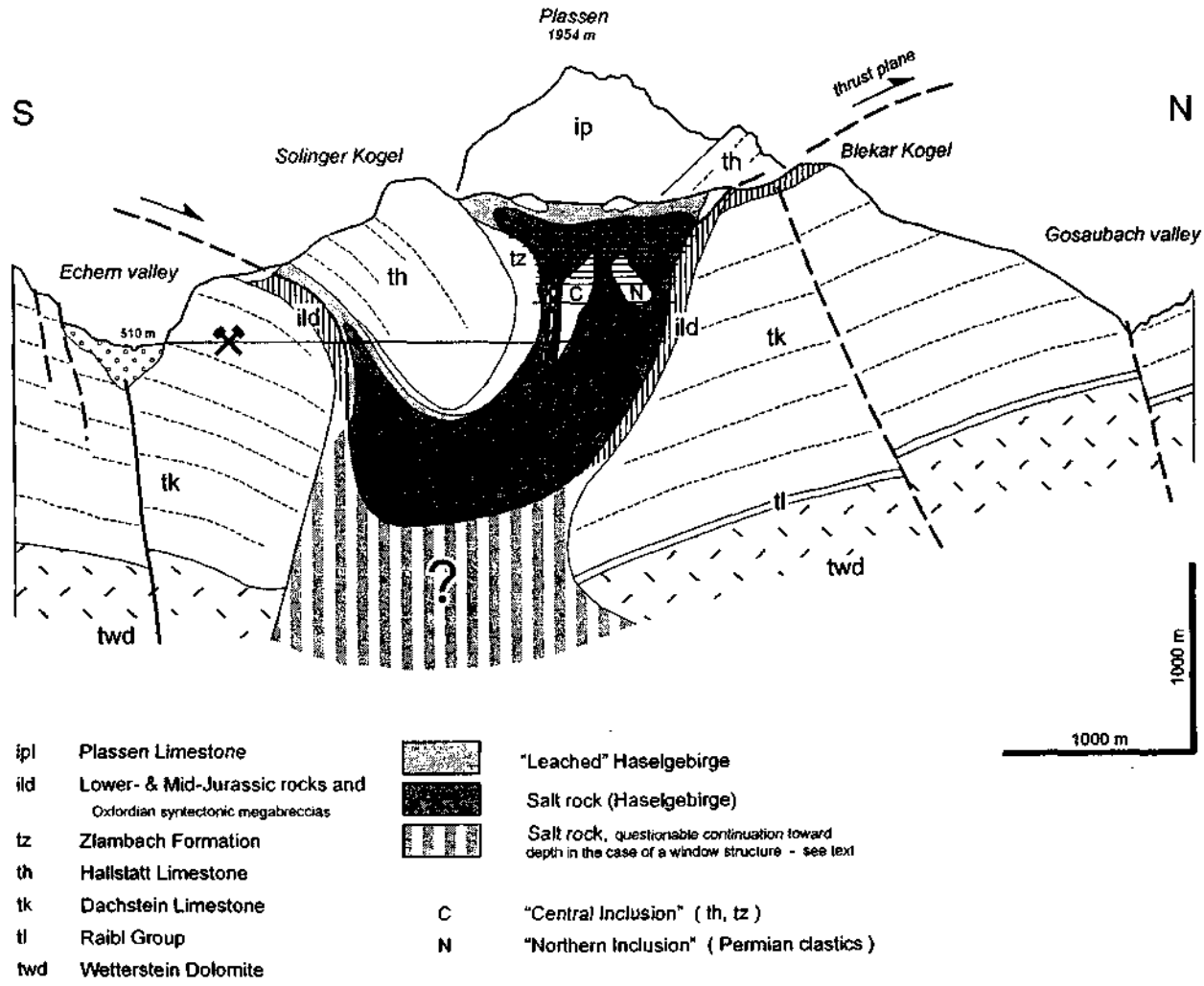
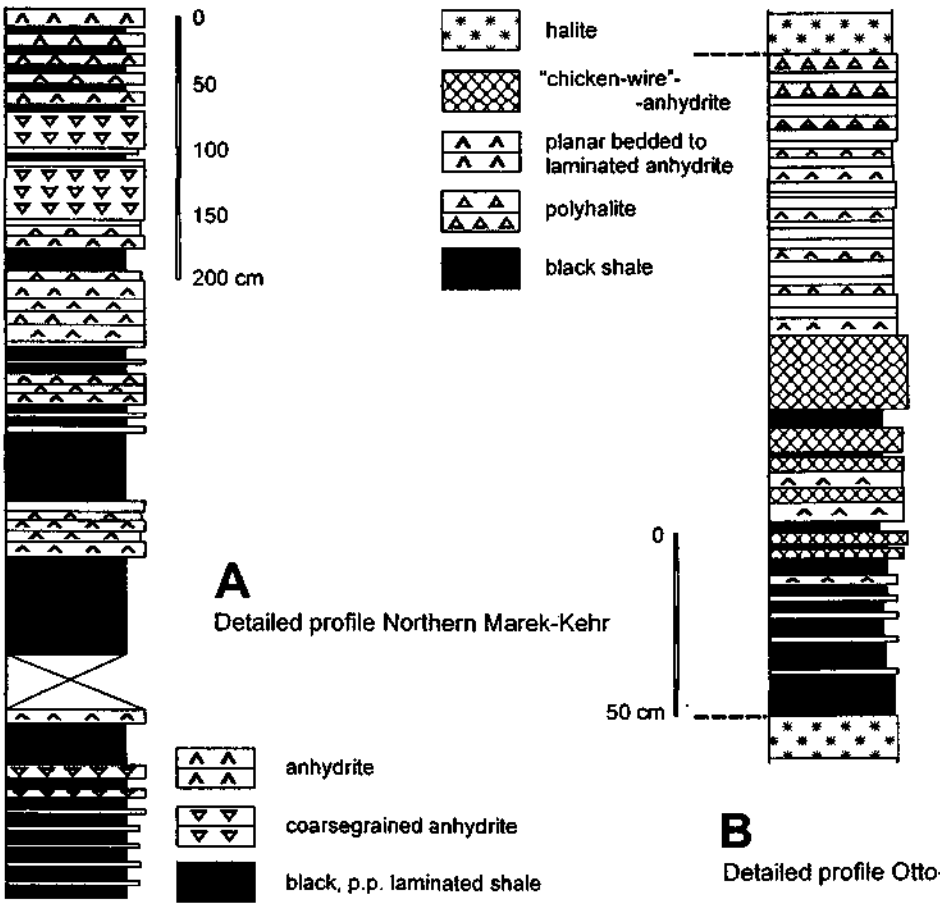


Fig. 5.2.1.: Schematic cross-section of the Hallstatt salt mine, according to SCHAUBERGER (1955).

Bituminous dolomites and anhydrites from the Grausalzgebirge surprisingly contained floral elements of late Lower Triassic.
Several sulphur isotope determinations supported the Upper Permian age as well as the Lower Triassic one (PAK, 1974, 1978, 1982, PAK & SCHAUBERGER, 1981, SPÖTL, 1988a,b).
Special attention has been directed in the last years to the basic magmatites, which are associated with the Haselgebirge at many localities. They are well known since long ago (JOHN, 1899, ZIRKL, 1957). Investigations of KIRCHNER (1977, 1979, 1980) have revealed indications of a possible ophiolitic origin due to the coexistence of tholeiitic pillow lavas, tuffites and lenses of serpentinite. Minerals as pumpellyite and sodium-amphiboles within the magmatites as well as in the surrounding sediments point at a low grade metamorphic overprint. Recent analysis by VOZAROVA et al. (in press) give hints for a high pressure metamorphism of basalts in the Haselgebirge of Bad Ischl.



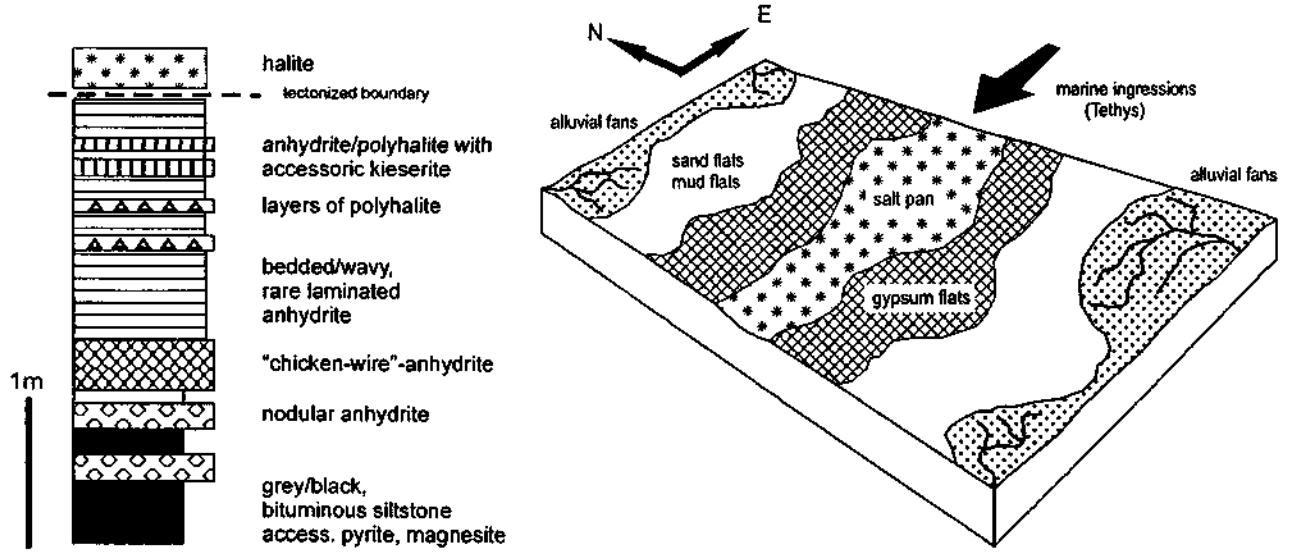


Fig. 5.2.2.: Sedimentary sequences of the Permian evaporites (Haselgebirge, evaporitic melange) of the Hallstatt salt mine, according to SPÖTL (1988 a,b).

All these data are of interest in so far as similar volcanites within Permian evaporites in a comparable tectonic position in the North Hungarian Carpathian mountains have been dated micropaleontologically by associated radiolarites as Middle Triassic. They are interpreted as a remnant of the Tethyan oceanic crust, which has been incorporated in an evaporitic melange during the Jurassic subduction of the Meliata segment of the Tethys ocean. KOZUR (1991), KOZUR & MOSTLER (1992) insist on an equivalent origin of the magmatites of the Austrian Haselgebirge.
SPÖTL et al. (1998) and SPÖTL & HASENHÜTTL (1998) studied the metamorphism of mudrock/dolostone components in the evaporitic melange of several Austrian localities. Illite crystallinity, vitrinite reflectance and fluid/rock reactions record a complex deformation- and thermal history, changing between and within individual outcrops. IC values vary between diagenesis and anchizone, vitrinite data point at temperatures of 160-180 °C. $^{40}Ar/^{39}Ar$ analysis of authigenic K-feldspar at the locality Moosegg yielded step-heating spectra which suggest Late Jurassic cooling. This supports again the concept of Jurassic initial detachment of the Juvavic nappes.

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