Isotopic analyses of the Middle Miocene evaporite assemblage and its fluid inclusions (Praid, Transylvanian Basin, Romania)

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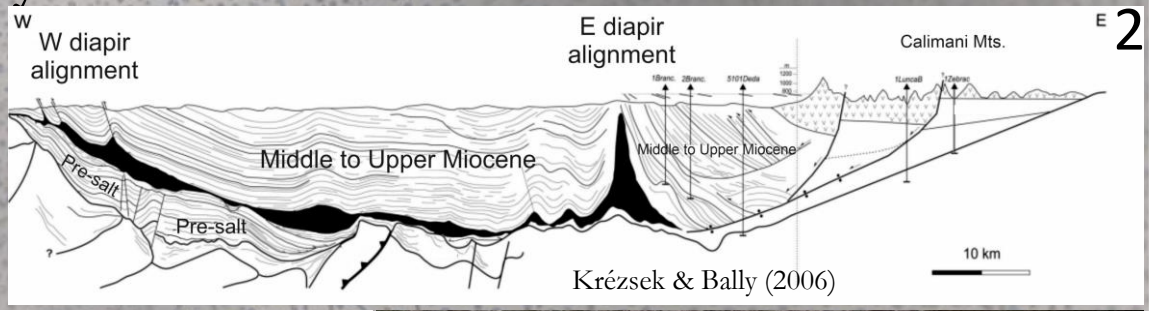
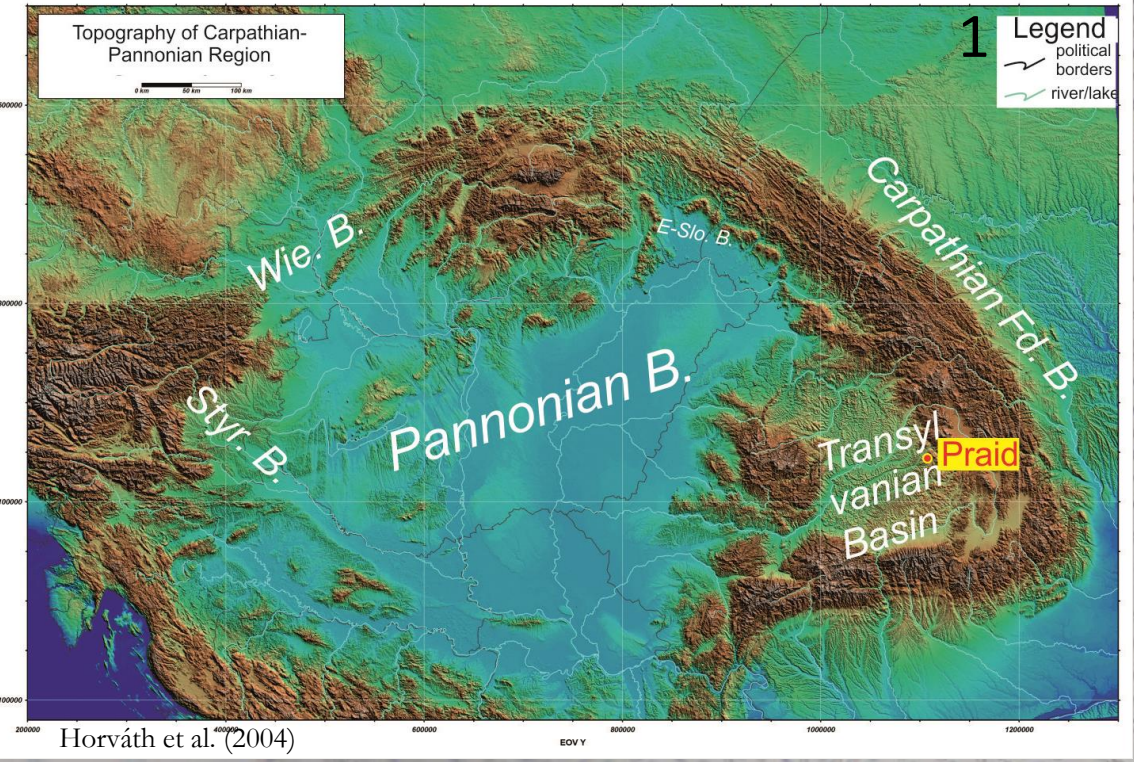
About the project

What are the geochemical signatures of the salt during the Badenian Salinity Crisis?



Krézsek & Bally (2006)



Horváth et al. (2004)

(1) The objective of this study is to constrain the formation conditions of deposition of the Middle Miocene marine evaporite in the Transylvanian Basin (TB). The salt rock, formed during the Badenian Salinity Crisis (BSC), consists principally of halite (> 90 %).

(2) BSC is resulted in the deposition of large amounts of marine salt rocks which recently forms diapirs in the eastern margin of the Transylvanian Basin.

(3) Representative samples were collected from mine in Praid Salt Mine.

Applied techniques

Petrography

Distinguishing primary and secondary features (e.g. primary fluid inclusions)

Microthermometry

Crystallization temperature and ionic composition

Raman spectroscopy

Identifying the type of salt component

Stable isotope geochemistry

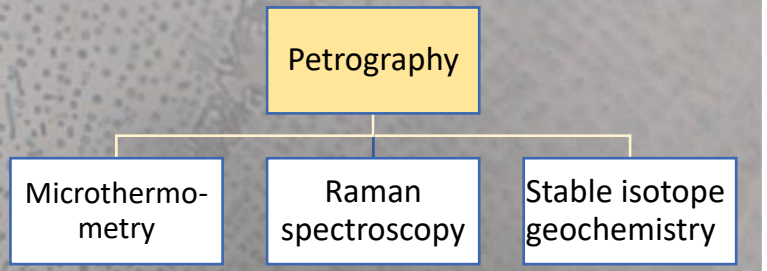
The sources of solutes and solvents

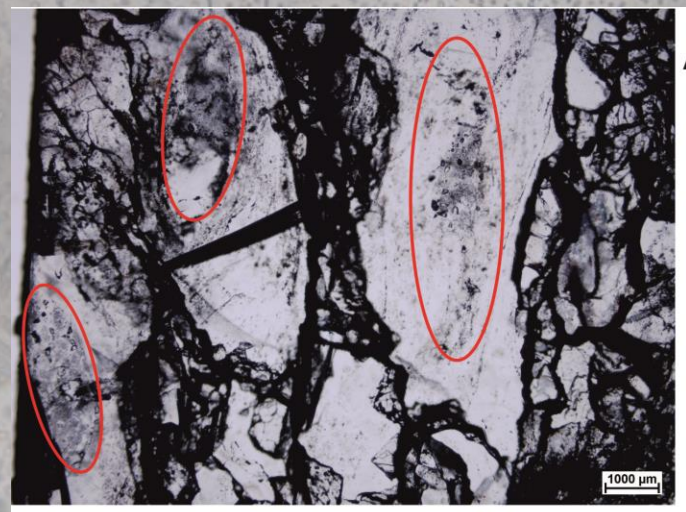
Petrographic studies (on texture and fluid inclusions) were carried out according to Hardie et al. (1985)

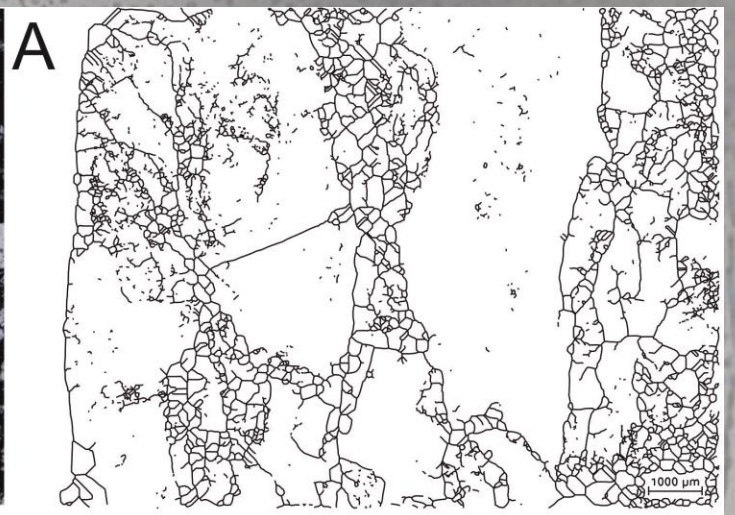
The identification of the solid phases by Raman spectroscopy is based on the databases of Uriarte et al. (2015), Baumgartner and Bakker (2015) and Dubessy et al. (1982).

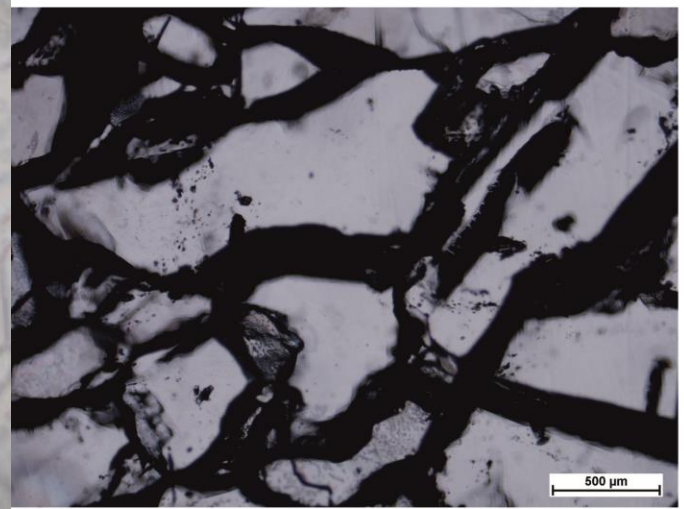
Three constituents of the salt rock were analyzed isotopically. Halite fluid inclusions (FI) for O and H, anhydrite for S and O, dolomite for C and O.

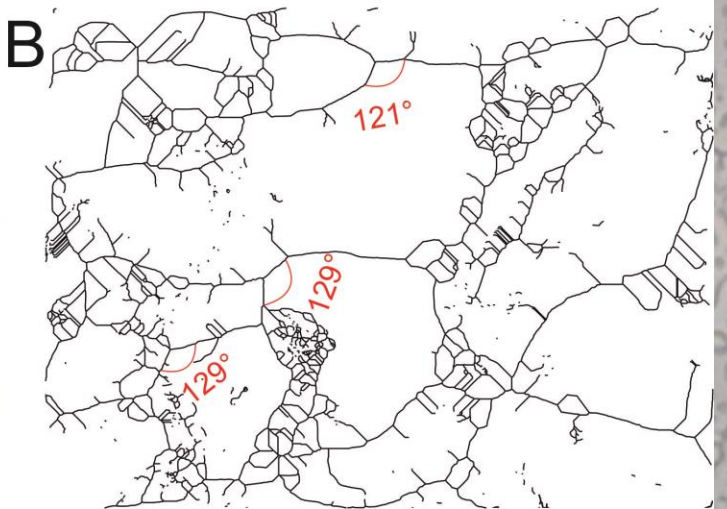
Textural observations









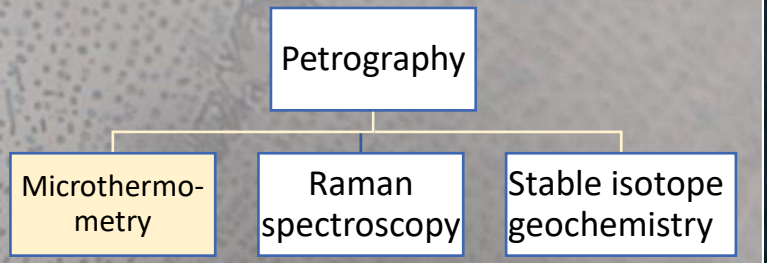


Two types of fabric can be distinguished.

A-type: Elongated halite crystals placed in a submillimeter size crystal mash. Large grains are remnants of chevron halite formed directly from the concentrated paleo-seawater.

B-type: Grainsize distribution is more consistent compared to A-type, 120° joints -> mosaic structure. Lack of primary fluid inclusions.

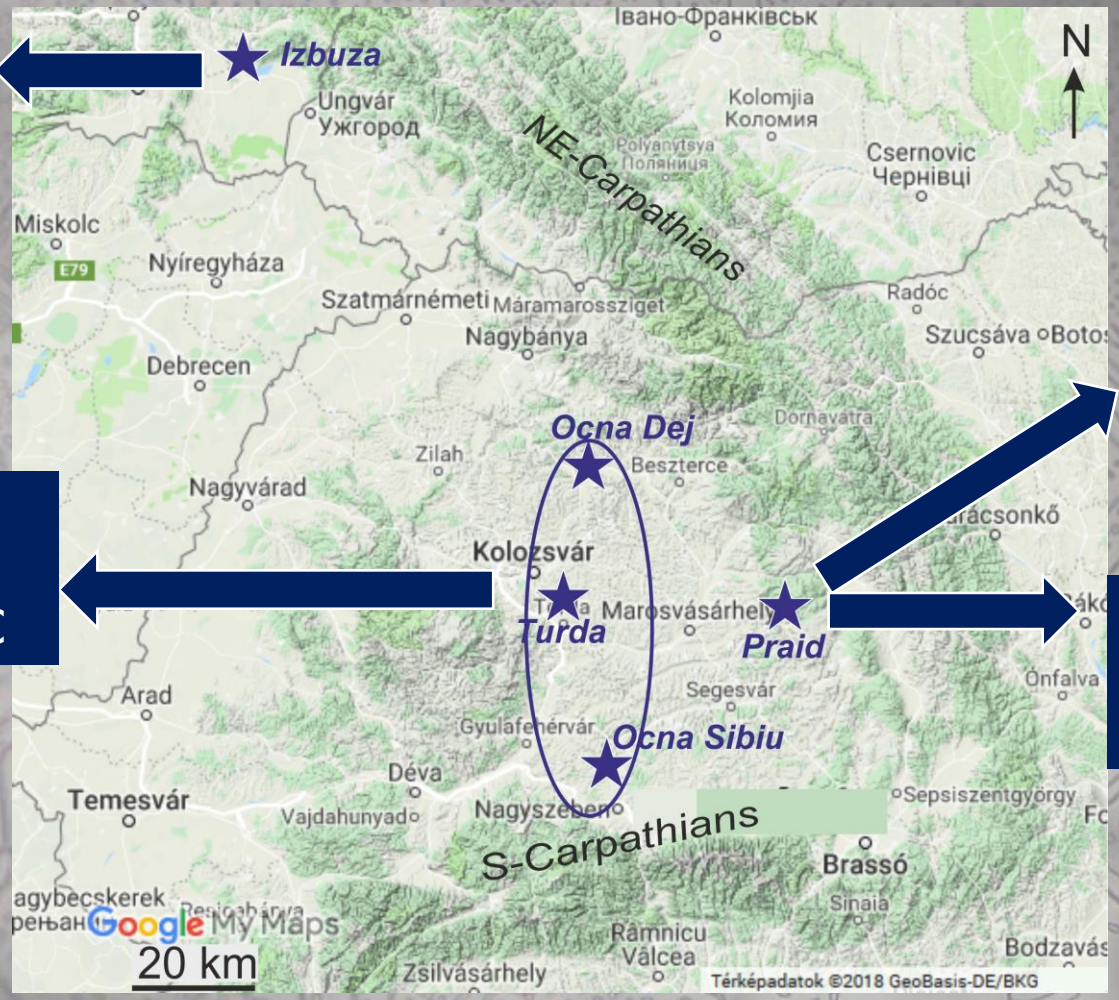
Microthermometry



Homogenization temperatures (Th) measured on primary fluid inclusion are similar to the other Badenian salts.

Eutectic temperatures (Te) show complex chemical composition.

Galamay et al. (2004):
Th: 10 – 36 °C



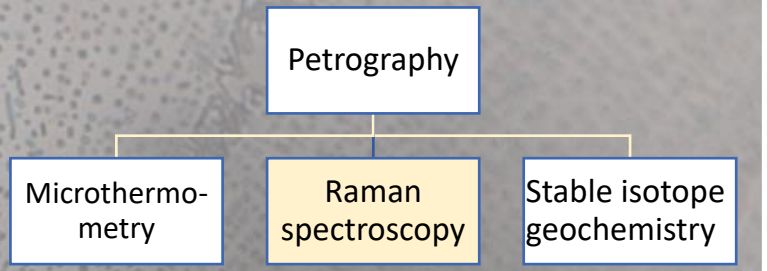
This study:
Th: 10 – 24 °C
Te: - 55 – -42 °C

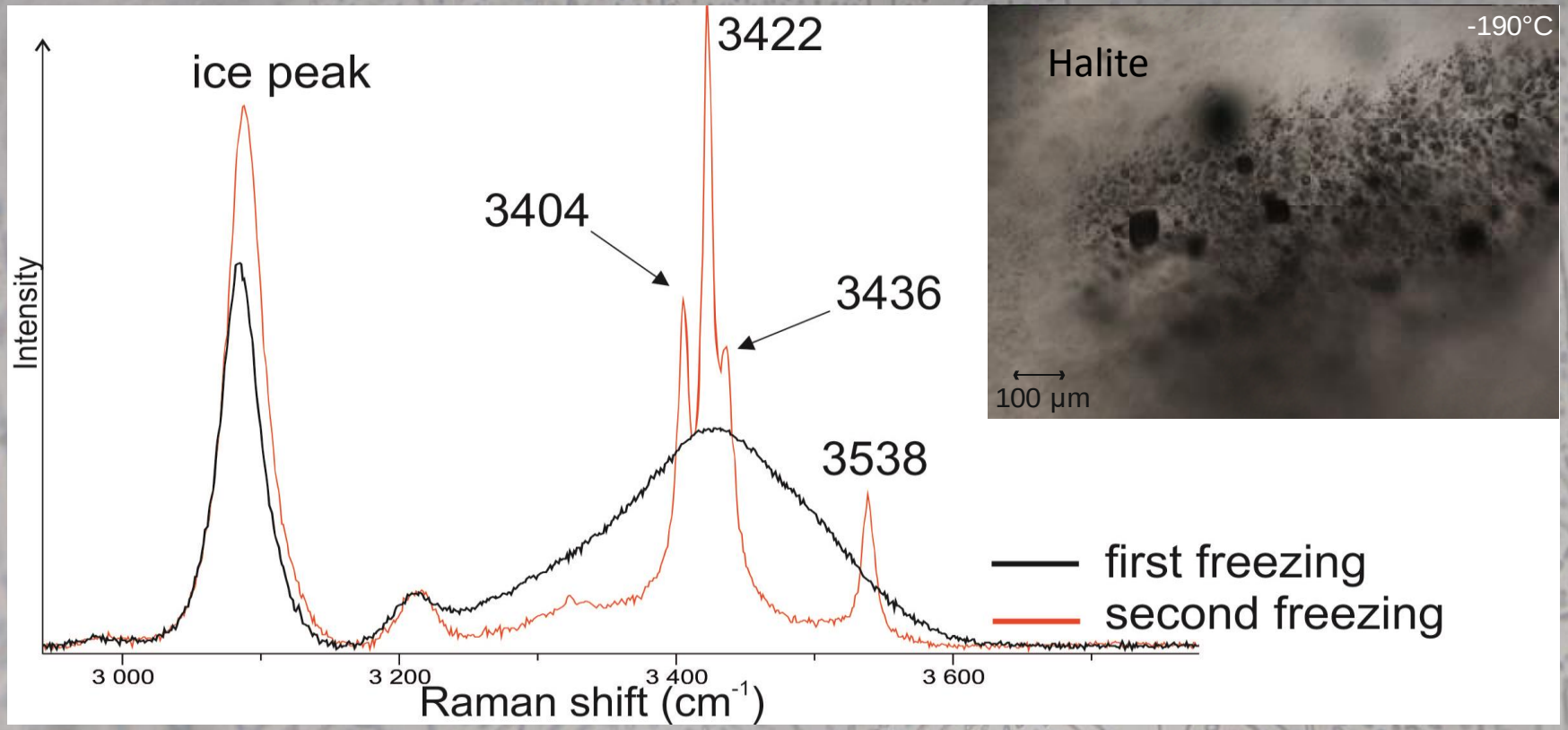
Pintea (2008):
Th: 10 – 15 °C
Te: - 36 – -18 °C

Kátai (2017):
Th: 15 – 32,7 °C
Te: -52 – -47 °C

Microthermometry measurements were performed on samples in the Lithosphere Fluid Research Lab (Eötvös University) using LINKAM THMSG600 stage.

Cryogenic Raman spectroscopy





Characteristic Raman spectra of primary fluid inclusions (black cubes on the photomicrograph) on -190 °C after first (black) and second (red) freezing in the stretching regions of structural H_2O.

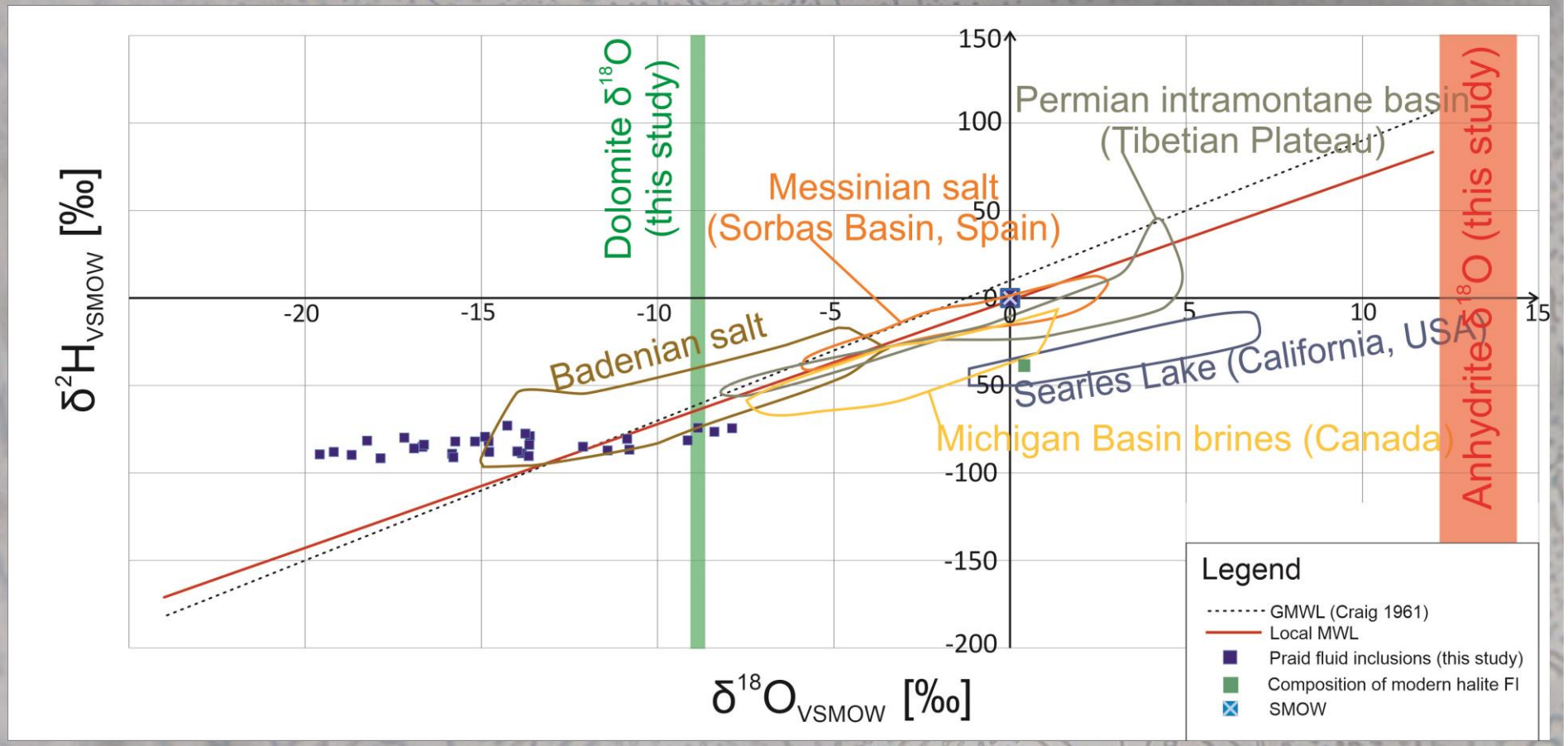
Raman analyses were carried out in the Research and Instrument Core Facility at the Faculty of Science (Eötvös University) by a Horiba Jobin Yvon LabRam HR800.

Isotope geochemistry

Petrography

Microthermo-metry | Raman spectroscopy | Stable isotope geochemistry

Stable isotopic study was completed in the Isotope Climatology and Environmental Research Centre, Institute for Nuclear Research, Debrecen (Hungary).



Literature of FI: (Koehler et al. 1991; Horita 1990), brines: (Horita 1990; Wilson & Long 1993), and gypsum hydration water: (Halas & Krouse 1981; Evans et al. 2015; Li et al. 2017)

Isotopic characteristics of primary FI draw very low-slope line. Delta values are partially overlapped with the other BSC data (Halas & Krouse, 1982).

Translucent dolomite has negative delta values ($\delta^{18}O$ -7.07 - -4.55 ‰ and $\delta^{13}C$ -9.03 - -8.31 ‰)

Sulfate isotope values measured in anhydrite are ranging $\delta^{34}S$ 20.4 – 22.4 ‰ and $\delta^{18}O$ 12.9 – 14.5 ‰ that coincide with the BSC deposits from the Carpathian foredeep (Peryt, 2010) and support seawater origin.

Summary

- Primary features of the Middle Miocene salt rock were detected.
- Although further studies are in process, it is clear that the geochemical characters of the evaporite minerals reveal a complex restricted hydrogeologic evolution.
- Negative isotopic characteristics of fluid inclusion H_2O and carbonates suggest presence of organisms in the evaporating environment.

Új Nemzeti Kiválóság Program

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Ministry for Innovation and Technology

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