

## **New evidence from halogen and boron isotopes for multiple sources of Middle Miocene Badenian evaporites, Carpathian mountain region**

YAO ZHAO<sup>1</sup>, YI-JING WANG<sup>2</sup>, HAI-ZHEN WEI<sup>2</sup>, SHAO-YONG JIANG<sup>1,2</sup>, CHRISTOPHER J. EASTOE<sup>3</sup>, TADEUSZ M. PERYT<sup>4</sup>

<sup>1</sup>State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan 430074, China. Email: 1436657115@qq.com, shyjiang@cug.edu.cn

<sup>2</sup>State Key Laboratory for Mineral Deposits Research, Nanjing University, Nanjing 210093, China. Email: haizhenwei@nju.edu.cn, 2278386653@qq.com

<sup>3</sup>Department of Geosciences, University of Arizona, Tucson, Arizona, United States. Email: eastoe@email.arizona.edu

<sup>4</sup>Polish Geological Institute - NRI, Warsaw, Poland tper@pgi.gov.pl

The stable halogens (Br, Cl) and boron isotopes have emerged as powerful geochemical tracers for tracing the sources and evolution of evaporites or brines with understanding their fundamentals in equilibrium/dynamic isotopic fractionations [1-4]. Here we report a systematic chlorine and boron isotope study in the Badenian evaporites in Carpathian mountain region. All the Badenian evaporites show a limited  $\delta^{37}\text{Cl}$  variation from -0.2 to +0.8 ‰, but the  $\delta^{11}\text{B}$  display a wider range of variation in the three evaporite basins: Wieliczka Basin (-4.5 to +28.6 ‰), Transcarpathian Basin (+2.2 to +35.7 ‰) and East Slovakia Basin (+5.4 to +23.4 ‰), which overlap the boron isotope variations of non-marine (-39 to 0 ‰) and marine evaporites (+8 to +39 ‰).

Halite from three basins has bromine contents and  $\delta^{37}\text{Cl}$  consistent with marine origin and multiple evaporation and recharge cycles [3]. The stratum with lower  $\delta^{11}\text{B}$  values may reflect mixing of the local continental water, while that with the  $\delta^{11}\text{B}$  higher than +10 ‰ may preserve primary evaporites from buried seawater. Given that the empirical boron isotope fractionation factor of 0.969 between brine and salt for the early stages of precipitation (gypsum and halite range) and the  $\delta^{11}\text{B}$  of  $-3\pm 5$  ‰ for the input continental water [4], a proportion of 22 to 28% of non-marine fluids was estimated to have accumulated into the evaporites in Wieliczka Basin. [1] Eastoe et al. (2016) *Appl. Geochem.* 74, 1-12. [2] Eggenkamp et al. (2016) *Chem. Geol.* 433, 46-56. [3] Eastoe et al. (1999) *Terra Nova.* 11, 118-23. [4] Vengosh et al. (1992) *Geology* 20, 799-802