

Editorial

Editorial for Special Issue “Mineralogy, Petrology, and Geochemistry of Evaporites”

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In his excellent and complete compendium “Evaporites” [1], John Warren defines evaporites as salt rocks that were originally precipitated from a saturated surface or sub-surface brine under hydrology conditions, driven by solar evaporation. The purpose of this publication is to attempt to provide new information on the petrology, mineralogy, and geochemistry of evaporite environments. This Special Issue presents results of studies on evaporites of various ages (from Precambrian salts to sediments of modern salt lakes), from the Eurasian area (China, Russia, Pakistan), but also the Americas (Canada, Brazil) and Europe (Poland, Ukraine, Romania, Slovakia).

This set of studies is only seemingly random. Undoubtedly, all presented articles share one common feature—the use of petrological and geochemical studies of evaporites to reconstruct ancient sedimentary environments. Mineralogical and geochemical studies of marine evaporites, especially those based on isotopic analyses and studies of fluid inclusions, allow us to learn about the evolution and transformation of the world’s oceans, from the beginning of the Earth’s history to modern times. In many cases, the formation of evaporites also has broader paleoclimatic and paleogeographic implications.

The first part of the volume contains papers covering geochemical studies, including studies of fluid inclusions, to interpret the environments and genesis of salt formations. To emphasize the importance of the method in the study of fluid inclusions, the opening article of the volume, by Galamay et al. [2], describes an ultramicrochemical analysis technique for quantifying the chemical composition of primary fluid inclusions in halite. This is one of several methods used to quantify the chemical composition of fluid inclusions. The method is distinguished from other similar techniques by the simplicity of its methodological operations and is used to determine the content of major ions (K, SO₄, Mg, Ca). The second paper, by Toboła and Kukiałka [3], presents a geochemical analysis and microthermometric measurements of fluid inclusions from the Devonian Lotsberg Salt Formation, Canada. In this work, the authors complemented previous petrological studies by integrating them with Raman microspectroscopy and fluid inclusion analyses. Features such as halite recrystallization, low bromine content, and the high-temperature homogenization of fluid inclusions indicate that post-depositional transformations played an important role in the formation of the Lotsberg salt deposits. Subsequently, the paper by Bukowski et al. [4] presents petrological and geochemical studies of the rock salts and content of major ions in fluid inclusions of primary sedimentary halites from the Carpathian area. The results confirmed that it is possible to preserve primary halite sedimentary structures at great depths (~5000 m), and their inclusion chemistry has not changed. Microthermometry studies of inclusions in Miocene halites from several selected locations in the Carpathian region were presented by Galamay et al. [5]. The homogenization of primary inclusions was key to reconstructing the specific conditions that lead to evaporite formation, determining brine temperature, and indirectly indicating the climate during the Badenian salinity crisis in the Carpathian region.

The second part of the volume (six papers) illustrates that accurate mineralogical and geochemical characterization with isotopic analysis is essential to understand the origin



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and evolution of evaporite sedimentary basins. The first paper, by Xu et al. [6], based on geochemical results and stable isotope contents, indicates that the evaporite sequence of the upper Paleocene was formed by transgression. Thus, the mineralogy and geochemistry of evaporites have been used to interpret and reconstruct the geological evolution history of the Tarim Basin and the transgression in the Tethys during this period. The articles by Lou et al. [7], Shen et al. [8], and Han et al. [9] present recent reports from studies in the Lanping–Simao Basin, southern China. They present the results of geochemical studies of Late Cretaceous potassium salts [7], infer the evaporite basin evolution from stable isotope studies [8], and make paleogeographic inferences regarding the Late Cretaceous period in southern China [9]. The next paper, by Hussein et al. [10], focuses on boron geochemistry in evaporites from the Salt Range, Pakistan. Boron isotope determinations in halites and brines distinguish marine from non-marine sources and are used to track paleosalinity. The results of this study were used to reconstruct paleoclimatic conditions in the late Neoproterozoic (~540 Ma). Another topic, presented by Pontes et al. [11], includes several complex studies on the reconstruction of the formation conditions of inner basins of northeastern Brazil. This paper focuses on a study of the organic behavior of evaporites and shales from the Santana Group (Lower Cretaceous) and discusses their role in the evolution of depositional systems. The results suggest a variable paleosalinity, indicating that most of the shales were formed under brackish waters with a saline influence, yet tended to increase the salinity to hypersaline conditions. The isotope data also suggest the occurrence of marine incursions in the depositional systems.

Finally, in the last part of the volume, two articles describe mineralogical and petrographic studies of rocks associated with evaporites. The article by Yeremchuk et al. [12] provides an overview of the association of authigenic clay minerals in marine evaporite sediments. A synthesis of the published data on dozens of Phanerozoic marine evaporite formations worldwide indicates that the association composition of clay minerals of evaporites depends on the brine concentration and correlates with a change in the seawater chemical type. Last but not least, the paper by Khrushcheva et al. [13] illustrates the mineral and geochemical composition of recent salt lake sediments located in semi-arid climates in more detail. The obtained results bring us closer to understanding the physicochemical processes that occur in intermittent salt lakes, associated with orogenic depressions of steppes, deserts, and semi-deserts.

This volume shows that evaporite basins are dynamic systems, and that it is possible to track changes in sedimentation and post-sedimentation processes using mineralogical and geochemical research methods. I hope that this Special Issue provides interesting reading for mineralogists and geochemists, as well as for scientists concerned with sedimentary environments in the broadest sense.

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