

Sulfate starved subbasins: Implications for Permian seawater composition

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The Zechstein evaporites represent a vast 1,000,000 km² evaporitic basin of the Late Permian that extended from the British Isles to Poland and beneath the North Sea. The Zechstein evaporites of northern Poland precipitated in a subbasin of the Zechstein Sea forming the Peribaltic Gulf. Fluid inclusions in halites of the Polish Zechstein oldest Halite (Na1) have been analyzed by Cryo-SEM-EDS together with the $\delta^{34}\text{S}$ $\delta^{18}\text{O}$ of accompanying sulfates and Br contents in halite. The A1d (anhydrite) and Na1 (halite and anhydrite) were chosen as they have the potential to better represent the original source of brine, minimizing common recycling processes within evaporitic basins. Fluid inclusions have major-ion compositions similar to evaporated modern seawater. Sulfate isotopes generally coincide with previous values for Permian evaporites assigned as marine in origin. However variations in both $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ are considerable when compared to smaller marine-continental settings such as the South Pyrenean basin [1, 2]. We postulate that the further restriction from the main Zechstein basin could have caused brines to be extremely sensitive to SO_4 -concentration variations, the result being that the Peribaltic Gulf could have been periodically starved of sulfate. This was registered by several isotopic reservoir effects during anhydrite and halite precipitation in the A1d and Na-1 cycles.

Brines trapped in primary halite fluid inclusions in our data set are similar to those expected from the evaporation of modern seawater, except for SO_4 always being depleted when compared to modern values. The palaeogeographic setting of the basin could explain why brines were depleted with respect to SO_4 , without the need to invoke more complicated global processes, such as secular variations in seawater chemistry. While these findings don't deny possible variation in seawater chemistry over the Phanerozoic, they reinforce the need for accurate interpretation of evaporitic precipitates.

References

[1] Ayora et al. (1994) *GCA* **58**, 3379-3394.

[2] Cendón et al. (2003) *CG* **200**, 339-357.