

Characterization and timing of diagenetically altered sedimentary gypsum in Luneburg and Othfresen (Northern Germany) by using modern OSL, petrographic and geochemical investigations

ASTRID TECHMER¹, MICHAEL MERTINEIT², HARALD STRAUSS³ AND MICHAEL SCHRAMM⁴

¹LIAG-Institute of Applied Geophysics

²Federal Institute for Geosciences and Natural Resources (BGR)

³Universität Münster, Institut für Geologie und Paläontologie,
48149 Münster, Germany

⁴Federal Institute of Geosciences and Natural Resources (BGR)

Gypsum of caprocks from Upper Permian (Zechstein) salt structures in Luneburg and Othfresen, both Northern Germany, were investigated for geochronological, mineralogical-geochemical, stable isotopic ($\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ of the SO_4^{2-} ion; $\delta^{18}\text{O}$ of the hydration water of gypsum) and petrographic characteristics. Cap rocks are formed during salt diapirism and groundwater contact (dissolution, re-precipitation, transition of evaporite minerals). For dating the precipitation of gypsum, Optical Stimulated Luminescence (OSL) was used (1).

OSL measurements were performed by using a typical SAR-measurement protocol (blue OSL stimulation, UV-detection system, Hoya U-340 5 mm filter). Assessing the reliability of the measurements, tests concerning preheat temperatures, residuals, „anomalous fading“ and „dose recovery tests“ were performed.

Gypsum is the main mineral phase with minor fractions of anhydrite, calcite, magnesite and Fe-oxides. The gypsum crystals (2 mm to 2 cm) show pseudomorphs from anhydrite to gypsum. Anhydrite relicts are present in larger gypsum crystals, suggesting incomplete younger alteration processes of Permian anhydrite to gypsum.

First uncorrected age estimates range from $0.4 \text{ ka} \pm 0.3 \text{ ka}$ to $2.5 \text{ ka} \pm 2.3 \text{ ka}$ for the Luneburg samples and $1.0 \text{ ka} \pm 0.4 \text{ ka}$ to $6.8 \text{ ka} \pm 6.2 \text{ ka}$ for the gypsum pit Othfresen, respectively. The age estimates represent the lower detection limit of the method for these samples. Some individual subsamples yield uncorrected age estimates from $4.2 \text{ ka} \pm 2.7 \text{ ka}$ to $114 \text{ ka} \pm 25 \text{ ka}$ for samples from Luneburg and $9.3 \text{ ka} \pm 5.0 \text{ ka}$ up to $> 394 \text{ ka}$ for gypsum from Othfresen. Age estimates of these subsamples could be part of an unbleachable OSL-component or it could reflect the timing of different solution/ precipitation phases of gypsum crystals during alteration.

$\delta^{34}\text{S}$ - and $\delta^{18}\text{O}$ - values of the sulfate ion average 11.5 ‰ (VCDT) and 12.1 ‰ (VSMOW), representing a typical Upper Permian Zechstein signature. In contrast, $\delta^{18}\text{O}$ - values of bulk gypsum average 5.8 ‰ (VSMOW), indicating the influence of isotopically light hydration water from the transformation of Permian anhydrite to gypsum. These results are in line with the young ages derived from OSL and the petrographic observations.