

Comment on egusphere-2022-655

Prokop Závada (Referee)

Referee comment on "Grain size dependent large rheology contrasts of halite at low differential stress: evidence from microstructural study of naturally deformed gneissic Zechstein-2 rock salt (Kristallbrockensalz) from the Northern Netherlands" by Jessica Barabasch et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-655-RC1>, 2022

This is a very nice microstructural study on the Zechstein salt sequence rocksalt samples that address the rheology of subsurface salt formations. The manuscript is concisely written, reads well, English is good and the imagery and diagrams are also well prepared. The microstructures of selected samples are also nicely illustrated in traced grain boundaries (Fig. 3). The outcomes are relevant for salt tectonics researchers and salt mine engineers.

I only have some minor comments and suggestions on how to improve the manuscript. These suggestions are provided as embedded „sticky notes“ within the annotated pdf that I attach to this review.

I would point out the two main remarks that should be addressed by the authors in the revised version.

- The rheology contrast between the coarse rectangular halite grains in the 'Kristalllage/Kristallbrocken' and the fine-grained 'matrix halite' is attributed to the different deformation mechanisms. I quite agree with this, but the reason for this difference is mainly the original grain size, explained on line 314. All other features are secondary. The Bromide impurity content discussion is redundant as no Br content data from this study or earlier studies is indicated. Can you offer the explanation for these enigmatic Kristalllage layers in the introduction, and how the large crystals of halite may have formed? Does it reflect a special sedimentary/diagenetic environment? Can we expect such very coarse-grained in other salt basins?
- The discussion does not completely reflect the datasets acquired in the manuscript. The quantitative datasets - grain sizes presented in Figure 7 are completely omitted in the description (Results section), although this is the only link between the salt samples from the 4 diapirs studied. Can you evaluate the meaning of the grain size distributions

from the diapirs a bit more? Do you find any correlation in grain size, the degree of macroscopic deformation (e.g. intensity of folding, boudinage at sampling site), and the modal content of Kristallbrocken layers vs. matrix rocksalt between the studied diapirs? Do the samples show any difference? Instead, the discussion about the composite rheology of the mechanically anisotropic rock sequences containing the coarse-grained layers is inaccurate and not supported by the datasets.

I suggest dividing the Results and Discussion sections into subsections. For the results section, you can provide first the microstructural description (shapes of crystals, the relationship between layers, modal content of Kristalllagen/Kristallbrocken), second the quantitative microstructural analysis (grain sizes, subgrain sizes), and third the EBSD data.

Reference to figure 7 is completely missing!!! Dataset presented in Fig. 7 is not described or discussed, although this is one of the primary results of this whole quantitative microstructural study.

Keep the sequential referencing of the figures throughout the text. For example, Figure 8 is called before Figure 6 in the text.

Revise the micrographs, few of them would be more distinct when their contrast and brightness are enhanced (Fig. 5b, f, g, also 4b).

Please also note the supplement to this comment:

<https://egusphere.copernicus.org/preprints/2022/egusphere-2022-655/egusphere-2022-655-RC1-supplement.pdf>