General Author response:

We thank the reviewers for their constructive review and adapted the manuscript according to most of their suggestions. Individual reviewer comments are addressed in the comments of the "tracked-changes" word file and also in this document under the "list of all relevant changes made in the manuscript".

Authors response as posted on EGUsphere:

We appreciate Hans de Bressers comments and individual ones are addressed in the revised manuscript version. We clarify our interpretation on the role of dynamic recrystallization also adding considerations (i.e. that after the Ter Heegeet al. (2005) recrystallized grain size piezometer one would get unrealistically high stresses if the fine grained halite had been deformed dominantly via dynamic recrystallization). However, due to overprinting and complexity of the polyphase samples we cannot present more clear observations regarding the contribution of dynamic recrystallization in the fine grained matrix halite. Similarly, we offer the interpretation that small grain size in the matrix is mostly pre-deformational by presenting an undeformed equivalent of the Barradeel samples with both fine-grained halite and Kristalllagen.

We thank Prokop Závada and address the embedded comments and suggestions in the revised manuscript version. As suggested, we omit the reference to Bromide content distribution and correlation to microstructure similarity. However, we keep the reference to the role of solid solution content on viscosity in the introduction and conclusion section. We agree that more information regarding the enigmatic Kristalllagen and their genesis would help to better asses the rheology of the sequence. We include further information on the Kristalllagen and Kristallbrocken crystallographic orientation, however we present no new hypothesis regarding their genesis or possible further deposits as this was not studied and would be somewhat speculative. As suggested, we add more evaluation regarding the quantitative grain size dataset in the results and discussion section.
We slightly modify the discussion about the composite rheology of mechanically anisotropic rock sequence to be more accurate. However, we decide to keep the part of the discussion even though the suggested model is only supported by our data to some extent (subgrainsize analysis) as we think this adds insight into the rheological aspect of the sequence. We add one subsection (EBSD results) in the results part and modify one subheading to make the structure of the results section more clear. We add subsections in the discussion part of the manuscript as suggested. We agree and elaborate more on results shown in figure 7. Sequential referencing is corrected. Micrographs are contrast and brightness are enhanced as suggested.

List of all relevant changes made in the manuscript:

The term differential is now consistently used instead of deviatoric.

The abstract was shortened.

We clarified the use of the term domal salt in line 154: "We use the term domal salt to refer to the subsurface diapirs in the Zechstein basin"

Elaboration and clarifications on dynamic recrystallization considerations have been applied:

in the abstract, line 40: “The fine-grained matrix salt is dynamically recrystallized *to some extent*, […]”

line 271: “Such recrystallized parts and the presumed primary fine-grained matrix halite cannot clearly be distinguished and grain size measurements regarding fine-grained matrix halite in Figure 7 comprise both classes, referring to the halite-labelled grains in Figure 3.“

line 346: “Additionally, if one would take the mean grain sizes from the matrix (Fig. 7), assume that these are recrystallized grain sizes, and then apply the recrystallized grain size piezometer from Ter Heege et al. (2005a), one would get unrealistically high stresses between 5 and 10 MPa for the deformation.”

line 364: ”Because pressure solution creep is strongly grain size-dependent (see eq. 2), this difference is caused by the large difference in grain size between Kristallbrocken and matrix, *that we interpret to be sedimentary or early diagenetic, somewhat modified by dynamic recrystallization.*”

Extension of a paragraph, line 381: ” 4.3 Dynamic recrystallization and grain boundary mobility

The dynamic recrystallization of Kristallbrocken is also recognized in grains directly next to Kristallbrocken (Fig. 4b, d, Fig. 5b, e, f), with a very interesting change of the solid inclusions present in the Kristallbrocken - these are completely reworked by grain boundary migration (Fig. 5e) and not present in the same configuration in the new grains. However, iIn our interpretation the fraction of newly recrystallized grains in the matrix is relatively minor, and grain size is similar to the ones already present in the undeformed samples: providing the small grains for implying dominant pressure solution creep:. The small grain size in the matrix is interpreted to be pre-deformational as in relatively undeformed Barradeel samples; hardly influenced by dynamic recrystallization as seen by rare abundance ofonly minor subgrains and a small grainsize which would indicate unrealistic high differential stresses when plotted in the (Ter Heege et al., (2005a) recrystallized grain size piezometer (cp. 4.1 Comparison to previous studies). Recrystallization reduces the grain size of large Kristallbrocken single crystals and increases the relative content of finer grained salt. Overgrowth of large Kristallbrocken crystals (increasing their size) has been observed in boudin necks. Hopper crystals indicating primary grains (Pape et al., 2002) were preserved in some BAS samples, but not found in highly deformed domal salt. The relatively minor amount of newly recrystallized grain fraction in the strongly deformed diapiric salt samples is interesting, and suggests that grain boundary mobility in nature is lower than in the models of (Peach et al., 2001; Schléder and Urai, 2005) and that recrystallization and grain growth in salt is more sluggish than previously thought.”

We provide values for parameters used in given equations (in caption of Figure 9)

We have added a sentence in the introduction and a paragraph in the discussion about Kristallbrockensalt

In l.118: Although the genesis of extraordinary large Kristalllagen is not clear, different models have been proposed that suggest post-sedimentary diagenetic grain growth or coalescence of fine grained halite (Küster et al., 2011).

> l. 410: The different crystallographic orientation of individual Kristallbrocken with respect to the bedding (Fig. 8a) has not been studied previously and might contribute to the understanding of Kristalllagen formation (Küster, 2011). The absence of a crystallographic preferred orientation of individual Kristallbrocken neither promotes nor prevents the activation of different slip systems and hence would not significantly influence the bulk rheology (Linckens et al., 2016). However, to substantiate this observation and hypothesis more studies of Kristallbrocken crystallographic orientation with respect to bedding on different samples are required.

EBSD data is now presented separately and later so that referencing is chronologically. Technical information regarding EBSD measurements was moved to the figure caption (Fig. 8)

The Discussion section was divided in Subsections with Subheadings

We have added error bars to Figure 10 to make a correlation more clear.

We have improved image in Figure 5g for brightness and added arrows.

We have added a small section on the comparison of microstructures from different diapirs based on Figure 7 in section 4.2. (l.366):

> l. 367: "The studied diapiric samples have comparable mean grain sizes in the fine-grained salt around 1 or 2 mm (Fig. 7), while folding of anhydrite layers was best observed in Zuidwending samples and overgrowth in boudin necks is especially pronounced in Pieterburen samples (Fig. 3, 4)."
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> However, in this study we laid focus on the deformation mechanisms/ microstructures of Kristallbrocken vs matrix halite and observed similar microstructures in all diapiric samples. More quantitative comparisons would require also more elaborate studies regarding solid inclusion and impurities, Kristallbrocken crystallographic orientation, … Therefore, we prefer not to elaborate based on our observations.

We have added description and arrows in Figure 5e on solid inclusions.

We agree that anisotropy will effect pure and simple shearing and have modified the text accordingly, l.398: "During shearing, this rock must have had an extremely anisotropic rheology due to the weak fine-grained and very fine-grained salt depending on the orientation of the original layering with respect to the shortening direction". However, we disagree with the hypothesis that a load bearing framework would not form.