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Internal deformation in layered Zechstein-III K-Mg salts. Structures formed by complex deformation and high contrasts in viscosity observed in drill cores.

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During the evaporation of a massive salt body, alternations of interrupted and full evaporation sequences can form a complex layering of different lithologies. Viscosity contrasts of up to five orders of magnitude between these different lithologies are possible in this environment. During the late stage of an evaporation cycle potassium and magnesium (K-Mg) salts are precipitated. These K-Mg salts are of economic interest but also a known drilling hazard due to their very low viscosity. How up to 200m thick layers of these evaporites affect salt deformation at different scales is not well known. A better understanding of salt tectonics with extreme mechanical stratification is needed for better exploration and production of potassium-magnesium salts and to predict the internal structure of potential nuclear waste repositories in salt. To gain a better understanding of the internal deformation of these layers we analyzed K-Mg salt rich drill cores out of the Zechstein III-1b subunit from the Veendam Pillow 10 km southeast of Groningen, near the city Veendam in the NE Netherlands. The study area has a complex geological history with multiple tectonic phases of extension and compression forming internal deformation in the pillow but also conserving most of the original layering. Beside halite the most common minerals in the ZIII-1b are carnallite, kieserite, anhydrite and bischofite alternating in thin layers of simple composition. Seismic interpretation revealed that the internal structure of the Veendam Pillow shows areas, in which the K-Mg salt rich ZIII 1b layer is much thicker than elsewhere, as a result of salt deformation. The internal structure of the ZIII-1b on the other hand, remains unknown. The core analysis shows a strong strain concentration in the weaker Bischofite (MgCl2*6H20) and Carnallite (KMgCl3*6H20) rich layers producing tectonic breccias and highly strained layers completely overprinting the original layering. Layers formed by alternating beds of Halite and Carnallite show complex folding of different scales with horizontal fold axis but also evidence for brittle deformation, veins and boudinage of stronger layers. Folds with horizontal axial planes are commonly interrupted by shear zones, which prevent large scale layer doubling.