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AMS of salt rocks of the Northern German Basin

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The measurement of anisotropy of magnetic susceptibility (AMS) is a frequently used method for determining the fabric of rocks. AMS reflects aligned of minerals and can therefore give information about deformation processes. However, there are only few studies of AMS in salt rocks, although they play an important role in deformation processes. The AMS in salt rocks is expected to be very low due to the high content of diamagnetic salt minerals. Therefore, the AMS must be created by accessory minerals within the salt rocks.
We investigated salt rocks from the Northern German Zechstein Basin of the Zechstein 2 (Stassfurt series). Specifically, we chose samples from two mines in Germany, the salt mine Sondershausen and the Gorleben exploration mine. In the salt mine Sondershausen, the salt deposit is only slightly deformed and horizontal bedding predominates, whereas the Gorleben mine is in a strongly deformed salt dome.
The aim of our study is to investigate the weak AMS of salt rocks and how it is related to the different deformation situations in the two salt mines. Additionally, it is necessary to identify the accessory minerals which produce a measureable AMS in salt rocks to interpret the data correctly.
Low-field AMS measurements were made using a kappabridge (AGICO) by measuring the samples 10 times at each position after Biedermann et al. (2013). A weak but significant AMS was found in gray rock salt, sylvinite and carnallitite samples. The difference of minimum and maximum magnetic susceptibility is on the order of 10-7 SI, but can reach values up to 2.5 x 10-6 SI. Using different mineralogical and magnetic methods we tried to identify the minerals, which cause this anisotropy. With mineralogical analysis, phyllosilicates and hematite were found as magnetically anisotropic minerals. Magnetite was identified by measuring IRM acquisition curves. In addition we used high-field torque measurements to separate the ferromagnetic and paramagnetic contributions to the AMS. The results show that the paramagnetic contributions dominates the AMS in most samples, which indicates alignment of phyllosilicates. The correlation of the magnitude of the AMS and the bulk susceptibility in rock salt is weak, and significant in carnallitite. The relationship between AMS and deformation seems to be complex and has to be interpreted with care.
The shape of the AMS ellipsoid in sylvinite, which contains much phyllosilicates, is oblate. In weakly deformed rock salt, the AMS ellipsoid is mostly oblate and prolate in a fold. The AMS of stronger deformed carnallitite samples is predominantly prolate. Samples from one region of the salt dome showed almost no anisotropy despite strong deformation.

Keywords: salt rocks, magnetic anisotropy, deformation

References:
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