



Numerical models of finite deformations within down-built diapirs: effects of composite rocksalt rheology on deformation patterns

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In general, salt diapirs seem to be driven by differential loading of sediments creating an uneven load that drives the salt from high to low pressure areas, e.g. a down-built diapir. Rocksalt, by itself, does behave in a non-Newtonian way under certain natural conditions, e.g. coarse grained salt. The non-Newtonian effect in the salt affects the general dynamics and therefore the internal deformation patterns within a down-built diapir.

In this study, we use a two-dimensional finite difference code (FDCON) in combination with a marker and cell method to calculate the effect of a composite rocksalt rheology on finite deformation patterns within a down-built diapir. For the sake of convenience, we fix the geometry of the diapir by using two rigid rectangular bodies sinking into a source layer of a certain rheology. Within the model one can observe three different deformation regimes: (1) a squeezing channel-flow deformation regime, (2) a corner-flow/pure shear deformation regime, and (3) a vertical channel flow deformation regime. (1) and (2) occur within the source layer as the overburden subsides, which drives the salt towards the stem and the material starts to rise vertically. Regime (3) occurs within the stem while the salt rises further. Both, the evolution of the individual finite deformation in each regime as well as the progressive deformation for a particle passing all three regimes, are analysed for a Newtonian and non-Newtonian rocksalt rheology. Within each individual regime the finite deformation continuously increases with time and the finite deformation reaches its maximum within regions of large strain rates. However, within the progressive deformation of a passive marker passing through all three deformation regimes, the deformation path shows a decreasing finite deformation as the particle rises through the stem. Due to the inherited deformation before the particle enters the stem and its corresponding orientation with respect to the shear deformation in the stem, the finite deformation decreases slightly within the channel-flow deformation regime.

In the case of a source layer with a non-Newtonian rheology the finite deformation is concentrated within areas of a strong viscosity gradient, i.e. areas of an increasing strain rate. Therefore, we obtain a broader area of less finite deformation within the source layer and the deformation is more local compared to the Newtonian rheology. Due to the composite rheology the finite deformation is reduced within regions of small deformations and increased within regions of large deformations.