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Numerical modelling of internal deformation and flow structures in down-built salt diapirs

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A two-dimensional finite difference code (FDCON) is used to estimate the progressive deformation and internal flow structure within a down-built diapir. The geometry of the diapir is fixed by using two rigid rectangular overburden units which sink into a source layer of a certain viscosity (Newtonian or composite rheology). Thus, the model refers to diapirs consisting of a source layer feeding a vertical stem, and not to other salt structures (e.g. salt sheets or pillows). Model results show a high deformation zone in the middle of the stem and zones of decreasing progressive strain between its middle and its flanks. Such high deformation zones within the stem are observed within natural diapirs (e.g. Klodowa, Poland). The location and structure of these high deformation zones, which can be symmetric or asymmetric, could reveal information about rates and timing of salt supply from the source layer. Thus, the deformation pattern could directly be correlated to the evolution of the diapir. During salt movement, initially vertically- and horizontally-oriented passive marker-lines within the salt layer are folded. Initially horizontal marker-lines in the source layer show upright folds in the middle of the stem. Within the source layer, initially vertical marker-lines form recumbent folds, which are refolded during their flow from the source layer into the stem. During their refolding, the hinge of the fold migrates outwards towards the flank of the diapir. A temporal and spatial hinge migration is observed for sub-horizontal folds that originated in the source layer as they are refolded. Both strain, folding patterns and hinge migration are influenced by the geometry of the overburden corner with the stem. Around a curved overburden corner, the folds are more open, strain is decreased and the low-deformation zones become broader than around a sharp corner. Moreover, temporal hinge migration is less profound, whereas spatial migration is still significant.