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6c.Restoration results

The restorations bracket the contractional phase of the structure to the Late Cretaceous, with only minor regional tilting during other stages.
The rate of shortening sharply increased from the Late Triassic and Early Cretaceous regional tilting to the active thrusting and folding of the Late Cretaceous (Figure 5g). The amount of contraction decreased during the Maastrichtian and did not continue into the Tertiary.

Other studies across the entire NW German Basin show abundant evidence that the contraction phase started no earlier than the onset of the Late Cretaceous Coniacian stage (88ma according to Harland et al., 1989), and lasted through the Coniacian–Santonian and partly into the Campanian and Maastrichtian (Baldschuhn et al., 1991, and references therein).

Our analyses do not have enough resolution to precisely establish the onset of the contractional phase. Even so, application of this new restoration technique to this structure has produced results that are in agreement with the regional geohistory already established.

7. Conclusions

A new, robust technique for 3–D restoration of flexural–slip folds has been presented. This plane–strain technique preserves:
1. volume between folded layers
2. orthogonal thickness of layers
3. line length in the unfolding direction of layers parallel to the template surface
4. maintains the folded object topology.

An important advantage of this algorithm over previously published techniques is that restoration of multiple, geometrically complex, and non–parallel surfaces is possible in a single modelling increment.

A 3–D model of a salt–cored, fault–propagation fold has been sequentially restored using this technique.
Conclusions from the analyses:

1. the shortening direction for the fold was approximately N–S (189^{O})
2. the fold initiated during Late Cretaceous
3. shortening and fold amplification ceasing by Tertiary
4. timing of fold development (and by inference the initiation of regional compression during the Late Cretaceous) determined from the restorations agrees with published interpretation for the initiation of shortening in NW Germany
5. map–view loose lines from the 3–D restorations identify geometric problem areas in the model or regions that have experienced more intense deformation.

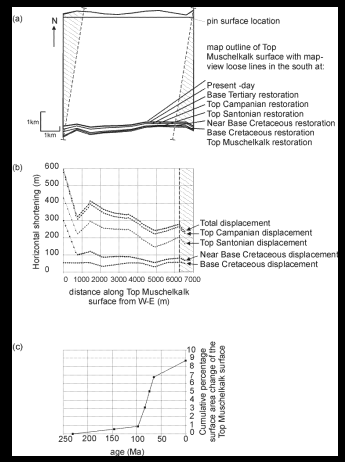

Figure 7. Analyses of the shortening and area strain at Top Muschelkalk level based on sequential restorations. (a) Map of the outlines of the Top Muschelkalk surface at each restoration stage. The southern margin of each surface represents the loose line from each restoration. (b) Plot of horizontal shortening versus distance along the Top Muschelkalk surface from west to east. Lines on the plot show the variation in shortening at Top Muschelkalk level at each stage of the restoration. (c) Plot of cumulative percentage area change for the Top Muschelkalk surface versus geological age. The plot illustrates the accumulation of strain from the undeformed to the present–day shape of the Top Muschelkalk surface.

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