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Extension, sedimentation and diapirism: understanding evolution of diapiric structures in the Central High Atlas using analogue modelling

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Analogue modelling has proven to be an essential tool for the study and analysis of the mechanisms involved in tectonic processes. Applied to salt tectonics, analogue modelling has been used to understand the mechanisms that trigger the onset of diapirs and the evolution of diapiric structures and minibasins. Analogue modelling has also been applied to analyse the impact of the progradation of sedimentary systems above a ductile layer, representing the source of diapirs. However, these models did not consider ongoing tectonic processes during progradation.

To analyse how extension and sedimentary progradation influence on the formation of diapiric structures and their geometries, we present models composed of a mildly extension followed by post-extension period. Each model includes a particular sedimentary pattern: homogeneous sedimentation during extension and post-extension, homogeneous sedimentation during extension followed by prograding sedimentation during post-extension and prograding sedimentation during both extension and post-extension.

Proximal high sedimentation rates enhance the mobilization of ductile material towards growing diapirs, resulting well-developed passive diapirs. Diapirs from distal domain of the model with post-extension progradation show silicone extrusions, that are caused by the decreased sedimentation rate associated to the progradation. By contrast, reduced sedimentation in the distal part of the model with syn- and post-extension progradation (3.5 times smaller than in the proximal domain) causes a limited migration of the silicone and hampers the transition from reactive diapirs to active and passive diapirs. These models show that the ratio between diapir growth and sedimentation rate, the time of the onset of the progradation and the relative thickness of the sedimentary cover beneath the prograding system have a clear impact on the final diapiric geometries.

Additionally, we present two models with increasing amounts of shortening (6% and 10%). These models show that the presence and location of diapirs clearly controls the distribution of the deformation associated with the inversion, primarily affecting the post-diapiric layers in the vicinities of the salt structures whereas very little deformation occurs away from diapirs.

This deformation pattern is observed in the Early to Middle Jurassic Tazoult salt wall and Azourki diapir of the Central High Atlas (Morocco). These structures show that the deformation associated with the Alpine orogeny is focused on the sedimentary units fossilizing the salt structures and mainly localised above them. The presented results provide key information that can be applied to other diapiric structures of the Central High Atlas diapiric basin and similar examples elsewhere.

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