Review of the manuscript

Inversion of transfer zones in salt-bearing extensional systems: insights from analogue modeling by

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The submitted manuscript aims to demonstrate the variation of structural styles in salt-bearing segmented rift systems that underwent subsequent shortening and syn-shortening sedimentation. The sand-polymer-based analog experiments involved three models, in which two salt-bearing half-graben basins segmented by an intervening transfer zone experienced rifting (Model 1), rifting and inversion of the rift system (Model 2), and rifting and inversion with syn-contractional sedimentation (Model 3). The obtained results of analog modeling are compared to the geological structures of the Northern Lusitanian Basin, offshore Portugal and Isàbena area, South-Central Pyrenees, Spain.

Experimental setup and procedure are well described. Preparing and conducting experiments likely required a substantial amount of work. The manuscript represents a thorough analysis of experimental results and provides a new insight into the salt decoupled extensional and inversion systems.

It would be helpful if the following comments and questions might be clarified:

Lines 110-115: why Mylar sheet remains not deformable under the simulation settings of extension and subsequent shortening? The basal friction at the top of the steel plate and Mylar sheet is different. Did it influence the model deformation?

Lines 120-130: Is there any difference in mechanical properties of the basement and upper sand packs? In sand material itself or in a way it was packed? See comment for lines 485-490.

Lines 125-130: what procedure was applied to ensure that the triangular polymer prisms would not be deformed during the model buildup and burial of the prisms by 9 cm-thick sand pack simulating the basement?

Lines 130-135, 140-145, 170-175: The applied combined velocity during extension phases was set equal to 2.78 x 10^{-4} cm/s (phase 1) and 1.67 x 10^{-4} cm/s (Phase 3) and to 1.67 x 10-4 cm/s during the shortening (Phase 5). Please explain what does “combined velocity” mean. Deformation of the polymer is sensitive to applied strain rate. How the velocity of extension and shortening was chosen? Was there any sensitivity study performed to determine the range of applicable strain rate?

What was sedimentation rate of sand layers during syn-contractional deformation?

Line 170: Please clarify here which wall was pushed - the one at the side of the Mylar sheet or of the metal plate. It seems to be the right wall with attached Mylar sheet that was used for shortening (Figs 8 and 11).

Line 180-185: what steps were undertaken to facilitate the models’ slicing at intervals of 3 mm (!!) at the end of each experiment? Salt model polymer flows fast….

Line 200-205. Why MF1 attains more slip than MF2 in Model 1? The master listric faults MF2 and MF1 in Fig. 4a and 4c have different geometry, in particular degree of curvature and dip angle. Could these differences be related to the shape of triangle shape of salt model seeds in the basement? The seed SS2 after the extension generally preserves its triangle shape (Fig. 4a), while SS1 has migrated resulting in a weld between the basement sand layers and basal sheet (Fig. 4c).

Lines 240-250: "Half-graben 1 propagated along strike across the whole model width (Fig. 4 a-c). This is probably related to the presence of the underlying velocity discontinuity (V.D. in Fig. 2) that favors extension localization, lateral slip transfer along the strike of the polymer seed, and the formation of the largest depocenter of Model 1. Conversely, extension along MF2 produces a more diffuse structural pattern, with one largest depocenter right of the master fault".

Why MF2 and associated graben did not localize and propagate laterally to the same extent as MF1 and associated depocenter? Could it be that the behaviour of the V.D. between the rubber sheet and the Mylar sheet (MF2 system) was different from the V.D. between the steel plate and the rubber sheet due to the variation in the strength contrast between the basement materials: steel plate - rubber sheet - Mylar sheet? This suggestion is likely confirmed on lines 494-496.

Line 273: It is not mentioned here whether Model 2 was subjected to extension before the shortening. How steady are the results of extension obtained in Model 1 (Fig. 4)? Could it be expected that the results of Model 1 were repeated in Model 2 during the extension, and the shortening has started from the same or similar point as shown in Fig. 4?

Line 313. Replace SS2 by SS1 as Fig. 7c represents the section across the SS1 salt seed.

Line 310-315: If the results of extension in Model 2 repeated the results of Model 1, one could expect that the geometry of thrust fault systems in MF1 and MF2 during the shortening phase (Fig. 7a and 7c) would be controlled by the shape of listric faults MF1 and MF2 at the end of extension, which, in turn, might have been controlled by the behavior (degree of migration) of the model salt triangle seeds SS1 and SS2.

Models 2-3: Could the lower degree of shortening along MF1 be resulted from the greater distance between MF1 and movable backstop at the right, if compared to the shorter distance between the backstop and MF2? In both cases, most of the shortening is accommodated along MF2 that is located closer to the movable backstop, and the shortening structures progressed laterally across the model, accommodating most of the contractional deformation. As a result, shortening was more distributed in the section across MF1, and it contributed to reactivation of MF1 to lower degree.

Lines 485-490: "In our models, the syn-rift basin geometry and related sediment distribution are strongly controlled by the position of the underlying pre-salt basement faults, the amount and rate of slip attained by those faults, the original distribution and thickness of model salt, as well as the thickness and mechanical properties of the pre-kinematic sand pack".

However, in the model setup, nothing is said about the difference of mechanical properties of the basement and upper (pre-kinematic) sand packs (lines 120-130).