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A new experimental approach to assess the influence of gravity gliding on salt tectonics in rift basins

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Salt flow in rift basins is mainly driven by sub- and supra-salt extension imposing shear stresses and differential loading on the salt layer. In many rift basins, the graben flanks are tilted as a result of thermal subsidence and sediment load. Such tilt induces additional basin-ward directed stresses potentially causing downward directed salt flow and gravity gliding of the supra-salt overburden. However, sediment loading in extensional basins is usually largest in the basin centre, which would lead to an upward directed salt expulsion and might act as an effective buttress resisting downward gliding.

Our aim is to investigate the opposing influence of sub-salt extension, sedimentary loading and tilting on deformation patterns in the viscous salt and the brittle overburden. We try to assess under which geological configurations (e.g. minimum basin slope or topographic gradient) upward directed salt flow and downward directed gravity gliding are the dominating deformation processes in extensional basins. Therefore, we developed a new analogue modelling apparatus enabling to simulate the processes of tectonic extension of a graben structure and the gradual tilting of the graben flanks, acting either simultaneously or separately. Using digital image correlation technique, temporal and spatial changes of the displacement and strain patterns can be analysed. Cross sections through the final experiments enable to identify structures characteristic for specific driving processes.

Here, we present results of a preliminary experimental study in which the basic influence of flank tilting and syn-kinematic sedimentation on salt tectonics in rift basins is examined. In case that the graben flanks remain flat during extension, widespread extensional fault zones develop on the footwall sides near the graben faults. In case that the flanks are tilted simultaneously with basal extension, additional extensional fault zones evolve at the upslope basin margins resulting from downward gliding of the overburden. In the downslope basin centre, this peripheral extension is balanced by reduced amounts of extension near the graben and later by shortening above the graben bounding faults and the hanging wall graben centre. If syn-kinematic sedimentation is introduced, downslope gravity gliding is significantly reduced and extensional fault zones are rather localized. Peripheral extensional structures observed in the experiments resemble typical thin-skinned extensional structures occurring at the flanks of many salt-bearing rift basins, e.g. the

Polish Basin and Norwegian-Danish Basin. Thus, such structures might serve as diagnostic indicators for the occurrence of gravity gliding in rift basins.