Analogue Experiments of Up-Doming with Wrench Strain: Insights for Fault Patterns above Salt Domes

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Regional strain has significant impacts on fault development during formation of dome structures. In order to examine such effects of wrench strain, we conducted a series of analogue experiments of up-doming using dry granular materials and observed the deformation on the top free surface. The experiments were also aimed to analyse effects of deformation sequence: 1) up-doming then wrench, 2) simultaneous up-doming and wrench, and 3) wrench then up-doming.

In the first series of the experiments, simple up-doming produced a series of radial faults above the dome. They were then overprinted by two strike slip fault systems generated by subsequent wrench deformation. The second series of experiments with the configuration of simultaneous up-doming and wrench generated normal faults in the direction perpendicular to that of relative extension by the wrench. In the third series of experiments, the Riedel and anti-Riedel shear faults formed by wrench strain were deformed by the subsequent up-doming, and were overprinted by the faults related to the up-doming. These results also showed that the faults formed after a stress conversion were commonly affected by the pre-existing faults.

The experimental results (Fig. 1) can be applied to the fault systems above dome structures in the Middle East, where extensive faults in the northwest-southeast direction are observed. A comparison with the experimental results (up-doming with dextral wrench) and their mirror images (up-doming with sinistral wrench) suggests that the faults seen in real dome structures may be generated by up-doming with simultaneous dextral wrench in the ENE-WSW direction. This wrench can be compared with a primary shear of the Oman stress active during the late Cretaceous. The timing of up-doming investigated from thickness change on seismic sections agrees with this conclusion.

These results can be useful to interpret faults above dome structures in the regions of poor seismic quality, to predict possible fault systems of sub-seismic scale, and also to construct fractured reservoir model.

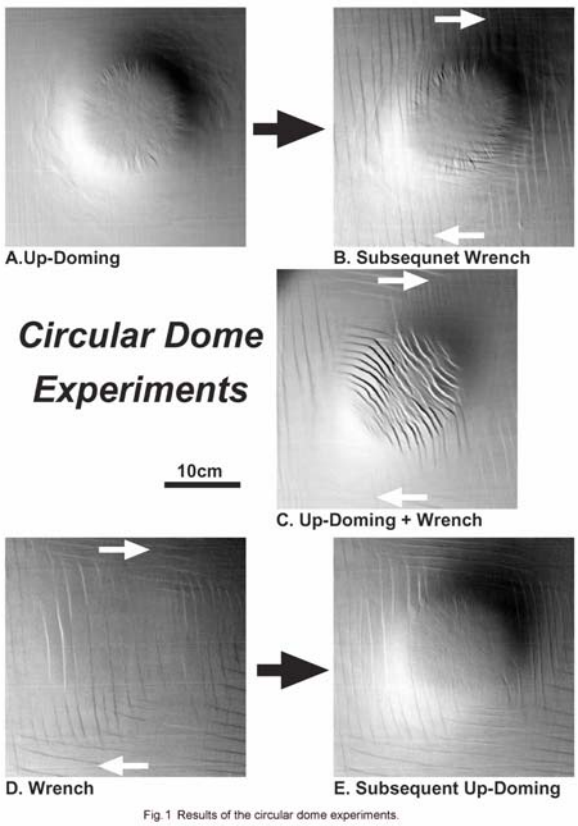

Fig. 1 Results of circular dome experiments.