DEFORMATION OF CAPROCK ON EXTRUDING SALT DIAPIRS – INSIGHTS FROM ANALOG MODELLING

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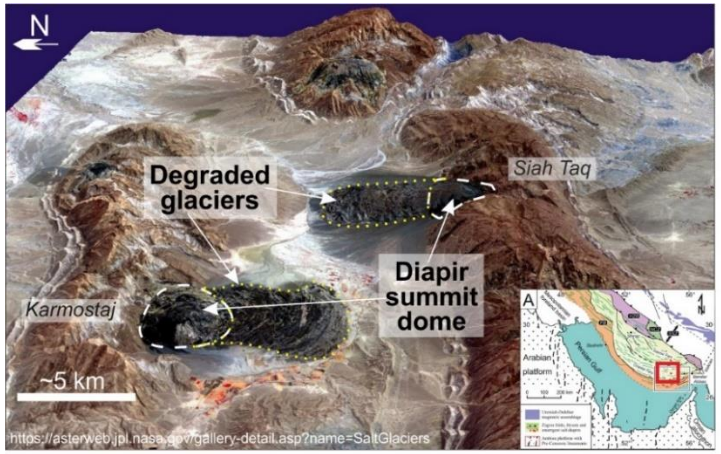
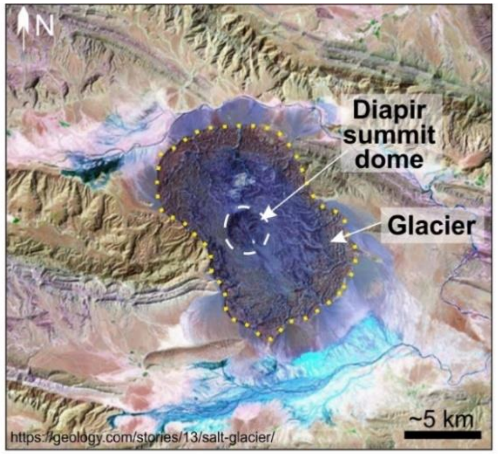
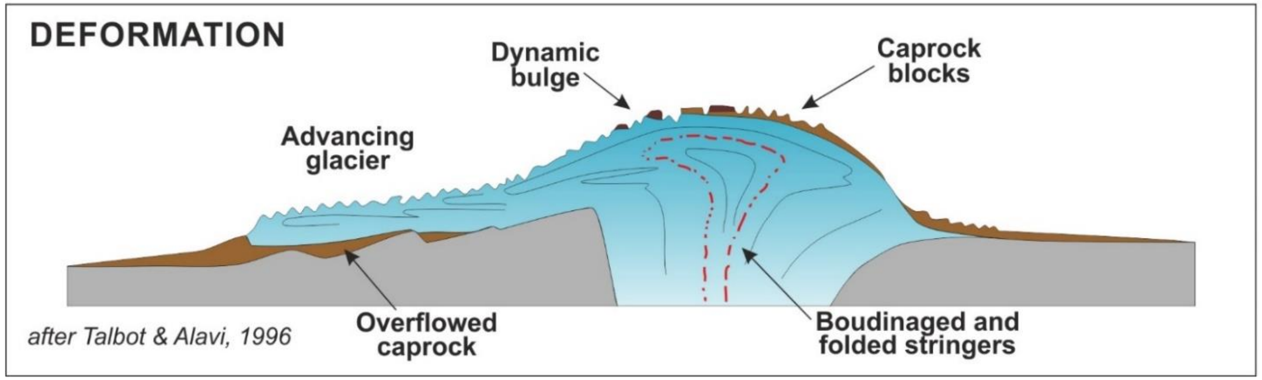
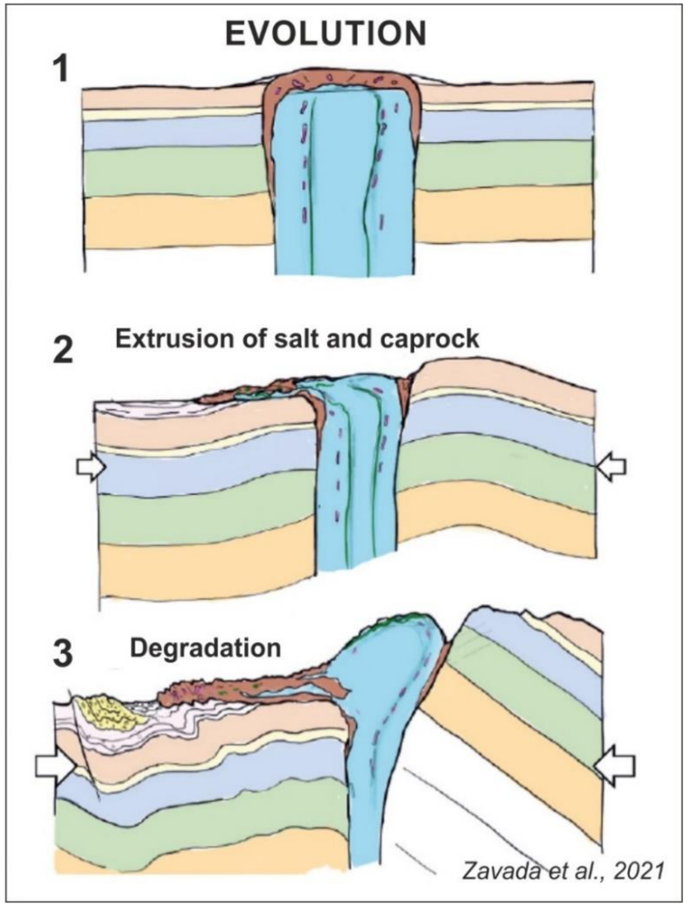


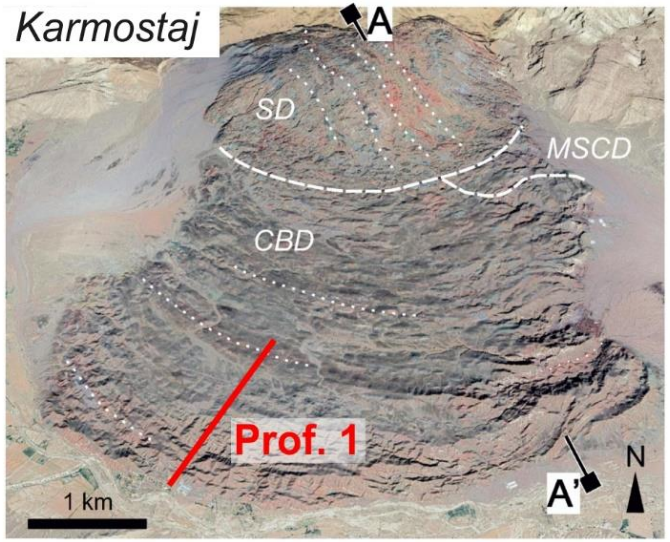


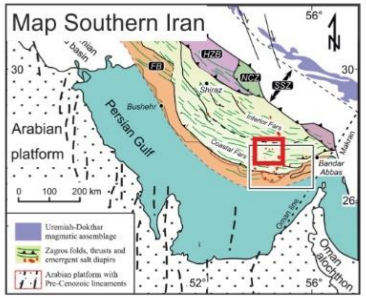


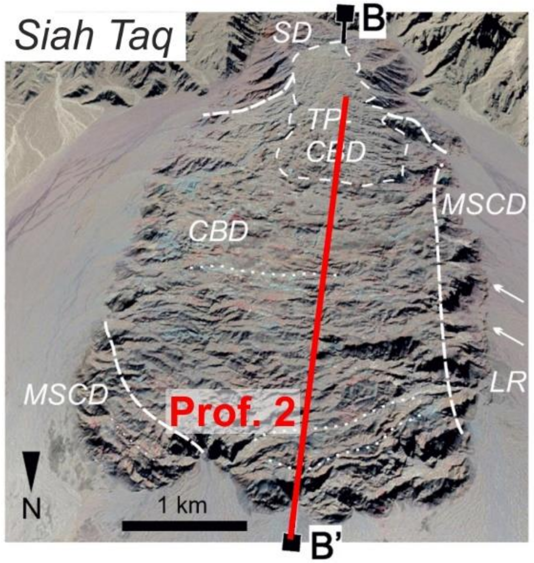


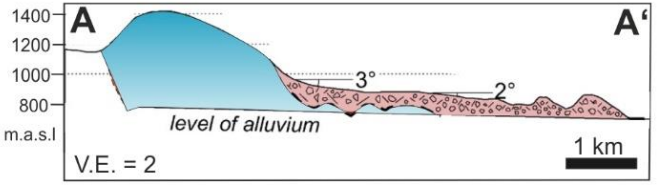
This study is part of a Czech-German bilateral project (GACR, DFG) in collaboration with the LMU Munich: ‘Influence of caprock on the growth dynamics of salt diapirs in Iran’
https://www.ig.cas.cz/en/observatories/tect-mod-lab/caprock-zagros/

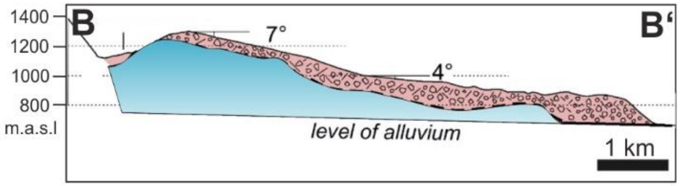
CAPROCK DEFORMATION

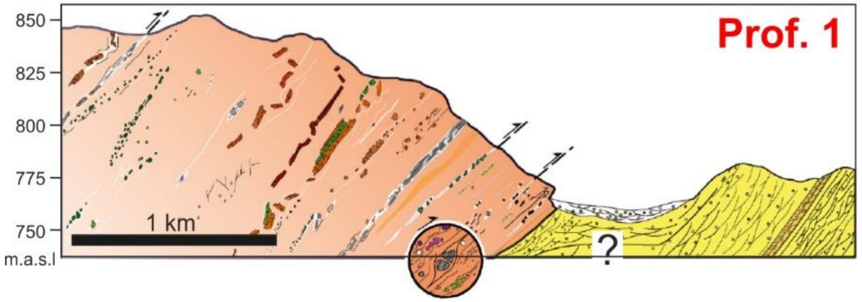


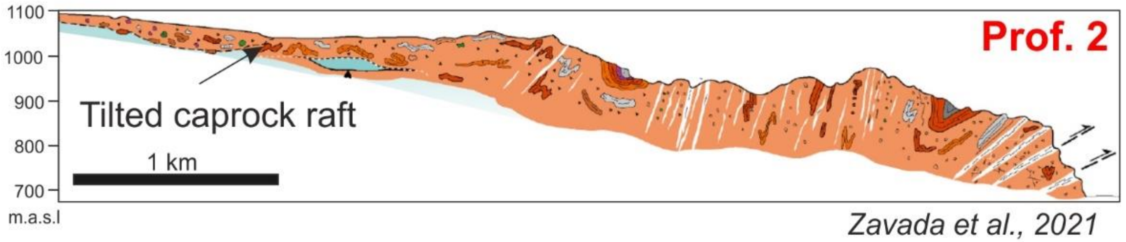






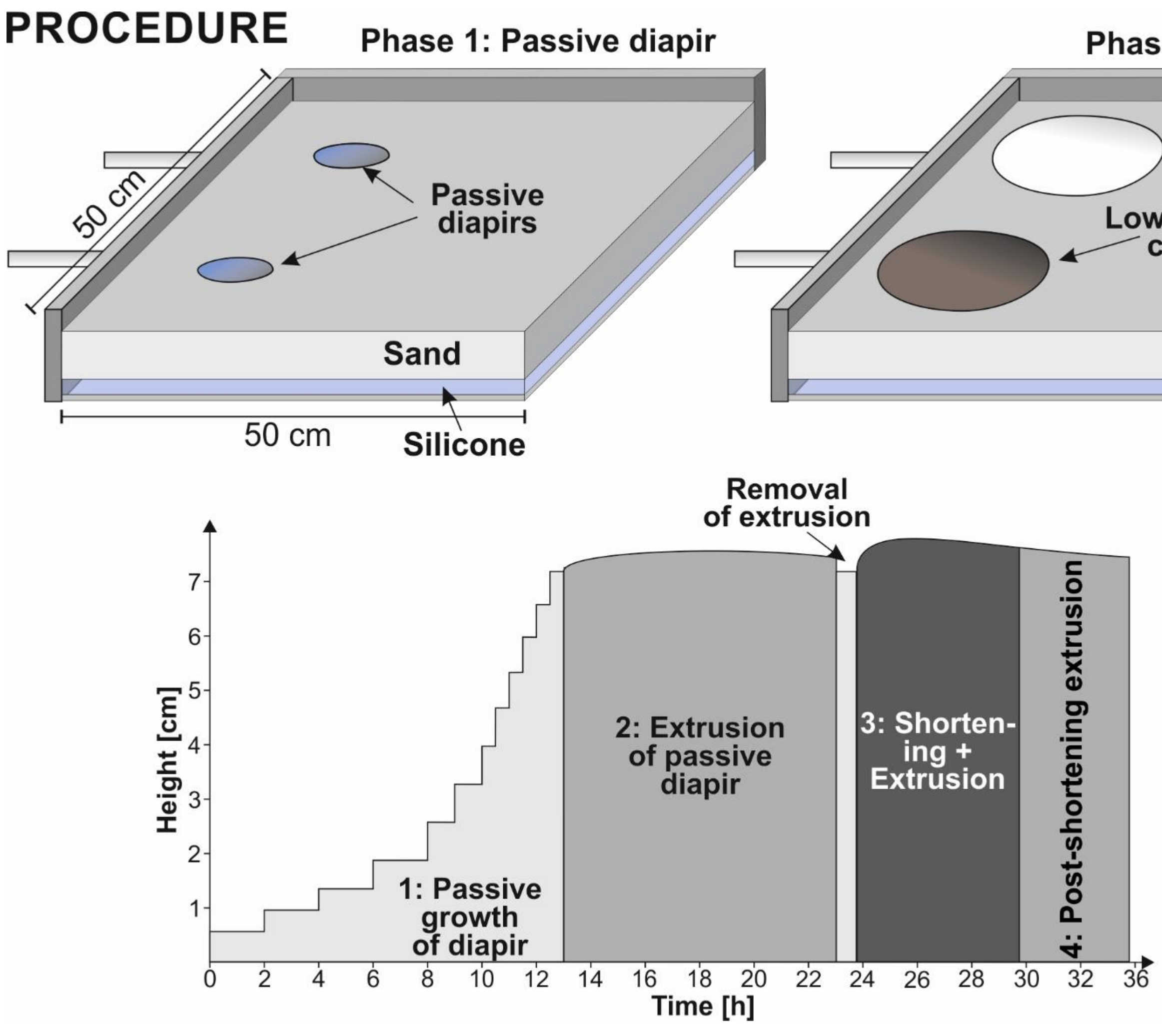






Zavada et al., 2021

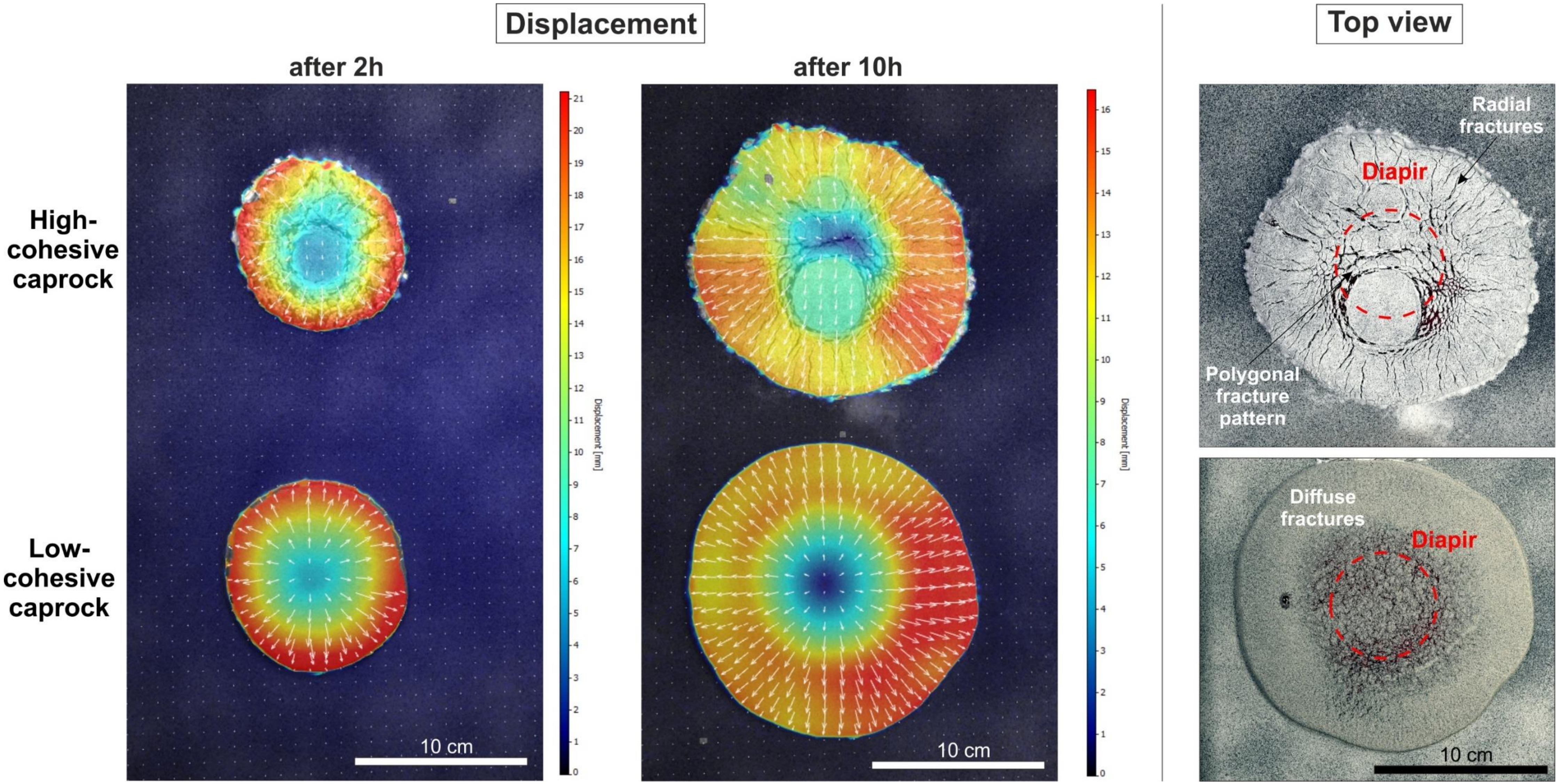
EXPERIMENTAL SETUP



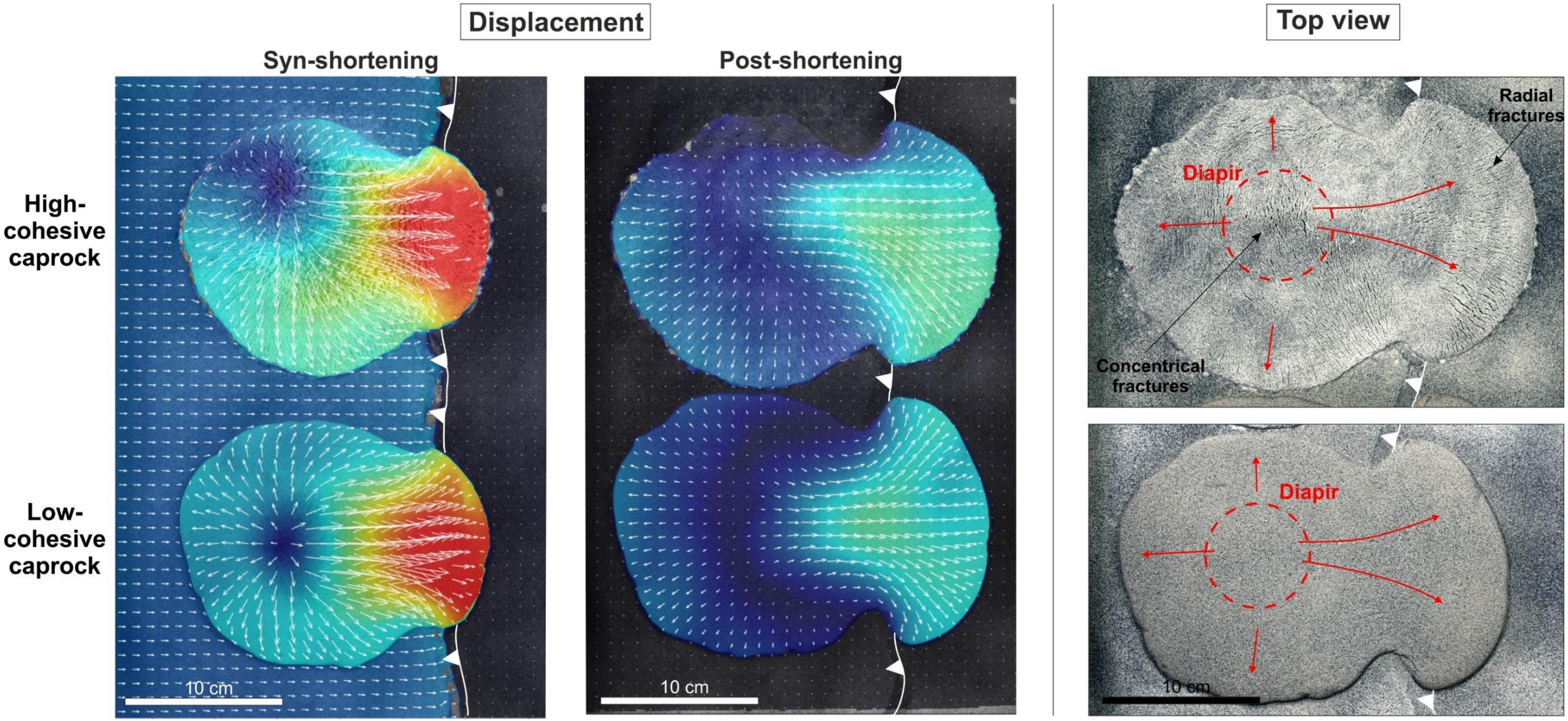
Aims

- Investigate deformation patterns in caprock layers
- Test different analog material representing caprock
- Compare passive and squeezed diapirs

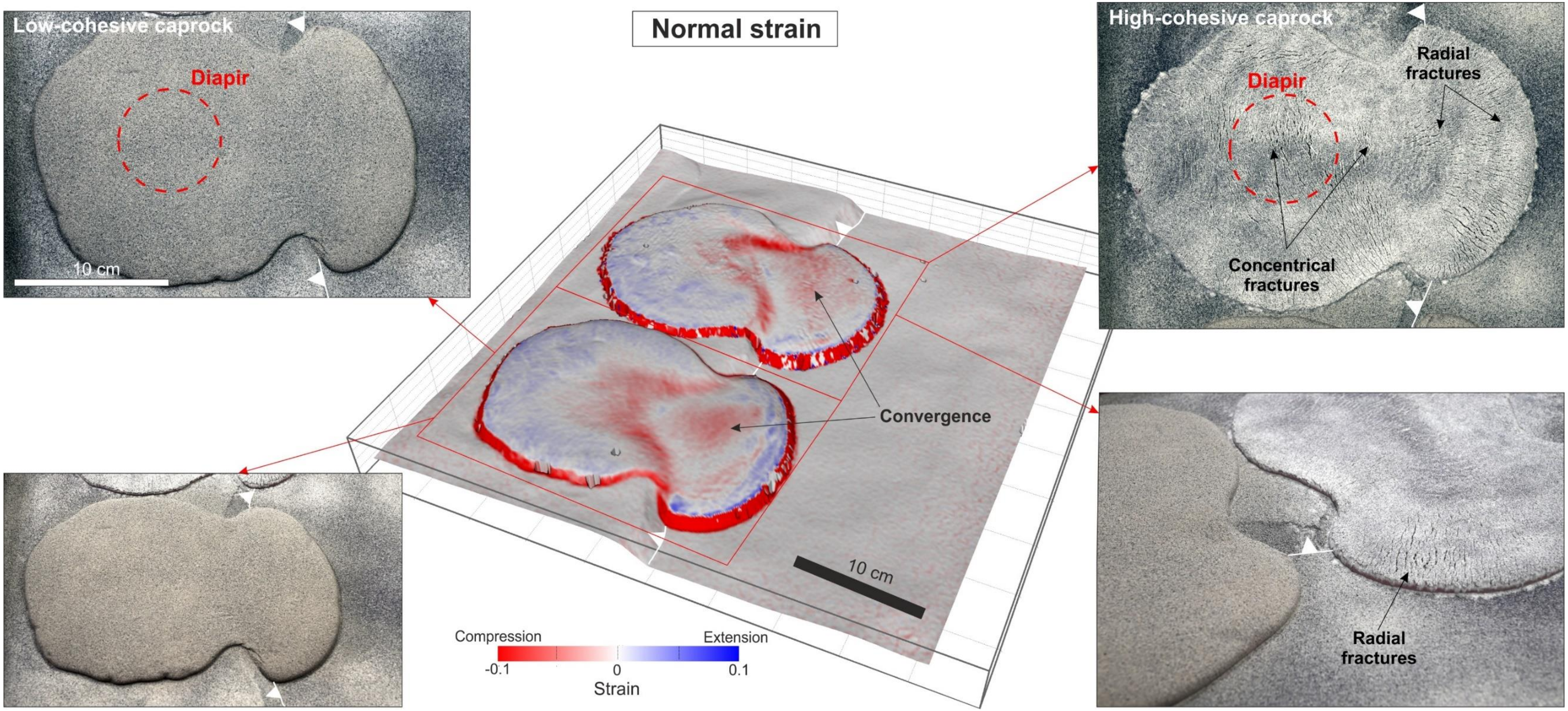
1st EXTRUSION OF PASSIVE DIAPIR



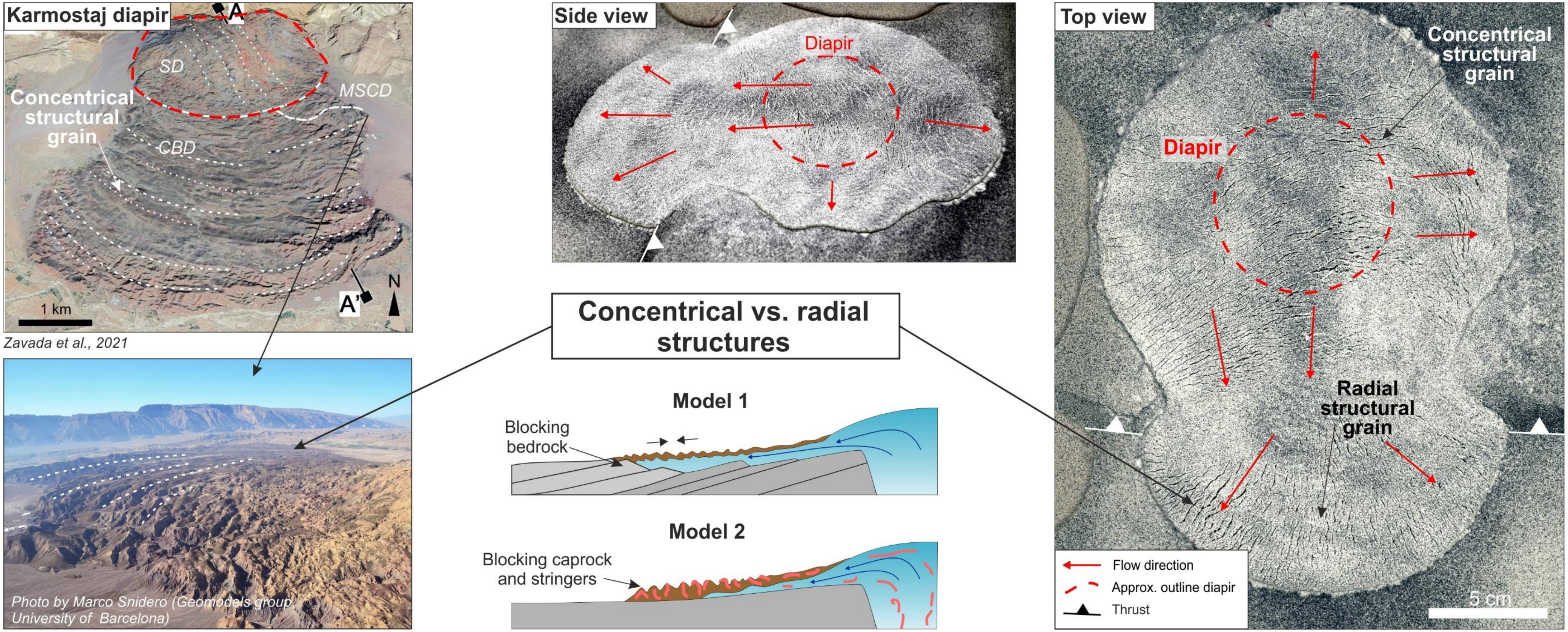
2nd EXTRUSION OF SQUEEZED DIAPIR



2nd EXTRUSION OF SQUEEZED DIAPIR



SUMMARY & COMPARISON WITH NATURE



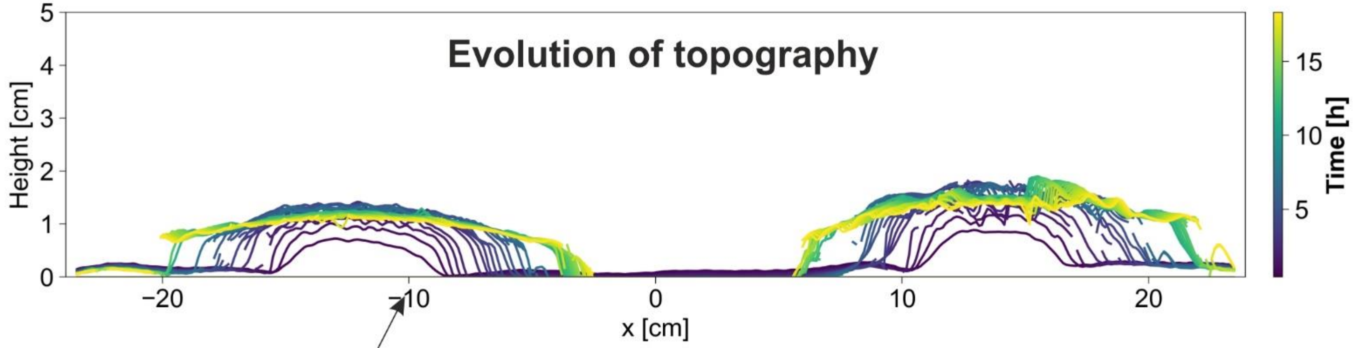
>> Please find additional results of the analog experiments as well as of 2D numerical models in the display material (EGU22-6980)

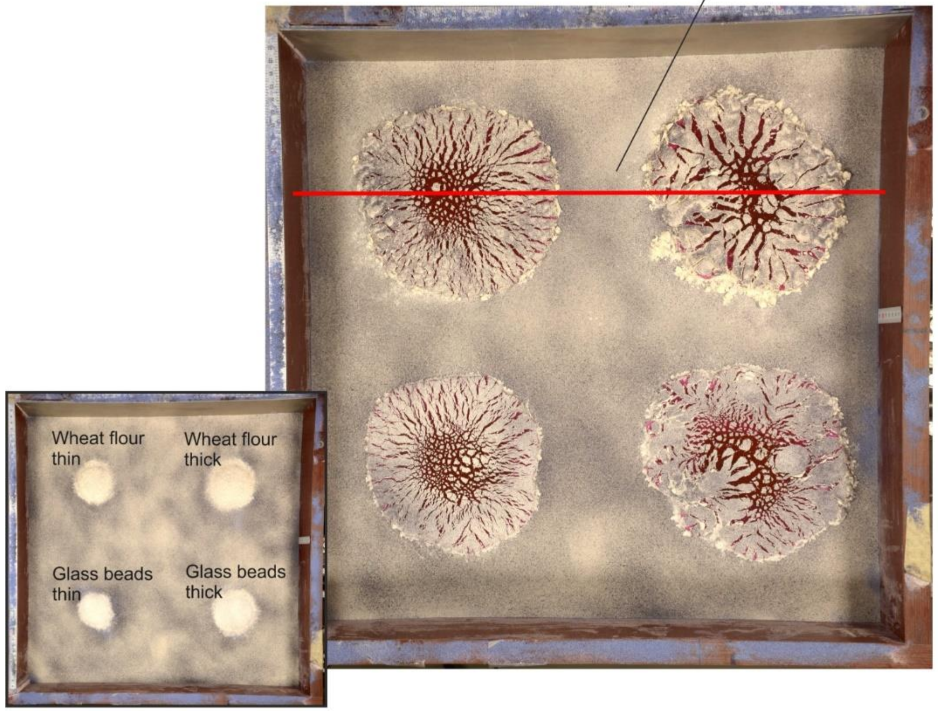
ADDITIONAL DISPLAY MATERIAL

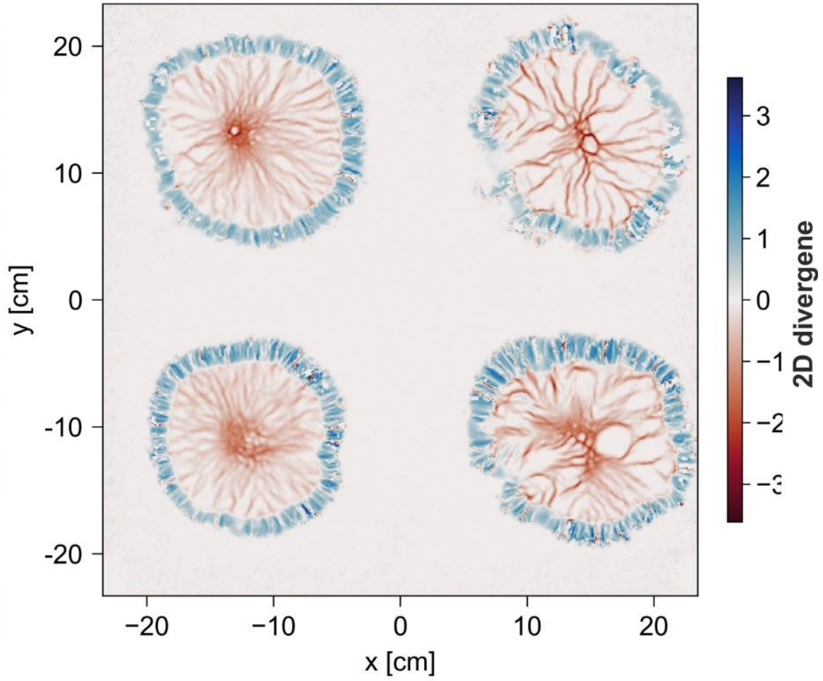
- **Part 1:** Additional results of analog experiments
- **Part 2:** Concept and results of 2D numerical models on caprock deformation on extruding diapirs.

This study is part of a Czech-German bilateral project (GACR, DFG) in collaboration with the LMU Munich
https://www.ig.cas.cz/en/observatories/tect-mod-lab/caprock-zagros/

PART 1: EXTRUSION OF PASSIVE DIAPIRS

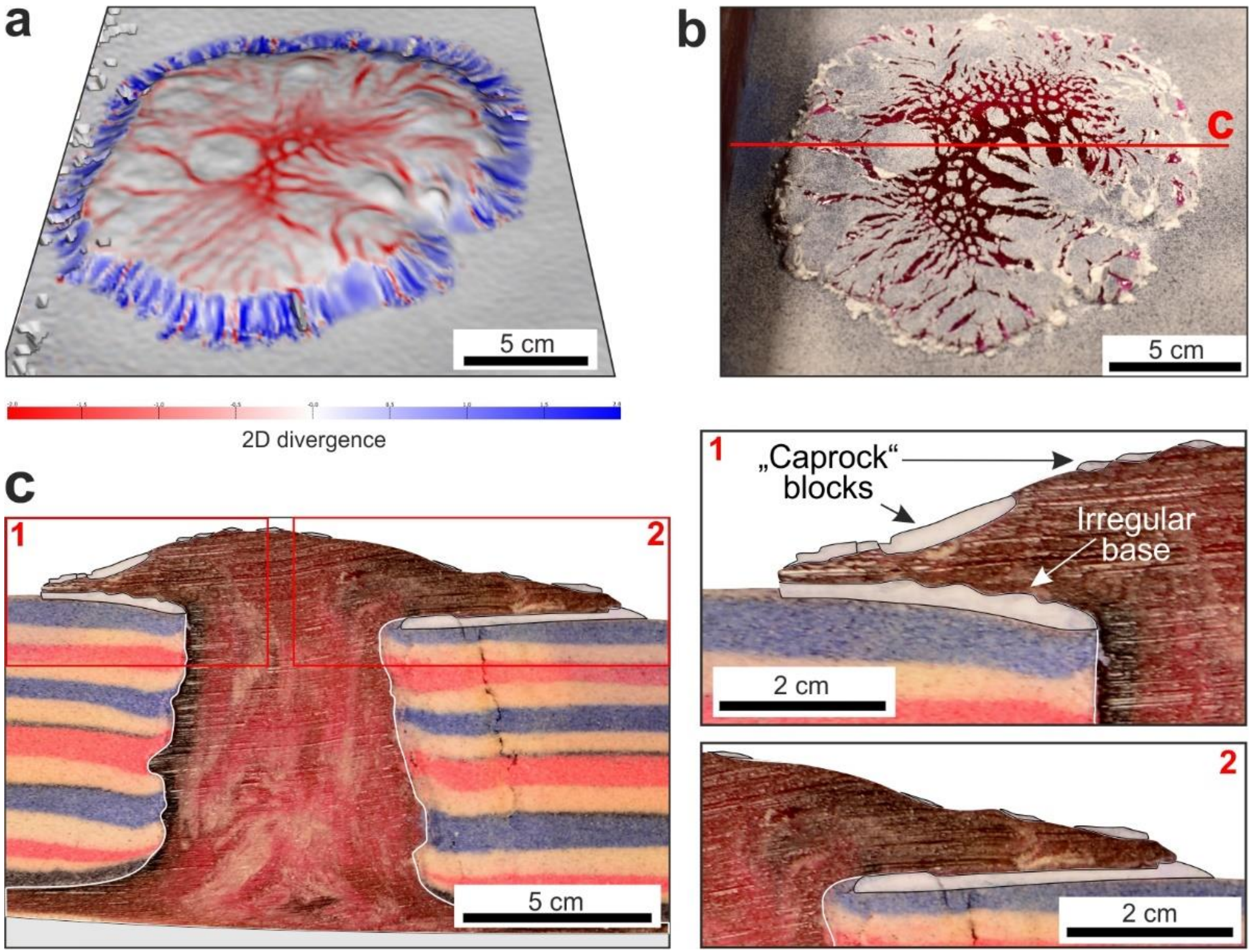






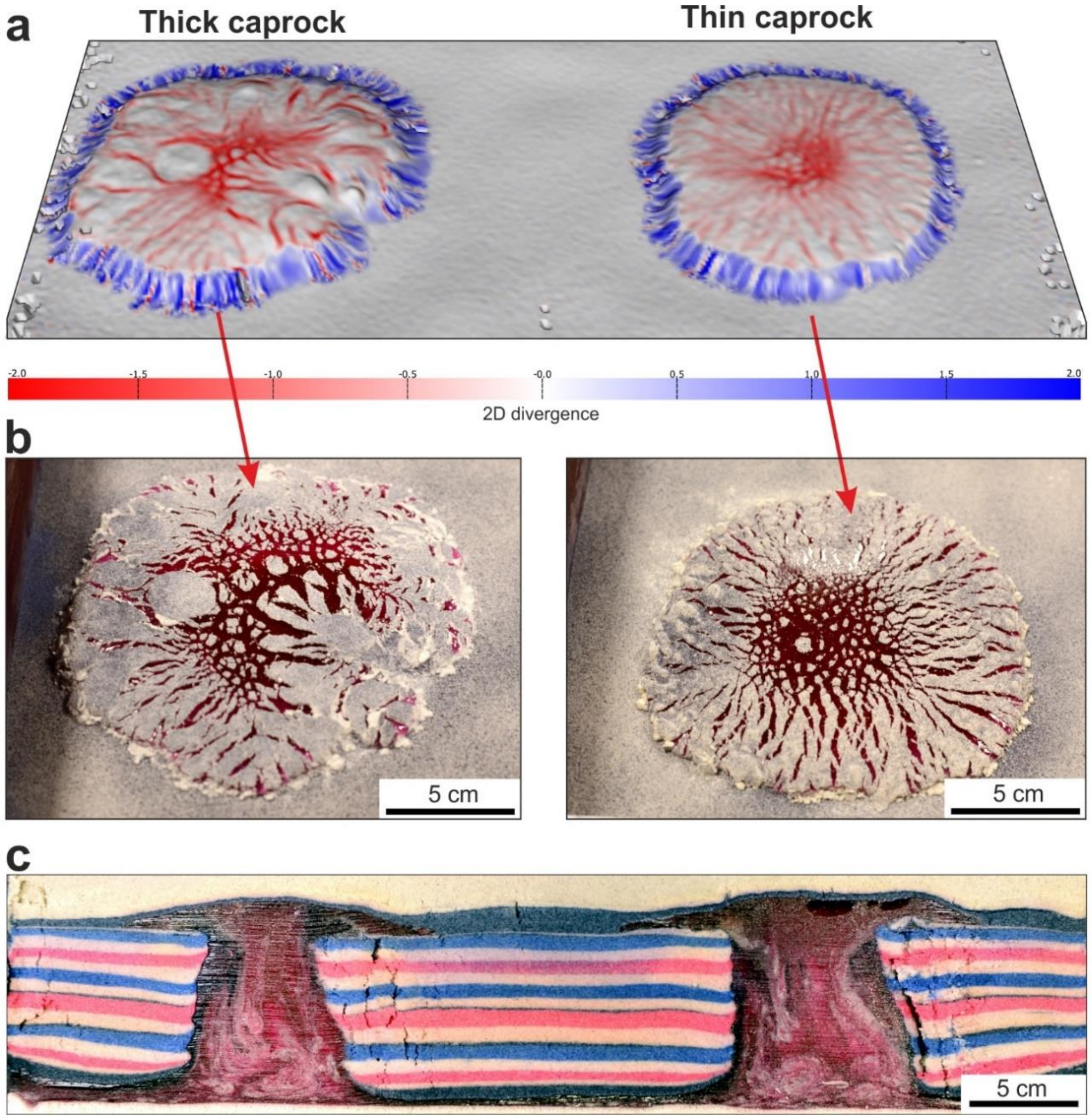
- Different high-cohesive caprock materials (Flour, fine-grained glass beads) behave similar
- Independent of density

EXTRUSION OF PASSIVE DIAPIRS



- Caprock blocks floating on the extrusion
- Caprock is overflowed by extrusion

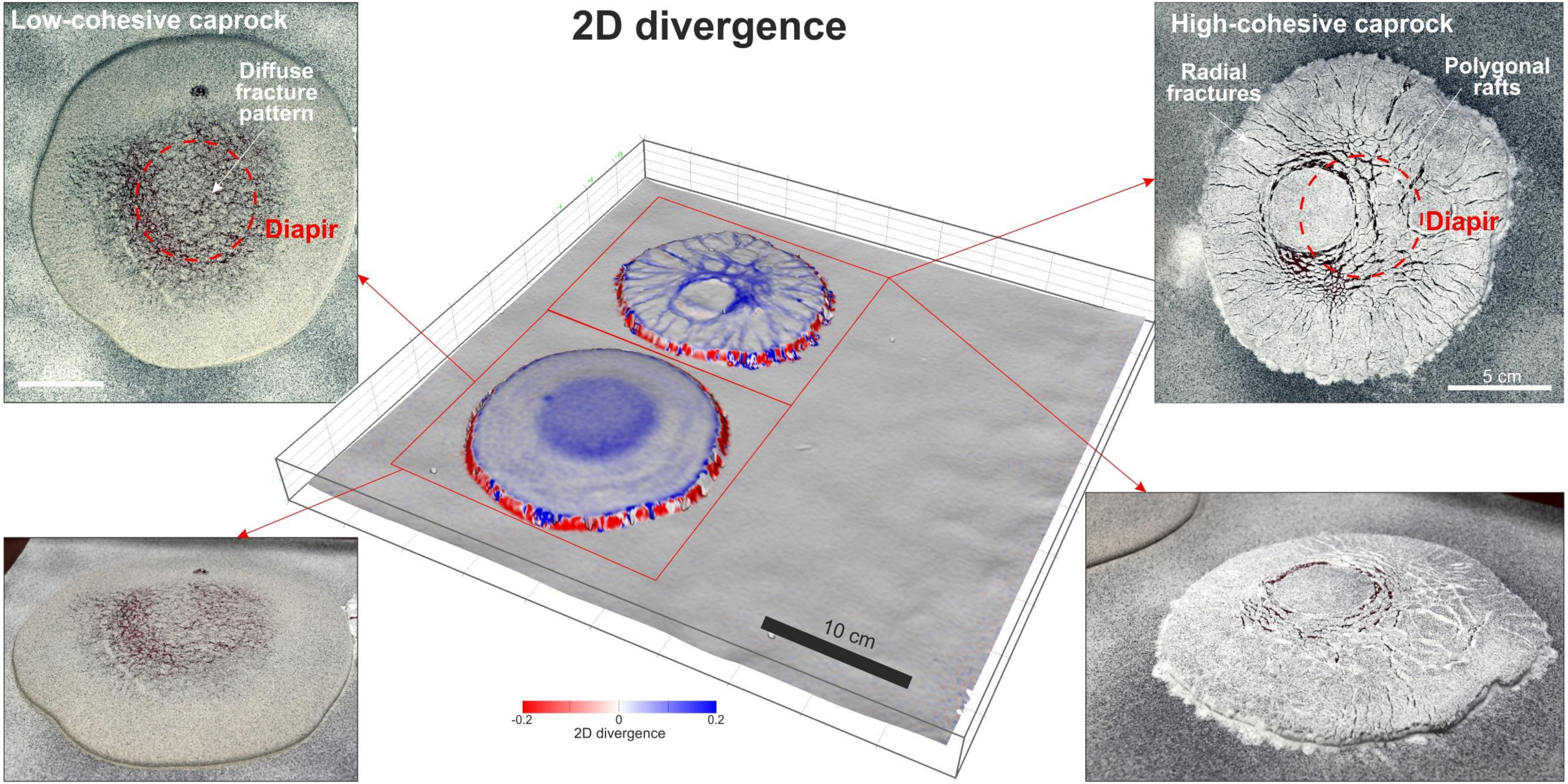
EXTRUSION OF PASSIVE DIAPIRS



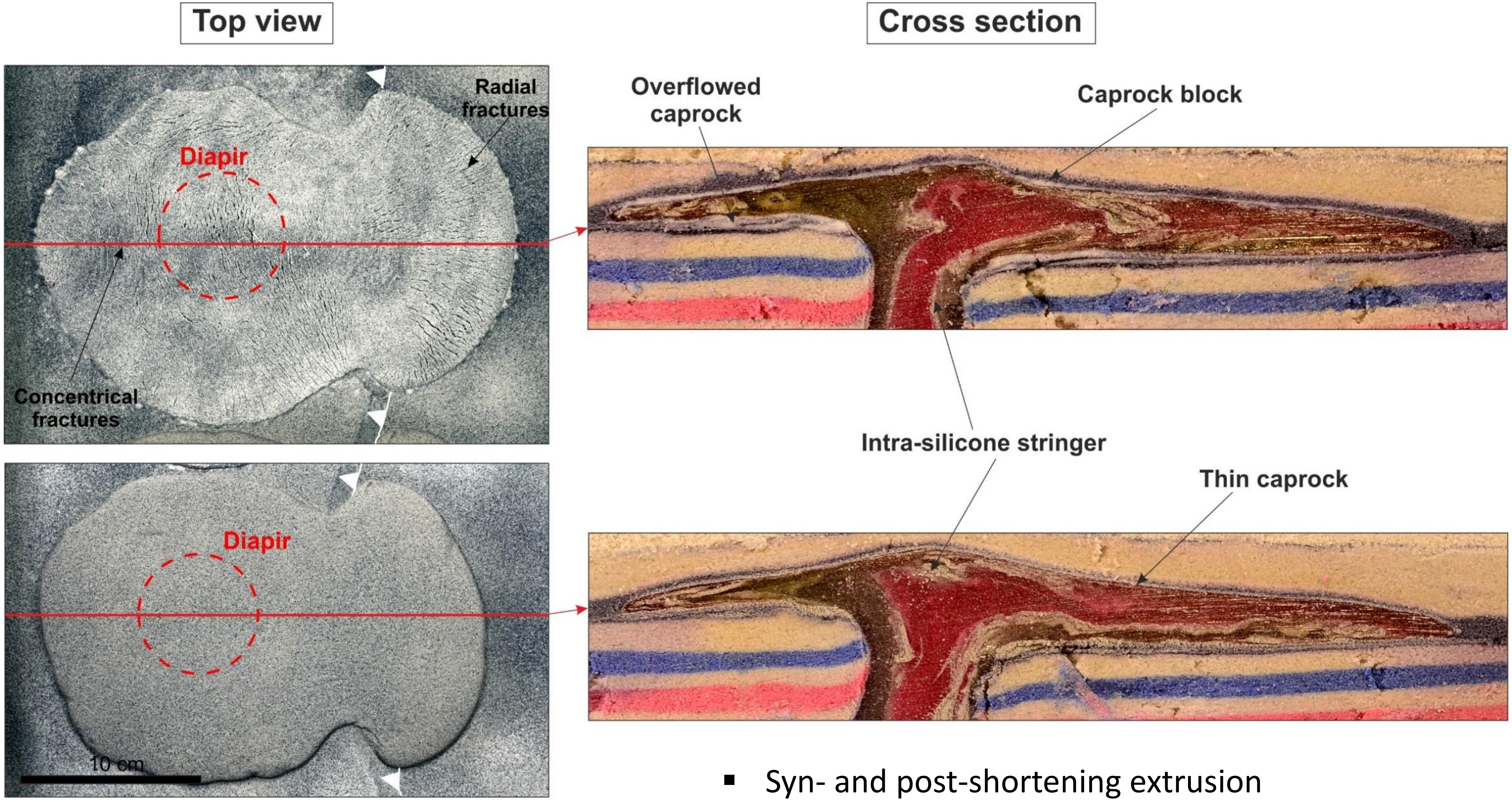
If caprock is thicker:

- Caprock rafts are larger
- Radial fractures at outer lobes are irregular

EXTRUSION OF PASSIVE DIAPIR

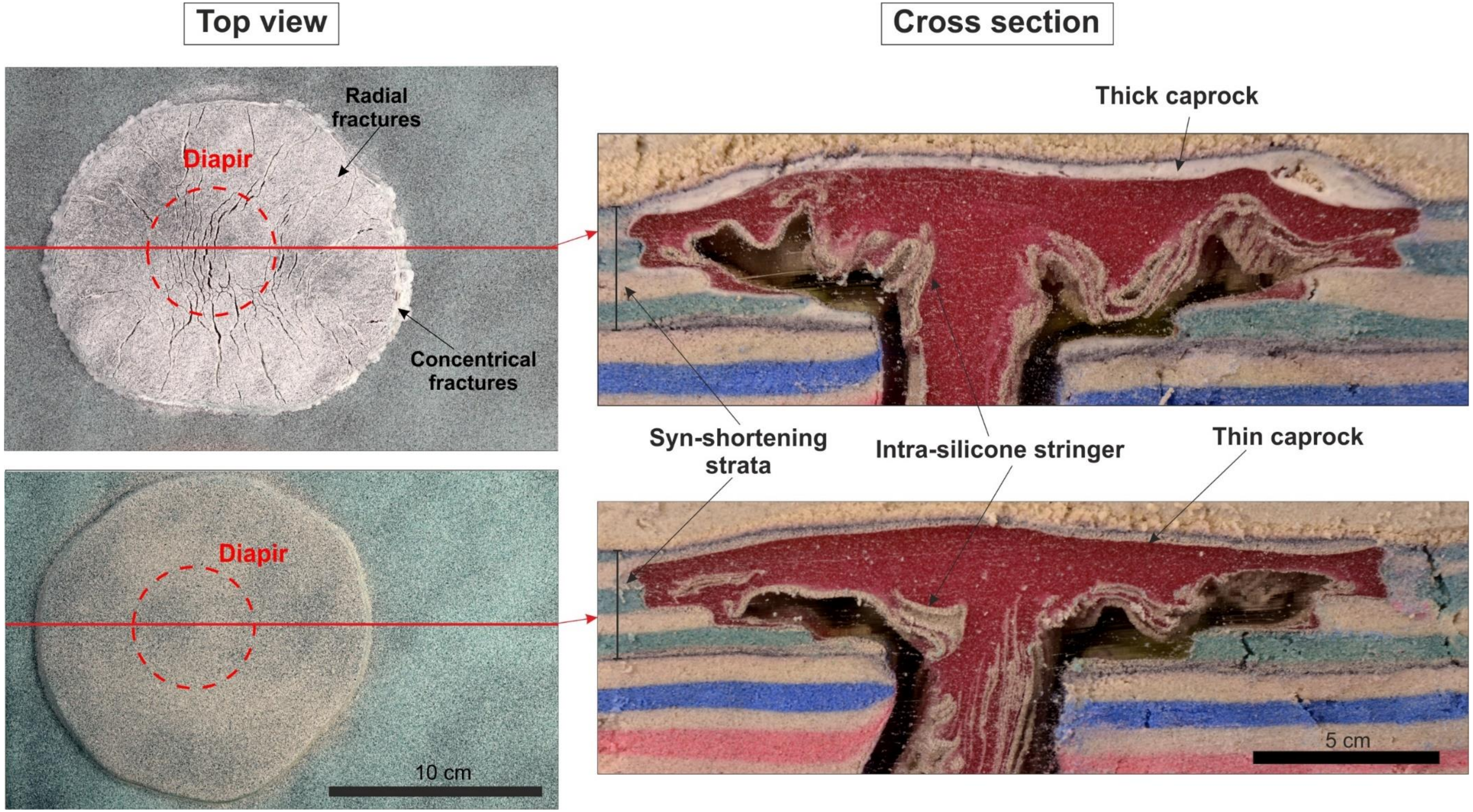


EXTRUSION OF SQUEEZED DIAPIRS



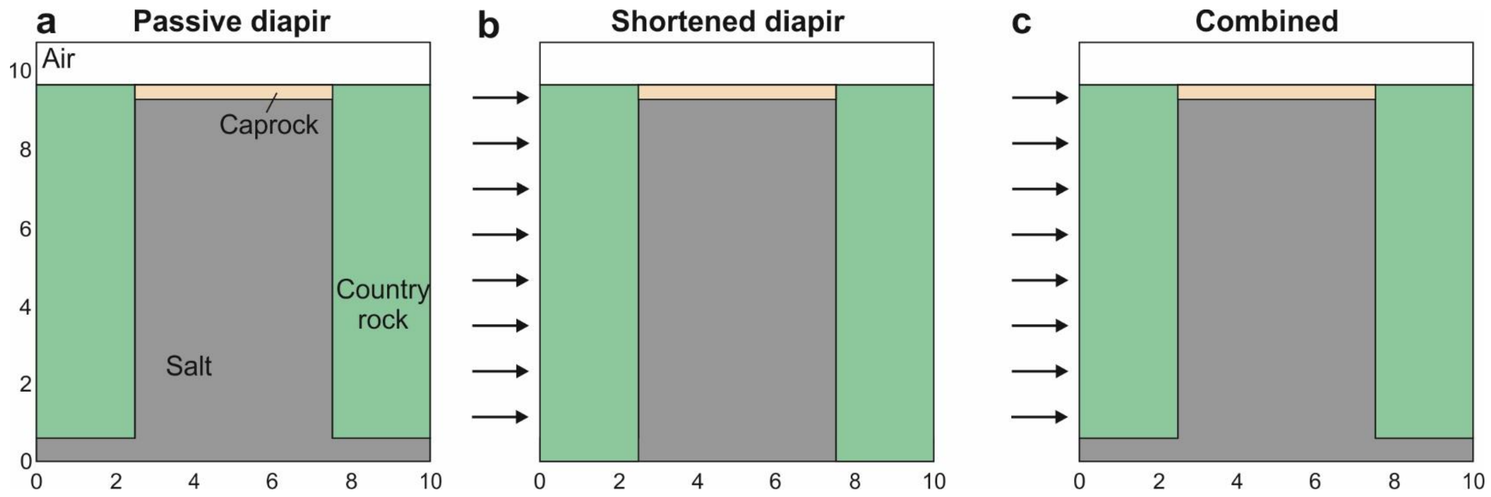
- Syn- and post-shortening extrusion

EXTRUSION OF SQUEEZED DIAPIRS



- Including syn-shortening sedimentation

PART 2: 2D NUMERICAL MODELS



- MATLAB-based, finite element method (FEM) solver MVEP2
- (Kaus et al. 2010)
- developed on basis of MILAMIN (Dabrowski et al., 2008)
- Allows Maxwell viscoelastic rheology with non-associated plasticity of simulated rocks
- Test of various rheologic and geometric parameters of the caprock:
  - Plastic or viscous rheology
  - Thickness
  - Density
  - Etc.

Default parameters

Diapir height – 10 km

Model width – 10 km

Sediment thickness – 9km/10km (passive and combined/compression)

Source layer thickness – 1 km (passive and combined)

Salt viscosity – 10^{18} Pas

Sediment and caprock viscosity 10^{25} Pas

Sediment cohesion – 20 MPa

Caprock cohesion – 5 MPa

Salt cohesion – 10 MPa

Friction angle for all layers – 30°

Sediment and caprock density – 2500 kg/m^3

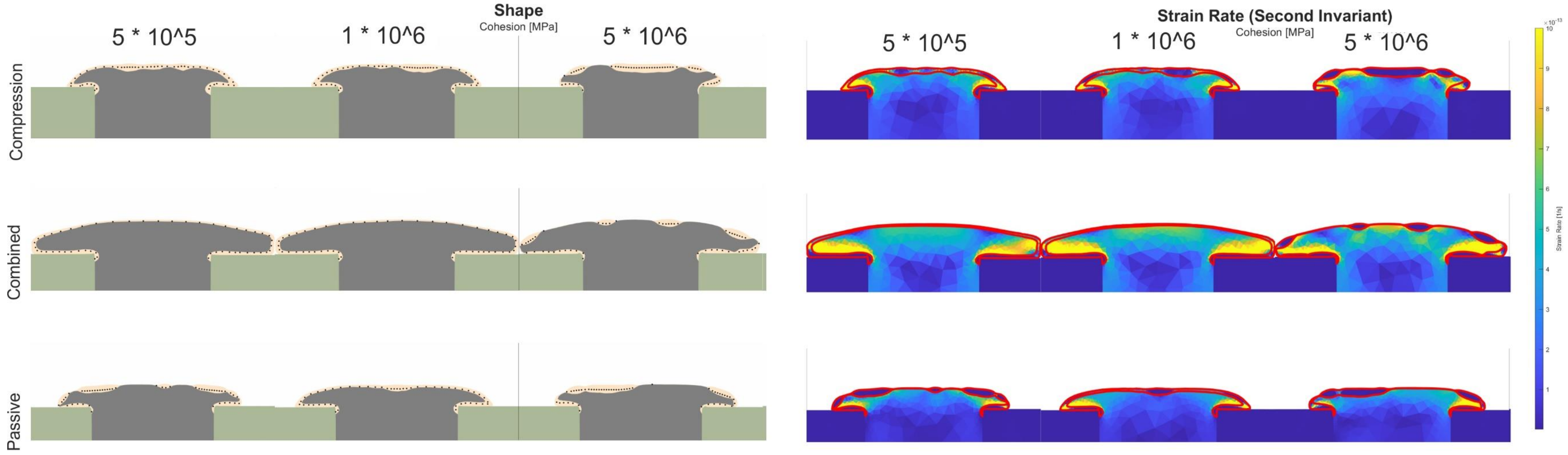
Salt density – 2200 kg/m^3

Caprock thickness – 300 m

Compression rate – 0.5 cm/yr

2D NUMERICAL MODELS

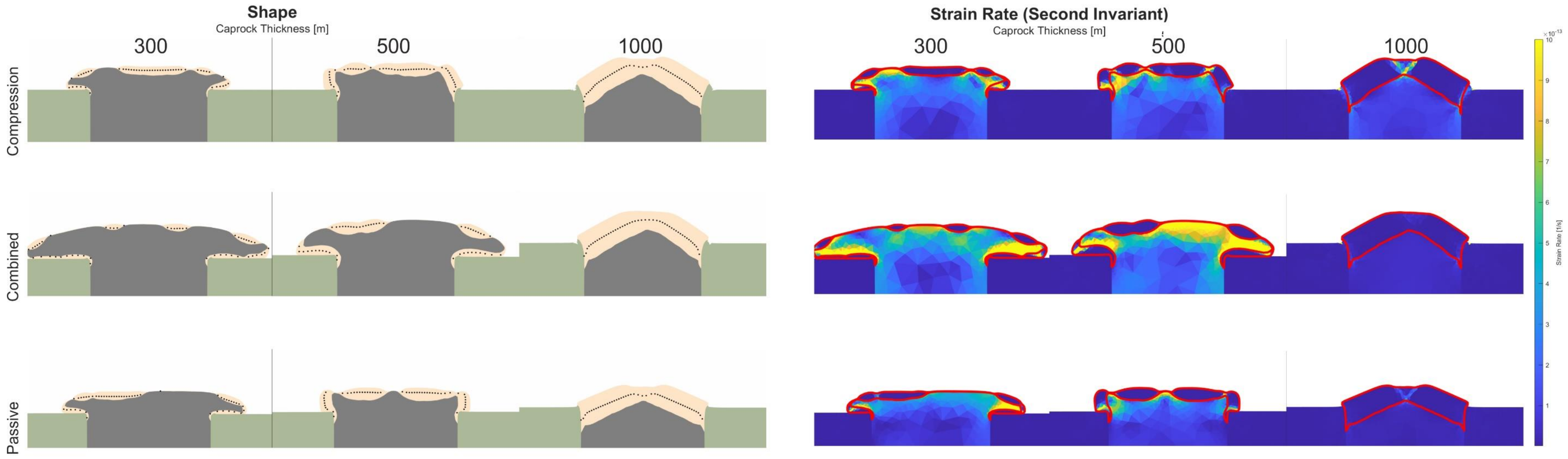
CAPROCK COHESION



- Caprock dominated by elastoplastic rheology
- The higher the caprock cohesion, the larger and thicker are caprock rafts

2D NUMERICAL MODELS

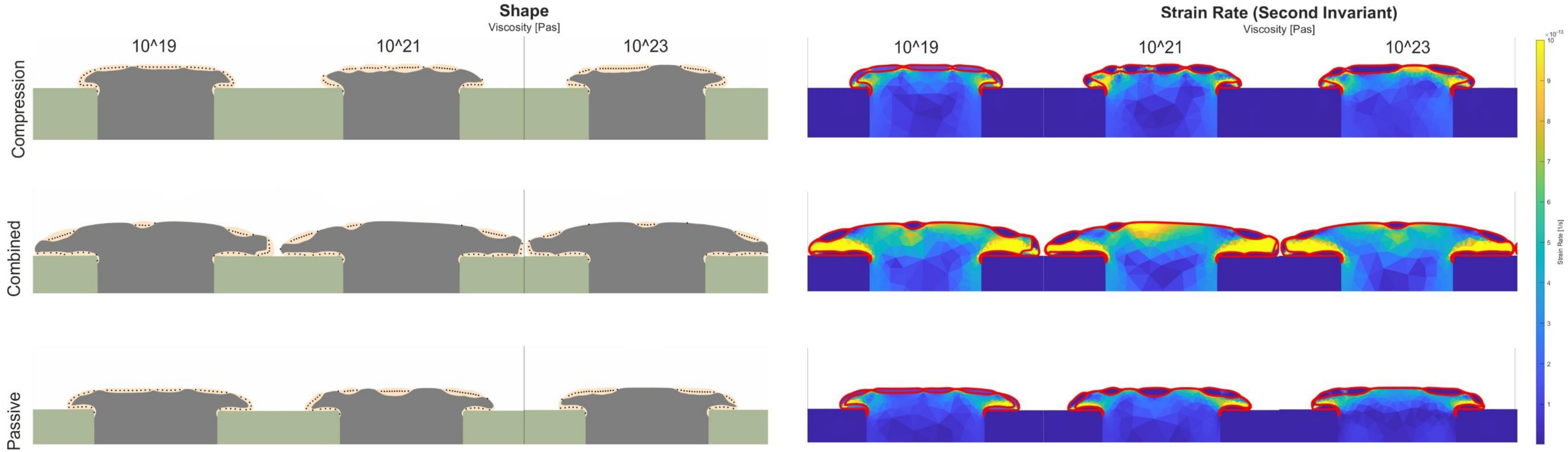
CAPROCK THICKNESS



- Caprock dominated by elastoplastic rheology
- The thicker the caprock cohesion, the larger are caprock rafts

2D NUMERICAL MODELS

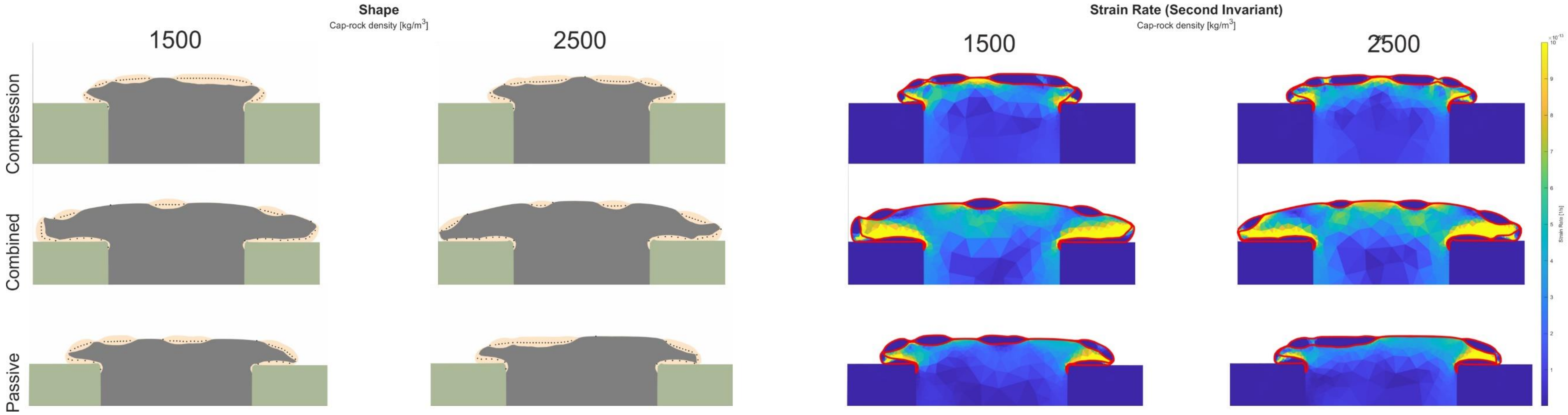
CAPROCK VISCOSITY



- Caprock dominated by viscous rheology
- Only minor influence of the viscosity on the deformation of the caprock

2D NUMERICAL MODELS

CAPROCK DENSITY



- no major influence of the caprock density on the deformation