EGU22-2089

European Geosciences Union

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Civil and Environmental Engineering

ExxonMobil

Anisotropic Fault Permeability Upscaling and Modeling of Fault CO_2 Migration during Geologic Carbon Sequestration (GCS)

Lluís Saló-Salgado, Josimar A. Silva, J. Steven Davis, Ruben Juanes

This presentation participates in OSPP

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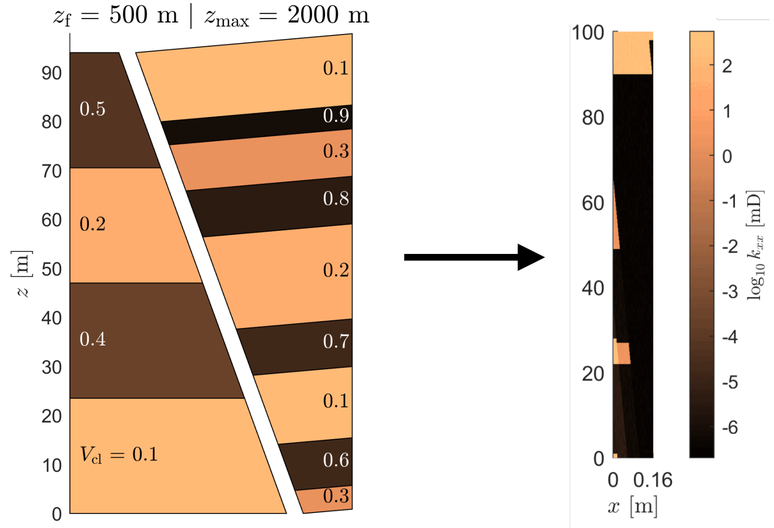
Abstract & Judging

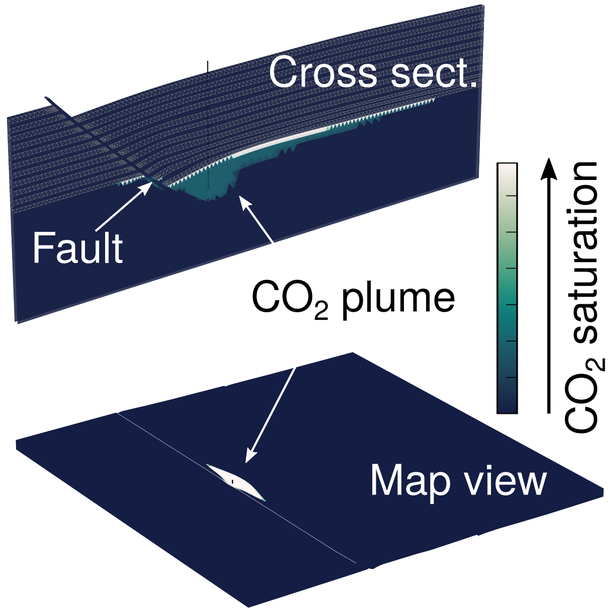
Stochastic property prediction



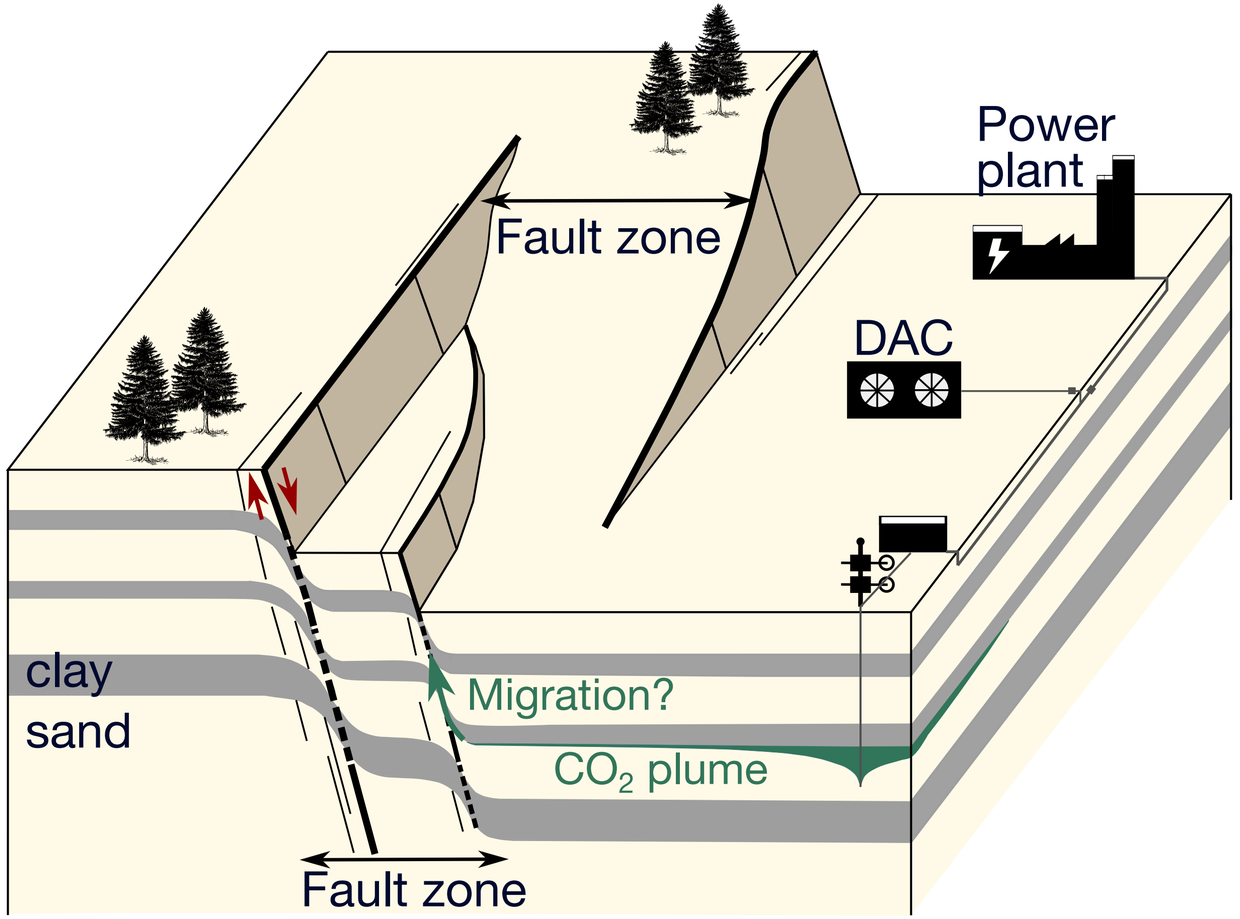
Faulted stratigraphy

Fault

Physics-based modeling



Migration of CO_2 through faults and leakage into overlying units and/or the surface is a concern in large-scale Geologic Carbon Storage (GCS)

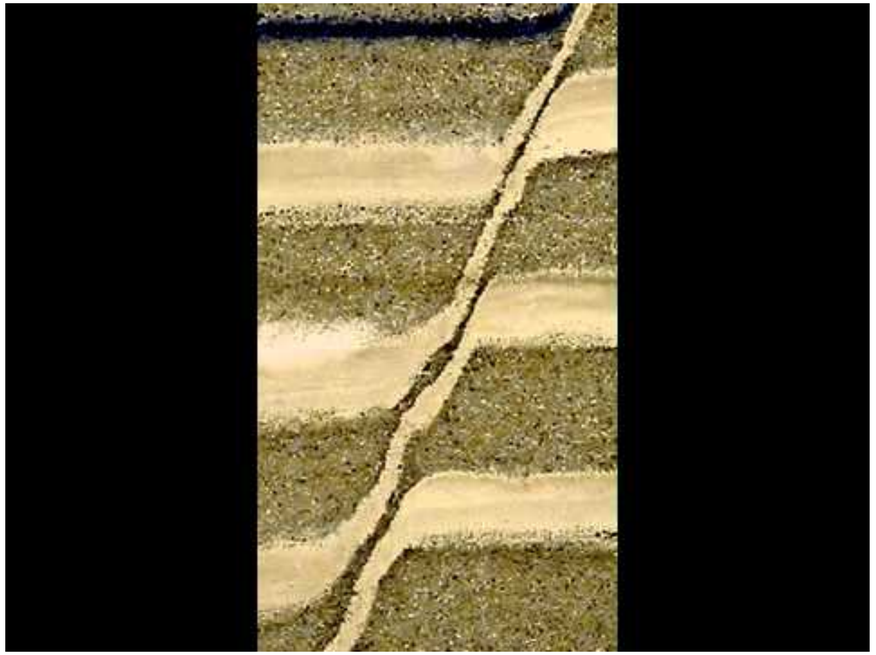


Surface segmentation pattern modified from Childs et al., *JSG* 2009

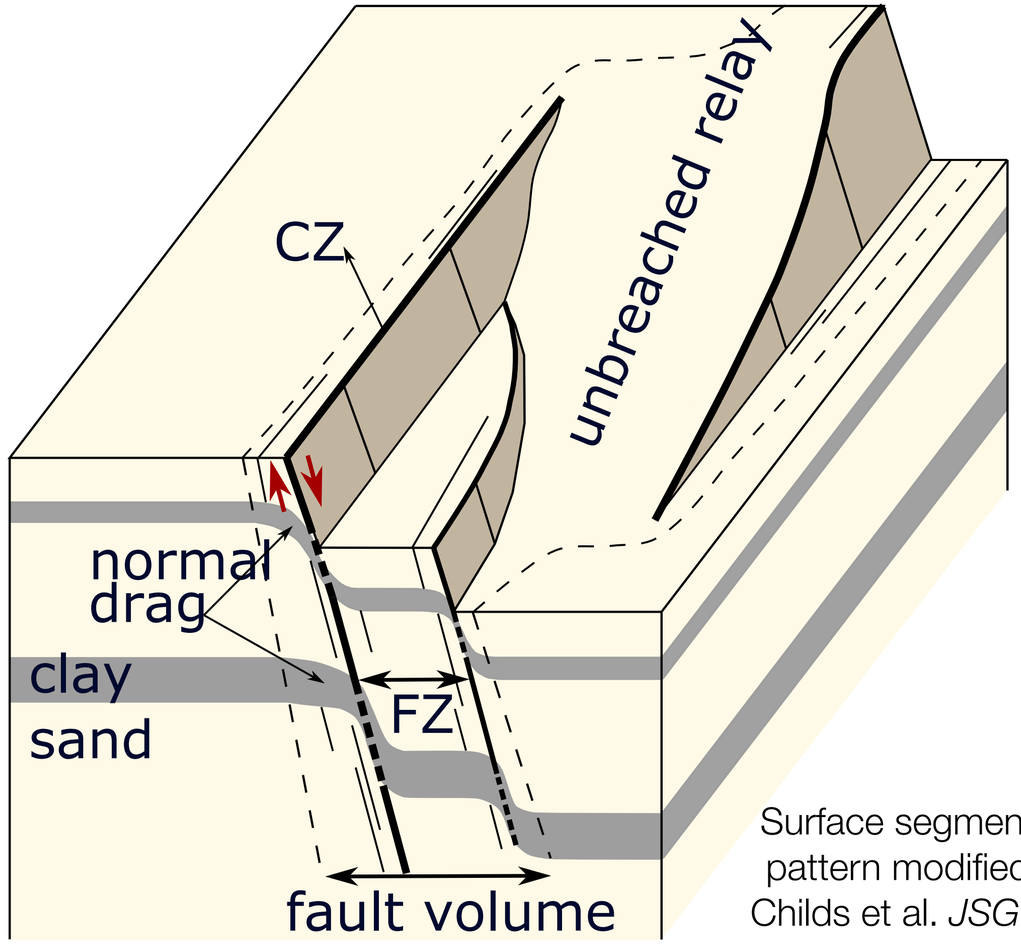
We focus on faults in soft siliciclastic basins, best suited to diminish the hazards of induced seismicity and fault leakage

- Soft siliciclastic basins have advantageous rheological properties for large-scale GCS

Juanes et al., *PNAS* 2012
Vilarrasa & Carrera, *PNAS* 2015



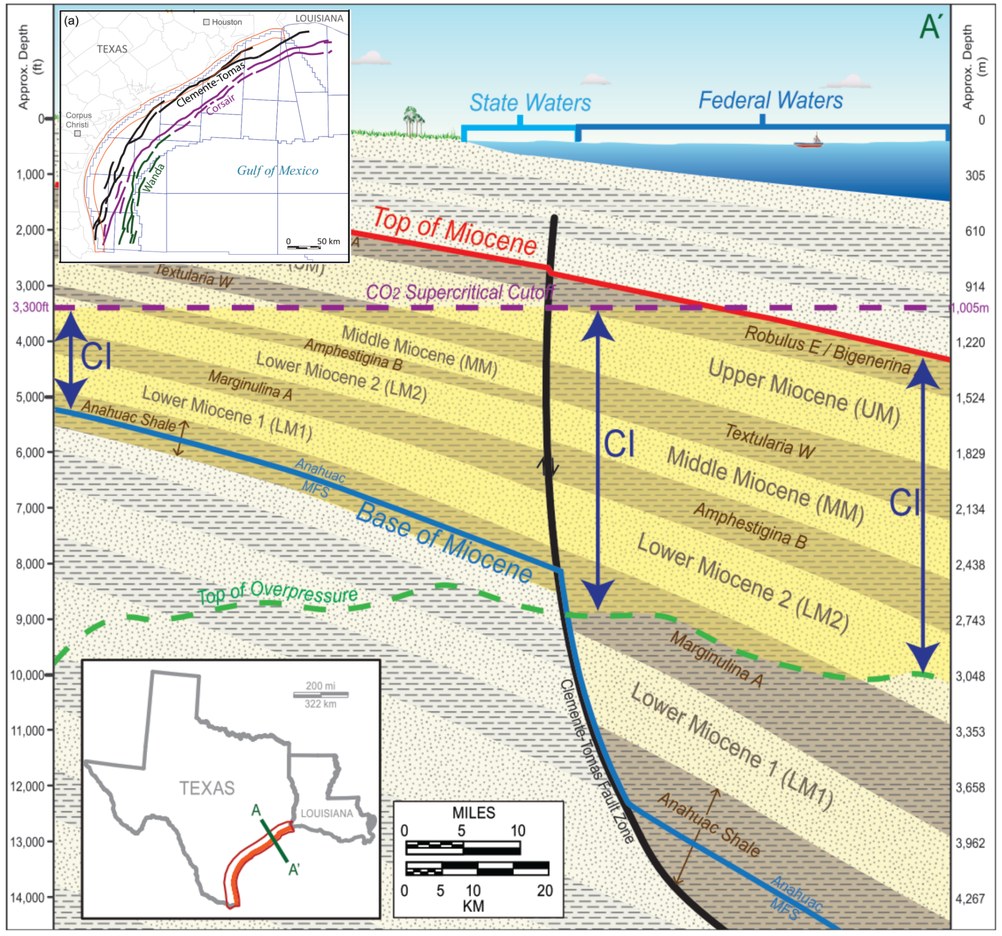
Schmatz, Urai, et al. (RWTH Aachen)
Video from StrucGeology Youtube channel



Surface segmentation pattern modified from Childs et al. *JSG* 2009

Fault Zone CO_2 migration in the Miocene section offshore Texas (Gulf of Mexico)

- **Goal**: Assess potential migration of CO_2 through a fault partially offsetting the caprock



Modified from Treviño & Rhatigan (ch. 1) and Carr et al. (ch. 5) in Treviño & Meckel (eds), Report of Investigations No. 283, Bureau of Economic Geology, UT Austin (2017)

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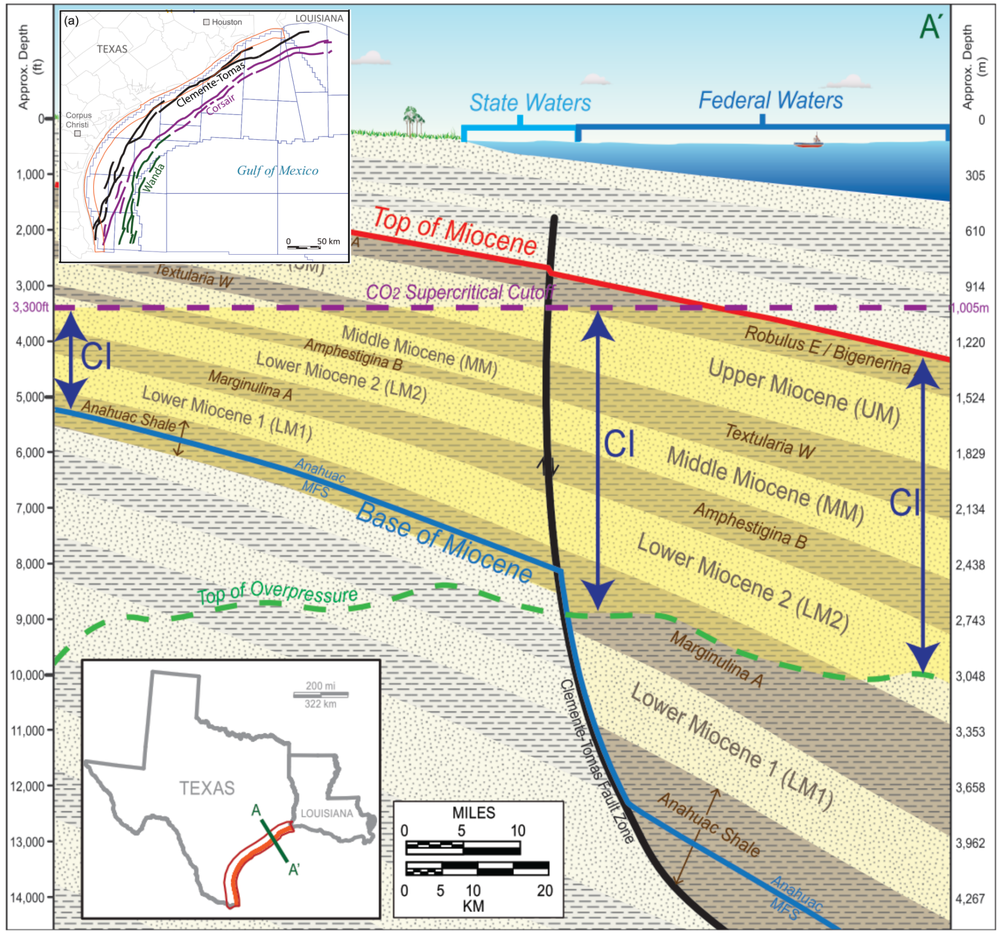

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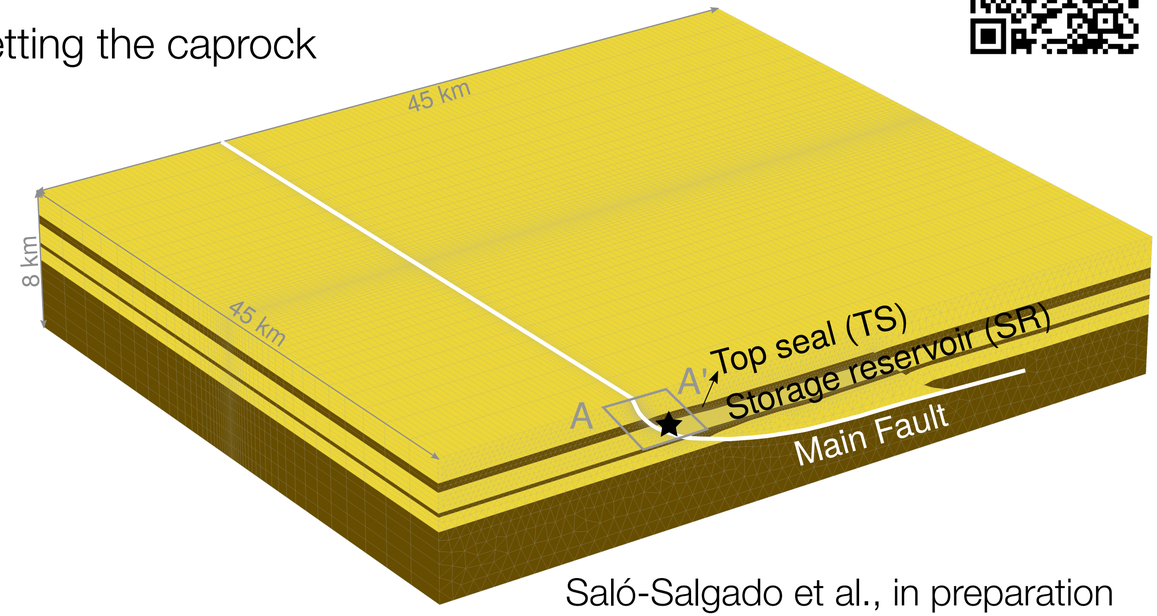
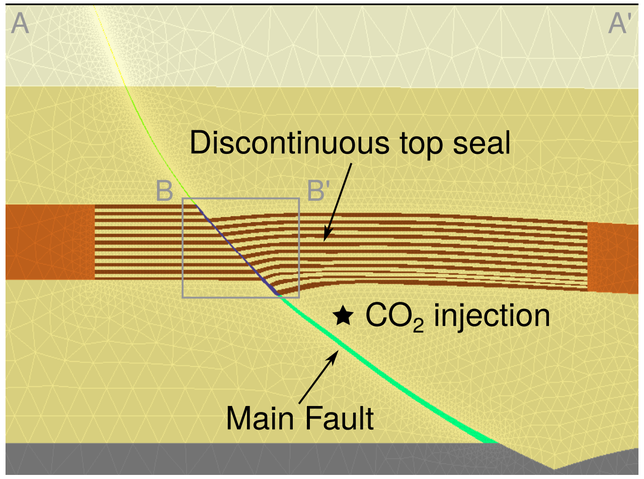
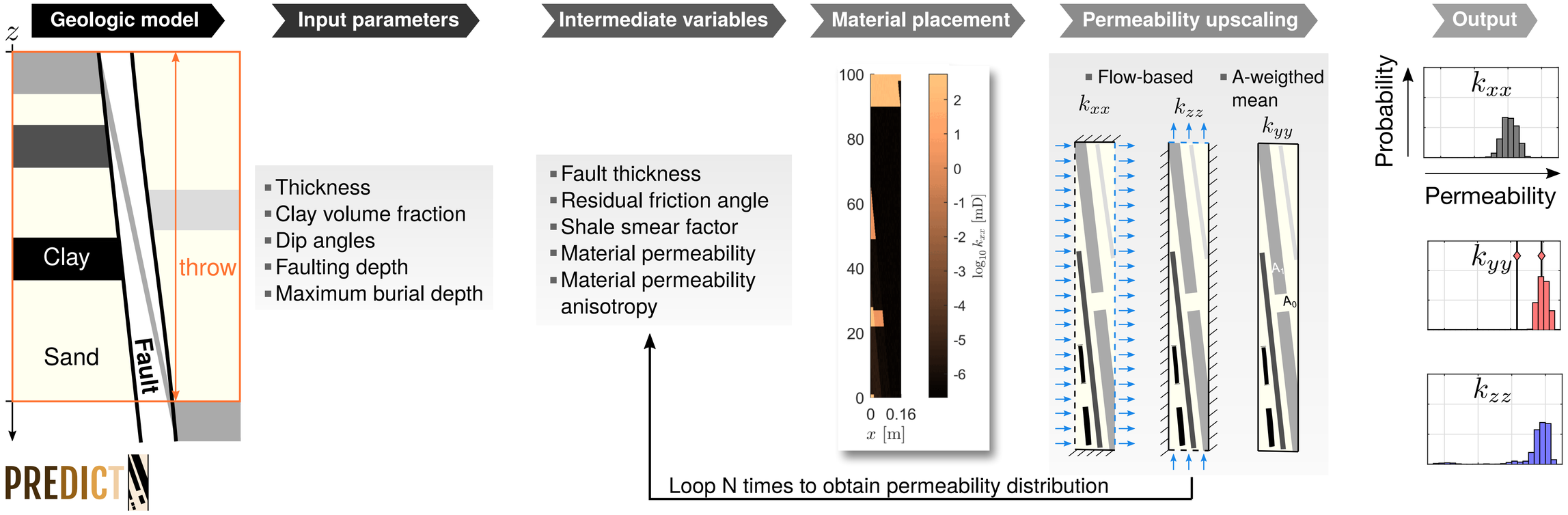


Saló-Salgado et al., in preparation



The intrinsic permeability k [L²] controls fluid flow through porous media. However, previous approaches cannot quantify the fault permeability tensor

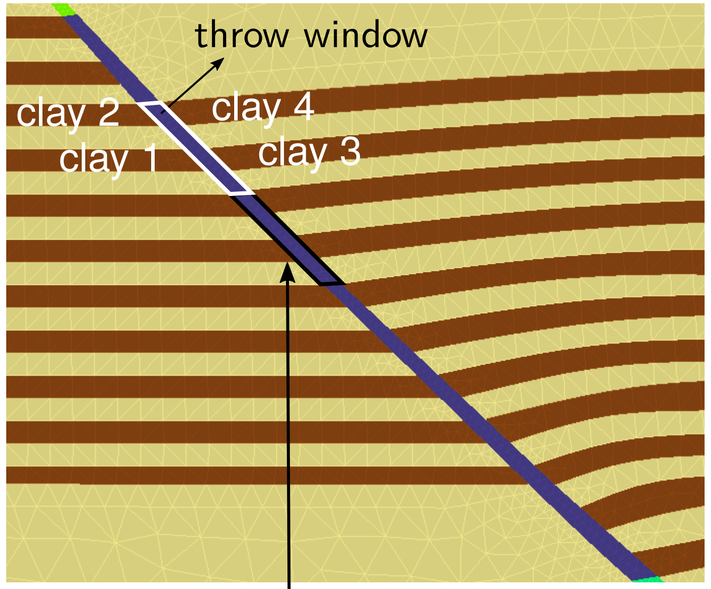
- We developed a new methodology, PREDICT, which uses a geologically-consistent, probabilistic approach to modeling the directional components of the fault permeability tensor.



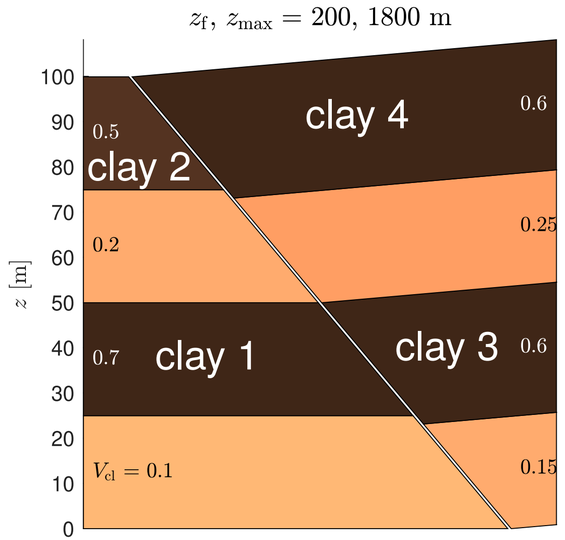
Saló-Salgado et al., in preparation

Application of PREDICT: fault screening and faulted reservoir simulation

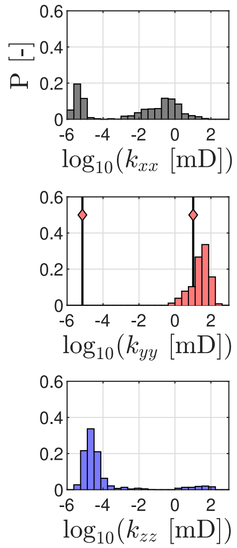
Cross section in simulation model



Throw window in PREDICT



Output Permeability



- Selection (scenario-based)
- Sampling (probabilistic)

Pick next throw window

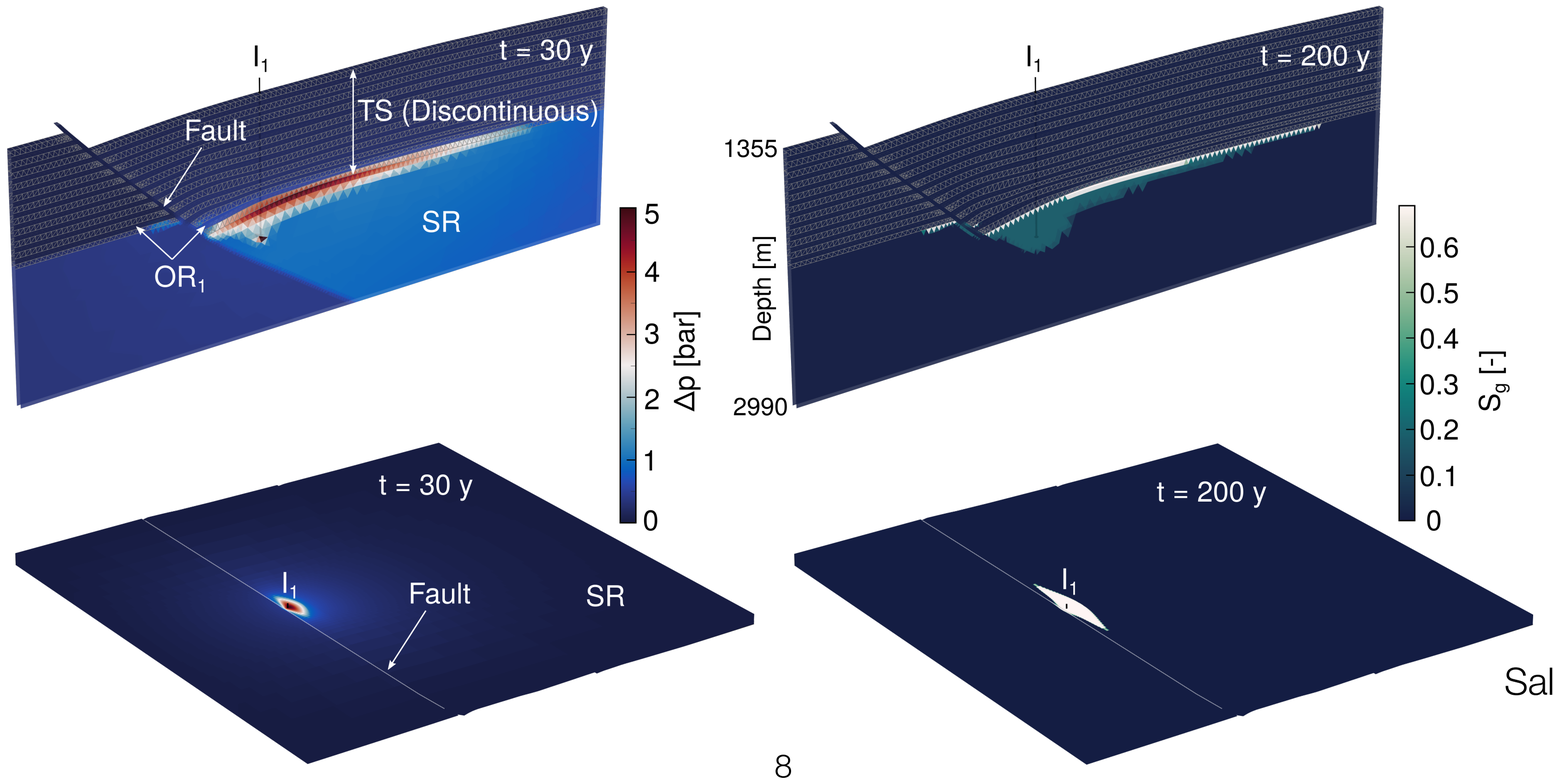
- The output is suitable for either scenario-based modeling or sampling in a fully probabilistic framework
- **Permeability**: obtain the 3-component upscaled permeability distribution for each throw window
- ***P_c, k_r***: Use high-resolution material distributions and the desired upscaling method

Saló-Salgado et al., in preparation

Fault Zone CO_2 migration in the Miocene section offshore Texas (Gulf of Mexico): Base-case result

- After 200y, a small amount of CO_2 has traveled along the fault and into the first overlying reservoir (OR_1). The CO_2 saturation in OR_2 is almost 0, and no CO_2 is observed above.
- **Hypothesis**: Faults that partially offset a discontinuous caprock may act as partial vertical conduits. Updip migration through the whole caprock interval is very unlikely.

CO_2 injection rate: 1 Mt/y
t_{inj} = 30 y; **t_{sim}** = 200 y



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