Understanding structural development is vital for modeling petroleum systems through maturation, migration and reservoir charge stages. Real-world analogs show only a single time step of structures that evolved over thousands or millions of years, and are often not even accessible to seismic interpreters.

Physical analog modeling is a well-established laboratory technique for reproducing the developmental sequence and overall geometry of geologic structures. Physical analog models are three-dimensional kinematically and geometrically realistic simulations of processes that form complex geologic structures.

Rock strata are represented in the models by tabletop-scale analog layers such as sand, claycake, and silicon putty. These analog materials are carefully selected to reproduce at small scale the geometric and kinematic features of natural geologic structures.

Southwest Research Institute® (SwRI®) scientists have developed physical analog models that can be used to test a variety of tectonic histories. By calibrating model results against natural structures, tectonic history can be incorporated into the interpretation of complex structural terrains.

SwRI's Physical Modeling Laboratory is a state-of-the-art facility designed to emulate a variety of tectonic settings. The modeling apparatus is modular and can be configured to represent most tectonic deformation styles, including:

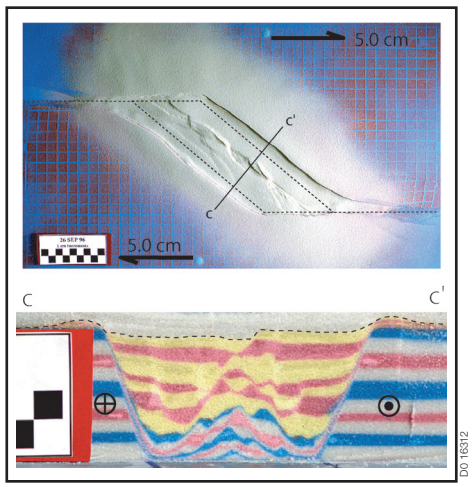
- Extension
- Shortening
- Strike slip
- Localized uplift and doming
- Normal and reverse faulting
- Tectonism of a brittle layer over a ductile substratum
- Combinations of these styles

Still photographs are used to document the pre-, syn- and post-kinematic stages of the experiments. While deformation is active, models are photographed from above at set intervals and with a variety of illumination angles.

Physical analog models can be configured at crustal, basin, field, and outcrop scales. This multi-scale approach allows representation of structural features that are below the detection limits of seismic methods.

D0 16311

Cross-section of sand model of pull-apart basin showing graben in growth strata (blue and red) above horst earlier growth strata (yellow and red).



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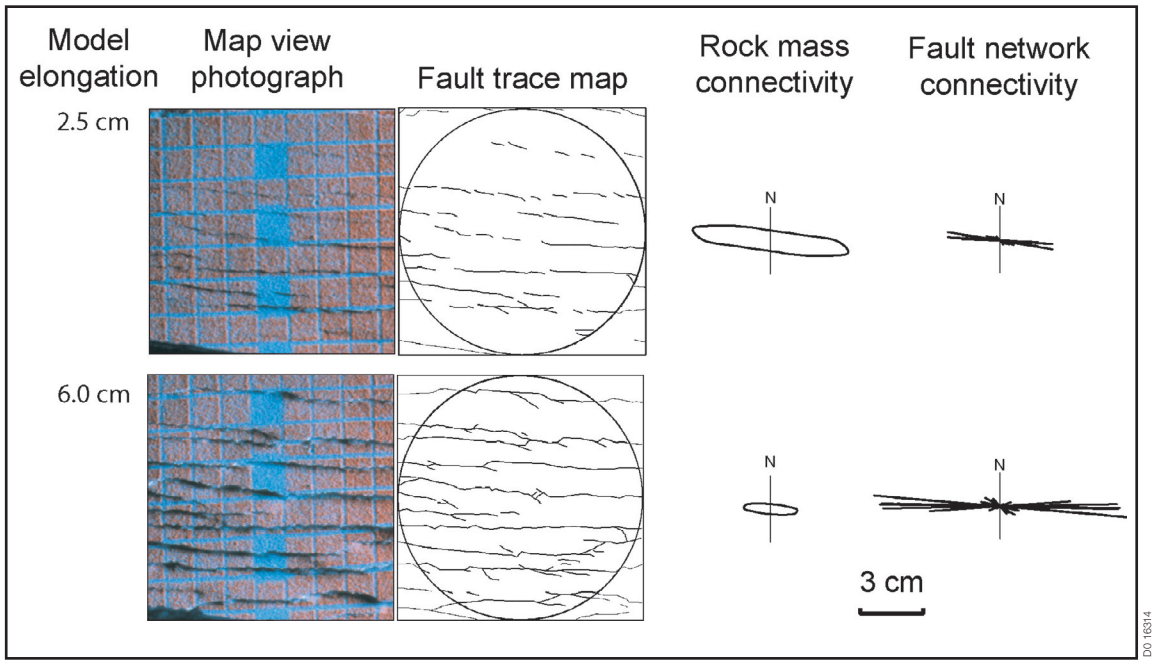
Vertical and cross-section views of sand pack deformed to simulate a pull-apart basin. Yellow and red layers are growth strata added to fill the basin during its formation.

D0 16313

Oblique view of normal fault scarps in deformed sandbox model



Analysis of two deformation stages from extensional fault system development illustrating evolution of rock mass connectivity and fault network connectivity. These are essential elements in quantifying permeability anisotropy in fractured and faulted reservoirs.

We welcome your inquiries. For additional information, please contact:

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Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,100 employees who perform contract work for industry and government clients.

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Physical Analog Modeling of Geologic Structures