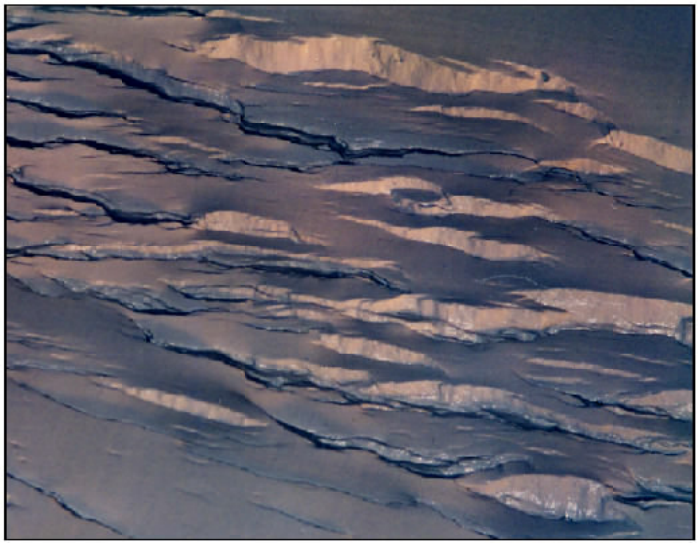
Rutgers University
Department of Geological Sciences
Structural Geology & Tectonics Group

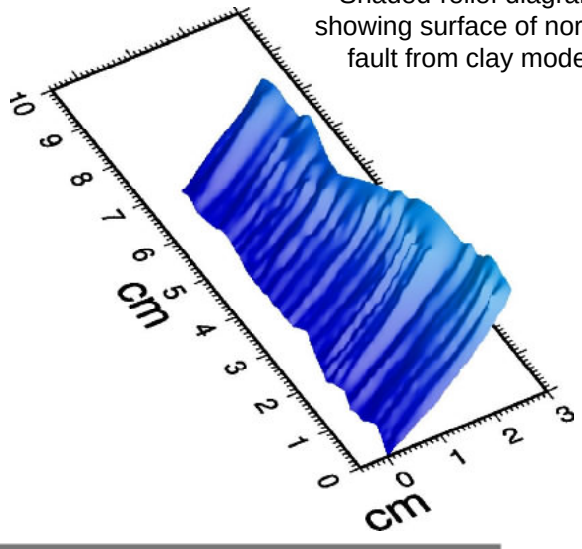
Scaled Experimental Modeling of Geologic Structures

Why is structural modeling important to the oil & gas industry?

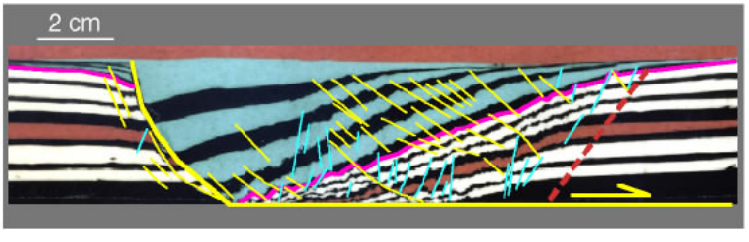
Scaled experimental models provide valuable information about structural processes, especially those not observed directly in nature. For example, we can observe and document the evolution of fault and fold patterns. Thus, experimental models provide 4D templates for interpreting geological structures, reducing the level of uncertainty associated with hydrocarbon exploration and production. Furthermore, experimental models allow us to test the accuracy of numerical and restoration algorithms.



Oblique view of surface of clay model showing normal faults



Shaded-relief diagram showing surface of normal fault from clay model



Layered clay model of listric normal fault with growth

What are our current research projects?

Our current research addresses the following questions:

- What factors affect the propagation and linkage of normal faults? How does the presence of pre-existing normal faults affect the nucleation, growth, and linkage of subsequent normal faults? How does normal-fault development affect depositional patterns, migration pathways, and fault sealing?
- Why do accommodation/transfer zones develop, and how do they affect the petroleum system?
- What structural traps are associated with basin inversion? How do the structures that form during the shortening phase affect trap integrity?
- How does oblique deformation (extension, shortening, or inversion) affect trap geometries and reservoir compartmentalization?
- How does salt affect the geometry of extensional and inversion structures? How do subsalt traps relate to suprasalt traps?

To address these questions, we are using a multi-faceted approach, incorporating scaled experimental modeling, geometric modeling and restoration, 2D and 3D seismic interpretation, and field studies.

Faculty experience

• Dr. Martha Oliver Withjack is a tenured Professor in the Department of Geological Sciences at Rutgers University. She has thirty years of experience in the oil & gas industry. She was an AAPG Distinguished Lecturer, a recipient of the J. C. "Cam" Sproule Memorial Award, a Distinguished Lecturer for the Petroleum Exploration Society of Australia, and a recipient of the Matson Memorial Award.

• Dr. Roy Schlische is a tenured Professor in the Department of Geological Sciences at Rutgers University. He has more than fifteen years of experience in structural geology.

Their research interests include scaled experimental modeling, rift basins and rift-basin inversion, deposition in rift basins, and seismic interpretation. Some recent publications are listed below.

Schlische, R. W., and Withjack, M. O., 2007, Origin of fault domains and fault-domain boundaries (transfer zones and accommodation zones) in extensional provinces: result of random nucleation and self-organized fault growth: Journal of Structural Geology, submitted.

Withjack, M. O., Schlische, R. W., and Henza, A. A., 2007, Scaled experimental models of extension: dry sand vs. wet clay: Bulletin Houston Geological Society, p. 31-49.

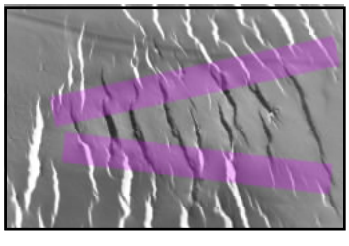
Withjack, M. O., and Schlische, R. W., 2006, Geometric and experimental models of extensional fault-bend folds: Buiter, S., and Schreurs, G., eds., Analogue and Numerical Modelling of Crustal-Scale Processes, Geological Society (London) Special Publication 253, p. 285-305.

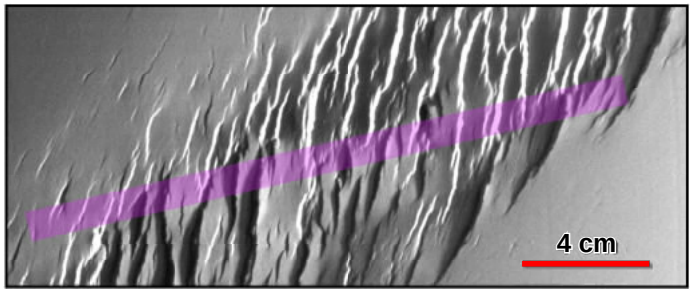
Withjack, M. O., Schlische, R. W., and Olsen, P. E., 2002, Rift-basin structure and its influence on sedimentation and stratigraphy, in Renaut, R., and Ashley, G. M., eds., Continental Rift Basin Sedimentology: SEPM Special Publication No. 73, p. 57-81.

Schlische, R. W., Withjack, M. O., and Eisenstadt, G., 2002, An experimental study of the secondary fault patterns produced by oblique-slip normal faulting: Amer. Assoc. Petrol. Geol. Bull., v. 86, p. 885-906.

Ackermann, R. V., Schlische, R. W., and Withjack, M. O., 2001, The geometric and statistical evolution of normal fault systems -- an experimental study of the effects of mechanical layer thickness on scaling laws: Journal of Structural Geology, v. 23, p. 1803-1819.

Withjack, M. O. and Callaway, J. S., 2000, Active normal faulting beneath a salt layer -- an experimental study of deformation in the cover sequence: Amer. Assoc. Petrol. Geol. Bull., v. 84, p. 627-651.





Top surface of clay models (bright surfaces are right-dipping normal faults; dark surfaces are left-dipping normal faults; purple lines are accommodation zones)

What facilities are available?

Our group has a state-of-the-art laboratory designed specifically for scaled experimental modeling. With our versatile equipment, we can simulate most structural styles, including basement-involved extension and contraction, detached extension and contraction, oblique extension and contraction, salt tectonics, and inversion. Rutgers University also has a seismic-interpretation laboratory, equipped with workstations and software for 2D and 3D seismic projects.

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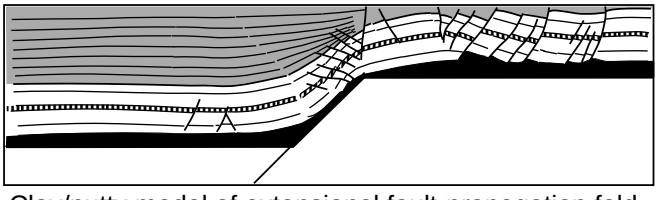

Clay/putty model of extensional fault-propagation fold