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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Tour of the structural analog modeling lab at Bureau of Economic Geology, Austin, Texas. 20-5704-166

PLACE/DATE: Austin, Texas; March 15, 1994

AUTHOR: David A. Ferrill

PERSONS PRESENT: CNWRA: D. Ferrill, S. Young, R. Martin, K. Spivey, Consultant: A. Morris; and Student: M. Hamilton

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BACKGROUND AND PURPOSE:

Task 6 of the CNWRA research project on regional tectonic processes in the Central Basin and Range region is "analyses of database and modeling of tectonic processes and geologic deformation affecting the central Basin and Range region." A main emphasis of this task is "on the mechanics and style of faulting in the central Basin and Range region." Analog modeling has successfully been used to improve understanding of the mechanics, style, and 3-dimensional evolution of strike-slip and extensional structures. Analog modeling and non-destructive analysis of the internal geometry of analog models using x-ray tomography are being investigated as a potential tool to model deformation processes that are active in the Death Valley Region including Yucca Mountain. The purposes of this trip were to tour the analog modeling facilities at the Bureau of Economic Geology in Austin, Texas, to gain familiarity with the modeling techniques in use there, and to investigate the potential for collaboration between Bruno Vendeville at the Bureau and the Tectonics Research Group at CNWRA.

SUMMARY OF PERTINENT POINTS:

The analog modeling lab at the Bureau of Economic Geology was originally set up by Martin Jackson to perform centrifuge modeling of salt diapirs, a continuation of his earlier work at the University of Uppsala. Bruno Vendeville, recognized for his previous modeling experience from his Ph.D. with Peter Cobbold in Rennes, France, and postdoctoral work at Texas A&M, was hired by the Bureau six years ago to design and set up a sand and clay modeling facility. The sand and clay modeling facility has been used for modeling a variety of structures including listric normal faults, domino style extensional faulting, density driven structures, and complex 3-dimensional compressional folding and faulting. Vendeville has extensive experience in modeling of a wide range of extensional and diapiric structures, use of a wide variety of modeling materials, and the design and construction of modeling apparatuses. Vendeville and Jackson have recently displayed an innovative approach to modeling in their successful use of a Dow-Corning silicone gel product (similar to but less viscous than the silica gel used in breast implants; possibly similar to the gel used in running shoe soles) to model density and differential-loading driven

diapirism which produces deformed geometries that are quite similar to structures seen on reflection seismic data from the Gulf of Mexico. Funding for the analog modeling work at the Bureau is mostly from a consortium of 10-15 oil companies, however a minor amount of additional funding comes from a grant from the state of Texas.

SUMMARY OF ACTIVITIES:

The participants left CNWRA at 7:15am and arrived at Bureau of Economic Geology in Austin at 9:15am. Bruno Vendeville met the group in the lobby and introduced the group to Martin Jackson, director of the analog modeling lab. Vendeville briefly discussed with us our interests in analog modeling and their lab. At our request, Vendeville gave us reprints of 12 publications discussing modeling work that he has performed or in which he has taken part (included in References). Vendeville then led us on a tour of the actual modeling labs. The modeling equipment occupies three rooms, the first of which is dominantly devoted to construction and deformation of centrifuge models. The second room is used for sand modeling, including the salt tectonics simulations using the silicone gel and sand in a transparent plexiglass box. The third room is set up with a dual axis compression apparatus to produce complex interfering fold sets.

The first sand and clay table that Vendeville directed the construction of for the Bureau was patterned after the table used by Ernst Cloos (Cloos 1955, 1968) and was soon found to be too limiting. Vendeville designed a more versatile deformation apparatus and currently has two versions that allow for multiple drive screws and motors, giving the ability to model more complicated structures than permitted by the original Cloos table. Exxon has recently donated a modeling table that is similar to the Cloos table and is not in use for modeling, because of its lack of versatility. Vendeville has experimented with x-ray tomography and knows personally the french geologists that have published the most detailed x-ray tomographic images of the internal deformation in an analog model (Colletta et al. 1993).

IMPRESSIONS/CONCLUSIONS:

The Bureau of Economic Geology analog modeling lab is argubly the best lab of its kind in the country and is probably one of the top 5 analog modeling labs in the world. Vendeville has extensive experience in techniques and materials used for analog modeling of extensional and strike-slip fault systems. Vendeville's expertise would be instrumental in quickly moving forward with the modeling efforts of the Tectonics Research staff at the CNWRA.

PENDING ACTION: None.

RECOMMENDATIONS:

Because of the large experience base, connection with the modeling community, and proximity to the CNWRA, it is recommended that the CNWRA Tectonics Program move forward with trying to hire Bruno Vendeville as a consultant, to provide advice on analog modeling, and specifically advice on model design and modeling materials for use as part of the Regional Tectonics Research program.

PROBLEMS ENCOUNTERED: None.

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SIGNATURES:

David A. Ferrill
Research Scientist

5 April 1994.
Date

CONCURRENCE SIGNATURES AND DATA:

H. Lawrence McKague
Manager, Geologic Setting

4/8/94
Date

Budhi Sagar
Technical Director

4/8/94
Date