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## CATEGORY: DIAGNOSTIC AND IMAGING SYSTEMS

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**PUB ID** DOE/BC/15100-2      **ORDER #** 773383

**TITLE** *Advanced Characterization of Fractured Reservoirs in Carbonate Rocks: The Michigan Basin*, Semi-Annual Report, April 1, 1999-September 31, 1999, 16 pp.

**PUB DATE** 01/22/2001

**CONTRACTOR** Michigan Technological University

The main objective of this project is for a university-industry consortium to develop a comprehensive model for fractured carbonate reservoirs based on the "data cube" concept, using the Michigan Basin as a prototype. This project combined traditional historical data with 2-D and 3-D seismic data as well as data from modern logging tools in a novel way to produce a new methodology for characterizing fractured reservoirs in carbonate rocks. Advanced visualization software was used to fuse the data and to image it on a variety of scales, ranging from basin-scale to well-scales.

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**PUB ID** DOE/BC/15105-1      **ORDER #** 774007

**TITLE** *Integrated Outcrop and Subsurface Studies of the Interwell Environment of Carbonate Reservoirs: Clear Fork (Leonardian Age) Reservoirs, West Texas and New Mexico*, Semi-Annual Report, March 30, 1999-October 1, 1999, 26 pp.

**PUB DATE** 02/01/2001

**CONTRACTOR** The University of Texas at Austin

Characterization of cycle and facies architecture on lower Clear Fork and lowermost upper Clear Fork equivalent outcrops in Apache Canyon of Sierra Diablo was complete. The focus of detailed study in Apache Canyon has been the upper Clear Fork section because this interval contains the productive interval in South Wasson field, the preliminary subsurface study area. Parts of three high-frequency sequences (HFS), each 60 to 100 ft thick, are present on the south wall of Apache Canyon. HFSs display an upper-deepening or backstepping pattern associated with longer-term sea level rise. Each HFS is composed of upward-shallowing cycles whose thickness, facies composition, and continuity vary within and between HFSs.

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**PUB ID** DOE/BC/15105-2      **ORDER #** 780436

**TITLE**      *Integrated Outcrop and Subsurface Studies of the Interwell Environment of Carbonate Reservoirs: Clear Fork (Leonardian Age) Reservoirs, West Texas and New Mexico*, Semi-Annual Report, October 1, 1999-March 31, 2000, 6 pp.

**PUB DATE** 05/01/2001

**CONTRACTOR** The University of Texas at Austin

The timing of dolomite formation relative to fracture formation was the key issue in efforts to predict fracture permeability in the SWCF reservoir. Although synkinematic dolomite was observed, developing criteria for identifying synkinematic dolomite in the matrix remains a problem. The SWCF reservoir is completely dolomitized, and there are most likely multiple periods of dolomitization. Methods for distinguishing the various periods of dolomitization have not yet been established. However, phases of dolomite cement have been successfully distinguished in other dolomite reservoirs by using conventional CL, so the prospects are good for successfully unraveling these relations by using the more powerful imaging methods now available.

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**PUB ID** DOE/BC/15105-3      **ORDER #** 780437

**TITLE**      *Integrated Outcrop and Subsurface Studies of the Interwell Environment of Carbonate Reservoirs: Clear Fork (Leonardian Age) Reservoirs, West Texas and New Mexico*, Semi-Annual Report, March 31, 2000-October 1, 2000, 16 pp.

**PUB DATE** 05/01/2001

**CONTRACTOR** The University of Texas at Austin

A preliminary reservoir model was constructed for the Lower Clear Fork of the South Wasson Clear fork reservoir. The model was constructed by calibrating high-frequency cycles observed in cores to the porosity log. The rock fabrics mostly fall in petrophysical Class I, and cross plots of porosity and water saturation could not be used to identify rock fabrics. Data from two limestone fields and one dolostone field were presented to support the contention that grain-dominated fabrics have higher porosity than mud-dominated fabrics do and that this difference is retained when the limestone is dolomitized.

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**PUB ID** DOE/BC/15105-4      **ORDER #** 780438

**TITLE**      *Integrated Outcrop and Subsurface Studies of the Interwell Environment of Carbonate Reservoirs: Clear Fork (Leonardian Age) Reservoirs, West Texas and New Mexico*, Semi-Annual Report, October 1, 2000-March 31, 2001, 15 pp.

**PUB DATE** 05/01/2001

**CONTRACTOR** The University of Texas at Austin

The major goal of this project was to evaluate the impact of fracture porosity on performance of the South Wasson Clear Fork reservoir. The approach was to use subcritical crack (SCC) index measurements and a crack-growth simulator to model potential fracture geometries in this reservoir.

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**PUB ID** DOE/BC/15203-2      **ORDER #** 773808

**TITLE**      *A Methodology to Integrate Magnetic Resonance and Acoustic Measurements for Reservoir Characterization*, Semi-Annual Report, April 1, 1999-October 31, 1999, 109 pp.

**PUB DATE** 01/24/2001

**CONTRACTOR** Southwest Research Institute

The objective of this project was to develop an advanced imaging method, including pore-scale imaging, to integrate magnetic resonance (MR) techniques and acoustic measurements to improve predictability of the pay zone in two hydrocarbon reservoirs. This was accomplished by extracting the fluid property parameters using MR laboratory measurements and the elastic parameters of the rock matrix from acoustic measurements to create poroelastic models of different parts of the reservoir. Laboratory measurements were compared with petrographic analysis results to determine the relative roles of petrographic elements such as porosity type, mineralogy, texture, and distribution of clay and cement in creating permeability heterogeneity.

## CATEGORY: DRILLING, COMPLETION, AND STIMULATION

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**PUB ID** DOE/BC/15024-2      **ORDER #** 773002

**TITLE**      *Design and Development of Gas-Liquid Cylindrical Cyclone Compact Separators for Three-Phase Flow, Semi-Annual Report, Semi-Annual Report, April 1, 2000-September 30, 2000, 25 pp.*

**PUB DATE** 01/10/2001

**CONTRACTOR** The University of Tulsa

The objective of this five-year project (October 1997 - September 2002) was to expand the current research activities of Tulsa University Separation Technology Projects (TUSTP) to multiphase oil/water/gas separation. This project was executed in two phases. Phase I (1997 - 2000) focused on the investigations of the complex multiphase hydrodynamic flow behavior in a three-phase Gas-Liquid Cylindrical Cyclone (GLCC) Separator. The activities of this phase included the development of a mechanistic model, a computational fluid dynamics (CFD) simulator, and detailed experimentation on the three-phase GLCC. The experimental and CFD simulation results will be suitably integrated with the mechanistic model. In Phase II (2000 - 2002), the developed GLCC separator will be tested under high pressure and real crude conditions. This is crucial for validating the GLCC design for field application and facilitating easy and rapid technology deployment. Design criteria for industrial applications will be developed based on these results and will be incorporated into the mechanistic model by TUSTP.

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**PUB ID** DOE/BC/15024-4      **ORDER #** 773336

**TITLE**      *Design and Development of Gas-Liquid Cylindrical Cyclone Compact Separators for Three-Phase Flow, Semi-Annual Report, October 1, 1998-March 31, 1999, 18 pp.*

**PUB DATE** 01/18/2001

**CONTRACTOR** The University of Tulsa

The objective of this five-year project (October 1997 - September 2002) was to expand the current research activities of Tulsa University Separation Technology Projects (TUSTP) to multiphase oil/water/gas separation. This project was executed in two phases. Phase I (1997 - 2000) focused on the investigations of the complex multiphase hydrodynamic flow behavior in a three-phase Gas-Liquid Cylindrical Cyclone (GLCC) Separator. The activities of this phase included the development of a mechanistic model, a computational fluid dynamics (CFD) simulator, and detailed experimentation on the

three-phase GLCC. The experimental and CFD simulation results will be suitably integrated with the mechanistic model. In Phase II (2000 - 2002), the developed GLCC separator will be tested under high pressure and real crude conditions. This is crucial for validating the GLCC design for field application and facilitating easy and rapid technology deployment. Design criteria for industrial applications will be developed based on these results and will be incorporated into the mechanistic model by TUSTP.

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**PUB ID** DOE/BC/15128-1      **ORDER #** 777920

**TITLE**      *Heterogeneous Shallow-Shelf Carbonate Buildups in the Paradox Basin, Utah and Colorado: Targets for Increased Oil Production and Reserves Using Horizontal Drilling Techniques, Semi-Annual Report, April 6-September 5, 2000, 22 pp.*

**PUB DATE** 04/19/2001

**CONTRACTOR** Utah Geological Survey

The primary objective of this project was to enhance domestic petroleum production by demonstration and transfer of horizontal drilling technology in the Paradox basin, Utah, Colorado, Arizona, and New Mexico. If this project can demonstrate technical and economic feasibility, then the technique can be applied to approximately 100 additional small fields in the Paradox basin alone, and result in increased recovery of 25 to 50 million barrels (40-80 million m<sup>3</sup>) of oil. This project was designed to characterize several shallow-shelf carbonate reservoirs in the Pennsylvania (Desmoinesian) Paradox Formation, choose the best candidate(s) for a pilot demonstration project to drill horizontally from existing vertical wells, monitor well performances), and report associated validation activities.

## CATEGORY: ENVIRONMENTAL, SAFETY AND HEALTH

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**PUB ID** DOE/BC/14849-3      **ORDER #** 774789  
Vol. 1 of 4

**TITLE**      *Restored Drill Cuttings for Wetlands Creation: Year One Results of Mesocosm Approach to Emulate Field Conditions Under Varying Hydrologic Regimes, Topical Report, December 1996, 41 pp.*

**PUB DATE** 02/13/2001

**CONTRACTOR** Pioneer Natural Resources

The purpose of this study was to demonstrate that restored drill cuttings, a byproduct of the petroleum industry, can be safely used in coastal as well as inland

wetland restoration projects. Prior to conducting laboratory experiments, composite soil samples of the recycled sediments were analyzed for pH and heavy metal concentrations.

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**PUB ID** DOE/BC/14849-3      **ORDER #** 774790  
Vol. 3 of 4

**TITLE** *Restored Drill Cuttings for Wetlands Creation: Results of Mesocosm Approach to Emulate Field Conditions Under Varying Salinity and Hydrologic Conditions*, Topical Report, April 2000, 86 pp.

**PUB DATE** 02/13/2001

**CONTRACTOR** Pioneer Natural Resources

This study builds upon earlier research conducted by Southeastern Louisiana University concerning the efficacy of utilizing processed drill cuttings as an alternative substrate source for wetland rehabilitation (wetland creation and restoration). Previous research has indicated that processed drill cuttings exhibit a low degree of contaminant migration from the process drill cuttings to interstitial water and low toxicity, as tested by seven-day mysid shrimp chronic toxicity trials.

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**PUB ID** DOE/BC/W-31-109-ENG-38-10  
**ORDER #** 781351

**TITLE** *A Study of the Effects of Gas Well Compressor Noise on Breeding Bird Populations of the Rattlesnake Canyon Habitat Management Area, San Juan County, New Mexico*, Final Report, May 2001, 90 pp.

**PUB DATE** 06/04/2001

**CONTRACTOR** Argonne National Laboratory

This report, conducted from May through July 2000, addressed the potential effect of compressor noise on breeding birds in gas-production areas administered by the FFO, specifically in the Rattlesnake Canyon Habitat Management Area northeast of Farmington, New Mexico. The study was designed to quantify and characterize noise output from these compressors and to determine if compressor noise affected bird populations in adjacent habitat during the breeding season.

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**PUB ID** DOE/FEW 8242-1      **ORDER #** 774489

**TITLE** *Multiphase Flow and Cavern Abandonment in Salt*, Final Report, October 2000, 12 pp.

**PUB DATE** 02/13/2001

**CONTRACTOR** Sandia National Laboratory

This report will explore the hypothesis that an underground cavity in gassy salt will eventually be gas filled as is observed on a small scale in some naturally occurring salt inclusions. First, a summary is presented on what is known about gas occurrences, flow mechanisms, and cavern behavior after abandonment. Then, background information is synthesized into theory on how gas can fill a cavern and simultaneously displace cavern fluids into the surrounding salt. Lastly, two-phase (gas and brine) flow visualization experiments are presented that demonstrate some of the associated flow mechanisms and support the theory and hypothesis that a cavity in salt can become gas filled after plugging and abandonment.

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**PUB ID** DOE/SW/45043-1      **ORDER #** 774579

**TITLE** *Lease Operations Environmental Guidance Document*, Final Report, September 2000, 170 pp.

**PUB DATE** 02/14/2001

**CONTRACTOR** Bureau of Land Management

This report contains discussions in nine different areas as follows: (1) Good Lease Operating Practices; (2) Site Assessment and Sampling; (3) Spills/Accidents; (4) Containment and Disposal of Produced Waters; (5) Restoration of Hydrocarbon-Impacted Soils; (6) Restoration of Salt-Impacted Soils; (7) Pit Closures; (8) Identification, Removal and Disposal of Naturally Occurring Radioactive Materials (NORM); and (9) Site Closure and Construction Methods for Abandonment Wells/Locations. This report is primarily directed towards the operation of oil and gas producing wells.

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**PUB ID** FEW 3692-2      **ORDER #** 777919

**TITLE** *An Investigation of the Integrity of Cemented Casing Seals with Application to Salt Cavern Sealing and Abandonment*, Final Report, October 2000, 100 pp.

**PUB DATE** 04/18/2001

**CONTRACTOR** Sandia National Laboratories/RESPEC/Terralog Technologies

This research project was pursued in three key areas. (1) Salt permeability testing under complex stress states; (2) Hydraulic and mechanical integrity investigations of the well casing shoe through benchscale testing; and (3) Geomechanical modeling of the fluid/salt hydraulic and mechanical interaction of a sealed cavern.

## CATEGORY: FIELD DEMONSTRATION

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**PUB ID** DOE/BC/14935-9      **ORDER #** 776910

**TITLE**      *Feasibility of Optimizing Recovery & Reserves from a Mature & Geological Complex Multiple Turbidite Offshore California Reservoir through the Drilling & Completion of a Trilateral Horizontal Well, Class III, Final Report, January 15, 2001, 48 pp.*

**PUB DATE** 04/02/2001

**CONTRACTOR** Pacific Operators Offshore, Inc.

The intent of this project was to increase production and extend the economic life of this mature field through the application of advanced reservoir characterization and drilling technology, demonstrating the efficacy of these technologies to other small operators of aging fields. Two study periods were proposed: the first to include data assimilation and reservoir characterization and the second to drill the demonstration well. The initial study period showed that a single tri-lateral well would not be economically efficient in redevelopment of Carpinteria's multiple deep water turbidite sand reservoirs, and the study was amended to include the drilling of a series of horizontal redrills from existing surplus well bores on Pacific Operators' Platform Hogan.

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**PUB ID** DOE/BC/14936-17      **ORDER #** 780435

**TITLE**      *Application of Advanced Reservoir Characterization, Simulation, and Production Optimization Strategies to Maximize Recovery in Slope and Basin Clastic Reservoirs, West Texas (Delaware Basin), Class III, Annual Report, March 31, 2000-March 30, 2001, 72 pp.*

**PUB DATE** 05/01/2001

**CONTRACTOR** The University of Texas at Austin

The objective of this Class III project was demonstrate that detailed reservoir characterization of slope and basin clastic reservoirs in sandstones of the Delaware Mountain Group in the Delaware Basin of West Texas and New Mexico is a cost effective way to recover a higher percentage of the original oil in place through strategic placement of infill wells and geologically based field development. Project objectives are divided into two main phases. The original objectives of the reservoir-characterization phase of the project were (1) to provide a detailed understanding of the architecture and heterogeneity of two representative fields of the Delaware Mountain Group, Geraldine Ford and Ford West, which produce from the Bell Canyon and Cherry Canyon Formations, respectively, (2) to choose a demonstration area in one of the fields, and (3) to simulate a CO<sub>2</sub> flood in the demonstration area.

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**PUB ID** DOE/BC/14937-12      **ORDER #** 772932

**TITLE**      *Reactivation of an Idle Lease to Increase Heavy Oil Recovery through Application of Conventional Steam Drive Technology in a Low-Dip Slope & Reservoir in the Midway-Sunset Field, San Joaquin Basin, California, Class III, Annual Report, June 13, 1999-June 12, 2000, 42 pp.*

**PUB DATE** 01/09/2001

**CONTRACTOR** University of Utah

The objective of this project is not just to produce oil from the Pru Fee property, but rather to test which operational strategies best optimize total oil recovery at economically acceptable rates of production and production costs.

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**PUB ID** DOE/BC/14938-16      **ORDER #** 776907

**TITLE**      *Advanced Reservoir Characterization in the Antelope Shale to Establish the Viability of CO<sub>2</sub> Enhanced Oil Recovery in California's Monterey Formation Siliceous Shales, Class II, Annual Report, February 7, 2000-February 6, 2001, 163 pp.*

**PUB DATE** 04/02/2001

**CONTRACTOR** Chevron USA Production Company

This report describes the evaluation, design, and implementation of a DOE funded CO<sub>2</sub> pilot project in the Lost Hills Field, Kern County, California. The pilot consists of four inverted (injector-centered) 5-spot patterns covering approximately 10 acres, and is located in a portion of the field, which has been under waterflood since early 1992. The target reservoir for the CO<sub>2</sub> pilot is the Belridge Diatomite. The pilot location was selected based on geology, reservoir quality and reservoir performance during the waterflood. A CO<sub>2</sub> pilot was chosen, rather than full-field implementation, to investigate uncertainties associated with CO<sub>2</sub> utilization rate and premature CO<sub>2</sub> breakthrough, and overall uncertainty in the unproven CO<sub>2</sub> flood process in the San Joaquin Valley.

## CATEGORY: OIL FIELD PRODUCTION AND OPERATION

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**PUB ID** DOE/BC/14851-4      **ORDER #** 776387

**TITLE** *Prediction of Gas Injection Performance for Heterogeneous Reservoirs*, Final Report, June 2000, 207 pp.

**PUB DATE** 03/27/2001

**CONTRACTOR** Stanford University

This report was an integrated study of the physics and chemistry affecting gas injection, from the pore scale to the field scale, and involved theoretical analysis, laboratory experiments and numerical simulation. Specifically, advances were made on streamline-based simulation, analytical solutions to 1D compositional displacements, and modeling and experimental measures of three-phase flow.

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**PUB ID** DOE/BC/15026-1      **ORDER #** 756282

**TITLE** *Location, Reprocessing, and Analysis of Two Dimensional Seismic Reflection Data on the Jicarilla Apache Indian Reservation, New Mexico*, Topical Report, September 1, 1997-February 1, 2000, 51 pp.

**PUB DATE** 04/23/2001

**CONTRACTOR** U.S. Geological Survey

Exploration for oil and gas by both large and small companies has taken place in northern part of the San Juan Basin in New Mexico, including the Jicarilla Apache reservation, for many years. As part of their exploration efforts various companies acquired a significant amount of a two-dimensional multichannel seismic reflection data on both regional and prospect scales. The primary purpose of this study was to locate and collect as much of this seismic data as possible, bringing it into a central location where it could be evaluated, reprocessed, and interpreted. The interpretation provides additional subsurface structural information valuable in support of traditional geologic mapping using well log data.

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**PUB ID** DOE/BC/15026-2      **ORDER #** 778489

**TITLE** *Outcrop Analysis of the Cretaceous Mesaverde Group: Jicarilla Apache Reservation, New Mexico*, Topical Report, January 22, 1998-June 30, 1999, 131 pp.

**PUB DATE** 04/23/2001

**CONTRACTOR** U.S. Geological Survey

Field work for this project was conducted during July and April 1998, at which time fourteen measured sections were described and correlated on or adjacent to Jicarilla Apache Reservation lands. A fifteenth section, described east of the main field area, is included in this report, although its distant location precluded use in the correlations and cross sections presented herein. Ground-based photo mosaics were shot for much of the exposed Mesaverde outcrop belt and were used to assist in correlation. Outcrop gamma-ray surveys at six of the fifteen measured sections using a GAD-6 scintillometer was conducted. The raw gamma-ray data are included in this report, however, analysis of those data is part of the ongoing Phase Two of this project.

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**PUB ID** DOE/BC/15026-3      **ORDER #** 778870

**TITLE** *Outcrop Gamma-ray Analysis of the Cretaceous Mesaverde Group: Jicarilla Apache Indian Reservation, New Mexico*, Topical Report, January 22, 1998-March 31, 2000, 68 pp.

**PUB DATE** 04/23/2001

**CONTRACTOR** U.S. Geological Survey

This report presents the results of an outcrop gamma-ray survey of six selected measured sections included in the original report. The primary objective of this second study is to provide a baseline to correlate from the outcrop and reservoir model into Mesaverde strata in the San Juan Basin subsurface. Outcrop logs were generated using a GAD-6 gamma-ray spectrometer that simultaneously recorded total counts, potassium, uranium, and thorium data.

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**PUB ID** DOE/BC/15047-5      **ORDER #** 776908

**TITLE** *Improved Efficiency of Miscible CO<sub>2</sub> Floods and Enhanced Prospects for CO<sub>2</sub> Flooding Heterogeneous Reservoirs*, Final Report, June 1, 1997-September 30, 2000, 191 pp.

**PUB DATE** 04/02/2001

**CONTRACTOR** New Mexico Institute of Mining & Technology

This report continues the progress on understanding CO<sub>2</sub> flooding in heterogeneous reservoirs, further the development of methods to enable CO<sub>2</sub> flooding in more heterogeneous reservoirs, and continue the dissemination of this information to promote successful implementation of these methods. The research covers three related areas: (1) Fluid and matrix interactions (understanding the problems), (2) Conformation control/sweep efficiency

(solving the problems), and (3) Reservoir simulation for improved oil recovery (predicting results). All areas originate from research on the mechanics of oil recovery by high-pressure CO<sub>2</sub>. Experience gained during the current project is relevant to our continued efforts.

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**PUB ID** DOE/BC/15102-1      **ORDER #** 772926

**TITLE**      *The Influence of Fold and Fracture Development on Reservoir Behavior of the Lisburne Group of Northern Alaska*, Semi-Annual Report, May-October 1999, 81 pp.

**PUB DATE** 01/09/2001

**CONTRACTOR** University of Alaska-Geophysical Institute

The objectives of this study were to develop a better understanding of four major aspects of the Lisburne: (1) The geometry and kinematics of detachment folds and their truncation by thrust faults, (2) The influence of folding and lithostratigraphy on fracture patterns, (3) Lithostratigraphy and its influence on folding, faulting, fracturing, and reservoir characteristics, and (4) The influence of lithostratigraphy and deformation on fluid flow.

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**PUB ID** DOE/BC/15102-2      **ORDER #** 775022

**TITLE**      *The Influence of Fold and Fracture Development on Reservoir Behavior of the Lisburne Group of Northern Alaska*, Annual Report, May 1999-May 2000, 300 pp.

**PUB DATE** 02/27/2001

**CONTRACTOR** University of Alaska-Geophysical Institute

The objectives of this study were to develop a better understanding of four major aspects of the Lisburne: (1) The geometry and kinematics of detachment folds and their truncation by thrust faults, (2) The influence of folding and lithostratigraphy on fracture patterns, (3) Lithostratigraphy and its influence on folding, faulting, fracturing, and reservoir characteristics, and (4) The influence of lithostratigraphy and deformation on fluid flow.

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**PUB ID** DOE/BC/15107-1      **ORDER #** 773160

**TITLE**      *Enhancing the Effectiveness of Carbon Dioxide Flooding by Managing Asphaltene Precipitation*, Annual Report, September 10, 1999-September 30, 2000, 86 pp.

**PUB DATE** 01/12/2001

**CONTRACTOR** University of Utah

The objective of this project was to identify conditions at which carbon dioxide induced precipitation occurred in crude oils. Establishing compositions of the relevant liquid and solid phases was planned. Other goals of the project were to determine if precipitation occurred in cores and to implement thermodynamic and compositional models to examine the phenomenon. Exploring kinetics of precipitation was also one of the project goals. Crude oil from the Rangely Field (eastern Colorado) was used as a prototype.

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**PUB ID** DOE/BC/15111-2      **ORDER #** 775021

**TITLE**      *Responsive Copolymers for Enhanced Petroleum Recovery*, Annual Report, September 30, 1999-September 29, 2000, 150 pp.

**PUB DATE** 02/27/2001

**CONTRACTOR** University of Southern Mississippi

The objectives of this work was to: synthesize responsive copolymer systems; characterize molecular structure and solution behavior; measure rheological properties of aqueous fluids in fixed geometry flow profiles; and to tailor final polymer compositions for in situ rheology control under simulated conditions. This report focuses on the synthesis and characterization of novel stimuli responsive copolymers, the investigation of dilute polymer solutions in extensional flow and the design of a rheometer capable of measuring very dilute aqueous polymer solutions at low torque.

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**PUB ID** DOE/BC/15112-2      **ORDER #** 775023

**TITLE**      *Optimization of Surfactant Mixtures and Their Interfacial Behavior for Advanced Oil Recovery*, Annual Report, September 30, 1998-September 29, 1999, 41 pp.

**PUB DATE** 02/27/2001

**CONTRACTOR** Columbia University

The goal of this report is to develop improved extraction processes to mobilize and produce the oil left untapped using conventional techniques. Current chemical schemes for recovering the residual oil have been in general less than satisfactory. High cost of the processes as well as significant loss of chemicals by adsorption on reservoir materials and precipitation has limited the utility of chemical-flooding operations. There is a need to develop cost-effective, improved reagent schemes to increase recovery from domestic oil reservoirs. The goal of the report was to develop and evaluate novel mixtures of surfactants for improved oil recovery.

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**PUB ID** DOE/BC/15112-3      **ORDER #** 776909

**TITLE** *Optimization of Surfactant Mixtures and Their Interfacial Behavior for Advanced Oil Recovery*, Annual Report, September 30, 1999-September 30, 2000, 47 pp.

**PUB DATE** 04/02/2001

**CONTRACTOR** Columbia University

The goal of this report is to develop improved extraction processes to mobilize and produce the oil left untapped using conventional techniques. Current chemical schemes for recovering the residual oil have been in general less than satisfactory. High cost of the processes as well as significant loss of chemicals by adsorption on reservoir materials and precipitation has limited the utility of chemical-flooding operations. There is a need to develop cost-effective, improved reagent schemes to increase recovery from domestic oil reservoirs. The goal of the report was to develop and evaluate novel mixtures of surfactants for improved oil recovery.

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**PUB ID** DOE/BC/15125-1      **ORDER #** 780434

**TITLE** *Exploitation and Optimization of Reservoir Performance in Hunton Formation, Oklahoma*, Annual Report, April 1, 2000-March 31, 2001, 208 pp.

**PUB DATE** 05/01/2001

**CONTRACTOR** The University of Tulsa

This report presents the work done so far on Hunton Formation in West Carney Field in Lincoln County, Oklahoma. West Carney Field produces oil and gas from the Hunton Formation. The field was developed starting in 1995. Some of the unique characteristics of the field include decreasing water oil and ratio over time, decreasing gas-oil ratio at the beginning of production, inability to calculate oil reserves in the field based on long data, and sustained oil rates over long periods of time.

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**PUB ID** DOE/BC/15209-2      **ORDER #** 773362

**TITLE** *Increased Oil Recovery from Mature Oil Fields Using Gelled Polymer Treatments*, Annual Report, June 16, 1999-June 15, 2000, 61 pp.

**PUB DATE** 01/22/2001

**CONTRACTOR** University of Kansas, Center for Research, Inc.

This report describes the progress of the first year of a three-year research program. This program is aimed at reducing barriers to the widespread use of gelled polymer

treatments by (1) developing methods to predict gel behavior during placement in matrix rock and fractures, (2) determining the persistence of permeability reduction after gel placement, and (3) developing methods to design production well treatments to control water production.

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**PUB ID** DOE/BC/15209-3      **ORDER #** 776495

**TITLE** *Increased Oil Recovery from Mature Oil Fields Using Gelled Polymer Treatments*, Semi-Annual Report, June 16, 2000-December 16, 2000, 13 pp.

**PUB DATE** 03/28/2001

**CONTRACTOR** University of Kansas, Center for Research, Inc.

Gelled polymer treatments were applied to oil reservoirs to increase oil production and to reduce water production by altering the fluid movement within the reservoir. This report is aimed at reducing barriers to the widespread use of these treatments by developing methods to predict gel behavior during placement in matrix rock and fractures, determining the persistence of permeability reduction after gel placement, and by developing methods to design production well treatments to control water production. Procedures were developed to determine the weight-average molecular weight and average size of polyacrylamide samples in aqueous solutions. Sample preparation techniques were key to achieving reproducible results.

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**PUB ID** DOE/BC/15211-10      **ORDER #** 773827

**TITLE** *A Pore-Network Model of In-Situ Combustion in Porous Media*, Topical Report, January 2001, 31 pp.

**PUB DATE** 01/29/2001

**CONTRACTOR** University of Southern California

In this report the use of dual pore networks (pores and solid sites) for modeling the effect of the microstructure on combustion processes in porous media is considered. The model accounts for flow and transport of the gas phase in the porespace, where convection predominates, and for heat transfer by conduction in the solid phase. Gas phase flow in the pore and throats is governed by Darcy's law.

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**PUB ID** DOE/BC/15211-11      **ORDER #** 775024

**TITLE** *Time Scaling of the Rates of Produced Fluids in Laboratory Displacements*, Topical Report, February 2001, 43 pp.

**PUB DATE** 02/27/2001

**CONTRACTOR** University of Southern California

In this report, the use of an asymptotic method, based on the time scaling of the ratio of produced fluids, to infer the relative permeability exponent of the displaced phase near its residual saturation, for immiscible displacements in laboratory cores was proposed. Sufficiently large injection rates, the existence of a power law can be detected, and its exponent inferred, by plotting in an appropriate plot the ratio of the flow rates of the two fluids at the effluent for some time after breakthrough.

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**PUB ID** DOE/BC/15211-13      **ORDER #** 781148

**TITLE** *Investigation of Multiscale and Multiphase Flow, Transport and Reaction in Heavy Oil Recovery Processes*, Annual Report, May 6, 2000-May 5, 2001, 300 pp.

**PUB DATE** 05/29/2001

**CONTRACTOR** University of Southern California

This report is an investigation of various multi-phase and multi-scale transport and reaction processes associated with heavy oil recovery. The thrust areas of the project include the following: Internal drives, vapor-liquid flows, combustion and reaction processes, fluid displacements and the effect of instabilities and heterogeneities and the flow of fluids with yield stress. These find respective applications in foamy oils, the evolution of dissolved gas, internal steam drives, the mechanics of concurrent and countercurrent vapor-liquid flows, associated with thermal methods and steam injection, such as SAGD, the in-situ combustion, the upscaling of displacements in heterogeneous media and the flow of foams, Bingham plastics and heavy oils in porous media and the development of wormholes during cold production.

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**PUB ID** DOE/BC/15211-9      **ORDER #** 772929

**TITLE** *On the Upscaling of Reaction-Transport Processes in Porous Media with Fast Kinetics*, Topical Report, June 2000, 34 pp.

**PUB DATE** 01/09/2001

**CONTRACTOR** University of Southern California

This report is organized as follows: Provide a brief review of the upscaling constraints of the type (2) for a typical diffusion-reaction system. In this an analogy with two-phase flow in porous media was drawn. Then, using the methodology of QW a problem at the unit cell for the computation of the effective mass transfer coefficient, in processes where local thermodynamic equilibrium applies was derived. This problem is found to be different than in QW, as it depends on the gradients of the macroscale variable, and can be cast in terms of an eigenvalue problem. Two simple, examples, one involving advection-dissolution and another involving drying in a pore network, was presented to illustrate the coupling between scales and to show the quantitative effect in case this coupling was neglected. Finally, similar ideas and an illustrative example was applied to reaction-diffusion systems with fast kinetics, where an equilibrium state is approached.

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**PUB ID** DOE/BC/15212-1      **ORDER #** 776494

**TITLE** *Development of Reservoir Characterization Techniques and Production Models for Exploiting Naturally Fractured Reservoirs*, Semi-Annual Report, July 1, 2000-December 31, 2000, 49 pp.

**PUB DATE** 03/28/2001

**CONTRACTOR** The University of Oklahoma

This report focuses on integrating geoscience and engineering data to develop a consistent characterization of the naturally fractured reservoirs. During this reporting period, effort was focused on relating seismic data to reservoir properties of naturally fractured reservoirs, scaling well log data to generate interwell descriptors of these reservoirs, enhancing and debugging a naturally fractured reservoir simulator, and developing a horizontal wellbore model for use in the simulator.

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**PUB ID** DOE/BC/15311-1      **ORDER #** 773283

**TITLE** *Surfactant Concentration and End Effects on Foam Flow in Porous Media, TR-120*, Topical Report, October 2000, 43 pp.

**PUB DATE** 01/17/2001

**CONTRACTOR** Stanford University (SUPRI)

This project studies foam flow behavior at a variety of surfactant concentrations using experiments and a numerical model. Thus, the foam behavior examined spans from strong to weak.

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**PUB ID** DOE/BC/15311-2      **ORDER #** 773294

**TITLE** *Scaling of Counter-Current Imbibition Process in Low-Permeability Porous Media, TR-121*, Topical Report, December 2000, 43 pp.

**PUB DATE** 01/17/2001

**CONTRACTOR** Stanford University (SUPRI)

This project presents the recent work on imaging imbibition in low-permeability porous media (diatomite) with X-ray computed tomography. The viscosity ratio between nonwetting and wetting fluids is varied over several orders of magnitude yielding different levels of imbibition performance. Also performed is mathematical analysis of counter-current imbibition processes and development of a modified scaling group incorporating the mobility ratio. This modified group is physically based and appears to improve scaling accuracy of countercurrent imbibition significantly.

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**PUB ID** DOE/BC/15311-3      **ORDER #** 776933

**TITLE** *Doublets and Other Allied Well Patterns, SUPRI TR-122*, Topical Report, December 2000, 110 pp.

**PUB DATE** 04/02/2001

**CONTRACTOR** Stanford University

This report looks at a host of balanced patterns at unity mobility ratio. The geometries and rates ranged broadly. It was found that whenever total production and injection are equal, considerable insight on the flow equations and the fluid movement can be gained. In the balanced patterns, where the wells are arrayed around a single injector or a single producer, we found that simple equations can define the nature of steady state flow lines and geometries of the flow paths, and their breakthrough behavior. When the rates are not equal, but still are balanced, the geometries are more complex, but still amenable to analytic solution.

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**PUB ID** DOE/BC/15311-4      **ORDER #** 777917

**TITLE** *Porosity and Permeability Evolution Accompanying Hot fluid Injection into Diatomite, SUPRI TR-123*, Topical Report, March 2001, 27 pp.

**PUB DATE** 04/18/2001

**CONTRACTOR** Stanford University

An experimental study of silica dissolution was performed to probe the evolution of permeability and porosity in siliceous diatomite during hot fluid injection such as water or steam flooding. Two competing mechanisms

were identified. Silica solubility in water at elevated temperature causes rock dissolution thereby increasing permeability; however, the rock is mechanically weak leading to compressing of the solid matrix during injection. Permeability and porosity can decrease at the onset of fluid flow. A laboratory flow apparatus was designed and built to examine these processes in diatomite core samples.

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**PUB ID** FEW 49397-1      **ORDER #** 777907

**TITLE** *Summary of Data from DOE-Subsidized Field Trial #1 of Downhole Oil/Water Separator Technology, Texas Well Bilbrey 30-Federal No. 5 Lea County, New Mexico*, Topical Report, May 2000, 39 pp.

**PUB DATE** 04/18/2001

**CONTRACTOR** Argonne National Laboratory

DOWS technology reduced the quality of produced water that is handled at the surface by separating it from the oil downhole and simultaneously injecting it underground. The two primary components of a DOWS system are an oil/water separation system and at least one pump to lift oil to the surface and inject the water. Two basic types of DOWS have been developed—one type using hydrocyclones to mechanically separate oil and water and one relying on gravity separation that takes place in the well bore.

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**PUB ID** FEW 49397-2      **ORDER #** 777913

**TITLE** *Analysis of Data from a Downhole Oil/Water Separator Field Trial in East Texas*, Topical Report, February 2001, 60 pp.

**PUB DATE** 04/18/2001

**CONTRACTOR** Argonne National Laboratory

Downhole oil/water separator (DOWS) technology is available to separate oil from produced water at the bottom of an oil well. Produced water can be injected directly to a disposal formation rather than lifting it to the surface, treating it there, and reinjecting it. Because of a lack of detailed performance data on DOWS systems, the U.S. Department of Energy (DOE) provided funding to secure DOWS performance data. A large U.S. oil and gas operator offered to share its data with Argonne National Laboratory. This report summarizes data from the DOWS installation in eastern Texas.

# Computer Software & Supporting Documentation

Personal Computer Programs are available on 3.5" HD 1.4 MB disks. The software can also be downloaded from the NPTO website at

**[www.npto.doe.gov/software/softindx.html](http://www.npto.doe.gov/software/softindx.html)**

1. **DOE/BC-88/1/SP.** *EOR Predictive Models: Handbook for Personal Computer Versions of Enhanced Oil Recovery Predictive Models.* BPO Staff. February 1988. 76 pp. NTIS Order No. DE89001204. FORTRAN source code and executable programs for five EOR Predictive Models shown below are available. The five recovery processes modeled are Steamflood, In-Situ Combustion, Polymer, Chemical, and CO<sub>2</sub> Miscible Flooding. The models are available individually. Min Req.: IBM PC/XT, PS-2, or compatible computer with 640 Kbytes of memory.

a. **DOE/BC-86/6/SP.** *Steamflood Predictive Model, Supporting Technology for Enhanced Oil Recovery.* Dec 1986, 594 pp. NTIS Order No. DE87001219.

b. **DOE/BC-86/7/SP.** *In-Situ Combustion Predictive Model, Supporting Technology for Enhanced Oil Recovery.* Dec 1986, 263 pp. NTIS Order No. DE86000264.

c. **DOE/BC-86/10/SP.** *Polymer Predictive Model, Supporting Technology for Enhanced Oil Recovery.* Dec 1986, 394 pp. NTIS Order No. DE87001207.

d. **DOE/BC-86/10/SP.** *Polymer/Waterflood Predictive Model: Windows Version 1.1:* June 1995. This is an update to the Polymer Flood Predictive Model (PFPM) released in 1986. An addendum is available describing the updated economic cost and tax functions included in this release. This serves as a supplement to the original PFPM user's manual. This version runs out of the Microsoft Windows environment and supports post-processing graphics. Min Req.: 80386, 4 Mbytes extended memory, and Windows v3.1.

e. **DOE/BC-86/11/SP.** *Chemical Flood Predictive Model, Supporting Technology for Enhanced Oil Recovery.* Dec 1986, 360 pp. NTIS Order No. DE87001208.

f. **DOE/BC-86/12/SP.** *CO<sub>2</sub> Miscible Flood Predictive Model, Supporting Technology for Enhanced Oil Recovery.* Dec 1986, 469 pp. NTIS Order No. DE87001209.

g. **DOE/BC-86/12/SP.** *CO<sub>2</sub> Miscible Predictive Model: Windows Version 1.1:* 1995. This is an update to the CO<sub>2</sub> Miscible Flood Predictive Model (CO<sub>2</sub>PM) released in 1986. This version runs out of the Microsoft Windows environment and supports post-processing graphics. Min Req.: 80386, 4 Mbytes extended memory, and Windows v3.1.

2. **DOE/BC-95/2/SP.** *Infill Drilling Predictive Model: User's Guide and Documentation Manual - Release 1.2.0,* Feb. 1995 for the PC. FORTRAN source code and executable program. Min Req.: 80386/80387, DOS v3.1, and 2 Mbytes extended memory.

a. **DOE/BC-95/2/SP.** *Infill Drilling Predictive Model: Windows Version 1.1:* June 1995. This is an update to the Infill Drilling Predictive Model (IDPM) released in 1995. This version runs out of the Microsoft Windows environment and supports post-processing graphics. Min Req.: 80386, 4 Mbytes extended memory, and Windows v3.1.

3. **DOE/BC/14960-7.** *CO<sub>2</sub> Prophet: Water and CO<sub>2</sub> Flood Prediction Software.* CO<sub>2</sub> Prophet, conceived by Texaco Exploration and Production Technology Department (EPTD), was partially developed as part of the DOE Class I cost-share program "Post Waterflood, CO<sub>2</sub> Flood in a Light Oil, Fluvial Dominated Deltaic Reservoir" under DOE Contract No. DE-FC22-93BC14960. Min Req.: 80386/80387 and 4 Mbytes extended memory and will run under the Microsoft Windows environment. DOE does not provide technical support for this application.

4. **DOE/BC-89/3/SP.** *Handbook for Personal Computer Version of BOAST II: A Three-Dimensional, Three-Phase Black Oil Applied Simulation Tool.* Bartlesville Project Office. January 1989. 82 pp. NTIS Order No. DE89000725. FORTRAN source code and executable program. Min. Req.: IBM PC/AT, PS-2, or compatible computer with 640 Kbytes of memory.

5. **NIPER-542.** *BOAST-VHS: FORTRAN source code and executable program.* User's Guide and Documentation Manual, National Institute for Petroleum and Energy Research (NIPER). January 1992. 92 pp. NTIS Order No. DE92001021. Min. Req.: IBM PC/AT, PS-2, or compatible computer with 640 Kbytes of memory. Math coprocessor optional.
6. **DOE/BC/14831-18.** *BOAST-3: FORTRAN Source code and executable program.* User's Guide and Documentation Manual. Bartlesville Project Office, September 21, 1996 (version 1.6). BOAST-3 is a modified version of BOAST-II containing postprocessors COLORGRID and B3PLOT2. The executable was compiled with the 32-bit Microsoft PowerStation FORTRAN and is 100% compatible with Windows. Min Req.: 386/486 PC environment.
7. **BOAST98:** (Version 4.2.3) FORTRAN 90 source code and executable program. Visual, dynamic, and interactive update of BOAST3. Rock region saturation corrected by WOC and GOC. Interacts with EdBOAST. Beta tested. User's Guide and Documentation Manual. National Petroleum Technology Office by TRW Petroleum Technologies, December 1998. Compiled with Lahey FORTRAN 90 and ISS/Interacter. Min. Req. Windows95, Windows NT, or Windows 3.1 with Win32s installed. Recommend 32 MB memory. Anticipate need of 40 to 100 MB disk space.
8. **EdBOAST:** Version 1.3.3, FORTRAN 90 source code and executable program. Dialog oriented reservoir data editor for input files directed to BOAST98 and BOAST3. Graphic plots and spreadsheet import/export features. Interacts with BOAST98. Beta tested. User's Guide. National Petroleum Technology Office by TRW Petroleum Technologies, December 1998. Compiled with Lahey FORTRAN 90 AND ISS/Interacter. Min. Req. Windows98, Windows NT, or Windows 3.1 with Win32s installed. Recommend 32 MB memory.
9. **DOE/BC-91/2/SP.** *MASTER: Miscible Applied Simulation Techniques for Energy Recovery - Version 2.0.* User's Guide and Technical Manual. Morgantown Energy Technology Center (METC). February 1991. 192 pp. NTIS Order No. DE91002222. FORTRAN source code and executable program. Min. Req.: See Users Guide.
10. **NIPER-705.** *PC-GEL: A Three-Dimensional, Three-Phase, Permeability Modification Simulator.* IIT Research Institute, National Institute for Petroleum and Energy Research (NIPER). October 1993. 190 pp. NTIS Order No. DE94000104. FORTRAN source code and executable program. Min. Req.: IBM PC/AT, PS-2, or compatible computer with 640 Kbytes of memory Math coprocessor optional
11. **DOE/BC/20006-18.** *TRACRL-Single-Well Chemical Tracer Test Simulator.* A deliverable as part of "The Single-Well Chemical Tracer Method for Measuring Residual Oil Saturation-Final Report." Bartlesville Energy Technology Center (BETC), predecessor to National Institute for Petroleum and Energy Research (NIPER). October 1980. 190 pp. FORTRAN source code and sample input datasets for both PC and Apple environments. Executable program for the PC.
12. **DOE/PC/91008-0042.** *NPC Public Database: (NPCPUBDB.GEO) Database developed for the National Petroleum Council (NPC) for its 1984 assessment of the nation's enhanced oil recovery (EOR) potential.* The technical data description is at the reservoir level. Included with the database are the Appendices from the "TORIS Data Preparation Guidelines" defining the data elements in the database. Available in ASCII or Spreadsheet format.
13. **DOE/PC/91008-0151.** *Crude Oil Analysis Database: COADB, v2.0, 1995.* Database contains information on 9,056 crude oil analyses performed at the National Institute for Petroleum and Energy Research (NIPER). A printed user's guide is available by request. The database is also available on disk. Min Reqs.: DOS v5.0, 80386 processor, 4 MB RAM, and 20 MB hard disk memory.
14. **Risk Analysis and Decision Making Software:**
  - a. *Neuro3 - Neural Network Software:* Neural networks are systems that are constructed to use some organizational principles resembling those of the human brain. They are information-processing systems that demonstrate the ability to learn, recall, and generalize from training patterns or data. They are good at tasks such as pattern matching and classification, data clustering, and forecasting. Common oil and gas applications include forecasting of reservoir

properties from wireline log signatures, extension of reservoir properties for simulation, and seismic interpretation. While this application was written for the oil and gas community, it is generic enough to apply to any problem for data-mining, correlation, or categorization needs. The application is a 32-bit MS Windows application. It contains an extensive help system with a tutorial and background information on neural networks. The application also has a spreadsheet interface to allow import and export of external data sets.

b. *TREE2000-Decision Tree Software*: Decision tree software embodies a highly customizable tool for risk management and informed decision making. Variables such as price, production, and operating costs contain unknowns that must be accounted for when looking at the value of a given decision or project. Decision tree software allows you to apply all the information you have on various unknowns and give you the “big picture” of the situation, showing how that information affects your future and current choices. This assistance will illustrate possible outcomes of decisions and better inform you of where to invest effort in reducing uncertainties. The application is a 32-bit MS Windows application. It contains a help system with an example and background information on decision tree construction.

**15. DOE/PC/91008-0261. FRAC-EXPLORE:**

Analyzes the characteristics and patterns of subsurface lineaments, fractures, and other geological features for the purpose of identifying the locations of potential subsurface oil and gas reservoirs.

Developed at the National Institute for Petroleum and Energy Research (NIPER) by BDM-Oklahoma, Inc. A printed user's guide is available by request. Min Req. Windows v3.1, 6 MB hard disk space, 4 MB RAM, VGA color monitor configured to at least 800x600 resolution, and an 80386 processor.

**16. Microbial Transport Simulator:** The microbial transport simulator (MTS) is a three-dimensional, three-phase, multiple-component numerical model that permits the study of the transport of microorganisms and nutrients in porous media. Microbial parameters incorporated into MTS include: microbial growth and decay, microbial deposition, chemotaxis, diffusion, convective dispersion, tumbling, and nutrient consumption. Governing equations for

microbial and nutrient transport are coupled with continuity and flow equations under conditions appropriate for a black oil reservoir. The model's mathematical formulations and preparation procedures of data files for conducting simulations using MTS are described in the electronic manual. Min. Req.: IBM PC/AT, PS-2, or compatible computer with 640 Kbytes of memory. Math coprocessor optional.

**17. DOE/PC/91008-0346. User's Guide and Documentation Manual:** The improved PC-GEL permeability modification simulator is an improved version of National Institute for Petroleum and Energy Research's (NIPER's) PC-GEL permeability modification simulator. It is developed under a cooperative research and development agreement (CRADA) established between BDM-Oklahoma, Inc. and Schlumberger Dowell. In addition to the features included in the PC-GEL simulator, the improved version includes a radial model, a thermal energy equation in both rectangular and cylindrical coordinates, (r,0,z), a modified version of Schlumberger Dowell's wellbore simulator, a fully implicit time-stepping option, and the temperature-dependent gelation kinetics and fluid rheology of an inorganic delayed gel system (DGS). Detailed description of the development of these new features is reported in a topical report entitled, “Development of an Improved Permeability Modification Simulator.”

**18. DOE/PC/91008-0361. Maganom Software USER'S GUIDE:** Maganom is a computer program for modeling magnetic data over 2-D structure. The program computes the magnetic anomalies across 2-D structure (models) to allow you to compare observed and computed magnetic data across the model structure. If a match between the computed and the observed magnetic values is unsatisfactory, you construct a new model and rerun Maganom to recalculate new magnetic values. In this way, you can continue calculations until you obtain a satisfactory match between the observed and the calculated values.

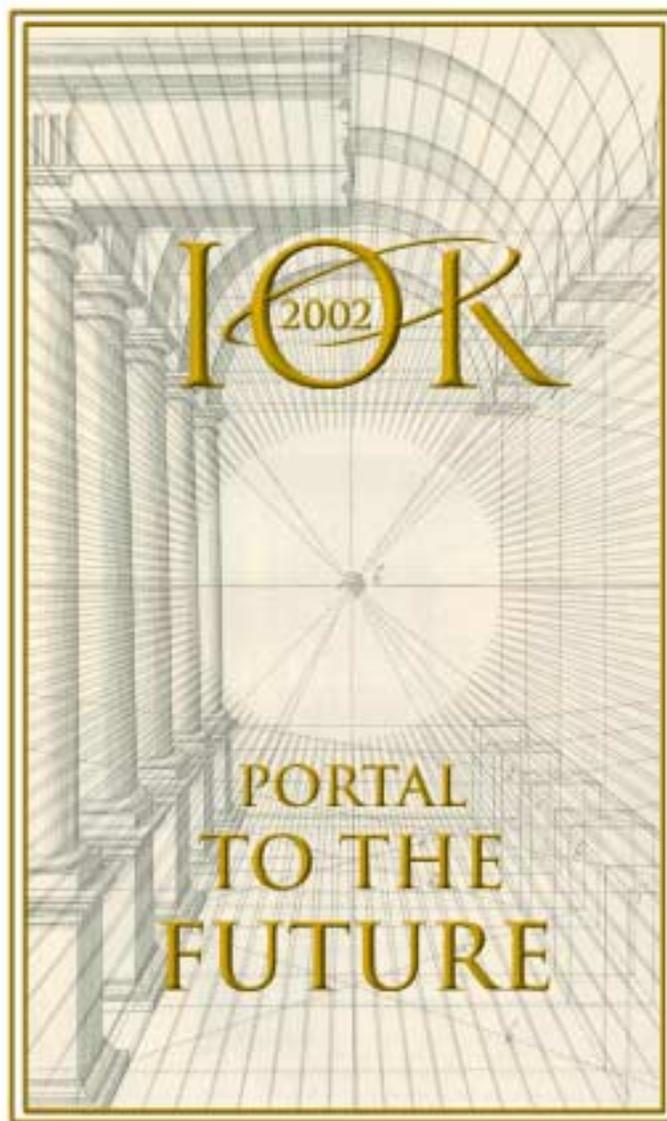
**19. DOE/PC/91008-0349. Gravanom Software USER'S GUIDE:** Gravanom is a computer program for modeling gravity data over 2-D structure. The program computes the gravity anomalies across 2-D structure (models) to allow you to compare observed and computed gravity data across the model structure. If a match between the computed

and the observed gravity values is unsatisfactory, you construct a new model and rerun Gravanom to recalculate gravity values. In this way, you can continue calculations until you obtain a satisfactory match between the observed and the calculated values.

**20. DOE/PC/91008-0344. *Development of an Improved Permeability Modification Simulator:*** This report describes the development of a permeability modification simulator. The improved simulator is developed through the modification of the existing PC-GEL permeability modification simulator to include a radical, a thermal energy equation, a modified version of Schlumberger Dowell's wellbore simulator, and a fully implicit time-stepping option. The developed simulator describes the flow of the injected fluid in the wellbore, through the perforations, and the reservoir. Flow in the reservoir is three dimensional and includes thermal conduction/convection among the injected fluid, the reservoir formation, the reservoir fluids, the overburden, and the underburden.

**21. *Exploration and Production CD-ROM:*** A new CD-ROM available from the DOE's National Petroleum Technology Office (NPTO) contains more than 20 programs, database applications, and model documentation fields for the oil and gas industry. The CD also features BOAST '98—the newest version of the DOE's popular software.

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