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Exploration & Drilling

DOE/BC/14862-20 Productivity and Injectivity of Horizontal Wells. Annual Report. March 1996 to March 1997. Stanford University. June 1997. 177 pp. Order No. DE96001290. A general wellbore flow model is presented to incorporate not only frictional, acceleration and gravitational pressure drops, but also the pressure drop caused by inflow. Influence of inflow or outflow on the wellbore pressure drop is analyzed. New friction factor correlations accounting for both inflow and outflow are also developed.

Extraction Research

DOE/BC/14994 CT Imaging Techniques For Two-Phase and Three-Phase Insitu Saturation Measurements. SUPRI TR 107. Stanford University. June 1997. 107 pp. Order No. DE96001289. The aim of this research is to use the SUPRI 3D steam injection laboratory model to establish a reliable method for 3-phase in-situ saturation measurements, and thereafter investigate the mechanism of steamflood at residual oil saturation. Demiral et al. (1992) designed and constructed a three dimensional laboratory model that can be used to measure temperature, pressure and heat loss data. The model is also designed so that its construction materials are not a limiting factor for CT scanning. This report gives details of the experimental procedures, the data acquisition and data processing computer programs, and the analysis of a steam flood experiment carried out at residual oil saturation.

DOE/BC/14899-45 CT Measurements of Two-Phase Flow In Fractured Porous Media. SUPRI TR 104. Stanford University. June 1997. 57 pp. Order No. DE96001288. This report describes the design, construction, and preliminary results of an experiment that studies imbibition displacement in two fracture blocks. Multiphase (oil/water) displacements will be conducted at the same rate on three core configurations. The configurations

are a compact core, a two-block system with a 1 mm spacer between the blocks, and a two-block system with no spacer. The blocks are sealed in epoxy so that saturation measurements can be made throughout the displacement experiments using a Computed Tomography (CT) scanner. Preliminary results are presented from a water/air experiment. These results suggest that it is incorrect to assume negligible capillary continuity between matrix blocks as is often done.

Field Demonstration

DOE/BC/14940-5 Economic Recovery of Oil Trapped At Fan Margins Using High Angle Wells And Multiple Hydraulic Fractures. Annual Report. September 1995 to September 1996. Atlantic Richfield Company. May 1997. 90 pp. Order No. 96001285. The distal fan margin in the northeast portion of the Yowlumne field contains significant reserves but is not economic to develop using vertical wells. This project attempts to demonstrate the effectiveness of exploiting the distal fan margin of this slope-basin clastic reservoir.

DOE/BC/14988-8 Increased Oil Production and Reserves Utilizing Secondary/Tertiary Recovery Techniques on Small Reserves In The Paradox Basin, Utah. Annual Report. February 1995 to February 1996. Utah Geological Survey. March 1997. 128 pp. Order No. DE96001268. The Paradox basin of Utah, Colorado, and Arizona contains nearly 100 small oil fields producing from carbonate buildups or mounds within the Pennsylvanian (Desmoinesian) Paradox Formation. Five fields (Anasazi, Mule, Blue Hogan, Heron North, and Runway) within the Navajo Nation are being evaluated for waterflood or carbon-dioxide-miscible flood projects. The results can be applied to other fields in the Paradox basin and the Rocky Mountain region, the Michigan and Illinois basins, and the Mid-continent. Procedures for quantitatively characterizing the Anasazi field reservoir have been defined and the required data assembled from a variety of sources. A comprehensive fluid property characterization program was completed. Mechanistic reservoir production performance simulation studies were also completed.

DOE/BC/14989-14 Application Of Integrated Reservoir Management And Reservoir Characterization To Optimize Infill Drilling. Topical Report. June 1994 to March 1996. Fina Oil and Chemical Company. June 1997. 252 pp. Order No. DE96001271. This project has used a multi-disciplinary approach employing geology, geophysics, and engineering to conduct advanced reservoir characterization and management activities to design and implement an optimized infill drilling program at the North Robertson (Clearfork) Unit in Gaines County, Texas. The activities during the first Budget Period consisted of developing an integrated reservoir description from geological, engineering, and geostatistical studies, and using this description for reservoir flow simulation. Specific reservoir management activities were identified and tested. The geologically targeted infill drilling program currently being implemented is a result of this work. A significant contribution of this project is to demonstrate the use of cost-effective reservoir characterization and management tools that will be helpful to both independent and major operators for the optimal development of heterogeneous, low permeability shallow shelf carbonate (SSC) reservoirs. The techniques that are outlined for the formulation of an integrated reservoir description apply to all oil and gas reservoirs, but are specifically tailored for use in the heterogeneous,

low permeability carbonate reservoirs of West Texas. The overall thrust of this project has been Geologically targeted Infill Drilling. Specifically, in Budget Period I we have demonstrated that it is possible to optimize economics for each and every new well in an infill drilling program. We have demonstrated that strategic drilling is an important advanced drilling in shallow shelf carbonate (SSC) reservoirs is neither prudent nor warranted with the modern reservoir characterization tools and techniques available to operators. The key is reservoir characterization. Operators need to recognize its importance and how it can help in optimizing and maximizing recovery economics. The project's comprehensive technology transfer activities have helped in promoting this awareness. The cost/benefits of the technologies and evaluation schemes employed in this project will be an important topic for the technology transfer workshops. The validation work during Budget Period II will also be important in establishing these cost/benefit relationships.

DOE/BC/14991-11 **Design And Implementation of a CO2 Flood Utilizing Advanced Reservoir Characterization And Horizontal Injection Wells in a Shallow Shelf Carbonate Approaching Waterflood Depletion. Annual Report. July 1995 to June 1996. Phillips Petroleum Company. May 1997. 76 pp. DE96001283.** The work reported herein covers select tasks remaining in Budget Phase I and many of the tasks of Budget Phase II. The principal Tasks in Budget Phase I included in this report are Reservoir Analysis and Characterization, Advanced Technical Studies, and Technology Transfer, Reporting and Project Management Activities for Budget Phase I. The principle Task in Budget Phase II included in this report is Field Demonstration. Completion of these tasks has enabled an optimum carbon dioxide (CO2) flood project to be designed, economically evaluated, and implemented in the field. Field implementation of the project commenced during late 1995, with actual CO2 injection scheduled for start-up in mid-July, 1996.

Reservoir Characterization

DOE/BC/14875-13 **Research Program On Fractured Petroleum Reservoir. Final Report. January 1996 to December 1996. Reservoir Engineering Research Institute. May 1997. 234 pp. Order No. 96001276.** In this final report, we summarize some of our achievements in the understanding of multiphase flow in fractured media. Since some of the features of two-phase flow in fractured and layered media are similar due to the capillary forces, the work includes progress in both types of media. There are some basic issues of flow in both fractured and unfractured media that are currently unresolved. A brief summary of our findings in the last three years during the course of the project is presented.

DOE/BC/14892-15 **Visual Display of Reservoir Parameters Affecting Enhanced Oil Recovery. Annual Report. October 1995 to September 1996. Michigan Technological University. April 1997. 24 pp. Order No. 96001272.** This project provides a detailed example, based on a field trail, of how to evaluate a field EOR operations utilizing data typically available in older fields which have undergone primary development.

DOE/BC/14892-16 **Visual Display of Reservoir Parameters Affecting Enhanced Oil Recovery. Final Report. September 1993 to September 1996. Michigan Technological University. May 1997. 156 pp. Order No. DE96001279.** This project provides a detailed example, based on a field trail, of how to evaluate a field EOR operations utilizing data typically available in older fields which have undergone primary development.

DOE/BC/14893-14 **Integration Of Advanced Geoscience And Engineering Techniques To Quantify Interwell Heterogeneity In Reservoir Models. Final Report. September 1993 to September 1996. New Mexico Insti-**

tute of Mining and Technology. May 1997. 142 pp. Order No. DE96001286. The goal of this three year project was to provide a quantitative definition of reservoir heterogeneity. A field laboratory, the Sulimar Queen Unit, was available for the field research. The results of the crosswell seismic data were used to develop a new approach in the estimation of interwell reservoir properties using neural networks. Combining the information from outcrop data, logs, crosswell seismic, and petrographic analysis, a new geological model is proposed for the Queen formation. The results of the three year were presented to oil companies producing from the Queen formation and various publications were prepared to describe the results of the project.

DOE/BC/14894-4 **Application of Artificial Intelligence To Reservoir Characterization: An Interdisciplinary Approach. Annual Report. October 1995 to October 1996. University of Tulsa. May 1997. 80 pp. Order No. DE96001273.** We have decomposed the overall system development into smaller components so we can focus on the expert knowledge required for that component. The decomposition will facilitate the implementation of the system and its validation and verification. The three component systems will be representative of how each expert in geology, geostatistics, and engineering characterizes the reservoir. The concurrent development of these component systems fits into the development of the large and small scale aspects of the system as originally stated in the proposal.

DOE/BC/14895-13 (Vol I) **Geoscience/Engineering Characterization of The Interwell Environment In Carbonate Reservoirs Based On Outcrop Analogs, Permian Basin, West Texas and New Mexico--Waterflood Performance Analysis For The South Cowden Grayburg Reservoir, Ector County, Texas. Final Report. University of Texas at Austin. May 1997. 66 pp. Order No. DE96001280.** A reservoir engineering study was conducted of waterflood performance in the South Cowden field, an Upper Permian Grayburg reservoir on the Central Basin Platform in West Texas. The study was undertaken to understand the historically poor waterflood performance, evaluate three techniques for incorporating petrophysical measurements and geological interpretation in heterogeneous reservoir models, and identify issues in heterogeneity modeling and fluid flow scaleup.

DOE/BC/14895-13 (Vol II) **Geoscience/Engineering Characterization of The Interwell Environment In Carbonate Reservoirs Based On Outcrop Analogs, Permian Basin, West Texas and New Mexico--Petrophysical Characterization Of The South Cowden Grayburg Reservoir, Ector County, Texas. Final Report. University of Texas at Austin. June 1997. 51 pp. Order No. DE96001281.** The purpose of this study is to construct a realistic reservoir model to be used to predict the location of the remaining mobile oil. In this paper we develop a reservoir model that includes areas where depositional patterns are useful and areas where they are not useful because diagenetic overprinting masks depositional patterns.

DOE/BC/14895-13 (Vol III) **Geoscience/Engineering Characterization of The Interwell Environment In Carbonate Reservoirs Based On Outcrop Analogs, Permian Basin, West Texas and New Mexico--Stratigraphic Hierarchy And Cycle Stacking, Facies Distribution, And Interwell-scale Heterogeneity: Grayburg Formation, New Mexico. Final Report. University of Texas at Austin. June 1997. 71 pp. Order No. DE96001282.** The Grayburg Formation is a major producing interval in the Permian Basin in West Texas. Efficient design of enhanced recovery programs dictates improved geological models to better understand and predict reservoir heterogeneity imposed by depositional and diagenetic controls. A detailed, three-dimensional image of the stratigraphic and facies architecture model can be applied towards improved description and characterization of heterogeneity in analogous Grayburg reservoirs. Four orders of stratigraphic hierarchy are recognized in the Grayburg Forma-

tion. Grayburg HFS 1 unconformably overlies the top of the San Andres Formation. Grayburg HFS 1 and 2 record increased accommodation during long term transgression. A widespread fusulinid rich unit at the base of HFS 3 records regional maximum flooding in the Grayburg composite sequence. This flooding event is recognized throughout the Permian Basin in outcrop and subsurface. The remaining portion of HFS 3 and all of HFS 4 reflect decreased accommodation during late highstand. The stratigraphic setting strongly influenced the distribution and heterogeneity of permeable reservoir facies.

DOE/BC/14897-15 **Anisotropy And Spatial Variation of Relative Permeability And Lithologic Character of Tensleep Sandstone Reservoirs In The Big-horn And Wind River Basins, Wyoming. Final Report. September 1993 to October 1996. University of Wyoming. May 1997. 184 pp. Order No. DE96001269.** This multidisciplinary study was designed to provide improvements in advanced reservoir characterization techniques. This goal was accomplished through: (1) an examination of the spatial variation and anisotropy of relative permeability in the Tensleep Sandstone reservoirs of Wyoming; (2) the placement of that variation and anisotropy into paleogeographic, and depositional regional frame works; (3) the development of pore-system imagery techniques for the calculation of relative permeability; and (4) reservoir simulations testing the impact of relative permeability anisotropy and spatial variation on Tensleep Sandstone reservoir enhanced oil recovery. Concurrent efforts were aimed at understanding the spatial and dynamic alteration in sandstone reservoirs that is caused by rock fluid interaction during CO₂ enhanced oil recovery processes. The work focused on quantifying the interrelationship of fluid rock interaction with lithologic characterization and with fluid characterization in terms of changes in chemical composition and fluid properties. This work establishes new criteria for the susceptibility of Tensleep Sandstone reservoirs to formation alteration that results in wellbore scale damage. This task was accomplished by flow experiments using core material; examination of regional trends in water chemistry; examination of local water chemistry trends at the field scale; and chemical modeling of both the experimental and reservoir systems.

DOE/BC/14963-16 **West Hackberry Tertiary Project. Final Report. September 1995 to September 1996. Amoco Exploration and Production Sector. May 1997. 71 pp. Order No. DE96001287.** The West Hackberry Tertiary Project is a field test of the concept that air injection can be combined with the Double Displacement Process to produce a tertiary recovery process that is both low cost and economic at current oil prices. The Double Displacement Process is the gas displacement of a water invaded oil column for the purpose of recovering tertiary oil by gravity drainage. In reservoirs with pronounced bed dip such as those found in West Hackberry and other Gulf Coast salt dome fields, reservoir performance has shown that gravity drainage recoveries average 80% to 90% of the original oil in place while waterdrive recoveries average 50% to 60% of the original oil in place. The target for tertiary oil recovery in the Double Displacement Process is the incremental oil between the 50% to 60% waterdrive recoveries and the 80% to 90% gravity drainage recoveries. In previous field tests, the Double Dis-

placement Process has proven successful in generating tertiary oil recovery. The use of air injection in this process combines the benefits of air's low cost and universal accessibility with the potential for accelerated oil recovery from the combustion process. If successful, this project will demonstrate that utilizing air injection in the Double Displacement Process will result in an economically viable tertiary process in reservoirs (such as Gulf Coast salt dome reservoirs) where any other tertiary process is presently uneconomic.

DOE/BC/14970-7

Gypsy Field Project In Reservoir Characterization. Final Report. May 1994 to May 1996. University of Oklahoma. May 1997. 157 pp. Order No. DE96001277. An output least squares estimation technique is formulated to detect discontinuities on a two dimensional region with sparse pointwise measurements. A method to estimate the location and magnitude of a jump discontinuity is also developed. This technique is presented as a detection tool in the context of well test measurements of pressure for detecting permeability variations. The study is aimed at understanding our ability to detect discontinuities in geological or petrophysical properties due to, for example, channels, as are found in the Gypsy formation. Such discontinuities can have a profound effect on oil recovery. A numerical example demonstrates the use of our method for locating in a permeability function in the presence of a background. Conditions are given for uniqueness and differentiability of the optimal estimated permeability function with respect to perturbations of the data.

DOE/DC/91008

Characterization Of Fracture Reservoirs Using Static And Dynamic Data: From Sonic And 3D Seismic To Permeability Distribution. Annual Report. March 1996 to February 1997. Southwest Research Institute. June 1997. 184 pp. Order No. DE96001284. The first topic is devoted to the development of an analytical solution for plane-harmonic seismic waves propagating in a poroelastic anisotropic media, including the Biot and squirt flow mechanisms. The following topic is devoted to the development and testing of a three dimensional streamline simulator for modeling multiphase flow and transport in heterogeneous permeable media. The emphasis was on speed and accuracy so that the multiphase model can be embedded in an inversion scheme to derive fracture characteristics using production data. The next topic discusses the integration of petrophysical data and 2D seismic data based on the data catalog of the Twin Creek reservoir owned by Union Pacific Resources in the Utah-Wyoming Overthrust belt. The last topic describes the initial efforts for transferring the concepts and results of the project to the oil and gas industry.

DOE/BC-96-2

Contracts For Field Projects And Supporting Research On Enhanced Oil Recovery. Progress Review No. 86. Quarter Ending March 1996. 124 pp. Order No. DE96001274. Status reports are given for various enhanced oil recovery and gas recovery projects sponsored by the Department of Energy. The field tests and supporting research on enhanced oil recovery include chemical flooding, gas displacement, thermal/heavy oil, resource assessment, geoscience technology, microbial technology, field demonstrations in high priority reservoir classes, novel, technology, and environmental technology.

DISCLAIMER

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U.S. DEPARTMENT OF ENERGY

COMPUTER SOFTWARE AND SUPPORTING DOCUMENTATION

Personal Computer Programs

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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 CO₂ 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-86/11/SP. **Chemical Flood Predictive Model**, Supporting Technology for Enhanced Oil Recovery. Dec 1986, 360 pp. NTIS Order No. DE87001208.
 - e- DOE/BC-86/12/SP. **CO₂ Miscible Flood Predictive Model**, Supporting Technology for Enhanced Oil Recovery. Dec 1986, 469 pp. NTIS Order No. DE87001209.
2. DOE/BC-95/2/SP. **Infill Drilling Predictive Model**: User's Guide and Documentation Manual - Release 1.2.0, 1995 for the PC. FORTRAN source code and executable program. Min Req.: 80386/80387, DOS v3.1, and 2 Mbytes extended memory.
3. 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.
4. **CO₂ Prophet**: Water and CO₂ Flood Prediction Software. CO₂ 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, CO₂ 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. The DOE does not provide technical support for this application.
5. 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.
6. **BOAST-VHS**: FORTRAN source code and executable program. User's Guide and Documentation Manual, NIPER-542, 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.
7. **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.
8. 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.

9. 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
10. 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 Technical 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.
11. ***UTCHEM***: A Three-Dimensional Chemical Flood Simulator, version 5.1, May 1992. Developed under the Enhanced Oil and Gas Recovery Research Program at the Center for Petroleum and Geosystems Engineering, The University of Texas at Austin. Software is not distributed or supported by the DOE. Contact Dr. Gary Pope at (512) 471-7234 for details.
12. ***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*" (NIPER/BDM-0042) defining the data elements in the database. Available in ASCII or Spreadsheet format.
13. ***CLEVER***: Class Evaluation Executive Report, v2.0, December 1995. Database application describing information from the DOE's Geologic/Reservoir Class Program. Developed at National Institute for Petroleum and Energy Research (NIPER) by BDM-Oklahoma, Inc. This includes administrative and general technical data. Covers Classes 1 - 3. Distributed as an executable PC program, FoxPro application not required. Min Reqs.: Windows v3.1 and an 80386 processor.
14. ***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). The database is publicly available via a Bulletin Board System (BBS) by dialing (918) 337-4440. A user's guide is available from the BBS in Microsoft Word v6.0. A printed user's guide is available by request, NIPER/BDM-0151. The database is also available on disk. Min Reqs.: DOS v5.0, 80386 processor, 4 MB RAM, and 20 MB hard disk memory.
15. ***Risk Analysis and Decision Making Software***: Software package includes tools for Monte Carlo simulation, best fit for distributed functions, sample or rank correlation, investment risk analysis, and EOR method screening. Developed at National Institute for Petroleum and Energy Research (NIPER) by BDM-Oklahoma, Inc. A printed user's guide is available by request, NIPER/BDM-0227. Min Req. Windows v3.11, 8 MB hard disk space, 8 MB RAM, VGA color monitor, and an 80486 processor.
16. ***FRAC-EXPLORE***: 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 National Institute for Petroleum and Energy Research (NIPER) by BDM-Oklahoma, Inc. A printed user's guide is available by request, NIPER/BDM-0261. 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.

Reel Tape Computer Programs

1. ***Enhanced Oil Recovery Predictive Models***: FORTRAN source code, sample input datasets and output. The five recovery processes modeled are Steamflood, In-Situ Combustion, Polymer, Chemical Flooding, and CO2 Miscible Flooding; 1600 bpi, 9 inch, 9 track tape, ASCII, 80 bytes per record, 800 bytes per block. *Tape available on 14 day loan basis only.*
 - a- DOE/BC-86/6/SP. ***Steamflood Predictive Model.***, Supporting Technology for Enhanced Oil Recovery. December 1986. 594 pp. NTIS Order No. DE87001219.
 - b- DOE/BC-86/7/SP. ***In-Situ Combustion Predictive Model.***, Supporting Technology for Enhanced Oil Recovery. December 1986. 263 pp. NTIS Order No. DE86000264.
 - c- DOE/BC-86/10/SP. ***Polymer Predictive Model.***, Supporting Technology for Enhanced Oil Recovery. December 1986. 394 pp. NTIS Order No. DE87001207.
 - d- DOE/BC-86/11/SP. ***Chemical Flood Predictive Model.***, Supporting Technology for Enhanced Oil Recovery. December 1986. 360 pp. NTIS Order No. DE87001208.

- e- DOE/BC-86/12/SP. *CO₂ Miscible Flood Predictive Model.*, Supporting Technology for Enhanced Oil Recovery. December 1986. 469 pp. NTIS Order No. DE87001209.
2. DOE/BC/10033-3. *BOAST*: A Three-Dimensional, Three-Phase Black Oil Applied Simulation Tool, version 1.1, K&A Inc., & The BDM Corp. NTIS Order No. DE83003031, (Vols. 1 & 2). Prepared for U.S. DOE at Bartlesville Energy Technical Center (BETC), predecessor to National Institute for Petroleum and Energy Research (NIPER). September 1982. FORTRAN source code; 1600 bpi, 6 inch, 9 track tape, ASCII, 80 bytes per record, 800 bytes per block. *Tape available on 14 day loan basis only.*
 3. DOE/BC-88/2/SP. *BOAST II*: A Three-Dimensional, Three-Phase Black Oil Applied Simulation Tool. K & A Technology, prepared for U.S. DOE at National Institute for Petroleum and Energy Research (NIPER), December 1987. 420 pp. NTIS Order No. DE88001205. FORTRAN source code; 1600 bpi, 6 inch, 9 track tape, ASCII, 80 bytes per record, 800 bytes per block. *Tape available on 14 day loan basis only.*
 4. NIPER-326. *BOAST-VHS*: Modified BOAST program. Simulation of Production from Wells with Horizontal/Slanted Laterals. Final Report. National Institute for Petroleum and Energy Research (NIPER). March 1989. 41 pp. NTIS Order No. DE89000711. FORTRAN source code; 1600 bpi, 9 inch, 9 track tape, ASCII, 80 bytes per record, 800 bytes per block. *Tape available on 14 day loan basis only.*

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