

***PTTC Focused Technology Workshop
Technical Report to PTTC***

**INTO THE NEW MILLENIUM:
THE CHANGING FACE OF EXPLORATION IN THE KNOX PLAY**

Held October 20, 1999

Hosted by: The Ohio Geological Society and ODNR, Division of Geological Survey

Purpose of workshop

The Ohio Geological Society and the Ohio Department of Natural Resources, Division of Geological Survey co-hosted a Focused Technology Workshop in Akron, Ohio on October 20, 1999. The focus of the workshop was to provide technical information to the oil and gas community on new and current technologies being employed in the search for hydrocarbons in the Knox play. The workshop was held in conjunction with the Ohio Oil and Gas Association's (OOGA) Fall Technical Meeting at the Radisson Hotel at Akron City Centre.

Problem addressed

The host organizations worked with one of Ohio's Producer's Advisory Group (PAG) representative and Appalachian PAG Chairman, Kevin Smith, to select the topic for the focused technology workshop. This topic was chosen because drilling and production in the Knox Group is the most significant play currently being developed in Ohio. However, drilling activity to these targets had slowed over the last year, in part because industry was struggling to better understand the reservoirs and how best to locate additional reserves within them.

Technology identification and selection

The focus of this workshop was to present a variety of technologies that are being used within the Knox Play, or that could be applied to this play. Co-chairmen Larry Wickstrom and Greg Mason discussed this workshop theme with many people in industry over the course of three months to identify prospective technologies and speakers. Although we could not obtain speakers willing, or able, to cover a couple chosen topics (e.g. case histories of recent 3-D seismic programs) the overall theme was delivered.

The following topics and speakers were selected for the workshop:

Oral Presentations

Use of PC-based Seismic Analysis Software to Improve Exploration for Rose Run Remnants; Chuck Weisenberg, Lauren Geophysical Processing Service

Integration of RBDMS Digital Geologic Data with Geographix Mapping Software; John F. Miller, NGO Development Corp.

Horizontal Drilling Technology Applied in New York – Lessons Applicable to the Knox?; Steven E. B. George, The Atlas Group, Inc., and Paul Conti, Wilson Downhole.

Knox Logging Y2K; Brad Posner, Schlumberger Oilfield Services

Using Soil Gas Geochemistry in Conjunction with Seismic to Increase Drilling Success Rates; Rick Reeve, Geological Consultant.

S/N Ratio and Bandwidth Considerations When Utilizing Seismic Data in Exploring for Subtle Traps – Examples from the Knox Play; Ed R. Tegland, Exploration Development Inc.

Hydrodynamic Traps along the Knox in Pickaway County, Ohio; R. J. Yedlosky, Geological Consultant

Structurally Related Migration of Hydrocarbons in the Central Appalachian Basin of Eastern Ohio; Greg Mason,
NGO Development Corp

Using the Production of Oil and Gas in Ohio (POGO) database in a mapping and exploration environment;
William A. Grubaugh, Michelle L. Baruth, CGAS Exploration, Inc., Joseph G. Wells and Lawrence H.
Wickstrom, Ohio Division of Geological Survey

Poster Sessions

**A new interpretation of Precambrian geology along the structurally restored Ohio Consortium
for Continental Reflection Profiling (COCORP) seismic lines;** Stuart L. Dean, University of Toledo,
Mark T. Baranoski, Ohio Division of Geological Survey, and John L. Wicks, Red Bird Producing

**An updated preliminary structure map on the top of the Precambrian unconformity and
location of wells drilled deeper than the Knox Dolomite with reported shows of oil and gas;**
Mark T. Baranoski, and Christian D Steck, Ohio Division of Geological Survey

Information on the Speakers

Brad Posner
Schlumberger
3401 East Pike Street
Zanesville, OH 43701
740-450-8370

Graduated from S.U.N.Y. @ Stonybrook with a BS in Physics in 1979. Has worked for Schlumberger for 20 years in various field and sales assignments in the Michigan, Illinois, Appalachian Basins, the Gulf of Mexico, and Northern Alberta Canada. Currently, Brad is District Engineer for the NorthEast region and is located in Zanesville, Ohio.

Ed R. Tegland
Exploration Development Inc.
10970 South Pikes Peak Dr.
Parker, CO 80134
303-840-7021

Graduated South Dakota School of Mines 1959 with a BS in Geological Engineering. Graduated University of Missouri at Rolla in 1961 with a MS in Petroleum Engineering. Did graduate work at Tulane University in Math and Computer Science. Member SEG, European SEG, SPE, Denver Geophysical Society, Billings Geophysical Society, Michigan OGA. 1970 A.I. Leversen award winner, 1974 SEG Best Presentation Award, 1976 appointed TI fellow, 1983 SEG Best Paper in Geophysics award. Thirty-six years of total industry experience. Expertise in land and marine 2D and 3D seismic acquisition, processing and interpretation on a worldwide basis.

Rick Reeve
7345 Cheryl Lane NW
Massilon, OH 44646
330-830-3315

Consulting geologist for Gatherco and Four Knox Exploration Group. Has been conducting soil gas surveys for 5 years in the Appalachian basin of eastern Ohio. Has 14 years experience in prospect development and completion procedures in the Knox unconformity play. Received BS Geology from Kent State in 1980, MS Geology from Kent State in 1983. Worked for David Shafer Oil Producers from 1984 to 1994. Has extensive

experience in Knox exploration activities in Ohio related to prospect generation including database generation, mapping software, and seismic acquisition and interpretation.

Chuck Weisenberg, Ph.D.
Lauren Geophysical Processing Service
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303-799-1637

BA Geology, Univ. California, Santa Barbara. MA Rice University 1973, Ph.D. Rice University 1979 Faculty TCU 1976-77, U. of Redlands 1977-80 Exploration Geologist ARCO Oil and Gas Co. 1980-86. Earthquake safety US bureau of Reclamation 1986-90. Front Range College 1990-92. Nuclear Waste siting, Science Applications Intl. (for US Geological Survey) 1992-95 Oil and gas Consultant 1996-present Lauren Geophysical company

Steven E. B. George
The Atlas Group, Inc.
311 Rouser Rd.
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412-262-2830 ext. 162

Graduated 1983 from Brigham Young University with a MS in Geology. Worked for Mapco Production in Houston and Tulsa from 1982 to 1984. Worked for Reserve Exploration from 1984 to 1986 in Tulsa. Has worked for Resource Exploration as Senior Geologist in the Appalachian basin since 1986.

R. J. Yedlosky
Rt. 8 Box 336-AA
Fairmont WV 26554
304-366-9572

Graduated West Virginia University in 1960 with MS degree in Geology. Did graduate work in engineering and geology for two years at WVU. Member AAPG, SPE, Society of Mining, Metallurgy, and Exploration, Inc. Certified Professional Geologic Scientist #4417. Thirty-six years experience as an engineering geologist in the oil and gas business in the US, Canada and Alaska.

Greg Mason
NGO Development Corp
1500 Granville Rd
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740-348-1267

Joined NGO Development Corp. in May of 1997. Has 14 years experience in prospect development and completion procedures in the Knox unconformity play. Received BS Geology from Kent State in 1991. Prior to joining the Company, was employed by CGAS Exploration, Murphy Oil Company, and Atwood Resources with areas of responsibility including seismic interpretation, wellsite geology/engineering, pipeline and production equipment design and construction.

John F. Miller
NGO Development Corp
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740-348-1267

Currently working as an exploration consultant for NGO Development focusing on Knox and shallow prospects in Ohio. Previously worked for CGAS in the Geophysics group performing seismic interpretation. Worked for CTL Engineering as the Geotechnical drilling coordinator. Received a MS from the Ohio State University, and a BS in Geology from Kent State University.

Mark T. Baranoski
Ohio Geological Survey
4383 Fountain Square Dr.
Columbus, OH 43224-1362
614-265-6586

Graduated from the University of Toledo with BS in Geology in 1980 and an MS in Geology in 1982. Worked the Rocky Mountain region for Gulf Oil Corp. and as a Michigan basin consultant from 1982 to 1985. Has been working for the Ohio Division of Geological Survey from 1985 to the present, working on various applied oil and gas related projects, primarily in the Appalachian Basin. The results of this work have been presented in numerous papers since 1985. Is currently working on several projects related to the Precambrian and Cambrian of Ohio and the surrounding region.

Lawrence H. Wickstrom
Ohio Geological Survey
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Larry Wickstrom received both his BS (1980) and MS (1982) degrees in geology from Kent State University. Mr. Wickstrom has been a geologist with the Ohio Geological Survey since 1983. He has performed many petroleum geology investigations that have led to over 20 publications and numerous speaking engagements before professional groups. Since the late 1980's Larry has also served as the Survey's computer and information technology coordinator. Since 1996 Larry has held the position of Supervisor of the Petroleum Geology Group at the Ohio Geological Survey.

Technologies Presented

Use of PC-based Seismic Analysis Software to Improve Exploration for Rose Run Remnants; Chuck Weisenberg, Lauren Geophysical Processing Service

Dr. Weisenberg presented a study wherein he reevaluated 70 older seismic lines using new PC-based seismic analysis software. Seismic data over a small population of Rose Run tests examined on a computer system showed that most of the remnant highs exhibit a positive amplitude anomaly on displays filtered between about 15-40 Hz, and show a relatively low dominant frequency on the instantaneous frequency attribute plot. Prospects shown by drilling not to be remnant highs show these characteristics much less commonly. Reprocessing of old Rose Run trend seismic profiles using these methods represents a way for operators to develop new prospects from old data. The criterion also allows better resolution of prospects on new data and the ability to rank marginal prospects.

Integration of RBDMS Digital Geologic Data with Geographix Mapping Software; John F. Miller, NGO Development Corp.

The Risk Based Data Management System (RBDMS) is a national data model developed by the Ground Water Protection Council (GWPC) and adopted by over 25 state oil and gas regulatory agencies. The Ohio Division of Oil and Gas and the Ohio Geological Survey have modified the system to act as an overall oil and gas well data management system. Information on over 100,000 wells currently resides in the system which is available to operators for a nominal fee (\$15.00). Mr. Miller walked the attendees through the process he uses to bring data from the RBDMS database in to the GeoGraphix mapping environment.

Horizontal Drilling Technology Applied in New York – Lessons Applicable to the Knox?; Steven E. B. George, The Atlas Group, Inc., and Paul Conti, Wilson Downhole.

Resource America, Inc. with financial assistance from the New York State Energy Research and Development Authority (NYSERDA), drilled the first horizontal well in the Bass Islands trend of New York. The method used was the re-entry of an existing well bore and the drilling of a short radius horizontal leg into the pay zone using slim-hole equipment (smaller than 4 ½" OD), 2-3/8" drill pipe, adjustable down-hole motors, and down-hole steering tools. This method has been proven in other basins and works perfectly for the Bass Island. The horizontal leg extended approximately 323 feet from the kick off point in the vertical well bore. Eighty-five feet of fractured and faulted reservoir rock was penetrated. Short and medium radius drilling techniques similar to this one (used in New York) could be applied to Knox reservoirs in Ohio. Targets with surface limitations, truncated formations, vertical karst features or near misses are possible candidates for horizontal drilling.

Knox Logging Y2K; Brad Posner, Schlumberger Oilfield Services

Mr. Posner highlighted the technological advancements made during the 1990's by Schlumberger. New generation resistivity and density measurements, and the advent of Magnetic Resonance and Formation Imaging tools has led to better log interpretation and characterization of the reservoirs below the Knox unconformity. Improvements of tool design and combinability has allowed for shorter tool strings with measurements of higher resolution and accuracy. Many examples from Knox wells were shown with the new log types.

Using Soil Gas Geochemistry in Conjunction with Seismic to Increase Drilling Success Rates; Rick Reeve, Geological Consultant.

Mr. Reeve illustrated that hydrocarbon microseepage eventually reaches the surface where the introduction of hydrocarbons into the soil substrate leads to significant changes in the soil chemistry over and adjacent to hydrocarbon reservoirs. These chemical changes can be seen in differences in the Eh, pH and conductivity of the soils overlying commercial reservoirs. Measurements made of the soil hydrocarbons, Eh, pH and conductivity of individual soil samples over an area show irrefutable proof of vertical migration. Case histories of soil-gas surveys over Trempealeau and Rose Run seismic prospects in Ohio were used to substantiate this. Soil-gas samples taken in a grid pattern over known seismic remnants are seen to differentiate regional background values over dry holes from anomalously high hydrocarbon values over productive remnants. Reeve used numerous soil-gas surveys conducted over Trempealeau and Rose Run seismic prospects in Ohio to illustrate an overall successful prediction rate of 80% for predicting productive wells and 85% for predicting dry holes.

S/N Ratio and Bandwidth Considerations When Utilizing Seismic Data in Exploring for Subtle Traps – Examples from the Knox Play; Ed R. Tegland, Exploration Development Inc.

Mr. Tegland gave an enlightening presentation focusing on what is signal, noise, and bandwidth. He then illustrated just how processors deal with each type of problem encountered when dealing with these parameters and what is safe to use. He demonstrated that the seismic interpreter working the Knox should attempt to work with the maximum effective bandwidth. He further demonstrated that the use of several bandwidths and types of enhancement may be required to fully understand the data in any particular area. He stressed that the person(s) making the final interpretation should be familiar with some of the more primitive data such as the raw CDP stack and even selected field records in order to understand how far the data has evolved from the beginning to the end of the processing. Case examples from the Knox were used.

Hydrodynamic Traps along the Knox in Pickaway County, Ohio; R. J. Yedlosky, Geological Consultant

The Pickaway County Knox play has been very problematic. Predictability of adjacent prospects has frustrated the companies involved. Mr. Yedlosky attempted to make some sense of the picture by explaining the traps in this area using a hydrodynamic model. In this model early oil and gas migration into the sub-Knox strata of the Pickaway County area was later displaced in a downdip direction by updip relatively fresh meteoric waters. The moving hydrocarbons were trapped against downdip deep erosional cutouts. This hydrodynamic entrapment caused tilted water tables that confuse the basic nature of the play.

Structurally Related Migration of Hydrocarbons in the Central Appalachian Basin of Eastern Ohio; Greg Mason, NGO Development Corp

Mr. Mason illustrated that recent advances in PC technology have allowed for an in-depth study of the surface topography of Ohio on a macro scale. Surface features and interpreted lineaments were correlated with subsurface maps. He interprets topographic lows to have developed along zones of preexisting weaknesses in the form of joints, faults, fractures, or some structural component. Topographic highs he shows to have sometimes been interpreted to develop as a result of actual structural uplift. Surface topography can, in many cases, be shown to correlate to actual basement structure. Further, he correlates these zones of weakness, or fracture zones, to known productive oil and gas fields in eastern Ohio and pointed out major routes of migration for hydrocarbons.

Using the Production of Oil and Gas in Ohio (POGO) database in a mapping and exploration environment; Lawrence H. Wickstrom, Ohio Division of Geological Survey

Of all oil and gas information types commonly used in Ohio, production data has, historically, been one of the least accessible. Recognizing this, the Petroleum Geology Group of the Ohio Geological Survey has been quietly collecting production data from public and industry sources since 1986. This database now contains production data from 58 Ohio Counties, from 81 unique producing formations, 4,363 unique well operators, and 57,353 unique wells. There are 625,252 yearly production records and 83,996 monthly production records available in this dataset. The database was released to the public in the fall of 1998, and was subsequently named POGO through a naming contest. Wickstrom illustrated how this new set of tools can be used and imported to mapping software for use in exploration and development efforts.

Poster Sessions

A new interpretation of Precambrian geology along the structurally restored Ohio Consortium for Continental Reflection Profiling (COCORP) seismic lines; Mark T. Baranoski, Ohio Division of Geological Survey

An updated preliminary structure map on the top of the Precambrian unconformity and location of wells drilled deeper than the Knox Dolomite with reported shows of oil and gas; Mark T. Baranoski, Ohio Division of Geological Survey

Baranoski presented preliminary results of current Precambrian research in two poster displays. A structural restoration of the original 1987 Ohio COCORP seismic lines, reprocessed to 3 seconds two-way time, has clarified the configuration and chronological development of the Fort Wayne rift (an arm of the East Continent Rift Basin) and a series of sediment-filled Precambrian foreland basins east of the previously accepted Grenville Front. This new interpretation presents the possibility of a previously unknown regional exploration play in low-velocity foreland-basin-fill sediments. This new interpretation of this deep seismic profile and the new structure map on the top of the Precambrian unconformity both reaffirm the effects that Precambrian structures have had on Paleozoic geology.

Operator Reception of New Technologies

All comments received from industry representatives at the meeting have been very favorable. The attendees feel, in general, that a very effective group of presentations were made at the workshop. The general chairmen have both received numerous calls since the meeting complementing the program. Judging from these results and the evaluation forms, the workshop was a success.

Summary of attendee evaluation forms

Of the 90 individuals in attendance at the workshop, 33 returned evaluation forms to the chairmen. Overall, the evaluation forms were very favorable. The evaluation forms are enclosed.