SOUTH DAKOTA OIL & GAS DEVELOPMENT

PAST, PRESENT, AND FUTURE

BY

GERALD (MACK) McGILLIVRAY

SENIOR GEOLOGIST, SD DENR OIL & GAS SECTION

SDSM&T GEOL/GEOE/PALEO SEMINAR

JANUARY 22, 2010
THE PAST

- FIRST REPORTED SALABLE GAS (SHALLOW METHANE VS. CASING HEAD) PRODUCTION WAS 1899-1948 IN PIERRE, THE STATE CAPITOL. MODERN SALABLE GAS PRODUCTION IS FROM 1977-PRESENT, ALL IN HARDING COUNTY IN NORTHWESTERN SD.

PIERRE GAS FIELD HISTORY

- 1889  Pierre Gas Plant installed
- 1892  Gas from Indian School water well flared until 1939
- 1894
  - Locke Hotel;  cook, heat, lights
  - City Gas Plant;  “(every) home...”
  - City Streets;  all lit with gas
Tank for natural gas separated from artesian water in Fort Pierre, 1908.
Although the first oil producing well wasn’t drilled until 1953, there is a long history of oil exploration in the state, as evidenced by this wooden derrick rig drilling in the Barker Dome area of Custer County in 1929. Oil was actually discovered in a well drilled in 1955, just over the hill to the south of this rig.
1954: Buffalo Field discovered. Cumulative oil production, almost 33 million barrels, 68% of the state’s total production of 48.5 million bbls.

Harding County cumulative production is 44.4 million bbls, 89% of the state’s total.
HARDING COUNTY – BUFFALO FIELD 1943
CURRENT OIL AND GAS EXPLORATION AND PRODUCTION IN SOUTH DAKOTA
South Dakota Crude Oil Production (bbls)

1954-2008

1954 – First Production
2 Wells
36,152 Barrels

1988 – OLD RECORD HIGH
207 Wells
1,668,197 Barrels

2008 – NEW RECORD HIGH!
162 Wells
1,696,842 Barrels

2009
162 Wells
1,665,304 Barrels

SD Department of Environment & Natural Resources
01/20/2010
Although Harding County has produced by far the most oil (43.3 million barrels), other counties such as Fall River (4.6 million), Custer (310 thousand), and Dewey (133 thousand) have all contributed to the states total of 48.3 million barrels.
The colors denote horizontal drilling spacing units, and show the large areas spaced not only by established Operators like Continental Resources and Luff, but new Players like Tecton and Zenergy.
Methane production from the Dakota Sandstone, Pierre Gas Field, 1899-1953

Methane production from the Eagle/Shannon members of the Pierre Shale 1979-Present

1899-2009 Shallow Gas Production
1,097 MMCF (1.1 BCF)

1982 Shallow Gas Production
1,856 MMCF (1.9 BCF)

2008 Shallow Gas Production
1,097 MMCF (1.1 BCF)

2009 Shallow Gas Production
1,557 MMCF (1.6 BCF)
Dakota Sandstone
Inyan Kara Group (Fall River & Lakota Sandstone)
Missouri River
Igneous and Metamorphic Rock
Pierre Shale
Jump Off Field - Pierre Shale Formation (Shannon Member) Est. 2008, 17 Wells, Cumulative Production 1,451,404 MCF

West Short Pine Hills - Pierre Shale Formation (Shannon Member) Est. 1977, 45 Wells, Cumulative Production 20,659,547 MCF

Cady Creek - Pierre Shale Formation (Shannon Member) Est. 1978, 25 Wells, Cumulative Production 3,893,177 MCF
Small Rig used to Drill shallow Gas and Oil wells, limited to 1000-1500 feet.
Medium sized rig, limited to depths of 5000 feet.
Bigger rig, limited to depths of 10,000-15,000 feet.
Biggest rigs (in SD), limited to depths of 15,000-20,000 feet. Longest horizontal lateral in the state currently over 16,000 feet (MD)
One of the biggest, Nabors 42, KB-20’+90’ to stabbing board+30’ to crown = 140’ total.
THE FUTURE OF OIL AND GAS EXPLORATION AND PRODUCTION IN SOUTH DAKOTA
Although the numbers are still low compared to surrounding States and Provinces, the upward trend is encouraging.

In 2009, all but eleven of the permits are for Shannon gas wells.
This map of southern Harding and northern Butte counties show the recent Shannon spacing units, and new wells and permits.
RECENT “WILDCAT” SHALLOW GAS EXPLORATION

Houston Exploration Dakota Sand/Niobrara Gas Tests
Drilled and Plugged June-July 2005

Fidelity Exploration Dakota Sand/Niobrara Gas Tests
Drilled October 2007, currently undergoing testing/evaluation.

Stanley County
Hugos County

While every effort has been made to ensure the integrity of this map and factual data
upon which it is based, the South Dakota Department of Environment and Natural
Resources makes no representation or warranty, expressed or implied, with respect
to its accuracy, completeness, or usefulness for any particular purpose or scale.
RECENT “WILDCAT” SHALLOW GAS EXPLORATION CONT'D.

Biorock Exploration Sub Glacial/Niobrara Gas Tests
Drilled and Plugged July & October 2007
HARDING COUNTY
GAS FIELDS HISTORY CONTD.

Harding County Gas Wells/Tests

Jump Off Field - Pierre Shale Formation (Shannon Member)
Est. 2008, 17 Wells, Cumulative Production 1,451,404 MCF

West Short Pine Hills - Pierre Shale Formation (Shannon Member)
Est. 1977, 45 Wells, Cumulative Production: 20,559,547 MCF

Cady Creek - Pierre Shale Formation (Shannon Member)
Est. 1978, 25 Wells, Cumulative Production: 3,893,177 MCF

New Permits
New Drills
Producing
SI/TA
P&A
GAS FIELDS
WBI Pipeline
RECENT “WILDCAT” SHALLOW GAS EXPLORATION CONTD.

After conducting exhaustive research of past/current Bakken publications/maps (including those done by Julie LeFever), and looking at dozens of SD well logs, the SD DENR Oil & Gas Section has constructed a map of the Bakken formation in South Dakota. The map is being unveiled here for the first time ever!
EXTENT OF THE BAKKEN FORMATION IN SOUTH DAKOTA
But seriously folks, even though the Bakken formation has not been identified in South Dakota, that doesn’t mean it doesn’t exist.

Also, we do have a formation that is currently making a big splash in North Dakota and Manitoba, and does exist in SD, the (drum roll please)

THREE FORKS!!!
This Isopach map of the Three Forks shows that in all probability, the formation does not end at the ND/SD Border. Unless the infamous “Stateline Fault” we have all heard about DOES exist!

Isopach of the Three Forks Formation

Julie A. LeFever

The Three Forks Formation (Upper Cretaceous) is present only in the vicinity of the Williston basin and extends over approximately two-thirds of the area of North Dakota (see map). The formation consists of clean and medium-grained sand and gravel containing varying amounts of silt, clay, and siltstone. These sediments were deposited in and along a broad open basin during several successive and submergence stages. The Three Forks Formation overlies the Redfield Formation and is conformably overlain by the lower Badlands member at the central portion of the basin and is unconformably overlain by a progression of younger, more recent, terrigenous sediments of the Pierre Shale, the middle Badlands member, upper Badlands member, and the Lodgepole Formation.

The formation attains a maximum thickness of 270 ft (82 m) and has a well-defined depositional center covering western, central, and eastern McKenzie counties. The Three Forks Formation thins to an erosional border edge to the east and along the northern flank of the Cedar Creek anticline in the extreme northeastern corner of the state.

Reference Log

- Thickness of the Three Forks Formation (in feet)
- Township Boundaries
- County Boundaries

Scale: 1:1,600,000

North American Datum 1983

Lambert Conformal Conic

Geological Investigation No. 32
North Dakota Geological Survey
According to Lynn Helms, the Director of the ND Oil & Gas Division, the first Three Forks wells were drilled in July, 2006. Since that time, 157 wells have been drilled with total production of over eight million barrels (and many of those recently drilled are still on confidential status).
Base on the work that the ND and MB Surveys have done with well log Correlations, we pulled similar types of logs from wells in Perkins County, and identified the Three Forks sections using the SD/MB logs for Reference, as well as the formation tops as determined by the well-site Geologist. As you can see all of the wells have a very visible Three Forks Section (#5 is off the screen).

So, we know the rocks are there, we just need to determine if they have Any oil in them!
SDGS/ DENR MAPS AND PUBLICATIONS THAT MAY HELP IDENTIFY THE THREE FORKS AND OTHER POTENTIAL PRODUCING FORMATIONS
Cross Section Showing Geophysical Logs of Phanerozoic Rocks In the Northern Portion of the Williston Basin in South Dakota
By J.E. Fox (SDSMT) and K.A. McCormick and T.N. Haggar (SDGS)

Became available as a SDGS publication July, 2008
Cross Sections of Geophysical Logs of Phanerozoic Rocks in South Dakota
Stratigraphic Correlation Chart of South Dakota

By
MD Fahrenbach,
FS Steece,
FS Sawyer,
KA McCormick,
GL (Mack) McGillivray,
JA Redden,
LD Schulze

Joint effort by DENR
Oil & Gas Section
And
South Dakota Geological Survey

Became available as a SDGS publication
(Oil & Gas Investigation 1)
July, 2007
Enlarged Section from the Stratigraphic Column showing the Williston Basin section from the Madison to the Winnipeg.

Notice we have a question mark after the Bakken, but there is no question the Three Forks is present.
The DENR O&G Section and Geological Survey plan to continue research on the Three Forks, and plan to construct structural contour maps, study drill cores and cuttings, conduct research, and consult with Industry to bring Exploration and Production to the state.

So, What can YOU do to help!
(point to audience)
The SDSM&T Administration can help by creating Petroleum Geology/Engineering Undergraduate and Graduate programs.

- The Faculty can help by offering to teach more petroleum courses.
- The Students can help by asking for (demanding?) the above, use the resources available for writing undergraduate/graduate papers, and applying for Summer Internships, such as the ones we have available.
INTERN PROGRAM – Summer 2010
Geologic Assistant Intern (2 openings)

POSITION TITLE: Geologic Assistant Intern (2 openings)  REQUISITION NUMBER: 90836
DEPARTMENT: Department of Environment and Natural Resources  LOCATION: Rapid City
SUPERVISOR: Gerald (Mack) McGillivray

POSITION DESCRIPTION: Intern will assist in both office and field duties dealing with the regulation of oil and gas exploration and production in the state, as well as providing customer service to industry representatives and the general public. Office duties may include assisting staff with duties and activities associated with Governor Rounds’ directive to promote the exploration and development of oil and gas in South Dakota, constructing or digitizing oil and gas maps, reviewing/analyzing geophysical well logs and reports, preparing geologic cross sections, and conducting closely supervised geologic research. Field duties may include inspection and monitoring of oil and gas operations such as; drilling, production, plugging, and injection operations in the field, evaluation of reclamation progress and procedures for plugged and abandoned well sites and investigation of environmental damage from crude oil or produced water spills. Field work may be required after normal business hours, such as evenings and weekends.

QUALIFICATIONS: Applicant must be a full-time student at a college or university. Preference will be given to those with junior standing or above by the end of the Spring 2010 semester, or who are currently enrolled at a vocational-technical school and have completed one year (nine months) by the start of the internship. Must have specific coursework in geology and/or geological engineering. Knowledge of GIS software (ArcInfo/ArcMap) is desired.

APPLICATION DEADLINE: 2/05/2010  MINIMUM SALARY: $8.40 - $9.45 per hour (depending on qualifications)

WEBSITES

SD BUREAU OF PERSONNEL (BOP)

SD DENR
http://denr.sd.gov/jobs.aspx#INTERNS

SD DENR O&G SECTION
FOR MORE INFORMATION,


OR CONTACT:

FRED STEECE (SUPERVISOR) email: fred.steece@state.sd.us

MACK MCGILLIVRAY (SENIOR GEOLOGIST) email: mack.mcgillivray@state.sd.us

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT & NATURAL RESOURCES
MINERALS & MINING PROGRAM - OIL & GAS SECTION
2050 WEST MAIN, SUITE #1
RAPID CITY, SD  57702-2493
PHONE: (605)394-2229           FAX: (605)394-5317