History of Geologic Investigations and Oil Operations at Teapot Dome, Wyoming*

Tom Anderson

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Abstract

Teapot Dome has a rich, sometimes infamous history. Currently operated by the U.S. Department of Energy (DOE), the field still produces about 200 barrels of oil per day (BOPD) from several hundred active wells, but in its heyday, it produced 6000 BOPD, and over 1300 wells were drilled. Cumulative production is about 30 MMBO, primarily from the Cretaceous Shannon Sandstone, Wall Creek (Frontier) Sands, and the Pennsylvanian/Permian Tensleep Formation. Minor production also comes from the Cretaceous Dakota and Muddy Formations. From an unconventional perspective, significant production has come from the Niobrara and Steele Shale Formations, all in vertical wells and influenced by the presence of natural fractures. The structure was initially discovered and named by geologist C.H. Wegemann in 1911, as a probable oil-bearing anticline on trend with the giant Salt Creek Field. Soon after that (1915) it was established as Naval Petroleum Reserve No. 3, and placed off-limits for development. The Teapot Dome Scandal during the Harding administration of the 1920's involved leasing and drilling the reserve. But the eventual outcome of the scandal was the U.S Supreme Court invalidating the leases and re-establishing the site as a reserve once more. Nevertheless, there are remnant vestiges today of the development during the 1920's, including concrete foundations, fireplaces, sidewalks, excavations, and old pipes. The federal government eventually authorized full field development in the 1970's. High-resolution, low-altitude aerial photography obtained at this time was indexed and incorporated into a GIS system, and this provided a basis for surface geologic mapping initiatives as well as locating historical sites from the abortive development of the 1920's. Field staff have created a historic map of the 1920's 'camps' (townsites) in the Teapot Dome oil field area. The author, a petroleum geologist who previously worked at the site, conducted numerous scientific studies of Teapot Dome, including collaborations with academic research partners. This includes subsurface interpretation and modeling in support of field operations, research studies, and enhanced oil recovery opportunities, including carbon dioxide injection. Detailed surface geological mapping was also included in this effort. One project was mapping the Quaternary terraces, both erosional and depositional, and relating those terrace ages to expected soil conditions as well as historic cultural sites.

References Cited


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Well 301, 28,000 BO for 6 days, fractured shale

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Outline

• History
  – Salt Creek
  – Early geologic investigations
  – Teapot Dome Scandal
  – RMOTC

• Geology
  – Mapping Quaternary terraces
  – Surface geologic mapping
  – Research studies

• Future – *For Sale!*
First Was Salt Creek

Aughey, 1886

Beck, 1929

Knight, 1896

Trumbull, 1914
Salt Creek vs Teapot Dome Dome Cumulatives

Salt Creek: 699,026,402 BO
726,375,228 MCFG

Teapot Dome: 28,517,156 BO
62,018,588 MCFG

Salt Creek has produced 25 times more oil than Teapot Dome

Start of CO₂ flood

400,000 BO per month

>13,000 BOPD

5,000 BO per month = 164 BOPD

5,000 BO per month = 164 BOPD
Images of Salt Creek
<table>
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<tr>
<th>Year</th>
<th>Author</th>
<th>Title</th>
<th>Reference</th>
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<tr>
<td>1886</td>
<td>Aughey</td>
<td>Annual Report of the Territorial Geologist to the Governor of Wyoming.</td>
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<td>1888</td>
<td>Ricketts</td>
<td>Annual Report of the Territorial Geologist to the Governor of Wyoming.</td>
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<td>1893</td>
<td>Knight</td>
<td>Salt Creek oil field</td>
<td>Univ. WY Science Series Bulletin 14</td>
</tr>
<tr>
<td>1896</td>
<td>Knight and Slosson</td>
<td>The petroleum of Salt Creek, Wyo</td>
<td>Univ. WY Petroleum Series Bulletin 1</td>
</tr>
<tr>
<td>1911</td>
<td>Wegemann</td>
<td>The Salt Creek oil field, Wyoming (first mention of “Teapot Dome”, first structure map)</td>
<td>U.S. Geological Survey Bulletin 452</td>
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<tr>
<td>1912</td>
<td>Jamison</td>
<td>The Salt Creek Oil Field, Natrona County, Wyoming</td>
<td>State of Wyoming Geologist’s Office, Bulletin 4, Series B</td>
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<td>1914</td>
<td>Trumbull</td>
<td>The Salt Creek Oil Field, Natrona County, Wyoming</td>
<td>State of Wyoming Geologist’s Office, Bulletin 8, Series B</td>
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<td>1923</td>
<td>Wegemann</td>
<td>A report on the position of the dividing line between Salt Creek/ Teapot Dome</td>
<td>67th U.S. Congress, 2nd Session, Senate Document 210</td>
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<td>1923</td>
<td>Lewis</td>
<td>Report of the geological conditions of Teapot Dome</td>
<td>Hearings before the Committee on Public Lands and Surveys: U.S. Senate Resolution 282 &amp; 294</td>
</tr>
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<td>1925</td>
<td>Estabrook and Rader</td>
<td>History of production of Salt Creek oilfield, Wyoming</td>
<td>Amer. Inst. of Mining, Metal., and Petrol. Engineers Transactions no. 5103</td>
</tr>
<tr>
<td>1926</td>
<td>Estabrook and Rader</td>
<td>Petroleum development and technology in 1925</td>
<td>Amer. Inst. of Mining, Metal., and Petrol. Engineers Transactions no. 1570</td>
</tr>
<tr>
<td>1927</td>
<td>Link</td>
<td>Origin and significance of “epi-anticlinal” faults as revealed by experiments</td>
<td>AAPG Bulletin, vol. 11</td>
</tr>
<tr>
<td>1929</td>
<td>Beck</td>
<td>Salt Creek Oil Field, Natrona County, Wyoming</td>
<td>Structure of Typical American oil fields, vol. II: AAPG</td>
</tr>
<tr>
<td>1930</td>
<td>Trexel</td>
<td>Compilation of data on Naval Petroleum Reserve No. 3 (Teapot Dome), Natrona County, Wyoming</td>
<td>Report to Director, Naval Petroleum and Oil Shale Reserves-Colorado, Utah, and Wyoming</td>
</tr>
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<td>1931</td>
<td>Stabler</td>
<td>Waters of the Salt Creek-Teapot Dome uplift</td>
<td>U.S. Geological Survey Professional Paper 163</td>
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</table>
First Mapping

Carroll H. Wegemann, USGS geologist, completed the first comprehensive study of the Salt Creek Field area in 1911 (USGS Bulletin 452), including Teapot Dome, shown here – the first structure map made and prior to any drilling. He was also the first to name the structure “Teapot Dome”, after Teapot Creek.

Teapot Rock
Naval Petroleum Reserves Are Born

• 1908: Dr. Otis Smith, USGS Director, recommends DOI retain oil lands for fuel reserve for Navy.

• 1909: President Taft withdraws 3,000,000 acres in WY and CA.

• 1910: Concern over the President’s authority to withdraw lands, so Congress passes the Pickett Act.

• 1910: Withdrawn lands over Salt Creek Field reinstated, but Teapot Dome area remains off limits

• 1912: President Taft Executive Order creates NPR-1 and NPR-2 in California.

• 1915: President Wilson Executive Order creates NPR-3 at Teapot Dome.

George Otis Smith, Director of the U.S. Geological Survey, 1907-1930.
Revision - 1918

Wegemann published a revised study of the Salt Creek Field area (USGS Bulletin 670). His 1918 map adds two Shannon wells on the west flank (just outside the NPR-3 boundary) and extended the anticlinal crest southward.

Image: USGS

Field work in the Salt Creek/Teapot Dome area 1910-1920

Contours on First Wall Creek
The Scandal Begins

- 1921: Senator Albert Fall (NM) becomes President Harding's Secretary of the Interior, has NPRs moved to DOI, then quickly moves to open reserves to private exploitation.
- 3/22: Sinclair buys and quitclaims all existing mining claim rights at Teapot Dome, and applies for a lease on all of Teapot Dome.
- 4/22: Mammoth is secretly awarded a noncompetitive lease covering all of Teapot Dome, with no restrictions.

U.S. Marines land at Teapot Dome, 1922, eject Mutual Oil Co. squatters!
Teapot Dome Scandal – the Utah Connection

Tom Chidsey’s grandfather Senator Reed Smoot of Utah, Tom Chidsey’s great-grandfather President Calvin Coolidge.
Congress Investigates

- 8/23: Harding dies, and Coolidge becomes President.
- 10/23: Senate Committee hearings are convened.
- Investigators find that the Sinclair leases were fraudulent, and that EO 3474, transferring lands from Navy to DOI, was illegal and should be set aside.
- 3/24: U.S. files suit to cancel Mammoth’s Teapot Dome lease.
- 3/27: President Coolidge EO 4614 overturns EO 3474, and returns NPRs to Navy control.
- 10/27: Supreme Court rules in favor of U.S. and immediately shuts in Teapot Dome.
- 2/28: Just to be sure, Congress passes an Act to transfer jurisdiction of NPRs from DOI back to the Navy.
- 1930: Lt. Trexel Report
Historic Photos of Teapot Dome, 1927

North
Geologic Maps after the 1920s

Beck, 1929, AAPG Structure Symposium

Thom and Spieker, 1931, USGS PP 163
Teapot Dome Since The 1920s

- Some exploratory and drainage offset wells were drilled in the ‘50s and ‘60s.
- NPR-1 and NPR-3 opened to full development in 1976.
- 1977: NPR jurisdiction transferred from Navy to (newly created) DOE. William H. ‘Skip’ Curry publishes excellent AAPG Bulletin summary article
- Subsequent development and IOR projects raised rates to 5000 BOPD in 1979-80.
- 1995 - present: Rocky Mountain Oilfield Testing Center.
  - 1998: NPR-1 (Elk Hills, CA) sold to Occidental
  - 2000: NOSR-2 transferred to Ute Tribe, and NOSR-1, NOSR-3, and NPR-2 (Buena Vista Hills, CA) transferred to DOI
- 3D Seismic acquired in 2001; multiple testing projects; surface mapping
- Current production is 150-200 BOPD.

The latest: Teapot Dome is for sale! Bid package out in 2014
What Happened to Teapot Rock?

Over time, the features that gave the formation its name have been eroded by storms; the "handle" disappeared in 1930 and the "spout" in 1962.
“Best Second Wall Creek well in the field”
Well 402-20
22nd well drilled, 20 Feb 1923
Cost $30,000
IP 8000 BOPD
Flowing 510 BOPD March, 1924
Cum 582,000 BO 31 Dec 1927
Sinclair Pump Station

1927

2008

1976 air photo

North

2006 aeromag
3D Seismic Survey – 2001

2D lines, 1977
Fracturing and Faulting at Teapot Dome

Left: Conjugate normal faults and fractures in outcrop. Photo from Scott Cooper, Sandia National Laboratory.

Right: Location of Casper, Teapot Dome, and Alcova.

Below: The Alcova Anticline, a Teapot Dome analog. Shown is the northwest canyon wall. Photo from Neil Hurley, Colorado School of Mines.
Mapping Quaternary Terraces

- T3 (oldest, 10,000 YBP)
- T2 (2,000 YBP)
- T1 (500 YBP)
- T0 (present stream)
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<th>Period</th>
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<td>195</td>
<td>30</td>
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<td>Shannon</td>
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<td>Upper</td>
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**Surface Mapping**

- **Steele Shale**
- **Bentonites**
- **Sussex Sand**
- **T0 terrace**
- **T1 terrace**
- **T2 terrace**
- **T3 terrace**

**Legend**
- Faults
- Terraces
Research Partners

- University of Houston
- Stanford University
- University of Wyoming
- Enhanced Oil Recovery Institute (UW)
- Wyoming State Geological Survey
- University of Manchester
- Cambridge University
- Energy and Geoscience Institute
- Energistics
- Public Petroleum Data Model
- ESRI
- National Energy Technology Laboratory
- Colorado School of Mines
- Colorado Energy Research Institute
- Lawrence Livermore National Laboratory
- Princeton University
- West Virginia University
- Brigham Young University
- Sandia National Laboratory
- Southwest Research Institute
- U. S. Geological Survey
- Texas A&M University
- Lawrence Berkeley National Laboratory
- Los Alamos National Laboratory

Many theses, dissertations, open-file reports, and other publications are available for Teapot Dome scientific research, building upon a rich legacy of early historic studies and operations at Teapot Dome.