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

Tom Anderson[1]

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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

Aughey, S., 1886, Annual Report of the Territorial Geologist to the Governor of Wyoming, January 1886: Publisher – Unknown, Laramie WY, 120 p.

Beck, A., 1929, Salt Creek Oil Field, Natrona County, Wyoming: Structure of Typical American Oil Fields, v. 2, p. 589-603.

Curry, W.H., Jr., 1977, Teapot Dome-Past, Present, and Future: AAPG Bulletin, V. 61/5, p. 671-697.

Knight, W.C., and E.E. Slosson, 1896, The Petroleum of Salt Creek, Wyoming: University of Wyoming, Petroleum Series Bulletin 1, 47 p.

Thom, W.T., Jr., and E.M. Spieker, 1931, The significance of geologic conditions in Naval Petroleum Reserve No. 3, Wyoming: U.S. Geological Survey Professional Paper, Report # P 0163, 64 p.

Trumbull, L.W., 1914, The Salt Creek Oil Field, Natrona County, Wyoming: State of Wyoming Geologist's Office, Bulletin 8, Series B., p. 103-148.

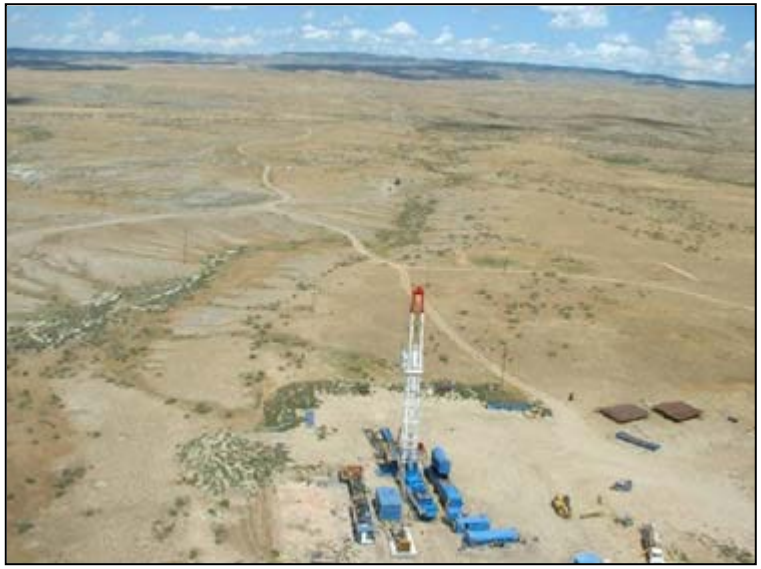
Trexel, C.A., 1930, Compilation of data on Naval Petroleum Reserve No. 3 (Teapot Dome), Natrona County, Wyoming: Report to the Director Naval Petroleum and Oil Shale Reserves, 248 p.

Wegemann, C.H., 1911, The Salt Creek Oil Field, Wyoming: United States Geological Survey Bulletin 452, p. 37-82.

Wegemann, C.H., 1918, The Salt Creek oil field, Wyoming, United States Geological Survey Bulletin 670, 52 p.

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

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



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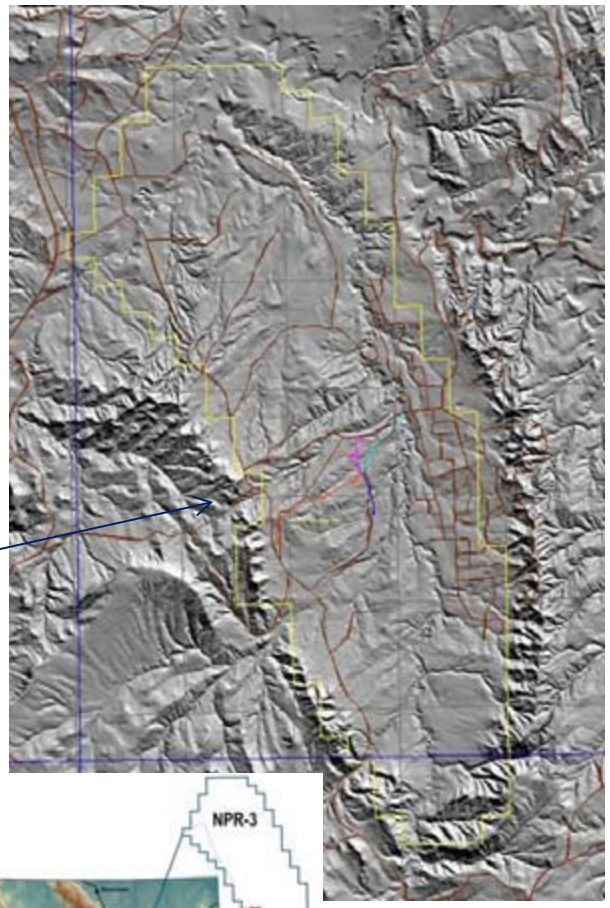
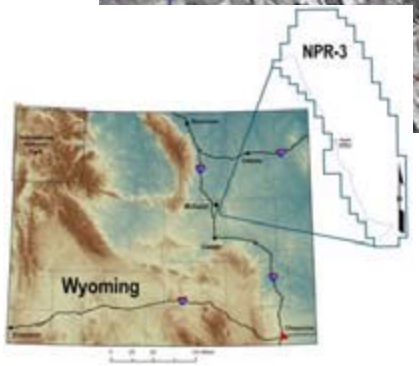
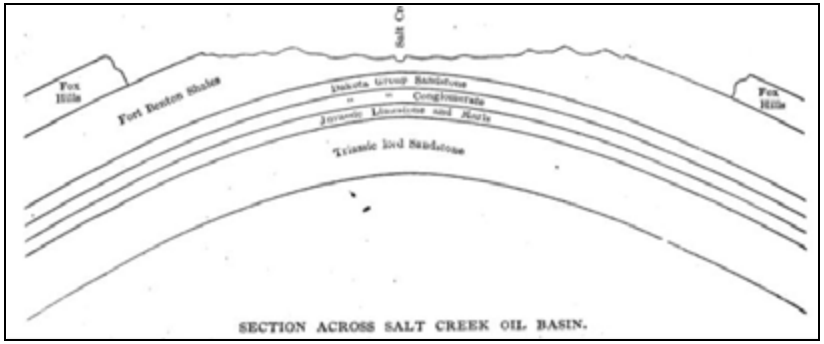
Outline

- History
  - Salt Creek
  - Early geologic investigations
  - Teapot Dome Scandal
  - RMOTC
- Geology
  - Mapping Quaternary terraces
  - Surface geologic mapping
  - Research studies
- Future – *For Sale!*



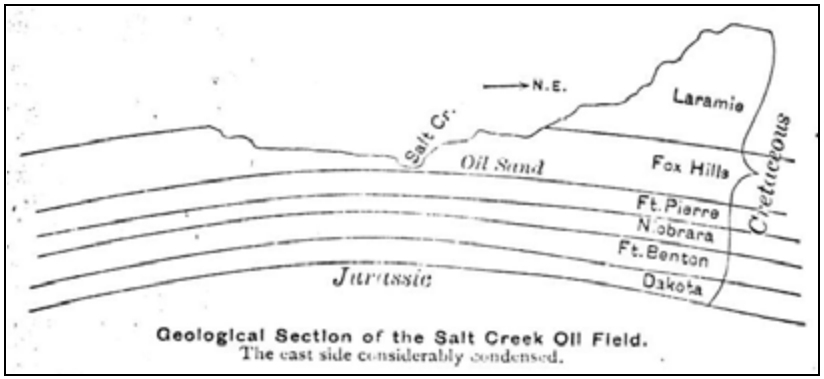


First Was Salt Creek



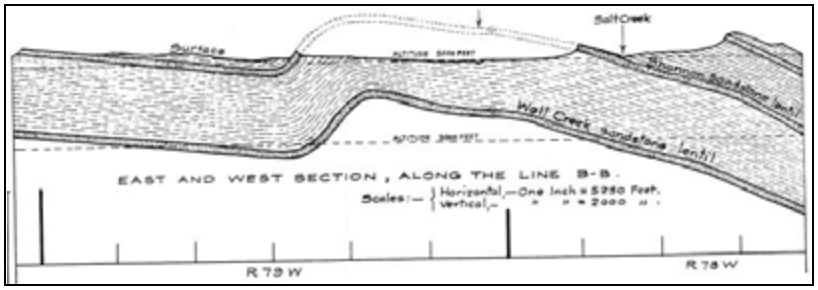
SECTION ACROSS SALT CREEK OIL BASIN.

Aughey, 1886

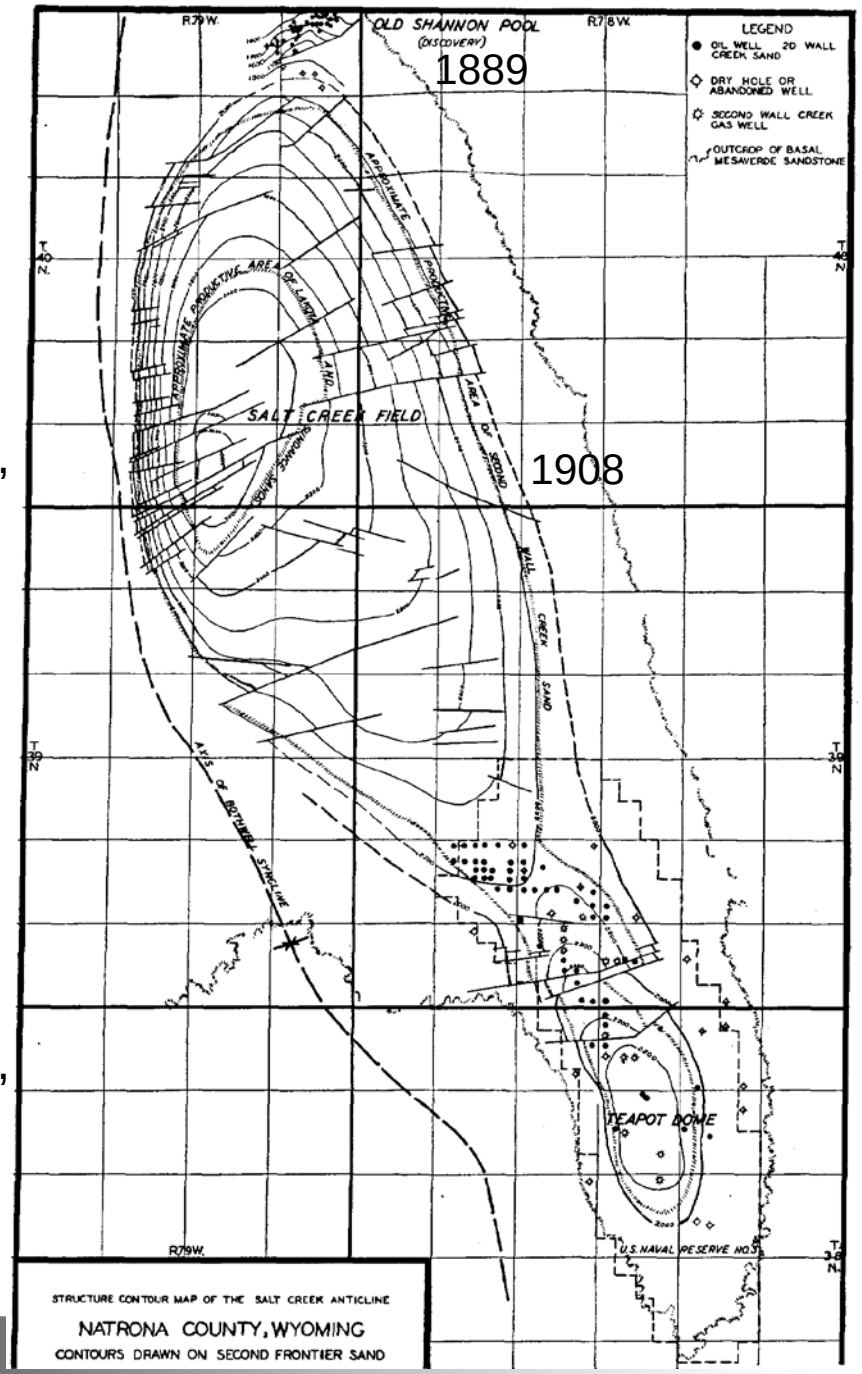


Geological Section of the Salt Creek Oil Field.
The east side considerably condensed.

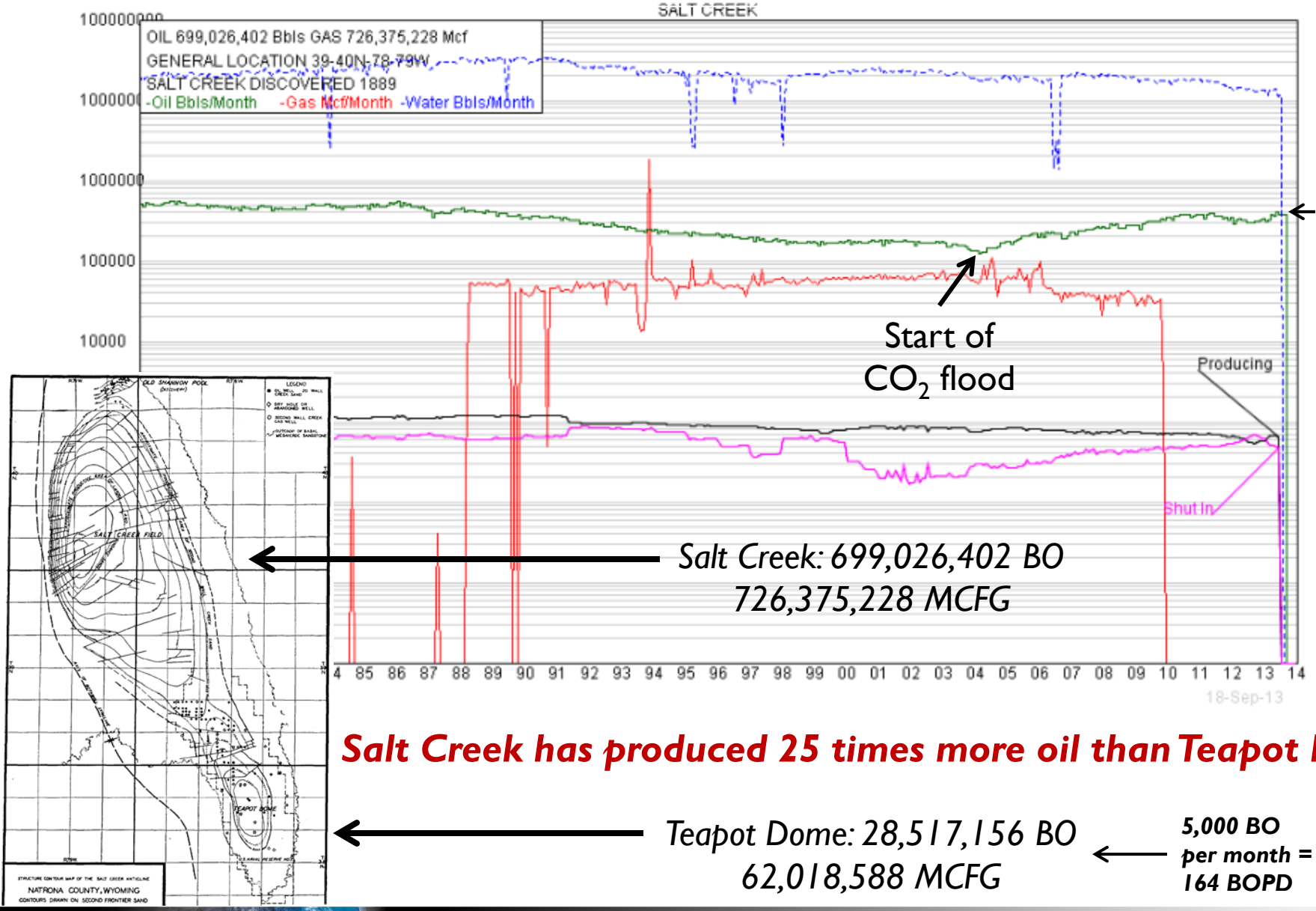
Knight, 1896



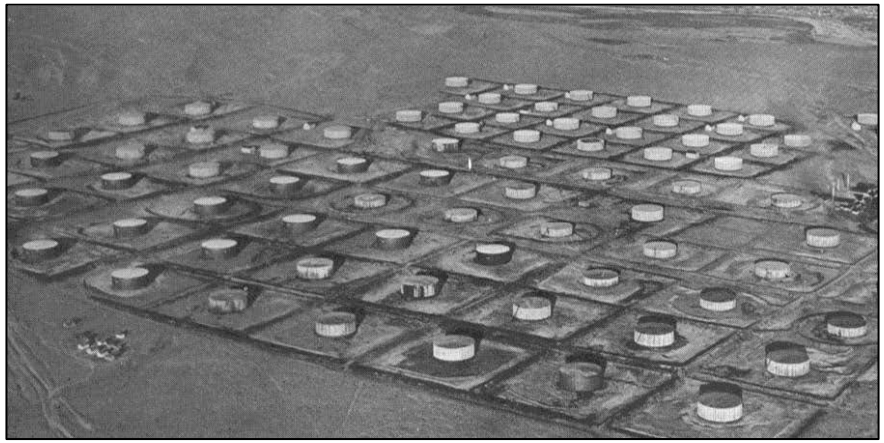
Trumbull, 1914



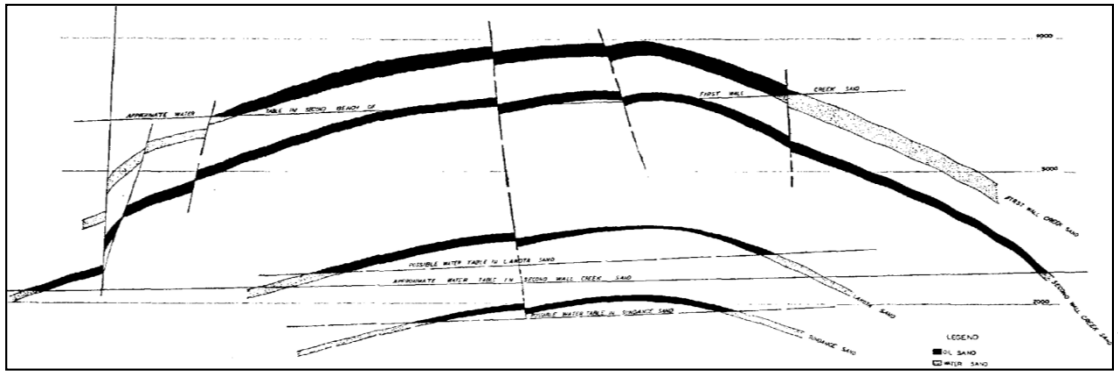
Salt Creek vs Teapot Dome Cumulatives

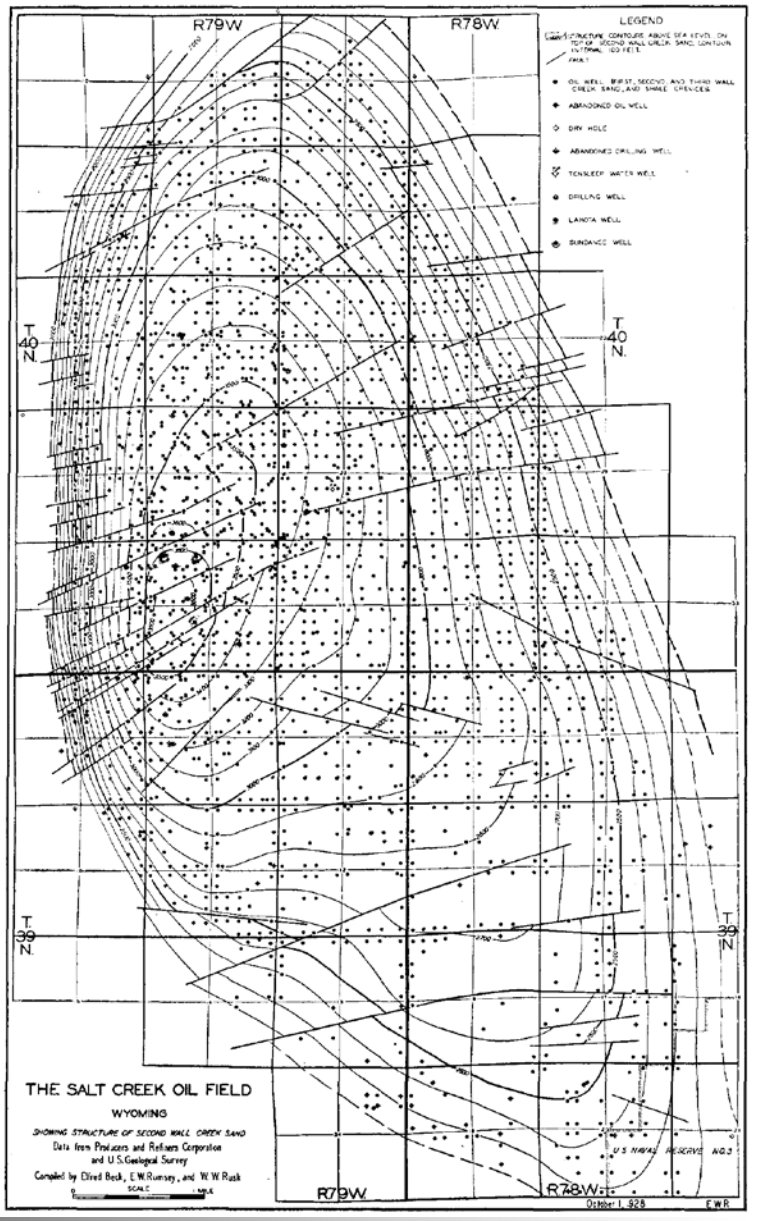


Images of Salt Creek



Images of Salt Creek 2



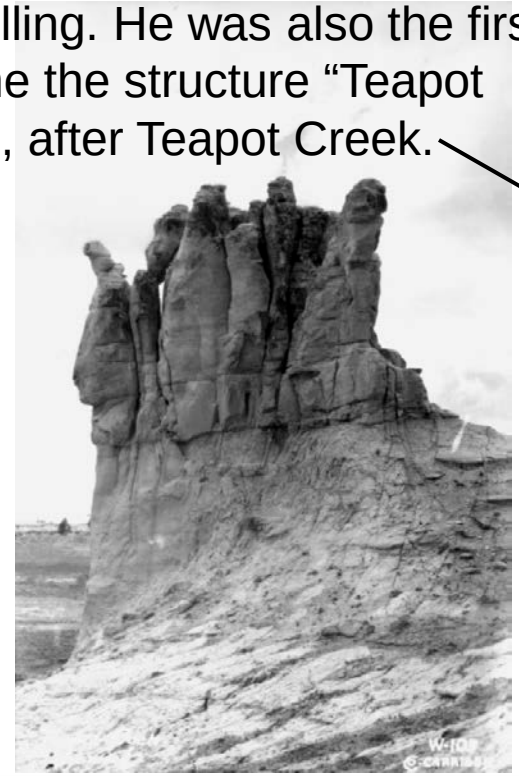


Early Geology: selected reference table, 1886-1931

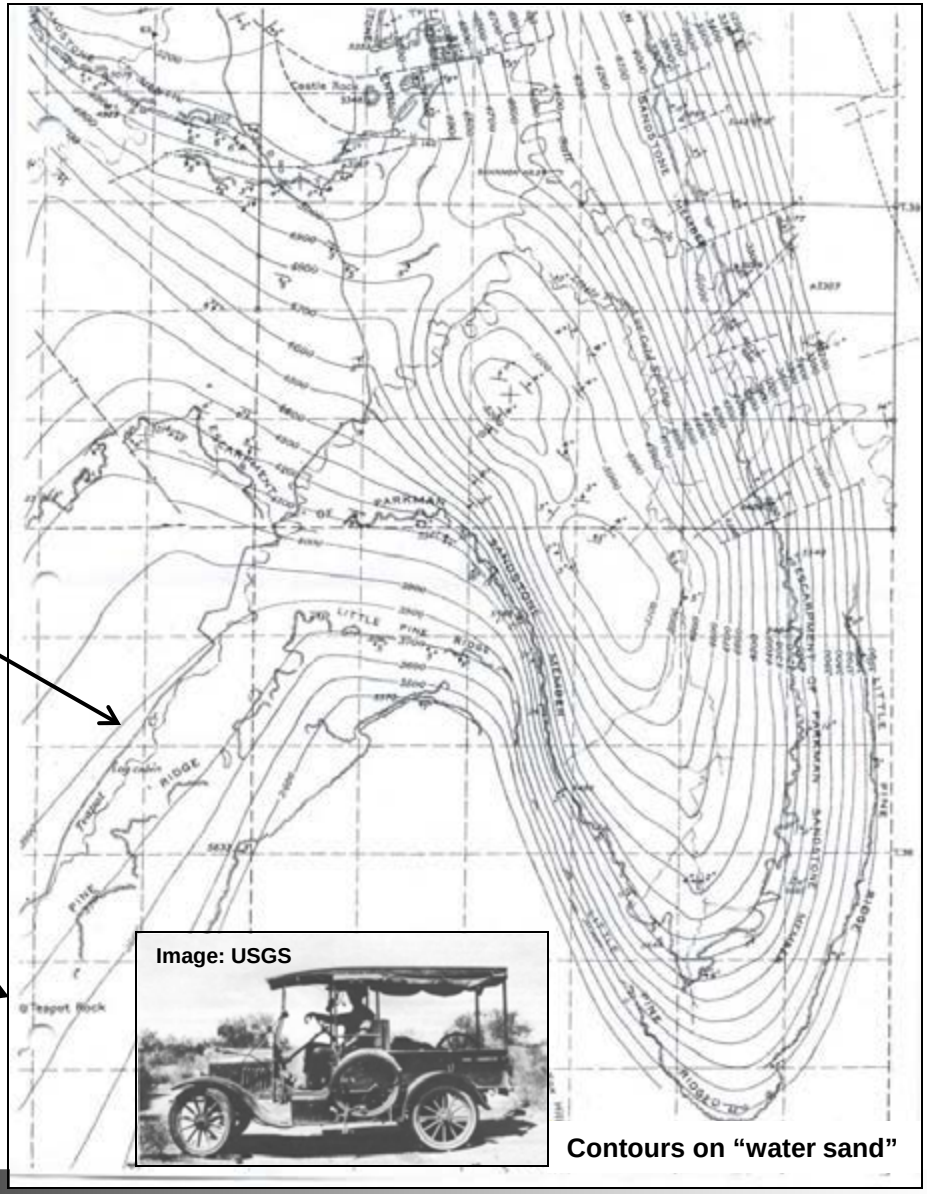
Year	Author	Title	Reference
1886	Aughey	Annual Report of the Territorial Geologist to the Governor of Wyoming.	
1888	Ricketts	Annual Report of the Territorial Geologist to the Governor of Wyoming.	
1893	Knight	Salt Creek oil field	Univ. WY Science Series Bulletin 14
1896	Knight and Slosson	The petroleum of Salt Creek, Wyo	Univ. WY Petroleum Series Bulletin 1
1911	**Wegemann**	**The Salt Creek oil field, Wyoming *(first mention of "Teapot Dome", first structure map)***	**U.S. Geological Survey Bulletin 452**
1912	Jamison	The Salt Creek Oil Field, Natrona County, Wyoming	State of Wyoming Geologist's Office, Bulletin 4, Series B
1914	Trumbull	The Salt Creek Oil Field, Natrona County, Wyoming	State of Wyoming Geologist's Office, Bulletin 8, Series B
1918	Wegemann	The Salt Creek oil field, Wyoming	U.S. Geological Survey Bulletin 670
1923	Wegemann	A report on the position of the dividing line between Salt Creek/ Teapot Dome	67th U.S. Congress, 2nd Session, Senate Document 210
1923	Lewis	Report of the geological conditions of Teapot Dome	Hearings before the Committee on Public Lands and Surveys: U.S. Senate Resolution 282 & 294
1925	Estabrook and Rader	History of production of Salt Creek oilfield, Wyoming	Amer. Inst. of Mining, Metal., and Petrol. Engineers Transactions no. 5103
1926	Estabrook and Rader	Petroleum development and technology in 1925	Amer. Inst. of Mining, Metal., and Petrol. Engineers Transactions no. 1570
1927	Link	Origin and significance of "epi-anticlinal" faults as revealed by experiments	AAPG Bulletin, vol. 11
1929	Beck	Salt Creek Oil Field, Natrona County, Wyoming	Structure of Typical American oil fields, vol. II: AAPG
1930	**Trexel**	**Compilation of data on Naval Petroleum Reserve No. 3 (Teapot Dome), Natrona County, Wyoming**	**Report to Director, Naval Petroleum and Oil Shale Reserves-Colorado, Utah, and Wyoming**
1931	Stabler	Waters of the Salt Creek-Teapot Dome uplift	U.S. Geological Survey Professional Paper 163
1931	**Thom and Spieker**	**The significance of geologic conditions in Naval Petroleum Reserve No. 3, Wyo**	**U.S. Geological Survey Professional Paper 163**

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



Contours on “water sand”

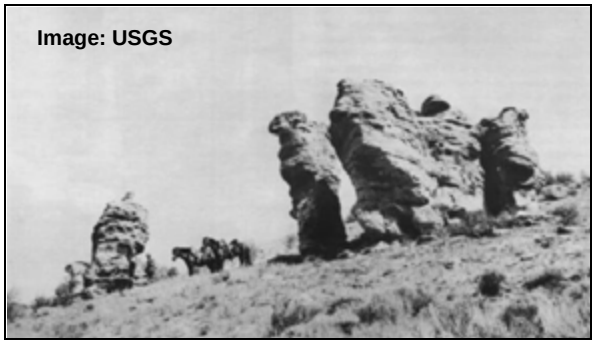
Naval Petroleum Reserves Are Born

- 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.

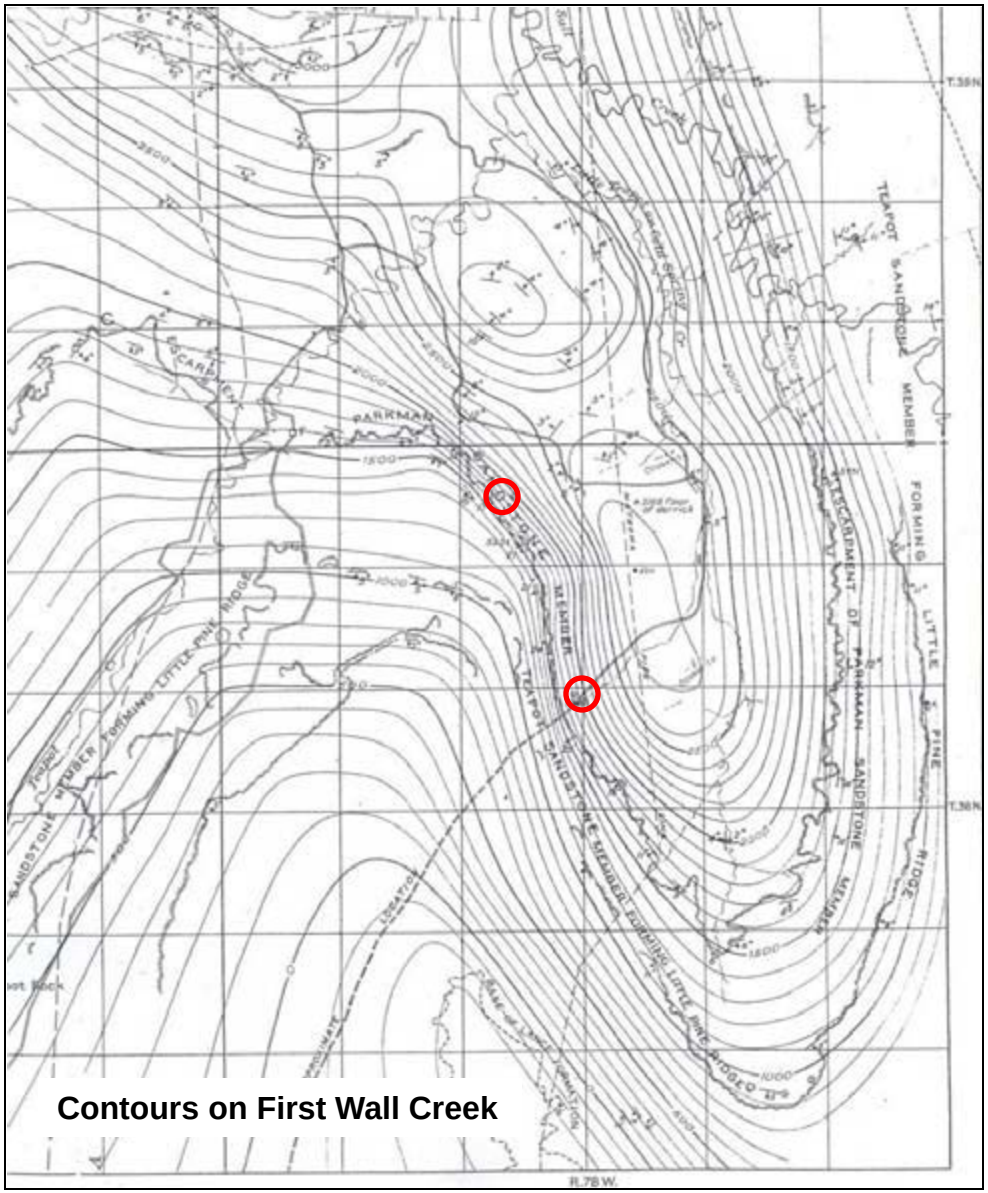
George Otis Smith, Director of the U.S. Geological Survey, 1907-1930.

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.

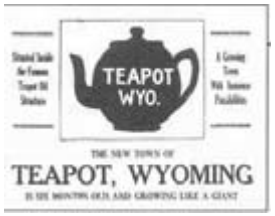


Field work in the Salt Creek/Teapot Dome area 1910-1920



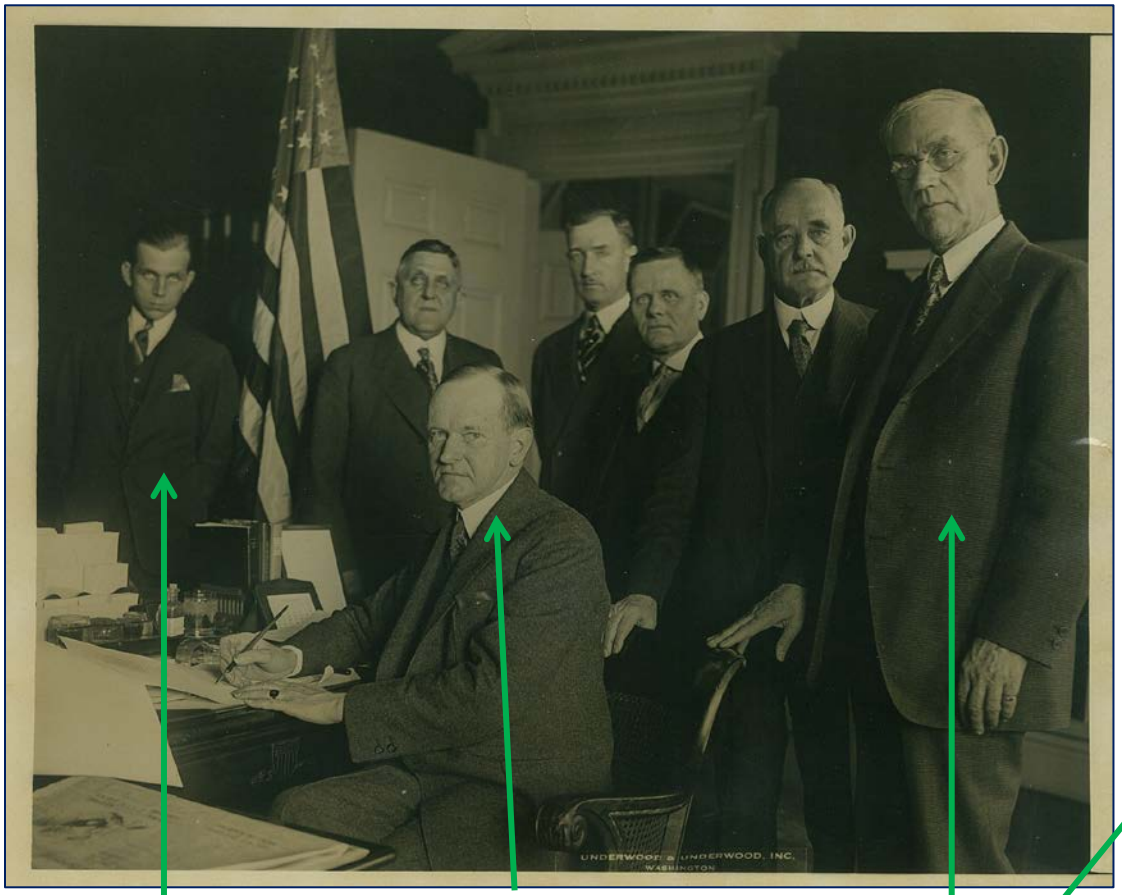
The Scandal Begins

U.S. Marines land at Teapot Dome, 1922, eject Mutual Oil Co. squatters!



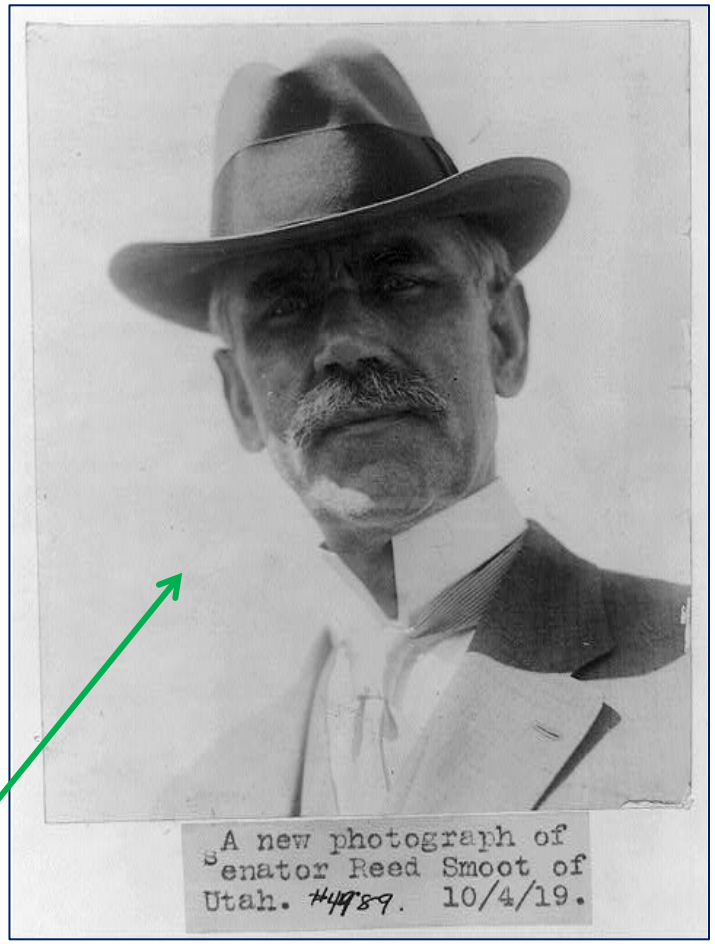
- 1921: Senator Albert Fall (NM) becomes President Harding's Secretary of the Interior, has NPRs moved to DOI, then quickly moves to open reserves to private exploitation.
- 2/22: Harry Sinclair incorporates Mammoth Oil Company.
- 3/22: Sinclair buys and quitclaims all existing mining claim rights at 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.
- 4/22: Congress calls for an investigation of NPR-3.

Teapot Dome Scandal – the Utah Connection



President Calvin Coolidge

Tom Chidsey's grandfather



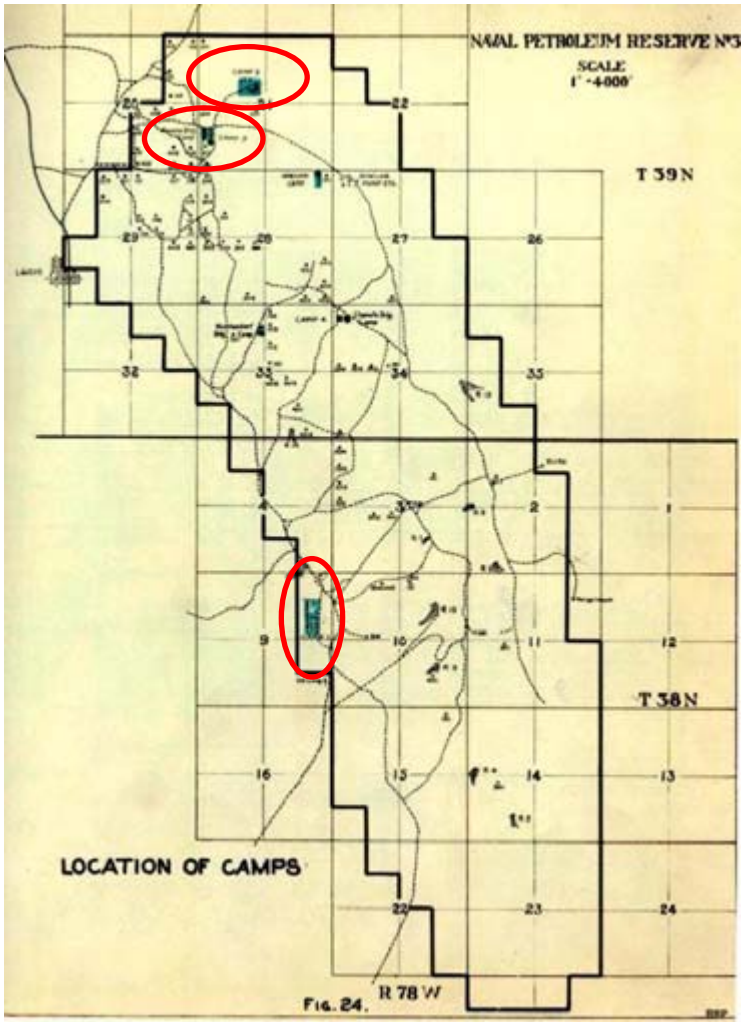
Senator Reed Smoot of Utah, Tom Chidsey's great-grandfather

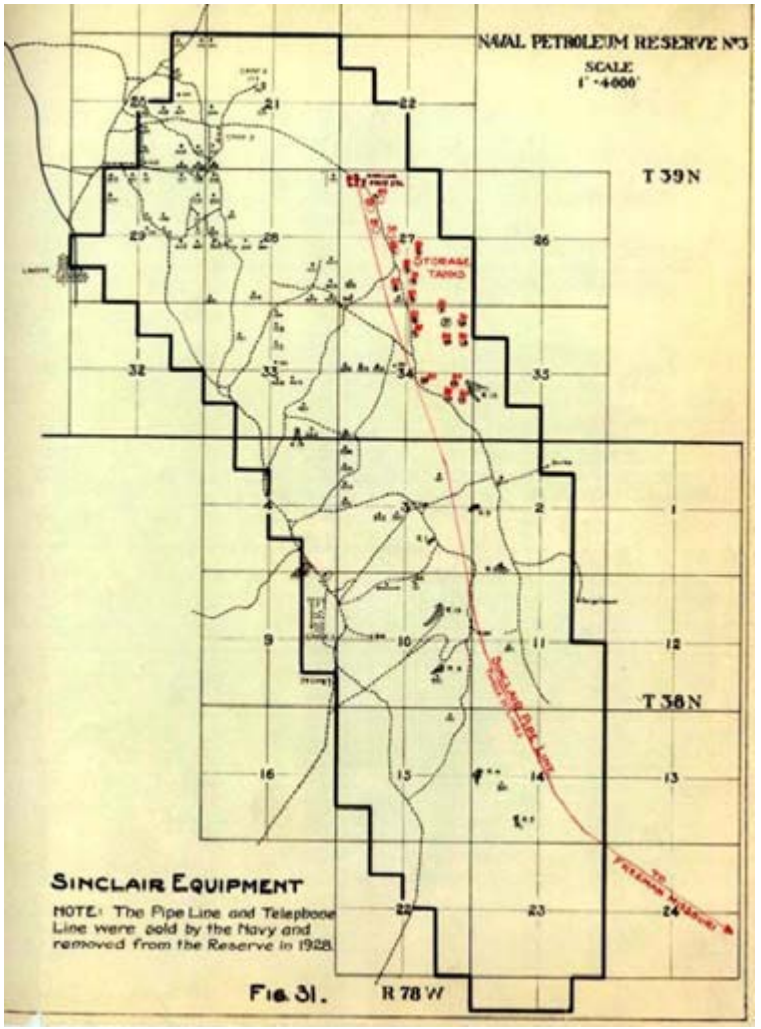
Congress Investigates

- 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.

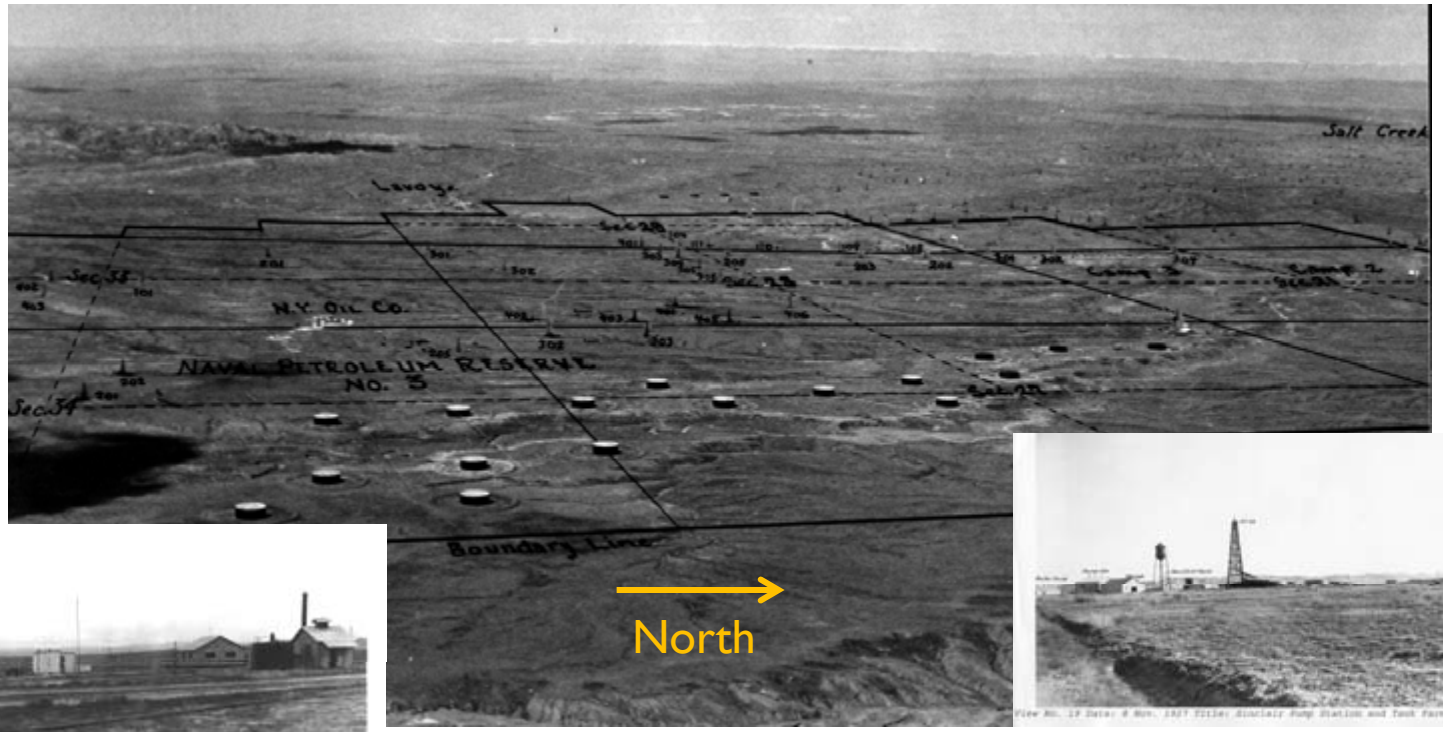
- 3/24: U.S. files suit to cancel Mammoth's Teapot Dome lease.
- 6/25: Court overrules the U.S., and upholds Sinclair. The U.S. appeals.
- 3/27: President Coolidge EO 4614 overturns EO 3474, and returns NPRs to Navy control.
- 10/27: Supreme Court rules in favor of U.S. and immediately shuts in Teapot 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

Maps from Trexel Report, 1930





Historic Photos of Teapot Dome, 1927

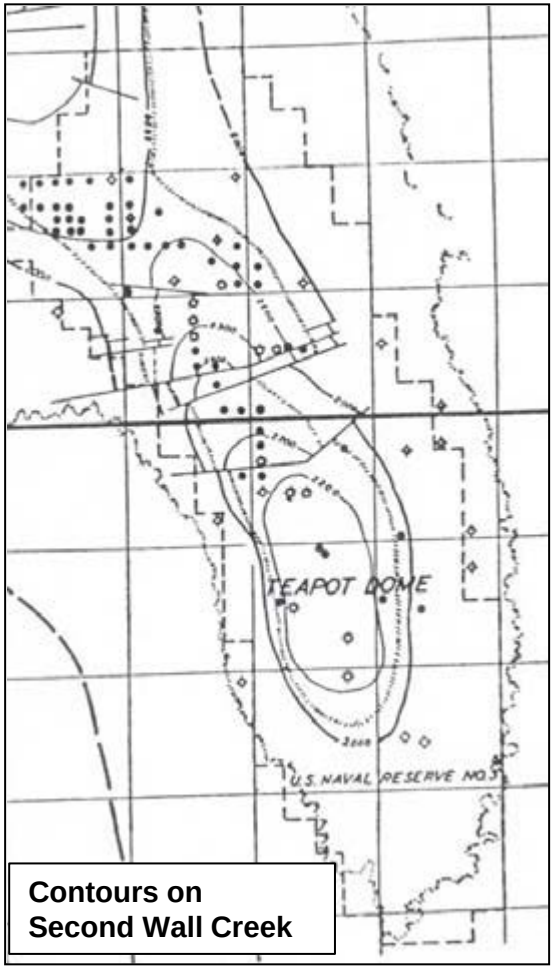


Geologic Maps after the 1920s

Teapot Dome Geologic Column

Natrona County, Wyoming
T 38 & 39 N R 78 W

Period	Formation		Lithology	Thickness	Depth (feet)	Productive
				195		
Upper Cretaceous	Steele	Sussex		30		□
				290	225	
		Shannon		120	515	■
				1355	635	◙
	Niobrara Shale			450	1990	◙
	Carlisle Shale			240	2440	□
	Frontier	1st Wall Creek		160	2680	□
				245	2840	
		2nd Wall Creek		65	3085	■
				175	3150	
		3rd Wall Creek		5	3325	◙
				265	3330	
Lower Cretaceous	Mowry Shale			230	3595	
	Muddy Sandstone			15	3825	◙
	Thermopolis Shale			135	3840	
	Dakota			85	3975	◙
	Lakota			10	4060	◙
Jurassic	Morrison			270	4070	□
	Sundance	Upper		95	4340	
		Lower		150	4435	□
Triassic	Chugwater Group	Crow Mtn		80	4585	
		Alcova LS		20	4665	
		Red Peak		520	4685	□
Permian	Goose Egg			320	5205	□
Pennsylvanian	Tensleep			320	5525	■
	Amsden			160	5845	
Mississippian	Madison			300	6005	
Cambrian through Devonian	Undifferentiated			780	6305	
Pre-Cambrian	Granite				7085	



Contours on Second Wall Creek

Beck, 1929, AAPG Structure Symposium

Contours on "water sand"

Thom and Spieker, 1931, USGS PP 163

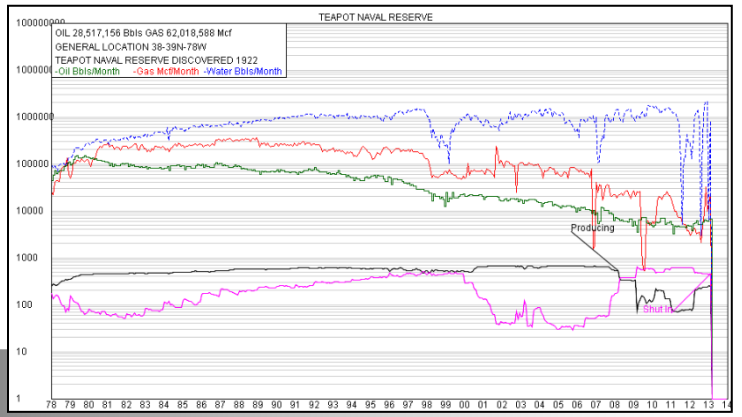
Teapot Dome Since The 1920s

- 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

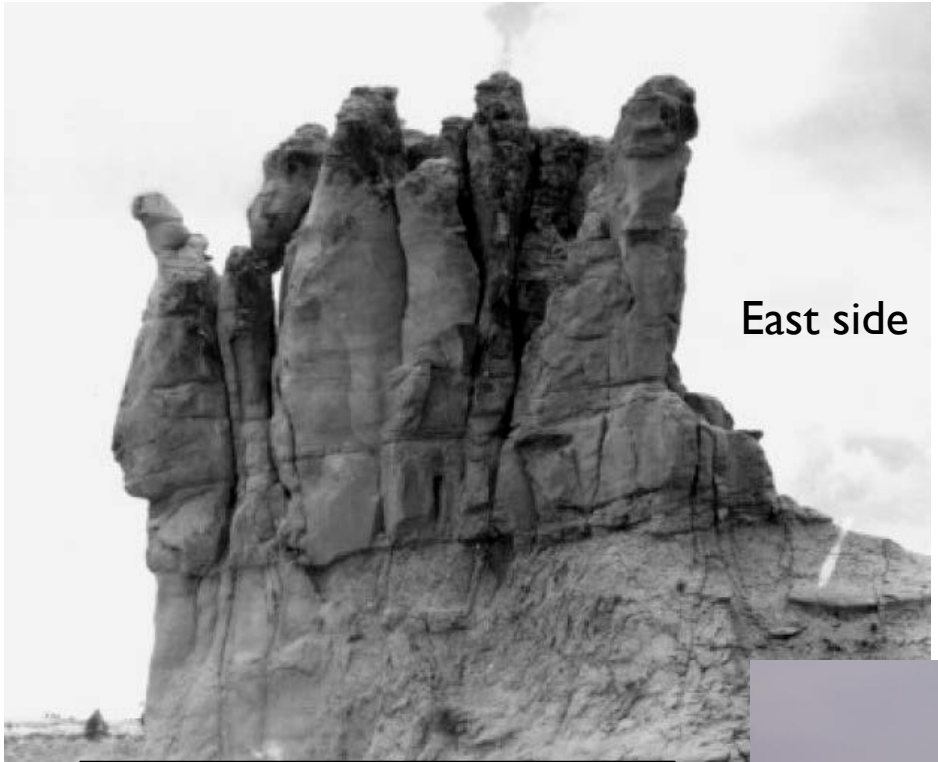
RMOTC
Rocky Mountain Oilfield Testing Center

- 3D Seismic acquired in 2001; multiple testing projects; surface mapping
- Current production is 150-200 BOPD.

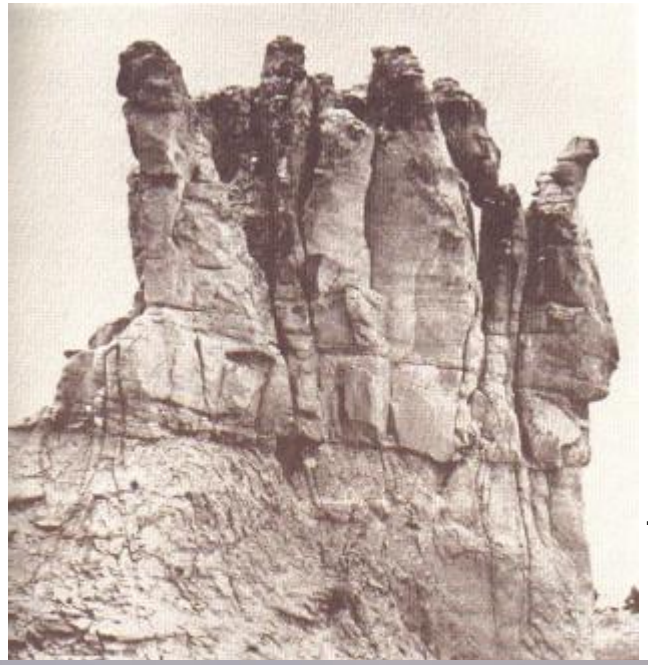
The latest: Teapot Dome is for sale! Bid package out in 2014



What Happened to Teapot Rock?



East side



East side, flipped

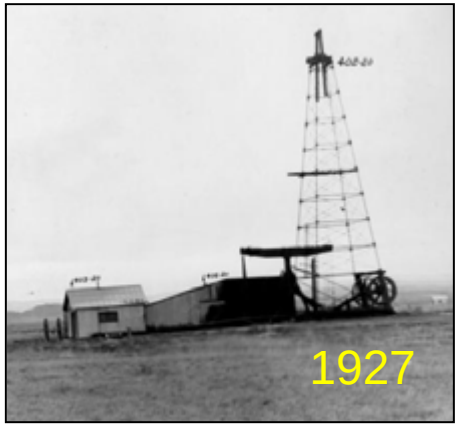
Over time, the features that gave the formation its name have been eroded by storms; the "handle" disappeared in 1930 and the "spout" in 1962

West side

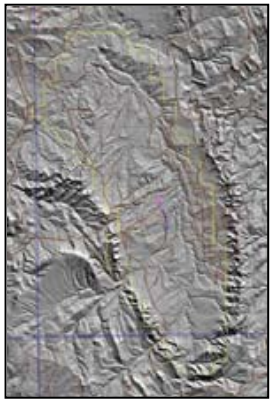
Teapot Rock today

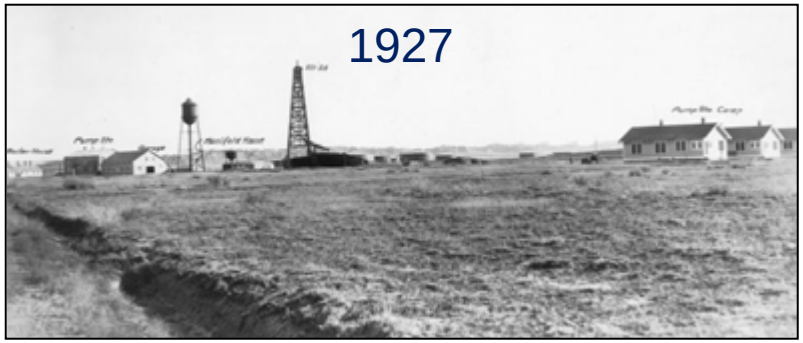
Then and Now

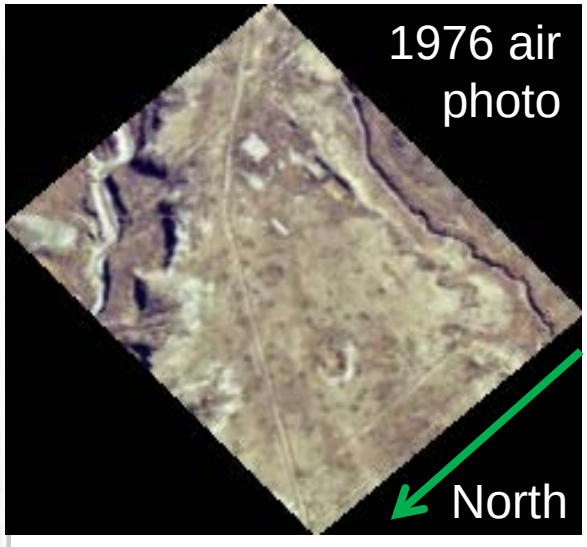
"Best Second Wall Creek well in the field"
Well 402-20
22nd well drilled, 20 Feb 1923
Cost $30,000
IP 8000 BOPD
Flowing 510 BOPD March, 1924
Cum 582,000 BO 31 Dec 1927

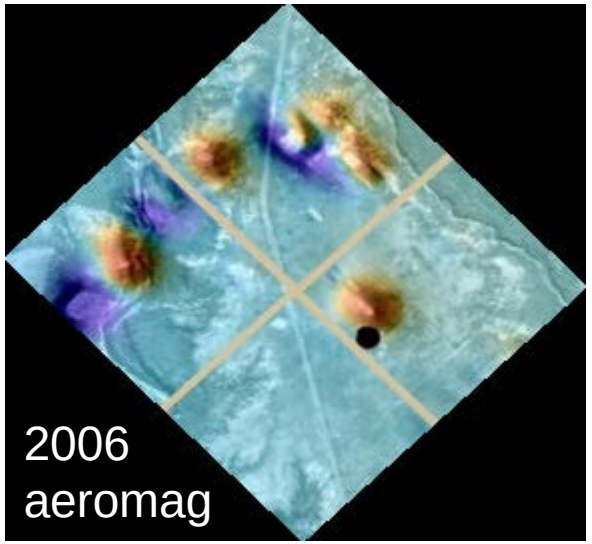


Sinclair Pump Station

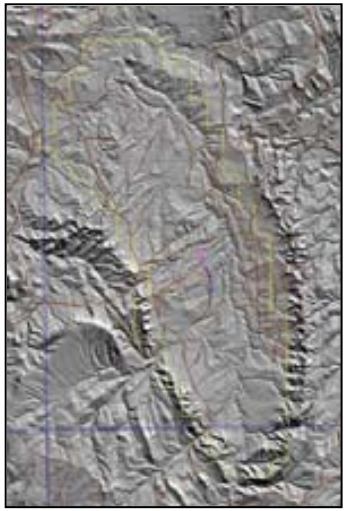






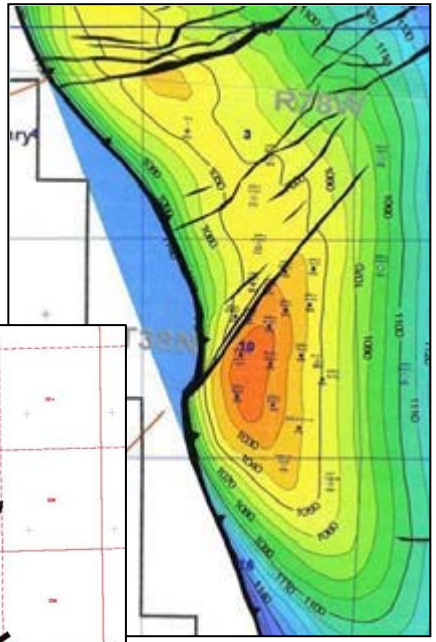


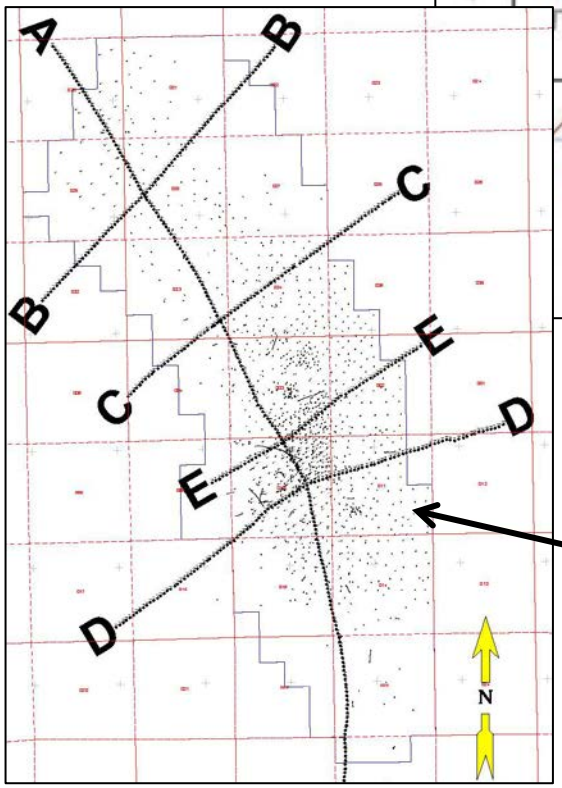
“Pumping Power” – Boiler House



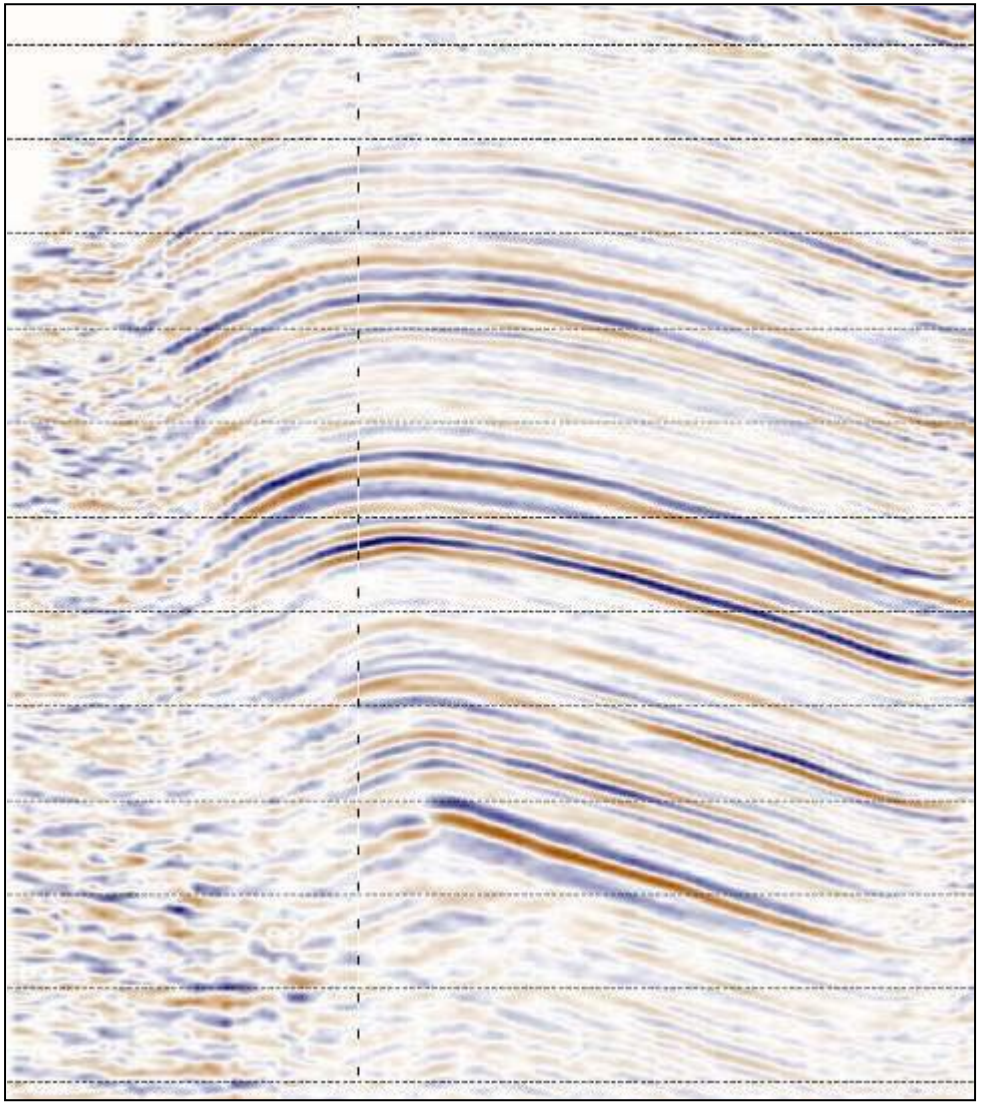
North

3D Seismic Survey – 2001

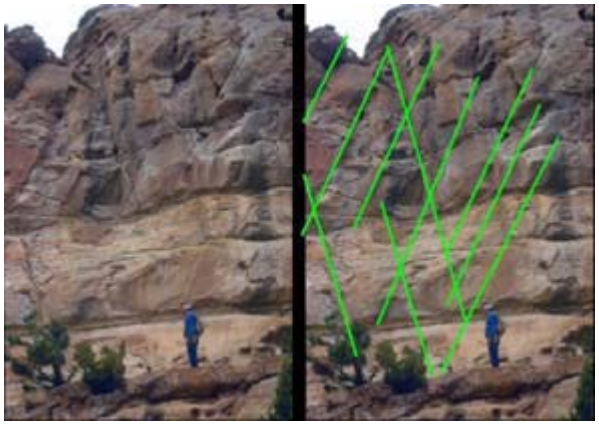




2D lines, 1977

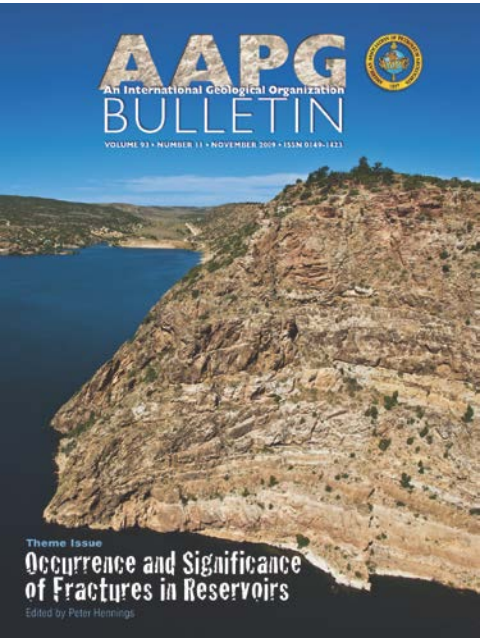


Fracturing and Faulting at Teapot Dome



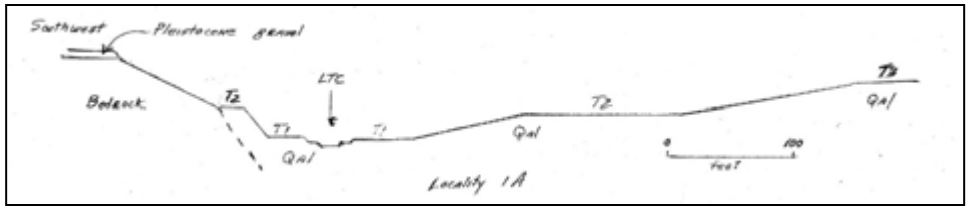
Left: Conjugate normal faults and fractures in outcrop. Photo from Scott Cooper, Sandia National Laboratory.

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

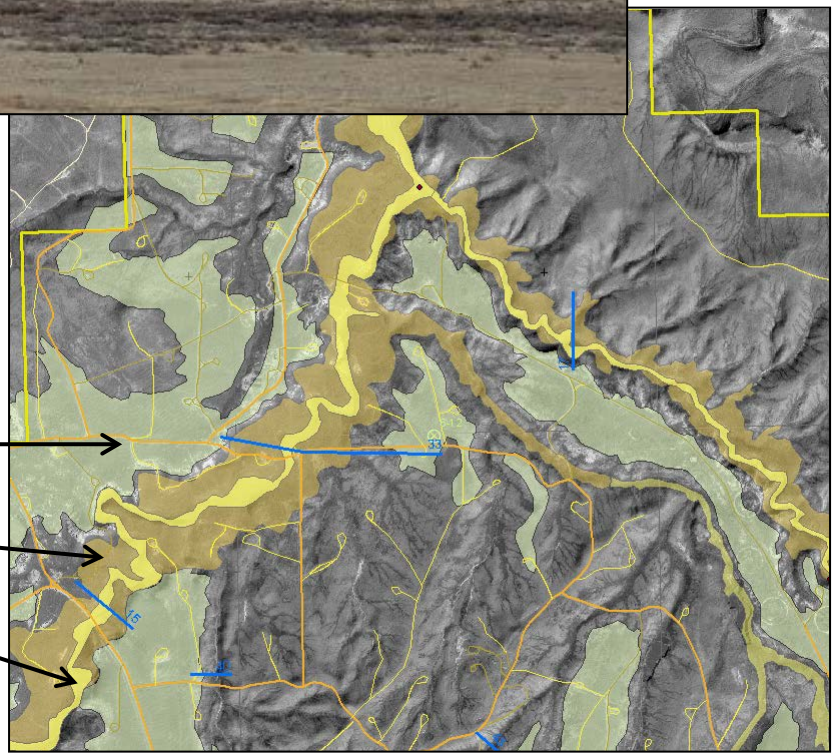


Below: The Alcova Anticline, a Teapot Dome analog. Shown is the northwest canyon wall. Photo from Neil Hurley, Colorado School of Mines.

Mapping Quaternary Terraces



- T3 (oldest, 10,000 YBP)
- T2 (2,000 YBP)
- T1 (500 YBP)
- T0 (present stream)

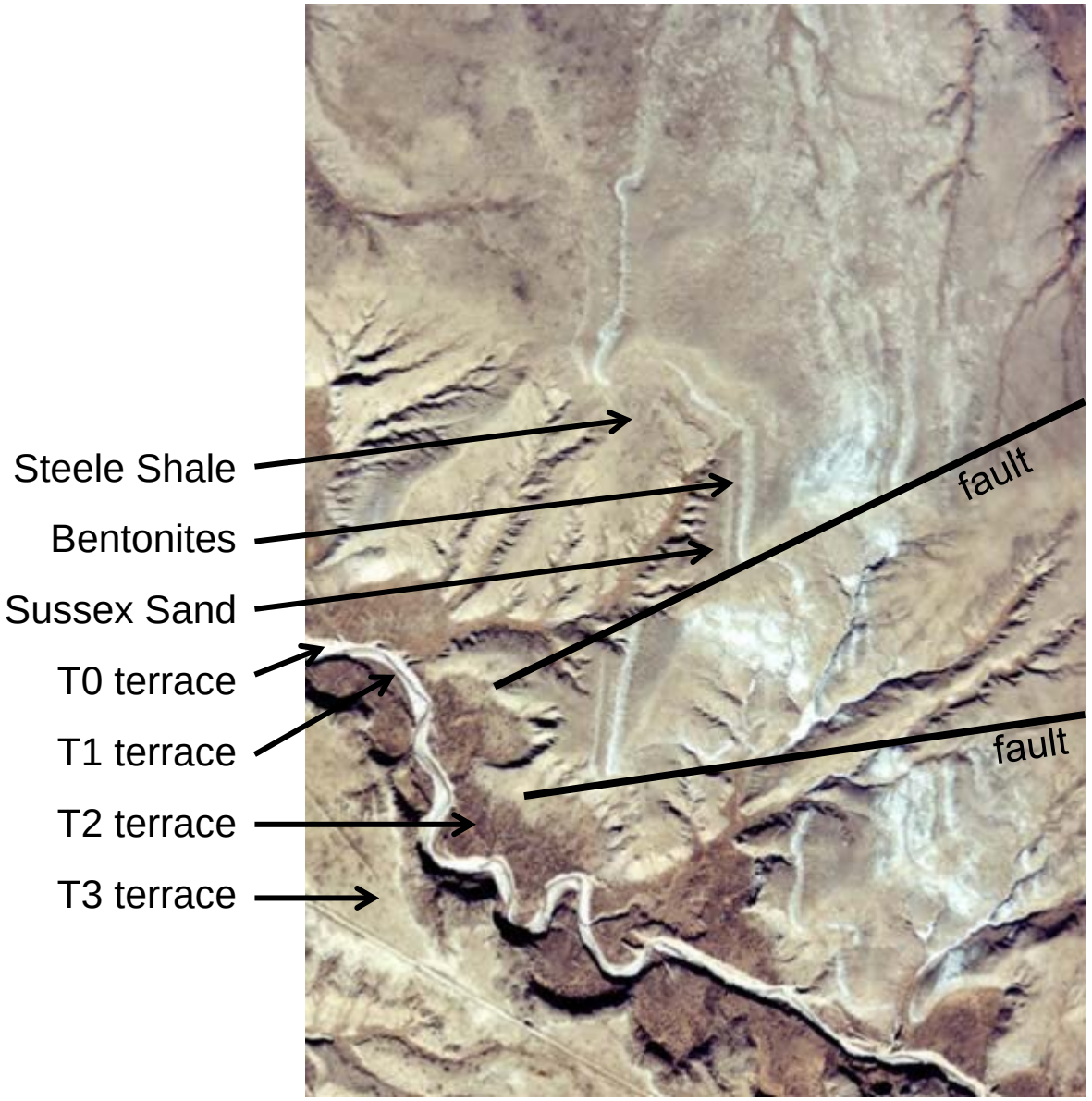


Surface Mapping

Teapot Dome Geologic Column

Natrona County, Wyoming
T 38 & 39 N R 78 W

Period	Formation		Lithology	Thickness	Depth (feet)	Productive
Upper Cretaceous	Steele			195		
		Sussex		30		□
				290	225	
		Shannon		120	515	■
				1355	635	◙
	Niobrara Shale			450	1990	◙
	Carlisle Shale			240	2440	□
	Frontier	1st Wall Creek		160	2680	□
				245	2840	
		2nd Wall Creek		65	3085	■
				175	3150	
		3rd Wall Creek		5	3325	◙
				265	3330	
Lower Cretaceous	Mowry Shale			230	3595	
	Muddy Sandstone			15	3825	◙
	Thermopolis Shale			135	3840	
	Dakota			85	3975	◙
	Lakota			10	4060	◙
Jurassic	Morrison			270	4070	□
	Sundance	Upper		95	4340	
		Lower		150	4435	□
Triassic	Chugwater Group	Crow Mtn		80	4585	
		Alcova LS		20	4665	
		Red Peak		520	4685	□
Permian	Goose Egg			320	5205	□
Pennsylvanian	Tensleep			320	5525	■
	Amsden			160	5845	
Mississippian	Madison			300	6005	
Cambrian through Devonian	Undifferentiated			780	6305	
Pre-Cambrian	Granite				7085	



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.