

Wells Drilled to Basement in Oklahoma

Introduction

Basement is a general term used by geologists to indicate crystalline (igneous and metamorphic) rock, particularly where it is concealed below sedimentary rocks. The concept of basement is a practical one for petroleum and natural gas exploration because those fluids are less likely to occur in crystalline rock. Basement rocks are also of general geologic interest; because they help geologists understand the origin and age of the Earth's crust in any area or region.

Basement rock is variable in Oklahoma. It consists of Cambrian granites and rhyolites and gabbroic rocks in the Wichita Mountains and in most of the subsurface of southwestern Oklahoma. Also an area of low-to-medium grade metasedimentary rocks of Early Cambrian or Late Precambrian age is known only in the subsurface south of the Wichitas. Granites of Precambrian age (1.1 to 1.4 billion years old) crop out in the eastern Arbuckle Mountains and in Mayes County (Ham and others, 1964; Denison, 1981). The rest of the State is underlain mostly by Precambrian granites and rhyolites. Direct evidence of the basement underlying the Ouachita Mountains of southeastern Oklahoma is unknown (Denison and others, 1984).

The compilation began as an effort to identify wells drilled to basement to construct a statewide map of the basement surface. The first step established a list of aliases for *basement* to identify wells that were drilled to basement and then to extract them from electronic databases. The list evolved during the course of the work and appears as Table 1. In some cases, an alias may identify only one well.

Table 1. Terms Considered to Signify Basement Rock

Andesite	Obsidian
Basalt	Peridotite
Basement	Perlite
Diorite	Pitchstone
Dunite	Precambrian (Pre-Cambrian)
Felsite	Pumice
Gabbro	Pyroxenite
Gneiss	Rhyolite (Carlton)
Granite (Spavinaw, Tishomingo, Troy, Wichita)	Syenite
Hornblendite	Trachyte
Igneous	Volcanics

The resulting list of wells was compared to the appendices in two significant studies of basement published by the Oklahoma Geological Survey: Ham and others (1964), and Denison (1981). The comparisons led to the identification of many wells drilled to basement that were not captured from electronic databases [NRIS (Natural Resources Information System) and

PI/Dwights/IHS Energy Group]. While many of the wells were *in* the databases, they were not identified as drilled to *basement*. So a search was undertaken to find other investigations in which wells drilled to basement were identified. The majority of wells represented here were drilled in exploration for oil and gas; but other holes drilled to basement for stratigraphic tests, mining purposes, or water/waste disposal also were included. The section on Data Field Names and Descriptions lists all the sources; however, no claim is made that the list is complete.

References cited:

Denison, R. E., 1981, Basement rocks in northeastern Oklahoma: Oklahoma Geological Survey Circular 84, 84 p.

Denison, R. E., Lidiak, E. G., Bickford, M. E., and Kisvarsani, E. B., 1984, Geology and geochronology of Precambrian rocks in the central interior of the United States: U. S. Geological Survey Professional Paper 1241-C, 20 p.

Ham, W. E., Denison, R. E., and Merritt, C. A., 1964, Basement rocks and structural evolution of southern Oklahoma: Oklahoma Geological Survey Bulletin 95, 302 p.

Process

With few exceptions, there was no independent confirmation of the data presented by examination of electric logs or drill cuttings. Data for each well, however, were matched and verified carefully with data in one or more of three major databases: NRIS, IHS, and OCC (Oklahoma Corporation Commission). If a record was incomplete in the initial source, the missing information was obtained from a matching well record in another source. In some cases, a matching record was not found, and in others the matching record lacked the same information. An incomplete record was retained in the database if that well had been identified as a basement well by a geologist. Data elements considered “impossible” (e.g., a basement value deeper than a total depth value) were left blank.

Where discrepancies existed between sources, especially with regard to the top of the basement datum, selections made or reviewed by a geologist were preferred. Geologists had examined electric logs or samples in most cases, and so their decisions were considered more reliable. Where different spellings for a well name occurred, its initial source spelling usually was retained. Inconsistent operator names were typically due to a change in the operator, a merger/buyout by another company, or reporting the names of different partnership operators.

Other problems encountered in matching well data from different sources included the following:

(1) Studies reported in older OGS publications did not include API (American Petroleum Institute) numbers.

(2) Drilling a twin well sometimes resulted in separate but essentially duplicate data records.

(3) A well reported by one source as reaching basement rock might have “granite wash” or conglomerate listed at that depth by another source. Generally, if any source reported that a well reached basement rock, then that well was included in the database.

(4) A small number of wells had two API numbers assigned. The well that had “OTC/OCC not assigned” under Operator Name in the Oklahoma Corporation Commission’s database was *not* used in this database.

Other obvious inaccuracies probably were due to typographical error or misunderstood field communications.

Data Field Names and Descriptions (Order corresponds to the sequence of database headings.)

API: Well Number as assigned according to criteria established by the American Petroleum Institute. If no number was listed in our initial source, one was obtained by matching the well’s data with its correspondent in the OCC, NRIS and/or IHS database(s). No API numbers were assigned for some wells drilled prior to 1960, or for wells that were drilled for purposes unrelated to exploration for oil and gas.

Source: The origin of the information listed. In many cases, data from multiple sources were required to complete the information for a given record; however, no more than two sources are listed. The first reference given is where the well data were first found.

B95: Oklahoma Geological Survey Bulletin 95 (1964)
B126: Oklahoma Geological Survey Bulletin 126 (1979)
C80: Oklahoma Geological Survey Circular 80 (1980); Table 16
C84: Oklahoma Geological Survey Circular 84 (1982)
C100: Oklahoma Geological Survey Circular 100 (1997)
DEQ: Oklahoma Department of Environmental Quality files
Fay: Oklahoma Geological Survey Open-File Report 1-2002 (2002)
I: Ireland, AAPG Bulletin, v. 39, no. 4, p. 468-483 (1955)
J: Oklahoma Geological Survey Open-File Report 8-2003 (Jordan, 1963)
J&S: Oklahoma Geological Survey Open-File Report 7-2003 (Jordan and Smith, 1961)
LOG: Investigation of electric logs or driller’s logs by J. A. Campbell
M: D. A. McConnell doctoral dissertation (Appendix C):Texas A & M University (1987)
NRIS: Natural Resources Information System well data file
OCC: Oklahoma Corporation Commission, Division of Oil and Gas Conservation
www.occ.state.ok.us/divisions/og/og.htm
OCGS: Oklahoma City Geological Society files
PC: Personal communication. Critical information about one or more wells was received from the following:

Robert W. Allen
Bruce Carpenter

Steve Hadaway
G. Carlyle Hinshaw

Rodger E. Denison
James R. Derby
Craig Elder
Kent Gatewood
Lloyd E. Gatewood

Jerry G. McCaskill, Jr.
Robert A. Northcutt
James Puckett
Kurt Rottmann
Brian Sralla

PI: PI/Dwights/IHS Energy
R: Reeder, Shale Shaker, v. 24, no. 5 (1974)
SP 91-3: Oklahoma Geological Survey Special Publication 91-3 (1991)

Operator: Name of well-permit holder (usually the original operator) provided by the first source listed.

Lease: Name that the operator designates for property on which the well is drilled.

Well: Well number as assigned by the operator.

Township and Township Direction: North/South location coordinates as assigned by the U. S. Public Land Survey grid system. Direction north or south of the Base Line latitude is noted as N or S, respectively. For the panhandle region, townships are only north of the Base Line.

Range and Range Direction: East/West location coordinates as assigned by the U. S. Public Land Survey grid system. Direction east or west of the Indian Meridian is noted as E or W, respectively. Direction east of the Cimarron Meridian in the panhandle region is indicated as C.

Section: Within a township the number assigned by the U. S. Public Land Survey grid system to, ideally, a one square mile (640 acre) portion. The number order of sections is shown below.
NOTE: Some townships have fewer than 36 sections and some sections may be irregular.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Quarter: Well location within the designated section, based on dividing that section into fourths, eighths, etc.

Year Completed: The year the well was completed or spudded (initiation of drilling). On some records it was not clear whether the date reported was the spud or the completion date. When later re-entry resulted in basement information being reported for the first time, years for both the original drilling and the re-entry of the well are listed.

Total Depth (TD): Distance from the top to the bottom of the borehole as reported by the first source listed. Different sources usually agreed within a few feet of one another. Occasional larger discrepancies occurred, depending on whether the driller depth or log depth was reported. Hole condition (e.g., crooked or caved) may have prevented the logging tool from going to the drilled depth; or the lower hole diameter may have been too small for logging tools.

Surface Elevation: Altitude of the ground surface above mean sea level. Where reported as “+ or – ” or as “estimated” and when no definite value was available from other sources, the surface elevation is listed as EST.

Type: Position or kind of measurement used to determine surface elevation. Where type was unreported or the reported elevation was “estimated”, UNK (unknown) indicates no information. Other referenced elevation measurements are:

DF: Derrick floor

GR: Ground

KB: Kelly bushing

PA: Paulin altimeter

TS: Topographic sheet or survey. Campbell consulted topographic maps when a basement depth was reported but surface elevation was not.

Basement Depth: The shallowest depth from the surface at which basement rock was reported in the well, even if only one source reported it. Two wells listed granite at the surface, i.e., at 0-ft depth. In addition, a known granite outcrop (T. 22N, R. 21E, Sec. 15) has been included in the database. NOTE: Basement depth is not provided for 17 wells; however, the authors believe these *are* basement wells because credible individuals in the geological community reported that they penetrated basement.

Flag: An asterisk (*) denotes a well that is known to have re-entered sedimentary rock below the basement depth listed. Such an occurrence indicates the presence of a reverse fault.

Basement Penetration: The drilled interval of basement rock measured between the top of basement rock and total depth. For wells flagged with an asterisk and lacking reported penetration data, the interval penetrated was calculated from top of basement rock to the next reported formation top.

Basement Subsea: The elevation (altitude) of basement relative to mean sea level. If the basement was penetrated more than once, the elevation (altitude) of the first (shallowest) contact with the basement is listed.

Latitude: Angular distance in decimal degrees north from the equator. If latitude was not reported in the initial source, it was obtained from that well's record in the NRIS or IHS database, or calculated from the well's legal description using the spatial calculator at <http://www.geo.ou.edu>.

Longitude: Angular distance in decimal degrees west from the Greenwich prime meridian. Longitude values are shown as negative numbers to correspond with standard international practice for the Western Hemisphere. If longitude was not reported in the initial source, it was obtained from that well's record in the NRIS or IHS database, or calculated from the well's legal description using the spatial calculator at <http://www.geo.ou.edu>.

NOTE: Latitude and longitude values are derived from different sources, and are based on different landgrids (Tobin, Topographic Mapping) and/or different datums (North American Datum, 1927; North American Datum, 1983). For this reason, they are not consistent internally. Consequently, the dataset applies only to mapping at statewide or regional scales, and is not intended for site-specific use.

Acknowledgements

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DISCLAIMER REGARDING USE: This database is provided as a service to the State of Oklahoma through the Oklahoma Geological Survey. The authors' intent was to identify as many wells as possible that were reported to have penetrated basement rock in the State. Most data originated from well-completion reports by operators, but all wells identified by credible sources within the geological community have been included, with little independent verification of the data. However, no claim is made that the list is complete. Neither the authors nor the Oklahoma Geological Survey makes any implicit or explicit warranty or assumes any responsibility for the accuracy, completeness, or usefulness of the data.