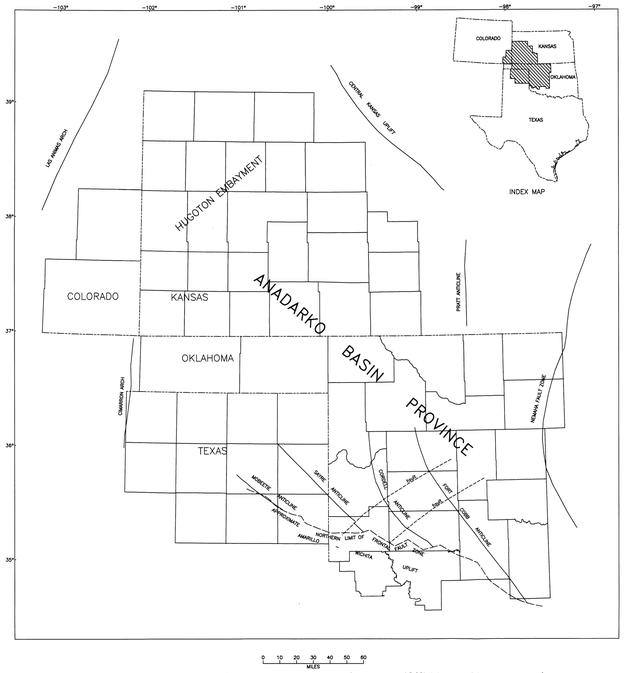
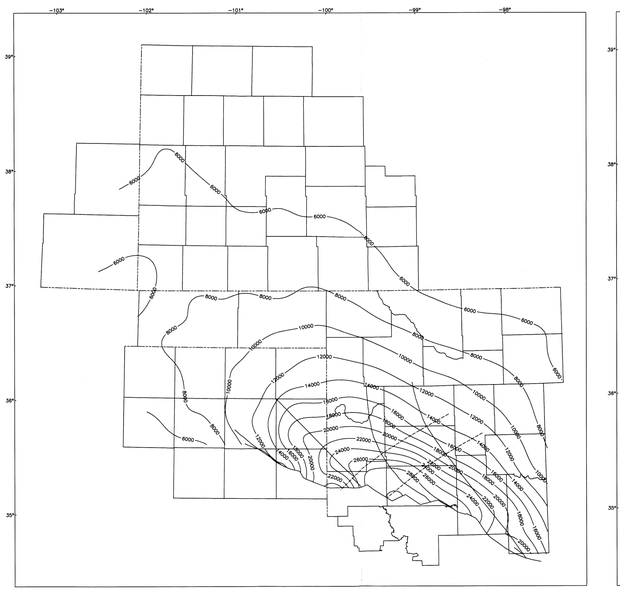
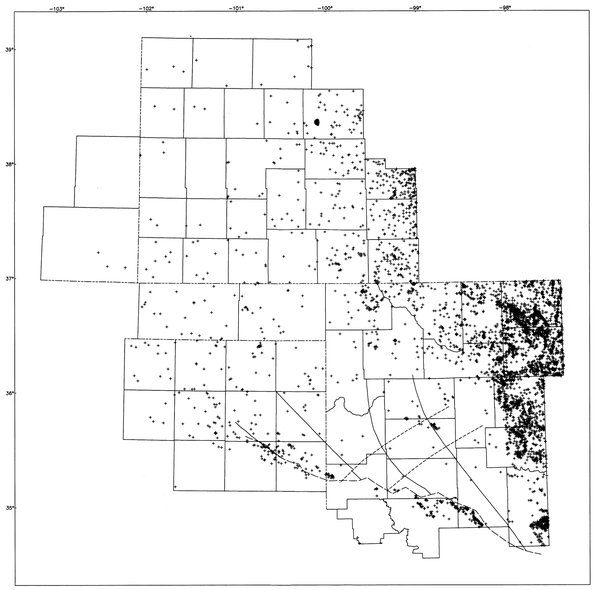


Map A. Anadarko basin province and selected basin-bounding structures (from Barrett, 1963). Major pre-Mississippian anticlines and faults in southern part of province are from Wrolelewski (1967). The boundary between the deep basin and the Amarillo-Wichita uplift is represented by a line showing the approximate northern limit of the mountains-front fault zone. The scale bar is also applicable to maps B-F.



Map B. Depth to top of Simpson Group. Contour interval is 2,000 ft. Simpson Group rocks exist within the fault zone but because of structural complexity, the contours have been omitted. See map A for explanation of other features on this map.



Map C. Locations of wells reporting Simpson Group tops. See map A for explanation of other features on this map.

SIMPSON GROUP

[See sheet 1 for introductory text and references]

The Middle Ordovician Simpson Group is a rather anomalous lithology with respect to other lower Paleozoic rocks in the Anadarko basin (map A). The Simpson is predominately a terrigenous deposit composed of sand, shale, and some carbonate, whereas the bulk of the pre-Devonian is carbonate. Previous work (Dapples, 1955; Cole, 1975) shows the Simpson Group absent from the northwestern part of the province; however, recent Petroleum Information (PI) well data reports Simpson penetrations virtually throughout the province (except in the Amarillo-Wichita Mountains). Simpson rocks increase in thickness and become more shale-rich to the south. The number and thickness of individual sandstone beds also increases in that direction (Dapples, 1955). Simpson rocks range in thickness from a few tens of feet in southwestern Kansas to about 1,900 ft in the deep Anadarko basin (Schramm, 1964). The Simpson Group is composed of the Joins, Oil Creek, McLish, Tulip Creek, and Bromide (informally named Simpson dense or Wilcox) Formations (Bebout and others, 1993). Lithofacies relationships within the Simpson Group and its age equivalent—the St. Peter Sandstone—are discussed by Dapples (1955) for most of the greater mid-continent; lithofacies analysis of the Simpson Group in Oklahoma is discussed by Schramm (1964).

A computer-generated map (map B) shows the depth to the top of the Simpson Group. Because Simpson penetrations in the deep part of the basin are limited, depths to the top of the Simpson in this area were estimated from reported tops and thicknesses of the overlying Viola and Hunton Groups. These estimated depths were combined with the reported Simpson tops to control the shape of the grid calculated by the modeling program. Because of intense faulting and large vertical variations in depth to the top of the Simpson, drilling depths are not modeled south of the line showing the "approximate northern limit of the frontal fault zone" (map A), which separates the Amarillo-Wichita uplift from the deep Anadarko basin.

Map C shows the locations of all wells in the Petroleum Information (PI) data set reporting Simpson Group penetrations. This data set contains about 4,800 wells. The areas where Simpson rocks are most intensely drilled are almost the same as the areas where the Arbuckle is most intensely drilled. The Simpson, however, is much more intensely drilled than the Arbuckle along the west flank of the Nemaha fault zone. There are probably wells penetrating Simpson rocks that are not in the PI data set, and therefore not on map C; however, map C is believed to represent the present-day pattern and level of exploration in the Simpson.

More than 500 wells with reported Simpson production are shown in map D. Producing wells are concentrated in the eastern part of the province along the west flank of the Nemaha fault zone and near the Amarillo-Wichita uplift. Like Arbuckle and Ellenburger rocks, the Simpson does not produce in most of the province. The continuity of individual sandstone beds in this play may account for its general lack of production. In the absence of structure or other trapping mechanisms, Simpson sandstone beds may be better migration conduits than reservoir rocks. Although several structural features identified by Schramm (1964) were present in western and central Oklahoma during the time of Simpson deposition, 30 years of drilling has generated little production in those areas.

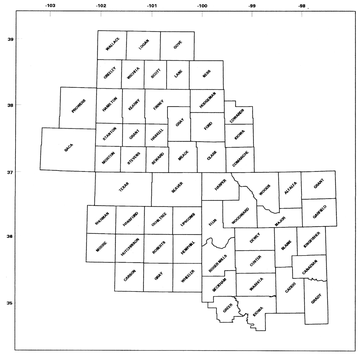
Petroleum Information records show production from Simpson rocks in almost 120 named fields and 11 wells not assigned to a field. Simpson rocks also contain more major accumulations (24 are identified on map E) than do Arbuckle or Ellenburger rocks. Reservoirs are generally sandstone units interbedded with shale. Dapples (1955) shows more than 16 individual sandstone beds of greater than 5 ft thickness, and a net sandstone thickness of about 400 ft in the southern part of the province. Reservoir quality is expected to be good in much of the play. Simpson Group sandstone is described as well-sorted (Dapples, 1955) and often highly porous and permeable where uncemented (Johnson, 1991). The Simpson Group is bounded above and below by unconformities in the northern part of the province, in southwestern Kansas, and northwestern Oklahoma (Bebout and others, 1993).

Ten of the 24 major Simpson accumulations are described in the 1992 Nehring Rtsearch Group (NRG) data set. All are primarily anticlines or faulted anticlines, with some secondary influence involving stratigraphic facies change (NRG, 1992). Hydrocarbon seals are probably interbedded Simpson shale beds. Known major accumulations exist at depths of from about 3,400 to 15,800 ft.

Possible sources for oil found in Simpson rocks are interbedded Simpson shale, Woodford Shale, Sylvan Shale, and the Arbuckle Group. In much of the northern and western parts of the province, the Woodford has been removed by erosion and is stratigraphically isolated from the Simpson. Except along unconformity surfaces near the major uplifts, the Woodford was probably not a source for the Simpson. The Sylvan Shale, also an unlikely hydrocarbon source for much of the Simpson, is not a prolific hydrocarbon source in the province overall, and it is stratigraphically separated from the Simpson Group by the Viola Group. There are conflicting interpretations regarding the source rock quality of the Arbuckle, leaving significant doubt about the viability of the Arbuckle as an alternative hydrocarbon source for the Simpson. Oil source-rock studies of Simpson rocks (Burruss and Hatch, 1989, 1992) and analyses of Ordovician oils (Longman and Palmer, 1987) indicate that Simpson Group reservoirs contain oil more characteristic of an Ordovician source. Therefore, shale within the Simpson Group appears to be the most likely petroleum source for Simpson sandstone reservoirs; oil is the expected product.

Simpson-age rocks probably entered the oil window as early as 275 Ma in the southern part of the basin and about 160 Ma (or later) in the northern part of the basin (Schmoker, 1986; his figs. 15, 16, and 17). The contours of map F show the depths to the top of the Simpson Group (6,000, 13,500, 17,500, and 26,500 ft) that represent Ro values of 0.6, 1.3, 2.0, and 5.0 percent, respectively, based on Ro-depth curves of Schmoker (1986). The Ro values (in increasing percent) reflect the onset of oil generation, the end of oil generation, the upper limit of occurrence of oil with API gravity less than 50°, and the approximate dry gas deadline (Waples, 1980).

Simpson rocks have been explored more thoroughly than have Arbuckle or Ellenburger rocks, but are still not heavily drilled. The lack of significant Simpson Group production in the greater part of the province does not rule out significant undiscovered accumulations in that area, but suggests that the more productive areas may be along the flanks of the major uplifts.



INDEX MAP SHOWING ANADARKO BASIN PROVINCE AND COUNTIES WITHIN PROVINCE

Table 1. Selected data for oil accumulations greater than 1 million barrels and gas accumulations greater than 6 billion cubic feet in Simpson Group reservoirs

FIELD NAME	FIELD NUMBER	RESERVOIR LITHOLOGY	RESERVOIR DEPTH(ft)	MAJOR PRODUCT	ESTIMATED ULTIMATE RECOVERY CODE*
ALDEN, NORTHEAST	1	SANDSTONE	8711	OIL	a
ALEDO	2	SANDSTONE	15770	GAS	a
ALEX, EAST	3		14281	OIL	a
APACHE	4	SANDSTONE	3391	OIL	c
BEALS	5	SANDSTONE	5502	GAS	a
BRADLEY, NORTHEAST	6		15058	OIL	b
BROWN	7	SANDSTONE	5820	OIL	a
CARNEGIE, WEST	8	SANDSTONE	5330	OIL	a
GARBER	9		7025	GAS	a
CHITWOOD	10	SANDSTONE	14756	OIL	a
CONCHO, NORTHEAST	11	SANDSTONE	10060	GAS	a
CURTIS, SOUTHWEST	12	SANDSTONE	12745	OIL	b
EL RENO	13	SANDSTONE	10318	GAS	b
ENID, NORTHEAST	14		6881	GAS	a
GARBER	15	SANDSTONE	5055	GAS	a
HUNTER, WEST	16	SANDSTONE	6349	OIL	a
KNOX	17	SANDSTONE	15113	OIL	c
LAMONT, SOUTHEAST	18	SANDSTONE	4910	OIL	a
RICH VALLEY	19	SANDSTONE	5816	OIL	a
SALT FORK, WEST	20	SANDSTONE	5992	OIL	a
SOONER TREND	21		6800-9800	OIL	a
UNION CITY	22	SANDSTONE	12340	GAS	a
WEBB, NORTH	23	SANDSTONE	4685	OIL	a
YELLOWSTONE	24	SANDSTONE	5936	GAS	a

* See Table 2 for key to letter codes

Table 2. Letter codes for estimated ultimate recoveries

MILLIONS OF BARRELS (OIL)	CODE	BILLIONS OF CUBIC FEET (GAS)	CODE
1 to 4	a	6 to 24	a
>4 to16	b	>24 to 96	b
>16 to 64	c	>96 to 384	c
>64 to 256	d	>384 to 1536	d
>256 to 1024	e	>1536 to 6144	e
>1024	f	>6144	f

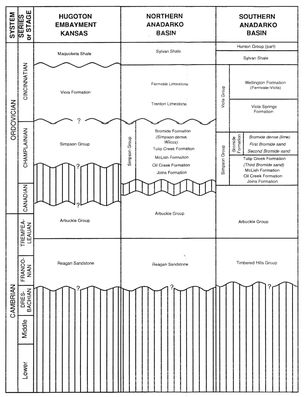
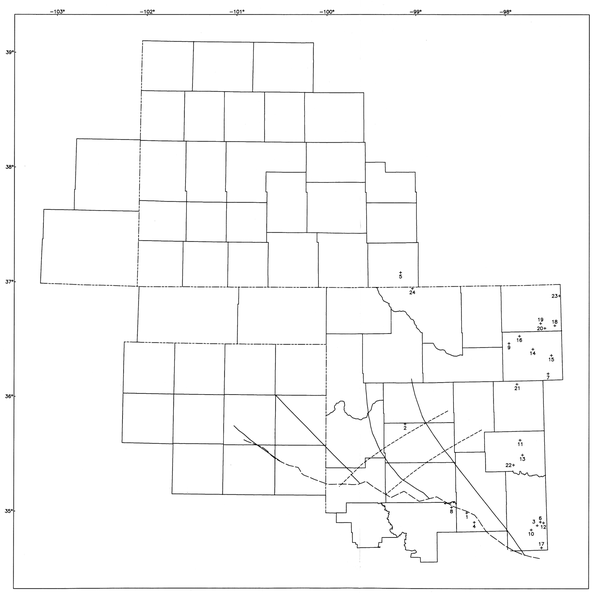
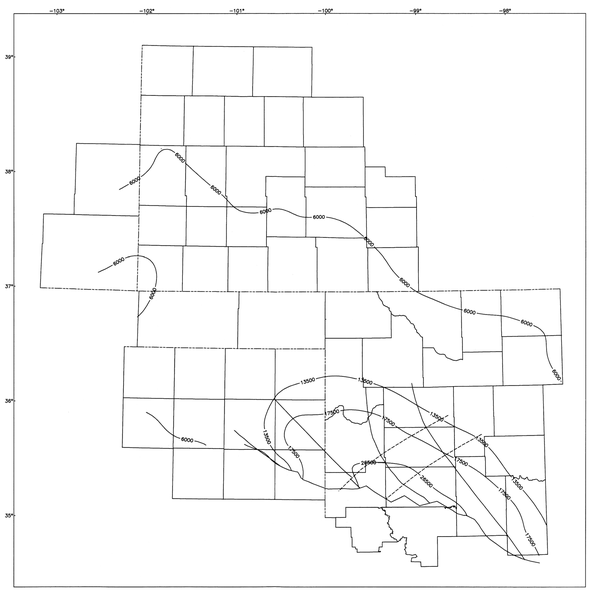


Figure 1. Generalized Cambrian and Ordovician surface and subsurface stratigraphic section for the Anadarko basin province. Italics indicate informal names. Modified from Bebout and others (1993).

Map D. Locations of wells reporting Simpson Group petroleum production. See map A for explanation of other features on this map.



Map E. Locations of fields that have major Simpson Group petroleum production. Field locations are approximate centerpoints and do not reflect the areal extent of the accumulation. Field names and field-size codes (estimated ultimate recovery) associated with field numbers are shown in table 1. Explanation of field-size codes is shown in table 2. See map A for explanation of other features on this map.



Map F. Drilling depths to the top of the Simpson Group. Selected isopleths represent vitrinite reflectance (Ro) values corresponding to various stages of oil or gas generation. Depths of 6,000, 13,500, 17,500, and 26,000 ft represent Ro values of 0.6, 1.3, 2.0, and 5.0 percent, respectively. Oil generation generally occurs between Ro= 0.6 and 1.3 percent. Gas generation predominates at Ro values greater than about 1.3 percent. See map A for explanation of other features on this map.

SIMPSON GROUP

MAPS SHOWING PETROLEUM EXPLORATION INTENSITY AND PRODUCTION IN MAJOR CAMBRIAN TO ORDOVICIAN RESERVOIR ROCKS IN THE ANADARKO BASIN

By
Mitch Henry and Tim Hester

1996

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