URANIFEROUS ASPHALTITE IN MOORE AND POTTER COUNTIES, TEXAS

By

C. Robertson Handford

and

George E. Granata

Project funded by
Bendix Field Engineering Corporation
Subcontract No 78-158-E

Bureau of Economic Geology
The University of Texas at Austin
University Station, Box X
Austin, Texas 78712
W. L. Fisher, Director

1979

INTRODUCTION

This report presents data regarding the origin, occurrence, distribution, and relative abundance of uraniferous asphaltite in the Red Cave Formation and "Panhandle lime" from Moore County and portions of Potter County, Texas. It is a brief survey that was based largely upon (1) microscopic examination of drill cuttings stored at the Well Sample and Core Library, University of Texas Balcones Reserch Center, and (2) megascopic examination of several cores loaned to the Bureau of Economic Geology by the U.S. Bureau of Mines - Branch of Helium Operations, Maynard Oil Company, and Colorado Interstate Gas Company.

REGIONAL GEOLOGIC SETTING AND STRATIGRAPHY

The Panhandle Gas Field and the southern edge of Moore County are on the north flank of the Amarillo Uplift, a northwest-southeast trending, faulted block of Precambrian granite, rhyolite, and gabbro (fig. 1). The uplift was created during Early Pennsylvanian time as a result of continental collision-induced deformation of the Southern Oklahoma Aulacogen along the southern margin of the North American continent. Wickham (1978) has shown that the Anadarko Basin and Amarillo Uplift were among several paired uplifts and basins that formed from deformation of the Aulacogen.

The Amarillo Uplift stood high through Late Pennsylvanian and Early Permian (Wolfcampian) time while surrounding areas rapidly subsided. Thus the stratigraphic succession over the crest of the uplift (fig. 2) is abbreviated in comparison to adjacent basinal areas. Upper Pennsylvanian and Lower Permian (Wolfcampian) rocks generally consist of fan-delta granite wash, or arkose that overlies basement, followed above by shallow shelf carbonates and approximately 2000 ft of Middle to Upper Permian red beds and evaporites. Asphaltite-bearing rocks are mainly the Red Cave Formation (Clear Fork Group) and "Panhandle lime" (Wichita Group), which form the cap rock over Lower Permian reservoir facies in the Panhandle Field.

Depositional Setting - Red Cave Formation and Panhandle Lime

The Red Cave and Panhandle Formations consist of red-bed clastic, carbonate, and evaporite facies that reflect deposition in extensive coastal sabkhas and desert wadi plains located across the Texas Panhandle. These environments were bounded to the south in the Palo Duro Basin by a shallow-marine inner shelf that flanked deep marine environments of the northern Midland Basin.

Sedimentary sequences in these formations commonly exhibit features that are characteristic of Holocene tidal flat and sabkha environments. Inner shelf dolomites include slightly fossiliferous, faintly laminated to burrowed mudstone and pellet wackestone. These lithofacies are commonly overlain by, and interbedded with dolomite and anhydrite deposited in intertidal to supratidal zones of a large coastal sabkha. Pellet packstone and oolitic grainstone displaying well developed cross-lamination suggest intertidal deposition. Supratidal facies include dolomitic mudstone with algal laminae and some intraclasts. Progradational sequences are normally capped by nodular anhydrite deposited in sabkha environments.

Carbonate and evaporite facies of the lower Clear Fork, Red Cave, and "Panhandle lime" Formations pinch out to the northwest and pass into red beds in Oldham, Potter, Moore, Hutchinson, and Sherman Counties. These terrigenous sedimentary rocks thicken into the Dalhart Basin and coarsen northwestward into New Mexico, suggesting sources in the Sierra Grande Uplift of New Mexico. Facies include ripple-drift cross laminated, tan siltstone and very fine sandstone, adhesion-rippled red siltstone, and red to green mudstone. Dessication features, intraclasts, root zones, paleosols, and fluvial, braided channel-fill deposits attest to deposition in desert wadi plain environments.

URANIFEROUS ASPHALTITE

According to Pierce and others (1964) cap rocks over the Panhandle Gas Field contain 10 to 20 ppm uranium through a section about 250 ft thick. The uranium is said to be concentrated (1%) in asphaltite, a metalliferous, carbonaceous mineraloid that occurs as botryoidal nodules and impregnations filling secondary pore spaces and fractures. Asphaltite is black, lustrous, brittle, and insoluble to most organic reagents. Aside from uranium, asphaltite also contains arsenic, nickel, cobalt, and iron. Although nodules are as large as 2.5 cm in diameter, most (by volume) are 1 to 3 mm and the most numerous nodules are less than 0.1 mm in diameter. The authors (idem.) suggested that asphaltite is an epigenetic product derived from petroleum and was formed contemporaneously with the introduction of sulfate-bearing solutions after sediment lithification and fracturing. Uranium was most likely derived from the red beds.

URANIFEROUS ASPHALTITE IN MOORE AND POTTER COUNTIES

Drill cuttings from 30 wells in Moore County and 4 cores were examined for asphaltite. A binocular microscope was used to survey the drill cuttings. Figure 3 shows the general core locations and well sites, and Appendix I lists the wells that were used in this study.

Drill cuttings in every well examined but one in Moore County contain asphaltite in the Red Cave - "Panhandle lime" interval. Because data control is exteremely low, no effort was made to construct isopachous maps of asphaltite-bearing zones. However, there are areas of relatively greater abundance of asphaltite, both in terms of the number of 10-ft sample intervals that contain asphaltite, as well as the concentration of asphaltite within the samples (fig. 4). One can cautiously state that there is a relationship between the number of asphaltite-bearing intervals and regional structure (figs. 4 and 5). Wells with fewer than 10 asphaltite-bearing 10-ft intervals are generally on the lowest flanks of the Cimarron Arch, a broad, gentle anticlinal structure that trends north-south through Moore County. Most asphaltite-bearing intervals occur on the higher flanks of the Cimarron Arch and Amarillo Uplift. A large area in southern Moore County, which is nearly on the crest of the Amarillo Uplift, is marked by several wells, each of which contains 20 or more asphaltite-bearing intervals. Furthermore, wells with 10-ft intervals in which asphaltite-bearing drill cuttings comprise greater than 1 percent of the sample occur in the same area and on top of the Amarillo Uplift (figs. 4 and 5).

Examination of drill cuttings and cores for asphaltite revealed evidence of facies control of asphaltite occurrences. It must be noted, however, that drill cuttings may not be representative samples. Contamination by cavings and loss of sample by crushing during drilling are just two potential sources of error. Of the samples that contain asphaltite, most contain nodules that are generally less than 0.05 mm in diameter. A small proportion of nodules range from 0.05 to 1.0 mm and 1.0 to 3.0 mm in diameter (fig. 6). Comparison of lithology to nodule size (fig. 7) reveals that the smallest nodules occur in sandstone, and the largest nodules occur in anhydrite, dolomite, and mudstone. Furthermore, by far the greatest number of nodules occur in fine-grained sandstone (fig. 8). In summary, examination of drill cuttings indicates that sandstone contains the greatest number of asphaltite nodules but the nodules are also smallest. Largest nodules occur in other facies but in smaller quantities.

Examination of core samples seems to confirm at least part of those observations. The Colorado Interstate Gas Company, Bivins 55R well in Potter County (figs. 3 and 9) consists of numerous 10 to 15-ft thick fluvial, braided-channel sandstones interbedded with overbank or interchannel mudstone in the Red Cave Formation.

These deposits represent distal wadi or desert alluvial plain environments. Clastics were introduced from a northwestern source. Channel-fill sandstones contain a few small black flecks of asphaltite (?) (less than ~0.1 mm in diameter). Large nodules (1 to 10 mm) are quite common in red-green mudstones only. Many are uniformly scattered throughout mudstones, and some are concentrated in beds or zones, such as around anhydrite nodules. These rocks tend to break very easily so that nodules can be plucked free from the matrix. Thus, in this core asphaltite is present and is most abundant in mudstones. Note that this rock type is also relatively nonporous and impermeable (fig. 9).

Asphaltite was also noted in two other Red Cave cores, Maynard Oil Co., Sneed 3-6, and Colorado Interstate Gas Co., Masterson 2R, both of which are in Moore County (fig. 3). Several asphaltite nodules are present in the former core and range from 0.5 to 3.0 mm in diameter. They were noted to be present in red to green mudstones. Core from the latter well contains asphaltite nodules in siltstone and mudstone. Those within siltstone range from 0.1 to 5.0 mm, but most were less than 1 mm. Red to green mudstone contains nodules that range from 1 to 2 mm in diameter.

A scintillometer was passed over Bivins 55R and Masterson 2R cores to check for gamma ray anomalies but none were detected. In fact, approximately 15 asphaltite-bearing samples were set aside and collectively checked with the scintillometer, but even this concentration of material did not excite the instrument.

Over 100 ft of core representing the Red Cave-"Panhandle lime" intervals in the USBM Bush A-6 well were examined but no asphaltite was detected. This well sits astride the Bush Dome, a producing structure in southern Potter County.

ASPHALTITE ZONES

Facies and structural control of asphaltite occurrences in the Red Cave and "Panhandle lime" Formations provide criteria for selection of future core sites and prediction of most likely asphaltite-bearing rocks. Lack of sufficient data, however, do not permit us to suggest specific coring sites. Future studies and potential coring sites must take into account the following:

(1) Coincidence of asphaltite with Panhandle Gas Field and The Amarillo Uplift,

(2) Facies control of abundance and size of asphaltite nodules.

Because interchannel mudstones and channel-fill sandstones are the principal host-facies for asphaltite, considerable attention must be given to detailed facies mapping in county-size areas. Delineation of channel-fill sandstones and interchannel, mudstone-rich areas would provide first order criteria for selection of core sites. Distribution of these host facies in relationship to regional structure would perhaps define the most likely drilling sites.

ORIGIN OF URANIFEROUS ASPHALTITE

This brief survey supports Pierce and others (1964) hypothesis that uraniferous asphaltite is derived from petroleum, and that uranium was derived from the red beds but redistributed and concentrated epigenetically in asphaltite.

Presently it is not known whether uranium was originally disseminated throughout the clastic facies during deposition, or whether oxidizing, uranium-enriched ground waters entered fluvial channel sandstone aquifers in recharge zones and subsequently precipitated uranium at facies boundaries or along geochemical fronts. Events leading to the combination of uranium and asphaltite are unclear. This study has recognized that asphaltite is epigenetic; it fills secondary vugs in dolomite and apparently replaces mudstone. Pierce and others (1964) recognize this occurrence and suggest that uranium was "redistributed and concentrated in rock interstices through which petroleum and brine have migrated or in which they have accumulated. Redistribution and concentration of uranuium has been associated in time with structural and diagenetic events including compaction, fracturing and cementation of the rocks, and concentration of metals in organic materials derived from petroleum or petroleum waters."

SUMMARY AND CONCLUSIONS

Asphaltite is present in facies of the Red Cave and "Panhandle lime" Formation. Drill cuttings from 30 Moore County wells and 4 cores distributed across Moore and Potter Counties were examined for asphaltite. Results show that asphaltite is widespread but seems to be most abundant over structural highs, and that there is a facies control of asphaltite occurrences. In drill cuttings sandstones contain most abundant nodules yet the nodules are generally very small. Largest nodules were commonly observed in mudstone core samples.

A potential exploration program should take those observations into account. Once exploitable deposits are located and if proper in situ leaching materials were developed for extraction of uranium, only sandstones could be worked. Interchannel mudstones are too impermeable and nonporous. Subsurface mining would be forced to address potential problems derived from high concentrations of hydrocarbons in the target rocks (Red Cave Formation produces oil and gas in Moore County) as well as high levels of radon (averages 100 x 10^{-12} curies per liter STP) in gas produced from the Panhandle Field.

REFERENCES

Pierce, A. P., G. B. Gott, and J. W. Mytton, 1964, Uranium and helium in the Panhandle Gas Field Texas, and adjacent areas: U.S.G.S. Professional Paper 454-G, 57 p.

Wickham, J., 1978, The Southern Oklahoma Aulacogen, in Structural style of the Arbuckle region: Geological Society of America, South-central region field trip 3, p. 8-41.

APPENDIX I - WELL SAMPLES AND INTERVALS EXAMINED

MAP NO.	BEG SAMPLE NO.	DEPTH	OPERATOR AND LEASE
1.	R 16,358	1600' - 2889'	Canadian River Gas Co., C-1, Crawford
2.	R 17,015	1500'- 3030'	Canadian River Gas Co., A-6, Kilgore
3.	R 17,434	2000' - 3330'	Canadian River Gas Co., 7-A, C. L. Kilgore
4.	R 16,836	1500' - 2880'	Canadian River Gas Co., A-1, Luberstedt
5.	R 17,431	1500' - 2585'	Canadian River Gas Co., 4-A, Sneed
6.	R-17,433	1500' - 3450'	Canadian River Gas Co., 5-B, Thompson Est.
7.	R 17,432	1500' - 2645'	Canadian River Gas Co., 6-A, Thompson
13.	R 16,212	2000' - 3250'	Kerr - McGee O. Ind. Inc., 2, Clifton
15.	R 16,290	2100' - 3595'	Kerr - McGee 1, Cox
16.	R 16,388	2500' - 3432'	Kerr - McGee, 1, Houter
18.	R 37,240	2500' - 3450'	Kerr - McGee, 1, Reeves
20.	R 27,257	500' - 5762'	Magnolia Pet., 1, E. Pool
24.	R 16,269	2450' - 3297'	Phillips Pet., 1, Brunts
25.	R 37,243	2800' - 3305'	Phillips, 1, Gasser
26.	R 17,016	2700' - 3527'	Phillips, 1, Idell
28.	R 26,834	1610' - 3712'	Dave Rubin 1, W. H. Brown

MAP NO.	BEG SAMPLE NO.	DEPTH	OPERATOR AND LEASE
29.	R 17,374	900' - 3450'	Shamrock Oil and Gas, 1, Brumley
32.	R 6924	1140' - 3782'	Shamrock O. & G. 1, Crabb
33.	R 17,228	2600' - 3345'	Shamrock O. & G., 1, Harrison
34.	R 16,776	1800' - 3294'	Shamrock O. & G., A-1, Harrison
35.	R 16,243	250' - 3627'	Shamrock O. & G., 1, Huff
37.	R 17,227	2600' - 3310'	Shamrock O. & G., 1, Ella Makelys
38.	R 16,430	540' - 3402'	Shamrock O. & G., 1-E, Read
39.	R 16,834	1800' - 3447'	Shamrock O. & G., 1, Roberts
41.	R 15,139	132' - 6709'	Shamrock O. & G., 2, Taylor
42.	R 16,151	525' - 3666'	Shell (was Shamrock), 1, J. C. Phillips
46.	R 14,310	1435' - 2996'	Skelly O. & G., 1, Armstrong
47.	R 26,691 R 37,227 R 26,833	0' - 3870' 0' - 5606' 3880' - 5606'	Skelly O. & G., 16, Armstrong
49.	R 37,241	2400' - 2900'	Phillips, 1, Kinney
50.	R 14,321	730' - 3800'	Prairie O. & G., 2, Sneed

FIGURES

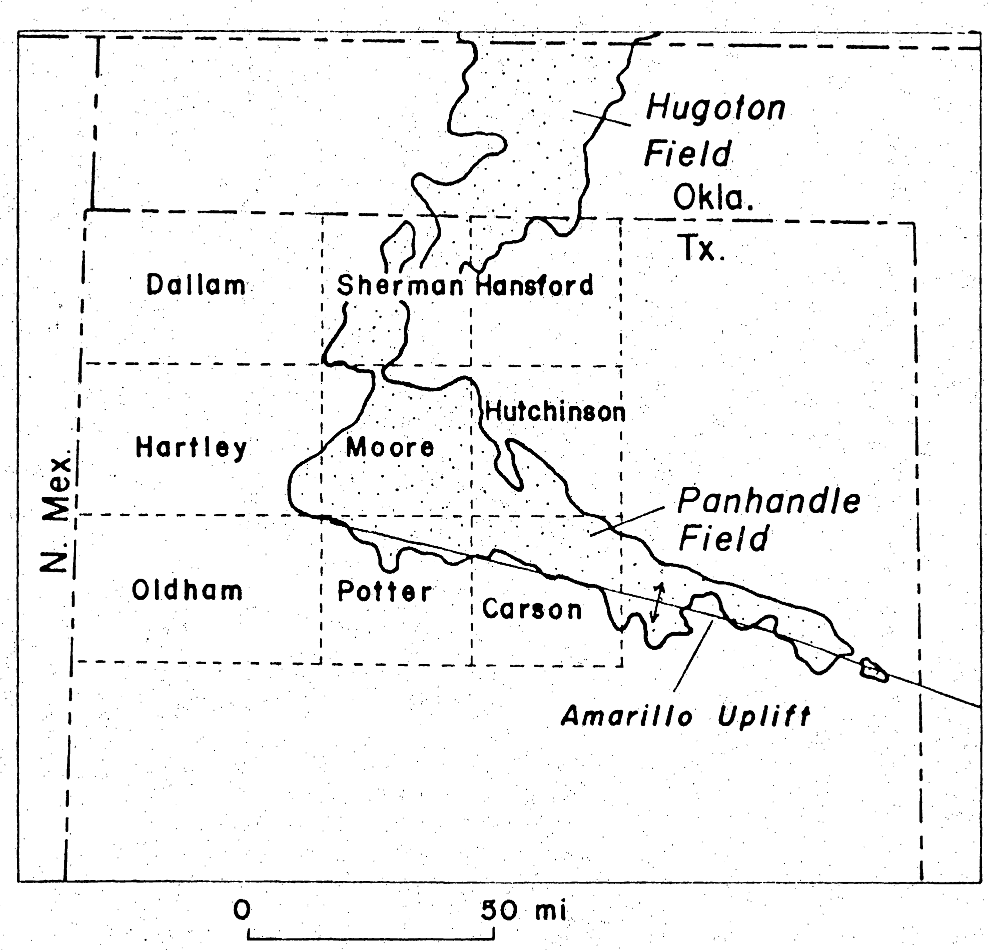


Figure 1

Texas Panhandle showing the Panhandle Gas Field and its relationship to the Amarillo Uplift. This study involved Moore County. Modified from Pierce and others (1964).

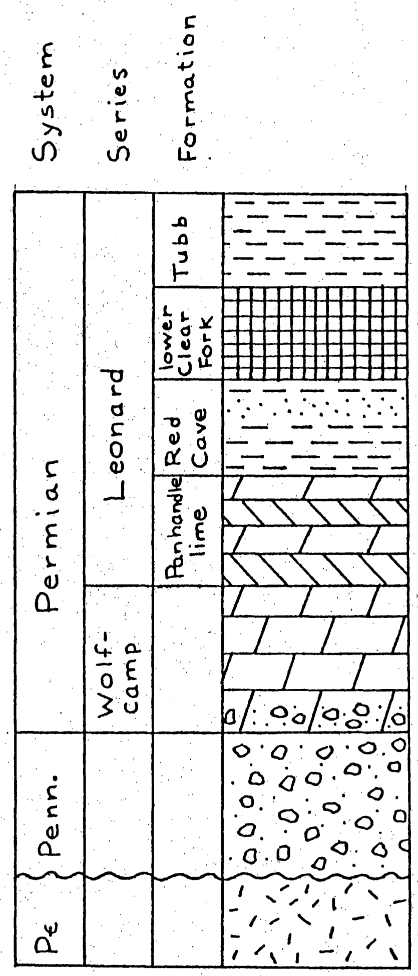


Figure 2

Generalized stratigraphic column for Pennsylvanian and lower Permian rocks over the Amarillo Uplift.

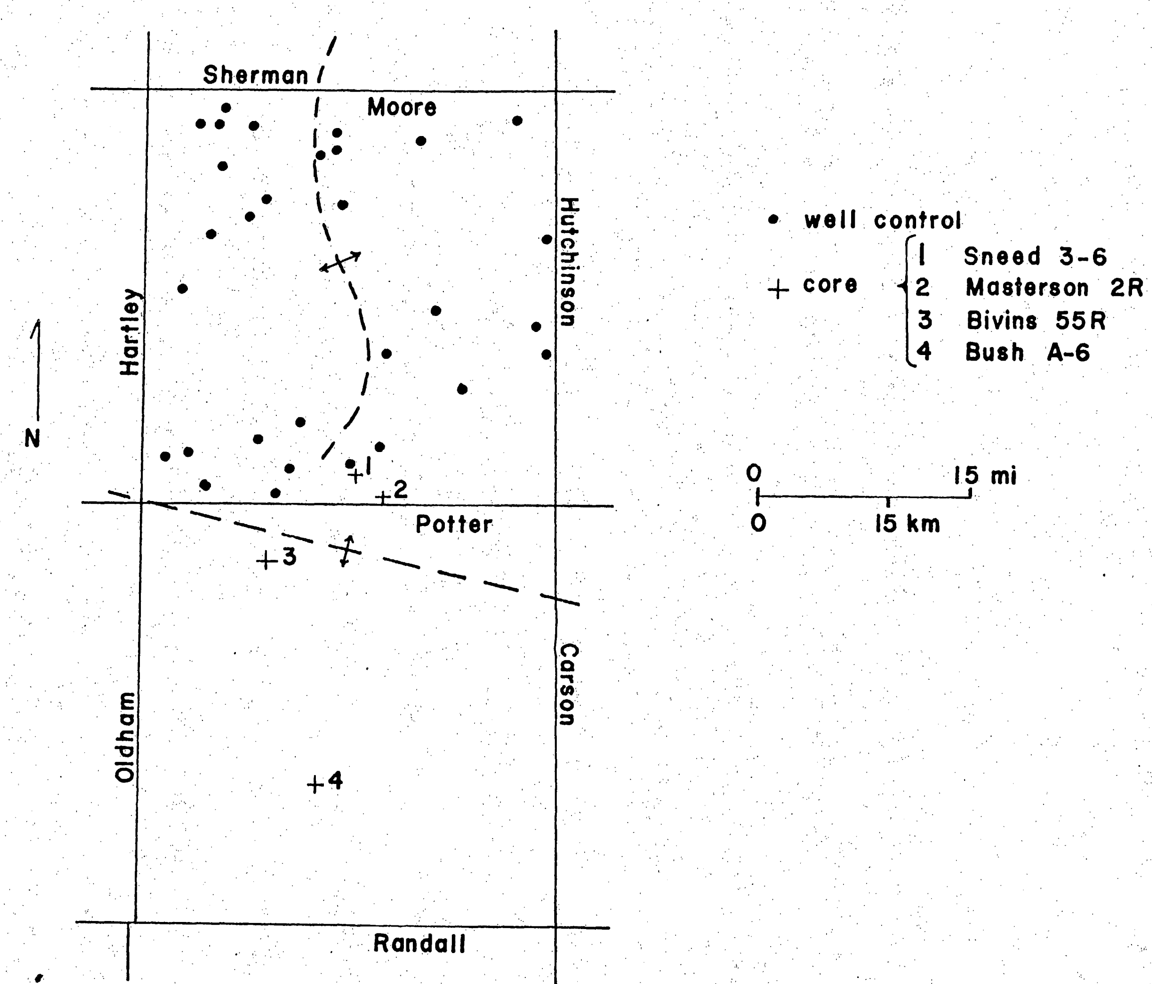


Figure 3

Locations of wells with core and drill cuttings examined in this study. Northwest-southeast structure is the Amarillo Uplift; north-south trending structure is the Cimarron Arch.

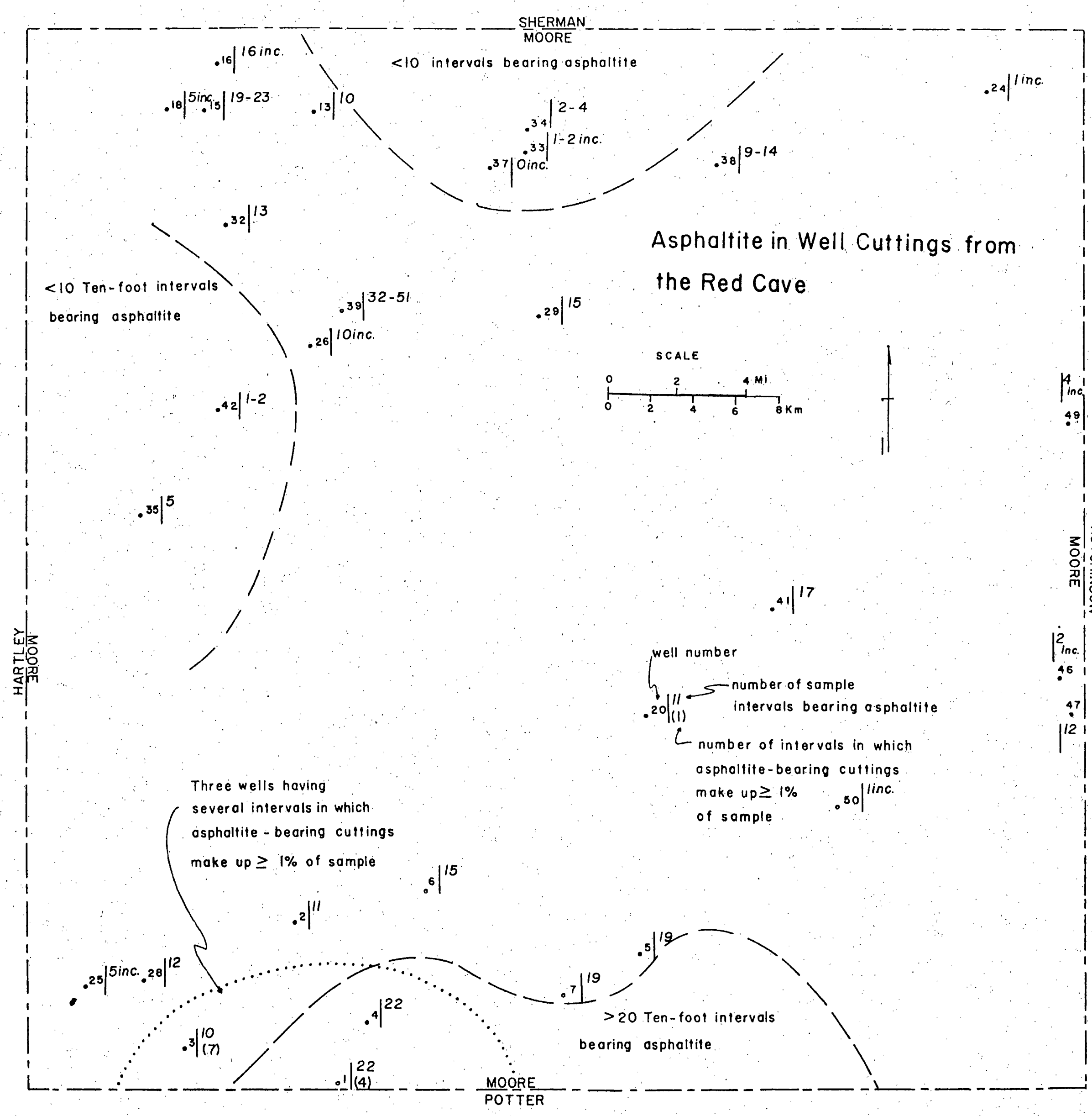


Figure 4

Regional distribution and concentration of asphaltite in Moore County as determined by analysis of drill cuttings through the Red Cave and "Panhandle lime" formations. *Inc.* notation means incomplete sample. Refer to Appendix I for well names.

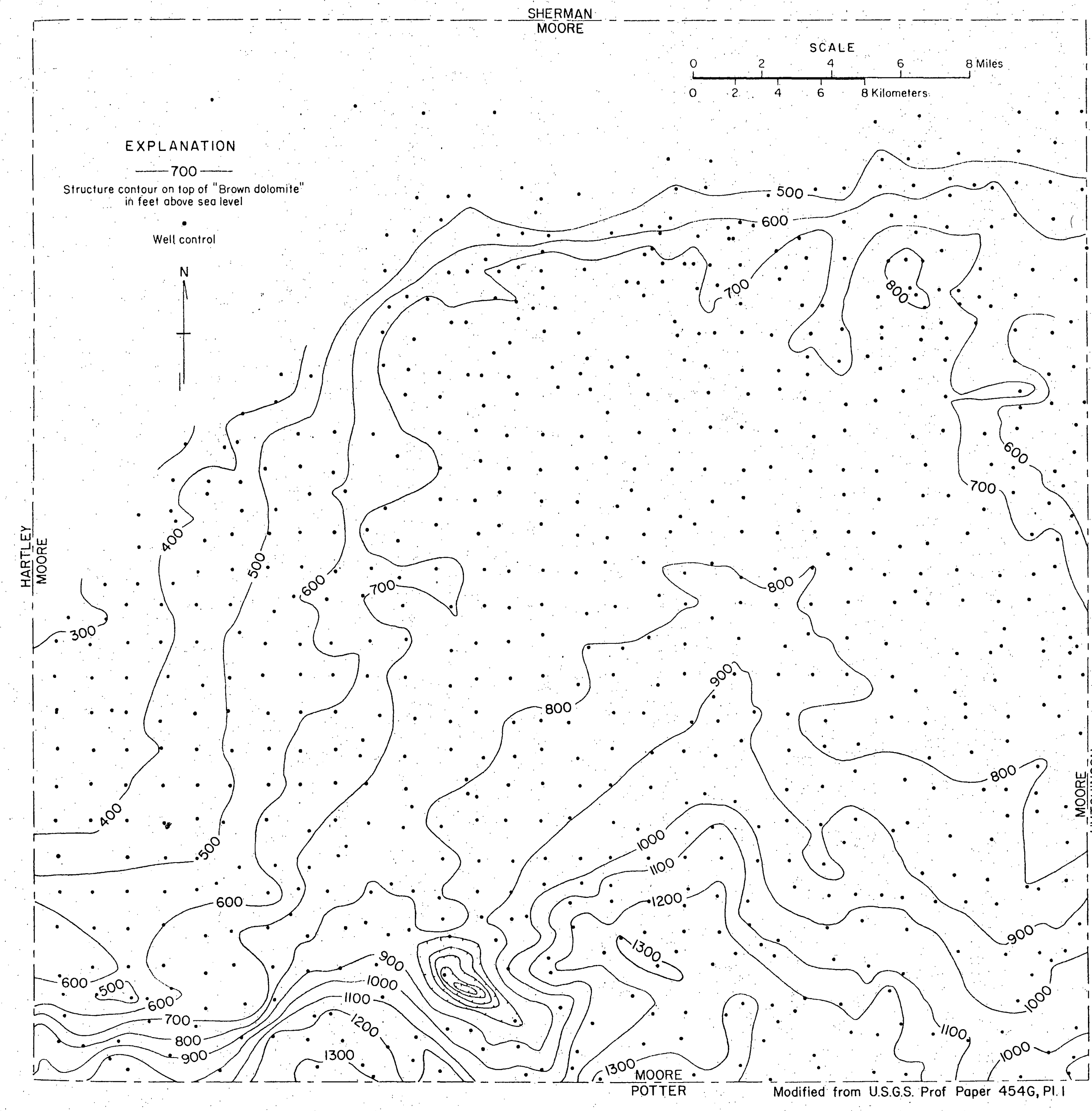


Figure 5

Structure on top of "Brown dolomite" or Wolfcampian Series. Modified From Pierce and others (1964).

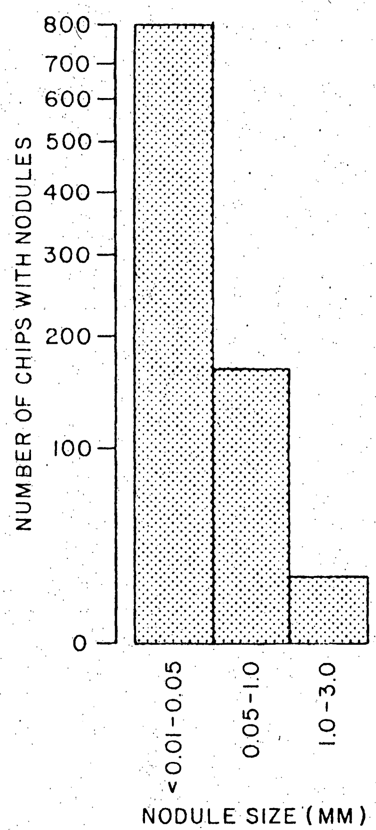


Figure 6

Histogram of nodule size versus number of drill chips containing nodules.

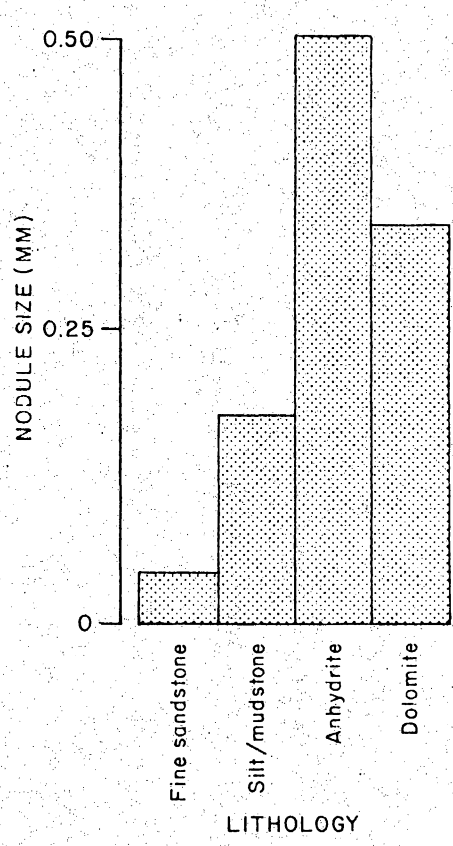


Figure 7

Histogram of nodule size versus lithology.

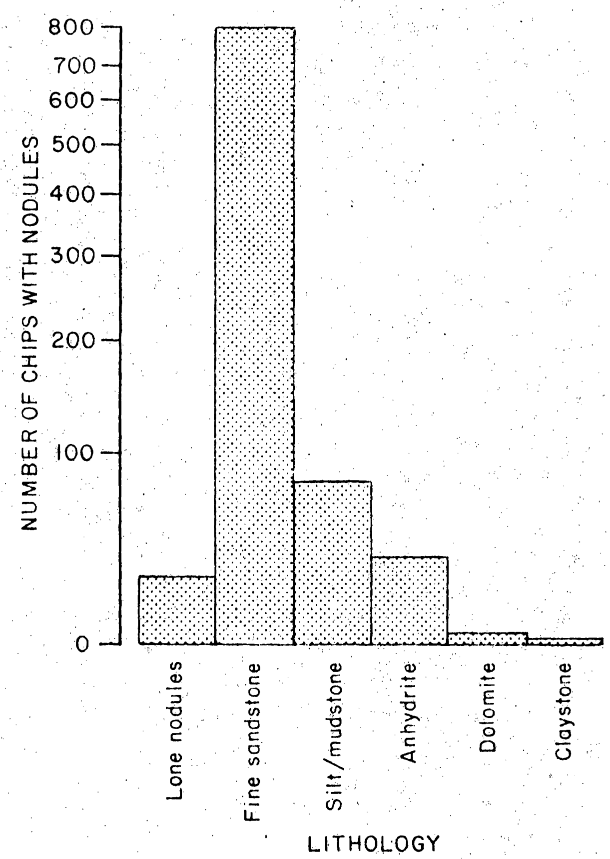
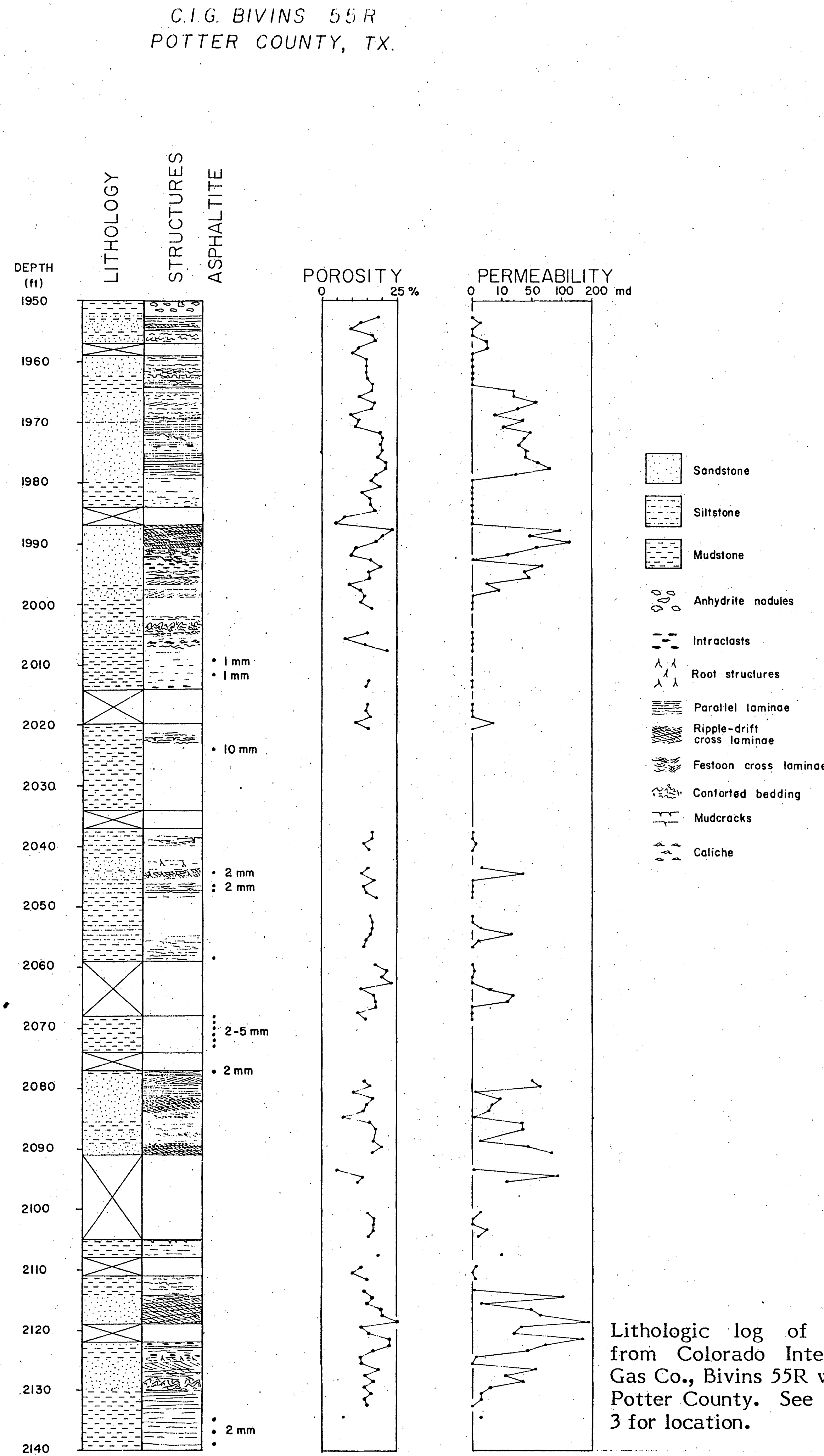


Figure 8

Histogram of number of chips containing nodule versus lithology.



Lithologic log of cores from Colorado Interstate Gas Co., Bivins 55R well in Potter County. See figure 3 for location.

Figure 9