

Maps showing land status and well locations, and tables of well data, eastern North Slope petroleum province, Alaska, with a section on exploration by H. C. Jamison

I. L. Tailleux, G. H. Pessel and
S. E. Engwicht

1978

Introductory Notes

Leasable land in the Colville-Canning Rivers region between the National Petroleum Reserve-Alaska and the Arctic National Wildlife Range in northern Alaska has attracted intense petroleum exploration since discovery and confirmation by the Prudhoe Bay State No. 1 and Sag River State No. 1 wells in 1968. By the end of 1975, over 140 wells had been drilled in that region (Alaska Div. of Oil and Gas, 1975).

Only a few reports have attempted to compile and synthesize the data resulting from this drilling activity. Much of the proprietary data and the most sophisticated interpretations reside within industry, and, with exploration still going on and lease sales in the offshore part of the basin pending, this information is likely to remain private.

However, the official record does contain voluminous amounts of information. Most drilling data, logs, and samples filed by statute with the Alaska Division of Oil and Gas can be inspected or copied 25 months after completion of a well. Public hearings have resulted in a considerable amount of information on the subsurface, and reports filed with development contracts on federal acreage, which become public after termination of the contract, have also contributed to the knowledge of the North Slope.

The large amount of data available in the public record is scattered among a number of sources and in a number of formats. We found that this mass of data was so unwieldy for interpretation that some organization and compilation was desirable, at least for internal use by the public agencies. Comments from a number of individuals indicated that an assemblage of information on the subsurface, along with a preliminary and generalized interpretation of the stratigraphy and structure, would serve a broad range of interests. The result has been the series of maps presented in this folio, based on the tabulated data on most of the wells of regional interest available to the public prior to 1975.

Compilation and interpretation of the data were done by Pessel, Tailleux, Bird, and Carter, at the Menlo Park offices of the USGS in February of 1975. The interpretation was guided by criteria derived by the North Slope Stratigraphic Committee of the Alaska Geological Society and by other geologists experienced on the North Slope. Levorsen reviewed the results, and modified and refined some interpretations on the basis of his studies of the Prudhoe Bay field for the Alaska Division of Oil and Gas.

Data on a number of wells have been released to the public record in the time that has elapsed since the original compilation was finished but most of these have not been included in the folio. Preliminary correlations indicate that the regional geology depicted by the isopach and structure maps would not be changed significantly by the data from these wells.

Log correlations and some lithologic descriptions sufficed for a general assessment of the subsurface stratigraphy and structure. Seismic, paleontologic, and other data not in the public record have undoubtedly been used by the oil companies for more accurate and detailed interpretations. We believe, however, despite the acknowledged lack of certain types of data, that this folio adequately generalizes the subsurface geology of the region, including basin size and shape, unit thicknesses, and major stratigraphic trends.

Electric logs and lithologic logs from over 60 wells were used to derive the maps. Most of the wells were drilled in the immediate vicinity of Prudhoe Bay, and therefore the distribution of the data is not entirely satisfactory for good regional control. The stratigraphic units in the subsurface are taken from cross sections published by the Alaska Geological Society and from other reports (Alaska Geological Society, 1970, 1972; Morgridge and Smith, 1972; Jones and Speers, 1976, with reproductions by permission of the American Association of Petroleum Geologists). The stratigraphic units were modified and generalized to correlate as closely as possible with known surface geology in the region. The contour intervals in both the structure maps and the isopach maps were also generalized to minimize the effect of possible correlation mistakes in individual wells. The maps are intended to show regional trends rather than the detailed structure of individual oil and gas fields. The stratigraphic units are listed in detail on the well data tables.

The series of maps on stratigraphic units incorporated into the folio are listed below (titles are shortened):

- MF 928-A Tailleux, I.L., Pessel, G.H., and Engwicht, S.E., Maps showing land status and well locations and tables of well data, with a section on exploration by H.C. Jamison
- MF 928-B Tailleux, I.L., and Engwicht, S.E., Generalized structure map of top, middle, and

- basal Tertiary markers with geothermal gradients, eastern North Slope petroleum province, Alaska
- MF 928-C Pessel, G.H., Tailleux, I.L., and Bird, K.J., Generalized structure map of the top of Colville Group, eastern North Slope petroleum province, Alaska
- MF 928-D Pessel, G.H., Tailleux, I.L., and Bird, K.J., Generalized isopach map of sandstone within the Colville Group, eastern North Slope petroleum province, Alaska
- MF 928-E Pessel, G.H., Tailleux, I.L., and Bird, K.J., Generalized isopach map of shale in the Colville Group, eastern North Slope petroleum province, Alaska
- MF 928-F Pessel, G.H., Tailleux, I.L., and Bird, K.J., Generalized isopach map of the Colville Group, eastern North Slope petroleum province, Alaska
- MF 928-G Tailleux, I.L., and Engwicht, S.E., Seismic maps of shallow Cretaceous horizons, eastern North Slope petroleum province, Alaska
- MF 928-H Pessel, G.H., Levorsen, J.A., and Tailleux, I.L., Generalized structure map of Lower Cretaceous unconformity, eastern North Slope petroleum province, Alaska
- MF 928-I Tailleux, I.L., Pessel, G.H., and Engwicht, S.E., Subcrop map at Lower Cretaceous unconformity, and maps of Jurassic and Lower Cretaceous seismic horizons, eastern North Slope petroleum province, Alaska
- MF 928-J Pessel, G.H., Levorsen, J.A., and Tailleux, I.L., Generalized isopach and net sand maps of Lower Cretaceous sands, eastern North Slope petroleum province, Alaska
- MF 928-K Pessel, G.H., Levorsen, J.A., and Tailleux, I.L., Generalized isopach map of Jurassic and possibly Lower Cretaceous shale, including Kingak shale, eastern North Slope petroleum province, Alaska
- MF 928-L Pessel, G.H., Tailleux, I.L., and Levorsen, J.A., Generalized structure map of top of Sag River Sandstone, eastern North Slope petroleum province, Alaska
- MF 928-M Pessel, G.H., Tailleux, I.L., and Levorsen, J.A., Generalized isopach map of Sag River Sandstone, and overlying siltstone, eastern North Slope petroleum province, Alaska
- MF 928-N Pessel, G.H., Levorsen, J.A., and Tailleux, I.L., Generalized isopach map of the Shublik Formation, eastern North Slope petroleum province, Alaska
- MF 928-O Tailleux, I.L., and Engwicht, S.E., Structure maps of top of Sadlerochit Group and cross sections of the Sadlerochit reservoir (after Alaska Division of Oil and Gas, 1974), eastern North Slope petroleum province, Alaska
- MF 928-P Levorsen, J.A., Pessel, G.H., and Tailleux, I.L., Generalized isopach map of Ledge Sandstone Member of the Ivishak Formation, eastern North Slope petroleum province, Alaska
- MF 928-Q Levorsen, J.A., Pessel, G.H., Carter, R.D., and Tailleux, I.L., Generalized isopach map of the Ivishak Formation, eastern North Slope petroleum province, Alaska
- MF 928-R Pessel, G.H., and Tailleux, I.L., Generalized isopach map of the Echooka Formation, eastern North Slope petroleum province, Alaska
- MF 928-S Bird, K.J., Generalized isopach map of the Lisburne Group, eastern North Slope petroleum province, Alaska
- MF 928-T Bird, K.J., Generalized isopach map of the Endicott Group, eastern North Slope petroleum province, Alaska
- MF 928-U Tailleux, I.L., Bird, K.J., and Engwicht, S.E., Map showing depth to basement from drilling and from seismic exploration, eastern North Slope petroleum province, Alaska
- MF 928-V Albert, Nairn R.D., Landsat mosaics of eastern North Slope petroleum province, Alaska, with preliminary interpretation of observed features

Interpretations from a number of sources beside the compilers summarize the subsurface information for this part of the North Slope. Many physical, social, and political features and boundaries are compiled on a separate sheet (Map A) and are printed as a background on the succeeding maps. References cited throughout the folio have been consolidated into a single list.

Sue Engwicht assisted in the compilation and had charge of graphics and designing the format of the maps.

A detailed history of early North Slope exploration, under the U.S. Navy in the years immediately following World War II, is available in a series of U.S. Geological Survey professional papers. However, little has been published on the history of the exploration by industry, in the late 1950's and 1960's, that resulted in the discovery of Prudhoe Bay. The following short account of company activity was kindly furnished by one of the geologists responsible for the discovery of the super-giant Prudhoe Bay field.

H. C. Jamison^{1/}

Introduction

Significant events that led to the discovery of the Prudhoe Bay field on the North Slope of Alaska spanned a period of about 45 years. The following chronology is presented from the viewpoint of Atlantic Richfield Company and its predecessor companies - Atlantic, Richfield, and Sinclair) which, as operator for itself and Humble Oil and Refining Company (now Exxon), completed the ARCO-Humble Prudhoe Bay State No. 1 discovery well in early 1968. Individual events or groups of events did not necessarily seem important at the time and do not always appear relevant even now, unless viewed in the context of over-all progress and development of background knowledge. This chronology may help to provide that perspective.

Contributors to the knowledge of the geology and hydrocarbon potential of the North Slope include explorationists of the U.S. Geological Survey, the U.S. Navy, the State of Alaska, and certainly those of the petroleum industry. Prior to direct industry involvement in 1958, interest in the hydrocarbon potential of the North Slope had its inception when Naval Petroleum Reserve No. 4 (NPR-4) was created by Executive Order in 1923. NPR-4 constituted a 23 million-acre area lying generally west and north of the Colville River and extending from the Arctic Ocean on the north to into the Brooks Range on the south. In 1944, the entire North Slope was designated as a defense area and the Navy began exploration activity in that year. Under Navy auspices, the USGS initially conducted extensive surface geologic work, together with seismic, gravity, and magnetic surveys, and drilled 45 core holes. When the program was terminated in 1953, the Navy had spent about \$60 million and drilled 37 test wells. Three oil and two gas accumulations had been found, all uneconomic to produce. Nevertheless, the scientific and operational data and experience gained formed a solid basis for future exploration.

Two major events signaled the entry of the petroleum industry into exploration on the North Slope. First was the initial commercial oil discovery in Alaska, the completion of the Richfield Oil Corporation Swanson River Unit No. 1 well on the Kenai Peninsula in August, 1957. Second the North Slope lands lying both east and west of NPR-4 that were previously withdrawn under Public Land Order (PLO) 82 were opened for public acquisition in 1958. Lands first made available, on a competitive bidding basis, were in the Gubik gas field area. Later in the same year, 4 million acres east and southeast of NPR-4 were offered for simultaneous filing and subsequent drawing. The discovery of the Swanson River field and the 1958 land sales, plus the intention to make additional lands available in the 28,000 square miles of PLO 82, provided the incentive for industry to begin intensive exploration on the North Slope.

^{1/}Chief Geologist, North American Producing Division, Atlantic Richfield Company, Dallas, Texas.

^{2/}The writer would like to thank L. D. Brockett, D. A. Mabra, and J. M. Sweet, Atlantic Richfield Company, for contributing to the content and preparation of this paper.

-1923 to 1953-

Naval Petroleum Reserve No. 4 was established in 1923 during the administration of President Harding. Until the supply of petroleum resources became critical during World War II, NPR-4 remained unexplored. In 1944 under U.S. Navy auspices, the U.S. Geological Survey began an intensive exploration program including surface geology, geophysical surveys and drilling. By 1953 when the program was terminated, three oil accumulations had been found in the Umiat, Cape Simpson, and Fish Creek areas. In addition, six gas accumulations were discovered in the Gubik, South Barrow, Meade, Square Lake, Titaluk, and Wolf Creek areas. Of these accumulations, only two deserve designation as "fields". Umiat oil reserves have been estimated at 30-100 million barrels of oil and Gubik reserves at 370-900 billion cubic feet. Even these "fields" were and are uneconomic in terms of productive capacity and reserves, considering the high costs and extreme logistic problems of development, production, and transportation to a market.

Until the announcement by the Federal Government of its intention to make lands available by competitive bids and simultaneous filing in 1958, there was no real incentive for industry exploration on the North Slope.

-1958-

Richfield Oil Corporation established a permanent exploration and production office in Anchorage as a result of the discovery at Swanson River in the preceding year. An industry-wide surge of surface field party exploration throughout Alaska was also triggered by the discovery. During the summer of 1958, Sinclair Oil and Gas Corporation began surface geologic work on the North Slope with a field party based at Umiat for the three-month operational field season.

The Bureau of Land Management (BLM) received competitive sealed bids for lands in the Gubik gas field, which was classified as a "known geological structure". In September, after a 60-day simultaneous filing period, the Bureau held a drawing on 4 million acres in the general area east and southeast of and adjacent to NPR-4. These steps marked the first availability of lands that had previously been withdrawn under PLO 82. Filings were designated on the basis of four-section "blocks", which set a precedent for future land filings and land sales by both the Federal Government and the State of Alaska. In this instance, 1,300 blocks drew a total of 7,500 offers to lease.

-1959-

Sinclair opened a permanent office in Anchorage, and both Richfield and Sinclair conducted field geologic surveys on the North Slope. These field parties were engaged in surface geologic reconnaissance and consisted of eight to twelve geologists for the three-month field season. At least five other companies conducted similar surveys.

-1960-

The industry continued exploration with six companies operating geologic field parties.

The Federal Government established the Arctic National Wildlife Range in December, thus effectively restricting industry entry for major exploration in an area extending from the Canning River on the west to the Canadian Border on the east, and from the Brooks Range on the south to the Beaufort Sea on the north. The creation of the Arctic National Wildlife Range and the earlier establishment of NPR-4 limited potential land acquisition by industry to the area between the Colville and Canning Rivers. Additional areas of potential interest in the Arctic Foothills to the south and in the Coastal Plain west of NPR-4 would also eventually become available.

-1961-

Richfield purchased "protection" acreage from brokers in the area south and east of Umiat. These initial purchases totaled 25 blocks located on surface anticlines along the northern fringes of the Arctic Foothills. Sinclair purchased acreage in the Gubik, Little Twist, and East Umiat areas and signed a joint exploration agreement with British Petroleum Company (B.P.).

Five other companies operated geologic field parties on the North Slope for a total of 28-1/2 crew months.

-1962-

Atlantic Refining Company opened a permanent office located in Anchorage and filed leases in the South Ocean Point area totaling 230,000 acres. During the summer, Atlantic conducted geologic fieldwork for the first time on the North Slope.

In May, the joint Sinclair/B.P. exploration venture began seismic operations which totaled 6-1/2 crew months during the year. This was the first seismic work conducted since the Navy program had been terminated in 1953 and also was the first industry seismic operation on the North Slope.

The Department of Interior approved the Outpost and Chandler River Development Contracts for further operations under the Sinclair/B.P. joint exploration agreement.

During the summer, four other companies conducted surface geologic fieldwork, total crew months decreasing to 12-3/4.

-1963-

Richfield, Sinclair (with B.P.) and Atlantic all operated surface geologic field parties. By this time, surface work included considerable effort toward detailed stratigraphic mapping, as well as the usual reconnaissance investigations and structural analyses. All three companies also conducted extensive seismic programs, with Richfield and Atlantic initiating their separate programs during the year. The three companies utilized a total of six seismic crews.

During 1963-64, Sinclair and B.P. drilled a total of seven exploratory wells on strongly folded surface anticlines that had been defined by both surface geology and seismic surveys. All of these test wells penetrated a Cretaceous clastic section, and none was successful in finding economic reserves.

The Department of Interior approved the South Ocean Point Development Contract for Atlantic and the Echooka Development Contract for Shell and Standard of California.

Surface fieldwork increased to a total of 29 months, involving ten industry operators, plus the USGS. Total industry seismic efforts increased almost fivefold for a total of 20-1/4 crew months.

Colorado Oil & Gas and assisting companies, completed the Gubik Unit No. 1 for 890 million cubic feet of gas per day.

-1964-

Richfield and Humble (Exxon) signed a joint exploration agreement with Richfield acting as operator. After the Federal simultaneous filing of 3.68 million acres in the "Corridor" area of the Sagavanirktok and Kuparuk River drainage areas, Richfield acquired a major leasehold. A large proportion of this acreage was incorporated into the Toolik and the Sagavanirktok Development Contract later in the year. Richfield added a third seismic crew during the fall and winter season and acquired detailed coverage in the Sagavanirktok and Toolik areas. Reconnaissance seismic lines were extended north to the coast of the Beaufort Sea, and it was at this time that the two companies obtained first definition of the Prudhoe Bay structure. One reconnaissance line across the Prudhoe feature had been acquired by Sinclair in 1963, and further detail coverage was obtained during 1964. Atlantic operated two seismic crews for acquisition of data in the Sagavanirktok River, Kavik River, Beechey Mound, and East Beechey Mound areas. Atlantic also mapped the Prudhoe Bay structure as a result of this program.

Atlantic received approval from the Department of Interior for the White Hills Development Contract.

Richfield and Atlantic each conducted surface geologic fieldwork during the summer season. Six other companies had geologic parties in the field for an over-all total of 19 crew months. This year was the culmination of conventional seismic work, which increased once again to a total of 53-1/2 crew months.

Under the Statehood Act, the State of Alaska selected some 80 townships across the northern tier of lands between the Colville and Canning Rivers and received tentative approvals from the Federal Government in October. The State of Alaska held the 13th State Competitive Sale in December for leases covering some 625,000 acres in the Colville area. As a result of the sale, the State received a \$4.382 million bonus on the 476,000 acres purchased. In this sale, Sinclair spent \$1,986,000, Atlantic \$128,000, and Richfield \$50,000.

B.P. completed the East Umiat No. 1 well for a 3.5 million cubic feet per day potential. The U.S. Navy South Barrow No. 6 was completed for 9.6 million cubic feet per day as a gas supply well for the native village of Barrow.

-1965-

Richfield and Atlantic continued exploration activity with geologic field parties on the North Slope during the summer season. All three companies conducted seismic programs with a total of

seven crews. Owing to the negative results from the exploratory wells drilled under the joint agreement with B.P., Sinclair closed the Anchorage office and curtailed future exploration activity.

The State of Alaska held the 14th State Competitive Lease Sale in July. This sale was the first opportunity for the industry to acquire leases on the Prudhoe Bay structure. Richfield-Humble acquired 28 four-section blocks in the crestal area for a total of \$2.479 million. B.P., bidding alone after Sinclair withdrew from participation in the lease sale, acquired 32 blocks flanking the crestal that was obtained by Richfield-Humble.

The BLM conducted the third Federal simultaneous filing in the general Canning River area and south into the Arctic Foothills. Of the total of 3,150 blocks available for filing, 428 received offers. Richfield-Humble acquired a major land position in the Kavik area. Atlantic, with its partners Sun and Pan American, had now acquired several hundred thousand acres in the general Colville-Canning region.

Atlantic's South Ocean Point Development Contract was terminated and the B.P.-Sinclair Outpost Development Contract was reduced in area by a total of 200,000 acres.

Surface geologic fieldwork by industry decreased to a total of 15-1/2 crew months, and seismic programs were reduced to a total of 26-3/4 crew months.

Sinclair initiated drilling operations on the Colville No. 1 well on the extensive acreage block acquired in the 1964 State Sale.

During the summer, Richfield moved in construction equipment to prepare the location for drilling the Susie Unit No. 1 well in the Sagavan Development Contract area. Plans for this winter operation included modification of a Loffland Brothers rig for transportation by Hercules Aircraft from Fairbanks to the North Slope drilling location. This operation would initiate the first commercial use of the Hercules Aircraft, which was later to become the workhorse of the Arctic during the intensive drilling campaign that followed the discovery.

-1966-

Atlantic Richfield (after the merger of the two companies) spudded the ARCO-Humble Susie Unit No. 1 well in March. At the end of the year the well had reached total depth and was testing minor showings. Sinclair abandoned the Colville No. 1, and Union was drilling the Kookpuk No. 1 well at the end of the year at a location 7 miles southwest of the Sinclair abandonment. Under the joint exploration agreement, Atlantic Richfield conducted both seismic and surface geologic fieldwork although the level of activity decreased markedly. Total industry exploration virtually came to a halt with a total of only 2-3/4 seismic crew months.

The BLM opened 4 million acres for simultaneous filing in the area west of NPR-4. Only 765 offers to lease were received on a total of 209 blocks. No leases were issued pending settlement of Native Land Claims.

In January, ARCO-Humble acquired seven critical offshore Prudhoe Bay tracts in the State of Alaska 18th Competitive Sale. The leases, acquired for a total of \$1.2 million, covered the remaining unleased crestal part of the structure and were vital in the decision to proceed with the drilling of the first well. Since the Susie Unit No. 1 well had been abandoned as a dry hole earlier in January, the Loffland Brothers rig was moved via cat-train on the frozen tundra some 60 miles north to the location of the Prudhoe Bay State No. 1 well. The well spudded in April, shut down for break-up in May and resumed drilling in late fall, and the first significant hydrocarbon shows were found in December.

Industry exploratory activity further declined to a total of three crew months of surface geologic fieldwork, and no seismic programs were conducted during the year.

Union abandoned the Kookpuk No. 1 well. By this time, it was apparent that only significant activity to be conducted in the foreseeable future was the drilling of the Prudhoe Bay State No. 1. In effect, all other exploration had come to a complete standstill.

-1968-

ARCO-Humble announced the discovery at Prudhoe in January and continuing announcements through March indicated the significance attributed to the well. In June, the companies announced confirmation of the magnitude of the field with completion of the Sag River State No. 1 well, which was located 7 miles southeast of the discovery. In July, the companies released the DeGolyer & McNaughton estimate that Prudhoe Bay "...could develop into a field with recoverable reserves of some five to ten billion barrels of oil, which would rate it as one of the largest petroleum accumulations known to the world today".

Conclusion

After the Navy program in NPR-4 came to a halt in 1953, a five-year hiatus occurred in North Slope exploration. The industry effort from 1958 to 1968 resulted in ten dry holes with resultant discouragement and a virtual halt in exploration activity immediately prior to the discovery. The cumulative years of intensive and expensive geologic and geophysical work land acquisition, and exploratory drilling nevertheless culminated in discovery of the largest oil field in the United States.

Bibliography

Mann, H.; Lian, H.M.; Bruce, D.D.; Bush, E.R.; Calderwood, K.W.; Sweet, J.M.; Saunders, R.A.; Fay, L.F.; East, E.E.; Wilson, T.; Kirkpatrick, T.D.; "Developments in Alaska", Bull. Amer. Assoc. Petrol. Geol., Vols. 43-53, No. 6 (June), 1959-68.

References for folio

This listing consolidates references cited throughout the folio and includes some for maps still in preparation. Maher and Trollman (1970) and Carter and others (1975) provide comprehensive bibliographies for northern Alaska.

- Alaska Division of Oil and Gas, 1974, In place volumetric determination of reservoir fluids, Sadlerochit Formation, Prudhoe Bay field, in The Trans-Alaska Pipeline and west coast petroleum supply, 1977-1982: U.S. Senate, Committee on Interior and Insular Affairs, Washington, D.C., p. 126-175.
- Alaska Division of Oil and Gas, State of Alaska, 1975, Current statistics on Prudhoe Bay field: Oil and Gas Bulletin, October, p. 1.
- Albert, N. R. D., and Steele, W. C., 1976a, Interpretation of Landsat imagery of the McCarthy quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-773N, 3 sheets, scale 1:250,000.
- _____, 1976b, Interpretation of Landsat imagery of the Tanacross quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-767C, 3 sheets, scale 1:250,000.
- American Association of Petroleum Geologists, (undated), Geothermal gradient of north and south-central Alaska: American Association of Petroleum Geologists, portfolio map area no. 26, scale 1:1,000,000.
- Armstrong, A. K., 1972, Biostratigraphy of Mississippian lithostrotionoid corals, Lisburne Group, arctic Alaska: U.S. Geological Survey Professional Paper 743-A, p. A1-A28.
- _____, 1973, Pennsylvanian carbonates, paleoecology, and rugose colonial corals, north flank eastern Brooks Range, arctic Alaska: U.S. Geological Survey Professional Paper 747, 21 p.
- _____, 1974, Carboniferous carbonate depositional models, preliminary lithofacies and paleotectonic maps, arctic Alaska: American Association Petroleum Geologists Bulletin, v. 58, no. 4, p. 621-645.
- Armstrong, A. K., and Mamet, B. L., 1974, Carboniferous biostratigraphy, Prudhoe Bay State No. 1 to northeastern Brooks Range, arctic Alaska: American Association of Petroleum Geologists Bulletin, v. 58, no. 4, p. 646-660.
- _____, 1975, Carboniferous biostratigraphy, northeastern Brooks Range, arctic Alaska: U.S. Geological Survey Professional Paper 884, 29 p.
- Armstrong, A. K., Mamet, B. L., and Dutro, J. T., Jr., 1970, Foraminiferal zonation and carbonate facies of the Mississippian and Pennsylvanian Lisburne Group, central and eastern Brooks Range, Alaska: American Association of Petroleum Geologists Bulletin, v. 54, no. 5, p. 687-698.
- Atlantic Refining Company, 1966, South Ocean Point development contract: Atlantic Refining Co., 26 p.
- _____, 1968, South White Hills development contract: Atlantic Refining Co., 40 p.
- Atlantic-Richfield Company, 1971, Sagavan development contract: Atlantic-Richfield Co., 28 p.
- _____, 1973, Toolik development contract: Atlantic-Richfield Co., 25 p.
- Barnes, D. F., 1976, Bouguer gravity map of Alaska: U.S. Geological Survey Geophysical Investigations Map GP-913, 1977, scale 1:2,500,000.
- Bird, K. J., 1976, Petroleum potential of the Lisburne Group, eastern Arctic Slope, in Cobb, E. H., ed., The United States Geological Survey in Alaska: Accomplishments during 1975: U.S. Geological Survey Circular 733, p. 26.
- Bird, K. J., and Jordan, C. F., 1976, Lisburne Group--Potential major objective of eastern Arctic Slope, Alaska [abs.]: American Association of Petroleum Geologists Bulletin, v. 60, p. 649-650.
- Blanton, S. L., 1970, Discussion, in Adkison, W. L., and Brosgè, M. M., eds., Proceedings of the geological seminar on the North Slope of Alaska: Pacific Section, American Association of Petroleum Geologists, Los Angeles, California, 1970, Proceedings, p. K14.
- Brosgè, W. P., and Dutro, J. T., Jr., 1970, Paleozoic of northern and central Alaska [abs.], in Second International Arctic Geology Symposium: American Association of Petroleum Geologists Bulletin, v. 54, no. 12, p. 2473.
- Brosgè, W. P., and Reiser, H. N., 1971, Preliminary bedrock geologic map, Wiseman and eastern Survey Pass quadrangles, Alaska: U.S. Geological Survey open-file report, scale 1:250,000.
- Brosgè, W. P., and Tailleux, I. L., 1970, Depositional history of northern Alaska, in Adkison, W. L. and Brosgè, M. M., eds., Proceedings of the geological seminar on the North Slope of Alaska: Pacific Section, American Association of Petroleum Geologists, Los Angeles, p. D1-D18.
- _____, 1971, Northern Alaska, in Future petroleum provinces of the United States: American Association of Petroleum Geologists Memoir 15, p. 68-99.
- Brosgè, W. P., and Whittington, G. L., 1966, Geology of the Umiat-Maybe Creek region, Alaska; Part 3, Areal geology (with a section on heavy-mineral studies by R. H. Morris): U.S. Geological Survey Professional Paper 303-H, p. 501-638.
- BP Exploration Company (Alaska) Inc., 1966, Outpost development contract: BP Exploration Company, Inc., 12 p.
- Carter, Claire, and Laufeld, Sven, 1975, Ordovician and Silurian fossils in well cores from North Slope of Alaska, 1969-1974: American Association of Petroleum Geologists Bulletin, v. 59, p. 457-464.
- Carter, R. D., Denman, J. M., and Pierpoint, J. G., 1975, Geological literature on the North Slope of Alaska: U.S. Geological Survey open-file report 75-384, 81 p.
- Churkin, Michael, 1975, Basement rocks of Barrow arch, Alaska, and Circum-Arctic Paleozoic-mobile belt: American Association of Petroleum Geologists Bulletin, v. 59, p. 451-456.
- Detterman, R. L., 1974, Fence diagram showing lithologic facies of the Sadlerochit Formation, northeastern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-584, scale 1:500,000.
- _____, 1976, Lithofacies fence diagram of Sadlerochit Group for Philip Smith Mountains quadrangle and adjacent areas, northeastern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-744.

- Detterman, R. L., Bickel, R. S., and Gryc, George, 1963, Geology of the Chandler River region, Alaska: U.S. Geological Survey Professional Paper 303-E, p. 223-324.
- Detterman, R. L., Reiser, H. N., Brosgè, W. P., and Dutro, J. T., Jr., 1975, Post-Carboniferous stratigraphy, northeastern Alaska: U.S. Geological Survey Professional Paper 886, 46 p.
- Donovan, T. J., and Tailleir, I. L., 1975, Map showing paleocurrent and clast-size data from the Devonian-Mississippian Endicott Group, northern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-692, scale 1:7,500,000.
- Dutro, J. T., Jr., Brosgè, W. P., and Reiser, H. N., 1972, Significance of recently discovered Cambrian fossils and reinterpretation of Neruokpuk Formation, northeastern Alaska: American Association of Petroleum Geologists Bulletin, v. 56, no. 4, p. 808-815.
- Drummond, K. J., 1974, Paleozoic arctic margin of North America, in Burk, C. A., and Drake, C. L., eds., The geology of continental margins: New York, Springer-Verlag, p. 753-763.
- Fackler, W. C., (Chairman, North Slope Stratigraphic Committee), 1971, West to east stratigraphic correlation section, Point Barrow to Ignek Valley, arctic North Slope, Alaska: Alaska Geological Society, Anchorage, Alaska.
- Gold, L. W., and Lachenbruch, A. H., 1973, Thermal conditions in permafrost - A review of North American literature, in Permafrost: The North American contribution to the Second International Conference: National Academy of Science, ISBN 0-309-02115-4, p. 3-23.
- Grantz, Arthur, Holmes, H. L., and Kososki, B. A., 1975, Geologic framework of the Alaskan continental terrace in the Chukchi and Beaufort Seas, in Yorath, C. J., Parker, E. R., and Glass, D. J., eds., Canada's continental margins and offshore petroleum exploration: Canadian Society of Petroleum Geologists Memoir 4, p. 669-700.
- Gryc, George, and others, 1956, Mesozoic sequence in Colville River region, northern Alaska: American Association of Petroleum Geologists Bulletin, v. 40, no. 2, p. 209-254.
- Hendricks, T. A., 1965, Resources of oil, gas, and natural gas liquids in the United States and the world: U.S. Geological Survey Circular 572, 20 p.
- Howitt, Frank, 1971, Permafrost geology at Prudhoe Bay: World Petroleum, p. 28-38.
- Jones, H. P., and Speers, R. G., 1976, Permo-Triassic reservoirs of Prudhoe Bay field, North Slope, Alaska, in Braunstein, Jules, ed., North American oil fields: American Association of Petroleum Geologists Memoir 24, p. 23-50.
- Keller, A. S., Morris, R. H., and Detterman, R. L., 1961, Geology of the Shaviovik and Sagavanirktok Rivers region, Alaska: U.S. Geological Survey Professional Paper 303-D, p. 169-222.
- Latham, E. H., 1965, New analysis of geologic structure of northern Alaska, in Geological Survey research 1965, Chapter A: U.S. Geological Survey Professional Paper 525-A, p. A101.
- Lerand, Montl, 1973, Beaufort Sea, in McCrossan, R. G., ed., The future petroleum provinces of Canada - Their geology and potential: Canadian Society of Petroleum Geologists Memoir 1, p. 315-386.
- Maher, J. C., and Trollman, W. M., 1970, Geological literature on the North Slope of Alaska: Tulsa, Oklahoma, American Association of Petroleum Geologists, 133 p.
- Mamet, B. L., and Armstrong, A. K., 1972, Lisburne Group, Franklin and Romanzof Mountains, northeastern Alaska, in Geological Survey research 1972: U.S. Geological Survey Professional Paper 800-C, p. C127-C144.
- Mangus, M. D., and Pessel, G. H., (Chairmen, North Slope Stratigraphic Committee), 1972, Northwest to southeast stratigraphic correlation section Prudhoe Bay to Ignek Valley, arctic North Slope, Alaska: Alaska Geological Society, Anchorage, Alaska.
- Mann, H., Lian, H. M., Bruce, D. D., Bush, E. R., Calderwood, K. W., Sweet, J. M., Saunders, R. A., Fay, L. F., East, E. E., Wilson, T., Kirkpatrick, T. D.; "Developments in Alaska": American Association of Petroleum Geologists Bulletin, vols. 43-53, no. 6 (June), 1959-68.
- McKelvey, V. E., 1973, Mineral resource estimates and public policy, in Brobst, D. A., and Pratt, W. P., eds., United States mineral resources: U.S. Geological Survey Professional Paper 820, p. 9-19.
- Morgridge, D. L., and Smith, W. B., Jr., 1972, Geology and discovery of Prudhoe Bay field, eastern Arctic Slope, Alaska, in Stratigraphic oil and gas fields - Classification, exploration methods, and case histories: American Association of Petroleum Geologists Memoir 16, p. 489-501.
- Mull, C. G., and Mangus, M. D., 1972, Itkilyariak Formation; new Mississippian formation of Endicott Group, Arctic Slope of Alaska: American Association of Petroleum Geologists Bulletin, v. 56, p. 1364-1369.
- Mull, C. G., Tailleir, I. L., Mayfield, C. F., and Pessel, G. H., 1976, New structural and stratigraphic interpretations, central and western Brooks Range and Arctic Slope: in Cobb, E. H., ed., The United States Geological Survey in Alaska: Accomplishments during 1975: U.S. Geological Survey Circular 733, p. 24-26. North Slope Stratigraphic Committee, Alaska Geological Society, 1970, The Sag River Sandstone and Kuparuk River Sands, two important subsurface units in the Prudhoe Bay field: in Adkison, W. L., and Brosgè, M. M., eds., Proceedings of the geological seminar on the North Slope of Alaska: Los Angeles, Pacific Section, American Association of Petroleum Geologists, p. P1-P3.
- Patton, W. W., Jr., 1964, Petroleum and natural gas in northern and interior Alaska, in Mineral and water resources of Alaska: U.S. Geological Survey Report to the Committee on Interior and Insular Affairs, U.S. Senate, p. 62-77.
- Patton, W. W., Jr., and Miller, T. P., 1968, Regional geologic map of the Selawik and southeastern Baird Mountains quadrangles, Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-530, scale 1:250,000.

- Patton, W. W., Jr., Miller, T. P., and Tailleir, I. L., 1968, Regional geologic map of the Shungnak and southern part of the Ambler River quadrangles, Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-554, scale 1:250,000.
- Payne, T. G., and others, 1951, Geology of Arctic Slope of Alaska: U.S. Geological Survey Oil and Gas Investigations Map OM-126, scale 1:1,000,000.
- Price, N. C., 1973, Proposed trans-Alaska pipeline system environmental atlas: U.S. Bureau of Land Management, 27 p.
- Reiser, H. N., Brosgé, W. P., Dutro, J. T., Jr., and Detterman, R. L., 1971, Preliminary geologic map, Mt. Michelson quadrangle, Alaska: U.S. Geological Survey open-file report, scale 1:200,000.
- Reiser, H. N., Brosgé, W. P., Dutro, J. T., Jr., and Detterman, R. L., 1974, Preliminary geologic map of the Demarcation Point quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-610, scale 1:200,000.
- Reiser, H. N., Dutro, J. T., Jr., Brosgé, W. P., Armstrong, A. K., and Detterman, R. L., 1970, Progress map, geology of the Sadlerochit and Shublik Mountains, Mt. Michelson C-1, C-2, C-3, and C-4 quadrangles, Alaska: U.S. Geological Survey open-file report, scale 1:63,360.
- Rickwood, F. K., 1970, The Prudhoe Bay field. *in* Adkison, W. L., and Brosgé, M. M., eds., Proceedings of the geological seminar on the North Slope of Alaska: Los Angeles, Pacific Section, American Association of Petroleum Geologists, p. L1-L5.
- Robinson, F. M., 1959, Test wells, Simpson area, Alaska, with a section on core analyses by Yuster, S. T.: U.S. Geological Survey Professional Paper 305-J, p. 523-568.
- Shell Oil Company, 1963, Echooka River development contract: Shell Oil Company, 29 p.
- Sinclair Oil and Gas Company, 1967, Chandler River development contract area: Sinclair Oil and Gas Company, 7 p.
- Stoneley, Robert, 1969, Geologic testimony given before the Alaska Division of Oil and Gas, November 13, 1969, at a public hearing on Prudhoe Bay Field Rules.
- _____, 1970, Discussion on permafrost, *in* Adkison, W. L., and Brosgé, M. M., eds., Proceedings of the geological seminar on the North Slope of Alaska: Pacific Section, American Association of Petroleum Geologists, Los Angeles, California, p. J2-J4.
- Tailleir, I. L., 1969, Speculations on North Slope geology - Part 1-2: Oil and Gas Journal, v. 67, no. 38, p. 215-220, 225-226, and no. 39, p. 128-130.
- _____, 1970, Probable rift origin of Canada basin, Arctic Ocean [abs.], *in* Second International Arctic Geology Symposium: American Association of Petroleum Geologists Bulletin, v. 54, no. 12, p. 2508.
- _____, 1973, Biostratigraphic record extended to Early Silurian or Ordovician; *in* Geological Survey research 1973: U.S. Geological Survey Professional Paper 850, p. 63-64.
- _____, 1975, New graptolite discovery indicates Lower Ordovician rocks in southwestern Brooks Range; *in* Geological Survey research, 1975: U.S. Geological Survey Professional Paper 975, p. 64.
- Tailleir, I. L., and Brosgé, W. P., 1976a, Coal resources of northern Alaska may be nation's largest, *in* Rao, P. D., and Wolff, E. N., eds., Focus on Alaska's coal '75, Proceedings of Conference, University of Alaska, Fairbanks, October 1975: Mineral Investigation Research Laboratory Report, no. 37, p. 222.
- _____, 1976b, Need to revise and test estimates of northern Alaska coal resources; *in* Cobb, E.H., ed., The United States Geological Survey in Alaska: Accomplishments during 1975: U.S. Geological Survey Circular 733, p. 26-27.
- Tailleir, I. L., Brosgé, W. P., and Reiser, H. N., 1967, Palinspastic analysis of Devonian rocks in northwestern Alaska, *in* Oswald, D. H., ed., International symposium on the Devonian System, Calgary, Alberta, 1967, Proceedings v. 2: Calgary, Alberta Society of Petroleum Geologists, p. 1345-1361 (1968).
- Tailleir, I. L., and Pessel, G. H., 1976, Subsurface geology and some implications concerning future petroleum exploration in the eastern North Slope, Alaska [abs.]: Pacific Section, American Association of Petroleum Geologists, Annual Meeting, 51st Program, p. 24-25.
- Thompson, C. J., Coleman, H. J., Dooley, J. E., and Hirsch, D. E., 1971, Bureau of Mines analysis shows characteristics of Prudhoe Bay crude: Oil and Gas Journal, v. 69, no. 43, p. 112-114, 118-120.
- U.S. Bureau of Land Management, 1974, Outer continental shelf official protraction diagram: Harrison Bay NR 5-4, Beechey Point NR 6-3, and Flaxman Island NR 7-3, scale 1:250,000.
- U.S. Bureau of Land Management, 1974, Land status map: U.S. Government Printing Office, Washington, D.C., scale 1:2,500,000.
- U.S. Department of the Interior, 1975, Alaska natural gas transportation system, draft environmental impact statement: U.S. Department of the Interior Part II, v. 1, p. 11-1028; Map 3A-0211-1011, p. 11-13, v. 1 of 3; Map 8.1.1.1-1, p. 11-1330, v. 2; Map 4-204-1001-A, p. 1797, v. 3.
- Van Hinte, J. E., 1976, A Cretaceous time scale: American Association of Petroleum Geologists Bulletin, v. 60, p. 498-516.
- Walker, D. B., 1971, Geologic testimony given before the Alaska Division of Oil and Gas, February 9, 1971, at a public hearing on Prudhoe Bay Sadlerochit Pool Rules.
- Wood, G. V., and Armstrong, A.K., 1975, Diagenesis and stratigraphy of the Lisburne Group limestones of the Sadlerochit Mountains and adjacent areas, northeastern Alaska: U.S. Geological Survey Professional Paper 857, 47 p.