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Precambrian Basement Features in Northern Alberta

by

R. GREEN

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INTRODUCTION

As additional information becomes available it is possible to amplify or to modify previous hypotheses and concepts concerning the geological history of northern Alberta. This paper discusses the topography and structure of the Precambrian basement rocks and their influence on Devonian sedimentation.

The present topography on the Precambrian rocks in northern Alberta has been illustrated by Darling and Wood (1955), Sproule (1956) and Sikabonyi (1957). The Precambrian basement rocks and their overlying arenaceous deposits have been discussed by Baillie (1956), Goodman (1956), Greenwalt (1956), Guthrie (1956), and Sproule (1956), and the Peace River region has been the subject of a symposium of the Alberta Society of Petroleum Geologists (DeMille, 1958; Lavoie, 1958; Williams, 1958).

On a map of the present topography on the Precambrian rocks (fig. 1) it is difficult to visualize properly and to evaluate the significance of the various discernible features. Thus an attempt (fig. 2) has been made to reconstruct the topography of the basement rocks late in the Devonian period—at the time of deposition of the shales of the Exshaw formation—and to discuss the tectonic and paleogeographic significance of the major topographic features.

The region covered in the reconstruction is the northern portion of the Province of Alberta, the southern boundary of which is drawn at the southern boundary of township 66 (latitude 54° 40′ north). The northern, eastern and western boundaries are the provincial borders—latitude 60 degrees north, and longitudes 110 degrees and 120 degrees west, respectively. The method of topographic reconstruction is essentially that used by Greenwalt (1956); the data on which it is based were obtained mainly from the Schedules of Wells of the Oil and Gas Conservation Board, Calgary, Alberta. An isopach map was constructed of the strata between the base of the Exshaw formation and the Precambrian basement. If the pre-Exshaw surface is considered to be a plane, and is rotated into a horizontal position, the isopachs become in effect contours on the surface of the basement. These relative contours (fig. 2) are at 250 feet intervals and the lowest has been designated as zero feet.

The contact of the Exshaw strata with earlier Devonian sediments (Storey, 1956; Warren, 1956) is a paraconformity* but as there is no significant angular discordance this surface is considered to be suitable for use in the reconstruction, and the data utilized to be within an acceptable margin of error.

* Dunbar and Rodgers (1957) divide unconformities into four types; the term paraconformity describes the structural relation between unconformable units where the beds are parallel and the contact is a simple bedding plane.

The top of the Elk Point group was considered for use as a datum, but was not used for several reasons: in northwestern Alberta the upper boundary of Elk Point strata is in some areas diachronous (Law, 1955); towards the southeast this boundary, the base of the Slave Point formation, becomes a paraconformity; in the McMurray area there is evidence of solution of Elk Point evaporites (Carrigy, 1958); in the Peace River area Elk Point strata are absent over the basement high.

East of the erosion edge of the Exshaw formation reconstruction has involved an extrapolation of the datum control plane. From faunal evidence it is generally considered that the Devonian strata of Western Canada thinned out against a low-lying Precambrian land-mass to the east (Warren and Stelck, 1958) which may have been covered by a veneer of Lower Paleozic sediments (Cooke, 1947). It is assumed that in the latitudes of northern Alberta the eastern limit of deposition of Devonian sediments was 200 miles east of the erosion edge of Exshaw strata, that is, approximately 50 miles east of the Alberta-Saskatchewan boundary. On the basis of this assumption thicknesses of pre-Exshaw Devonian sediments have been estimated for the area from the present erosion edge east to the Alberta-Saskatchewan boundary.

The method of topographic reconstruction has several limitations including an increasing margin of error towards the northeast; nevertheless the map constructed (fig. 2) still yields information of considerable interest. In particular, the topography illustrated, that of the surface of the Precambrian basement at the time of deposition of the Exshaw formation, is an approximation to that of the pre-Devonian surface on which Middle and Upper Devonian sediments were deposited.

The data available on which to base reconstruction are subject to more than one interpretation. Comparison should be made of the Peace River region as illustrated on figure 2 and on figure 6 of DeMille (1958). The reconstruction presented here is based primarily on an erosional concept, whereas DeMille's is a more complex structural hypothesis.

LATE DEVONIAN BASEMENT TOPOGRAPHY

The pre-Devonian erosion surface is described below as it existed and as it is illustrated on figure 2.

The pre-Devonian erosion surface is one of low relief and gentle slopes. The maximum slope, 125 feet to the mile, is found on the northern flank of the Peace River high. Some slopes have gradients as low as 7 feet to the mile but most approximate to 15 feet to the mile. On this surface several major topographic features are present: the Peace River high (Peace River land-mass of Webb, 1951), the Bede embayment (Bede trough of Workman, 1953), the northern portion of the Elk Point basin and the western margin of the stable Shield region.

The Peace River high covers some 30,000 square miles between the Lesser Slave Lake area and the western boundary of the province, and has a relief of almost 3,000 feet. The highest area is elongate in a general northeasterly direction, and a general northeasterly trend is recognizable over most of the Peace River region. This highest area lies northwest of Spirit River town in the vicinity of Imperial Royce No. 1 well (56° 11′ north, 119° 5′ west). Southwest of the Royce well detailed control data are lacking, but the surface probably reaches its maximum elevation in that direction. The 800 feet of granite wash* type of sediments in this well probably were derived from an area of higher ground to the southwest.

Northwest of the area of maximum elevation is a slope with a constant gradient of 50 to 60 feet to the mile. To the east this slope becomes north-facing, and the gradient decreases towards the floor of the Bede embayment. Northeast of the Royce well there is a southerly-trending re-entrant into the high, 30 miles wide and 50 miles long. This indentation is a broad valley, up to 1,000 feet deep, which probably received drainage off the higher ground to the south. At present up to 500 feet of arenaceous sediments, particularly of granite wash type, are preserved here. Similar sediments appear to be spread as a blanket up to 200 feet thick on the more open slope north of the re-entrant.

Along the northern flanks of the Peace River high contours trend in a general easterly direction, and swing southward in the area 40 to 50 miles northeast of Peace River town. The swing is related to a northeast-trending trough, which was probably occupied by a stream flowing to the northeast. Deposits of arenaceous material in this depression are extremely thin or absent; no explanation can be offered to account for the absence of arenaceous deposits in this depression and their presence in the south-trending valley mentioned above.

Over an extensive area of the south and east portions of the Peace River high the contours maintain a northeasterly trend. The slope to the southeast is less than the slopes on the northwest and north flanks of the high, and has an over-all gradient of 20 feet to the mile. In this area basal arenaceous deposits at present lying on the surface attain thicknesses of over 500 feet; thickness variations of the deposit apparently bear little relationship to local topography, but in general thicknesses increase towards the southeast away from the areas of maximum elevation.

The Bede embayment is a broad westerly-sloping region north of the Peace River high. In the embayment and on its eastern and northern flanks the gradients of slopes are 10 feet to the mile or less. Few wells have been drilled in the area of the northeast flank and hence control points are scarce; it is suggested that in this area the ground rises gradually towards the presently-exposed Shield region. The south margin of the embayment rises more steeply to-

* "The material eroded from outcrops of granites, syenites, diorites, monzonites and their fine-grained or aphanitic equivalents . . . and redeposited, forming a rock having approximately the same major mineral constituents as the original rock." Taylor and Reno (1948).

wards the Peace River high, some 2,500 feet in 60 miles, or 40 feet to the mile. On the southeast edge of the embayment a broad sill, at an elevation of approximately 500 feet above the basin floor, connects the Bede embayment with the Elk Point basin of east-central Alberta and Saskatchewan.

The stable Shield region extends westward into the Fort McKay-McMurray area; although control data in this area are somewhat scattered the reconstructed topography apparently contrasts with that of the Peace River high. The topography of this dominantly granitic (Burwash, 1957) terrain is low and rounded, with at least one broad valley-like indentation trending eastward and the ground rising towards the east at approximately 10 feet to the mile. On the southern margin of the low depression the ground rises 350 feet to McMurray and culminates in a low rounded knob. North and east of McMurray the general contour trend is north-northwest—a trend which is visible also on aeromagnetic maps of the region (Geol. Surv. Can. 1956-57). Farther north towards Lake Athabasca the contours swing northeastward on the southern side of the topographic low occupied by the present lake. To the north of this low area the surface rises to the northeast.

South and southeast of McMurray the contours trend east- southeast, roughly parallel to the margin of the presently-exposed Shield near the Alberta-Saskatchewan boundary. The plane-like surface slopes southward towards the centre of the Alberta Elk Point basin with a gradient of 10 feet to the mile. Only the northern margins of the Elk Point basin are shown on figure 2.

TECTONIC IMPLICATIONS

According to Burwash (1957) the Precambrian rocks of the Peace River area are dominantly granitic gneisses, with common basic gneisses and schists. Information available from identification of rock types in wells (Burwash, 1957) is insufficient to show any relationship between lithology and topography. Thus any structural interpretation must be made on the basis of comparison with exposed Shield areas in which more data are available.

In the northeast corner of Alberta where Precambrian rocks are exposed linear topographic features may be expressions of faults, fractures, shear zones and alternating granitic and sedimentary or metamorphic belts (Godfrey, 1958). In many places faults and fractures are localized and controlled by less competent metasedimentary belts. Thus, commonly in this region bedrock lithology and structure are closely related.

On the basis of these relationships the northeasterly trend of the basement complex over an extensive area of the Peace River high is attributed to its structure, or to both its structure and its lithology. If the northeasterly lineation represents a continuation of the Lake Athabasca tectonic trend (Sproule, 1956) its extension of

over 200 miles is required. Examination of a tectonic map of Canada (Derry, 1950) shows that structural lines of weakness may be discontinuous and also may change their direction over relatively short distances. However, the fact that a northeasterly lineation is apparently extant over much of the Peace River high suggests that the northeast-trending structures exhibited on the adjacent exposed Shield area extend to the west beneath the present sedimentary cover. Thus the rocks of the Peace River region and those of the Athabasca province of the exposed Shield regions may be structurally related.

It has been illustrated by Law (1955) on isopach maps of lower and upper Elk Point strata that there was differential subsidence in the Bede embayment about an east-trending axis off the northern flank of the Peace River high. Thus, an east-trending line of structural weakness probably exists to the north of the Peace River high. It seems that this line controlled the easterly lineation of the contours in this region and was the cause of the change of shape of the pre-Devonian erosion surface.

The floor of the Alberta Elk Point basin (fig. 2) extends down to at least 1,000 feet below the level of the Chipewyan Lakes sill. The basin is probably one of intracratonic subsidence and this subsidence was partially controlled by lines of weakness (Buller, 1958). Middle Devonian sediments in both the Elk Point basin and Bede embayment are of shallow-water type, and, as sediment thicknesses may be as much as 2,000 feet, subsidence must have been partially contemporaneous with sedimentation. Thus, initially in Middle Devonian time these basins were less well-defined and had much less relief than at present. The Middle Devonian seas probably spread over an erosion surface on which gradients were less than five feet to the mile. Conditions were thus favorable for widespread reefal growth when circulation was good, and for evaporite deposition when circulation was restricted.

TECTONIC AND SEDIMENTARY HISTORY

The stable cratonic region of North America in Cambrian time, as outlined by Lochman-Balk and Wilson (1958), was bordered by unstable cratonic shelves. In Western Canada the margin of the inherently stable region was probably close to the present limit of Precambrian rock outcrops. The unstable cratonic margin (hedreocraton of Warren and Stelck, 1958), on which intracratonic basins and positive areas developed at different periods of geologic time, extended over central and southern Saskatchewan, Alberta and parts of eastern British Columbia.

It is probable that all major fault movements along the northeast-trending lines of structural weakness of the Shield regions took place in Precambrian times. Campbell (1958, p. 171) discussing faults in the Great Slave Lake area which, where projected, appear to underlie the Pine Point mineralized belt, states, "In view of the fact that undislocated Proterozoic diabase dikes cross some of the faults,

it would appear unlikely that they were rejuvenated in Paleozoic times. Nevertheless local structures and the pronounced sedimentary differentiation in the middle Devonian sediments overlying the Precambrian faults in the Pine Point area may be interpreted in terms of tectonic movements hinged along an axis approximately coincident with earlier faulting in the basement complex."

The basement rocks in Western Canada underwent a major planation in late Precambrian time and large quantities of clastic sediments were deposited along the western margins of the craton (Warren, 1951). An erosion surface of low relief was produced (Cooke, 1947), and Cambrian seas transgressed over this surface in the unstable shelf region (Lochman-Balk and Wilson, 1958) depositing initially coarse clastics, products of a prolonged period of erosion (Raasch and Campau, 1957). In northern Alberta and northwestern Saskatchewan these initial clastics included sediments of granite wash type (Guthrie, 1956); Buller, 1958). There was probably some uplift and regression of seas from the region early in the Ordovician period (North and Henderson, 1954), followed by an extensive flooding late in the Ordovician, at which time beds of Winnipeg and Red River age were deposited in northwestern Saskatchewan (Borden, 1955; Buller, 1958). It is possible that the Peace River-McMurray region tended to be positive during Cambro-Ordovician times, but the evidence available is inconclusive.

In late Silurian or early Devonian time there was a period of uplift, accompanied by mild crustal warping and erosion, as evidenced in Saskatchewan where the Ashern formation at the base of the Elk Point group transgresses over tilted Cambrian to lower Silurian strata (Baillie, 1953), and on the southeastern flank of the Peace River high where Middle Devonian sediments lie unconformably on a south-dipping Cambrian and pre-Devonian succession (Guthrie, 1956; DeMille, 1958). The Peace River high in its general present form probably developed at this time, as a mild crustal upwarp complementary to the basin developments of the cratonic shelf region to the north and to the southeast which permitted ingress of Elk Point epeiric seas.

In northwestern Saskatchewan (Buller, 1958) and in the Great Slave Lake area (Campbell, 1958) late Silurian to Middle Devonian differential regional subsidence was influenced by lines of structural weakness, and took place as warping along such lines rather than as fault block movement. In northern Alberta similar conditions apparently prevailed, for the map of pre-Devonian topography (fig. 2) shows no sharply-defined linear features which could represent fault or fault-line scarps, and major linear features are recognizable only when study is made on a regional, rather than a local, scale. There were probably minor post-Devonian movements along fault lines (Sikabonyi, 1957; DeMille, 1958; Lavoie, 1958) but these are not distinguishable on a map of regional scale.

The Middle Devonian Elk Point seas spread into the region from the west across the Bede embayment. The basal red beds in the embayment are of unknown age (Law, 1955), but the overlying

evaporitic unit, the Chinchaga formation, is considered by Law to be of Middle Devonian age. This formation is probably the northward continuation of the evaporites which occur below the Methy dolomite in the McMurray area, and of the Meadow Lake beds (Van Hees, 1956) of east-central Alberta and northwestern Saskatchewan. Shallow-water conditions in the Bede embayment, with some restriction of circulation, led to deposition of the dolomites and anhydrites of the Chinchaga formation. Farther to the southeast more restricted circulation induced by the Chipewyan Lakes sill led to the deposition of the two lowest salt beds and their associated evaporites in the Alberta portion of the Elk Point basin (Buller, 1958).

Increase in the rate of regional subsidence caused a widespread incursion of seas, which extended across central Saskatchewan, and then the stromatoporoidal-coral-algal reefs and related calcareous strata of the Keg River, Methy and Winnipegosis formations were deposited. Law (1955) suggested that increased rates of reefal growth on the seaward margins of the Bede embayment would result in the restricted circulation in the back-reef regions. As a consequence the back-reef facies of dolomite-anhydrite (Muskeg formation) were deposited in the Bede embayment. A result of further restriction, again induced by the Chipewyan Lakes sill, was the widespread deposition of salt to the southeast (upper salt of the Alberta Elk Point group, Prairie evaporite of Saskatchewan), primarily in the Elk Point basin. Slight fluctuations of sea level led to the later development of local calcareous deposits and evaporitic basins, mainly in Saskatchewan (Walker, 1957). Final regression of the sea brought an end to evaporite deposition, and thin clastic deposits were spread over the evaporites in both the Elk Point basin and the Bede embayment. In the latter area arkosic material (Watt Mountain formation) was deposited on the flanks of the Peace River land-mass (Law, 1955).

Evaporites and red beds indicate that arid or semi-arid conditions prevailed over the region during Middle Devonian time. Weathering of the Peace River and stable Shield land-masses under arid conditions produced the arkose or granite wash which was incorporated into the sediments flanking those land areas.

Further gradual regional subsidence of the cratonic shelf, which continued until the end of Palliser or Wabamun time, allowed an incursion of the sea from the west and resulted in the eventual submergence of the Peace River land-mass.

The Upper Devonian regional subsidence probably took place about a hinge along the margin of the stable craton, and this hinge almost coincided with the presently-exposed Shield margins. Thus in northern Alberta the inferred hinge-line trended north, and lay close to the eastern boundary of the province, and in central Saskatchewan the inferred hinge-line trended northwest.

The Elk Point basin would probably be defined as "discordant" in the classification of Umbgrove (1947). However, DeSitter (1956) considers that a close study of basins always reveals some kind of connection between the elongation or axis of the basin and the

trend of the basement. In the Michigan basin region a transverse northwest-trending arch (Kankakee arch) developed in the basement rocks early in Devonian time (DeSitter, 1956) and continued to be active during the Middle Devonian. It is considered that the northwest-trending Elk Point basin and adjacent land area to the southwest, which included the Peace River high, were products of the same epeirogenic movements that developed the Kankakee arch of the Michigan basin region. Sikabonyi (1957) and Lavoie (1958) have presented evidence for minor post-Devonian movements along northwest-trending fault lines in the Peace River region, and Carrigy (1958) has suggested similar activity in the McMurray area. Thus in addition to the more easily recognizable northeast-trending lines, some structural lines in the basement complex in Saskatchewan and Alberta apparently trend northwest.

After the end of Devonian time, the cratonic shelf in Western Canada became generally stable although the Peace River region had negative tendencies during late Paleozoic and early Mesozoic times.

CONCLUSIONS

Pre-Devonian topographic features in northern Alberta were primarily structural in origin; they were produced by warping of the late Precambrian erosion surface, and not by fault movements.

The Peace River high is an eroded asymmetric domal structure in Precambrian rocks, separated from the Bede embayment by a structurally weak line.

A westward continuation of the Lake Athabasca tectonic trend is more likely to mark the northern boundary of the Peace River high than to pass through the high itself.

Most of the warping in the cratonic margin of Western Canada is controlled by basement structural lines.

Structures in the rocks of the Athabasca and Peace River provinces are similar.

REFERENCES CITED

Baillie, A. D. (1953): Devonian system of the Williston Basin area; Manitoba Mines Br. Publ. 52-5, 105 pages.

..... (1956): Granite wash in the Clear Hills area; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 9, p. 206-212.

Borden, R. L. (1955): Ordovician and Silurian stratigraphy of the southern part of the prairie provinces, Canada; Jour. Alberta Soc. Petroleum Geol., Vol. 3, No. 10, p. 169-177, 190.

Buller, J. V. (1958): The sub-Ashern stratigraphy of northwest Saskatchewan; Oil in Canada, Vol. 10, No. 23, p. 34-51.

Burwash, R. A. (1957): Reconnaissance of subsurface Precambrian of Alberta; Bull. Am. Assoc. Petroleum Geol., Vol. 41, p. 70-103.

Campbell, N. (1958): Stratigraphy and structure of Pine Point area, N.W.T.; Structural geology of Canadian ore deposits, Vol. II, Congress Vol. Can. Inst. Min. Met. Geol. Div., p. 161-174.

Carrigy, M. A. (1958): Geology of the McMurray formation: Part III, General geology of the McMurray area; Res. Coun. Alberta (in press).

Cooke, H. C. (1947): The Canadian Shield; in Geology and economic minerals of Canada, Geol. Surv. Can. Econ. Geol. Ser. No. 1, p. 11-97.

Darling, G. B. and Wood, P. W. J. (1955): Oil in the Canadian portion of the Williston basin; Jour. Alberta Soc. Petroleum Geol., Vol. 3, No. 6, p. 84-87.

DeMille, G. (1958): Pre-Mississippian history of the Peace River arch; Jour. Alberta Soc. Petroleum Geol., Vol. 6, No. 3, p. 61-69.

Derry, D. R. et al. (1950): Tectonic map of Canada; Geol. Assoc. Can.

DeSitter, L. U. (1956): Structural geology; McGraw-Hill, New York, 358 pages.

Dunbar, C. O. and Rodgers, J. (1957): Principles of stratigraphy; J. Wiley and Sons, Inc., New York, 356 pages.

Geological Survey of Canada (1956--1957): Geophysics papers Nos. 305-358, 407-422, 437-469.

Godfrey, J. D. (1958): Aerial photographic interpretation of Precambrian structures north of Lake Athabasca; Res. Coun. Alberta, Geol. Div., Bull. 1, 19 pages.

Goodman, H. W. (1956): Granite wash of the Bat Lake area, Alberta; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 10, p. 223-226.

Greenwalt, W. A. (1956): Granite wash of the Peace River area; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 9, p. 204-205, 213.

Guthrie, D. C. (1956): Gilwood sandstone in the Giroux Lake area; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 10, p. 227-231.

Lavoie, D. H. (1958): The Peace River arch during Mississippian and Permo-Pennsylvanian time; Peace River Symposium Number, Jour. Alberta Soc. Petroleum Geol., Vol. 6, No. 3, p. 69-74.

Law, J. (1955): Geology of northwestern Alberta and adjacent areas; Bull. Am. Assoc. Petroleum Geol., Vol. 39, p. 1927-1975.

Lochman-Balk, C. and Wilson, J. L. (1958): Cambrian biostratigraphy in North America; Jour. Paleont., Vol. 32, p. 312-350.

North, F. K. and Henderson, G. G. L. (1954): Summary of the geology of the southern Rocky Mountains of Canada; Alberta Soc. Petroleum Geol., Fourth Ann. Field Conf. Guide Book, p. 15-81.

Raasch, G. O. and Campau, D. E. (1957): Cambrian biostratigraphy; Jour. Alberta Soc. Petroleum Geol., Vol. 5, No. 7, p. 140-144.

Sikabonyi, L. A. (1957): Tectonic trends in the prairie region of Canada; Jour. Alberta Soc. Petroleum Geol., Vol. 5, No. 2, p. 23-28.

Sproule, J. C. (1956): Granite wash of northern Alberta; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 9, p. 197-203, 213.

Storey, T. P. (1956): Evidence for pre-Mississippian erosion of Devonian in Manitoba; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 8, p. 186-187.

Taylor, G. L. and Reno. D. H. (1948): Magnetic properties of "granite" wash and unweathered "granite"; Geophysics, Vol. 13, No. 2, p. 164.

Umbgrove, J. H. F. (1947): The pulse of the earth; Martinus Nijhoff, The Hague, 358 pages.

Van Hees, H. (1956): Elk Point group; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 2, p. 29-37, 39.

Walker, C. T. (1957): Correlations of Middle Devonian rocks in western Saskatchewan; Saskatchewan Dept. Mineral Res. Rept. 25, 59 pages.

Warren, P. S. 1951): The Rocky Mountain geosyncline in Canada; Trans. Roy. Soc. Can., 3rd Ser., Sec. 4, Vol. 45, p. 1-10.

..... (1956): The Exshaw shale; Jour. Alberta Soc. Petroleum Geol., Vol. 4, No. 6, p. 141-142.

Warren, P. S. and Stelck, C. R. (1958): Continental margins of Western Canada in pre-Jurassic time; Jour. Alberta Soc. Petroleum Geol., Vol. 6, No. 2, p. 29-42.

Webb, J. B. (1951): Geological history of plains of Western Canada; Bull. Am. Assoc. Petroleum Geol., Vol. 35, No. 11, p. 2291-2315.

Williams, G. K. (1958): Influence of the Peace River arch on Mesozoic strata; Jour. Alberta Soc. Petroleum Geol., Vol. 6, No. 3, p. 74-81.

Workman, L. E. (1953): Elk Point formation in the Peace River region; Alberta Soc. Petroleum Geol., News Bull., Vol. 1, No. 8, p. 7-8.

FIGURE 1

PRESENT TOPOGRAPHY OF THE PRECAMBRIAN BASEMENT IN NORTHERN ALBERTA

SCALE IN MILES

10 0 10 20 30 40 50

LEGEND

CONTROL POINTS

WELLS DRILLED TO BASEMENT.....●

GROUND ELEVATIONS.....+

CONTOUR INTERVAL 250 FEET

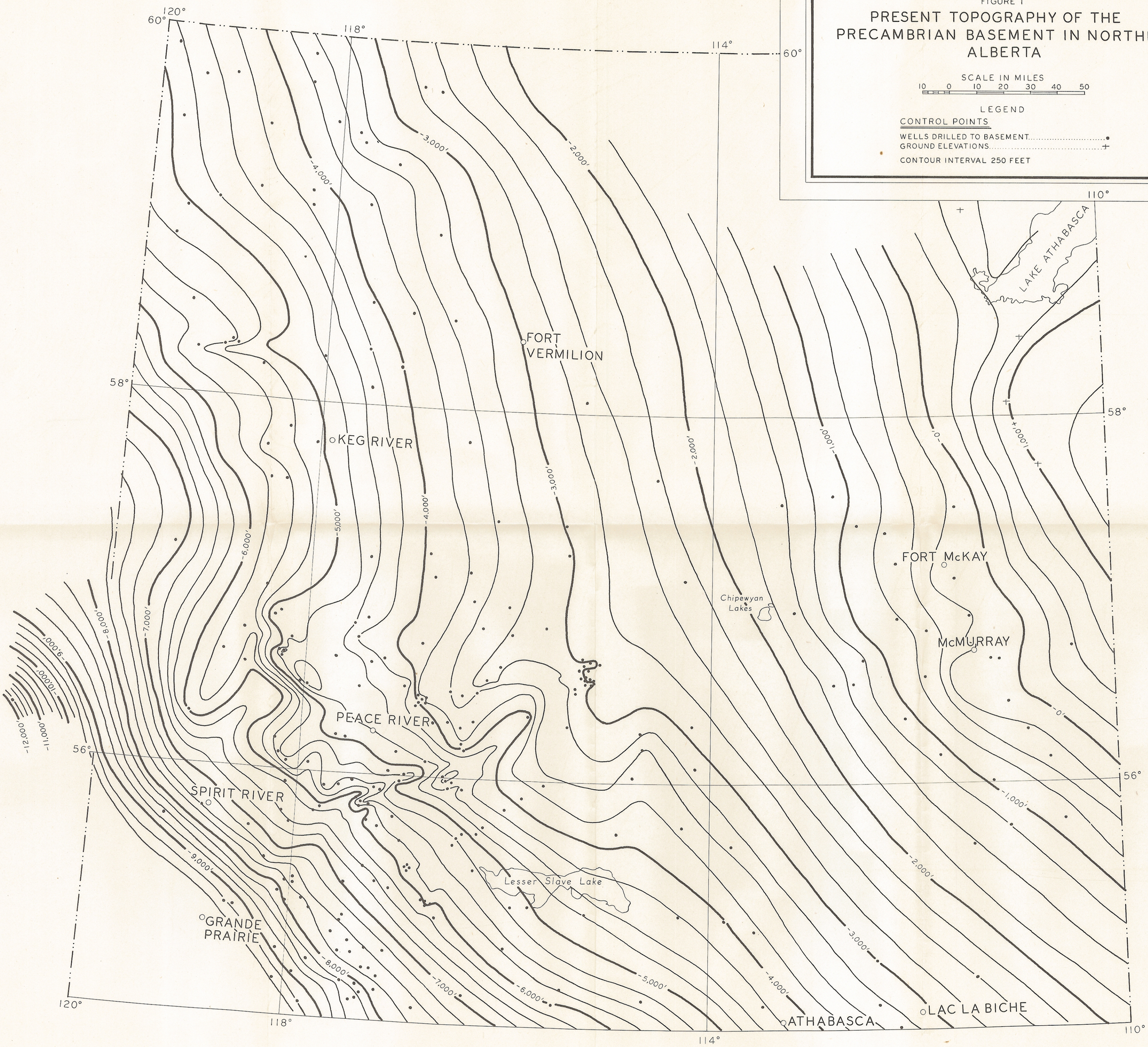

FIGURE 2

LATE DEVONIAN TOPOGRAPHY OF THE PRECAMBRIAN BASEMENT IN NORTHERN ALBERTA

SCALE IN MILES

10 0 10 20 30 40 50

LEGEND

CONTROL POINTS

WELLS DRILLED TO BASEMENT.....●

GROUND ELEVATIONS.....+

EROSION LIMIT OF EXSHAW FORMATION. —·····—

CONTOUR INTERVAL 250 FEET

120°
60°
118°
114°
60°
110°
58°
56°
0'
1000'
2000'
3000'
4000'
FORT VERMILION
KEG RIVER
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
LAKE ATHABASCA
FORT McKAY
McMURRAY
Chipewyan Lakes
Lesser Slave Lake
ATHABASCA
LAC LA BICHE