Exposure of the Elk Point Basin, Bonaparte core of layered halite beds from the Devonian Prairie Supergroup of the Elk Point Group. Associated potash facies salts in Saskatchewan are the foundation of longstanding commercial exploitation.

Photograph by G.D. Moseley.
Chapter 10 – Devonian Elk Point Group of the Western Canada Sedimentary Basin

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Introduction

In the Interior Plains, the Lower to Middle Devonian clastics, red beds, evaporites and carbonates of the Elk Point Group (Fig. 10.1) overlie Precambrian or lower Paleozoic rocks with an erosional unconformity that has up to 1400 m of relief. The sediments and evaporites accumulated in paleotopographic basins separated by highlands. Taltihina Highland, Western Alberta Ridge and Peace River Highland (Fig. 10.2) remained emergent during the Middle Devonian.

Lower and lower Middle Devonian strata are present in the southern Mackenzie Mountains (NWT) and extend eastward into the subsurface of the northern plains. They accumulated in Root Basin and Willow Lake Embayment (Fig. 10.2). Here, the Lower Elk Point subgroup (Fig. 10.1) reaches a thickness of more than 1000 m. Equivalent beds in the southern plains attain a maximum thickness of 358 m. The strata of the Upper Elk Point subgroup conformably overlie the lower subgroup and accumulated in the Willow Lake and Elk Point embayments. They attain a thickness of more than 340 m in the northern plains and 315 m in the southern plains.

The Elk Point strata are discontinuously exposed along the northeastern margin of the Western Canada Sedimentary Basin in southeastern Manitoba, western Saskatchewan, northeastern Alberta and the southeastern part of the District of Mackenzie. They are also exposed in the Cordilleran Orogens to the west.

Previous Work

There are many reports available that deal with the economically important Lower and Middle Devonian rocks of the Elk Point Group. The Pine Point lead-zinc deposits in the District of Mackenzie, Northwest Territories were described by Campbell (1967), Skall (1977), Ayle (1981), Jibodes et al. (1984) and Krebs and Macquen (1984); the lead zinc deposits in northeastern British Columbia were discussed by Taylor et al. (1975).

The salt deposits in the subsurface of the Interior Plains were mapped by Hamilton (1973) and Meijer Drees (1986); the potash deposits in southern Saskatchewan by Holmes (1969). Some of the oil pools in the Rainbow Lake field of northern Alberta were described by Krake, Jr. et al. (1967), Langdon and Chun (1960) and Pridwell (1989); the Zama Lake reservoir rocks were described by McCormick and Griffith (1967), Collin and Lake (1969) discussed the Leduc gas field of northeastern British Columbia. The reservoir rocks of the Pointed Mountain, Kotaneelee and Beaver River gas fields of the Nelson Sandstone of the British Columbia and the District of Mackenzie were described by Snowdon (1977) and Morrow et al. (1986). Those of the Tabeland oil field in southeastern Saskatchewan were discussed by Martin and MacDonald (1989). The reservoir rocks of the Mistou and Nipisi oil fields in central Alberta were described by Krakers and Lempke (1967), Shawa (1969) and Alcock and Bonteau (1979).


Geological Framework

The lower part of the Elk Point succession onlaps a triangular irregular surface of considerable relief. In the interior plains of the District of Mackenzie the succession unconformably overlies Ordovician and Silurian carbonates; in northern Alberta it overlies Precambrian igneous and metamorphic rocks; in southern Alberta it overlies Ordovician and Silurian carbonates. The absence of lower Paleozoic strata in the Northern Alberta sub-basin suggests that this region was deeply eroded before the onset of Devonian deposition.

The formations in the upper part of the Elk Point Group are widely distributed and outline an ancient embayment (the Elk Point Embayment) that extended southeastward from northwestern British Columbia and the District of Mackenzie into the Williston Basin of southern Saskatchewan, Manitoba and North Dakota. The smaller embayment in southwestern British Columbia (the Golden Embayment) is separated from the Elk Point Embayment by the Western Alberta Ridge in southwestern Alberta (Fig. 10.2).

The upper boundary of the Elk Point Group is a relatively flat surface; consequently the Elk Point isopach (Fig. 10.3) clearly indicate the outline of the paleotopographic basins and the amount of paleotopographic relief in the area southwest of the Devonian outcrop belt that parallels the Canadian Shield, the orientation of the isopach changes. Here, salt was leached from the Elk Point succession, resulting in a collapse of the upper surface.

Depositional History

The distribution and facies of Elk Point Group strata are illustrated in a series of five maps (Figs. 10.4 to 10.8 inclusive), each encompassing a designated stratigraphic interval. The maps are ordered from oldest to youngest.

The oldest Devonian beds are present in the southern Mackenzie Mountains of the District of Mackenzie. Here, Lower and lower Middle Devonian shallow-marine carbonates, peritidal evaporites and some more sandy deposits of the Innisfail and Tumana formations accumulated in a semi-restricted to restricted marine environment in Root Basin and Willow Lake Embayment (Morrow and Cook, 1987). Root Basin lies at the edge of the Devonian continental margin, and the great thickness of the sediments in the basin indicates that the basin was subsiding.

Figure 10.1 Correlation chart for the Lower and Middle Devonian strata of the Elk Point Group.

Stratigraphy

Stratigraphic Nomenclature

The Elk Point Group includes formal and informal units (Fig. 10.1) that were introduced by Baille (1953), Law (1955), Sherwin (1962), Belyea and Norris (1962), and Gray and Kasubi (1963). Some of the formal definitions were subsequently modified to reflect new information.

The base of the Elk Point Group coincides with the pre-Devonian erosional unconformity. The top of the Elk Point is defined at the base of a thin, green or reddish brown shale unit (the Watt Mountain Formation) that overlies an unconformity. The shale unit is widely distributed in the subsurface of the southern plains. In the northern plains it is not present and the underlying formations change facies. Here, the upper boundary is selected at the unconformity or below the associated hiatus.

Several authors described local erosional unconformities within the Elk Point succession. Law (1955) and Meijer Drees (1988) described the sub-Watt Mountain unconformity; Douglas and Norris (1961a), Belyea (1970), Law (1971), and Meijer Drees (1990) reported on the sub-Headless unconformity.

The presence of these two erosional unconformities and the regional distribution pattern of the dominant lithologies within the basin suggest that the Elk Point Group includes three complete depositional sequences and the basal part of a fourth one (Moore, 1986; Morrow and Goldfeder, 1988). However, the sequence boundaries do not coincide with either the top of the Elk Point Group or the contact between the Lower and Upper Elk Point subgroups.

Each depositional sequence is composed of marginal clastics, red beds, anhydrite carbonates and fossiliferous carbonates. Some of the sequences include extensive evaporites.

The Elk Point nomenclature used in the subsurface is shown on Figure 10.1. Map units defined in outcrop sections are not included because, in general, they do not make suitable reference sections. Coherence of the evaporite interbeds is lost on exposure. In the shallow subsurface, salt is dissolved by circulating groundwater and anhydrite changes to gypsum. Beds overlying the collapsed salt cop out as carbonate or pyroclastic breccia.

The carbonate deposits of the Elk Point Group locally contain age-diagnostic corals, brachiopods, conodonts and ostracods. The correspondence on Figure 10.1 incorporates the results of the biostratigraphic studies published by Craig et al. (1967), Fuller and Pollock (1972), Pedder (1975), Norris and Uyeno (1983), Norris et al. (1982) and Braun et al. (1988).

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Figure 10.2 Pre-Devonian, Lower Elk Point paleotopographic features, and lines of regional cross sections.
Figure 10.3 Isopach map of the Elk Point Group, southern Interior Plains, Canada.
Figure 10.4 Distribution of Lower Devonian strata (Tsatsco, Camseki, lower Mirage Point and Lotseberg).
Figure 10.3 Distribution of lower Middle Devonian, sub-Headless strata (Arctica, Fort Norman, Fortuna, Mirage Point, Cold Lake and Basal Red Beds).
Figure 10.6 Distribution of the lower Middle Devonian, Headless equivalents (lower Lonely Bay, upper Chinchaga, Contact Rapids and Ashern).

DISTRIBUTION OF THE LOWER MIDDLE DEVONIAN, HEADLESS EQUIVALENTS (lower Lonely Bay, upper Chinchaga, Contact Rapids and Ashern)

- Depositional (marginal) edge
- Well-defined facies change
- Poorly defined facies change
- Emergent uplands

Legend:
- Agglomerates and sandstones, dolomites, and limestones (Contact Rapids, Ashern)
- Dolostones and argillites, silts, and sands (upper Chinchaga)
- Dolostones and marls (lower Chinchaga)
- Dolostones (lower Chinchaga)
- Agglomerates, carbonates, and shales (sandstone and shale)

Scale: 1:5,000,000

Note: The diagram illustrates the distribution of geological formations in the region.
Figure 10.7: Distribution of the Lower Givetian strata (Evie, Pine Point, Muskeg, Prairie Evaporite).
Figure 10.8 Distribution of the Middle Givetian (sub-Watt Mountain) strata (Otter Park, Sulphur Point, Blatcho and Dawson Bay).
Figure 10.9 Regional stratigraphic cross section H-H, Cll Lake to Great Slave Lake, eastern District of Mackenzie. Note that the vertical scale (1:3500) is considerably expanded from the atlas standard (1:6000). Horizontal spacing is not to scale.
During periods of low water level and excessive evaporation, anhydrite and salt (Muksegg and Prairie Evaporite formations) accumulated in the supratidal flats, coastal lagoons and ephemeral lakes behind the barrier by the process of "evaporative drawdown" (Maiden, 1973). Klimkower (1989) and Corrigan (1975) documented several major cycles of flooding and dessication in the southeastern part of the Elk Point Embayment. These events led to periodic deposition of previously deposited evaporites and the accumulation of potash salts.

Sea level fell after the accumulation of these evaporites and the entire embayment became emergent during the mid-Givetian (sub-Watertownian) regression. Parts of the Peace River and Tataba highlands were eroded and the Presqu'ile Barrier was exposed. The nearshore and ancient alluvial gravel-outwash deposits in the highlands were eroded and dispersed by rivers into the former embayment, under moist climatic conditions. The southeastern part of the Elk Point Embayment remained emergent and here the salt deposits were partly leached and recrystallized into potash-rich minerals. The second Red Bed probably is an eolian deposit. Reef growth along the seaward (northwest) edge of the Presqu'ile Barrier established itself at a lower level and prograded seaward to form the bioturbated and associated deposits of the Sulphur Point formations (Meijer, 1988) that overlies older slope and basinal deposits of the Elvick and Kuia formations (Figs. 10.1, 10.8).

During the initial phase of the subsequent late Givetian to early Frasian rise in sea level, the Sulphur Point reef edge stabilized and sandy deposits around the Peace River Highland were reworked into the nearshore, deltaic and lagoonal sediment of the Glenwood Member (Watertown Mountain Formation). Foraminiferal carbonate of the Dawson Bay Formation prograded into the southeastern part of the Elk Point Embayment. A return to more arid conditions led to a drop in sand transport from the highland and to the accumulation of salt (the Hubbard Member) in the southeastern part of the former embayment. Windblown deposition of salt and silicous sands are present in the First Red Bed and the upper part of the Wat Mountain Formation.

During the late Givetian (sub-Watertownian) regression, meteoric water entered the subsurface causing local dissolution and extensive dolomitization of the Presqu'ile Barrier limestones. This porous, paleo-aquifer system and the older, sub-Headless paleo-aquifer system were subsequently flushed and enlarged during post-Dinantian periods of uplift and erosion. The following sequence is thought to have formed: a white, coarse-crystalline dolomite facies (the Manetose and Presqu'ile formations) is disrupted as a layer of undolomitized grains and the deposits at Pine Point (Rhodes et al., 1984) and is gas bearing at Beaver River, Pointed Mountain and Kootaneelee (Morrow et al., 1986).

Regional Cross Sections

The stratigraphic cross sections accompanying this chapter are selected to show the salient geological features of the Elk Point Embayment. In the following sections the strata are described from the base upward and from north to south. For practical reasons it is not possible to show all the important sections. It is concluded not to be rigid in the choice of datum. In some sections two or more datum surfaces are used if this is warranted.

The oldest Devonian formations in Western Canada are penetrated by the Editors Mattee Creek No. 1 (6 15-21W6N, long 123°48'W00" located in the District of Mackenzie, just west of Nahanni Butte (Fig. 10.2). Here, Ordovician carbonates are overlain by an interbedded sequence of gray sandy dolomite and sandstone, dolomitic sandstone and silty or sandy anhydrite that is 1304 m thick. The interval includes the equivalents of the Root River, Cassells and Tsatoa formations (Morrow and Cook, 1987; p. 21). It includes synclinal rocks (that Thrallau formation, Proterozoic in age, lies beneath the Devonian formations). The lower two formations are exposed in the north and west and are not present in the subsurface of the Interior Plains.

Cross section H-H'

The cross section across the southern part of the Willow Lake Embayment (Fig. 10.9) represents an area higher up on the flank of Talitna Highland. Here, evaporites of the Fort Norman and Miette Formations overlay the pre-Devonian unconformity. The correlations below the Headless Formation indicate that the carbonates of the Landry, Manetose and Arrima formations change eastward into evaporites. These evaporites overlie a highland that separates the Willow Lake Embayment from the Great Slave sub-basin.

The sub-Headless unconformity has been traced southwestward on Figure 10.9 to the red beds that overlie the Cold Lake Formation. The correlation directly above the unconformity shows the lateral facies changes due to transgression and regressive cycles. The argillaceous limestones of the Headless grade eastward into locally siltstone and sandy dolomite beds and the Buffalo River and Sulphur Point formations, can be displayed.

Cross section I-I'

The Elk Point strata onlap and overlie Talitna Uplift in the southern part of the District of Mackenzie (Fig. 10.10). The map units that are part of the Presqu'ile Barrier directly overlie Precambrian rocks in the northern part of the cross section. Correlations below the unconformity indicate that the sub-Watertown Mountain unconformity divides the barrier into lower and upper parts. The lower part of the Presqu'ile Barrier includes the Sulphur Point Formation and the Presqu'ile and Pine Point map units. The upper part of the barrier is represented by the Carboniferous Slave Point Formation and belongs to the Beaverhill Lake Group.

Cross section J-J'

The stratigraphic relations within the Elk Point Group in northeastern part of the Columbia and northwestern Alberta are shown in the cross section Figure 10.11. The boundary between the Danedien and Stone formations (Griffith, 1967) in the northwestern part of the figure may be coincident with the sub-Headless unconformity, but it is not known if this unconformity extends southeastward into the Chinchaga Formation. The argillaceous and silty carbonates overlying the Stone Formation grade southeastward into the detrital units. Below this unit the Elk Point is relatively thin and is represented by sandstones, shales, carbonates and evaporites of the Wopuskah, Basal Red Beds, Elmentea Lake, Cold Lake and lower Chinchaga. These units accumulated in local depocenters of the Northern Alberta sub-basin. The Ernestina Lake carbonates extend further onto the highlands than the salt deposits of the Cold Lake, suggesting that this sub-basin probably diminished in size as a result of erosion. The Lower Elk Point units in Alberta onlap Peace River Highland and change south-eastward into nearshore dolomitic and continental-gravel-wash sands of the Contact Rapids Formation and the marginal clastics unit. The Elk Point strata directly above the detrital unit include the Sulphur Point Formation and overlie sandstone and siltstone beds and arkosic sandstones.
Figure 10.11 Regional stratigraphic cross section J-J', Beaver River to Worsley, northeastern British Columbia and west-central Alberta (location on Fig. 10.2). Note that the vertical scale (1:4000) is considerably expanded from the Atlas standard (1:6000).
The upper part of the Elk Point Group (Fig. 10.11) consists of a progradational wedge of carbonate deposits that is truncated by the sub-Watt Mountain unconformity. The prominent facies change from carbonates to shales in the central area of the figure represents the seaward part of the wedge. It is composed of reef deposits similar to those of the Porcupine Barrier in the Great Slave Lake region, although the stratigraphic nomenclature is different.

The fossiliferous carbonates of the Dunedin Formation (Fig. 10.11) are overlain by bioturbated shale and limestone beds (the Eocene Formation of the Horn River Group - Grain and Kaserbo, 1963) or locally grade upward into low or high reef mounds similar to the Horn Plateau reefs (Fig. 10.8). Examples of such reef complexes are the Vayo and Sierra gas fields of northeastern British Columbia. Other carbonate reef complexes occur above the Eocene and Klua formations, either as separate mounds (Sablanara reef) or as reef tongues that extend westward from the Porcupine Barrier into the Otter Parks shale basin. It is not known whether these reef deposits belong to the Elk Point Group or the Beaverhill Lake Group. The stratigraphic position of the Klua unit resembles that of the Buffalo River Shale in the District of Mackenzie. The position of the Otter Park resembles that of the upper part of the Speese River Formation in the central part of Figure 10.9, suggesting that it may include early Frasnian strata.

The reefal deposits of the Porcupine Barrier change gradually southeastward into carbonate deposits that include anhydrite interbeds. The lateral facies change between the fossiliferous carbonates of the Pine Point dolostone unit, the Bistcho and the Keg River formations, and the evaporitic carbonates of the Muskeg Formation is difficult to map. Correlations in the southeastern portion of Figure 10.11 indicate that the carbonates of the Keg River Formation change into nearshore and continental sandstones, while the carbonates of the Bistcho Formation grade into anhydrite.

The Wat Mountain Formation is a discontinuous map unit in the region southeast of the Porcupine Barrier and varies greatly in thickness. This is also seen in northeastern Alberta and the District of Mackenzie. The two components that give the characteristic gamma-ray signature of the Wat Mountain Formation apparently act independently of one another. One component reflects the presence or absence of detrital sediment, overlying the unconformity, that was derived from the Peace River landmass. Thus the thick Wat Mountain sections may represent either sediment-filled erosional channels or breccia-filled depressions on a dissolution surface. Thin Wat Mountain sections include only the argillaceous and sandy "fossiliferous" deposits of the overlying, basal transgressive sediments that wedge out to zero toward the northwest.

The sub-Watt Mountain unconformity extends northwestward into the central Alberta sub-basin (Fig. 10.13), but is elusive beyond the foreshore of the overlying clastics because it overlays a palaeotectonic high area (Fig. 10.9). In the District of Mackenzie, the unconformity changes into a paraconformity that separates the reefal carbonates of the Sulphur Point from those of the Slave Point formations (Meijer-Drees, 1988).

**Red Earth cross section**

A more detailed onlap pattern of the Elk Point strata against the Peace River Highland is shown in Figure 10.12. Here the facies changes between the reef beds and marginal clastics of the Contact Rapids Formation and carbonates and nearshore clastics of the Keg River Formation (also known as the "Granite Wash") indicate transgressive onlap. The relations between the Keg River Formation and the overlying evaporites suggest the presence of a platform edge in the upper part of the Keg River.

**Worsley cross section**

Both the Elk Point and Beaverhill Lake strata exhibit onlap due to onlap along the northern flank of the Peace River Highland (Fig. 10.13). The anhydritic deposits of the Muskeg Formation change laterally into reddish brown mottled sandstones and shales. The sandy interbeds of the Watt Mountain Formation (the Gilwood Member) are extensions of a much thicker succession of nearshore and continental sandy deposits that onlapse and surrounds the landmass. By selecting the top of the Beaverhill Lake Group as a datum it is demonstrated that the Gilwood sandstone is diachronous. The marine part of the wedge belongs to the Elk Point Group, and the continental part to the Beaverhill Lake Group.

**Cross section K-K'**

The cross section on Figure 10.14 in northeastern British Columbia and northern Alberta represents a longitudinal slice across the northern Alberta sub-basin. On this figure, the onlap preferentially increases from the east to the west, and the onlap is more evident upward. The cross section is split into two parts by the roughly east-west line. The east part is shown as a westward view and the west part as an eastward view. The cross section includes the entire onlap sequence, with the more onlap on the west side.

The regional dip in the east part is shown by the west dipping strata, while the west part is shown by the east dipping strata. The cross section includes the detailed strata of the Keg River Formation, the Unicorn Group, the Muskeg Formation, and the overlying evaporites. The cross section is split into two parts by the roughly east-west line, with the east part shown as a westward view and the west part as an eastward view. The cross section includes the entire onlap sequence, with the more onlap on the west side.

**Cross section L-L'**

The cross section across the central Alberta sub-basin (Fig. 10.15) shows the Elk Point strata onlapping the Western Alberta Ridge, a highland located in southwestern Alberta and composed of Cambrian rocks. The decrease in thickness to the northeast is due to the solution of salt deposits in the subsurface. Because the datum (top of the Beaverhill Lake) does not compensate for the dissolved salt deposits and the presence of Winnipegosis reef mounds, the arrangement gives a false impression of isoclinal uplift in the north-
Figure 10.14 Regional stratigraphic cross section K-K', Kingou to Wood Buffalo, Elk Point Group, northeastern British Columbia and northern Alberta (location on Fig. 10.2).
Figure 10.15 Regional stratigraphic cross section L'-L', Brazeau River to Beaver River, central Alberta and Saskatchewan (location on Fig. 10.2).
By using the top of the Beaverhill Lake Group as datum it is shown that the Watt Mountain Formation overlies a pre-Devonian landmass in the southwest (the Western Alberta Ridge) and suggests a diachronous unit. The Watt Mountain Formation becomes thicker toward the northeast, where it includes the feather edges of the Dawson Bay Formation and the basal shale member (or "First Red Bed") unit of the Souris River Formation.

**Cross section M-M'**

The cross section northeast of Peace River Highland in the Usikuma Lake and Fort McMurray regions (Fig. 10.16) shows a highland in the east (the Canadian Shield). The lower Elk Point formations overlie the shield and grade into sandstones of the La Loche Formation and the Basal Red Beds unit. The correlations above the contact are based on the Keg River and Winnipegosis formations that overlies the highland and grades into clastics. The upper part of this platform includes a bed of shale between the Algar River and Telegraph wells that is similar to the one shown in Figure 10.12. East of this edge, the lower part of the carbonate platform is locally overlain by reefal mounds of the Muddy Formation. The progradation of carbonates was apparently halted before the basin was filled.

The evaporites of the Prairie Evaporite Formation in the centre of the cross section grade eastward into the Keg River Formation and an unnamed shale unit similar to the basal shale beds of the Eyot unit on Figure 10.15. The salt deposits of the Whitkow Member about the upper part of the underlying carbonate platform. The platform and Whitkow Member are overlain by the Shell Lake Member, which forms a marker bed that can be traced westward into the bulbous to appendage shapes of Unit A. The salt deposits of the Leeford Member decrease in thickness toward the west and change laterally into anhydritic deposits of the Muegke Formation.

Although the Dawson Bay Formation is not present on the cross section, information from boreholes to the south indicates that the anhydritic dolostone unit of the Dawson Bay Formation is equivalent to the anhydritic beds just below the Watt Mountain Formation in the Telegraph 6-30-86-13W4 well (Meier Drees, 1986, Fig. 53). Evidence from core in 14-29-52-2W4 suggests that the "First Red Bed" (now known as the Souris River Formation) overlies an erosional surface, whereas the "Second Red Bed" (Dawson Bay Formation) overlies a dissolution surface. The significance of these observations is schematically shown on Figure 10.1.

**Cross section N-N'**

The Elk Point Group in the southeastern part of the embayment in southern Saskatchewan (Fig. 10.17) is represented by the Asheim, Winnipegosis, Prairie Evaporite and Dawson Bay Formations and the basal shale unit (the first Red Bed unit) of the Souris River Formation. Green et al. (1964) and Meier Drees (1986) Bailey (1953), Lane (1959), Norris et al. (1982) and Dunn (1982) considered the Dawson Bay and Souris River formations to be part of the Mannville Group. The evaporites are pronounced non-conformity between the Prairie Evaporite and Dawson Bay Formations as a result of reaching of Prairie Evaporite salt.

In Figure 10.17, the salt beds of the Prairie Evaporite Formation are locally absent because of post-Devonian dissolution and the local presence of Winnipegosis reefal mounds. These mounds are porous and contain oil in the Tablerland oil field (Fig. 10.3). The correlations in Figure 10.17 also indicate that the Elk Point strata overlie a pre-Devonian highland in the southwest. The sandy and shaly dolostones of the Asheim Formation are widely distributed and overlie the highland. In this area both the Winnipegosis and Prairie Evaporite formations decrease in thickness to the south.

The Dawson Bay Formation overlies the Prairie Evaporite Formation and includes a lower red bed member or "Second Red Bed" and an upper part composed of carbonates including the Muddy and Neely members (Dunn, 1982). It is locally overlain by a unit of salt (the Hubbard Evaporite of Lake, 1959). The Dawson Bay Formation is widely distributed (Fig. 10.17) and overlies the Winnipegosis Formation in places where the Prairie Evaporite salt has been dissolved. In these places the shaly and anhydritic residue from the Prairie Evaporite Formation is part of the "Second Red Bed" unit.

**Cross section O-O'**

In the central part of the Elk Point Embayment (Fig. 10.18) the potash- rich deposits form distinct, mappable units in the Leeford and Neely Members. The Prairie Evaporite Formation (Fig. 10.18) increase in thickness toward the southeast, replacing the underlying Leeford Member. This suggests that the Prairie Evaporite Formation was affected by surficial dissolution before the Dawson Bay carbonates were deposited.

**Reference Logs**

McGhee (1949) introduced the Elk Point Formation in central Alberta, and the Geological Staff of Imperial Oil Ltd. (1950) defined the top above the First Red Bed unit. The formation was given group status by Belyna (1952), and Bollie (1953) extended the Elk Point Group into southern Saskatchewan. Crickmay (1954) selected the type section for the Elk Point Group in central Alberta, shown in Figure 10.19. Law (1955, 1973) recognized the group in northern Alberta and the District of Mackenzie. Reference wells used by these authors are incorporated in the cross sections.

Crickmay's type section of the Elk Point Group in the Anglo Canadian Elk Point No. 1, 2, 21-57-59W4 well is compared with the section in the Canadian Seaboard Ernestina Lake 10-13-60W4 well in which Sherwin (1962) defined the Basin Red Beds unit and the Lotsberg, Ernestina Lake, Cold Lake and Contact Rapids formations (Fig. 10.19). Information presently available suggests that the Elk Point succession in the Anglo Canadian Elk Point No. 1 well is incomplete because the well does not penetrate the Cambrian. It should also be noted that the shaly member above the Winnipegosis Formation, composed of laminated, baffle-inter- pated, shaly and bituminous dolostone rich in calciphyllic oolitica, correlates with the Shell Lake Member (figs. 10.15, 10.16). This locally anhydritized deposit was included by Reinson and Wardlaw (1971) in the Prairie Evaporite Formation.
The California Standard Steen River 2-22-117-5W6 well in northern Alberta (Fig. 10.10, section 1) was chosen to represent the type sections of the Chinchaga, Keg River, Muskeg, Watt Mountain and Slave Point formations. It is important to note that since Law (1955) introduced these map units, several authors have proposed changes in the stratigraphic nomenclature that affect the status and boundaries of the original Muskeg, Watt Mountain and Slave Point formations. Figure 10.10 shows the most recently proposed (Meijer Drees, 1988) subdivision into the Slave Point, Fort Vermilion, Watt Mountain, Sulphur Point and Muskeg formations.

Structure

The regional, long distance correlations of shaly and anhydritic marker beds on borehole logs in the Muskeg and Prairie Evaporite formations by Klingpor (1969) suggest that the markers were deposited as flat layers. The tops of the Prairie Evaporite, Watt Mountain and Dawson Bay formations in the central part of the Elk Point Embayment parallel the marker beds, thus the structure map on Figure 10.20 should give a fair representation of the structural configuration of the Elk Point basin in northeastern British Columbia, northern and east-central Alberta and parts of southern Saskatchewan. The general dip to the southwest and south-southwest is due to post-Devonian episodic events along the western margin of the Paleozoic craton. The dip of the homedine increases toward the southwest and west from about 3.5 to 7.8 m/km. The structural configuration in Saskatchewan reflects the influence of the Williston Basin.

In northeastern Alberta, central Saskatchewan and southwestern Manitoba, the Elk Point salt deposits are absent as a result of dissolution along the outcrop margin. The beds in the upper part of the Elk Point Group have collapsed and the Elk Point surface is between 0 and 180 m, or locally between 0 and 360 m, below the pre-erosional depth. The consequent synformal depression is clearly visible along the northwestern margin of the Elk Point Embayment (Fig. 10.25).

The Prairie Evaporite salt deposits are absent in the area southwest of Regina and south of Saskatoon. Here the Elk Point surface is between 0 and 180 m below the regional trend because of dissolution. The structural contours outline the "Moose Jaw Syncline" (Williams and Burke, 1964) and the "Rosetown Trough" (Kern, 1968).

Correlations on cross sections that terminate at the pre-Devonian highlands (Figs. 10.10, 10.11 and 10.15) show that the top of the Elk Point Group is diachronous along the flanks of the Peace River and Tattleina landmasses and the Western Alberta Ridge. Sedimentary onlap and differential compaction in the basin are the likely reasons why the Elk Point surface lies between 0 and 160 m above the regional trend (Fig. 10.18).

Thickness and Facies Distribution

Many of the variations in thickness in the Elk Point Group (Fig. 10.3) reflect the pre-Devonian paleotopography. It is also apparent on Figure 10.3 that only the western part of the Elk Point succession is completely preserved (Williams, 1984). The contours in the southern District of Mackenzie are less or more outline the Tattleina Highland. The absence of the Elk Point Group in west-central Alberta reflects the presence of the Peace River Highland. The succession thin in southwestern and southern Alberta because it overlies the Western Alberta Ridge. The area occupied by the east-northeast-trending, closely spaced isopachs east of Edmonton overlies the Meadow Creek Escarpment.

Other regional variations in thickness are due to the effects of salt dissolution in the area west and southwest of the Devonian outcrop belt along the Canadian Shield. The prominent, northwest-trending decrease in thickness in east-central Alberta results from the loss of the upper Lotsberg, Cold Lake and Prairie Evaporite salt deposits. The southeast-trending decrease in thickness in central Saskatchewan, north of Saskatoon, which continues into southwestern Manitoba, is due to the dissolution of the salt beds in the Prairie Evaporite Formation.
Figure 10.20 Structure contour map, top of Watt Mountain and Dawson Bay formations, southern Interior Plains.
The Elk Point Group is thin or absent in the region southwest of Regina and south of Saskatchewan because of the dissolution of salt around the Bowdoin Dome in northern Montana. The regional distribution of the red beds and evaporitic facies in the lower part of the Elk Point succession suggests deposition in continental basins. The red beds may represent the shoreline deposits of a salt water lake and the evaporites the nearshore deposits of a partly or completely desiccated lake. The presence of two widely distributed, fossiliferous carbonate units (Emestina Lake and Winiwapsigus-Keg River) in the middle part of the Elk Point group and the regional distribution of the reefal carbonates, peloidal carbonates, nodular anhydrite, salt and red beds deposits in the upper Elk Point successions (Figs. 10, 10.7) suggest a marine influence and a periodic connection with the sea to the north. The presence of Dawson Bay carbonates in southern Saskatchewan (Fig. 10.12) points to an additional connection with the sea in the southeast.

It is difficult to establish time equivalence between the basinal shale, reefal carbonates, anhydritic carbonates and salt deposits without relative age control. Presently available conodont data (Meijer Drees, 1990) suggest that equivalents of the upper Middle Devonian strata in the Elk Point Embayment are thin or absent in the region north of the Presqu'ile Barrier. It is assumed that this hiatus is the result of depositional condensation in a "starved" basinal setting.

The Elk Point succession includes transgressive (onlapping) and regressive (offlapping or progradational) deposits. The transgressive deposits accumulated during periods of rising sea level and relatively little sediment supply. They consist mainly of nearshore sediments, reefs along the margin of the basin, which grew upward rather than seaward, and thick salt deposits that accumulates by evaporation from flooded areas on the coastal or interior plains. The regresive deposits accumulated during periods marked by abundant sediment supply or during periods of uplift or falling sea level. They include nearshore deposits on the carbonate ramps and platforms that prograded toward the basin centre. Nodular anhydrite accumulated in the supratidal part, and thin salt deposits further inland.

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