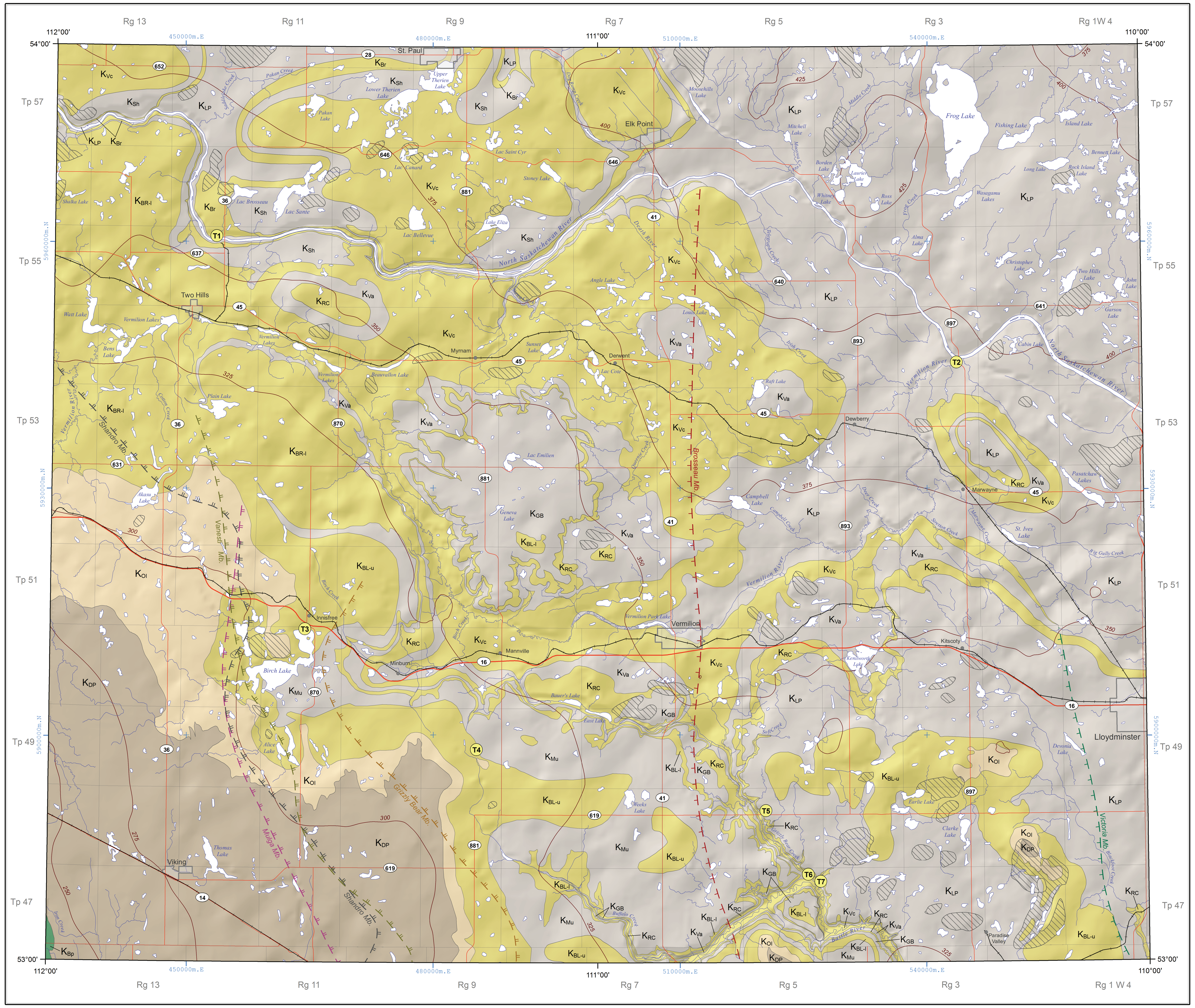
NTS 73E
BEDROCK GEOLOGY



SYMBOL LEGEND

(T1) Type section

Area of glacial thrusting that may involve bedrock (from Shetsen, 1990; 2007)

Top of First White Specks Member (Niobrara Formation) structure contour in metres above sea level

Subsurface extents of stratigraphic units in plan view (listed in ascending stratigraphic order from left; ticks show direction of thickening)

Sandstone units ► Brosseau Mb. Victoria Mb.

Shale units ► Shandro Mb. Vanesti Mb. Grizzly Bear Mb. Mulga Mb.

UPPER CRETACEOUS

UPPER CAMPANIAN TO LOWER MAASTRICHTIAN

K_{Bp} **Bearpaw Formation:** dark grey, blocky-weathering shale and silty shale; greenish (glauconitic) and grey, muddy sandstone; thin concretionary sideritic and bentonite layers; concretions locally yield ammonites (marine to marginal marine).

CAMPANIAN

BELLY RIVER GROUP

K_{DP} **Dinosaur Park Formation:** pale grey, very fine to medium-grained, bentonitic to carbonaceous sandstone interbedded with grey to brownish-grey siltstone, carbonaceous siltstone to mudstone, and coal; disconformity at base; coal restricted to upper part (fluvial and estuarine, uppermost part marginal marine).

K_{Ol} **Oldman Formation:** fine to coarse-grained, light grey to yellow-weathering sandstone; beds are commonly trough cross-bedded, fining upwards and lenticular; grey, muddy siltstone; grey to greenish grey-weathering mudstone, commonly with carbonaceous fragments; dark grey to brown carbonaceous mudstone; concretionary sideritic layers; locally divisible into lower sandstone-dominated unit and upper siltstone unit (nonmarine).

K_{BR-l} **Undivided lower Belly River Group (equivalent in part to Foremost Formation):** pale grey and pale brown sandstone; grey to greenish-grey siltstone; dark grey carbonaceous mudstone; coal; concretionary sideritic layers; coal seams present near the top of the formation (marginal marine to nonmarine).

K_{BL-u} **Upper Birch Lake Member (informal; Belly River Group):** very fine to fine-grained, buff-coloured, massive to cross-bedded sandstone; lesser siltstone and mudstone; calcareous concretions up to 2 m in diameter; thins and becomes fine-grained from west to east; lower contact gradational, upper contact at uppermost coal seam (nonmarine to shallow marine).

K_{Mu} **Mulga Member (Lea Park Formation):** massive, dark-grey mudstone; thin siltstone interbeds, increasing in number and thickness upwards; carbonaceous fragments common; minor pyrite; lower contact sharp, upper contact gradational (marine).

K_{BL-l} **Lower Birch Lake Member (informal; Belly River Group):** very fine to fine-grained, buff-coloured, massive to cross-bedded sandstone; lesser siltstone and mudstone; thins and becomes fine-grained from west to east; lower contact gradational, upper contact sharp (nonmarine to shallow marine).

K_{GB} **Grizzly Bear Member (Lea Park Formation):** dark grey mudstone containing ironstone concretions; thin siltstone and sandstone beds, increasing in thickness and abundance upwards; sharp lower contact, gradational upper contact (marine).

K_{RC} **Ribstone Creek Member (Belly River Group):** massive to cross-bedded, very fine to medium-grained buff to light yellow-weathering sandstone; local thin coal interbeds, carbonaceous fragments common; calcite-cemented; lower contact gradational, upper contact sharp; (shallow to nonmarine).

K_{Va} **Vanesti Member (Lea Park Formation):** interbedded medium to dark-grey mudstone and siltstone; variably bioturbated; siltiness increasing upwards; sharp lower contact; upper contact gradational (marine).

K_{Vc} **Victoria Member (Belly River Group):** massive, yellow to brownish-grey weathering, fine to medium-grained sandstone; carbonaceous silty mudstone, local thin coal seams (shallow marine to nonmarine).

K_{Sh} **Shandro Member (Lea Park Formation):** interbedded dark-grey mudstone and siltstone; very fine-grained sandstone; weakly calcareous, carbonaeous fragments; ironstone concretions; abundance of siltstone and sandstone increasing upwards; sharp lower contact, gradational upper contact (marine).

K_{Br} **Brosseau Member (Belly River Group):** thin-bedded, resistant-weathering sandstone interbedded with brown, sandy to silty mudstone; local thin coal seams; abundance of sandstone increases upwards (shallow marine to nonmarine).

K_{LP} **Lea Park Formation:** medium to dark grey mudstone; thin stringers of fine-grained, tan siltstone to fine-grained sandstone; thin-bedded, light grey bentonite; sideritic concretions; calcite veining common; intertongues with shallow to marginal-marine sandstone of the lower Belly River Group in east-central Alberta (marine).

BASEMAP LEGEND

- City or town
- Village
- Railway
- Road (major highway)
- Road (minor)
- Water body (lake or major river)
- Stream
- 540000m.E UTM, Zone 12 grid

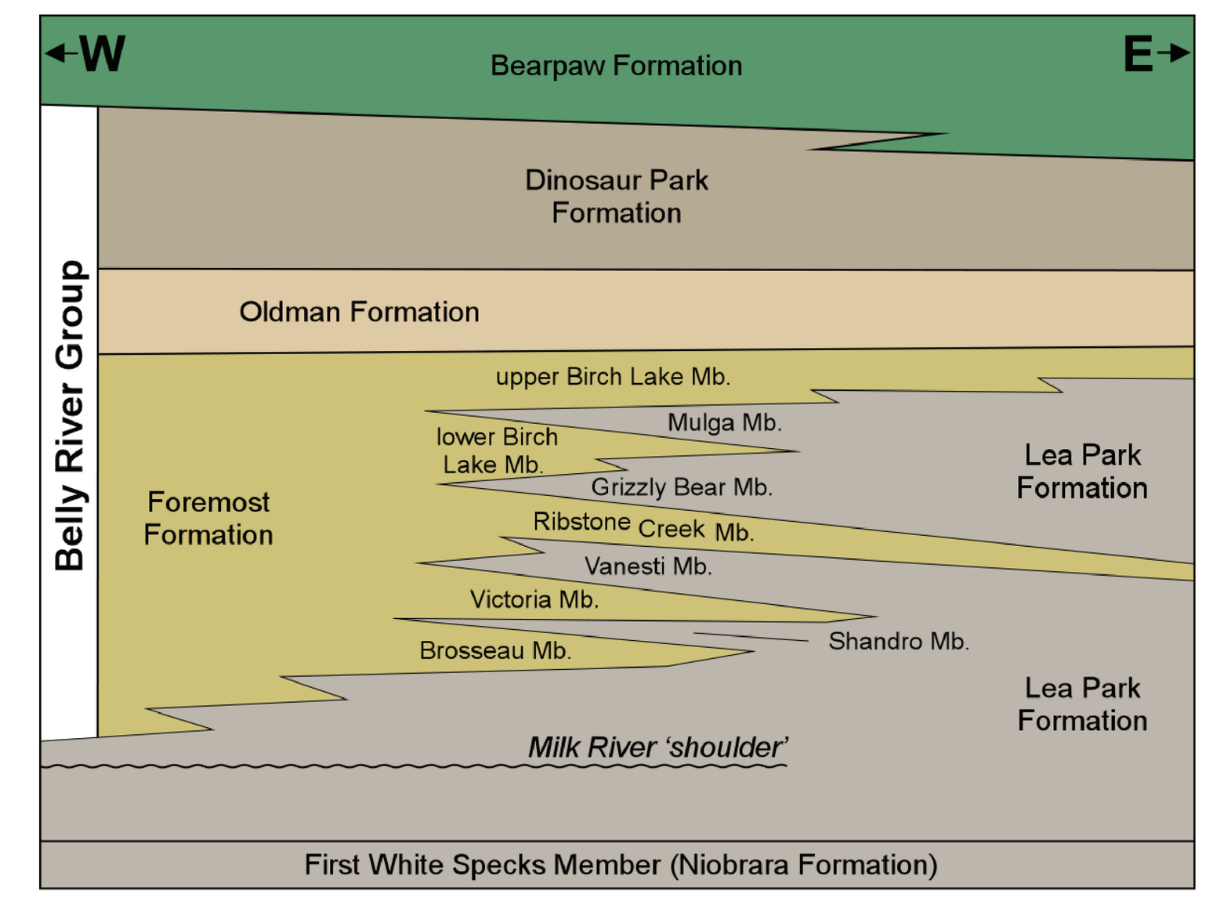


Figure 1. Schematic, east-west-trending stratigraphic cross-section showing the relationship between lithostratigraphic units in eastern Alberta (modified from Nauss, 1945; Shaw and Harding, 1949; Nichols and Wyman, 1969).

Description of Type Sections Located within NTS 73E Vermilion Map Sheet

T1 — **Unit:** Brosseau Member; **Type:** outcrop; **Easting:** 453 768 m **Northing:** 5 960 573 m; **Reference:** Allan, 1918; **Notes:** exact location uncertain

T2 — **Unit:** Lea Park Formation; **Type:** outcrop; **Easting:** 542 913 m **Northing:** 5 945 444 m; **Reference:** Allan, 1918; **Notes:** exact location uncertain

T3 — **Unit:** Birch Lake Member (upper); **Type:** outcrop; **Easting:** 463 770 m **Northing:** 5 912 557 m; **Reference:** Slipper, 1918; **Notes:** exact location uncertain

T4 — **Unit:** Mulga Member; **Type:** well; **Easting:** 485 383 m **Northing:** 5 898 109 m; **Reference:** Nauss, 1945; **Notes:** Imperial Oil core test No. 44

T5 — **Unit:** Grizzly Bear Member; **Type:** outcrop; **Easting:** 520 422 m **Northing:** 5 890 702 m; **Reference:** Hage and Hume, 1941; **Notes:** one of several sections described

T6 — **Unit:** Vanesti Member; **Type:** outcrop; **Easting:** 524 878 m **Northing:** 5 883 276 m; **Reference:** Nauss, 1945; **Notes:** Section 1 of 2

T7 — **Unit:** Vanesti Member; **Type:** outcrop; **Easting:** 527 000 m **Northing:** 5 882 003 m; **Reference:** Nauss, 1945; **Notes:** Section 2 of 2

Coordinates in UTM Zone 12, NAD83.

Background

Exposed bedrock in the area is composed dominantly of Upper Cretaceous clastic sedimentary rocks of the Bearpaw Formation, Belly River Group, and the Lea Park Formation. From west to east, there is a complex transition between nonmarine to marginal marine clastic rocks of the Foremost Formation and marine mudstone and siltstone of the Lea Park Formation. In the transitional zone, sandstone-dominated regressive members of the Belly River Group (Brosseau, Victoria, Ribstone Creek, upper and lower Birch Lake members) interfinger with mudstone-dominated units of the Lea Park Formation (Shandro, Vanesti, Grizzly Bear, and Mulga members; Figure 1). The maximum westward extent, shown in plan view, of each of the members of Lea Park Formation is shown on the map, as is the easternmost extent of the sandstone-dominated members of the Belly River Group.

Structure contours are shown for the top of the First White Specks Member of the Niobrara Formation. A broad structural arch, known as the Bow Island Arch, extends north-northeastward from the northern flank of the dome into east-central Alberta. This arch separates the Alberta Basin in the west from the Williston Basin in the east. The Bow Island Arch terminates northwards against an unnamed domal structural high in east-central Alberta, located in the northern half of the map sheet.

Approach

Bedrock units were mapped in the subsurface using downhole geophysical well logs (Figure 2; Glombick, 2010a, b; 2011a, b; 2013a, b, c, d). Additional data points were obtained from outcrop sections, previously published maps (Crickmay et al., 1942a, b) and air photo interpretation. Elevation data for outcrop locations were obtained using topographic contour data. All data were modelled using ArcGIS Geostatistical Analyst® to create structure surfaces for the top of each stratigraphic unit. The intersection of each surface with a model of bedrock topography (Figure 3; Atkinson and Lyster, 2010) provided the preliminary map trace for each unit. Structure surfaces were also intersected with a digital elevation model (DEM; United States Geological Survey, 2004) for comparison. Map traces were modified to honour the control data as best as possible. As the regional structure of the area is gentle, map patterns are controlled to a large degree by topography on the bedrock surface.

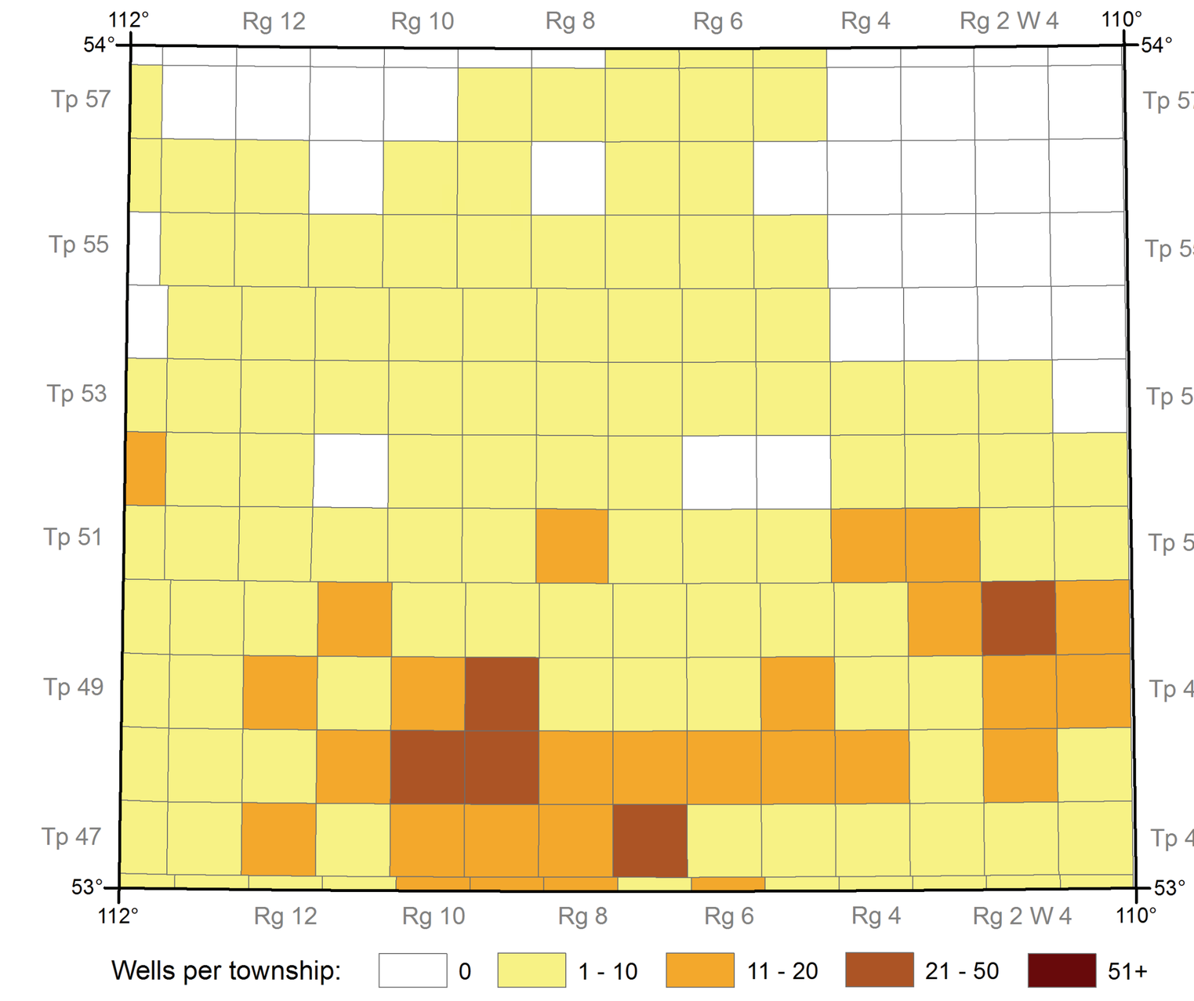


Figure 2. Map showing subsurface well data distribution used in this study.

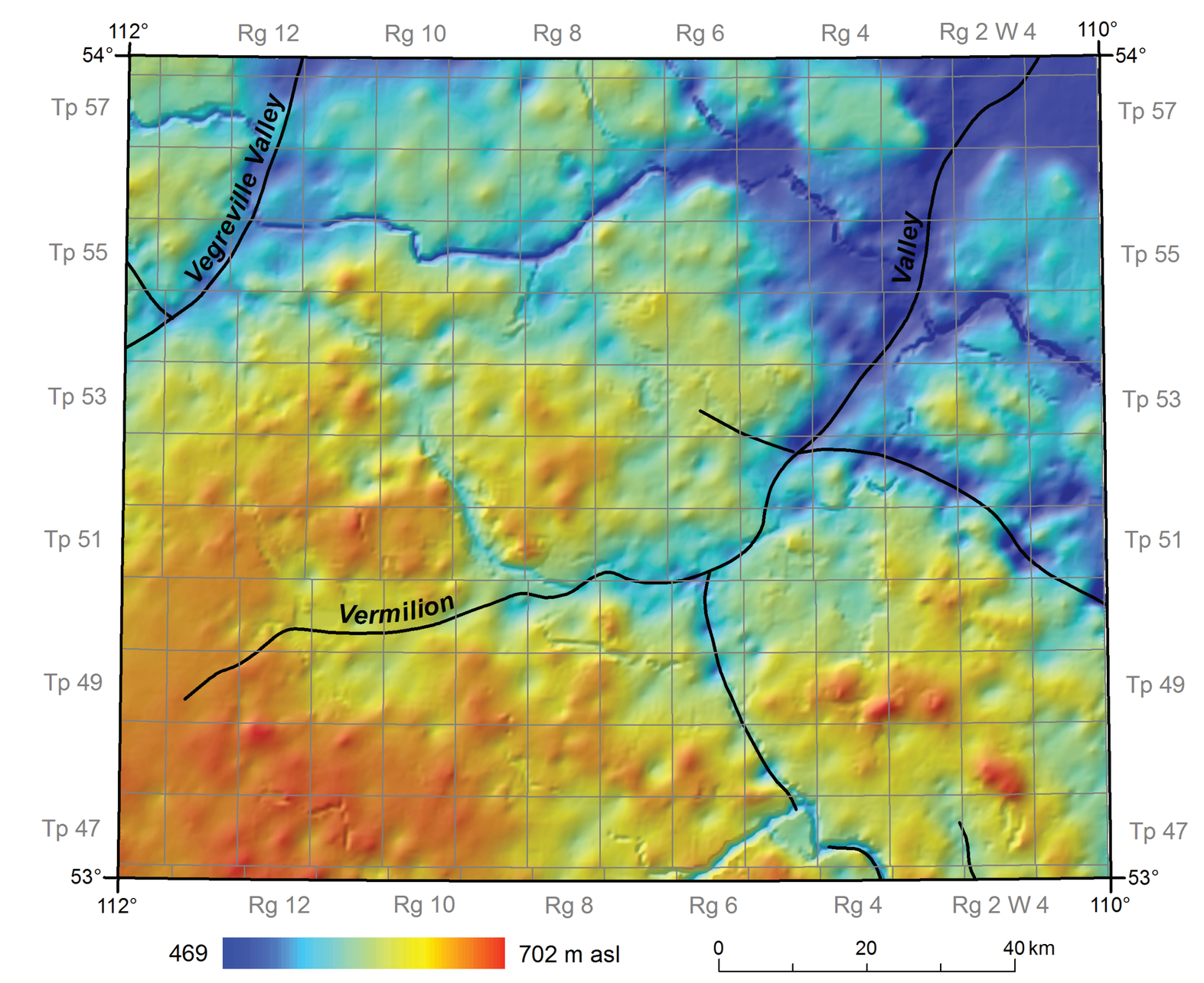


Figure 3. Shaded relief map of bedrock topography from Atkinson and Lyster (2010) showing the location of major preglacial valleys (from Carlson and Currie, 1974).

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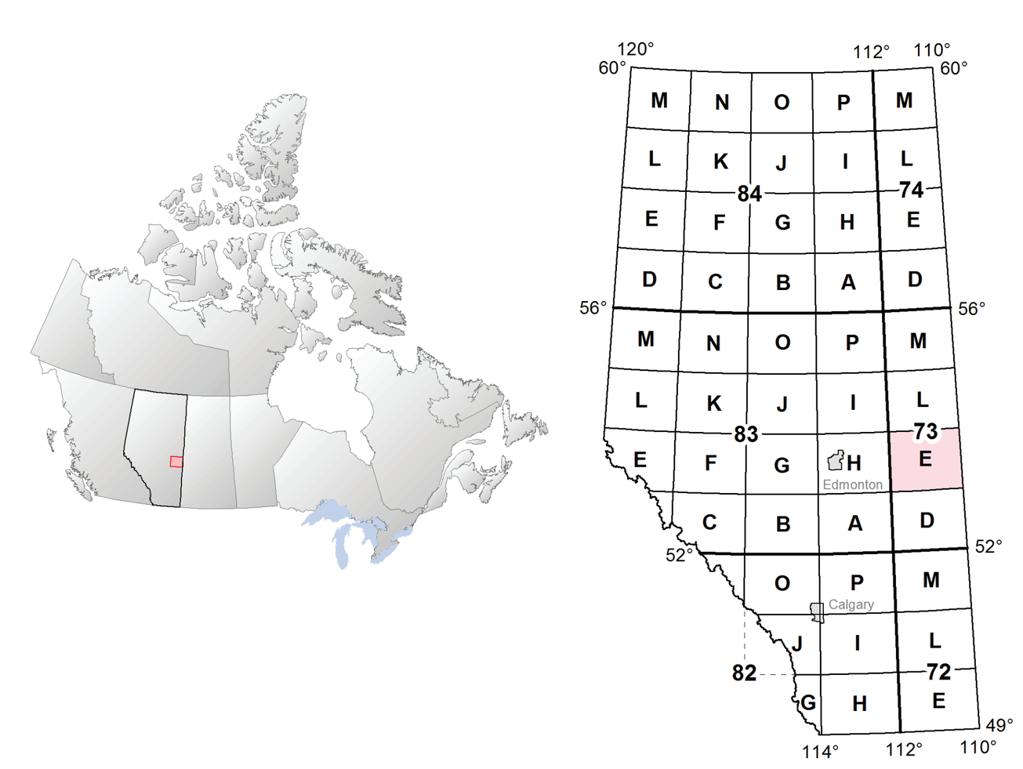


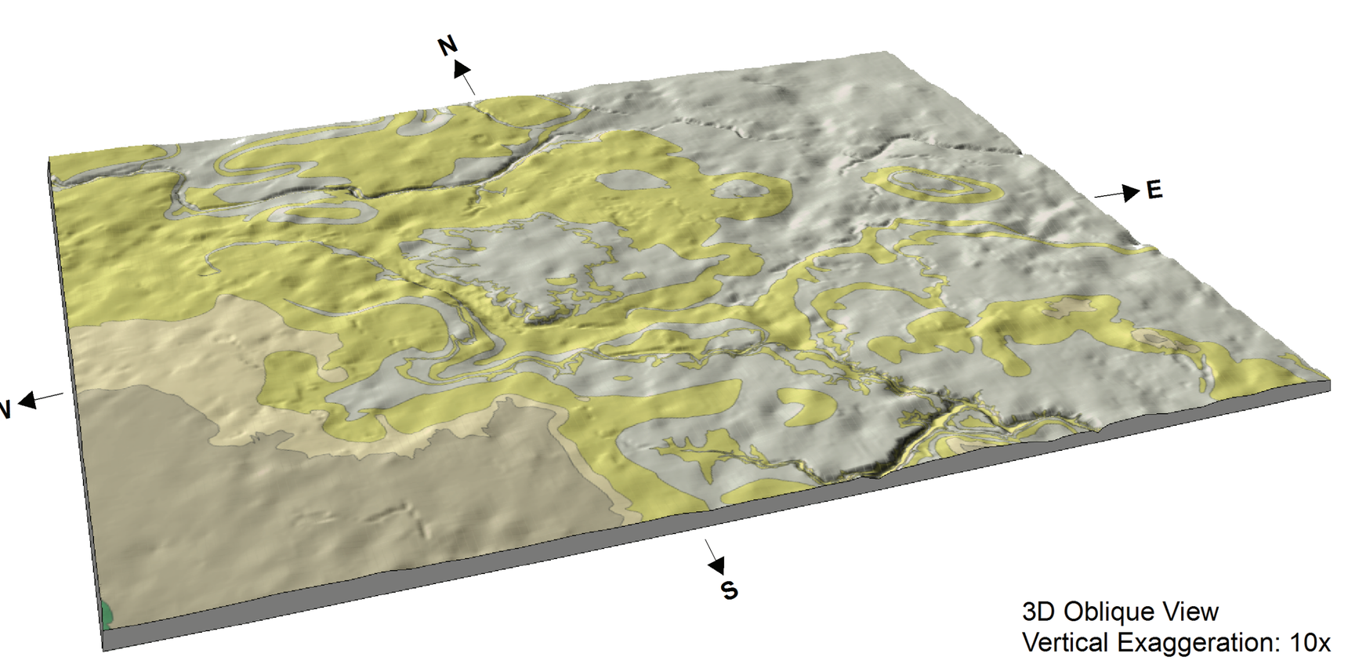
Map 570

Bedrock Geology of the Vermilion Area (NTS 73E)

Geology by: P.M. Glombick

Scale 1:250 000

Projection: Universal Transverse Mercator, Zone 12
Datum: North American Datum, 1983



3D Oblique View
Vertical Exaggeration: 10x

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