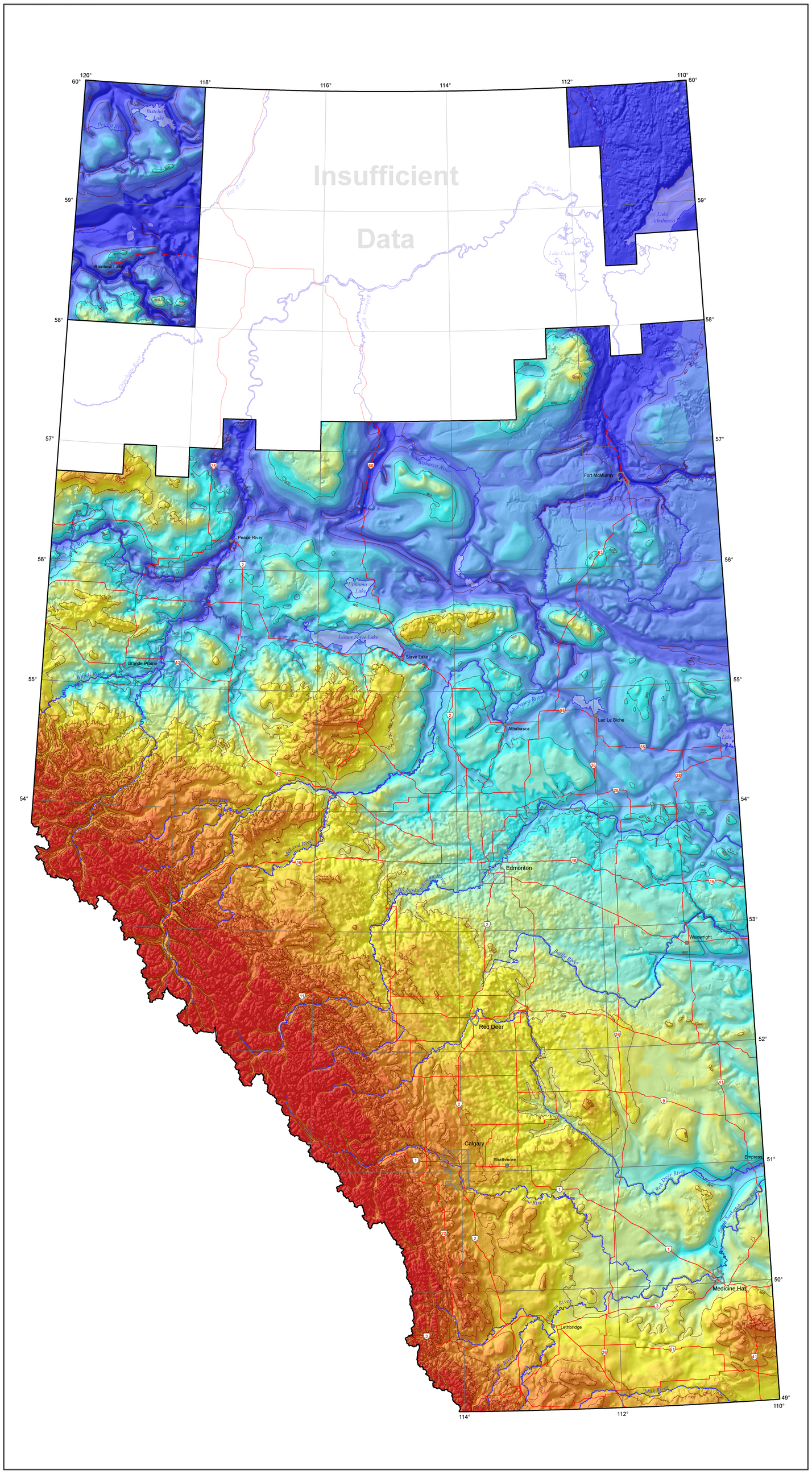
ALBERTA
BEDROCK TOPOGRAPHY



Elevation (metres above sea level)

20 - 345	555 - 600	725 - 765	975 - 1100
345 - 440	600 - 640	765 - 820	1100 - 1340
440 - 500	640 - 680	820 - 890	1340 - 1800
500 - 555	680 - 725	890 - 975	1800 - 3600

Bedrock surface contour, 200 metre interval

Introduction
This map represents a computer-generated geostatistical model of the bedrock topography of Alberta using previously published information from Alberta Geological Survey maps and reports, as well as new data and updates AGS Map 226 (Pawlowicz and Fenton, 1995). This map is an interim product, which focuses on those regions of the province that have sufficient data to warrant an interpretation of the bedrock surface. The incompleteness of this map reflects the absence of sufficient data to interpret part of northern Alberta.

Map Area
Alberta covers an area of approximately 662 000 km^2 and occupies the Interior Plains of Western Canada, with small components of the Canadian Shield and Western Cordillera in the northeast and southwest parts of the province respectively. To the south, Alberta borders the 49th parallel, separating it from Montana. To the north Alberta borders the Northwest Territories along the 60th parallel. To the east, Alberta is separated from Saskatchewan along the 110th meridian. To the west Alberta borders British Columbia following the 120th meridian until the Continental Divide, which the Alberta border follows to Montana. The surface topography of Alberta is characterized by five major physiographic regions: lowlands (275–750 metres above sea level (m asl)), plains (450–1100 m asl), uplands (350–1650 m asl), foothills (1200–2000 m asl) and mountains (1200–3400 m asl; Pettapiece, 1986; Figure 1).

Data Sources and Modelling Methods
Digital data used to construct the model and resulting map were derived from a number of sources. These include stratigraphic picks made from oil and gas petrophysical logs maintained by the Energy Resources Conservation Board, lithological picks made from water-well litholog records obtained from Alberta Environment, data derived from digitized contour interpretations from bedrock topography maps previously published by the Alberta Geological Survey, and the Shuttle Radar Topography Mission (SRTM) 60 m grid-spaced digital elevation model (DEM).

The bedrock topography data were modelled using ArcGIS Geostatistical Analyst. Regional variations in the bedrock surface were accounted for by a local, first-order, polynomial trend model with a weight parameter of 100 km. Smaller-scale features were modelled by ordinary kriging (Deutsch and Journel, 1998) using an exponential variogram with a nugget effect of 200 m^2, a sill of 1500 m^2 and a range of 14 km. A smooth-search neighbourhood (Gribov and Krivoruchko, 2004) was used to minimize any potential discontinuities between the different data sources.

Interpretation
Examination of the bedrock topography map reveals five major bedrock terrain elements within Alberta. These include: 1) lowlands; 2) plains; 3) uplands; 4) highlands and 5) paleovalley systems. The distribution and topography of each of these bedrock terrain elements is discussed below.

Bedrock Lowlands
The bedrock lowlands terrain element is considered to span the northern part of Alberta, although much of this region currently lacks sufficient data to generate a model of the bedrock surface. The bedrock lowlands are characterized by a low-relief, gently undulating bedrock surface ranging in elevation from 200 to 500 m asl. The surface physiography of the Fort Nelson (E1), McMurray (E3), Peace River (E4) and western Wabasca (E5) lowlands largely reflects the topography of the underlying bedrock surface (Figure 1). However, the bedrock lowlands exhibit a more restricted distribution than the Northern Alberta Lowlands physiographic region (Pettapiece, 1986; Figure 1). This is particularly evident beneath the central Wabasca Lowland (E5) west of the Athabasca River, which is underlain by dissected bedrock plain. Other exceptions to this spatial relationship between the topography of the bedrock lowlands and physiography of the Northern Alberta Lowlands occur within the western parts of the Fort Nelson Lowland (E1), which is underlain by prominent paleovalley systems. Recent bedrock-floored river valleys represent an additional topographic feature evident across these bedrock lowlands, particularly along the Peace, Smoky, Athabasca and Clearwater rivers.

Bedrock Plains
The bedrock plains terrain element occurs in parts of southern, central and northeastern Alberta. In southern and central Alberta, bedrock plains comprise an undulating, gently sloping bedrock surface, which rises from 650 m asl in the east to 900 m asl in the west, where it transitions with the bedrock uplands terrain element. The bedrock topography map and physiographic regions map of Alberta (Pettapiece, 1986; Figure 1) indicate that the surface topography of the eastern and western parts of the Alberta Plains physiographic region is primarily influenced by the topography of the underlying bedrock plains. In northeastern Alberta, the bedrock plains terrain element comprises a low-lying surface that exhibits a gentle slope that rises from 400 m asl in the east to 600 m asl in the west. In contrast to the other bedrock terrain elements described in this map, the northern Alberta bedrock plains are incised by a regionally integrated system of paleovalleys, which span the width of the province between northeastern British Columbia and west-central Saskatchewan. There is little physiographic expression of these incised bedrock plains in the modern landscape of northern Alberta, particularly across the Peace River (E4) and Wabasca (E5) lowlands and the Lac La Biche (F2) and Tawatinaw (F5) plains. This is particularly evident in the Mostoos Hills Upland physiographic unit (F10), which exhibits a topographic reversal, within which the highest elements of the surface landscape lie above the deepest parts of the buried Wiau paleovalley (Figure 2).

Bedrock Uplands
The bedrock uplands terrain element mainly occurs in western and northern Alberta, with small components in the central and southern parts of the province. In western Alberta, the bedrock uplands terrain element is characterized by a moderately sloping, dissected surface that descends eastward from 1350 to 900 m asl. In northern Alberta, this terrain element consists of isolated plateaus rising from 500 m asl at their base to summits ranging from 600 to 1000 m asl. These plateaus include the Cameron Hills (H1), Clear Hills (H3), Birch Mountains (H5), Utikuma (H6) and Stony Mountain (H7) uplands (Figure 1). Isolated plateaus in central and southern Alberta similarly comprise bedrock uplands and include the Saddle Hills (J2), Swan Hills (J3) and Cypress Hills (J11) uplands, which rise from 700 m asl at their base to summits ranging from 975 to 1440 m asl (Figure 1). The close relationship between the topography of bedrock uplands and physiography of the land surface in the northern and southern Alberta uplands indicates that large parts of the contemporary Alberta landscape reflect the topography of the underlying bedrock.

Bedrock Highlands
The terrain element occurs in southwestern Alberta. This terrain element is characterized by steep slopes and variable relief, which reflect the topography of the Rocky Mountains and Foothills physiographic regions (Figure 1). The relationship between the topography of the bedrock highlands and the physiography of the land surface demonstrates that the landscape of southwestern Alberta is controlled by the topography of the underlying bedrock, except along the axes of large valleys, which contain a succession of Quaternary sediments along their floors.

Paleovalley Systems
In addition to the recent bedrock-floored river valleys that dissect the contemporary Alberta landscape, previously published maps have documented the distribution of buried paleovalleys incised into the bedrock surface at a provincial scale (Pawlowicz and Fenton, 1995), regional scale (Andriashek et al., 2001a; Slattery and Barker, 2010) and local scale (Andriashek et al., 2001b). This bedrock topography map integrates that information with newly interpreted data to create a provincial-scale interpretation that refines our understanding of the distribution and morphology of buried paleovalleys across Alberta (Figure 2).

The bedrock surface of southern Alberta contains two major paleovalley systems. These are characterized as dendritic drainage networks that are separated by a southeast-northwest–trending divide. The southern drainage network occupies a basin-shaped catchment containing six sub-basins that comprise first-, second- and third-order paleovalleys (Hanna, Red Deer River, Calgary, Teepee, Lethbridge and Medicine Hat; Figure 2). The confluence of these paleovalleys underlies the town of Empress and is characterized by an eastward–trending, fourth-order trunk paleovalley that is eroded to 520 m asl, approximately 140 m below the adjacent bedrock surface. The northern paleovalley system occupies a linear, eastward-trending basin that comprises two second-order paleovalley systems (Red Deer and Buffalo Lake; Figure 2) that converge to form a single trunk paleovalley (Wainwright). This paleovalley is eroded to 530 m asl, up to 140 m below the adjacent bedrock surface and extends eastward beneath Wainwright, en route to the Alberta-Saskatchewan border.

Paleovalley systems are more common in central and northern Alberta, particularly across the northern Alberta bedrock plains. This distribution broadly corresponds to the boundary between the Northern and Southern Alberta uplands physiographic regions and the northern edge of the Eastern Alberta Plains physiographic region (Figure 1). These paleovalleys form a regionally integrated system comprising two northwest-southeast–trending trunk paleovalleys (Wiau and High Prairie-Helina), with subsidiary paleovalleys extending to the north and south. The Wiau paleovalley is the longest of these paleovalley systems, located between the Buffalo Head Hills (H4) and Utikuma (H6) uplands, east of the Peace River, and extends eastward beneath the Stony Mountain Upland (H7) and the Mostoos Hills Upland (F10) en route to the Alberta-Saskatchewan border. This major system is at least 600 km long, comprising diachronous, abandoned valley segments, with valley floors ranging from 370 to 450 m asl. A subparallel system lies to the south and extends eastward beneath the Lac La Biche Plain (F2) into Saskatchewan. The shorter High Prairie paleovalley parallels the Wiau paleovalley and extends eastward beneath the Peace River Lowlands and Lesser Slave Lake, beyond which it possibly converges with the Helina paleovalley beneath the Tawatinaw Plain (F5).

Acknowledgements
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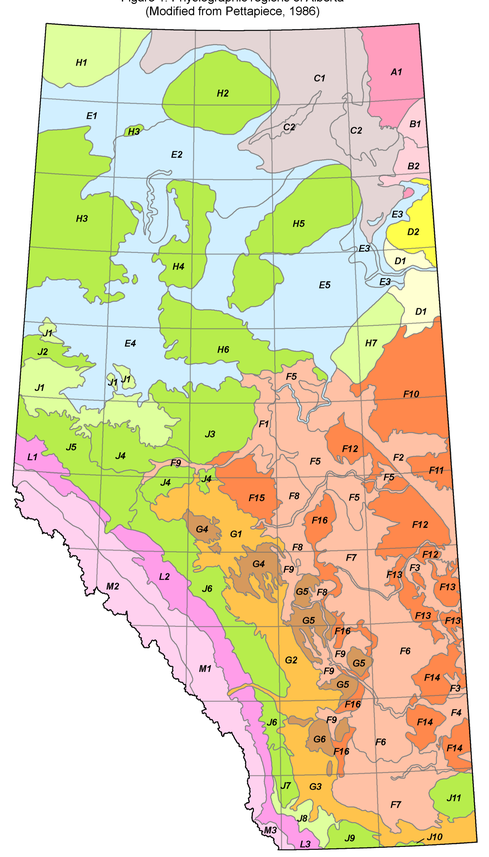
Figure 1. Physiographic regions of Alberta
(Modified from Pettapiece, 1986)



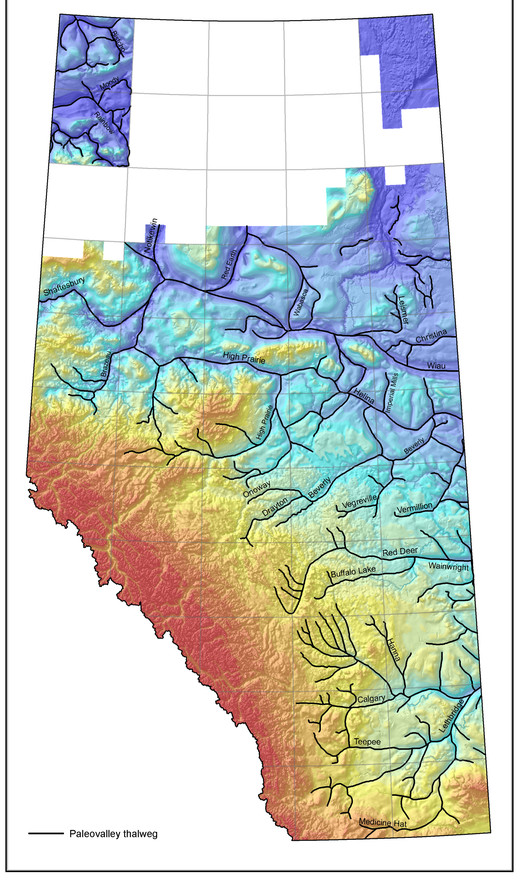
A - Kazan Upland (200 m - 400 m)
B - Athabasca Plain (210 m - 400 m)
C - Northern Plains (200 m - 350 m)
D - Saskatchewan Plains (425 m - 650 m)
E - Northern Alberta Lowlands (275 m - 750 m)
F - Eastern Alberta Plains (450 m - 950 m)

A1 - Tazin River Upland
B1 - Harrison River Plain
B2 - Richardson Upland
C1 - Great Slave Plain
C2 - Delta Plains
D1 - Methy Portage Plains
D2 - Firebag Hills Uplands
E1 - Fort Nelson Lowland
E2 - Vermilion Lowland
E3 - McMurray Lowland
E4 - Peace River Lowland
E5 - Wabasca Lowland
F1 - Lesser Slave Lowland
F2 - Lac La Biche Plain
F3 - Snipe Lake Plain
F4 - Bigstick Lake Plain
F5 - Tawatinaw Plain
F6 - Sullivan Lake Plain
F7 - Coulee Plain
F8 - Edmonton Plain
F9 - Big Rivers Plains
F10 - Mostoos Hills Upland
F11 - Thickwood Hills Uplands
F12 - Vermilion Uplands
F13 - Neutral Hills Uplands
F14 - Rainy Hills Uplands
F15 - Cherhill Uplands
F16 - Cooking Lake Uplands

G - Western Alberta Plains (750 m - 1100 m)
H - Northern Alberta Uplands (350 m - 1050 m)
J - Southern Alberta Uplands (600 m - 1650 m)
L - Rocky Mountain Foothills (1200 m - 2000 m)
M - Rocky Mountains (1200 m - 3400 m)

G1 - Drayton Plain
G2 - Olds Plain
G3 - Southwest Plains
G4 - Lodgepole Uplands
G5 - Drumheller Uplands
G6 - Blackfoot Uplands
H1 - Cameron Hills Uplands
H2 - Caribou Mountains Upland
H3 - Clear Hills Uplands
H4 - Buffalo Head Hills Upland
H5 - Birch Mountains Uplands
H6 - Utikuma Uplands
H7 - Stony Mountain Upland
J1 - Wapiti Plains
J2 - Saddle Hills Upland
J3 - Swan Hills Upland
J4 - Summit Benchlands
J5 - Grande Cache Benchlands
J6 - Western Benchlands
J7 - Porcupine Hills Upland
J8 - Cardston Plain
J9 - Milk River Upland
J10 - Sweetgrass Upland
J11 - Cypress Hills Upland
L1 - Northern Foothills
L2 - Central Foothills
L3 - Southern Foothills
M1 - Front Ranges
M2 - Park Ranges
M3 - Border Ranges

Figure 2. Bedrock topography and paleovalley distribution in Alberta



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Copies of the map may be obtained from:
Information Centre
Alberta Geological Survey
Telephone: (780) 422-1927
Website: www.ags.gov.ab.ca

Map 550

Bedrock Topography of Alberta, Canada

Geology compiled by: N. Atkinson and S. Lyster

Scale 1:1 500 000

0 25 50 100 150 200 kilometres
0 12.5 25 50 75 100 miles

Projection: 10 Degree Transverse Mercator
Datum: North American Datum, 1983

Recommended Reference Format
Atkinson, N. and Lyster, S. (2010): Bedrock topography of Alberta, Canada; Energy Resources Conservation Board, ERCB/AGS Map 550, scale 1:1 500 000.