Section 3: Level II, Level III and Level IV Ecoregions of the Cordillera

3.1 Introduction

Section 3 provides a general overview of the Cordillera and the Level II ecoregions that are included within it (Section 3.2), a summary of how Level III and Level IV ecoregions are described (Section 3.3) and detailed descriptions of five Level III and 36 Level IV ecoregions (Sections 3.4 through 3.8). Level III ecoregions are presented in order of their occurrence from north to south. Within each Level III ecoregion, Level IV ecoregions are organized in the order of their occurrence on the map, reading from top to bottom.

Note: The ecoregion labels on the Cordillera ecosystem map (Appendix 3) and to the right of each Level IV ecoregion name in the title bar were determined in part by the existing framework of the continental *Ecological Regions of North America (*discussed in Section 1.2). They do not correspond to the section numbers; for example, Section 3.7.1 presents attributes of the Level III Boreal Cordillera HB Ecoregion, which corresponds most closely to ecoregion label 6.1.5 in the continental *Ecological Regions of North America.*[12]

3.2 Cordillera Summary

3.2.1 Overview

The Cordillera covers 164,351 km^2, about 14 percent of the Northwest Territories mainland. It includes the mountains, foothills, and plateaus that in the far north extend east in a narrow strip from the Yukon to the Mackenzie Delta and that further south form a crescent-shaped massif from the Northwest Territories – Yukon border to the lowlands of the Taiga Plains.

The Cordillera spans portions of three huge continental ecosystems: the Level I Tundra Ecoregion includes the mountains and plateaus west of the Mackenzie Delta; the Level I Taiga Ecoregion includes the central and northern portions of the southern massif; and the Level I Northwestern Forested Mountains Ecoregion includes the south and southwest portions of the massif.[13] Each of these Level I ecoregions contains one montane Level II ecoregion. The Tundra Cordillera is included within the Tundra, the Taiga Cordillera is part of the Taiga, and the Boreal Cordillera is the northernmost montane element of the Northwestern Forested Mountains.[14] These Level II ecoregions are briefly described in Sections 3.2.2 through 3.2.4 below, and detailed descriptions of their component Level III and Level IV ecoregions are given in Sections 3.4 through 3.8. Figure 34 shows the Level I and Level II ecoregions within the Cordillera context.

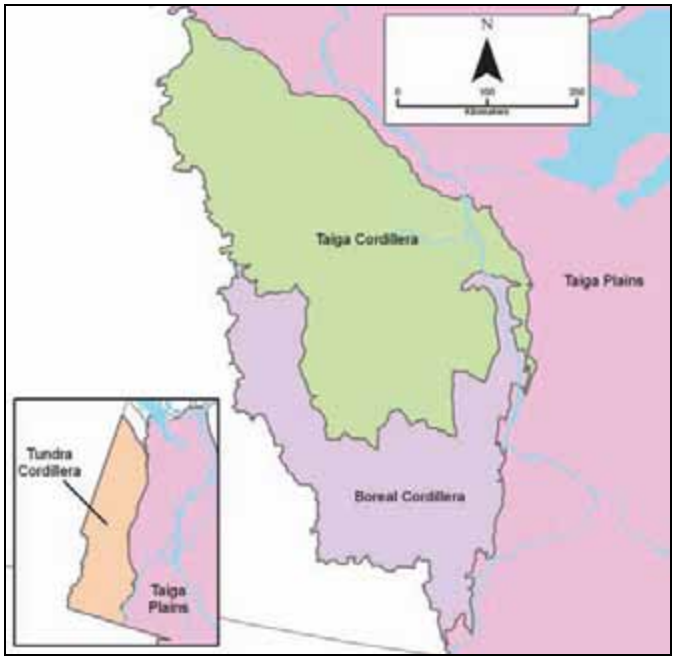

Figure 34. Level II Ecoregions within the Cordillera and part of the adjacent Level II Taiga Plains Ecoregion. The Tundra Cordillera is part of the Level I Tundra Ecoregion, the Taiga Cordillera is part of the Level I Taiga Ecoregion, and the Boreal Cordillera is part of the Level I Northwestern Forested Mountains. The inset map shows the Tundra Cordillera Ecoregion adjacent to the Mackenzie Delta.

The Cordillera is a complex landscape of rugged peaks and ridges, rolling hills, eroded plateaus, deep V- and U-shaped valleys, fast-flowing braided rivers and streams and slow-flowing meandering rivers, and in the south and west, glaciers and icefields. Glacial deposits are widely distributed and occur mainly on the floors and lower slopes of valleys, lakes and ponds are small and sparsely distributed, and wetlands are locally common only on the floodplains and lower slopes of large rivers and on a few broad plateaus. It contrasts strongly with the neighbouring Taiga Plains that with a few exceptions is typically low-relief with slow-flowing meandering rivers, thousands of lakes and ponds, deep layers of glacial till, ancient lakebed materials and glacial stream deposits over bedrock, and huge wetland expanses with thick organic blankets overlying wet mineral soil (Figures 35 to 37).

Hundreds of millions of years ago, crustal movements pushed thick layers of sediments against the ancient western coastline of North America; the layers were sheared, folded, and sometimes overturned, and water, ice and wind carved

[12] The Level III unit names for the 2010 Cordilleran ecosystem classification have been changed from those shown on the *Ecological Regions of North America* map to incorporate local and regional climatic and physiographic knowledge. For example, unit 6.1.5 is labeled as the "Watson Highlands" on the *Ecological Regions of North America* map, but as the "Boreal Cordillera High Boreal (HB) Ecoregion" in the present ecological classification.

[13] Refer to Section 1.2.1 for Level I definition and discussion.

[14] Refer to Section 1.2.2 for Level II definition and discussion.

the present-day peaks and valleys. In places, magma upwellings in the Mesozoic period melted slowly upward through overlying sediments, creating domes of erosion-resistant igneous rock surrounded by kilometres-wide haloes of sedimentary rock metamorphosed by the intense heat. Erosion of the overlying sedimentary rocks has produced some of the most spectacular montane landscapes in the Northwest Territories, such as the sharp granite spires of the southwestern Ragged Ranges. Figures 38, 39 and 40 are generalized maps of bedrock geology, surficial geology and glacial history in the Cordillera; all three figures include Level IV ecoregion lines and labels that are described in Sections 3.4 through 3.8 and shown in Appendix 3.

Mountain landscapes in the Cordillera are highly variable because of historic and ongoing mountain building, erosion, and glaciation processes, and because of the wide array of sedimentary and sometimes metamorphic or igneous bedrock. Limestones, dolomites, sandstones, quartzites, siltstones, shales, and slates sometimes occur as beds hundreds of metres thick and sometimes as alternating thin bands of different materials, reflecting the different depositional environments that have existed from the Precambrian era over a billion years ago to present-day glacier and river deposits. The southern Cordillera massif has been affected by at least five Continental and Cordilleran glaciations over the past two million years (Duk-Rodkin *et al.* 2004), but there are parts of the Cordillera in the far north that have not been glaciated for perhaps three million years and are part of Beringia.[15] Water erosion of limestones over hundreds of thousands of years has produced some of the world's finest examples of karst topography; caves, sinkholes, canyons and other solution features occur in the plateaus along the eastern side of the Cordillera (Ford 2008).

Geologic variations within the complex landscapes of the Cordillera along with climate change from west to east and south to north interact to produce regionally distinctive vegetation patterns. These patterns help to characterize both Level III and Level IV ecoregions. Vegetation patterns within the Cordillera reflect latitudinal and elevational changes, and are strongly affected by landform characteristics, as outlined in Section 1.5.2.2. In the far northwest corner adjacent to the Mackenzie Delta, alpine and arctic tundra communities prevail even at low elevations and conifers grow only in sheltered locales on well-drained river terraces and lower slopes. In the north part of the main massif, tree line is generally below 1000 mASL and stunted conifers grow in open woodlands intermixed with sedge, shrub and lichen tundra.

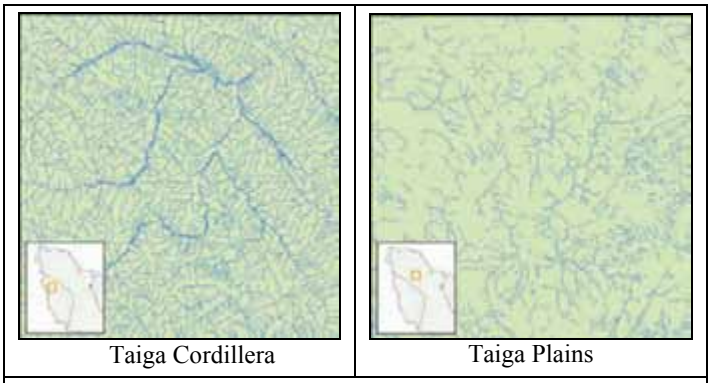

Figure 35. Stream pattern and density differences. The well-organized Cordilleran stream systems on the left are controlled by steep slopes and bedrock; the less-organized Taiga Plains streams on the right flow across gentle terrain with low slopes. Insets show the locations of the example areas.

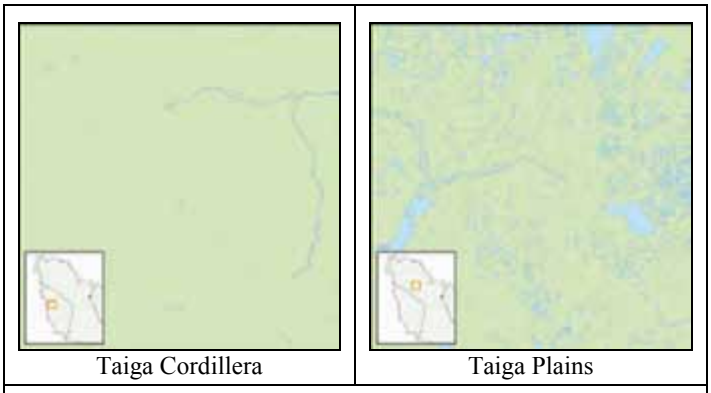

Figure 36. Lake density differences. There are very few lakes and ponds in the Cordillera (the linear feature is a river). In contrast, the Taiga Plains have thousands of ponds and lakes associated with gentle terrain and extensive fine-textured and organic deposits. Insets show the locations of the example areas.

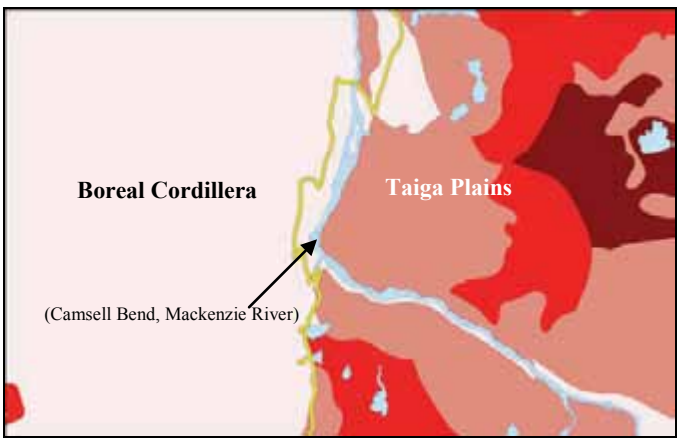

Figure 37. Peatland cover differences. The mountainous terrain of the Cordillera (left of yellow line) is less favourable for the development of extensive peatlands than the level terrain of the Taiga Plains (right of yellow line). (Source: Tarnocai *et al.* 2005). Light pink = <6% peatlands; darker pink 6-25% wetlands, red = >25% peatlands, dark red = >50% peatlands.

[15] Beringia is an unglaciated, mostly treeless part of the Yukon, Alaska and eastern Siberia. The surrounding landscapes have been affected by numerous glaciations occurring between three million and ten thousand years before present.

Tree line elevation increases to the south, tree density and height also increases, and tree species appear that are typical of less severe climates, such as trembling aspen, jack pine, lodgepole pine and alpine fir. Subalpine plants that flourish in Alaska, British Columbia and Alberta under the influence of mild, moist Cordilleran climates occur in the Northwest Territories in the southwestern part of the main massif and along with lush forest, shrub and wetland communities in the valley bottoms, similarly indicate a Pacific climate influence. The high mountain ranges in the western parts of the Cordillera remove much of the Pacific moisture and create a rainshadow effect to the east.

Soil development in the Cordillera is mainly restricted to lower valley slopes and valley bottoms. Soil development on exposed bedrock or bouldery colluvial slopes is restricted to small pockets of fine-textured materials between boulders or in crevices where Regosols occur. Regosols or weakly developed Brunisols also occur on plateau tops, well-drained slopes, and alluvial terraces. Both mineral and organic Cryosols are common especially on lower seepage-fed north-facing slopes where they are associated with spruce woodlands and sedge tussock fens.

3.2.2 Level II Tundra Cordillera Ecoregion

The Level II Tundra Cordillera Ecoregion is a long, narrow western component of the continent-wide Tundra; it includes 7,828 km^2, or about five percent of the Cordillera[16] within the Northwest Territories. The Ecoregion is influenced mainly by a High Subarctic climate with Low Arctic conditions on the nearly level plain in the extreme north. Permafrost is continuous, trees are generally restricted to valley bottoms and southerly slopes, reaching maximum elevations of about 1000 mASL on southerly slopes, and dwarf shrub and sedge tundra is the dominant vegetation type on uplands.

The lower elevation plateaus to the east were glaciated by the most recent Continental glaciation, and Mesozoic shales and sandstones are blanketed by tills. The higher elevation mountains have not been glaciated for millions of years and are part of Beringia; Mesozoic and Paleozoic sandstones, shales and limestones are prevalent. This Ecoregion contains one Level III ecoregion and two Level IV ecoregions that are described in Section 3.4.[17]

3.2.3 Level II Taiga Cordillera Ecoregion

The Level II Taiga Cordillera Ecoregion is a crescent-shaped western element of the continent-wide Taiga; it occupies about two-thirds of the main Cordillera massif. About half of the Taiga Cordillera lies within the Northwest Territories and half within the Yukon with a minor extension into Alaska; within the Northwest Territories, it covers 99,505 km^2 or about 61 percent of the total Cordillera within the Northwest Territories. A High Subarctic climate dominates the northern third of the Ecoregion as indicated by continuous permafrost and sparsely treed stunted spruce woodlands in low-elevation valley bottoms; trees reach maximum elevations on south slopes of about 1250 mASL in the northern part of the High Subarctic portion to 1450 mASL in the south. The southern two-thirds of the Ecoregion is influenced by a slightly milder Low Subarctic climate, as indicated by discontinuous permafrost, denser woodlands and forests than those occurring in the High Subarctic, and trees reach maximum elevations of 1450 mASL in the northern part of the Low Subarctic portion to about 1650 mASL in the south. Other indications of a milder climate include the appearance of boreal tree species such as trembling aspen, paper birch and balsam poplar on southerly slopes and river terraces. High mountains on the west side of the Ecoregion create a rainshadow effect and consequently the eastern portion is relatively dry.

The Taiga Cordillera is a complex of high rugged peaks, low rounded mountains, foothills, dissected plateaus, and broad valleys. Almost all of the bedrock is of sedimentary origin, and includes limestones, dolomites, shales, siltstones, conglomerates, sandstones, and quartzites; most of the formations are Paleozoic (Devonian) to Precambrian. The western third of the Ecoregion was covered by Cordilleran icecaps in the last glaciation, and Continental ice sheets reached as far west as the lower slopes and plateaus of the eastern third; parts of the central portion have not been glaciated for several hundred thousand years. This Ecoregion contains two Level III ecoregions and 15 Level IV ecoregions that are described in Sections 3.5 and 3.6.

3.2.4 Level II Boreal Cordillera Ecoregion

The Level II Boreal Cordillera Ecoregion is part of the Northwestern Forested Mountains that includes most of the mountain ranges from Alaska to California. It occupies the southern third of the main Cordillera massif and extends north into the Mackenzie Valley west of the Franklin Mountains; it includes an area of 57,018 km^2, about 35 percent of the Cordillera within the Northwest Territories.

A High Boreal climate influences much of the Ecoregion; discontinuous permafrost, dense, tall spruce forests and stands of trembling aspen, lodgepole pine and jack pine occur throughout, with jack pine and lodgepole pine – jack pine hybrids occurring in the north and east. The western third and the southeastern tip of the Ecoregion are influenced by a moister and somewhat milder Mid-Boreal climate. Precipitation is higher because moisture-bearing Pacific systems approaching from the west are forced upward by high mountain ranges, and higher rainfall and snowfall result.

[16] Only the easternmost part of the continental Level II Brooks Range Tundra extends into the Northwest Territories and is called the Tundra Cordillera in this document for unity of nomenclature i.e. Tundra Cordillera, Taiga Cordillera, Boreal Cordillera.

[17] Level I, II, III and IV ecoregions are defined in Section 1.

Tall, dense conifer and mixed-wood forests, tall shrublands, and rich wetlands are characteristic of lower elevation valley bottoms and slopes, and high-elevation subalpine forests include alpine fir and several plants that are typical of moist montane ecosystems to the south and west in Alberta, British Columbia and Alaska. Trees grow to maximum elevations of about 1450 mASL in the northeast part of the Ecoregion to over 1700 mASL in the southwest. Extensive icefields and glaciers occur at high elevations to the west. The Boreal Cordillera Ecoregion includes the highest, most rugged mountains in the Northwest Territories along the western border with the Yukon, but topography is highly variable and includes lower mountains, plateaus, foothills, long ridges, and broad valleys to the east and north.

Most of the bedrock is of sedimentary origin, and Precambrian to Paleozoic limestones and shales are dominant. The Ragged Range and a few peaks of the Sapper Ranges are composed of Mesozoic magma domes that melted upward into overlying sediments; subsequent erosion has removed the sediments and sculpted the rock into towering granite peaks with sheer faces hundreds of metres high. Like the neighbouring Taiga Cordillera, the western third of the Boreal Cordillera Ecoregion was covered by Cordilleran icecaps in the last glaciation, and Continental ice sheets reached as far west as the lower slopes and plateaus of the eastern third; parts of the central portion have not been glaciated for several hundred thousand years. This Ecoregion contains two Level III ecoregions and 19 Level IV ecoregions that are described in Sections 3.7 and 3.8.

3.3 How Level III and Level IV Ecoregions are Described

Each Level III and Level IV ecoregion description in Sections 3.4 through 3.8 begins with a one- or two- sentence overview statement and a summary outlining the distinguishing ecosystem characteristics. Climate statistics (mean annual temperature, mean temperatures of the warmest and coldest months, mean annual precipitation, wettest and driest months, mean annual daily solar radiation input, mean daily solar radiation input in June and December) are summarized at the Level III ecoregion level; for most Level IV ecoregions there is insufficient information to provide a meaningful summary. Where information is available, local climatic influences are discussed.

Within each Level III and Level IV ecoregion, the following attributes are described:

- Total area and elevation statistics (source: GIS spatial data), along with a bar chart showing the proportional distribution of elevations at 500 m intervals;
- General description of ecoregion characteristics;
- Discussion of geology and geomorphology, including dominant bedrock types, surficial landforms and parent material characteristics and underlying geologic features that influence ecosystems (sources: Soil Landscapes of Canada polygon attributes within ecoregions, surficial and bedrock geology maps and 2007 digital photographs and field observations);
- Discussion of soil features. Soils are described to the Great Group level because this reflects the degree of reliability in the available data, and because Great Groups can be reasonably related to major physiographic features and drainage characteristics (sources: Soil Landscapes of Canada polygon attributes within ecoregions; 2007 field observations);
- Discussion of typical vegetation for the ecoregion (sources: 2007 digital photographs, a small sample plot dataset from fieldwork in 2007, and for a few Level IV ecoregions in the south, vegetation classifications provided by Gimbarzevsky *et al.* (1979) for Nahanni National Park Reserve);
- Discussion of water and wetland features;
- Discussion of notable features (sources: ENR staff, Parks Canada staff, publications, and 2007 digital photographs and field visits);
- Descriptive photographs, included with each ecoregion on facing pages.

Ecozones and Ecoregions of Canada descriptions (Ecological Stratification Working Group 1995) were reviewed and incorporated as appropriate.

A glossary of terms used within this report is provided in Appendix 5.

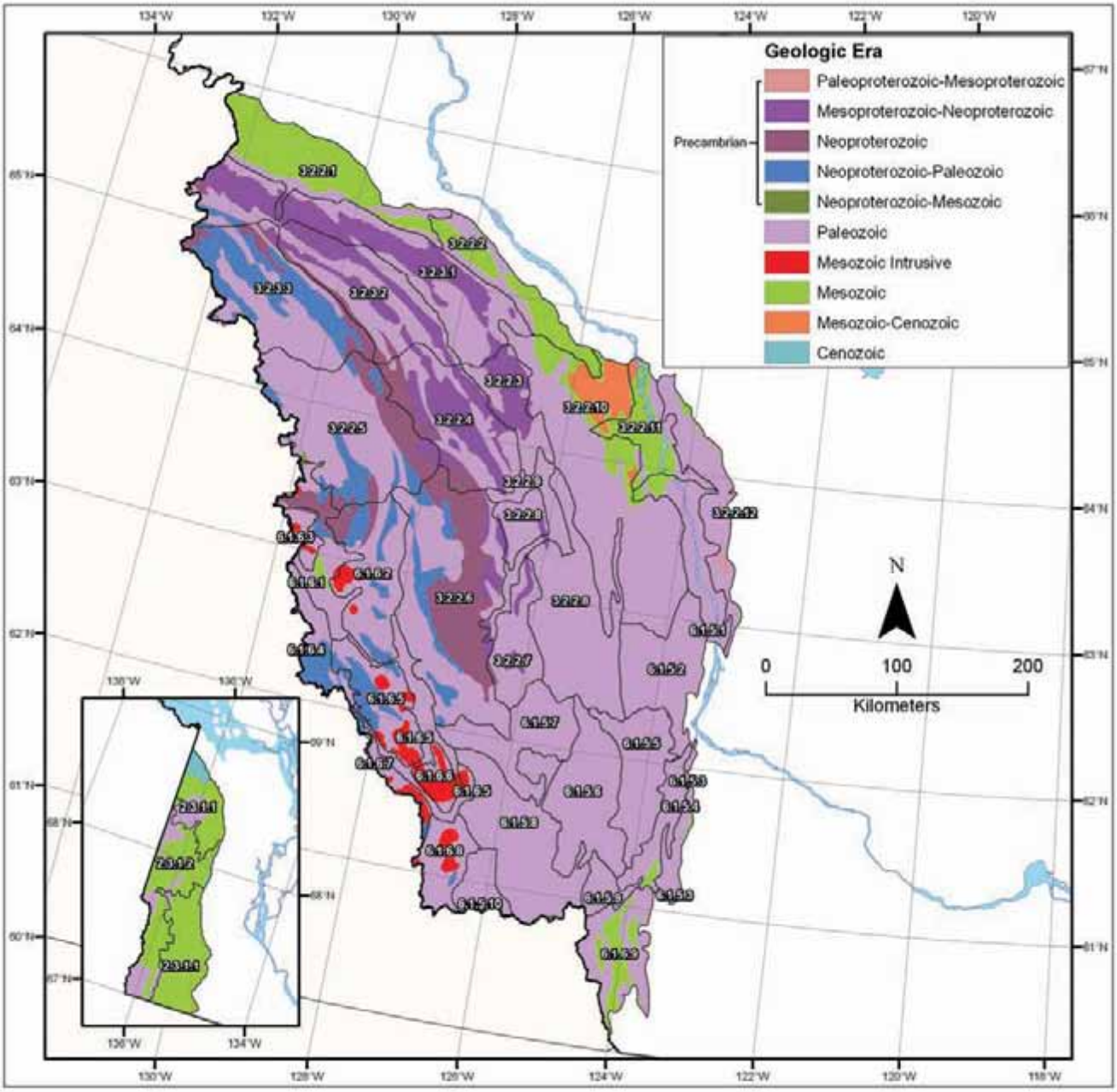

Figure 38. Generalized bedrock geology of the Cordillera showing major geologic age classes (eras). (Source: Wheeler *et al.* 1997). Narrow black lines enclose numbered Level IV ecoregions; refer to Sections 3.4 to 3.8 for descriptions. The inset box shows the Tundra Cordillera Ecoregion adjacent to the Mackenzie Delta.

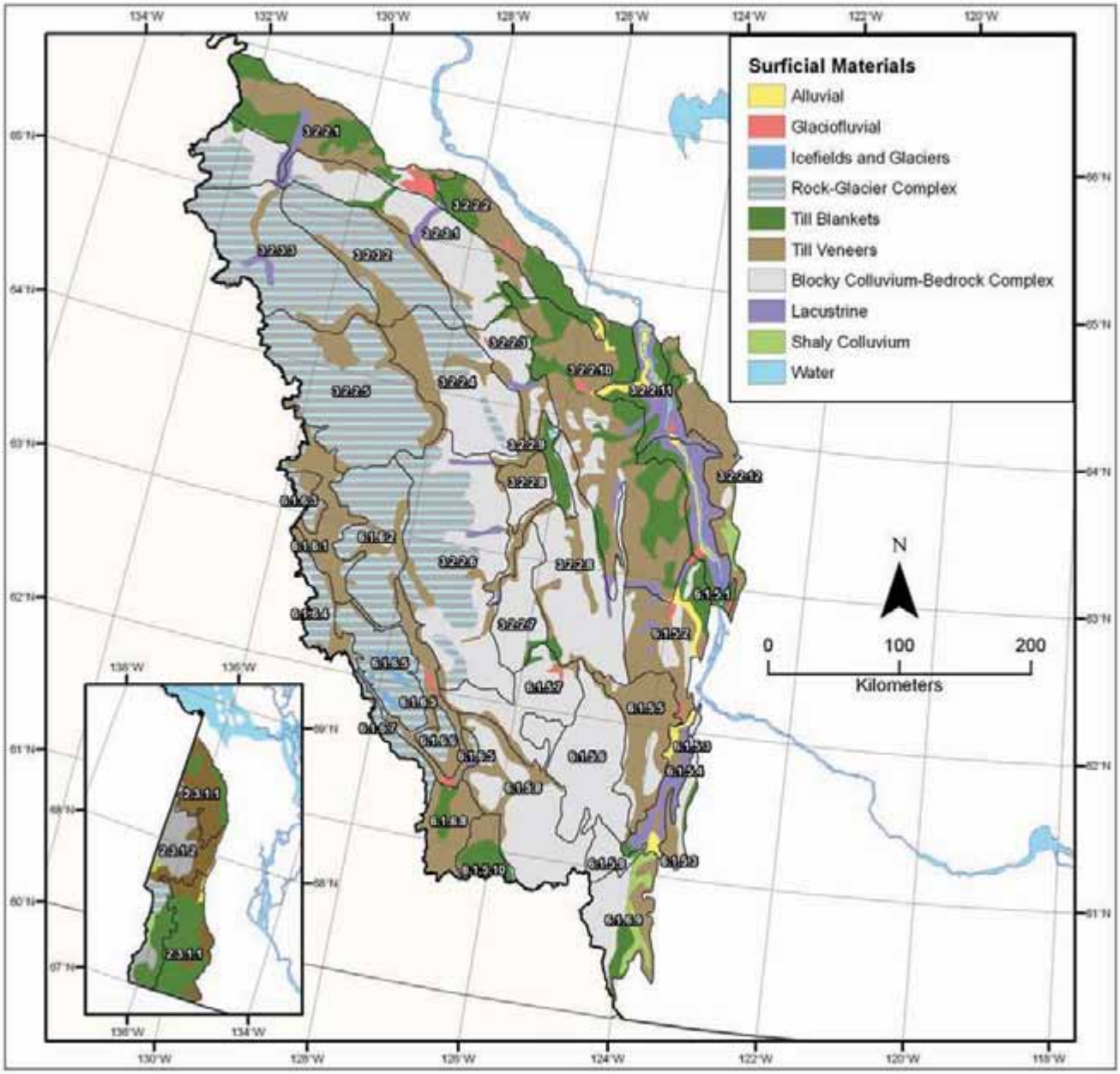

Figure 39. Generalized surficial geology of the Cordillera. (Source: Fulton 1995). Narrow black lines enclose numbered Level IV ecoregions; refer to Sections 3.4 to 3.8 for descriptions. The inset box shows the Tundra Cordillera Ecoregion adjacent to the Mackenzie Delta.

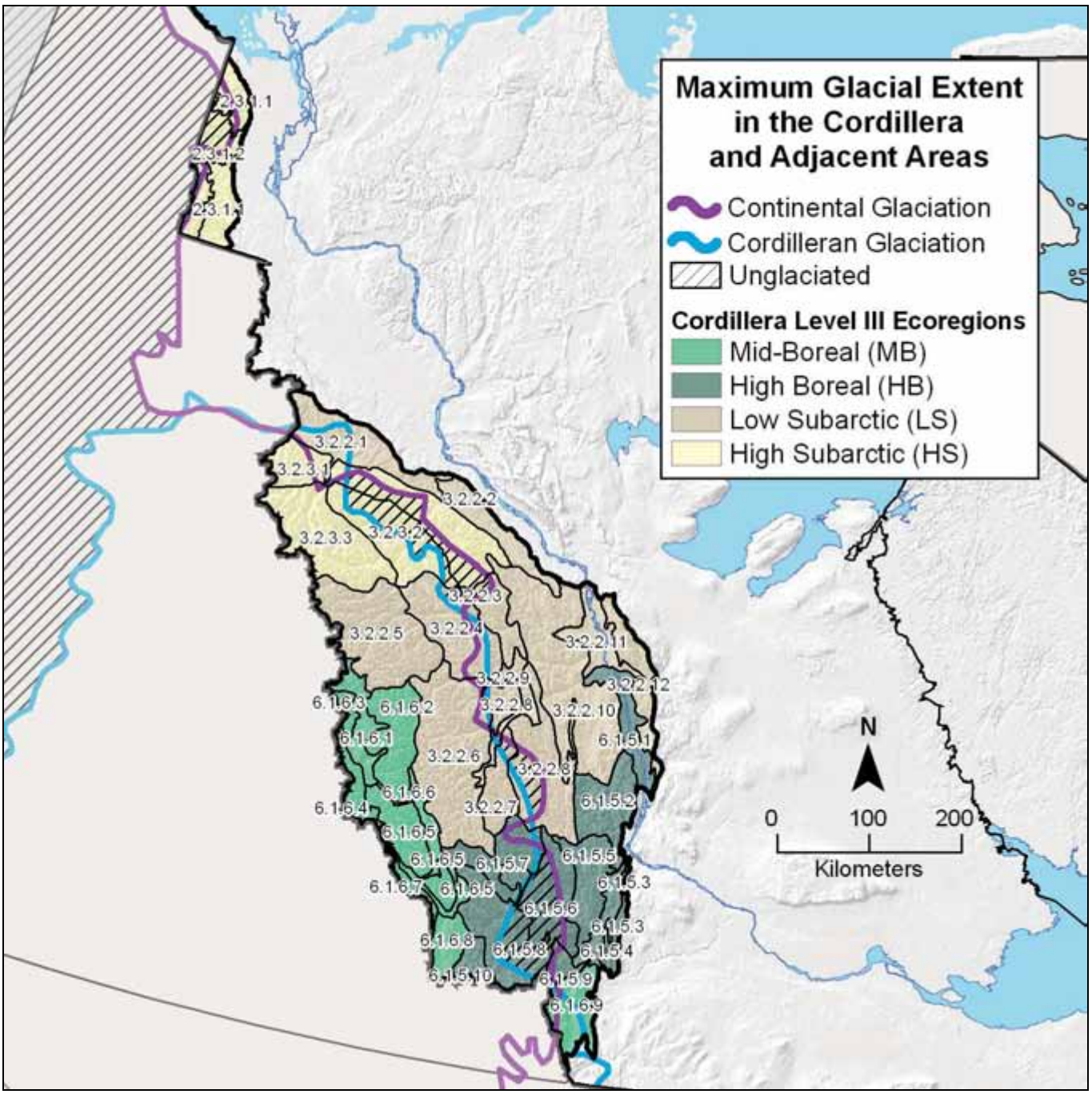

Figure 40. Glacial history of the Cordillera and adjacent areas. Colours indicate Level III ecoregions; black lines enclose numbered Level IV ecoregions. Refer to Sections 3.4 through 3.8 for descriptions. The maximum Continental line shows the furthest west that Continental ice reached and the maximum Cordilleran line shows the furthest east that Cordilleran ice reached. The crosshatched areas were not glaciated in the most recent glacial period. (Maximum glacial extents reported in Duk-Rodkin *et al.* 2004).