Geological Survey of Canada
Scientific Presentation 13

GEOLOGY OF THE ROCKY MOUNTAINS, WEST OF CALGARY, ALBERTA, IN THE KANANASKIS WEST HALF MAP AREA (82-J)

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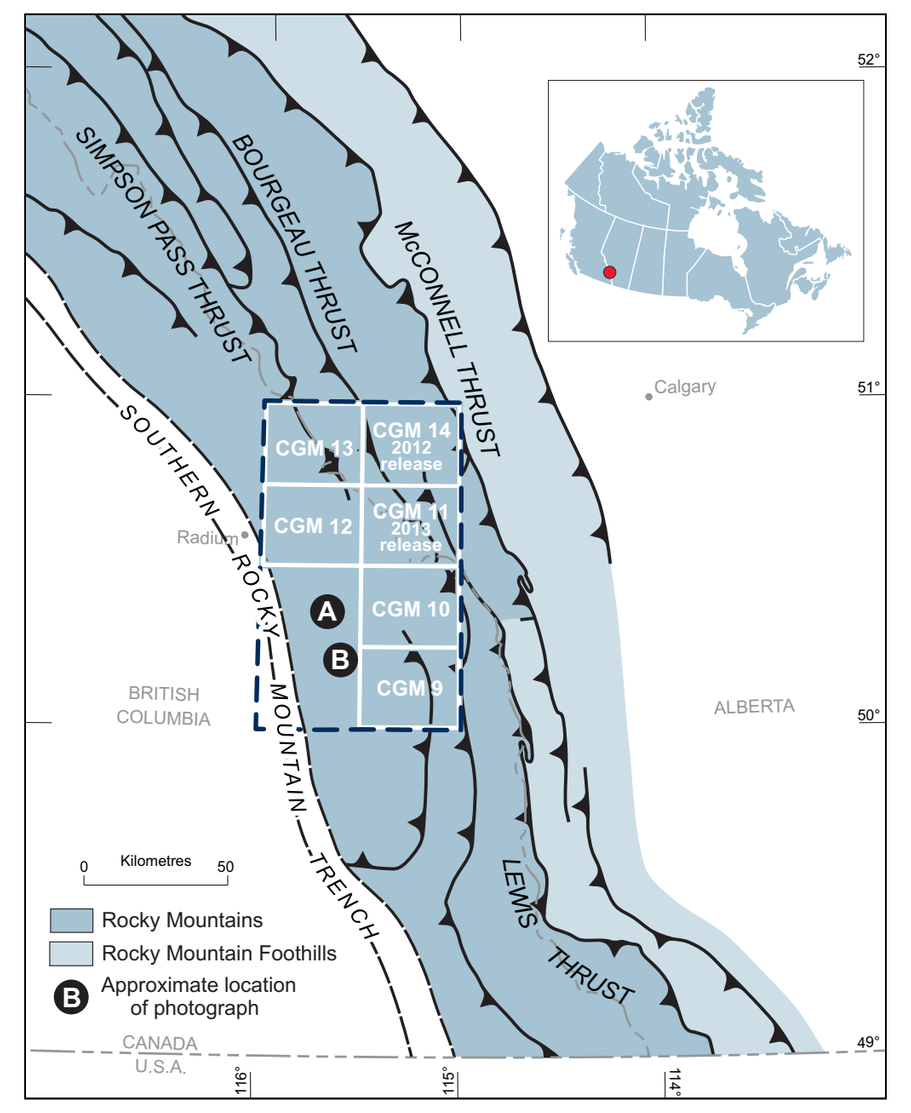
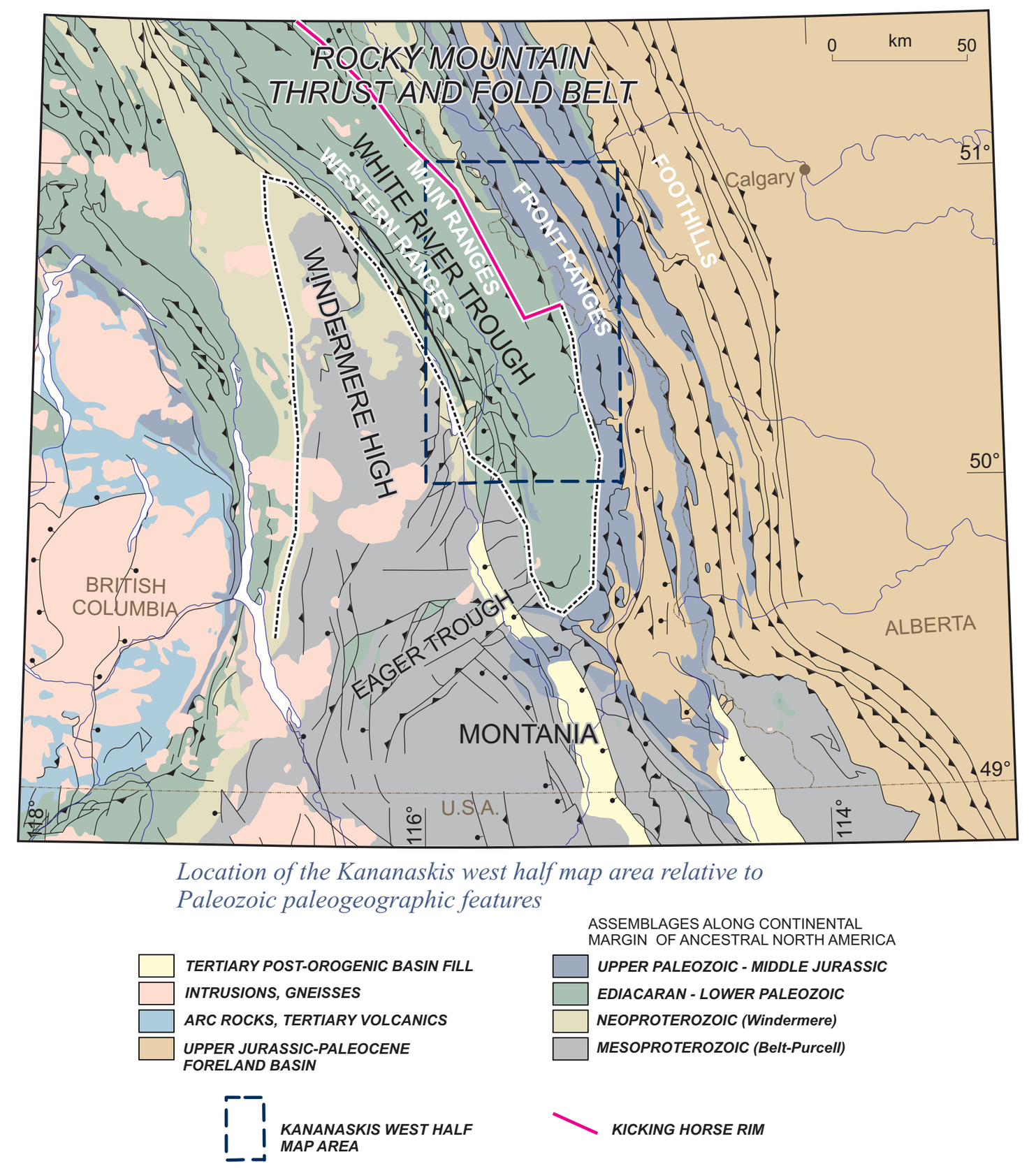
GEOLOGICAL SETTING

The Kananaskis west half area occurs along the eastern margin of the Canadian Cordillera southwest of Calgary. It forms part of the Rocky Mountain Thrust and Fold Belt, one of the world's classic thin-skinned thrust and fold belts.

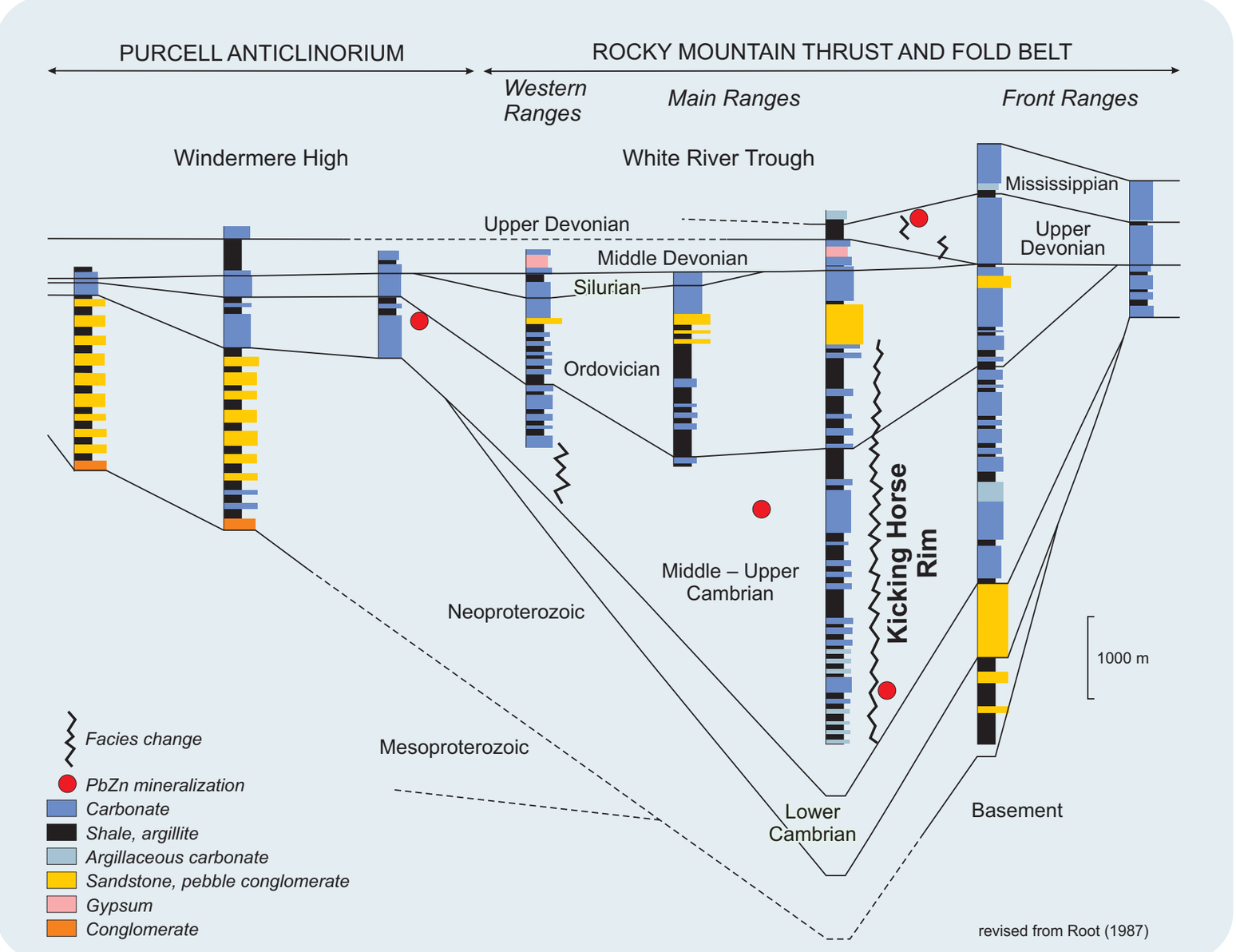
The area crosses a major Lower Paleozoic extensional basin: the White River Trough.



Location of the Kananaskis west half map area and new GIS-enabled bedrock geology maps relative to the major thrust faults in the southern Canadian Rocky Mountains Thrust and Fold Belt.



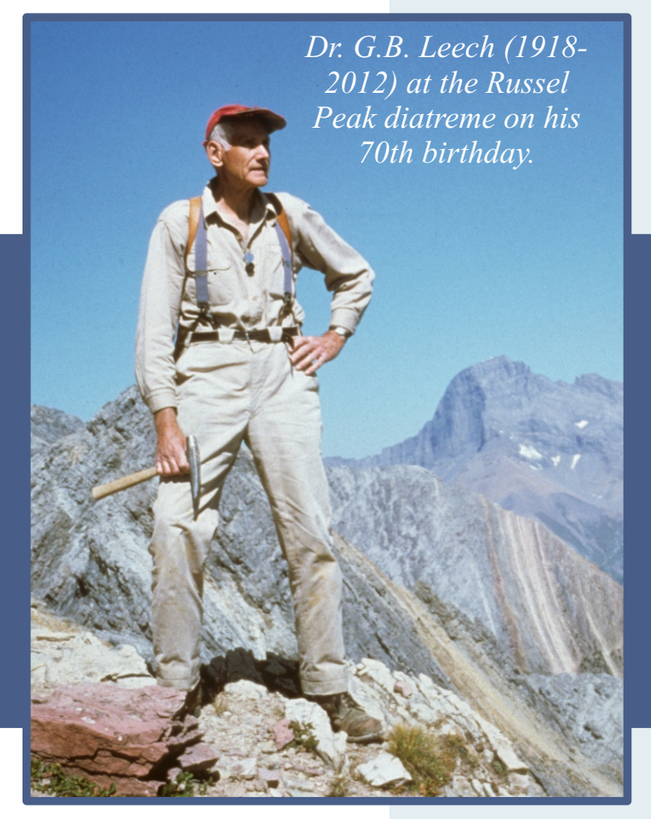
Location of the Kananaskis west half map area relative to Paleozoic paleogeographic features



Stratigraphic cross section of pre-Pennsylvanian and Proterozoic strata from the leading edge of the McConnell Thrust sheet to southwest of Radium.

MAPS

Until now bedrock geological map coverage in the Kananaskis west half area was incomplete. New GIS-enabled bedrock geological maps for 4 of the 8 1:50,000 sheets comprising the area are published (McMechan and Leech, 2011a,b,c; McMechan, 2011) and available for free download at http://geoscan.ess.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/geoscan_e.web and two should be published by 2013. These maps incorporate new and historical data, including the outstanding field observations of Dr. G.B. Leech and his assistants from 1963-1966.



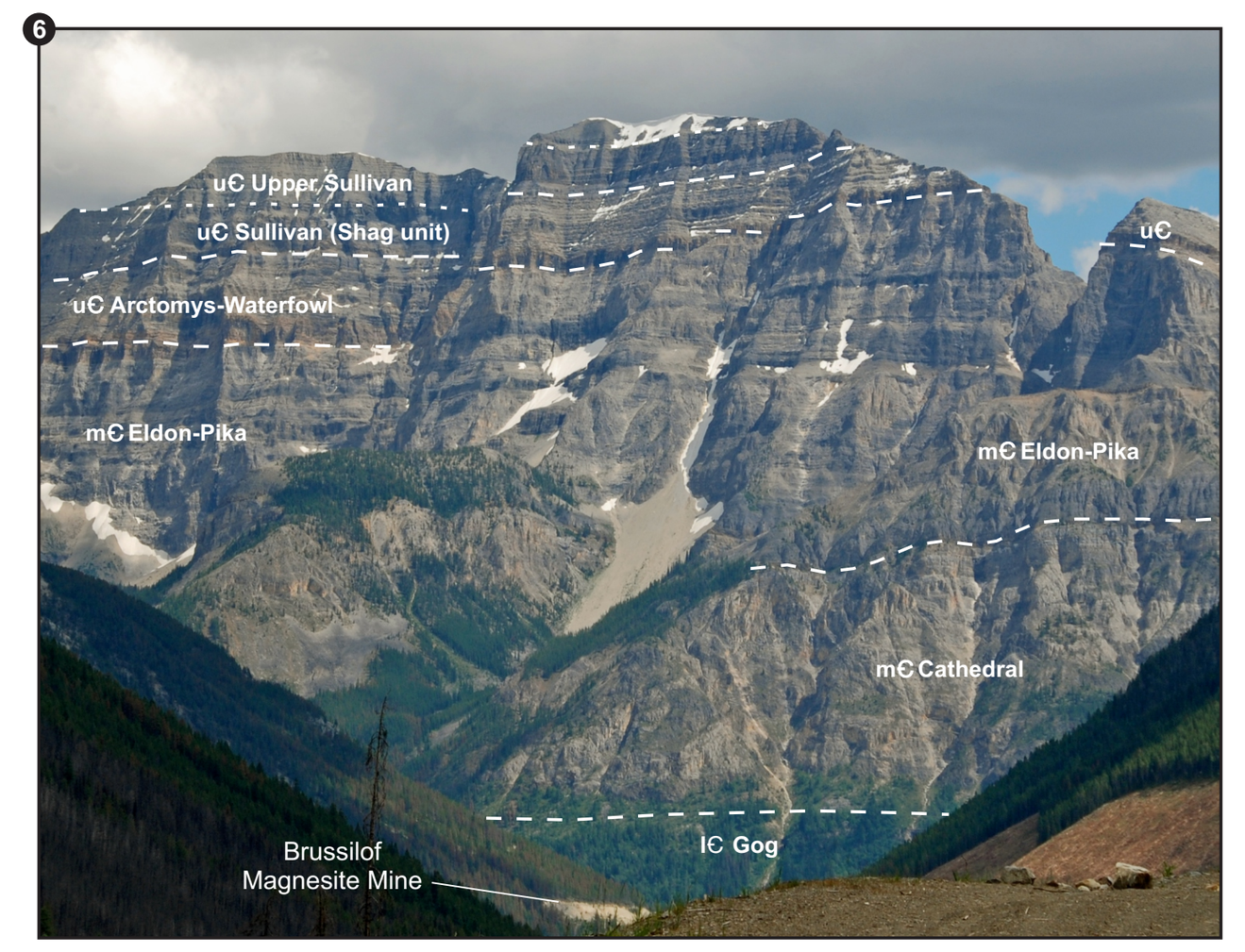
Dr. G.B. Leech (1918-2012) at the Russel Peak diatreme on his 70th birthday.

STRATIGRAPHY

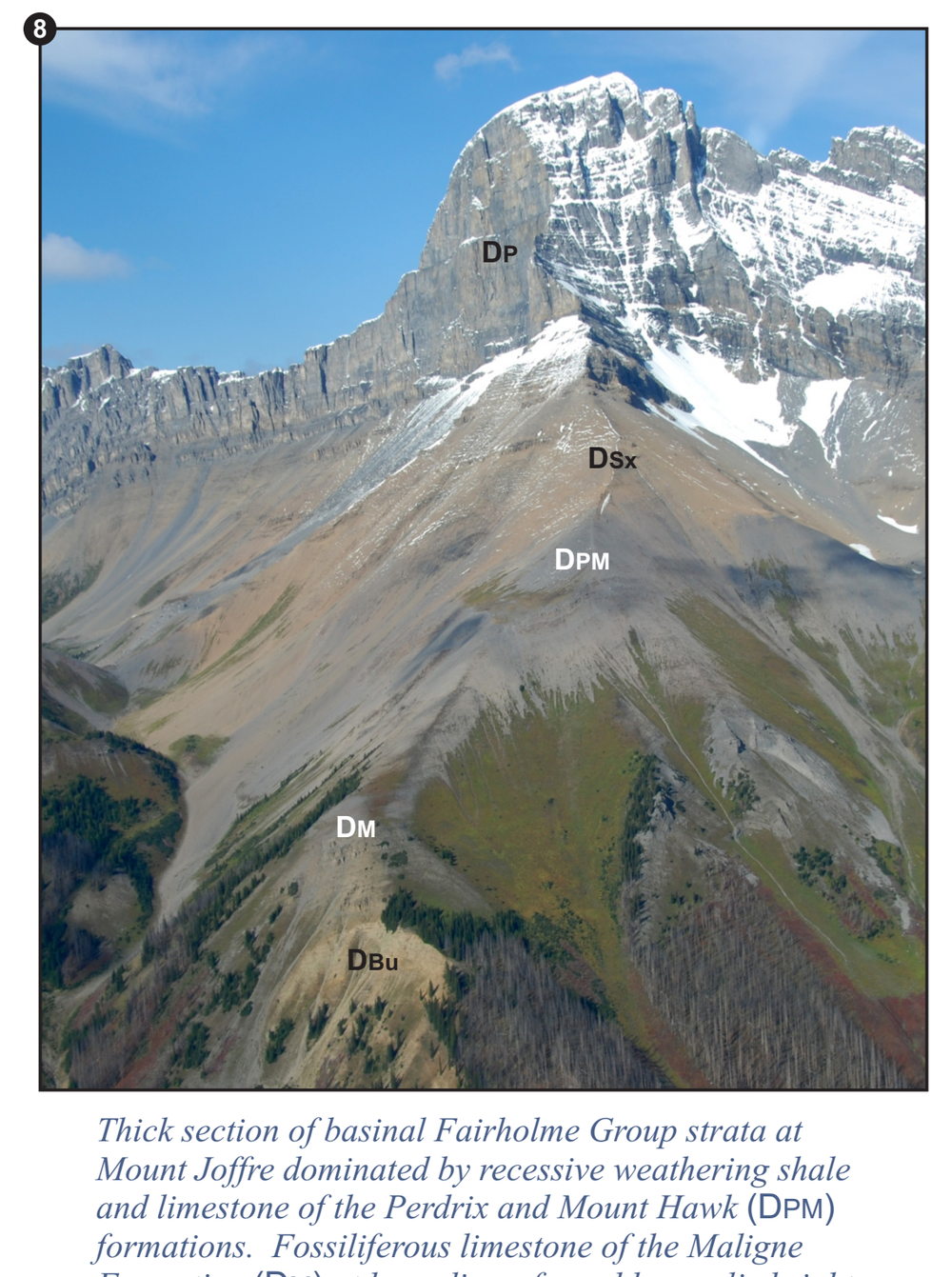
Major changes in stratigraphy occur across the area. The Lower Paleozoic section thickens dramatically from both the northeast and the southwest into the White River Trough extensional basin (Cecile and Norford, 1993) by a combination of depositional thickening and increased preservation beneath the sub-Devonian unconformity. A major facies change in Middle Cambrian to Middle Ordovician strata from "platformal carbonates" to a thick, shaley, basinal succession at the Kicking Horse Rim (Aitken, 1971) marks the eastern boundary of the White River Trough in the north-central part of the Kananaskis west half area. Late Ordovician and Early Devonian ultramafic diatreme breccia pipes and dykes in the White River Trough succession indicate episodic crustal extension continued into the Devonian. Significant hydrothermal alteration occurred along the Kicking Horse Rim and produced the Brussilof magnesite mine and several Zn showings. Upper Devonian Fairholme Group and Palliser Formation strata also change facies westward into basinal strata in the Kananaskis west half area. The changes in facies affected the subsequent structural style.

Abrupt facies change from the dolomitized Middle Cambrian Eldon-Pika carbonate platform (ЄEP) to slope deposits of the Chancellor Group (ЄCh) at the Kicking Horse Rim, near Indian Peak. Megabreccias (mb), megaconglomerates, megatruncation surfaces, slideblocks and conglomerates indicate tectonic instablity.

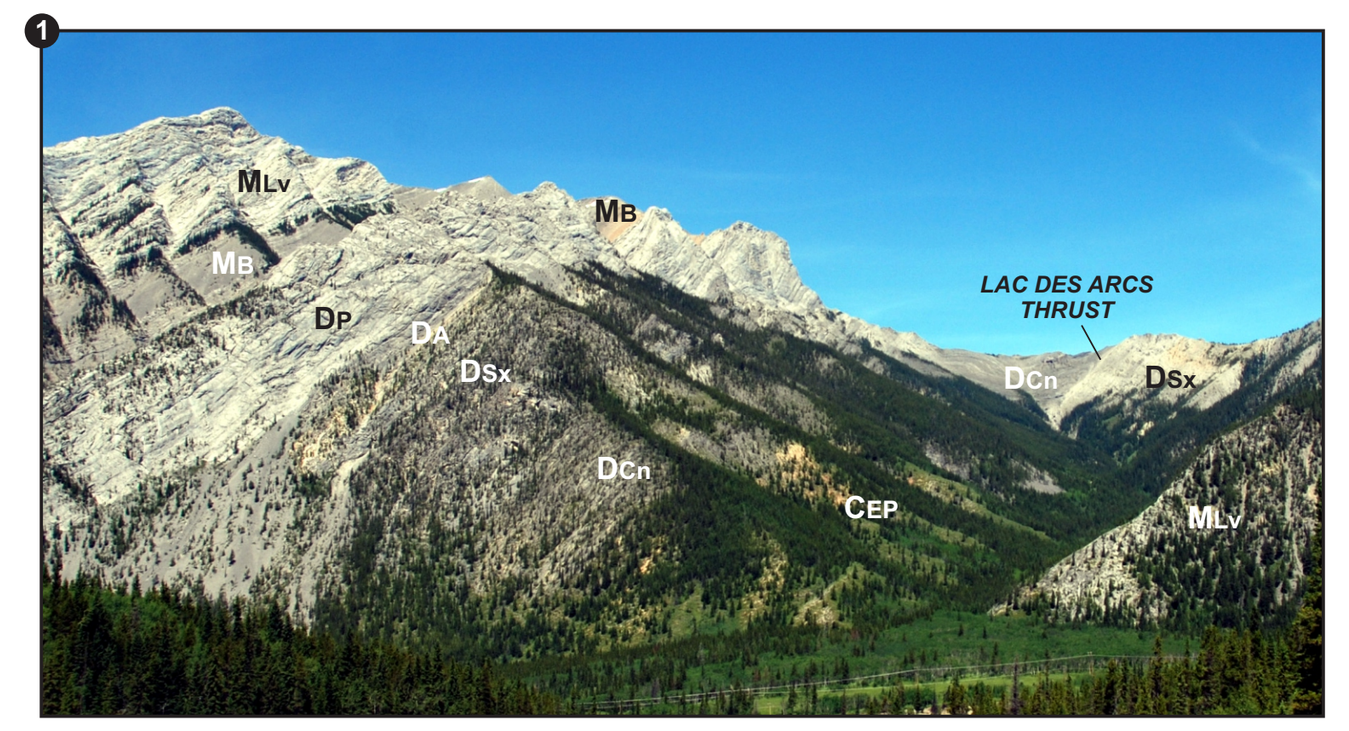
The Russell Peak diatreme, 2 kilometres south of Russell Peak. This diatreme intrudes Upper Ordovician Beaverfoot carbonates and pre-dates deposition of Middle Devonian carbonates and sandstones.



Thick Cambrian carbonate platform at the Kicking Horse Rim, east edge White River Trough, at Mount Brussilof. Limestone and argillite in the basal part of the Sullivan Formation and the Arctomys-Waterfowl interval have become crystalline dolostone at the Kicking Horse Rim.

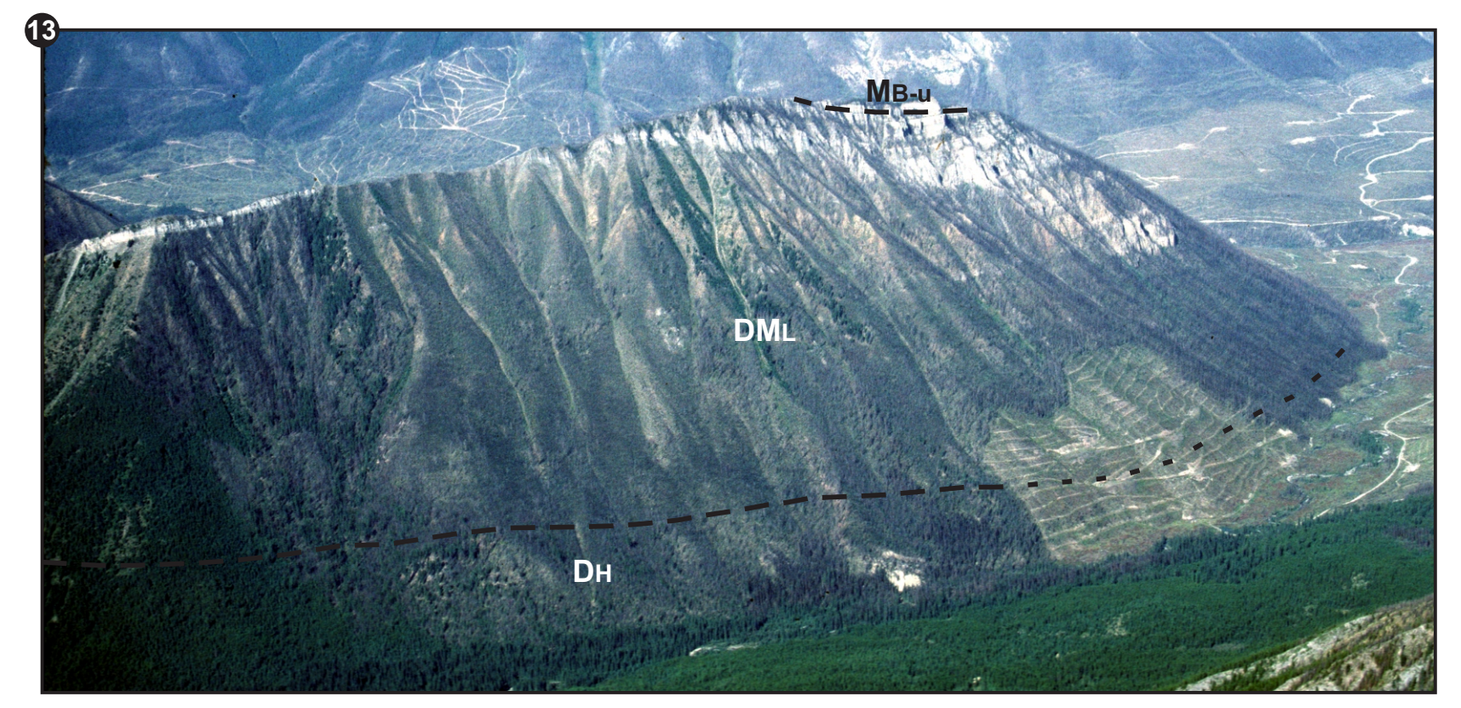


Thick section of basinal Fairholme Group strata at Mount Joffre dominated by recessive weathering shale and limestone of the Perdrix and Mount Hawk (DPM) formations. Fossiliferous limestone of the Maligne Formation (DM) at base disconformably overlie bright weathering solution collapse breccia of Middle Devonian Burnais Formation (DBu). Sandy strata at top of group (Sassenach Formation, DSs) are overlain by cliff forming Palliser limestone (DP).

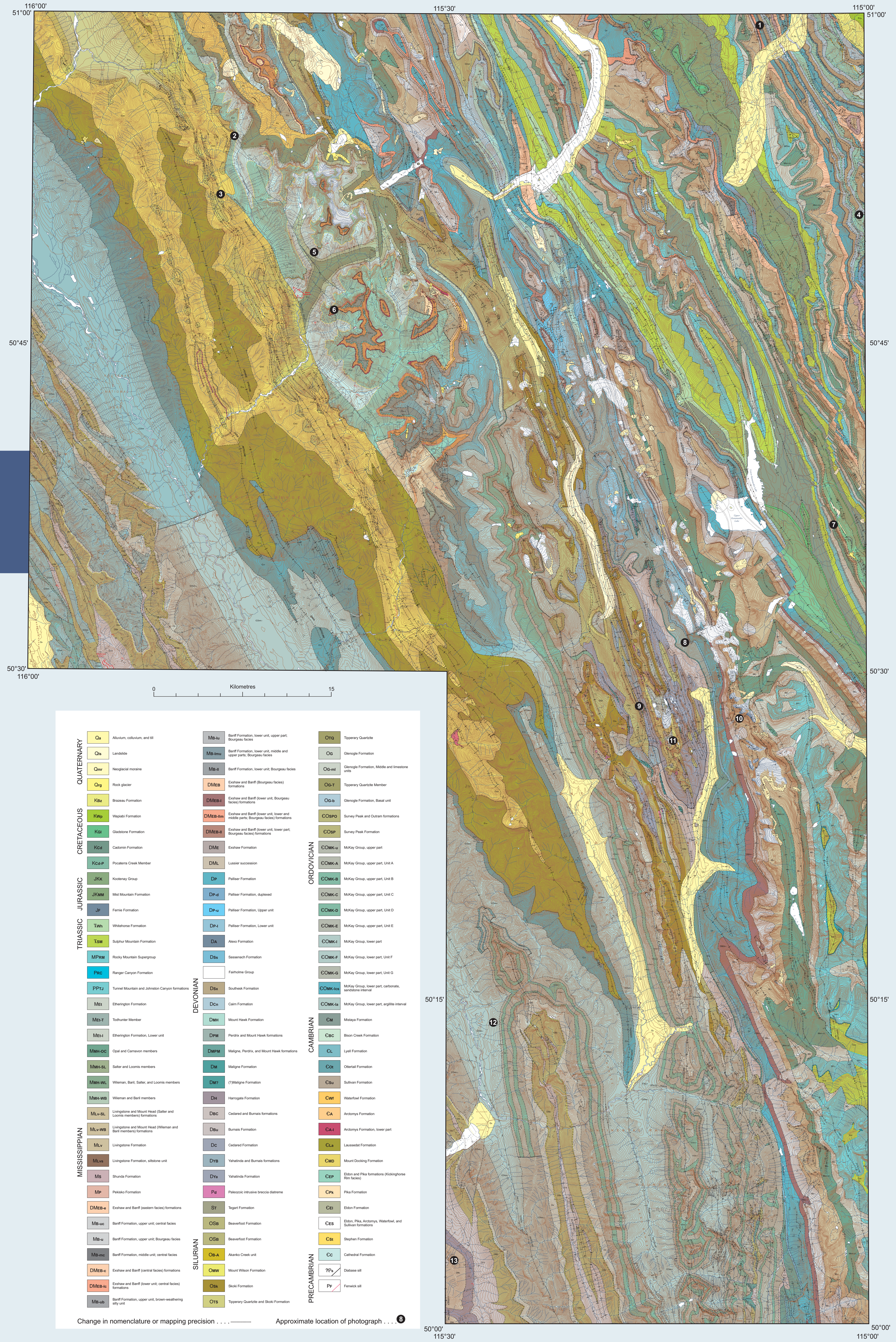


Cambrian to Mississippian section exposed in the eastern Front Ranges, Mount Lorette. Reef-facies Upper Devonian Fairholme Group strata (DCn, DSx) unconformably overlie the Middle Cambrian Eldon-Pika (CEP) in the Lac des Arc thrust sheet. DCn - Cairn Fm, DSx - Southesk Fm, DA - Alexo Fm, DP - Palliser Fm, MB - Banff Fm, MLv - Livingstone Fm.

Thick Upper Cambrian-Lower Ordovician section in the White River Trough, northeast of Whiteswan Lake. Poorly exposed argillite of lower McKay Group (ЄOMK-l) overlain by argillite - carbonate cycles of the upper McKay (ЄOMK-u), and then recessive shale and limestone of Glenogle Formation (OG).



Shale and spiculitic strata of the Upper Devonian - lower Mississippian Lussier succession (DML), Lussier Syncline. The Lussier succession is the basinal facies equivalent of the Fairholme Group and the Sassenach, Palliser, Exshaw and lower Banff formations. DH - Middle Devonian Harrogate Formation, MB-u - Banff Formation (upper part Bourgeau facies).

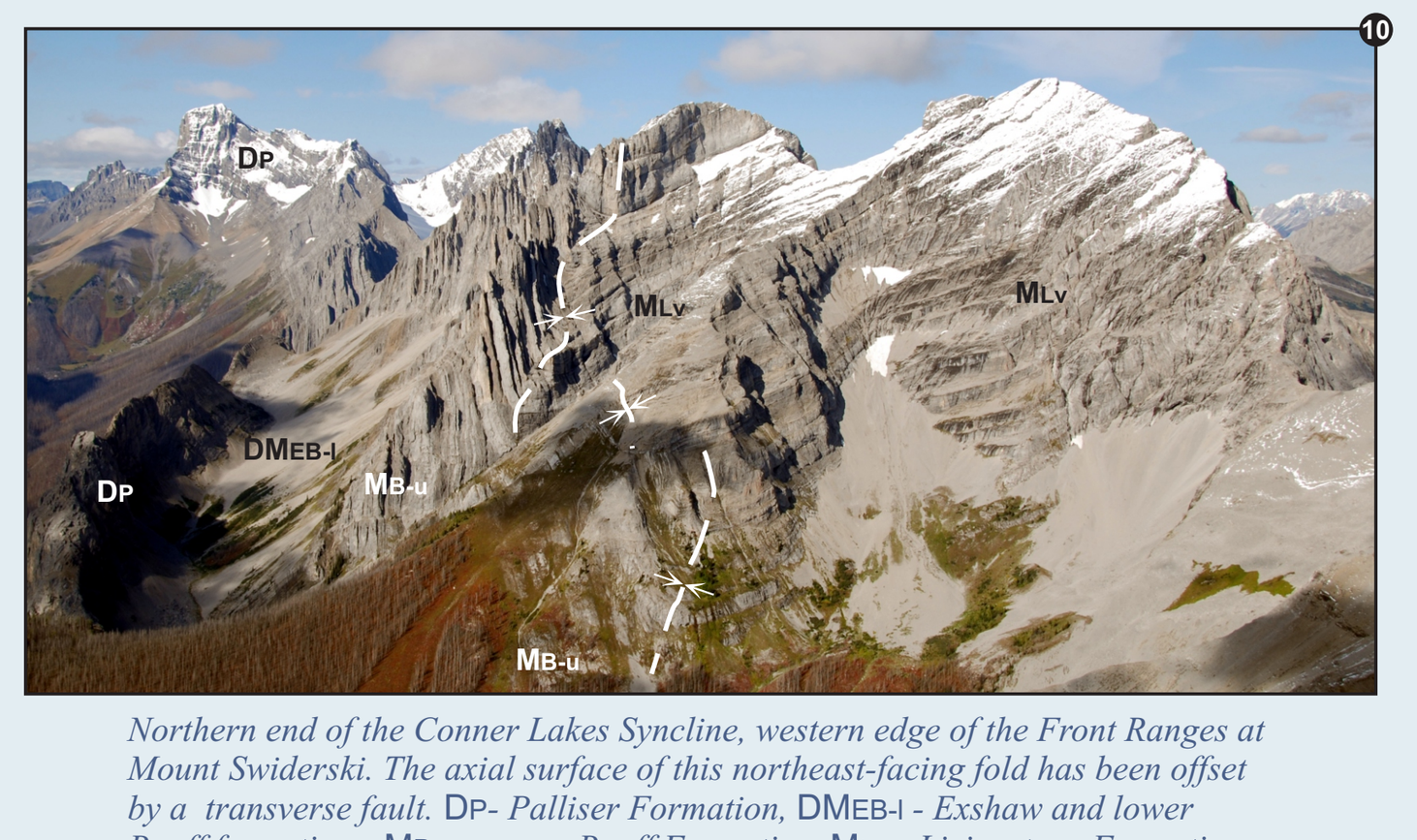


STRUCTURE

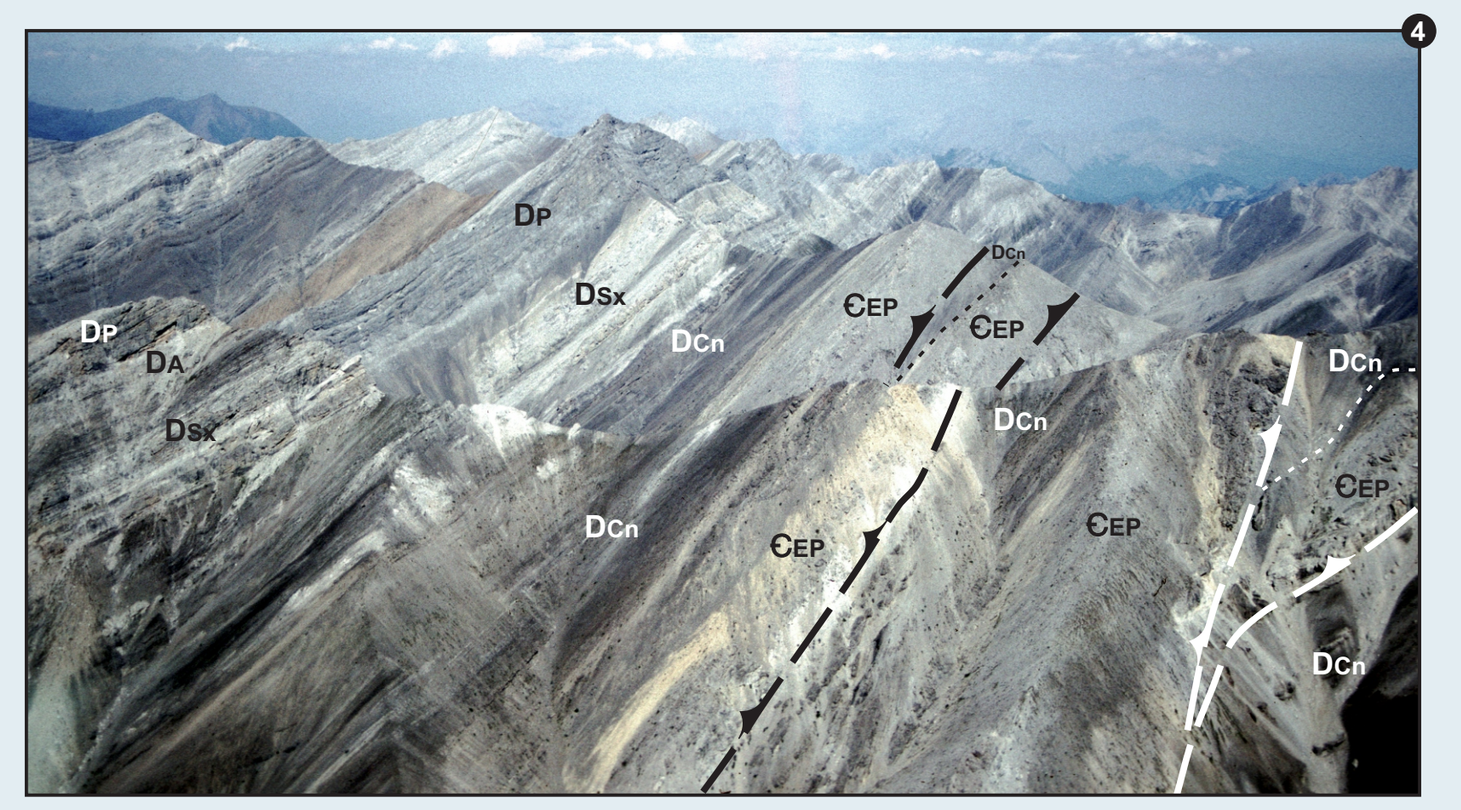
FRONT RANGES

The structural style in the Front Ranges is dominated by major thrust faults carrying variably folded Paleozoic and Mesozoic carbonate and clastic strata. Imbricate thrust slices and duplexes are commonly developed along the leading edge of each major thrust fault. Map relationships show significant displacement transfer and kinematic linkage occurred between the individual thrust faults. A prominent zone of transverse faults, with a syn-sedimentary, basement-controlled origin (McMechan, 2010), crosscut Paleozoic strata in each thrust sheet in the east-central part of the area. Kilometre-scale folds dominate the structural style of upper Paleozoic strata where the Upper Devonian Fairholme Group strata are in a basinal shale facies.

Transverse faults in immediate hanging wall of the Lewis Thrust sheet.



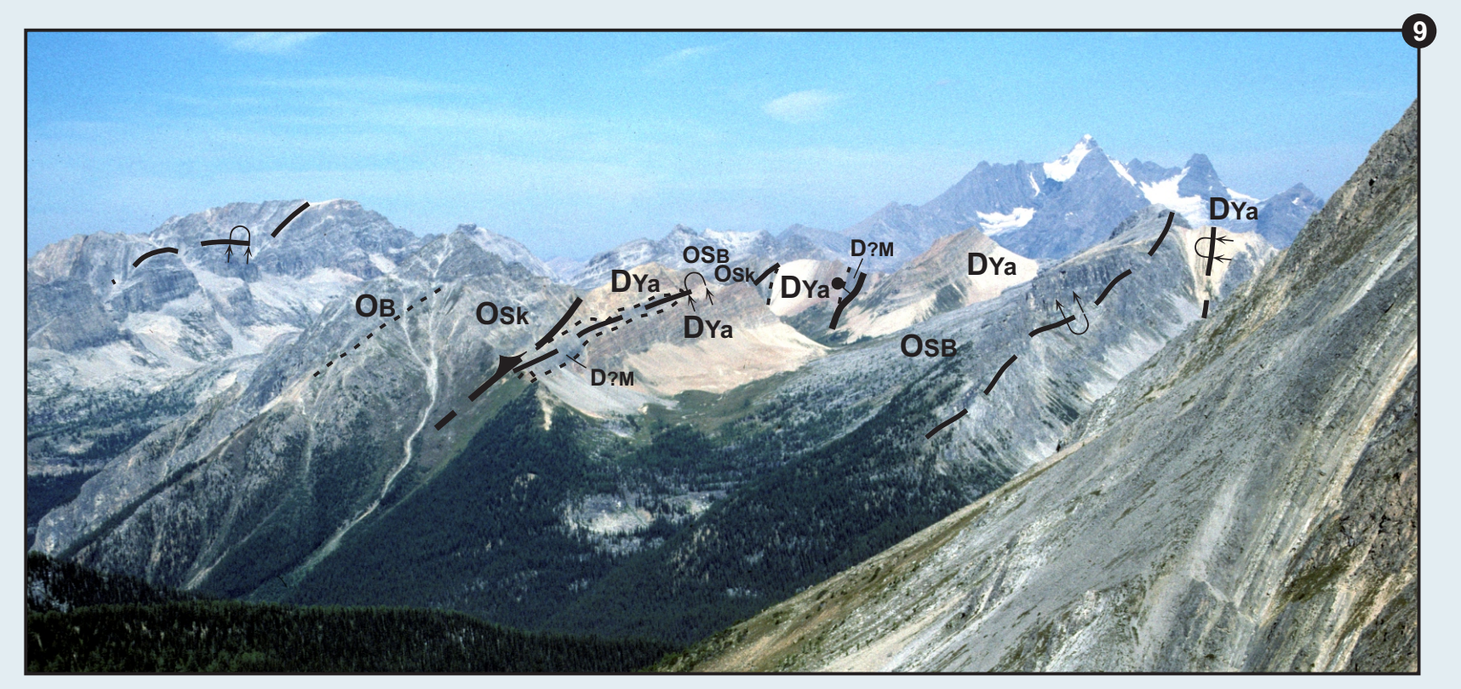
Northern end of the Conner Lakes Syncline, western edge of the Front Ranges at Mount Swiderski. The axial surface of this northeast-facing fold has been offset by a transverse fault. DP- Palliser Formation, DMEB-l - Exshaw and lower Banff formations, MB-u - upper Banff Formation, MLv - Livingstone Formation.



Imbricate fault repeats of Cambrian Eldon-Pika (ЄEP) and Devonian Cairn (DCn) strata along leading edge Kananaskis Thrust. DSx - Southesk Formation, DA - Alexo Formation, DP - Palliser Formation.

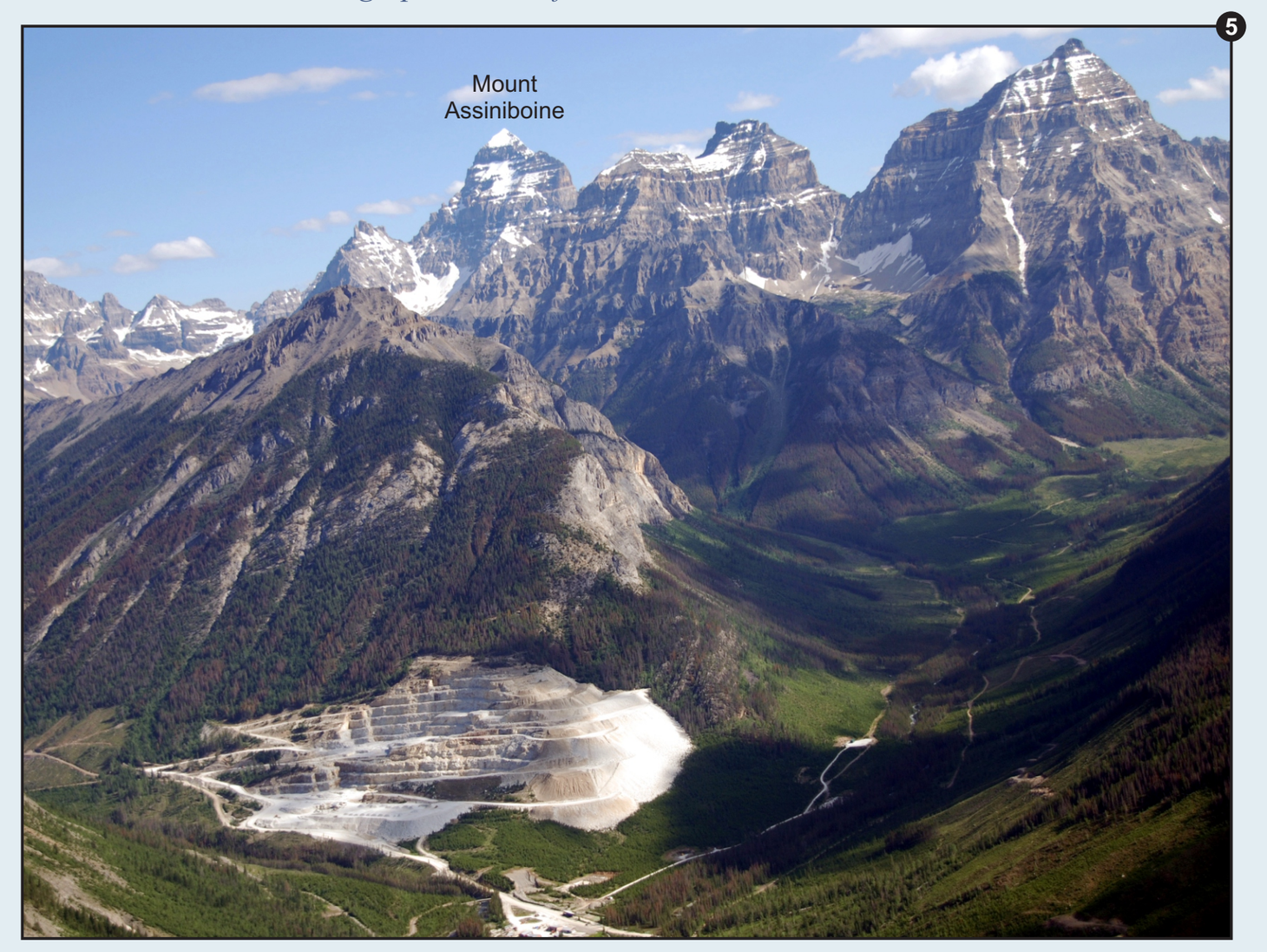
MAIN RANGES

A change in level of exposure to Neoproterozoic, Cambrian and Ordovician strata marks the transition into the Main Ranges and a south-plunging culmination in the Bourgeau thrust sheet. East and north of the Kicking Horse Rim, competent Lower Paleozoic strata outline the classic large-scale open-folded eastern Main Ranges structural style and form castellated mountain peaks including Mount Assiniboine. Immediately basinward of the Rim, tight and overturned northeast-facing folds occur. A regional southwest-facing, overturned fold occurs along the western edge of the Main Ranges at the transition into the Western Ranges.



Folded and faulted Middle Ordovician to Devonian strata in the Main Ranges south of the Kicking Horse Rim. Up-plunge in the distance the Cambro-Ordovician McKay Group underlies Mount King George and the Royal Group. OSk - Skoki Formation, OSB - Beaverfoot Formation, DYa - Yahatinda Formation, D?M- Maligne Formation or Harrogate Formation.

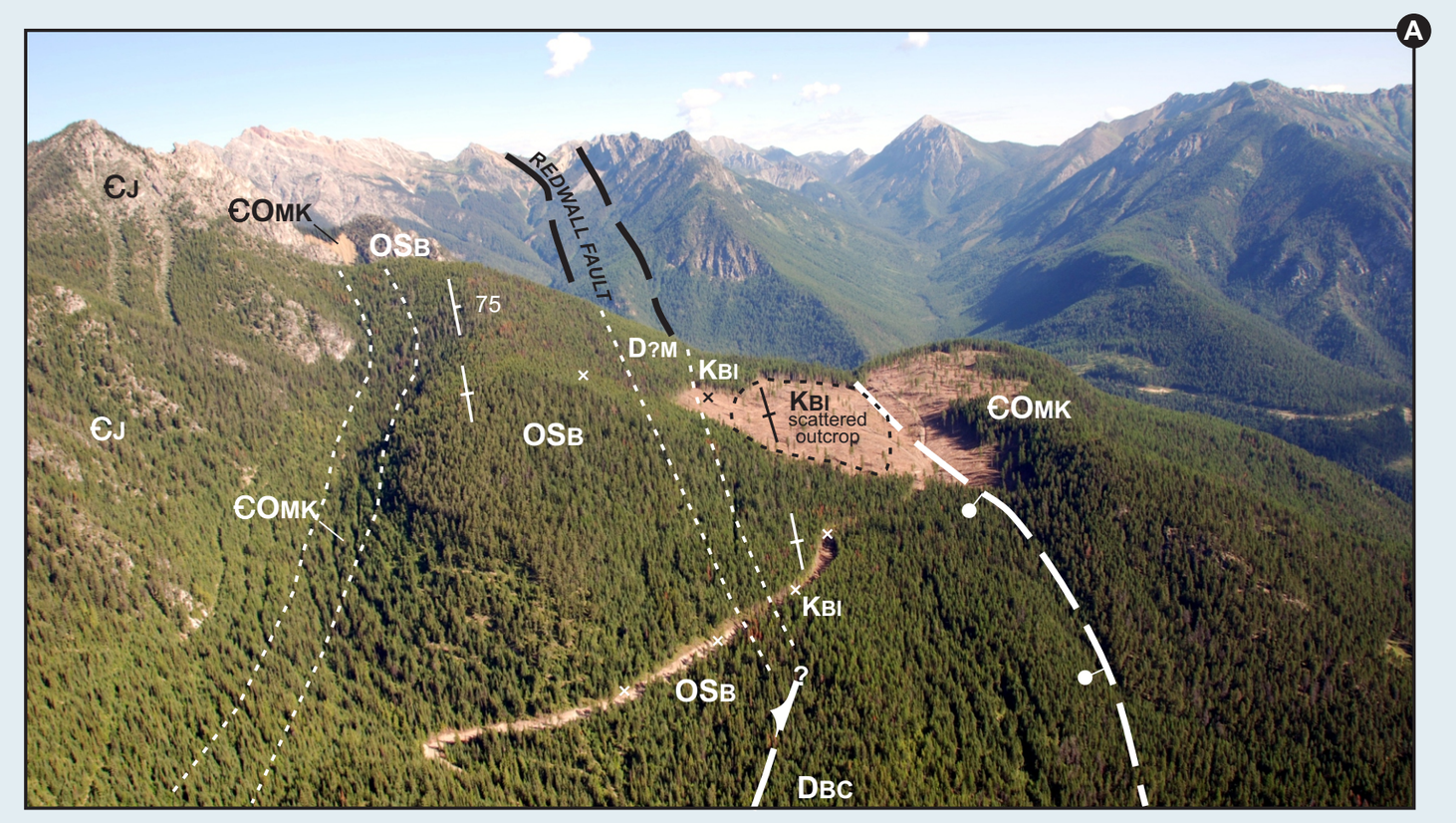
Tight overturned folds in the Chancellor Group, immediately west of the Kicking Horse Rim. More open folds occur at the same stratigraphic level a few kilometres to the west.



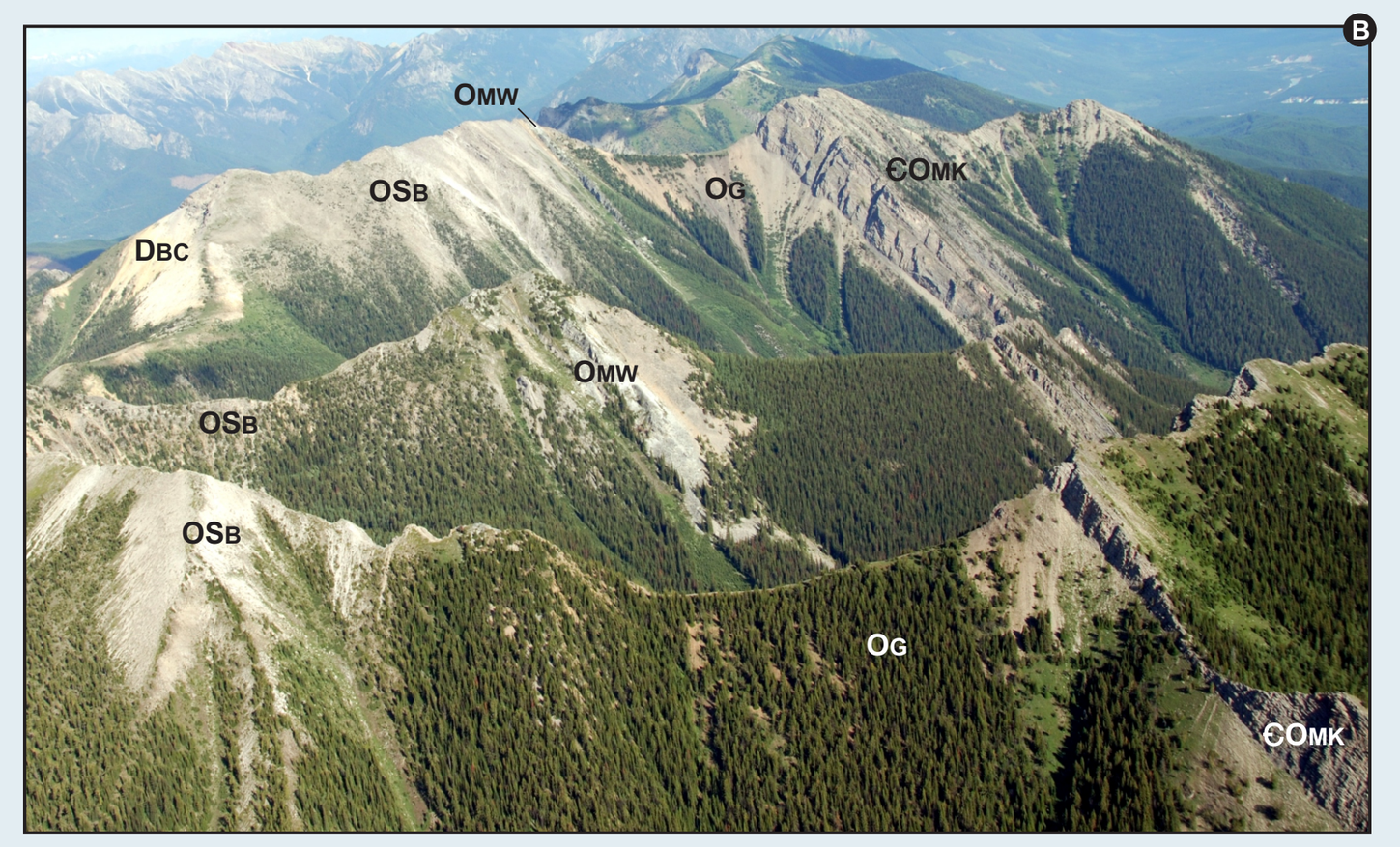
Open structure and castellated peaks of the eastern Main Ranges. The thick Middle and Upper Cambrian carbonate succession at the Kicking Horse Rim forms the highest mountains in the southern Canadian Rockies. Mississippi Valley type alteration along the Kicking Horse Rim produced the Mount Brussilof Magnesite Mine (foreground). This deposit was discovered by G.B. Leech while mapping in the Kananaskis west half area for the Geological Survey of Canada.

WESTERN RANGES

Steep longitudinal and transverse faults cutting folded Cambrian to Middle Devonian strata characterize the Western Ranges shown on the accompanying



Steeply dipping Cretaceous Blairmore Group strata (KBl) exposed along the steeply dipping Redwall fault zone, southern Stanford Range (82J/5). Major changes in preservation and facies occur across this fault zone in the lower Paleozoic section. ЄJ - Jubilee Formation, ЄOMK - McKay Group, OSB - Beaverfoot Formation, DBC - Cedared and Burnais formations, x - outcrop.



Overturned limb of regional southwest-facing anticline that forms eastern part of Western Ranges. ЄOMK - McKay Group, OG - Glenogle Formation, OMW - Mount Wilson Formation, OSB - Beaverfoot Formation, DBC - Cedared and Burnais formations.

REFERENCES

Aitken, J.D., 1971. Control of lower Paleozoic sedimentary facies by the Kicking Horse Rim, southern Rocky Mountains, Canada: Canadian Society of Petroleum Geology, v. 19, p. 557–569.

Cecile, M.P. and Norford, B.S., 1993. Ordovician and Silurian: In Sedimentary Cover of the North American Craton in Canada: Chapter 4c, D.F. Stott and J.D. Aitken, (ed.), Geological Survey of Canada, Geology of Canada no. 5, p. 383–388.

McMechan, M.E., 2010. Basement controlled mineralization, intrusions and facies, southeastern British Columbia; "Two for One Exploration Targets": Geological Survey of Canada, Open File 5874, 44 p.

McMechan, M.E., 2011. Geology, Mount Abruzzi, British Columbia: Geological Survey of Canada, Canadian Geoscience Map 10, scale 1:50 000. doi:10.4095/288142

McMechan, M.E. and Leach, G.B., 2011. Geology, Mount Peck, British Columbia: Geological Survey of Canada, Canadian Geoscience Map 9, scale 1:50 000. doi:10.4095/288765

McMechan, M.E. and Leach, G.B., 2011b. Geology, Tangle Peak, British Columbia: Geological Survey of Canada, Canadian Geoscience Map 12, scale 1:50 000. doi:10.4095/287454

McMechan, M.E. and Leach, G.B., 2011c. Geology, Mount Assiniboine, British Columbia: Geological Survey of Canada, Canadian Geoscience Map 13, scale 1:50 000. doi:10.4095/287204

Root, K.G., 1987. Geology of the Delphine Creek area, southeastern British Columbia: implications for the Proterozoic and Paleozoic development of the Cordilleran Divergent Margin: unpublished Ph.D. thesis, University of Calgary, Calgary, Alberta, 446 p.

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