Natural Resources Canada
Ressources naturelles Canada

CANADIAN GEOSCIENCE MAP 8

GEOLOGY

MOUNT HEAD

Alberta–British Columbia

Map Information Document

Canadian Geoscience Maps

2012

Canada

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1:50 000

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Cover Illustration

View looking southeast of Carnarvon Lake and environs, nestled in the immediate hanging wall of the Lewis Thrust, Alberta. Cliffs of gently to moderately southwest-dipping carbonate strata of the Mississippian Rundle Group rise up from the lake, thrust over erosionally recessive Cretaceous clastic rocks seen through what is locally called ‘Gunsight Pass’. The high ridge visible through the pass in the far distance is the Highwood Range, underlain by the same erosionally resistant Mississippian strata, carried by the Sentinel Peak and associated thrust faults. The Great Divide passes through this view, approximately 100 m from the west edge of the lake. Photograph by G.S. Stockmal. 2010-278

ABSTRACT

This 1:50 000-scale bedrock geological map of Mount Head (NTS 82-J/7) is the result of compilation and reinterpretation of pre-existing maps combined with new geological mapping conducted during the 2008 field season. The map spans the transition from the Southern Rocky Mountain Foothills to the Front Ranges and straddles the Great Divide. The bedrock geology is characterized by Late Devonian to Late Cretaceous sedimentary strata that were deformed by a series of probable Late Cretaceous to Early Tertiary thin-skinned thrust faults and associated folds. The three major thrusts, the McConnell–Sentinel Peak, Lewis, and Bourgeau (from east to west), dominate the structural geology. Mapped structures include folded thrusts, duplexes, thrust-overridden folds, and prominent plunge magnitudes related to probable subsurface lateral thrust ramps. Coupled with regional map relationships, these features indicate out-of-sequence thrust development and substantial kinematic interaction between thrust sheets carried on long-lived thrusts.

RÉSUME

La carte géologique du substratum rocheux de la région de la carte Mount Head (82-J/7 du SNRC, à l'échelle de 1/50 000) est le résultat d'une compilation et d'une réinterprétation de cartes préexistantes, en combinaison avec la nouvelle cartographie géologique réalisée en 2008 au cours d'une campagne sur le terrain. La carte couvre la zone de transition depuis les contreforts jusqu'aux chaînons frontaux des Rocheuses du Sud, et chevauche la ligne de partage des eaux. La géologie du substratum rocheux est caractérisée par des couches sédimentaires du Dévonien tardif au Crétacé tardif, déformées par une série de failles de chevauchement de couverture et des plis qui y sont associés, datant vraisemblablement du Crétacé tardif au Tertiaire précoce. Trois grands chevauchements, soit les chevauchements de McConnell–Sentinel Peak, de Lewis et de Bourgeau (d'est en ouest), dominent la structure géologique. Les structures cartographiées comprennent notamment des chevauchements plissés, des duplex, des plis surmontés de chevauchements et des plongements marqués, probablement liés sous la surface à des rampes latérales de chevauchement. Combinés aux relations cartographiques régionales, ces éléments structuraux indiquent une évolution non séquentielle du chevauchement, ainsi qu'une interaction cinématique importante entre les nappes de charriage produites par des chevauchements de longue durée.

ABOUT THE MAP

General Information

Compiler: G.S. Stockmal

Geological interpretation and compilation by G.S. Stockmal, based on 2008 field observations including those of L. Currie, K. Fallas, and M.E. McMechan, published maps and reports by J.A. Allan and J.L. Carr (1947), R.J.W. Douglas (1958), D.A. Grieve (1993), and field notes by R.A. Price (reconnaissance field work in 1964 and 1965)

Cartography and geomatics by K. Fallas, L. MacDonald, S. Orzeck, N. Raska, and P.R.J. Wozniak

Scientific editing by E. Inglis

Map projection Universal Transverse Mercator, zone 11. North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications. Elevations in feet above mean sea level

Mean magnetic declination 2012, 15°2′ E, decreasing 12.0′ annually

The Geological Survey of Canada welcomes corrections or additional information from users.

Data may include additional features not portrayed on this map.
See documentation accompanying the data.
Additional descriptive notes are included in the map information document.

This publication is available for free download through GEOSCAN (http://geoscan.ess.nrcan.gc.ca/).

Map Viewing Files

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

The spatial geological data may be viewed with the Portable Map File (PMF), using ArcReader software available for free from ESRI. The representation of the data is organized thematically with an expanded set of attributes for all geological features from the database. The PMF provides a demonstration of the suitability of the data for viewing, querying, and analysis in a Geographic Information System (GIS).

About the Geology

Descriptive Notes

This 1:50 000-scale bedrock geological map of Mount Head (NTS 82-J/7) is the result of compilation and selected reinterpretation of pre-existing maps combined with new geological mapping conducted during the 2008 field season. It is a contribution to the Geological Survey of Canada's Secure Canadian Energy Supply Program (2004–2009).

The Mount Head map area spans the transition from the Rocky Mountain Foothills to the Front Ranges. It straddles the Great Divide (High Rock and Elk ranges; maximum elevation on the divide 9837 feet (2998 m) at Baril Peak, and 9987 feet (3044 m) 2 km west of the divide at Courcelette Peak) and encompasses portions of Kananaskis Country in Alberta (Highwood River drainage and Highwood Range; maximum elevation 9126 feet (2782 m) at Mount Head) and the upper Elk River valley area in British Columbia.

The bedrock geology of the map area is characterized by sedimentary strata of Late Devonian to Late Cretaceous age, deformed in a series of thin-skinned thrust faults and associated folds of probable Late Cretaceous to Early Tertiary age. A cratonic platformal succession is represented by a Late Devonian through Late Mississippian carbonate-dominated package and a latest Mississippian through Triassic siliciclastic-dominated package. These formed a mechanically competent succession (along with underlying older Paleozoic rocks not exposed in the map area) that controlled the structural framework of the principal thrust sheets in the map area: McConnell–Sentinel Peak, Lewis, and Bourgeau. The platformal succession is overlain by Jurassic through Late Cretaceous siliciclastic rocks representing the foreland basin that evolved adjacent to the growing Cordilleran Orogen. These foreland units were subsequently overridden by and structurally involved with thin-skinned thrust sheets during the development of the Rocky Mountains and Foothills. The Jurassic marine shale of the Fernie Formation, at the base of the foreland succession, formed a regional detachment horizon that accommodated varying degrees of structural decoupling.

The three major thrust sheets in the Mount Head map area, the McConnell–Sentinel Peak, Lewis, and Bourgeau (from east to west), carry Devonian and younger rocks in outcrop exposures. Douglas (1958) mapped the McConnell Thrust as folded in the Highwood Range, in the vicinity of Mount Head. A modern interpretation of the map pattern (Spratt et al., 1995) indicates that the mapped McConnell Thrust is the folded roof thrust of a forward-breaking duplex structure, with the Sentinel Peak Fault forming the floor thrust of the duplex. Although not explicitly linked by Douglas (1958), the compiler herein interprets a continuous fault trace between the features he mapped as the McConnell Thrust (to the north) and the Sentinel Peak Fault (to the south). The Cataract Creek, Mount Burke, and Zephyr Creek faults bound horses within the duplex.

The structure of the Lewis thrust sheet in the map area is simple in comparison to that of the McConnell–Sentinel Peak thrust sheet, but complexity does increase southward, where a structural culmination marked by large broad folds and associated cross-strike structures may indicate an underlying, but unexposed duplex within the Lewis thrust sheet or folding of the Lewis Thrust by deeper structures. A set of small-displacement, normal faults is interpreted to bound this structural culmination to the west (between Courcelette Peak and Mount Tuxford) on the basis of observable stratigraphic offset, known stratigraphic thicknesses, and airphoto interpretation. Along the leading edge of the Lewis Thrust, in its immediate hanging wall, is a spectacular and continuous zone of strongly and complexly deformed Livingstone Formation, up to approximately 150 m in thickness. This zone is observed from the south edge of the map area northward to the vicinity of Mount Bishop; its extent south of the map area is unknown.

Between Mount Bishop and Mount Odlum, the Lewis Thrust had cut downsection to carry the Upper Devonian through Early Mississippian Palliser, Exshaw, and Banff formations. In this vicinity, in the Lewis Thrust footwall, both the Etherington Creek Fault and a large overturned syncline cored by the Late Cretaceous Belly River Formation were crosscut and overridden by the Lewis thrust sheet. This large overturned syncline, called the Oyster syncline by Norris (1993), continues 20 km south of the Mount Head map area where it folded the Lewis thrust sheet at Beehive Mountain (Norris, 1993). This fold and others associated with it in the Lewis thrust sheet, continue 30 km south of Beehive Mountain, through Tornado Mountain to Gould Dome (Price et al., 1992). A structurally conformable syncline in the Lewis Thrust footwall continues another 22 km south of Gould Dome to fold the Lewis thrust sheet at the Crowsnest Mountain klippe (Price, 1962).

Near the north edge of the Mount Head map area, and prior to or perhaps partly contemporaneous with being crosscut and overridden by the Lewis Thrust, the Etherington Creek Fault and the hinge surface of the overturned Oyster syncline were monoclinally folded and tilted above a south-plunging structure, which is exposed at the south end of the Misty Range, immediately to the north of the Mount Head map area

(McMechan, 1995). This structure has been interpreted to reflect a hanging wall, lateral ramp on the Misty Thrust (Castonguay and Price, 1995), which lost displacement to the south and terminated in the northern portion of the Mount Head map area. The spatial coincidence of the Palliser through Banff section in the Lewis Thrust hanging wall with the crosscutting of structures by the fault in its footwall suggests that the lateral ramp continued beneath the Lewis thrust sheet, and that folding of strata in the Misty Thrust hanging wall affected the location of the Lewis Thrust as it propagated northward through the Devonian-Mississippian section in its early stages of development at this latitude. This indicates out-of-sequence initiation of the Misty and Lewis thrusts at this latitude, as suggested by Castonguay and Price (1995). The relationships between the Lewis and Misty thrusts, and the associated folding in the Lewis footwall and of the thrust itself, indicate overlap of the periods of displacement on these faults and the times of deformation of adjacent structures.

The structure of the Bourgeau thrust sheet is also relatively simple, with stratigraphic offset decreasing from north to south across the map area. This decrease in apparent displacement is associated with a number of south-plunging folds in the hanging wall of the Bougeau Thrust, and may reflect a decrease in absolute thrust displacement to the south.

The earliest detailed map of a portion of the Mount Head map area is the 1:63 360-scale map accompanying a 1947 Alberta government report by Allan and Carr (1947). Their map targeted the Triassic and younger, potentially coal-bearing, rocks from the Elbow River headwaters southward to the Highwood River. Approximately 40% of their map area overlaps with the Mount Head map area. The east half of the Mount Head map area was mapped by R.J.W. Douglas and published in 1958 as a 1:63 360-scale GSC A-series map (Map 1052A; Douglas, 1958) on a 1943 topographic base. The Jurassic and younger, potentially coal-bearing, rocks of the Elk River valley were mapped by Grieve (1993) at 1:50 000 scale.

Observations and interpretations of these three previous publications have been compiled into the new map, with significant reinterpretation in places. The topographic base of Allan and Carr (1947) was sufficiently poor that it was not always possible to confidently estimate their observation locations on the current modern base map. Adjustments were made by comparing the most robust features of the old and current topographic bases, such as stream junctions and meanders, ridge lines, and prominent incisions on ridges. In addition, significant adjustments of their structural interpretations, and occasionally their formation assignments, were necessary. All structural observations and interpretations of Douglas (1958) were transferred to the current 1:50 000 base, which required significant adjustments locally. These were achieved as for the Allan and Carr (1947) data, with due care taken to ensure that even minor topographic features were matched between the old and current bases. The map and structural measurements by Grieve (1993) were modified locally where new observations conflicted, or where additional detail was warranted.

In addition to these sources, R.A. Price (formerly of the GSC) very kindly provided copies of his unpublished field map and associated field notes stemming from limited helicopter-supported fieldwork undertaken in 1964 and 1965, in the Cretaceous units just east of the Alberta–British Columbia boundary. The present compiler significantly revised his interpretation of structures crossing Odlum Ridge, located north of Odlum Creek along and just north of the northern edge of the map, which are associated with the south-plunging Misty Range structure (Castonguay and Price, 1995). This revision, aided by the use of Google Earth™ and its 3D oblique viewing capability, has resulted in a mismatch of structural interpretation at Odlum Ridge in comparison to that of McMechan (1995), who used the interpretation of Castonguay and Price (1995) in her compilation.

New mapping in 2008 focused on exposures of Paleozoic rocks within the Lewis and Bourgeau thrust sheets, for which no maps had been published previously, and Mesozoic rocks in the footwall of the Lewis Thrust. Direct field observations were augmented with interpretations of stereographic aerial photographs (listed below), ground- and helicopter-based oblique photographs from the 2008 season, and Google Earth™ imagery.

The following sets of provincial aerial photographs were used: 1) Alberta, Project No. 93-130, 1:40 000 scale, AS4458: Line 20, photos 40 to 49; Line 21, photos 54 to 63; Line 22, Photos 69 to 79; Line 23, Photos 85 to 97; and Line 24, Photos 107 to 120; 2) British Columbia, Project BC81-109, Photos 173 to 190; Project BC81-112, Photos 57 to 63, 74 to 85, and 136 to 156.

Acknowledgments

Fieldwork and subsequent airphoto and map interpretation by K. Fallas, L. Currie, and M.E. McMechan (GSC) are gratefully acknowledged. Alberta Geological Survey (AGS) is thanked for cost-sharing with the GSC for helicopter support. G. Prior, D. Pana, and W. Langenberg (AGS), as well as N. Raska, M. Sommers, and K. Ball (summer students) are thanked for field assistance. Critical review by M. Cecile and M.E. McMechan is appreciated.

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 11
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 115°00′00″ W
Eastern longitude: 114°30′00″ W
Northern latitude: 50°30′00″ N
Southern latitude: 50°15′00″ N

Data Model Information

Surface bedrock data are organized into feature classes and themes consistent with logical groupings of geological features. All field observation point data are related through the Station_ID property of the Station theme. These feature attribute names and definitions are identical in the shapefiles and the XML files.

Consult PDFs in Data folder for complete description of the feature classes, feature attributes, and attribute domains.

The Bedrock Data Model and the Bedrock Domains documents are intended to describe all bedrock features which may be compiled at the 1:50 000 scale. Therefore, some of the feature classes and feature attributes described in these documents may not be present.

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2. At the end of the first term, this Agreement shall automatically be extended for successive one (1) year terms, subject to section 6.0 below.

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2. **Entire Agreement**
   This Agreement constitutes the entire agreement between the parties with respect to its subject matter. This Agreement may only be amended in writing, signed by both parties, which expressly states the intention to amend this Agreement.

3. **Dispute Resolution**
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2. À la fin du premier terme, cet Accord sera automatiquement renouvelé pour des termes successifs d'un (1) an, en vertu de la section 6.0 qui suit.

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   iii. par consentement mutuel des parties.

2. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, les obligations qui incombent au Détenteur de licence en vertu de la section 4.0 continueront de s'appliquer et les droits du Détenteur de licence en vertu de la section 2.0 cesseront immédiatement.

3. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, le Détenteur de licence devra immédiatement effacer ou détruire toutes les Données obtenues en vertu de cet Accord, ou à l'intérieur d'un délai raisonnable lorsque les Données sont nécessaires pour terminer la livraison de Produits dérivés commandés avant la résiliation de cet Accord.

7.0 GÉNÉRAL

1. **Lois d'application**
   Le présent Accord est régi et interprété en vertu des lois en vigueur dans la province de l'Ontario. Les parties acceptent de tomber sous la juridiction de la Cour supérieure de la Province de l'Ontario.

2. **Totalité de l'Accord**
   Le présent Accord constitue l'intégralité de l'entente conclue entre les parties relativement à l'objet du présent Accord. Toute modification à cet Accord ne peut être que par écrit, doit porter la signature de chaque partie et exprimer clairement l'intention de modifier cet Accord.

3. **Solution des litiges**
   Si un litige survient à propos de cet Accord, les parties tenteront de le résoudre par des négociations de bonne foi.