The Groundhog coalfield

British Columbia Geological Survey
Information Circular 2016-5

Red Chris
Copper - Gold

Spatsizi Plateau Wilderness Provincial Park

Jenkins Creek assemblage
Devil's Claw Formation
Groundhog-Gunanoot assemblage
Skelhorne assemblage
Muskaboo Creek assemblage
Undivided Bowser Lake Group
Undivided Bowser Lake Group

Coal, developed prospect MINFILE #
Coal, prospect MINFILE #
Coal showing MINFILE #
Coal exploration well
Coal exploration trench
Coal trench - Dawson and Ryan 1989-1991

Highway 37
Railbed for proposed BCR railway (Project not completed)
Parks
Electrical substation
287 kV transmission line
Power infrastructure symbols are schematic; locations are inexact.

Syncline, anticline, overturned anticline, overturned syncline
Normal fault, marks on downthrown side
2015 Klappan agreement area (see History box)

Scale
0 10 20 30
km

Reserve and resource estimates - Mount Klappan area

Reserve estimate for Lost-Fox (Arctos) area, 10% Ash
Proven 64.4 Mt Probable 4.8 Mt

Resource estimate (run of mine)
Measured & Indicated
192.8 Mt (including reserves)

Source: Fortune Minerals' NI 43-101 compliant report filed with SEDAR November 29 2012

Context

The Groundhog coalfield of northwestern British Columbia defines an ovoid (30 x 80 km) area extending southeastwards from the headwaters of the Klappan and Little Klappan rivers to Groundhog Mountain in the Skeena Ranges. Coal beds were deposited in the Bowser basin, which was filled with sediments derived from mountains eroded during the Late Jurassic and Early Cretaceous. At the northern end of the basin, peat accumulated in swamplands at the landward margins of ancient marine deltas. These peat deposits were then metamorphosed to form the coal-bearing sequences.

For further information

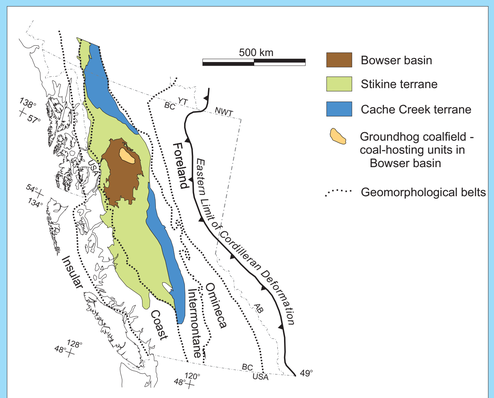
Visit the British Columbia Geological Survey website to access

COALFILE
Coal Titles
Coal Leases
MINFILE
Mineral Titles Online
British Columbia Geological Survey Publication Catalogue

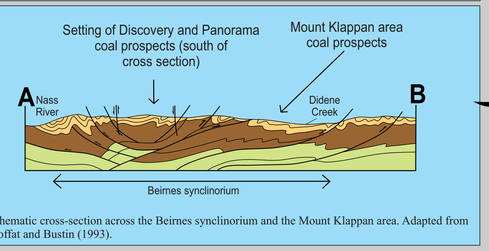
www.empr.gov.bc.ca/Mining/Geoscience/Coal/Pages/default

Tectonic setting and structure

Coal occurs in several units of the Bowser Lake Group, which consists of Jurassic and early Cretaceous marine and non-marine strata deposited in Bowser basin. Formed above a basement of Stikine terrane rocks, Bowser basin contains detritus derived from uplifted and eroded Cache Creek terrane, and records the amalgamation of Stikine and Cache Creek terranes.



The Groundhog coalfield and the Bowser basin within the geological framework of the Canadian Cordillera (modified from Evenchick et al., 2005)



Schematic cross-section across the Beirnes synclinorium and the Mount Klappan area. Adapted from Moffat and Bustin (1993).

The Groundhog coalfield is in the Skeena fold and thrust belt, where at least 150km of Cretaceous to earliest Tertiary shortening was accommodated by northwest-trending structures including the Beirnes synclinorium and closely spaced tight folds and thrust faults. Deformation is most intense in the less competent, coal-bearing sequences.

To make accurate resource and reserve estimates for coal deposits, Hughes et al. (1989) defined degrees of structural complexity, from low to severe. The deposits of the Groundhog coal field range from moderate to complex.

Resource estimate - Discovery & Panorama

Measured	Indicated	Inferred
16 Mt	553 Mt	998 Mt

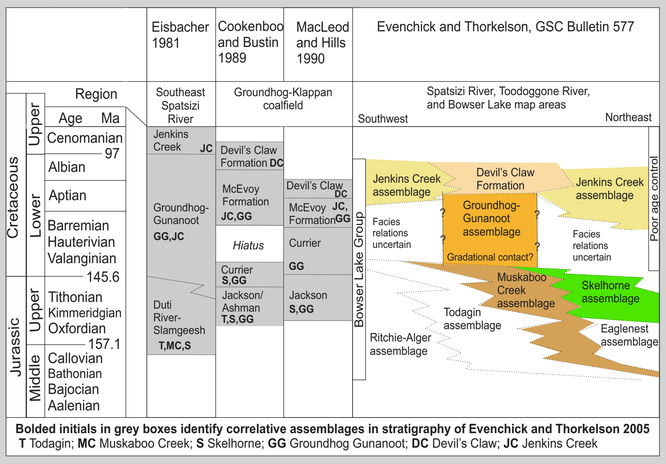
Source: Atrum Coal Annual Report 2014
Standard: JORC

Stratigraphy

Because of structural complexities and the lack of marker beds in cyclic successions with significant lateral facies changes, the stratigraphy of the Bowser Lake Group in the Groundhog coalfield has proven challenging for geologists to define, and different stratigraphic schemes have been proposed over decades of work (Eisbacher, 1981; Bustin and Moffat, 1983; MacLeod and Hills, 1990). Herein we adopt the scheme introduced by Evenchick and Thorkelson (2005) in which most units are defined as facies or facies assemblages rather than formal stratigraphic units.

The main coal-bearing unit is the Groundhog-Gunanoot assemblage (Evenchick and Thorkelson, 2005), which hosts the two best known deposits, near Mount Klappan, and in the "Discovery" area centred at the confluence of the Skeena River and Currier Creek. Coal also occurs in the Muskaboo Creek, Skelhorne, Jenkins Creek assemblages and the Devil's Claw Formation. On this compilation, only coal-bearing assemblages and formations are coloured. Most coal exploration reports prepared by industry geologists use stratigraphic divisions similar to that of MacLeod and Hills (1990), in which the Currier Formation is, by definition the main coal-bearing formation.

The coal-bearing sequences of the Groundhog coalfield are up to 1100 metres thick and include 33 identified coal horizons with true thicknesses of up to 11metres. These coal horizons are mainly interbedded with mudstone, siltstone and sandstone.



Bolded initials in grey boxes identify correlative assemblages in stratigraphy of Evenchick and Thorkelson 2005
T Todagin; **MC** Muskaboo Creek; **S** Skelhorne; **GG** Groundhog Gunanoot; **DC** Devil's Claw; **JC** Jenkins Creek

Bowser Lake Group stratigraphy in the Groundhog coalfield. Figure adapted from Evenchick and Thorkelson (2005).

Unit descriptions

Devil's Claw Formation
Fluvial conglomerate and sandstone; 30-80% pebble conglomerate in laterally continuous grey-weathering sheets. Thin coal seams, no significant deposits.

Jenkins Creek assemblage
Mudstone, siltstone, sandstone, rare conglomerate and coal. Hosts Sweeny and Nass Lake coal occurrences.

Groundhog-Gunanoot assemblage
Deltaic sandstone, siltstone, carbonaceous and calcareous mudstone, minor conglomerate, and coal. Plant fossils common, including in-situ trees. Hosts significant coal deposits in Mount Klappan, Discovery Creek, and Panorama North and Mount Jackson areas.

Skelhorne assemblage
Deltaic siltstone, sandstone, and conglomerate (with or without coal), bivalve coquina, local megaripples, and log fragments. Marine and non-marine. Hosts coal seams up to 9m thick in the Tzahny Ridge area.

Muskaboo Creek assemblage
Shelf sandstone, siltstone, and conglomerate. Hosts coal in the Panorama South area.

The coal

The Groundhog coalfield contains the only significant occurrences of anthracite in Canada. Anthracite is relatively rare, making up about 1% of coals globally. Of all coals, anthracite has the highest heat content per unit weight. The most significant market for anthracite is as PCI (pulverized coal injection) coal, which is used in making steel.

Raw coals from the Groundhog coalfield have generally moderate to high purity and are low in sulphur. Rank distribution is erratic due to the structural complexity of the coal-bearing sequences. Contours of rank values by Bustin and Moffat (1989) and Ryan and Dawson (1993) generally follow the northwest trends of the Skeena fold and thrust belt.

The best potential is in the Beirnes synclinorium, from Mount Klappan to the Discovery and Panorama areas, where the coal is purest and seams are up to 9m thick. West of the Beirnes synclinorium, near Maitland, Sweeny and Konigus creeks, seams are generally thinner and locally discontinuous, and contain shale. Although coal seams are up to 9m thick east of the Skeena River (at the Tzahny ridge, Prudential, and Operator areas) the mining potential is lower because of complex structures and impurities in the coal.

Anthracite at the Arctos (Lost-Fox) pit near Mount Klappan

History

Coal exploration in the Groundhog coalfield began in the late 1800s and continued until 1915. This work included trenching and cutting short drifts into thicker coal seams, and was concentrated around the 'Discovery' occurrences on the Skeena River and Discovery, Davis and Currier creeks (Buckham and Latour, 1950).

The Stewart-Cassiar Highway (Highway 37), completed in the1970s, provides access to Iskut, about 50 km northwest of the west end of the coalfield. In the 1970s, British Columbia Rail started to build a rail line connecting Fort St. James to Dease Lake and passing through the Groundhog coalfield along the Skeena and Little Klappan rivers. Tracks were never lain as far north as the coalfield, but the rail bed can be used in summer by off-road vehicles.

In the late 1970s companies such as Gulf Oil, Suncor, BP, BC Hydro, Quintana, Petrofina, Procan, and Imperial Metals explored the coalfield. The Klappan Mountain, Discovery and Panorama areas were explored extensively through the 1980s by Gulf and other companies. Dawson and Ryan (1992) examined mineral coal and the methane gas potential of the coalfield. No significant exploration programs were conducted from the early 1990s until the middle 2000s.

Shell Canada explored the Groundhog's coalbed methane potential from 2004 until 2012, when the company relinquished its tenure as part of an agreement between Shell, the British Columbia Government, and the Tahltan First Nation.

Fortune Minerals acquired coal tenure in the Mount Klappan area in 2002, and drilled and trenched the property. Atrum Coal acquired tenure in the Discovery area in 2012 and, by 2015, added the Panorama area and nearby occurrences. Exploration work from 2012 to 2016 included several thousand metres of drilling, trenching, seismic surveys, and bulk sampling. Resource estimates have been refined for both areas (see map).

In the early 2000s the Geological Survey of Canada and British Columbia Geological Survey mapped the Bowser basin and produced 1:50 000 scale geological maps for the entire Groundhog coalfield area. In 2004 the British Columbia Ministry of Energy and Mines established a coal reserve north of Panorama Creek to protect fossils sites identified during the project.

In 2015, the Province of British Columbia and Fortune Minerals announced an agreement in which the Province would acquire Fortune's tenure in the Mount Klappan area to facilitate work with the Tahltan Nation on a shared vision for the area. Fortune Minerals holds a 10 year option to repurchase the licenses at the original price. The agreement area is outlined in pink on the map.

BC Hydro expanded its power grid north from Terrace with construction of the 287 kilovolt Northwest Transmission Line and extensions in 2012-2014. Extensions provide power along Highway 37 to Iskut, with a substation at Tatogga Lake, bringing power to within 50 km of the west side of the Groundhog coalfield.

The 287 kilovolt Northwest Transmission Line (NTL)

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