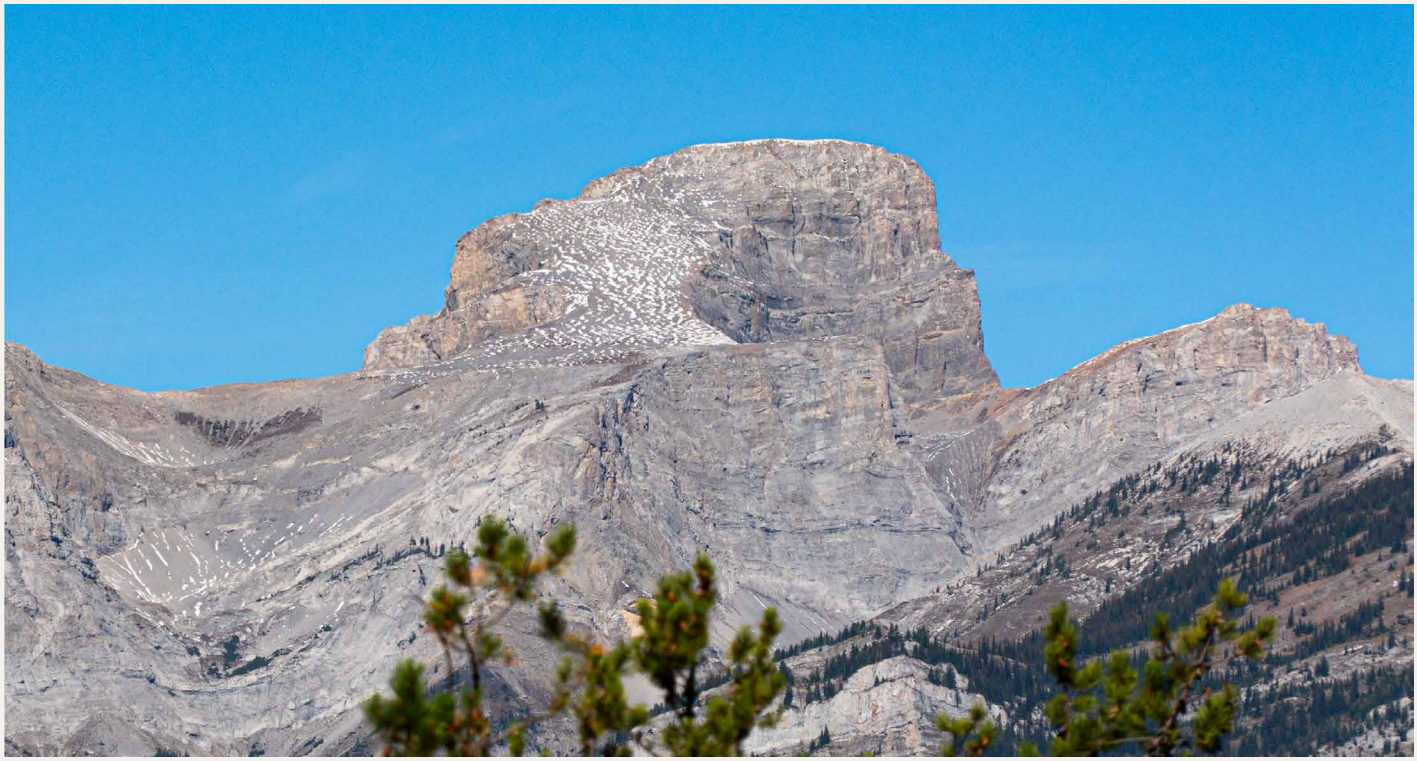
Fernie's Geology

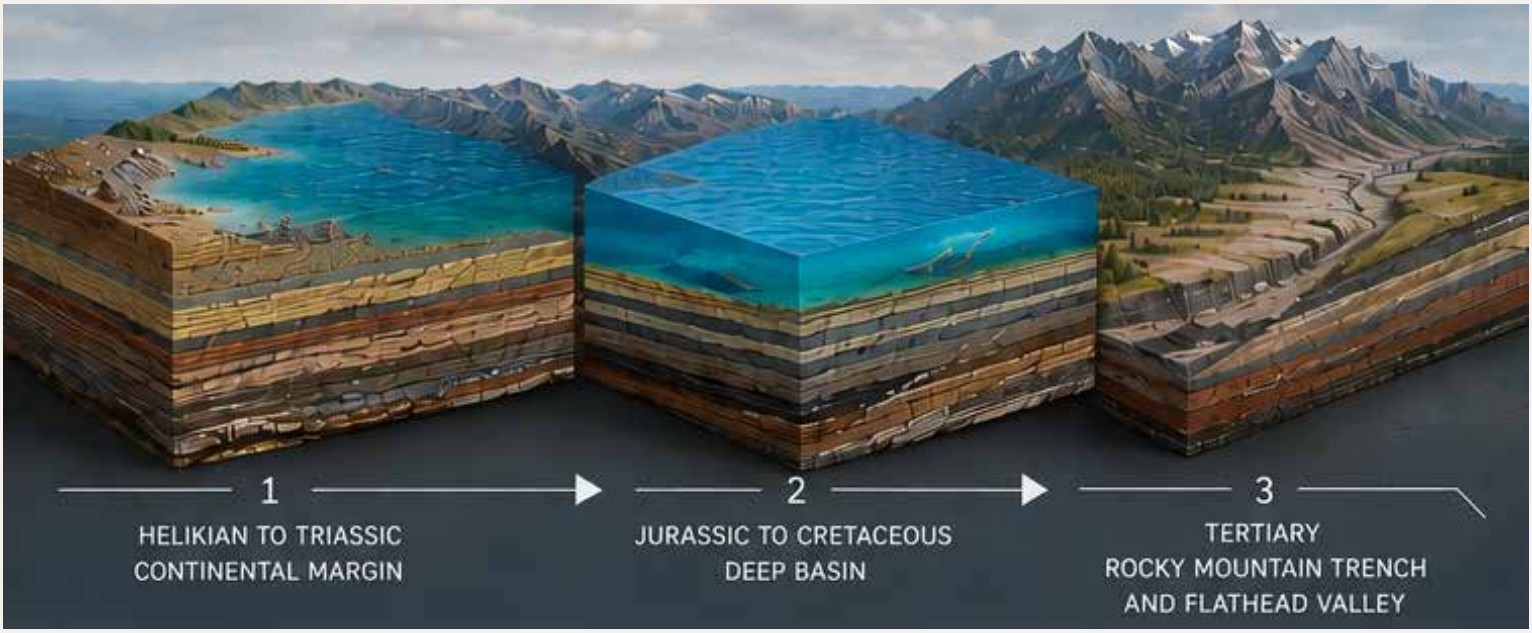


The Fernie Formation

The Fernie Formation records an ancient world that existed long before the Rocky Mountains. Much of the region was once covered by shallow seas where mud and sand slowly settled in layers. Over millions of years, these layers of mud and sand turned into rock. Later, as the Earth's crust was pushed upward to form the mountains, the rock layers were folded, tilted, and in some places even flipped upside down. Today, Fernie's landscape reveals this dramatic history, with ancient seafloor sediments now exposed high in the Rockies, preserving a unique geological story written over millions of years.

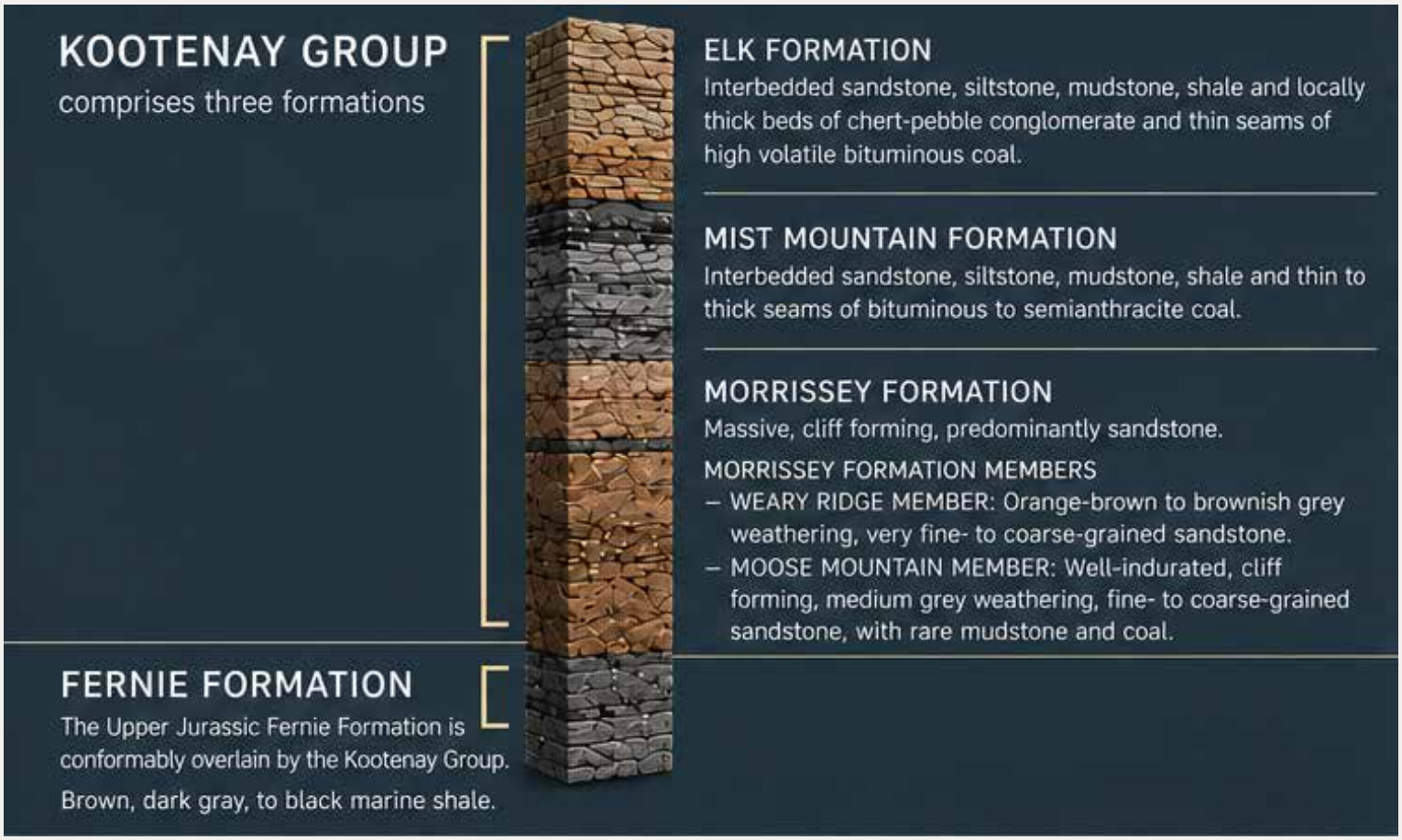
How the Rock Layers Formed

The rock layers around Fernie formed over hundreds of millions of years as oceans, rivers, and changing landscapes deposited mud, sand, and other sediments across the region. Over time, these layers were buried and slowly turned into rock.



Geologists divide this history into three main stages. First, ancient sediments built up along the edge of the continent from the Helikian to Triassic periods. Later, during the Jurassic and Cretaceous periods, sediments were carried eastward into a deep basin as mountains began rising to the west. Finally, younger sediments were deposited in valleys and lowlands during the Tertiary Period.

Together, these layers preserve a long geological history that records changing environments, ancient seas, and the forces that helped shape the Rocky Mountains.



The **Fernie Formation** represents deposition in a Jurassic marine environment and is made up primarily of dark shale, sandstone, and limestone laid down in a shallow inland sea.

Above it lies the **Kootenay Group**, a coal-bearing sequence that records a shift from marine to more coastal and swampy environments. It is divided into three formations:

1. **Morrissey Formation** – Dominated by massive, cliff-forming sandstone. It includes two members:
   Weary Ridge Member: orange-brown to brownish grey, very fine- to coarse-grained sandstone
   Moose Mountain Member: well-indurated, cliff-forming sandstone, fine- to coarse-grained, with rare mudstone and coal
2. **Mist Mountain Formation** – A mix of sandstone, siltstone, mudstone, shale, and thin to thick seams of bituminous to semianthracite coal, reflecting swampy, coal-forming environments
3. **Elk Formation** – Interbedded sandstone, siltstone, mudstone, and shale, with locally thick beds of chert-pebble conglomerate and thin seams of high volatile bituminous coal

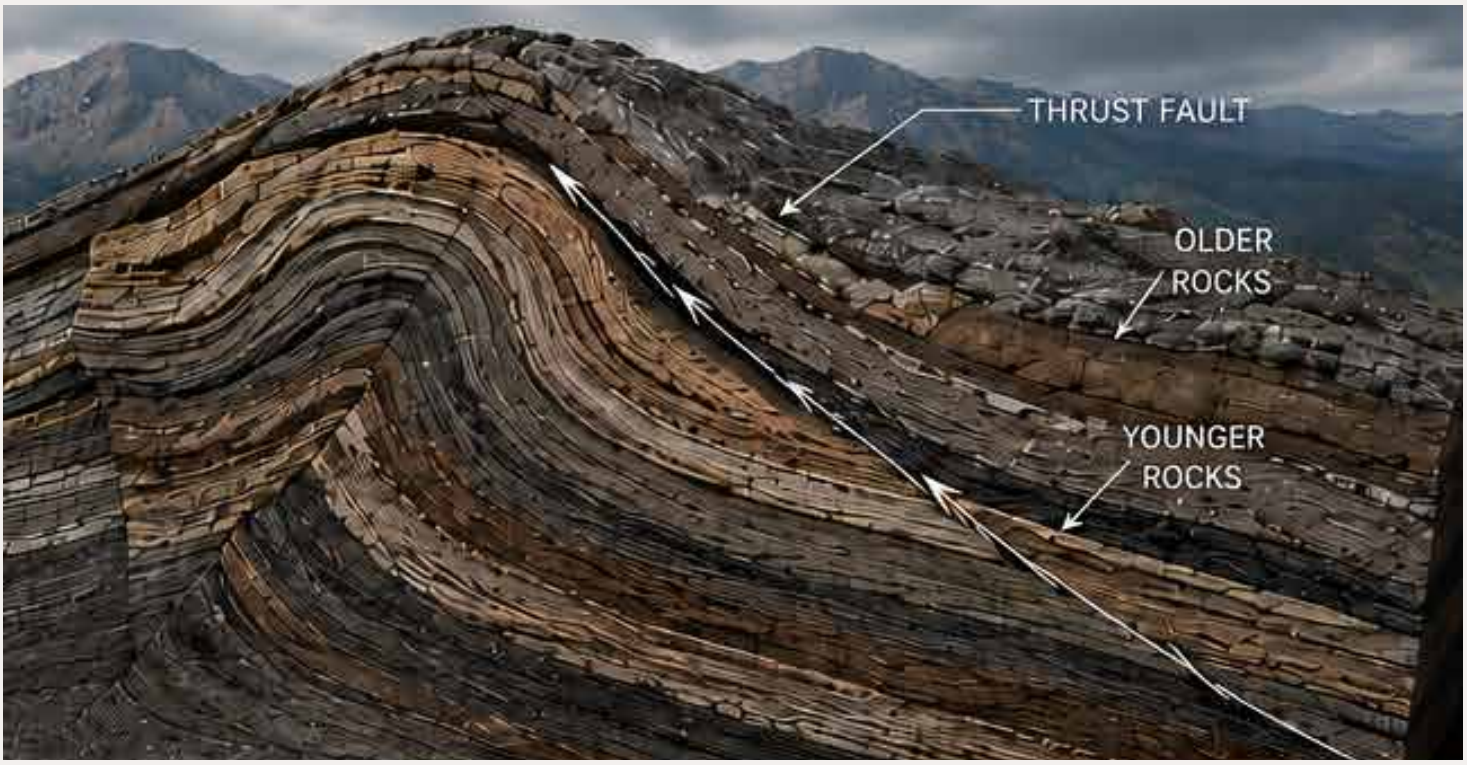
The Kootenay Group conformably overlies the Upper Jurassic Fernie Formation, marking a transition from marine conditions to coastal plains, river systems, and peat-forming wetlands.

Marine Shale

Marine shale is a fine-grained sedimentary rock formed from mud, clay, and organic material that settled in quiet, low-oxygen marine environments. In these settings, microscopic particles slowly drifted down through the water column, taking far longer to settle than coarser sands, which dropped out quickly in higher energy conditions. Over time, these fine sediments accumulated in thick layers on the seafloor and were gradually compacted into shale. Because most shales form in marine settings, they often preserve conditions where oxygen was limited and organic material could build up. Groundwater moving through these formations is frequently saline, reflecting their ancient seawater origins.

"Upside Down Mountains"

One unusual aspect of Fernie's geology is that some of the mountains appear "upside down," where older rocks sit above younger layers. This is the result of intense tectonic forces during the formation of the Rocky Mountains, when the Pacific Plate and related oceanic terranes collided with the western margin of North America.



Instead of simply pushing land upward, this collision created enormous compressional stress that caused the Earth's crust to shorten and crumple like a rug being pushed across a floor. As this happened, rock layers were not only folded but also broken along major thrust faults. In some cases, huge slabs of older sedimentary rock were detached from their original position and pushed eastward over younger formations.

In the Fernie region, this process is especially visible within the Rocky Mountain Foothills, where ancient marine sediments and older strata were shoved over relatively younger rocks, effectively reversing the normal geological order. The result is a landscape where the sequence of time is not always straightforward, and "older on top of younger" becomes a key clue to understanding the immense tectonic forces that built the mountains.

Ancient Seas and Fossils

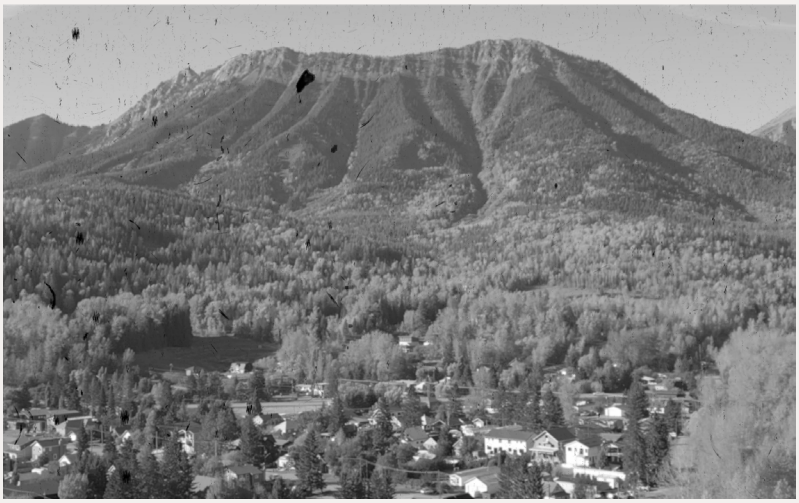
Long before the Rocky Mountains existed, the Fernie region lay beneath a vast warm inland sea that stretched across much of western North America. During the Jurassic Period, between roughly 200 and 145 million years ago, this subtropical sea covered areas from present day Montana and the Prairies north into British Columbia. Fine mud, sand, and marine sediments slowly settled to the seafloor, eventually forming the rocks of the Fernie Formation.

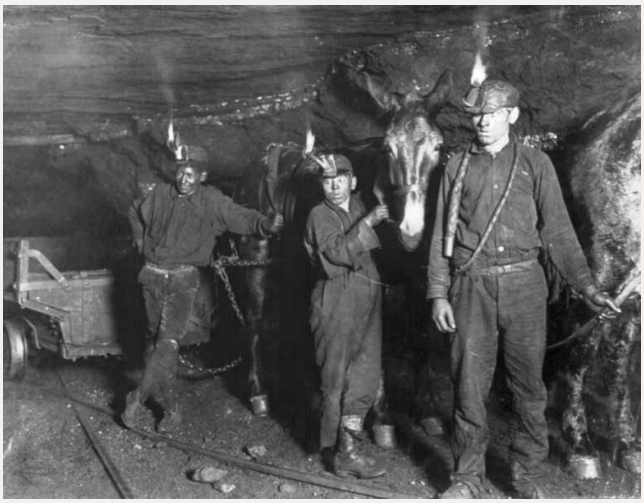
This ancient sea was filled with life. Large marine reptiles called ichthyosaurs swam through the waters hunting fish and squid, while ammonites drifted through the ocean in spiral shells. Fossils preserved in the Fernie Formation provide a remarkable glimpse into these ancient ecosystems and help scientists understand what life was like millions of years before humans existed.

Coal, Mountains, and Mining

Fernie's geology shaped not only the landscape, but also the history and growth of the region. The same ancient environments that formed the Fernie Formation and the overlying Kootenay Group also created the rich coal deposits that would later support mining communities throughout the Elk Valley.

Millions of years ago, dense vegetation built up in coastal swamps and wetlands along ancient shorelines. Over time, layers of sediment buried this plant material, while heat and pressure transformed it into coal. Many of these coal seams are found within the Mist Mountain Formation of the Kootenay Group, which sits above the Fernie Formation.

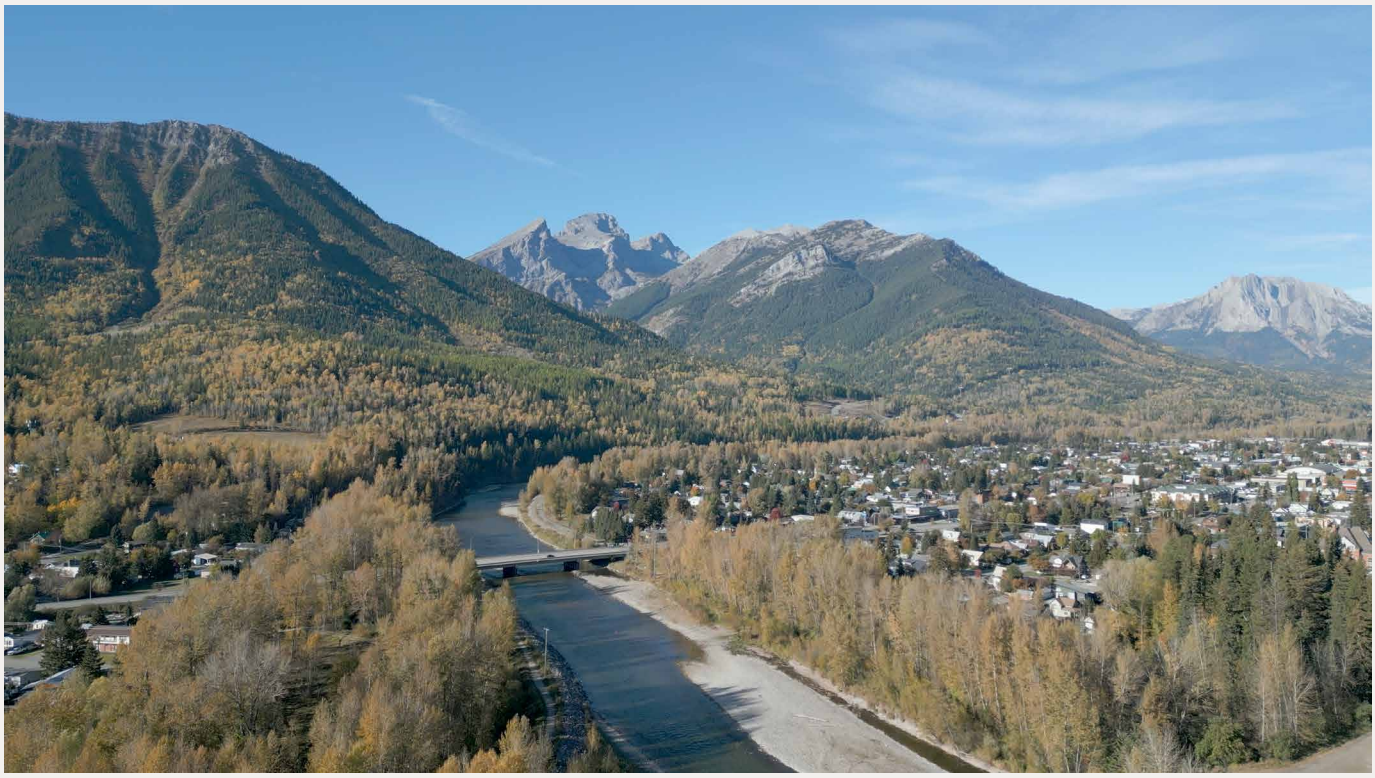




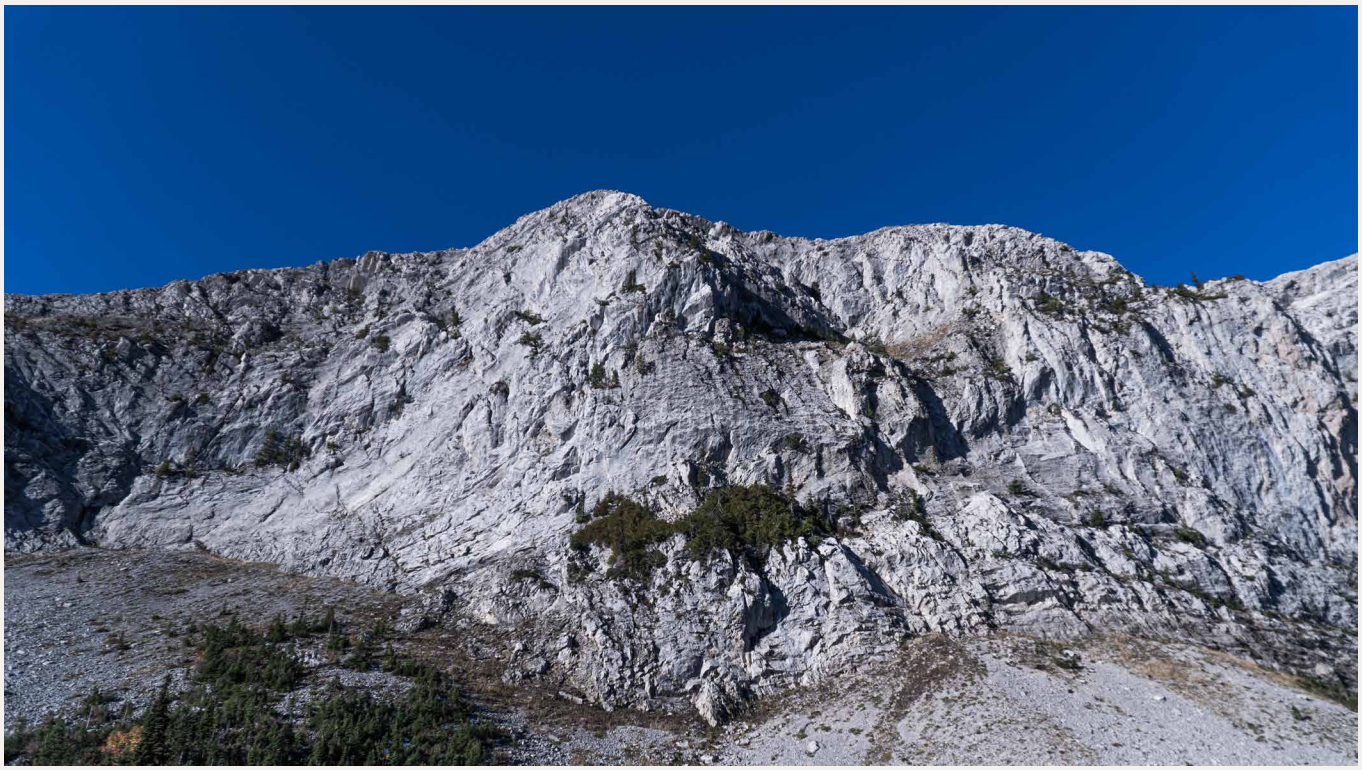
Mining these deposits was exceptionally difficult because the rock layers had been intensely folded and faulted during the formation of the Rocky Mountains. Coal seams were often tilted, fractured, or pinched off entirely, creating dangerous underground conditions.

These coal deposits helped drive industrial development in the late 1800s. William Fernie and Colonel James Baker helped establish mining and railway infrastructure that transformed Fernie into an important coal mining community. People from around the world, including many from Cape Breton, moved to the Elk Valley seeking opportunities created by the mines.

Today, large open pit coal mines continue to operate elsewhere in the valley, reflecting the lasting influence geology has had on Fernie's landscape, economy, and history.



Today, the mountains, coal seams, and fossils of Fernie stand as lasting evidence of a landscape built over hundreds of millions of years, shaped by ancient seas, powerful tectonic forces, and continuous geological change.



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