GeoNanaimo is a self-guided tour

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Jack Point / Biggs Park

Jack Point / Biggs Park provides the visitor with an opportunity to observe significant sedimentary features, in particular the sandstones and mudstones common to Nanaimo, as well as offering opportunities to identify typical geological features found in these formations along the coastline, such as bedding and concretions.

What makes the rocks exposed here so unique is that they are also displaying fantastic erosion features that can only occur along ocean, or coastal environments.

Here in this park, you may notice layers in the rock, or differences in colors, that appear parallel to one another. Most of these features are related to bedding.

Bedding

By looking at a sequence of sedimentary rock, with obvious bedding, generally the bottom layers are the oldest, with the youngest exposed on top. By looking at each layer, one can determine the environment in which it was deposited and sometimes where the material came from. Here at Jack Point / Biggs Park, you can see that the layers aren’t even, some layers stick out further, and others are carved inward. These are the mudstone/sandstone layers you are seeing from the Cedar District Fm. The mudstone is softer, so it erodes easier than the sandstone; therefore the dark colored mudstone layers have eroded away quicker than the lighter colored resistant sandstone of the De Courcy Formation.

These features can be found at anytime, anywhere along the shoreline, especially at low tide. Wave-cut platforms occur when storm waves and high tides erode away the bottom part of the rock exposure, leaving more resistant layers intact as an at sea level platform. Caves can also form by the same process.

Concretions

Concretions are small or large round sandstone “shapes” found in a much larger exposure of sandstone. They are formed when in a mineral cement fills the porosity (i.e. the spaces between the sediment grains) of the sandstone. Concretions are often oval or spherical in shape, although irregular shapes also occur. These formations may contain fossils inside.

Why These Parks?

The following parks represent some unique geological features in Nanaimo.

**Piper’s Lagoon Park**
Active Landscapes and forming the Geology of the Future

**Sugarloaf Mountain Park**
The impact of Glaciations and Differential Erosion on the Landscape

**Jack Point / Biggs Park**
The story of Estuaries, Faults and the Power of Erosion

**Bowen Park**
Basic fluvial processes, including the formation of cross beds and an ancient meandering river.

GeoNanaimo is a self-guided tour

A TOUR THROUGH NANAIMO’S GEOLOGY

GeoNanaimo sits on top of two main types of rock:
- Karmutsen Formation Basalt (Volcanic Rock)
- Nanaimo Group (Sedimentary Rock)
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Bowen Park

In Bowen Park, the Millstone River, exists as a remnant of the retreat of the last glacier that covered this area. Glaciers that covered this area 30,000 yrs ago retreated 14,000 yrs ago, leaving behind valleys and subsequently rivers, from melting glacier ice. Bowen Park is made up of sedimentary rocks of the Nanaimo Group. In this case the Extension Formation comes into contact with the Pender Formation.

The sedimentary rocks here reflect the depositional environments they were formed in, which can be determined by looking at these two formations in detail. Remember though, that the Nanaimo Group is Cretaceous in age (90-65 million years old), and were deposited long before this river began to run through these formations.

Cross bedding is evident in the area of flat rock just below the falls. Cross beds are beds at an angle to the main bedding.

They form in sediments that are deposited in flowing water and they are useful for telling us the flow direction (in this case, towards the north west). These cross beds formed in a river that was much bigger than this one here - one that was apparently flowing in the opposite direction!

Why These Parks?
The following parks represent some unique geological features in Nanaimo.

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**GeoNanaimo**

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### Sugarloaf Mountain Park

When looking south from Sugarloaf towards Departure Bay you can see the boundary between the Karmutsen Formation basalt and the much younger sedimentary rocks of the Nanaimo Group. Departure Bay and the adjacent lowland parts of Nanaimo, plus Newcastle Island, are all underlain by soft sedimentary rocks, while Sugarloaf and the hills towards the north are underlain by the much harder basalt. The glaciers easily eroded the sedimentary rocks into bays and valleys, leaving the basaltic rocks of Vancouver Island as hills and mountains. Mt. Benson, for example, is entirely made up of basalt.

**Basalt vs. Sedimentary Rock**

Basalt rock has a crystalline structure. This means that individual crystals within the rock are tightly and strongly interlocked. No empty spaces exist, therefore it is harder to erode.

Sedimentary rock has a "Clastic" structure. Clastic rock is made up of fragments, or clasts, of pre-existing rock. This means that tiny fragments of rock are held together by a cementing process. Empty spaces within the rock exist, making it easier to erode.

### Why These Parks?

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- **Bowen Park**
  - Basic fluvial processes, including the formation of cross beds and an ancient meandering river.

**Glaciation**

Several times over the past two million years large areas of northern North America and Europe were covered with glacial ice. The most recent glaciation started about 100,000 years ago and ended about 14,000 years ago. At the peak of the last glaciation, around 25,000 years ago, as much as 2000 m of ice covered most of Vancouver Island. Only the highest mountains—such as Mt. Arrowsmith—extended above the ice.

The weight of all that ice depressed the crust, and when glaciers started to melt in other parts of the world sea level reached higher than it does today. This higher sea level means that Nanaimo was once an "island". The eventual retreat of ice from Vancouver Island, approximately 12,000 years ago, caused sea levels to then drop over time. In some parts of Vancouver Island 12,000 year-old marine fossils can be found as high as 200 m above present sea-level. One such location is close to the Nanaimo Hospital. 

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**FIGURE 2**

**College Heights to Gabriola Island Cross Section**

<table>
<thead>
<tr>
<th></th>
<th>Vancouver Island University</th>
<th>Downtown</th>
<th>Nanaimo E. Estuary</th>
<th>Duke Point</th>
<th>Descanso Bay</th>
<th>Gabriola Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation (m)</td>
<td>(0)</td>
<td>-100</td>
<td>-50</td>
<td>0</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Distance (m)</td>
<td>0</td>
<td>200</td>
<td>400</td>
<td>600</td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>Trace</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glacial maximum: 17,000 years ago</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**The big retreat: 14,000 years ago**

Glaciers retreated from Vancouver Island, approximately 12,000 years ago, causing sea levels to then drop over time. In some parts of Vancouver Island 12,000 year-old marine fossils can be found as high as 200 m above present sea-level. One such location is close to the Nanaimo Hospital.
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**Pipers Lagoon Park**

**Why These Parks?**

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  - The story of Estuaries, Faults and the Power of Erosion

- **Bowen Park**
  - Basic fluvial processes, including the formation of cross beds and an ancient meandering river.

A sandy and pebbly spit extends from the western end of the main rocky “island” (C). In fact Pipers Lagoon has been almost closed off by spits and either side.

As Ocean tides advance, water is forced through the narrow channel and into the lagoon. The waters travel through a series of smaller channels out towards the outer edges of the lagoon and towards the entrance of the park. As tides retreat, the waters travel back out along the same channels, thus creating a delta-type situation, as it acts like a river emptying into the ocean.

Also located at this park, are excellent examples of Pillow Basalts. The Karmutsun Formation basalt was formed when lava extruded on the ocean floor. As a blob of lava extruded out of an underwater volcano, it cooled quickly, creating a hard glass shell surrounding a hot magma interior, which cooled more slowly.

**Geomorphology**

Geomorphology is the study of landforms, their evolution and origin, and the processes that shape them. This area provides excellent examples of geomorphology that is actively occurring today.

Piper’s Lagoon has the following landforms: Tombolos, Delta/Channel, Lagoon, Spits, Bays and Beaches. The volcanic rocks of the area also have pillows.

The backside of these Islands, or sides facing away from the predominant wave directions, are experiencing a buildup of sediment, or aggradation. Erosion occurs on the sides facing the predominant wave directions, in the form of wave action, or Mechanical Erosion.

When wave refraction began depositing sediment eroded from areas south of the Park, it began to create a “bridge”, or narrow strip of land that runs in a Northemly direction. It has formed between an island of Basalt in the ocean and the mainland, where the original headland existed. This landform is referred to as a Tombolo.

The main Tombolo, now cuts off a part of the ocean, and two new beaches are formed, one on each side.

The eastern beach faces Georgia Strait, and is in open waters. It is a clastic sand beach, meaning it is made up of sediment, or clasts, of sand and pebbles. This material is made up of Basalt with some Quartz clasts. The majority of Basalt in this beach is eroded from the surrounding bedrock. What is interesting about this beach is that as you travel North along the beach, on the East side of the Tombolo, the particles get finer.

The currents work these sediments, and sort them into coarse sands and eventually into the fine sands located at the far North end. This occurs due to a process called Longshore Drift.