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Geology of Spitsbergen

When you step foot on Spitsbergen it is worth remembering that you are not the only traveller here and in fact, compared to another Arctic 'journey', yours really is only a short trip . . . for Svalbard itself is perhaps the greatest (and oldest) of the Arctic travellers, making an incomprehensible journey from *below* the Equator, which started over 400 million years ago. With swamp ferns preserved within the fossil records next to strange creatures from tropical seas and the footprints of predatory dinosaurs set into the once-soft rock, tell-tale signs of Svalbard's great journey are scattered across the archipelago. With its countless types of rock strata and formations evident across the land, Svalbard is a rich tapestry of geological wonder.

Starting over 440 million years ago, follow the journey of the Svalbard archipelago through the eons; from its tropical beginning to the end of the recent ice-age – right into the modern day.

The Basement

The large-scale features of the Svalbard geology are relatively simple. The Basement i.e. the oldest formations, which include Ordovician, Cambrian and Precambrian rocks, occur along the western coast of Spitsbergen, where examples of Precambrian bedrock has been aged as being more than 570 million years old, and even rock dating back as far as 1,700 million years has been found, where the last remnants of mountains eroded long ago still remain. Much of the Precambrian rock, which was once deep within the Earths' crust is crystalised, due to the processes of metamorphosis. The oldest rock on Svalbard however is to be found on the north-western coast, where zircon deposits have been aged as being over 3,200 million years old.

The Silurian: the journey begins

As Svalbard sat on the Equator, two continental plates collided in what is currently the North Atlantic region, causing large-scale folding and faulting, some of which can still be seen in some of the oldest rocks on Svalbard, high up in the mountains.

The Devonian: 'Out of Africa'

Northern Svalbard began sinking and rivers caused the erosion of mountains, with immense quantities of sandstone and shale being deposited elsewhere around the archipelago. Strata from the Devonian period is often comprised of red sandstone, implying a very dry, desert-like environment. During this period, Svalbard sat just above the Equator.

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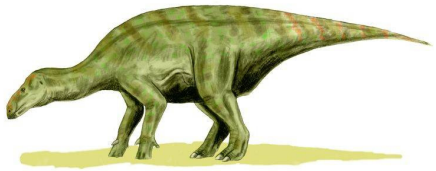
The Carboniferous: life in the swamps

Moving from a dry, hot climate (with a flat terrain dotted with lakes) to an era characterized by a wetter, more tropical climate, the Carboniferous period saw great changes in Svalbard. The swamps on Svalbard during the Carboniferous were rich in amphibians, insects and other invertebrates. During the latter period within the Carboniferous, Svalbard was subject to alternating events of deposition, where evaporation caused the deposition of dolomite and gypsum.

The Permian: warm waters

The Permian beds on Svalbard consist of shallow marine deposits in areas that experienced frequent drying periods, where intense evaporation created strata such as dolomite and gypsum. Fossils from this period include bivalves and sponges.

The Mesozoic: dawn of the dinosaurs



During the Mesozoic (spanning the Triassic, Jurassic and Cretaceous eras), Svalbard drifted from about 45°N (the mid-Atlantic, today) to about 65°N (between Iceland and Norway, today). This period in the geologic calendar was considerably warmer across the world and sea levels were much higher than they are at present. During this period, Svalbard had a humid and temperate environment. Fossils from the Triassic found on Svalbard are mainly marine invertebrates, such as bivalves and ammonites, although marine reptiles from this period are found infrequently. Fossils from the Jurassic and early Cretaceous include belemnites, as well as the abundant bivalves and ammonites. Large marine reptilian predators such as plesiosaurs and ichthyosaurs are also found from this era, often perfectly preserved in the rock. Fossils from the Cretaceous are preserved most-often within sandstone and fossilized footprints of the well-known iguanodon, a 13 m long herbivore, have been found along the south-western coast. Predatory allosaurs were also found across Svalbard and their fossilized prints have also been discovered. Towards the end of the Cretaceous, Svalbard experienced a major tectonic uplift, which caused erosion and a subsequent disruption within the geological record.

The Tertiary: the 'Crunch'

At some point between the Cretaceous and Tertiary periods, Svalbard collided with Greenland, causing the western coastal strata to 'fold' up, giving rise to its 'dramatic' mountainous scenery and the formation of a basin (where sedimentation occurred) in the East. The geology of central-southern Spitsbergen is characterized largely by the Central Tertiary Basin. Within the basin, Lower Tertiary deposits consist mainly of sandstone, along with numerous coal seams, formed by the decay of thick, tropical vegetation. Towards the end of the Tertiary period, the tectonic plate pressure lessened and Svalbard experienced intense subsequent faulting and volcanism. The climate of Svalbard became much cooler due to both its slow, northern drift and because of global cooling in general.

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The Quaternary: glacial environments

By the end of the Tertiary period, Svalbard had largely-reached its current dimensions. The dramatic Svalbard landscape, characterized by bays, fjords, mountains and valleys is predominantly due to repeated glaciations throughout the Quarternary and sediment from this time is poorly preserved, due to the removal by successive glaciations. During the last glacial ice age (from 115,000 – 10,000 years ago), the Svalbard archipelago experienced 2 – 3 major glaciations events i.e. a major ice sheet in the Barents Sea joined up with a smaller ice sheet over Svalbard. During their peak, glaciers extended in fjords and troughs out to the shelf break west of Spitsbergen. The last major glaciation on Svalbard ended with rapid melting during a period around 14,000 – 10,000 years ago. During the Late Quaternary (the Holocene), the glaciers on Svalbard were probably smaller than their current size, due to this being a milder period. Many of the valley glaciers probably did not exist earlier than 2,500 years BP.

Geologic eras		Million years BP	Rocks from this era
Quaternary		2	**BASALT VOLCANOES**
Tertiary	MESOZOIC	65	**BASALT & COAL**
Cretaceous	MESOZOIC	145	
Jurassic	MESOZOIC	210	**DOLERITE & BASALT**
Triassic	MESOZOIC	245	
Permian		290	**COAL**
Carboniferous		350	
Devonian		410	
Silurian		440	
Ordovician	BASEMENT	510	**GRANITE**
Cambrian	BASEMENT	570	**GABBRO**
Upper Proterozoic	BASEMENT	1000	
Middle & Lower Proterozoic	BASEMENT	2500	**GRANITE**
Archean	BASEMENT		

Simple stratigraphical column for Svalbard

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