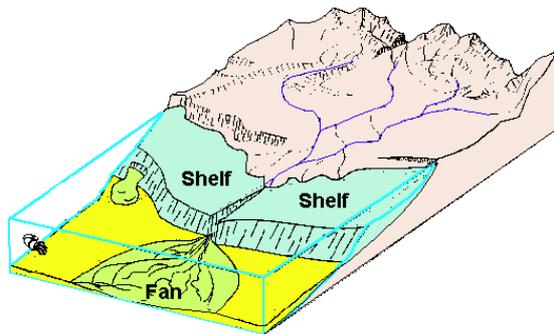
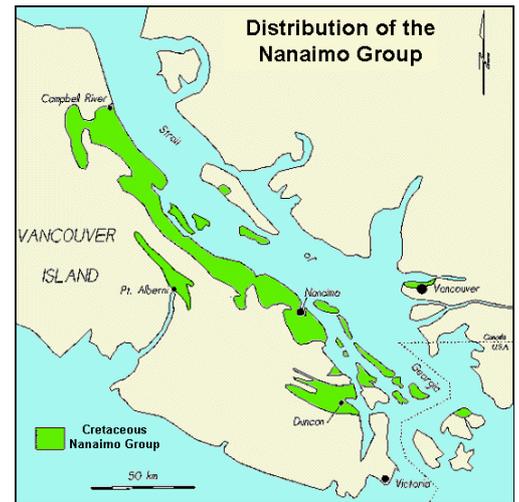


The Nanaimo Group

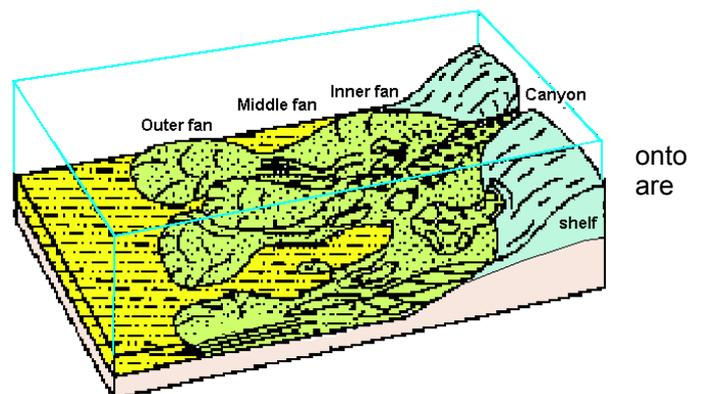
During the latter part of the Cretaceous Period (from around 85 to 65 million years ago), clastic sediments were deposited in a long trough-shaped basin extending from south of Duncan to north of Campbell River. Deposition probably began just after the micro-continent of Wrangellia - which comprises much of Vancouver Island and some other areas - was accreted onto the edge of North America. The continent-continent collision would have created significant uplift and mountain building, and hence over the period of formation of the Nanaimo Group there would have been rapid erosion and high sediment production in this area. The deposits were derived largely from volcanic, intrusive and metamorphic rocks of the mainland, with some minor contribution from Vancouver Island rocks. The Nanaimo Group includes conglomerate, sandstone and mudstone with important coal beds in some areas¹.

Up until a few years ago it was generally believed that the coarse clastic rocks of the Nanaimo Group (ie. the conglomerate and coarse sandstone) were exclusively the product of deposition by rivers - in continental environments - and that many of the sandy deposits were either fluvial or deltaic in origin. Changes in thinking about similar deposits in other parts of the world, and a better understanding of fossils from the Nanaimo Group, have led to a change in the interpretation of the depositional environment of the Nanaimo Group. It is now believed that most of the Nanaimo Group sediments were deposited in a marine environment, largely as submarine fan deposits.



Sediments of varying grain sizes, which are transported to the ocean in rivers and streams, build up in shelf deposits with extensive nearly flat surfaces, and steep fronts. Periodically the fronts of these shelves collapse, sometimes in response to earthquakes, but also as a result of flooding events. The resulting deposits on the deeper ocean floor are known as sub-marine fan deposits.

The sub-marine fans reach out to varying degrees the abyssal plain. The proximal deposits (inner fan) generally much coarser grained than the distal deposits (outer fan).



¹ Much of the material presented here, and some of the drawings, are from a Geological Survey of Canada publication: (Mustard, P., (1994) The Upper Cretaceous Nanaimo Group, Georgia Basin, British Columbia, in **Geology and geological hazards of the Vancouver Region, southwestern British Columbia**, J. Monger (ed), *Geological Survey of Canada*, Bulletin 481, p. 27-96.), and also from a 1998 field-trip guide to the Nanaimo Group rocks of Pender Island, also by Peter Mustard.

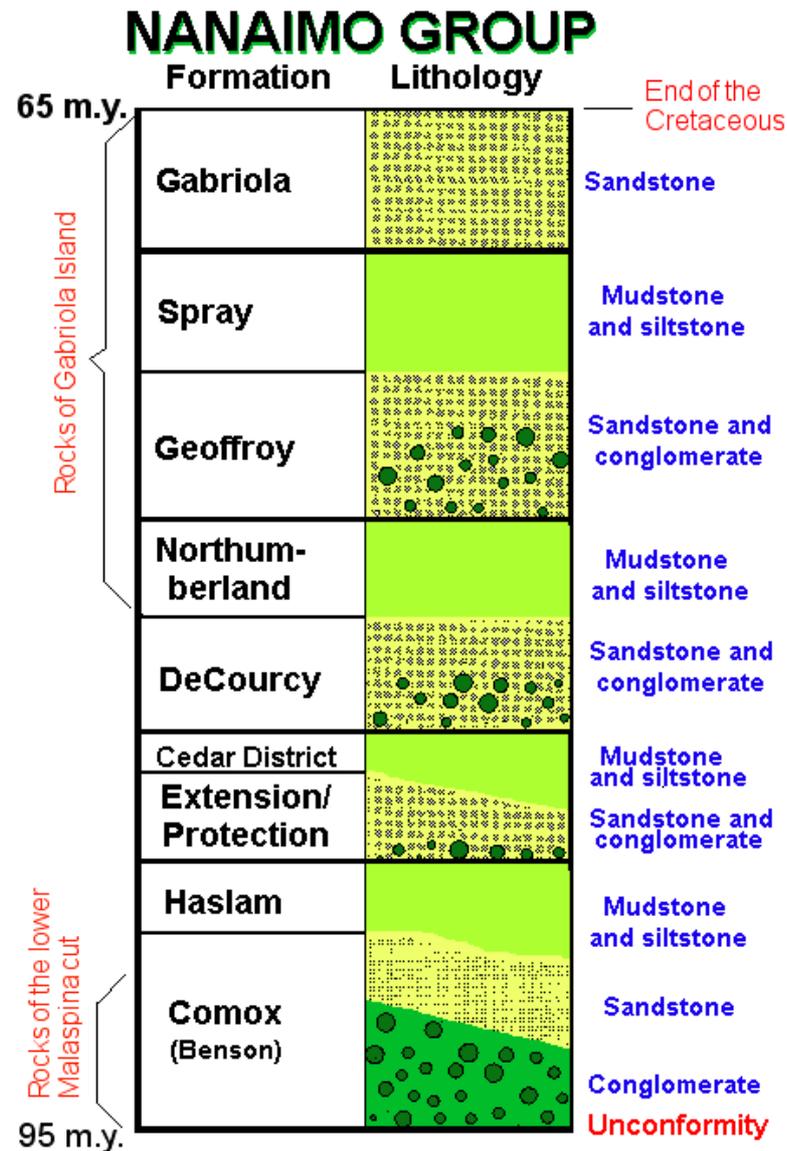
The Nanaimo Group has a total thickness of close to 5000 m. It includes a series of alternating layers of conglomerate, sandstone, siltstone and mudstone.

A likely explanation for the varied nature of Nanaimo Group sedimentation is that there were quite significant variations in the rate of coarse sediment input into the basin. During times when uplift, erosion and sedimentation rates were low, there would have been very slow accumulation of mudstone in the deeper parts of the basin, with coarse material being deposited only near to shore. Following periods of rapid uplift, the sedimentation rates would have been high, high volumes of coarse sediments would have been input, and with the periodic collapse of fan deposits these materials would have been

deposited well out into the basin. In this scenario the fine-grained parts of the Nanaimo Group would have been deposited during periods of slow erosion and deposition, while the coarse-grained parts would have been deposited during periods of rapid erosion and deposition.

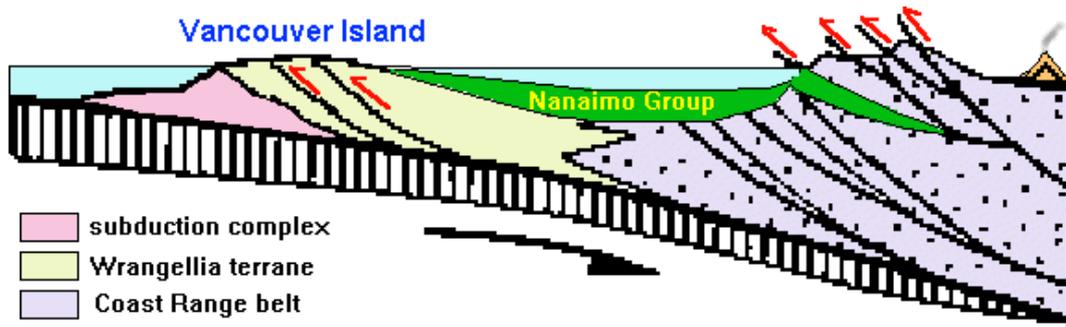
The Nanaimo Group coal deposits, which are largely restricted to the Nanaimo, Courtenay and Campbell River areas, were not deposited in a marine environment. Instead, it is believed that the organic matter which makes up the coal accumulated in near-shore swamps - areas characterized by very rich growth in a tropical environment². For coal beds to be preserved it is essential that the swamp deposits be buried relatively quickly so that the organic matter does not become oxidized. This commonly takes place under conditions of ongoing subsidence (like that in the Nanaimo Basin during the Cretaceous), which results in near-shore swamp areas being periodically inundated and covered with clastic sediments.

During the period in which the Nanaimo Group sediments were deposited (from 90 to 65 m.y. ago),



there was continuing subduction of oceanic crust beneath Vancouver Island. As shown below, the area which is now Vancouver Island was probably more topographically subdued than it is now, and hence most of the sedimentation into the basin was derived from the mainland.

² For an impressive view of what type of vegetation existed in this area during the Cretaceous, take a peak inside the tarp covered structure outside the back door of Building 370. These are fossilized palm leaves which were uncovered during construction of the Duke Point highway.



During much of the past 65 m.y. both the subduction and the westward thrusting continued. One of the products of this thrusting is that slices of Nanaimo Group rocks have been pushed westward and upward, nearly as far as the central part of Vancouver Island (see below). The rocks of the Wrangellia Terrane (part of the Insular SuperTerrane) have also been pushed up during this time, creating the mountains of Vancouver Island. The Tertiary rocks shown in orange are more recent sediments deposited on top of the Nanaimo Group.

