T2.5 THE NOVA SCOTIAN DESERT

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By the close of the Carboniferous Period, 280 million years ago, the shoreline of the inland sea had withdrawn to the east, and almost the entire surface area of Nova Scotia was above sea level. Only a small portion of Cape Breton remained under marine influence. This marine regression marked the beginning of the last continental phase of the province's geological history. Since that time, portions of Nova Scotia and the other Maritime provinces have been exposed to continuing subaerial erosion, with the products of this erosion being deposited into several large depressions.

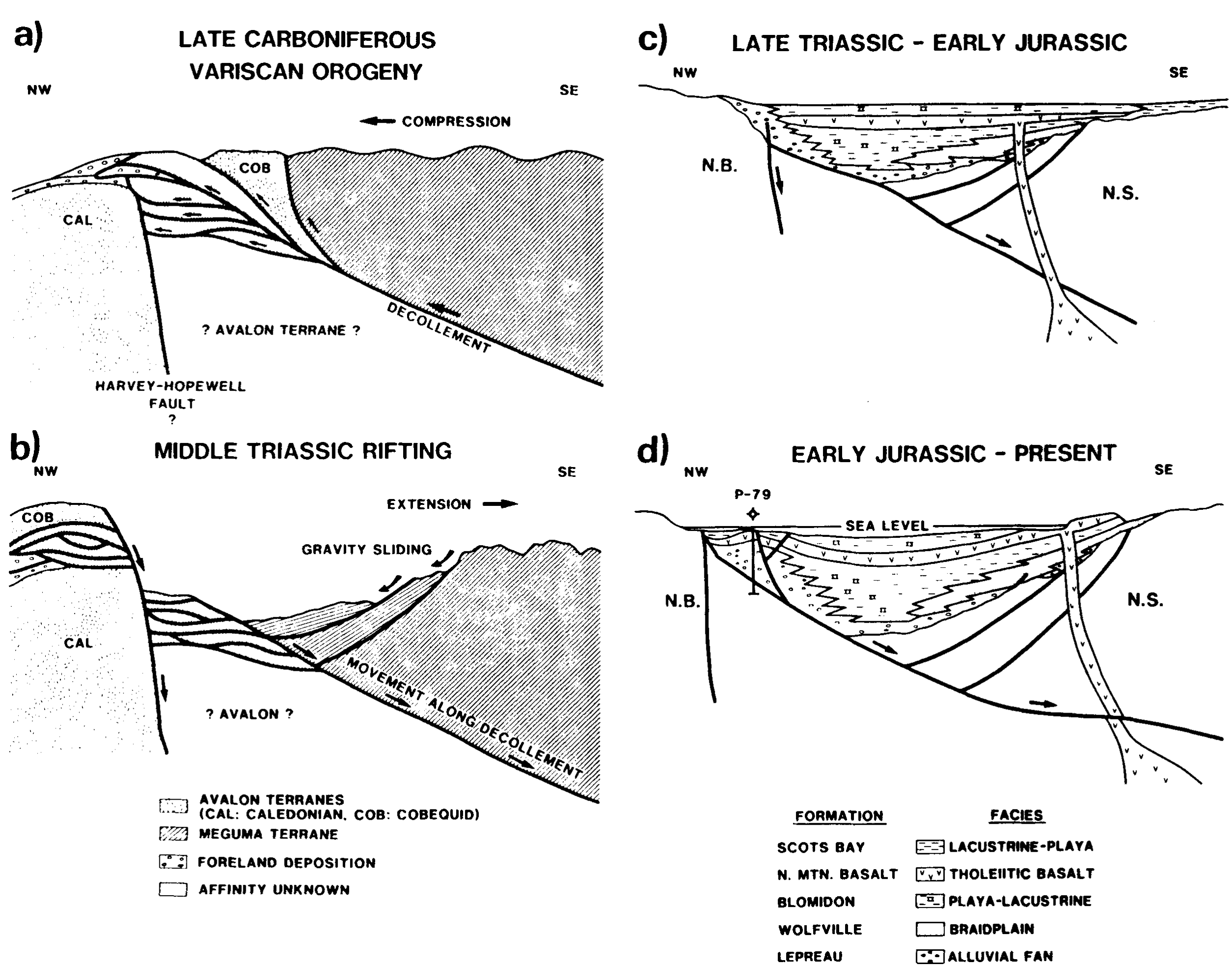

Figure T2.5.1: A cross-sectional profile across the Bay of Fundy, illustrating the interpreted structural and stratigraphic evolution of the Fundy Rift Basin. (a) Compressive collision of the Meguma terrane with Avalon terranes in southern New Brunswick, with the former being thrust over the latter along the inclined portion of the Minas Geofracture (décollement). (b) Reversal of motion on the décollement caused by extension, as the Meguma terrane moves down the fault plane in response to continental rifting further to the east, thus forming a deep depression. (c) The Triassic-Jurassic sedimentary section at about the end of the Early Jurassic. The position of the feeder dyke for the North Mountain Formation basalts is speculative. (d) The present-day profile of the Fundy Basin, with the strata having been deformed by faulting, probably during the Late Jurassic. The Cape Spencer P-79 exploration well was drilled on a large geologic structure in 1983, but did not encounter any hydrocarbons.[2] Figure T2.6.1 indicates the location of the profile line shown here.

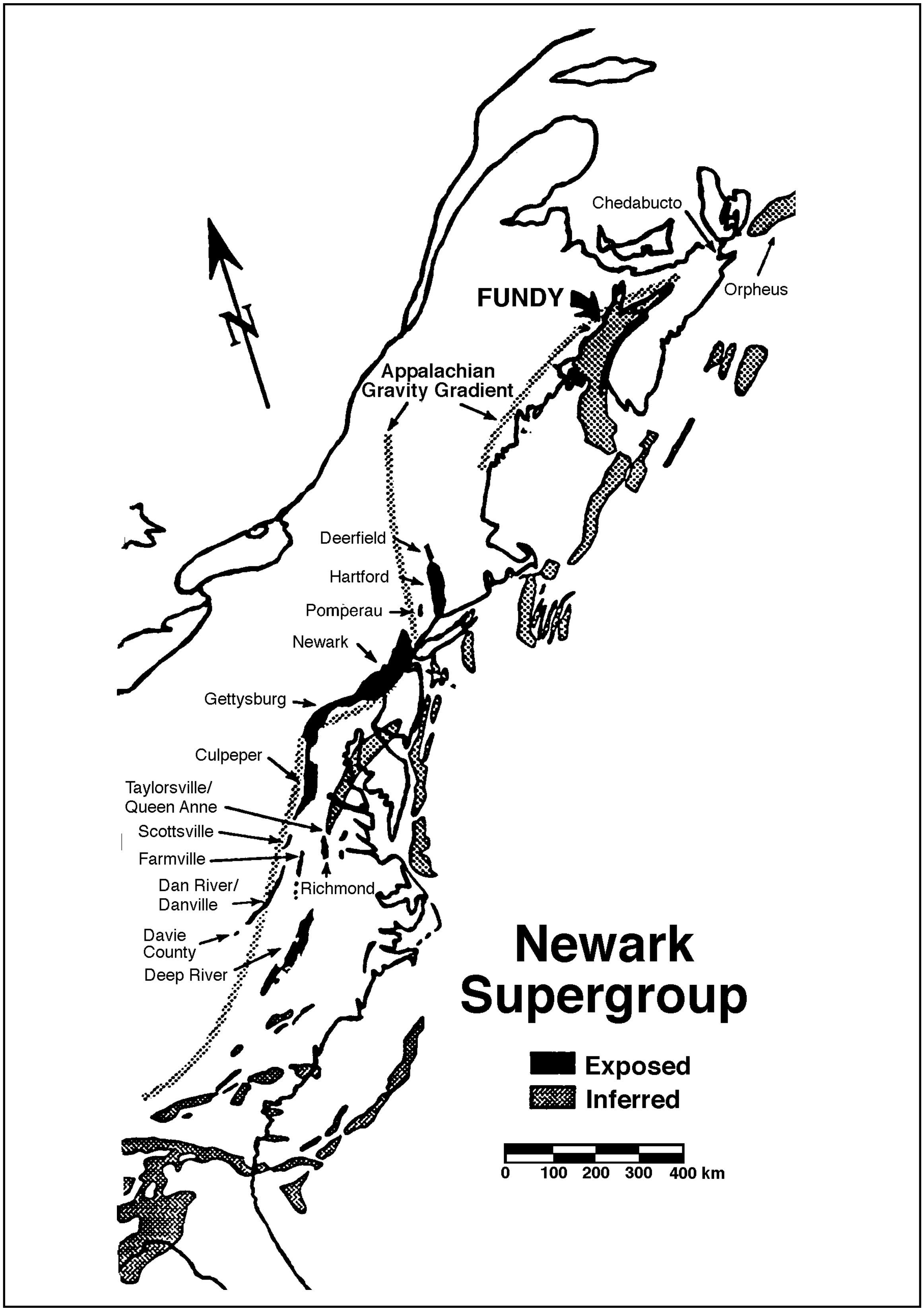

Figure T2.5.2: Distribution of Newark Supergroup basins, eastern North America (slightly modified after Olsen, et al.[3]). The Fundy Rift is the largest of all Newark-type basins and covers an area of about 14 000 km^2.

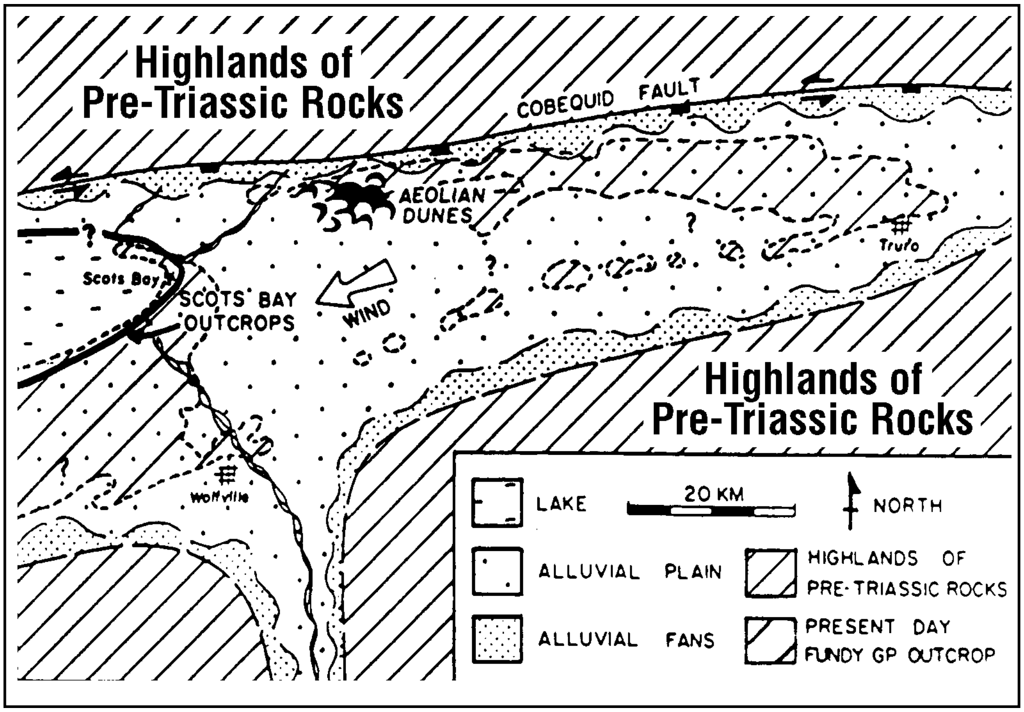

Figure T2.5.3: Paleogeographic map showing depositional facies of the Early Jurassic Scots Bay/McCoy Brook formations in the Minas Basin area. The present-day distribution of Fundy Group strata is within the areas outlined by the dashed lines. The dotted pattern is the interpreted maximum extent of Jurassic sediments (slightly modified after Birney-de Wet and Hubert[7]).

PERMIAN (280–230 MILLION YEARS AGO)

At the opening of the Permian Period, Nova Scotia occupied a central position on the Pangean supercontinent, at about 15 degrees north paleolatitude. The climatic conditions at this location were dominated by persistent easterly trade winds, which blew across the supercontinent, so that the climate was hot and dry, though having seasonal monsoonal rainfalls. The exposed rocks on the land surface became oxidized, were eroded to form red sands and muds and were deposited in a low, basinal area covering the Northumberland Strait, Prince Edward Island and the Gulf of St. Lawrence. Sediments derived from older strata in Nova Scotia and New Brunswick were redeposited within this basin and today form the foundation for the rolling landscape of Prince Edward Island.

During this time, Nova Scotia, including the continental shelf, was land undergoing erosion; the resulting sediments being deposited in the basinal area to the north. Any Permian-age sediments that were deposited were subsequently eroded away and thus are largely absent from the stratigraphic record of Nova Scotia.

TRIASSIC TO JURASSIC (230–140 MILLION YEARS AGO)

During the Middle Triassic, the Pangean supercontinent was subjected to extensional forces before the start of continental break-up. This process of continental rifting extended from the Gulf of Mexico to Newfoundland and beyond, and resulted in volcanism and development of subparallel fissures and faults along the thinned, weakened crust, as the crustal blocks of Pangea began to move apart[1] (see Figure T.2.5.1).

In the central portion of the rift, blocks of crustal material between parallel faults dropped down to form steep-sided, flat-bottomed valley- type structures called grabens. Further landward, away from the rift, the mechanics of fracturing were somewhat different and, in Middle Triassic time, when the Meguma terrane was pulled away from southern New Brunswick by sliding on the underlying Avalon terrane, the result was a series of half-grabens.

These half-grabens are known as the Fundy Rift System and can be traced through mainland Nova Scotia to Chedabucto Bay (District 570), into Chignecto Bay (Unit 913b), and out on to the Scotian Shelf (Region 900).[1] Similar rift basins are found extending down to the Gulf of Mexico.

The sediments which were deposited in the basins during rifting and the volcanic rocks within these basins are genetically similar to those in the Fundy Rift System, and thus are grouped together and collectively known as the Newark Supergroup (see Figure T2.5.2).[3]

In the Fundy region, three half-grabens are known to be filled with Triassic–Jurassic sediments: Fundy Basin, Chignecto Sub-basin and Minas Sub-basin. These sediments floor the similarly named bays.[2] Geological and seismic data indicate that up to 12 000 m of sediments fill the main Fundy Basin, about 6000 m fill the Chignecto Sub-basin and perhaps 3000 m fill the Minas Sub-basin. The strata in these basins are generally undisturbed, except along the faulted margins and where the Cobequid-Chedabucto Fault crosses the Fundy Basin.

The history of these basins records a long period of sedimentation interrupted by volcanism and ongoing tectonism along their faulted margins. The sedimentary fill in the basins records an overall filling-upwards sequence, from conglomerates to sands to shales and mudstones as the sources of the sediments were eroded away. These sediments and the associated basalts are collectively known as the Fundy Group; they range in age from the Early Middle Triassic to possibly the Early Middle Jurassic in the area of maximum deposition (depocentre) of the thick Fundy Basin. The whole sequence in the Fundy Basin was gently folded, possibly in the Middle Jurassic, and now has the shape of a tilted saucer which plunges southwestwards towards the mouth of the Bay of Fundy. These rocks are well exposed along the south shore of the Bay in the North Mountain–Annapolis Valley region and also all along the Minas Basin shoreline.

Rivers and braided streams flowing from the Meguma uplands formed alluvial fans along the fault-bounded margins of the basins and deposited thick sequences of poorly sorted conglomerates and lesser amounts of sandstones (the Wolfville Formation). Winds reworked some of these latter sandstones, which resulted in significant wind-blown dune deposits; these are spectacularly exposed at Red Head near Economy (District 710).[4,5]

The climate became drier and reduced the amount of water (and, hence, sediments) flowing into the basins. Evaporitic minerals such as gypsum were precipitated in temporary (ephemeral) lakes and mudflats which covered the basins (Blomidon Formation).[6] At the end of the Triassic Period, further rift-related stresses caused the formation of fissure-type volcanic eruptions, and the basins were covered with a virtually continuous sequence of lava flows of earliest Jurassic age (North Mountain Formation, District 720). The Triassic-Jurassic boundary occurs in the Blomidon sediments, a few metres from the base of the lava flows.

Following this event, slightly wetter climatic conditions began to develop. Fluvial sands and lacustrine muds and limestones of the McCoy Brook and Scots Bay formations were deposited on the surface of the basalt.[7,8]

Although these sediments are thick and extensive beneath the Bay of Fundy (at least 3000 m), they are limited to a few exposures in the Five Islands area (McCoy Brook Formation) in District 710 and several small, thin outcrops near Scots Bay (Scots Bay Formation) in District 720. Conditions were still dry enough at the beginning of the Jurassic that aeolian sand dunes were deposited into structural lows adjacent to the bounding faults in the Minas Sub-basin and are well exposed at Wasson's Bluff (see Figure 2.5.3).[3, 7]

The continental setting results in poor preservation of organic material, so fossils are rare in these deposits. Reptile and dinosaur remains occur in aeolian, alluvial fan and lacustrine sediments of the McCoy Brook Formation at Wasson's Bluff and in the lower Wolfville Formation fluvial sandstones at Carrs Brook in District 620. Rare reptile remains occur in Wolfville Formation sandstone along the south shore of Minas Basin.[9] Fish remains are present in Early Jurassic sediments of the McCoy Brook Formation on the west side of Five Islands Provincial Park, and in limestones of the Scots Bay Formation at Scots Bay.[9] Chertified logs are also very common at the latter site. Dinosaur footprints can be found in Wolfville Formation sandstones a few metres below its contact with the overlying Blomidon Formation in the cliffs at Pereau, near Kingsport.

No middle or late Jurassic deposits are to be found on land in Nova Scotia. The most recent, pre-glacial deposits in Nova Scotia are Cretaceous sands, clays and lignite in the Musquodoboit Valley near Middle Musquodoboit.[10] Evidence of climatic changes and geological events during the Jurassic Period must therefore be sought from the sedimentary record on the Scotian Shelf (see T3.5). The presence of red beds and salt in the offshore sequence indicates that the arid equatorial climate persisted into the Late Jurassic.[1]

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Associated Topics

T2.2 The Avalon and Meguma Zones, T2.4 The Carboniferous Basin, T3.5 Offshore Bottom Characteristics

References

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