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GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
OTTAWA

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ERA	SYSTEM	SERIES OR STAGE		FORMATION	LITHOLOGY
PALEOZOIC	DEVONIAN	UPPER	FAMENNIAN 353 million years	Okse Bay (Do)	Sandstone, quartzarenite, yellowish orange and red weathering; abundant large limonite concretions; friable with few outcrops
			FRASNIAN 359 million years		
		MIDDLE	GIVETIAN	Bird Fiord (Dbi)	Fine sandstone and siltstone, calcareous, green weathering, recessive
			EIFELIAN 370 million years	Undivided Devonian Carbonates (Du)	Interbedded limestone, dolomite, anhydrite and sandstone in order of abundance. Limestone and dolomite form resistant bluffs in the upper and lower parts of this unit. In some areas, anhydrite and sandstone form a middle, recessive sub-unit
		LOWER	EMSIAN 374 million years	Prince Alfred (DPa)	Sandstone, quartzarenite, yellow weathering and friable, recessive; some areas of thick red-bed sequences
			SIEGENIAN 390 million years		
			GEDINNIAN 395 million years	Sutherland River (DSr)	Dolomite, finely crystalline, bull to white weathering, medium to flaggy beds, resistant
	SILURIAN	PRIDOLIAN		Devon Island (SDdi)	Organic-rich silty limestone and dolomite, thinly laminated fissile bedding, dark brown but weathers yellowish orange, recessive
		LUDLOVIAN		Douro (Sdo)	Limestone, very argillaceous, medium bedded, fairly resistant, greyish green and fossiliferous
		WENLOCKIAN		Cape Storm (Scs)	Dolomite and limestone, yellow dolomite and grey limestone interbedded, moderately resistant
		LLANDOVERIAN 430-440 million years		Allen Bay (Osa)	Dolomite, massive to medium bedded, medium crystalline, sucrosic dolomite, moderately resistant to recessive, brown weathering
	ORDOVICIAN	UPPER	RICHMOND	Cornwallis Group: Irene Bay (Oci)	Shale, with fossiliferous limestone, greyish green, recessive
			MAYSVILLE		
			EDEN	Cornwallis Group: Thumb Mountain (Oct)	Limestone, fossiliferous with abundant finely comminuted bioclastic material, medium bedded, grey weathering, resistant
		MIDDLE	BARNVELD		
			WILDERNESS 445 million years	Cornwallis Group: Bay Fiord (Ocb)	Limestone, finely crystalline, greyish brown to tan, thin bedded; some dolomite, very finely crystalline, olive-grey; occasional shaly zones that are greenish grey; some anhydrite in the lower part of the formation that is very recessive
			PORTERFIELD		
			ASHBY		
			MARMOR		
			WHITEROCK	Eleanor River (Oe)	Limestone, pale to medium grey, medium bedded; moderately resistant
		LOWER	CANADIAN 500 million years?		

Table 1. Table of formations cropping out in the Prince Alfred Bay area, Devon Island. Map symbols are shown in brackets and are used on the geological map. The Thumb Mountain and Irene Bay Formations are combined on the geological map and are shown there as Octi.

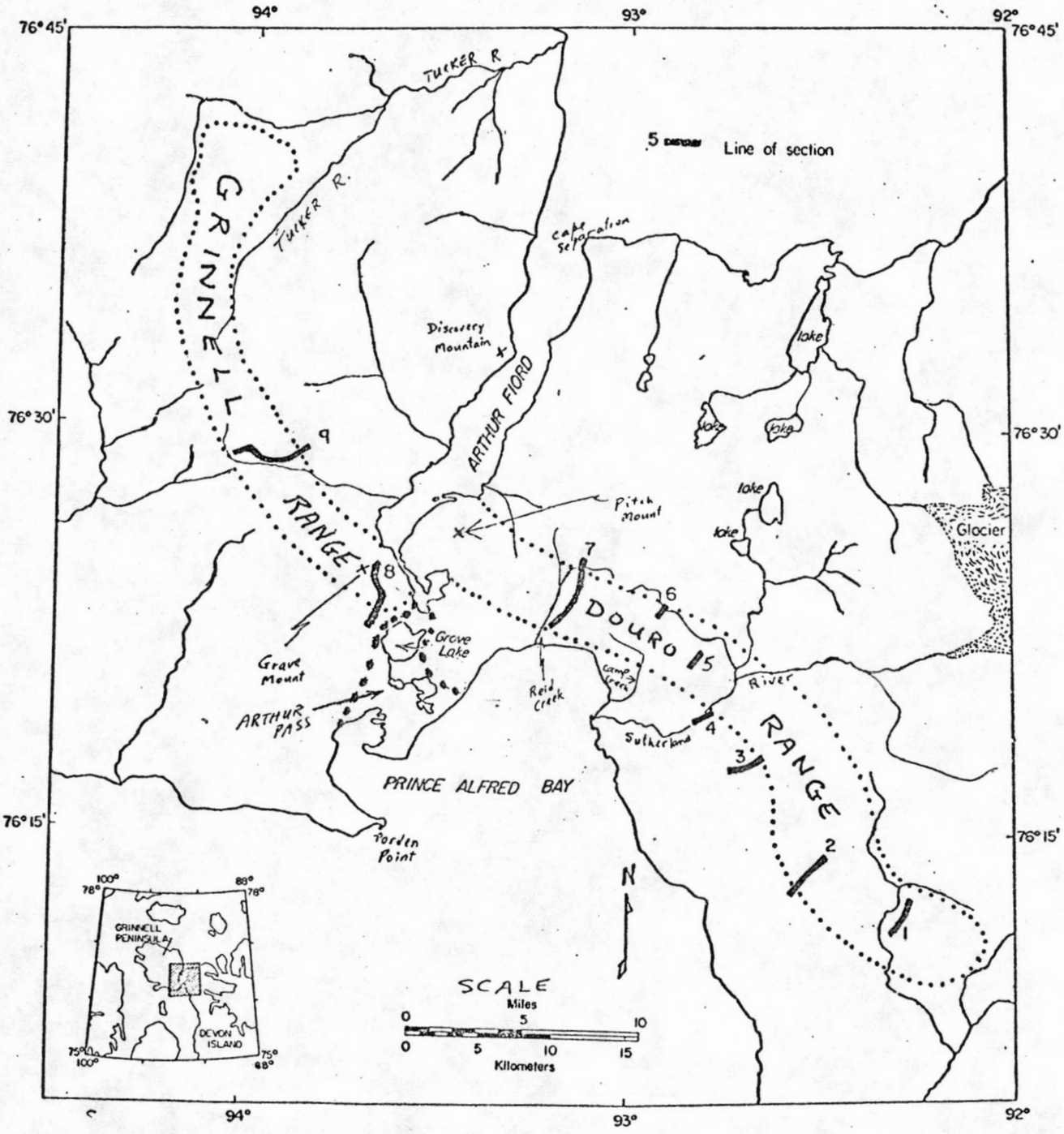

Figure 1. Index map showing geographical features in the Prince Alfred Bay area, and locations of stratigraphic sections.

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Figure 2. Westward view of the area around Prince Alfred Bay. The Grinnell Thrust Fault is the major structural feature. The Bay Fiord (Ocb), Thumb Mountain and Irene Bay combined (Octi), Allen Bay (Osa), Cape Storm (Scs), Douro (Sdo), Devon Island (SDdi), Sutherland River (Dsr), and Prince Alfred (Dpa) Formations all are upturned and well exposed along the hanging wall of the Grinnell Thrust

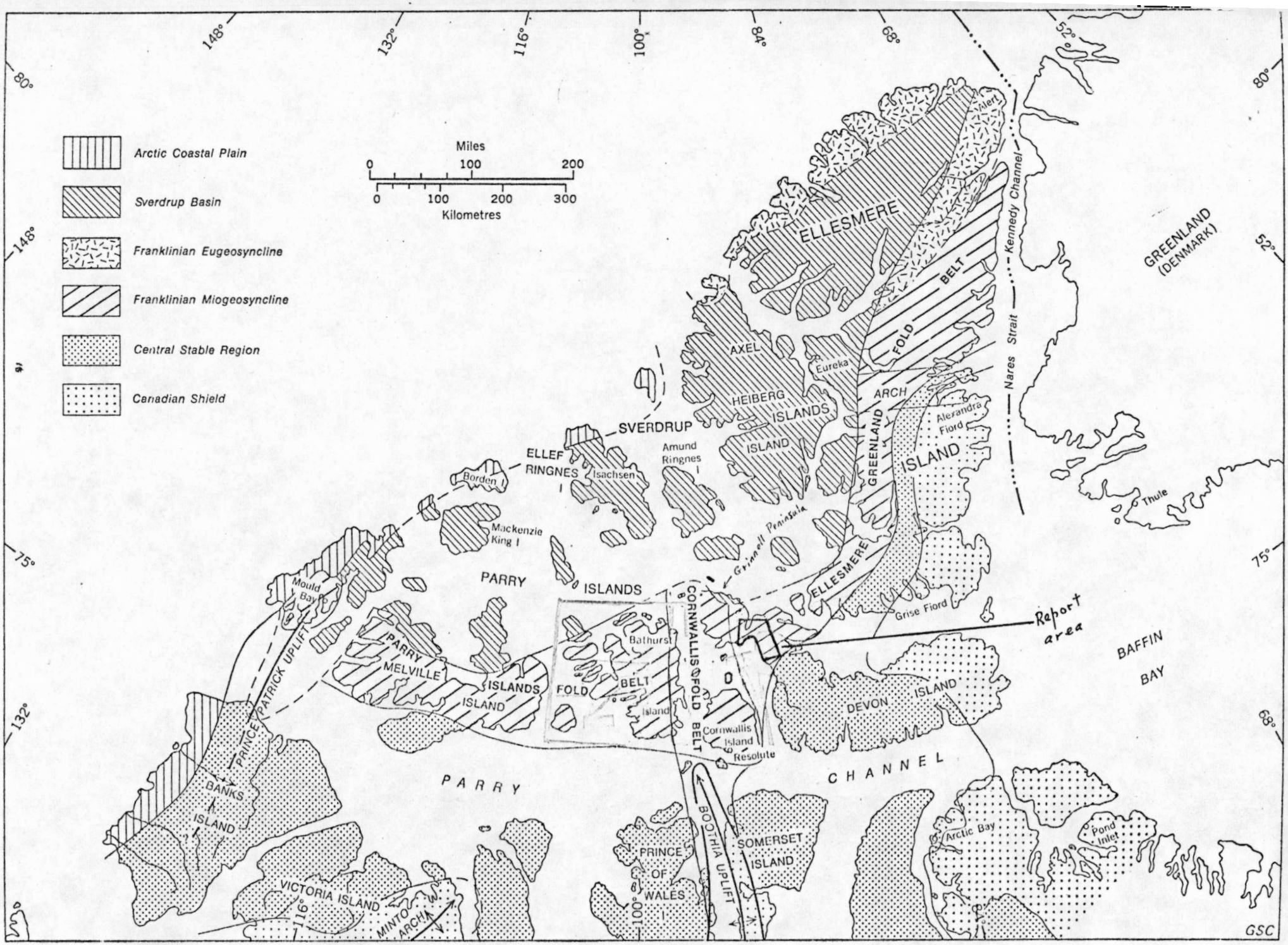

Figure 3. Stratigraphic - structural provinces in Canadian Arctic Islands; after Thorsteinsson and Tozer (1960), and Kerr (*in press*).

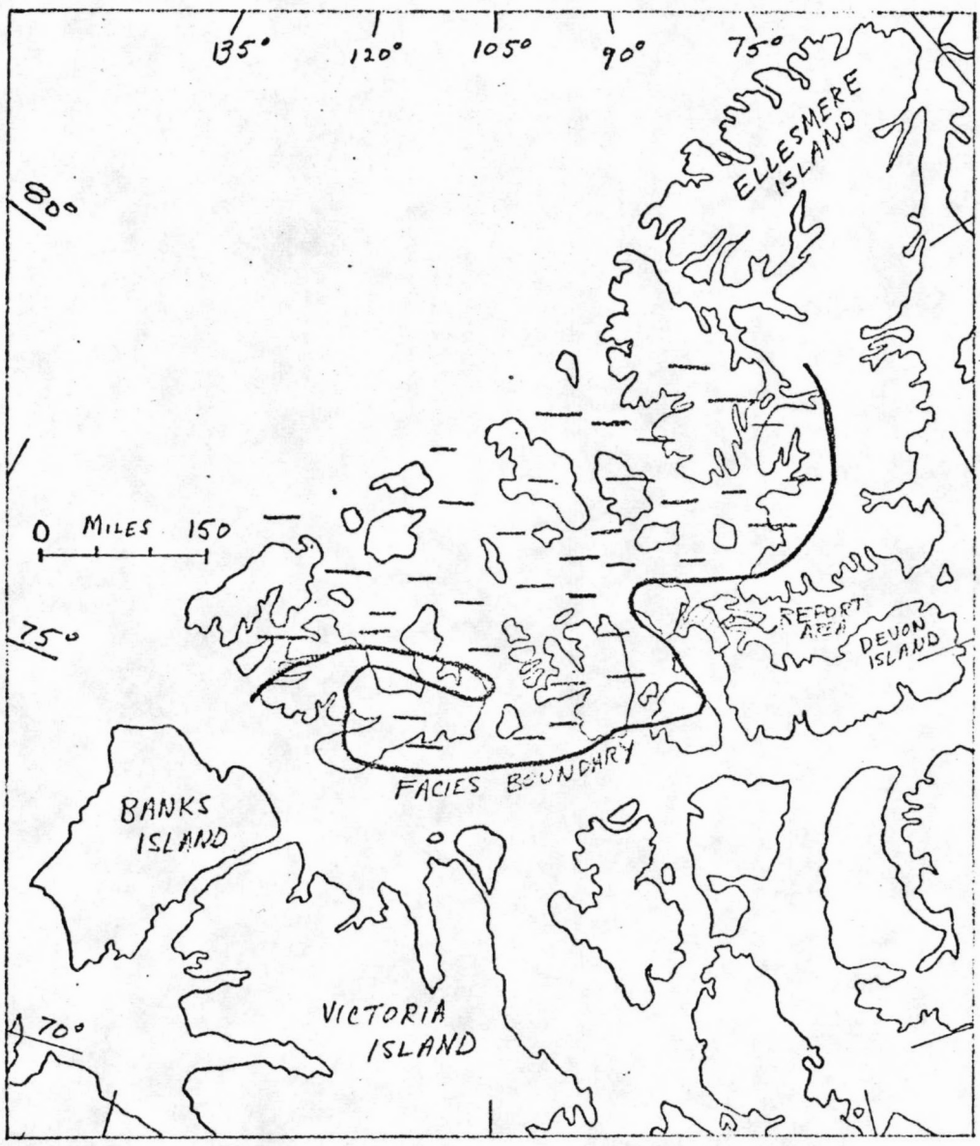

Figure 4. Map showing the location and extent of the early Paleozoic facies boundary in the Canadian Arctic Islands that divides terrigenous sediments of the Hazen Trough from carbonate sediments of the shelf area to the south and east.

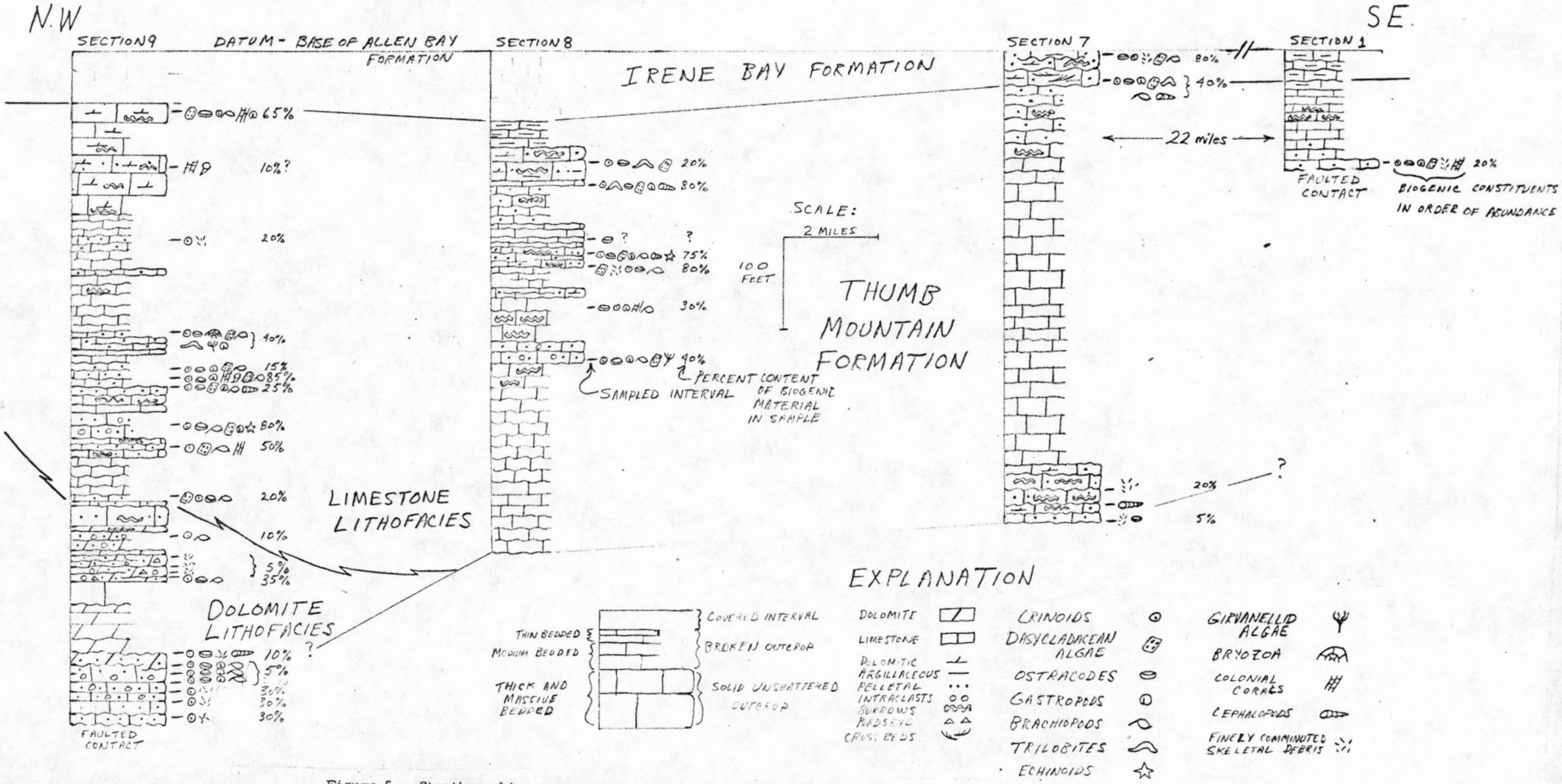

Figure 5. Stratigraphic cross-section of the Thumb Mountain and Irene Bay Formations.

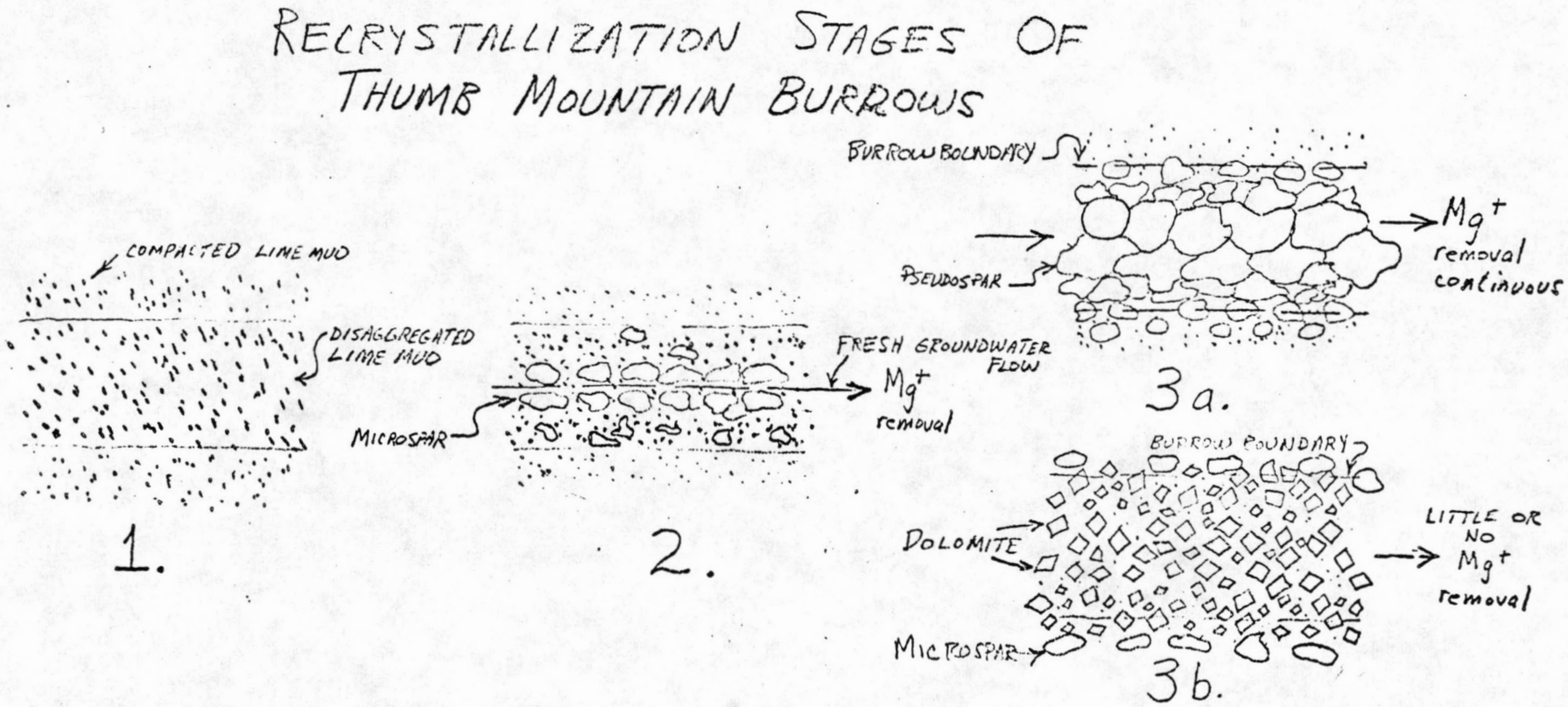

Figure 6. This shows a possible sequence of events leading to the recrystallization of burrows in the Thumb Mountain Formation. Disaggregated lime mud within burrows (stage 1) are relatively permeable pathways for the passage of fresh groundwater. This groundwater flushes magnesium from the burrow sediments which results in aggradational recrystallization of the sediment to microspar (stage 2) and finally to pseudospar (stage 3a). Slow groundwater flow may have resulted in dolomitization of recrystallizing lime mud in some burrows (stage 3b).

mud in some burrows (stage 3b).

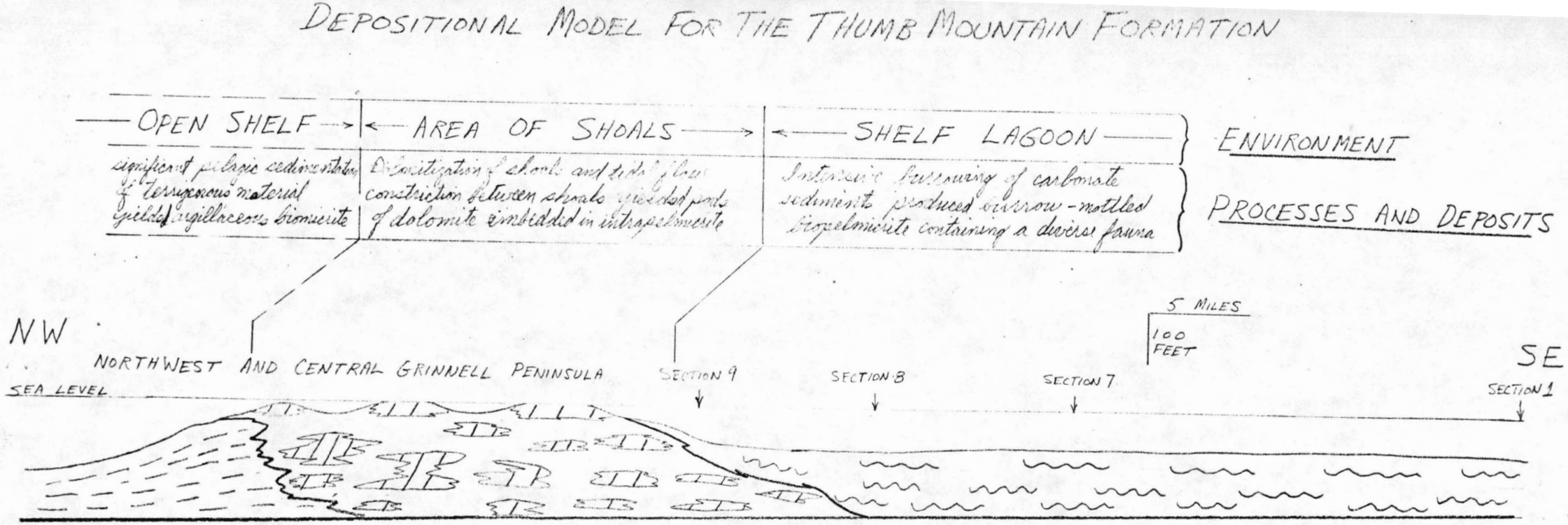

Figure 7. Depositional model for the Thumb Mountain Formation. Shoals, preserved as pods of dolomite, separated a shelf lagoon from an open shelf sea toward the northwest.

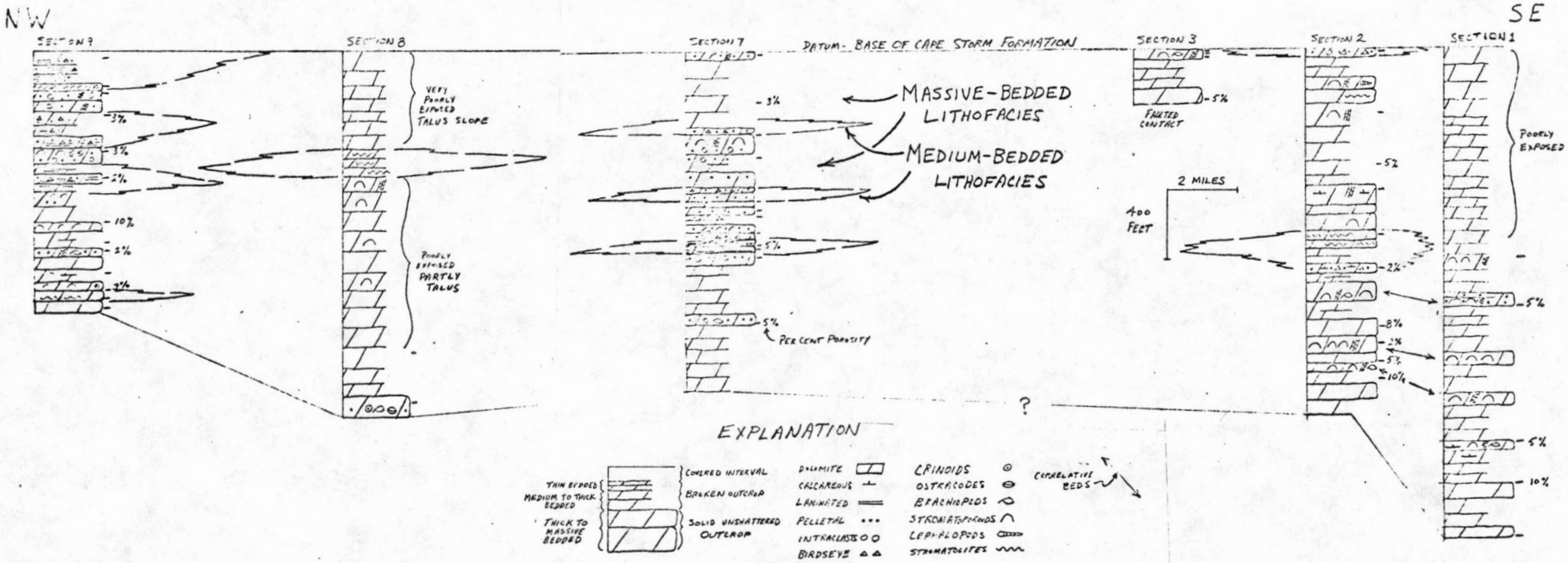

Figure 8. Stratigraphic cross-section of the Allen Bay Formation.

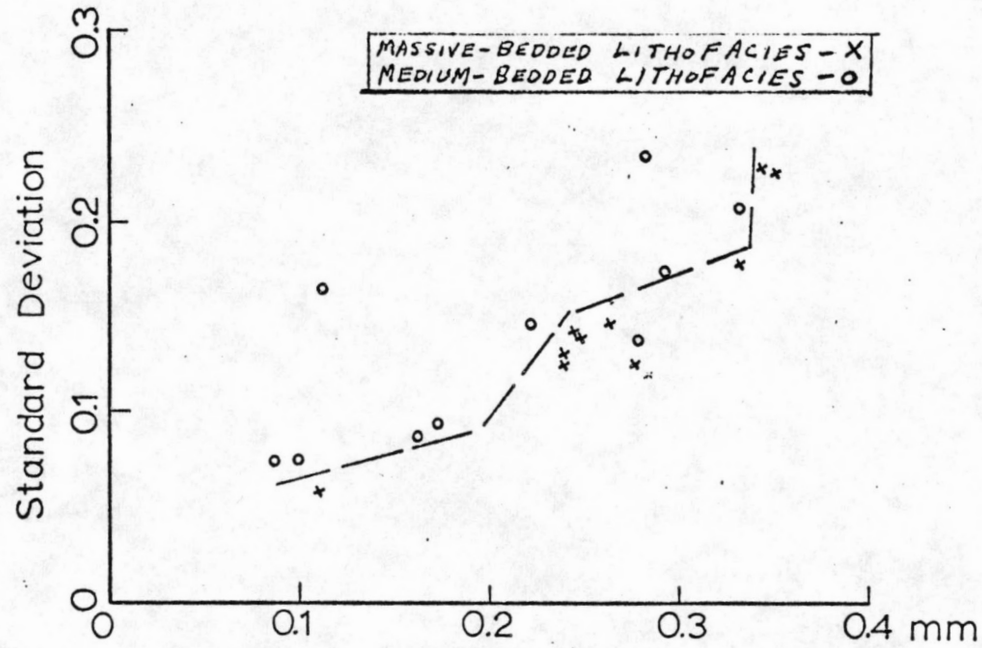

Figure 9. Bivariate plot of average or mean sample crystal size versus the standard deviation of crystal sizes in these samples. For a given mean crystal size, samples from the medium-bedded lithofacies have a greater standard deviation than samples from the massive-bedded lithofacies.

MODEL FOR DEPOSITION AND DIAGENESIS OF THE ALLEN BAY FORMATION

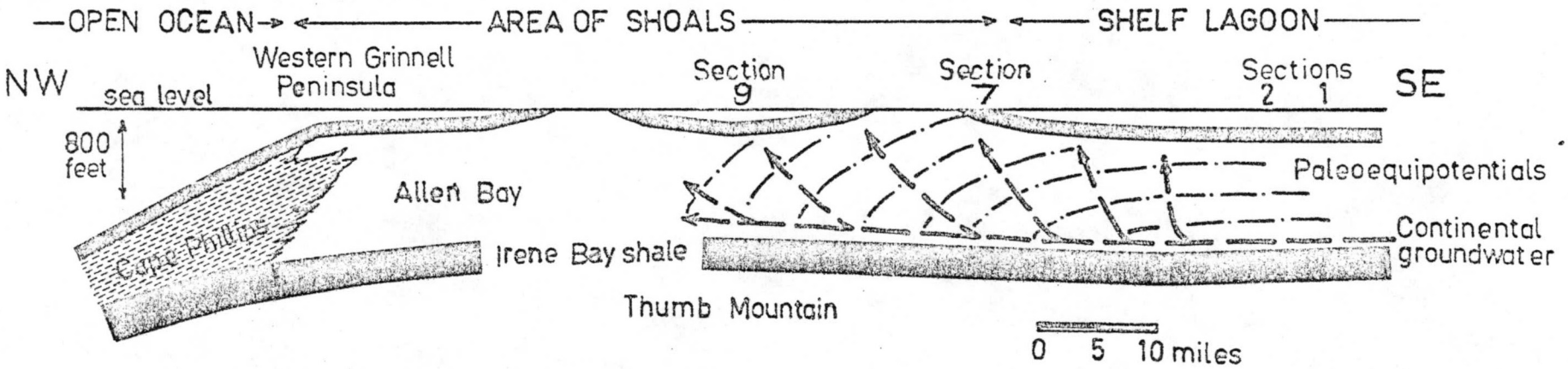

Figure 10. Model for the depositon and diagenesis of the Allen Bay Formation. An area of stromatoporoid shoals may have separated a shelf lagoon from the open ocean to the northwest. During and after deposition fresh continental goundwater may have invaded Allen Bay sediments from the southeast. This groundwater may have aided the progressive dolomitization of Allen Bay sediments.

MANGANESE AND STRONTIUM CONTENT OF THE ALLEN BAY FORMATION

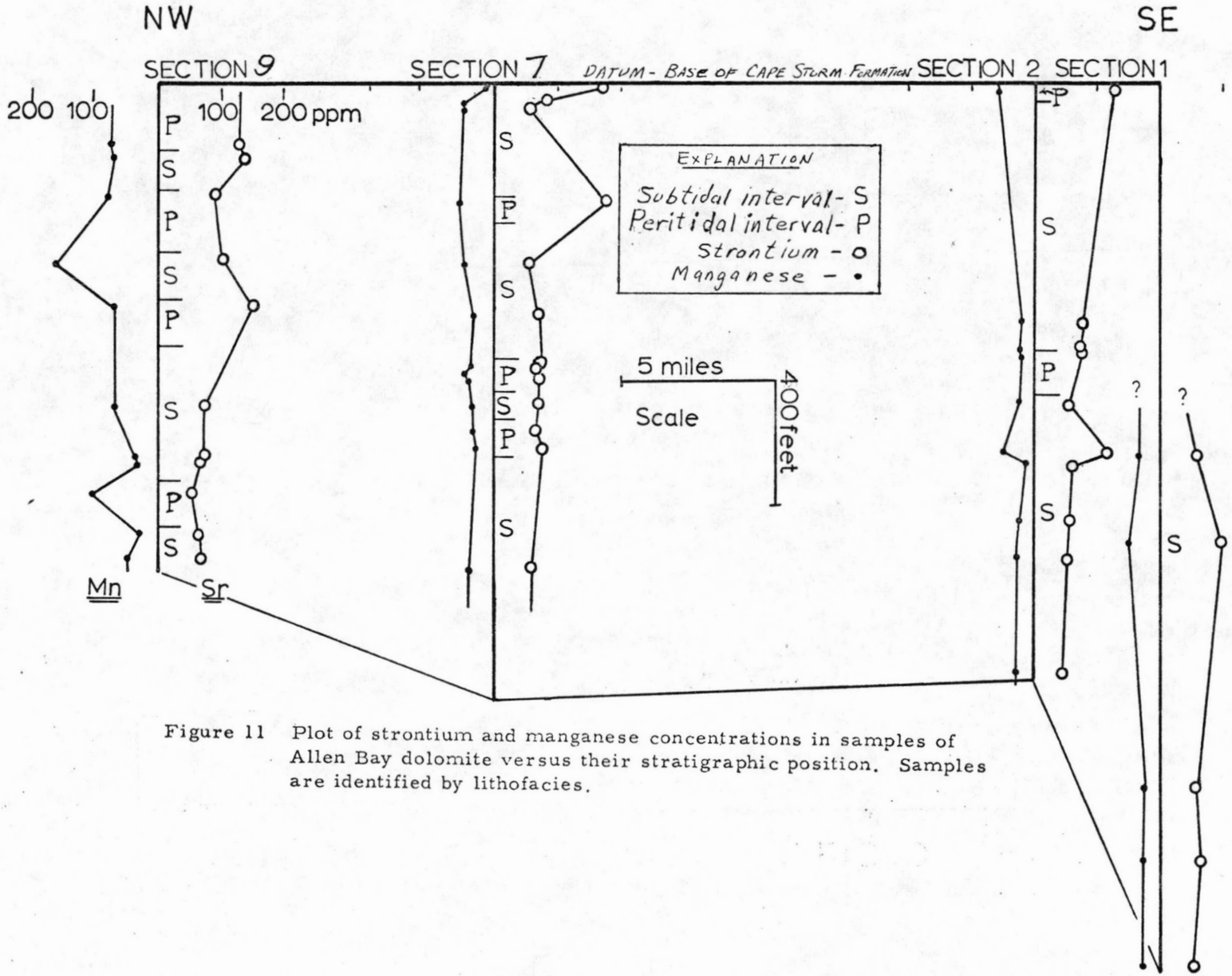

Figure 11 Plot of strontium and manganese concentrations in samples of Allen Bay dolomite versus their stratigraphic position. Samples are identified by lithofacies.

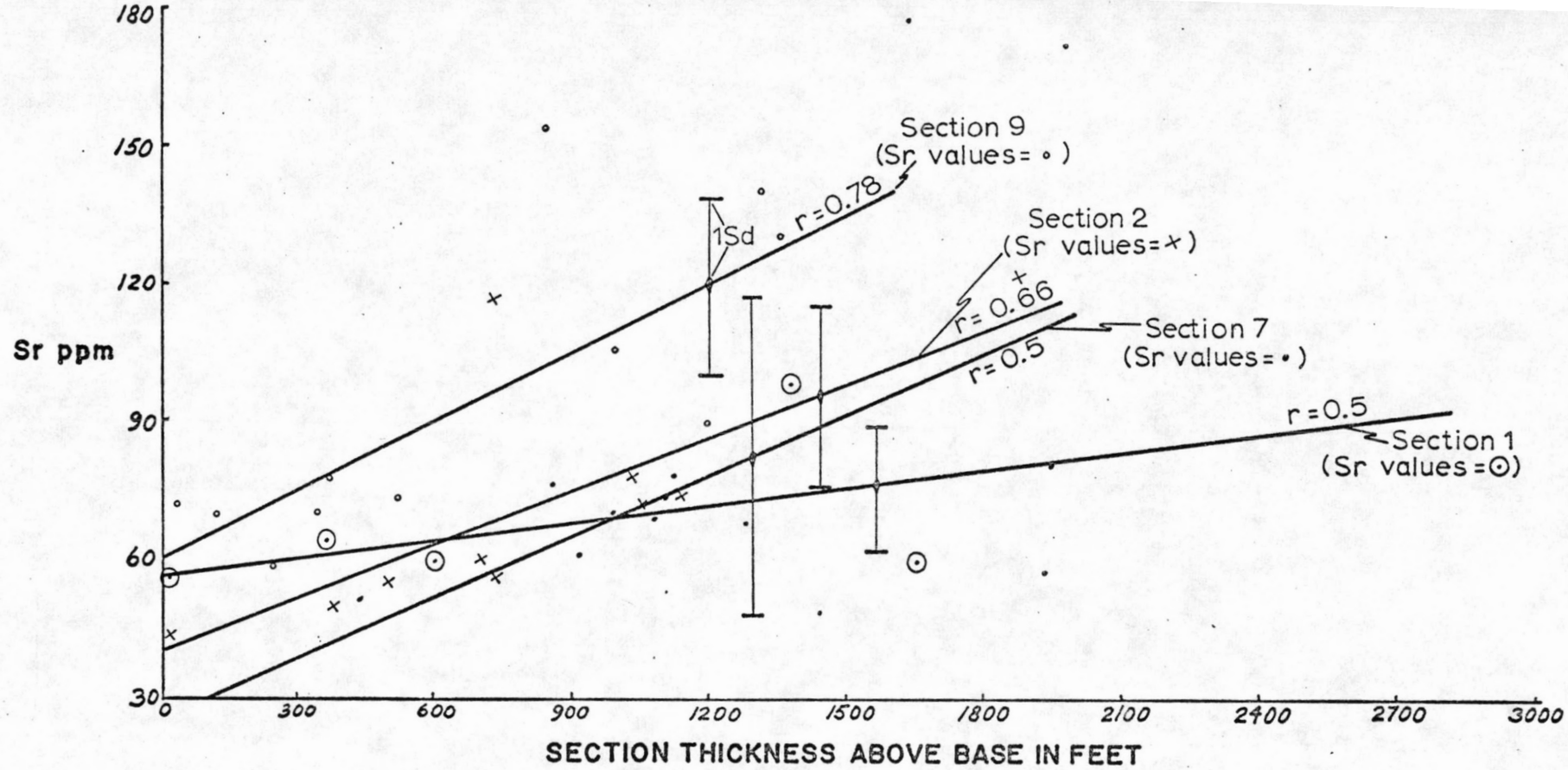

Figure 12. Plot of strontium concentrations in samples of Allen Bay dolomite versus their position above the base of the Allen Bay Formation. Least squares linear regression lines of these values for each section indicate that strontium concentrations increase upsection and that more northerly sections contain higher strontium concentrations.

TREND SURFACES OF STRONTIUM VALUES

ALLEN BAY FORMATION

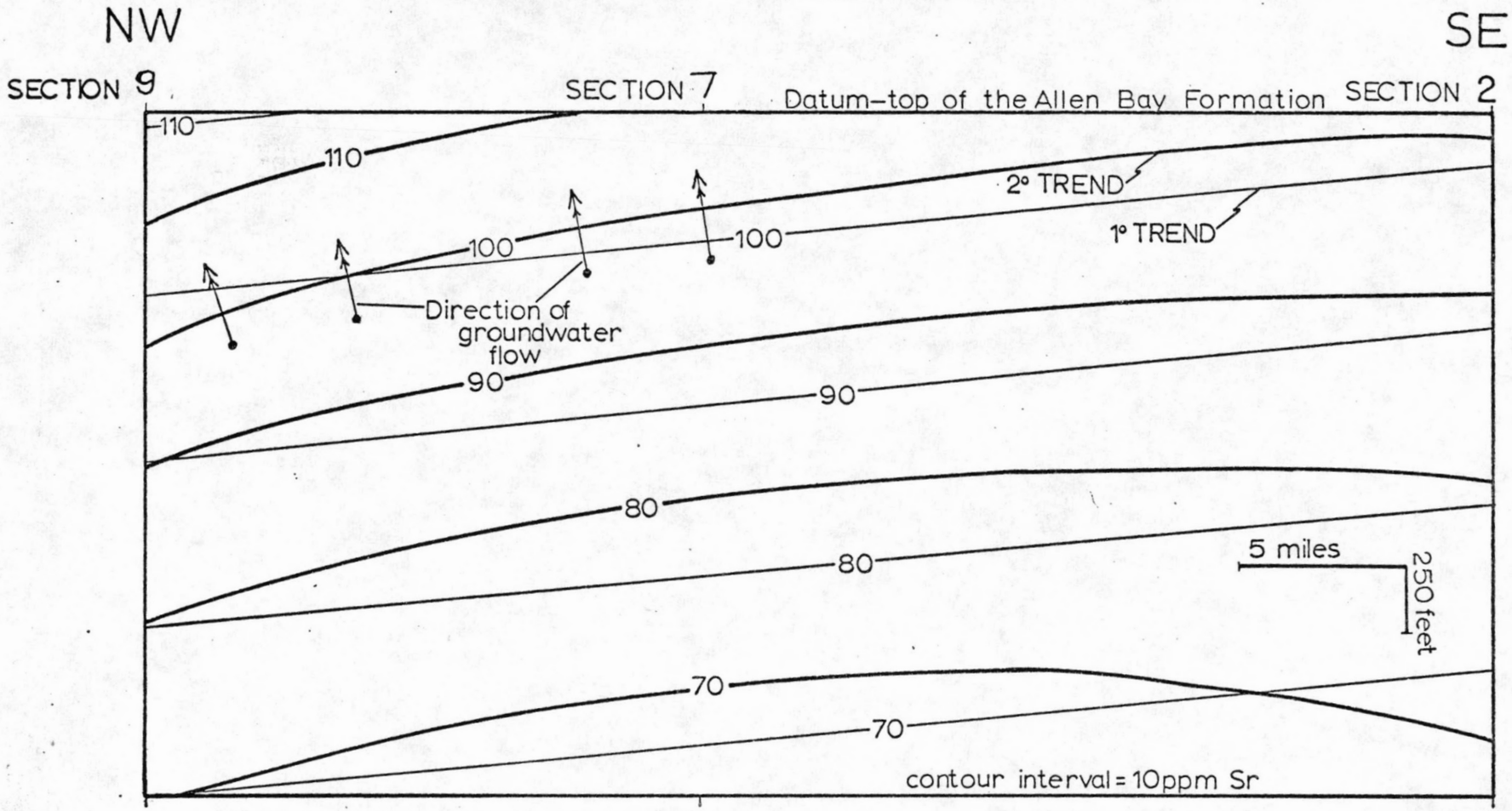

Figure 13. Plot of the first and second degree polynomial trend surfaces fitted to strontium concentrations along the line of section of this study. Note the higher values upsection and toward the northwest. These trend surface contours may approximate the position of ancient equipotential lines with respect to fresh groundwater flow.

TREND SURFACES OF MANGANESE VALUES
ALLEN BAY FORMATION

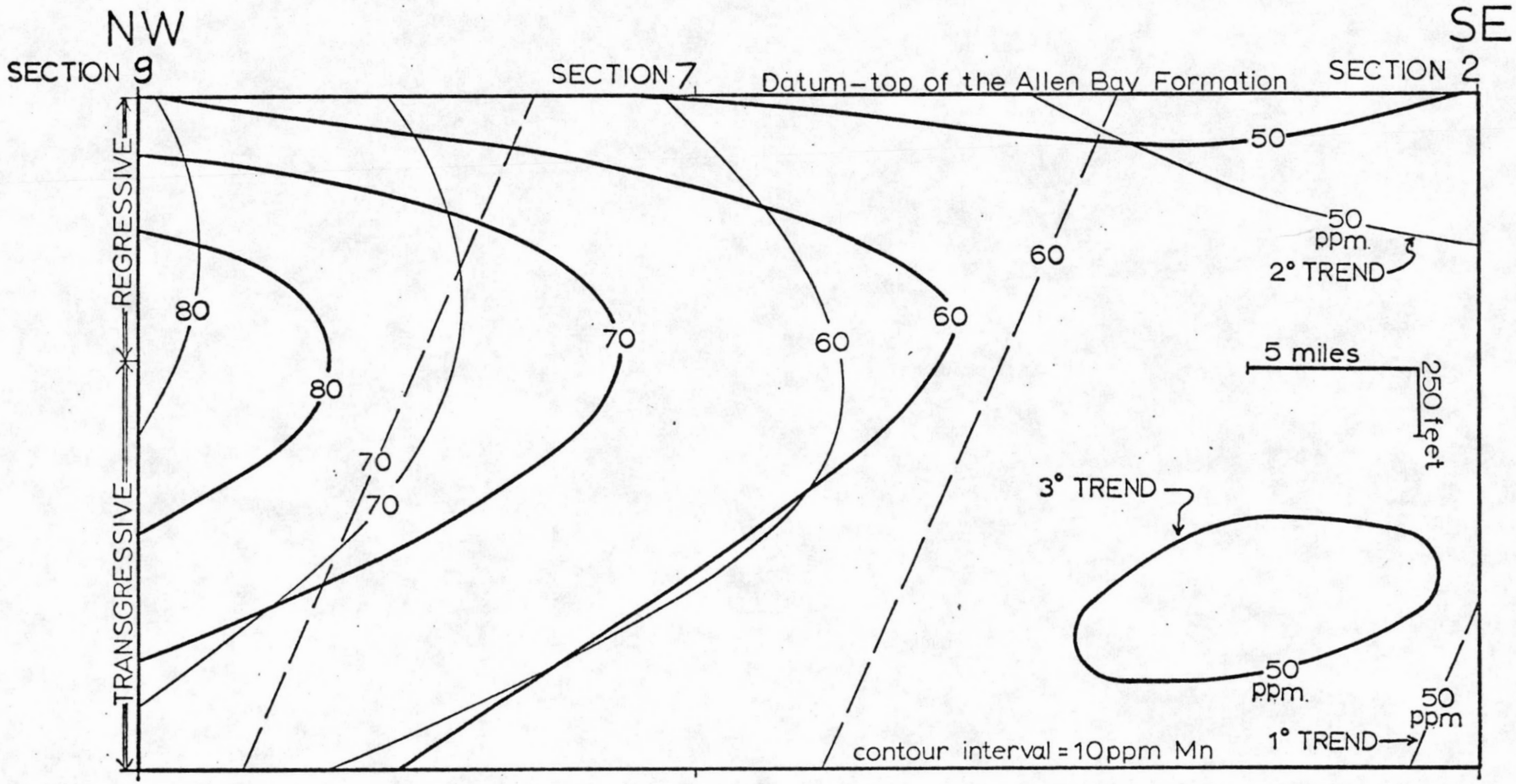

Figure 14. Plot of the first, second and third degree polynomial trend surfaces fitted to manganese concentrations along the line of section of this study. The wedge-shaped pattern of the second and third trend surfaces may indicate that a transgression was followed by a regression. This is because manganese concentrations probably reflect proximity to the open ocean.

DISTRIBUTION OF CARBON AND OXYGEN ISOTOPES IN THE ALLEN BAY FORMATION

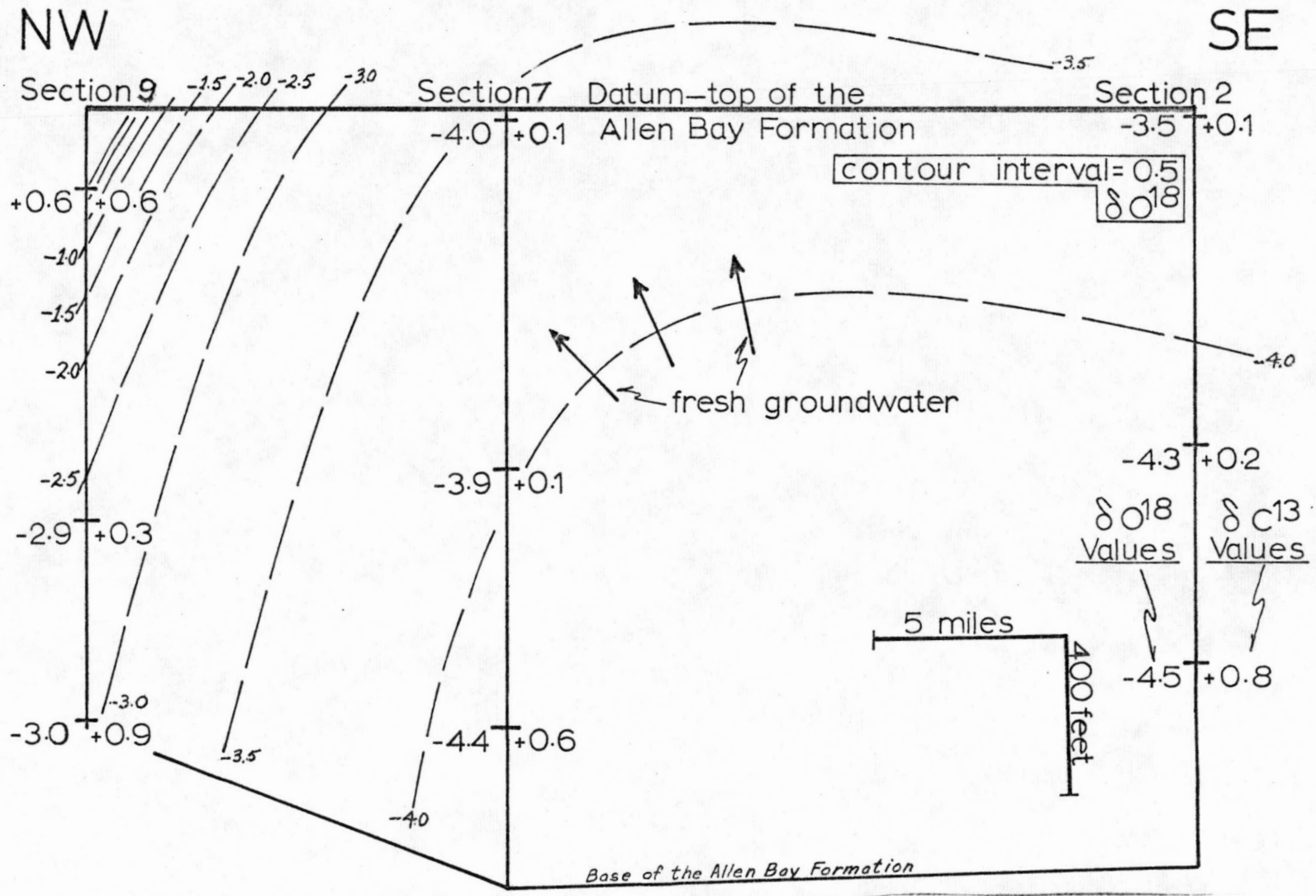

Figure 15. Plot of δO^{18} and δC^{13} concentrations in nine samples from three sections. Note the upsection and northwestward increase in δO^{18} values. This is consistent with the hypothesis that fresh groundwater invaded the Allen Bay Formation from the southeast.

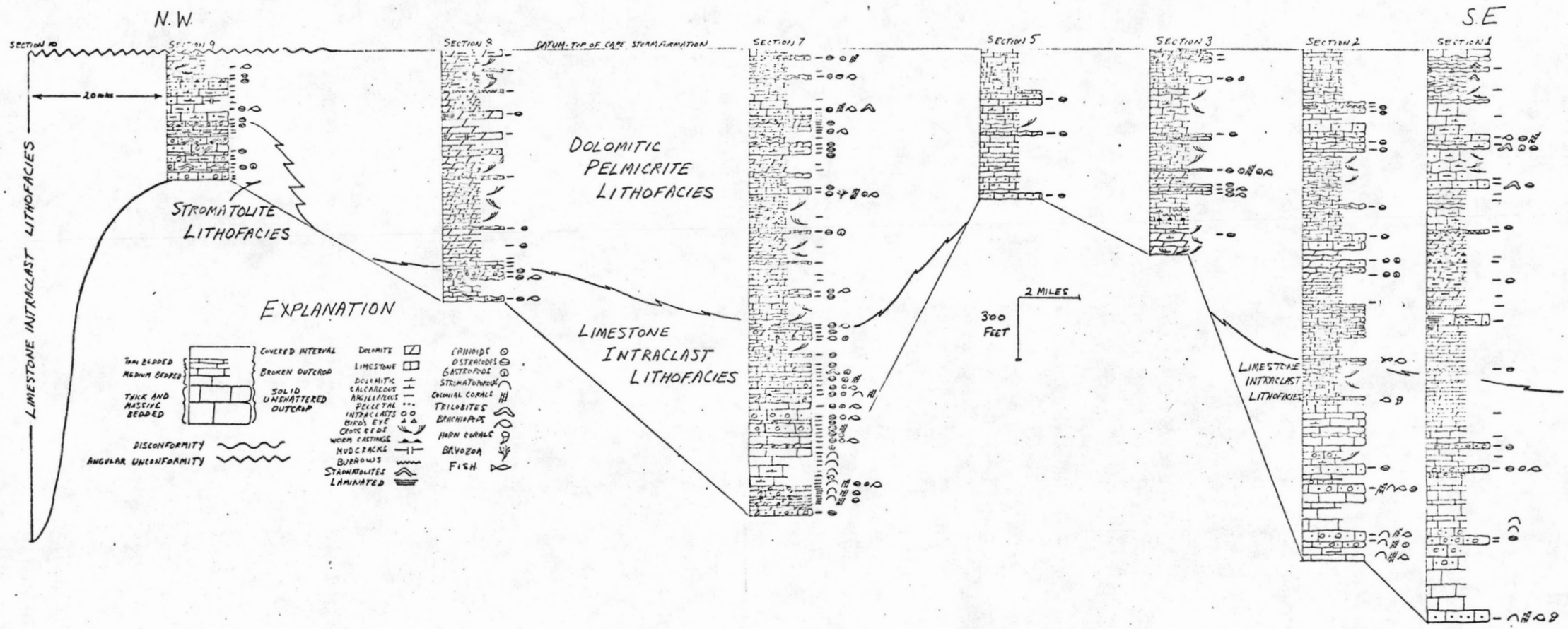

Figure 16. Stratigraphic cross-section of the Cape Storm Formation.

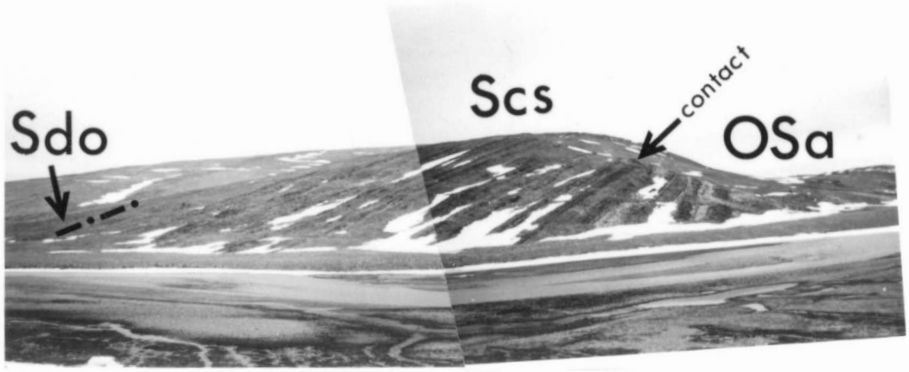

Figure 17. View northeast of the Cape Storm Formation (Scs) between the Allen Bay (Osa) and Douro (Sdo) Formations. Note the banded weathering pattern of alternate resistant and recessive beds. The thicker, more resistant beds near the base of the Cape Storm Formation represent the limestone intraclast lithofacies. This exposure is immediately northeast across a stream from Section 1

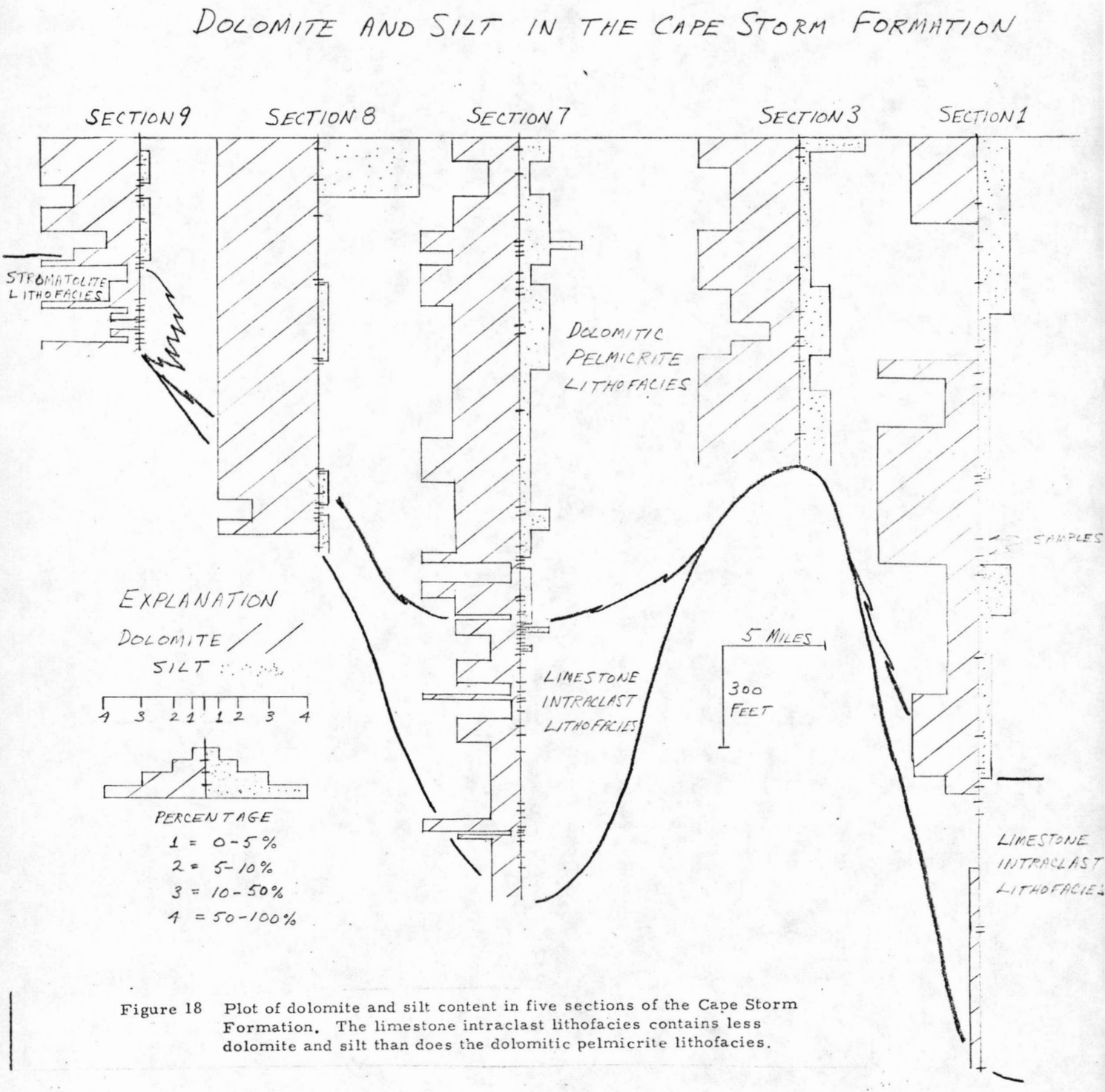

Figure 18 Plot of dolomite and silt content in five sections of the Cape Storm Formation. The limestone intraclast lithofacies contains less dolomite and silt than does the dolomitic pelmicrite lithofacies.

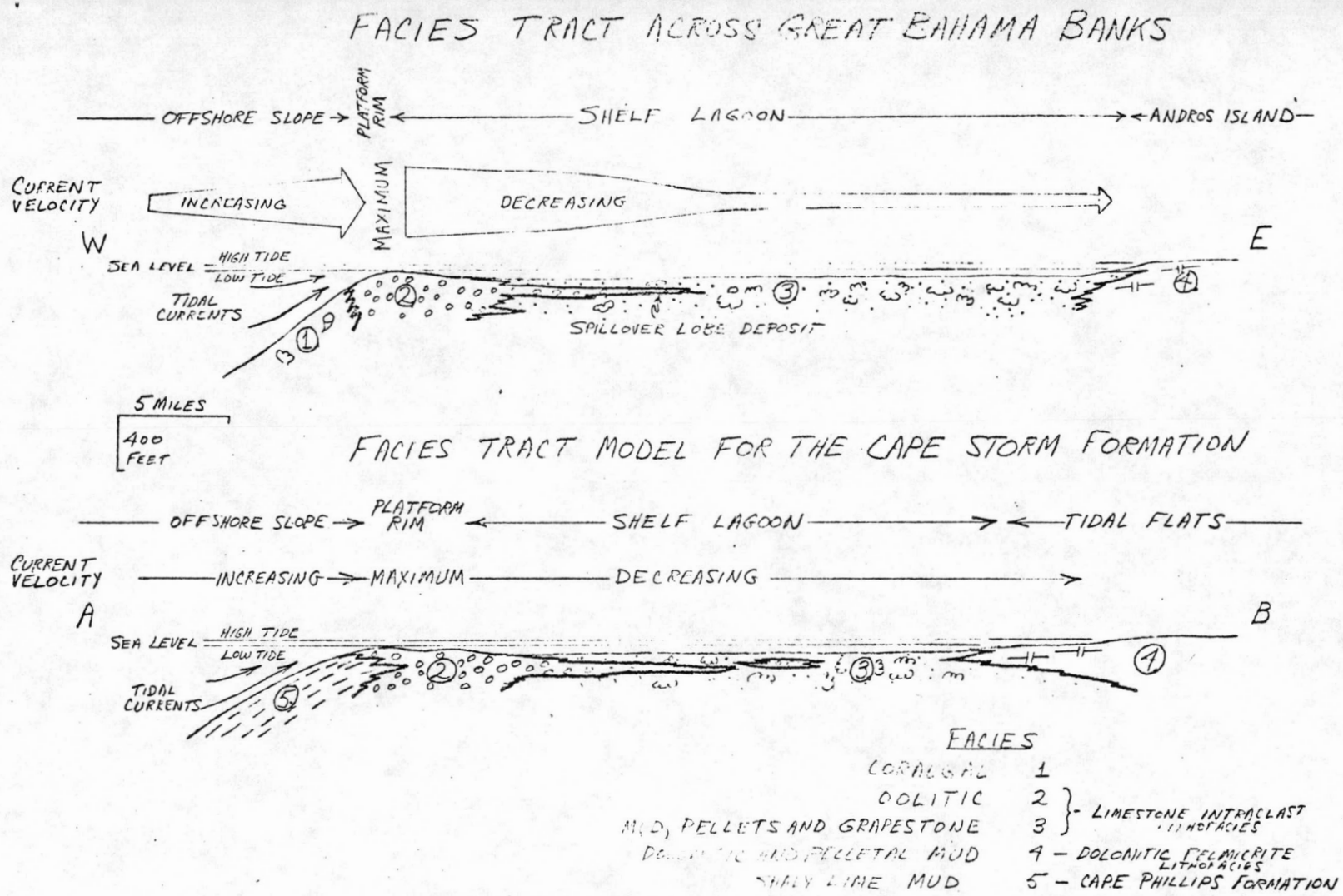

Figure 19. Comparision of a facies tract across the Great Bahama Banks (after Purdy, 1963a) with a conceptual facies tract model across the facies front of the Franklinian Geosyncline during deposition of the Cape Storm Formation. These facies tracts contain analogous sediments with the exception that the Cape Phillips shaly limestone slope deposits (5) are somewhat different from the coralgal slope facies (1) of the Great Bahama Banks. The offshore slope in the Great Bahama Banks produces tidal flow constriction toward the shelf platform. Line of section for the Cape Storm facies tract is on Figure 20.

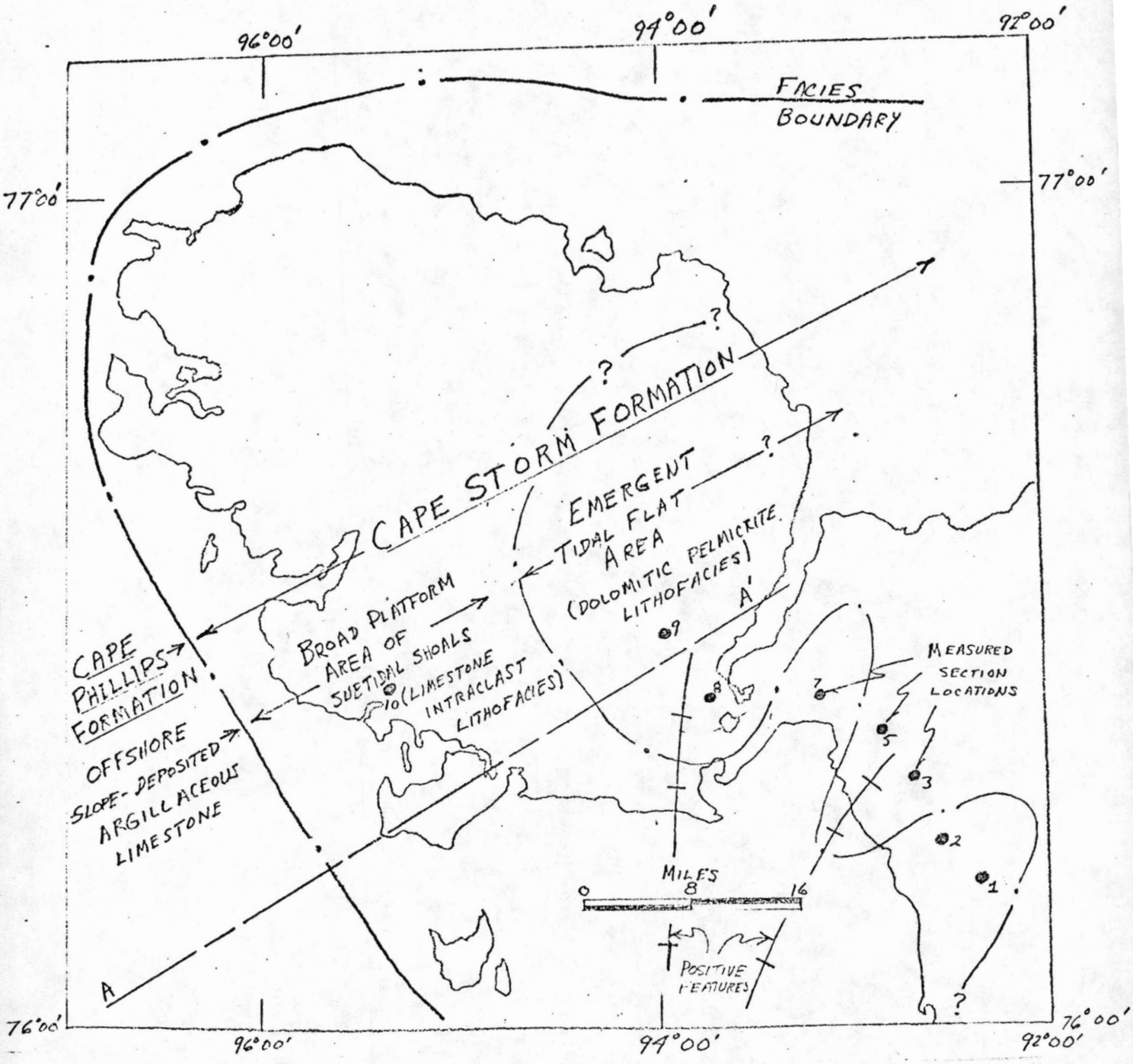

Figure 20. Disposition of facies and depositional environments on Grinnell Peninsula and nearby areas during early Wenlockian time when the lower part of the Cape Storm Formation accumulated. Positive features parallel to the Boothia Uplift may have caused depositional thinning of the Cape Storm in Sections 3, 5, 8 and 9. Data both from field mapping and measured sections are incorporated in this diagram. Facies boundary between Cape Phillips shaly limestone and Cape Storm carbonates is derived from Thorsteinsson (1968). A-A' is line of section for Figure 19.

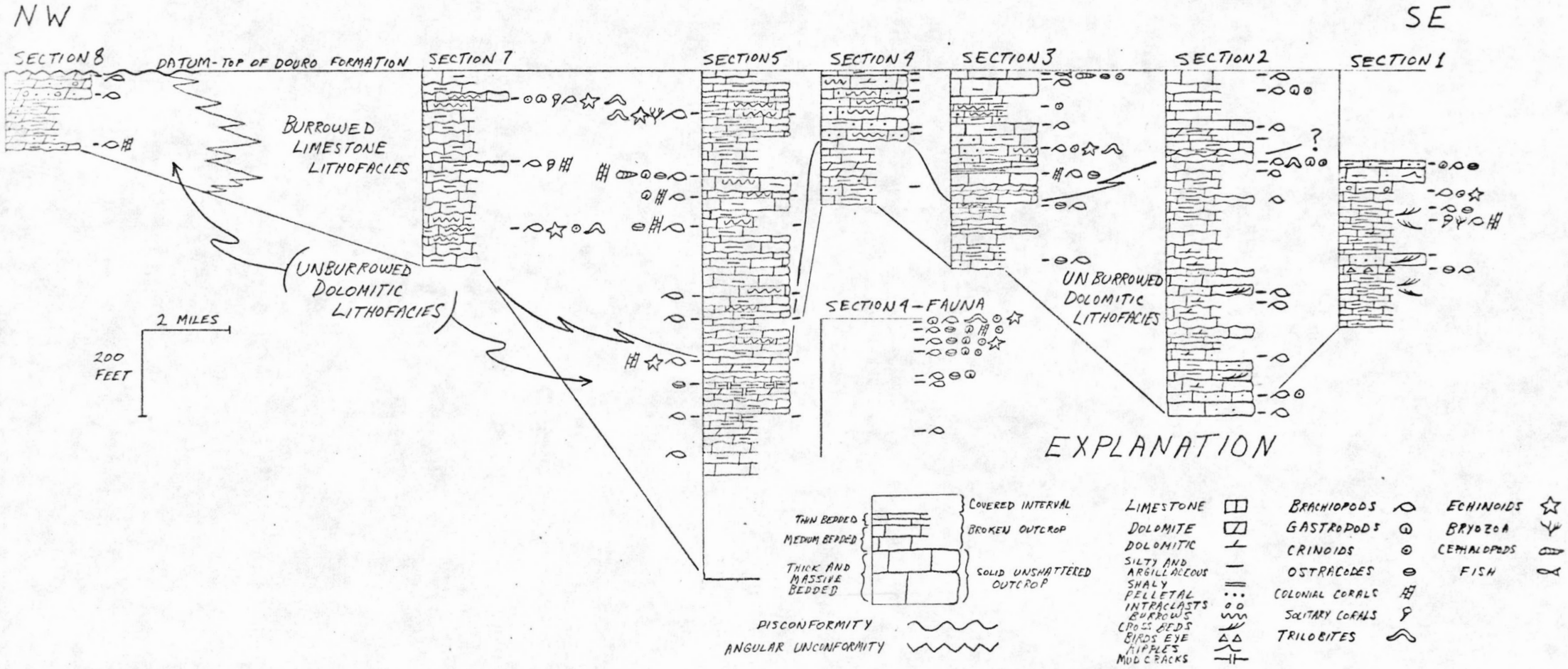

Figure 21 Stratigraphic cross-section of the Douro Formation.

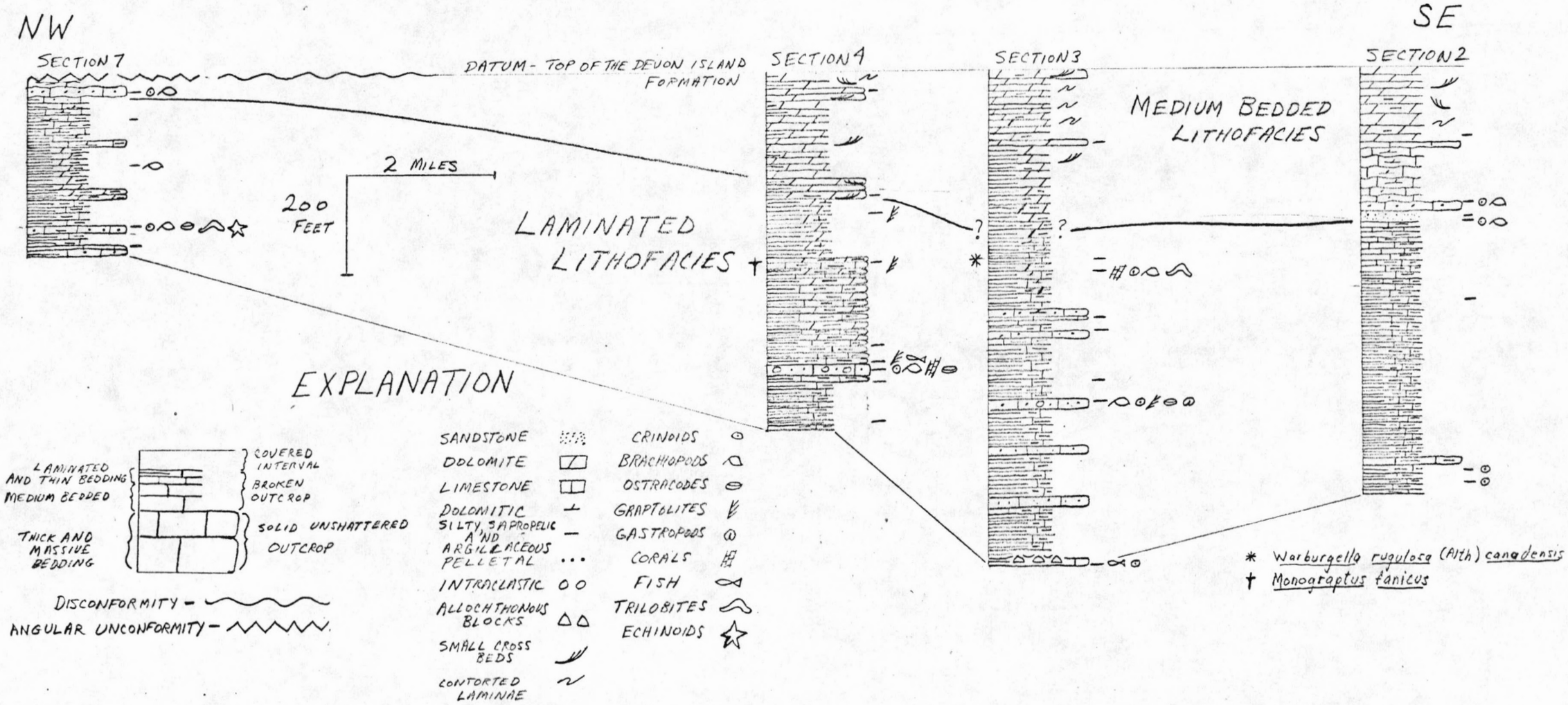

Figure 22 Stratigraphic cross-section of the Devon Island Formation.

DEPOSITIONAL MODEL FOR THE DEVON ISLAND FORMATION

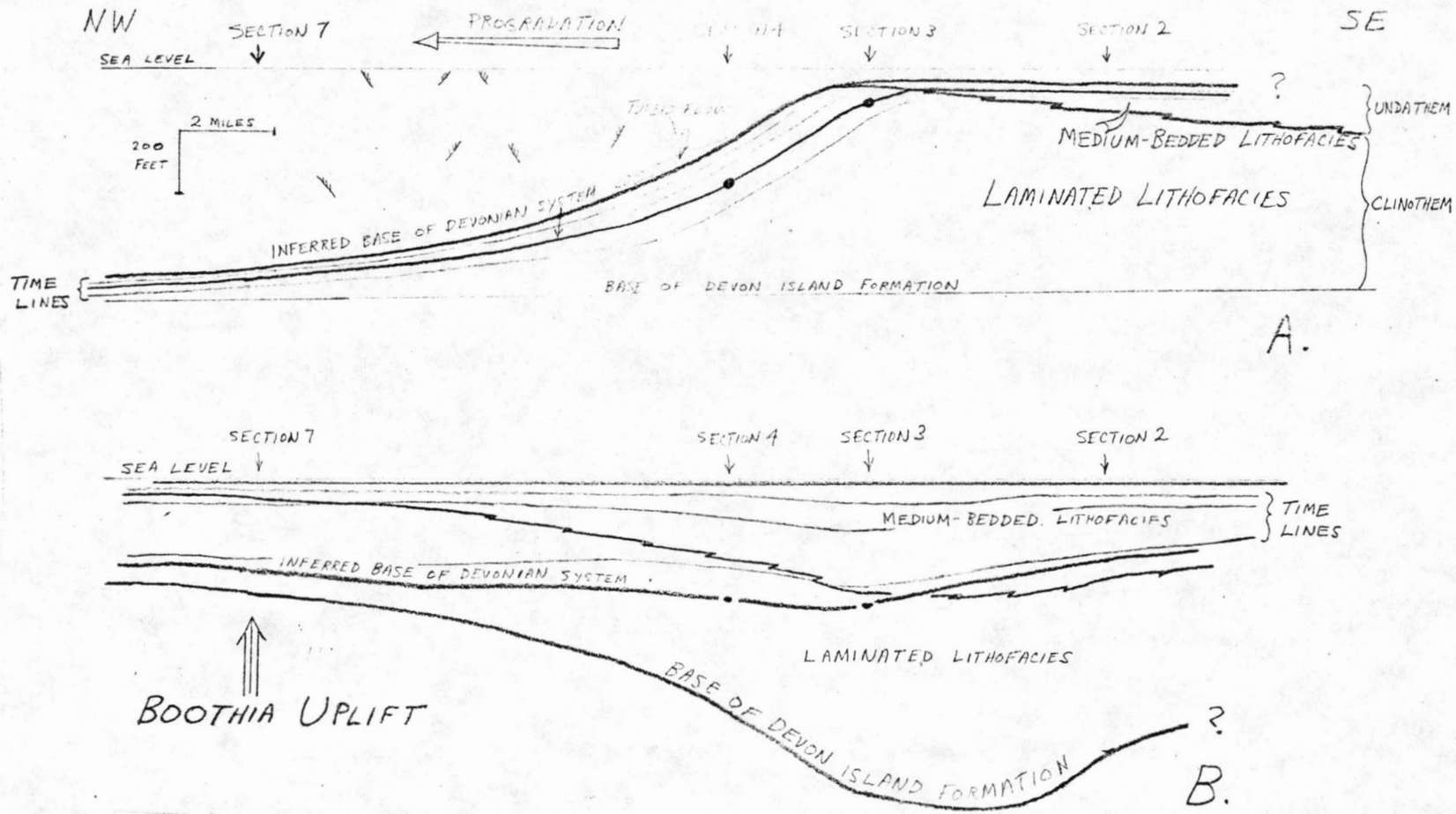

Figure 23 Diagram A is a conceptual representation of sedimentation during deposition of the lower part of the Devon Island Formation. The laminated lithofacies may have been the foreset beds of a northwesterly prograding shelf clinoform, whereas the medium-bedded lithofacies may have formed the topset beds. In Sections 3 and 4 the inferred base of the Devonian System is derived from faunal evidence (Fig. 21) and represents a depositional slope of about one degree. A rise of the Boothia Uplift to the west, as shown in Diagram B, may have ended the northwest advance of the Devon Island clinothem and initiated shallow-water sedimentation.

RESTORED STRATIGRAPHIC CROSS SECTION OF THE CAPE STORM, DOURO, AND DEVON ISLAND FORMATIONS

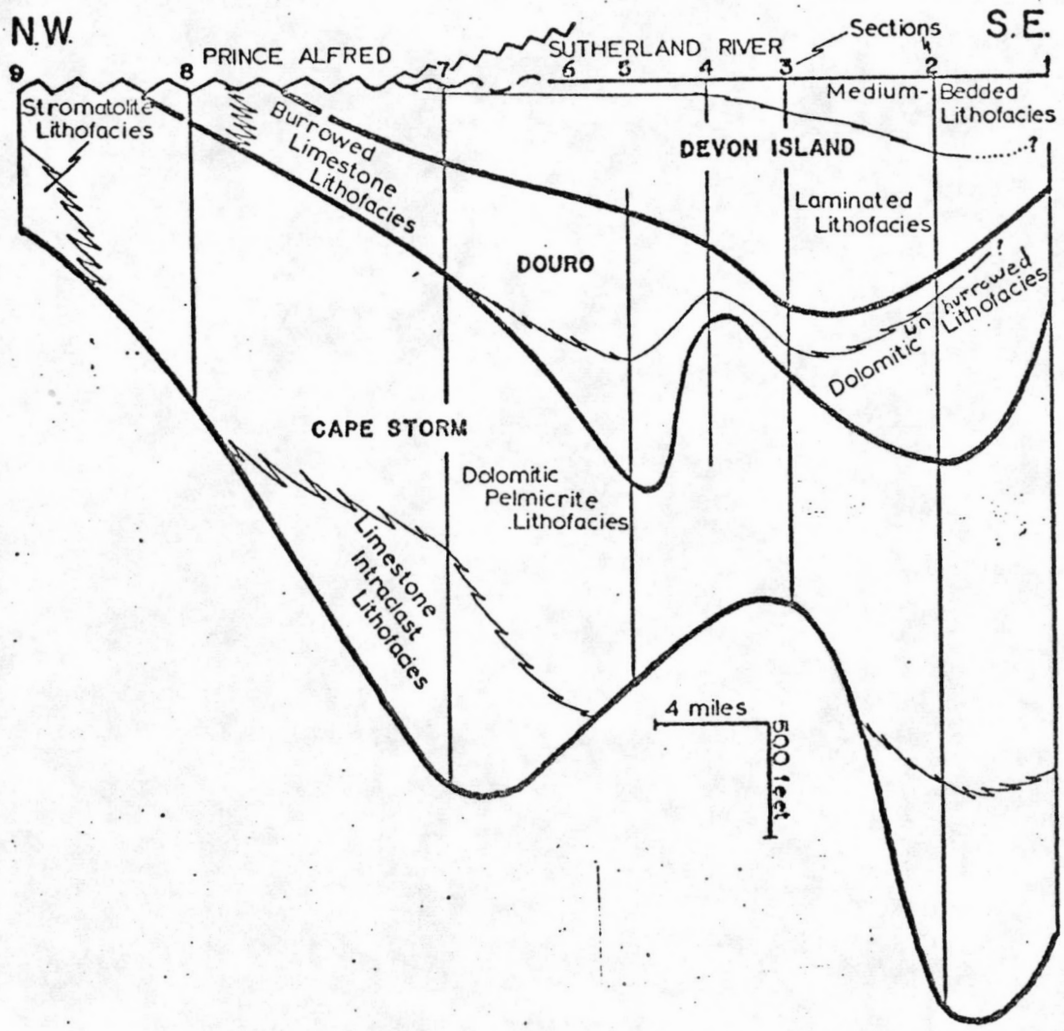

Figure 24. Restored stratigraphic cross-section of the combined Cape Storm, Douro, and Devon Island Formations with the base of the Sutherland River Formation as a datum. Where the Sutherland River Formation is absent, the base of the Prince Alfred Formation is used as a horizontal datum. The Boothia Uplift and Boothia Uplift-related positive features may have caused many of the thickness variations evident in this diagram.

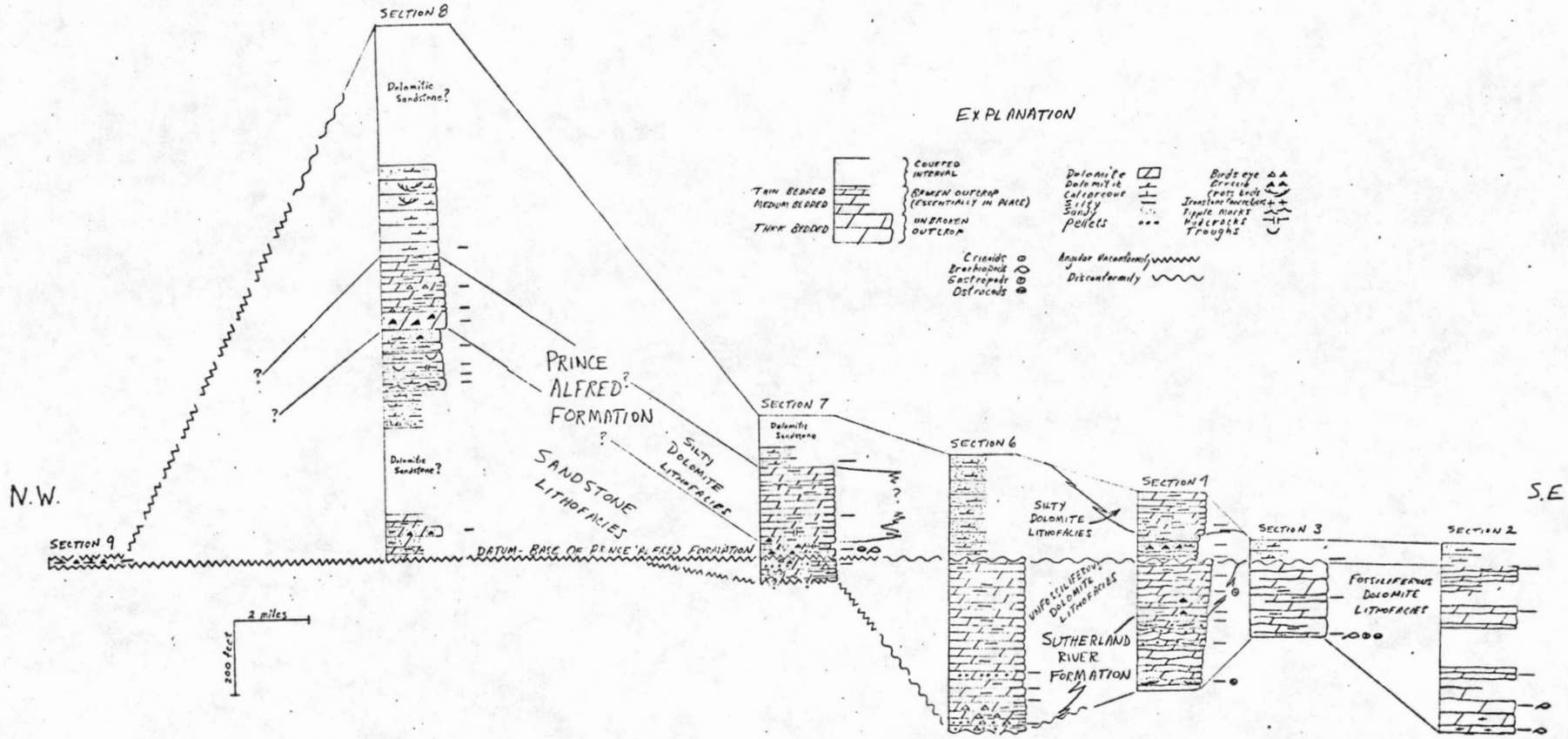

Figure 25 Stratigraphic cross-section of the combined Sutherland River and Prince Alfred Formations.

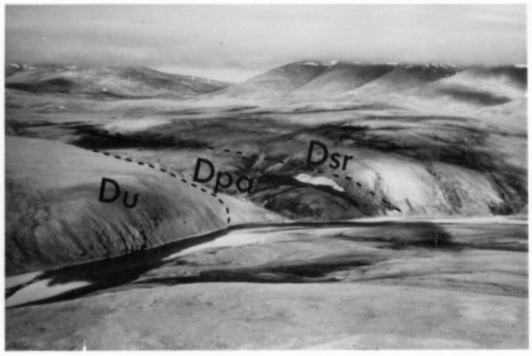

Figure 26. View of the Sutherland River (Dsr) and Prince Alfred (Dpa) Formations northeast from Section 4 across Sutherland River. Note the very pale weathering of the Sutherland River Formation

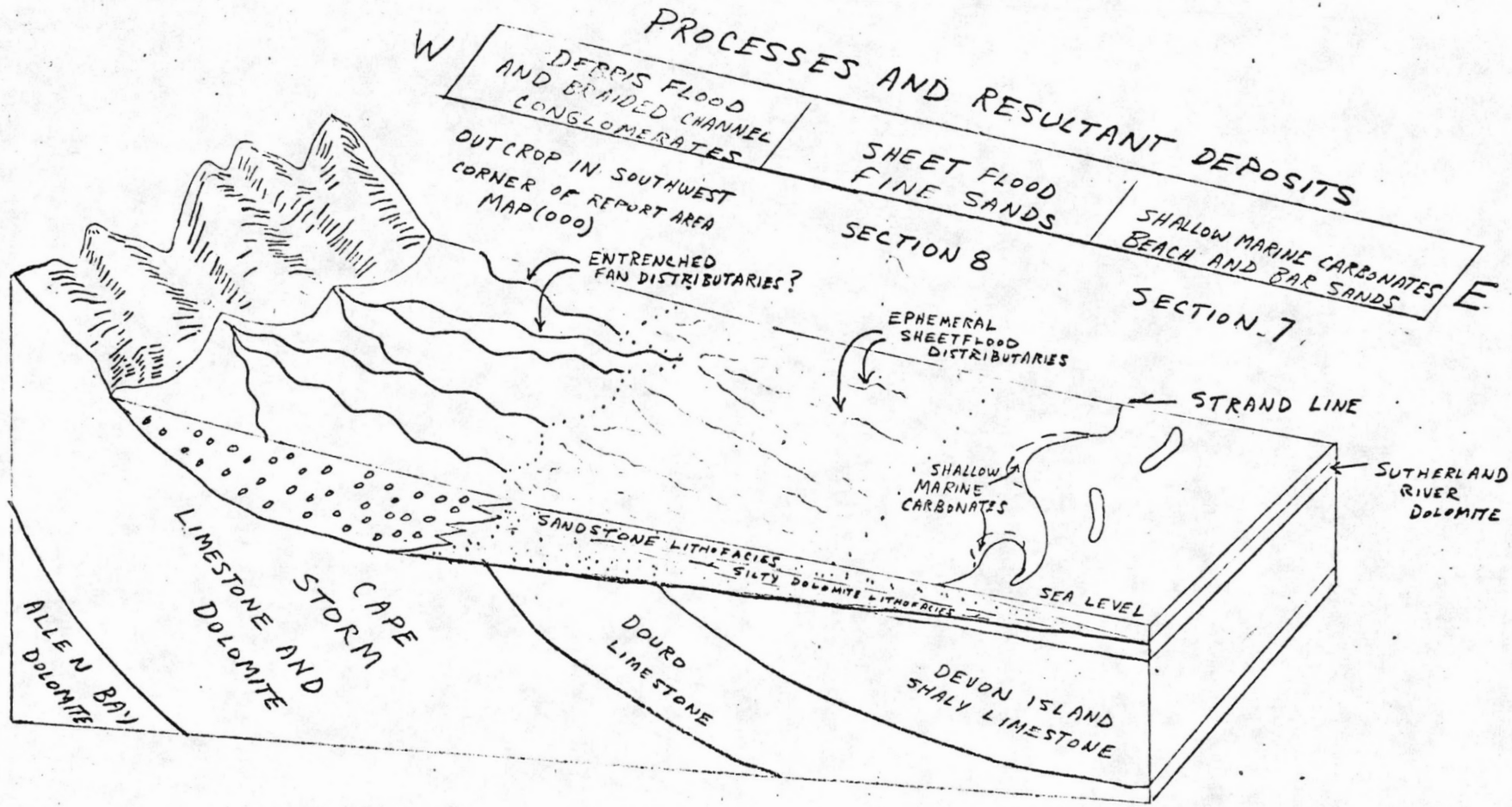

Figure 27 Conceptual model for deposition of the Prince Alfred Formation. The Boothia Uplift has exposed Lower Paleozoic carbonates in mountainous terrain to the west. This resulted in the construction eastward of an alluvial fan complex that encroached on areas of marine deposition.

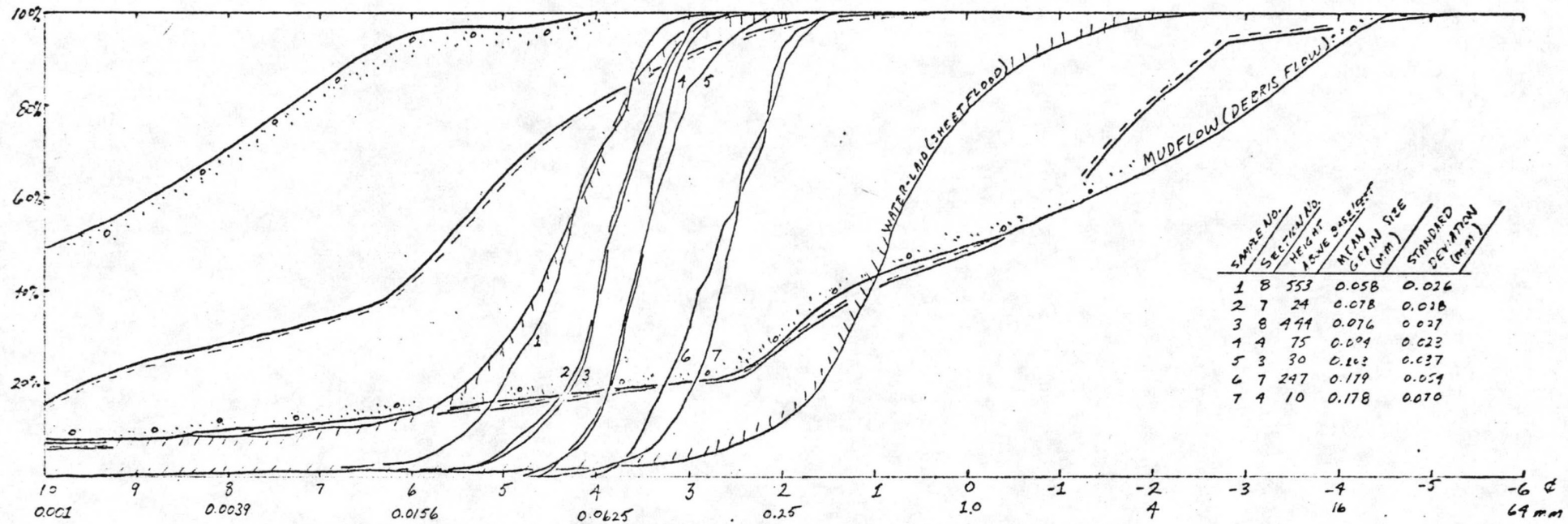

Figure 28. Cumulative curves of the grain-size distributions of seven samples from the Prince Alfred Formation. These grain-size distributions fall almost entirely within the domain defined by the cumulative curves of grain-size distributions of water-laid ephemeral sheetflood deposits that constitute part of the modern alluvial fans in the San Joaquin Valley in California, U.S.A. (adapted from Bull, 1963). Mud-flow or debris-flow deposits display much poorer overall sorting.

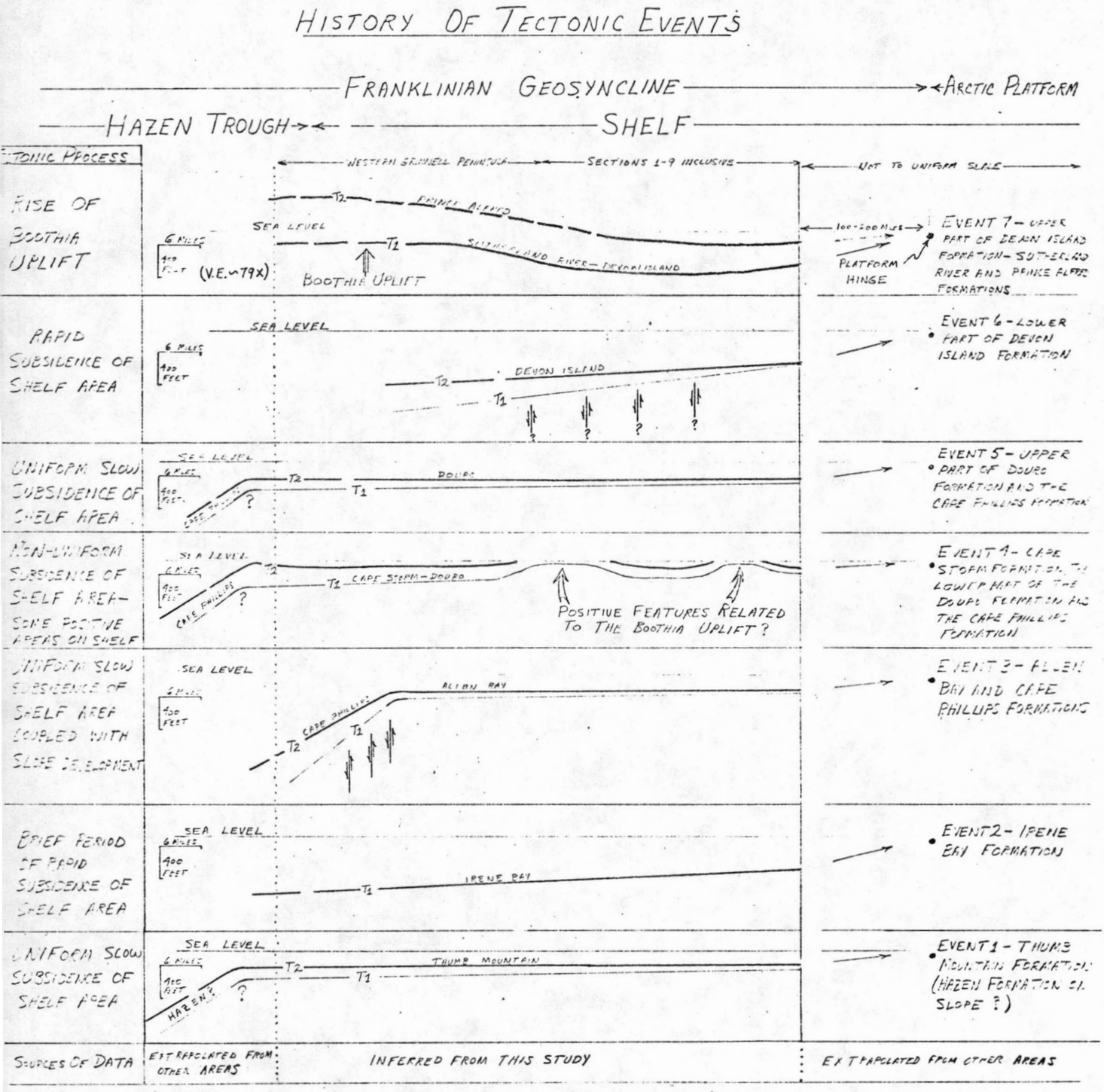

Figure 29. Diagrammatic representation of a sequence of tectonic events inferred from the stratigraphy and sedimentology of the Paleozoic units involved. T_1 and T_2 are arbitrary time lines. Time lines that are in the position of depositional interfaces are emphasized, whereas buried ones are not. The distance between T_1 and T_2 for each formation is meant to represent an equal increment of time.