Pleistocene Deposits Exposed Along the Yukon Coast

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ABSTRACT. Four measured sections of unconsolidated Pleistocene strata exposed on the Yukon coast between Shingle Point and Herschel Island are described. The sediments have suffered ice thrust deformation and are unconformably overlain by fluvioglacial retreatal gravels. The results of palynological examination, study of mollusca and a new ^{14}C determination are discussed. Deformation of the coastal strata probably occurred between 37,900 years and 9,510 years ago.

RÉSUMÉ. *Dépôts pléistocènes mis à jour le long de la côte du Yukon.* Les auteurs décrivent quatre sections mesurées de strates pléistocènes non consolidées, mises à jour sur la côte du Yukon entre Shingle Point et l'île de Herschel. Les sédiments ont subi une déformation de poussée glaciaire et sont recouverts en discordance par des graviers de retrait fluvio-glaciaire. On discute les résultats d'un examen palynologique, de l'étude de mollusques et d'une nouvelle datation au ^{14}C. La déformation de ces couches côtières s'est probablement produite entre 37,900 et 9,510 a.p.

РЕЗЮМЕ. *Обнажения плейстоценовых отложений на берегах Юкона.* Описаны четыре разреза рыхлых формаций Плейстоцена, обнаженных на берегу Юкона между Шингл пойнт и островом Гершеля. Отложения подверглись боковому давлению со стороны ледника и находятся в несогласованном залегании с флювиогляциальным галечником. Обсуждаются результаты изучения ископаемой пыльцы, моллюсков, а также результаты применения нового радиокарбонового метода. Деформация береговых слоёв произошла, по-видимому, от 37900 до 9510 лет назад.

INTRODUCTION

Unconsolidated sediments are exposed along much of the Yukon coastline between Shingle Point and Herschel Island (Fig. 1A). The strata in that area show extensive ice-thrust deformation as described and figured by MacKay (1959). The authors' observations agree substantially with those of MacKay regarding the lithologies and bed attitudes of the coastal exposures between Shingle Point and Herschel Island but add in this paper detailed notes on some aspects of the deposits.

DESCRIPTION OF SECTIONS

Four measured sections (1 — 4, Fig. 1A) form the basis of these notes. Mapping (1:50,000) and spot sampling by helicopter were carried out between the sections.

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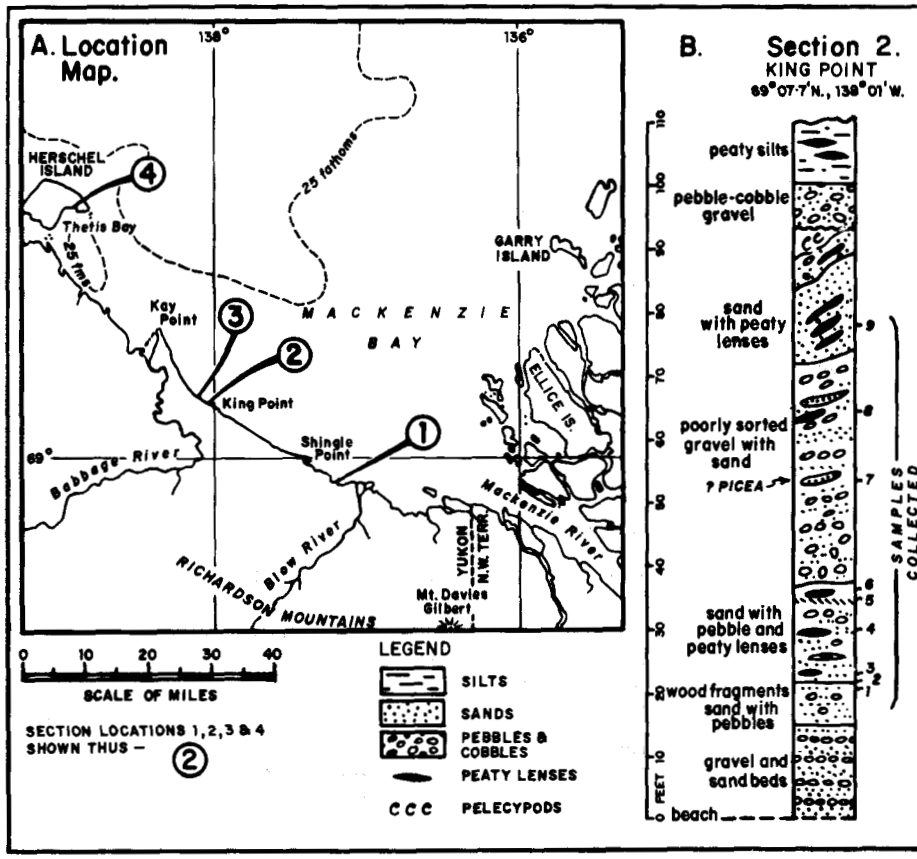

FIG. 1. A. Map of Yukon Coast showing location of sections; B. Details of the lithology of Section 2.

Section 1 (*68° 56.6'N., 137° 15'W.*). was measured in a gravel pit near the Shingle Point Dewline Station wharf. The pit is in the upper part of the gravel bank, rising 70 feet above the beach and the base of the gravel is not exposed. The pit exposes 35 feet of undifferentiated poorly-bedded gravel with silt and sand intercalations. The pebbles and cobbles are dominantly hard medium-grained sandstone. Wood fragments are common; no macro-fauna was observed. Five palynology samples (Table 1) were collected at regular intervals up the sequence.

Section 2 (*69° 07'N., 138° 01'W.*) is slightly over 1 mile west of the lagoon at King Point; it is thus probably immediately west of the cliff sections figured by MacKay (1959). Owing to ice-thrust folding detailed correlation between cliff sections is not possible and the exact stratigraphic relationship between Sections 2 and 3 is not known. The examined strata between King Point and Herschel Island all appear to be part of a large stratigraphic unit whose base is nowhere exposed.

Section 2 is divisible into small units (Fig. 1B), although the contacts between them are gradational.

Unit	Description	Unit Thick (ft.)	Height Above Beach (ft.)
G	Silts containing fibrous peaty material	10	110
F	Poorly sorted pebble and cobble gravels	7	100
	ANGULAR DISCORDANCE		
E	Fine to medium grained sands with peaty clay and silt lenses. Broken pelecypod shells	20	93
D	Sub-rounded gravel, pebble to cobble grade. Some sand lenses and one tree trunk (? *Picea*)	26	73
C	Well-bedded medium-grained sands with 2"-4" clay peat layers and pebble bands. Sand trough cross-bedded in part	16	37
B	Medium-grained sand with pebble layer at top containing twigs and leaves (Sample 1)	6	21
A	Alternating layers (3 inches to 1 foot) of medium- to coarse-grained sand and poorly sorted rounded pebble gravel	15	15

A sample of the wood from Unit B (Sample 1) was submitted for radiocarbon dating at the Department of Geology, University of Birmingham, England. The age in years (sample reference Birmingham 115) given was 37,900 (+2,800 to 2,100). Between Units E and F in this section there is a strong angular discordance. Beneath this level the beds are slightly deformed by ice thrusting whilst the overlying gravels appear to be unaffected. This appears to be plane of unconformity rather than a thrust plane of the type described by MacKay and it is exposed at various points between King Point and Herschel Island.

Section 3 (*69° 07.2'N., 138° 05'W.*) 2 miles to the west of Section 2, exposed approximately 60 feet of silt with fewer gravel layers than in Section 2. The silts are peaty in places and contain thin lenses of pebble gravel and specimens of *Astarte borealis* Schumacher. Seven samples (Table 1) were collected in regular ascending sequences up the cliff at 10 foot intervals (Sample 1 at beach level at the base of the cliff, Sample 7 at the top). Gravels are not exposed at the top of the cliff.

Section 4 (*69° 34'N., 138° 55'W.*) on Herschel Island is on the north side of Thetis Bay. Silty sand containing scattered pebbles forms a 40-foot cliff above the beach. Shells and shell fragments occur throughout the deposit and samples were collected. A bank rising a further 60 to 80 feet above the lower cliff is less well exposed but appears to be composed of the same sediment type. Four palynology samples (79-82) were taken at 10 foot intervals in the lower cliff, beginning 10 feet above the beach, and one other approximately 70 feet above the base of the section (Table 1).

PALYNOLOGY

The pollen and spores found in the 26 samples examined from Sections 1 to 4 are recorded in Table 1, either as percentages or presence only. Pollen diagrams have not been drawn because of the wide spacing of the samples and the inadequate pollen floras.

TABLE 1. Pollen and Spores from sections along the Yukon Coast

	Sample Number	Grains Counted	Pollen and Spore Percentages																
			Pinus	*Picea*	*Larix*	*Betula*	*Alnus*	*Salix*	Gramineae	Ericaceae	Cyperaceae	*Artemisia*	Compositae	Unknown NAP	Other NAP	Unknown Spores	*Lycopodium annotinum*	*L. selago*	*Sphagnum*
			Arboreal Pollen						Non Arboreal Pollen							Spores			
Section 2 King Point																			
	9	63	1	84	5				2	3				1			2		2
	8	42		19		24	7	9	5	5	5			2					26
	7	69		21	1	22	1	1	3	9	7		1	9		4			21
	6	38		87										2		9			2
83 ft.	5	19		+					+		+	+		+		+			
	4	12		+		+			+			+		+		+			
	3	10		+		+					+			+		+			+
	2	13				+	+	+			+			+	Ch	+			+
	1	17	+	+	+	+		+	+	+				+					
Section 3 King Point																			
	7	5		+															+
	6	122	1	38		15	2	2	2	4			2	8	Ch, Ca	5			21
	5	21		+	+	+	+							+		+			+
60 ft.	4	36		8		43	3	11	9	3				4					19
	3	11		+	+									+		+			
	2	9		+	+									+		+			
	1	31		36		17			10		26			3		4			4
Section 4 Herschel Is.																			
	83	9		+				+			+		+	+		+			
	82	146		58		8	3	+	2	1	3	8		+		7	9	+	+
ca. 100 ft.	81	86		48		12	1	2	5	3	3	4	5	3	Ch	8	3		1
	80	28		67		14			4	4	4					4	3		
	79	80	1	6	9	21	1	5	5		6	1	7	20	Ch	6	1	1	1
Section 1 Shingle Pt.																			
	5	376		27		7	19	3	3	3	1	1	2	9	T, Ca	8	6		10
	4	4		+															
70 ft.	3	181	+	83		3	3		+	+	+	+	1	+	Ep	+	4		1
	2	76		53		1										16	30		
	1								No Pollen										

+ Present; Ep Epilobium; Ca Caryophyllaceae; Ch Chenopodiaceae; T Typha.

Most samples contain abundant finely-comminuted woody and cuticular tissue which obscures many pollen grains and makes them difficult to concentrate. This is particularly so in samples from peaty layers and lenses of plant detritus. Pollen preservation is good, even in those samples with extremely low pollen content. Pollen, spores and dinoflagellates reworked from Lower and Upper Cretaceous deposits occur commonly. Some Paleozoic spores also occur.

In microfloras from Sections 2 and 3 (King Point) and Section 4 (Herschel Island) the dominant pollen is usually *Picea*. Pollen of *Betula* is usually present and in a few samples is dominant. Pollen grains of other genera, e.g., *Salix* and *Alnus*, are occasionally abundant (see Table 1).

The microfloras of Sections 2, 3 and 4 are considered to be of Pleistocene age and are similar to post-glacial and Late-Wisconsin microfloras recorded from the Yukon and Northwest Territories by Terasmae (1968), Terasmae and Hughes (1966), MacKay and Terasmae (1963) both in the paucity of species and the dominance and abundance of *Picea* and *Betula*.

The pollen assemblages of Section 1 (Shingle Point), which is probably post-glacial in age, are similar to those from King Point and Herschel Island. The microfloras from all 4 sections indicate cool conditions and were probably shed by vegetation similar to that now growing in the Mackenzie Delta area. It was not possible to establish any microfloral zones in the sections examined and the

Picea and *Betula* dominated pollen assemblages in the 4 sections could not be correlated. The changes in *Picea* and *Betula* dominance represent vegetational changes which are probably caused by minor climatic fluctuations. The increase of *Betula* suggests a cooling trend whereas *Picea* increase indicates a warming trend.

MOLLUSCA

A collection of Mollusca from the lowermost 40 feet of Section 4 on Herschel Island contains the following species:

Solariella obscura (Couthouy 1838). One small shell referable to the var. *bella* Verkruzen 1875. MacGinitie (1959) records the species as living at Point Barrow, Alaska.

Tachyrhynchus erosus (Couthouy 1838). A single shell.

Astarte borealis (Schumacher 1917). Three valves, a few hinge-fragments, and about 7 other fragments.

Astarte montagui (Dillwyn 1817). One imperfect valve. Dall (1919) does not record this species in his account of the Recent Mollusca of the Canadian Arctic Expedition of 1913-18, but does record *A. fabula* Reeve 1855 which MacGinitie (1959) considers to be a varietal form of *montagui*.

Astarte alaskensis (Dall 1903). One valve, H.24 mm. L. 30 mm. (from anterior to posterior).

Macoma calcarea (Gmelin 1792). Several small valves; a complete one measured H.10 mm. and L.13 mm.

Macoma incongrua (von Martens 1865)? Two valves in good condition (H.12 mm. L.16 mm.) still retaining much of the periostracum. MacGinitie (1959) records the species from Point Barrow, Alaska.

Ptychotractus occidentalis (Stearns 1871). One small specimen. Dall (1919) gives its range as Bering Island, Bering Sea, and E. to the Shumagin Islands, Alaska.

Dall (1919) and MacGinitie (1959) have recorded all the 8 species listed above as Recent species along the coast of Alaska and arctic Canada. Dall (1919) reporting on the Pleistocene Mollusca obtained on the Canadian Arctic Expedition of 1913-1918 comments "They belong to species now living in adjacent waters which form part of the Western Arctic fauna." The Herschel Island material certainly lends support to this statement.

DISCUSSION

The Yukon coastal plain as far west as Herschel Island and the Lower Firth River (MacKay 1959) has been glaciated. Ice moved down the Mackenzie valley to the coast without crossing the Richardson Mountains. It spread across the Mackenzie Delta and moved northwestwards along the coast, deforming the coastal strata. MacKay (1959) also suggests that Herschel Island, which rises to almost 600 feet a.s.l. was thrust into position by the ice excavating Herschel Basin, an unusual seafloor depression to the southeast of the Island (Fig. 1A).

Dyck *et al.* (1966) record a ^{14}C date (superseding an earlier determination from the same sample by Dyck and Fyles (1964)) of more than 51,000 years for

wood and peaty samples collected 2 feet above the base of the sea cliff 3.5 miles east of the east end of King Point spit. The samples appear to be from sands and silts broadly correlative with the deformed sediments (described in Sections 2 and 3 above) in the cliffs west of King Point. These are overlain in succession by till, sand and silt and surface peat. A sample from silts 4 feet above the till 0.2 miles further west (Dyck and Fyles 1964) yielded an age of 9,510 ± 170 years B.P. (7,560 B.C.). The most westerly exposure of the till is in the coastal bluff at the western end of the sandspit at King Point (O. L. Hughes, personal communication). East of King Point the till is apparently conformable on the underlying undeformed sediments and is overlain in turn by fluvioglacial retreatal gravels and silts. This gravel layer is continuous with the gravels which rest unconformably on the truncated and deformed strata west of King Point and with those at Section 1. The same gravels occur as a sheet over much of the coastal plain east of Herschel Island (see also Rampton 1969) and are well exposed along the banks of the Blow River where they rest on folded, bevelled Mesozoic strata.

MacKay (1959, p. 11) considered the deformed King Point beds to be of probable Pleistocene age, but possibly older. The evidence from palynomorphs and mollusca from the measured sections points to a Pleistocene age for the strata. The ^{14}C date of 37,900 years (+2,800—2,100); i.e., 35,950 years B.C. obtained by the Birmingham laboratory poses a problem. Either the sediments from which the GSC-151 sample (Dyck *et al.* 1966) was taken, are older than the sediments in Section 2 (Fig. 1B), or one of the two carbon determinations is erroneous. Pretreatment of the Birmingham sample included a hot NaOH leach. The Libby Half Life was used and standard errors quoted are calculated by combining one standard deviation of C1 and B. A 6-litre gas proportional counter (15 lbs. per sq. inch) was employed. If the Birmingham determination is accepted then ice deformation must be younger than 37,900 years. The fluvioglacial retreatal gravels are equivalent in age to, or younger than, the sediment overlying the till which was dated (Dyck and Fyles 1964) at 9,510 years; that age is in general agreement with the view of MacKay and Terasmae (1963) that deglaciation in the Mackenzie Delta area occurred about 12,000 years ago. The evidence suggests that the deformed King Point beds were deposited during the long mid-Wisconsin interval (20,000 years to ? 50,000 years ago; Terasmae (1967)). Their deformation probably occurred during the last major ice advance of the Wisconsin. The undeformed till which overlies the same sequence of beds east of King Point, may represent this ice advance.

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