

A Late-Pleistocene Glacial Sequence from Prince of Wales Island, Alaska

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ABSTRACT. Evidence of two late-Pleistocene glacial advances is exposed in Maybeso Creek valley. A cemented "younger" till with a shallow weathered zone directly overlies a thoroughly leached and partly oxidized "older" till. The younger till was deposited by a glaciation of regional extent representing the last major glacial advance of classical Wisconsin age in southeast Alaska. The older till may also represent a regional glaciation, tentatively correlated with an intermediate to early-late Wisconsin age.

Four recessional moraines in the valley record dying pulsations of the glaciation that deposited the younger till during the early part of the late glacial interval preceding the Hypsithermal.

RÉSUMÉ. *Séquence glaciaire fini-pléistocène sur l'île du Prince-de-Galles, Alaska.* Des preuves de deux avancées glaciaires fini-pléistocènes apparaissent dans la vallée du ruisseau Maybeso. Un till cimenté "plus jeune", avec une mince zone météorisée, recouvre directement un till "plus vieux" complètement lessivé et partiellement oxidé. Le till plus jeune a été déposé par une glaciation d'extension régionale représentant la dernière avancée glaciaire majeure de l'âge Wisconsin classique dans le sud-est de l'Alaska. Le till plus vieux pourrait aussi correspondre à une glaciation régionale, que l'on pourrait relier à un âge Wisconsin intermédiaire ou fini-ancien.

Dans la vallée, quatre moraines de récession marquent les dernières pulsations de la glaciation qui déposa le till plus jeune au cours de la première partie de l'interglaciaire précédant l'Hypsithermal.

РЕЗЮМЕ. *Позднеплейстоценовые ледниковые отложения на о. Принца Уэльского (Аляска).* Следы двух наступлений ледника позднеплейстоценового возраста были обнаружены в долине Мэйбесо Крик на о. Принца Уэльского (Аляска). Сцементированные ледниковые отложения с тонким выветренным слоем непосредственно перекрывают сильно выщелоченный и частично окисленный тилль более раннего возраста. Первые отложились во время регионального оледенения, представляющего собою последнее крупное наступление ледника классического Висконсинского возраста в юго-восточной Аляске. Возможно, что и подстилающие отложения свидетельствуют о региональном оледенении среднего или более позднего Висконсинского возраста.

Четыре конечных морены отступающего ледника в той же долине свидетельствуют о затухающих пульсациях оледенения, отложившего верхний тилль в ранней стадии позднеледникового интервала, предшествующего гипсистермальному периоду.

INTRODUCTION

Evidence of two Wisconsin glacial advances was discovered during engineering geology investigations in Maybeso Creek valley, Prince of Wales Island, Alaska. Stratigraphic position and the differences in degree of weathering of these two

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tills suggest a correlation of the deposits with late-Wisconsin advances. The discovery of these deposits complements glacial sequences previously reported in southeast Alaska by Sainsbury (1961) from the northeast portion of the Craig quadrangle, Prince of Wales Island, and Miller (1963) from the Taku River area (Fig. 1).

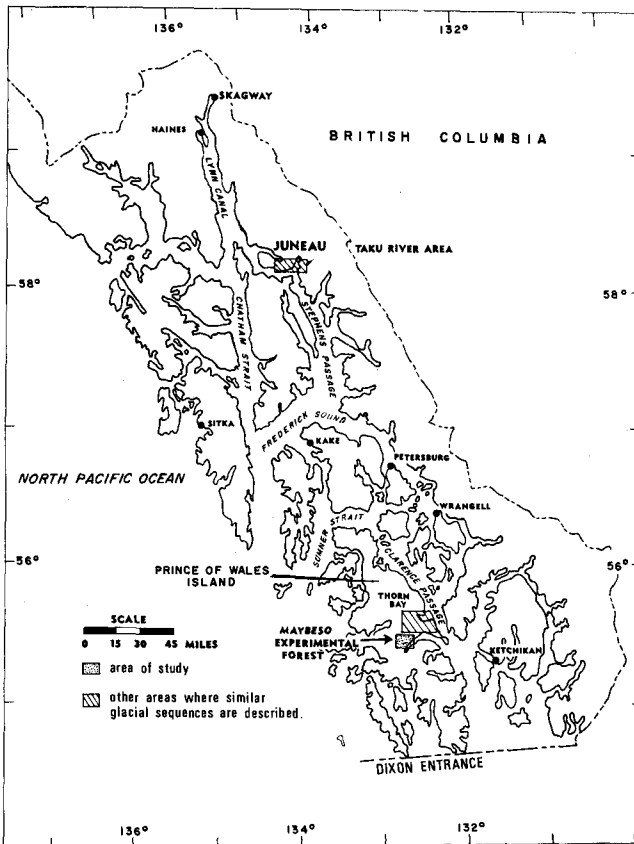


FIG. 1. Location of the Maybeso Creek valley and other areas in southeast Alaska where similar glacial sequences have been described.

STUDY AREA

The Maybeso Creek watershed is located on the east coast of Prince of Wales Island, about 45 miles west of Ketchikan, Alaska (Fig. 1). It is a typical U-shaped glacial valley, veneered with glacial till of variable thickness. Underlying bedrock consists of interbedded graywacke, black argillite, and andesite striking northwest and dipping steeply to the southwest. These units are intruded locally by granite and quartz diorite stocks. The axis of the valley trends northwest, apparently controlled by strike of the underlying bedrock. The present climate is temperate maritime, with a mean annual temperature of 44°F. and mean annual precipitation of 108 inches. Principal vegetation is old-growth Sitka spruce and western hemlock with scattered areas of muskeg.

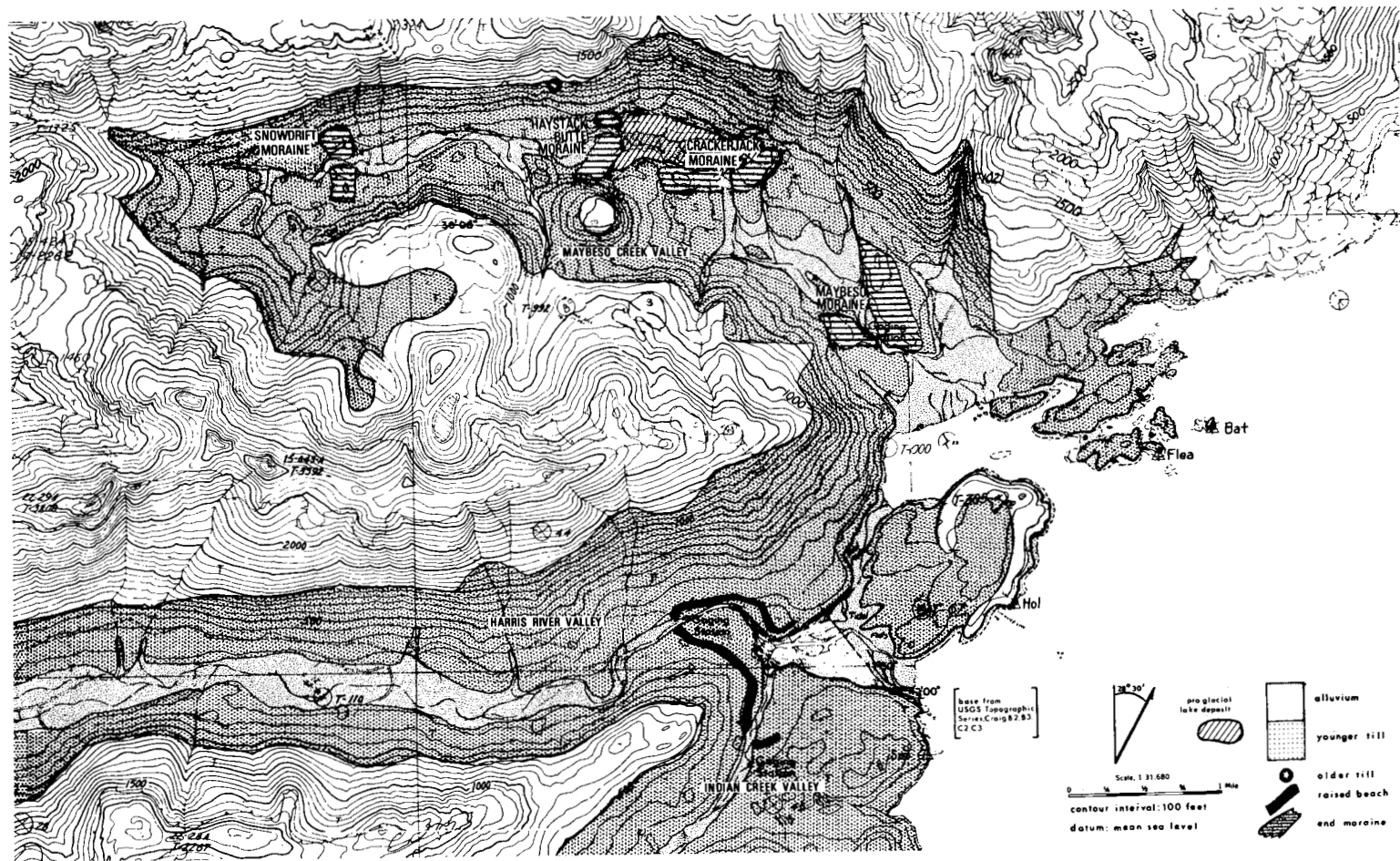


FIG. 2. Late-Pleistocene deposits in Maybeso Creek valley and the lower part of Harris River valley, Prince of Wales Island, Alaska.

GLACIAL GEOLOGY

Two tills of probable late-Pleistocene age are exposed in the valley (Fig. 2). The younger is a blue-gray, compacted till weathered to a maximum depth of 3 feet. It is represented in the valley by well-developed end moraines, drumlinoid features, and extensive ground moraine deposits. The till is variable in thickness, ranging from less than 1 foot on bedrock bosses and benches along the valley flanks to as much as 30 feet in subsequent side valleys filled with till during the last glacial expansion and now being re-excavated by running water. The younger till extends up to 1,500 feet above sea level. The upper limit is marked by a shoulder that can be traced intermittently along the Maybeso Creek valley flanks and into the neighbouring valleys. Four recessional moraines, composed of the younger till, mark periods of stillstand during final retreat of the latest glacier from the valley. The older formation is represented in the valley by a remnant deposit of strongly weathered, light-brown *till* exposed at an elevation of 350 feet in a rock quarry near the valley floor. No distinct soil horizons or organic material were found in the till remnant, and it was directly overlain by the younger till (Fig. 3). Scattered patches of a light-brown till, similar in lithology to the older

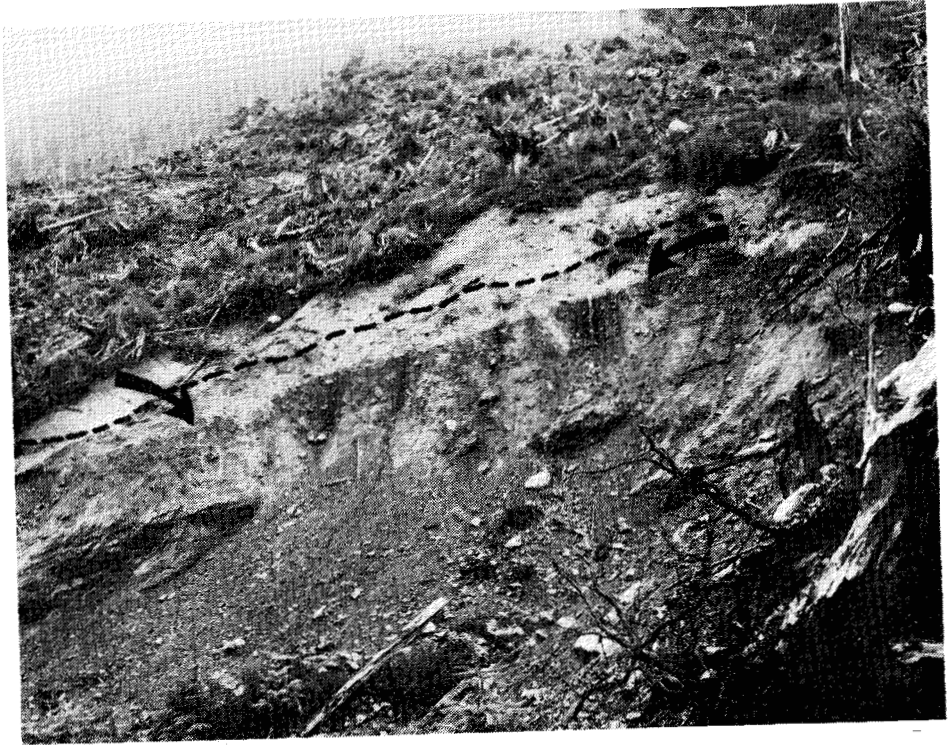


FIG. 3. Till sequence exposed in a gravel quarry in the upper valley. Note the distinct textural and tonal differences between the two tills. The older till has been thoroughly leached, and oxidation has turned the material to a light brown. No discernible soil horizons occur. The overlying younger till is blue gray, compact, and highly calcareous with a shallow 2-ft. zone of podzolization near its upper surface. Slumping has covered much of this soil zone, but its approximate lower limit is marked by a dotted line.

till, are found above the upper limit of the younger till along the flanks of the valley, and may be correlates of the older till.

Regionally, the ridges and summits below 3,000 feet have been modified by overriding ice. Diorite and quartz diorite erratics associated with this high-level glaciation are common on the rounded ridges and lower summits surrounding the valley. Sainsbury (1961) reports similar erratics and patches of an older high-level till north of the valley.

The Older Till

The older till is coarse, consisting of semirounded to rounded cobbles and pebbles of diorite, andesite, graywacke, and black argillite in a matrix of silty sand. The predominant rock type is black argillite. Faceting and striations were often observed on the boulders, cobbles, and pebbles of diorite and graywacke. In the single observed deposit, scattered pebble orientation measurements indicated an apparent fabric, oriented at a slight angle to the valley axis and plunging into it (Fig. 4).

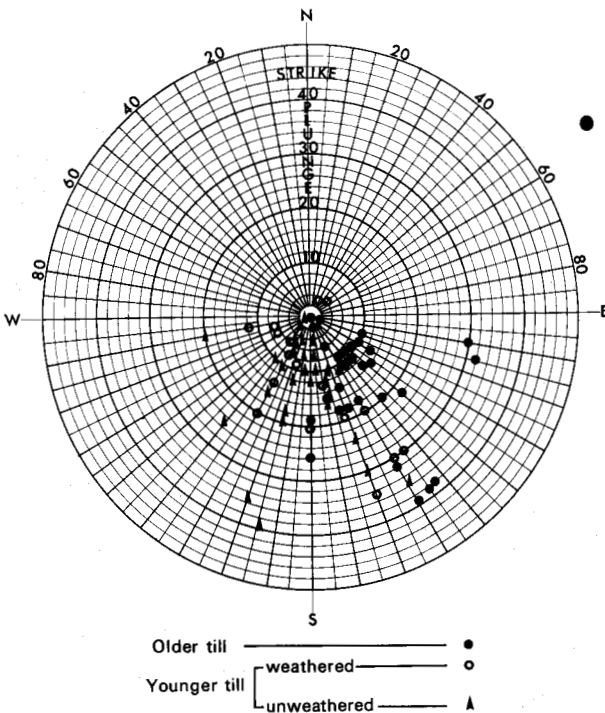


FIG. 4. Apparent fabric of the older and younger till as determined from random sampling at 3 scattered sites in the lower part of the valley. There is a difference in fabric strike of the 2 tills which may reflect gross differences in flow characteristics of the masses that deposited the tills.

Thorough leaching and particle surface oxidation suggest that the exposed remnant is a portion of the B horizon of a fossil till soil truncated by advance of the glacier that deposited the younger till. The absence of a measurable weathered rind on the boulders, cobbles, and pebbles in the older till indicates the period of weathering to have been of moderate duration.

The occurrence of isolated patches of what appear to be older till above the younger till limit along the upper valley flanks suggests deposition of the older till by the high-level, more vigorous glaciation that overrode the ridgetops and lower summits surrounding the valley. Sainsbury (1961) has correlated a similar older till with this high-level glaciation in the northeastern portion of the Craig quadrangle.

The Younger Till

The younger till in its unweathered condition is bluish gray and is very hard and impermeable. This indurated condition is due partly to compaction and partly to calcium carbonate cementation. The till contains a large number of rounded boulders, cobbles, and pebbles of graywacke and diorite with smaller amounts of semirounded to angular black slate fragments. These are all embedded in a matrix of calcareous silty sand. Pebble orientations measured with a Brunton compass at three sites in the valley indicate an apparent till fabric oriented at a slight angle to the valley axis and plunging into it (Fig. 4). Striations in the bedrock directly beneath the younger till also plunge into the valley at acute angles. The orientation and plunge of the fabric and striations indicate a general ice movement from west to east suggesting a local ice source westward in the highland at the centre of Prince of Wales Island.

The till is weathered to an average depth of 3 feet. The weathered zone is weakly podzolized and is designated as part of the Karta soil series (Gass *et al.* 1967), a soil typically developed on glacial till in coastal Alaska.

Age Relationships

A raised marine beach at an elevation of approximately 30 feet directly overlies the younger till near the mouths of Indian Creek and Harris River south of the Maybeso Creek valley (Fig. 2). Sainsbury (1961) reports marine shell fragments from the till near the mouth of Maybeso Creek valley which may be related. He also reports a similar raised marine beach approximately 50 feet above sea level, overlying younger till at Coal Bay, approximately 3 miles east of Maybeso Creek valley near the mouth of Twelvemile Arm. The Indian Creek-Harris River deposit occurs as a beach terrace looping across the valley mouths. As a distinct entity, the terrace disappears near the mouth of Maybeso Creek valley. Evidence has been found, however, of a continuation of the beach deposit across the mouth of the valley. Auger holes, drilled in front of the outermost recessional moraine as part of a road relocation survey [Alaska Department of Highways, Project S-0924 (1)], indicate a subsurface deposit of silty sand overlapping the moraine at an elevation of approximately 30 feet from which marine shell fragments have been reported.

The best exposure of the raised marine beach is in a streambank about 1 mile from the mouth of Indian Creek. Exposed are bedded marine sands and silts, 8 feet thick, with numerous shells of recent pelecypods embedded in the silt layers. The pelecypods have been identified as *Clinocardium nuttallii* Conrad, *Saxidomus giganteus* Deshayes, *Macoma icongrua* Von Martens, *Macoma hasuta* Conrad, and *Macoma brota* Dall. These genera are cold-water forms with a

stratigraphic range of Jurassic to Recent. All are common to coastal Alaska today. The marine silts are overlain by 10 feet of coarse, crossbedded stream gravels topped by an organic layer. A carbon-14 date (I 1621) obtained from the shells embedded in the marine silt indicates that the beach was deposited on the younger till $9,510 \pm 280$ years before present. Deposition of the younger till must have occurred shortly before this time since no noticeable weathering had occurred on the till surface before the beach sediments were deposited.

Sainsbury (1961) described a blue-gray younger till of similar character from the northeast portion of the Craig quadrangle, Prince of Wales Island, and Miller (1963) identified a comparable till, the *upper drift* from the Juneau-Taku River area. Numerous deposits of a blue-gray till of the same character have also been observed by the present writer on the mainland and on most of the islands in the Alexander Archipelago. Thus the till probably represents the youngest deposit of regional extent in an area just recently deglaciated. Minimum limiting age of the till indicates it may correlate with till of the last major advance of Wisconsin age in the Cook Inlet area, approximately 10,500 years before present (Karlstrom 1961).

The older till directly underlies the younger till and has undergone a period of weathering and soil development of undetermined length following its initial deposition. No appreciable weathering rind was developed on the pebbles, cobbles, and boulders, however, as is correlated with early Wisconsin deposits underlying late-Wisconsin deposits elsewhere in the Pacific Northwest and Alaska (Karlstrom 1964; Crandell 1964). Thus, an age no greater than intermediate Wisconsin is indicated. The older till in Maybeso valley is similar in physical characteristics and stratigraphic relations to the older till of Sainsbury (1961), described in the northeast portion of the Craig quadrangle, and to a similar till deposit (the *basal drift*) located directly beneath blue-gray till in the Taku River area (Miller 1963, 1964).

Sainsbury (1961) has tentatively correlated his older till with a high-level glaciation extending to elevations of over 3,000 feet. Evidence in Maybeso Creek valley indicates a similar correlation of the older till with the high-level glaciation. Since this high-level glaciation is regional in extent, it may represent the southeast Alaska equivalent of the late-Wisconsin maximum reported in the Cook Inlet area by Karlstrom (1964) 15,000 to 20,000 years before present.

Final retreat of the latest glacier and the beginning of a major warming trend is evidenced by deposition of the 4 recessional moraines in the valley bottom. The oldest, here called the Maybeso Moraine, crosses the valley at its mouth. The extension of the raised beach in front of and onlapping the moraine indicates deposition of the moraine and withdrawal of the ice into the valley some time before beach deposition. The next moraine in the sequence, here called the Crackerjack Moraine, was probably deposited more than 8,000 years before present, a date inferred from a comparison of similarities in pollen stratigraphy and the equivalent location of ligneous peat horizons of a peat bog core taken in front of the moraine and radiocarbon dated cores taken elsewhere in the Alexander Archipelago and British Columbia by Heusser (1960). Heusser has correlated the regional climatic events recorded by these cores, with events occurring

during the major postglacial warming trend, the Hypsithermal interval, which he believes began approximately 8,000 years before present and culminated approximately 6,000 years before present. The Maybeso and Crackerjack Moraines were deposited before the Hypsithermal and are here tentatively correlated with a late glacial period defined by Heusser which lasted about 2,000 years from approximately 10,000 to 8,000 years before present in southeast Alaska. No dates can be directly applied to the deposition of the third moraine in the sequence, the Haystack Butte Moraine, or the fourth moraine, here called the Snowdrift, but both record apparent stillstands of the Maybeso valley glacier during the Hypsithermal interval. The Haystack Butte Moraine is a sharply defined ridge crossing the valley approximately 1 mile above the Crackerjack Moraine. Directly in front of it is evidence, in the form of varved silts, of a proglacial lake dammed behind the Crackerjack Moraine. The Haystack Butte Moraine was probably deposited early in the Hypsithermal since its sharply developed topographic form and the occurrence of an associated proglacial lake in front of it suggest a substantial pause in the retreat of a still vigorous ice mass. The Snowdrift Moraine, on the other hand, is subdued and hummocky, consisting of several low ridges crossing the valley about 6 miles from tidewater. It represents a rapidly wasting ice mass and marks the last stillstand of ice in the valley, probably before culmination of the Hypsithermal interval delimited by Heusser (1960).

CONCLUSIONS

The marked twofold division of the glacial deposits in Maybeso Creek valley is found elsewhere in southeast Alaska and may represent the most frequently definable major unit of late-Pleistocene age. This, coupled with the sequence of 4 recessional moraines, provides a framework for future comparison and correlation of glacial sequences found elsewhere on the mainland and in the Alexander Archipelago.

ACKNOWLEDGEMENT

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