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Joint Canadian-American Workshop on Correlation of Quaternary Deposits and Events in the Area Around the Beaufort Sea

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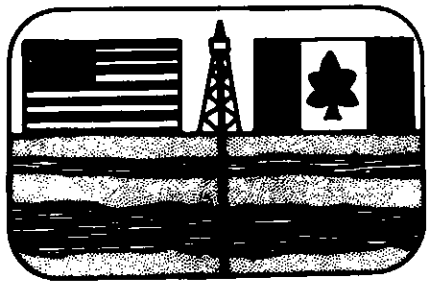

Joint Canadian-American Workshop on Correlation of Quaternary Deposits and Events in the Area Around the Beaufort Sea

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Canadian and American geologists concerned with the Quaternary have been studying the area of and around the Beaufort Sea in increasing detail over the last ten to twenty years. Although there has been considerable contact between individual scientists working on both sides of the international boundary, rather different pictures of the Quaternary geological history of the region have developed in Canada and Alaska. Given the continuing level of exploration and development activity in and around the Beaufort Sea, the need for a coherent picture of the Quaternary geology of the region both as a basis for interpreting other earth science data and for its intrinsic scientific value, is greater than ever.

Accordingly, the Terrain Sciences Division, Geological Survey of Canada, hosted a special workshop on this subject in Calgary, on April 3-4, 1984. The invited participants came from the academic and consulting communities, the Geological Survey of Canada, The United States Geological Survey and the Alaska Division of Geological and Geophysical Surveys.

The workshop was opened by J.G. Fyles (Chief Geologist, GSC), who challenged the participants to develop a correlation chart for the Quaternary of the Beaufort Sea region. The first session was devoted to short presentations by each of the participants, in which they briefly summarized their knowledge of the region, made suggestions regarding correlations, noted areas where knowledge was lacking and recommended future research to resolve these problems. Only questions of clarification were accepted during these presentations.

The first four speakers described the surficial geology and Quaternary history of the Canadian sector: J-S. Vincent (GSC) summarized the general framework of glacial limits and correlations of Quaternary deposits and events in northwestern Canada; V.N. Rampton (Terrain Analysis and Mapping Services Ltd.) described the history and geomorphology of the mainland Arctic coastal plain in Canada; O.L. Hughes (GSC) reviewed the limits of the Laurentide and Cordilleran ice sheets in the northern Cordillera; and N.R. Catto (University of Alberta) described Quaternary stratigraphy and chronology for Richardson Mountains-Peel Plateau area. The next four speakers presented similar information for the Alaskan sector: D.M. Hopkins (USGS) reviewed the general framework of glacial limits and correlations for northeastern Alaska; L.D. Carter (USGS) described the history and geomorphology of the Arctic coastal plain in Alaska; T.D. Hamilton (USGS) summarized the glacial stratigraphy of the Brooks Range; and S.E. Rawlinson (Alaska Geological Survey) reviewed the Quaternary geology of northeastern Alaska.

In a session on geochronology and paleoecology, C. Schweger (University of Alberta) and J.V. Matthews, Jr. (GSC) discussed the paleoenvironmental record of the Brooks Range and of the northern Yukon, respectively. Then N.W. Rutter (University of Alberta) reviewed the contribution of amino acid dating methods to the development of the chronology for the region. On the theme of "cryostratigraphy", J.R. Mackay (University of British Columbia) and O.J. Ferrians, Jr. (USGS) discussed the permafrost record for northwestern Canada and northeastern Alaska, and considered the implications for an understanding of the Quaternary history of the area. Following this discussion, A.S. Judge (Earth Physics Branch, Canada) presented information on deep ground temperatures and the implications with regard to the Quaternary history. The final group of presentations looked at the offshore geology and sea level history of the Alaskan and Canada sectors of the Beaufort Sea, with presentations by D.L. Dinter (USGS), S.M. Blasco (GSC) and P.R. Hill (GSC).

These opening presentations were followed by animated periods of guided discussion. The first two were devoted to the chronology and limits of the Laurentide Ice Sheet, with T.D. Hamilton as discussion leader, and of the Cordilleran and Brooks Range glacial complexes, led by J-S. Vincent. Two shorter sessions on the sea level history of the area (led by J.R. Mackay) and the periglacial environment of the region (N.W. Rutter) followed.

These discussions on selected topics enabled the participants to familiarize themselves with the data, in the various regions, on which the chronologies and reconstruction of events were built. The strengths and weaknesses of the different frameworks as well as the converging elements of many of the schemes became apparent. These discussions provided the basis for the final session, jointly led by J.G. Fyles and D.M. Hopkins, which addressed the problem of creating for the first time a detailed correlation chart for the region.

The first draft of this chart is shown in Table I. We cannot overemphasize the preliminary, embryonic nature of this chart. The age relationships of the data shown in some of the columns are uncertain; the relationship between the columns is therefore very tentative. While none of us was completely satisfied with this document, we agreed that it was a reasonable first attempt at such a chart. A long and complex Quaternary record exists in both Canada and Alaska. Clearly, as more fieldwork is done in the region and as more radiometric and other geochronologic data become available, revisions will be necessary.

The workshop concluded with consideration of possible future joint activities. Joint Canadian-American field excursions to examine key sites in both Canada and Alaska were proposed. In discussing this, four potential field excursions or correlation trips were identified. The most important of these was seen to be a tour along the Arctic Coastal Plain, from southern Banks Island to at least as far west as Prudhoe Bay, and possibly as far as Skull Cliff, west of Point Barrow. A twenty-day trip is planned for late July-early August 1985; the party will comprise two scientists from each of the USGS and the GSC.

It was agreed that a second invitational workshop meeting would be held some time after this field tour to review the new knowledge obtained and to update and refine the correlation chart. This meeting is tentatively planned for April 1986, possibly in Anchorage, Alaska.

The Calgary meeting helped clarify long-standing problems of Quaternary chronology and correlation. It contributed by clearly defining critical problems that remain, and in producing information for inclusion in the forthcoming volume on the Quaternary Geology of Canada and Greenland. In addition, it created an avenue through which continuing communication, between Canadian scientists from different institutions and between Canadians and Americans, was made possible. Because of the oil and gas developments in the Beaufort Sea area, basic information on Quaternary deposits is essential. This information will help provide a better understanding of the engineering behaviour of soils, of geological hazards, and of the location of aggregate sources. It is hoped that the extended abstracts of the workshop can be published in the paper series of the Geological Survey of Canada.

Table 1

CORRELATION OF QUATERNARY DEPOSITS AND EVENTS IN THE AREA ADJACENT TO THE BEAUFORT SEA – A FIRST APPROXIMATION[1]

(COMPILED by J-S. VINCENT, -from data provided by S.M. Blasco, J.K. Brigham-Grette, L.D. Carter, N. Catto, D.A. Dinter, T.D. Hamilton, P.R. Hill, D.M. Hopkins, O.L. Hughes, J.V. Matthews, Jr., S.E. Rawlinson, N.W. Rutter, V.N. Rampton, C. Schweger, P.A. Smith and J-S. Vincent)

GENERAL CHRONOSTRATIGRAPHY (age in ka)			OXYGEN ISOTOPE STAGES	YUKON CORDILLERAN ICE SHEETS (O.L. Hughes)	YUKON BASINS (O.L. Hughes J.V. Matthews, Jr., N.W. Rutter and C. Schweger)	BROOKS RANGE AND BASINS TO SOUTH (T.D. Hamilton)	ALASKAN ARCTIC COASTAL PLAIN (J.K. Brigham-Grette, L.D. Carter, D.A. Dinter, D.M. Hopkins, S.E. Rawlinson and P.A. Smith)	YUKON COASTAL PLAIN AND MACKENZIE DELTA AND VALLEY (N. Catto, O.L. Hughes, V.N. Rampton and J-S. Vincent)	MACKENZIE DELTA OFFSHORE (P.R. Hill and S.M. Blasco)	WESTERN ARCTIC ISLANDS (J-S. Vincent)
LATE PLEISTOCENE	WISCONSINAN STAGE	LATE	2	McCONNELL GLACIATION MACALLEY GLACIATION	Upper glaciolacustrine (12–30ka-^{14}C) Interstadial fluctuation? Hanging Lake interval (at about 18–20 ka-^{14}C)	WALKER LAKE GLAC. (13–24 ka-^{14}C)	Put River outwash and alluv. (9–13 ka-^{14}C); UNIT A marine wedge on middle and outer shelf (9–13 ka-^{14}C) Ikpikpuk sand sea Canning gravel	Sitidgi Lake stade = Tutsieta Lake phase (13 ka-^{14}C) HUNGRY CREEK GLAC. (16–25 ka-^{14}C)	*Sea level drop or standstill-Mackenzie Delta progradation in west and outwash plain in east (8.8 to 21.6 ka-^{14}C)* *Sea level rise from mid or early(?) Wisconsinan minimum* *Delta progradation in west (21.6 to 27.4 ka-^{14}C)*	AMUNDSEN GLACIATION (RUSSELL STADE) = PRINCE OF WALES FM (incl. SCHUYTER POINT SEA SEDS.-12.6 to 9 ka-^{14}C; and PASSAGE POINT SEDS)
		MIDDLE	3	THOM CREEK INTERSTADIAL (28 ka-^{14}C) BOUTELLIER NONGLACIAL INTERVAL (29, >37 ka-^{14}C)	*Alternating warm and cold intervals within stage 5d to 3 and including*	*Unnamed paleosol* (24–34 ka-^{14}C)	Paleosols in Put River outwash and alluvium (29 and 43 ka-^{14}C); Ugnuravik sand marine UNIT B on middle and outer shelf	*Nonglacial beds* (33.8 and 36.9 ka-^{14}C)	*Outwash plain in east, off Tuktoyaktuk Peninsula*	*Unnamed interstadial* (>41 and >49 ka-^{14}C)
		EARLY	5d–4	Sheep Creek Tephra (>42 ka-^{14}C, 73, 78 ka-U/Th) Old Crow Tephra MIRROR CREEK GLACIATION REID GLACIATION	Koy-Yukon Thermal Event Old Crow Tephra	ITKILLIK GLACIATION (Chebanika advance) *Forest beds* (>55 ka-^{14}C) Old Crow Tephra ITKILLIK GLACIATION (maximum advance)	FLAXMAN MEMBER of GUBIK FM (75 ka-TI) = Cross Island Unit on inner shelf? = mid shelf deltas = UNIT C marine wedge (?)	Deception glaciation = BUCKLAND GLACIATION[2] = Toker Point stade (>35 and >39 ka-^{14}C) *Deformed ground ice* *Sabine grey member?*		AMUNDSEN GLACIATION (McCLURE STADE) = PRINCE OF WALES FM (incl. MEEK POINT SEA SEDS. and EAST COAST SEA SEDS-51 ka-U/Th; CARPENTER, BAR HARBOUR, MERCY, SACHS and JESSE TILLS; and PRE AMUNDSEN SEA SEDIMENTS-106 ka-U/Th)
	115									
	SANGAMONIAN STAGE		5e			Bettles gravel	Walakpa Member of GUBIK FM = Teshekpuk transg. (125 ka-TI) = PELUKIAN TRANSG. = MCGUIRE ISLAND UNIT on inner shelf = UNIT E marine wedge = Ugnuravik gravel	*Sabine oxidized member?* *Mason River driftwood* (>38 and >39 ka-^{14}C) *Maitland brown sand?* *Peel fluvial deposits?*		CAPE COLLINSON INTERGLAC. = CAPE COLLINSON FM (>61 ka-^{14}C and 83.3 ka-U/Th)
	128									
MIDDLE PLEISTOCENE					*Interlacustrine alluvium with multiple paleosols*	SAGAVANIRKTOK RIVER GLACIATION *Long interglacial*	Cape Simpson transg. (210 ka-TI) = Karmuk Member of GUBIK FM (500 ka-Aa) = KOTZEBUAN TRANSG. = LEFFINGWELL LAGOON UNIT on inner shelf (?) = UNIT I marine wedge (?)	Mason River Glaciation Maitland thinly bedded silts? Maitland lower brown sands and silts? Peel gravels? Maitland clay		THOMSEN GLACIATION = NELSON RIVER FM (incl. BIG SEA SEDS. 116 and 118 ka-U/Th; KELLETT, BAKER and KANGE tills; and PRE THOMSEN SEA SEDS) MORGAN BLUFFS INTERGLAC. = MORGAN BLUFFS FM (>300 ka-U/Th)
	730									
EARLY PLEISTOCENE				KLAZA GLACIATION Fort Selkirk Tephra (.96 ma-Ft and 1.08 ma-K-Ar) NANSEN GLACIATION Klondike gravels Flat Creek beds White Channel gravels	Little Timber Tephra (= 1.2 ma-Ft) Lower lacustrine (in Old Crow Basin) *Sands containing permafrost structures (in Bluefish Basin)*	ANAKTUVUK RIVER GLAC. *High terraces*	Fishcreekan transg. = Tuapaktushak Member of GUBIK FM(-?) Colvillean II transg.(+) = ANVILIAN TRANSG. = Killi Creek Member of GUBIK FM(+) (1.7–2.2 ma-Aa, mammals) = OLDUVAI GEOMAGNETIC EVENT?			BANKS GLACIATION = DUCK HAWK BLUFFS FM (incl. POST BANKS SEA SEDS.; BERNARD, PLATEAU and DURHAM HEIGHT TILLS; and PRE BANKS SEA SEDS-*magnetically reversed in Duck Hawk Bluffs*) *Old erratics* ?
LATE TERTIARY					*Paleosol with extinct Larix minuta type, Picea and Pinus?*	Gunsight Mountain erratics	Colvillean I transg. = BERINGIAN TRANSG.? = Nulavik Member of GUBIK FM (<3.5 ma, -Pacific molluscs) Erratics in Kuparuk gravel NUWOK FM = Papigak Clay			WORTH POINT FORMATION (*proglacial*) BEAUFORT FORMATION

[1] a) Names in upper case letters are published and in the Alaskan columns are formal names that are published and/or have the approval of the USGS Geologic Names Committee.

b) Names in lower case are informal and in the Alaskan column, if formal, have not yet been published and do not have the approval of the USGS Geologic Names Committee.

c) Names and comments in italics are quite informal and are included for the sake of completeness of the chart.

d) It should be stressed that the correlation chart is a working document. Readers will note the lack of consistency in the nature of the units discussed. Few formally defined names of lithological units are used. Geologic-climate units (glaciations, interglaciations, stades, and interstades) are used even though these have been abandonned by the North American Commission on Stratigraphic Nomenclature, and are now recognized only as informal units.

[2] According to Hughes, the Buckland Glaciation is correlative with the Hungry Creek Glaciation.

Aa age estimate from amino acid analyses
^{14}C age estimate from radiocarbon analyses
Ft age estimate from fission track analyses
TI age estimate from thermoluminescence analyses
U/Th age estimate from Uranium-Thorium analyses
(+) magnetically normal
(-) magnetically reversed