Circum-Arctic Late Tertiary/Early Pleistocene Stratigraphy and Environments — A Preface

During the 1980s there were many advances to our knowledge of late Tertiary environments in the Arctic. In the Canadian Arctic, study of the Beaufort Formation and its fossils intensified. Ongoing investigations in the Old Crow and Bluefish basins in the northern Yukon showed that parts of sections once thought to be entirely late Quaternary were actually Tertiary. Deposits were discovered along the Porcupine River in eastern Alaska that displayed forest beds and peats interbedded with Miocene basalts and lake sediments.

Similar breakthroughs occurred in western and northern Alaska. A group of workers began detailed study of the stratigraphy and age of the Gubik Formation, a marine and terrestrial unit found along the Arctic Ocean. Two milestones in this continuing program were reports on paleontology of the Fish Creek site, near the Colville River, and an amino-stratigraphic analysis of the complex transgression sequence exposed at Skull Cliff near Barrow, Alaska. To the south, on the Seward Peninsula, the long-standing chronology of glaciation and marine transgressions originally formulated by D.M. Hopkins was being challenged and altered by new dates.

During the 1980s the Geological Survey of Canada (GSC) and the U.S. Geological Survey (USGS) initiated a program of joint workshops and cooperative field excursions. The first meeting took place in Calgary, Alberta, in 1984. It dealt with correlation of Quaternary deposits in northwestern North America, but touched on the Tertiary.

A second GSC/USGS workshop in early 1987 concerned the Quaternary history of interior basins of Alaska and Canada, but once again the Tertiary became an item of discussion because some of the basins contain a thick sequence of Pliocene and Miocene sediments.

It was apparent from the questions that arose at these meetings that there was a need for a dedicated forum on the late Tertiary. The authors organized and convened a workshop with that theme at Denver, Colorado, in October 1987. The papers in this special issue are based on presentations and discussions at that meeting.

The first two reports deal with biostratigraphy. David McNeil uses foraminifera in an attempt to clarify the dating of two important marine units in the Arctic: the Nuwok Member as exposed at the Carter Creek locality and the marine sediments in the Beaufort Formation on Meighen Island. Carter Creek deposits, he concludes, are much older than previously thought and the Meighen Island sequence is much younger. C.A. Repenning's contribution deals with small mammals, primarily the "grazing meadow mice." He shows that their fossils may be used to date waves of late Tertiary dispersal of grassland animals from the Arctic to the central part of the continent.

The next three papers describe specific sites. Meteor Impact craters (astroblemes) represent an instant in time, and much can be learned about that instant when the crater has subsequently filled with fossil-bearing sediments. This happened to the early Miocene Haughton Astrobleme on Devon Island in the Northwest Territories of Canada. Whitlock and Dawson, authors of the next paper, are in an enviable position, for the Haughton sediments contain a variety of fossils — mammals, fish, birds, plant macro remains, pollen — providing the basis for a holistic reconstruction of the early Miocene environment in the Canadian Arctic.

Bennike and Böcher discuss a much younger site at Kap København, northern Greenland. The number of types of fossils is only slightly less than at the Haughton site. Several lines of evidence suggest the terrestrial unit of the Kap København Formation is about 2 Ma in age, i.e., younger than the earliest record of North American glaciation. Even so, northern Greenland at that time was forested.

In the next paper J-S. Vincent provides the first complete review of the Worth Point site and its stratigraphic context. Though Worth Point is not as precisely dated as Kap København, and is probably somewhat younger, it is equally important because it probably represents the last time coniferous trees grew on Banks Island, or for that matter any of the islands of the Arctic Archipelago.

Matthews and Ovenden write about many sites in their attempt to place on record much of the dispersed and unpublished information on plant macrofossils from late Tertiary deposits in northern Alaska and Canada. Actually their paper is a progress report, because many of the sites they discuss are still under study. Nevertheless, it is clear that the present boreal forest is but a pale imitation of the one that existed in the Arctic as late as 3 Ma ago.

The Beaufort Formation, a wedge of sand and gravel containing organic debris, occurs on the western islands of the Canadian Archipelago. It is mentioned often in the the papers of this issue. But in recent years the Beaufort Formation has become a "wastebasket" for all unconsolidated deposits younger than the early Tertiary. In the final paper of this issue, John Fyles attempts to tighten the definition of the Beaufort Formation and in doing so proposes some new informal names for deposits at some well-known localities. Fyles is unquestionably the one best qualified to make such a reappraisal since he is the only person who has seen (often discovered) virtually all of the known Neogene sites in the Canadian Arctic.

Convenors of workshops often must beg for papers when the time comes to publish a proceedings volume. Our problem was different. We have too many papers. Subsequent issues of *Arctic* will include other papers based on the theme of the 1987 workshop. Two papers were solicited from Soviet workers: one (V. Zarkhidze) on the history of the Barents Sea and another (Y. Zyryanov) on the Neogene Nerpichy sequence on the New Siberian Islands. A contribution from C.E. Schweger will discuss palynological data from the Old Crow and Bluefish Basin in the northern Yukon, and J. Brigham-Grette and D. Carter will review the stratigraphy of the Gubik Formation and attempt to relate it to other circum-arctic Plio/Pleistocene deposits. Finally, C. Tarnocai and C.E. Schweger will discuss paleosols and their usefulness in environmental reconstruction and correlation, a topic

usually ignored in discussions on Quaternary and Tertiary environments.

The 1987 workshop in Denver was not the last between the USGS and the GSC. In October 1989 another meeting in Denver dealt specifically with the the last major warm interval of the Tertiary, currently the focus of a major research initiative by the USGS. And in 1990 scientists from the USGS and the GSC revisited the Tertiary deposits along the Porcupine River in Alaska in order to prepare for drilling one or more scientific boreholes. To a degree the 1987 workshop has been the stimulus for these activities, for it brought together, for the first time, the group of people who now form the nucleus of a team for conducting research on the late Tertiary in northern North America.

The convenors of the workshop owe a great debt of gratitude to the editors of *Arctic* for agreeing to dedicate an issue to the proceedings, for agreeing to consider publication of the overflow of papers in subsequent issues, and most important, for their good will in dealing with authors who seemed to be eternally going to or just returning from field work. But perhaps this last problem is no more than a sign of continuing interest in the theme of the 1987 workshop and this dedicated issue.

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