cause productivity of plankton can reflect climatic changes, careful plots of "abundance intervals" of *G. pachyderma* have been constructed. The time of greatest abundance of *G. pachyderma* shows some variation from core to core but in general two "abundance intervals" are present. The most recent occurs in the upper 20–30 cm of the cores and suggests that the present warming trend (indicated by slightly greater number of dextrally coiled Foraminifera) is the cause. The second "abundance interval" occurs at or above the level represented by the Brunhes-Matuyama magnetic reversal (690,000 years ago). At other positions in the cores, *G. pachyderma* and other forms constitute only a few percent of the total coarse fraction.

Apparently, there have been only 2 intervals of substantial *G. pachyderma* abundance during the past 3 m.y. and these intervals are difficult to correlate with the Pleistocene glacial cycles known on the continents. In spite of previous attempts to show a relation, it appears that there is no real correlation between the 4 glacial and interglacial stages represented in Pleistocene deposits of the continents and the *G. pachyderma* abundances in the Pleistocene Arctic Ocean sediments.

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TECTONICS OF NORTHERN FRANKLIN MOUNTAINS AND COLVILLE HILLS, DISTRICT OF MACKENZIE, CANADA

The northern Franklin Mountains and the Colville Hills, District of Mackenzie, are a series of ridges of divergent trends, separated by broad, mostly drift-covered valleys. Some ridges are supported by thrust plates, others by asymmetric anticlines. These structures, which represent shortening of the sedimentary cover, record tangential compression. Despite a variety of structural trends, there is no evidence for more than one phase of compression.

The structural province is characterized by enigmatic "reversals" in the sense that a southwest-dipping thrust plate, traced along strike, can be replaced abruptly by a northeast-dipping plate. In most cases the opposing blocks are separated by a transverse fault which indicates longitudinal shortening of the range in addition to the more obvious shortening perpendicular to it.

Anticlines are asymmetric but the sense of asymmetry changes from one range to another. In one case an asymmetry reversal takes place along trend, from northeast directed to southwest directed. This geometric similarity to the pattern of thrust plates is taken to signify a common genesis for the thrust and fold structures. These reversals along the trend of a particular range are inadequately explained, but the close geometric relation between reversals and transverse faults suggests an interrelated origin dependent on longitudinal shortening in conjunction with lateral shortening.

Most of the northern Franklin Mountains appear to be floored by a *décollement* zone in shale and evaporite beds of the Cambrian Saline River Formation. Structures above the zone probably are accentuated by tectonic thickening of Saline River. The *décollement* is assumed to extend beneath the Colville Hills about 175–200 mi northeast of the Mackenzie Mountain Front. In the McConnell Range on the south and the Mackenzie Mountains on the southeast, the *décollement* zone must be at a lower stratigraphic level, because beds older than Saline River Formation are exposed in structures.

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CHUKCHI SEA CONTINENTAL SHELF SEDIMENTATION

The topography of the Chukchi Sea continental shelf south of Herald Shoal is and has been dominated since at least Wisconsin time by Hope Valley (which trends northwest through the central part of the area) and by structural and sedimentary spit-like features trending offshore from Point Hope and Cape Prince of Wales. During the Wisconsin time of lowered sea level, Hope Valley was retrenched and most pre-Wisconsin Pleistocene sediments were stripped from the interfluves. The drainage system was considerably more complex than indicated by the present bathymetry. High-frequency (12 kHz) subbottom profiles and gravity and piston core sediments indicate 1–26 cm post-Wisconsin sediment deposited mostly in a large estuarine environment produced as Hope Valley was inundated. The main sources of sediment initially were the Kobuk-Noatak river system and the shores; smaller amounts were derived from lateral river discharge. Approximately 13,000–14,000 years ago, sea level had risen sufficiently to connect the Bering and Chukchi Seas. After the 2 seas were connected, a major source of sediment was introduced from the Yukon through Bering Strait into the central Hope Valley estuary. A period of rapid deposition followed. Deltaic deposits came from both the Noatak-Kobuk and Yukon sources. In addition, significant deposition north of Point Hope and Cape Prince of Wales resulted from the prevailing current established through Bering Strait. Transgressive sands, open-shelf facies, paralic sediments, and residual deposits can be recognized when related to the modern shelf sediment environment. The total post-Wisconsin deposition has buried numerous small Wisconsin stream valleys, displaced Hope Valley northward through the building of the Bering Strait "delta," produced thick deposits of current-derived sediment on the downstream lee sides of Point Hope and Cape Prince of Wales, and subdued the more rugged Wisconsin subaerial topography.

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SETTLEMENT ASSOCIATED WITH THAWING OF PERMAFROST

Unique engineering problems are encountered in the design, construction, and maintenance of facilities in permafrost areas. Changes to the thermal regime of permafrost produces corresponding changes in the mechanical and physical properties of the soils. Degradation of permafrost can result in large settlements which commonly are differential and hence more damaging or detrimental to the operation and performance of structures, utilities, roads, and airfields. The degradation of permafrost may be caused by building heat or from disturbance to the ground cover, solar radiation, drainage, underground utilities, groundwater flow, or by construction methods. An assessment of the potential settlement associated with the thawing of permafrost is therefore essential, and requires a thorough understanding of frozen soil mechanics.

The known occurrence and distribution of ice in permafrost and the basic relations between volume and weights of frozen and thawed soils can be shown in diagrams and sections, and can be expressed by appropriate equations. Laboratory test results on thaw-con-