Geomagnetic secular variations (inclination) of high latitude fiord cores: eastern Canadian Arctic*

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Paleomagnetic measurements are reported from 11 piston cores, from the fiords and shelf of eastern Baffin Island, N.W.T., between latitudes 66 and 72 degrees north. The majority of the measurements are from bioturbated, massive, or laminated mud, with some drop-stones and graded sand beds. Corrected radiocarbon dates on the acid-insoluble organic matter fraction, supplemented by AMS dates on in situ bivalves, indicate that all cores extend into the early Holocene, and three extend into the latest Pleistocene. Sedimentation rates averaged between 0.2 m/ka and 1.4 m/ka. Because of varying sedimentation rates, the depth scales are converted to 100 or 200 yr/sample time series. The results indicate a series of geomagnetic secular oscillations with amplitudes in inclination of c. 10 degrees. A stacked record from four piston cores suggests seven major oscillations in inclination. Times when inclinations consistently exceeded 80° occurred c. 1,400, 4,500, and 8,000 B.P. The most characteristic oscillation occurred c. 1,400 ± B.P., when inclinations were nearly vertical. Inclination errors are associated with gravity flows and/or with an increase in sand content, or changes in physical properties. In one core an interval of reverse polarity is attributed to a slump.

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The geomagnetic secular variations of the last 10 ka are derived primarily from the mid-latitudes of the Northern Hemisphere. Verosub (1982, p. 832) noted the need for paleomagnetic studies at high latitudes to document changes in the nature of the secular variations. Furthermore, in 1986, Løvlie et al. reported on the magnetostratigraphy of three piston cores from the Arctic Ocean, and noted that two reversed paleomagnetic zones occurred <60 ka, and probably represented two short-lived excursions of the geomagnetic field (Løvlie et al. 1986, p. 173).

Our main purpose in undertaking paleomagnetic studies was to see if there are regionally correlative secular variations in high latitude fiord sediments over a distance of 6 degrees of latitude along the eastern margin of Baffin Island, N.W.T. (Fig. 1) (cf. Løvlie 1989). As we will show, such studies must take note of the depositional processes that occur within fiords. Our emphasis is on expanding the observational framework for high-latitude secular variations rather than contributing to geophysical theories about the causes of such fluctuations.

In mid-latitudes there is now adequate geographic coverage of Holocene paleomagnetic lake records. Thus, current research demands duplicate cores from single lake basins to test reproducibility of the results. Conversely, in polar areas there is a dearth of published high-resolution paleo- and rock-magnetic records. We have studied a suite of piston cores from different fiord basins from a restricted area on east-central Baffin Island (Fig. 1) with variable sediment types and rates of sediment accumulation. Previous results from paleomagnetic studies in the area of Baffin Island include publications by Andrews et al. (1986), Horvath (1986), and Thouveny (1988).

Sedimentology and chronology

Stratigraphy and sedimentology

The cores mainly sampled acoustically stratified sediments which are ponded in fiord basins (Gilbert 1985). These sediments are mainly muds derived from the rain-out of suspended particles from glacial/fluvial meltwater plumes interspersed with sediment gravity flows. Sand-size particles have been contributed from ice rafting and eolian transport (cf. Gilbert et al. 1990). The uppermost unit in the fiords is acoustically transparent; it represents reworking of the glacial

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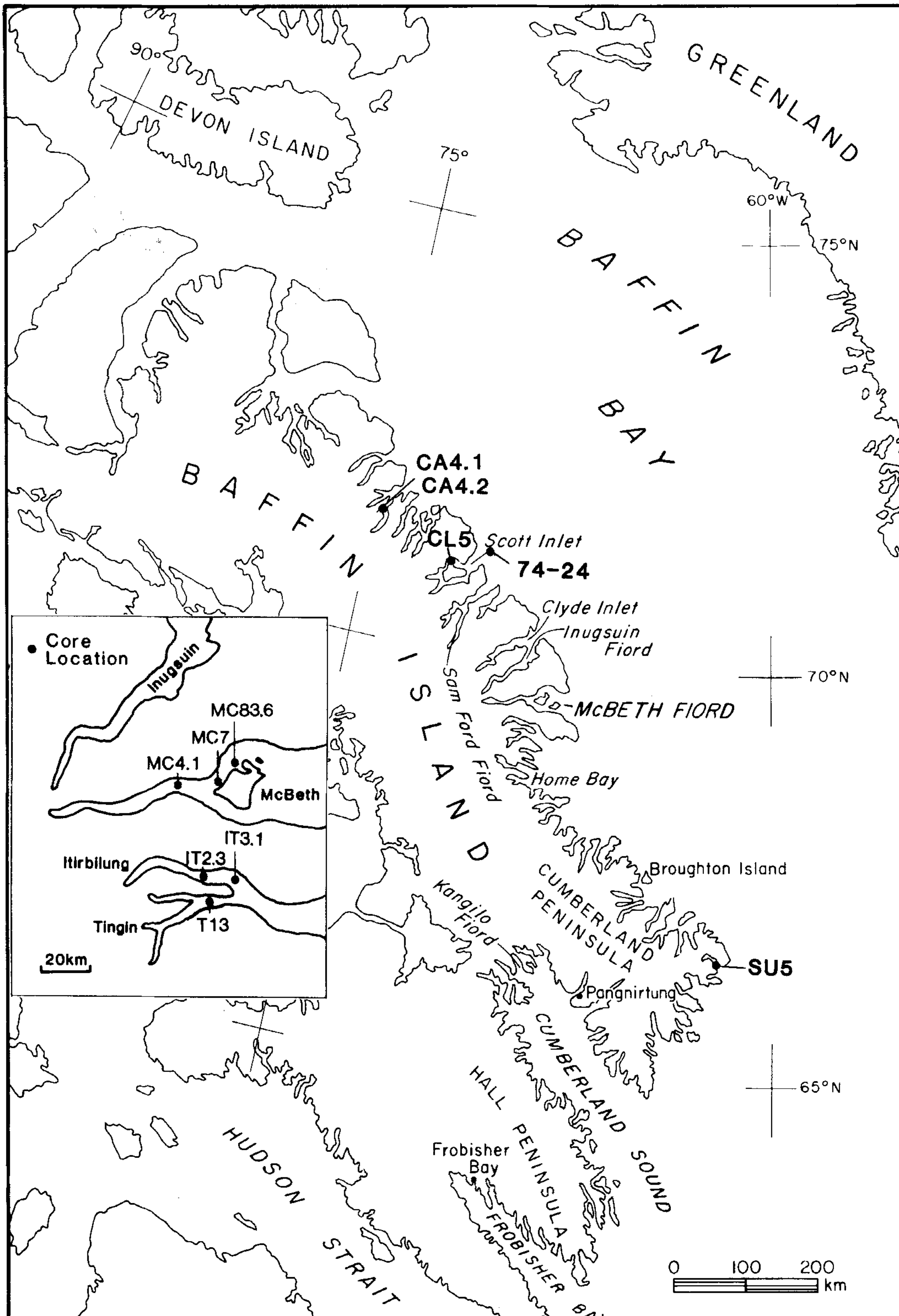
90°
DEVON ISLAND
75°
GREENLAND
60°W
75°N
BAFFIN BAY
BAFFIN ISLAND
CA4.1
CA4.2
CL5
Scott Inlet
74–24
Clyde Inlet
Inugsuin Fiord
70°N
McBETH FIORD
Sam Ford Fiord
Home Bay
Broughton Island
CUMBERLAND PENINSULA
Kangilo Fiord
SU5
Pangnirtung
CUMBERLAND SOUND
HALL PENINSULA
65°N
Frobisher Bay
FROBISHER BAY
HUDSON STRAIT
0 100 200
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Core Location
Inugsuin
MC83.6
MC7
MC4.1
McBeth
IT3.1
Itirbilung
IT2.3
Tingin
T13
20km

marine sediments and focused deposition of suspended sediment.

Lithologic descriptions, mass physical properties, and the seismic settings of the cores are published in 'Sedimentology of Arctic Fjords' (SAFE) data reports (Syvitski & Blakeney 1983; Syvitski 1984; Syvitski & Praeg 1987) and in Gilbert (1985), Jennings (1986), Andrews et al. (1986), and Andrews (1990). Sediments vary between fine-grained laminated (Fl) muds and massive bioturbated muds (Fm-b) (Fig. 2) (cf. Gilbert et al. 1990; Eyles et al. 1987). Such sediments reflect deposition in quiet water where conditions should, theoretically, be suitable for the acquisition of a stable, post-depositional remanent magnetization (PDRM) (Verosub 1977). In most cores there is evidence of ice-rafting and sediment gravity flows (cf. Andrews et al. 1986; Gilbert et al. 1990) (Fig. 2), both of which have the potential for imprinting a strong depositional remanent magnetic (DRM) signature.

Chronology

The chronology is based on 19 accelerator mass spectrometry (AMS) dates on the >125 μm acid-insoluble, organic matter (AIOM) fraction and 4 shell dates; foraminifera could not be used because the sediments lack calcareous foraminifera (Jennings 1986; Schafer & Cole 1986) and molluscs are rare in the deeper fiord basins. Comparison of paired shell/AIOM dates from the region indicated that organic dates are too old (Andrews et al. 1985) due to contamination by reworked Quaternary and pre-Quaternary organics (cf. Short et al. 1989).

The corrected dates suggest that the basal sediment is <13 ka and most commonly between 8–9 ka. Short et al. (1989) and Jennings (1986) used corrected AIOM dates, and found substantial core-to-core time correlations in sediment rate patterns, lithology, and palynology zonations. Depth/time graphs for the fiord cores (Andrews 1990) indicate substantial changes in the rate of sediment accumulation, with high rates in the early Holocene and rates nearly an order of magnitude lower after c. 5 ka.

We have not dated core tops, although there is some evidence that the piston cores do not contain a complete late Holocene sequence. At several stations, 11 cm diameter Lehigh gravity cores were taken of the upper 1 to 2 m of sediment. Comparisons of the magnetic susceptibility (MS) of adjacent piston and Lehigh cores (Andrews unpublished) suggest that the tops of the piston cores date >0 BP. An AIOM date on a grab sample in the inner reaches of Clark Fiord indicated an apparent age of the 'surface' sediment of 2,000 years. Based on several qualitative criteria we have assumed that the 0 cm level in the piston cores dates 500 ± BP.

Due to the variability in rates of sediment accumulation, we elected to transfer depth scales to time scales, using the program EQSPL (Davis 1973, pp. 178–179). This is a simple linear interpolation between dated intervals. We used this algorithm (Davis 1972) to define either a 100-yr or 200-yr resolution time series; the choice depended on the rate of sediment accumulation for each core. For example, in cores with high rates of sediment accumulation, sampling at 5 cm intervals allowed us to develop a 100-yr resolution series. The major assumption in this approach is that sedimentation has been continuous; this is a reasonable assumption for the following reasons: 1) X-radiographs indicate that the bulk of the sediment is a mud deposited by rain-out from overflows, a process that occurs today, and would have occurred annually during deglaciation; 2) graded beds are thin and the turbidites were largely non-erosive; 3) the seismic style of deposition (Gilbert 1985) suggests that the fiord basins have been a focus of deposition during the Holocene. If the assumption of continuous deposition is seriously flawed, which we do not believe, then the time series from the different cores should have no correlative paleomagnetic events.

Methods

Magnetic susceptibility (MS) was measured on the archive half of each core using a 70 mm Bartington loop and meter. Fig. 2 illustrates core lithologies and MS for two cores, and shows the profound effect that provenance has on this rock magnetic property (see Andrews & Jennings 1987; Andrews 1990). Downcore MS measure-

Fig. 1. Location of the core sites along the east coast of Baffin Island, N.W.T., Canada. Insert shows the location of the main cluster of cores in the area north of Home Bay. CA are sites in Cambridge Fiord, CL is a site in Clark Fiord, and SU refers to Sunneshine Fiord.

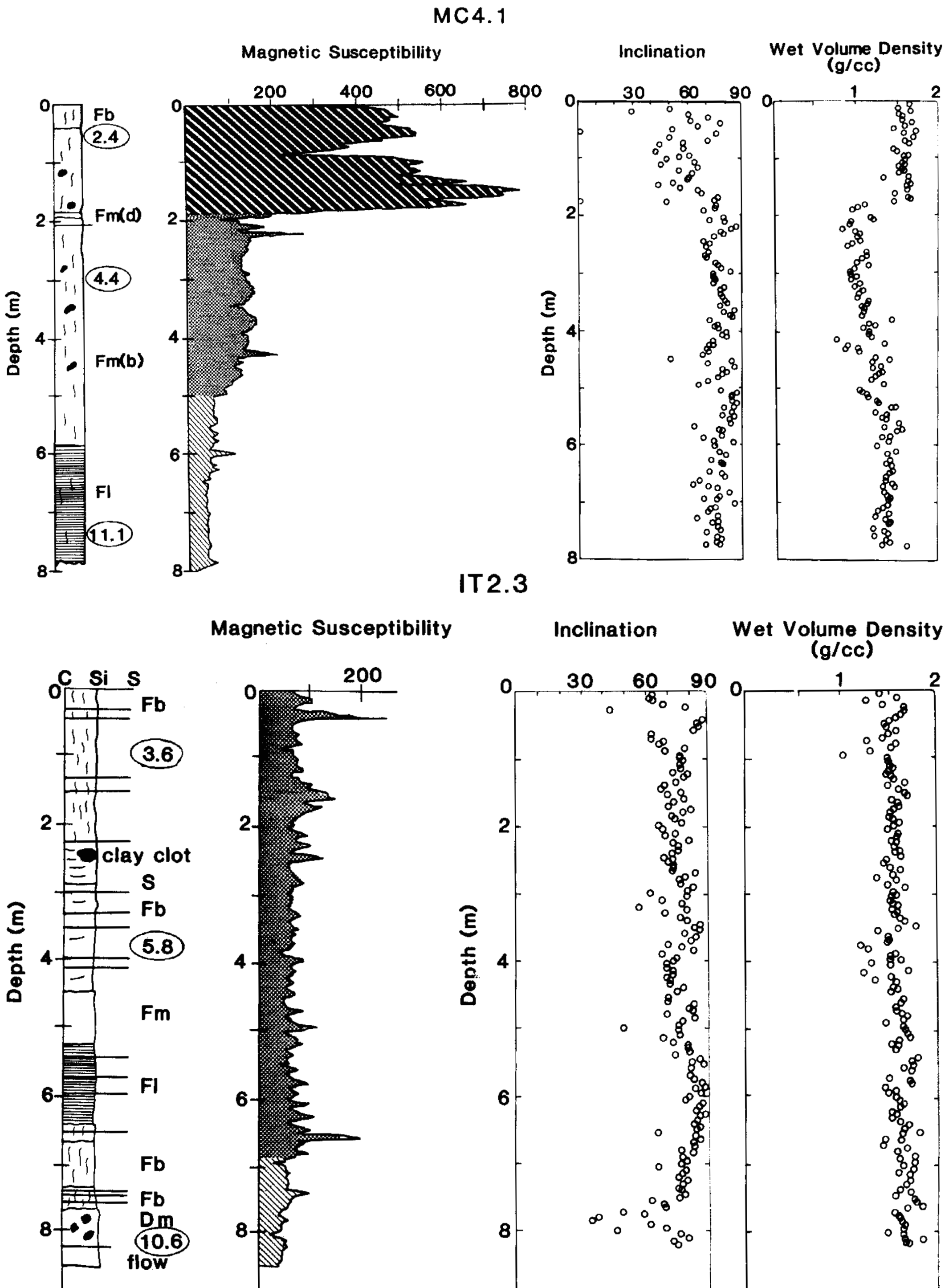

Fig. 2. Examples of core lithologies, magnetic susceptibility (MS), and inclination estimates for MC4.1 and IT2.3 (see Table 1, Fig. 1). The shading on the MS logs refers to two end-member sediment sources (Andrews 1990). Units are kg/m^3 × 10^{-8}. Key to lithofacies (left column) as follows: Fb = fine-grained burrowed; Fm = fine-grained massive; Fl = fine-grained laminated; Dm = massive diamicton; S = sand (see text for further discussion).

Table 1. Core locations, water depth, and length.

Core Id.#	Lat. & Long	Water depth (m)	Length (cm) (number samples)
HU82-SU5	66 33.3	146	770
	61 42.6		(n = 72)
HU82-TI3	69 11.5	487	1,141
	69 23.5		(n = 186)
HU83-IT3.1	69 17.6	365	483
	68 12.3		(n = 59)
HU83-IT2.3	69 17.5	410	853
	68 27.0		(n = 161
HU82-MC7	69 37.5	497	1,121
	69 16.0		(n = 147)
HU83-MC4.1	69 31.4	549	810
	69 57.0		(n = 145)
HU83-MC83.6	69 40.7	429	280
	69 09.8		(n = 49)
HU82-CL5	71 05.5	683	1,016
	71 53.0		(n = 126)
HU78-24	71 13.02	832	581
	70 45.06		(n = 100)
HU83-CA4.1	71 25.5	515	502
	74 45.7		(n = 94)
HU83-CA4.2	71 25.5	365	479
	74 50.0		(n = 40)

ments indicated two distinct sediment sources (Fig. 2). The first, with high MS values, is associated with Precambrian granitic complexes, whereas the second, with MS values one to two orders of magnitude lower, is spatially correlative with Proterozoic fold-belt rocks (Andrews & Jennings 1987; Andrews 1990).

The cores were sampled with 3.15 cc plastic cubes at regular intervals (usually 5 cm) (Table 1). Magnetic directions and intensity were measured on a spinner magnetometer (Schonstedt DSM-1) at the USGS in Denver and at the University of Colorado in Boulder. Demagnetization was accomplished using a tumbling AF apparatus. After NRM measurements, representative samples were chosen for detailed stepwise AF demagnetization (Fig. 3). Inspection of these and other results indicated that the samples were adequately cleaned in fields of between 10 and 15 mT. Coercivity spectra produced from stepwise demagnetization of anhysteretic remanent magnetization, plus the pattern in the decrease of intensity with successive demagnetization (see Fig. 3) indicated that the bulk of the remanence is carried by fine-grained magnetite (Jennings 1986). The changes in inclination associated with stepwise demagnetization from NRM to the characteristic remanent magnetization (Løvlie 1989) were on average extremely small (<2 degrees) (cf. Fig. 3). Ten of the eleven cores were processed in Colorado, whereas MC7 was analysed by Mothersill (Andrews et al. 1986).

We discuss the inclination rather than the declination records because: 1) the cores were not oriented; 2) the piston cores were cut into 1.5 m sections, but the relative orientation of each section to each other was not marked. At these latitudes (Table 1) the inclination for an axial geocentric dipole is between 77 and 80 degrees (Tarling 1983).

Several cores, or portions of cores, have coherent records, whereas others had 'noisy' segments. As a first-order indicator of coherence of the paleomagnetic signal we computed the length of the resultant vector, R, based on a 5-point moving average (Tarling 1983). A value of R of >3.5 suggests ($p = 0.95$) that the samples are from a single population, whereas values of $R < 3.5$ imply that the inclination and declination vary randomly. R values <3.5 can be attributed to sediment disturbance during coring, transportation, or sampling, or they could be caused by characteristics of the depositional processes. Our examination of the statistic, R, for the 11 cores indicated that out of 80 m of sediment some 60 m were potentially useful for a study of geomagnetic secular variations.

Paleomagnetic results

On Fig. 4 we show the median inclinations for all 11 cores and the limits that include 50% of inclination values for each core site, i.e. the hinges (Velleman & Hoaglin 1981). Seven cores have median inclinations close to those predicted by the latitude of the cores. The four cores with lower medians suggest significant overall inclination error; these cores all contain sections with R values <3.5. An example of a clear relationship between sedimentology and inclination errors is noted in the top 2 m of MC4.1 (Fig. 2), where lower than expected inclinations are recorded in a sandy mud derived from renewed mountain glacier activity in an adjacent side-valley (Andrews 1990).

100-yr resolution records

We initially focus on the inclination records from TI3, IT2.3, MC4.1, and MC7, because they are

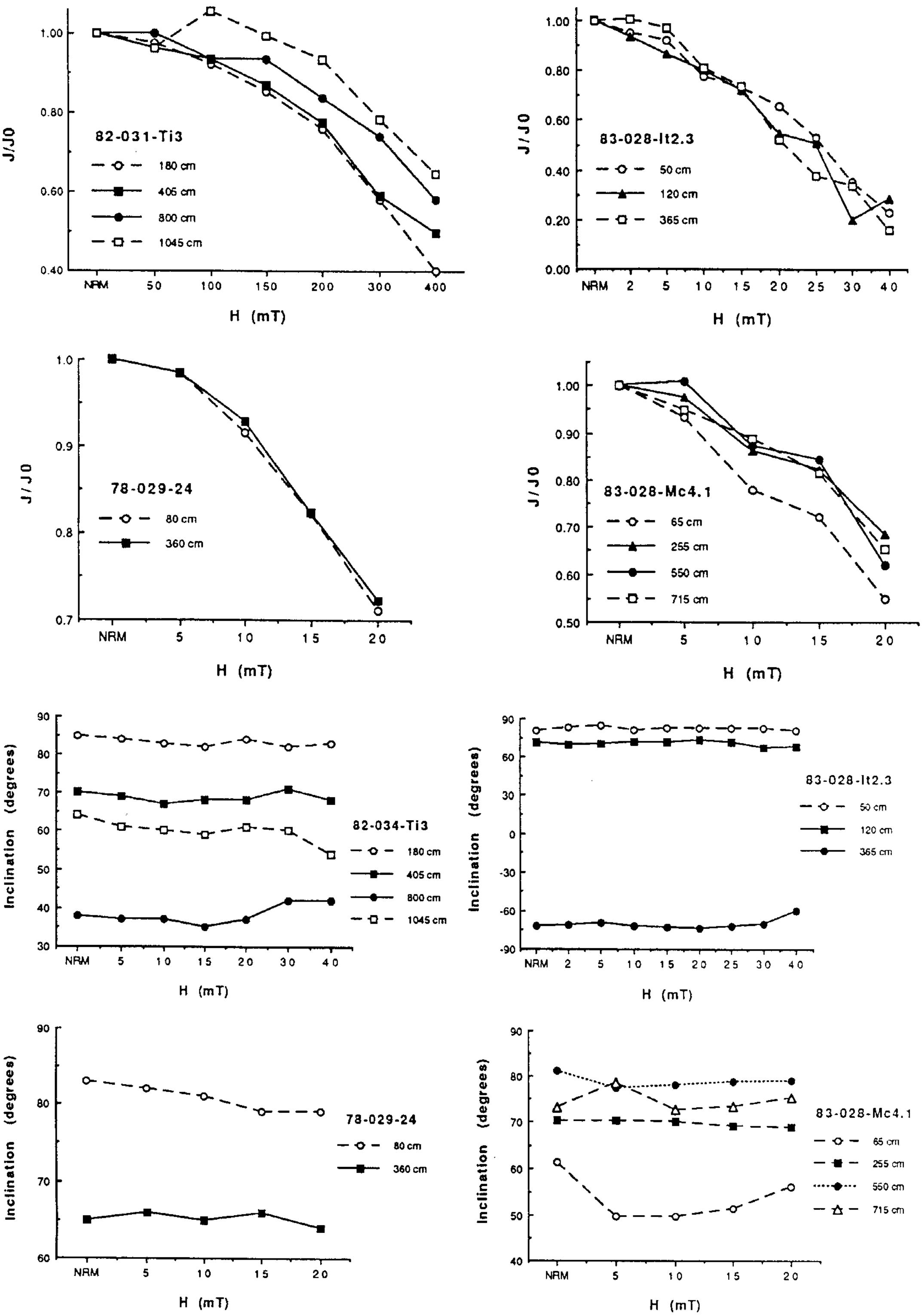

Fig. 3. Examples of AF demagnetization and its effect on intensity and inclination for different cores used in the study.

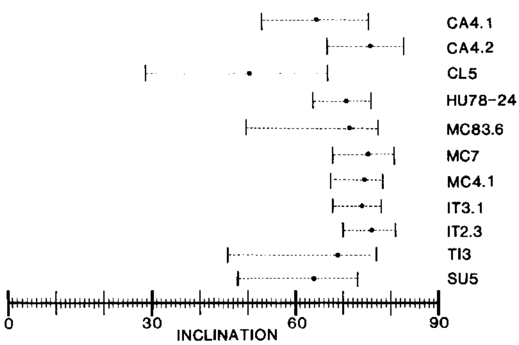

Fig. 4. Median inclination and limits on the central 50% of measurements around the median. Cores arranged from south to north (see Fig. 1, Table 1).

1) geographically close to each other and 2) moderately well-dated. Radiocarbon dates are available from MC4.1, IT2.3, and TI3 (Table 2), but the chronology for MC7 is based on a graphic correlation between it and TI3, as discussed in Andrews et al. (1986).

The lithostratigraphy of MC4.1 and IT2.3 is illustrated in Fig. 2. Fig. 5 shows the variations in inclination and intensity plotted against depth. The inclination records in the lowermost sections of MC7 and TI3 are erratic, and are associated with intervals of rapid sedimentation; these sections are not included in the data analysis (cf. Andrews et al. 1986). As discussed above, we converted the depth scale to a time scale, and then derived an inclination estimate for every 100 years (cf. Davis 1973). The time series for each core is based on the best estimates of the rates of sediment accumulation. Even so, the problems of dating (see above) are such that adjustments in time scales to achieve correlation may be required (cf. Tipper 1988; Ghose 1984).

Our *null hypothesis* was that the inclination records were not correlated. Thus, if we combined the records from the four cores we would not expect to preserve any structure of geomagnetic secular variations. Fig. 6A is the stacked record of inclination from the four cores; it shows the *average* inclination and the 95% confidence limit about the mean inclination, and is our best estimate for the regional Holocene geomagnetic secular variations. Qualitatively, the appearance of Fig. 6A contradicts the null hypothesis that the geomagnetic inclination records from these four cores are uncorrelated. The large departures in

Table 2. Radiocarbon dates from the cores (full descriptions published in Andrews et al. 1989) (AIOM dates are corrected for old carbon contamination).

Core Id.#	Depth (cm)	Lab. no.	Material	Date ±
HU82-SU5	165	AA-560	Shell	5,600 ± 330
	277	AA-412	Shell	9,450 ± 360
	618	AA-264	Shell	10,490 ± 450
HU82-TI3	140	GX-11335	AIOM	3,870±**
	374	GX-9434	AIOM	7,500±
	1,092	AA-190	AIOM	8,700±
HU83-IT2.3	101	AA-2276	AIOM	3,670±
	372.5	AA-2275	AIOM	5,750±
	843	AA.1523	AIOM	10,560±
HU83-IT3.1	105	AA-3260	AIOM	10,510±
	448.5	AA-935	AIOM	9,100±
HU83-MC4.1	81	AA-1011	AIOM	2,410±
	325	AA-1801	Shell	4,370±
	784	AA-653	AIOM	11,150±
HU83-MC83.6	86.5	AA-1012	AIOM	8,730±
	292	AA-654	AIOM	12,800±
HU82-CL5	103.5	AA-650	AIOM	3,200±
	176	GX-9430	AIOM	5,400±
	973	AA-651	AIOM	6,920±
HU78-24	275	GX-8753	AIOM	6,480±
	415	GX-8754	AIOM	7,350±
	531	GX-9344	AIOM	10,700±
HU83-CA4.1	462.5	GX-9430	AIOM	3,500±

** Because these dates are corrected (see text), we do not report a standard error for the dates.

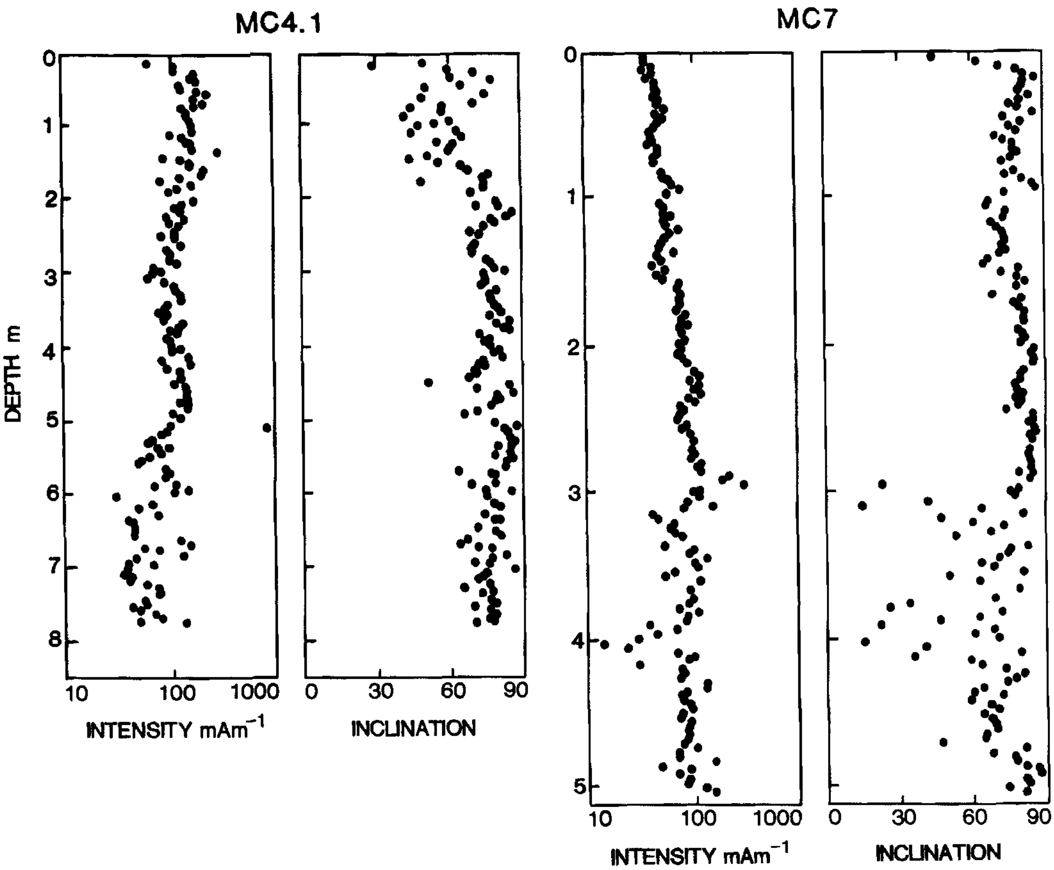

Fig. 5. Downcore measurements of intensity and inclination for cores TI3, MC7, IT2.3, and MC4.1. Intensity is reported prior to demagnetization and inclination measurements are after demagnetization by 10 to 15 mT.

the first 2–3 ka are caused by the obvious inclination error in the upper 2 m of HU83-MC4.1 (see above). The inclination variations (Fig. 6) are characterized by coherent swings of 8–15 degrees; the seven major oscillations are labelled #1 through #7. Three intervals with average inclinations >75 degrees occurred at about 1.5, 4.5, and 8 ka.

A robust Tukey smoother was applied to the four data sets (Velleman & Hoaglin 1981). This gave average residuals of only 2 to 4 degrees. To determine the similarities between the four time series, factor analysis was performed on the smoothed data (Davis 1973). The first two factors explained 70% of the variance. The first factor was strongly correlated with the records from cores IT2.3, MC4.1, and TI3. The loadings on the first factor mimic the average inclinations (Fig. 6) such that the correlation between the factor scores and the average inclination record is high, r = 0.94.

Inclination errors (Verosub 1977), caused by the sedimentology or handling, usually resulted in shallower inclinations than expected. Thus a 'best' estimate of geomagnetic secular variation should be the *upper* confidence level of Fig. 6A. To investigate this hypothesis, we plotted the *maximum* inclination value in each 100-yr interval. These parallel the average inclinations but are 5 to 10 degrees steeper (Fig. 6B). For example, event #2 (Fig. 6A) at c. 1,400 ± B.P. has an average stacked inclination of 74 degrees, an upper 95% confidence limit of 83 degrees, but a maximum inclination of 89 degrees.

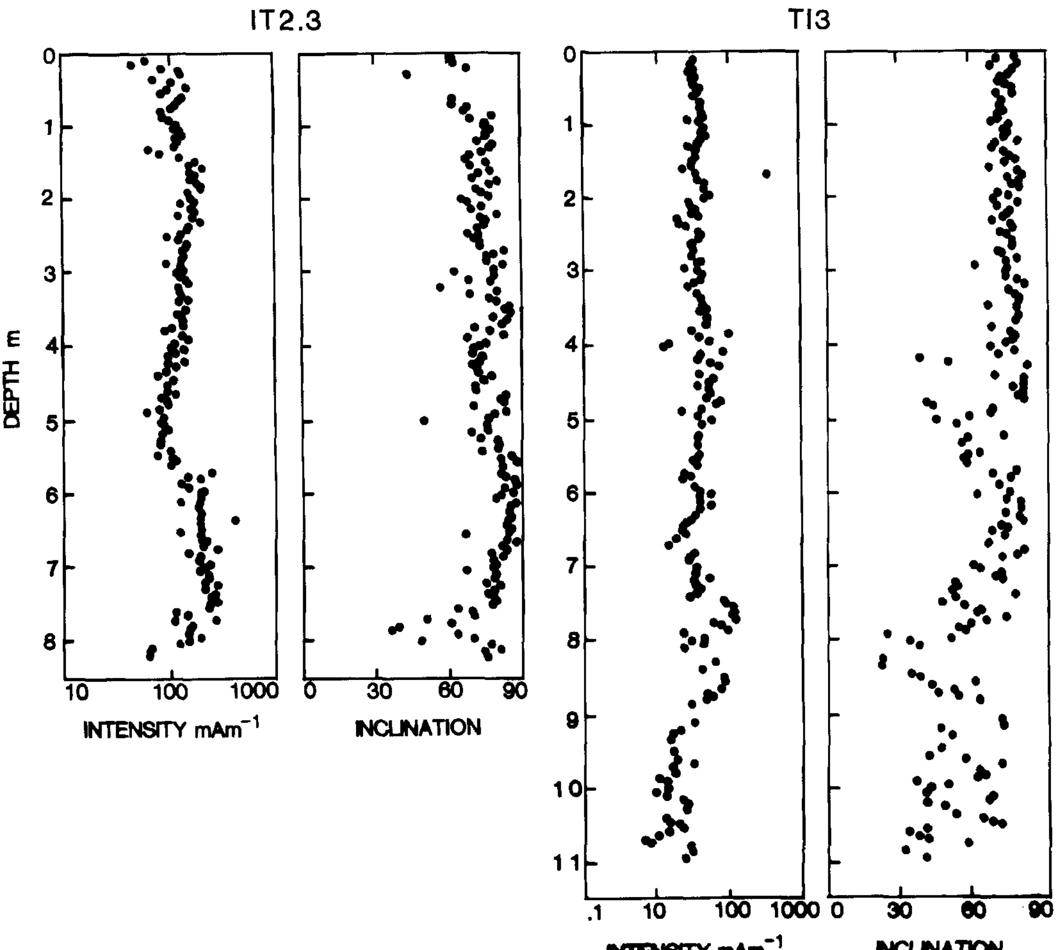

Fig. 5. cont.

200-yr resolution records

Cores from the outer fiord basins and shelf, SU5, MC83.6, and HU78-24, are shorter in length and have slower sedimentation rates than the previous four cores (Table 2). They span c. 5 degrees of latitude (Fig. 1; Table 1). SU5 is the most reliably dated core as its chronology is based on in situ shell AMS dates. Because of the slower sedimentation rates, we used the EQSPL routine (Davis 1973) to interpolate a 200-yr time series for each of these cores.

SU5 has an erratic inclination record with many measurements <60 degrees, indicating significant inclination error. An upper 2 m zone of shallow inclinations in SU5 coincides with changes in the physical properties of the sediment, such as an increase in the Fluid Index. The shallow inclinations may be caused by post-coring handling and transportation. In MC83.6 and HU78-24 (Jennings 1986) (Fig. 4) most inclinations are >70 degrees and there is no clear control on the paleomagnetic record exerted by the sediment characteristics.

To compare the records from SU5, MC83.6, and HU78-24 with those from TI3, IT2.3, MC4.1, and MC7, we plot the *maximum* 100-yr and *maximum* 200-yr inclination estimates for the four and three cores, respectively (Fig. 7). The steepest inclinations recorded in both data sets occurred c. 1,400 B.P. (oscillation #2) and the inclinations match closely between 6,500 and 10,500 B.P. (oscillations #5, 6, and 7) (Fig. 7). The major difference is that the 200-year record does not show the pronounced trough at 2,500 B.P., which

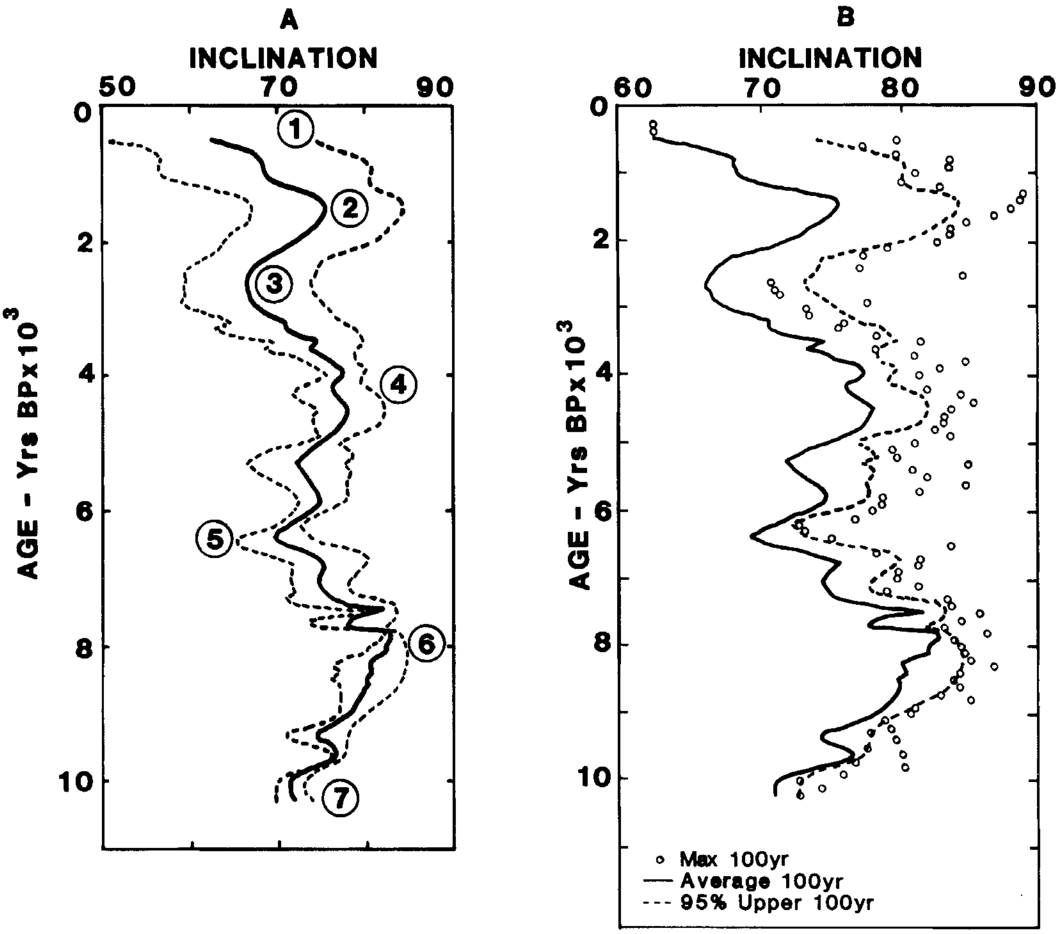

Fig. 6. A: Average ('stacked') inclination estimates for four cores, illustrated on Fig. 4, based on an interpolated sampling interval of 100 years. The 95% confidence limits on the means are shown by the bounding lines. B: The average and upper 95% standard error of the mean for the 100-year data set plotted against the maximum inclination value in any of the four cores in 100 year steps.

is a prominent feature in the 100-yr record (oscillation #3). The correlation between the two records is statistically significant (r = 0.83) (N = 48) at the 0.01% level.

Remaining four cores

The remaining four cores CA4.1, CA4.2, CL5, and IT3.1 (Table 1), are either poorly dated (CA4.1 and CA4.2) or have special problems (see below). They are discussed geographically from north to south.

Cambridge Fiord lies north of McBeth Fiord (Fig. 1; Table 1); hence inclinations should be slightly steeper. The single 14-C date of 3.5 ka (Table 2) suggests that the sedimentation rate has been c. 1 m/ka, or about twice the late Holocene rates in cores TI3, IT2.3, MC4.1, and MC7 (see also Gilbert et al. 1990). A rate of 1 m/ka was used to produce Fig. 8, which shows inclination values from CA4.1 and CA4.2 plotted against the average and maximum inclination curves from TI3, IT2.3, MC4.1, and MC7 (cf. Fig. 6). Inclinations in both CA4.2 and CA4.1 reach maximum values in the upper 1 m. This suggests a correlation with oscillation #2. Below this the inclination values from CA4.1 are shallower than expected for the latitude. Syvitski (1984, pp. 13–27) suggested that CA4.1 penetrated a paleoslump; thus the shallow inclinations may relate to rotation of the sediments during slumping. The data from CA4.2 are similar to the regional paleo-inclination record (Fig. 8). Oscillation #3 is probably represented by the shallowing of inclinations between 2–3 ka, although the rise to the next maxima (#4) is not well defined.

Clark Fiord lies south of Cambridge Fiord (Fig. 1). Core CL5 was retrieved from a basin toward the mouth of the fiord. The stratigraphy, mineralogy, and the rock and paleomagnetic record

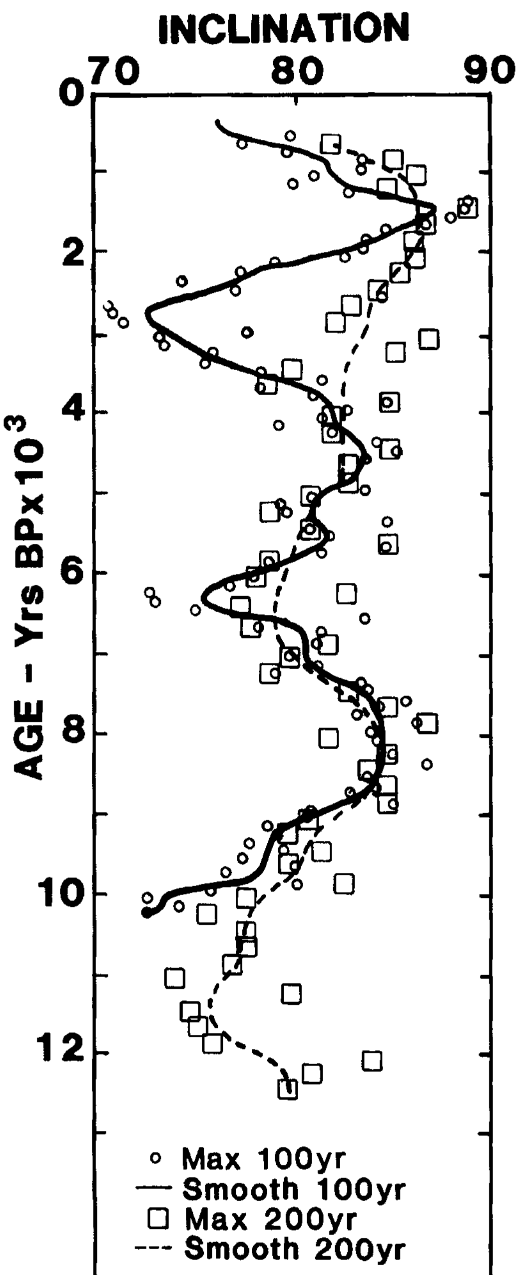

Fig. 7. Comparison of the individual maximum inclinations for the 100- and 200-yr data sets and their smoothed estimates.

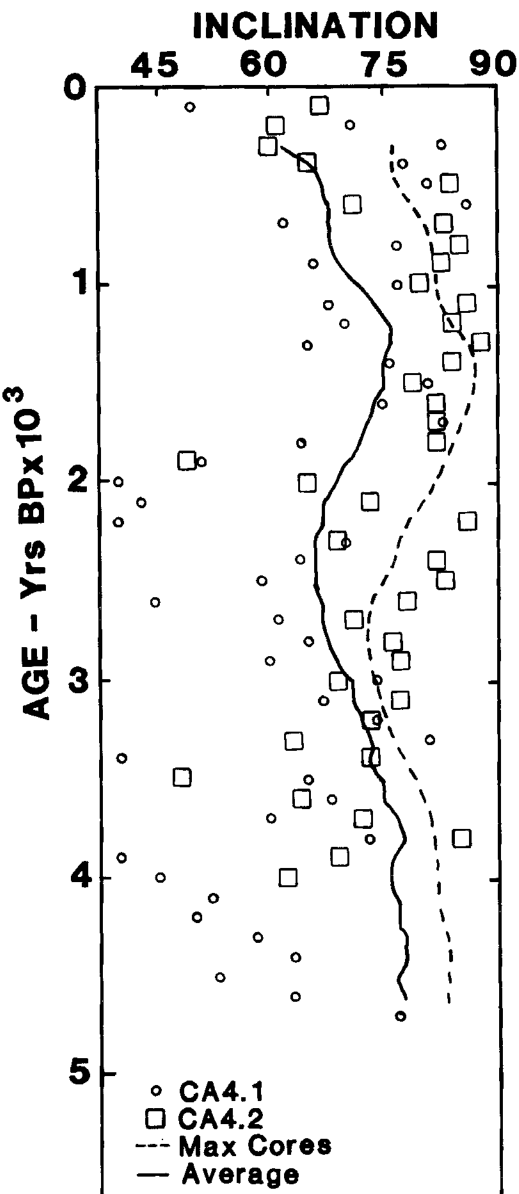

Fig. 8. Individual data points from cores CA4.1 and CA4.2 (Fig. 1) plotted against the maximum and average inclinations (Fig. 6B).

are described in Jennings (1986). We include a brief description of the results from this site as an example of a core that contained little useful paleomagnetic information. R values indicate that the lowermost 3 to 4 m and the upper 1 m are suspect (Jennings 1986). Both parts of the core contained negative inclinations. The lowermost interval is characterized by a marked increase in silt content, evidence for weak bottom-currents, and rapid sedimentation rates. The sediment in the upper part of the core was badly disturbed during coring and handling. The useable part of this core only extends between 6 and 4 ka (Jennings 1986, p. 107) and this core will not be discussed further.

IT3.1, from *Itirbilung Fiord* (Fig. 1), illustrates some of the ways in which paleomagnetism can be used to infer elements of the depositional

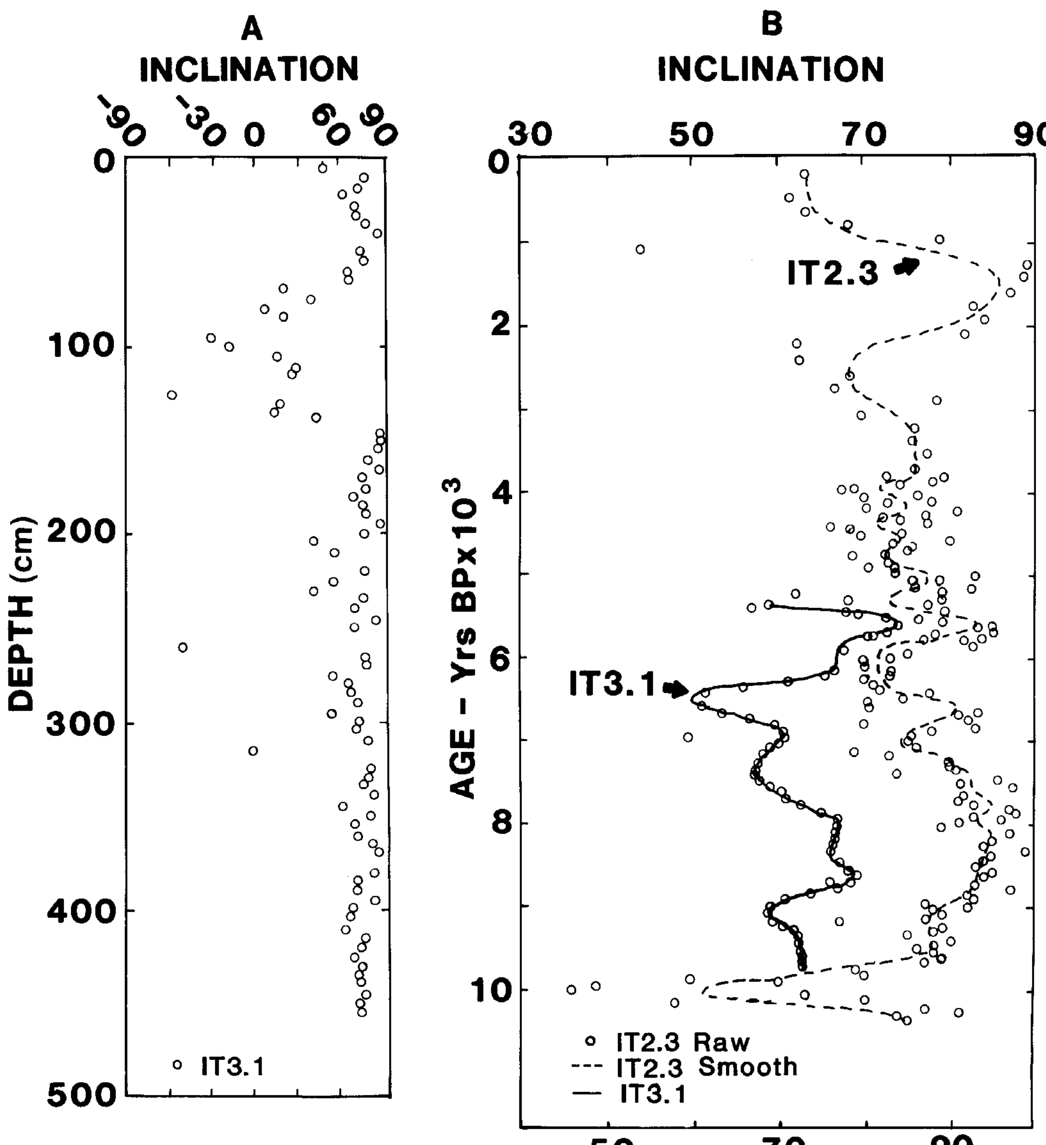

Fig. 9. A: Inclination at core site IT3.1 (Fig. 1). B: The suggested correlation between IT3.1 and IT2.3 based on their smoothed records. The interval between 0 and 150 cm has been omitted from IT3.1 (see text).

history. The palynology of IT3.1 led Short et al. (1989) to conclude that the piston core failed to sample upper Holocene sediment. In IT3.1 there is an apparent reversal in the C-14 dates (Table 2) and a section of negative inclinations (Fig. 9). From 0–50 cm inclinations steepen smoothly to c. 85 degrees. Between c. 50 and 150 cm inclinations are either shallow or reversed. One explanation for both the reversed inclinations and the reversal in 14-C dates is that a rotated block of sediment was cored. Hein (1987) noted 'relict cross-bedding or deformed stratification' at 130 cm in this core and observed that 'massive, structureless grey . . .' mud occurred from 10 to 140 cm. Below 150 cm core depth shallow inclinations (0–30 degrees) infrequently occur; each one is associated with graded silt to sandy beds (Hein 1987) emplaced by turbidity currents.

We cross-correlated between IT3.1 and the neighbouring IT2.3 (Fig. 1) to see if we could infer the age of the postulated slump/flow event. On Fig. 9 we show the smoothed inclination record for IT3.1 and indicate the probable correlation with IT2.3. The preferred correlation (Fig. 9B) suggests that the slump occurred shortly after 5.6 ka.

Summary and discussion

Deposition of fine-grained sediments into fiord basins provides the potential for high resolution paleomagnetic records at polar latitudes. However, there have been very few studies to confirm or deny the suitability of these particular environments for the acquisition of paleomagnetic records of secular variations. Verosub (1982) noted that '. . . the behaviour of the geomagnetic field at high latitudes can not necessarily be inferred from its behaviour at mid latitudes'. He argued, for example, that because of the high amplitude of the Tangle Lake, Alaska, secular variations between 2,700 and 4,600 B.P. have important geophysical implications. He further noted that there may be reasons why the geomagnetic secular variations in high latitude cores may not correlate with those from mid-latitudes.

The influence of sedimentary processes on the DRM can be noted in several cores (e.g. MC4.1, SU5), in which shifts in inclination are associated with changes in the physical nature of the sediment. In other cores, such as IT2.3 and IT3.1, individual shallow inclinations are associated with sand, or silty sand beds that reflect sediment gravity flows within the fiord basin. In the case of IT3.1 we suggest that about 1 m of the record reflects slumping at the core site. Slumping could be caused by normal failures or could be triggered by local earthquakes (Adams & Basham 1989). Despite these problems, the bulk of the sediment is associated with the settling of suspended sediment from meltwater plumes to produce either massive or bioturbated silty clays that our results indicate are suitable for paleomagnetic studies.

When we undertook this study, our basic objective was to see if fiord sediments preserved a regionally coherent record of geomagnetic secular variations. The stacked 100-yr inclination record from TI3, IT2.3, MC4.1, and MC7 (Fig. 6) indicates that there have been regional trends in the secular field over the last 10 ka. The match between these four cores leads us to conclude that the corrected radiocarbon dates are 'reasonable'. Otherwise, we would expect that the process of averaging would result in a record that was essentially flat. Furthermore, the comparison of inclinations between IT2.3 and IT3.1 (Fig. 9A) implies that even fine details may be present that allow correlation between nearby cores with similar sediment accumulation rates.

The differences in sedimentation rates make a correlation between Thouveny's (1988) offshore sequence and our difficult. He noted three major oscillations in inclination within the last 16 ka, contained in 1.5 m of sediment, whereas we note 7 or 8 oscillations within the last 12 ka in cores between 5 and 11 m in length (Figs. 4 and 6).

Thompson (1984) presented a series of Holocene paleomagnetic master-curves (his Fig. 5.1b) which indicated considerable variation in both timing and amplitude of the records from region to region. Indeed, these vary so much that it is difficult to judge whether particular events can be recognized and correlated (e.g. event n, Thompson 1984, Fig. 5.1b). Our regional curve (Fig. 10) is drawn on the basis of the average and upper 95% confidence limit from TI3, IT2.1, MC4.1, and MC7. As discussed in our paper, there are similarities between this regional curve and the records from other cores in the region (e.g. Figs. 7, 8, and 9). A universal feature that could be an important element for correlation is the peak of oscillation #2 and the subsequent interval of lower inclinations, oscillation #3. The timing of oscillation #2 is not well constrained; the age estimate is influenced by our choice of

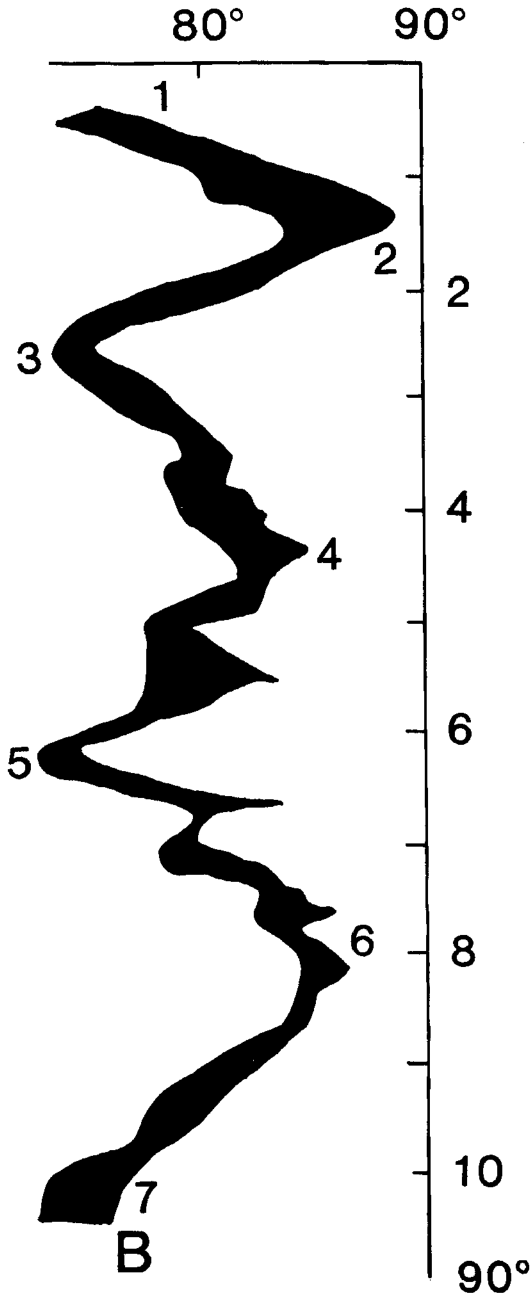

Fig. 10. Regional curve of inclination from eastern Baffin Island at c. latitude 69N, based on cores TI3, IT2.3, MC4.1, and MC7 (see Fig. 6).

500 years as the age of the core tops (see previous discussion). On our time-scale #2 occurs between 1,200—1,500 B.P. Between oscillations #3 and #6 (Fig. 10) there are a number of small-scale oscillations especially superimposed on oscillation #4 (see Fig. 9).

We conclude that the geomagnetic secular variations (Fig. 10) contain a sufficient number of features for inclination records from inshore marine cores to be used to correlate between fiords, and possibly between fiord and lake records in this region of the eastern Canadian Arctic.

Holocene fiord sediments can carry strong geomagnetic signals, but this can be overprinted by depositional processes. The hemipelagic sediments that dominate distal fiord basins are good candidates for very high-resolution paleomagnetic studies, although neither every site nor every level in such basins retains a perfect record of the geomagnetic field.

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