

Pleistocene Walrus (*Odobenus Rosmarus*) from Forteau, Labrador

Exhumation d'un morse (*Odobenus rosmarus*) du Pléistocène à Forteau, au Labrador.

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Résumé de l'article

Le squelette partiel d'un morse adulte mâle a été exhumé d'une plage soulevée sur la côte du Labrador, près de l'habitat de la communauté actuelle. Le collagène des os du spécimen a été daté au radiocarbone à 11 500 BP. Le pollen fossile, les dinoflagellés, les diatomées, les éponges, les échinodermes, les balanes, les foraminifères et les ostracodes prélevés dans l'argile sableuse des environs ont été étudiés en fonction des implications paléo-environnementales. En supposant que la date de l'os est juste, les données sur le pollen et les mollusques semblent indiquer que le squelette du morse a été dérangé et redéposé par une mer en recul il y a 10 300-10 400 ans, alors qu'une végétation clairsemée de toundra occupait les abords d'un milieu glacio-marin.

Note

PLEISTOCENE WALRUS (*ODOBENUS ROSMARUS*) FROM FORTEAU, LABRADOR*

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ABSTRACT A partial skeleton of an adult male walrus (*Odobenus rosmarus*) was excavated from a raised beach on the Labrador coast, near the present community of Forteau. Bone collagen from the specimen has been radiocarbon dated at about 11 500 yr BP. Fossil pollen, dinoflagellates, diatoms, sponges, echinoderms, barnacles, foraminifers and ostracodes from sandy clay surrounding the specimen are considered in terms of their paleoenvironmental implications. Presuming the bone date is correct, palynological and molluscan data suggest that the walrus skeleton was reworked and redeposited by a receding sea some 10 300 to 10 400 years ago, when sparse tundra vegetation evidently bordered on a glaciomarine environment.

RÉSUMÉ Exhumation d'un morse (*Odobenus rosmarus*) du Pléistocène à Forteau, au Labrador. Le squelette partiel d'un morse adulte mâle a été exhumé d'une plage soulevée sur la côte du Labrador, près de l'habitat de la communauté actuelle. Le collagène des os du spécimen a été daté au radiocarbone à 11 500 BP. Le pollen fossile, les dinoflagellés, les diatomées, les éponges, les échinodermes, les balanes, les foraminifères et les ostracodes prélevés dans l'argile sableuse des environs ont été étudiés en fonction des implications paléo-environnementales. En supposant que la date de l'os est juste, les données sur le pollen et les mollusques semblent indiquer que le squelette du morse a été dérangé et redéposé par une mer en recul il y a 10 300-10 400 ans, alors qu'une végétation clairsemée de toundra occupait les abords d'un milieu glacio-marin.

INTRODUCTION

On 19 October 1984 Jane Sproull Thomson (Historic Resources Division, Government of Newfoundland and Labrador) was contacted by Robert Chafe, project engineer for a new reservoir system being installed by Newfoundland Design Associates for the town of Forteau, Labrador. He reported that a backhoe operator had uncovered a "burial" containing mollusc shells and two walrus tusks at a depth below the surface of about 3.0-4.6 m, taken as 4 m. Since Sproull Thomson knew that L'Anse Amour burial site, dating to about 7500 yr BP lay only 3.2 km away, she decided to assess the situation. On arriving at Forteau on 20 October, she examined the muddy trench from which the specimens had been excavated and then the bones, which "contained no human materials, but were the remains of a large walrus" (J. Sproull Thomson, personal communication, 1984). Since she saw no evidence of butchering marks on the bones and no more bones could be seen in the trench, construction work was allowed to proceed.

The walrus remains were loaned to the first author for study, and permission was received to take a bone sample for radiocarbon dating and to remove a tooth for sectioning in order to obtain an estimate of the age-at-death of the walrus. In addition, samples of grey sandy clay extracted from pits and crevices in the walrus skull were sent to the second and

third authors for study of contained pollen and other organic remains.

The purpose of this paper is to describe and illustrate the specimen, discuss its stratigraphic and paleogeographic position, radiocarbon age, age-at-death, as well as the paleoenvironmental implications of the organic remains.

LOCALITY AND STRATIGRAPHIC POSITION

The walrus specimen was excavated, approximately 2.5 km northwest of Town Wharf, Forteau, Labrador (51°29.3'N, 56°58.6'W; NTS Sheet No. 12 P/7; Fig. 1) at about 84 m asl — approximately 4 m below the upper surface of the excavation. Although the bones were removed from their place of deposition beforehand, they are assumed to have been derived from raised beach deposits. The maximum recorded marine level in the area is 137 m asl (D.R. Grant, personal communication, 1988). It is worth noting that walrus do not normally range this far south on the Labrador coast at present (Fay, 1982, Fig. 3). Although they occurred much farther south in the nineteenth century, apparently walrus were brought to extinction there by excessive commercial hunting.

RADIOCARBON DATING

A 166-gram sample of bone was removed from two rib fragments and submitted on 9 May 1986 to Beta Analytic Inc. of Coral Gables, Florida for radiocarbon analysis. The bone was pretreated by picking out any apparent rootlets, and then

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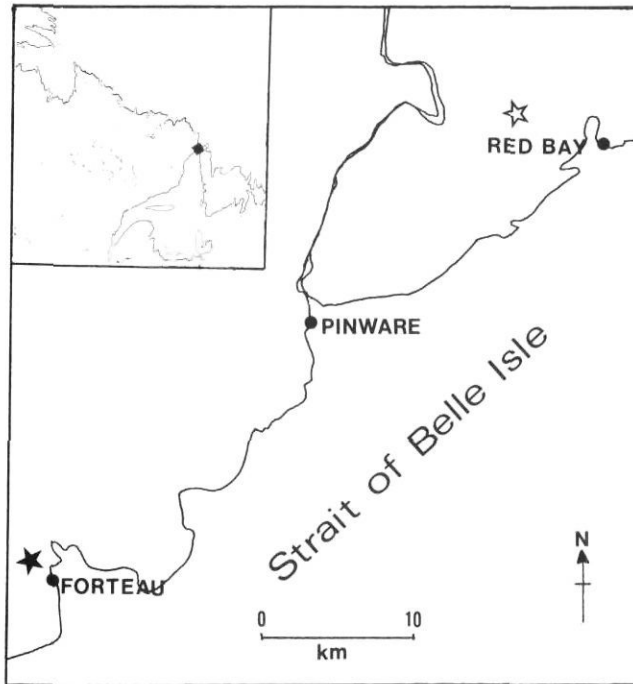


FIGURE 1. Location of the Forteau walrus site (black star) in relation to the palynological site at "Isabelle Lake", Labrador (white star). Inset shows the position of this area within Atlantic Canada.

Localisation du site abritant le morse, à Forteau (étoile noire) en relation avec le site palynologique de «Isabelle Lake», au Labrador (étoile blanche). Localisation de la région en carton.

washed to remove sediment adhering to the surface. The sample was soaked in dilute hydrochloric acid for several days, the acid being renewed repeatedly to remove the mineral fraction and leave the collagen. The collagen was filtered and repeatedly rinsed to neutrality. The material was combusted in an enclosed system to extract carbon for the measurements. Benzene synthesis and counting that followed proceeded normally, yielding a radiocarbon date of $11\,490 \pm 160$ yr BP (Beta-16518). This date indicates that walruses occupied the Strait of Belle Isle region toward the close of the last (Wisconsinan) glaciation.

Articulated valves of the marine pelecypod *Mya arenaria* from stony mud, reportedly associated with the walrus remains, yielded an uncorrected radiocarbon date of $10\,400 \pm 120$ yr BP (GSC-4175). Evidently the shell and walrus remains occur at elevations higher than any other dated marine specimens in the Strait of Belle Isle region. Grant (in press, Fig. 48), in a shoreline-relation diagram, shows the elevations of paleosea levels in the region at 1000-year intervals. The 11 000-year level is inferred to lie about 90 m above present mean sea level — a shoreline position in accord with the general scheme for the region. D.R. Grant (personal communication, 1988) considers that the above-mentioned bone date is... "slightly discordant with the other dates. Rather than yielding a younger age than coeval shell or wood (as is often the case with bone), it seems to be too old by about 1000 years. If the determination is reliable it would require a revision of inferred paleosea levels which would be difficult to



FIGURE 2. Field photograph of the Forteau walrus cranium taken shortly after the specimen was excavated.

Photographie prise sur le terrain du crâne du morse peu de temps après son exhumation.

accommodate in the general scheme. Alternatively, if both bone and shell ages are accepted as correct, they could be interpreted as meaning that the walrus dates from a sea level at about 100 m... On death it sank to the seafloor about 15 m below, hence the enclosing mud and a present elevation of about 85 m. By 10 400 BP the sea level had fallen to about 85 m at which time the shells were deposited". Since the walrus bone appeared to be in excellent condition for radiocarbon dating and because of the degree of preservation of the walrus skeleton (evidently partially articulated) and the nature of the enclosing sediment, the second explanation seems better.

A piece of willow (*Salix* sp.) wood, collected from the backhoe trench when the walrus and *Mya* specimens were found, is obviously much younger [2470 ± 70 yr BP (GSC-4021)], and "probably represents part of a tree root that penetrated the site long after deposition [of the walrus remains]..." (comment on GSC-4021 by D.G. Vanderveer).

DESCRIPTION

Order Carnivora Bowdich, 1821
 Family Odobenidae Allen, 1880
 Genus *Odobenus* Brisson, 1762
Odobenus rosmarus (Linnaeus, 1758)

The specimen (Newfoundland Museum NFM MA.60.1-27; Figs. 2-5) consists of several parts of an adult walrus skeleton. The presence of a baculum indicates that the specimen represents a male. Parts of the specimen that were collected follow.

Cranium (Figs. 2-4) — with tusks (C¹s) and other well-worn teeth (I³s, P¹s, P²s, P³s). The posterior part of the braincase

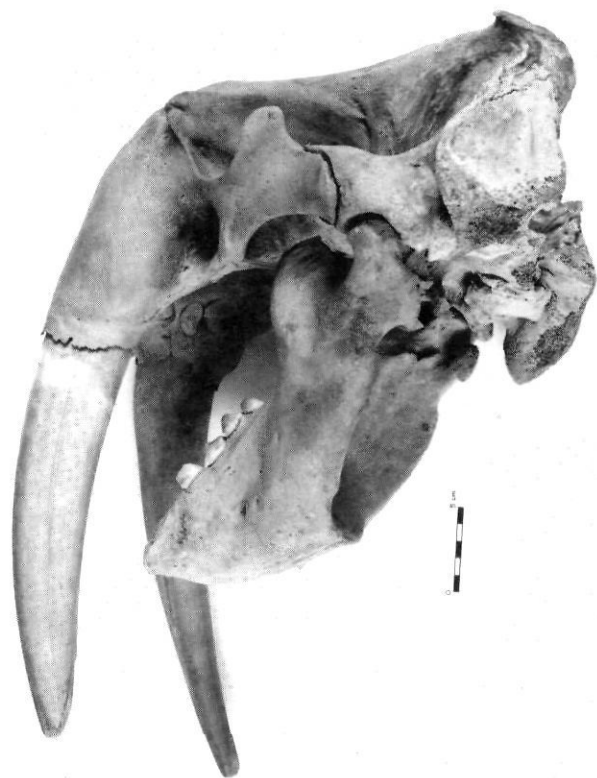


FIGURE 3. Left side view (photograph taken from slightly behind to show the teeth more clearly) of the Forteau walrus skull (NFM MA.60.1,2).

Vue du côté gauche de la boîte crânienne du morse prélevé à Forteau (NFM MA.60.1,2).

is missing — apparently it was broken away and the surface was slightly eroded. Tusks are worn at the tips and on the posterior surfaces above the tips (45 mm above the left tip and 25 mm above the right tip). The rather large size of the skull and tusks suggest an adult male. According to the average circumference of the tusks at the cingula (150 mm), and interpretation of its place on a rudimentary graph relating this measurement to age (Harington, 1975, Fig. 4), the walrus may have been about 13 years old at death.

Mandible (Figs. 3, 5) — with teeth. The right second premolar (RP₂) was removed and sectioned. A study of annuli counted in a longitudinal section through the cementum of this tooth gave an estimate of age-at-death for the individual — approximately 20 years (Fig. 6). Since the age estimate based on analysis of a tooth section is considered more precise than those based on tusk-cingulum circumference (see above) or baculum length (see below), evidently the Forteau walrus died near the beginning of its twentieth year. Thus the other estimates may err greatly — in this case by as much as 7 and 5 years respectively.

Baculum (penis bone) — broken at the proximal end. Based on its minimum height compared to total length, its original length is estimated to have been about 570 mm. According to a diagram for Pacific walruses (Fay, 1982, Fig. 22), this length would indicate an age-at-death of about 15 years.



FIGURE 4. Ventral view of the Forteau walrus cranium showing well-worn tusks, incisors and premolars (C's, I's, P's, P²s, P³s). The skull is well preserved except for signs of erosion posteriorly where part of the braincase apparently broke away.

Face ventrale du crâne du morse de Forteau montrant des défenses, des incisives et des prémolaires usées (C's, I's, P's, P²s, P³s). Le crâne est bien préservé sauf pour des signes d'érosion postérieure alors qu'une partie de la boîte crânienne semble avoir été cassée.



FIGURE 5. Dorsal view of the Forteau mandible showing the lower teeth (C₁s, P₂s, P₃s, P₄s, and the socket for RM₁). The right second premolar (RP₂) was removed and sectioned to get an estimate of the age-at-death of the walrus.

Vue dorsale de la mandibule du morse de Forteau montrant les dents inférieures (C₁s, P₂s, P₃s, P₄s et l'alvéole de MD₁). La deuxième prémolaire droite (PD₂) a été enlevée et sectionnée afin de calculer l'âge du morse à sa mort.



FIGURE 6. Photomicrograph (scale bar is ~ 1 mm) of a longitudinal section through the root of the right second premolar (RP_2) of the Forteau walrus using plane polarized light. The number of annuli counted in the cementum layer of the tooth indicate an age-at-death of about 20 years.

Microphotographie (échelle de ~ 1 mm) d'une coupe longitudinale à travers la racine de la deuxième prémolaire (PD_2) du morse en se servant d'une lumière polarisée. Le nombre d'anneaux comptés dans le ciment de la dent donne un âge de 20 ans au morse.

Vertebrae — Sixth cervical (neck) vertebra: the posterior epiphysal plate is missing, as well as most of the bone on the right side of the neural canal; only the bases of the processes on the right side are preserved. Seventh cervical: the centrum and base of the left transverse process are preserved, whereas the right side of the neural canal is largely missing.

Ribs (identifications to number are approximate) — Right fourth lacking the distal end. Right fifth lacking the distal end. Right sixth lacking the distal half. Right seventh lacking the distal end. Right tenth: middle portion. Right eleventh lacking the distal end. Left fifth: middle portion. Left seventh lacking the distal half. Left eighth lacking the distal half. Left ninth:

75 km inland (Dyke and Prest, 1986). A radiocarbon date of $10\,300 \pm 120$ yr BP (GSC-4283) (McNeely and McCuaig, 1991) on basal sediment in the informally named "Isabelle Lake" ($51^{\circ}44.8'N$, $56^{\circ}30.6'W$) (above the postglacial marine limit and 43 km northeast of the site; Fig. 1) provides a minimum age for retreat of Laurentide Ice from southeastern Labrador. Probably winter sea ice was much more extensive, running east of the Labrador and Newfoundland coasts well south of Greenland to Iceland (COHMAP, 1988, Fig. 3, Data 12 ka). Would fossil pollen and other organic remains enclosed in matrix removed from crevices and pits in the skull yield information of value to clarify the nature of this intriguing marginal habitat of Late Wisconsinan age?

FOSSIL POLLEN

Although poorly preserved, pollen is sufficiently abundant in the sediment matrix to warrant calculation of percent fossil taxa. Percentages of most taxa are less than 20% maximum, and with the exception of fern spores (Polypodiaceae), no single taxon dominates. Tree and shrub pollen are represented by 10-12% spruce (*Picea*), pine (*Pinus*) and birch (*Betula*); 3.6% oak (*Quercus*), hornbeam (*Carpinus/Ostrya*) and other trees; and by 20% alder (*Alnus*). Other shrubs are represented by juniper (*Juniperus*: 4.5%), heath (Ericaceae: 3.2%), sweet gale (*Myrica*: 2.3%), and willow (*Salix*) and bufaloberry (*Shepherdia canadensis*) which are less than 1%.

Herbs are diverse but the percentage values are low. Sedges (Cyperaceae) dominate at 9.2%, followed by grasses (Gramineae: 5.5%), rose family (Rosaceae) and sage (*Artemisia*) at 1.3%. Other herbs [mountain sorrel (*Oxyria digyna*), smoothleaf dryas (*Dryas integrifolia*), spikemoss (*Selaginella selaginoides*) and taxa in the pea family (Leguminosae)] are present as minor amounts.

The pollen spectra are compared with the basal pollen record from Isabelle Lake. The lowermost pollen assemblage zone (zone 2) in the record (Fig. 7) from this lake is characterized by relatively high percentages of *Picea*, *Pinus*, *Juniperus*, *Alnus* and herb pollen including *Artemisia*, *Oxyria digyna*, *Thalictrum*, taxa in the families Papaveraceae (cf. *Papaver radicum*), Gramineae, Cruciferae, Caryophyllaceae, Cyperaceae and fern spores of Polypodiaceae. In contrast, the upper zone (zone 1) shows a preponderance of *Salix*, slight increases in *Betula* and Cyperaceae (near top of zone), and much reduced profiles of *Picea*, *Pinus*, *Alnus* and herb pollen. Maximum percentages of *Salix* also characterize the basal portion of the pollen diagram at Whitney's Gulch (Lamb, 1980), located about 30 km west of Forteau. Here the upward transition from *Salix* to *Betula* is dated at 9820 ± 110 yr BP.

The Forteau sample fits best with the Isabelle Lake profile at the 550 cm level where sediment is dated at $10\,300 \pm 120$ yr BP (GSC-4283). The vegetation at this time resembled

"ISABELLE LAKE", LABRADOR

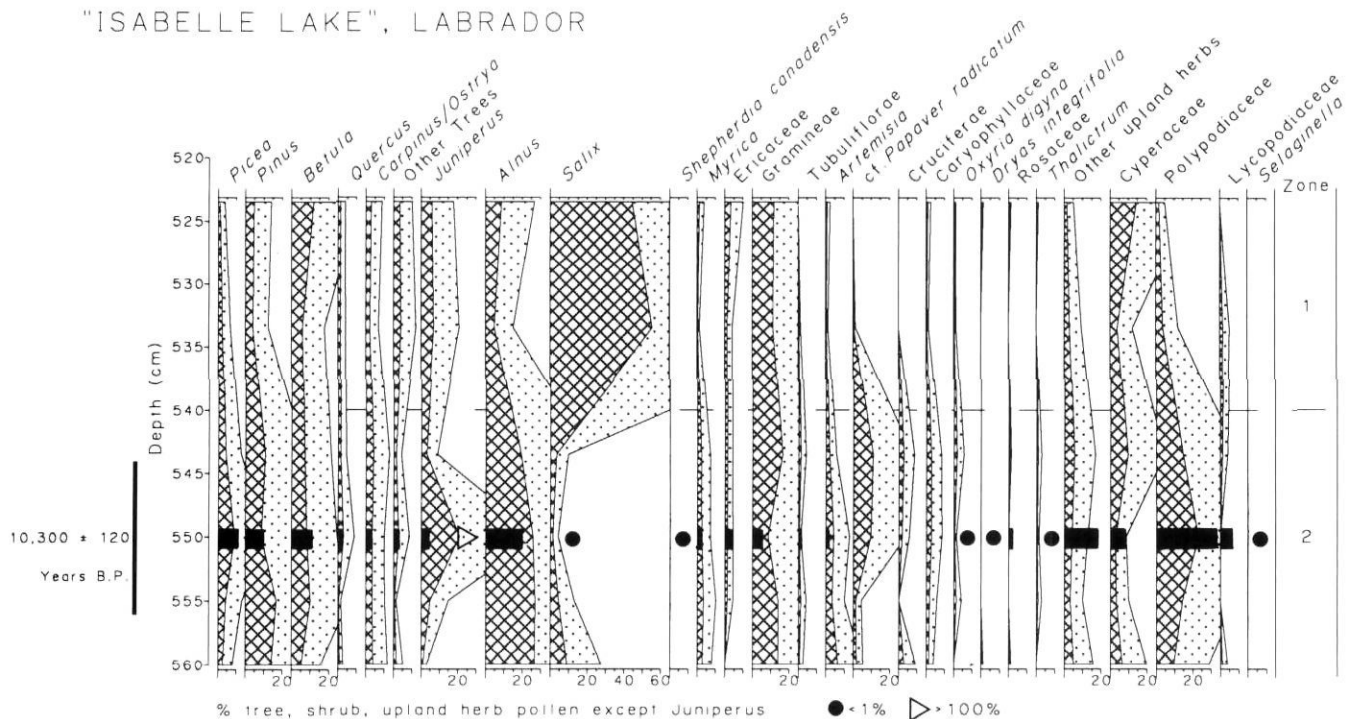


FIGURE 7. Fossil pollen percentages (black bar) for the sandy clay matrix associated with the Forteau walrus skeleton superimposed on an abbreviated pollen record of the basal sediments at "Isabelle Lake", Labrador. Dotted pattern represents three times exaggeration. "Other upland herbs" include taxa ($\leq 1\%$) of the Chenopodiaceae, Ambrosiaceae, Rosaceae, Ranunculaceae, Leguminosae, Umbelliferae, Saxifragaceae, Rubiaceae and Urticaceae, as well as unidentified nonarboreal pollen.

Pourcentages du pollen fossile (trait noir) de la matrice d'argile sableuse associée au squelette du morse de Forteau superposés au diagramme pollinique résumé des sédiments basaux de « Isabelle Lake », au Labrador. La partie tramée en pointillé représente un agrandissement de 3 x). La rubrique « Other upland herbs » comprend les taxons ($\leq 1\%$) de Chenopodiaceae, Ambrosiaceae, Rosaceae, Ranunculaceae, Leguminosae, Umbelliferae, Saxifragaceae, Rubiaceae et Urticaceae, ainsi que le pollen non arboréen non identifié.

herb tundra which apparently comprised prostrate shrubs and herbs including possibly dwarf birch, juniper, willow, sage, arctic poppy (*Papaver radicum*), mountain sorrel, smoothleaf dryas, and taxa within the grass, sedge, heath, mustard (Cruciferae), pink (Caryophyllaceae), saxifrage (Saxifragaceae), parsley (Umbelliferae), madder (Rubiaceae), crowfoot (Ranunculaceae) and fern (Polypodiaceae) families. *Picea*, *Pinus*, *Quercus*, *Carpinus/Ostrya* and *Alnus* are regarded as exotic pollen introduced by wind from sources well south of the area.

Thus a sparse tundra vegetation bordering on a glaciomarine environment is inferred as the environment of deposition for the walrus skeleton. This is further corroborated by the paleogeographic, sedimentological, dinoflagellate, invertebrate and vertebrate evidence.

FOSSIL DINOFLAGELLATES

H. Jetté, in a separate analysis of the same clay sample, identified four dinoflagellate taxa (*Multispina minuta*: 45%, *Birgantedinium simplex*: 38%, *Operculodinium centrocarpum*: 11%, and *Spiniferites* sp.: 5%). The first two species commonly occur in shallow coastal arctic waters (e.g. Notre Dame Bay, Newfoundland), and so are consistent with the inferred shallow-water depositional environment for the walrus remains. Her analysis also agrees with the paleoenvironmental conclusions of the third author's study of other marine organisms from the matrix sample.

OTHER MARINE ORGANIC FOSSILS

Taxa identified (C.G. Rodrigues, Forteau sample report, May 3, 1988) from the same matrix sample examined for fossil pollen and dinoflagellates include: diatoms (*Cosinodiscus*-type); monaxon sponge spicules; echinoderms (ophiuroid spines); barnacles (*Balanus* fragments); foraminifera (*Buccella frigida*, *Cassidulina reniforme*, *Cibicides lobatulus*, *Elphidium excavata* forma *clavata* and two other species of this genus, *Haynesina orbicularis*, *Islandiella helenae*, *Nonionellina labradorica*, *Pateoris hauerinoides*, *Quinqueloculina agglutinata*, *Triloculina* sp., *Neogloboquadrina pachyderma* (planktonic, left-coiled juveniles); and ostracodes (*Cytherura* sp., *Elofsonella concinna*, *Normanicothera leioderma*, *Palmenella limicola*, *Sarsicytheridea macrolaminata*, *Sclerochilus contortus*). This evidence indicates clearly that the sediment is marine and that bottom-water salinity was probably <30‰.

DISCUSSION

A review summarizing facts on the evolution of walruses is found in Harington and Beard (1991). Presumably the Pacific (*Odobenus rosmarus divergens*) and Atlantic (*Odobenus rosmarus rosmarus*) subspecies arose because of enduring Canadian Arctic glacial and sea-ice barriers (Harington, 1966; Dyke and Prest, 1986) dividing the stocks during the late Pleistocene. The main difference between the subspecies is the larger physical size (including much larger tusks) of the Pacific group.

Probably modern walruses reached their most southerly known geographic limits near late Pleistocene glacial max-

ima. Evidently Pacific walruses, or their forerunners, occupied more southerly waters along that coast during the Early Wisconsinan stadial (Qualicum Beach, British Columbia) and even farther south (San Francisco Bay, California) in the early Late Wisconsinan (Harington and Beard, 1991).

On the opposite coast, Atlantic walruses, or their ancestors, seem to have reached as far south as Edisto Island, South Carolina (Clayton E. Ray, personal communication, 1991), although geochronological data are not available for those specimens. Quaternary walrus remains found in coastal deposits of Québec and the Maritime Provinces of Canada have been summarized (Harington and Occhietti, 1988; Miller, 1990). Of particular interest are radiocarbon-dated fossils of roughly similar geological age to the Forteau walrus. A nearly complete skeleton of a walrus was recovered from an Intercolonial Railway gravel pit near Moncton, New Brunswick about 1871 by a crew under the supervision of Sandford Fleming. Bone from this skeleton has been radiocarbon dated at 9700 ± 130 yr BP (Beta-16161). Walrus specimens dredged from the bottom near the centre of the Bay of Fundy have yielded bone-collagen dates of 9360 ± 90 yr BP (TO-1554; Miller, 1990) and $12\,760 \pm 90$ yr BP (TO-1927; R.F. Miller, personal communication, 1990). So, at least, walruses occupied coastal waters of what are now the southern Maritime Provinces from shortly after deglaciation to about 9400 years ago. Perhaps subarctic sea-surface temperatures of <12°C would have prevailed in the region near 12 500 yr BP (Bousfield and Thomas, 1975). Walruses are known to have occupied the Champlain Sea (Ste-Julienne, Québec) to the west of this region by $10\,090 \pm 60$ yr BP (TO-2224; M.A. Bouchard, personal communication, 1991) and penetrated the central Canadian Arctic Islands (Bathurst Island, Northwest Territories) by 7320 ± 120 yr BP (I-7796; Harington, 1975). Presumably, more information on the post-glacial invasion of the Arctic Islands by walruses will become available as radiocarbon dates on other walrus specimens that have been collected are published (e.g. Dyke and Morris, 1990).

CONCLUSION

Toward the end of the last glaciation, about 11 500 years ago, an adult male walrus died in coastal waters near what is now Forteau, Labrador. It seems to have sunk, and perhaps like the Qualicum walrus (Harington and Beard, 1991), settled belly-up, being eventually covered by mud and sand containing remains of pollen, dinoflagellates, diatoms, sponges, echinoderms, barnacles, foraminifera, ostracodes and pelecypods. Perhaps the *Mya arenaria* shells were deposited about 10 400 years ago — when the sea dropped to nearly the level at which the walrus lay. Probably the bottom-water salinity about the time when the walrus was deposited was <30‰.

Palynological evidence also suggests that the walrus skeleton was reworked and redeposited as the sea receded about that time (approximately 10 300 years ago). Alternatively, if reworking and redeposition were not involved, the bone date may be nearly 1000 years too old.

The walrus remains and associated fossils provide an interesting glimpse of environmental conditions in this area near the northeastern margin of the Goldthwait Sea, when the edge of the Laurentide Ice Sheet was only about 75 km inland. The Forteau walrus also fills an important gap between 12 800 year-old remains from the Maritime Provinces and 7300 year-old remains from the central Arctic Islands, helping to give us a better idea of the northward shift of the species in postglacial time.

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