Research Note

A new interglacial sequence from Washington Land, northern Greenland

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Macrofossil analyses of a Quaternary, till-covered sequence in Washington Land, north-western Greenland, are indicative of biotas similar to those of today. The only southern extralimital species found is *Empetrum nigrum*; its presence indicates slightly higher summer temperatures than today. AMS radiocarbon dating confirms that the sequence is pre-Holocene, and we suggest that the sequence belongs to the last interglacial stage.

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Deposits from Greenland with late Quaternary non-marine interglacial plant and animal remains were found in Warming Land in 1984, near Thule Air Base in 1986, and on Jameson Land in East Greenland in 1990 (Fig. 1; Meldgaard & Bennike 1989; Bennike & Böcher 1992, 1994). However, an earlier find was made during fieldwork in Washington Land in 1976, and the aim of this note is to report on this sequence, the discovery of which was brought to light during analyses of late Cenozoic wood from Washington Land (Bennike 1998). Although several studies of sites that are referred to the last interglacial stage have been published during the last decade, knowledge about interglacial biotas in Greenland is still very patchy. This small study focuses on macrofossils, which are usually of local origin.

The sequence is exposed on the northern shoulder above the river draining the larger Romer Sø (Romer Lake), located at an elevation of ca. 285 m asl, at 79°59.9′N, 62°1.9′W, in southern Washington Land (Fig. 1). The sequence consists of ca. 1 m of intercalated sandy layers and organic-rich layers, capped by a till deposit (Figs. 2, 3). The organic layers are peat-like, and the plant remains in these layers appear to be autochthonous. The sand layers may represent aeolian deposits, or slush flows. The overlying till deposit shows that the site was glaciated, but no deformations due to ice push were noted.

The topography of southern Washington Land is characterized by dissected plateaux, plains and river valleys. The region belongs to the high Arctic bioclimatic zone, and the total number of vascular plants recorded from Washington Land amounts to only 61 species (Bay 1992). Three species of woody plants, *Dryas integrifolia*, *Salix arctica* and *Cassiope tetragona*, have been reported, and of these the third is rare. The mean July temperature is 3–4°C, and the annual precipitation is probably 100–200 mm. The most productive areas are lowlands with moist or wet ground, but open vegetation with scattered plants dominates.

Material and methods

Five samples were collected and analysed for macroscopical plant and animal remains. The sediment was wet sieved on 0.4, 0.2 and 0.1 mm sieves, and the residue left on the sieves analysed using a dissecting microscope. The material is stored at the Geological Survey of Denmark and Greenland.

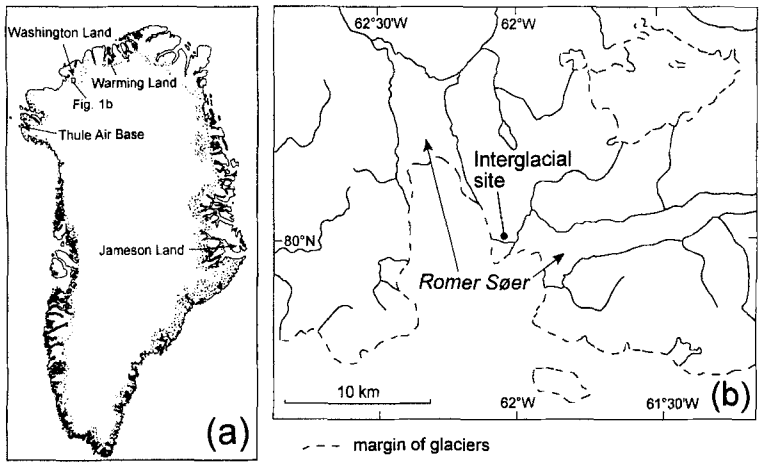

Fig. 1. (a) Map of Greenland showing places mentioned in the text. (b) Map of a portion of southern Washington Land, showing the location of the interglacial site.

Results

AMS radiocarbon datings were performed on the humic and non-soluble fractions of *Dryas integrifolia* remains. The humic fraction gave a date of >44 ^{14}C Kya (GGU No. 206055, AAR-4217-1), and the non-soluble fraction gave a date of >45 ^{14}C Kya (GGU No. 206055, AAR-4217-2).

The results of the macrofossil analyses appear in Fig. 3. The organic remains were well preserved, even though the samples had been stored for more than 20 years at room temperature. The remains are obviously not reworked from older deposits. The samples were small (less than one litre), but the concentration of macrofossils high, and thus a large number of macrofossils were present in the samples. The difference between the individual samples is small, and could be due to small differences in the local environment, or to taphonomic factors. The diversity is small, probably because the remains represent plants growing at the site or in the near vicinity.

Three of the samples are dominated by remains of *Drepanocladus* sensu lato sp. Members of this taxon grow in mires and in lakes; the growth form of the stem fragments in the samples indicates that the plants grew in a mire. The other dominating plant, *Dryas integrifolia*, is characteristic of dry soils. Although *D. integrifolia* can also grow in moist soil, it rarely grows together with *Drepanocladus*, and it is suggested that its remains were blown and washed out into the mire from surrounding slopes.

In the most recent review of the northern Greenland flora, all *Dryas* are referred to the North American *D. integrifolia* (Bay 1992) but, as discussed by previous botanists, all transitional forms between typical *D. integrifolia* and the Old

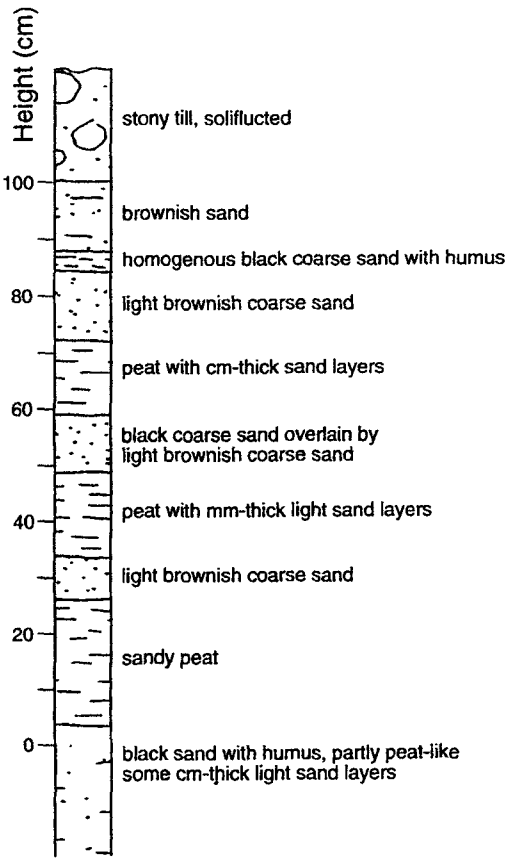

Fig. 2. Lithostratigraphy of the site.

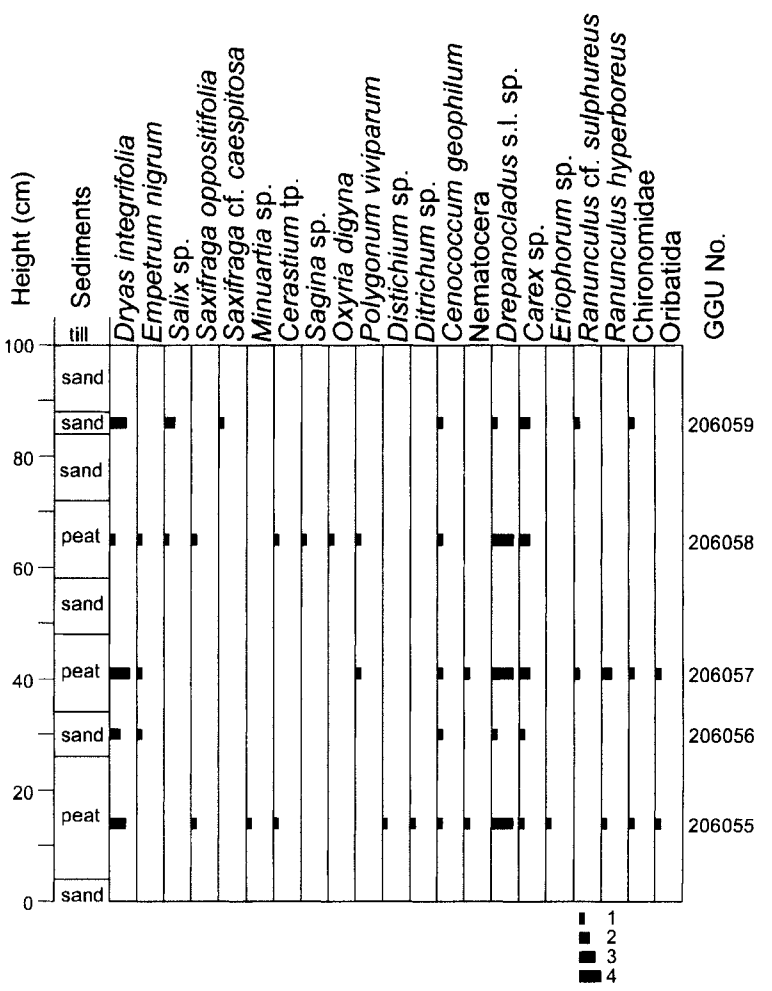

Fig. 3. Simplified macrofossil concentration diagram of the sequence. The plant and animal remains consist of a variety of different remains, including vegetative remains that could not be quantified precisely. Their subjectively ranked abundance is on a scale of 1 (rare) to 4 (abundant); see key.

World species *D. octopetala* can be found in northern Greenland (Holmen 1957; Elkington 1965). Forms of the *D. integrifolia* type dominate the fossil leaves from Washington Land, but some leaves have teeth and resemble *D. octopetala*. If compared with interglacial material from Thule and Warming Land, the leaves from Washington Land look much like the leaves from Thule (Bennike & Böcher 1992), but not like Warming Land leaves (Meldgaard & Bennike 1989).

Most of the other taxa recorded have rather wide ecological amplitudes, and might have grown in the mire or on moist or dry soils around the mire. *Ranunculus* spp., *Eriophorum* sp. and probably *Carex* sp. grew in the mire. Midge larvae (Chironomidae), of which a few larval head capsules were found, usually live in lakes or ponds, but some species live in wet soils.

The flora and fauna indicate a high Arctic environment similar to the current one. The only southern extralimital species is *Empetrum nigrum*, but its known northern range limit is only ca. 150 km south of the fossil site. The climate was probably also similar to that at the present, perhaps with slightly warmer summers.

Comparisons

Late Tertiary and early Quaternary sites with plant remains are known from several sites in Washington Land and elsewhere in northern Greenland (Bennike 1990, 1998), and it may be speculated if the sequence reported on here correlates with any of these. Many of the species found, including typical Arctic taxa such as *Dryas*, *Saxifraga*

oppositifolia and *Oxyria digyna*, have been reported from the Kap København Formation and late Tertiary deposits from northern Canada (Matthews & Ovenden 1990); thus their presence does not preclude a late Tertiary age. However, the complete lack of remains of boreal trees or associated insects, common at late Tertiary/early Quaternary sites, speaks against such an old age. The till cover and the non-finite radiocarbon dates show that the sequence is pre-Holocene, and since the fossil remains point to conditions similar to those at the present, an interglacial age, rather than an interstadial, is inferred. A last interglacial age is provisionally proposed, but it is hoped that it will be possible to collect samples for luminescence datings at a later stage, to better constrain the age of the deposit.

Sites from Greenland that can provide a basis for comparison with the sequence reported on here have been reported from Warming Land, Thule and Jameson Land. From northern Warming Land, a single sample yielded fairly small flora and fauna, and a non-finite radiocarbon date was obtained (Meldgaard & Bennike 1989). The species composition points to a climate similar to the present one. Near Thule Air Base, another single sample yielded a flora and a fauna that included a number of southern extralimital taxa; a mean summer temperature around 4°C higher than at present was suggested (Bennike & Böcher 1992). This sample was originally referred to the early Weichselian, but after correction of the luminescence dates for the effect of shallow traps, the sample is now referred to the last interglacial stage (Mejdahl et al. 1992; Kelly et al. 1999). From Jameson Land, numerous samples from many sites have been located, and rich and diverse flora and fauna recorded (Bennike & Böcher 1994; Bennike unpubl. data). Many southern extralimital species are present, and the mean summer temperature during the peak of the last interglacial stage was ca. 5°C higher than today. The Jameson Land deposits have been dated by numerous luminescence dates (Mejdahl & Funder 1994).

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References

Bay, C. 1992: *A phytogeographical study of the vascular plants of northern Greenland – north of 74° northern latitude. Medd. Grønland, Biosci. 36.*

Bennike, O. 1990: *The Kap København Formation: stratigraphy and palaeobotany of a Plio-Pleistocene sequence in Peary Land, North Greenland. Medd. Grønland, Geosci. 23.*

Bennike, O. 1998: Late Cenozoic wood from Washington Land. *Geol. Greenl. Surv. Bull. 180*, 155–158.

Bennike, O. & Böcher, J. 1992: Early Weichselian interstadial land biotas at Thule, northwest Greenland. *Boreas 21*, 111–117.

Bennike, O. & Böcher, J. 1994: Land biotas of the last interglacial/glacial cycle on Jameson Land, east Greenland. *Boreas 23*, 479–487.

Elkington, T. T. 1965: Studies of the variation of the genus *Dryas* in Greenland. *Medd. Grønland 178(1)*, 1–56.

Holmen, K. 1957: The vascular plants of Peary Land, north Greenland. *Medd. Grønland 124(9)*, 1–149.

Kelly, M., Funder, S., Houmark-Nielsen, M., Knudsen, K. L., Kronborg, C., Landvik, J. & Sorby, L. 1999: Quaternary glacial and marine environmental history of northwest Greenland: a review and reappraisal. *Quat. Sci. Revi. 18*, 373–392.

Matthews, J. V., Jr. & Ovenden, L. E. 1990: Late Tertiary plant macrofossils from localities in Arctic/subarctic North America: a review of the data. *Arctic 43*, 364–392.

Mejdahl, V. & Funder, S. 1994: Luminescence dating of late Quaternary sediments from east Greenland. *Boreas 23*, 525–535.

Mejdahl, V., Shlukov, A. I., Shakhovets, S. A., Voskovskaya, L. T. & Lyashenko, H. G. 1992: The effect of shallow traps: a possible source of error in TL dating of sediments. *Ancient TL 10*, 22–25.

Meldgaard, M. & Bennike, O. 1989: Interglacial remains of caribou (*Rangifer tarandus*) and lemming (*Dicrostonyx torquatus* (?)) from north Greenland. *Boreas 18*, 359–366.