Ancient Eskimo dwelling sites and Holocene relative sea-level changes in southern Disko Bugt, central West Greenland

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A coordinated geological-archaeological investigation has been carried out in southern Disko Bugt with the primary purpose of elucidating Holocene relative sea-level (RSL) changes. Two RSL curves representing the Early–Middle Holocene emergence of respectively southeastern and southwestern Disko Bugt have been constructed. Elevations of paleo-Eskimo sites of different ages have been surveyed and supplemented with similar elevations compiled from the literature. Detailed investigations have been carried out at two partly submerged Dorset I sites. At both sites, the stratigraphy of the foreshore has been recorded in terrain profiles.

It is concluded that the RSL history of southern Disko Bugt was one of steady emergence during Early–Middle Holocene followed by submergence in Late Holocene. The stratigraphy of the foreshore at the two Dorset I sites indicates that RSL has been at least 2–2.5 m below sea-level, and that the transgression to present sea-level started after ca 1 ka B.P.

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Introduction

Most studies of Holocene relative sea-level (RSL) changes in West Greenland have focused upon the construction of emergence curves representing the Early–Middle Holocene glacioisostatic rebound. Hundreds of Early–Middle Holocene shell samples from West Greenland have been dated and used in emergence curves representing smaller regions (Disko Bugt: Weidick 1972a, 1996; Donner & Jungner 1975; Donner 1978; Frich & Ingólfsson 1990; Ingólfsson et al. 1990; Rasch & Nielsen 1995; Rasch in press; Rasch et al. in press). From these curves it is well-established that emergence occurred in West Greenland between the Wisconsinan deglaciation (11–7 ka B.P.) and 5–3 ka B.P. (1 ka B.P. = $1000\,^{14}C$ years before 1950 A.D.). Since then, RSL in Greenland has been either very close to or below present sea-level (Kelly 1980, 1985; Funder 1989; Weidick 1993). As a result, Late Holocene datable marine material is situated below sea-level, and present knowledge about Late Holocene RSL changes in West Greenland therefore originates mostly from information arising from archaeological and geomorphological investigations (e.g. Mathiassen in Gabel-Jørgensen & Egedal 1940; Kelly 1980; Weidick 1976, 1993, 1996; Rasch & Nielsen 1994, 1995; Kramer 1996; Rasch et al. in press). These investigations have revealed that the Early–Middle Holocene emergence was followed by a general submergence beginning between 3 and 1 ka B.P. (Kelly 1980; Funder 1989; Weidick 1993, 1996), and it has been suggested that transgressions (separated by periods having stable or slightly regressive conditions) culminated before ca 1 ka B.P., in the 14th century, and in the middle of this century (Mathiassen in Gabel-Jørgensen & Egedal 1940; Weidick 1993, 1996; Rasch & Nielsen 1995; Rasch et al. in press).

With short interruptions, Greenland has been inhabited since ca 4 ka B.P., in West Greenland by three different Eskimo cultures (Saqqaq Culture, ca 4400–2800 B.P.; Dorset Culture, 2600–1800 B.P.; Thule Culture, after 900 B.P.) and the Norsemen (reviews: Fitzhugh 1984; Jordan 1984; Kleivan 1984; Møbjerg 1986). Both the Eskimoes and the Norsemen were dependent on the sea. Accordingly, settlements from the last ca 4 ka are found very close to the sea throughout West Greenland. Many archaeologists have noted that elevational differences between settlements of different ages provide evidence of RSL history (e.g. Mathiassen in Gabel-Jørgensen & Egedal

1940; Roussel 1941; Knuth 1958; Larsen & Meldgaard 1958; Møbjerg 1986; Hansen & Brinch Petersen 1989b, 1990; Kramer 1996).

In 1988 and 1990 Saqqaq (4400–2800 B.P.) and Dorset (2600–1800 B.P.) sites were registered in large numbers in Disko Bugt. Based on these registrations, Hansen and Brinch Petersen (1989b, 1990) noted that Saqqaq sites generally occur at higher elevations than Dorset I sites. A similar elevational distribution of paleo-Eskimo sites occurs in the Sisimiut area, where Saqqaq sites consistently occur at levels above 8 m a.s.l. while Dorset sites occur at levels below 8 m a.s.l. (Kramer 1996).

The fact that many Thule Culture (after ca 900 B.P.) ruins from the 17th and 18th centuries are damaged or partly submerged by the sea throughout western and southeastern Greenland (Mathiassen 1930, 1931, 1933, 1934, 1936a, 1936b) has been interpreted as evidence of low RSL during the 17th and 18th centuries and rising RSL thereafter (Mathiassen in Gabel-Jørgensen & Egedal 1940). Investigations of Norse settlements (ca 1000–600 B.P.) have also contributed to our knowledge of RSL changes in the recent past. A submerged church at Sandnes in the Nuuk area is a frequently cited example (Bruun 1918; Roussell 1936, 1941; Weidick 1976).

In this paper, new and previously published archaeological and geological/geomorphological observations are combined in a discussion of Holocene RSL changes in southern Disko Bugt. In this area, 45 shell samples (all older than ca 4 ka B.P.), 61 archaeological samples (all younger than ca 4 ka) and 1 gyttja sample have been dated. In addition, some of the most extensive archaeological excavations in Greenland have been carried out in the area (Meldgaard 1952, 1983, 1991;

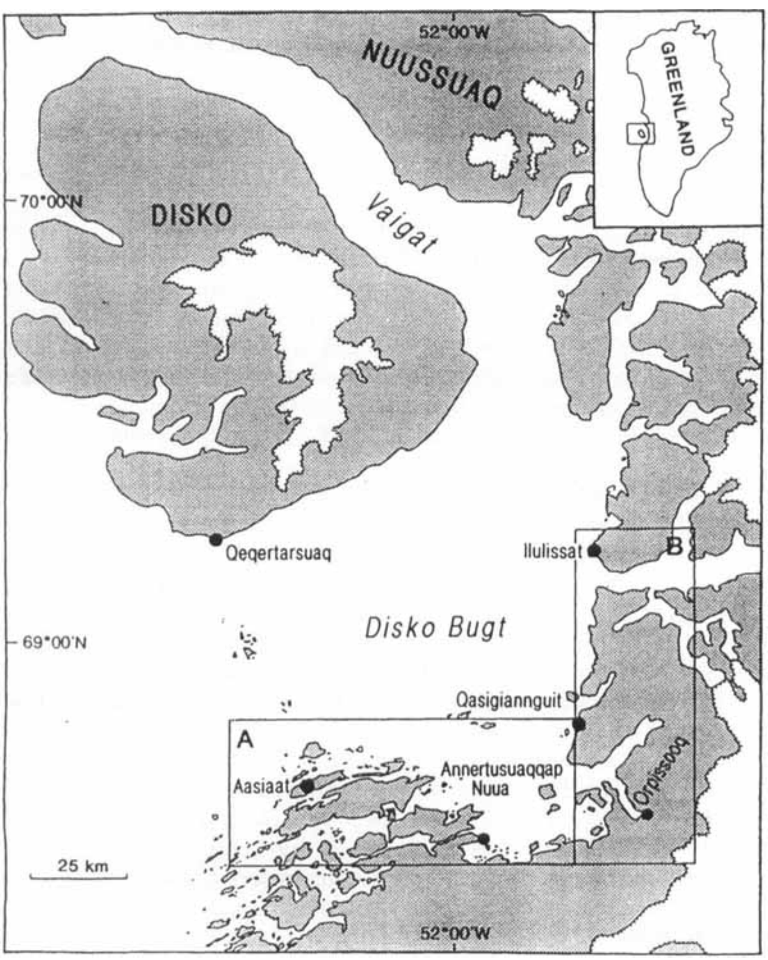

Fig. 1. Location map. The frames A and B indicate detail maps of southwestern and southeastern Disko Bugt which are represented in Figs. 2 and 4, respectively. Place names are spelled in accordance with current Greenlandic orthography.

Larsen & Meldgaard 1958; Mathiassen 1958; Møbjerg 1986; Grønnow & Meldgaard 1988, 1991; Grønnow 1990, 1994; Hansen & Jensen 1991; Evaldsen & Brinch Petersen 1995; Jensen 1995), and registration of former Eskimo dwelling sites is at an advanced stage (Mathiassen 1934; Larsen & Meldgaard 1958; Hansen & Brinch Petersen 1989a, 1989b, 1990; Jensen et al. 1995). The datings have allowed us to construct two RSL curves representing southeastern and southwestern Disko Bugt, respectively. More detailed information about RSL changes during the last ca 4 ka has been achieved by studying elevation differences between Eskimo sites of different ages and by studying the stratigraphy beneath the foreshore at two partly submerged Dorset I sites.

Physical setting

The study area includes southern Disko Bugt between 68°30′N and 69°15′N and between 50°00′W and 54°00′W (Figs. 1, 2 and 4). To the east, the area is bordered by the Greenland Ice Sheet. The general altitude of the area decreases westwards from ca 500 m a.s.l. near the Greenland Ice Sheet to below 100 m a.s.l. east of Aasiaat. No local glaciers occur in the area.

Bedrock consists mainly of Precambrian gneiss (Escher et al. 1976). The landscape has developed by aerial scouring by the Greenland Ice Sheet during the Quaternary glaciations (Sugden 1974). Southwestern Disko Bugt is fringed by an archipelago. Towards the east, a landscape with plains dissected by troughs and fiords becomes more common.

Southern Disko Bugt was deglaciated between ca 11 and ca 7 ka B.P. The oldest date on postglacial marine fossils from central West Greenland (>11.8 ka B.P.) originates from Nassuttooq a little southwest of the study area (Kelly 1985). During the deglaciation, there were probably periods of glacial readvances or still stands (Weidick 1972a; Donner & Jungner 1975; Funder 1989; Funder & Hansen 1996). The oldest date on marine shells from the eastern part of the study area is 7210 ± 170 B.P. (Hel-369, see Table 1). The altitude of the Holocene marine limit increases westward from ca 70 m a.s.l. near the Ice Sheet to above 120 m a.s.l. west of Aasiaat (Donner & Jungner 1975; Funder 1989; Funder & Hansen 1996; Rasch 1996).

The wave climate in southern Disko Bugt is characterised by wind waves from the east caused by katabatic winds from the Ice Sheet and by swell from the west caused by the passage of depressions in Davis Strait and Baffin Bay. Generally, the wave energy decreases eastwards from the outer skerries of the archipelago towards the mainland coast. Sea ice normally covers Disko Bugt from the middle of December to the beginning of June (Danish Meteorological Institute 1967–1986). Spring tidal range is a little more than 2.5 m (Farvandsvæsenet 1994).

Methods

The datings applied in this investigation have been carried out by many different laboratories. Datings given without δ^{13}C-values have not been corrected for isotopic fractionation. Errors introduced by lack of δ^{13}C-corrections are assumed to be less than ±80 years on shell samples, while dates on terrestrial samples are assumed to be up to 200 years too young. Datings on terrestrial material with given δ^{13}C-values have been corrected to $\delta^{13}C = -25.0‰$ PDB. Datings on marine material with given δ^{13}C-values have been corrected to $\delta^{13}C = 0.0‰$ PDB. The marine reservoir effect in Greenland is expected to be 410 years (Rasmussen & Rahbek 1996).

Dated samples have been collected by different scientists using different methods for altitude determinations. As a result, errors on sampling altitudes vary from sample to sample. Unless otherwise stated in Table 1, errors on sampling altitudes on geological samples (shells) are expected to be less than ±5 m, while altitude errors on archaeological samples are expected to be less than ±2 m. The sampling altitudes on most archaeological samples were originally given in metres above spring high-water level. In Table 1, these altitudes have been converted to metres above mean sea-level by subtracting the difference (1.4 m) between mean spring high-water level and mean sea-level at Qasigiannguit from all measured altitudes.

Terrain profiles have been surveyed using theodolite. Spring high-water level on the beaches (highest occurrence of relatively fresh seaweed) has been used as temporary datum in the field. During data processing, datums have been corrected to mean sea-level using the method

Table 1. Holocene radiocarbon datings from southern Disko Bugt. Sources for dates and sampling altitudes: 1. Harder et al. 1949; 2. Laursen 1950; 3. Mathiassen 1958; 4. Tauber 1960; 5. Tauber 1964; 6. Fredskild 1967; 7. Weidick 1968; 8. Tauber 1968; 9. Weidick 1972a; 10. Weidick 1972b; 11. Weidick 1973; 12. Weidick 1974; 13. Donner & Jungner 1975; 14. Meldgaard 1983; 15. Møbjerg 1986; 16. Böcher & Fredskild 1993; 17. Grønnow 1994; 18. Grønnow, B. pers. comm.; 19. Meldgaard, J. pers. comm.; 20. This work.

Loc. no.	Lab. no.	Reference no.	N Lat.	W Long.	Material	^{14}C age	±	m a.s.l.	δ^{13}C ‰ PDB
17	HEL-365	13	68°39′	52°15′	Shells	5330	210	8.7	
17	HEL-343	13	68°38′	52°16′	Shells	5340	145	5.1	
5	I-6242	11	68°56′	51°00′	Shells	5395	110	2	
8	HEL-361	13	68°34′	52°59′	Shells	5480	130	21.8	−2.5
8	K-2026	12	68°37′	52°20′	Shells	5460	100	3	
20	AAR-2555	20	68°38′	52°20′	Shells	5660	180	7–10	−1.9
8	K-1815	10	68°37′	50°51′	Shells	5820	110	3.6	
8	K-2020	2, 12	68°37′	50°40′	Shells	5890	100	3	
23	AAR-2556	20	68°40′	52°49′	Shells	5920	110	6	−1.3
8	HEL-328	13	68°37′	50°52′	Shells	5970	130	14.1	−2.7
10	HEL-367	13	68°33′	51°29′	Shells	6040	150	29	
17	HEL-436	13	68°39′	52°15′	Shells	6100	160	15.3	
34	HEL-360	13	68°34′	52°58′	Shells	6110	140	15.3	−3.4
17	HEL-364	13	68°39′	52°15′	Shells	6220	160	28.9	
17	HEL-344	13	68°38′	52°16′	Shells	6300	160	5.1	
8	K-1814	10	68°37′	50°51′	Shells	6360	160	3	
8	K-2019	12	68°37′	50°40′	Shells	6380	110	37	
10	HEL-438	13	68°33′	51°29′	Shells	6460	210	40.3	
6	HEL-454	13	68°39′	51°15′	Shells	6560	210	37.9	
7	HEL-370	13	68°38′	51°10′	Shells	6680	160	18.9	
6	HEL-371	13	68°39′	51°15′	Shells	6690	160	37.9	
10	HEL-366	13	68°33′	51°29′	Shells	6790	170	40.3	−0.7
22	HEL-342	13	68°36′	52°32′	Shells	6800	165	21.4	
3	I-6243	10	69°05′	51°08′	Shells	6835	125	30	
13	HEL-347	13	68°36′	51°53′	Shells	7010	170	24.3	
8	K-1817	10	68°37′	50°51′	Shells	7030	130	2	
3	K-992	7, 9	69°01′	51°04′	Shells	7110	140	40	
21	HEL-363	13	68°37′	52°21′	Shells	7150	210	17.2	
8	HEL-369	1, 13	68°37′	50°52′	Shells	7210	170	10.7	
13	HEL-346	13	68°36′	51°51′	Shells	7160	170	43	−3.6
4	K-993	7, 9	68°58′	50°53′	Shells	7650	140	52	
3	K-2022	2, 12	69°03′	51°08′	Shells	7690	120	<15	
28	HEL-455	13	68°34′	52°58′	Shells	7800	260	42.2	
11	HEL-329	13	68°31′	51°39′	Shells	7880	150	50	−2.6
3	K-987	7, 8, 9	69°01′	51°04′	Gyttja	7850	190	?	
11	HEL-368	13	68°31′	51°38′	Shells	7880	250	50	
28	HEL-341	13	68°34′	52°58′	Shells	8330	220	42.2	
17	HEL-345	13	68°39′	52°15′	Shells	8550	190	15.3	−1.6
17	HEL-437	13	68°39′	52°15′	Shells	8630	200	28.9	
3	K-1818	10	69°06′	51°04′	Shells	8630	140	5–10	
3	K-2023	12	69°01′	51°08′	Shells	8680	130	?	
22	HEL-362	13	68°36′	52°34′	Shells	8970	170	18.5	−3.0
1	K-557	3, 4	69°12′	51°11′	Peat	710	100	6–7	
2	K-3653	14, 19	69°08′	50°43′	Peat	750	70	<5	−24.3
1	K-556	3, 4	69°12′	51°11′	Peat	940	120	6–7	
8	AAR-2554	20	68°37′	50°52′	Peat	1025	55	5	−27.7
1	K-813	3, 5, 6	69°12′	51°11′	Peat	1540	100	4.4	
2	K-3652	14, 19	69°08′	50°43′	Peat	1600	55	<5	−24.3
9	K-4560	18	68°35′	51°05′	Peat w. cult. rem.	1730	70	<2.5	−24.2
2	K-3903	14, 19	69°08′	50°43′	Peat	1860	70	<5	−24.7
1	K-515	3, 5, 6	69°12′	51°11′	Peat	1910	100	4	
1	K-517	3, 5, 6	69°12′	51°11′	Peat	1940	100	4.4	
2	K-3898	14, 19	69°08′	50°43′	Peat	2150	75	<5	−25.1
2	K-3897	14, 19	69°08′	50°43′	Peat	2200	75	<5	−24.7
8	AAR-2350	21	68°37′	50°52′	Caribou	2200	65	1.4	−18.0

Table 1. Continued.

Loc. no.	Lab. no.	Reference no.	N Lat.	W Long.	Material	^{14}C age	±	m a.s.l.	$\delta^{13}C$ ‰ PDB
2	K-3902	14, 19	69°08′	50°43′	Peat	2210	70	<5	−24.5
1	K-3769	15, 19	69°12′	51°11′	Peat w. cult. rem.	2260	70	<5	−25.0
2	K-3896	14, 19	69°08′	50°43′	Peat	2280	75	<5	−25.5
1	K-812	3, 5	69°12′	51°11′	Peat w. cult rem.	2330	110	4.2	
1	K-811	3, 4, 5	69°12′	51°11′	Peat	2350	110	4	
12	AAR-2343	20	68°35′	51°52′	Caribou	2460	70	1.5	−18.7
12	AAR-2351	20	68°35′	51°52′	Charcoal	2530	75	−0.1	−23.4
1	K-809	3, 4, 5	69°12′	51°11′	Peat	2570	110	3.8	
2	K-3895	14, 19	69°08′	50°43′	Peat	2640	75	<5	−25.4
2	K-3894	14, 19	69°08′	50°43′	Peat	2700	75	<5	−25.5
2	K-3649	14, 19	69°08′	50°43′	Peat	2720	80	<5	−25.1
1	K-516	3, 4, 5	69°12′	51°11′	Peat	2740	100	3.7	
2	K-3901	14, 19	69°08′	50°43′	Peat	2830	80	<5	−24.2
1	K-808	3, 5	69°12′	51°11′	Peat	2830	120	3.8	
2	K-3647	14, 19	69°08′	50°43′	Wood	2850	80	<5	−26.2
2	K-3646	14, 19	69°08′	50°43′	Peat	2890	65	<5	−23.8
2	K-3905	14, 19	69°08′	50°43′	Peat	2910	75	<5	−25.6
2	K-3651	14, 19	69°08′	50°43′	Peat	3100	75	<5	−24.0
9	K-4820	16, 17, 18	68°35′	51°05′	Peat w. cult rem.	3150	80	4.5–5.5	−27.9
2	K-3645	14, 19	69°08′	50°43′	Peat	3150	80	<5	−25.1
2	K-3650	14, 19	69°08′	50°43′	Peat	3290	80	<5	−27.3
9	K-4816	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3310	80	4.5–5.5	−26.2
1	K-807	3, 4, 5	69°12′	51°11′	Peat w. cult rem.	3360	120	3.6	
9	K-4561	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3390	80	4.5–5.5	−24.8
9	K-5128	17, 18	68°35′	51°05′	Seal in midden	3400	80	4.5–5.5	−14.9
2	K-3648	14, 19	69°08′	50°43′	Peat	3430	85	<5	−25.8
2	K-3900	14, 19	69°08′	50°43′	Wood	3440	80	<5	−25.9
9	K-5124	18	68°35′	51°05′	Seal from midden	3460	80	<2.5	−14.4
2	K-3906	14, 19	69°08′	50°43′	Wood	3490	140	<5	−26.7
9	K-5126	17, 18	68°352′	51°05′	Seal from midden	3500	80	4.5–5.5	−14.1
1	K-806	3, 4, 5	69°12′	51°11′	Peat w. cult. rem.	3510	120	3.5	
2	K-3904	14, 19	69°08′	50°43′	Wood	3550	85	<5	−26.7
2	K-3899	14, 19	69°08′	50°43′	Wood	3550	80	<5	−25.6
9	K-5127	17, 19	68°35′	51°05′	Seal from midden	3570	80	4.5–5.5	−14.0
25	AAR-2957	20	68°382′	52°38′	Seal from midden	3630	60	12	−14.0
9	K-4822	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3640	75	4.5–5.5	−26.7
9	K-4818	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3650	85	4.5–5.5	−27.3
9	K-4817	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3680	85	4.5–5.5	−26.6
9	K-4562	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3690	80	<2.5	−22.5
1	K-3768	15, 19	69°12′	51°11′	Peat w. cult. rem.	3690	80	?	−23.3
9	K-4563	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3720	80	<2.5	−24.2
9	K-4564	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3730	80	<2.5	−24.3
9	K-4565	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3750	80	<2.5	−22.4
9	K-4821	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3760	80	4.5–5.5	−27.3
9	K-4819	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3780	85	4.5–5.5	−25.6
9	K-5125	18	68°35′	51°05′	Seal from midden	3820	60	<2.5	−14.6
9	K-4566	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3880	85	<2.5	−22.5
9	K-4823	16, 17, 18	68°35′	51°05′	Peat w. cult. rem.	3980	85	4.5–5.5	−25.5
27	HEL-359	13	68°39′	53°02′	Shells	4070	130	8	−0.6
8	K-1816	10	68°37′	50°51′	Shells	4870	110	6.8	
8	HEL-330	13	68°37′	50°52′	Shells	5040	140	12.9	−0.6
8	K-2021	12	68°37′	50°51′	Shells	5190	100	7	

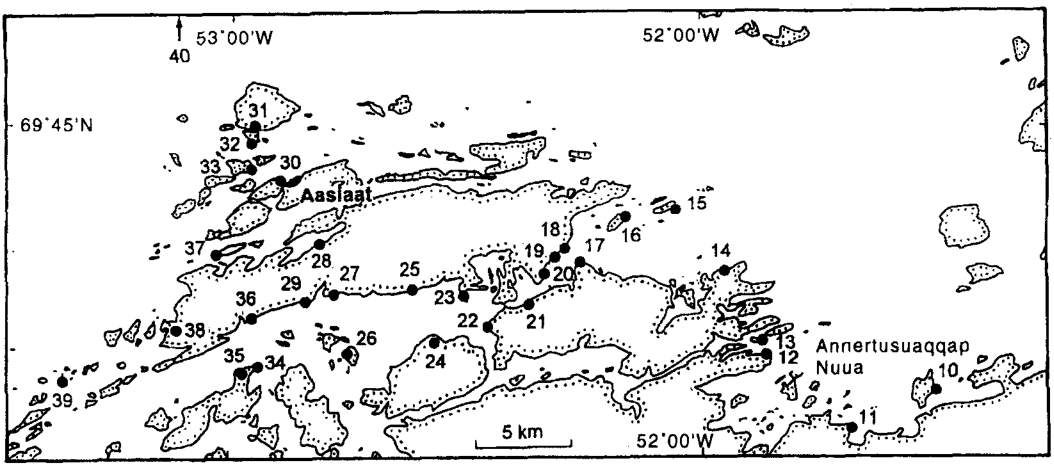

Fig. 2. Detail map of southwestern Disko Bugt. The numbers on the map refer to the location numbers in Table 1 and Fig. 6.

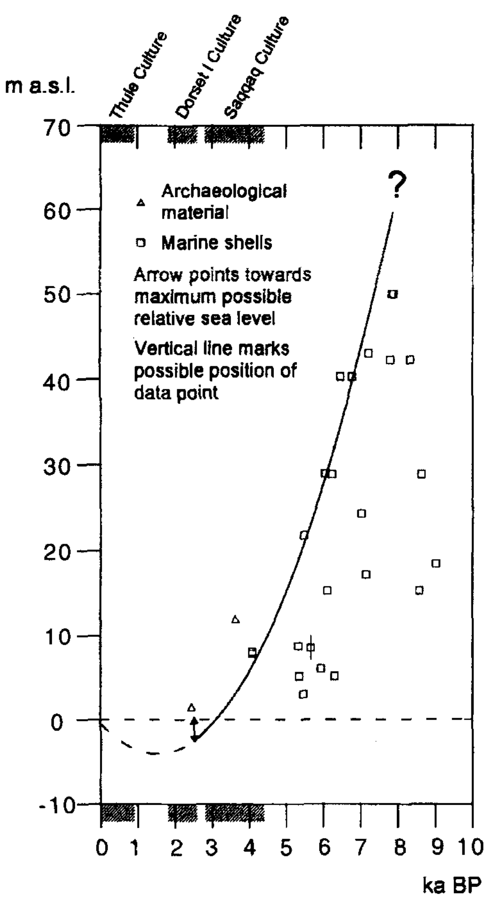

Fig. 3. RSL curve for southwestern Disko Bugt. The area was deglaciated between ca 11 and ca 8 ka B.P., and the Holocene marine limit is situated between ca 80 and ca 130 m a.s.l. (Kelly 1985; Funder 1989).

mentioned above. Absolute and relative errors on terrain profiles are assumed to be less than ±0.5 m and less than ±0.1 m, respectively.

Results

Data for this investigation originate from field work carried out in the summers of 1989, 1993, 1994 and 1995 and from data compiled from the literature.

RSL curves

Two RSL curves representing, respectively, the western and the eastern part of southern Disko Bugt have been constructed (Figs. 3 and 5). Each curve represents regions having almost uniform altitudes of the Holocene marine limit (Donner & Jungner 1975; Funder 1989; Funder & Hansen 1996; Rasch 1996). In southwestern Disko Bugt (Fig. 2) the Holocene marine limit varies between 100 and 130 m a.s.l. In southeastern Disko Bugt (Fig. 4) the limit varies between 70 and 100 m a.s.l.

Previously published and new datings on both terrestrial and marine material have been used for constructing the curves. The curve representing the eastern part of the study area is based on 78 datings of which 2 are new. The curve representing the western part is based on 26 datings of which 5 are new. Three datings were excluded

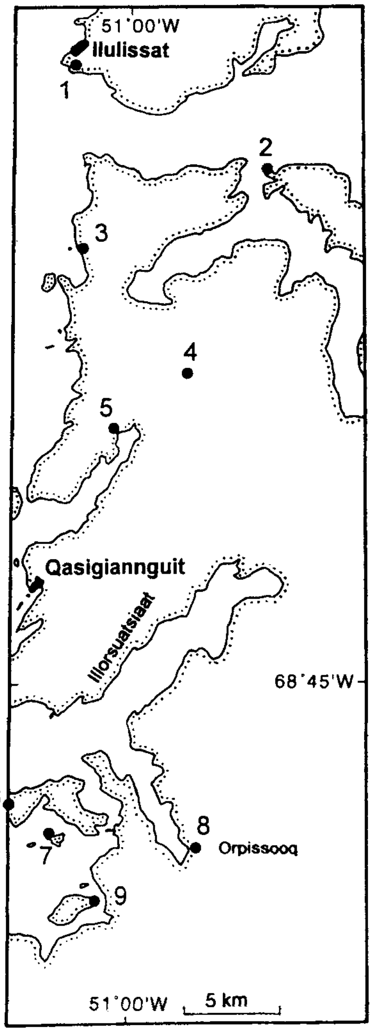

Fig. 4. Detail map of southeastern Disko Bugt. The numbers on the map refer to the location numbers in Table 1.

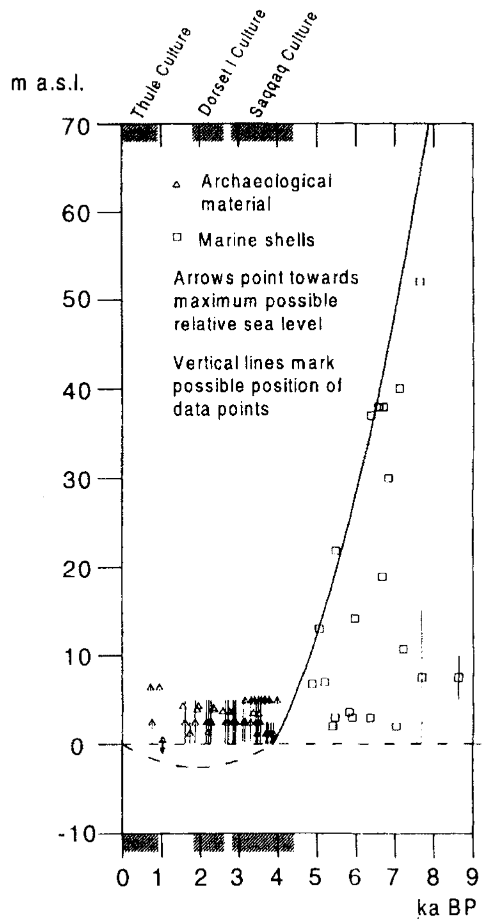

Fig. 5. RSL curve for southeastern Disko Bugt. The area was deglaciated at ca 8 ka B.P., and the Holocene marine limit is situated between ca 60 and ca 80 m a.s.l. (Donner & Jungner 1975).

because the field altitude of the samples were unknown. Datings are listed in Table 1.

Most archaeological samples from southeastern Disko Bugt were collected in midden layers in active coastal cliffs. The low elevation of these middens and the fact that they are being eroded indicate that they were developed at a RSL very close to or below present sea-level.

Above sea-level both RSL curves have been constructed as the best fitting polynomial to data points representing dated marine deposits which are assumed to have been formed near sea-level. As a result, the RSL depicted by the curves are probably slightly too low. For southwestern Disko Bugt, the polynomial has been extended below sea-level. For southeastern Disko Bugt the RSL curve below sea-level has been drawn free-hand, taking archaeological evidence into consideration. In this part of Disko Bugt the occurrence of layered middens with remnants from Saqqaq, Dorset I and Thule Culture suggests minor RSL changes since the first immigration to the region (see below).

Elevational distribution of archaeological sites

Southwestern Disko Bugt. – Fig. 6 presents a

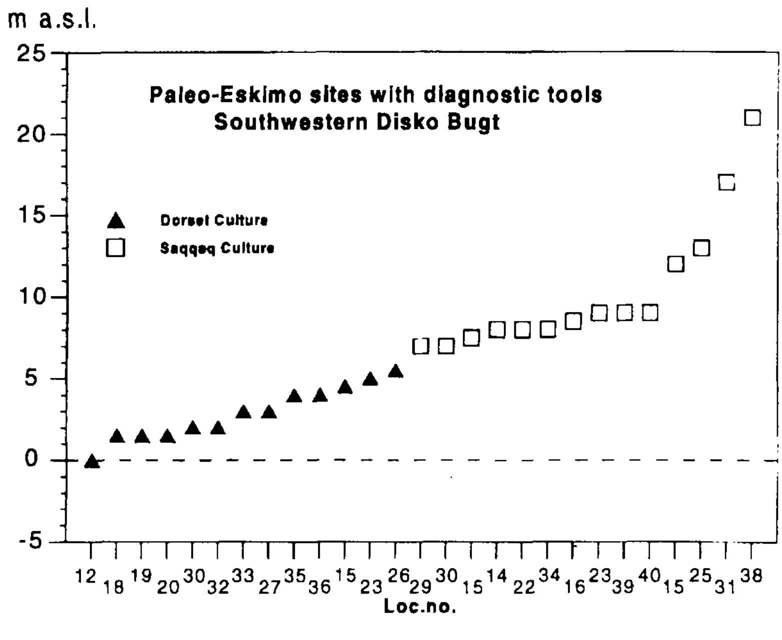

Fig. 6. Altitudes of the lowest points on Dorset I and Saqqaq sites with diagnostic tools in southwestern Disko Bugt. Location numbers refer to the numbers on the map in Fig. 2.

compilation of elevational data from the three most recent archaeological reconnaissance surveys in the western part of the area (Fig. 2) (Hansen & Brinch Petersen 1989b, 1990; Jensen et al. 1995). Altitudes of the lowest point on registered Saqqaq and Dorset I sites have been plotted using the graph type introduced by Kramer (1996). Chronologically significant tools (Fig. 7) distinguishing Saqqaq sites from Dorset I sites have been found at all sites, but extensive test pitting has only been conducted in a few cases.

At Illorsuup Nuua (Loc. 19, Fig. 2) and Niuertusannguaq (Loc. 20, Fig. 2), Dorset I artifacts were found at levels up to 10 m a.s.l., which is surprisingly high. However, the artifacts above 3 m a.s.l. occur sparsely in peat deposits on gravel terraces. This might suggest a functional difference (i.e. different sites for different purposes) compared with lower sites, which have relatively rich artifact deposits. A comparable situation has been described from Philips Garden, Newfoundland, where Renouf (1993) suggests the same age but functional differences between artifact-poor sites located high on a bluff (used for short term, warm weather occupations) and artifact-richer lower lying sites (used for cold weather occupations).

Southeastern Disko Bugt. – Unfortunately, the data from southeastern Disko Bugt (Fig. 4) are

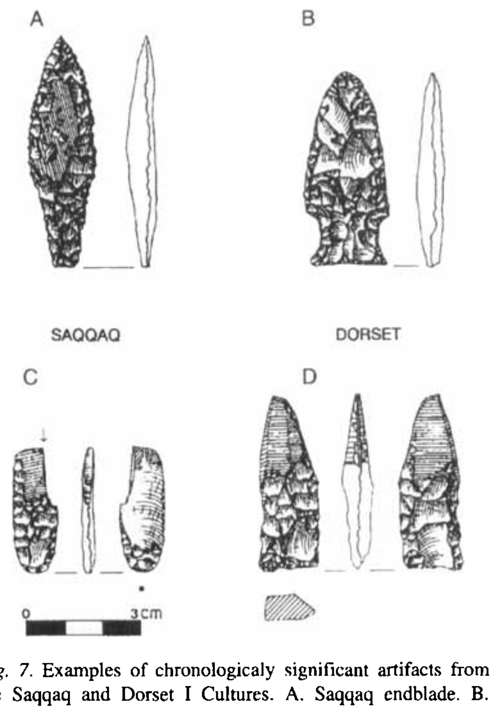

Fig. 7. Examples of chronologicaly significant artifacts from the Saqqaq and Dorset I Cultures. A. Saqqaq endblade. B. Dorset I endblade. C. Saqqaq burin. D. Dorset I burin. Drawing: Lykke Johansen.

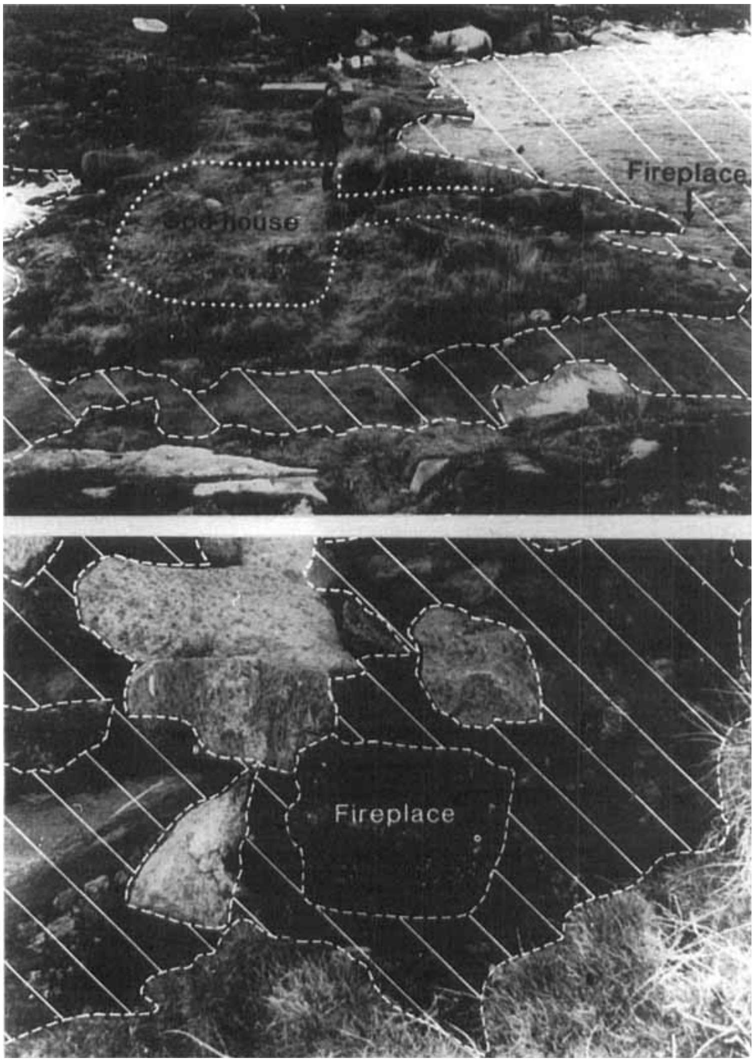

Fig. 8. Thule Culture sod house (upper picture) and fireplace with fire encrusted blubber (lower picture) at Illorsuup Nuua (Loc. 19). The photos were taken at spring high-tide. White hatching indicates areas under water.

more limited and less unequivocal than the data from southwestern Disko Bugt. At Orpissooq (Loc. 8, Fig. 4), a Saqqaq site occurs at ca 4–5 m a.s.l., while a Dorset I site at the same locality occurs at 0–1 m a.s.l. (see next section). However, what characterises the best known settlements in this region (e.g. Sermermiut (Loc. 1, Fig. 4), Qajaa (Loc. 2, Fig. 4) and Illorsuatsiaat (Fig. 4)) is that Dorset I Eskimoes have established their sites on top of former Saqqaq sites (Larsen & Meldgaard 1958; Mathiassen 1958; Meldgaard 1983, 1991). This suggests that only small changes of RSL have occurred in this part of Disko Bugt between the immigration of the Saqqaq people (ca 4.4 ka B.P.) and the disappearance of the Dorset I Culture (ca 1.8 ka B.P.).

Thule Culture settlements. – Only little attention has been paid to Thule Culture sites. In the study area, sod houses (winter dwellings) from the Thule Culture (<900 B.P.) are found at very different elevations. However, submergence of Thule Culture dwelling sites occurs frequently. At Illorsuup Nuua (Fig. 2, Loc. 19) a Thule Culture sod house occurs just above spring high-water level. The fireplace and the entrance passage of the house becomes flooded at spring high tide (Fig. 8). The typology of the house suggest that it was built around the 17th century (Gulløv 1983). The flooding of Thule Culture sites indicate transgression after establishment of the sites.

Geomorphology at two Dorset I sites

Field work was carried out at Orpissooq (68°37'N 50°52'W, Fig. 1) and at Annertusuaqqap Nuua (68°35'N 51°52'W, Fig. 1) in order to determine the highest possible RSL at the time of occupation. Terrain profiles of the beach were surveyed at both sites (Figs. 11 and 12).

Orpissooq. – At Orpissooq, a Saqqaq site and a Dorset I site occur within a distance of a few hundred metres. The Saqqaq site lies on a blowout approximately 4–5 m a.s.l., and the Dorset I site lies on a tombolo covered by minor dune deposits, grass and marsh vegetation (Fig. 9). Today most of the tombolo is flooded at spring high-tide.

At the Dorset I site, the stratigraphy above spring high-water level was recorded in a 4 × 1 m transect excavated in 1989, while the stratigraphy below spring high-water level was recorded in 1995 from cores taken at ca 5 m intervals along the profile line.

Well-sorted sand constitutes the foreshore sediment at Orpissooq. Peat layers containing Dorset I cultural remains (tools, debitage and charcoal) extend below foreshore sediments to a level of 0.3 m a.s.l. (Fig. 11).

A bulk sample from the top of the peat (AAR-2554; 1025 ± 55 B.P.) beneath the foreshore at 0.3 m a.s.l. and a caribou bone (AAR-2350; 2200 ± 65 B.P.) from the middle of the peat layer beneath the subaerial part of the tombolo were dated (Fig. 11, Table 1). The date on the caribou bone corresponds well with the generally accepted duration of the Dorset I Culture, whereas the peat bulk sample is too young to be contemporaneous with the Dorset I occupation. The occurrence of Dorset I artifacts in the younger peat suggests that some redeposition of cultural material has occurred. Probably, the redeposition results from a transgression starting after ca 1 ka B.P.

Annertusuaqqap Nuua. – At Annertusuaqqap Nuua a Dorset I site is located on a tombolo immediately above spring high-water level (Fig. 10) (Jensen 1995). A trench (Fig. 12) dug across the foreshore showed subangular-subrounded cobbles overlying patches of peat containing cultural remains (tools, debitage, charcoal and bone) and extending down to −0.1 m a.s.l. (Figs. 10, 12 and 13).

A caribou bone from the excavated dwelling structure at 1.5 m a.s.l. (AAR-2343; 2460 ± 70 B.P.) and a sample of charcoal (AAR-2351; 2530 ± 75 B.P.) from the peat layer underneath the foreshore at −0.1 m a.s.l. were dated (Figs. 12 and 13, Table 1).

The low-lying cultural deposits at −0.1 m a.s.l. consist of unsorted charcoal, bone, and stone artifacts which indicate that significant redeposition has not occurred. The good concordance between the two dates from this site supports the conclusion that peat deposits beneath foreshore cobbles are the eroded but not redeposited remnants of a formerly more extensive culture layer extending over the flat area now constituting the foreshore.

Discussion and conclusions

The two RSL curves from southern Disko Bugt indicate emergence during Early–Middle Holocene. It is evident that the curve from southeastern Disko Bugt is steeper than the curve from southwestern Disko Bugt. This result accords well with results from earlier investigations both in Disko Bugt (Rasch & Nielsen 1995; Rasch et al. in press; Weidick 1996) and other parts of Greenland (e.g. Funder & Hansen 1996; Weidick 1996), indicating higher rates of Early–Middle Holocene emergence closer to the Greenland Ice Sheet. It is suggested that the differences between the two curves is mainly the result of difference in the rate of eustatic sea-level rise in the periods of rapid glacio-isostatic land rise immediately after the deglaciation of the two regions. When western Disko Bugt was deglaciated at ca 10 ka B.P. the eustatic sea-level was rising ca 1.3 cm per year, while when eastern Disko Bugt was deglaciated at ca 7 ka B.P., the eustatic sea-level was only rising 0.7 cm per year, and the rate was decreasing rapidly (Fairbanks 1989). Accordingly, the glacio-isostatic land rise probably had a larger relative effect on the Early–Middle Holocene RSL

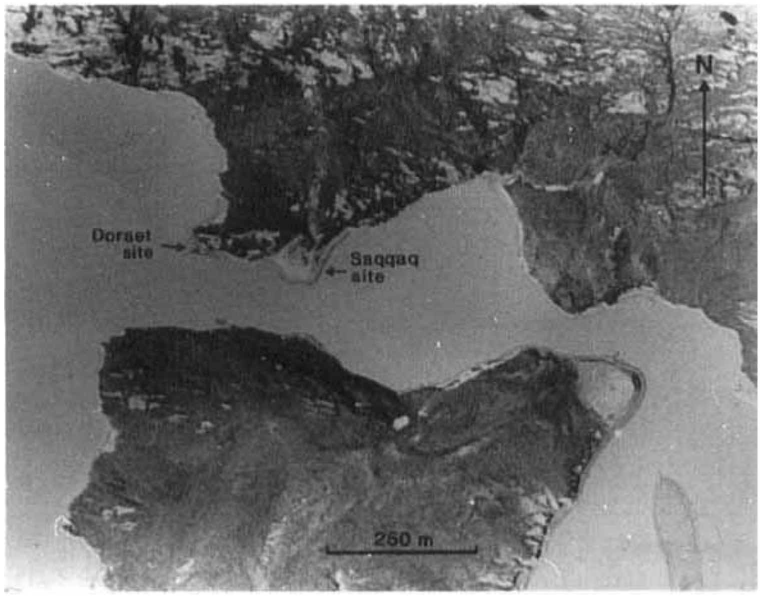

Fig. 9. Air photograph showing the position of the Dorset I site and the Saqqaq sites at Orpissooq (Loc. 8) (Copyright: Kort- og Matrikelstyrelsen, Denmark).

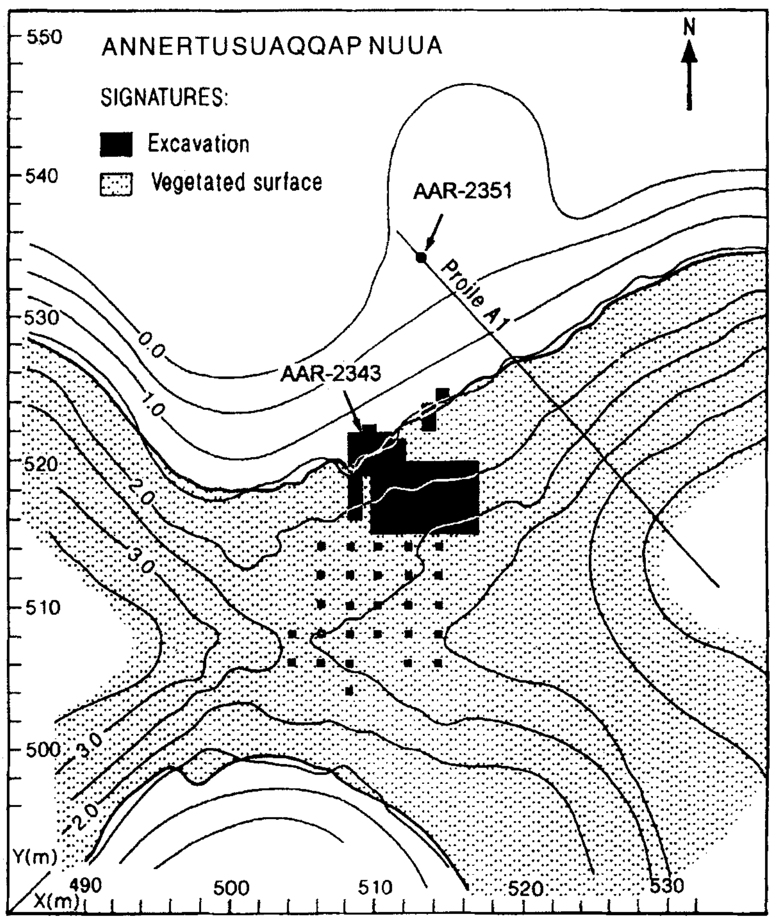

Fig. 10. The excavated Dorset I site at Annertusuaqqap Nuua (Loc. 12). Altitudes are given in m a.s.l.

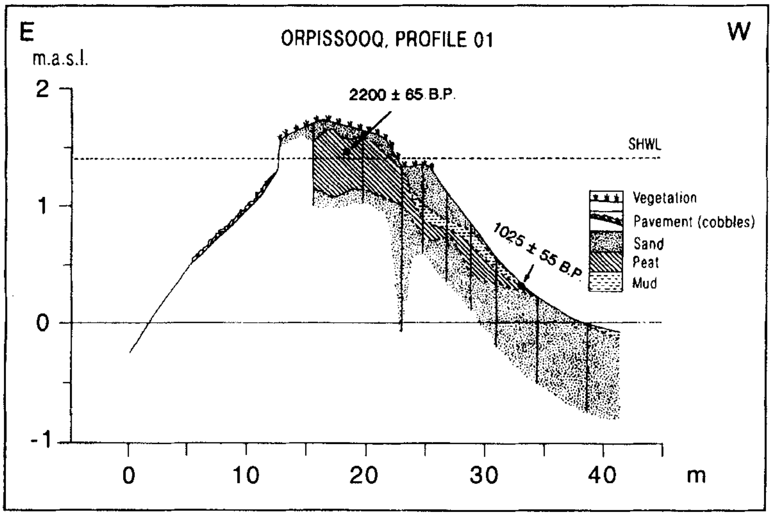

Fig. 11. Profile showing the stratigraphy beneath the foreshore at the Dorset I site at Orpissooq (Loc. 8).

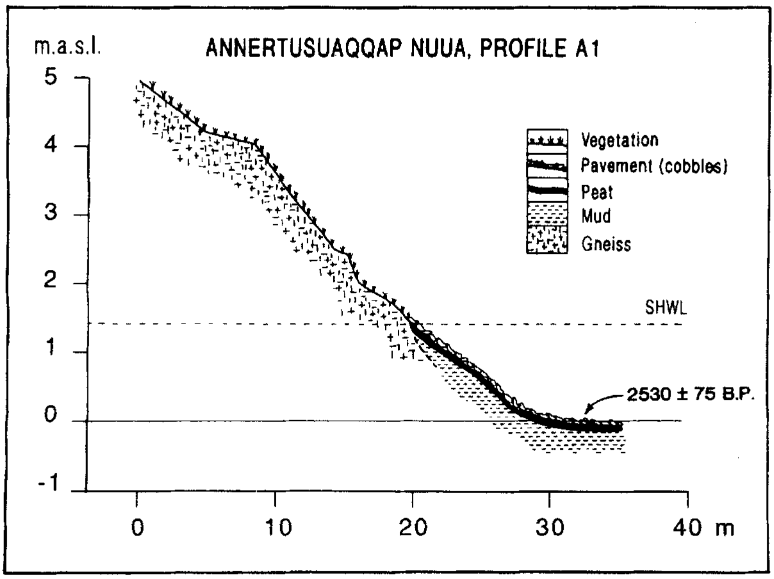

Fig. 12. Profile showing the stratigraphy of the foreshore at Annertusuaqqap Nuua (Loc. 12). The position of the profile is shown in Fig. 10.

changes in eastern Disko Bugt than in western Disko Bugt.

Both RSL curves from southern Disko Bugt are relatively steep where they reach present sea-level (Figs. 3 and 5). This suggests that they continue below present sea-level (as depicted in the figures), and, consequently, that the Holocene RSL history of southern Disko Bugt was one of emergence during Early–Middle Holocene followed by submergence during Late Holocene. A Late Holocene submergence in southern Disko Bugt is supported by (1) the occurrence of peat with cultural remains below present high-tide level at Annertusuaqqap Nuua and Orpissooq, and (2) the frequent occurrence of partly submerged Dorset I and Thule Culture ruins.

At Orpissooq and Annertusuaqqap Nuua the lowest occurrence of peat with cultural remains are 1.1 and 1.5 metres below spring high tide level, respectively (Figs. 11 and 12). This indicates that RSL has been at least 1.1–1.5 metres lower than at present. It is, however, unlikely that the Dorset I Eskimoes resided exactly at the high-tide level. Accordingly, it is

Fig. 13. The foreshore at Annertusuaqqap Nuua at normal low tide. The arrow points at the lowest occurrence of peat with Dorset I remains. Spring high-water level is indicated by the dashed line.

considered more probable that RSL has been at least 2–2.5 metres lower than at present.

The dating of the peat immediately below the foreshore sediment at Orpissooq (AAR-2554; 1025 ± 55 B.P., Fig. 11) suggests a transgression after ca 1 ka B.P. This accords well with the implications of datings of basal peat from several lagoons on Disko (Rasch 1996; Rasch et al. in press). These lagoons probably developed as a result of transgression after ca 800 B.P.

The general distribution of archaeological sites in southwestern Disko Bugt, with Saqqaq sites occurring at higher elevations than Dorset I sites (Fig. 6), agrees well with the RSL curve for the region showing falling RSL at least until 3 ka B.P. (Fig. 3). The RSL curve for southeastern Disko Bugt shows that RSL reached present sea-level at about the time (ca 4.4 ka B.P.) Saqqaq people came to the region. The fact that Dorset I sites generally are found very close to Saqqaq sites suggests that only small RSL changes occurred from the immigration of the Saqqaq people at ca 4400 B.P. to the disappearance of the Dorset I Culture at ca 1800 B.P. This suggestion might appear to correspond poorly with the steepness at ca 4 ka B.P. of the RSL-curve for the region, which, when extrapolated, suggests continuing RSL fall after 4 ka B.P. (Fig. 5). However, a reduction in the rate of RSL fall and a subsequent RSL rise may have occurred as a glacio-isostatic response to a readvance of the Greenland Ice Sheet during the Neoglacial, i.e. the last 3 ka (Kelly 1980; Weidick 1993). According to Weidick et al. (1990), the Ice Sheet has advanced by ca 10–20 km in southern Disko Bugt since 4–5 ka B.P. Based on computer models, Kelly (1980) demonstrated that the Late Holocene readvance of the Greenland Ice Sheet may have caused glacio-isostatic subsidence of ca 10 m even at the outer coast of Greenland.

Based on the location of former Thule Culture sites of different ages it has been suggested that a transgression before ca 1400 A.D. led to relatively high RSL in the 15th century which was followed by relatively low RSL in the 17th century and rising RSL thereafter (Mathiassen in Gabel-Jørgensen & Egedal 1940; Weidick 1993, 1996). These suggestions have recently been supported by studies of the coastal geomorphology and lagoon sediment stratigraphy on the island Disko (Rasch et al. in press) which suggest several regression/transgression cycles during the last ca 1000 years.

Our studies neither support nor contradict suggestions of recent cyclic sea-level change. The evidence of buried peat (dated to 1025 B.P.) below present high-water level at Orpissooq (Fig. 4, Loc. 8) and the submerged Thule Culture ruin from the 17th century (assuming the dating based on typology of the ruin is correct) at Illorsuup Nuua (Fig. 2, Loc. 19) indicate net rise in RSL since ca 1 ka B.P.

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