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Article abstract

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NOTE

VERTEBRA OF A BOWHEAD WHALE (*BALAENA MYSTICETUS*) IN LATE WISCONSINAN DEGLACIAL MARINE SEDIMENTS, TROUT RIVER, NEWFOUNDLAND, AND LOCAL LATE-GLACIAL SEA-LEVEL CHANGE

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ABSTRACT. This note reports the geological contexts and radiocarbon and calibrated ages of whalebone and bivalve recovered from emerged deglacial marine sediments at Trout River, Newfoundland (49°28.6' N, 58°07' W). The rate of sea-level fall is calculated for the first deglacial millennium, and discrepancies are noted between calibrated ages of bone and shell.

RÉSUMÉ. Cette note fait état du contexte géologique et des âges radiocarbone et calibrés d'une vertèbre de baleine et d'un coquillage issus de dépôts marins tardiglaciaires à Trout River, Terre-Neuve (49°28.6' N, 58°07' W). Le taux de diminution du niveau de la mer est calculé pour le premier millénaire, et la divergence des âges entre l'os et le coquillage est discutée.

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A heavy overnight rain on August 4th and 5th, 1981, loosened a whale vertebra from sandy sediments exposed in a fresh road cut beside Newfoundland Provincial Road 431, leaving it in a ditch at road level, outside the community of Trout River, Newfoundland (49°28.6' N, 58°07' W,). The vertebra had fallen from a cavity still visible the next day, within 30 cm of the surface of the cut, at a levelled elevation of 45 m asl. Part of a lateral process had broken off in the fall, and lay on the cut. The bone, collected by the author, was identified by C.R. Harington, Canadian Museum of Nature (Ottawa), as the fifth lumbar vertebra of a Bowhead whale (*Balaena mysticetus*), and is catalogued at the Canadian Museum of Nature (CMN-38465).

The sediment enclosing the bone comprised gravely sand in beds 10 to 30 cm thick, dipping gently southwest, below a gently southwest-sloping surface. The deposits and the surface rise inland to a junction of sand and glacio-marine diamict, at approximately 60 m asl. The marine limit, not well defined here against compact till, is clearly expressed nearby at the rear of a terrace, levelled at 70 m (Brookes, 1974). The surface and deposits near the marine limit above the bone found can be described as pro-glacial outwash deposited in the marine inshore zone. Downslope, extending below the bone's original position, these well-exposed sediments are unequivocally deltaic foreset beds.

Upslope from the bone, the sands, approximately 5 m thick, are underlain by dark grey, glacio-marine mud, with stones and sand, and abundant sub-fossil marine shells — *Balanus balanus*, *Buccinum undatum*, *Cyrtodaria siliqua*, *Hiatella arctica*, *Macoma calcarea*, *Mya arenaria*, *Mya truncata*, *Mytilus edulis*, *Nuculana tenuisulcata*, *Serripes groenlandicus*, and *Yoldia glacialis*. The sands were deposited from glacier ice, grounded and floating in a deglacial sea. Near the bone find, striae on bedrock indicate northward ice-flow within the right frontal lobe of a glacier tongue occupying Trout River Ponds glacial trough. Against this lobe an end moraine was deposited (Brookes, 1993), and it was this ice from which the stony muds close to the marine limit were deposited.

Shells of *Mya truncata* in the glacio-marine diamict below the sands were radiocarbon-dated conventionally at 12 500 ± 120 yr BP (GSC-2936; Lowdon and Blake, 1980; Grant, 1987). This normalizes to 12 900 ± 120. The 2σ quoted on GSC ages was reduced to 1σ before a 530-year reservoir correction was applied (an average of corrections for the southwest and north parts of Gulf of St. Lawrence, in Dyke *et al.*, 2003), resulting in an age of 14 214 ± 215 cal yr BP (Fairbanks *et al.*, 2005).

The broken lateral process of the whale vertebra was radiocarbon-dated conventionally at 11 720 ± 205 yr BP (1σ, as quoted, S-2149). Due to its near-surface position in porous sands, the vertebra was weathered, and penetrated by rootlets, so that, even with strong H_2O_2 treatment, contamination with young ^{14}C cannot be discounted. The radiocarbon age normalizes to 11 910 ± 205. After reservoir correction by

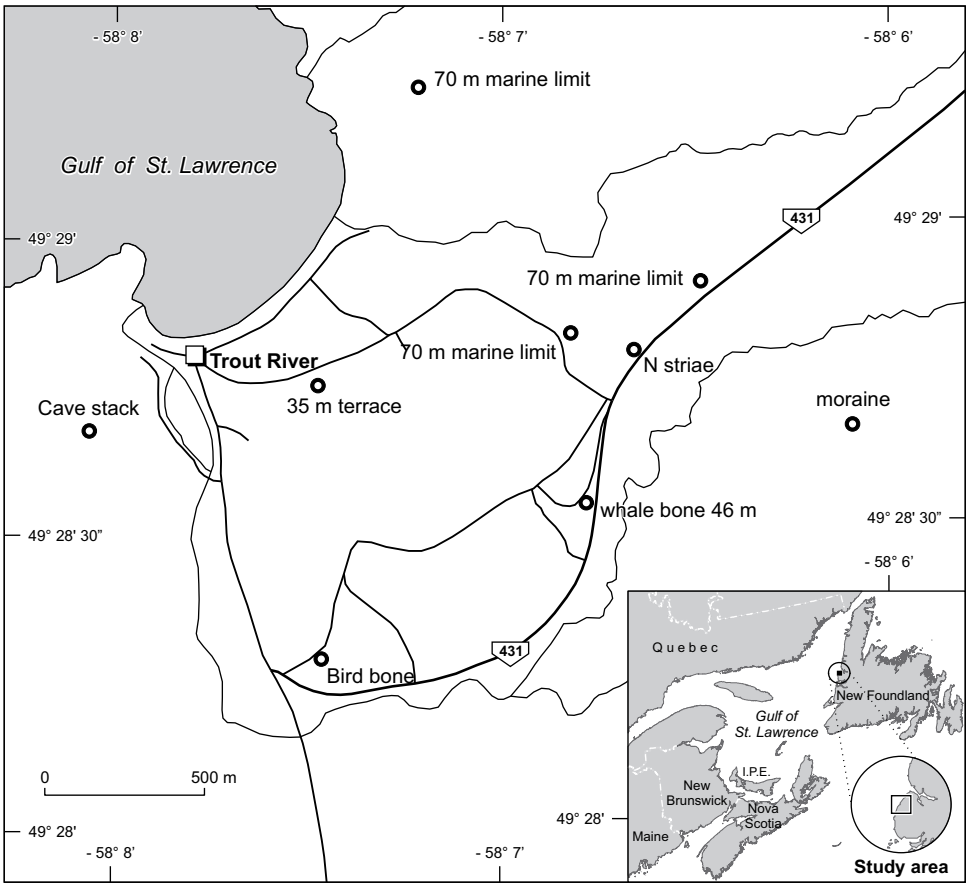

FIGURE 1. Location of collected whalebone (46 m elevation reduced to mid-level level, 45 m to high-tide as in text), with three locations of marine limit (70 m), surface of 35 m terrace, sea-caves and stack at rear of 35 m terrace in Trout River, Newfoundland. Label bird bone marks location of duck's sternum (*Anas* sp.), initially believed to have lain in sediments of the 35 m terrace, but which yielded a modern radiocarbon age.

530 years, the calibrated age of the bone is 13 232 ± 212 cal yr BP (Fairbanks *et al*., 2005), which is 982 years younger than the calibrated shell date.

The age of shell related to marine limit here (GSC-2936) is corroborated by an indirect estimate based on a shoreline diagram for this coast between St. George's Bay and Bonne Bay (Brookes, unpublished). Marine terraces radiocarbon-dated at approximately 12.5 kyr fall on a northerly-rising line from 30 m at Stephenville, to 48 m at Humbermouth (Corner Brook), and to 70 m at Trout River (elevations in Brookes, 1974).

Within the nearby community of Trout River a prominent marine terrace at 35 m asl is represented medially by a broad delta, and laterally by an intertidal platform cut across tectonically shattered, erodible volcanics. Emerged sea caves and a stack mark the southern edge of this platform against bedrock (Brookes, 1974). The age of this terrace, built medially of sediment supplied by the aforementioned glacier tongue, somewhat receded but still emerging from the Trout River Ponds trough, is given by a conventional radiocarbon age of 11 900 ± 160 yr BP on *Mya truncata* shells at 31 m in foreset beds (GSC-2487; Lowdon and Blake, 1978; Grant, 1987). This age normalize to 12 300 ± 160. With 2σ uncertainty reduced to 1σ, and a 530-year reservoir-correction applied, the age is 13 625 ± 81 cal yr BP (Fairbanks *et al*., 2005). Between the calibrated ages of the marine limit and the 35 m terrace, relative sea-level therefore fell from 70 to 35 m in 589 years, at an average rate of approximately 5.94 m/century.

Returning to the implications of the calibrated age of the whale-bone, application of a 530-year reservoir correction to the radiocarbon ages of shell and bone, assuming both relate to the marine limit, produce a 1470-year difference in calibrated ages. Explanation of the difference may lie (1) in contamination of the whalebone by young radiocarbon; (2) death of the whale at the elevation occupied by the vertebra, 25 m lower than the marine limit; from the rate of sea-level fall, this, however, explains only about 30 percent of the age difference; (3) reservoir correction differs for the whale and the bivalve. This last explanation holds true for 19th century molluscs and whales along the Norwegian coast (Mangerud *et al*., 2006). Note, however, that, at this locality, there would have been no difference in the feeding depth of each organism, since whales feed only on pelagic organisms (Mangerud *et al*., 2006), while the shell (*Mya truncata*) would have fed siphonally at a depth of ~10 m.

The Trout River whale vertebra is one of only two deglacial whale bones found and dated from the island of Newfoundland. The other, part of a rib of *Balaena mysticetus*, was collected by D.R. Grant from marine clay exposed at 6-8 m asl in a costal cliff at Romaines, north shore of St. George's Bay. This specimen has been radiocarbon-dated conventionally at 13 345 ± 230 ^{14}C yr BP (1σ, as quoted, S-3047), which normalizes to 13 505 ± 290 cal yr BP (Fairbanks *et al*., 2005), ~2500 cal yr older than the Trout River specimen.

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C.R. Harington (Canadian Museum of Nature) identified the whalebone. A.S. Dyke (Geological Survey of Canada) gave invaluable advice on normalization and calibration of the radiocarbon dates herein. My thanks to the journal for redrawing Figure 1 from Google Earth.

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