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DALHOUSIE UNIVERSITY NATURAL RADIOCARBON MEASUREMENTS II

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The following list includes determinations completed since publication of our last date list (R, 1976, v 18, p 43-49). Sample preparation and counting configuration remains the same as for DAL-I. Age determinations are based on at least two counter fillings (except as noted for very small samples) for a total of 3000 minutes and are calculated from at least 5000 minutes modern and background counts updated weekly by alternating modern and background samples in the counters over weekends. Age calculations are based on the Libby half-life of 5568 y and includes 1 σ statistical uncertainties of sample, modern, and background activity. Reference age is AD 1950 and is determined from .95 oxalic acid activity or age-corrected 1850 wood.

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I. GEOLOGIC SAMPLES—LAKE SEDIMENTATION

Halifax Lake series

Short core samples were studied to determine sedimentation rates in Halifax lakes as part of a study on the stratigraphic distribution of mercury in culturally influenced and primitive lakes in various soil types in Halifax Co. Details are in Underwood (unpub MSc thesis, Biology Dept, Dalhousie Univ). Coll and subm J K Underwood, NS Dept Environment.

DAL-111. Duncan's Lake **1240 ± 50**

Core DL-1: 75 to 79cm. Shallow pond .5 km W of Atlantic coast shoreline (44° 30′ N, 63° 33′ W).

DAL-152. Lovett Lake **2060 ± 80**

Core LVT-4: 51 to 56cm. A 15ha pond adjacent to an industrial park. *Ambrosia* horizon at 18cm, Sr-90 horizon at 10cm (44° 39′ N, 63° 42′ W).

DAL-161. Otter Lake **3380 ± 160**

Core OL-1: 80 to 90cm. Water supply lake, 94ha, ca 15km W of Halifax, NS (44° 36′ N, 63° 45′ W). No *Ambrosia* horizon as lake is remote from habitation.

General Comment (JGO): with exception of culturally influenced lakes (eg, Lovett, DAL-152), sedimentation in the Halifax area lakes is ca 4 mm/yr.

DAL-53A. Lawrence Lake, Michigan **105 ± 80**

Organic fraction of marl-rich core from Lawrence Lake, Michigan (44° 26′ N, 85° 21′ W). Sample from *Ambrosia* pollen horizon (16.5 to 20.5cm in core) to calibrate organic and marl dates previously reported (R, 1976, v 18, p 47). Coll by R O Kapp and R G Wetzel, subm by R G W. *Comment* (B A Manny): approx correct date for *Ambrosia* horizon (ca AD 1830) implies little paleozoic lime contribution to organic dates.

Wintergreen Lake series

Sediment core from central basin of Wintergreen Lake, Kalamazoo Co, Michigan (42° 24′ N, 85° 23′ W). Intensive studies on palaeolimnology, including sedimentation rates of carbon, nitrogen, phosphorus, pigments, and pollen are reported in Manny & Wetzel (1976). 4 core segments were dated independently by Wisconsin Radiocarbon Lab. No correction for marl carbonate has been applied to the determinations. Least square power curve regression [$\hat{x}$ (age) = ay^b (depth)] gives a mean error of estimate of 148 yr, excluding DAL-202 (see Lab comments below). Coll and subm by R E Bailey and R G Wetzel.

Laboratory Comment (JGO): lab suspicion of gas quality for DAL-202 confirmed by least squares regression as grounds for rejection of sample

TABLE 1

Radiocarbon and Estimated Age of Sediments, Wintergreen Lake, Michigan

Lab no.	Mean depth cm (y)	Radiocarbon* age ± σ ($\bar{x}$)	Estimated age† ($\hat{x}$)	Difference $\lvert \bar{x} - \hat{x} \rvert$	Sedimentation rate (mm/yr)
DAL-175A	2.5	125 ± 90	0	130	
DAL-175B	2.5	135 ± 95	0		
DAL-177	196	2320 ± 135	2371	51	8.27
WIS-668	233.5	3245 ± 60	3008	237	5.89
DAL-201	366	5370 ± 175	5542	172	5.23
[DAL-202**	441	5585 ± 125]	—	—	—
WIS-670	504	8820 ± 90	8563	257	4.57
DAL-203	541	9610 ± 600	9429	181	4.27
WIS-672	614	11,295 ± 110	11,120	175	4.12
DAL-205	651	11,790 ± 770	12,127	337	3.99
WIS-676	676	13,065 ± 125	12,765	300	3.92

* Core radiocarbon determinations corrected by subtracting mean surface age (−130 yr)
** DAL-202 excluded from regression
† Regression equation $\hat{x}$ (age) = ay^b (depth)
a = 1.81128
b = 1.35975 r^2 = .999

determination. Excellent agreement between independent determinations by 2 labs is reassuring confirmation of results.

Cedar Lake series

Sediment core from central basin of Cedar Lake, Lake Co, Indiana (41° 22′ N, 87° 26′ W). Part of general study of pollen stratigraphy and chronology of central Great Lakes region. Coll and subm by R E Bailey. See Table 2. *Comment* (REB): dates correspond well with established chronology and pollen sequences from central Great Lakes region. Inversion of DAL-126 and -127 are puzzling, but similar inversions are known from other sequences in region. Basal date (DAL-132) is older than expected for a sequence on the Valaraiso moraine, believed to be ca 14,500 yr BP.

Laboratory Comment (JGO): least squares power curve regression [$\hat{x}$ (age) = ay^b (depth)] shows a mean error of estimate of 1468 yr, indicating that function does not describe the sedimentary history of the system. Inspection of the results indicates a major change in sedimentary processes 8000 to 10,000 yr ago.

Everitt Lake, Digby Co, N S series

Sediment core from central basin of (9.1 m) Everitt Lake, Digby Co, NS, ca 12km E of Weymouth, NS (44° 27′ N, 65° 52′ W). Lake is headwater system, surface area 40ha with a watershed of ca 200ha and a flushing time (period for runoff and rainfall input to equal basin volume) of 18 mos. Pollen stratigraphy (at ca 50 yr intervals reported in Green (1976). Coll and subm by D Green.

DAL-207. EL-2.1:0.10cm **104.1 ± 1.3% above modern**

DAL-208. EL-2:50-60cm **1065 ± 195**

TABLE 2
Radiocarbon and Estimated Age of Sediments, Cedar Lake, Indiana

Lab no.	Mean depth cm (y)	Radiocarbon age ± σ ($\bar{x}$)	Estimated age* ($\hat{x}$)	Difference $\lvert \bar{x} - \hat{x} \rvert$	Sedimentation rate (mm/yr)
DAL-123	313	1410 ± 95	999	411	31.3
DAL-126	573	2820 ± 65	3505	685	10.4
DAL-127	628	2775 ± 130	4239	1464	7.5
DAL-128	718	4840 ± 160	5599	759	6.6
DAL-129	813	6270 ± 105	7247	977	5.8
DAL-130	908	11,255 ± 230	9116	2139	5.1
DAL-131	1013	12,610 ± 400	11,441	2169	4.5
DAL-132	1118	17,190 ± 400	14,041	3144	4.0

* Regression equation $\hat{x}$ (age) = ay^b (depth)
a = .006569
b = 2.07643
r^2 = .91

DAL-209. EL-2:150-160cm **3340 ± 175**

DAL-212. EL-2:450-460cm **7030 ± 340**

Curry Pond, Yarmouth, N S series

Sediment core from central basin of Curry Pond, Yarmouth Co, NS, ca 10.5km NE of Tusket, NS (43° 53′ N, 65° 51′ W). Headwater lake, 9m maximum depth, surface area 22ha. Watershed is ca 120ha and lake has flushing time of ca 7 mos. Pollen stratigraphy is reported in Green (1976).

DAL-229. CT-1:5-15cm **3770 ± 180**

DAL-232. CT-1:180-190cm **8130 ± 380**

DAL-233. CT-1:240-255cm **10,810 ± 475**

Collins Lake, Port Elgin, New Brunswick series

Sediment core from central basin of Collins Lake, 8km NW Port Elgin, New Brunswick (46° 6′ N, 64° 6′ W). Headwater Lake, 6m maximum depth with a surface area of 75ha. Watershed area is ca 225ha and flushing time is ca 12 mos. Pollen stratigraphy is reported in Green (1976).

DAL-234. CL-1:34-45cm **905 ± 90**

DAL-235. CL-1:70-84cm (28% dilution) **1150 ± 255**

DAL-236. CL-1:122-122cm **2175 ± 195**

DAL-237. CL-1:177-183cm **905 ± 170**

DAL-238. CL-1:242-256cm **5500 ± 170**

DAL-239. CL-1:306-332cm **10,215 ± 270**

Comment (JGO): review of sample preparation and gas quality does not resolve anomalous age for DAL-237.

Lake Quexil, Guatemala series

First report of a broad series of archaeological, microfossil, and biogeochemical investigations of environmental history of Guatemala. The Peten is a country of karsted limestone in which lake basins are sealed to some extent by residual clay, perhaps the result of former forest clearance, and are probably influenced to variable extent by fossil carbonate from ground water. Samples to evaluate possible carbonate error are being investigated. Without measurements in Lake Quexil of the ^{14}C content equivalent to zero age, interpretation of stratigraphic dates must be provisional. Core from Lago Quexil (16° 55′ N, 89° 48′ W). Coll and subm E S Deevey, Jr and H Vaughan, Florida State Mus, Gainesville, Florida.

DAL-223. Lake Quexil 250-255cm **2440 ± 90**

Algal gyttja. *Comment* (ESD): an acceptable date which allows correlation of this core with results from Lake Petenxil and Mayan archaeologic sequence.

DAL-224. Lake Quexil 300-305cm **4535 ± 115**

Algal gyttja. *Comment* (ESD): regardless of absolute age, this sample and DAL-223 show sec from 2.5 to 3m as one of slow sedimentation. This is consistent with results found in neighboring Lake Petenxil and is inferred to be due to an extremely low or widely fluctuating lake level.

DAL-225. Lake Quexil 520-525cm **4855 ± 120**

Algal gyttja. This date suggests anomalously low sedimentation during the period represented by the section of the core from 5.5 to 5.2m. Sedimentation rates have varied widely throughout the history of this lake because of Mayan agriculture in upper secs and of changing lake levels in secs below 2.5m. Contributions of fossil carbon from carbonates may have varied with degree of perching of water table. Without correction for carbonate, we cannot decide whether this sample is too young or DAL-226 is too old, or both.

DAL-226. Lake Quexil 550-555cm **8390 ± 260**

Algal gyttja. Small sample, counted at 38cm counting pressure. *Comment* (ESD): less than a desirable amount of carbon was available for this date; see comment for DAL-225.

DAL-227. Lake Quexil 610-615cm **13,160 ± 560**

Algal gyttja. Small sample, counted at 38cm pressure. *Comment* (ESD): lacking any indication of a possible inversion of sediments in gross stratigraphy, or in pollen record, which below this level clearly indicates a successional development of aquatic macrophytes, this date would seem erroneous due to failure to separate autocthonous organic carbon from clastic carbonate material.

DAL-198. Lake Quexil 623-624cm **8410 ± 180**

Algal gyttja and wood fragments. *Comment* (ESD): this date, from sec of sediments high in woody fragments, fungal hyphae, and other apparently allocthonous materials, apparently represents an initial postglacial filling of basin. Most other lakes of approx equal depth in Central America and Florida show a similar age for oldest sediment; we anticipated a similar case here.

II. GEOLOGIC SAMPLES—OCEAN SEDIMENTATION

Black Sea series

Continuation of series reported in OWU-V (R, 1976, v 18, p 363). Sequences compare marl and organic fraction determinations from Kasten cores.

DAL-70. Core 1464K: 45-51cm **550 ± 145**

Organic fraction of core sample previously dated as marl fraction, OWU-456A, 1410 ± 110 (43° 00′ N, 35° 28′ E).

DAL-71. Core 1464K: 74-79.5cm **55 ± 135**

Organic fraction of core sample previously dated as marl fraction, OWU-457A, 880 ± 90.

DAL-79. Core 1463K: 5-15cm **215 ± 95**

Marl sample previously dated as OWU-462A, 100.1 ± 1.3% modern (43° 00′ N, 33° 00′ E). *Comment* (WC): marl carbonate ages ca 800 yr younger than organic carbon determinations.

Mid-Atlantic Ridge series

Core samples from Mid-Atlantic Ridge locations taken during 1971 "Deep Drill" cruise of *CSS Hudson*. Coll and subm by C Stehman.

DAL-142. Core 377 **32,430 ± 4100**

Foraminiferal ooze. Sample at 580cm from 1160cm core raised from 2631m water (45° 31.8′ N, 27° 25.6′ W). Small sample, single count.

DAL-187. Core 328 **12,500 ± 250**

Formaniferal ooza from 380cm in 1070cm core raised from 2328m water (45° 36.7′ N, 27° 27.0′ W).

DAL-189. Core 464 **>39,900**

Foraminiferal ooze from 220cm in 545cm core raised from 2805m water (45° 43.7′ N, 27° 14.5′ W). *Comment* (CS): dates substantiate chronology obtained from analysis of planktonic foraminifera in 9 cores from Mid-Atlantic Ridge. Details in Stehman (1975).

Chaleur Bay series

DAL-191. Central Chaleur Bay, Core 34-5B **9480 ± 315**

Fragments of *Mytilus* and *Mya* shell from 34 to 94cm in Core 35-5B (47° 55′ N, 65° 30′ W).

DAL-192. Central Chaleur Bay, Core 34-5B **10,360 ± 450**

Samples from conspicuous shell fragment layers (*Mytilus* and *Mya*) in Core 34-5B from central Chaleur Bay (47° 55′ N, 65° 30′ W). Coll and subm by C Schaffer, Bedford Inst Oceanog.

Grand Banks Seamount series

Samples are from a long core of pelagic sediment overlying seamount in 3780m water (Piper, 1975) SW of Grand Banks (40° 28.8′ N, 51° 30.0′ W). Coll and subm by B Piper.

DAL-195. Core 72-021-6: 5-10cm **16,280 ± 320**

Globigerina ooze.

DAL-196. Core 71-021-6: 44-53cm >35,000

Globigerina ooze.

General Comment (DP): dates establish stratigraphy of top of core and indicate that carbonate rich interval with warm water foram assemblage at ca 1m depth corresponds to Sangamon Interglacial. Core can be correlated with other seamount cores further N for which Alam (1976) has made detailed paleoclimatic and sedimentologic analysis. Plio-Pleistocene climatic history from this suite of cores is reviewed by Alam and Piper (ms in preparation).

III. MISCELLANEOUS GEOLOGIC SAMPLES

DAL-81. Buried wood, Dovercourt, England 585 ± 115

Wood (*Ulmus* spp) id by J G Ogden from tree trunk at Dovercourt near Harwich, Essex, England (51° 56.6′ N, 1° 16.5′ E). Sample from stump ca 50m offshore from brick and concrete retaining wall ca 5.5m below present high tide. Coll and subm by K H Mann. *Comment* (KHM): weathering of exposed trunk makes it unclear if trees are in growth position. Regularity of spacing implies planting, thinning, or emplacement as early sea wall. Date indicates very rapid submergence in this region.

DAL-240. Buried woodland, Yarmouth, N S 615 ± 85

Wood (*Picea* spp) from stump rooted in till and surrounded by thin veneer of woody peat near Lighthouse Beach, Yarmouth, NS (43° 39′ N, 66° 10′ W). One of several stumps exposed by recent beach retreat showing root crowns ca 30cm below datum (HHWL—Higher High Water Line). Coll and subm by J G Ogden.

DAL-241. Freeport log canoe, N S 102 ± 1.2%

From outer rings of axe-hewn log canoe exposed in dike wall breached by a severe coastal storm near Digby, NS (44° 30′ N, 66° 00′ W). Canoe was cut from log ca 61cm diam, and was ca 4m long. Coll and subm by NS Mus. *Comment* (JGO): evidence of metal axe shaping and contemporary date suggest Acadian origin.

IV. ARCHAEOLOGIC SAMPLES

DAL-116. Seid Mound, Columbus, Ohio 1720 ± 80

Charcoal deposit (burnt stick) from Unit D, Sq 20L2, Midden layer, S central portion of sq at Seid Mound (State Memorial Park Excavation). From 0.54m below Stake 30. Coll and subm by R S Baby, Ohio State Mus.

DAL-141. Incinerator Village site 295 ± 100

Storage pit charcoal from Fort Ancient House site, Sec 17, Harrison twp, Montgomery Co, Ohio (39° 43′ N, 84° 14′ W). Sample id as ring-porous angiosperm (not oak, G W Burns). Coll by B J Smith, and subm by R S Baby. *Comment* (RSB): date is in line with UGa determination

(270 ± 120) for 46Pu31, the Buffalo site, a late Fort Ancient village site in West Virginia.

Laboratory Comment (JGO): sample is re-run of OWU-397 (R, 1973, v 15, p 365) which indicated post-1950 AD. Extensive leaching with hot 5% KOH apparently removed modern contamination.

DAL-242. Truro fireplace **440 ± 90**

Charcoal in Fireplace #10, 38 to 46cm below present land surface stripped by housing development (ca 30cm removed), at crest of hill, +70m, near Truro, Colchester Co, NS (41° 22′ N, 63° 17′ W). Coll and subm by C M Shipley. *Comment* (CMS): one of several fireplaces constructed of rock with apparent mortaring of joints.

References

Alam, M, 1976, Quaternary paleoclimates and sedimentation southwest of the Grand Banks: Unpub MSc thesis, Dalhousie University.

Green, D, 1976, Nova Scotia forest history: Evidence from statistical analysis of pollen data: Unpub PhD thesis, Dalhousie University.

Manny, B and Wetzel, R G, 1976, Postglacial chronology of sedimentation: nutrient deposition and pigment derivatives of a hardwater marl lake of Michigan; 2d internatl symp on paleolimnology, Polish Acad Sci, Mikolajki, Poland, Sept 1976.

Ogden, J G, II and Hart, W C, 1976, Dalhousie University natural radiocarbon measurements I: Radiocarbon, v 18, p 43-49.

Ogden, J G and Hay, R J, 1973, Ohio Wesleyan University natural radiocarbon measurements V: Radiocarbon, v 15, p 350-366.

Piper, D, 1975, Upper Cenozoic glacial history south of the Grand Banks of Newfoundland: Can Jour Earth Sci, v 12, p 503-508.

Stehman, C, 1975, The Mid-Atlantic ridge at 45°N: Late Pleistocene history of the Brock-Kettle area sediments. Unpub PhD thesis, Dalhousie University.

Underwood, J, 1975, Stratigraphic distribution of mercury in lake sediments in the Halifax, NS area: Unpub MSc thesis, Dalhousie University.