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Boreal Ecosystem-Atmosphere Study (BOREAS) 1993 Laboratory Data and Notes; Thompson, Manitoba

Katherine P. O'Neill [1], Jennifer W. Harden [1], and Susan E. Trumbore [2]

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[1] U.S. Geological Survey, Menlo Park, CA 94025
[2] University of California Irvine, Irvine CA 92717-3100

I. Introduction

Data reported within this document were collected during August of 1993 as part of the Boreal Ecosystem-Atmosphere Study (BOREAS) project. BOREAS is a joint effort of the U.S. and Canadian government sponsored by the National Aeronautics and Space Administration (NASA). The objective of the study is to improve understanding of the interactions between the boreal forest biome and the atmosphere in order to clarify their roles in global change. All measurements reported in this document were collected at the Northern Study Area in Thompson, Manitoba. A map of site locations may be found in an accompanying Open-File Report which details field descriptions and notes (O'Neill *et al*, in review).

During the 1993 field campaign, soil samples were collected at each of the five BOREAS tower sites and the Gilliam Road auxiliary site (1964 burn). 500 m transects were made across each of these locations, brief descriptions made every 50m, and a representative transect point selected for more detailed description and sampling. An age-sequence of three fire scars (ranging from 4 to 37 years in age) located near the Thompson area was also described and sampled in the same manner.

The following document includes notes and laboratory analyses from all detailed pits sampled during the 1993 field season. Sampling locations, field descriptions, and other notes may be found in O'Neill *et al* , in review.

II. Field Procedure

500 m transects were made across each tower and fire site. Every 50 m, a small soil pit was dug down to the B horizon. Horizon thicknesses, vegetation, and observed hydrology (drainage, slope, standing water, depth to permafrost, depth to water table) were noted. This information was used to locate a detailed soil pit representative of conditions across the site.

Sample locations may be divided into categories on the basis of B horizon particle size (sand vs. clay) and surface moisture content. Our designations are: dry clay, wet clay, and sand.

Sites were sampled as follows:

Dry Clay

1. Soil pit was dug and described. Horizon depths and thicknesses, moist color, root size and density, particle size, structure, consistency, clay films, and other information were recorded for each organic and mineral horizon. (See O'Neill *et al*, in review, for descriptions)

2. Organic horizons were sampled once, mineral horizons twice. For mineral horizons, one sample was taken volumetrically and used for moisture and density determinations; the other, a channel sample (grab sample integrating material from depths within a horizon), was taken for chemical analysis. Both sample types (volumetric and channel) were placed in zip lock bags for transport to the lab. (**NOTE:** Significant water loss occurred through the plastic bags. As best as possible, this water exchange was corrected for in the 1993 data set. Moisture samples from following field campaigns were stored in air tight glass canning jars).

Wet Clay

1. Soil pit was dug and described as above.

2. Mineral and organic horizons were sampled as above.

3. If moss and brown moss were thick (i.e. *Sphagnum* hummock) then entire hummock was excavated with a saw. Care was taken to prevent deformation or compaction of hummock dimensions. To account for volume changes due to moisture loss, lines were drawn every 5 cm across one face of the sample with correction fluid (White-out). Entire sample was placed in a Tupperware container to minimize moisture loss and transported to the lab.

Sand

1. Soil pit was dug and described as above.

2. Organic horizons were sampled as above.

4. Mineral horizons were sampled as above. In some instances, a mineral horizon was too gravelly to allow for a representative bulk density sample to be taken with standard volumetric coring devices. In this case, a larger area was excavated with a shovel and the material removed to a large plastic bag. As bags filled, they were weighed with a fish scale and dumped onto a tarp. When the entire horizon has been removed, the area of the excavation is measured and recorded. Cobbles and large gravel were removed from the excavated material, weighed with a fish scale, and this weight used to calculate the % >2mm material. The gravel-free material remaining on the tarp was piled, cone and quartered, split into a manageable size and then re-bagged and taken to the lab.

Lab Procedure

All samples were transported moist to Menlo Park laboratories in ice-filled coolers. To minimize moisture gain from ice melt, samples were stored in tape-sealed zip-lock bags and profiles wrapped together in several thicknesses of industrial strength plastic wrap. Upon arrival in Menlo Park, samples were placed in a cold storage core room and maintained at a constant temperature until further preparation.

Moist samples were split into three parts using the "cone-and-quartering" method. One split was immediately returned, untouched, to a cold storage room. A second split for determining % moisture was placed in a tared crucible, allowed to air dry for approximately two weeks, and reweighed. When a constant weight was reached, the crucibles were placed in a forced draft lab oven until a stable oven-dry weight was attained. Organic samples were dried at 65°C for two days, mineral samples at 105°C for three days. Upon removal from oven, crucibles were immediately placed in a dessicator and allowed to cool prior to weighing. Weight loss was used to correct air-dry weights to oven-dry weights.

The remainder of the sample was spread out on aluminum foil and allowed to dry for two weeks. Once a constant weight was reached, the samples were sieved through a 2 mm mesh to remove rocks, roots, and any other > 2mm non-mineral particles (e.g. charcoal, wood, pine needles). The weight of these materials was recorded. Separation of roots and rocks is performed on a sample large enough to adequately represent the coarse fraction; for example, if rocks were 10 cm in diameter, we excavated a cube 100 X 100 cm throughout the entire thickness of the horizon.

Air dry splits of approximately 50 g were taken using a riffle splitter and these splits ground to <100 mesh by hand in an agate mortar and pestle. The <100 mesh splits were analyzed for weight %C, %N, and %$CaCO_3$ with a commercial combustion analyzer (Carlo Erba NA1500). This instrument flash-combusts organic matter, oxidizes all C to CO_2, and reduces all N to N_2. These gases are then separated chromatographically and measured with a thermal conductivity detector. The detector response for C and N is determined by combusting known amounts of C and N containing pure compounds. Because small amounts of C may be present in the tin boats used to hold the sample (for C) or small amounts of residual air (for N2), blanks were determined by combusting empty capsules. The combustion analyzer oxidizes both organic carbon and inorganic carbonates to CO_2.

The Lake Agassiz clays underlying many of the soils contain significant amounts of $CACO_3$. Soil samples which reacted to acid, or otherwise indicated high pH, were re-analyzed for total and inorganic carbon using a Coulometric Instrument Total Carbon Apparatus (Model 5020), a Coulometric Instrument Carbonate Carbon Apparatus (Model 5030), and a Coulometrics Instrument Coulometer (Model 5010). For total carbon analysis, 20 to 50 mg of air dry sample (ground to <100 mesh) was

weighed into a platinum boat which was placed into a glass ladle. The ladle was then placed inside the glass tube of the apparatus' oxygen train which was held at a constant 1000 °C. The CO_2 evolved was passed through the coulometer cell and the result displayed in micrograms of carbon. After calibration with blanks and standards, the evolved mass of carbon is expressed as a weight percent of the original sample weight.

Samples ground to <100 mesh were also analyzed to determine the amount of inorganic carbon. Carbonate carbon in the samples was evolved as CO_2 following the injection of acid into the dispenser of the Model 5030. The CO_2 evolved was passed through the coulometer cell and the result displayed in micrograms C. After calibration with blanks and standards, the weight of carbon evolved is expressed as a ratio to the original sample weight. Organic carbon is determined by subtracting inorganic carbon results from total carbon results determined on the same sample.

Unless otherwise specified, %C and %N data in this report were determined by Carlo Erba C:H:N analysis. For several samples with high pH or inorganic carbon (typically those deeper in the profile), results from the coulometric method were used. For these samples, data are reported in italic type.

References cited:

O'Neill, Harden, Trumbore, Bentley, Winston, Stephens, and Black, in review: Boreal Ecosystem-Atmosphere Study (BOREAS) 1993 Field Notes; Thompson, Manitoba U.S. Geological Survey Open-File Report.

Notes on Lab Data and Calculations

Sample ID Site numbers and locations are presented by O'Neill and others, 1995 in press

Sample Depth The basal depth at which the sample was taken. This is measured in centimeters beneath the surface, with the top of the moss = 0.

Sample description A brief description of material; see O'Neill and others, 1995 for detail

Lab gravimetric Air/Oven ratio
Ratio of air dry soil to oven dry soil used to convert %C in air-dry basis as analysed to oven-dry basis

Field gravimentric moisture percent
Calculated as tared field weight minus tared oven-dry weight; because of transport in coolers and plastic bags, these data are not reliable as field moisture values

Total Bulk Density Calculated as the mass of oven dry soil/unit volume (g/cm3).

$$\frac{\text{(1- \% Moisture)*(weight of moist sample)}}{\text{(3.14)*(radius\^2)*(core length)}}$$

Where volumetric samples were taken from a square rather than a round core, the denominator is changed to:

$$\text{(core length)* (core area)}$$

<2mm Bulk Density
Calculated as the mass of < 2mm oven dry soil/ unit volume (g/cm3). This differs from total Bulk Density in that the weight of >2mm rocks and roots have been removed.

$$\frac{\text{(1- \% Moisture)*(weight of moist sample - weight of > 2mm rocks)}}{\text{(3.14)*(radius\^2)*(core length)}}$$

Whole fraction root and rock fragments
Percent >2mm root and rock fragments after sieving, expressed on air-dry basis

% total N and C air dry basis
Weight percent N and C (air dry sample). Data reported as presented by lab instrument

% inorganic C air dry basis
Weight percent inorganic C per air-dry soil as determined coulometrically by acidification in 2 M HCLO4 ; only samples with soil pH values greater than 7.0 were run.

%C oven-dry basis Weight percent C after correction for water in air-dry soil. Calculated as:
%C air-dry basis * Ratio of Air dry/ Oven dry soil

C/N Ratio of weight % organic C to weight % total N.

Organic g C cm-2 Organic carbon storage in each horizon or layer as calculated from: **%C of <2mm basis * <2mm bulk density plus %C of >2mm roots * percent > 2mm roots * total bulk density**

%C of >2mm roots estimated to be .29% carbon based on analysis of 5 >2mm root samples

Total g N cm-2 Total nitrogen storage in each horizon or layer as calculated from:

%N of <2mm basis * <2mm bulk density plus %N of >2mm roots * percent > 2mm roots * total bulk density

%N of >2mm roots estimated to be 0.9% carbon based on analysis of 5 >2mm root samples

Delta 14C, material
14C. Carbon-14 is measured by Accelerator mass spectrometry of graphite targets prepared from CO2 (see one of several references, including Trumbore, 1995). Samples (of 1-2 mg carbon equivalent) are combusted in vacuo in quartz tubes with cupric oxide wire at 900 Celcius. The resulting CO2 is purified cryogenically, then reduced to graphite coating cobalt powder in a sealed pyrex tube at 500-550 Celcius with zinc and titanium hydride powder. Accelerator mass spectrometry measurements were made at the Lawrence Livermore National Laboratory Center for Accelerator Mass Spectrometry. One sigma precision is usually +/- 8-10 per mil (.8-1.0 % Modern) and overall accuracy (based on repeated measurements of substandards prepared in the same way as samples)is 1.0 - 1.5% of Modern (10 - 15 per mil). We have noted what was measured for 14C, as often specific fractions of the organic C only are measured; these fractions include macrofossils (sphagnum leaves, fine root hairs, deciduous leaves, or charcoal), and chemically treated samples (residue after treatment with 0.5N HCl).

We express 14C data in the geochemical Delta notation (Delta 3D large greed delta), the deviation in parts per thousand (per mil) from an absolute standard .(95 times the activity of NBS oxalic acid measured in 1950). In this notation, zero equals the 14C content of 1895 wood, positive values indicate the presence of 'bomb' radiocarbon, and negative values indicate the predominance of C fixed from the atmosphere more than several hundred years ago. One important correction made in calcualting the Delta 14C value is of note here - the 13C correct needed to account for isotopic fractionation effects. As an example, consider the d13C difference between atmospheric CO2 and carbon fixed during photosynthesis by C3 plants, approximately 2094. Assuming the fractionation of 14C will be roughly twice that of 13C (since the mass difference between 12 and 14 is twice that between 12 and 13), the 14C contents of a tree and the CO2 which it is fixing

through photosynthesis will differ by approximately 4094 , even though both CO2 and the tree are the same 'age '. To account for fractionation effects, the sample (with d13C of d) sample and standard are corrected to a constant 13C content (-2594): The standard oxalic acid is corrected in the same way, to -19 per mil (see references below for more detail). MACROFOSSILS, or seeds, deciduous leaves, etc, that represent a single year's growth, the 14C content of recent samples may be used to determine the age of a sample to within a year or two for samples in the 'bomb' period, <30 years old. The 14C content of the sample is compared to the 14C record of atmospheric C in the northern hemisphere (see Burcholadze reference, below, as and example). Evergreen needles, that may average several years' growth, will be less easi ly interpreted. For samples prior to 1960, radiocarbon ages in years may be calculated from the given Delta values as -8033*(ln(Delta*.995/1000 +1)). The conventional radiocarbon age must be converted to a calibrated age using the tree-ring based calibration curves which correct for known variations in atmospheric 14C over time Both ages are usually rounded to the nearest decade or pentade.

SOIL ANALYTICAL REFERENCES

Klute, A. (Ed), 1986, Methods of soil analysis, part 1, Physical and mineralogical methods Second edition, Agronomy monograph No 9; 1. Amer. Soc. Agronomy and Soil Sci.Soc. Amer. Publisher, Madison, Wisconsin.

Chapman, H.D. and Pratt, P.F. , 1961, Methods of analysis for soils, plants and waters. University of California Division of Agricultural Sciences.

RADIOCARBON REFERENCES

Donahue, D. J., T. W. Linick and A. J. T. Jull, Isotope-ratio and background corrections for accelerator mass spectrometry radiocarbon measurements, Radiocarbon 32: 135-142 (1990).

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Southon, J., R., J. S. Vogel, S. E. Trumbore and others, Progress in AMS measurements at the LLNL spectrometer, Radiocarbon 34: 473 - 477 (1992).

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Taylor, R. E., A. Long, and R. Kra, eds., Radiocarbon after Four Decades: An interdisciplinary perspective, Springer-Verlag, NY,596 pp. (1992).

Trumbore,S. E., Comparison of carbon dynamics in two soils using measurements of radiocarbon in pre-and post-bomb soils. Global Biogeochemical Cycles 7:275-290 (1993).

Sample I.D.	Sample Depth (cm)	Description	Lab Gravimetric Air/Oven ratio (Air Dry Basis)	Field Gravimetric % Moisture (Oven Basis)	Total Bulk density (includes rocks)	<2mm Bulk Density (rocks out)	Whole Fraction % >2mm rock fragment (air dry basis)	Whole Fraction %>2mm wood and roots
GR1.02 Litte	0.2	Litter	1.09	20.68	0.372	0.372	0.000	0.000
GR1.2 LFH	2	Decomposed litter	1.08	35.18	0.140	0.140	0.000	0.000
GR1.11	11	Mineral A horizon	1.05	32.02	0.932	0.922	0.000	0.004
GR1.20	20	Clay B horizon	1.06	31.88	1.305	1.305	0.000	0.000
GR1.40	40	Clay B horizon	1.07	31.58	1.230	1.230	0.000	0.000
GR1.60	60	Clay BC horizon	1.06	31.46	1.328	1.328	0.000	0.000
GR1.80	80	Clay BC horizon	1.06	30.86	1.347	1.347	0.000	0.000
GR1.100	100	Clay BC horizon	1.05	30.36	1.292	1.292	0.000	0.000
GR2.Litter	4	Green feather moss with litter	1.06	200.00	0.009	0.009	0.000	0.000
GR2.BD.6	6	Blackened moss with litter	1.05	221.63	0.035	0.035	0.000	0.000
GR2.BD.11	11	Brown moss with very fine roots	1.09	165.35	0.016	0.016	0.000	0.000
GR2.BD.13	13	Fungus, roots	1.07	50.29	0.344	0.344	0.000	0.000
GR2.21	21	Darkened A horizon	1.04	22.47	0.869	0.789	0.000	0.004
GR2.45	45	Clay subsoil	1.05	25.48	1.532	1.532	0.000	0.000
GR2.60	60	Shotty clay subsoil	1.05	29.91	1.406	1.406	0.000	0.000
GR2.80	80	Shotty clay subsoil	1.05	28.77	1.128	1.128	0.000	0.000
GR2.100	100	Shotty clay subsoil	1.05	31.28	1.279	1.279	0.000	0.000
GR3.2	2	Living sphagnum	1.06	778.89	0.016	0.016	0.000	0.000
GR3.4	4	Brown moss	1.06	778.89	0.009	0.009	0.000	0.000
GR3.6	6	Brown moss	1.06	778.89	0.012	0.012	0.000	0.000
GR3.8	8	Brown moss	1.06	778.89	0.019	0.019	0.000	0.000
GR3.10	10	Brown moss	1.06	778.89	0.035	0.035	0.000	0.000
GR3.12	12	Brown moss	1.06	778.89	0.027	0.027	0.000	0.000
GR3.14	14	Brown moss	1.06	778.89	0.026	0.026	0.000	0.000
GR3.16	16	Brown moss	1.06	778.89	0.031	0.031	0.000	0.000
GR3.18	18	Brown moss	1.06	778.89	0.028	0.028	0.000	0.000
GR3.40.22	22	Brown/black moss	1.10	665.75	0.045	0.045	0.000	0.000
GR3.40.24	24	Brown/black moss	1.10	936.57	0.053	0.053	0.000	0.000
GR3.40.26	26	Brown/black moss	1.08	776.59	0.054	0.054	0.000	0.000
GR3.40.28	28	Black, charred moss	1.08	776.59	0.054	0.054	0.000	0.000
GR3.40.30	30	Black, charred moss	1.10	369.52	0.085	0.080	0.000	0.259
GR3.40.32	32	Black, charred moss	1.09	309.28	0.174	0.174	0.000	0.000
GR3.40.34	34	Black, charred moss	1.08	223.42	0.271	0.271	0.000	0.000
GR3.40.36	36	Black, charred moss	1.13	163.60	0.413	0.404	0.000	0.054
GR3.40.38	38	Black, charred moss	1.13	140.35	0.479	0.469	0.000	0.043
GR3.42	42	Black, charred moss	1.07	57.35	N/A	0.475	0.000	0.002
GR3.58	58	Blocky clay	1.05	37.29	N/A	1.000	0.000	0.000
GR3.69	69	Granular, shotty clay	1.04	43.36	N/A	1.000	0.000	0.000
GR3.BD.80	80	Dense, wet clay	1.04	37.28	1.340	1.340	0.000	0.000

MD = Missing Data; information lost or not recorded
N/A = Not Applicable; data intentionally not collected

Sample I.D.	Sample Depth (cm)	Description	Lab Gravimetric Air/Oven ratio (Air Dry Basis)	Field Gravimetric % Moisture (Oven Basis)	Total Bulk density (includes rocks)	<2mm Bulk Density (rocks out)	Whole Fraction % >2mm rock fragment (air dry basis)	Whole Fraction %>2mm wood and roots
GR4.2	2	Living sphagnum	1.06	761.41	0.033	0.033	0.000	0.000
GR4.4	4	Brown moss	1.06	761.41	0.044	0.044	0.000	0.000
GR4.6	6	Brown moss	1.06	761.41	0.048	0.048	0.000	0.000
GR4.8	8	Brown moss	1.06	761.41	0.042	0.042	0.000	0.000
GR4.10	10	Brown moss	1.06	761.41	0.048	0.048	0.000	0.000
GR4.12	12	Brown moss	1.06	761.41	0.043	0.043	0.000	0.000
GR4.14	14	Brown moss	1.06	761.41	0.030	0.030	0.000	0.000
GR4.16	16	Brown moss	1.06	761.41	0.035	0.035	0.000	0.000
GR4.18	18	Brown moss	1.06	761.41	0.042	0.042	0.000	0.000
GR4.20	20	Brown moss	1.06	761.41	0.032	0.032	0.000	0.000
GR4.22	22	Brown moss	1.06	761.41	0.041	0.041	0.000	0.000
GR4.24	24	Charred dark moss	1.06	761.41	0.034	0.034	0.000	0.000
GR4.26	26	Fibrous brown moss	1.06	761.41	0.067	0.067	0.000	0.000
GR4.BD.34	34	Fibrous brown moss	1.06	228.17	0.068	0.068	0.000	0.000
GR4.BD.38	38	Root mat curly roots clay	1.07	295.50	0.278	0.278	0.000	0.000
GR4.60	60	Aggregated clay	1.05	31.31	1.508	1.508	0.001	0.000
GR4.BD.81	81	Granular clay	1.05	32.12	0.992	0.992	0.000	0.000
GR5.Litter	4	Living feather moss litter	1.09	191.56	0.004	0.004	0.000	0.000
GR5.BD.7	7	Decomposed organics Oi	1.11	316.08	0.017	0.017	0.000	0.000
GR5.BD.11	11	Decomposed organics Oe	1.07	62.35	0.096	0.096	0.000	0.000
GR5.16	16	Darkened mineral A	1.04	43.37	1.549	1.546	0.000	0.014
GR5.33	33	Well aggregated clay Bt	1.05	33.15	1.474	1.474	0.000	0.000
GR5.53	53	Shotty clay B2	1.07	31.67	1.609	1.609	0.001	0.000
GR5.66	63	Shotty clay	1.05	31.10	1.351	1.342	0.000	0.000
GR5.88	85	Massive clay with varves	1.04	26.89	1.667	1.667	0.000	0.000
GR5.BD.100	100	Massive clay with varves	1.05	28.78	1.178	1.171	0.007	0.000
FF1.Litter	2	Living moss	1.07	100.00	0.006	0.006	0.000	0.000
FF1.BD.5	5	Charred topsoil	1.06	136.44	0.087	0.087	0.000	0.000
FF1.20	20	Clay subsoil	1.06	33.97	0.884	0.883	0.000	0.002
FF1.37	37	Clay subsoil	1.05	30.77	1.084	1.083	0.000	0.000
FF1.60	60	Clay subsoil	1.03	31.31	1.560	1.560	0.000	0.000
FF1.70	70	Clay subsoil	1.02	27.40	1.585	1.585	0.000	0.000
SOAB1.LFH	6	Slightly decomposed organics	1.10	140.26	0.156	0.156	0.000	0.000
SOAB1.10	10	Decomposed charred organics	1.11	169.08	N/A	0.200	0.000	0.000
SOAB1.20	20	Dark A horizon	1.05	36.13	0.851	0.848	0.000	0.008
SOAB1.33	33	Aggregated subsoil	1.04	54.66	0.900	0.900	0.000	0.002
SOAB1.50	50	Aggregated subsoil	1.06	21.36	0.999	0.997	0.000	0.002
SOAB1.85	85	Wet clay	1.04	32.35	1.039	1.038	0.001	0.000
SOAB1.100	100	Clay	1.03	31.59	1.116	1.116	0.000	0.000

For GR4.2 to GR4.26; moisture contents from GR4.26 used

MD = Missing Data; information lost or not recorded
N/A = Not Applicable; data intentionally not collected

Sample I.D.	Sample Depth (cm)	Description	Lab Gravimetric Air/Oven ratio (Air Dry Basis)	Field Gravimetric % Moisture (Oven Basis)	Total Bulk density (includes rocks)	<2mm Bulk Density (rocks out)	Whole Fraction % >2mm rock fragment (air dry basis)	Whole Fraction %>2mm wood and roots
YJP1.Litter	2	Reindeer moss, cranberry, litter	1.10	145.71	0.015	0.015	0.000	0.000
YJP1.BD.4	4	Decomposed organics Oi	1.02	62.46	0.151	0.151	0.000	0.000
YJP1.8	8	Leached sand E	1.00	3.91	1.279	1.223	0.068	0.006
YJP1.17	17	Transition some iron oxides Bs1	1.01	4.12	1.396	1.205	0.129	0.002
YJP1.36	36	Sandy subsoil Bs2	1.00	2.60	1.585	1.272	0.131	0.007
YJP1.53	53	Sandy oxidized BC1	1.00	1.49	1.526	1.179	0.290	0.000
YJP1.65	65	Sandy oxidized BC2	1.00	1.46	1.526	1.179	0.343	0.000
YJP1.80	80	Sandy slightly oxidized C1	1.00	2.57	1.409	1.352	0.365	0.000
YJP1.100	100	Sandy slightly oxidized C2	1.00	1.38	1.657	1.359	0.368	0.000
OJP1.Litter	1	Reindeer moss, cranberry, blueberry	1.11	15.28	0.024	0.024	0.000	0.000
OJP1.BD.3	3	Decomposed organics, charcoal	1.04	68.85	0.338	0.338	0.000	0.000
OJP1.BD.20	20	Leached sand E	1.00	8.89	0.893	0.306	0.714	0.001
OJP1.BD.32	32	Sand with iron Bs1	1.01	7.18	2.283	1.046	0.575	0.000
OJP1.52	52	Sand with iron Bs2	1.00	3.78	1.814	1.593	0.001	0.000
OJP1.60	60	Sand with iron Bs3	1.00	3.27	1.686	1.683	0.000	0.000
OJP1.80	80	Oxidized sand	1.01	4.80	1.794	1.792	0.001	0.000
OJP1.100	100	Oxidized sand	1.00	23.57	1.782	2.713	0.001	0.001
OJP2.BD.12	12	Sand	1.00	10.62	MD	MD	0.015	0.002
OJP2.BD.33	33	Sand	1.01	7.42	1.426	1.413	0.008	0.001
OJP2.BD.43	43	Sand	1.01	5.61	MD	MD	MD	MD
OJP2.BD.53	53	Sand	1.00	4.00	1.740	1.698	0.024	0.000
OJP2.BD.73	73	Sand	1.00	4.24	1.694	1.690	0.002	0.000
OJP2.BD.90	90	Sand	1.00	8.90	1.598	1.598	0.000	0.000
OBS1.Litter	4	Green sphagnum	1.09	97.35	0.011	0.011	0.000	0.000
OBS1.BD.8	8	Brown sphagnum	1.05	457.21	0.018	0.018	0.000	0.000
OBS1.18	18	Slightly decomposed organics Oe	1.11	204.55	0.123	0.064	0.000	0.000
OBS1.21	21	Burned	1.12	64.62	0.208	0.208	0.000	0.000
OBS1.27	27	Darkened A	1.06	32.86	0.882	0.875	0.004	0.002
OBS1.44	44	Wweakly drained clay	1.06	32.80	1.135	1.135	0.000	0.000
OBS1.64	64	Shotty clay	1.07	39.27	1.094	1.094	0.000	0.000
OBS1.82	85	Shotty clay	1.04	35.63	2.098	2.098	MD	MD
OBS1.Frozen	92	Frozen clay	1.05	33.26	2.098	2.098	0.000	0.000

MD = Missing Data; information lost or not recorded
N/A = Not Applicable; data intentionally not collected

Sample I.D.	< 2mm Fraction %N (Air Dry)	%Ct (Air Dry)	%C inorg. (Air Dry)	%C org. (Air Dry)	%Corg. (Oven Dry)	C/N	Organic g C cm-2	Total g N cm-2
GR1.02 Litte	1.40	42.98	MD	42.98	46.95	30.70	0.035	0.001
GR1.2 LFH	0.78	21.62	MD	21.62	23.43	27.72	0.059	0.002
GR1.11	0.12	2.61	MD	2.61	2.74	21.75	0.239	0.039
GR1.20	0.09	1.17	MD	1.17	1.24	13.00	0.147	0.012
GR1.40	MD	*0.65*	*0.05*	*0.60*	*0.64*	MD	*0.159*	MD
GR1.60	0.05	*0.88*	*0.46*	*0.42*	*0.45*	*17.60*	*0.119*	0.016
GR1.80	0.04	*1.55*	*1.17*	*0.38*	*0.40*	*38.75*	*0.110*	0.015
GR1.100	0.03	*1.69*	*1.40*	*0.29*	*0.30*	*56.33*	*0.079*	0.008
GR2.Litter	1.12	45.48	MD	45.48	48.24	40.61	0.018	0.000
GR2.BD.6	1.02	45.23	MD	45.23	47.45	44.34	0.033	0.001
GR2.BD.11	1.00	44.83	MD	44.83	49.07	44.83	0.040	0.001
GR2.BD.13	0.55	27.57	MD	27.57	29.48	50.13	0.203	0.004
GR2.21	0.11	2.97	MD	2.97	3.10	27.00	0.207	0.032
GR2.45	0.07	1.04	MD	1.04	1.09	14.86	0.403	0.028
GR2.60	0.04	0.70	MD	0.70	0.73	17.50	0.156	0.012
GR2.80	0.03	*0.59*	*0.31*	*0.28*	*0.29*	*19.67*	*0.066*	0.006
GR2.100	0.04	*0.54*	*0.25*	*0.29*	*0.30*	*13.50*	*0.078*	0.010
GR3.2	MD	MD	MD	MD	MD	MD	MD	0.00
GR3.4	1.13	45.60	MD	45.60	48.13	40.31	0.009	0.000
GR3.6	0.89	45.08	MD	45.08	47.58	50.86	0.011	0.000
GR3.8	1.04	46.06	MD	46.06	48.62	44.42	0.018	0.000
GR3.10	0.94	45.19	MD	45.19	47.70	48.11	0.034	0.001
GR3.12	0.79	43.11	MD	43.11	45.50	54.91	0.025	0.000
GR3.14	0.76	43.63	MD	43.63	46.05	57.79	0.024	0.000
GR3.16	0.89	42.75	MD	42.75	45.12	48.16	0.028	0.001
GR3.18	0.92	42.62	MD	42.62	44.99	46.33	0.025	0.000
GR3.40.22	1.21	42.03	MD	42.03	46.35	34.60	0.083	0.002
GR3.40.24	1.07	41.48	MD	41.48	45.74	38.68	0.048	0.00
GR3.40.26	0.93	38.99	MD	38.99	41.93	41.88	0.045	0.00
GR3.40.28	1.32	37.97	MD	37.97	40.83	28.78	0.045	0.00
GR3.40.30	1.19	32.45	MD	32.45	35.83	27.27	0.068	0.038
GR3.40.32	1.23	29.22	MD	29.22	31.87	23.83	0.111	0.004
GR3.40.34	1.08	21.91	MD	21.91	23.61	20.26	0.128	0.005
GR3.40.36	0.90	19.57	MD	19.57	22.11	21.73	0.190	0.042
GR3.40.38	0.95	20.59	MD	20.59	23.29	21.68	0.229	0.041
GR3.42	0.37	7.36	MD	7.36	7.88	19.68	0.151	0.009
GR3.58	0.12	2.11	MD	2.11	2.23	17.52	0.356	0.018
GR3.69	0.07	1.29	MD	1.29	1.34	17.41	0.148	0.008
GR3.BD.80	0.02	0.79	MD	0.79	0.82	39.97	0.121	0.003

%C values in normal type were performed on a Carlo Erba C:H:N analyzer
%C values in Italic type were performed coulometrically (see text for description)

Sample I.D.	< 2mm Fraction %N (Air Dry)	%Ct (Air Dry)	%C inorg. (Air Dry)	%C org. (Air Dry)	%Corg. (Oven Dry)	C/N	Organic g C cm-2	Total g N cm-2
GR4.2	0.52	42.20	MD	42.20	44.54	81.70	0.029	0.000
GR4.4	0.53	43.06	MD	43.06	45.45	80.83	0.040	0.000
GR4.6	0.35	43.58	MD	43.58	46.00	122.90	0.044	0.000
GR4.8	0.38	43.23	MD	43.23	45.63	113.31	0.038	0.000
GR4.10	0.37	44.33	MD	44.33	46.79	116.19	0.045	0.000
GR4.12	0.37	42.95	MD	42.95	45.34	116.56	0.039	0.000
GR4.14	0.39	44.43	MD	44.43	46.90	119.30	0.028	0.000
GR4.16	0.37	45.34	MD	45.34	47.86	117.63	0.034	0.000
GR4.18	0.49	50.98	MD	50.98	53.81	138.62	0.045	0.000
GR4.20	0.57	51.49	MD	51.49	54.35	104.24	0.034	0.000
GR4.22	0.53	51.36	MD	51.36	54.21	89.81	0.045	0.000
GR4.24	0.79	52.52	MD	52.52	55.44	99.84	0.038	0.000
GR4.26	0.73	52.75	MD	52.75	55.68	67.02	0.075	0.001
GR4.BD.34	1.15	45.65	MD	45.65	48.19	62.55	0.263	0.005
GR4.BD.38	0.09	21.80	MD	21.80	23.31	18.92	0.260	0.000
GR4.60	N/A	*1.43*	*MD*	*1.43*	*1.51*	*16.35*	*0.501*	*MD*
GR4.BD.81	N/A	*0.55*	*MD*	*0.55*	*0.58*	*MD*	*0.120*	*MD*
GR5.Litter	0.85	48.27	MD	48.27	52.78	56.79	0.009	0.000
GR5.BD.7	1.25	43.69	MD	43.69	48.29	34.95	0.025	0.001
GR5.BD.11	0.45	13.11	MD	13.11	13.97	29.13	0.054	0.002
GR5.16	0.18	4.12	MD	4.12	4.30	22.89	0.361	0.104
GR5.33	0.08	0.68	MD	0.68	0.72	8.50	0.180	0.022
GR5.53	0.07	*0.46*	*0.010*	*0.45*	*0.48*	*6.57*	*0.158*	0.033
GR5.66	0.05	*1.19*	*0.780*	*0.41*	*0.43*	*23.80*	*0.059*	0.009
GR5.88	0.04	*3.14*	*2.190*	*0.95*	*0.99*	*78.50*	*0.365*	0.022
GR5.BD.100	0.03	*2.11*	*0.040*	*2.07*	*2.18*	*70.33*	*0.383*	0.007
FF1.Litter	0.47	49.46	MD	49.46	52.93	105.23	0.006	0.000
FF1.BD.5	0.62	14.35	MD	14.35	15.14	23.15	0.040	0.002
FF1.20	0.11	1.82	MD	1.82	1.92	16.55	0.261	0.035
FF1.37	0.06	**0.95**	MD	0.95	1.00	15.83	0.186	0.018
FF1.60	0.04	*2.72*	*2.340*	*0.38*	*0.39*	*68.75*	*0.141*	0.014
FF1.70	0.03	*2.36*	*2.020*	*0.34*	*0.35*	*80.33*	*0.055*	0.005
SOAB1.LFH	0.91	39.91	N/A	39.91	43.97	43.86	0.412	0.008
SOAB1.10	1.13	40.71	N/A	40.71	45.31	36.03	0.362	0.008
SOAB1.20	0.38	0.87	N/A	0.87	0.91	2.29	0.095	0.086
SOAB1.33	0.06	0.96	N/A	0.96	1.00	16.00	0.122	0.022
SOAB1.50	0.04	*2.38*	*1.74*	*0.64*	*0.68*	*59.50*	*0.121*	0.028
SOAB1.85	0.04	*2.63*	*2.21*	*0.42*	*0.44*	*65.75*	*0.160*	0.019
SOAB1.100	0.04	*3.03*	*2.59*	*0.44*	*0.45*	*75.75*	*0.076*	0.006

%C values in normal type were performed on a Carlo Erba C:H:N analyzer

%C values in Italic type were performed coulometrically (see text for description)

Sample I.D.	< 2mm Fraction %N (Air Dry)	%Ct (Air Dry)	%C inorg. (Air Dry)	%C org. (Air Dry)	%Corg. (Oven Dry)	C/N	Organic g C cm-2	Total g N cm-2
YJP1.Litter	0.78	49.04	MD	49.04	53.94	62.87	0.016	0.000
YJP1.BD.4	0.29	11.86	MD	11.86	12.14	40.90	0.037	0.001
YJP1.8	0.04	0.33	MD	0.33	0.33	8.25	0.026	0.032
YJP1.17	0.03	0.32	MD	0.32	0.32	10.67	0.044	0.030
YJP1.36	0.03	0.15	MD	0.15	0.15	5.00	0.100	0.210
YJP1.53	0.02	0.07	MD	0.07	0.07	3.50	0.015	0.005
YJP1.65	0.03	0.06	MD	0.06	0.06	2.00	0.015	0.005
YJP1.80	0.03	0.05	MD	0.05	0.05	1.67	0.010	0.006
YJP1.100	0.03	0.05	MD	0.05	0.05	1.67	0.014	0.008
OJP1.Litter	0.78	48.31	MD	48.31	53.68	61.94	0.013	0.000
OJP1.BD.3	0.41	13.38	MD	13.38	13.94	32.63	0.094	0.003
OJP1.BD.20	0.02	0.44	MD	0.44	0.44	22.00	0.026	0.011
OJP1.BD.32	0.03	0.52	MD	0.52	0.53	17.33	0.066	0.005
OJP1.52	0.02	0.07	MD	0.07	0.07	3.50	0.022	0.006
OJP1.60	MD	MD	MD	MD	MD	MD	MD	MD
OJP1.80	0.03	0.04	MD	0.04	0.04	1.33	0.014	0.011
OJP1.100	0.04	0.09	MD	0.09	0.09	2.25	0.055	0.040
OJP2.BD.12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OJP2.BD.33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OJP2.BD.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OJP2.BD.53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OJP2.BD.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OJP2.BD.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OBS1.Litter	0.86	51.59	MD	51.59	56.16	59.99	0.025	0.000
OBS1.BD.8	0.88	46.26	MD	46.26	48.55	52.57	0.034	0.001
OBS1.18	0.78	40.90	MD	40.90	45.44	52.44	0.292	0.005
OBS1.21	0.74	44.92	MD	44.92	50.20	60.70	0.313	0.004
OBS1.27	0.10	1.41	MD	1.41	1.49	14.10	0.082	0.016
OBS1.44	0.05	0.86	MD	0.86	0.92	17.20	0.177	0.009
OBS1.64	0.04	0.33	MD	0.33	0.35	8.25	0.077	0.008
OBS1.82	MD	MD	MD	MD	MD	N/A	MD	MD
OBS1.Frozen	0.03	0.35	MD	0.35	0.37	11.67	**0.054**	**0.00**

%C values in normal type were performed on a Carlo Erba C:H:N analyzer

%C values in Italic type were performed coulometrically (see text for description)

RADIOCARBON MEASUREMENTS

FORMAT OF DATA:

SAMPLE # , DEL14C MATERIAL DATED, DEL14C MATERIAL DATED,
DEL14C MATERIAL DATED

Gillam Road #1 (GR1)

GR1.02 Litter 156 j.p.needles 139.4 decid. leaves 243.6 sticks
GR1.2 LFH NA NA 118.3 roots -39.1 charcoal
GR1.11 NA NA NA NA NA NA
GR1.20 NA NA NA NA NA NA
GR1.40 NA NA NA NA NA NA
GR1.60 NA NA NA NA NA NA
GR1.80 NA NA NA NA NA NA
GR1.100 NA NA NA NA NA NA

Gillam Road # 2 (GR2)

GR2.Litter 119.5 living moss 150 dead moss 201.4 needles
GR2.BD.6 176.7 moss NA NA 253.9 needles
GR2.BD.11 160.7 moss 161.7 decid leaves 260.6 needles
GR2.BD.13 0 NA NA NA NA NA
GR2.21 NA NA NA NA
GR2.45 NA NA NA NA
GR2.60 NA NA NA NA
GR2.80 NA NA NA NA
GR2.100 NA NA NA NA

Gillam Road #3 (GR3)

GR3.2 NA NA NA NA
GR3.4 120 sphag NA NA
GR3.6 107.5 sphag NA NA
GR3.8 NA NA NA NA
GR3.10 234.5 sphag NA NA
GR3.12 249.9 sphag NA NA
GR3.14 286.2 sphag NA NA
GR3.16 NA NA NA NA
GR3.18 361.8 sphag NA NA
GR3.20 368.1 sphag NA NA

GR3.40.22	317.1	sphag	NA	NA
GR3.40.24	132.1	sphag	NA	NA
GR3.40.26	22.1	sphag	NA	NA
GR3.40.28	36.06	sphag	NA	NA
GR3.40.30	41.1	sphag	NA	NA
GR3.40.32	-8.65	bulk organic	NA	NA
GR3.40.34	-44.9	bulk organic	NA	NA
GR3.40.36	-103	bulk organic	NA	NA
GR3.40.38	-161	bulk organic	NA	NA
GR3.42	-228	bulk organic	NA	NA
GR3.58	-253	bulk organic	NA	NA
GR3.69	-452	bulk organic	NA	NA
GR3.BD.80	-877	bulk organic	NA	NA

Gillam Road #4 (GR4)

GR4.2	141.9	Sphagnum	NA	NA
GR4.4	175.4	Sphagnum	NA	NA
GR4.6	247.2	Sphagnum	NA	NA
GR4.8	354.8	Sphagnum	NA	NA
GR4.10	675.2	Sphagnum	NA	NA
GR4.12	350.9	Sphagnum	NA	NA
GR4.14	MD	Sphagnum	NA	NA
GR4.16	30.4	Sphagnum	NA	NA
GR4.18	10.1	Sphagnum	NA	NA
GR4.20	13.7	Sphagnum	NA	NA
GR4.22	-1.5	Sphagnum	NA	NA
GR4.24	-6.5	Sphagnum	NA	NA
GR4.26	35.6	Sphagnum	NA	NA
GR4.BD.34	12.1	bulk organics	NA	NA
GR4.BD.38	-19.2	bulk organics	NA	NA
GR4.60	-238	bulk organics	NA	NA
GR4.BD.81	-284	bulk organics	NA	NA

Gillam Road # 5 (GR5)

GR5.Litter	187	needles	150	decid. leaves
GR5.BD.7	237.6	needles	187.9	decid. leaves
GR5.BD.11	NA	NA	NA	NA
GR5.16	NA	NA	NA	NA
GR5.33	NA	NA	NA	NA
GR5.53	NA	NA	NA	NA
GR5.66	NA	NA	NA	NA
GR5.88	NA	NA	NA	NA
GR5.BD.100	NA	NA	NA	NA

Footprint fire # 1 (FF1)

FF1.Litter	NA	NA	NA	NA
FF1.BD.5	NA	NA	NA	NA
FF1.20	NA	NA	NA	NA
FF1.37	NA	NA	NA	NA
FF1.60	NA	NA	NA	NA
FF1.70	NA	NA	NA	NA

SOAB RIVER#1 (SOAB1)

SOAB1.LFH	NA	NA	NA	NA
SOAB1.10	NA	NA	NA	NA
SOAB1.20	NA	NA	NA	NA
SOAB1.33	NA	NA	NA	NA
SOAB1.50	NA	NA	NA	NA
SOAB1.85	NA	NA	NA	NA
SOAB1.100	NA	NA	NA	NA

Young Jack Pine #1 (YJP1)

YJP1.Litter	173.7	bulk	NA	NA
YJP1.BD.4	8.1	bulk	NA	NA
YJP1.8	7.4	bulk	NA	NA
YJP1.17	29.2	bulk	NA	NA
YJP1.36	-37.5	bulk	NA	NA
YJP1.53	NA	NA	NA	NA
YJP1.65	NA	NA	NA	NA
YJP1.80	NA	NA	NA	NA
YJP1.100	NA	NA	NA	NA

Old Jack Pine 1 (OJP1)

OJP1.Litter	NA	NA	NA	NA
OJP1.BD.3	247	bulk	NA	NA
OJP1.BD.20	8.04	bulk	NA	NA
OJP1.BD.32	63.59	bulk	NA	NA
OJP1.52	21.84	bulk	NA	NA
OJP1.60	-149	bulk	NA	NA
OJP1.80	-211	bulk	NA	NA
OJP1.100	-413	bulk	NA	NA