Mississippi Basin Carbon Project - Upland Soil Database for Sites in Nishnabotna River Basin, Iowa

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1.0 BACKGROUND

The conversion of land from its native state to an agricultural use commonly results in a significant loss of soil carbon (Mann, 1985; Davidson and Ackerman, 1993). Globally, this loss is estimated to account for as much as 1/3 of the net CO_2 emissions for the period of 1850 to 1980 (Houghton and others, 1983). Roughly 20 to 40 percent of original soil carbon is estimated to be lost as CO_2 as a result of agricultural conversion, or "decomposition enhancement". Global models use this estimate along with land conversion data to provide agricultural contributions of CO_2 emissions for global carbon budgets (Houghton and others, 1983; Schimel, 1995).

Soil erosion rates are significantly (10X) higher on croplands than on their undisturbed equivalents (Dabney and others, 1997). Most of the concern over erosion is related to diminished productivity of the uplands (Stallings, 1957; McGregor and others, 1969; Rhoton, 1990) or to increased hazards and navigability of the lowlands in the late 1800's to early 1900's. Yet because soil carbon is concentrated at the soil surface, with an exponential decline in concentration with depth (Harden et al, 1999), it is clear that changes in erosion rates seen on croplands must also impact soil carbon storage and terrestrial carbon budgets as well.

As yet, erosional losses of carbon are not included in global carbon budgets explicitly as a factor in land conversion nor implicitly as a portion of the decomposition enhancement. However, recent work by Lal and others (1995) and by Stallard (1998) suggests that significant amounts of eroded soil may be stored in man-made reservoirs and depositional environments as a result of agricultural conversion. Moreover, Stallard points out that eroding soils have the potential for replacing part of the carbon trapped in man-made reservoirs. If true, then the global carbon budget may grossly underestimate or ignore a significant sink term resulting from the burial of eroded soil.

1.1 OBJECTIVES

A primary goal of the Mississippi Basin Carbon Project (Sundquist and others, 1998) is to define simple, functional relationships between hillslope erosion/sedimentation and soil organic matter dynamics. To meet this goal, small watersheds (Huntington and others,1998) were chosen for studies of upland soils in context of and collaboration with ongoing erosion/sedimentation studies. Our strategies for site selection and sampling approaches are described by Harden and others (1998, 1999 and in press).

The study sites are located in watersheds of the Nishnabotna River Basin in western Iowa (Fig. 1). The agricultural sites are located within the an experimental watershed, which has been maintained by U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) under the auspices of the Deep Loess Research Station (DLRS) near the town of Treynor. The cultivated sites are located within watershed 1-1 (watershed 1, sub-basin 1) of the DLRS. The undisturbed

prairie sites, used as control sites, are located near the town of Harlan in a small parcel of land referred to as the Dinesen Prairie, which is owned by USDA Natural Resources Conservation Service (NRCS) and is maintained by Iowa's Department of Natural Resources. All soils of this study are developed on Peoria Loess (Bettis, 1990; Muhs and Bettis, 2000;), which is a postglacial deposit that thins westward of its origin at the Missouri River.

In this report we present soil analytical data for the Dineson Prairie (control) and Treynor (cropland) sites. Field and analytical methods are described herein in text format, and data are presented as downloadable ASCII text from the internet site http://geochange.er.usgs.gov/usgs/mbcp/.

1.2 APPROACH

As discussed in Harden and others, 1998 for a similar sampling campaign in the state of Mississippi, a sampling strategy was designed to allow for stratification of soil data by depth, slope position, and cultivation history. Soil samples were collected at ridgetop, erosional midslope ("upper") and depositional lower slope ("lower") positions of small drainage basins for cultivated and uncultivated landuse pairs. Documentation and data sets described in this report include (1) site location, (2) descriptive field data, (3) physical, chemical, and isotopic analysis of (solid phase) soil samples, and (4) isotopic analysis of soil gas collected from static field chambers. A companion report by Huntington and others (in prep) provides soil respiration and soil climate data at these sites. Another companion report by Manies and others (2000) provides parameterization strategies for running the Century ecosystem model and provides documentation for the landuse history of these sites.

1.3 LAND USE HISTORY

Details of tilth, fertilization, and historic erosion are documented in detail by Manies and others (2000). Dinesen Prairie was chosen as a control site because it is uncultivated, unplowed , and representative of the original, pre-agricultural soil. At the Treynor cropland site, rotations of corn-wheat or corn-oat-clover were used from 1870 to 1964, followed by corn from 1964 to 1996 with conventional tillage. In 1997, soybeans were planted in the watershed using no-till drill methods. The switch from 30 years of corn to 2 years of soybean provides an opportunity for an isotopic tracer study.

2.0 METHODS.

2.1 FIELD METHODS.

Soil profiles were described according to USDA-NRCS methods (Soil Survey Staff, 1951) in which a variety of field properties were recorded for soil horizons at different depths. Properties

such as soil color, consistence, texture, structure, root size and density were recorded on field sheets and transferred to data sets.

The mass of soil organic carbon and total C per unit land surface area is referred to as the carbon inventory of a site. Measurements of percent organic C, bulk density and depth are included in these data. The calculation of carbon inventory is depth-dependent and can be measured or calculated to 0.5m, 1m, or greater depths. Most of MBCP-Upland measurements include data to 1m depths.

Soil samples were collected such that volumetric data could be combined with gravimetric data to provide measurements in units of volume (3 dimensional), area (2 dimensional), and depth (1 dimensional). Bulk density, field moisture content, and depth increments are included in soil sampling. Bulk density samples were collected with a variety of tools, including cores of known diameter (mineral soil) or boxes (litter and organic horizons) of known area. Samples were collected into the core or box of known volume. Our most consistent and accurate density measurements for Iowa soils were obtained with a coring device by Soil Moisture Corporation that we named "whomper" in which internal rings can be disassembled for intact samples. Less consistent and less accurate measurements were obtained from a hand-driven soil AMS core with internal sleeves; we found that a slighly crimped tip on the commercial core gave densities comparable to "whomper". The revised tip of the AMS probe was mainly at the Dinesen Prairie where we were careful to not disturb the rare and fragile soil and at both Treynor and Dineson for incubation and fractionation samples (0-20 and 20-40 cm depth increments). For deep samples at both Treynor and Dinesen, we used a Giddings automated, truck mounted coring device, which yielded bulk density values in close agreement with the "whomper" method. As separate samples or as portions of the bulk density samples, gravimetric samples were collected for analysis of C, N, isotopic analysis, and moisture content. Profiles were sampled at depth intervals of 0-5, 5-10, 10-20, and every 20 cm below a depth of 20cm. Maximum depth of samples vary from about 200 to 300 cm. Volumetric and gravimetric samples were weighed on collection day on a calibrated balance to 0.01 g. The weights of moisture samples were then tracked throughout air-drying and oven-drying to determine moisture content and bulk density based on air and oven-dry weights.

Samples of soil gas were collected through a soil chamber that was connected with a LICOR gas analyzer. These sites were monitored seasonally for soil CO_2 flux, by T. Huntington (Huntington and others, in prep). For soil $^{14}CO_2$ and $^{13}CO_2$, the soil chamber was placed into a sand ring that was confined between two pieces of PVC rings (see Huntington and others, 1998). The chamber was "scrubbed" by placing a soda lime trap (along with a dessicant to protect the soda lime) in line with the circulating air for a period of time (1000 to 3000 sec) that allowed approximately 2.5 to 3 volumes of chamber air to pass through the soda lime. This way, only a small fraction (about 5% to 10%) of CO_2 in circulating chamber air was likely to be contributed from the atmosphere, leaving the majority (90 to 95%) of CO_2 to be respired from roots and soil heterotrophs. After "scrubbing" the chamber gas with soda lime, a valve was used to close the soda

lime trap. For radiocarbon samples, we allowed CO_2 to build up in the soil chamber; a valve was then used to trap soil CO_2 onto molecular sieve material for determination of ^{14}C and ^{13}C.

Samples of soil gas were also collected for ^{13}C of CO_2 using the LICOR gas analyser and in-line glass vials. In this method, the chamber was placed in the PVC/sand ring. While the vial was in line with circulating soil air, soil CO_2 was allowed to build up in the vial and chamber for about 6 minutes (collection time noted) before closing the vial.   We compared this method to ^{13}C obtained from scrubbing and trapping onto the molecular sieve and found the results to be very similar (data not shown).

2.2 SAMPLE PREPARATION AND DRYING

Field notes were used to inventory all samples entering the laboratory. Samples were visually inspected and weighed as received. Any inconsistency between field descriptions or weights and laboratory observations was resolved before sample preparation began. If samples taken for analytical, moisture or bulk density measurements could not be processed immediately they were stored in the dark, at 4 ^{o}C.

Soil and litter samples were laid out on open shelves, in an isolated room and allowed to air dry to a constant weight. Temperature in the air drying room ranged from 20-30 ^{o}C during this process. Air dry moisture samples, or portions of air dry samples, were then oven dried to constant weight in a forced-draft oven. Litter samples, as well as any other samples that appreared to contain greater than 20 percent organic matter, were oven dried at a temperature of $65^{o}C$ to avoid loss of organic matter by oxidation or decomposition. All other samples were oven dried at a temperature of $105^{o}C$. Air-dry and oven dry weights from this procedure were used in the calculations of percent moisture and bulk density.

To prepare air dry soil samples for analysis the samples were first gently crushed using a ceramic mallet and plate. The crushed sample material was thoroughly mixed and then split into analytical and archive portions. The analytical portion was weighed and sieved using a 2mm screen. Material not passing the 2mm screen was removed, weighed and transferred to a plastic bag marked with the sample identification, the starting weight of the analytical portion and the weight of the material not passing through the 2 mm screen. Material passing the 2mm screen was then ground by hand, using a mortar and pestle, to pass through a 60 mesh (0.246 mm) screen. The ground material was carefully mixed, then split into subsamples for oven drying, analytical chemistry and archiving. Portions of the sample, such as large sections of bark or large diameter (> 1 cm) material, were placed in separate bags and included with the archive portion. The analytical portion of the air dry litter sample was prepared for analysis by first manually chopping or crushing larger material and then milling the entire sample to pass a 0.5 mm screen using a cyclone sample mill. The milled sample was then thoroughly mixed and a representative sample placed in a labeled, glass sample bottle.

The archive portions of the litter, 60 mesh, and 0.5 mm sample were placed in labeled, plastic bag for storage. For litter samples, the bags used for storage were large enough that the entire air-dry archive portion could be placed in the bag without crushing the sample. Archive materials were then boxed for storage at the U.S. Geological Survey District Office, 3039 Amwiler Rd. Atlanta, GA. All excess sample materials and waste were oven dried at $120^{o}C$ for 72 hours prior to disposal as per U.S. Dept. Agriculture guidelines for sterilization and soil disposal.

2.3 TOTAL CARBON, INORGANIC CARBON, ORGANIC CARBON, TOTAL NITROGEN, AND ^{13}C, ^{15}N

Total percent carbon (TC) was determined by measuring the carbon dioxide (CO_2) produced by combusting the sample in a stream of oxygen (O_2). Total carbon measurements were made using either a LECO carbon determinator (WR-112) or a Fisons NA1500 elemental analyser(EA)/ Optima isotope ratio mass spectrometer (IRMS).   Percent inorganic carbon (IC) was determined by measuring the CO_2 generated by heating a sample at $105\ ^{o}C$ in acid. A UIC coulometer was used for this measurement. Percent organic carbon was calculated as the difference between TC and IC. A Fisons NA1500 EA/Optima IRMS was also used for the determination of total nitrogen and for ^{15}N and ^{13}C measurements.

Total carbon measurements made using the LECO carbon determinator were carried out by analyzing between 0.1 and 1.0 g of sample, depending on expected carbon concentration. The sample material was mixed with copper metal and iron chip accelerators in a ceramic crucible, the ceramic crucible was placed in a radio frequency furnace and the sample combusted in a stream of carbon dioxide-free oxygen. Gases generated by the combustion process were passed through a series of catalysts, to ensure complete oxidation, and scrubbers, to remove components that would interfere with the CO_2 measurement. The CO_2 was then absorbed onto molecular sieve at room temperature. When sample combustion and CO_2 collection were complete the molecular sieve was heated to 350 ^{o}C, releasing the absorbed CO_2, and the CO_2 measured using a thermal conductivity detector.

The Fisons NA1500 EA/Optima IRMS was used to determine total carbon, total nitrogen; ^{13}C and ^{15}N employed a Fisons NA1500 elemental analyser for sample combustion and separation of CO_2 and N_2 from other combustion products. The gas stream from the elemental analyser then entered the Optima IRMS which was used to obtain analytical data for total carbon, total nitrogen, ^{13}C and ^{15}N. For this analysis between 1 and 30 mg of sample, depending on the estimated carbon concentration, was loaded into a tin capsule and the capsule tightly crimped to exclude atmospheric gases. Samples were then combusted at 1000 ^{o}C in a stream of oxygen. The gases generated during combustion then pass through heated combustion and reduction reactors to achieve quantitative conversion of carbon and nitrogen from the sample to CO_2 and nitrogen (N_2).   The combustion products next passed through a chromatographic column where CO_2 and N_2 were separated and then introduced into the mass spectrometer for measurement. Elemental concentrations were calculated

based on instrument responses for calibration standards. Isotope ratio measurements were corrected for fractionation effects and calibrated based on materials with known values.

In the early stages of this study, the Fisons NA1500 EA/Optima IRMS was used only to obtain total nitrogen and ^{15}N data. However, total carbon data for samples analyzed using the LECO instrument, and ^{13}C data for samples analyzed in a conventional extraction line/mass spectrometer lab, showed close agreement with data for the same samples analyzed using the EA/IRMS instrument (data not shown). As a result of this data comparison the EA/IRMS was used for nearly all TC, IC, ^{13}C, and ^{15}N analyses performed on solid samples.

In addition to calibration materials, three standard materials were routinely included in all EA/IRMS sample runs.   These materials were a well analyzed sample of ethylenediaminetetracetic acid (EDTA) obtained from Fisons Instruments, S.p.a., a marine sediment (MESS-1) issued by the Chemistry Division of the Canadian National Research Council and a river sediment (NBS1645) issued by the National Bureau of Standards, now known as National Institute of Standards and Technology. Precision estimates, expressed as relative standard deviation, were 3.6-6.5percent for total carbon, 3.7-6.5 percent for total nitrogen, 1.4-2.9 percent for ^{13}C, and 20-47 percent for ^{15}N, based on results for the standard materials (table below). Approximately 3percent of all samples were also analyzed in duplicate. For these duplicate runs the range, expressed as a percentage of the average of the duplicate runs, was less than 1percent for total carbon, less than 2percent for total nitrogen, less than 1 percent for ^{13}C and about 15 percent for [15]N.

I.D.	total %C (%rsd)	total %N (%rsd)	delta 13C (%rsd)	delta 15N (%rsd)
EDTA	3.6	3.7	1.5	---
MESS-1	4	3.9	2.9	20.1
NBS-1645	6.5	6.5	1.4	47.2

Inorganic carbon was determined by measuring the CO_2 generated by treating approximately 100 mg of sample with 2N perchloric acid ($HClO_4$) and heating the mixture at 105 ^{o}C. The evolved gases were first passed through an acidic (pH3) saturated silver sulfate (Ag_2SO_4) solution containing 3percent hydrogen peroxide (H_2O_2) to remove contaminants and then were bubbled through a partially aqueous solution containing ethanolamine and a colorimetric indicator. The CO_2 was quantitatively absorbed and converted to a strong, titratable acid by the ethanolamine. The amount of CO_2 evolved from the sample was measured by integrating the amount of current required to electrically generate enough base to titrate the acid.

The uncertainty in the IC determinations, expressed as relative standard deviation, is approximately 5 percent when IC is present. The range of IC values for standard materials run in duplicate was less than one percent of the carbon value.

2.4 RADIOCARBON

The ^{14}C content of the solid and gas phases of soil is used to calculate overall turnover time or to partition the organic carbon into more labile or stable pools. Radiocarbon content of ground, untreated soil was measured by sealing enough homogenized sample to make ~1 mg of C with cupric oxide wire and a small piece of silver wire in an evacuated, quartz tube. The CO_2 produced is purified cryogenically and then reduced to graphite using a zinc- or iron-catalyzed reduction method described in Vogel (1984). . The ratio of ^{14}C to ^{13}C and ^{12}C atoms is measured directly from the graphite target using a high energy accelerator as an inlet to a mass spectrometer (AMS).

We express ^{14}C data in the geochemical Delta notation (Delta = capitol greek delta), the deviation in parts per thousand (per mil) from an absolute standard .(95 times the activity of NBS oxalic acid measured in 1950). We also note the ratio of $^{14}C/^{12}C$, referred to as Fraction Modern notation. In calculating the Delta ^{14}C or Fraction Modern, we correct for isotopic fractionation effects that occur as a result of photosynthesis (the origin of soil organic matter) by correcting both sample and standard to a measured ^{13}C value of the same sample. If ^{13}C was not measured on the sample, then we correct using a value -25 per mil (as noted in parentheses in tables). The standard oxalic acid is corrected in the same way, to -19 per mil.

2.5 PARTICLE SIZE ANALYSIS

Samples were selected to characterize particle-size distribution of soils. Based on limited sample sizes, not all soil horizons and not all sites were fully characterized for particle size. Two preparations, conventional dispersal and water-based dispersal, were used to characterize sand, silt and clay particles.

Conventional dispersal of soil samples is based on the principal that soil particles aggregate to form coarser particles and must be dispersed chemically or physically. Sodium hydroxide, sodium hexametaphosphate, and citrate-bicarbonate were used for dispersal according to methods of Gee and Bauder (1986, p400-401), and samples were sieved (Gee and Bauder, p 401) and analysed by pipet (Gee and Bauder, p. 401-402) for determination of USDA sizes for sand (> 0.05mm or 50 micrometer), coarse silt (0 .02 to 0.05 mm or 20 to 50 micrometer), fine silt (0.002 to 0.02 mm or 2 to 20 micrometer), and clay (<0.002mm or <2 micrometer) fractions. For water-based dispersal, no pretreatment was used before sieving and pipet analysis.

2.6 ^{10}Be ANALYSIS

For ^{10}Be analysis, bulk soil is decomposed by $HClO_4$ + HF + HCl and dried. The dried solid cake is extracted by 3N HCl and precipitated by NH_4OH to form $Fe(OH)_3$. The precipitate is dissolved by 10% HF and re-precipitated to $Fe(OH)_3$ by NH_4OH, while Be complex ion is formed in solution. The solution is dried at 250deg C, treated with HCL and NH_4OH to form $Be(OH)_2$, baked again at 550 deg C for a BeO target for accelerator mass spectrometry at the Lawrence Livermore

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Laboratory. This method was developed by Fouad Tera of the Canegie Institution in Washington D.C.

3.00 DATA-SET IDENTIFICATION

The data presented represent sampling from the fall of 1996 to the fall of 1997. The MBCP-IAUpland Soils Database is structured as a set of tables in both Microsoft Access (_mdb) files and as tab-delimited ASCII (_rdb) files. Records in each of the four types of files (Iowa _Site, Iowa _Field, Iowa _Soil, Iowa _Isotope, Iowa_Psize) form a unique file that relate on the fields PROFILE and DEPTH. Four data sets are included for Iowa sites:

Iowa_Site   (Site Location and Explanation)

Iowa _Field   (Field Descriptions of Soils)

Iowa _Soil   (Chemical, Physical, Isotopic Data from Soils)

Iowa _Isotope (Radiocarbon of Soil and Soil Gas)

Iowa _Psize   (Particle Size Analysis of Soils)

Iowa_10Be   (Be Isotope Analysis of Bulk Soil)

The " Iowa _site" file includes site locations and explanations of sites. All other files use site codes described in the Iowa_Site file.

The "Iowa_Field" files include those properties described by USDA for field characterization and classification. (USDA, 1987).

The " Iowa _Soil" file includes solid phase analyses of bulk soil samples.

The " Iowa_C_Isotope" file includes radiocarbon analyses on solid and gas-phase samples.

The " Iowa _Psize" file includes particle size analysis data.

The "Iowa_10Be" file contains Be analyses of bulk soil samples.

3.10 LABELING SCHEMES

The overall strategy for labling samples is designed for replicate measurements at each ridge, upper (erosional) and lower (depositional) hillslope position at each site, for example at the Dinesen Prairie Upper slope. Replicate profiles are numbered consecutively, for example DPU1 through 3. Soil samples were collected in depth increments (soil horizons) in a vertical array at each site replicate. A decimal is used to designate basal depth (in cm) of the sample and is placed to the right of the decimal point, for example TRPU1.20 for 20 cm basal depth or TRPU1.200 for 200 cm basal depth. In some cases, lower case letters are used to indicate the intended purpose of the sample at the time of collection, including a, b, m, f, and i for analytical, bulk density, moisture content, fractionation, incubation samples respectively, for example TRPU1.20a,b,m. In other cases, replicate samples are indicated by a lower case to the left of the decimal, for example TRPU1a, TRPU1b.

3.20 DATA SET DESCRIPTIONS

Six categories of data sets are presented, including site and location data (Iowa_Site), field data (Iowa_Field), soil analytical data (Iowa_Soil), soil isotopic data (Iowa _Isotope), particle size data (Iowa_Psize) and 10Be data (Iowa_10Be). Column headings and units for each of these data sets are described herein:

3.21 IOWA_SITE FILES contain the following information in text format

Site location, slope description, landuse notes, date of sampling, purpose of sampling, field personnel.

3.22 IOWA_FIELD FILES contain the following information in column format

PROFILE is keyed to the Iowa_Site file for location and site information

DEPTH indicates the basal depth in cm of sampling increment

HORIZON includes a general description of the sampled horizon (A horizon, oxidized B horizon, etc.) (see Soil Survey Staff, 1981).

MCOLOR includes moist soil color using the Munsell soil color chart

STRUCTURE includes classes of size, strength and type of soil structure following conventions of Soil Survey Staff (1981)

TEXTURE includes soil texture class following conventions of Soil Survey Staff (1981)

PLASTICITY includes wet consistence class following conventions of Soil Survey Staff (1981)

STICKINESS includes wet consistence class following conventions of Soil Survey Staff (1981)

FIRMNESS includes moist consistence following conventions of Soil Survey Staff (1981)

ROOTS includes root abundance and size classes following conventions of Soil Survey Staff (1981)

3.23 IOWA_SOIL FILES contain analytical data on the solid phase of soil samples, using numbers assigned in the _Site file and the labling scheme described above.

PROFILE refers to the profile number in the Iowa _Site file for information regarding location and sampling conditions.

DEPTH is the depth in cm of the base of the soil horizon sample; the top depth is generally the basal depth of the superjacent soil horizon.

AIRDRYM is the airdry soil moisture is reported as the gravimetric moisture content (grams water per gram oven-dry soil) and can be used to convert other data to the oven-dry basis : $WW = DW/(1+DW)$ and $DW = WW/(1-WW)$, where DW is water content on the dry-weight basis, and WW is water content on the wet-weight basis (Gardner, 1986, p493-541). Using this

relationship, %C or Bulk Density, which are reported per g air-dry soil, can be converted to the more conventional per g oven-dry basis using the formula:

%C(air dry basis) * WW/(1-WW) = %C (oven-dry basis)

TOTALC1 is total carbon determined by Leco combustion analyser and is expressed as gravimetric percent on an air-dry soil basis. Samples were analyzed on the <2mm soil on a LECO combustion analyser.

TOTALC2 is total carbon expressed as gravimetric percent on an air-dry soil basis. Samples were analyzed on the <2mm soil fractions (once homogenized and ground to <60 mesh) on a Fisons NA1500 elemental analyser.

INORGANICC is carbonate carbon determined by acid treatment and UIC coulometer and is reported as %C on air-dry basis.

ORGANICC is the difference between TotalC2 and InorganicC and is expressed as %C on air-dry basis.

BD is bulk density as g of air-dry soil per cubic cm of soil. Conversion to oven-dry basis is described in AIRDRYMoisture

TOTALN total N content is expressed as gravimetric percent of air-dry soil

SOILC13 stable isotope ^{13}C content of the <2mm (bulk) soil is presented in Delta notation using per mil units

SOILN15 stable isotope 15N content of the <2mm (bulk) soil is presented in Delta notation

CDENSITY carbon density is calculated from TOTALC2 * BD

CSTORAGE carbon storage is calculated from TOTALC2* BD * thickness of sample as basal depth minus basal depth of superjacent horizon.

3. 24 Iowa _Isotope files contain the ^{14}C analyses for solid and chamber gas samples.

PROFILE is the profile number that keys back to Iowa _Site files

SAMPLE sample identification keys back to _Site files

DEPTH indicates depth of sample; NA not applicable usually refers to chamber samples collected at the soil surface

LABID is the laboratory identification number used by University of California Irvine and Lawrence Livermore Laboratories

TYPE sample type analysed

DEL^{13}C values for Delta^{13}C

DEL^{14}Cvalues for Delta^{14}C

LABSD values for error in radiocarbon counting

3.25 IOWA_PSIZE files contain the following information in column format

SampleID sample identification keys back to the IOWA_SITE files

USDASAND standard dispersant, percent by weight of particles greater than 50 micrometer in size

USDACOSI standard dispersant, percent by weight of particles between 20 and 50 micrometers in size

USDAFISI standard dispersant, percent by weight of particles between 2 and 20 micrometers in size

USDACL standard dispersant, percent by weight of particles less than 2 micrometers in size

WSAND water dispersant, percent by weight of particles greater than 50 micrometer in size

WCOSI water dispersant, percent by weight of particles between 20 and 50 micrometers in size

WFISI water dispersant, percent by weight of particles between 2 and 20 micrometers in size

WCLAY Water dispersant, percent by weight of particles less than 2 micrometers in size

3.26 IOWA_BE10 files contain ^{10}Be isotopic data for solid phase samples.

PROFILE is the profile number that keys back to Iowa _Site files

DEPTH indicates depth of sample; NA not applicable usually refers to chamber samples collected at the soil surface

10Be 10^8atom/g indicates the number of ^{10}Be atoms per g of sample

4.00 Application of the Data Set

The main purpose of the data set is to gain insight into the interaction between the carbon cycle and erosion-sedimentation cycle (see Harden et al, 1999). The data sets are best suited to address C and sedimentation processes on small hillslopes, with applications to land-atmosphere exchange of carbon, surface water chemistry, and watershed modelling.

Our sampling strategy allows several types of comparative analyses that can be used to test hypotheses or modeling scenarios. (1) Soil properties across a hillslope gradient can be assessed by comparing ridge (R), upper eroding midslope (U) and lower depositional slope (L) positions. Particle size and ^{10}Be isotopes allow an evaluation of particle sorting as a function of slope distance (Rosenbloom et al, 2000) or the balance between loess accumulation and hillslope degradation during soil development (Harden et al, submitted). This comparison can be applied to each a hillslope in a native prairie and an hillslope in an agricultural cropland. (2) Comparisons can also be made between the prairie and cropland for analysis of changes in landuse or as a "space for time substitute" in which the prairie site represents soils in their native, pre-agricultural state and the cropland represents soils as they exist throughout the midwest today (with the exception of course of small remnant preserves) (Harden et al, 1999). (3) Comparisons can be made among samples collected in a time series from May 1997 to November 1999, when the Treynor site was converted from a longstanding corn field under conventional tillage (see Manies et al, 2000) to a soybean field under no-till (drilled) methods. This time series records the isotopic shift in ^{13}C of soil organic matter that results from the

conversion of corn to soybean, which in turn can facilitate estimates of soil carbon turnover (ref). (4) For carbon cycle and radiocarbon studies and models, basic variables and equations can be applied or tested with these data. For example, turnover times for soil carbon can be constrained somewhat by the ^{14}C content of soil gas and bulk soil, as described by Trumbore 1996. The interaction among plant input, decomposition, and erosion can be studied with more robust data (Harden et al, 1999). (5) Last, information on the fate of carbon in deep sediment can be addressed through ^{10}Be and ^{14}C data of the deep samples (see Harden et al, submitted).

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