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HAMBURG RADIOCARBON THIN LAYER SOILS DATABASE

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ABSTRACT. We report here the remainder of the Hamburg University dates on thin soil layers (HAM 1652–3129).

INTRODUCTION

Soils and especially soil organic matter (SOM) have been objects of radiocarbon dating since the early days of the technique (Scharpenseel and Becker-Heidmann 1992). The first major objective, to determine the "age" or starting point of the development of a specific soil, is still open to methodological questions. On the other hand, natural ^{14}C measurements have been successful in providing information on the dynamics of SOM. Chemical and physical fractions of SOM have been "dated" separately to study the mechanisms of turnover, humification and stabilization. Interest in pedogenesis and the processes of soil development motivated the dating of several or all horizons of a soil profile. In the 1970s, with the increase in global environmental research and computer modeling of the major nutrient cycles, demand grew for more detailed information on soil carbon inventory and fluxes. SOM represents the second largest organic pool in the global carbon cycle, comprising 1200 to 1500 Pg of C in the 12.8×10^9 ha of ice-free terrestrial soils and 300–500 Pg of C in the 6.3×10^8 ha of wetlands (Scharpenseel and Becker-Heidmann 1994b).

In 1981 we started sampling and dating entire soil profiles as thin layers. Trying to cover the important soil classes, we have now completed ^{14}C and $\delta^{13}C$ measurements on 26 profiles and set up a database in dBASE IV. Here, we present these data together with available additional information according to the specifications of the planned International Radiocarbon Soils Data Base (IRSDB) (Becker-Heidmann 1996). Our intention is to provide the modeling community with test and reference soil data. Useful examples of applications were first published by Harrison *et al.* (1993) and Becker-Heidmann *et al.* (1995).

METHODS

The soil samples were taken as successive complete 2-cm thin layers from the top to the bottom of the profile, using trowel, meter and water level to control depth and horizontal plane, as described by Becker-Heidmann and Scharpenseel (1986). After air drying and transport to the laboratory in Hamburg, roots and stones were removed. Each sample was carefully homogenized, followed by sieving to 2 mm and drying at 105°C, before subsamples were taken for the different analyses. We measured pH in a 0.01 M $CaCl_2$ solution, and tested for the presence of $CaCO_3$.

Organic and inorganic carbon content were measured conductometrically using a Wösthoff apparatus and were separated by temperature (Becker-Heidmann 1990). For the determination of $\delta^{13}C$, the samples were combusted in an oxygen stream. The CO_2 was purified in a vacuum line and trapped. Details on the preparation line with computer-controlled cooling traps are given in Becker-Heidmann (1989). The measurements were carried out using a high-precision isotope mass spectrometer (Finnigan MAT 250). The natural ^{14}C concentrations were determined as described by Becker-Heidmann (1989, 1990), *via* combustion and conversion of the sample carbon to strontium carbonate, benzene synthesis and measurement by liquid scintillation spectrometry. Some samples with very low carbon content were augmented with CO_2 free of ^{14}C (Scharpenseel and Pietig 1970).

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Soil database

At present, the database contains the measurement results of pH, carbon content, $\delta^{13}C$ and ^{14}C activity of 26 complete profiles. Additionally, the conventional ^{14}C age (Stuiver and Polach 1977) is given here for organic matter of C_3 plant origin, *i.e.,* corrected for isotope discrimination to a nominal $\delta^{13}C$ value of –25‰ PDB. Rice (*Oryza sativa* L.), for example, is a C_3 plant. For carbonates and C_4-plant-derived organic matter (*e.g.,* sorghum and tropical grasses) the ^{14}C age is calculated without isotope correction.

We also list here all available information on the soil profiles relevant for further use in modeling SOM dynamics. The profile description is kept brief; where the detailed results have already been published, reference is made to the corresponding literature.

The profiles are grouped according to their hydrological, climatic and management regime and their location.

A Terrestrial soils
A1 Humid climate
A1a Forest soils
- Ohlendorf Forest, Profile A
- Ohlendorf Forest, Profile B
- Wohldorf Forest
- Timmendorf Forest
- Trittau Forest

A1b Agricultural soils
- Klein Altendorf
- Savarit, Profile 1
- Savarit, Profile 2

A2 Mediterranean Climate
- Akko
- Qedma

A3 Semiarid Climate
- Patancheru, Profile P
- Patancheru, Profile R

B Wetland soils
- Los Baños
- Pangil
- Pao
- Bugallon
- Tiaong, Profile L
- Tiaong, Profile H
- San Dionisio, Profile T
- Namtou Hsien
- Pingtung
- Chum Pae
- Klong Luang
- Tachiat, Profile 1
- Tachiat, Profile 2
- Tonsang

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OHLENDORF FOREST, PROFILE A

Profile-Related Data

Location (longitude, latitude):	52°17′N, 9°42′E
Location (country, next city or village):	Germany, Hiddestorf south of Hannover
Soil order and type (FAO classification):	Stagnic Luvisol
Soil order and type (local classification):	Pseudogley-Parabraunerde
Parent material:	Würmian loess
Mean annual temperature:	8.5°C
Annual rainfall:	620 mm
Vegetation and land use:	120-yr-old beech stand (*Fagus sylvatica* L.) with single *Carpinus betulus* L. and oaks (*Quercus robur* L.), farmer's woodland
Site description:	67.0 m above sea level (asl), plane
Date of sampling:	1982
Date of measurement:	1983 and 1984
Collector:	Becker-Heidmann
Submitter:	Becker-Heidmann
Submitter's comment:	See literature refs.
Literature references:	Becker-Heidmann (1989); Becker-Heidmann and Scharpenseel (1986); Neue (1980)

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Description of Profile A at Ohlendorf Forest

Depth (cm)	Horizon	Description
−4 to −1	L	Litter
−1 to 0	Of	
0–2	Ah1	Brown (10YR 5/3)[1], silt, roots
2–4	Ah2	Silt loam
4–8	Ae	White (10YR 8/2), silt, few roots
8–15	Bhs	Humus enriched, light gray (10YR 7/2), silt loam, frequent roots
15–40	Al1	Clay eluviated, Lessivé, light gray (10YR 7/2), silt loam, few to frequent roots
40–50	Al2	Pale brown (10YR 7/3), silt loam
50–60	SwBt1	Clay enriched, pale brown (10YR 7/4), silt loam, few coarse roots, clay cutanes, few manganese concretions
60–70	SwBt2	Pale brown (10YR 7/4), silt loam
70–78	SdBt	Water impeding, clay enriched, pale brown (10YR 7/4), stark lehmiger Schluff, manganese concretions

TABLE 1. Ohlendorf Forest, Profile A

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1652	0–2	--	5.05	−28.0	113.33 ± 0.74	Modern
HAM-1654	2–4	3.6	2.23	−27.4	99.20 ± 1.02	30 ± 80
HAM-1655	4–6	3.5	0.50	−26.8	99.79 ± 1.03	30 ± 80
HAM-1656	6–8	3.7	0.53	−27.1	94.50 ± 0.99	420 ± 80
HAM-1657	8–10	3.6	1.02	−27.0	94.76 ± 0.99	400 ± 80
HAM-1658	10–12	3.7	0.76	−27.0	96.48 ± 1.00	260 ± 80
HAM-1659	12–15	3.8	1.01	−26.6	94.07 ± 0.99	470 ± 90
HAM-1660	15–18	3.8	0.72	−27.0	94.45 ± 0.98	430 ± 80
HAM-1661	18–20	3.8	0.67	−26.7	96.66 ± 1.00	250 ± 80
HAM-1662	20–22	3.8	0.53	−26.7	96.70 ± 0.87	240 ± 70
HAM-1663	22–24	3.8	0.60	−26.6	96.48 ± 0.86	260 ± 70
HAM-1664	24–26	3.8	0.47	−26.8	99.15 ± 0.89	40 ± 70
HAM-1665	26–28	3.8	0.50	−27.0	93.69 ± 0.63	490 ± 50
HAM-1666	28–30	3.8	0.53	−26.4	93.61 ± 0.98	510 ± 80
HAM-1667	30–32	3.8	0.44	−27.0	94.09 ± 0.85	460 ± 70
HAM-1668	32–34	3.8	0.45	−26.0	91.62 ± 0.84	690 ± 70
HAM-1669	34–36	3.7	0.41	−26.6	94.31 ± 0.85	440 ± 70
HAM-1670	36–38	3.8	0.33	−26.3	96.32 ± 0.97	280 ± 80
HAM-1671	38–40	3.7	0.44	−25.8	108.67 ± 0.70	Modern
HAM-1672	40–42	3.8	0.36	−26.7	92.39 ± 0.63	610 ± 60
HAM-1673	42–44	3.7	0.37	−26.4	94.42 ± 0.64	440 ± 50
HAM-1674	44–46	3.8	0.24	−26.3	93.94 ± 0.64	480 ± 50
HAM-1675	46–48	3.8	0.27	−26.4	89.76 ± 0.94	850 ± 80
HAM-1676	48–50	3.7	0.25	−26.4	90.30 ± 0.94	800 ± 80
HAM-1677	50–52	3.7	0.22	−26.3	86.90 ± 0.92	1110 ± 90
HAM-1678	52–54	3.8	0.19	−26.0	86.62 ± 0.90	1140 ± 80
HAM-1679	54–56	3.7	0.20	−25.9	83.52 ± 0.88	1430 ± 90

[1]For YR soil color codes, see *Munsell Soil Color Charts* (1975).

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TABLE 1. Ohlendorf Forest, Profile A (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1680	56–58	3.7	0.14	−25.7	85.31 ± 0.60	1260 ± 60
HAM-1681	58–60	3.7	0.18	−26.0	80.49 ± 0.85	1730 ± 90
HAM-1682	60–62	3.7	0.14	−25.6	84.28 ± 0.60	1360 ± 60
HAM-1683	62–64	3.7	0.16	−25.6	83.54 ± 0.60	1440 ± 60
HAM-1684	64–66	3.7	0.14	−25.5	77.54 ± 0.58	2030 ± 60
HAM-1685	66–68	3.8	0.12	−25.8	70.48 ± 0.76	2800 ± 90
HAM-1686	68–70	3.9	0.12	−26.0	67.25 ± 0.74	3170 ± 90
HAM-1687	70–72	3.8	0.09	−25.5	84.66 ± 0.60	1330 ± 60
HAM-1688	72–74	3.9	0.11	−25.5	66.06 ± 0.72	3320 ± 90
HAM-1689	74–76	3.9	0.11	−25.6	68.85 ± 0.75	2990 ± 90
HAM-1690	76–78	3.8	0.58	−25.6	79.61 ± 0.58	1820 ± 60

Bulk Density (Neue 1980: Table 16, p. 177)

Depth (cm)	Bulk density ($g\ cm^{-3}$)
0–15	0.88
15–33	1.39
33–50	1.34
50–65	1.47
65–80	1.56
80–100	1.60
100–120	1.65
120–138	1.67
138–150	1.61
>150	1.89

OHLENDORF FOREST, PROFILE B

Profile-Related Data

Location (longitude, latitude):	52°17′N, 9°42′E
Location (country, next city or village):	Germany, Hiddestorf, south of Hannover
Soil order and type (FAO classification):	Stagnic Luvisol
Soil order and type (local classification):	Parabraunerde-Pseudogley
Parent material:	Würmian loess
Mean annual temperature:	8.5°C
Annual rainfall:	620 mm
Vegetation and land use:	120-yr-old beech stand (*Fagus sylvatica* L.) with single *Carpinus betulus* L. and oaks (*Quercus robur* L.), farmer's woodland
Site description:	66.2 m asl, plane, *ca.* 20 m southeast of Profile A
Date of sampling:	1983
Date of measurement:	1984 and 1985
Collector:	Becker-Heidmann
Submitter:	Becker-Heidmann
Submitter's comment:	See literature references
Literature references:	Becker-Heidmann (1989); Becker-Heidmann and Scharpenseel (1986); Neue (1980)

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Description of Profile B at Ohlendorf Forest

Depth (cm)	Horizon	Description
−4 to 2	L	Litter
−2 to 0	Of	Fermented litter
0–5	Ah	Dark brown (10YR 4/3), silt loam, frequent roots
5–10	Ae	Pale brown (10YR 6/3), silt, few roots
10–20	Bhs	Light yellowish brown (10YR 6/4), silt loam, frequent roots
20–38	Al1	Clay eluviated, Lessivé, brownish yellow (10YR 6/6), silt, frequent roots
38–44	Al2	Silt
44–58	SwAl	Light yellowish brown (10YR 6/4), pale mottles, silt, few roots, esp. at the lower border of the horizon
58–84	SdBt	Yellowish brown (10YR 5/6) with dark mottles (clay lentils), silty clay loam, in the upper part horizontal root veins, partly filled with Al material, clay cutanes, few manganese concretions
84–90	BtSd1	Yellowish brown (10YR 5/6), more frequently mottled, silt loam, increasing concretions
90–102	BtSd2	Yellowish brown (10YR 5/8), silt loam
102–140	BtSd3	Yellowish brown (10YR 5/6), few roots, partly dead, gray lentil with ferrous coating, gravels partly with manganese coating, silt loam
140+	IIC	Yellowish brown (10YR 5/6) to brown (10YR 5/3) mottled, gravelled loam

TABLE 2. Ohlendorf Forest, Profile B

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1910	0–3	3.8	5.42	−26.7	107.22 ± 0.72	Modern
HAM-1911	3–5	3.6	5.17	−26.4	100.23 ± 0.71	Modern
HAM-1912	5–7	3.8	2.10	−26.1	99.52 ± 0.68	20 ± 60
HAM-1913	7–10	3.9	1.01	−26.5	96.91 ± 0.70	230 ± 60
HAM-1914	10–12	3.9	1.45	−26.4	95.48 ± 0.67	350 ± 60
HAM-1915	12–14	4.0	1.28	−26.5	98.37 ± 0.68	110 ± 60
HAM-1916	14–16	4.1	1.41	−26.6	96.48 ± 0.67	260 ± 60
HAM-1917	16–18	3.8	1.02	−26.3	97.74 ± 0.67	160 ± 60
HAM-1918	18–20	3.8	1.36	−26.3	95.82 ± 0.67	320 ± 60
HAM-1919	20–22	3.8	0.73	−26.0	97.09 ± 0.67	220 ± 60
HAM-1920	22–24	3.8	0.59	−26.0	95.00 ± 0.74	400 ± 60
HAM-1921	24–26	3.8	0.58	−26.3	95.18 ± 0.66	380 ± 60
HAM-1922	26–28	4.0	0.39	−25.9	95.51 ± 0.67	360 ± 60
HAM-1923	28–30	3.9	0.40	−25.5	93.20 ± 0.66	560 ± 60
HAM-1924	30–32	3.8	0.32	−25.5	90.69 ± 0.66	780 ± 60
HAM-1925	32–34	3.8	0.31	−25.2	91.03 ± 0.65	750 ± 60
HAM-1926	34–36	3.8	0.34	−25.3	89.03 ± 0.64	930 ± 60
HAM-1927	36–38	3.8	0.16	−25.1	96.47 ± 0.67	290 ± 60
HAM-1928	38–40	3.9	0.20	−25.1	87.29 ± 0.63	1090 ± 60
HAM-1929	40–42	3.8	0.23	−25.0	86.49 ± 0.63	1170 ± 60
HAM-1930	42–44	3.9	0.16	−25.3	84.25 ± 0.62	1370 ± 60
HAM-1931	44–46	3.9	0.12	−25.1	94.57 ± 0.67	450 ± 60
HAM-1932	46–48	3.8	0.15	−25.2	86.61 ± 0.63	1150 ± 60
HAM-1933	48–50	3.8	0.12	−25.1	87.39 ± 0.64	1080 ± 60

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TABLE 2. Ohlendorf Forest, Profile B (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1934	50–52	3.8	0.13	−25.3	74.58 ± 0.59	2350 ± 60
HAM-1935	52–54	3.7	0.14	−25.2	71.09 ± 0.57	2740 ± 70
HAM-1936	54–56	3.5	0.15	−25.0	82.75 ± 0.62	1520 ± 60
HAM-1937	56–58	3.5	0.17	−24.6	95.76 ± 0.67	350 ± 60
HAM-1938	58–60	3.5	0.17	−24.7	85.45 ± 0.59	1270 ± 60
HAM-1939	60–62	3.5	0.20	−24.4	87.76 ± 0.64	1060 ± 60
HAM-1940	62–64	3.6	0.18	−24.4	88.21 ± 0.64	1020 ± 60
HAM-1941	64–66	3.6	0.19	−24.3	75.85 ± 0.59	2230 ± 60
HAM-1942	66–68	3.7	0.15	−24.7	90.02 ± 0.65	850 ± 60
HAM-1943	68–70	3.8	0.17	−24.8	82.29 ± 0.68	1570 ± 70
HAM-1944	70–72	3.6	0.16	−24.5	84.23 ± 0.68	1390 ± 60
HAM-1945	72–74	3.8	0.13	−24.5	78.79 ± 0.66	1920 ± 70
HAM-1946	74–76	4.0	0.11	−24.4	83.34 ± 0.67	1470 ± 70
HAM-1947	76–78	3.9	0.10	−24.4	72.82 ± 0.64	2560 ± 70
HAM-1948	78–80	4.1	0.09	−24.5	85.76 ± 0.68	1240 ± 60
HAM-1949	80–82	4.1	0.08	−24.4	--	--
HAM-1950	82–84	4.2	0.07	−24.5	111.16 ± 0.80	Modern
HAM-1951	84–86	4.0	0.10	−24.2	83.09 ± 0.68	1500 ± 70
HAM-1952	86–88	4.3	0.08	−24.6	88.24 ± 0.80	1010 ± 70
HAM-1953	88–90	4.2	0.09	−24.5	113.45 ± 0.80	Modern
HAM-1954	90–93	4.5	0.08	−24.1	93.04 ± 0.73	590 ± 60
HAM-1955	93–96	4.3	0.09	−24.4	85.60 ± 0.68	1260 ± 60
HAM-1956	96–99	4.6	0.08	−24.1	73.02 ± 0.63	2540 ± 70
HAM-1957	99–102	4.6	0.07	−24.7	123.09 ± 0.84	Modern
HAM-1958	102–105	4.7	0.07	−24.6	95.13 ± 0.72	410 ± 60
HAM-1959	105–108	4.7	0.06	−24.4	96.23 ± 0.73	320 ± 60
HAM-1960	108–111	4.9	0.09	−24.5	92.65 ± 0.71	620 ± 60
HAM-1961	111–114	4.9	0.08	−24.2	71.27 ± 0.70	2730 ± 80
HAM-1962	114–117	5.1	0.07	−24.5	81.21 ± 0.85	1680 ± 80
HAM-1963	117–120	5.1	0.11	−24.0	75.63 ± 0.87	2260 ± 90
HAM-1964	120–123	5.7	0.11	−25.4	81.23 ± 0.67	1660 ± 70
HAM-1965	123–126	5.7	0.07	−24.7	73.77 ± 0.63	2450 ± 70
HAM-1966	126–129	5.8	0.06	−25.7	85.46 ± 0.68	1250 ± 60
HAM-1967	129–132	6.2	0.07	−25.4	76.29 ± 0.64	2170 ± 70
HAM-1968	132–135	6.0	0.06	−25.6	73.61 ± 0.63	2450 ± 70
HAM-1969	135–138	6.0	0.06	−25.6	84.84 ± 0.68	1310 ± 60
HAM-1970	138–140	5.9	0.06	−25.0	84.48 ± 0.79	1350 ± 80
HAM-1971	140–142	5.8	0.06	−25.2	77.71 ± 0.73	2020 ± 80
HAM-1972	142–144	6.0	0.06	−24.9	96.02 ± 0.90	330 ± 80
HAM-1973	144–146	5.9	0.10	−26.4	98.01 ± 0.74	140 ± 60

Bulk Density (Neue 1980: Table 17, p. 178)

Depth (cm)	Bulk density (g cm^{-3})
0–5	0.92
5–10	1.23
10–20	1.30
20–37	1.37

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Bulk Density (Neue 1980: Table 17, p. 178) (Continued)

Depth (cm)	Bulk density (g cm^{-3})
37–50	1.48
50–70	1.52
70–110	1.59
110–130	1.66
130–144	1.72
144–164	1.85

Wohldorf Forest

Profile-Related Data

Location (longitude, latitude):	53°43′N, 10°9′E
Location (country, next city or village):	Germany, Hamburg
Soil order and type (FAO classification):	Stagnic Luvisol
Soil order and type (local classification):	Podsolige Braunerde above Parabraunerde-Pseudogley
Parent material:	Weichselian boulder cover sand above Saalean boulder loam
Mean annual temperature:	8.5°C
Annual rainfall:	741 mm
Vegetation and land use:	100-yr beech stand, forest, nature reserve
Site description:	31.1 m asl, top of terminal moraine, plane
Date of sampling:	1982
Date of measurement:	1983
Collector:	Becker-Heidmann
Submitter:	Becker-Heidmann
Submitter's comment:	See literature references
Literature references:	Becker-Heidmann (1989); Becker-Heidmann and Scharpenseel (1986); Scharpenseel and Becker-Heidmann (1994b)

Description of the Profile at Wohldorf Forest

Depth (cm)	Horizon	Description
−8 to 5	L	Litter
−5 to 3	Of1	Leaf structure visible
−3 to 1	Of2	Macerated litter
−1 to 0	Oh	
0–3	Ah	Grayish brown (10YR 5/2), loamy sand, very frequent roots
3–5	Ae	Light gray (10YR 7/2), loamy sand, few roots
5–11	Bhs	Very pale brown (10YR 7/3), sandy loam, very frequent roots
11–23	Bv	Very pale brown (10YR 7/3), sandy loam, very frequent roots
23–40	IISwAl	Clay eluviated (Lessivé), white (10YR 8/2), sandy loam, few roots
40–50	IISdBt1	Clay enriched, water impeding, very pale brown (10YR 8/3), sandy loam, few roots
50–63	IISdBt2	Very pale brown (10YR 8/4), sandy loam

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63–73	IISdBt3	Very pale brown (10YR 8/4), silt loam, roots in leading channels
73–88	IISdBt4	Very pale brown (10YR 8/4), loam, roots in leading channels
88–100	IISdBt5	Very pale brown (10YR 7/4), mottled, sandy loam, roots in leading channels
100–110+	IIICv	Very pale brown (10YR 7/4), loamy sand, gravels, bands, iron enriched

TABLE 3. Wohldorf Forest

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1750	−8 to −5	--	40.36	−30.4	--	--
HAM-1751	−5 to −4	--	27.38	−30.2	129.23 ± 0.87	Modern
HAM-1752	−4 to −3	--	29.33	−30.0	142.47 ± 0.92	Modern
HAM-1753	−3 to −1	--	25.89	−27.4	145.06 ± 0.94	Modern
HAM-1754	−1 to 0	--	15.77	−27.1	107.05 ± 0.77	Modern
HAM-1755	0–3	3.0	3.46	−28.6	103.26 ± 0.88	Modern
HAM-1756	3–5	3.4	0.72	−28.1	113.27 ± 0.95	Modern
HAM-1757	5–7	3.7	1.36	−27.5	107.18 ± 1.03	Modern
HAM-1758	7–9	3.7	1.26	−27.1	105.00 ± 1.01	Modern
HAM-1759	9–11	3.8	1.46	−27.8	102.44 ± 0.99	Modern
HAM-1760	11–13	3.9	0.75	−27.3	97.93 ± 0.85	130 ± 70
HAM-1761	13–15	4.0	0.88	−27.3	116.07 ± 1.01	Modern
HAM-1762	15–17	3.9	0.99	−27.4	95.51 ± 0.83	330 ± 70
HAM-1763	17–19	4.1	1.13	−27.1	95.37 ± 0.83	350 ± 70
HAM-1764	19–21	4.1	0.45	−26.9	96.69 ± 0.84	240 ± 70
HAM-1765	21–23	4.1	0.26	−27.1	95.08 ± 0.83	370 ± 70
HAM-1766	23–25	4.1	0.78	−27.5	106.75 ± 1.03	Modern
HAM-1767	25–27	4.2	0.47	−27.3	125.62 ± 1.17	Modern
HAM-1768	27–29	4.2	0.46	−27.2	97.96 ± 0.85	130 ± 70
HAM-1769	29–31	4.2	1.29	−27.4	94.84 ± 0.83	390 ± 70
HAM-1770	31–33	4.2	0.53	−27.2	93.50 ± 0.82	510 ± 70
HAM-1771	33–35	4.3	0.21	−27.0	99.24 ± 1.09	30 ± 90
HAM-1772	35–37	4.2	0.38	−27.1	101.49 ± 1.00	Modern
HAM-1773	37–40	4.2	0.16	−26.7	114.98 ± 1.10	Modern
HAM-1774	40–42	4.2	0.16	−26.4	119.28 ± 1.14	Modern
HAM-1775	42–44	4.1	0.14	−26.4	110.81 ± 1.05	Modern
HAM-1776	44–46	4.1	0.17	−25.7	89.87 ± 0.80	850 ± 70
HAM-1777	46–48	4.0	0.16	−26.2	88.57 ± 1.10	960 ± 100
HAM-1778	48–50	4.0	0.15	−25.9	103.67 ± 1.00	Modern
HAM-1779	50–52	3.9	0.15	−25.8	94.06 ± 0.91	480 ± 80
HAM-1780	52–55	3.9	0.10	−25.7	87.14 ± 0.78	1090 ± 70
HAM-1781	55–58	3.8	0.15	−25.5	89.13 ± 0.79	920 ± 70
HAM-1782	58–60	3.9	0.07	−26.1	78.49 ± 0.72	1930 ± 70
HAM-1783	60–63	3.9	0.11	−26.1	94.90 ± 0.92	400 ± 80
HAM-1784	63–65	3.8	0.12	−25.7	94.67 ± 0.92	430 ± 80
HAM-1785	65–67	3.8	0.19	−25.7	83.23 ± 0.76	1460 ± 70
HAM-1786	67–69	3.8	0.10	−25.4	82.14 ± 0.76	1570 ± 70
HAM-1787	69–71	3.8	0.14	−25.4	86.24 ± 0.78	1180 ± 70
HAM-1788	71–73	3.8	0.10	−25.7	92.33 ± 0.92	630 ± 80
HAM-1789	73–75	3.8	0.09	−25.9	85.78 ± 0.85	1220 ± 80
HAM-1790	75–77	3.8	0.09	−25.7	85.11 ± 0.85	1280 ± 80
HAM-1791	77–80	3.8	0.07	−26.1	79.68 ± 0.80	1810 ± 80
HAM-1792	80–82	3.8	0.10	−25.7	77.75 ± 0.79	2010 ± 80
HAM-1793	82–84	3.7	0.09	−25.3	74.73 ± 0.86	2340 ± 90

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TABLE 3. Wohldorf Forest (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1794	84–86	3.8	0.09	−26.2	76.78 ± 0.71	2100 ± 80
HAM-1795	86–88	3.8	0.08	−26.3	81.92 ± 0.75	1580 ± 70
HAM-1796	88–90	3.7	0.06	−26.1	77.29 ± 0.73	2050 ± 80
HAM-1797	90–92	3.7	0.05	−25.4	74.92 ± 0.70	2310 ± 80
HAM-1798	92–94	3.6	0.07	−25.0	85.60 ± 0.84	1250 ± 90
HAM-1799	94–96	3.7	0.06	−25.6	--	--
HAM-1800	96–98	3.7	0.06	−24.9	78.95 ± 0.73	1900 ± 70
HAM-1801	98–100	3.7	0.04	−26.8	82.78 ± 0.87	1490 ± 80
HAM-1802	100–102	3.7	0.06	−26.2	99.16 ± 0.88	50 ± 70
HAM-1803	102–104	3.8	0.05	−25.7	94.10 ± 0.79	480 ± 70
HAM-1804	104–106	3.8	0.04	−27.6	84.71 ± 0.72	1290 ± 70
HAM-1805	106–108	3.9	0.04	−28.8	79.20 ± 0.93	1810 ± 90
HAM-1806	108–110	4.0	0.03	−27.4	80.96 ± 1.14	1660 ± 110

TIMMENDORF FOREST

Profile-Related Data

Location (longitude, latitude):	54°0′N, 10°47′E
Location (country, next city or village):	Germany, Timmendorf
Soil order and type (FAO classification):	Stagnic Luvisol
Soil order and type (local classification):	Pseudogley-Parabraunerde
Parent material:	Weichselian loam
Mean annual temperature:	8.2°C
Annual rainfall:	600 mm
Vegetation and land use:	110-yr-old beech (*Fagus sylvatica* L.), nature reserve
Site description:	2.5 m asl, plane
Date of sampling:	1982
Date of measurement:	1984
Collector:	Becker-Heidmann
Submitter:	Becker-Heidmann
Submitter's comment:	See literature references
Lab comment:	--
Literature references:	Becker-Heidmann (1989)

Description of the Profile at Timmendorf Forest

Depth (cm)	Horizon	Description
−4 to −3	L	Litter
−3 to 0	Of	Leaf structure visible
0–10	Ah1	Black (10YR 2/1), sandy loam, very frequent roots
10–18	Ah2	Dark brown (10YR 3/3), silty clay loam, frequent roots
18–30	AhAl	Dark brown (10YR 3/3), sandy loam, frequent roots
30–38	Al1	Clay eluviated (Lessivé), brown (10YR 4/3), sandy loam, gravels, single vertical roots
38–56	Al2	Brown (10YR 4/3), sandy loam
56–74	SwBt	Clay enriched, dark yellowish brown (10YR 4/4), mottled, clay loam, gravels, horizontal roots, iron and manganese concretions, weathered rock material, mica, single earthworms (*L. terrestris*)

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74–110	(II)SdBt	Water impeding, clay enriched, dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/4), sandy loam, few gravels, old horizontal root channels, clay cutanes clearly visible
110+	IIC	Boulder marl

TABLE 4. Timmendorf Forest

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1860	0–2	3.5	4.77	−26.8	119.51 ± 0.73	Modern
HAM-1861	2–4	3.5	4.53	−26.7	117.05 ± 0.73	Modern
HAM-1862	4–6	3.5	3.37	−26.6	110.35 ± 0.70	Modern
HAM-1863	6–8	3.4	2.76	−26.5	103.61 ± 0.68	Modern
HAM-1864	8–10	3.5	1.47	−26.5	100.21 ± 0.56	Modern
HAM-1865	10–12	3.6	3.21	−26.4	98.72 ± 0.63	80 ± 50
HAM-1866	12–14	3.7	1.77	−26.2	95.70 ± 0.62	330 ± 50
HAM-1867	14–16	3.7	1.61	−26.7	93.51 ± 0.62	510 ± 50
HAM-1868	16–18	3.7	2.61	−26.3	93.98 ± 0.62	480 ± 50
HAM-1869	18–20	3.8	1.06	−26.2	95.77 ± 0.61	330 ± 50
HAM-1870	20–22	3.7	0.87	−25.0	94.12 ± 0.62	490 ± 50
HAM-1871	22–24	3.9	0.87	−26.0	92.16 ± 0.61	640 ± 50
HAM-1872	24–26	4.0	0.68	−26.2	91.92 ± 0.60	660 ± 50
HAM-1873	26–28	3.8	1.10	−25.9	91.46 ± 0.61	700 ± 50
HAM-1874	28–30	3.9	0.67	−25.9	91.35 ± 0.61	710 ± 50
HAM-1875	30–32	4.0	1.04	−25.9	90.11 ± 0.60	820 ± 50
HAM-1876	32–34	4.0	0.90	−26.2	90.56 ± 0.61	780 ± 50
HAM-1877	34–36	4.0	1.21	−26.0	88.28 ± 0.60	990 ± 50
HAM-1878	36–38	4.2	0.43	−25.7	91.52 ± 0.63	700 ± 60
HAM-1879	38–40	4.0	0.69	−25.6	87.70 ± 0.59	1040 ± 50
HAM-1880	40–42	4.1	0.24	−25.5	87.35 ± 0.59	1080 ± 50
HAM-1881	42–44	4.1	0.39	−25.6	87.01 ± 0.59	1110 ± 60
HAM-1882	44–46	4.1	0.25	−25.2	85.43 ± 0.59	1260 ± 60
HAM-1883	46–48	4.0	0.41	−25.5	84.41 ± 0.61	1350 ± 60
HAM-1884	48–50	4.2	0.13	−25.3	88.72 ± 0.60	960 ± 50
HAM-1885	50–52	4.2	0.20	−25.6	83.69 ± 0.58	1420 ± 60
HAM-1886	52–54	4.2	0.10	−25.2	81.48 ± 0.57	1640 ± 60
HAM-1887	54–56	4.0	0.37	−25.2	88.19 ± 0.60	1010 ± 50
HAM-1888	56–58	4.1	0.18	−25.4	82.28 ± 0.57	1560 ± 60
HAM-1889	58–60	4.2	0.13	−25.3	89.60 ± 0.60	880 ± 50
HAM-1890	60–62	4.0	0.20	−25.3	85.38 ± 0.59	1260 ± 60
HAM-1891	62–64	4.1	0.39	−25.5	83.13 ± 0.58	1480 ± 60
HAM-1892	64–66	3.8	0.42	−24.7	79.73 ± 0.58	1820 ± 60
HAM-1893	66–68	3.9	0.24	−25.1	78.81 ± 0.58	1910 ± 60
HAM-1894	68–70	4.0	0.26	−25.1	76.41 ± 0.55	2160 ± 60
HAM-1895	70–72	4.1	0.16	−25.0	75.48 ± 0.55	2260 ± 60
HAM-1896	72–74	4.4	0.15	−25.1	71.87 ± 0.53	2650 ± 60
HAM-1897	74–76	5.0	0.15	−25.1	71.20 ± 0.53	2730 ± 60
HAM-1898	76–78	5.1	0.10	−24.9	75.28 ± 0.54	2280 ± 60
HAM-1899	78–80	5.0	0.11	−24.8	77.80 ± 0.56	2020 ± 60
HAM-1900	80–82	5.0	0.18	−24.9	80.02 ± 0.56	1790 ± 60
HAM-1901	82–84	5.1	0.18	−24.8	83.46 ± 0.57	1460 ± 60

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Trittau Forest

Profile-Related Data

Location (longitude, latitude):	53°37′N, 10°28′E
Location (country, next city or village):	Germany, Trittau (Hahnheide)
Soil order and type (FAO classification):	Cambic Podzol
Soil order and type (local classification):	Schwach podsolierte Braunerde above Pseudogley-Parabraunerde
Parent material:	Weichselian boulder cover sand above Weichselian or late Saalean boulder loam (Fuhlsbüttel moraine)
Mean annual temperature:	8.1°C
Annual rainfall:	742 mm
Vegetation and land use:	110-yr-old beech stand, forest
Site description:	70 m asl, slope
Date of sampling:	1982
Date of measurement:	1983/1984
Collector:	Becker-Heidmann
Submitter:	Becker-Heidmann
Submitter's comment:	The profile seemed to be disturbed
Lab comment:	--
Literature references:	Neue (1980)

Description of the Profile at Trittau Forest:

Depth (cm)	Horizon	Description
–5 to –3	L	Litter
–3 to –2	Of	Fungus
–2 to 0	Oh	Many roots
0–4	Aeh	Silty loamy sand, gray (10YR 5/1), few roots, undulating border
4–7	Bhs	Dark brown (7.5YR 3/2), many fine roots
7–20	Bv1	Yellowish brown (10YR 5/8), many roots
20–32	Bv2	Weathered
32–44	SwBv	
44–54	IISdBt1	Loamy sand, brownish yellow (10YR 6/6), very few roots, single vertical roots
54+	IISdBt2	Dark brown (10YR 4/6), few roots, manganese concretions

TABLE 5. Trittau Forest

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1704	0–1	3.1	4.61	–27.6	96.85 ± 0.61	215 ± 50
HAM-1705	1–4	3.1	4.05	–27.4	96.78 ± 0.69	220 ± 60
HAM-1708	4–7	3.3	2.75	–26.9	100.61 ± 0.61	Modern
HAM-1709	7–10	3.5	0.99	–26.7	99.86 ± 0.61	Modern
HAM-1710	10–12	3.7	1.02	–26.8	98.81 ± 0.61	65 ± 50
HAM-1711	12–14	3.9	1.11	–26.6	98.58 ± 0.61	90 ± 50
HAM-1712	14–16	4.1	0.72	–26.5	97.82 ± 0.61	155 ± 50
HAM-1713	16–18	4.0	1.08	–26.5	94.50 ± 0.60	430 ± 50
HAM-1714	18–20	4.1	1.02	–26.4	96.36 ± 0.61	275 ± 50
HAM-1715	20–22	4.1	0.76	–26.4	94.85 ± 0.60	400 ± 50

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TABLE 5. Trittau Forest (Continued)

Lab code	Depth (cm)	pH	C	δ^{13}C	^{14}C activity	^{14}C age
HAM-1716	22–24	4.1	0.77	−26.4	96.64 ± 0.60	255 ± 50
HAM-1717	24–26	4.1	0.66	−26.3	93.69 ± 0.60	500 ± 50
HAM-1718	26–28	4.1	0.54	−26.2	95.26 ± 0.60	370 ± 50
HAM-1719	28–30	4.1	0.44	−26.0	97.95 ± 0.61	150 ± 50
HAM-1720	30–32	4.1	0.38	−26.0	95.66 ± 0.60	340 ± 50
HAM-1721	32–34	4.1	0.30	−25.6	105.25 ± 0.63	Modern
HAM-1722	34–36	4.1	0.21	−25.3	97.56 ± 0.85	190 ± 70
HAM-1723	36–38	4.0	0.17	−25.0	97.24 ± 0.61	225 ± 50
HAM-1724	38–40	4.0	0.15	−25.1	94.07 ± 0.59	490 ± 50
HAM-1725	40–42	4.0	0.13	−24.6	94.65 ± 0.60	450 ± 50
HAM-1726	42–44	3.9	0.12	−25.0	122.70 ± 0.69	Modern
HAM-1727	44–46	3.9	0.10	−24.9	101.57 ± 0.62	Modern
HAM-1728	46–48	3.8	0.10	−24.8	102.90 ± 0.63	Modern
HAM-1729	48–50	3.8	0.08	−24.2	93.99 ± 0.69	510 ± 60
HAM-1730	50–52	3.7	0.08	−24.3	98.96 ± 0.61	95 ± 50
HAM-1731	52–54	3.7	0.07	−24.3	123.23 ± 1.38	Modern
HAM-1732	54–56	3.7	0.08	−24.3	117.03 ± 2.02	Modern
HAM-1733	56–58	3.7	0.08	−24.4	115.97 ± 1.37	Modern
HAM-1734	58–60	3.7	0.07	−24.2	124.35 ± 1.93	Modern

Bulk density (Neue 1980: Table 24, p. 185)

Depth (cm)	Bulk density (g cm^{-3})
0–3	1.13
3–5	1.29
5–9	1.30
9–20	1.34
20–38	1.67
38–48	1.72
48–68	1.81

KLEIN ALTENDORF

Profile-Related Data

Location (longitude, latitude):	50°38′N, 6°59′E
Location (country, next city or village):	Germany, Klein Altendorf south of Bonn
Soil order and type (FAO classification):	Haplic Luvisol
Soil order and type (local classification):	Parabraunerde
Parent material:	Würmian loess
Mean annual temperature:	8.9°C
Annual rainfall:	625 mm
Vegetation and land use:	Test area for fruit production, 1956–1981 apples, 1981–1982 cherries
Site description:	177.5 m asl, plane
Date of sampling:	1982
Date of measurement:	1984
Collector:	Becker-Heidmann

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Submitter:	Becker-Heidmann
Submitter's comment:	See literature references
Lab comment:	--
Literature references:	Becker-Heidmann (1989); Scharpenseel and Becker-Heidmann (1994b)

Description of the Profile at Klein Altendorf Experimental Station

Depth (cm)	Horizon	Description
0–14	Ap1	Light yellowish brown (10YR 6/4), loamy silt, frequent roots
14–24	Ap2	Very frequent fine roots, loamy silt
24–40	ApAl	Clay eluviated, light yellowish brown (10YR 6/4), loamy silt, few roots
40–54	Al1	Clay eluviated, very pale brown (10YR 7/4), loamy silt, very few roots
54–68	Al2	Very pale brown (10YR 7/4), loamy silt
68–78	Bt1	Clay enriched, brownish yellow (10YR 6/6), loamy silt, no roots
78–92+	Bt2	Bright yellowish brown (10YR 6/6), loamy silt

TABLE 6. Klein Altendorf

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1810	0–2	6.5	0.70	−25.0	87.25 ± 0.66	1090 ± 60
HAM-1811	2–4	6.6	0.82	−25.2	86.61 ± 0.66	1150 ± 60
HAM-1812	4–6	6.4	0.70	−25.0	89.04 ± 0.67	930 ± 60
HAM-1813	6–8	6.2	0.87	−25.7	85.77 ± 0.66	1220 ± 60
HAM-1814	8–10	6.0	0.88	−24.9	88.40 ± 0.66	990 ± 60
HAM-1815	10–12	5.9	0.97	−25.0	88.72 ± 0.66	960 ± 60
HAM-1816	12–14	5.8	1.00	−25.9	89.02 ± 0.84	920 ± 80
HAM-1817	14–16	5.8	1.11	−25.1	94.35 ± 0.69	470 ± 60
HAM-1818	16–18	6.0	1.01	−24.9	87.49 ± 0.66	1080 ± 60
HAM-1819	18–20	6.2	1.19	−25.7	95.23 ± 0.62	380 ± 50
HAM-1820	20–22	6.1	1.16	−25.7	96.43 ± 0.67	280 ± 60
HAM-1821	22–24	6.0	1.17	−26.0	96.30 ± 0.67	290 ± 60
HAM-1822	24–26	6.0	0.92	−24.7	89.99 ± 0.65	850 ± 60
HAM-1823	26–28	6.1	0.81	−25.4	89.09 ± 0.63	920 ± 60
HAM-1824	28–30	6.2	0.74	−24.5	90.43 ± 0.65	820 ± 60
HAM-1825	30–32	6.3	0.58	−23.9	89.50 ± 0.64	910 ± 60
HAM-1826	32–34	6.3	0.44	−24.2	87.90 ± 0.62	1050 ± 60
HAM-1827	34–36	6.4	0.43	−24.1	89.98 ± 0.65	860 ± 60
HAM-1828	36–38	6.3	0.41	−24.1	87.49 ± 0.64	1090 ± 60
HAM-1829	38–40	6.1	0.38	−24.0	87.17 ± 0.63	1120 ± 60
HAM-1830	40–42	6.1	0.37	−24.6	84.50 ± 0.62	1360 ± 60
HAM-1831	42–44	6.3	0.38	−24.7	81.79 ± 0.62	1620 ± 60
HAM-1832	44–46	6.2	0.37	−23.5	79.80 ± 0.63	1840 ± 60
HAM-1833	46–48	6.3	0.36	−23.3	81.17 ± 0.61	1700 ± 60
HAM-1834	48–50	6.4	0.36	−24.3	80.51 ± 0.61	1750 ± 60
HAM-1835	50–52	6.5	0.36	−24.9	79.67 ± 0.61	1830 ± 60
HAM-1836	52–54	6.2	0.35	−23.8	78.80 ± 0.60	1930 ± 60
HAM-1837	54–56	6.2	0.36	−24.0	79.38 ± 0.75	1870 ± 80
HAM-1838	56–58	6.5	0.36	−23.8	74.43 ± 0.59	2390 ± 60
HAM-1839	58–60	6.5	0.36	−23.9	72.15 ± 0.57	2640 ± 60
HAM-1840	60–62	6.5	0.39	−24.1	68.25 ± 0.56	3080 ± 70

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TABLE 6. Klein Altendorf (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-1841	62–64	6.6	0.35	–23.9	67.36 ± 0.55	3190 ± 70
HAM-1842	64–66	6.3	0.35	–23.6	66.26 ± 0.55	3330 ± 70
HAM-1843	66–68	6.3	0.34	–23.8	65.00 ± 0.54	3480 ± 70
HAM-1844	68–70	6.6	0.38	–23.8	60.60 ± 0.53	4040 ± 70
HAM-1845	70–72	6.6	0.38	–24.2	59.93 ± 0.53	4130 ± 70
HAM-1846	72–74	6.4	0.39	–24.9	58.72 ± 0.53	4280 ± 70
HAM-1847	74–76	6.5	0.38	–24.9	59.30 ± 0.52	4200 ± 70
HAM-1848	76–78	6.6	0.39	–24.6	62.88 ± 0.56	3730 ± 70
HAM-1849	78–80	6.3	0.33	–24.5	64.05 ± 0.54	3590 ± 70
HAM-1850	80–82	6.4	0.31	–24.8	63.50 ± 0.54	3650 ± 70
HAM-1851	82–84	6.4	0.26	–24.6	60.48 ± 0.58	4050 ± 80
HAM-1852	84–86	6.6	0.44	–24.6	60.40 ± 0.53	4060 ± 70
HAM-1853	86–88	6.7	0.44	–24.6	60.55 ± 0.52	4040 ± 70
HAM-1854	88–90	6.6	0.35	–24.6	59.60 ± 0.52	4160 ± 70
HAM-1855	90–92	6.5	0.35	–24.7	62.33 ± 0.53	3800 ± 70

SAVARIT, PROFILE 1

Profile-Related Data

Location (longitude, latitude): 46°07′N, 0°50′W
Location (country, next city or village): France, Savarit, 60 km southwest of Niort in Poitou-Charentes province
Soil order and type (FAO classification): Rendzic Leptosol
Soil order and type (USDA classification): Lithic Rendoll, clayey skeletal mesic udic
Soil order and type (local classification): Groies
Parent material: Malm
Mean annual temperature: 15°C
Annual rainfall: 790 mm
Vegetation and land use: Wheat, sunflower, currently experimental site for studies on biological nitrogen fixation (BNF)
Site description: 24 m asl, slight slope, top of a toposequence
Date of sampling: 1990
Date of measurement: 1990
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

Both Savarit soil profiles contain large amounts of carbonate. Therefore, after measuring the pH of the total samples, carbon, $\delta^{13}C$ and ^{14}C activity were measured on the inorganic and organic fraction of the samples separately. The high carbon content, *ca.* 3–4% throughout the profile, supports good crop production. The amounts of organic and inorganic carbon are nearly equal except in the uppermost 2 cm. The $\delta^{13}C$ values of organic and inorganic carbon are very distinguishable, with *ca.* –22‰ for organic and –2‰ for inorganic C. We detected no substantial exchange between carbonate- and Humus-C. The humus is well decomposed throughout the whole profile, consistently with high pH. The ^{14}C activity of the organic carbon is rather low (<100 pmC), which reflects good decomposition of the humus. The ^{14}C activity of the carbonate is low, corresponding to a high ^{14}C age between 8000 and 11,000 BP. The reason for its great variation over the soil profile is not clear.

Literature references: Becker-Heidmann (1992); Drachenberg (1992)

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Description of the Profile at Savarit 1

Depth (cm)	Horizon	Description
0–14	Ap	Silty loam, dark brown, 10 YR 3/3, calcareous, gravels
14–20	R	Clayey silt, brown 10 YR 4/3, calcareous, gravels
20+	C	

TABLE 7. Savarit, Profile 1

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ activity	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ activity	$^{14}C_{in}$ age
HAM-3035	0–2	7.4	2.83	−22.3	96.10 ± 0.56	365 ± 50	3.81	−2.1	39.96 ± 0.40	7370 ± 80
HAM-3036	2–4	7.5	3.37	−20.8	95.35 ± 0.57	450 ± 50	3.52	−2.3	28.53 ± 0.36	10,080 ± 110
HAM-3037	4–6	7.4	3.22	−21.0	95.46 ± 0.56	435 ± 50	3.67	−2.4	23.21 ± 0.35	11,730 ± 130
HAM-3038	6–8	7.4	3.54	−22.2	95.02 ± 0.58	460 ± 50	3.40	−2.8	35.95 ± 0.38	8220 ± 90
HAM-3039	8–10	7.4	3.48	−21.6	95.06 ± 0.56	460 ± 50	3.26	−2.5	33.66 ± 0.52	8750 ± 130
HAM-3040	10–12	7.3	3.37	−21.7	95.58 ± 0.56	415 ± 50	3.45	−2.7	31.64 ± 0.37	9240 ± 100
HAM-3041	12–14	7.4	3.19	−21.0	95.39 ± 0.56	445 ± 50	3.64	−2.5	31.52 ± 0.37	9270 ± 100
HAM-3042	14–16	7.4	3.38	−20.1	93.59 ± 0.55	610 ± 50	3.59	−2.7	25.13 ± 0.35	11,090 ± 120
HAM-3043	16–18	7.4	2.99	−21.5	91.65 ± 0.55	760 ± 50	3.57	−2.3	24.67 ± 0.35	11,240 ± 120

SAVARIT, PROFILE 2

Profile-Related Data

Same as Profile 1, except:

Site description: Bottom of the toposequence

Submitter's comment:

The values of pH, organic carbon, $\delta^{13}C$ and ^{14}C are similar to those of Profile 1. The carbonate content is higher, and even more striking; the variation of the values is relatively high. The $\delta^{13}C$ value is generally *ca.* 2‰ higher. The $\delta^{13}C$ depth distribution of the organic carbon shows an unexpected rise from −20‰ to −16‰ at *ca.* 8 cm. The ^{14}C activity of the carbonate fraction changes several times between 20 and 30 pMC; the corresponding ^{14}C age differs between 10,000 and 15,000 BP within the lower half of the soil profile. The reason for this irregularity is not clear.

Description of Profile at Savarit 2

Depth (cm)	Horizon	Description
0–18	Ap	Silty loam, brown 10 YR 4/3, calcareous, many fine roots, gravels
18–30	R	Silty loam, brown 10 YR 4/3, calcareous, some fine roots, gravels
30+	C	

TABLE 8. Savarit, Profile 2

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ activity	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ activity	$^{14}C_{in}$ age
HAM-3044	0–2	7.4	3.00	−20.6	95.32 ± 0.57	455 ± 50	5.28	−1.9	16.83 ± 0.33	14,310 ± 170
HAM-3045	2–4	7.5	3.18	−19.5	94.24 ± 0.56	565 ± 50	5.09	−1.4	16.10 ± 0.33	14,670 ± 170
HAM-3046	4–6	7.4	3.36	−20.1	95.87 ± 0.56	420 ± 50	5.00	−1.5	20.11 ± 0.34	12,880 ± 150
HAM-3047	6–8	7.4	3.24	−19.8	96.71 ± 0.56	355 ± 50	5.22	−1.7	21.50 ± 0.34	12,350 ± 140
HAM-3048	8–10	7.5	3.33	−16.6	97.90 ± 0.57	305 ± 50	5.15	−1.1	26.31 ± 0.35	10,730 ± 120
HAM-3049	10–12	7.3	3.23	−19.6	93.15 ± 0.56	660 ± 50	5.02	−1.6	18.28 ± 0.33	13,650 ± 160
HAM-3050	12–14	7.3	3.41	−21.4	95.39 ± 0.56	440 ± 50	4.93	−1.5	26.77 ± 0.36	10,590 ± 120
HAM-3051	14–16	7.4	3.48	−20.3	92.57 ± 0.56	700 ± 50	5.10	−1.6	15.66 ± 0.32	14,890 ± 180

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TABLE 8. Savarit, Profile 2 (Continued)

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ activity	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ activity	$^{14}C_{in}$ age
HAM-3052	16–18	7.4	2.99	−20.6	97.58 ± 0.56	265 ± 50	5.54	−1.1	28.61 ± 0.36	10,050 ± 110
HAM-3053	18–20	7.5	2.36	−19.9	95.23 ± 0.56	475 ± 50	5.57	−0.8	19.29 ± 0.34	13,220 ± 150
HAM-3054	20–22	7.5	2.21	−17.7	93.45 ± 0.55	660 ± 50	5.61	−0.5	22.86 ± 0.34	11,850 ± 130
HAM-3055	22–24	7.5	1.94	−19.4	92.59 ± 0.55	710 ± 50	5.36	−0.7	20.84 ± 0.34	12,600 ± 140

AKKO

Profile-Related Data

Location (longitude, latitude): 32°54′N, 35°15′E
Location (country, next city or village): Israel, Akko
Soil order and type (USDA classification): Typic Pelloxerert, fine, mixed (calcareous), thermic
Soil order and type (local classification): Grumusol
Mean annual temperature: 19°C
Annual rainfall: 626 mm
Vegetation and land use: Noncultivated
Site description:

The profile was located on site GR-4 of the Western Galilee Experimental Farm in the coastal plain near Akko, in the north of Israel. The soil had been studied before by Yaalon and Kalmar (1972, 1978) regarding its pedoturbation by cracking and swelling processes.

Date of sampling: 1985
Date of measurement: 1986/1987
Collector: Dov Kalmar, Dan Yaalon
Submitter: Dov Kalmar
Lab comment:

This Vertisol has a pH close to 8 throughout the profile. Accordingly, the carbonate content is on average as high as the organic carbon content, almost exceeding the latter in the bottom of the soil, and only less in the A1 horizon. The $\delta^{13}C$ value of the organic matter corresponds to the C_3-type crops grown here, with −28‰ at the soil surface, and also the shift with depth of *ca.* 3‰ is in the expected range for terrestrial soils (*cf.* Becker-Heidmann 1989; Bertram 1986). The $\delta^{13}C$ value of the inorganic carbon *ca.* −13‰ is low compared to primary carbonate with 0‰. As in the other carbonate-containing profiles, an exchange between organic and inorganic matter has occurred within the whole profile. The shift, when related to the absolute $\delta^{13}C$ values of the organic fraction, is comparable. Therefore, the same mechanism can be assumed. The exchange is also obvious when comparing the ^{14}C activity values. The carbonate of this soil is assumed to belong to the original sediment from which the soil developed, *i.e.*, it should have a very low ^{14}C activity corresponding to a high ^{14}C age. Instead, it follows a depth curve similar to that of the ^{14}C activity of the organic carbon, at a lower level, ending up with a ^{14}C activity of *ca.* 20 pMC, corresponding to a ^{14}C age of 14,000 BP. The ^{14}C activities of the organic fraction as well as of the carbonate carbon fraction decrease distinctively with depth, and there is no discontinuity in the depth curve. So far, a pedoturbation, as expected for a Vertisol, could not be found.

Literature references: Becker-Heidmann (1990); Yaalon and Kalmar (1972)

Description of the Profile at Akko

Depth (cm)	Horizon	Description
0–15	A	Heavy clay, very dark grayish brown, very small carbonate nodules, many fine and medium roots
15–40	B1	Heavy clay, very dark grayish brown, very small carbonate nodules, many fine roots

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40–100	B21	Heavy clay, very dark grayish brown, very small carbonate nodules, many slickensides, very few fine roots
100–140	B22	Heavy clay, very dark grayish brown, very small carbonate nodules, many well-expressed slickensides, very few fine roots
140–187+	B23	Heavy clay, very dark grayish brown, some carbonate nodules, many slickensides, no roots

TABLE 9. Akko

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2501	0–2	7.4	2.04	−26.5	111.58 ± 0.87	Modern	0.17	−15.5	88.68 ± 0.70	970 ± 60
HAM-2502	2–4	7.6	1.39	−25.9	83.94 ± 0.67	1390 ± 60	0.24	−13.4	--	--
HAM-2503	4–6	7.7	1.13	−26.1	105.74 ± 0.77	Modern	0.04	−12.2	69.73 ± 0.77	2900 ± 100
HAM-2504	6–8	7.6	0.96	−24.7	106.44 ± 0.58	Modern	0.17	−15.6	65.45 ± 0.92	3410 ± 80
HAM-2505	8–10	7.5	0.72	−25.5	104.51 ± 0.76	Modern	0.30	−13.5	70.76 ± 0.49	2780 ± 60
HAM-2506	10–12	7.7	0.65	−24.6	87.63 ± 0.55	1070 ± 50	0.32	−12.4	66.22 ± 0.89	3310 ± 70
HAM-2507	12–15	7.7	0.67	−25.1	105.83 ± 0.63	Modern	0.51	−13.0	58.85 ± 0.89	4260 ± 80
HAM-2508	15–18	7.6	0.78	−24.7	96.49 ± 1.02	290 ± 90	0.20	−13.6	51.09 ± 0.61	5390 ± 70
HAM-2509	18–21	7.6	0.71	−25.2	96.83 ± 1.23	260 ± 100	0.16	−13.4	58.27 ± 1.56	4340 ± 150
HAM-2510	21–24	7.8	0.59	−24.2	97.92 ± 0.73	180 ± 60	0.32	−12.8	72.65 ± 0.58	2570 ± 60
HAM-2511	24–27	7.7	0.63	−24.2	96.49 ± 0.88	300 ± 70	0.26	−13.2	62.42 ± 0.90	3790 ± 80
HAM-2512	27–30	7.7	0.57	−24.4	84.92 ± 0.65	1320 ± 60	0.28	−13.7	60.69 ± 0.88	4010 ± 80
HAM-2513	30–33	8.0	0.57	−24.6	95.21 ± 0.72	400 ± 60	0.25	−12.7	51.78 ± 0.82	5290 ± 90
HAM-2514	33–36	7.9	0.60	−24.0	81.53 ± 5.19	1660 ± 510	0.24	−14.8	55.24 ± 0.90	4770 ± 90
HAM-2515	36–39	7.8	0.53	−23.3	84.34 ± 0.70	1400 ± 70	0.31	−11.5	54.65 ± 0.59	4850 ± 90
HAM-2516	39–42	7.8	0.51	−23.9	80.40 ± 0.73	1770 ± 70	0.23	−13.1	42.60 ± 0.78	6850 ± 100
HAM-2517	42–45	7.8	0.51	−23.6	79.40 ± 0.66	1880 ± 70	0.30	−13.3	45.84 ± 0.81	6270 ± 100
HAM-2518	45–48	7.9	0.41	−23.8	--	--	0.28	−14.7	60.26 ± 0.52	4070 ± 70
HAM-2519	48–51	7.9	0.55	−23.7	78.06 ± 0.65	2010 ± 70	0.12	−12.1	46.90 ± 0.68	6080 ± 80
HAM-2520	51–55	7.9	0.36	−24.2	68.45 ± 0.53	3060 ± 60	0.28	−13.1	58.35 ± 0.45	4330 ± 60
HAM-2521	55–59	7.9	0.40	−23.1	78.90 ± 0.94	1930 ± 100	0.24	−12.4	59.59 ± 0.66	4160 ± 90
HAM-2522	59–63	7.9	0.55	−24.7	77.88 ± 0.65	2010 ± 70	0.19	−13.3	59.13 ± 0.62	4220 ± 80
HAM-2523	63–67	7.5	0.41	−24.4	75.70 ± 0.65	2250 ± 70	0.25	−12.1	43.86 ± 1.34	6620 ± 170
HAM-2524	67–71	7.9	0.37	−23.7	76.83 ± 0.67	2140 ± 70	0.34	−14.1	--	--
HAM-2525	71–75	7.8	0.39	−22.4	70.31 ± 0.66	2870 ± 80	0.35	−12.3	44.91 ± 0.84	6430 ± 100
HAM-2526	75–79	8.0	0.30	−24.4	69.98 ± 0.61	2880 ± 70	0.50	−13.4	54.43 ± 0.54	4890 ± 80
HAM-2527	79–83	7.9	0.37	−24.5	69.22 ± 0.61	2960 ± 70	0.30	−13.1	52.52 ± 0.60	5170 ± 90
HAM-2528	83–87	7.9	0.31	−23.9	72.65 ± 0.53	2580 ± 60	0.43	−13.1	55.18 ± 0.60	4780 ± 90
HAM-2529	87–91	8.0	0.33	−24.5	67.08 ± 0.62	3220 ± 80	0.41	−12.9	52.07 ± 0.59	5240 ± 90
HAM-2530	91–95	8.0	0.29	−23.1	70.16 ± 0.80	2880 ± 90	0.47	−13.1	51.57 ± 0.43	5320 ± 70
HAM-2531	95–99	8.0	0.33	−24.3	66.14 ± 0.68	3330 ± 80	0.33	−13.1	49.07 ± 0.82	5720 ± 90
HAM-2532	99–103	8.0	0.38	−23.1	61.18 ± 2.14	3980 ± 280	0.28	−13.3	51.24 ± 0.45	5370 ± 70
HAM-2533	103–107	7.8	0.38	−24.1	62.37 ± 0.87	3810 ± 110	0.33	−12.3	50.79 ± 1.14	5440 ± 180
HAM-2534	107–111	7.8	0.28	−22.3	63.30 ± 0.67	3720 ± 90	0.26	−12.0	50.70 ± 0.63	5460 ± 100
HAM-2535	111–115	7.9	0.36	−23.7	70.83 ± 0.67	2790 ± 80	0.37	−13.0	48.71 ± 0.55	5780 ± 90
HAM-2536	115–119	7.7	0.39	−23.3	63.99 ± 0.46	3610 ± 60	0.27	−12.7	52.43 ± 0.64	5190 ± 100
HAM-2537	119–123	8.2	0.31	−22.8	60.31 ± 0.50	4100 ± 90	0.31	−12.0	47.88 ± 0.58	5920 ± 100
HAM-2538	123–127	7.9	0.41	−21.8	61.37 ± 0.56	3970 ± 70	0.25	−12.3	49.16 ± 0.54	5700 ± 90
HAM-2539	127–131	8.2	0.28	−22.9	57.68 ± 0.58	4450 ± 80	0.40	−11.5	48.53 ± 0.57	5810 ± 90
HAM-2540	131–135	7.9	0.35	−21.8	56.38 ± 0.61	4660 ± 90	0.45	−13.1	45.29 ± 0.41	6360 ± 70
HAM-2541	135–139	8.0	0.34	−23.2	53.95 ± 0.64	4990 ± 100	0.43	−12.8	45.00 ± 0.61	6410 ± 110
HAM-2542	139–143	8.1	0.33	−23.2	59.52 ± 0.55	4200 ± 80	0.46	−11.9	31.97 ± 0.80	9160 ± 140
HAM-2543	143–147	8.2	0.27	−23.1	55.97 ± 0.56	4690 ± 80	0.59	−11.1	28.98 ± 0.60	9950 ± 110
HAM-2544	147–151	8.2	0.24	−23.0	59.40 ± 0.47	4220 ± 60	0.50	−12.1	30.28 ± 0.69	9600 ± 80
HAM-2545	157–163	8.1	0.32	−23.1	47.61 ± 0.53	5990 ± 90	0.49	−11.5	18.91 ± 0.64	13,380 ± 180
HAM-2546	172–176	8.2	0.21	−22.8	42.24 ± 0.40	6960 ± 80	0.58	−11.4	19.79 ± 0.48	13,010 ± 200
HAM-2547	183–187	8.1	0.15	−22.2	41.66 ± 0.50	7080 ± 100	0.64	−11.4	18.41 ± 0.34	13,590 ± 150

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Bulk density (Yaalon and Kalmar 1972)

Depth (cm)	Bulk density(g cm^{-3})
0–15	1.25
15–100	1.31
100–140	1.36
140–185	1.37

QEDMA

Profile-Related Data

Location (longitude, latitude): 31°41′N, 34°47′E
Location (country, next city or village): Israel, Qedma near Qiriat Gat southwest of Jerusalem
Soil order and type (FAO classification): Calcic Vertisol
Soil order and type (USDA classification): Typic Pelloxerert, fine, mixed (calcareous), thermic
Soil order and type (local classification): Grumusol
Parent material: Aeolian clay
Mean annual temperature: 19°C
Annual rainfall: 465 mm
Vegetation and land use: Fallow, before cotton (irrigated)
Site description: 100 m asl

The profile was located at a cement mining pit. Therefore, the soil was sampled down to 9 m, giving the chance to study the differences of soil and sediment.

Date of sampling: 1986
Date of measurement: 1987/1988
Collectors: Becker-Heidmann, Scharpenseel, Yaalon
Submitter: Becker-Heidmann, Scharpenseel, Yaalon
Submitter's comment:

The pH is nearly the same in value and depth curve as in the Akko profile. The organic carbon content is generally extremely low (< 0.5%), whereas the carbonate carbon content is comparably high, 2.5% in the topsoil and between 0.5 and 1% in layer C. The lowest sediment layer, Cca, again has 1.5%. Although the $\delta^{13}C$ of the inorganic carbon is nearly homogeneous through the profile, the $\delta^{13}C$ value of the organic carbon shows a great variability and an increasing tendency down to 140 cm. It can be concluded that decomposition processes, increasing the $\delta^{13}C$ value of the soil remaining residue fraction, are considerable, but that pedoturbation has disturbed the expected linearily increasing depth curve. The inorganic carbon is obviously not influenced by the actual $\delta^{13}C$ of the organic matter. The constant $\delta^{13}C$ value of −10‰ throughout the profile indicates that the exchange process between organic and inorganic carbon occurred a long time ago. This interpretation is supported by the ^{14}C activity of the inorganic carbon, which is very low, *ca.* 40%, corresponding to a ^{14}C age of nearly 8000 BP. Only the topmost surface layers seem to take part in a recent exchange process. The ^{14}C activity depth distribution curves of both organic and inorganic carbon show only a very slight decrease down to a depth of 90 cm, which is the maximum depth of observed cracks, and decrease more steeply in the lower part of the profile. In this soil, in contrast to the Akko soil, a distinctive self-mulching effect can therefore be recognized from the ^{14}C activity curves. The increase in $\delta^{13}C$ can be explained by the comparison of transport and mulching speeds: Peloturbation lasts 2000 yr and is slower than organic carbon transport (Yaalon, personal communication).

Literature references: Becker-Heidmann (1990)

Description of the Profile at Qedma:

Depth (cm)	Horizon	Description
0–8	A11	Heavy clay, very dark grayish brown
8–26	A12	Heavy clay, very dark grayish brown

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26–56	B1	Dry and heavy clay, carbonate nodules at 52–56 cm
56–112	B21	Heavy clay, very dark grayish brown many well expressed slickensides, polyeder, Mn concretions, cracks down to 100–112 cm
112–140	B22	Heavy clay, very dark grayish brown, many slickensides
140–250	B23	Slickensides, carbonate nodules at 250 cm
250–750	C	Bedrock
750–900	Cca	Calcic horizon, bedrock

TABLE 10. Qedma

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2552	0–2	8.1	0.35	–25.0	93.99 ± 0.49	495 ± 40	2.30	–8.9	22.31 ± 0.29	12,050 ± 100
HAM-2553	2–4	8.1	0.31	–20.7	75.50 ± 1.31	2330 ± 140	2.58	–9.4	41.03 ± 0.55	7160 ± 110
HAM-2554	4–6	8.0	0.29	–20.2	106.24 ± 0.61	Modern	2.62	–11.9	37.64 ± 0.32	7850 ± 70
HAM-2555	6–8	8.1	0.30	–19.6	106.09 ± 0.52	Modern	2.56	--	35.16 ± 0.32	8400 ± 70
HAM-2556	8–10	8.2	0.36	–21.2	94.08 ± 0.78	550 ± 70	2.61	–9.8	33.57 ± 0.78	8770 ± 120
HAM-2557	10–12	8.2	0.37	–20.3	110.32 ± 0.61	Modern	2.26	–9.7	43.21 ± 0.34	6740 ± 60
HAM-2558	12–14	8.1	0.37	–23.8	105.41 ± 0.52	Modern	2.68	–9.8	36.05 ± 0.32	8200 ± 70
HAM-2559	14–16	8.0	0.38	–19.6	101.64 ± 0.77	Modern	2.46	–9.6	35.55 ± 0.32	8310 ± 70
HAM-2560	16–18	8.1	0.41	–19.8	101.64 ± 0.51	Modern	2.37	–9.7	36.40 ± 0.32	8120 ± 70
HAM-2561	18–20	8.0	0.40	–18.9	102.99 ± 0.60	Modern	2.36	–9.9	33.63 ± 0.38	8750 ± 90
HAM-2562	20–22	8.0	0.36	–23.5	103.77 ± 0.59	Modern	2.47	–9.7	38.53 ± 0.40	7660 ± 80
HAM-2563	22–24	8.1	0.31	–21.2	103.44 ± 0.58	Modern	2.50	–9.5	46.21 ± 0.59	6200 ± 100
HAM-2564	24–26	8.0	0.34	–21.8	103.82 ± 0.61	Modern	2.38	–8.8	40.32 ± 0.40	7300 ± 80
HAM-2565	26–28	7.9	0.32	–22.2	80.31 ± 0.48	1805 ± 45	2.16	–9.4	38.52 ± 0.33	7660 ± 70
HAM-2566	28–30	7.8	0.32	–21.1	100.26 ± 0.83	Modern	2.37	–9.6	42.59 ± 0.56	6860 ± 110
HAM-2567	30–32	8.2	0.31	–22.7	90.37 ± 0.66	850 ± 60	2.22	–9.7	38.95 ± 0.33	7570 ± 70
HAM-2568	32–36	8.0	0.31	–18.7	90.31 ± 0.57	920 ± 50	2.39	–9.4	37.71 ± 0.40	7830 ± 80
HAM-2569	36–40	7.8	0.30	–17.6	92.88 ± 0.61	710 ± 50	2.46	–9.9	37.67 ± 0.84	7840 ± 170
HAM-2570	40–44	7.8	0.29	–16.6	86.43 ± 0.47	1310 ± 40	2.39	–9.9	36.82 ± 0.39	8030 ± 80
HAM-2571	44–48	8.0	0.30	–19.3	89.35 ± 0.47	995 ± 40	2.56	–9.7	35.83 ± 0.39	8240 ± 80
HAM-2572	48–52	8.2	0.27	–22.4	92.29 ± 0.48	685 ± 40	2.54	–10.3	36.80 ± 0.51	8030 ± 110
HAM-2573	52–56	8.1	0.20	–18.0	86.24 ± 0.65	1300 ± 60	2.68	–9.8	37.07 ± 0.72	7970 ± 150
HAM-2574	56–60	7.9	0.27	–16.4	--	--	2.47	–9.6	35.97 ± 0.32	8210 ± 70
HAM-2575	60–64	8.1	0.28	–16.3	83.54 ± 0.52	1585 ± 50	2.42	–9.4	34.22 ± 0.32	8610 ± 70
HAM-2576	64–68	8.1	0.15	–16.8	79.04 ± 0.73	2020 ± 70	2.60	–9.6	31.45 ± 0.43	9290 ± 110
HAM-2577	68–72	8.3	0.24	–16.0	81.84 ± 0.67	1760 ± 70	2.78	–9.5	29.73 ± 0.81	9740 ± 150
HAM-2578	72–76	8.2	0.25	–17.3	81.78 ± 0.52	1740 ± 50	2.43	–9.5	37.71 ± 0.38	7830 ± 80
HAM-2579	76–80	8.3	0.25	–16.4	79.72 ± 0.50	1960 ± 50	2.51	–9.6	30.36 ± 0.31	9580 ± 80
HAM-2580	80–84	8.3	0.18	–17.1	77.91 ± 0.69	2130 ± 70	2.61	–9.7	34.13 ± 0.79	8640 ± 120
HAM-2581	84–88	8.1	0.22	–14.8	78.34 ± 0.62	2130 ± 60	2.48	–9.5	30.28 ± 0.37	9600 ± 100
HAM-2582	88–92	8.3	0.16	–16.0	77.32 ± 0.68	2210 ± 70	2.51	–9.5	30.40 ± 0.54	9570 ± 140
HAM-2583	92–96	8.3	0.20	–15.6	77.34 ± 0.72	2220 ± 70	2.52	–9.3	27.08 ± 0.50	10,490 ± 150
HAM-2584	96–100	8.3	0.23	–18.0	74.12 ± 0.46	2520 ± 50	2.44	–9.5	--	--
HAM-2585	100–104	8.4	0.17	–20.3	71.32 ± 0.63	2790 ± 70	2.58	–8.9	--	--
HAM-2586	104–108	8.5	0.23	–18.0	65.78 ± 0.47	3480 ± 60	2.54	–8.7	20.58 ± 0.34	12,700 ± 130
HAM-2587	108–112	8.5	0.20	–13.0	56.45 ± 1.75	4790 ± 240	2.56	–8.8	17.16 ± 0.47	14,160 ± 230
HAM-2588	112–116	8.2	0.19	–15.6	43.09 ± 0.56	6920 ± 110	2.63	–8.7	15.70 ± 0.32	14,870 ± 160
HAM-2589	116–120	8.4	0.14	–14.2	44.64 ± 0.57	6650 ± 100	2.45	–9.1	18.33 ± 0.28	13,630 ± 120
HAM-2590	120–124	8.4	0.18	–13.8	51.25 ± 0.65	5550 ± 100	2.66	–8.6	12.14 ± 0.45	16,940 ± 290
HAM-2591	124–128	8.3	0.16	–14.3	41.87 ± 1.29	7170 ± 250	2.49	–9.5	10.96 ± 0.48	17,760 ± 380
HAM-2592	128–132	8.5	0.11	–12.1	37.85 ± 0.39	8010 ± 80	2.22	–7.6	6.32 ± 0.57	22,180 ± 450
HAM-2593	132–136	8.5	0.18	–13.5	43.82 ± 0.94	6810 ± 110	2.23	–8.6	7.89 ± 0.39	20,400 ± 280
HAM-2594	136–140	8.3	0.15	–12.0	44.13 ± 1.59	6780 ± 290	2.20	–9.1	24.33 ± 0.29	11,350 ± 90
HAM-2595	140–144	8.3	0.18	–12.0	21.95 ± 0.35	12,390 ± 120	2.18	–8.4	5.31 ± 0.97	23,580 ± 1370
HAM-2596	144–148	8.3	0.17	–12.6	39.80 ± 0.47	7600 ± 90	1.93	–8.9	7.30 ± 0.43	21,020 ± 500
HAM-2597	148–152	8.3	0.15	–13.4	17.07 ± 0.33	14,390 ± 150	2.01	–8.6	5.87 ± 0.29	22,780 ± 390
HAM-2598	152–156	8.3	0.20	–14.3	--	--	1.79	–7.9	6.51 ± 0.36	21,940 ± 430
HAM-2599	156–160	8.4	0.16	–13.2	34.59 ± 0.49	8720 ± 110	1.82	–8.6	6.09 ± 0.42	22,480 ± 550
HAM-2600	160–164	--	0.23	–13.2	21.49 ± 3.00	12,540 ± 1030	1.82	–8.7	5.26 ± 0.55	23,660 ± 610

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TABLE 10. Qedma (Continued)

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2601	164–168	8.3	0.26	−13.0	26.58 ± 0.35	10,840 ± 110	1.77	−8.8	4.25 ± 0.29	25,370 ± 540
HAM-2602	168–172	8.4	0.36	−13.4	33.14 ± 0.52	9060 ± 130	1.67	−9.2	5.61 ± 0.30	23,140 ± 430
HAM-2603	172–176	8.4	0.09	−14.1	36.48 ± 1.01	8280 ± 220	1.90	−9.8	6.72 ± 0.43	21,690 ± 530
HAM-2604	176–180	8.4	0.14	−13.0	28.79 ± 0.43	10,200 ± 120	1.55	−9.1	6.75 ± 0.25	21,650 ± 290
HAM-2605	180–184	8.3	0.10	−14.0	25.79 ± 0.48	11,060 ± 150	1.97	−8.8	4.09 ± 0.45	25,680 ± 820
HAM-2606	184–188	8.4	0.12	−13.7	23.31 ± 0.49	11,888 ± 170	1.93	−8.8	--	--
HAM-2607	188–192	8.4	0.21	−13.9	23.63 ± 0.49	11,770 ± 170	1.76	−9.6	3.46 ± 0.42	27,020 ± 1080
HAM-2608	192–196	8.3	0.18	−14.0	22.68 ± 0.34	12,100 ± 120	1.64	−10.4	3.71 ± 0.42	26,460 ± 980
HAM-2609	196–200	8.4	0.26	−15.0	18.85 ± 0.47	13,570 ± 200	1.45	−10.0	3.06 ± 0.42	28,010 ± 1100
HAM-2610	200–210	8.2	0.21	−16.1	21.68 ± 0.28	12,420 ± 100	1.56	−10.2	1.76 ± 0.23	32,450 ± 1040
HAM-2611	210–220	8.3	0.23	−16.3	--	--	1.47	−11.3	--	--
HAM-2612	220–230	8.4	0.15	−15.3	21.54 ± 0.82	12,490 ± 300	1.48	−11.1	--	--
HAM-2613	230–240	8.3	0.08	−14.9	21.20 ± 0.71	12,420 ± 270	1.58	−10.8	--	--
HAM-2614	240–250	8.3	0.17	−13.8	30.89 ± 0.73	9620 ± 190	1.84	−10.4	1.77 ± 0.41	32,410 ± 1920

The texture is characterized by 21.7% sand, 25.4% silt and 52.9% clay (Andresen 1987). The clay fraction consists mostly of montmorillonite (*ca.* 57%), kaolinite (*ca.* 21%) and illite (*ca.* 13%), besides 3% each of calcite, free oxides and quartz (Gal *et al.* 1974).

PATANCHERU, PROFILE P

Profile-Related Data

Location (longitude, latitude): 17°35′N, 78°17′E
Location (country, next city or village): India, Patancheru near Hyderabad (ICRISAT)
Soil order and type (FAO classification): Pellic Vertisol
Soil order and type (USDA classification): Typic Pellustert, very fine, montmorillonitic, calcareous, isohyperthermic
Soil order and type (local classification): Kasireddipalli Series
Parent material: Basaltic alluvium
Mean annual temperature: 25.8°C
Annual rainfall: 760 mm
Vegetation and land use: Sorghum, pulses, safflower
Site description: 540 m asl

The profile is on the ICRISAT farm, *ca.* 500 m southeast of the Rhodustalf profile. Like this profile, it had been prepared for the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT). A comparable site nearby was later used within the decomposition studies with ^{14}C labeled groundnut straw by Singer (1993). The vertisols are very homogeneous over the ICRISAT farm area.

Date of sampling: 1983
Date of measurement: 1988/1989
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The Vertisol differs from the Alfisol in some ways; it contains more clay and silt, but has no argillic horizon. The pH is 0.5–2 higher, because $CaCO_3$ content is about as high as the organic carbon content in the topsoil and even higher in the subsoil. Inorganic carbon is unhomogeneously distributed, increasing slightly from the top to the AC–C boundary and decreasing in horizon C with depth. Organic C decreases only slightly in the Ap, remains constant *ca.* 0.4% from A1 through A4, and decreases in AC down to 0.2% in C. With ^{14}C activity generally below 80% NBS, there is very little recent carbon in the soil. As usual, the ^{14}C activity decreases in Ap and below A14, reaching values of 40% comparable to the Alfisol. The $\delta^{13}C$ value of organic

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carbon is higher than expected for the C_3 plants grown in this soil, and the $\delta^{13}C$ value of the carbonate is lower than primary (marine) carbonate. Therefore, an exchange of organic and inorganic carbon in the soil via HCO_3^- in solution/dissolution processes is most probable. The decrease of the ^{14}C activity and the increase of ^{14}C age, respectively, of organic carbon is generally very low, noteworthy only in the top 10 cm as an indicator of decomposition, and below 90 cm, which corresponds to the maximum depth of cracks due to the self-mulching effect. The typical swelling and shrinking cracks as well as the slickensides in the Vertisol were found down to a depth of 60–90 cm, corresponding to a constant ^{14}C age, while the ^{14}C age rises below 90 cm depth. The increase of the $\delta^{13}C$ value of the inorganic carbon to –2‰ within the AC means that it consists mainly of primary carbonate here, not influenced by biogenic processes.

Comment on both the Alfisol (R) and the Vertisol (P) profile:

The results of the two ICRISAT soils, concerning decomposition and fixation of organic matter, correspond not only to the abovementioned results of decomposition experiments by Singer (1993), but also to biomass determinations (organic C, Chloroform and fumigize method) by Sahrawat (personal communication). He found more biomass in the Alfisol than in the Vertisol, *i.e.*, the decomposition is more intensive in the Alfisol than in the Vertisol.

Literature references: Becker-Heidmann (1990); Murthy (1982)

Description of Profile P at Patancheru

Depth (cm)	Horizon	Description
0–20	Ap	Very dark grayish brown (10YR 3/2), common roots, lime
20–40	A12	Very dark grayish brown (10YR 3/2), common roots, lime
40–60	A13	Very dark gray (10YR 3/1), very few roots, lime concretions
60–90	A14	Very dark gray (10YR 3/1), very few roots, lime concretions
90–130	AC	Very dark gray (10YR 3/1), darkbrown (10YR 3/3) mottles
130–180+	C	Yellowish to olive brown (2.5Y 5/4), basaltic alluvium

TABLE 11. Patancheru, Profile P

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2054	0–2	7.4	0.53	–15.5	81.81 ± 0.53	1615 ± 50	0.45	–6.7	67.86 ± 0.65	3110 ± 80
HAM-2055	2–4	7.4	0.57	–15.2	70.30 ± 0.53	2830 ± 60	0.38	–7.5	70.50 ± 0.66	2810 ± 80
HAM-2056	4–6	7.4	0.52	–14.9	73.57 ± 0.56	2470 ± 60	0.45	–7.0	68.52 ± 0.66	3040 ± 80
HAM-2057	6–8	7.4	0.46	–14.8	74.10 ± 0.50	2410 ± 50	0.32	–6.7	67.50 ± 0.65	3160 ± 80
HAM-2058	8–10	7.4	0.50	–14.9	73.64 ± 0.50	2460 ± 60	0.48	–6.7	66.38 ± 0.64	3290 ± 80
HAM-2059	10–12	7.4	0.52	–14.3	71.86 ± 0.50	2650 ± 50	0.37	–6.4	64.80 ± 1.15	3490 ± 140
HAM-2060	12–14	7.4	0.44	–14.7	72.62 ± 0.50	2570 ± 60	0.42	–6.8	--	--
HAM-2061	14–16	7.4	0.53	–14.7	71.72 ± 0.51	2670 ± 50	0.46	–6.9	64.35 ± 0.64	3540 ± 80
HAM-2062	16–18	7.4	0.43	–14.8	72.13 ± 0.51	2620 ± 60	0.53	–7.0	64.69 ± 0.64	3500 ± 80
HAM-2063	18–20	7.4	0.44	–14.8	63.08 ± 0.47	3700 ± 60	0.58	–6.9	70.94 ± 0.70	2760 ± 80
HAM-2064	20–22	7.4	0.45	–14.8	70.34 ± 0.49	2830 ± 60	0.54	–7.2	65.13 ± 0.63	3440 ± 80
HAM-2065	22–24	7.4	0.46	–14.9	73.50 ± 0.50	2470 ± 60	0.35	–7.4	45.55 ± 0.61	6320 ± 110
HAM-2066	24–26	7.4	0.45	–14.6	32.20 ± 0.38	9100 ± 90	0.50	–6.9	64.04 ± 0.51	3580 ± 60
HAM-2067	26–28	7.5	0.47	–14.6	68.59 ± 0.49	3030 ± 60	0.45	–7.3	64.90 ± 0.48	3470 ± 60
HAM-2068	28–30	7.5	0.46	–14.6	68.13 ± 0.49	3080 ± 60	0.51	–6.7	63.01 ± 0.69	3710 ± 90
HAM-2069	30–32	7.5	0.46	–14.4	69.88 ± 0.49	2880 ± 60	0.42	–7.0	63.88 ± 0.63	3600 ± 80
HAM-2070	32–34	7.5	0.46	–14.8	64.70 ± 0.47	3500 ± 60	0.34	–7.4	64.38 ± 0.63	3540 ± 80
HAM-2071	34–36	7.4	0.47	–14.6	68.85 ± 0.49	3000 ± 60	0.42	–6.9	64.42 ± 0.65	3530 ± 80
HAM-2072	36–38	7.6	0.44	–14.5	74.24 ± 1.08	2390 ± 120	0.50	–6.8	61.09 ± 0.46	3960 ± 60
HAM-2073	38–40	7.6	0.48	–14.5	71.45 ± 0.50	2700 ± 60	0.34	–7.2	62.32 ± 0.63	3800 ± 80
HAM-2074	40–42	7.6	0.46	–14.4	75.49 ± 0.51	2260 ± 50	0.48	–6.5	60.79 ± 0.46	4000 ± 60
HAM-2075	42–44	7.6	0.48	–14.5	73.13 ± 0.60	2510 ± 70	0.38	–6.8	45.47 ± 0.70	6330 ± 120
HAM-2076	44–46	7.6	0.48	–14.7	75.56 ± 0.68	2250 ± 70	0.46	–6.6	59.66 ± 0.62	4150 ± 80
HAM-2077	46–48	7.6	0.48	–14.5	68.33 ± 0.65	3060 ± 80	0.50	–6.8	63.10 ± 0.63	3700 ± 80

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TABLE 11. Patancheru, Profile P (Continued)

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2078	48–50	7.6	0.48	−14.5	74.30 ± 0.48	2390 ± 50	0.44	−6.7	61.39 ± 0.62	3920 ± 80
HAM-2079	50–52	7.7	0.46	−14.4	28.47 ± 0.50	10,090 ± 140	0.36	−6.9	59.51 ± 0.61	4170 ± 80
HAM-2080	52–54	7.7	0.44	−14.6	68.24 ± 1.26	3070 ± 150	0.41	−6.9	10.23 ± 0.46	18,310 ± 360
HAM-2081	54–56	7.7	0.46	−14.4	77.24 ± 0.69	2070 ± 70	0.51	−7.0	54.86 ± 0.60	4820 ± 90
HAM-2082	56–58	7.7	0.42	−14.7	81.61 ± 0.61	1630 ± 60	0.55	−6.9	58.33 ± 0.62	4330 ± 90
HAM-2083	58–60	7.7	0.43	−14.3	--	--	0.61	−7.7	--	--
HAM-2084	60–62	7.7	0.46	−14.9	83.54 ± 0.61	1440 ± 60	0.43	−7.4	61.64 ± 0.63	3890 ± 80
HAM-2085	62–64	7.8	0.47	−14.3	76.47 ± 0.95	2160 ± 100	0.52	−6.9	60.14 ± 0.63	4080 ± 80
HAM-2086	64–66	7.8	0.46	−14.3	71.33 ± 0.62	2710 ± 70	0.37	−6.9	57.69 ± 0.61	4420 ± 90
HAM-2087	66–68	7.7	0.46	−14.2	75.82 ± 2.37	2220 ± 250	0.54	−6.8	23.79 ± 0.48	11,530 ± 160
HAM-2088	68–70	7.7	0.45	−14.3	57.40 ± 0.62	4460 ± 90	0.57	−6.7	61.88 ± 0.63	3860 ± 80
HAM-2089	70–72	7.7	0.42	−14.3	30.85 ± 0.52	9450 ± 140	0.62	−6.7	48.47 ± 0.58	5820 ± 100
HAM-2090	72–74	7.8	0.44	−14.2	68.68 ± 0.65	3020 ± 80	0.61	−6.5	59.16 ± 0.62	4220 ± 80
HAM-2091	74–76	7.9	0.46	−14.4	67.73 ± 3.01	3130 ± 360	0.42	−6.7	57.22 ± 0.46	4480 ± 70
HAM-2092	76–78	7.8	0.48	−14.2	65.26 ± 0.50	3430 ± 60	0.40	−6.7	61.24 ± 0.77	3940 ± 100
HAM-2093	78–80	7.8	0.44	−14.2	70.69 ± 0.93	2790 ± 110	0.61	−6.3	58.11 ± 0.61	4360 ± 80
HAM-2094	80–82	7.8	0.47	−14.0	66.09 ± 0.64	3330 ± 80	0.48	−6.3	57.23 ± 0.62	4480 ± 90
HAM-2095	82–84	7.9	0.46	−14.7	75.97 ± 0.68	2210 ± 70	0.43	−7.0	60.39 ± 0.62	4050 ± 80
HAM-2096	84–86	7.9	0.46	−14.0	70.78 ± 0.66	2780 ± 80	0.63	−6.3	55.57 ± 0.61	4720 ± 90
HAM-2097	86–88	8.0	0.44	−14.2	47.85 ± 0.42	5920 ± 70	0.44	−6.4	23.35 ± 0.74	11,680 ± 250
HAM-2098	88–90	7.9	0.43	−14.2	67.08 ± 0.66	3210 ± 80	0.42	−6.8	55.92 ± 0.60	4670 ± 90
HAM-2099	90–92	7.9	0.44	−14.4	60.17 ± 0.53	4080 ± 70	0.42	−6.4	52.32 ± 3.68	5200 ± 560
HAM-2100	92–94	7.9	0.39	−14.2	66.97 ± 0.65	3220 ± 80	0.63	6.1	53.25 ± 0.60	5060 ± 90
HAM-2101	94–96	8.0	0.40	−14.0	63.48 ± 0.65	3650 ± 80	0.50	−5.8	48.39 ± 0.64	5830 ± 110
HAM-2102	96–98	8.0	0.38	−14.0	46.04 ± 0.57	6230 ± 100	0.59	5.7	50.48 ± 0.59	5490 ± 90
HAM-2103	98–100	7.9	0.46	−14.3	74.66 ± 0.67	2350 ± 70	0.40	−5.9	53.12 ± 0.60	5080 ± 90
HAM-2104	100–102	8.1	0.35	−14.0	60.49 ± 0.80	4040 ± 110	0.53	−5.0	47.87 ± 0.58	5920 ± 100
HAM-2105	102–104	8.0	0.35	−13.8	--	--	0.41	−5.4	--	--
HAM-2106	104–106	8.0	0.34	−13.4	60.74 ± 0.56	4000 ± 70	0.66	−4.5	42.91 ± 0.41	6800 ± 80
HAM-2107	106–108	8.0	0.34	−13.6	72.92 ± 0.83	2540 ± 90	0.51	−4.9	44.32 ± 0.57	6540 ± 100
HAM-2108	108–110	8.1	0.30	−13.3	36.61 ± 1.60	8070 ± 350	0.78	−4.2	38.72 ± 0.54	7620 ± 110
HAM-2109	110–112	8.0	0.33	−13.9	71.89 ± 0.67	2650 ± 70	0.56	−4.9	44.66 ± 0.57	6480 ± 100
HAM-2110	112–114	8.0	0.32	−13.8	68.01 ± 0.75	3100 ± 90	0.50	−5.2	41.70 ± 0.55	7030 ± 110
HAM-2111	114–116	8.0	0.27	−13.2	59.11 ± 0.83	4220 ± 110	0.50	−4.9	37.61 ± 0.54	7860 ± 120
HAM-2112	116–118	8.0	0.29	−14.5	47.68 ± 0.58	5950 ± 100	0.48	−4.7	2.83 ± 0.40	28,640 ± 1150
HAM-2113	118–120	8.0	0.27	−13.5	70.86 ± 0.86	2770 ± 100	0.50	−4.4	41.38 ± 0.55	7090 ± 110
HAM-2114	120–122	8.0	0.22	−13.2	63.48 ± 0.77	3650 ± 100	0.46	−4.6	38.99 ± 0.58	7570 ± 120
HAM-2115	122–124	8.1	0.20	−12.4	58.69 ± 0.46	4280 ± 60	0.68	−3.9	29.59 ± 0.51	9780 ± 140
HAM-2116	124–126	8.0	0.20	−13.3	71.37 ± 0.57	2710 ± 60	0.82	−3.4	40.91 ± 0.55	7180 ± 110
HAM-2117	126–128	8.1	0.22	−11.1	61.34 ± 0.86	3930 ± 110	1.04	−2.3	30.68 ± 0.51	9490 ± 130
HAM-2118	128–130	8.0	0.20	−11.3	51.09 ± 0.49	5390 ± 80	1.26	−2.2	22.36 ± 0.49	12,030 ± 180
HAM-2119	130–132	8.0	0.22	−13.0	68.19 ± 0.96	3080 ± 110	0.52	−3.5	33.92 ± 0.52	8690 ± 120
HAM-2120	132–134	8.1	0.18	−12.0	67.84 ± 0.90	3120 ± 110	0.61	−3.3	30.72 ± 0.50	9480 ± 130
HAM-2121	134–136	8.0	0.23	−12.8	40.05 ± 0.55	7350 ± 110	0.53	−3.6	28.27 ± 0.50	10,150 ± 140
HAM-2122	136–138	8.1	0.21	−12.6	63.23 ± 0.63	3680 ± 80	0.46	−3.5	27.42 ± 0.49	10,390 ± 140
HAM-2123	138–140	8.1	0.18	−12.4	66.13 ± 0.64	3320 ± 80	0.58	−3.3	30.10 ± 0.50	9640 ± 140
HAM-2124	140–142	8.0	0.21	−14.1	70.20 ± 0.87	2840 ± 100	0.50	−3.3	30.38 ± 0.51	9570 ± 140
HAM-2125	142–144	8.0	0.19	−11.5	--	--	0.95	−2.7	--	--
HAM-2126	144–146	8.1	0.18	−11.5	--	--	0.59	−3.1	29.54 ± 0.50	9800 ± 140
HAM-2127	146–148	8.1	0.19	−14.0	68.37 ± 0.67	3050 ± 80	0.67	−3.6	22.27 ± 0.47	12,070 ± 170
HAM-2128	148–150	8.0	0.21	−11.6	71.00 ± 1.00	2750 ± 110	0.77	−3.3	26.37 ± 0.49	10,710 ± 150
HAM-2129	150–152	8.1	0.21	−12.5	--	--	0.68	−2.4	20.39 ± 0.46	12,770 ± 180
HAM-2130	152–154	8.1	0.10	−11.4	58.97 ± 0.63	4240 ± 90	0.61	−2.5	19.10 ± 0.47	13,300 ± 200
HAM-2131	154–156	8.1	0.17	−11.4	65.34 ± 0.67	3420 ± 80	0.42	−3.0	28.37 ± 0.51	10,120 ± 140
HAM-2132	156–158	8.1	0.17	−11.2	65.77 ± 0.83	3370 ± 100	0.61	−2.6	21.54 ± 0.48	12,330 ± 180
HAM-2133	158–160	8.1	0.18	−12.4	60.56 ± 0.48	4030 ± 60	0.35	−3.4	20.06 ± 0.47	12,900 ± 190

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TABLE 11. Patancheru, Profile P (Continued)

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2134	160–162	8.1	0.17	−11.2	61.33 ± 0.66	3930 ± 90	0.33	−2.9	18.60 ± 0.47	13,510 ± 200
HAM-2135	162–164	8.1	0.12	−13.4	63.81 ± 0.65	3610 ± 80	0.42	−3.2	27.06 ± 0.50	10,500 ± 150
HAM-2136	164–166	8.1	0.16	−12.2	58.98 ± 0.90	4240 ± 120	0.36	−2.9	21.30 ± 0.47	12,420 ± 180
HAM-2137	166–168	8.1	0.15	−12.4	70.77 ± 1.06	2780 ± 120	0.41	−2.8	24.63 ± 0.49	11,260 ± 160
HAM-2138	168–170	8.1	0.17	−12.3	62.27 ± 0.89	3810 ± 120	0.17	−2.8	21.19 ± 0.48	12,460 ± 180
HAM-2139	170–172	8.0	0.19	−11.7	66.38 ± 0.91	3290 ± 110	0.35	−3.2	24.08 ± 0.48	11,440 ± 160
HAM-2140	172–174	8.1	0.15	−10.4	45.01 ± 0.64	6410 ± 110	0.62	−1.9	11.29 ± 0.44	17,520 ± 310
HAM-2141	174–176	8.0	0.16	−11.4	71.86 ± 0.96	2650 ± 110	0.60	−2.1	18.22 ± 0.47	13,680 ± 210
HAM-2142	176–178	8.1	0.16	−12.4	61.40 ± 0.70	3920 ± 90	0.37	−3.1	26.36 ± 0.49	10,710 ± 150
HAM-2143	178–180	8.0	0.19	−13.5	74.36 ± 0.71	2380 ± 80	0.50	−2.5	22.99 ± 0.48	11,810 ± 170
HAM-2144	180–182	8.1	0.15	−12.7	68.05 ± 1.06	3090 ± 130	0.30	−3.0	24.86 ± 0.48	11,180 ± 160
HAM-2145	182–184	8.0	0.16	−12.5	66.20 ± 1.02	3310 ± 120	0.40	−3.1	19.08 ± 0.46	13,310 ± 200
HAM-2146	184–186	8.1	0.15	−13.0	68.34 ± 0.95	3060 ± 110	0.29	−3.0	22.85 ± 0.48	11,860 ± 170

Bulk density: 1–1.2 g cm^{-3}, according to VERMA (1990), cited in Singer (1993).

PATANCHERU, PROFILE R

Profile-Related Data

Location (longitude, latitude):	17°35′N, 78°17′E
Location (country, next city or village):	India, Patancheru near Hyderabad (ICRISAT)
Soil order and type (FAO classification):	Chromic Luvisol
Soil order and type (USDA classification):	Udic Rhodustalf, clayey-skeletal, mixed, nonacid, iso-hyperthermic
Soil order and type (local classification):	Patancheru series
Parent material:	Weathered granite-gneiss
Mean annual temperature:	25.8°C
Annual rainfall:	760 mm
Vegetation and land use:	Rainfed Sorghum, maize, pulses
Site description:	540 m asl

The sampling area is located within the experimental farm of the Institute for Crops Research of the Semi-Arid Tropics (ICRISAT). The mean soil temperature is 1° higher than the air temperature. On both soils also decomposition experiments with ^{14}C labeled straw have been conducted (SINGER 1993). The chosen soil profile had been prepared for the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT).

Date of sampling:	1983
Date of measurement:	1984/1985
Collector:	Becker-Heidmann
Submitter:	Becker-Heidmann

Submitter's comment:

The C content of the Rhodustalf profile is very low. Only the topmost 2-cm layer and the bottom of the A12 horizon shows a maximum value of 0.8%, probably due to the recently settled grass vegetation. The site had been fallow since 1973, when ICRISAT was founded. The decomposition of SOM then probably led to the decrease of C content from the bottom to the top of the formerly plowed horizon. In the B horizon the C content is decreasing with depth in the normal manner. The increase beneath the B, in the Cv, is according to increasing $CaCO_3$ content.

Concerning the natural ^{14}C activity, four zones can be distinguished in the Patancheru profile. The ^{14}C activity is equal to the atmospheric bomb carbon level only in the topmost 2-cm layer. The ^{14}C activity is nearly

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uniform, as expected, but <120 pMC below the first 4 cm of the plowed horizon. This indicates low annual C input combined with rapid turnover, in accordance with the low C content of the soil. This interpretation is strongly supported by experiments of Singer (1993) who found 76% of incorporated ^{14}C-labeled groundnut straw decomposed in a nearby Alfisol after 30 weeks. The $\delta^{13}C$ value decreases from −15‰ to −18‰. $\delta^{13}C$ usually is not only more negative but also increases with depth in the topsoil, correlating with C_3 plants and the increasing decomposition stage of organic matter with depth (Stout, Goh and Rafter (1981); O'Brien and Stout (1978); Becker-Heidmann and Scharpenseel (1986)). The reason for a different curve in this profile is most probably a recent change in cultivation from pulses (C_3 plants) to sorghum (C_4), as could be clarified by measurements of $\delta^{13}C$ of the vegetation presently found there (Becker-Heidmann 1989, Table 5.1). Some of the fresh organic substances with higher $\delta^{13}C$ values move downwards and are added to the older organic matter, which originated in the C_3 crops. Below Ap and A1, $\delta^{13}C$ shows a normal pattern. From A12 to B21t horizons, the ^{14}C activity decreases continuously until it is *ca.* 60 pMC, corresponding to a rapidly decreasing rejuvenation by translocated carbon. Accordingly, increasing $\delta^{13}C$ shows a rise in more decomposed organic matter with depth. In the B22t horizon, then, the tendencies of both ^{14}C activity and $\delta^{13}C$ inflect coincidently with the beginning of the decline of the clay content. We also found the same effect in Alfisols from temperate zone forests, *e.g.*, at Wohldorf and Ohlendorf Forest (see above) (Becker-Heidmann and Scharpenseel 1986).

Because of the low precipitation at Patancheru, little young organic matter enters and moves downwards into the profile. But with decreasing amounts of clay and, consequently, of clay-complexated old organic matter, the influence of young organic matter grows with depth. Greenland (1971) and Theng (1979) found 98% of the carbon of tropical red soils (C content 1.7%) bound to clay minerals.

Literature references: Becker-Heidmann (1989); Murthy *et al.* (1982)

Description of Profile R at Patancheru

Depth (cm)	Horizon	Description
0–10	Ap	Yellowish red (5YR 5/6), many fine roots
10–20	A12	Reddish brown (5YR 4/4), few fine roots
20–30	B1	Reddish brown (2.5YR 4/4), few fine roots
30–48	B21t	Dark reddish brown (2.5YR 3/4), few fine roots
48–102	B22t	Dark reddish brown (2.5YR 3/4), very few roots
102–146	BC	Reddish (2.5YR 5/4) to yellowish brown (10YR 6/4), iron concretions
146–160+	C	Yellowish brown (10YR 6/4), weathered granite-gneiss

TABLE 12. Patancheru, Profile R

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age*
HAM-1975	0–2	6.7	0.72	−14.9	114.88 ± 0.71	Modern
HAM-1976	2–4	6.3	0.42	−16.2	101.16 ± 0.66	Modern
HAM-1977	4–6	6.6	0.45	−16.4	107.37 ± 0.67	Modern
HAM-1978	6–8	6.5	0.43	−16.8	105.48 ± 0.67	Modern
HAM-1979	8–10	6.4	0.48	−16.8	107.44 ± 0.68	Modern
HAM-1980	10–12	6.2	0.42	−17.3	104.38 ± 0.66	Modern
HAM-1981	12–14	6.0	0.44	−17.8	99.60 ± 0.64	150 ± 50
HAM-1982	14–16	5.9	0.56	−17.6	97.42 ± 0.63	330 ± 50
HAM-1983	16–18	5.8	0.59	−17.8	95.09 ± 0.62	520 ± 50
HAM-1984	18–20	5.8	0.65	−17.6	92.09 ± 0.61	780 ± 50
HAM-1985	20–22	5.7	0.60	−18.0	90.52 ± 0.61	910 ± 50
HAM-1986	22–24	5.8	0.67	−17.2	89.25 ± 0.60	1040 ± 50
HAM-1987	24–26	5.8	0.58	−17.3	88.94 ± 0.60	1070 ± 50
HAM-1988	26–28	5.8	0.55	−17.4	87.57 ± 0.60	1190 ± 60

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TABLE 12. Patancheru, Profile R (Continued)

Lab code	Depth (cm)	pH	C	δ^{13}C	^{14}C activity	^{14}C age*
HAM-1989	28–30	5.9	0.55	−16.9	86.81 ± 0.59	1270 ± 50
HAM-1990	30–32	5.9	0.52	−16.7	86.16 ± 0.59	1330 ± 60
HAM-1991	32–34	6.3	0.53	−16.9	83.74 ± 0.62	1560 ± 60
HAM-1992	34–36	5.9	0.50	−16.9	82.79 ± 0.58	1650 ± 60
HAM-1993	36–38	6.2	0.47	−16.1	78.71 ± 0.56	2070 ± 60
HAM-1994	38–40	5.9	0.48	−16.1	77.76 ± 0.56	2170 ± 60
HAM-1995	40–42	5.9	0.52	−15.2	77.37 ± 0.55	2220 ± 60
HAM-1996	42–44	5.8	0.46	−15.5	73.21 ± 0.55	2660 ± 60
HAM-1997	44–46	5.8	0.51	−15.5	69.79 ± 0.53	3040 ± 60
HAM-1998	46–48	5.7	0.53	−15.4	65.51 ± 0.52	3550 ± 60
HAM-1999	48–50	5.8	0.51	−15.4	65.54 ± 0.52	3550 ± 60
HAM-2000	50–52	5.7	0.45	−15.5	67.06 ± 0.52	3360 ± 60
HAM-2001	52–54	5.8	0.54	−15.3	71.06 ± 0.53	2900 ± 60
HAM-2002	54–56	5.7	0.33	−15.7	62.38 ± 0.51	3940 ± 70
HAM-2003	56–58	5.7	0.40	−15.2	67.52 ± 0.52	3310 ± 60
HAM-2004	58–60	5.7	0.44	−15.3	64.39 ± 0.51	3690 ± 60
HAM-2005	60–62	5.7	0.36	−15.1	63.97 ± 0.60	3750 ± 80
HAM-2006	62–64	5.7	0.40	−15.1	61.99 ± 0.59	4000 ± 80
HAM-2007	64–66	5.8	0.43	−14.9	63.38 ± 0.60	3660 ± 80
HAM-2008	66–68	5.7	0.33	−14.9	61.02 ± 0.58	3970 ± 80
HAM-2009	68–70	5.7	0.31	−15.0	60.79 ± 0.58	4160 ± 80
HAM-2010	70–72	5.8	0.32	−15.4	57.88 ± 0.57	4550 ± 80
HAM-2011	72–74	5.8	0.33	−15.7	60.61 ± 0.58	4170 ± 80
HAM-2012	74–76	6.0	0.49	−15.2	66.44 ± 0.60	3440 ± 70
HAM-2013	76–78	5.8	0.33	−16.0	62.50 ± 0.60	3920 ± 80
HAM-2014	78–80	5.8	0.33	−16.4	64.72 ± 0.60	3630 ± 70
HAM-2015	80–82	5.7	0.26	−17.0	63.37 ± 0.60	3790 ± 80
HAM-2016	82–84	5.7	0.26	−16.4	66.00 ± 0.60	3480 ± 70
HAM-2017	84–86	5.7	0.29	−15.8	62.46 ± 0.59	3930 ± 80
HAM-2018	86–88	5.8	0.31	−16.9	65.92 ± 0.60	3480 ± 70
HAM-2019	88–90	5.8	0.22	−17.1	66.74 ± 0.61	3380 ± 70
HAM-2020	90–92	5.8	0.32	−16.0	67.69 ± 0.61	3280 ± 70
HAM-2021	92–94	5.8	0.29	−16.7	67.25 ± 0.61	3320 ± 70
HAM-2022	94–96	5.8	0.24	−17.3	67.28 ± 0.61	3310 ± 70
HAM-2023	96–98	5.8	0.28	−17.7	65.62 ± 0.60	3500 ± 70
HAM-2024	98–100	5.8	0.25	−17.9	65.74 ± 0.60	3480 ± 70
HAM-2025	100–102	5.8	0.33	−17.7	66.69 ± 0.60	3370 ± 70
HAM-2026	102–104	5.8	0.24	−17.6	64.73 ± 0.59	3610 ± 70
HAM-2027	104–106	5.8	0.23	−17.5	67.97 ± 0.61	3220 ± 70
HAM-2028	106–108	5.8	0.27	−18.1	65.98 ± 0.60	3450 ± 70
HAM-2029	108–110	5.8	0.22	−18.1	67.34 ± 0.61	3290 ± 70
HAM-2030	110–112	5.8	0.30	−17.1	71.70 ± 0.62	2800 ± 70
HAM-2031	112–114	5.8	0.24	−17.5	67.06 ± 0.60	3330 ± 70
HAM-2032	114–116	5.8	0.25	−17.3	66.88 ± 0.60	3360 ± 70
HAM-2033	116–118	5.8	0.28	−17.4	66.53 ± 0.61	3400 ± 70
HAM-2034	118–120	6.0	0.19	−18.1	67.31 ± 0.61	3290 ± 70
HAM-2035	120–122	5.8	0.28	−17.2	65.50 ± 0.60	3530 ± 70
HAM-2036	122–124	6.4	0.24	−17.5	66.30 ± 0.60	3420 ± 70
HAM-2037	124–126	6.8	0.20	−16.9	65.49 ± 0.60	3530 ± 70

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TABLE 12. Patancheru, Profile R (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age*
HAM-2038	126–128	6.7	0.19	−17.2	65.03 ± 0.60	3580 ± 70
HAM-2039	128–130	7.1	0.17	−16.1	59.79 ± 0.61	4280 ± 80
HAM-2040	130–132	7.0	0.23	−15.7	58.14 ± 0.57	4510 ± 80
HAM-2041	132–134	7.2	0.24	−15.2	57.10 ± 0.56	4660 ± 80
HAM-2042	134–136	6.6	0.23	−17.2	65.68 ± 0.60	3500 ± 70
HAM-2043	136–138	6.6	0.19	−16.9	64.81 ± 0.59	3620 ± 70
HAM-2044	138–140	6.9	0.25	−15.3	60.28 ± 0.58	4220 ± 80
HAM-2045	140–142	7.1	0.24	−15.0	59.68 ± 0.57	4150 ± 80
HAM-2046	142–144	7.1	0.23	−15.4	60.60 ± 0.58	4180 ± 80
HAM-2047	144–146	7.2	0.27	−13.1	55.91 ± 0.56	4670 ± 80
HAM-2048	146–148	7.1	0.33	−12.8	54.04 ± 0.55	4940 ± 80
HAM-2049	148–150	7.2	0.41	−10.8	46.80 ± 0.61	6100 ± 110
HAM-2050	150–152	6.9	0.29	−12.1	50.57 ± 0.54	5480 ± 90
HAM-2051	152–154	7.1	0.40	−11.3	50.22 ± 0.54	5530 ± 90
HAM-2052	154–156	7.0	0.34	−11.8	49.44 ± 0.56	5660 ± 90
HAM-2053	156–158	7.1	0.38	−10.9	46.77 ± 0.53	6100 ± 90

*No isotope correction

Bulk density: 1.5–1.56 g cm^{-3}, according to VERMA (1990), cited in Singer (1993).

Los Baños

Profile-Related Data

Location (longitude, latitude): 14°10′N, 121°16′E
Location (country, next city or village): Philippines, Los Baños, Luzon, IRRI
Soil order and type (USDA classification): Aeric Tropaquept, fine, mixed, nonacid/noncalcareous, isohyperthermic
Soil order and type (local classification): Maahas clay series
Parent material: Mainly volcanic tuffa
Mean annual temperature: 26°C
Annual rainfall: 2150 mm
Vegetation and land use: Rice (former coconut)
Site description: 21 m asl

The Aeric Tropaquept on the IRRI farm at Los Baños was chosen, because a site of this series has also been used for decomposition experiments with ^{14}C-labeled rice straw (Martin 1985; Neue and Scharpenseel 1987). The soil was sampled after harvest, before puddling. In earlier geological periods the area was below the sea level of the nearby laguna.

Date of sampling: 1983
Date of measurement: 1985
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

Because of intensive rice cultivation, the Los Baños profile has a low organic C content and, consequently, a high ^{14}C activity level in the topsoil. The ^{14}C activity is uniform down to 8 cm, with a value of 121 pMC; below, in the main rooty zone, there is a maximum. After puddling, the ^{14}C activity should be the same everywhere within the Apg. The ^{14}C activity of the carbon input to the soil has been decreasing from one season to the next because of the continuing decrease of the ^{14}C activity of the atmosphere since the atomic bomb

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test ban treaty. Therefore, at the time of sampling, after harvest and before puddling, we expected in the main rooty zone between 10 and 14 cm a lower ^{14}C activity than elsewhere in the Apg. But the uppermost 8 cm showed a lower ^{14}C activity. This may be interpreted as a rapid translocation of the freshly decomposed material to the surface. This interpretation is supported by the results of decomposition experiments with ^{14}C-labeled rice straw in the same soil (Becker-Heidmann *et al.* 1985).

The uniform value of $\delta^{13}C$ in the entire Ap1g horizon indicates regular homogenization by puddling, whereas the Ap2g seems to be rarely puddled. Below the Apg horizon, the ^{14}C activity decreases to *ca.* 100 pMC; the ^{14}C increases. The portion of soluble, percolating organic substances is obviously too low to cause a considerable rejuvenation in the subsoil. The steep slope of the ^{14}C activity and the $\delta^{13}C$ curve at the plow pan, together with the low C content and maximum clay concentration at this layer, indicates a strong fixation of highly metabolized and aged humic substances to the clay. The percolating younger material passes through to the bottom, as can be concluded from both the $\delta^{13}C$ inflection and the high ^{14}C activity values in the whole basal soil.

Spikes of high-concentration bomb carbon can be found in the lower part of the ^{14}C activity depth distribution curve. These are located exactly at the transition layers of adjacent horizons, where there are wetter conditions than in the middle of the horizons, because drainage is impeded by texture changes. Thus, percolating organic matter cannot be bound permanently to clay in these layers, which would raise the ^{14}C age. Another explanation could be that fine roots would concentrate in these layers and, because of their high turnover rate, permanently introduce modern C. However, the amount of fresh root material necessary for such a shift in ^{14}C activity would also significantly alter $\delta^{13}C$, which has not been observed.

Literature references: Becker-Heidmann and Scharpenseel (1989); Scharpenseel and Becker-Heidmann (1993); Neue *et al.* (1990); Scharpenseel and Becker-Heidmann (1994b); Martin (1985); Scharpenseel, Pfeiffer and Becker-Heidmann (1995a, 1995b)

Description of the Profile at Los Baños:

Depth (cm)	Horizon	Description
0–14	Ap1g	Black (10YR 2/1), fine roots
14–22	Ap2g	
22–36	IIA3	Black (10YR 2/1), yellowish brown (10YR 5/6) mottles, larger aggregates with reddish brown coating (Fe), little fine roots
36–50	IIB1	Yellowish brown, black tongues from IIA3
50–76	IIB2	Yellowish brown, green-blue tongues from IIB2g
76–90	IIB2g	Green-blue
90+	IIIR	Green-blue, large brown mottles (tuffa)

TABLE 13. Los Baños

Lab code	Depth(cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2147	0–2	6.0	2.02	−22.8	121.80 ± 0.73	Modern
HAM-2148	2–4	5.8	2.26	−22.9	121.80 ± 0.72	Modern
HAM-2149	4–6	5.6	2.08	−23.0	121.40 ± 0.72	Modern
HAM-2150	6–8	5.7	1.90	−22.8	121.35 ± 0.77	Modern
HAM-2151	8–10	5.8	1.89	−22.9	123.65 ± 0.76	Modern
HAM-2152	10–12	6.1	1.82	−22.7	124.60 ± 0.73	Modern
HAM-2153	12–14	6.1	1.65	−22.8	123.20 ± 0.73	Modern
HAM-2154	14–16	6.1	2.10	−22.3	121.36 ± 0.72	Modern
HAM-2155	16–18	6.4	1.65	−22.0	121.36 ± 0.76	Modern
HAM-2156	18–20	6.4	1.36	−21.5	118.48 ± 0.71	Modern

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TABLE 13. Los Baños (Continued)

Lab code	Depth(cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2157	20–22	6.2	1.41	−20.8	116.08 ± 0.70	Modern
HAM-2158	22–24	6.3	0.99	−19.0	109.27 ± 0.67	Modern
HAM-2159	24–26	6.3	0.93	−17.7	106.52 ± 0.67	Modern
HAM-2160	26–28	6.5	0.80	−16.8	104.76 ± 0.66	Modern
HAM-2161	28–30	6.4	0.63	−16.1	101.61 ± 0.65	Modern
HAM-2162	30–32	6.7	0.64	−16.1	101.11 ± 0.65	Modern
HAM-2163	32–34	6.5	0.70	−16.1	102.45 ± 0.65	Modern
HAM-2164	34–36	6.6	0.52	−16.2	111.29 ± 0.68	Modern
HAM-2165	36–38	6.6	0.55	−15.9	106.19 ± 0.66	Modern
HAM-2166	38–40	6.5	0.51	−15.8	101.62 ± 0.65	Modern
HAM-2167	40–42	6.5	0.45	−15.7	103.74 ± 0.66	Modern
HAM-2168	42–44	6.5	0.45	−15.8	108.65 ± 0.67	Modern
HAM-2169	44–46	6.5	0.42	−15.7	104.21 ± 0.68	Modern
HAM-2170	46–48	6.5	0.36	−15.8	102.45 ± 0.65	Modern
HAM-2171	48–50	6.5	0.35	−15.9	119.38 ± 0.72	Modern
HAM-2172	50–52	6.5	0.30	−16.0	104.08 ± 0.66	Modern
HAM-2173	52–54	6.5	0.30	−16.0	102.87 ± 0.72	Modern
HAM-2174	54–56	6.4	0.29	−16.0	102.52 ± 0.65	Modern
HAM-2175	56–58	6.6	0.28	−16.0	109.69 ± 0.68	Modern
HAM-2176	58–60	6.5	0.26	−16.2	101.43 ± 0.65	Modern
HAM-2177	60–62	6.5	0.24	−16.1	101.51 ± 0.65	Modern
HAM-2178	62–64	6.3	0.24	−16.3	100.03 ± 0.64	Modern
HAM-2179	64–66	6.6	0.23	−16.4	102.30 ± 0.66	Modern
HAM-2180	66–68	6.5	0.23	−16.6	102.01 ± 0.65	Modern
HAM-2181	68–70	6.4	0.21	−16.5	103.46 ± 0.65	Modern
HAM-2182	70–72	6.4	0.22	−16.6	99.78 ± 0.64	150 ± 50
HAM-2183	72–74	6.5	0.22	−16.8	103.00 ± 0.65	Modern
HAM-2184	74–76	6.4	0.19	−16.9	99.89 ± 0.69	140 ± 60
HAM-2185	76–78	6.5	0.19	−17.3	107.81 ± 0.67	Modern
HAM-2186	78–80	6.7	0.20	−17.3	109.08 ± 0.86	Modern
HAM-2187	80–82	6.7	0.20	−17.0	102.14 ± 0.72	Modern

Bulk density: (Martin 1985) wet (not directly applicable for our data, as our soil was sampled during dry season

Depth (cm)	Bulk density (g cm^{-3})
0–5	1.08
5–10	1.13
10–15	1.22
15–20	1.37

PANGIL

Profile-Related Data

Location (longitude, latitude):	14°24′N, 121°28′E
Location (country, next city or village):	Philippines, Pangil, Luzon
Soil order and type (FAO classification):	Eutric Gleysol
Soil order and type (USDA classification):	Aeric Tropaquept, fine, kaolinitic, nonacid/noncalcareous, isohyperthermic

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Soil order and type (local classification): Bay clay series
Parent material: Alluvium (unspecified)
Mean annual temperature: 26°C
Annual rainfall: 2150 mm
Vegetation and land use: Rice (since >10 yr)
Site description: < 5 m asl, flat

The soil is on the site of an experimental station of IRRI. It has been used for lowland rice, but should be prepared for an upland rice experiment shortly after the sampling. The soil is known to suffer from phosphorus-deficiency. The profile was located within a plot that has never been fertilized.

Date of sampling: 1983
Date of measurement: 1986/1987
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The $\delta^{13}C$ value is *ca.* −22‰ in Apg, a value that has been found in several other tropical rice soils (see below). The increase of $\delta^{13}C$ with depth due to decomposition is rather small. The ^{14}C activity is the same as the ^{14}C activity of the atmosphere in the topsoil. An inhibited decomposition in topsoil can be inferred from the slight increase of $\delta^{13}C$ combined with the high C content. This interpretation fits with the known phosphorus deficiency and the low pH in this alluvial soil. It is also known that the farmers had not continuously grown rice in this field because of the low productivity. The ^{14}C activity decreases very steeply below the plow pan, indicating again the low decomposition but also a low infiltration rate of fresh organic matter, *i.e.*, an effective hardpan.

Lab comment: --
Literature references: Becker-Heidmann and Scharpenseel (1992a); Scharpenseel and Becker-Heidmann (1989)

Description of Profile at Pangil

Depth (cm)	Horizon	Description
0–16	Apg	Dark yellowish brown (10YR 3/4)
16–20	ABcn	Manganese concretions
20–60	Bg1	Grayish brown (10YR 3/2), red mottles (increasing to the bottom)
60+	Bg2	Lateral water seepage and groundwater table at 70+1

TABLE 14. Pangi

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2365	0–2	4.8	2.45	−21.8	122.06 ± 0.84	Modern
HAM-2366	2–4	4.6	2.33	−22.0	122.46 ± 0.87	Modern
HAM-2367	4–6	4.6	2.35	−22.1	122.92 ± 0.84	Modern
HAM-2368	6–8	4.7	2.32	−22.2	122.12 ± 0.84	Modern
HAM-2369	8–10	4.8	2.20	−22.1	124.56 ± 0.85	Modern
HAM-2370	10–12	4.9	1.88	−22.3	121.16 ± 0.93	Modern
HAM-2371	12–14	5.2	1.62	−22.5	119.73 ± 0.88	Modern
HAM-2372	14–16	5.7	1.37	−22.3	113.03 ± 0.80	Modern
HAM-2373	16–18	6.1	0.90	−21.4	104.53 ± 0.76	Modern
HAM-2374	18–20	6.0	0.62	−20.8	96.84 ± 0.73	330 ± 60
HAM-2375	20–22	6.0	0.48	−21.2	90.24 ± 0.70	890 ± 60
HAM-2376	22–24	--	--	--	--	--
HAM-2377	24–26	6.0	0.49	−20.1	89.33 ± 0.70	980 ± 60
HAM-2378	26–28	6.1	0.47	−21.4	86,33 ± 0.65	1240 ± 60

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TABLE 14. Pangi (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2379	28–30	6.0	0.47	−21.2	83.75 ± 0.61	1490 ± 50
HAM-2380	30–32	6.0	0.41	−20.7	84,85 ± 0.73	1390 ± 70
HAM-2381	32–34	6.1	0.42	−21.4	83.78 ± 0.60	1480 ± 50
HAM-2382	34–36	6.0	0.36	−20.5	83.94 ± 0.65	1480 ± 60
HAM-2383	36–38	6.1	0.38	−20.5	82.35 ± 0.60	1630 ± 50
HAM-2384	38–40	6.1	0.37	−20.7	82.63 ± 0.67	1600 ± 70
HAM-2385	40–42	5.9	0.32	−20.5	83.43 ± 0.68	1530 ± 70
HAM-2386	42–44	5.9	0.35	−20.1	83.75 ± 0.68	1500 ± 70
HAM-2387	44–46	6.1	0.48	−19.7	91.87 ± 0.71	770 ± 60
HAM-2388	46–48	6.0	0.30	−19.8	83.59 ± 0.67	1520 ± 70
HAM-2389	48–50	6.2	0.37	−20.8	82.38 ± 0.68	1630 ± 70
HAM-2390	50–52	6.1	0.33	−21.1	84.19 ± 0.66	1440 ± 60
HAM-2391	52–54	6.3	0.35	−21.1	81.28 ± 0.65	1730 ± 60
HAM-2392	54–56	5.8	0.31	−21.5	79.75 ± 0.64	1870 ± 70
HAM-2393	56–58	5.9	0.31	−21.5	78.95 ± 0.66	1960 ± 70
HAM-2394	58–60	6.1	0.32	−21.9	80.57 ± 0.65	1790 ± 70
HAM-2395	60–62	5.9	0.28	−21.9	80.68 ± 0.64	1770 ± 60
HAM-2396	62–64	5.7	0.32	−21.0	77.60 ± 0.63	2100 ± 70
HAM-2397	64–66	5.8	0.32	−21.7	80.65 ± 0.64	1780 ± 60
HAM-2398	66–68	5.6	0.32	−22.9	76.58 ± 0.77	2180 ± 80
HAM-2399	68–70	5.6	0.31	−21.8	50.92 ± 0.69	5470 ± 60

PAO

Profile-Related Data

Location (longitude, latitude): 16° N, 120°16′E
Location (country, next city or village): Philippines, Pao, Pangasinan, Luzon
Soil order and type (USDA classification): Aeric Tropaquept, fine silty over clayey, mixed, non-calcareous, isohyperthermic
Soil order and type (local classification): San Manuel clay loam series
Mean annual temperature: 28°C
Annual rainfall: 2250 mm
Vegetation and land use: Rice (rainy season) / Mungbeans (dry season, planned)
Site description: --
Date of sampling: 1983
Date of measurement: 1990
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The organic carbon content is low, *ca.* 1% in the Apg and <0.5% in the subsoil. The $\delta^{13}C$ value as well as the increase of $\delta^{13}C$ from the surface through the B1 is comparatively high. This might be due to methane formation. The ^{14}C activity in the Ap1g is only slight lower than the ^{14}C activity of the atmosphere, indicating a low decomposition activity. The comparatively high activity in the subsoil, its very slow decrease, and especially the single very high value corresponding to a low $\delta^{13}C$ at the B1–B2cn boundary, indicate a high percolation rate.

Lab comment: --

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Literature references: Becker-Heidmann (1990); Scharpenseel and Becker-Heidmann (1994a); Scharpenseel and Becker-Heidmann (1994b)

Description of the Profile at Pao:

Depth (cm)	Horizon	Description
0–10	Ap1g	Puddled zone, 8–10 "traffic pan"
10–19	Ap2g	Seldomly puddled zone
19–50	B1	
50–83	B2cn	Iron and manganese concretions
83+	B2g	Grayish blue

TABLE 15. Pao

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age*
HAM-2330	0–2	7.0	0.98	−18.7	114.02 ± 0.80	Modern
HAM-2331	2–4	7.1	0.97	−18.2	114.37 ± 0.81	Modern
HAM-2332	4–6	7.0	0.99	−18.4	114.80 ± 0.81	Modern
HAM-2333	6–8	7.1	1.02	−17.9	117.49 ± 0.82	Modern
HAM-2334	8–10	7.0	0.95	−17.7	114.26 ± 0.62	Modern
HAM-2335	10–12	7.0	0.93	−17.2	112.39 ± 0.62	Modern
HAM-2336	12–14	7.2	0.86	−16.2	111.48 ± 0.03	Modern
HAM-2337	14–16	6.9	0.71	−14.9	104.57 ± 0.77	Modern
HAM-2338	16–19	6.9	0.64	−15.2	100.37 ± 0.75	130 ± 60
HAM-2339	19–22	6.9	0.59	−14.5	97.86 ± 0.75	340 ± 60
HAM-2340	22–25	6.9	0.49	−14.3	93.28 ± 0.79	730 ± 70
HAM-2341	25–28	6.9	0.52	−14.3	95.40 ± 0.74	550 ± 70
HAM-2342	28–30	7.1	0.49	−13.7	97.24 ± 0.76	410 ± 70
HAM-2343	30–32	6.9	0.47	−14.0	95.33 ± 0.74	560 ± 70
HAM-2344	32–34	6.9	0.44	−15.3	95.08 ± 0.57	560 ± 50
HAM-2345	34–36	6.9	0.35	−14.6	95.35 ± 0.73	550 ± 70
HAM-2346	36–38	6.8	0.42	−14.0	93.85 ± 0.75	690 ± 70
HAM-2347	38–40	6.8	0.34	−14.5	92.82 ± 0.75	770 ± 70
HAM-2348	40–42	6.8	0.36	−14.0	93.26 ± 0.74	740 ± 70
HAM-2349	42–44	7.0	0.36	−13.5	93.58 ± 0.57	720 ± 50
HAM-2350	44–47	6.7	0.32	−13.5	94.06 ± 0.74	680 ± 70
HAM-2351	47–50	6.9	0.29	−15.1	128.23 ± 0.87	Modern
HAM-2352	50–53	6.9	0.28	−15.7	93.71 ± 0.73	670 ± 70
HAM-2353	53–56	6.8	0.29	−13.8	92.44 ± 0.72	810 ± 70
HAM-2354	56–59	6.8	0.26	−14.3	91.99 ± 0.73	840 ± 70
HAM-2355	59–62	6.6	0.25	−14.9	93.03 ± 0.74	740 ± 70
HAM-2356	62–65	6.5	0.24	−14.6	90.99 ± 0.92	930 ± 70
HAM-2357	65–68	6.6	0.25	−14.6	91.93 ± 0.55	840 ± 50
HAM-2358	68–71	6.6	0.27	−14.4	91.32 ± 0.73	900 ± 70
HAM-2359	71–74	6.8	0.27	−14.6	88.98 ± 0.73	1110 ± 70
HAM-2360	74–77	6.5	0.27	−14.8	97.78 ± 0.75	350 ± 70
HAM-2361	77–80	6.5	0.27	−14.8	90.10 ± 0.55	1000 ± 50
HAM-2362	80–83	6.3	0.29	−14.6	89.65 ± 0.72	1050 ± 70
HAM-2363	83–86	7.3	0.31	−14.6	88.88 ± 0.72	1120 ± 70
HAM-2364	86–88	6.5	0.33	−14.6	87.64 ± 0.71	1230 ± 70

*$\delta^{13}C$ correction applied, as the high $\delta^{13}C$ here results not from C_4 plants but from methane production.

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BUGALLON

Profile-Related Data

Location (longitude, latitude): 15°55′N, 120°15′E
Location (country, next city or village): Philippines, Bugallon, Pangasinan, Luzon
Soil order and type (USDA classification): Haplic Hydraquent, fine loamy to sandy, mixed, non-calcareous, isohyperthermic
Parent material: Alluvium
Mean annual temperature: 28°C
Annual rainfall: 2250 mm
Vegetation and land use: Grasses; rice until 3 yr before sampling
Site description:

The soil profile at Bugallon is located near Pao, *ca.* 700 m west of the road from Tarlac to Dagupan City. The area belongs to the western part of the Agno River basin between the foothills of the Zambales Mountains in the west and the floodplains of the Agno River. The surface relief is the result of alternate sedimentation and erosion processes during the development of the river beds. The soil has been studied by Haupenthal *et al.* (1979) with regard to Zn deficiency and by Scharpenseel *et al.* (1981) with regard to Cr- and Ni-toxicity and the possible interaction with the Zn-deficiency. A P deficiency has also been noticed. The soil has developed from ultrabasic, ophiolitic and basic alluvium of the nearby Zambales hills.

Date of sampling: 1983
Date of measurement: 1987
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The Bugallon soil was sampled only down to 30 cm, because artesian groundwater rapidly filled the profile. The carbon content decreases steeply at the plow pan, from 2% in the topsoil to 0.5% in the subsoil. The $\delta^{13}C$ value increases very steeply from a usual value of −22‰ at the surface to −14‰ in B2g. Here we have an indication of a decomposition producing mainly methane.

Lab comment: --
Literature references: Becker-Heidmann (1990); Scharpenseel and Becker-Heidmann (1994b)

Description of the Profile at Bugallon:

Depth (cm)	Horizon	Description
0–12	Ap	Black, rooty to very rooty, silty clay
12–45+	B2g	Olive brown to black, little rooty, clay loam
45		Groundwater table from artesian activity

TABLE 16. Bugallon

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2315	0–2	7.7	2.17	−22.0	116.19 ± 0.63	Modern
HAM-2316	2–4	7.4	2.22	−21.2	116.69 ± 0.64	Modern
HAM-2317	4–6	7.1	2.18	−21.6	109.07 ± 0.71	Modern
HAM-2318	6–8	7.4	1.96	−21.4	114.76 ± 0.62	Modern
HAM-2319	8–10	7.5	1.89	−20.9	111.01 ± 0.66	Modern
HAM-2320	10–12	7.3	1.39	−20.4	109.62 ± 0.60	Modern
HAM-2321	12–14	7.6	1.04	−17.4	104.88 ± 0.61	Modern
HAM-2322	14–16	7.4	0.79	−14.5	100.96 ± 0.65	Modern

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TABLE 16. Bugallon (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2323	16–18	6.7	0.68	–13.5	95.71 ± 0.81	540 ± 70
HAM-2324	18–20	6.9	0.62	–13.4	95.43 ± 0.67	560 ± 60
HAM-2325	20–22	7.2	0.46	–13.3	95.10 ± 0.56	595 ± 45
HAM-2326	22–24	6.7	0.75	–13.8	67.74 ± 0.80	3310 ± 90
HAM-2327	24–26	6.9	0.76	–13.9	65.75 ± 0.79	3550 ± 90
HAM-2328	26–28	6.5	0.71	–13.5	66.54 ± 0.78	3460 ± 90
HAM-2329	28–30	6.6	0.52	–13.4	65.18 ± 0.78	3630 ± 90

TIAONG, PROFILE L

Profile-Related Data

Location (longitude, latitude): 13°59′N, 121°21′E
Location (country, next city or village): Philippines, Tiaong, Luzon
Soil order and type (USDA classification): Haplic Hydraquent, coarse silty, mixed, calcareous, isohyperthermic
Parent material: Volcanic ash alluvium from Mt. Banahaw
Mean annual temperature: 26°C
Annual rainfall: 2150 mm
Vegetation and land use: Rice (grasses at sampling time)
Site description: 43 asl

The profile is the lowest one of a toposequence, investigated earlier by Scharpenseel (1978) and Scharpenseel *et al.* (1981). It is similar to the Bugallon profile, but contains much more plant debris and organic matter. It contains a large number of different species of snails, some of them down to 60 cm depth. Big roots, probably from bamboo, were found in 50 to 60 cm depth (not within the sampling area). Artesian water filled the profile up to 30 cm depth, when the sampling reached 60 cm. The local problems with rice cultivation result from a pronounced Zn deficiency. At the time of sampling the soil was fallow and covered by grasses.

Date of sampling: 1983
Date of measurement: 1990
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The lower profile of the Tiaong toposequence is characterized by a high pH of 7.5 to 8 throughout the profile and the highest organic carbon content of all studied Philippine rice soils. It contains also a great deal of carbonate, >3% in the topsoil and even 2% in most parts of the subsoil. The $\delta^{13}C$ value of the organic matter increases with depth within the Apg, as expected, and decreases below the plow pan in the subsoil. As the $\delta^{13}C$ value of the carbonate lies between the $\delta^{13}C$ value of primary carbonates and the $\delta^{13}C$ of fresh C_3 plant material, it is obvious that organic and inorganic carbon have exchanged in this profile. The parallel depth distribution curves of organic and inorganic $\delta^{13}C$ suggest that this exchange is permanently occurring.

Lab comment: --
Literature references: Becker-Heidmann (1990); Scharpenseel and Becker-Heidmann 1994b

Description of Profile L at Tiaong

Depth (cm)	Horizon	Description
0–16	Ap1g	Dark brown, very rooty, fibers of bamboo
16–22	Ap2g	Dark brown, very rooty

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22–58	B21g	Bluish green, rooty
58–64+	B22g	Green blue, snails

TABLE 17. Tiaong, Profile L

Lab code	Depth (cm)	pH	C_{org}	$\delta^{13}C_{org}$	$^{14}C_{org}$ act.	$^{14}C_{org}$ age	C_{in}	$\delta^{13}C_{in}$	$^{14}C_{in}$ act.	$^{14}C_{in}$ age
HAM-2188	0–2	7.9	9.27	−21.6	113.69 ± 0.81	Modern	3.29	−8.7	97.76 ± 0.76	180 ± 60
HAM-2189	2–4	7.9	8.58	−22.2	112.32 ± 0.80	Modern	3.41	−8.2	99.51 ± 0.75	40 ± 60
HAM-2190	4–6	8.0	8.89	−21.7	112.55 ± 0.62	Modern	3.57	−7.1	91.85 ± 0.73	680 ± 70
HAM-2191	6–8	8.1	8.52	−18.7	118.42 ± 0.83	Modern	3.23	−4.8	90.89 ± 0.55	765 ± 50
HAM-2192	8–10	8.2	7.98	−17.9	115.16 ± 0.81	Modern	3.14	−5.3	97.42 ± 0.75	210 ± 60
HAM-2193	10–12	8.0	7.74	−18.8	116.48 ± 0.82	Modern	3.28	−5.1	115.66 ± 0.82	Modern
HAM-2194	12–14	7.7	6.47	−17.2	118.42 ± 0.82	Modern	3.37	−7.5	99.98 ± 0.76	Modern
HAM-2195	14–16	8.0	6.65	−17.8	94.20 ± 0.74	600 ± 70	3.47	−5.7	96.63 ± 0.74	280 ± 60
HAM-2196	16–18	7.8	6.13	−17.4	118.32 ± 0.64	Modern	3.87	−5.6	95.39 ± 0.57	380 ± 50
HAM-2197	18–20	7.8	5.94	−16.6	112.87 ± 0.80	Modern	3.25	−5.4	97.21 ± 0.75	230 ± 70
HAM-2198	20–22	8.0	5.53	−19.0	113.74 ± 0.83	Modern	2.93	−5.9	86.10 ± 0.72	1200 ± 70
HAM-2199	22–24	8.0	2.01	−19.0	104.13 ± 0.77	Modern	2.65	−6.5	90.54 ± --	800 ± 80
HAM-2200	24–26	7.6	4.34	−18.9	99.03 ± 0.58	180 ± 50	2.32	−7.5	81.95 ± 0.53	1600 ± 50
HAM-2201	26–28	7.7	4.08	−19.3	95.68 ± 0.75	450 ± 60	2.54	−7.5	81.96 ± 0.70	1600 ± 70
HAM-2202	28–30	7.6	3.37	−19.4	94.28 ± 0.74	560 ± 60	2.75	−7.1	77.76 ± 0.70	2020 ± 70
HAM-2203	30–32	7.5	4.88	−19.8	93.41 ± 0.74	630 ± 70	2.38	−8.4	81.62 ± 0.69	1630 ± 70
HAM-2204	32–34	7.6	4.00	−18.9	91.10 ± 0.75	850 ± 70	2.88	−8.5	78.06 ± 0.70	1990 ± 70
HAM-2205	34–36	7.5	3.31	−19.1	91.49 ± 0.75	810 ± 70	3.01	−8.3	80.84 ± 0.70	1710 ± 70
HAM-2206	36–38	7.5	3.60	−19.1	89.14 ± 0.55	1020 ± 50	2.71	−8.4	80.40 ± 0.70	1750 ± 70
HAM-2207	38–40	7.4	4.17	−19.4	93.43 ± 0.74	640 ± 70	2.42	−8.9	81.26 ± 0.70	1670 ± 70
HAM-2208	40–42	7.5	3.50	−19.6	91.59 ± 0.73	790 ± 70	2.85	−8.5	82.16 ± 0.57	1580 ± 60
HAM-2209	42–44	7.4	4.30	−19.2	92.16 ± --	750 ± 70	2.60	−10.9	78.80 ± --	1910 ± 60
HAM-2210	44–46	7.6	2.93	−20.3	90.53 ± 0.72	880 ± 70	2.40	−9.2	80.70 ± 0.69	1720 ± 70
HAM-2211	46–48	7.5	2.85	−20.4	91.52 ± 0.73	790 ± 70	2.71	−9.2	80.87 ± 0.69	1710 ± 70
HAM-2212	48–50	7.5	2.95	−20.2	93.12 ± 0.73	650 ± 70	2.60	−8.9	97.67 ± 0.60	190 ± 60
HAM-2213	50–52	7.4	2.58	−20.8	118.09 ± 0.78	Modern	2.67	−9.4	81.23 ± 0.69	1670 ± 70
HAM-2214	52–54	7.5	2.37	−20.5	93.71 ± 0.73	590 ± 70	2.28	--	80.39 ± 0.59	1750 ± 60
HAM-2215	54–56	7.6	2.05	−22.0	95.17 ± 0.73	450 ± 60	2.16	−8.7	80.26 ± 0.68	1770 ± 70
HAM-2216	56–58	7.3	1.79	−21.8	101.11 ± 0.76	Modern	1.79	−9.1	86.55 ± 0.54	1160 ± 50
HAM-2217	58–60	7.4	0.93	−22.4	95.79 ± 0.80	390 ± 70	1.53	−9.3	82.44 ± 0.69	1550 ± 70
HAM-2218	60–62	8.0	1.19	−23.3	89.49 ± 0.71	920 ± 70	0.75	−9.8	81.63 ± 0.69	1630 ± 70
HAM-2219	62–64	7.3	0.72	−24.7	--	--	0.46	−10.6	--	--
HAM-2220	64–66	7.3	1.02	−25.2	99.90 ± 0.58	5 ± 50	0.27	−14.7	85.81 ± 0.71	1230 ± 70

TIAONG, PROFILE H

Profile-Related Data

Location (longitude, latitude):	13°59′N, 121°21′E
Location (country, next city or village):	Philippines, Tiaong, Luzon
Soil order and type (USDA classification):	Typic Haplaquoll, fine silty, mixed, noncalcareous, isohyperthermic
Parent material:	Volcanic ash from nearby Mt. Banahaw
Mean annual temperature:	26°C
Annual rainfall:	2150 mm
Vegetation and land use:	Banana, coconut
Site description:	45 m asl

This profile was located at the top of the toposequence at Tiaong, *ca.* 200 m apart from Profile L in a small banana and coconut grove, and was characterized by an epiaquic water regime.

Date of sampling: 1983

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Date of measurement: 1985
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The soil had not been plowed; thus, its A11 horizon shows a maximum of the ^{14}C activity between 6 and 8 cm below surface, in the main rooty zone, and a constant decrease below that. In the A12 horizon the ^{14}C activity varies *ca.* 110 pMC, and in the A12 and B2g horizons there are only a few layers where ^{14}C activity is < 100 pMC. This means that a continuous admixture of fresh organic matter had occurred throughout the whole profile. Because of the wet conditions combined with nonintensive cultivation, an accumulation of organic matter is probable. With decreasing clay content, $\delta^{13}C$ decreases with depth and ^{14}C activity increases slightly. At the transition zone between the A12 and the water-saturated B2g horizon, the redox potential seasonally changes with the groundwater level, as proven by a strong enrichment of Mn in the layers of the ^{14}C activity peaks. These conditions prevent fixation and aging of organic substances and lead to the "modern" ^{14}C activity peak.

The fact that organic substances with high ^{14}C activity ("bomb radiocarbon", *i.e.,* built after the beginning of thermonuclear testing) are found in the subsoil can be interpreted as intact bioturbation within the total profile depth of this Mollisol. Measurements of the ^{14}C activity of earthworms from a Mollisol showing the "bomb carbon" in worms of all depths, support this hypothesis (Scharpenseel *et al.* 1986). Recent carbon can be introduced also in clay-organic complexes of all depths in this clayey and silty soil. As a comparison, the age of the total organic matter of a Mollisol from Inner Mongolia in China (Becker-Heidmann, Liu and Scharpenseel 1988) increases with 69.3 yr cm^{-1} depth, which corresponds to a very slow soil development *via* an extended pararendzina phase. Here $\delta^{13}C$ does not deviate from the value of fresh plant material throughout the profile, indicating early protection against further degradation. The reason for the slow soil development is most probably the climatic regime, with temperatures of −20°C and <25 mm rainfall in January and *ca.* 18°C and between 25 and 50 mm rainfall in June, rather than the influence of the geological conditions.

Literature references: Becker-Heidmann and Scharpenseel (1989); Scharpenseel and Becker-Heidmann (1992b); Scharpenseel *et al.* (1989)

Description of the Profile at Tiaong (H):

Depth (cm)	Horizon	Description
0–20	A11	Black, rooty, big earthworms
20–36	A12	Slightly rooty
36–60	B2	Grayish brown, reddish brown mottles, no roots
60		Groundwater table

TABLE 18. Tiaong (H)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2222	0–2	6.4	3.74	−20.2	118.43 ± 0.82	Modern
HAM-2223	2–4	6.3	3.98	−20.1	119.23 ± 0.82	Modern
HAM-2224	4–6	6.7	3.47	−19.7	118.32 ± 0.82	Modern
HAM-2225	6–8	6.9	3.44	−19.5	120.96 ± 0.83	Modern
HAM-2226	8–10	7.0	2.71	−19.3	115.75 ± 0.81	Modern
HAM-2227	10–12	6.9	2.67	−19.3	116.54 ± 0.82	Modern
HAM-2228	12–14	7.2	2.42	−18.7	111.57 ± 0.79	Modern
HAM-2229	14–16	7.2	2.36	−18.5	110.72 ± 0.79	Modern
HAM-2230	16–18	7.1	1.86	−17.8	107.92 ± 0.78	Modern
HAM-2231	18–20	7.2	1.75	−16.5	103.15 ± 0.76	Modern

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TABLE 18. Tiaong (H) (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2232	20–22	7.0	1.53	−16.2	102.72 ± 0.75	Modern
HAM-2233	22–24	7.0	1.31	−16.3	101.55 ± 0.75	Modern
HAM-2234	24–26	7.1	1.27	−15.8	98.37 ± 0.74	280 ± 60
HAM-2235	26–28	7.0	1.16	−15.8	101.18 ± 0.75	Modern
HAM-2236	28–30	7.1	0.92	−16.0	101.16 ± 0.75	Modern
HAM-2237	30–32	7.1	0.80	−16.5	100.03 ± 0.74	Modern
HAM-2238	32–34	7.0	0.63	−16.8	98.97 ± 0.74	220 ± 60
HAM-2239	34–36	6.9	0.59	−17.3	100.63 ± 0.75	Modern
HAM-2240	36–38	6.9	0.50	−17.8	107.59 ± 0.77	Modern
HAM-2241	38–40	6.9	0.47	−18.1	107.08 ± 0.77	Modern
HAM-2242	40–42	7.0	0.36	−18.3	100.06 ± 0.74	Modern
HAM-2243	42–44	7.1	0.41	−18.4	99.74 ± 0.74	130 ± 60
HAM-2244	44–46	6.9	0.40	−18.7	96.80 ± 0.75	360 ± 60
HAM-2245	46–48	6.8	0.31	−15.9	103.86 ± 0.76	Modern
HAM-2246	48–50	6.9	0.31	−16.8	100.24 ± 0.74	Modern
HAM-2247	50–52	6.9	0.30	−19.6	102.84 ± 0.77	Modern
HAM-2248	52–54	6.6	0.30	−18.9	101.55 ± 0.79	Modern

SAN DIONISIO, PROFILE T

Profile-Related Data

Location (longitude, latitude): 11°32′N, 123°07′E
Location (country, next city or village): Philippines, San Dionisio, Panay
Soil order and type (USDA classification): Typic Paleudult, coarse loamy over clayey, mixed, oxidic, acid, isohyperthermic
Parent material: Colluvium above estuarine clayey alluvium
Mean annual temperature: 26°C
Annual rainfall: 3000 mm
Vegetation and land use: Rice, presently fallow
Site description:

The profile was located in the northernmost part of the island Panay, near the village San Dionisio. The area is part of a former river delta system. At San Dionisio, the former sediment contains pure kaolonite, which is now being mined for pottery. It is covered by colluvium of 300 cm depth from a nearby mountain with a high iron content. Therefore, the soil suffers from iron toxicity and is not very suitable for rice production. Some of the stones found below 100 cm have been dated to >16,000 yr (V. Toquillo, personal communication).

Date of sampling: 1983
Date of measurement: 1985
Collector: Becker-Heidmann, V. P. Singh
Submitter: Becker-Heidmann
Submitter's comment:

This profile has developed under tidal influence in a river estuary, where sedimentation and mangrove growing caused high contents of clay as well as organic matter. Microbial reduction of sulfates from seawater and anaerobic decomposition of the organic matter led to a decrease of the pH value and subsequently, a reduction of the minerals of the sediment to kaolinite. Later, the iron-rich colluvium of the nearby hill covered this acid sulfate soil. The present situation is characterized by the reduction of Fe_3+ to Fe_2+ under low pH and, simultaneously, the oxidation of SOM with a release of Fe_2+ in toxic concentrations under the anaerobic conditions of rice cultivation.

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An unexpectedly high value of $\delta^{13}C$ in and its decrease with depth may be explained by the field lying fallow and subsequent covering by tropical grasses, among which are probably some C_4 species. This is supported by the ^{14}C activity being nearly as high as the atmospheric level and indicating a continued high C input to the soil. Organic matter in the puddling zone is dominated by bomb carbon of the sampling year concentration (*ca.* 120 pMC), which indicates a high turnover rate. The high ^{14}C activity in the topsoil, together with the low carbon content, show also that the decomposition and humification is very low in this soil. Especially in the layers where $\delta^{13}C$ is constant, no biological activity was detected by IRRI's Dept. of Microbiology (V. P. Singh, personal communication 1983). The low biological activity is probably caused by the large percentage of kaolinite with a low cation exchange capacity responsible for a weak dispersion of the soil.

The soil below B1 shows a constant $\delta^{13}C$ value with a continuous and rapid decrease in ^{14}C activity and a correspondingly increasing ^{14}C age. The steep increase of the ^{14}C age up to *ca.* 3000 yr already at 80 cm depth can be explained by the high clay content of *ca.* 50%. We conclude that organic matter in the lower part of the profile is well protected against further metabolization or admixture of young material.

Literature references: Becker-Heidmann and Scharpenseel (1989)

Description of the Profile at San Dionisio:

Depth (cm)	Horizon	Description
0–20	Apg	Brown-gray, very rooty
20–36	B1	Light brown-gray, reddish mottles (iron), no roots
36–70	B2	Light reddish brown
70+	B2	Light reddish brown, intense red mottles, alluvium rich in iron

TABLE 19. San Dionisio, Profile T

Lab code	Depth(cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2249	0–2	3.9	1.48	−17.4	117.58 ± 0.82	Modern
HAM-2250	2–4	3.7	1.07	−18.3	121.42 ± 0.84	Modern
HAM-2251	4–6	3.7	0.99	−19.1	116.57 ± 0.82	Modern
HAM-2252	6–8	3.7	0.92	−18.8	121.56 ± 0.84	Modern
HAM-2253	8–10	3.7	0.83	−18.5	120.42 ± 0.83	Modern
HAM-2254	10–12	3.8	0.74	−18.8	120.00 ± 0.83	Modern
HAM-2255	12–14	3.6	0.69	−18.8	109.65 ± 0.80	Modern
HAM-2256	14–16	4.2	0.60	−19.3	105.48 ± 0.83	Modern
HAM-2257	16–18	3.5	0.60	−19.2	102.21 ± 0.76	Modern
HAM-2258	18–20	4.0	0.57	−19.4	100.03 ± 0.74	Modern
HAM-2259	20–22	4.0	0.58	−19.6	99.00 ± 0.75	170 ± 60
HAM-2260	22–24	3.4	0.48	−20.0	99.99 ± 0.74	80 ± 60
HAM-2261	24–26	3.7	0.50	−20.9	106.95 ± 0.60	Modern
HAM-2262	26–28	3.5	0.53	−22.1	93.50 ± 0.72	590 ± 60
HAM-2263	28–30	3.5	0.49	−23.0	94.03 ± 0.78	530 ± 70
HAM-2264	30–32	3.5	0.48	−22.9	102.15 ± 0.74	Modern
HAM-2265	32–34	3.6	0.49	−22.7	92.09 ± 0.66	700 ± 60
HAM-2266	34–36	3.7	0.47	−22.7	93.17 ± 0.62	600 ± 50
HAM-2267	36–38	3.5	0.48	−22.3	90.09 ± 0.60	880 ± 50
HAM-2268	38–40	3.7	0.47	−22.3	88.38 ± 0.60	1040 ± 50
HAM-2269	40–42	4.2	0.55	−22.3	89.53 ± 0.60	930 ± 50
HAM-2270	42–44	3.8	0.55	−22.4	87.70 ± 0.60	1100 ± 50
HAM-2271	44–46	3.6	0.55	−22.7	80.96 ± 0.57	1730 ± 60
HAM-2272	46–48	3.8	0.50	−22.3	83.36 ± 0.67	1510 ± 70
HAM-2273	48–50	3.7	0.54	−22.3	83.44 ± 0.61	1500 ± 60
HAM-2274	50–60	3.6	0.56	−22.3	81.21 ± 0.57	1720 ± 60

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TABLE 19. San Dionisio, Profile T (Continued)

Lab code	Depth(cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2275	60–70	3.6	0.57	−22.1	73.41 ± 0.59	2530 ± 60
HAM-2276	70–80	3.9	0.54	−22.0	70.23 ± 0.53	2890 ± 60
HAM-2277	80–90	3.6	0.57	−20.2	60.81 ± 0.50	4070 ± 70
HAM-2278	90–110	3.4	0.63	−19.3	52.87 ± 0.47	5210 ± 70
HAM-2279	110–130	3.7	0.53	−20.4	60.76 ± 0.58	4080 ± 80
HAM-2280	130–150	3.9	0.58	−21.0	47.38 ± 0.53	6070 ± 90
HAM-2281	150–170	3.7	0.44	−17.7	41.56 ± 0.60	7170 ± 120
HAM-2282	170–190	3.7	0.59	−16.1	31.02 ± 0.39	9550 ± 100
HAM-2283	190–210	3.9	0.51	−15.6	30.29 ± 0.39	9750 ± 100
HAM-2284	210–240	3.3	0.50	−15.7	45.63 ± 0.52	6450 ± 90
HAM-2285	240–270	3.2	0.73	−12.6	19.58 ± 0.35	13,300 ± 150
HAM-2286	270–285	3.3	0.31	−15.3	23.69 ± 0.52	11,730 ± 180
HAM-2287	285–300	3.1	0.28	−14.9	25.19 ± 0.37	11,240 ± 120
HAM-2288	300–315	3.9	0.46	−13.7	25.86 ± 0.55	11,050 ± 170
HAM-2289	315–330	3.4	0.66	−13.4	13.53 ± 0.35	16,260 ± 210
HAM-2290	330–340	3.7	1.85	−12.2	9.70 ± 0.39	18,950 ± 330
HAM-2291	340–350	3.7	1.31	−12.6	8.67 ± 0.32	19,850 ± 300
HAM-2292	350–360	3.6	1.21	−12.4	8.03 ± 0.32	20,460 ± 320
HAM-2293	360–370	4.0	0.80	−12.9	8.14 ± 0.32	20,350 ± 310
HAM-2294	370–380	3.3	0.64	−14.1	8.77 ± 0.32	19,730 ± 290
HAM-2295	380–390	3.9	0.74	−14.1	7.17 ± 0.39	21,350 ± 430
HAM-2296	390–410	3.6	5.06	−15.2	2.88 ± 0.37	28,660 ± 1040
HAM-2297	410–430	3.8	4.98	−14.4	4.06 ± 0.38	25,910 ± 750
HAM-2298	430–450	4.2	2.07	−14.4	4.46 ± 0.38	25,150 ± 680
HAM-2299	450–470	3.8	4.14	−14.6	4.08 ± 0.49	25,870 ± 960
HAM-2300	470–490	3.1	1.89	−13.6	4.91 ± 0.38	24,400 ± 620
HAM-2301	490–510	3.8	1.36	−15.8	4.10 ± 0.38	25,810 ± 740

NAMTOU HSIEN

Profile-Related Data

Location (longitude, latitude): 24°08′N, 120°41′E
Location (country, next city or village): Republic of China, Namtou Hsien near Taichung
Soil order and type (USDA classification): Typic Fluvaquent, fine to moderate
Parent material: Sandstone and shales alluvium
Mean annual temperature: 22°C
Annual rainfall: 2250 mm
Vegetation and land use: Rice
Site description:

The soil developed in a relatively new deposit above an old soil, which also was used for rice.

Date of sampling: 1984
Date of measurement: 1989
Collector: Becker-Heidmann, H.Y. Guo
Submitter: Becker-Heidmann, H.Y. Guo
Submitter's comment:

The $\delta^{13}C$ value was low in the Ap1, −26‰, corresponding to fresh plant material from rice. We observed a steep increase within the Ap2; in the subsoil the $\delta^{13}C$ value was *ca.* −16‰ PDB. As the fossil soil below was also used for growing rice and not for, *e.g.*, sugar cane, this increase can easily be explained by decomposi-

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tion processes involving larger amounts of CH_4. The ^{14}C activity value of only 108 pMC in the Ap1 strongly supports the hypothesis of a high decomposition rate. The curve in the subsoil shows the normal pattern.

Literature references: Becker-Heidmann (1990); Scharpenseel and Becker-Heidmann (1994b)

Description of the Profile at Namtou Hsien:

Depth (cm)	Horizon	Description
0–10	Ap1	Very dark gray brown, clay loam
10–20	Ap2	Dark gray brown
20–40	IIfAp	Silty clay
40–50	IIAB	Gray brown
50–70	IIB21	Gray brown
70+	IIB22	Gray brown

TABLE 20. Namtsou Hsien

Lab code	Depth(cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2661	0–2	4.5	1.60	−26.3	107.10 ± 0.79	Modern
HAM-2662	2–4	4.6	1.64	−25.9	108.09 ± 0.80	Modern
HAM-2663	4–6	4.8	1.50	−25.4	106.69 ± 0.80	Modern
HAM-2664	6–8	4.9	1.57	−25.9	105.77 ± 0.78	Modern
HAM-2665	8–10	5.4	1.47	−25.8	107.50 ± 0.61	Modern
HAM-2666	10–12	5.8	1.51	−25.0	106.58 ± 0.79	Modern
HAM-2667	12–14	5.9	1.32	−25.6	107.00 ± 0.79	Modern
HAM-2668	14–16	6.1	1.05	−24.0	104.81 ± 0.79	Modern
HAM-2669	16–18	6.0	0.85	−21.7	100.11 ± 0.76	Modern
HAM-2670	18–20	6.2	0.87	−20.6	98.93 ± 0.58	160 ± 50
HAM-2671	20–22	6.3	0.86	−19.3	94.12 ± 0.75	580 ± 70
HAM-2672	22–24	6.3	0.84	−17.0	92.71 ± 0.74	740 ± 70
HAM-2673	24–26	6.3	0.89	−16.1	93.00 ± 0.74	730 ± 70
HAM-2674	26–28	6.3	0.88	−16.1	91.49 ± 0.73	860 ± 70
HAM-2675	28–30	6.1	1.02	−16.4	93.90 ± 0.57	645 ± 50
HAM-2676	30–32	6.2	1.07	−15.7	93.96 ± 0.75	650 ± 70
HAM-2677	32–34	6.1	1.11	−15.6	91.02 ± 0.73	910 ± 70
HAM-2678	34–36	6.2	1.32	−15.7	90.78 ± 0.74	930 ± 70
HAM-2679	36–38	6.1	1.48	−15.7	92.82 ± 0.75	750 ± 70
HAM-2680	38–40	6.2	1.72	−14.8	89.78 ± 0.73	1030 ± 70
HAM-2681	40–42	6.2	1.75	−15.2	90.24 ± 0.56	985 ± 50
HAM-2682	42–44	6.1	1.20	−14.8	89.62 ± 0.73	1050 ± 70
HAM-2683	44–46	6.1	1.17	−14.7	86.96 ± 0.73	1290 ± 70
HAM-2684	46–48	6.1	1.13	−14.8	86.16 ± 0.72	1360 ± 70
HAM-2685	48–50	6.2	1.04	−15.3	86.32 ± 0.54	1340 ± 50
HAM-2686	50–60	6.2	0.97	−15.4	84.71 ± 0.71	1490 ± 70
HAM-2687	60–70	6.1	0.78	−16.0	81.63 ± 0.84	1780 ± 80
HAM-2688	70–80	5.9	0.73	−16.1	81.36 ± 0.95	1800 ± 100

PINGTUNG

Profile-Related Data

Location (longitude, latitude): 22°40′N, 120°29′E

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Location (country, next city or village):	Republic of China, experimental station of Pingtung near Kaohsiung
Soil order and type (USDA classification):	Typic Fluvaquent
Soil order and type (local classification):	--
Parent material:	Slate alluvium
Mean annual temperature:	24°C
Annual rainfall:	2500 mm
Vegetation and land use:	2× rice + 1× beans per year for 20 yr
Site description:	--
Date of sampling:	1984
Date of measurement:	1989
Collector:	Becker-Heidmann, Guo
Submitter:	Becker-Heidmann, Guo

Submitter's comment:

The carbon content is rather low, with 1.2% near the surface and <0.3% in the subsoil. The $\delta^{13}C$ value shows the normal pattern of increasing with depth within the topsoil. Its shift is not as pronounced as in the Taichung soil. Therefore, methane production might be not as high as in the Taichung profile. The ^{14}C activity is generally comparable in value and curve to the Taichung soil. This indicates that the strength of decomposition is also comparable. A considerable difference in the depth distribution pattern can be observed at the boundaries of the horizons of the subsoil. High to extremely high ^{14}C activity shows that considerable amounts of fresh soluble organic substances have been percolating down through the profile. In spite of the low organic matter content of the soil and of losses by percolation, the productivity of this soil is rather high. In a soil fertility study of 130 soils of Kaohsiung-Pingtung region, Chang *et al.* (1983) showed that the morphological characteristics of the subsoil created by illuviation, deposition, reduction, oxidation, and groundwater behavior has no response to rice production and surface soil fertility.

Lab comment:	--
Literature references:	Becker-Heidmann and Scharpenseel (1992a)

Description of the Profile at Pingtung:

Depth (cm)	Horizon	Description
0–16	Ap1	Brown-gray, brown mottles, rooty
16–26	Ap2	Brown-gray to ochre, many reddish mottles
26–44	B1	Gray-brown, light brown mottles, silty
44–80	B21	Gray-brown to brown
80+	B22	

TABLE 21. Pingtung

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2689	0–2	4.6	1.20	−22.1	108.49 ± 0.80	Modern
HAM-2690	2–4	4.7	1.18	−23.0	111.46 ± 0.62	Modern
HAM-2691	4–6	4.7	1.15	−22.9	112.36 ± 0.81	Modern
HAM-2692	6–8	4.7	1.08	−23.1	110.76 ± 0.80	Modern
HAM-2693	8–10	4.6	0.37	−23.1	97.09 ± 0.74	270 ± 60
HAM-2694	10–12	4.8	0.87	−22.6	105.98 ± 0.78	Modern
HAM-2695	12–14	5.1	1.00	−22.5	106.69 ± 0.78	Modern
HAM-2696	14–16	5.4	0.83	−22.5	102.46 ± 0.77	Modern
HAM-2697	16–18	5.5	0.75	−21.9	66.60 ± 0.66	3320 ± 80
HAM-2698	18–20	5.8	0.59	−21.3	91.36 ± 0.74	790 ± 70
HAM-2699	20–22	5.8	0.48	−20.2	89.55 ± 0.55	965 ± 50

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TABLE 21. Pingtung (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2700	22–24	6.3	0.36	−19.5	87.89 ± 0.72	1130 ± 70
HAM-2701	24–26	--	1.16	−19.1	105.55 ± 0.78	Modern
HAM-2702	26–28	6.1	0.44	−18.3	84.74 ± 0.73	1440 ± 70
HAM-2703	28–30	6.1	0.36	−18.6	82.97 ± 0.71	1600 ± 70
HAM-2704	30–32	6.1	0.41	−17.6	82.77 ± 0.65	1640 ± 60
HAM-2705	32–34	6.2	0.43	−17.6	92.09 ± 0.75	780 ± 70
HAM-2706	34–36	6.2	0.44	−17.2	100.39 ± 1.26	Modern
HAM-2707	36–38	6.1	0.45	−17.3	84.71 ± 0.54	1460 ± 50
HAM-2708	38–40	6.1	0.39	−17.7	84.04 ± 0.71	1520 ± 70
HAM-2709	40–42	6.1	0.31	−17.7	81.72 ± 0.70	1740 ± 70
HAM-2710	42–44	6.0	0.31	−18.6	135.60 ± 0.88	Modern
HAM-2711	44–46	6.2	0.29	−18.8	91.77 ± 0.73	790 ± 70
HAM-2712	46–48	6.2	0.28	−18.6	77.52 ± 0.52	2150 ± 50
HAM-2713	48–50	6.4	0.27	−18.9	76.37 ± 0.69	2260 ± 70
HAM-2714	50–60	6.1	0.25	−19.2	67.99 ± 0.91	3190 ± 110
HAM-2715	60–70	6.1	0.18	−19.3	62.46 ± 0.63	3870 ± 80
HAM-2716	70–80	6.2	0.16	−19.2	61.91 ± 0.63	3940 ± 80
HAM-2717	80–90	6.2	0.16	−18.8	70.35 ± 0.50	2930 ± 60
HAM-2718	90–100	6.2	0.19	−19.3	49.78 ± 0.59	5700 ± 100

CHUM PAE

Profile-Related Data

Location (longitude, latitude): 16°33′N, 102°02′E
Location (country, next city or village): Thailand, rice experimental station at Chum Pae near Khon Kaen
Soil order and type (USDA classification): Aeric Paleaquult, loamy, mixed, nonacid, isohyperthermic
Soil order and type (local classification): Roi Et series
Mean annual temperature: 28°C
Annual rainfall: 1100 mm
Vegetation and land use: Rice
Site description:

The Chum Pae rice experimental station is located at the depressed part of the Korat plateau in Northeast Thailand in an undulating region with limited rainfall. The groundwater table is below 300 cm during the peak of the dry season. At the time of sampling, the soil was dry down to 170 cm.

Date of sampling: 1984
Date of measurement: 1986
Collector: Becker-Heidmann
Submitter: Becker-Heidmann
Submitter's comment:

The carbon content is very low, not only in the subsoil, but especially in the topsoil and shows no difference between topsoil and subsoil. $\delta^{13}C$ is rather high but not unusual for tropical rice soils. The increase with depth from −21 to −18‰ is lower than in the other studied soils, indicating a weak decomposition. The fact that the ^{14}C activity is as high as the atmospheric one in the plowed horizon also indicates low decomposition. Decomposition is slow in this puddled soil with low and imbalanced nutrient supply, high bulk density and low biological diversity and activity, as was shown also by decomposition experiments with ^{14}C-labeled rice straw, which were conducted in the same field after the samples for this study were taken (Snitwongse

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et al. 1988). During the first year, 55–60% of the straw was lost. The half-life of the resistant part of the added organic matter was 13.5 yr in the submerged planted soil followed by dry fallow. After 3 yr, 30% was found within 50 cm depth.

Literature references: Becker-Heidmann (1990); Scharpenseel *et al.* (1989); Scharpenseel and Becker-Heidmann (1993); Scharpenseel and Becker-Heidmann (1994b)

Description of the Profile at Chum Pae Station

Depth (cm)	Horizon	Description
0–12	Ap1g	Light yellowish brown (10YR 6/4), silty, aggregate surfaces covered with iron
12–20	Ap2g	Dark yellowish brown (10YR 4/4), puddling zone
20–38	B1	Dark grayish brown (10YR 4/2), silty clay loam, hard black concretions (manganese) with red covering (iron), soft yellowish red concretions (iron)
38–48	B21tg	Dark grayish brown(10YR 4/2), clay loam, probably clay migration, manganese and iron concretions
48–74	B22tg	Dark grayish brown, clay loam, probably clay migration, concretions
74–92+	B3g	Dark grayish brown, clay loam, concretions

TABLE 22. Chum Pae

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2401	0–2	4.2	0.93	–20.4	116.72 ± 0.71	Modern
HAM-2402	2–4	4.4	0.20	–20.7	118.20 ± 0.71	Modern
HAM-2403	4–6	4.5	0.33	–19.8	118.07 ± 0.71	Modern
HAM-2404	6–8	4.5	0.48	–19.5	118.67 ± 0.71	Modern
HAM-2405	8–10	4.8	0.48	–19.6	119.37 ± 0.72	Modern
HAM-2406	10–12	5.0	0.29	–20.1	116.12 ± 0.70	Modern
HAM-2407	12–14	5.7	0.43	–19.4	101.65 ± 0.84	Modern
HAM-2408	14–16	6.2	0.33	–19.0	96.78 ± 0.73	360 ± 60
HAM-2409	16–18	5.0	0.32	–18.6	92.07 ± 0.61	770 ± 50
HAM-2410	18–20	6.7	0.37	–18.6	102.50 ± 0.65	Modern
HAM-2411	20–23	6.5	0.40	–18.5	95.15 ± 0.73	510 ± 60
HAM-2412	23–24	6.0	0.42	–18.5	93.85 ± 0.72	610 ± 60
HAM-2413	24–26	5.8	0.41	–18.3	99.37 ± 0.64	160 ± 50
HAM-2414	26–28	5.9	0.25	–18.6	98.19 ± 0.63	250 ± 50
HAM-2415	28–30	5.8	0.28	–18.2	94.94 ± 0.72	530 ± 60
HAM-2416	30–32	5.8	0.26	–18.2	93.79 ± 0.72	630 ± 60
HAM-2417	32–34	5.5	0.41	–18.1	94.14 ± 0.73	600 ± 60
HAM-2418	34–36	5.4	0.45	–18.3	93.32 ± 0.72	660 ± 60
HAM-2419	36–38	5.7	0.24	–18.4	98.01 ± 0.64	270 ± 50
HAM-2420	38–40	5.9	0.36	–18.5	92.26 ± 0.72	750 ± 60
HAM-2421	40–42	5.6	0.23	–18.4	93.30 ± 0.72	660 ± 60
HAM-2422	42–44	5.9	0.19	–18.8	92.47 ± 0.71	730 ± 60
HAM-2423	44–46	5.0	0.39	–18.5	95.39 ± 0.63	480 ± 50
HAM-2424	46–48	5.3	0.25	–18.6	96.90 ± 0.63	360 ± 50
HAM-2425	48–50	5.1	0.33	–18.8	93.76 ± 0.62	620 ± 50
HAM-2426	50–52	6.0	0.35	–19.0	95.70 ± 0.73	450 ± 60
HAM-2427	52–54	4.9	0.33	–18.8	93.88 ± 0.62	610 ± 50

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TABLE 22. Chum Pae (Continued)

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2428	54–56	5.3	0.25	−19.0	87.74 ± 0.70	1150 ± 60
HAM-2429	56–58	5.3	0.24	−19.1	87.08 ± 0.69	1210 ± 60
HAM-2430	58–60	5.1	0.30	−19.4	88.19 ± 0.69	1100 ± 60
HAM-2431	60–62	5.0	0.23	−19.3	89.90 ± 0.60	950 ± 50
HAM-2432	62–64	5.4	0.12	−19.8	90.40 ± 0.60	890 ± 50
HAM-2433	64–66	5.1	0.30	−19.9	86.62 ± 0.69	1240 ± 60
HAM-2434	66–68	5.0	0.22	−19.9	91.60 ± 0.61	790 ± 50
HAM-2435	68–70	5.1	0.22	−20.3	88.19 ± 0.75	1090 ± 70
HAM-2436	70–72	5.3	0.25	−20.1	86.10 ± 0.72	1280 ± 70
HAM-2437	72–74	5.2	0.28	−20.4	89.61 ± 0.61	960 ± 60
HAM-2438	74–76	5.8	0.19	−20.6	89.28 ± 0.60	980 ± 50
HAM-2439	76–78	5.4	0.25	−20.5	88.66 ± 0.60	1040 ± 50
HAM-2440	78–80	5.8	0.25	−20.8	85.36 ± 0.69	1340 ± 70
HAM-2441	80–82	5.9	0.18	−20.9	85.86 ± 0.79	1290 ± 70
HAM-2442	82–84	5.8	0.25	−20.9	87.42 ± 0.60	1150 ± 60
HAM-2443	84–86	5.5	0.16	−21.2	90.01 ± 0.62	910 ± 60
HAM-2444	86–88	5.7	0.18	−21.2	87.71 ± 0.60	1110 ± 60
HAM-2466	88–90	6.2	0.23	−21.4	88.77 ± 0.60	1020 ± 60
HAM-2467	90–92	5.8	0.16	−21.3	83.98 ± 0.68	1460 ± 70

KLONG LUANG

Profile-Related Data

Location (longitude, latitude): 14°05′N, 100°44′E
Location (country, next city or village): Thailand, Klong Luang near Bangkok
Soil order and type (USDA classification): Sulfic Tropaquept, loamy, mixed, acid, isohyperthermic
Soil order and type (local classification): Rangsit series
Parent material: River alluvium
Mean annual temperature: 27°C
Annual rainfall: 1300 mm
Vegetation and land use: Rice
Site description:

The soil, located at Klong Luang north of Bangkok, is representative of the acid sulfate soils that cover *ca.* 8000 km^2 in the Bangkok Plain. These soils were studied in detail by van Breemen (1976); a similar profile of Rangsit series is described in his book. By ^{14}C dating of peat material, van der Kevie (1972) estimated the formation of the tidal marsh deposits at *ca.* 3100 yr ago.

Date of sampling: 1984
Date of measurement: 1986
Collector: S. Pongpan, P. Snitwongse
Submitter: P. Snitwongse, Becker-Heidmann
Submitter's comment:

The pH is very low throughout the profile due to the high sulfate content. The carbon content is only 1.3% in the topsoil, but does not decrease much to the subsoil. The $\delta^{13}C$ value near the surface is the normal one for tropical rice soils (*cf.* the other soils in this study), but the increase with depth in the topsoil of this profile is the lowest. The ^{14}C activity in this soil is one of the lowest of all studied rice soils. Together with the small increase of $\delta^{13}C$, it suggests that there has been very little input of organic matter. Otherwise, the ^{14}C age of the subsoil could not have reached the age of the sediments, mentioned above in the soil description (*cf.* van der Kevie 1972).

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Literature references: Becker-Heidmann (1990)

Description of the Profile at Klong Luang:

Depth (cm)	Horizon	Description
0–10	Ap1g	Black (10YR 2/1), yellowish brown (10YR 5/6) mottles, frequent very fine roots
10–22	Ap2g	Black, few yellowish brown and red mottles, many very fine roots
22–30	A2g	Brown to dark grayish brown, very few very fine roots
30–42	B1g	Brown to dark brown, brown and red mottles, few very fine roots
42–58	B21g	Brown to dark brown, many red and "straw" yellow mottles, very few very fine roots
58+	B22g	Brown, "straw" yellow mottle, very few very fine roots

TABLE 23. Klong Luang

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2468	0–2	4.3	1.39	−22.6	106.01 ± 0.67	Modern
HAM-2469	2–4	4.4	1.31	−22.2	105.12 ± 0.66	Modern
HAM-2470	4–6	4.6	1.32	−22.2	99.99 ± 0.74	50 ± 60
HAM-2471	6–8	4.6	1.32	−21.9	104.83 ± 0.66	Modern
HAM-2472	8–10	4.3	1.41	−22.2	98.87 ± 0.79	140 ± 60
HAM-2473	10–12	4.4	1.38	−22.0	100.27 ± 0.75	Modern
HAM-2474	12–14	4.5	1.31	−21.2	104.03 ± 0.70	Modern
HAM-2475	14–16	4.5	1.21	−21.7	102.39 ± 0.65	Modern
HAM-2476	16–18	4.3	1.25	−20.8	89.67 ± 0.70	940 ± 60
HAM-2477	18–20	4.3	1.27	−20.2	95.60 ± 0.63	440 ± 50
HAM-2478	20–22	4.1	1.25	−20.4	85.71 ± 0.68	1310 ± 60
HAM-2479	22–24	4.0	1.30	−20.4	85.39 ± 0.59	1340 ± 60
HAM-2480	24–26	4.0	1.21	−21.0	80.22 ± 0.68	1840 ± 70
HAM-2481	26–28	4.2	1.15	−21.2	83.23 ± 0.60	1540 ± 60
HAM-2482	28–30	3.8	1.10	−20.9	81.20 ± 0.67	1740 ± 70
HAM-2483	30–32	4.3	0.98	−21.3	77.94 ± 0.69	2060 ± 70
HAM-2484	32–34	4.2	0.84	−21.2	80.39 ± 0.57	1820 ± 60
HAM-2485	34–36	3.7	0.81	−21.3	75.51 ± 0.65	2320 ± 70
HAM-2486	36–38	4.2	0.86	−21.1	79.21 ± 0.56	1930 ± 60
HAM-2487	38–40	3.9	0.79	−21.3	73.10 ± 0.63	2580 ± 70
HAM-2488	40–42	4.0	0.78	−21.0	75.84 ± 0.55	2290 ± 60
HAM-2489	42–44	4.0	0.72	−21.0	71.58 ± 0.63	2750 ± 70
HAM-2490	44–46	4.1	0.75	−21.0	74.94 ± 0.55	2380 ± 60
HAM-2491	46–48	4.0	0.74	−21.2	68.70 ± 0.61	3080 ± 70
HAM-2492	48–50	4.2	0.80	−21.1	74.04 ± 0.55	2480 ± 60
HAM-2493	50–52	4.0	0.79	−21.1	69.77 ± 0.65	2950 ± 70
HAM-2494	52–54	3.8	0.84	−21.3	73.02 ± 0.54	2590 ± 60
HAM-2495	54–56	3.9	0.77	−21.4	68.82 ± 0.69	3060 ± 80
HAM-2496	56–58	4.0	0.84	−21.7	67.15 ± 0.92	3250 ± 110
HAM-2497	58–60	4.2	0.88	−21.8	70.74 ± 0.54	2830 ± 60
HAM-2498	60–62	4.4	0.85	−21.9	65.47 ± 0.69	3450 ± 90
HAM-2499	62–64	4.3	0.84	−22.2	66.36 ± 0.60	3340 ± 70

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Tachiat, Profile 1

Profile-Related Data

Location (longitude, latitude):	7°22′N, 100°10′E
Location (country, next city or village):	Thailand, Tachiat, *ca.* 60 km northwest of Songkhla
Soil order and type (FAO classification):	Gleyic Acrisol
Soil order and type (USDA classification):	Typic Paleaquult, clayey-kaolonitic isohyperthermic
Soil order and type (local classification):	Bang Nara series
Parent material:	Marine sediment
Mean annual temperature:	27.6°C
Annual rainfall:	2500 mm
Vegetation and land use:	Farmers have grown rice at this site since land clearing > 40 yr ago. For the last 20 yr, rice has been planted nearly every rainy season, while during the dry season the soil was allowed to lie fallow.
Site description:	20 m asl

The field was located *ca.* 10 km from the lagoon of Phattalung on the experimental site of the Soils Department of Prince of Songkhla University. Puddling was usually done to a depth of ~13 cm. The hardpan was at *ca.* 40–50 cm depth. The surface had previously been undulating, but was leveled only a short time before sampling. Profile 1 was nearly unaffected by this, whereas Profile 2 was prepared within the former lower and now filled part of the field. The groundwater table at time of sampling was at 56 cm depth.

Date of sampling:	1990
Date of measurement:	1991
Collector:	Becker-Heidmann, Apinan Kamnalrut
Submitter:	Becker-Heidmann, Apinan Kamnalrut

Submitter's comment:

The pH of the Tachiat soils is very low. Both soils have a pH of only 4, with nearly no variation throughout the profile. The soil contains no carbonate, and the carbon content is also rather low. The low $\delta^{13}C$ value indicates little decomposition and humus maintanance. The only slight enrichment of $\delta^{13}C$ between the surface soil and the bottom of the puddling layer supports this interpretation. In particular, no additional anaerobic decomposition with methane production can be assumed based on this depth distribution. In the subsoil, the $\delta^{13}C$ value decreases, which means that there is no considerable transport of freshly decomposed organic matter into the deeper part of the soil. The ^{14}C activity in the topsoil reflects the actual ^{14}C activity of the atmosphere, supporting the thesis of reduced decomposition. Below the puddling zone, the ^{14}C activity sharply decreases, again indicating impeded percolation, down to a value of 84 pMC, which corresponds to a ^{14}C age of *ca.* 1400 BP. Obviously, the soil development within this alluvial sediment is relatively young. The comparable rice soil at Klong Luang shows ^{14}C ages up to 3400 BP.

Literature references: Becker-Heidmann (1992); Drachenberg (1992)

Description of Profile at Tachiat 1

Depth / cm	Horizon	Description
0–18	Apg	Brown (10 YR 5/3), with reddish mottles
18–30	B1g	Very pale brown (10YR 7/4), spotted, with microcracks coated with iron (5YR 5/8)
30–40	B21g	Light gray (10YR 7/2), microcracks coated (5YR 5/8)
40–52	B22g	Brown with red mottles (10YR 4/8), high coarse sand content
52+	B23g	Very pale brown with red mottles, water table at 56 cm

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TABLE 24. Tachiat, Profile 1

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-3070	0–2	4.1	1.07	−25.9	105.07 ± 0.75	Modern
HAM-3071	2–4	4.0	1.05	−24.6	105.76 ± 0.76	Modern
HAM-3072	4–6	3.8	0.97	−24.7	106.06 ± 0.76	Modern
HAM-3073	6–8	3.9	0.94	−24.6	106.52 ± 0.75	Modern
HAM-3074	8–10	3.9	0.99	−24.9	105.40 ± 0.75	Modern
HAM-3075	10–12	4.0	0.98	−25.3	105.89 ± 0.75	Modern
HAM-3076	12–14	3.9	0.99	−24.5	106.96 ± 0.74	Modern
HAM-3077	14–16	4.0	0.98	−24.9	105.87 ± 0.74	Modern
HAM-3078	16–18	4.0	0.99	−25.1	104.13 ± 0.74	Modern
HAM-3079	18–20	4.0	0.92	−24.4	105.30 ± 0.74	Modern
HAM-3080	20–22	3.9	0.91	−24.1	105.70 ± 0.75	Modern
HAM-3081	22–24	4.0	0.74	−23.9	104.07 ± 0.74	Modern
HAM-3082	24–26	4.1	0.51	−24.0	99.62 ± 0.72	50 ± 70
HAM-3083	26–28	4.1	0.40	−24.2	96.57 ± 0.71	290 ± 70
HAM-3084	28–30	4.0	0.38	−24.5	92.80 ± 0.71	610 ± 70
HAM-3085	30–32	4.0	0.34	−25.0	91.91 ± 0.69	680 ± 70
HAM-3086	32–34	3.9	0.38	−24.9	90.62 ± 0.69	790 ± 70
HAM-3087	34–36	4.0	0.33	−25.2	88.72 ± 0.70	960 ± 70
HAM-3088	36–38	4.0	0.33	−25.1	90.56 ± 0.70	790 ± 70
HAM-3089	38–40	3.9	0.32	−25.1	88.23 ± 0.68	1000 ± 70
HAM-3090	40–42	3.9	0.32	−25.5	89.61 ± 0.69	870 ± 70
HAM-3091	42–44	3.9	0.33	−25.4	88.65 ± 0.69	960 ± 70
HAM-3092	44–46	3.9	0.32	−25.3	86.63 ± 0.68	1150 ± 70
HAM-3093	46–48	3.9	0.32	−25.6	86.40 ± 0.70	1160 ± 70
HAM-3094	48–50	4.0	0.31	−25.3	86.09 ± 0.69	1200 ± 70
HAM-3095	50–52	3.9	0.31	−25.4	86.00 ± 0.67	1200 ± 70
HAM-3096	52–54	3.9	0.30	−25.6	85.52 ± 0.68	1250 ± 70
HAM-3097	54–56	4.0	0.31	−25.6	83.50 ± 0.67	1440 ± 70
HAM-3098	56–58	4.0	0.31	−25.6	84.08 ± 0.67	1380 ± 70
HAM-3099	58–60	4.0	0.31	−25.9	85.73 ± 0.68	1220 ± 70
HAM-3100	60–62	4.0	0.30	−25.4	85.91 ± 0.71	1210 ± 70

TACHIAT, PROFILE 2

Profile-Related Data

Same as Profile 1 except:

Date of measurement: 1991/1992

Submitter's comment:

The second profile does not differ from the first one regarding pH and carbon content in general. Only the humus layer is higher, as explained above. The $\delta^{13}C$ value is nearly the same within the topsoil. There is one exceptionally high value at *ca.* 17 cm depth, but the $\delta^{13}C$ value decreases in the subsoil and is generally lower than in Profile 1. Thus, we cannot detect a loss of organic substances by percolation. ^{14}C activity is slightly higher than in Profile 1, which means that the decomposition is even less intensive. The corresponding ^{14}C age within the subsoil reaches only *ca.* 1100 BP.

Literature references: Becker-Heidmann 1992; Drachenberg 1992

Description of Profile at Tachiat 2

Depth / cm	Horizon	Description
0–14	Ap1g	Dark gray with mottles, cracks, probably deposited Ap material

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14–32	Ap2g	Dark gray with more mottles (Fe?), probably original Ap
32–52	B1g	Light gray with orange-brown mottles (5YR 5/8)
52+	B2g	Orange-brown–light gray mottled, red mottles (less than at Tachiat 1), water table at 56 cm

TABLE 25. Tachiat, Profile 2

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-3101	0–2	4.1	1.13	–25.0	105.65 ± 0.73	Modern
HAM-3102	2–4	4.1	1.15	–24.9	105.54 ± 1.07	Modern
HAM-3103	4–6	4.1	1.10	–25.1	105.40 ± 0.78	Modern
HAM-3104	6–8	4.0	1.13	–24.9	105.02 ± 0.76	Modern
HAM-3105	8–10	4.1	1.20	–24.8	105.94 ± 0.74	Modern
HAM-3106	10–12	4.1	1.12	–24.8	109.99 ± 0.76	Modern
HAM-3107	12–14	4.1	1.12	–25.3	107.53 ± 0.75	Modern
HAM-3108	14–16	4.1	1.01	–25.0	106.62 ± 0.74	Modern
HAM-3109	16–18	4.1	0.96	–24.9	109.81 ± 0.75	Modern
HAM-3110	18–20	4.1	1.00	–25.3	110.34 ± 0.75	Modern
HAM-3111	20–22	4.1	0.85	–25.2	110.01 ± 0.82	Modern
HAM-3112	22–24	4.0	0.96	–25.3	105.71 ± 0.76	Modern
HAM-3113	24–26	4.2	0.86	–25.6	109.06 ± 0.74	Modern
HAM-3114	26–28	4.2	0.64	–26.0	104.14 ± 0.74	Modern
HAM-3115	28–30	4.2	0.45	–26.1	101.31 ± 0.73	Modern
HAM-3116	30–32	4.2	0.38	–26.2	96.49 ± 0.72	270 ± 70
HAM-3117	32–34	4.2	0.30	–26.9	94.58 ± 0.71	420 ± 70
HAM-3118	34–36	4.0	0.29	–26.5	93.88 ± 0.72	480 ± 70
HAM-3119	36–38	4.0	0.30	–26.4	92.36 ± 0.69	620 ± 70
HAM-3120	38–40	4.1	0.30	–26.5	91.90 ± 0.69	650 ± 70
HAM-3121	40–42	4.0	0.31	–27.0	93.27 ± 0.71	530 ± 70
HAM-3122	42–44	4.1	0.29	–26.8	89.20 ± 0.69	890 ± 70
HAM-3123	44–46	4.1	0.31	–26.6	92.77 ± 0.71	580 ± 70
HAM-3124	46–48	4.1	0.31	–26.7	92.69 ± 0.71	580 ± 70
HAM-3125	48–50	4.0	0.31	–26.1	90.16 ± 0.72	810 ± 70
HAM-3126	50–52	4.0	0.29	–26.9	89.36 ± 0.72	870 ± 70
HAM-3127	52–54	4.1	0.29	–27.3	87.82 ± 0.69	1010 ± 70
HAM-3128	54–56	4.1	0.28	–27.6	87.19 ± 0.68	1060 ± 70
HAM-3129	56–58	4.1	0.28	–27.7	87.94 ± 0.70	990 ± 70

TONSANG

Profile-Related Data

Location (longitude, latitude):	18°52′N, 99°02′E
Location (country, next city or village):	Thailand, Tonsang near San Sai, *ca.* 10 km northeast of Chiang Mai
Soil order and type (USDA classification):	Typic Tropaqualf
Soil order and type (local classification):	Low humic gley soil, Hang Dong series
Mean annual temperature:	25°C
Annual rainfall:	1220 mm
Vegetation and land use:	The experimental site has been cultivated for rice and soybean rotation for *ca.* 10 yr.

Site description:

The soil was very homogeneous. The groundwater level was at *ca.* 52 cm depth the first sampling day and rose to *ca.* 40 cm the second day.

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Date of sampling:	1991
Date of measurement:	1992
Collector:	Becker-Heidmann, Drachenberg, Arayangkoon
Submitter:	Becker-Heidmann, Arayangkoon

Submitter's comment:

The pH value is generally high, *ca.* 6.3 throughout the B1 and B2g horizons and the surface layer. Amazingly, the pH depth distribution curve shows a minimum of 5.6 between 6 and 10 cm depth, which is the main rooting zone. The carbon content is very low because of either rapid turnover or low input of organic crop residues. The decrease of carbon with depth within the topsoil, which is unusual for a plowed horizon, supports the rapid turnover hypothesis. The $\delta^{13}C$ value is generally high at the same level as the other studied tropical soils. If no C_4 plant has been grown in the past, the high value of 22‰ may be, in principle, a result of either anaerobic decomposition with methane production, or decomposing C_4 weeds, or exudation of carbohydrates from the roots during the past when the plot was used for rice. The increase from top to bottom of the Ap horizon by *ca.* 3‰ stands for high microbiological activity. The decrease within the B2g horizon is due to its anaerobic conditions (Becker-Heidmann 1990; Stout, Goh and Rafter 1981). The varying value near the top of the B2g horizon is probably a result of changes in the groundwater table. The depth distributions of carbon content, $\delta^{13}C$ value and ^{14}C activity indicate a high decomposition rate rather than low input of organic matter.

Literature references: Becker-Heidmann (1992)

Description of Profile at Tonsang

Depth / cm	Horizon	Description
0–16	Apg	Loamy clay, dark grayish brown (2.5Y 4/2), many fine roots, iron at root channels
16–25	B1g	Silty clay, yellowish brown (2.5Y 5/4), many fine roots, red mottles (Fe)
25–52+	B2g	Sandy clayey loam, pale red (2.5YR 6/2), few roots

TABLE 26. Tonsang

Lab code	Depth (cm)	pH	C	$\delta^{13}C$	^{14}C activity	^{14}C age
HAM-2837	0–2	6.8	1.35	−22.0	117.92 ± 0.84	Modern
HAM-2838	2–4	6.3	1.29	−21.6	119.37 ± 0.66	Modern
HAM-2839	4–6	5.8	1.17	−21.1	120.17 ± 0.84	Modern
HAM-2840	6–8	5.6	1.00	−21.1	120.63 ± 0.86	Modern
HAM-2841	8–10	5.6	0.92	−21.0	122.13 ± 0.85	Modern
HAM-2842	10–12	5.7	0.77	−21.4	121.46 ± 0.86	Modern
HAM-2843	12–14	6.1	0.44	−20.6	115.39 ± 0.65	Modern
HAM-2844	14–16	6.3	0.26	−19.3	105.37 ± 0.79	Modern
HAM-2845	16–18	6.4	0.17	−19.5	101.76 ± 0.76	Modern
HAM-2846	18–20	6.3	0.22	−19.4	101.77 ± 0.63	Modern
HAM-2847	20–22	6.3	0.17	−20.1	100.87 ± 0.60	Modern
HAM-2848	22–24	6.3	0.21	−19.9	100.82 ± 0.74	Modern
HAM-2849	24–26	6.3	0.17	−20.5	101.77 ± 0.60	Modern
HAM-2850	26–28	6.3	0.16	−20.3	100.41 ± 0.60	Modern
HAM-2851	28–30	6.3	0.16	−20.1	96.98 ± 0.77	330 ± 70
HAM-2910	30–32	6.3	0.16	−21.0	98.38 ± 0.73	200 ± 60
HAM-2911	32–34	6.3	0.13	−20.0	96.80 ± 0.62	340 ± 50
HAM-2912	34–36	6.2	0.12	−21.1	95.78 ± 0.59	410 ± 50
HAM-2913	36–38	6.3	0.11	−20.6	94.87 ± 0.75	490 ± 60
HAM-2914	38–40	6.3	0.10	−20.3	95.04 ± 0.73	480 ± 60
HAM-2915	40–42	6.3	0.10	−20.6	95.80 ± 0.61	420 ± 50

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