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HAMBURG UNIVERSITY RADIOCARBON DATES III

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The following list consists of dates of soil samples, partly produced in the former Bonn laboratory and bearing the code designations, BONN, and partly in the present dating lab at Hamburg University. The list comprises Mollisols and Inceptisols from Germany, sampled by layer and dated as whole soil, hydrolysis residue, and hydrolysate. Other profiles represent selected Australian Vertisols and Krasnozems, sampled by layer as well. Dates derived from marshes of the Elbe River as well as from paleosols buried by coastal levees are also included in the list. Pretreatment of soil samples is described in Scharpenseel and Pietig (1969) and Scharpenseel (1972; 1977).

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Germany

Soil profile dating was done on 5cm layers of Hapludoll in Würmian loess, near town of Söllingen, S of Brunswick (52° 5′ N, 10° 59′ E). First profile is highly organic and near surface. As much as possible, dates derived from original soil after removal of carbonate C were compared with dates of 6N HCl hydrolysate, of hydrolysis residue, and of acid phase used for carbonate destruction. Results, with other data sets, will contribute to integrated soil organic matter decomposition model, comprising initial phase of exponential decomposition of uniformly labeled plant material as well as steady-state slowed phase based on natural ^{14}C measurements (Scharpenseel & Neue, in press). Tables 1 and 2 show our results.

Samples coll and subm 1976 by H W Scharpenseel and H Schiffmann. Histic Hapludoll (BONN-2225 to -2272) shows expected increased age with depth, but with inflection below 70cm. Observed repeatedly, this could reflect earthworm transport of young, nearsurface organics, deep into soil when worms descend for hibernation. As demonstrated, HAM-623 to -801 (R, v 19, p 177), first 6 N HCl hydrolysis residue is not much older than original carbonate-free soil. Hydrolysate, itself, lags behind apparent age of residue. All samples based on acid from carbonate destruction are very small. Ages obtained are erratic and represent mixtures of atmospheric and dissolved carbonate-C species.

Typic Hapludoll (BONN-2275 to -2289) reveals generally younger dates. We discovered after sampling, that area was covered temporarily by sugar beet earth silo. Leachates produced rejuvenation. Again, there was age inflection below 65cm, possibly due to earthworm transport. Hydrolysate residues are markedly older; hydrolysate itself on bomb carbon level. Obviously, acid hydrolysis could remove part but not all leached, rejuvenating C. Dates produced from C in acid from carbonate

TABLE 1

Histic Hapludoll, 5km S of Söllingen

	Carbonate-free soil			6 N HCl hydrolysate residue		6 N HCl hydrolysate		Acid from carbonate destruction	
BONN no.	Depth (cm)	C content	Date	BONN no.	Date	BONN no.	Date	BONN no.	Date
-2255	0-5	27.1	1430 ± 60	-2401	1470 ± 100	-2400	640 ± 60		
-2256	5-10	19.7	1110 ± 60	-2403	1540 ± 60	-2402	830 ± 50		
-2257	10-15	22.9	1490 ± 50	-2405	1570 ± 70	-2404	830 ± 50		
-2258	15-20	11.7	1190 ± 50	-2407	1510 ± 60	-2406	670 ± 60	-2438	1740 ± 70
-2259	20-25	8.9	1460 ± 50	-2409	1840 ± 70	-2408	1100 ± 50	-2439	130 ± 50
-2260	25-30	7.7	1890 ± 60	-2411	2510 ± 80			-2457	3550 ± 70
-2261	30-35	5.1	3610 ± 70	-2413	3270 ± 130	-2412	3240 ± 70	-2456	3570 ± 70
-2262	35-40	4.5	3820 ± 80	-2415	2210 ± 100	-2414	2960 ± 100		
-2263	40-45	4.2	4280 ± 60	-2417	3350 ± 70	-2416	1180 ± 60	-2441	2250 ± 100
-2264	45-50	4.3	4570 ± 80	-2419	4680 ± 70			-2442	2930 ± 100
-2265	50-55	4.2	4920 ± 70	-2421	4840 ± 80	-2420	2550 ± 150	-2443	2700 ± 80
-2266	55-60	4.3	5770 ± 70	-2423	5550 ± 50	-2422	1910 ± 110		
-2267	60-65	2.3	5650 ± 70	-2425	5120 ± 80			-2445	880 ± 120
-2268	65-70	2.1	6120 ± 90	-2427	6370 ± 80	-2426	2520 ± 250		
-2269	70-75	1.8	4410-± 60	-2429	4990 ± 100	-2428	1730 ± 260	-2447	2660 ± 230
-2270	75-80	1.8	4870 ± 60					-2448	2130 ± 210
-2271	80-85	1.2	4510 ± 80	-2433	5690 ± 270			-2449	3080 ± 240
-2272	85-90	0.6	4440 ± 90					-2450	1140 ± 460

TABLE 2

Typic Hapludoll Söllingen, near old windmill

	Carbonate-free soil			6 N HCl hydrolysate residue		6 N HCl hydrolysate		Acid from carbonate destruction	
BONN no.	Depth (cm)	C content	Date	BONN no.	Date	BONN no.	Date	BONN no.	Date
-2275	0-5	4.5	500 ± 60	-2476	3320 ± 80	-2475	111.2% mod		
-2276	5-10	3.9	950 ± 50	-2478	1450 ± 70	-2477	110.1% mod		
-2277	10-15	6.3	1040 ± 60						
-2278	15-20	3.9	1100 ± 50						
-2279	20-25	3.9	1190 ± 50	-2484	2170 ± 90	-2483	105.7% mod	-2459	240 ± 90
-2280	25-30	3.5	1110 ± 50	-2486	2380 ± 70	-2485	40 ± 60	-2460	103.8% mod
-2281	30-35	3.6	1240 ± 60	-2488	600 ± 60	-2487	105.3% mod	-2461	106.4% mod
-2282	35-40	3.2	1320 ± 50	-2490	2500 ± 50	-2489	115.1% mod		
-2283	40-45	1.9	1600 ± 50	-2492	3260 ± 60	-2491	103.5% mod	-2463	101.0% mod
-2287	60-65	2.2	2450 ± 60	-2500	3040 ± 140	-2499	101.7% mod	-2467	108.0% mod
-2288	65-70	1.7	960 ± 60	-2502	1860 ± 70	-2501	105.2% mod	-2468	116.3% mod
-2289	70-75	1.6	520 ± 80	-2504	1680 ± 90	-2503	134.7% mod	-2469	106.0% mod

destruction were all modern and consisted predominantly of atmospheric young carbon, bomb carbon levels being reduced by intermixture with small dissolved quantities of old carbonate C.

Five-cm layers from Eutrochrept profile near Hohentrüdingen in Jurassic (Dogger), loam and Haplaquept, on Isar terrace, loess, near Landshut/Ergolding.

Hohentrüdingen, Nördlinger Ries crater (49° 0′ N, 10° 42′ E).

HAM-635.	5 to 10cm	102.6 ± 0.5% modern
HAM-636.	10 to 15cm	200 ± 90
HAM-637.	15 to 20cm	102.9 ± 0.4% modern
HAM-638.	20 to 25cm	160 ± 70
HAM-639.	25 to 30cm	860 ± 70
HAM-640.	30 to 35cm	2110 ± 80
HAM-641.	35 to 40cm	2700 ± 90
HAM-642.	40 to 45cm	3020 ± 80
HAM-643.	45 to 50cm	4170 ± 90
HAM-644.	50 to 55cm	5160 ± 90
HAM-645.	55 to 60cm	3880 ± 70
HAM-646.	60 to 65cm	3550 ± 90
HAM-647.	65 to 70cm	6700 ± 80
HAM-648.	70 to 75cm	8500 ± 130
HAM-649.	75 to 80cm	10,920 ± 140
HAM-650.	80 to 85cm	10,980 ± 140
HAM-651.	85 to 90cm	13,750 ± 190
HAM-652.	90 to 95cm	13,250 ± 180
HAM-653.	95 to 100cm	13,440 ± 180
HAM-654.	100 to 105cm	16,770 ± 280

Samples coll and subm 1976 by H Schiffmann and B Hofmann, Bayrisches Geol Landesamt, München. Explorative samples of same area are HAM-47 to -49 (R, v 18, p 272). Age inflection of HAM-645 and -646 could be due to slightly vertic properties of soil by migration through cracks. Dates will be used for decomposition model.

Landshut/Ergolding, loess, lowest Isar terrace (48° 35′ N, 12° 11′ E).

HAM-655.	0 to 5cm	110.0 ± 0.6% modern

HAM-656.	5 to 10cm	105.2 ± 0.8% modern
HAM-657.	10 to 15cm	105.6 ± 0.7% modern
HAM-658.	15 to 20cm	108.7 ± 0.9% modern
HAM-659.	20 to 25cm	720 ± 100
HAM-660.	25 to 30cm	180 ± 70
HAM-661.	30 to 35cm	2170 ± 80
HAM-662.	35 to 40cm	3440 ± 80
HAM-663.	40 to 45cm	4210 ± 90
HAM-664.	45 to 50cm	3810 ± 90
HAM-665.	50 to 55cm	4990 ± 80
HAM-666.	55 to 60cm	4980 ± 90
HAM-667.	60 to 65cm	5550 ± 80
HAM-668.	65 to 70cm	4970 ± 90
HAM-669.	70 to 75cm	5560 ± 80
HAM-670.	75 to 80cm	3990 ± 90
HAM-671.	80 to 85cm	2930 ± 80
HAM-672.	85 to 90cm	3090 ± 70

Samples coll and subm 1976 by H Schiffmann and B Hofmann, Bayrisches Geol Landesamt, München. Age inflection of HAM-670 to -672 not easy to explain, but same trend was observed in other profiles, perhaps result of animal transport. Age *vs* depth series of dates to be used for decomposition model.

Humic matter in coastline levee along Eastern Sea coast near Heiligenhafen (54° 29′ N, 10° 55′ E).

BONN-2367.	Cliff wall, sampling spot G 75/2, 16 to 26cm	300 ± 60
BONN-2368.	37 to 47cm	460 ± 60
BONN-2370.	55 to 65cm	880 ± 80
BONN-2372.	Sampling spot G 75/3, 20 to 30cm	360 ± 70
BONN-2373.	40 to 50cm	870 ± 70
BONN-2375.	98 to 110cm	2300 ± 70
BONN-2376.	110 to 120cm	1760 ± 70
BONN-2377.	130 to 140cm	1780 ± 100
BONN-2378.	Sampling spot G 75/4, 10 to 20cm	210 ± 70

BONN-2379.	105 to 115cm	200 ± 70
BONN-2380.	150 to 160cm	1090 ± 120
BONN-2381.	175 to 185cm	1180 ± 70
BONN-2382.	Sampling spot G 75/5, 120 to 130cm	1440 ± 80
BONN-2383.	130 to 140cm	2440 ± 70
BONN-2384.	140 to 155cm	2970 ± 80
BONN-2385.	158 to 165cm	6240 ± 110

Samples coll and subm 1975 by D Goetz, Ordin Bodenkunde, Univ Hamburg. *Comment*: results are supplemental to dates HAM-123 to -127 (R, v 18, p 279), helping date beach wall formation. Most C relics rather young, Sub-atlantic/Sub-boreal, except BONN-2385, reflecting origin in period of climatic optimum.

Elbe River marsh series, Allermöhe, Vier- und Marschlande, S Hamburg.

HAM-826. Allermöhe, Pastoratsweg, field plot near cemetery (53° 28′ N, 10° 7′ E) peat, 80 to 90cm. 2670 ± 80

HAM-827. 90 to 100cm 2090 ± 80

HAM-828. Allermöhe, cemetery between church and dike (53° 28′ N, 10° 7′ E) 430 to 440cm. 2220 ± 70

HAM-829. Peat, 440 to 450cm 2370 ± 80

HAM-830. Peat, 450 to 460cm 2640 ± 70

HAM-831. Allermöhe, church, below tower, old warft (settlement), peat (52° 28′ N, 10° 7′ E), 340 to 360cm. 2040 ± 70

HAM-832. Peat, 360 to 380cm 1470 ± 70

HAM-833. Peat, 380 to 400cm 2270 ± 80

HAM-834. Allermöhe, marsh, super-hwy line, peat (58° 28′ N, 10° 9′ E), 160 to 180cm. 1440 ± 70

HAM-835. Fossil A-horizon, 210 to 215cm 7420 ± 110

HAM-836. Allermöhe, church, buried fossil soil (A-horizon) (53° 28′ N, 10° 7′ E), 290 to 310cm. 1560 ± 70

HAM-837. Allermöhe, cemetery (old part), fossil A-horizon (53° 28′ N, 10° 7′ E), 275 to 295cm. 3970 ± 80

HAM-838. Humic clay, 355 to 375cm 2110 ± 70

HAM-839. Peat, 375 to 390cm 3240 ± 70

HAM-840. Basal peat, 420 to 430cm 3790 ± 70

HAM-841. Allermöhe, cemetery (new part), peat, (53° 28′ N, 10° 7′ E), 245 to 255cm. 2890 ± 80

Samples coll and subm 1976 by B Hintze. *Comment*: dated peats belong stratigraphically to same phase as samples, HAM-794 to -799 (R, v 19, p 179), Sub-boreal and early Sub-atlantic: divergent ages signify soil surfaces of different dates of origin (church and cemetery warft). They also relate to differing growth periods of peat layers and different grades of their compaction. Fossil Ah horizon of HAM-835 probably represents formation of Boreal soil at surface of early Holocene sands.

Peat samples underlying valley of Elbe River, sampled in three cross-sections E and W of Hamburg.

HAM-1393. Hamburg-Allermöhe, peat, (53° 31′ N, 10° 6′ E), 80 to 90cm. 3560 ± 70

HAM-1394. Hamburg-Moorfleet, peat, (53° 30′ N, 20° 6′ E), 140 to 150cm. 3810 ± 80

HAM-1395. Peat, 130 to 140cm 3850 ± 80

HAM-1396. Peat, 110 to 120cm 3060 ± 80

HAM-1397. Peat, 170 to 180cm 2790 ± 80

HAM-1398. Hamburg-Moorfleet, peat (53° 30′ N, 10° 6′ E), 160 to 170cm. 2220 ± 80

HAM-1399. Altes Land/Agathenburg, peat (53° 35′ N, 9° 33′ E), 500 to 510cm. 4770 ± 80

HAM-1400. Altes Land/Agathenburg, peat (53° 34′ N, 9° 32′ E), 310 to 320cm. 4590 ± 80

HAM-1401. Peat, 320 to 330cm 5320 ± 90

HAM-1402. Altes Land/Agathenburg, peat (53° 35.5′ N, 9° 34′ E), 540 to 550cm. 4970 ± 80

HAM-1403. Haseldorfer Marsch, peat (53° 38′ N, 9° 37.5′ E), 620 to 630cm. 4980 ± 80

HAM-1404. Hamburg-Neuland, basal peat (53° 27′ N, 10° 1.5′ E), 260 to 270cm. 8140 ± 100

HAM-1405. Hamburg-Spadenland, peat (53° 29′ N, 10° 3.5′ E), 190 to 200cm. 3400 ± 70

HAM-1406. Altes Land/Agathenburg, peat (53° 34′ N, 9° 32′ E), 360 to 370cm. 4700 ± 90

Samples coll and subm 1977 by B Hintze. *Comment*: two growth phases of peat can be distinguished in Elbe valley, dist Hamburg, older

one between 5000 and 4500 BP, which is limited to Altes Land and Haseldorfer Marsch regions; younger one between 4200 and 3000 BP in region of Vier and Marschlande.

^{14}C age at base of peat layer, which reaches depth up to 6m, eg, in Hamburg Neuland (HAM-1404), proves that peat began to form in this area during Boreal. Date also indicates that Elbe R did not reach this area before younger, Sub-atlantic period, since peat growth was nowhere interrupted by sedimentation phase.

Australia

Two typic Australian Vertisol and Oxisol (Krasnozem) profiles were dated by layers. Investigations of natural ^{14}C scanning of Australian Vertisols and Krasnozems are continuing (see BONN-664 to -772; R, v 15, p 258-263) for testing C dynamics of these soils.

Vertisol (Chromustert) on gently undulating plain at +300m, in Chinchilla, 80m from profile 10c(B554) (Handbook of Australian Soils, 1968, p 88-90). Deeply weathered profile on Mesozoic sandstone, covered with *Acacia harpophylla* (26° 43′ S, 150° 36′ E).

HAM-674.	2.58% C, 0 to 10cm	100 ± 70
HAM-675.	1.48% C, 10 to 20cm	110 ± 70
HAM-676.	1.01% C, 20 to 30cm	120 ± 70
HAM-677.	0.65% C, 30 to 40cm	660 ± 80
HAM-678.	0.59% C, 40 to 50cm	1200 ± 80
HAM-679.	0.53% C, 50 to 60cm	1350 ± 80
HAM-680.	0.48% C, 60 to 70cm	2430 ± 80
HAM-681.	0.42% C, 70 to 80cm	2500 ± 80
HAM-682.	0.43% C, 80 to 90cm	2280 ± 100
HAM-684.	0.37% C, 100 to 110cm	1090 ± 100
HAM-685.	0.35% C, 110 to 120cm	2760 ± 90
HAM-686.	0.33% C, 120 to 130cm	2730 ± 70
HAM-687.	0.30% C, 130 to 140cm	4550 ± 60
HAM-690.	0.24% C, 160 to 170cm	4670 ± 90
HAM-692.	0.22% C, 180 to 190cm	6470 ± 100
HAM-694.	0.18% C, 200 to 210cm	6510 ± 100
HAM-696.	0.15% C, 220 to 230cm	7850 ± 110
HAM-697.	0.15% C, 230 to 240cm	7700 ± 140
HAM-698.	0.13% C, 240 to 250cm	8190 ± 270

HAM-699.	0.12% C, 250 to 260cm	9230 ± 120
HAM-700.	0.12% C, 260 to 270cm	9690 ± 150
HAM-701.	0.13% C, 270 to 280cm	9340 ± 140
HAM-702.	0.14% C, 280 to 290cm	9850 ± 170

Vertisol (Chromustert) on lower edge of gently sloping pediment in Paget. Deeply weathered profile on lower Cretaceous sand and mudstone (27° 27′ S, 150° 31′ E).

HAM-734.	1.96% C, 10 to 20cm	102 ± 20
HAM-735.	1.47% C, 20 to 30cm	1360 ± 90
HAM-736.	1.29% C, 30 to 40cm	1760 ± 80
HAM-737.	1.10% C, 40 to 50cm	2290 ± 80
HAM-739.	0.96% C, 60 to 70cm	2780 ± 70
HAM-740.	0.94% C, 70 to 80cm	2870 ± 70
HAM-741.	0.86% C, 80 to 90cm	3250 ± 80
HAM-742.	0.85% C, 90 to 100cm	3270 ± 80
HAM-743.	0.77% C, 100 to 110cm	3360 ± 90
HAM-744.	0.66% C, 110 to 120cm	5560 ± 80
HAM-745.	0.72% C, 120 to 130cm	5170 ± 100
HAM-746.	0.66% C, 130 to 140cm	6540 ± 150
HAM-747.	0.50% C, 140 to 150cm	7790 ± 110
HAM-748.	0.51% C, 150 to 160cm	8840 ± 120
HAM-749.	0.49% C, 160 to 170cm	8220 ± 130
HAM-750.	0.50% C, 170 to 180cm	10,550 ± 130
HAM-751.	0.48% C, 180 to 190cm	10,670 ± 100
HAM-755.	0.42% C, 220 to 230cm	11,570 ± 210
HAM-758.	0.36% C, 250 to 260cm	10,890 ± 130

HAM-759 to -762. 260 to 300cm
C content too low for reliable dates.

Eutrustox (Krasnozem) on plateau remnant above precipitous scarp in clay laterite, in Gabbinbar. Soil formation from early Tertiary basalt with strongly weathered saprolitic transition zone (27° 26′ S, 159° 59′ E).

HAM-719.	11.25% C, 0 to 8cm	117.7 ± 0.9% modern
HAM-720.	4.50% C, 8 to 20cm	110.4 ± 0.9

HAM-722.	1.71% C, 34 to 47cm	30 ± 70
HAM-723.	1.09% C, 47 to 60cm	370 ± 70
HAM-724.	0.91% C, 60 to 80cm	1170 ± 70
HAM-725.	0.52% C, 80 to 100cm	1160 ± 80
HAM-726.	0.36% C, 100 to 120cm	1810 ± 80
HAM-731.	0.14% C, 200 to 220cm	3380 ± 120

Eutrustox (Krasnozem) on plateau, with escarpment up to 8° slope in Beechmont. Deeply weathered profile on soft weathered Tertiary basalt, covered by subtropical rainforest (28° 10′ S, 153° 12′ E).

HAM-703.	7.92% C, 0 to 10cm	111.0 ± 1% modern
HAM-704.	4.53% C, 10 to 20cm	102.2 ± 1.2% modern
HAM-705.	2.88% C, 20 to 30cm	240 ± 60
HAM-706.	2.01% C, 30 to 40cm	320 ± 70
HAM-707.	1.15% C, 40 to 60cm	260 ± 60
HAM-708.	0.85% C, 60 to 80cm	1530 ± 50
HAM-709.	0.75% C, 80 to 100cm	2020 ± 70
HAM-711.	0.58% C, 120 to 140cm	2000 ± 70

Samples of all four profiles coll and subm 1977 by G D Hubble, CSIRO, Cunningham Lab, St Lucia, Queensland. Vertisol dates comply quite well with former Australian Vertisol profile dates from Caniva dist, Victoria (R, v 15, p 258-263), which were interpreted with help of conventional analysis and micromorphology data (Blackburn, Sleeman, & Scharpenseel, 1979). Dates will be used for soil organic matter decomposition model, which attempts to integrate fast exponential and slower steady-state decomposition phases. Eutrustox (Krasnozem) data are rather young and repeat trends observed in previous Krasnozem dates (BONN-664 to -772: R, v 13, p 198-200). Since Oxisols are generally considered to be old soils, either Krasnozem type on basalt weathering is different, or more likely, profiles consist of relatively high members of erosion catenas, standing in erosion equilibrium with much transported younger material as well as with newly formed soil and humus.

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