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HAMBURG UNIVERSITY RADIOCARBON DATES IV

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This list consists of dates of soil samples from selected soil profiles in Tunisia, Sudan, and Argentina. The profiles from Tunisia were taken to elucidate ages of typic paleosols of paleoclimatic significance. The Sudan profiles increase our understanding of pedogenesis of Sudanese Vertisols. The existence of pedoturbation in these profiles is further explored and questioned. The profiles of Argentina were dated to supplement information from chemical and micromorphological studies.

ACKNOWLEDGMENTS

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SAMPLE DESCRIPTIONS

SOIL SAMPLES

Pretreatment of soil samples is described by Scharpenseel and Pietig (1969) and Scharpenseel (1972; 1977).

Tunisia

Dates are from genetic horizons or layers of soil largely characteristic of paleosols throughout Tunisia.

HAM-1029. **2420 ± 70**

Fossil gyttja, 12km NW of Degache, Chott el Rharsa (34° 5′ N, 8° 11′ E), 68cm depth.

HAM-1030. **22,730 ± 400**

Paleargid near Algerian border (33° 50′ N, 7° 43′ E), underlying fringes of dunes, 70 to 80cm depth.

HAM-1031. **8050 ± 100**

Oued Lakarit (34° 3′ N, 10° 2′ E), fA overlying fBt, 250cm depth.

HAM-1032. **3470 ± 70**

Buried Argixeroll, 12km before Ksour Essaf (35° 23′ N, 10° 54′ E), 90 to 100cm depth.

HAM-1033. **4550 ± 80**

Tirsoid Vertisol, Sta d'Amélioration des Parcours (36° 11′ N, 10° 29′ E) 200cm depth.

HAM-1034. **7960 ± 110**

Palexeroll, 18km before Tadjerouine (from Le Kef), (36° 5′ N, 8° 39′ E), 70cm depth.

HAM-1035. **8520 ± 180**

Same profile, fAh, 180 to 210cm depth. Samples coll and subm 1981 by H W Scharpenseel. *Comment*: results agree with previous soil dates from Tunisia, BONN-433 and -434, HAM-157, -174, and -258, -259 (R, v 12, p 33; v 18, p 282-283; v 19, p 172) regarding three main phases of age ca 2500, 4500-5000, and 8000 BP. HAM-1030 is important, representing soil formation in older pluvial.

Dates from paleosols of deep Tunisian soil profiles located in different climatic zones from perhumid to Saharian.

HAM-1222. **2790 ± 80**

Paleosol 20km W of Nefta (33° 48′ N, 7° 40′ E), exposed in sand dunes, 0.22% C, 0 to 20cm depth.

HAM-1223. **10,260 ± 120**

Same profile, 0.11% C, 60 to 80cm depth.

HAM-1224. **3350 ± 100**

Paleosol, N rim of Chott Djerid, 300m W, 13km to Nefta (33° 51′ N, 8° 31′ E), 0.23% C, 32 to 51cm depth.

HAM-1225. **4330 ± 90**

Same profile, 0.26% C, 73 to 90cm depth.

HAM-1226. **3980 ± 90**

Same profile, 0.15% C, 100 to 105cm depth.

HAM-1227. **1950 ± 60**

Humic layer in exposed gravel terrace, 7m towards Chott from HAM-1224, 40cm depth.

HAM-1229. **920 ± 80**

Paleosol, W bank, 300m N of streetbridge G P 16, Kebili to Gabès, 62km W of Gabès (33° 48′ N, 9° 36′ E), marl, 0.14% C, 50 to 80cm depth.

HAM-1233. **4810 ± 80**

Polyphasic steppe soil N of steep bank of Oued Ersifa, E St M C 107, Gabès-Matmata, ca 25km to Matmata (33° 46′ N, 10° 03′ E), 0.22% C, 0 to 20cm depth.

HAM-1234. **6260 ± 160**

Same profile, 0.04% C, fAh, 160 to 180cm depth.

HAM-1235. **5340 ± 90**

Same profile, 0.13% C, fAh, 220 to 237cm depth.

HAM-1236. **6420 ± 130**

Same profile, 1.15% C, fAh, 250 to 270cm depth.

HAM-1237. **5200 ± 160**

Fossil gleysoil, bank of Oued, 5km N of Remada, near G P 19 (32° 18′ N, 10° 20′ E), 0.04% C, 40 to 60cm depth.

HAM-1239. **5130 ± 80**

Same profile, 0.03% C, fGo, 90 to 120cm depth.

HAM-1240. **7010 ± 170**

Deep cut with several paleosols in bank of Oued Tatahouine, N of Foum Tatahouine, near St G P 19 (32° 58′ N, 10° 28′ E), steppe soil, fAh 0.04% C, 100 to 130cm depth.

HAM-1247. **13,490 ± 220**

Same profile, fossil Bv, 750 to 770cm depth.

HAM-1248. **7880 ± 130**

Cut in Quaternary sediments, 11m deep, with calcareous nodules, ca 300m SW of Matmata-Toujane St, 3.9km from Marhala-Hotel in Matmata (33° 35′ N, 10° 3′ E), 0.09% C, 160 to 200cm depth.

HAM-1249. **6570 ± 200**

Same profile, 0.03% C, 330 to 380cm depth. (Due to very low C concentration slight rejuvenation during handling cannot be excluded).

HAM-1251. **13,530 ± 370**

Paleosol, same profile, 430 to 500cm depth.

HAM-1261. **2820 ± 90**

Sequence of paleosols S of St M 201 Gafsa-Moulares, 18km from center of Gafsa, cut of bank Oued Melah (34° 31′ N, 8° 31′ E), 1.1% C, epipedon 0 to 15cm depth. Following samples are from same profile.

HAM-1264.	0.39% C, 68 to 79cm	3910 ± 80
HAM-1265.	0.5% C, 93 to 105cm	4320 ± 80
HAM-1266.	0.53% C, 105 to 131cm	2920 ± 80
HAM-1267.	2.25% C, 151 to 192cm	4490 ± 80
HAM-1268.	0.63% C, 192 to 200cm	4520 ± 80
HAM-1270.	0.66% C, 219 to 251cm	4340 ± 80
HAM-1271.	0.56% C, 251 to 264cm	3900 ± 80
HAM-1273.	0.58% C, 287 to 303cm	4510 ± 80
HAM-1274.	0.57% C, 319 to 339cm	5520 ± 80

HAM-1275. **117.0 ± 0.6% modern**

Polyphasic paleosol, W El Frouch, foot of Djebel Chambi, E of road to Serept (35° 13′ N, 8° 13′ E), lower part of "Historique layer," 0.26% C, 20 to 30cm depth. Following samples are from same profile.

HAM-1276.	fAh, 0.79% C, 30 to 80cm	1980 ± 70
HAM-1277.	fAh, 1.01% C, 80 to 110cm	1090 ± 70
HAM-1278.	fAh, 0.70% C, 110 to 160cm	5100 ± 80
HAM-1279.	fBt, 0.55% C, 160 to 200cm	7270 ± 90

HAM-1283. **4080 ± 80**

Red relic soil in crevices of rock, Sta Bordj Chambi, Djebel Chambi (35° 15′ N, 8° 40′ E), 1300m alt, 85 to 200cm depth.

HAM-1285. **1770 ± 80**

Polyphasic paleosol, ca 800m from HAM-1275-79 (35° 13′ N, 8° 43′ E), 0.65% C, 77 to 92cm depth. Following samples are from same profile.

HAM-1286.	fAh, 0.96% C, 92 to 144cm	1000 ± 70
HAM-1287.	0.51% C, 144 to 167cm	1900 ± 80
HAM-1289.	0.37% C, 192 to 225cm	3760 ± 90
HAM-1290.	1.25% C, 225 to 263cm	4880 ± 80
HAM-1292.	0.46% C, 287 to 312cm	4650 ± 80

HAM-1295. **103 ± 0.5% modern**

Cut in bank of Oued Bou Hamid, foot of Djebel Semmama (35° 15′ N, 8° 54′ E), 1.31% C, 10 to 20cm depth. Following samples are from same profile.

HAM-1296.	0.62% C, 40 to 90cm	2220 ± 80
HAM-1298.	0.44% C, 185 to 195cm	2460 ± 80
HAM-1300.	0.94% C, 230 to 240cm	2700 ± 80
HAM-1302.	0.56% C, 333 to 354cm	3270 ± 90
HAM-1303.	0.59% C, 354 to 460cm	2290 ± 80
HAM-1304.		3070 ± 90

Terrace material at foot of profile.

HAM-1305. **2610 ± 90**

Bank of Oued Bou Hamid, profile 200m downstream of HAM-1295-1304, 0.58% C, 52 to 67cm depth. Following samples are from same profile.

HAM-1306.	0.67% C, 67 to 105cm	3460 ± 90
HAM-1307.	0.58% C, 105 to 133cm	3260 ± 80
HAM-1308.	0.42% C, 133 to 169cm	3560 ± 90
HAM-1310.	0.23% C, 189 to 234cm	6860 ± 100
HAM-1311.	0.18% C, 288 to 321cm	14,530 ± 250

HAM-1312. **9920 ± 120**

Transition to terrace material at foot of profile, 0.03% C, 321 to 345cm (slight rejuvenation during processing of sample due to very low organic C content cannot be excluded).

HAM-1313. **900 ± 80**

Organic matter in terrace substrate of Oued Bou Hamid, opposite bank of river and HAM-1305-12, 0 to 40cm depth. Following samples are from same profile.

HAM-1314.	40 to 75cm	1650 ± 80
HAM-1315.	75 to 115cm	2930 ± 80
HAM-1316.	115 to 175cm	3110 ± 80
HAM-1317.	175 to 225cm	4140 ± 90
HAM-1318.	225 to 265cm	4670 ± 90

HAM-1319. **520 ± 70**

Douplex Vertisol, NW Jendouba, N of street to Chamtou, before Satfoura (Oued Bajer) (36° 33′ N, 8° 39′ E), 1.23% C, 63 to 100cm depth. Following samples are from same profile.

HAM-1319*.	HAM-1319 after 6 N HCl hydrolysis	2740 ± 80
HAM-1320.	0.34% C, 116 to 235cm	4840 ± 80
HAM-1321.	0.82% C, 235 to 250cm	4170 ± 100
HAM-1323.	0.45% C, 285 to 324cm	6760 ± 90
HAM-1324.	Flood deposited young material, 324 to 350cm.	1940 ± 80

HAM-1326. **1660 ± 60**

Polyphasic paleosol, bank of Oued Ogla, ca 2km W of street G P 17, Le Kef—Tadjerouine, N bank (36° 5′ N, 8° 38′ E), 0.74% C, 0 to 40cm depth. Following samples are from same profile.

HAM-1327.	1.15% C, 80 to 110cm	3100 ± 70
HAM-1329.	1.38% C, 146 to 178cm	5550 ± 80
HAM-1330.	0.88% C, 178 to 210cm	4270 ± 90

HAM-1333. **122.5 ± 0.7% modern**

Medjerdah alluvium, E Tebourba, S of street Tebourba to Tunis (36° 49′ N, 9° 53′ E), 0.84% C, 47 to 64cm depth. Following samples are from same profile.

HAM-1334.	0.49% C, 80 to 110cm	106.6 ± 0.5% modern
HAM-1335.	0.57% C, 110 to 140cm	1730 ± 80
HAM-1336.	0.37% C, 140 to 182cm	1240 ± 80

HAM-1337.	0.47% C, 182 to 212cm	2790 ± 80
HAM-1338.	0.75% C, 212 to 258cm	5620 ± 90
HAM-1339.	0.37% C, 252 to 306cm	5850 ± 90
HAM-1340.	0.25% C, 306 to 420cm	3350 ± 100

HAM-1341. **2420 ± 80**

Alluvium of Oued Miliane, N of street Pont du Fahs-Smindja, 10km from Pont de Fahs (36° 28′ N, 9° 56′ E), 0.40% C, 130 to 156cm depth. Following samples are from same profile.

HAM-1342.	0.78% C, 156 to 189cm	2830 ± 80
HAM-1343.	0.80% C, 225 to 258cm	3100 ± 80
HAM-1346.	0.19% C, 323 to 378cm	3350 ± 90

HAM-1347. **100% of modern**

Wadi with paleosols, N of G P 3, road from Kairouan to Sbeitla, 1300m W crossing Sbeitla-Kairouan-Tunis (35° 36′ N, 10° 1′ E), entrance to quarry, 0.32% C, 0 to 20cm depth. Following samples are from same profile.

HAM-1348.	0.33% C, 20 to 42cm	90 ± 80
HAM-1349.	0.32% C, 42 to 68cm	2030 ± 80
HAM-1350.	0.42% C, 68 to 87cm	2530 ± 80
HAM-1351.	0.57% C, 87 to 115cm	2650 ± 80
HAM-1352.	0.81% C, 130 to 172cm	4030 ± 90

HAM-1358. **4930 ± 90**

Cut in alluvium of Oued Melize, S of G P 6, Jendouba to Ghardimaou, near bridge (36° 28′ N, 8° 29′ E), fAh, 0.43% C, 290 to 340cm depth. Following samples are from same profile.

HAM-1360.	fAh, 0.36% C, 404 to 460cm	6560 ± 120
HAM-1361.	fAh, 0.76% C, 530 to 580cm	3510 ± 80
HAM-1362.	fAh, 0.77% C, 580 to 630cm	4460 ± 90
HAM-1363.	fAh, 0.60% C, 630 to 675cm	6420 ± 100
HAM-1364.	fAh, 0.34% C, 675 + cm	11,020 ± 130

HAM-1365. **146.5 ± 0.5% modern**

W of G P 1, Tunis—Sfax, km 84 to Sousse, near crossing, Hammamet R cut (36° 25′ N, 10° 28′ E), fAh, 0.19% C, 80 to 125cm depth. Following samples are from same profile.

HAM-1366.	0.19% C, 125 to 150cm	780 ± 80

HAM-1367. 0.67% C, 150 to 180cm 620 ± 80

HAM-1369. **1040 ± 80**

Paleosol in bank of Oued Guilene, E of G P 12, Haffouz to Maktar, near bridge (35° 50′ N, 9° 14′ E), fAh, 0.34% C, 40 to 60cm.

HAM-1371. **950 ± 80**

Paleosol in bank of Oued Hatab, S of G P 4, Maktar to Tebessa (35° 44′ N, 9° 3′ E), 300m before crossing with M C 71, 100m from street, fAhGr, 0.43% C, 380 to 450cm. Following samples are from same profile.

HAM-1372. 0.75% C, 450 to 497cm 2530 ± 70

HAM-1373. 0.89% C, 497 to 558cm 3880 ± 90

HAM-1374. 0.59% C, 558 to 586cm 3150 ± 90

HAM-1375. 0.35% C, 586 to 617cm 3450 ± 70

HAM-1376. 0.23% C, 617 to 650cm 6420 ± 100

HAM-1377. 0.32% C, 650 to 690cm 8080 ± 130

HAM-1378. **1790 ± 80**

Paleosol in N bank of Medjerdah R, 500m E of bridge Ghardimaou (36° 26′ N, 8° 22′ E), 0.26% C, 80 to 120cm. Following samples are from same profile.

HAM-1379. 0.40% C, 200 to 240cm 1420 ± 80

HAM-1380. 0.37% C, 270 to 400cm 3820 ± 80

HAM-1381. Parallel sample to HAM-1380, but 100m W. 15,000 ± 210

Samples coll and subm 1979 by H Schiffmann and H U Neue, Ordinariat f Bodenkunde, Univ Hamburg. *Comment*: most paleosols indicate origin during Rharbien/Holocene. Only HAM-1247, -1251, -1311, -1364, -1381 reach into late Soltanien/Würmian; HAM-1030, a buried Argid, suggests soil formation during Soltanien pluvial/Würmian high glacial.

In all other paleosol/sediment samples, ratio of organic to carbonate C was too low for reliable sample of 3g organic C after carbonate destruction. Our efforts were wasted, when we tried to produce datable samples from materials of low organic C but high carbonate C. The benzene method, requiring 2 to 3g C, is obsolete for such samples that contain <0.1% organic C.

Results further indicate, that depth of "Historique-layer" as well as of Rharbien/Holocene soils is often underestimated due to extensive fluvial transport during rainy season or torrential floods in ustic and xeric climate. Some anomalous dates, mostly at greater depth (HAM-1249, -1266, -1277, -1303, -1324, -1330, -1340, -1361, -1374) are explainable only by flood deposition of substantial lumps of soil at the flank of the riverbed. Another explanation, animal transport of younger organic matter cannot be excluded. The results confirm our hypothesis, that dating of

such sediments, eg, for paleoclimatic inf, is not very reliable when based on single or few samples. Layer by layer sampling and dating of 5 to 2cm intervals, including $\Delta^{13}C$, as we are doing now in connection with other sample collns, guarantees max resolution of C dynamics.

Results of Tunisia series including earlier dates (BONN-433 and -434; HAM-157 to -174, -258 and -259 (R, v 12, p 33; v 18, p 282-283; v 19, p 172) confirm strongly developed soil formation, frequently in several distinguishable phases during Rharbien (Scharpenseel & Zakosek, 1979; Scharpenseel *et al*, 1980; Scharpenseel *et al*, in press). Figures 1a and 1b are histograms of all available ^{14}C dates of Tunisian soil sediment and groundwater samples, indicating time intervals of higher humidity responsible for soil and groundwater formation. Since sampling was done rather randomly all over the country, the number of samples of certain ages may reflect, within limits of total number of samples, frequency of occurrence of different ages.

Sudan

Thirteen soil profiles of Vertisols from Gezira were measured. Instead of coordinates, which were not taken, sampling loci are according to figure 2. Samples are part of large sample colln including Vertisols of all continents (fig 3).

HAM-1407. **640 ± 80**

Profile 1, 1km SW of Wad Shawer, 0 to 20cm depth. Following samples are from same profile.

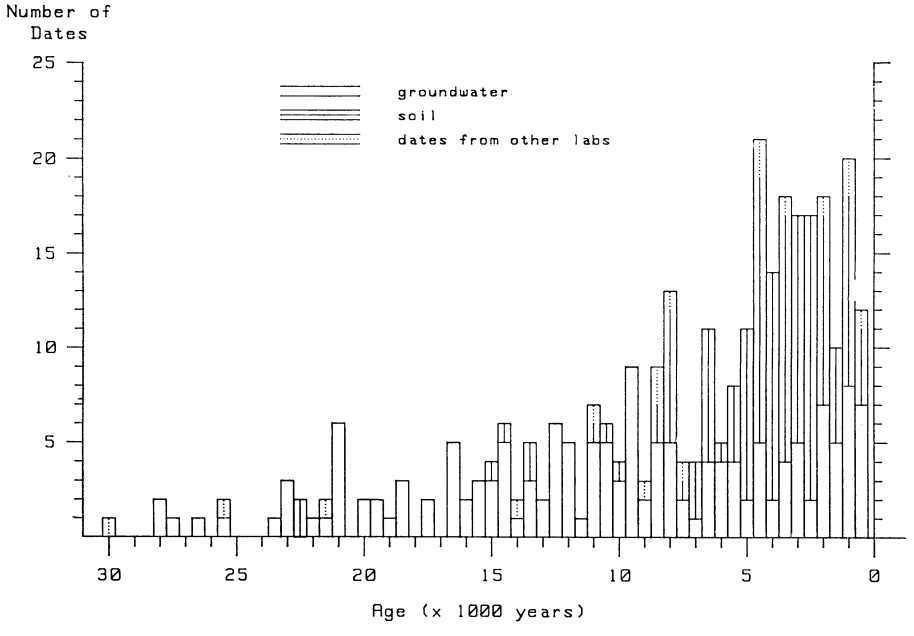

Fig 1a. ^{14}C dates of all available Tunesian groundwater and soil samples; histogram for 500 yr intervals (groundwater dates corrected according to Tamers (1967).

HAM-1408.	20 to 40cm	1720 ± 80
HAM-1409.	40 to 60cm	1870 ± 80
HAM-1410.	60 to 80cm	2640 ± 90
HAM-1411.	80 to 100cm	4660 ± 90
HAM-1412.	100 to 120cm	4680 ± 90
HAM-1413.	120 to 140cm	5190 ± 100
HAM-1414.	140 to 165cm	5580 ± 100
HAM-1415.	165 to 185cm	3390 ± 80
HAM-1416.	185 to 210cm	5050 ± 90
HAM-1417.	210 to 235cm	1900 ± 80
HAM-1418.	235 to 270cm	3470 ± 80
HAM-1419.	270 to 300cm	5770 ± 100
HAM-1420.	300 to 330cm	4780 ± 90

HAM-1424. **1570 ± 80**

Profile 2, Gezira Selemme Hum Dalik Minor/Wad Mahmoud Major, 0 to 15cm depth. Following samples are from same profile.

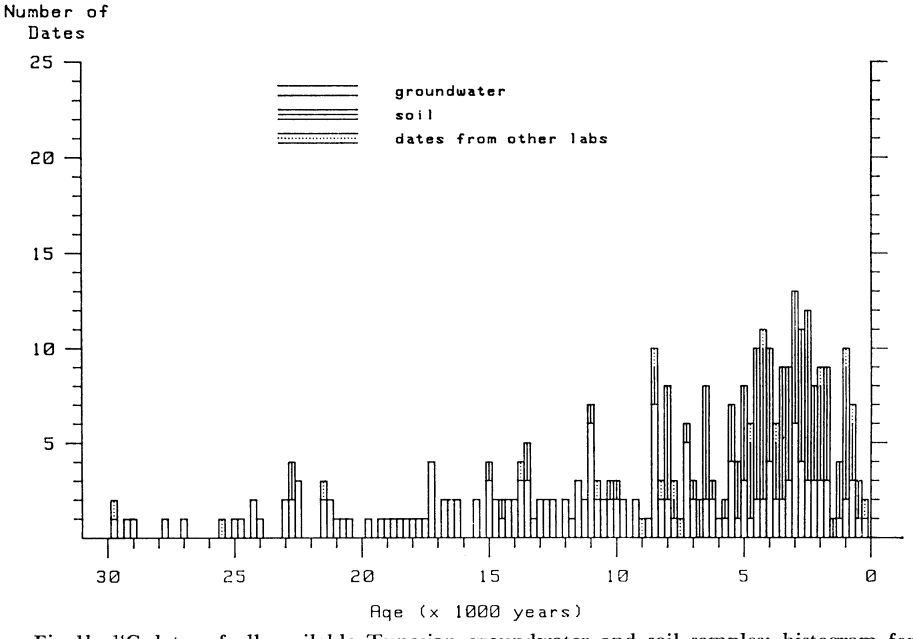

Fig 1b. ^{14}C dates of all available Tunesian groundwater and soil samples; histogram for 250 yr intervals (no groundwater date correction).

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HAM-1425.	15 to 40cm	2210 ± 80
HAM-1426.	40 to 65cm	2040 ± 80
HAM-1427.	65 to 90cm	3240 ± 80
HAM-1428.	90 to 120cm	5330 ± 90
HAM-1429.	120 to 140cm	6250 ± 100
HAM-1430.	140 to 160cm	6290 ± 90
HAM-1433.	210 to 245cm	4690 ± 80
HAM-1434.	245 to 280cm	6300 ± 90

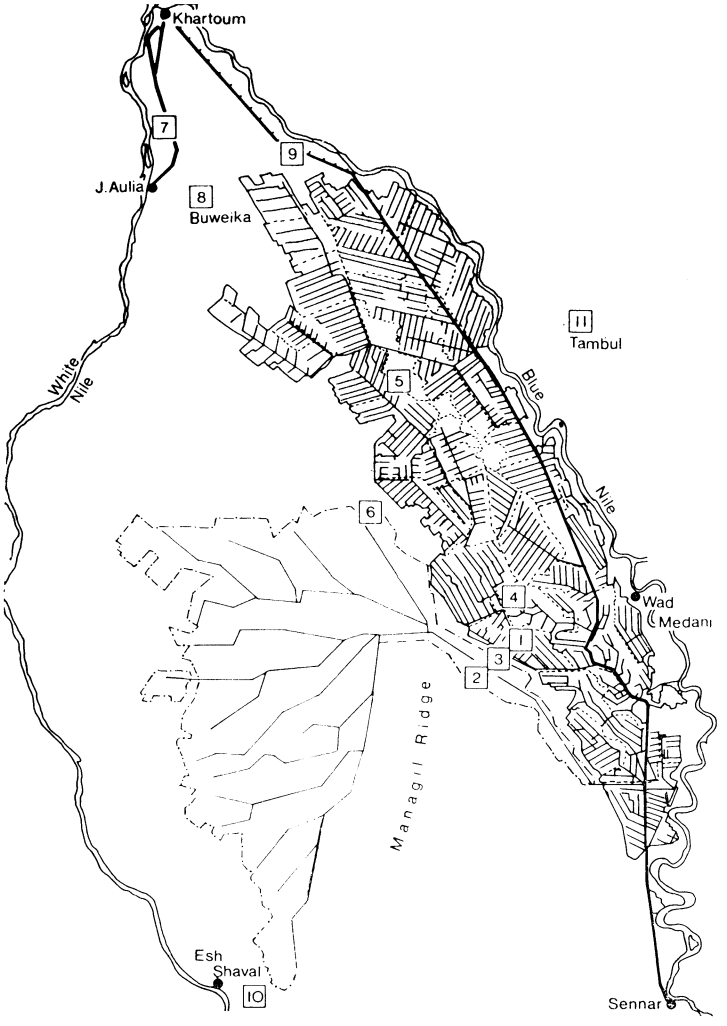

Fig 2. Sites of dated soil profiles in Gezira, Sudan.

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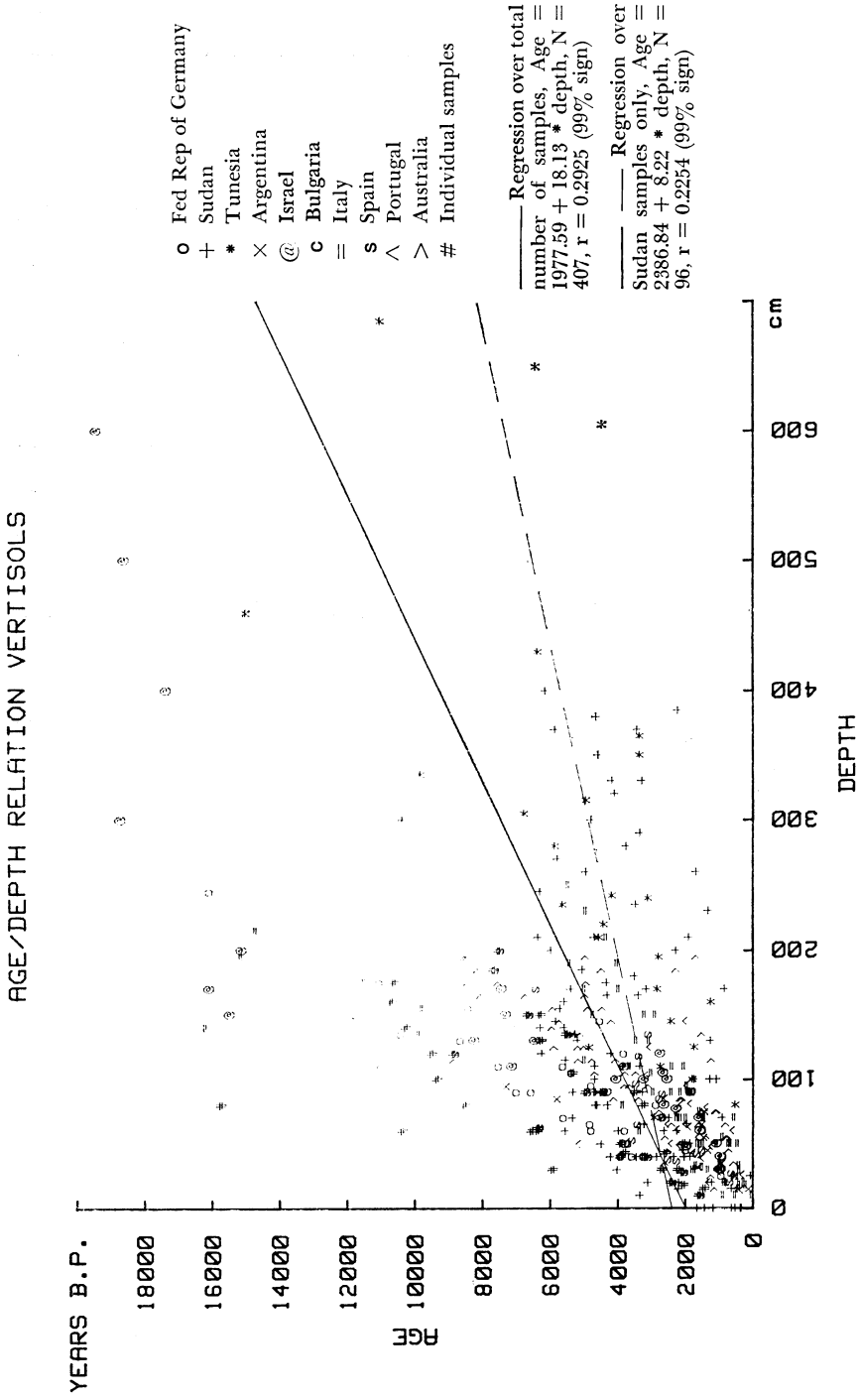

Fig 3. Age *vs* depth, Vertisols (world-wide), id by countries of origin.

HAM-1440. **106.5 ± 1% modern**

Profile 3, Vertisol, 400m W of Saraf Omeir Minor, 0 to 25cm depth. Following samples are from same profile.

HAM-1441.	25 to 45cm	70 ± 70
HAM-1442.	45 to 70cm	2070 ± 80
HAM-1443.	70 to 100cm	2500 ± 120
HAM-1445.	135 to 155cm	5270 ± 140
HAM-1446.	155 to 180cm	5710 ± 100
HAM-1447.	180 to 210cm	3500 ± 90
HAM-1448.	210 to 240cm	6360 ± 130
HAM-1451.	300 to 330cm	10,370 ± 150
HAM-1453.	370 to 400cm	5850 ± 180
HAM-1454.	400 to 430cm	6150 ± 170

HAM-1455. **540 ± 70**

Profile 4, Vertisol, Madina Block 15, 0 to 20cm depth. Following samples are from same profile.

HAM-1456.	20 to 40cm	1230 ± 80
HAM-1457.	40 to 60cm	2350 ± 80
HAM-1458.	60 to 80cm	2260 ± 80
HAM-1459.	80 to 100cm	4620 ± 90
HAM-1461.	120 to 140cm	4210 ± 90
HAM-1463.	165 to 175cm	4320 ± 120
HAM-1464.	175 to 205cm	4390 ± 120

HAM-1473. **370 ± 80**

Profile 5, Vertisol, 1km W of Meheiriba, 0 to 20cm depth. Following samples are from same profile.

HAM-1474.	20 to 40cm	2200 ± 80
HAM-1475.	40 to 65cm	3460 ± 90
HAM-1476.	65 to 90cm	3230 ± 90
HAM-1477.	90 to 115cm	4710 ± 100
HAM-1478.	115 to 145cm	5550 ± 100
HAM-1479.	145 to 170cm	5840 ± 100
HAM-1480.	170 to 200cm	5390 ± 120

HAM-1481.	200 to 230cm	5980 ± 170
HAM-1486.	350 to 380cm	4580 ± 180
HAM-1487.	380 to 410cm	4640 ± 190

HAM-1488. **1180 ± 80**

Profile 6, Vertisol, Qoz er Ruheid, 0 to 20cm depth. Following samples are from same profile.

HAM-1489.	20 to 40cm	1240 ± 80
HAM-1490.	40 to 70cm	2050 ± 80
HAM-1492.	100 to 130cm	1280 ± 80
HAM-1493.	130 to 170cm	1270 ± 100
HAM-1494.	170 to 200cm	3160 ± 80
HAM-1495.	200 to 230cm	2280 ± 110
HAM-1497.	260 to 300cm	4940 ± 250

HAM-1500. **152.8 ± 1.3% modern**

Profile 7, Vertisol in terrace of White Nile, SE rim of Tureina, 0 to 10cm depth. Following samples are from same profile.

HAM-1501.	10 to 30cm	3350 ± 80
HAM-1502.	30 to 50cm	4030 ± 90
HAM-1503.	50 to 70cm	4510 ± 90
HAM-1504.	70 to 90cm	5340 ± 100
HAM-1505.	90 to 110cm	3280 ± 90
HAM-1506.	110 to 140cm	3860 ± 90

HAM-1511. **147.5 ± 4% modern**

Profile 8, Vertisol, 1km W of Buweika, surface sample. Following samples are from same profile.

HAM-1512.	0 to 20cm	1660 ± 80
HAM-1513.	40 to 60cm	2870 ± 90
HAM-1514.	60 to 80cm	3600 ± 90
HAM-1515.	80 to 100cm	4310 ± 100

HAM-1521. **860 ± 80**

Profile 9, Vertisol, 8km W of Mesou dir Secondary scholl, Laota Block, 0 to 20cm depth. Following samples are from same profile.

HAM-1522.	20 to 40cm	3120 ± 90

HAM-1523. 40 to 60cm 4230 ± 250

HAM-1524. 60 to 80cm 5560 ± 100

HAM-1530. **320 ± 70**

Profile 10, Vertisol, 3km NE of Esh Shaval, 0 to 30cm depth. Following samples are from same profile.

HAM-1535. 150 to 180cm 4530 ± 80

HAM-1537. 210 to 240cm 5930 ± 120

HAM-1538. 240 to 285cm 5760 ± 100

HAM-1539. **120 ± 100**

Profile 11, Vertisol, 3km N of Tamsul, 0 to 25cm depth. Following samples are from same profile.

HAM-1540. 25 to 50cm 1780 ± 80

HAM-1541. 50 to 75cm 1930 ± 80

HAM-1542. 75 to 100cm 3220 ± 90

HAM-1543. 100 to 125cm 3850 ± 90

HAM-1544. 125 to 150cm 5260 ± 100

HAM-1545. 150 to 175cm 5190 ± 100

HAM-1546. 175 to 200cm 3660 ± 90

HAM-1547. 200 to 225cm 5320 ± 110

HAM-1012. **125.4 ± 1% modern**

Vertisol, sent by Gezira Admin, Hosh series, entic Pellustert, Ghabsaneblock, 0 to 15cm depth. Following samples are from same profile.

HAM-1013. 15 to 40cm 470 ± 80

HAM-1014. 40 to 90cm 1970 ± 80

HAM-1015. 90 to 135cm 3360 ± 90

HAM-1016. 135 to 180cm 3210 ± 90

HAM-1017. **1390 ± 70**

Vertisol, Seleimi clay, entic Chromustert, Gezira Research Sta, Wad Medani, fallow plot, 0 to 10cm depth. Following samples are from same profile.

HAM-1018. 10 to 30cm 430 ± 70

HAM-1020. 50 to 95cm 480 ± 70

HAM-1021. 95 to 140cm 1740 ± 80

Samples coll and subm 1979 by H Schiffmann and O Khodary, Ordinariat f Bodenkunde, Univ Hamburg and Soil Survey Admin Wad Medani, Sudan. *Comment*: 13 soil profiles of different depth, serving as cross-sec of Gezira Vertisols, reflect age gradients up to ca 10,000 BP, mostly 5000-6000 BP. This coincides with existing estimates (Greene, 1928; Tothill, 1946), placing origin of Gezira soils in Alleröd time, when allowance is made for slow development to climax of humic-C accumulation as well as for inevitable rejuvenation within cracking zone. Self-mulching, accompanied by above-mentioned crack formation during dry season can bring about inflections of age gradient with depth caused by modern organic matter dropping in deepest holes of cracks (profile 1, 5, 7). If below inflection trend of age *vs* depth increase continues, it confirms that pedoturbation ends with deepest point of age inflection (profile 2,11). Interruption of age *vs* depth trend can also be influenced by termite holes and droppings or individual deep roots. Within graph of dated Vertisols of worldwide origin, the correlation of age *vs* depth is highly significant, and dates of Sudanese Vertisols are located mostly below regression line in younger age *vs* depth bracket (see fig 3).

Argentina

Samples dated for genesis of Vertisols in Entre Rios prov, testing extent of vertic soil dynamics (pedoturbation).

HAM-1178. **2810 ± 70**

Soils from rolling pampa near Pergamino (33° 40′ S, 60° 3′ W), vertic Argiudoll, loess, Urquiza series.

HAM-1179. **2220 ± 70**

Typic Argiudoll (34° 13′ S, 60° 49′ W), loess, Rojas series.

HAM-1180. **1650 ± 60**

Typic Hapludoll (34° 53′ S, 60° 25′ W), sandy loess, Segui series.

HAM-1204. **300 ± 50**

Crossing Hwy La Paz to Feliciano street San Gustavo (30° 42′ S, 59° 26′ W), argillic Pelludert, 1.3% C, 15 to 30cm depth. Following samples are from same profile.

HAM-1205.	0.9% C, 30 to 50cm	1120 ± 60
HAM-1206.	0.8% C, 45 to 60cm	1650 ± 80
HAM-1207.	0.8% C, 60 to 75cm	2880 ± 80
HAM-1208.	0.6% C, 75 to 90cm	4440 ± 110

HAM-1209. **106 ± 0.9% modern**

Profile, Fac Agric, UNL near Paraná (31° 50′ S, 60° 32′ W), vertic Pelludert, 1.5% C, 0 to 17cm depth. Following samples are from same profile.

HAM-1210.	1.3% C, 17 to 43cm	240 ± 70
HAM-1211.	1.3% C, 43 to 60cm	440 ± 70
HAM-1212.	0.9% C, 80 to 100cm	2180 ± 90

HAM-1213. **108 ± 1% modern**

Fac Agric, UNL near Paraná (31° 50′ S, 60° 32′ W), Febré 2, vertic Argiudoll, 1.5% C, 0 to 17cm depth.

HAM-1214. **1120 ± 60**

10km SW of General Campos, near main street (31° 26′ S, 58° 25′ W), Yerna 1, argillic Pelludert, 1% C, 15 to 30cm depth. Following samples are from same profile.

HAM-1550.	2.7% C, 0 to 15cm	107 ± 1% modern
HAM-1551.	0.8% C, 30 to 45cm	2320 ± 60
HAM-1552.	0.7% C, 45 to 60cm	2610 ± 70
HAM-1553.	0.6% C, 60 to 75cm	2890 ± 70
HAM-1554.	0.4% C, 75 to 90cm	4140 ± 90
HAM-1666.	0.2% C, 90 to 105cm	3760 ± 70

HAM-1556. **1910 ± 60**

Oro Verde 2, 1.25km NW of Experimental Sta INTA, Paraná (31° 52′ S, 60° 27′ W), Campo anexo, aquic Argiudoll, 0.5% C, 45 to 65cm depth.

HAM-1549. **1110 ± 70**

Fac Agric, UNL near Paraná, Febré 2, vertic Argiudoll, 0.8% C, coord, see HAM-1213, 42 to 58cm depth.

Samples coll and subm by S Stephan, Inst f Bodenkunde, Univ Bonn. *Comment*: soils, investigated by micromorphology, scanning electron microscopy, EDAX and laser-induced mass spectroscopy, and ^{14}C dating show that process of pedoturbation is, at most, very slow and incomplete. ^{14}C age gradients in typical zone of crack formation in real Vertisols is not too pronounced for effective churning and self-mulching system (Stephan *et al,* 1983). As for most vertic soils, tested soil profiles are rather young.

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