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UNIVERSITY OF GRANADA RADIOCARBON DATES VI

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INTRODUCTION

This paper includes determinations of archaeological, geological, palaeobotanical and other samples from Spain, Portugal and Bolivia, measured at the University of Granada Radiocarbon Dating Laboratory, mostly from 1989 to 1990. Pretreatment of charcoal and wood samples is a standard acid-basic procedure using 8% HCl and 2% NaOH at boiling temperature. We obtain collagen from bone samples using the Longin (1971) method.

The method of dating is benzene synthesis and liquid scintillation counting as previously reported (González-Gómez, López-González and Domingo-García 1982; González-Gómez, Sánchez-Sánchez and Domingo-García 1985; González-Gómez, Sánchez-Sánchez and Villafranca-Sánchez 1986, 1987; González-Gómez and Sánchez-Sánchez 1991), but in this case, we changed the sample size and the scintillator, using 7 ml low ^{40}K Packard counting picovials with 5 ml synthesized benzene and 83.5 mg Butyl-PBD directly dissolved in the benzene (16.7 g/l) as a scintillator; smaller samples were made up to 5 ml with inactive benzene. ^{14}C activity was measured in a Packard Tri-Carb Mod 4640 liquid scintillation spectrometer. Efficiency was ~68%, using the part of the spectrum above the end point of tritium, with a background of ~7.2 cpm. At least one modern reference standard and two background vials were measured together with each series of measurements. All results are corrected for fractionation according to the quoted $\delta^{13}C$ (w.r.t. PDB) values.

In order to prevent any loss of benzene during counting and storage, we sealed the vials hermetically with a metallic cap. The joint is made of 3 mm silicon + 0.05 mm teflon sheet. For a second barrier, we placed a silicon O-ring, 10 mm in inner diameter and 2 mm thick, around the neck of the vial. The weight of the vials, checked one year after filling, remains constant.

Dates reported here are based on 0.95 of the activity of NBS oxalic acid modern standard, on the Libby ^{14}C half-life of 5568 years, and expressed in radiocarbon years relative to AD 1950, as suggested by Stuiver and Polach (1977). Samples were measured for 100 min repeated 40–45 times, as well as background and standard vials. The standard deviation quoted includes only 1 σ of the counting statistics of background, sample and modern standard counts. Calculations and data are processed by a PC computer, using a general program for radiocarbon dating laboratories made by González-Gómez (Computer general program for radiocarbon dating laboratories, ms in preparation). Calibrated ages for a 2 σ interval are obtained by the method of Pearson *et al.* (1986) running the computer programs CALIB (Stuiver & Reimer 1986) and CALI (González-Gómez, CALI, a computer program for calibration of radiocarbon dates, ms. in preparation) using the bidecadal curve for samples of atmospheric origin.

Sample descriptions and comments are based on information supplied by submitters of samples.

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ARCHAEOLOGICAL SAMPLES

SPAIN

UGRA-326. AMAREJO **2050 ± 70**

$\delta^{13}C = -25.9‰$

Charcoal from El Amarejo (38°31′N, 2°20′W), Bonete, Albacete province. The sample, from 3 m depth, was collected and submitted 1985 by S. Broncano-Rodríguez, Ministry of Cultura, Madrid, to date the time of deposit of some Iberian ceramics, needles, beads, *etc.*, at the site.

Comment: Expected age: ~3200 ± 60 BP; 349 cal BC–cal AD 80.

El Castillo de Burgos series

Samples from El Castillo de Burgos (Burgos Castle) (42°20′N, 3°43′W) were collected 1985 by J. M. Martínez-González and submitted 1985 by J. L. de Uribarri-Angulo to date cultural stages at the end of the Bronze Age and the beginning of the Iron Age. Other samples from El Castillo de Burgos were dated previously (González-Gómez & Sánchez-Sánchez 1991: 369).

UGRA-333. SII-NV-M3 **2590 ± 90**

Charcoal from 1.68 m depth; 920–410 cal BC. $\delta^{13}C = -25.6‰$

UGRA-334. SII-NVI-M4 **2400 ± 110**

Charcoal from 1.75 m depth; 810–200 cal BC. $\delta^{13}C = -24.9‰$

UGRA-339. No.7 Nivel X **3230 ± 70**

Charcoal from 1.96 m depth; 1680–1400 cal BC. $\delta^{13}C = -24.8‰$

General Comment: Expected age: ~2720 ± 250 BP.

Castillo de Monturque series

Samples from Castillo de Monturque (37°29′N, 4°35′W), Monturque, Córdoba province, were collected and submitted 1987 by L. A. López-Palomo, Delegación Provincial de Cultura, Córdoba, to date the Chalcolithic period in the Córdoba countryside, a very strong campanulate stage. The samples were dated to find a correlation between agricultural activities and traditional stages of the pre- and proto-history of the Guadalquivir Valley.

UGRA-303. MONT (87)-3 **4120 ± 160**

Charcoal from 5.90 m depth; 2910–2470 cal BC. Expected age: ~3910 ± 150 BP.

UGRA-308. MONT (87)-2 **3040 ± 90**

Charcoal from 4 m depth; 1420–1165 cal BC. Expected age: ~3360 ± 100 BP.

UGRA-311. MONT (87)-1 **3190 ± 120**
$\delta^{13}C = -23.4‰$

Charcoal from 2.25 m depth; 1740–1165 cal BC. Age is older than expected: 2610 ± 50 BP.

UGRA-323. MONT (87)-4 **3390 ± 110**
$\delta^{13}C = -25.1‰$

Charcoal from 6.75 m depth; 2011–1440 cal BC. Age is younger than expected: ~4310 ± 150 BP.

UGRA-336. N=IA/C-1 Z=188 **4510 ± 110**
$\delta^{13}C = -23.8‰$

Charcoal from Cova Puntassa (40°43′N, 0°05′E), Corachar, Castellón de la Plana province. The sample, from 0.46 m depth, was collected 1985 by J. A. Casabó-Bernard and submitted 1985 by V. Palomar-Macián, Research Service Archaeology & Prehistory County Council, Castellón de la Plana, to date the transition from Eneolithic to Bronze Age in this region.

Comment: 3597–2910 cal BC. Age is older than expected: ~3860 ± 100 BP.

Cova del Tossal de la Font series

Samples from Cova del Tossal de la Font (40°07′N, 0°08′W), Villafamés, Castellón de la Plana province, were collected and submitted 1985 by F. Gusi-Jener, Research Service Archaeology & Prehistory County Council, Castellón de la Plana, to date the transition from Eneolithic to the initial Bronze Age in the middle of the Castellón de la Plana province.

UGRA-335. C-1 Z=215-300 **4140 ± 100**

Charcoal from 1.13–1.98 m depth; 2920–2470 cal BC. $\delta^{13}C = -24.7‰$

UGRA-338. C-2 Z=233 **4760 ± 70**

Charcoal from 1.21 m depth; 3700–3360 cal BC. $\delta^{13}C = -24.0‰$

General Comment: Expected ages: ~3860 ± 100 BP.

UGRA-327. C PUERTO **5170 ± 110**
$\delta^{13}C = -18.3‰$

Bones from Cortijo del Puerto (37°32′N, 3°55′W), Castillo de Locubín, Jaén province, were collected and submitted 1986 by R. Alvarez de Morales.

Comment: Sample from 3 m depth; no expected age; 4295–3707 cal BC.

Cueva del Murciélago series

Charcoal from Cueva del Murciélago (39°49′N, 0°13′W), Altura, Castellón de la Plana province. The samples were collected and submitted 1985 by V. Palomar-Macián.

UGRA-341. CI/NIII **1620 ± 70**
$\delta^{13}C = -24.8‰$

Comment: Sample from 1 m depth; cal AD 250–600. Age is younger than expected: ~2660 ± 100 BP. Dates the end of the Bronze Age and its relation to the urnfields in the Iberian culture.

UGRA-342. CI.NIV-R1Z135-R2Z136 **3030 ± 110**
$\delta^{13}C = -24.2‰$

Comment: Sample from 1.25–1.36 m depth; 1520–942 cal BC. Expected age: 2810 ± 50 BP. Dates the transition from the Bronze Age to the Iron Age.

UGRA-344. CI-NV-Z156-Z180 **3520 ± 90**
$\delta^{13}C = -24.2‰$

Comment: Sample from 1.56–1.80 m depth; 2133–1640 cal BC. Expected age: ~2910 ± 50 BP. Dates the last Bronze Age period and its relation to the Iron Age.

Morra del Quintanar series

Charcoal from Morra del Quintanar (39°01′N, 2°27′W), Munera, Albacete province. The samples were collected and submitted 1987 by C. Martín-Morales, Instituto de Conservación y Restauración de Bienes Culturales, Ministry of Cultura, Madrid, to date the use of a wall in a fortress and its relation to the central area of the site; the samples are from a fire on the outside of this wall. Other samples of Morra del Quintanar were previously dated by González-Gómez, López-González and Domingo-García (1982:219), González-Gómez, Sánchez-Sánchez and Domingo-García (1985:612) and González-Gómez, Sánchez-Sánchez and Villafranca-Sánchez (1986: 1203).

UGRA-310. Q-10A-86-48 **3920 ± 80**

Sample from 1.2 m depth; 2851–2147 cal BC. $\delta^{13}C = -24.6‰$

UGRA-312. Q-10T-85-5 **3830 ± 100**

Sample from 1 m depth; 2577–1985 cal BC. Expected age: ~3450 BP. $\delta^{13}C = -23.3‰$

UGRA-315. Q-10-85-39 **3770 ± 90**

Sample from 2.5 m depth; 2470–1950 cal BC. Expected age: ~3650 BP. $\delta^{13}C = -23.4‰$

UGRA-329. PPU 18 **5510 ± 300**
$\delta^{13}C = -23.4‰$

Bones from Papauvas (37°16′N, 7°03′W), Aljaraque, Huelva province, were collected 1981 and submitted 1983 by J. C. Martín de la Cruz, Department of Prehistory and Archaeology, Universidad Autónoma, Madrid, to determine if bones were from the Chalcolithic period. Another sample from Papauvas was previously dated by González-Gómez, Sánchez-Sánchez and Villafranca-Sánchez (1986: 1202). This sample dates a deeper level in the site.

Comment: Sample from 2.2 m depth; 5060–3700 cal BC.

UGRA-345. R. OLVERA 2B **3420 ± 80**
$\delta^{13}C = -23.2‰$

Charcoal from Rincón de Olvera (38°01′N, 3°19′W), Ubeda, Jaén province. The samples were collected 1980 and submitted 1986 by J. Carrasco-Rús, Department of Prehistory, University of Granada, to date the Argaric culture in Jaén province. Other samples from Rincón de Olvera were previously dated by González-Gómez, Sánchez-Sánchez and Domingo-García (1985: 611). This

analysis is a repetition of UGRA-73 and the result agrees with others at the site.

Comment: 1940–1520 cal BC.

PORTUGAL

Alegrios series

Charcoal from Alegrios (40°04′N, 7°08′W), Monsanto, Idanha-a-Nova, Beira Baixa province. The samples were collected and submitted 1987 by R. M. da Rosa Vilaça, Faculdade de Letras, Universidade de Coimbra, to date the settlement, in the inner Beira, of a Late Bronze Age village with Atlantic bronze metallic materials.

UGRA-305. ALG-87 I G-6 03 **3650 ± 80**

Sample from 0.68 m depth; 2280–1781 cal BC.

UGRA-306. ALG-87 I G-7 03 **2480 ± 90**

Sample from 0.85 m depth; 820–390 cal BC.

General Comment: Expected ages: ~2750 ± 100 BP.

GEOLOGICAL SAMPLES

SPAIN

Braña de Ano series

Peat from Braña de Ano (43°06′N, 4°01′W), Bárcena de Pie de Concha, Cantabria province, was collected and submitted 1989 by L. Salas-Gómez, DCITTYM, Division de Ciencias de la Tierra, Universidad de Cantabria, to study the climate in Cantabria during the Holocene.

UGRA-325. A 1 **1090 ± 80**

Sample from 0.1 m depth; cal AD 770–1113. $\delta^{13}C = -28.1‰$

UGRA-343. A 2 **4130 ± 140**

Sample from 2 m depth; 3040–2330 cal BC. $\delta^{13}C = -27.9‰$

UGRA-316. STP-CAZ **Modern**

$\delta^{13}C = -27.6‰$

Wood from Santopetar (37°26′N, 2°02′W), Taberno, Almería province, was collected 1988 by A. Martín-Penela and submitted 1988 by L. García-Rossell, Instituto Andalúz de Geología Mediterránea, CSIC, Universidad de Granada, to study the desertification process in the Almanzora River basin.

Comment: Sample from 1 m depth, is not representative of the process in the study because the desertification process in this area is older.

Sierrapando series

Peat from Sierrapando (43°21′N, 4°02′W), Torrelavega, Cantabria province, was collected and

submitted 1989 by L. Salas-Gómez, DCITTYM, Division de Ciencias de la Tierra, Universidad de Cantabria, to study the climate in Cantabria during the Holocene.

UGRA-331. S 1 **680 ± 90**

Sample from 0.1 m depth; cal AD 1180–1420. $\delta^{13}C = -25.8‰$

UGRA-340. S 2 **2290 ± 60**

Sample from 1.3 m depth; 410–200 cal BC. $\delta^{13}C = -29.2‰$

UGRA-317. Pena Vella **9590 ± 120**
$\delta^{13}C = -28.7‰$

Peat from Turbera de Pena Vella (43°27′N, 7°31′W), Labrada, Abadín, Lugo province. The sample, from 2.5 m depth, was collected 1988 by M. J. Aira-Rodríguez and submitted 1988 by F. Díaz-Fierros Viqueira, Department of Edafology, Fac. Pharmacy, Universidad de Santiago de Compostela, La Coruña province. The date will be compared with the pollen analysis.

PALAEOBOTANICAL SAMPLES

SPAIN

UGRA-318. PA 88/151 **2630 ± 80**
$\delta^{13}C = -26.1‰$

Charcoal from Castro de Penalba (42°33′N, 8°33′W), Campo Lameiro, Pontevedra province. The sample was collected 1989 by P. Ramil-Rego and A. Alvarez-Núñez and submitted 1989 by M. J. Aira-Rodríguez, Department of Botany, Faculty Pharmacy, Universidad de Santiago de Compostela, La Coruña province, to study the transition from the Late Bronze Age to the end of the Iron Age.

Comment: 930–540 cal BC; expected age: ~2600 BP.

UGRA-319. LL. C. 1 **5880 ± 90**
$\delta^{13}C = -28.5‰$

Peat from Llano de la Cruz (43°21′N, 7°30′W), Abadín, Lugo province. The sample was collected 1989 by P. Ramil-Rego and submitted 1989 by M. J. Aira-Rodríguez for a palaeobotanical study of the Sierra del Xutral.

Comment: 4995–4530 cal BC.

UGRA-330. VEIRA 1 **5490 ± 90**
$\delta^{13}C = -29.2‰$

Peat from Pena Veira (43°21′N, 7°30′W), Abadín, Lugo province, as UGRA-319.

Comment: 4510–4049 cal BC.

Puerto de la Morcuera series

Peat from Puerto de la Morcuera (40°50′N, 3°50′W), Miraflores de la Sierra, Madrid province.

Samples were collected and submitted 1989 by M. J. Gil-García, Department of Geology, Universidad de Alcalá de Henares, Madrid province, to confirm the pollen data of vegetation and climate for this area.

UGRA-321. PM-III **1440 ± 110**

Sample from 1.4–1.5 m depth; cal AD 400–790. $\delta^{13}C = -27.0‰$

UGRA-322. PM-VIII **1710 ± 90**

Sample from 1.3–1.4 m depth; 110–540 cal BC. $\delta^{13}C = -29.2‰$

UGRA-362. PM-VII **640 ± 50**

Sample from 0.5–0.6 m depth; cal AD 1270–1410. $\delta^{13}C = -27.7‰$

UGRA-324. STAM I **1830 ± 110**

$\delta^{13}C = -28.1‰$

Peat from Santa María I (40°56'N, 3°53'W), Oteruelo del Valle, Madrid province. The sample was collected 1988 by R. Vázquez-Gómez and submitted 1989 by M. Peinado-Lorca, Department Vegetal Biology, Faculty of Sciences, Universidad de Alcalá de Henares, Madrid province, to confirm the pollen data in order to establish the vegetation history of this area.

Comment: 90 cal BC–cal AD 430.

SPECIAL SAMPLE

BOLIVIA

UGRA-332. **280 ± 60**

$\delta^{13}C = -28.1‰$

Wood from a violin peg. The violin has an inscription, 'Amathius Cremona 1676'. The sample is from Bolivia, submitted 1990 by F. Aragón, to confirm the age of the violin, that appears to be made by Amathius in Cremona (Italy) in the year stated above.

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