

UNIVERSITY OF GRANADA RADIOCARBON DATES VIII

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INTRODUCTION

This paper includes determinations of archaeological, geological and paleobotanical samples from Spain and Brazil, measured at the University of Granada Radiocarbon Dating Laboratory, mainly from 1991 to 1992. As previously reported (González-Gómez 1992), pretreatment of charcoal and wood samples is a standard acid-basic procedure using 8% HCl and 2% NaOH at boiling temperature. The collagen of bone samples was extracted by the Longin (1971) method. The method of dating is liquid scintillation counting of synthesized benzene.

The sample size and the scintillator was 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^{-1}) as a scintillator; smaller samples were expanded to 5 mL with inactive benzene. ^{14}C activity was measured in a Packard Tri-Carb[®] Mod 4640 liquid scintillation spectrometer. Efficiency was ~65% using the part of the spectrum above the endpoint of tritium, with a background of ~7 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 $\delta^{13}\text{C}$ (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 was made of a 3 mm silicone + 0.05 mm Teflon[®] sheet. As a second barrier we placed a silicone O-ring, 10 mm in inner diameter and 2 mm thick, around the neck of the vial. The weight of vials, checked one year after filling, remained unchanged (González-Gómez 1992).

Dates reported here are based on 0.95 of the activity of NBS HOxI, on the Libby ^{14}C half-life of 5568 yr, and expressed in radiocarbon years relative to AD 1950, as suggested by Stuiver and Polach (1977). Samples, backgrounds and standards were measured for 40–45 100-min intervals. The standard deviation quoted includes only 1σ of the counting statistics of background, sample and modern standard counts. Calculations and data were processed using a PC running a general program for radiocarbon dating laboratories written by González-Gómez (1995). Calibrated ages for a 2σ interval were obtained by the method of Pearson *et al.* (1986) running the computer programs CALIB (Stuiver and Reimer 1993) and CALI (González-Gómez 1988) and using the bidecadal curve for samples of atmospheric origin. Sample descriptions and comments are essentially based on information provided by submitters.

ACKNOWLEDGMENT

We thank the Departamento de Química Analítica, Facultad de Química, Universidad de Barcelona, for the $\delta^{13}\text{C}$ determinations.

ARCHAEOLOGICAL SAMPLES*SPAIN***Alcazaba de Loja Series**

Charcoal samples from Alcazaba de Loja (37°09'N, 4°29'W), Loja, Granada province, were collected and submitted from 1991 to 1993 by J. A. Alonso-Martínez, Loja Council.

UGRA-402. H.CH.(A-91)C-14 **2610 ± 70**
 $\delta^{13}\text{C} = -25.7\%$

Comment: Sample from depth 4.5 m; to date the most recent archaeological levels of the site establishment in the Loja Alcazaba (castle); 910–540 cal BC.

UGRA-464. LOJA 93 **3900 ± 60**
 $\delta^{13}\text{C} = -23.9\%$

Comment: Sample from depth 4.5 m; to date archaeological levels at the base of the Loja Alcazaba hill; 2573–2200 cal BC.

University of Salamanca Lecture-Room Series

Wood samples from an historic lecture-room at the University of Salamanca were collected and submitted 1991 to date the age of a lecture-room used by Fray Luis de León for his lectures in that University.

UGRA-388. n° 1 **530 ± 45**
 $\delta^{13}\text{C} = -24.4\%$

Sample from a plank of the floor under the second seat on the right side; cal AD 1304–1443.

UGRA-390. n° 2 **315 ± 40**
 $\delta^{13}\text{C} = -23.2\%$

Sample from the fourth seat on the right side; cal AD 1464–1656.

UGRA-391. n° 3 **420 ± 50**
 $\delta^{13}\text{C} = -21.9\%$

Sample from the floor-boarding under the professor's seat; cal AD 1410–1630.

UGRA-410 Cueva de los Olivos. HUESCAR 1 **1490 ± 40**
 $\delta^{13}\text{C} = -19.2\%$

Bones from Cueva de los Olivos (37°46'N, 2°31'W), Huescar, Granada province. Sample collected and submitted 1991 by J. Aguilera, Granada, to date a grave and the time of the zone's occupation. Sample from depth 40 cm; cal AD 444–645.

San Miguel de Lillo Series

Wood samples from the church San Miguel de Lillo (43°23'N, 5°52'W), Oviedo, Asturias province, were collected and submitted 1991 by C. García de Castro, Facultad de Geografía e Historia, Universidad de Oviedo.

UGRA-417. LILLO 1 **1090 ± 80**
 $\delta^{13}\text{C} = -25.0\%$

cal AD 770–1113.

UGRA-418. LILLO 2 **880 ± 45**
cal AD 1027–1253. $\delta^{13}\text{C} = -25.0\text{‰}$

Comment: These two samples from a height of 6.0 m above the ground were to date the widely debated date of erection of the church apse.

UGRA-419. LILLO 3 **245 ± 40**
cal AD 1521–1954. $\delta^{13}\text{C} = -24.0\text{‰}$

Comment: Sample from a height of 10.9 m to date the repair of the building cornice and other non-dated works.

UGRA-396. Santa Ana 4 y 6. PRIEGO. **685 ± 40**
 $\delta^{13}\text{C} = -25.6\text{‰}$

Wood sample from Santa Ana 4 y 6 (37°26'N, 4°11'W), Priego de Córdoba, Córdoba province, collected and submitted 1991 by R. Carmona, to date the walled precinct in the town; cal AD 1263–1387.

GEOLOGICAL SAMPLES

SPAIN

UGRA-394. Fines. ZL-5002. **280 ± 40**
 $\delta^{13}\text{C} = -24.9\text{‰}$

Charcoal sample from Fines (37°23'N, 2°11'W), Almería province, collected and submitted 1991 by L. García-Rossell, Instituto Andaluz de Ciencias de la Tierra (IACT), Consejo Superior de Investigaciones Científicas (CSIC), Facultad de Ciencias, Universidad de Granada, to date the industry associated with a furnace excavated in the marls. Sample from depth 3 m; cal AD 1486–1666.

Travertinos de Nívar Series

Travertine samples from Nívar (37°16'N, 3°34'W), Granada province, collected by M. Martín-Martín and submitted 1991 by A. Martín-Algarra, Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, to date Quaternary formations in the Granada basin, and to study the morphostratigraphy and recent climatic evolution of the zone. Samples were taken from the ground.

UGRA-399. NIVAR-1	13,210 ± 110 $\delta^{13}\text{C} = -6.9\text{‰}$
UGRA-400. NIVAR-4	20,900 ± 200 $\delta^{13}\text{C} = -7.8\text{‰}$
UGRA-401. NIVAR-8	32,600 ± 900 $\delta^{13}\text{C} = -6.3\text{‰}$
UGRA-404. NIVAR-10	35,500 ± 1300 $\delta^{13}\text{C} = -8.1\text{‰}$
UGRA-405. NIVAR-11	>45,000 $\delta^{13}\text{C} = -7.6\text{‰}$
UGRA-406. NIVAR-12	37,200 ± 1500 $\delta^{13}\text{C} = -7.5\text{‰}$
UGRA-407. NIVAR-13	36,200 ± 1600 $\delta^{13}\text{C} = -8.0\text{‰}$

BRAZIL**UGRA-395 Playa de Foguete FOGUETE****3930 ± 50** $\delta^{13}C = -19.9\text{‰}$

Peat from Playa de Foguete (23°05'S, 42°02'W), Arraial do Cabo, Rio de Janeiro, Brazil. Sample collected 1991 by A. Cendrero-Uceda and submitted 1991 by L. Salas-Gómez, CDITTYM, División de Ciencias de la Tierra, Universidad de Cantabria, Santander, to date the age of the Flandrian transgression in the coast of Rio de Janeiro State, Brazil. Sample from the ground; expected age was ~5460 ± 1500 BP; 2577–2300 cal BC.

PALEOBOTANICAL SAMPLES**SPAIN****UGRA-377. Pico del Lobo. PLB II C''****1170 ± 80** $\delta^{13}C = -28.2\text{‰}$

Peat from Pico del Lobo (40°59'N, 3°58'W), La Pinilla, Segovia province; sample was collected and submitted 1989 by M. J. Gil-García, Departamento de Geología, Universidad de Alcalá de Henares, Madrid province, to establish the botanical history of that zone; cal AD 670–1020.

UGRA-380. Hayedo de Montejo. HM I (50–55)**> Modern** $\delta^{13}C = -27.9\text{‰}$

Peat from Hayedo de Montejo (41°05'N, 3°30'W), Montejo de la Sierra, Madrid province; sample was collected and submitted 1990 by M. J. Gil-García, Departamento de Geología, Universidad de Alcalá de Henares, Madrid province, to establish the vegetation history of the zone.

Laguna del Hornillo Series

Peat samples from Laguna del Hornillo (41°57'N, 2°51'W), Covalada, Soria province, were collected and submitted from 1991 to 1992 by A. Gómez-Lobo, Departamento de Geología, Universidad de Alcalá de Henares, Madrid province, to establish the botanical history of the zone. To date the situation of different stages of Holocene vegetation.

UGRA-416. VLH-270**6860 ± 170**

Sample from depth 2.7 m; 6080–5429 cal BC.

 $\delta^{13}C = -29.0\text{‰}$ **UGRA-440. VLH-110****4860 ± 90**

Sample from depth 1.1 m; 3932–3379 cal BC.

 $\delta^{13}C = -29.0\text{‰}$ **UGRA-441. VLH-200****6150 ± 90**

Sample from depth 2.0 m; 5311–4853 cal BC.

 $\delta^{13}C = -29.0\text{‰}$ **UGRA-386 Nevero MHII****1080 ± 60** $\delta^{13}C = -28.1\text{‰}$

Peat from Nevero (41°00'N, 3°50'W), Sierra de Guadarrama, Pinilla del Valle, Madrid province, collected 1988 by R. Vázquez-Gómez and submitted 1990 by M. Peinado-Lorca, Departamento de Biología Vegetal, Botánica, Universidad de Alcalá de Henares, Madrid province, to establish the date of expansion of *Juniperus* brushwood and the disappearance of a pine wood existing in that zone. Sample from 50–70 cm; cal AD 809–1030.

Peñalara Series

Peat samples from Peñalara (40°50'N, 4°00'W), Sierra de Guadarrama, Rascafría, Madrid province, collected 1989 by R. Vázquez-Gómez and submitted 1990 by M. Peinado-Lorca, Departamento de Biología Vegetal, Botánica, Universidad de Alcalá de Henares, Madrid province.

UGRA-378. PÑB (20–30)	2800 ± 50
Sample from depth 20–30 cm; 1090–840 cal BC.	$\delta^{13}\text{C} = -27.7\text{‰}$
UGRA-381. PÑB (80–90)	1100 ± 60
Sample from depth 80–90 cm; cal AD 780–1020.	$\delta^{13}\text{C} = -28.1\text{‰}$
UGRA-382. PÑB (150–160)	4160 ± 70
Sample from depth 1.5–1.6 m; 2920–2505 cal BC.	$\delta^{13}\text{C} = -27.1\text{‰}$

Comment: The former samples were to date the possible felling of *Pinus sylvestris*.

UGRA-384. PHV	2060 ± 70
Sample from depth 74–85 cm; 354 cal BC–cal AD 80.	$\delta^{13}\text{C} = -28.0\text{‰}$
UGRA-385. PHIA	3350 ± 90
Sample from depth 58–68 cm; 1890–1440 cal BC.	$\delta^{13}\text{C} = -28.3\text{‰}$

Comment: These samples were to establish if the expansion of *Pinus sylvestris* coincided with the disappearance of a *Betula* wood existing in the vicinity of the peat bog.

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