1 Radiocarbon dating results for the Limmo peninsula clinker boat (XRW10)

1.1 Introduction

A single sample of tarred animal hair from between planks of the Limmo peninsula clinker built vessel (XRW10) was sent to Queens University Belfast (Chrono lab) for radiocarbon dating (21/11/12). The date aimed to refine the technological date that covered four centuries (11th to the 16th century) (see MOLA radiocarbon strategy).

1.1.1 Principle of radiocarbon dating

The element Carbon naturally occurs in three forms of differing mass (isotopes[1]): ^{12}C, ^{13}C and ^{14}C. The heaviest isotope, ^{12}C, is most abundant (98.9%) in the biosphere while ^{13}C makes up a smaller amount (1.1%). ^{14}C, occurring in tiny proportions (1×10^{10} %), is radioactive. After death, living organisms cease carbon exchange with the biosphere and the ^{14}C in the organism begins to decay. It is the measurement of the ratio of the amount of the ^{12}C to the ^{14}C that enables the amount of radioactive decay to be quantified and the age of the death of the organism to be determined.

1.2 Radiocarbon dating method

The tar in the sample, that contains 'old carbon', was dissolved by organic solvent extraction apparatus (soxhlet). The organic solvent was removed with washes with more water soluble solvents.

Accelerator Mass Spectrometer (AMS) is the analytical technique used by the lab to separate the particles within the sample by charge so that the actual number of atoms of the radioactive isotope of carbon can be counted. AMS not only enables small samples to be analysed but has increased the sensitivity of radiocarbon dating.

1.3 Results

The radiocarbon dated result is tabulated below (Table 1).

MOLA ref.	Lab no.	Material	Pre-treatment	δ13C	Radiocarbon determination	Calibrated date (cal yr AD) (95% probability)
XRW10_<79>_hair	UBA-21608	Tarred animal hair	Acid only	-25.1‰	743±31 BP	1223–1290

Table 1 Radiocarbon dating result from waterproofing material from Limmo peninsula clinker boat (XRW10)

[1] Isotopes are different types of atoms of the same chemical element, each having a different number of neutrons. Isotopes differ in mass number (or number of nucleons) but not in atomic number. The number of protons (the atomic number) is the same because that is what characterises the element.

The radiocarbon determination, quoted with a plus or minus (i.e. 743 ± 31) reflects the number of radiocarbon years before 1950 ('the present') based on an assumed constant level of ^{14}C in the atmosphere. The radiocarbon determination is sometimes called the conventional radiocarbon age or raw radiocarbon age to avoid confusing this reading with a true calendar date.

The error of ± 31 represents the statistical uncertainty or precision of the method. The amount of radioactive carbon in a sample is measured and treated as if it were normally distributed (bell-shaped) because it is not possible to repeat analyses. The radiocarbon determination is quoted with a range of 2 relative standard deviations from the mean (2σ).

As radiocarbon has fluctuated markedly over time, due to long-term variations in the production of ^{14}C in the upper atmosphere and various global carbon reservoirs (the biosphere, atmosphere and hydrosphere), radiocarbon determinations require calibration. Calibration curves compare the raw radiocarbon measurements with tree ring series, varved lake deposits, speleothems, coral and deep ocean records to obtain calendar ages. The most recent calibration curve is the IntCal09 calibration curve (Reimer et al 2009). The calibrated radiocarbon determination 743±31 BP is presented pictorially (Fig 1).

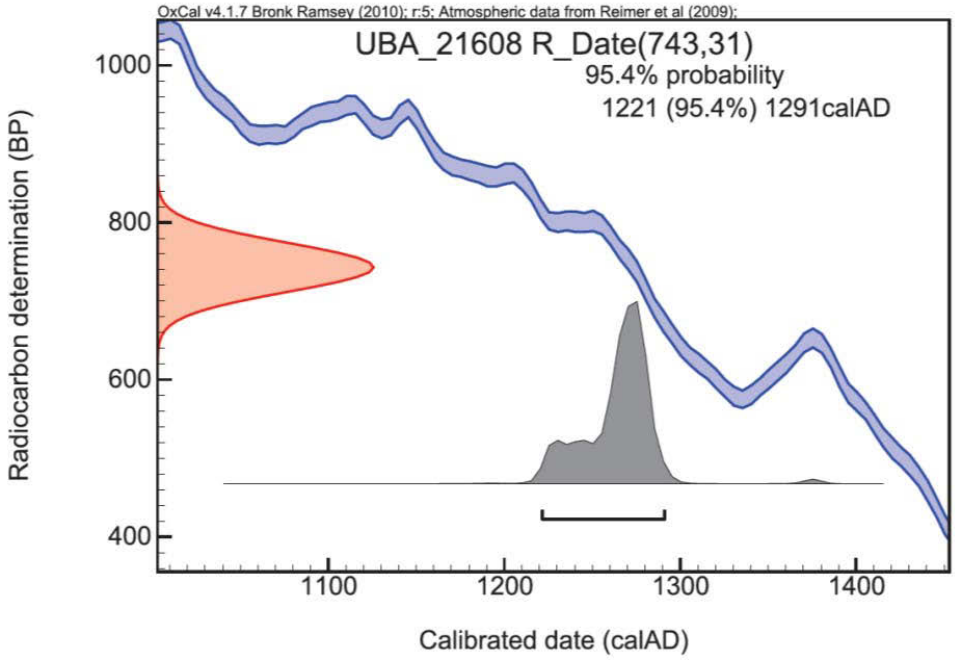

Fig 1 Single plot illustrating radiocarbon dating result UBA 21608 on tarred animal hair from the Limmo peninsula clinker boat (XRW10). Calibration was performed using OxCal 4.1

1.4 Discussion and Conclusions

The calibrated result of cal AD 1223–1290 dates the boat to the early part of the age range given on technological grounds with good precision (an age range of 67 years). Dates simulated in OxCal (4.1) prior to dating suggested likely precisions of *c* 70-150 years.

The result on animal hair dates the death of the animal, but provides a date most closely related to the last use of the boat, as may represent the last stages of construction or subsequent repair.

1.5 Bibliography

Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon, 51*(1), 337-360.

Bronk Ramsey, C., van der Plicht, J., & Weninger, B., 2001. 'Wiggle matching' radiocarbon dates. *Radiocarbon, 43*(2A), 381-389.

Krąpiec, M., Ossowski, W., 2000. Problems of absolute tree-ring dating. Geochronometria 19, 27–32.

Reimer, P. J., Baillie, M. G. L., Bard, E., Bayliss, A., Beck, J. W., Blackwell, P. G., Bronk Ramsey, C., Buck, C. E., Burr, G. S., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kaiser, K. F., Kromer, B., McCormac, F. G., Manning, S. W., Reimer, R. W., Richards, D. A., Southon, J. R., Talamo, S., Turney, C. S. M., van der Plicht, J., & Weyhenmeyer, C. E., 2009. IntCal09 and Marine09 radiocarbon age calibration curves, 0-50,000 years cal BP. *Radiocarbon, 51*(4), 1111-1150.