Thermal diffusion isotopic enrichment and radiocarbon dating beyond 50.000 years BP

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SUMMARY

The thermal diffusion enrichment apparatus in use in Amsterdam before 1967, has been rebuilt in the Groningen Radiocarbon Dating Laboratory. It has been shown to operate reliably and reproducibly. A reasonable agreement exists between the theoretical calculations and the experimental results. The ^{14}C enrichment of a CO sample is deduced from the simultaneous mass 30 enrichment, which is measured with a mass spectrometer. The relation between both enrichments follows from a series of calibration measurements. The over-all accuracy in the enrichment is a few percent, equivalent to a few hundred years in age.

The main problem in dating very old samples is their possible contamination with recent carbon. Generally, careful sample selection and rigorous pretreatment reduce sample contamination to an acceptable value.
Also, it has been established that laboratory contamination, due to a memory effect in the combustion system and to impurities in the oxygen and nitrogen gas used for combustion, can be eliminated.

A detailed analysis shows that the counter background in our set-up is almost exclusively caused by cosmic ray muons.

The measurement of 28 early glacial samples, mostly from North-west Europe, has yielded a consistent set of ages. These indicate the existence of three early glacial interstadials; using the Weichselian definitions: Amersfoort starting at 68 200 ± 1100, Brørup at 64 400 ± 800 and Odderade at 60 500 ± 600 years BP.

This ^{14}C chronology shows good agreement with the Camp Century chronology and the dated palaeo sea levels. The discrepancy in the age of the early part of the Last Glacial on the ^{14}C time scale and on that adopted for the deep-sea δ^{18} record, must probably be attributed to the use of a generalized δ^{18} curve and a wrong interpretation of this curve in terms of three Barbados terraces.