# 8–8 Reduced Geological Sample Size for Radiocarbon Dating at JAEA-AMS-TONO

## — Preparation Techniques Using One-Twentieth the Sample Size of the Conventional Method —

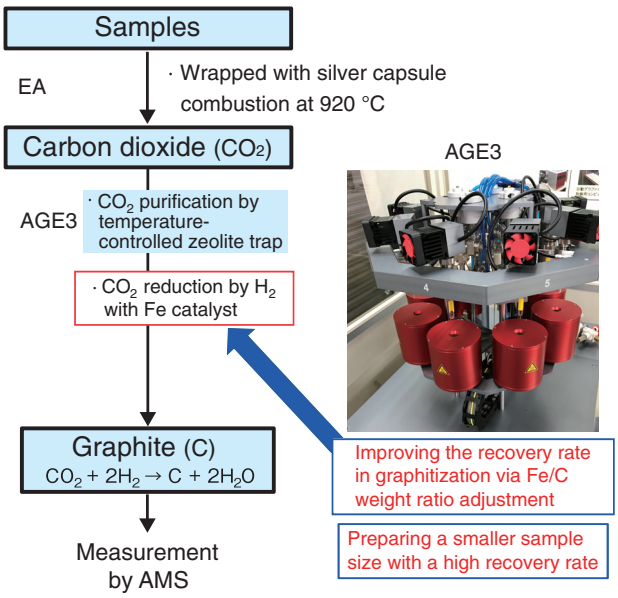


**Fig.8-24 Process for graphitization of a small sample**
Graphitization of a sample with a carbon weight of 0.1–0.05 mg (one-twentieth of the conventional method) was performed.

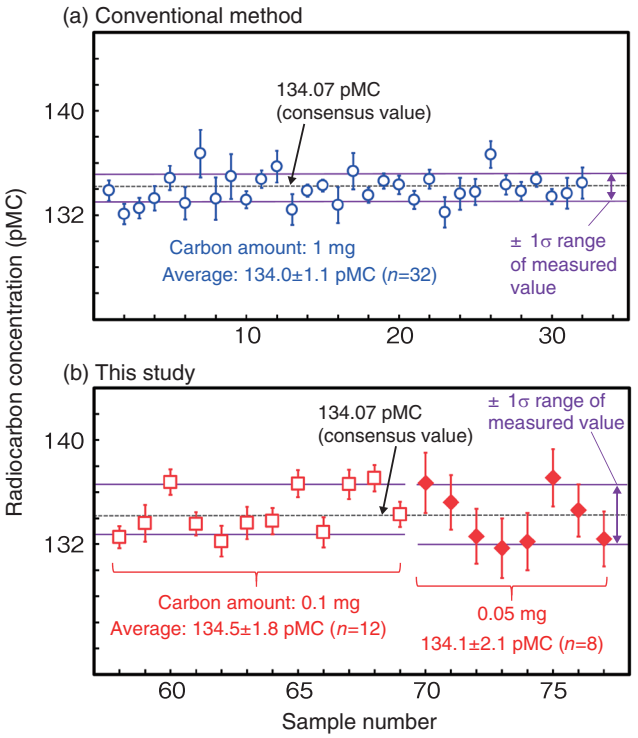


**Fig.8-25 $^{14}$C measurements of standard materials using small samples**
$^{14}$C measurements of standard materials containing (a) 1 and (b) 0.1–0.05 mg of carbon.

Accelerator mass spectrometry (AMS) is a technique widely used for measuring the radiocarbon ($^{14}$C) concentration in geochronological studies focused on the last 50000 years. AMS-$^{14}$C measurements of organic materials and carbonate minerals in natural samples have been applied to geological studies, such as the estimation of paleoenvironmental changes. However, suitable geological samples for $^{14}$C dating, such as plant residues, are often limited in volume. Therefore, $^{14}$C measurements using less than 0.1 mg of carbon are required to date geological samples.

Sample preparation procedures have included $CO_2$ gas purification and graphitization from solid samples using third-generation automated graphitization equipment (AGE3, IonPlus AG) combined with an elemental analyzer (EA), as shown in Fig.8-24. The EA-AGE3 can be utilized as an automated sample preparation system for $^{14}$C measurements of standard sample volume (approximately 1 mg of carbon).

Here, we developed preparation procedures using the EA-AGE3 system for AMS-$^{14}$C measurements using a smaller amount of carbon (0.1 and 0.05 mg). Notably, the recovery rates during graphitization were improved by adjusting the ratio of iron catalyst to carbon sample size in the EA-AGE3 system. The resulting average $^{14}$C concentrations (percent modern carbon: pMC) in the standard reference materials prepared by the EA-AGE3 system were close to their consensus values, as shown in Fig.8-25, thereby implying that the proposed preparation technique using only one-twentieth of the carbon sample of the conventional method can be used. Furthermore, the carbon background values were nearly cut in half after the capsules had undergone pre-baking at 500 ºC for 5 h. We expect that the recovery rate and mass-dependent background corrections of the EA-AGE3 system can be further refined to graphitize small samples as more data are accumulated.

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**Reference**

Watanabe, T. et al., Preliminary Report on Small-Mass Graphitization for Radiocarbon Dating Using EA–AGE3 at JAEA-AMS-TONO, Geochemical Journal, vol. 55, no.4, 2021, p.277–281.