

Re-evaluation of ABA pretreatment for ^{14}C dating of fossil charcoal from late Holocene layer

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It had been suspected and had been tried to clarify the effect of the contamination by exterior organic matter on the ^{14}C date from the beginning of development of radiocarbon dating. A comparison between ABA method and Acid-Base-Oxidation (ABOX) method confirmed the effect on the ^{14}C date of contaminated carbon using AMS. However, the research didn't examine objectively of the chemical quality of late Holocene charcoal samples. And, there exists no research with the objective method for the effect of residual external organic carbon after pretreatment on the ^{14}C date. Furthermore, in the researches of quality control of samples and pretreatment as described above, there were many cases where alkaline extraction time were less than 3 hours hence it was strongly suspected of the remnant of humic acid in dating samples. Thus, the discussion on what is reasonable and reliable sample in the ^{14}C dating method and the discussion on the most suitable chemical treatment condition are still left unsettled. Recently, a few researches are reported which based on objective chemical indicator for the ABA method. The assessment for charcoal using raman spectrometry has attempted, and the result shows the existence of humic acid in charcoal samples. But, the relation between the pretreatment and the ^{14}C dates has not been investigated yet. The mechanism of humification has been deduced from the comparison of fossil and recent charcoal. But it only shows humification under special desert environment, and has not investigated the effect of humification on the ^{14}C date. Moreover, there exists no reliable chemical method to distinguish external organic matter and humified charcoal of sample charcoal. But we know empirically that charcoal's characteristics to resist against NaOH solution are different by burial and preserved states. Therefore, many researchers are using NaOH solution of low concentration when charcoal's characteristics to resist against NaOH are weak. The problem on the conventional ABA method is that what degree of concentration of NaOH solution is the most effective to the ^{14}C dating samples. There exists no consensus on the problem. Here, we require the adequate condition of sample and the adequate pretreatment condition to obtain reliable ^{14}C dates. However, as far as we know, there exist few data and researches on conditions of ABA pretreatment. In the present research, we try 5 steps pretreatment using alkaline solution increasing concentrations stepwise in order to search the optimum condition of alkaline treatment stage of ABA method. We make comparisons by the ^{14}C dates among residual charcoal of the individual pretreatment stages, and compare emission intensity of dissolved organic matter and absorbance of the extracted solutions of the individual pretreatment steps. Namely, the present research aims to clarify the problem of ABA method and its practical solutions.

The results of the ^{14}C dates, UV-vis and 3-DF (3-dimensional fluorescence) show that there exists no correlation between the visible color of the solution and the intensity of humic emission of the solution. And, the results show that the multiple step treatment using NaOH solution of concentration from 0.001 M to over 1.2 M can enhance the effectivity of humic extraction in relatively short time (18-20 days). Furthermore, the multi-step extractions from low concentration of 0.001 M to high concentration of 1.2 M are necessary, because we can't predict the concentration of NaOH solution which yields high humic extraction effect. In addition, 3 DF meter must be necessary to confirm treatment effect by ABA method indirectly. The dating results show that the ^{14}C dates converge or saturate between from 1.0 to 2.0 M in concentration of NaOH solution.

Keywords: ABA(AAA) pretreatment, ^{14}C dating, late Holocene