Oral | Symbol H (Human Geosciences) | H-TT Technology & Techniques

[H-TT35_1PM1]Developments and applications of AMS techniques for earth and human environmental research

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Accelerator mass spectrometry (AMS) is a technique developed in 1977, to detect and count the small amount of nuclides in the environment, and to measure precisely the isotope ratios of the nuclides. In particular, by means of measuring rare radioisotopes in the environment, AMS techniques are applied for age measurement of samples from various application fields, such as geology, archeology and cultural properties. AMS can measure isotope ratios in the order of as low as 1.0E-10 to 1.0E-16, by the process of producing negative ions of specific nuclides by an ion source, accelerating the ions by a tandem accelerator, analyzing mass of the isotope ions by an analyzing magnet, and identifying the specific nuclides by an ionization detector. Thus AMS is used to measure isotope ratios of natural radionuclides of quite low natural abundances. AMS can be applied for studies of materials recycling and environmental science by using rare isotopes as a chemical tracer, and investigations of time sequence of tephra layers, land deposits, lacustrine and ocean sediments that are quite important for Quaternary research. This session offers a brief outlook of present status on technical progresses going on present days and interesting application programs, given by specific researchers and students engaged in AMS studies.

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[HTT35-P11_PG]Accurate age estimation using ^{14}C in human teeth enamel.

3-min talk in an oral session

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Radiocarbon (^{14}C) concentration in the atmosphere showed a stable value until 1955. However, as a result of the nuclear bomb testing, modern ^{14}C concentration in the atmosphere dramatically increased during late 1950s and early 1960s. These bomb-produced ^{14}C is then oxidized to form CO_2, and incorporated into plants by photosynthesis. Then, by eating plants or animals fed by these plants, the ^{14}C concentration in human body reflects the ^{14}C value of atmospheric CO_2 at a certain time. Recent studies insisted that these ^{14}C can play important role for forensic analysis, especially age estimation using ^{14}C in human teeth enamel. Teeth enamel is such a harder part of the human body that they are hardly destroyed by a natural process. And, the most important is, there is no turnover of enamel after its formation has completed. Although there are previous works which estimate the birth year of individuals by using ^{14}C concentration in enamel, their samples are teeth from Swedish, Scottish and American people, and study areas are mainly at high latitudes of the northern hemisphere. The precision of age estimation using teeth enamel is determined by enamel formation time of teeth and atmospheric ^{14}C concentration in a certain area at a certain year. It is known that teeth formation time of Japanese is different from that of Caucasian. It has been found that ^{14}C concentration in the atmosphere

indicates 5 different zones according to different peak ^{14}C concentration of the nuclear bomb testing. These zones are named NH zone1, NH zone2, NH zone3, SH zone3 and SH zone1-2 from north to south. The boundary between NH zone1 and NH zone2 is Ferrel cell - Hadley cell boundary. It is nearly located at 35 ^{o}N. So it means that previous works mainly focused on NH zone1 samples, not NH zone2 samples. One of NH zone2 samples, teeth enamels of Japanese have not studied sufficiently. The aim of this study is to clarify whether age estimation using teeth enamels of Japanese can determine the precise year of birth of individuals and to discuss the mechanism of carbon fixation of enamels or other parts of the teeth. 7 of 44 collected tooth samples have been analyzed. They are 5 third molars and 2 second molars. The year of birth of each individual is 1943, 1946, 1951, 1951, 1951 for third molars, and 1933 and 1959 for second molars. In order to get the estimated year of birth, a model age for enamel completion of Japanese was subtracted from the year given by the ^{14}C analysis of samples. The result shows that age estimation using teeth of Japanese gives precise age determination. Needless to say, taking account of the degree of individual variation and possibility of differences in local environment or in diet is important, however, this result seems to be uninfluenced by those effects. Larger number of, more and more various parts of teeth (for example, first molars, anteriors, such as early-completed teeth.) have to be analyzed. To determine whether an individual is born before or after the peak of atmospheric ^{14}C concentration (in 1964, in NH zone2), root of teeth have to be analyzed. Since root completion age is some years after enamel completion age, it can be easily found that the sample age is whether rising or falling part of the atmospheric ^{14}C curve. We now are preparing for analysis of ^{14}C of root dentine collagen and root inorganic matter. Their results will give more compelling data, now discover what is waiting for you!!