Radiocarbon dating

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Abstract

Commonly, radiocarbon dating has been used to determine the age of old samples up to 6×10^4 years old. In this report, several ways of dating are reviewed and fundamentals of radiocarbon dating are discussed. Then, an apparatus and its principle of the dating are explained for the case of the system, which Hachinohe Institute of Technology is planning to introduce.

1. Introduction

Around the end of 19th century, radioactive rays emitted from natural Uranium salts were noticed accidently by Becqerel and, soon after, Madam Curie separated several radioactive elements from minerals, which are now known as Polonium and Radium. In the beginning of 20th century, Rutherford studied the radiation and noticed that there were three different types of radiations: α, β and γ-rays. In those days, more than 20 radioactive elements were found in the nature. Nowadays artificial radio isotopes can be easily produced in reactors or by using accelerators and have been widely applied in many field. In this article, one of its applications to dating will be discussed. Also, an apparatus to measure radiations for the purpose of dating will be proposed, which Hachinohe Institute of Technology (HIT) is planning to introduce. Many good reviews about dating are found elsewhere[1].

There are more than 40 radioactive elements found in the earth, most of which have long lifetimes. The age of the earth is believed to be 4.5 billion years old and some of radioactive elements have been decaying since the birth of the earth. For example, ^{238}U has a lifetime of 4.5×10^9 y, which is almost same as the age of the earth. From this lifetime, the amount of ^{238}U is estimated to be twice as much as the amount of nowadays. This is the extreme case but there are other radioactive elements which have many different lifetimes. The selection of a radioactive element for dating depends on the age of interest and, at least, a few times of the lifetime must be within the age of samples. The field of research to study historical geological features of the earth is called Geochronology. In the field, the interest is in the determination of the age of minerals and strata which have been existing since the birth of the earth. For this measurement, as standard radioactive elements, following several nuclei can be used: ^{40}k (1.26×10^9 y), ^{87}Rb (50×10^9 y), ^{176}Lu (22×10^9 y), ^{187}Re (50×10^9 y), ^{232}Th (14×10^9 y), ^{235}U (0.7×10^9 y) and ^{238}U (4.5×10^9 y), where the numbers appeared in parentheses show the half lives of elements in the unit of years. Methods how to use these radioactive elements for dating are shown in references[1].

Received October 18, 1986

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