ESR DATING OF BRAZILIAN FISH FOSSIL

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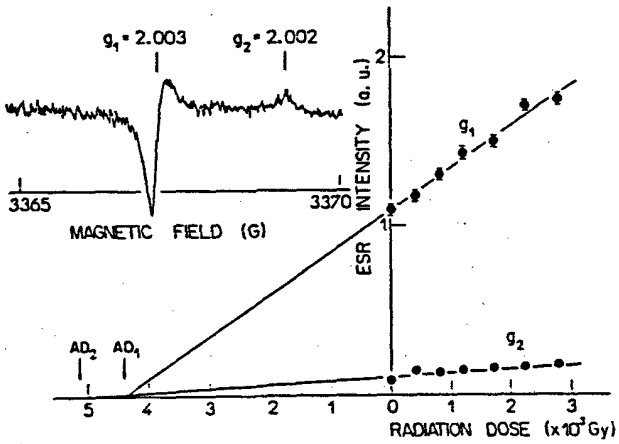
Geological materials have been exposed continuously to natural ionizing radiation. Electron spin resonance (ESR) has been developed recently as one of dating techniques, which utilize radiation-induced defects like thermoluminescence (TL) and fission track detection. The methodology of ESR dating is as follows:

1. Detection of radiation-induced ESR signal in the sample.
2. Obtaining the accumulate dose of natural radiation (AD) received by the sample, by a sample calibration with additive artificial radiation.
3. Calculation of the age with the AD divided by the annual average dose of natural radiation (D).

We have investigated ESR measurement of radiation-induced defects of a carbonate fish fossil found in northeastern Brazil. The geological period in which such a fish inhabited is called the Cretaceous (from 64 to 140 million years ago) in the Mesozoic era. ESR spectra were measured at the X-band on a JEOL JES-MS-3X spectrometer. The g value was obtained by referring to ESR spectra of Mn^{2+} in MgO and DPPH.

Resonance signal was observed at room temperature. The ESR spectra of the fish fossil is shown on the upper part of the figure, together with its g values which agree with those of CO_3^{3-} center (1). Two ESR intensities increase linearly with radiation dose of ^{60}Co γ rays, as shown in the figure. We can obtain $AD_1=4.4\times10^3$ Gy and $AD_2=5.1\times10^3$ Gy for the AD corresponding to the signals with g_1 and g_2, respectively, by the intersecting point between the radiation dose axis and the extrapolated straight line. For



ESR spectra measured for fish fossil and relationship between ESR intensity and radiation dose.

an D of about 1.6×10^{-3} Gy, these AD give an age of about 3×10^6 years. We obtained an age of 7.5×10^6 years for the same sample using TL dating technique and found that this age became 4.5 times longer by the correction of thermal instability of defects (2). Moreover, using ESR and TL dating techniques, the radial growth rate of stalactites in the Brazilian calcite cavern, Caverna do Diabo, is obtained as about 1μm/year which coincides with those obtained up to now. The present study has verified that ESR and TL dating agree fairly well.

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