ESR dating of pseudotachylyte

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ESR Dating Method

ESR (electron spin resonance) dating method has been used to determine the ages of Quaternary events. When a mineral receives radiation from natural radioactive elements, a part of paired electrons in quartz are ionized, and are trapped by lattice defects and impurities as unpaired electrons. The amount of unpaired electrons increases with time after geological zeroing event. The ESR age is obtained by dividing the total dose of natural radiation by the natural dose rate. Gamma ray doses are given to the sample to obtain the total dose by extrapolating the dose response of the signal intensity to the zero ordinate. The natural dose rate is calculated from U, Th, and K concentrations, and so on. Quartz is one of the promising minerals useful for ESR dating. In the present paper, we attempted to obtain ages of a land slide event. We collected pseudotachylyte from Lantang, Himalaya. A land of about 4 km in diameter has found to have slid several kilometres resulting in pseudotachylyte at the base.

Equivalent dose

The samples were gently crushed sieved and soaked in 6N HCl for 1 night and then in 20% HF for two hours, but quartz grains were too small to be extracted. However, ESR signals of characteristic quartz were observed. As long as the sample is uniform, it is not crucial to extract pure quartz grains. With the usual procedure of ESR dating, gamma ray irradiation and ESR measurements, we obtained accumulated natural doses of 290 to 450 Gy.

Dose rate

The concentrations of radioactive elements, K, U, Th, which give most of the natural dose to quartz grains, were measured by the low background gamma ray spectrometry. We obtained 7.62 ppm of uranium, 21.1 ppm of thorium, and 3.72% of K_2O. Assuming the cosmic dose rate of 0.1mGy/y, we obtained 6.22 mGy/y as the natural dose rate.

Conclusions

The ESR ages are obtained by dividing the accumulated doses by the natural dose rate to be 64ka from Al center signal (an electronic hole trapped at Al impurity in quartz) and 72ka from Ti center signal (an electron trapped at Ti impurity in quartz) for a sample, and 56ka and 58ka for Al and Ti center signals, respectively, for another sample. These ages are consistent with some constraints of other geological events.

Limitation of coral isotope records for paleo-SST & SSS reconstruction

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Oxgen and carbon isotope records in coral skeleton have been established as powerful tools for reconstraction of paleoclimate. Because skeletal oxygen isotope is controlled not only by the sea surface temperature (SST) but also by the oxygen isotopic composition of seawater which correlate closely with sea surface salinity (SSS), coral $\delta^{18}O$ could not be a direct SST proxy in the case that seasonal variation of precipitaion was large. Carbon isotope records have been also used as a proxy for the light availability for and / or growth rate of corals which could be controlled by the photosynthetic activities of symbiotic algae and also affected by surrounding environment. In order to distinguish complex effects of environmental conditions on coral $\delta^{18}O$ and $\delta^{13}C$, detailed comparison between isotope records in corals and various environmental parameters such as SST, SSS, and isotope values for sea waters.

We collected the coral skeleton (*Porites lutea*) from Hainan Island, located in the northwestern part of the South China Sea, where the influence of the Asian monsoon is large and two seasons characterized by cold/dry and hot/wet climate is distinctive. The SST and SSS at the sampling site had been measured from October 1999 to November 2000 and seawater sampling was conducted every one month during these periods. The $\delta^{18}O$ and $\delta^{13}C$ of the coral skeleton were analysed by ~50 μm interval which represents average 1 or 2 days. This super high resolution skeltal isotopic records corresponding to the periods of *in situ* SST and SSS measurements can be directly compared with seasonal variations of SST, SSS and seawater isotopic values.

At the sampling site, SST and SSS are changing widely throughout the year (SST: 17-33 ˚C, SSS: 18-34 psu). Isotopic compositions of coral skeleton expected from these SST, SSS and seawater isotopic values are –3 ‰ to –9 ‰ for oxygen and –3 ‰ to +1 ‰ for carbon. On the other hand, coral $\delta^{18}O$ and $\delta^{13}C$ range from –4 ‰ to –6 ‰ and from –1 ‰ to –5‰, respectively. These gaps suggest that SST less than 22 ˚C and high SST (>33 ˚C) / low SSS (<27 psu) prevent skeletal extension, which is consistent with the observation of living corals. Skeltal $\delta^{13}C$ is basically controlled by light carbon isotope of respiration origin and increase due to active photosynthesis during the dry season with low sea surface turbidity (high light availability). Seasonal variation of coral growth is not concordant with $\delta^{13}C$ and tends to correlate with SST.