

Potential of luminescence dating

NAGATOMO, Tsuneto^{1*}

¹Nara University of Education

Many kinds of natural phenomena such as radioactive decay and fission of nuclei, solid surface phenomena and chemical changes of organic compounds etc. are applied to radiometric dating and the other various dating methods. Luminescence dating is a technique using light emission from quartz when it is excited by heat or radiant energy. The phenomena applied in CHIME and C14 methods are not influenced by the change of environmental condition, but luminescence and ESR (electron spin resonance) which are surface phenomenon of solids and racemization of amino acid method which measures the rate of chemical reaction are sometimes affected by the changes of circumstances such as temperature and moisture. Under the circumstance at normal temperature under normal pressure, luminescence dating covers the age from several tens years to several hundred thousands years ago and even a million yeas ago in an ideal condition.

The phenomenon of quartz luminescence is the result of the radiation acting on its lattice defects formed by radiation or impurity elements. Meta-stable hole and electron pairs in crystal defects are stimulated by heat or light energy and recombined resulting light emission or luminescence. The crystal defects are created by secondary cosmic rays and radiations from natural radioactive nuclides, thus the number of them and the intensity of luminescence have increased for a function of time from the quartz crystallization. It is the same in the luminescence from the crystal defects caused by impurity elements.

When quartz is heated by volcanic eruption or artificial heating or exposed to light, the holes and electrons in its lattice defects recombine and result in light emission, and the number of them reduces to the initial state (zeroing). The luminescence age give the time elapsed from the zeroing. The luminescence dating technique covers the latter half of quaternary period or human period, and determines the natural events such as volcanic eruption, tsunami and dune formation which influence the human life, and artificial one such as open-air fire and pottery making.

The luminescence ages of several palaeolithic sites and the comparison of them with ages obtained by the other dating techniques will be shown at the session.

Keywords: luminescence, dating, radiation, quartz, human period, artificial event