Unclosure temperature and geometry

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A diffusion process in an object is analytically solved for sphere, cylinder and plane geometry. Diffusion parameters obtained in experiments are used to estimate closure temperature of minerals, assuming that those parameters are the same between cooling process in nature and short heating in laboratories. In the cooling model by Dodson (1973), the closure temperature at the start of an isotope clock are defined as the temperature when the diffusion process is considered to be practically ceased due to cooling. There seems to be some ambiguity left for the timing of the practical termination of diffusion. To deal with this, Dodson adopted a cooling rate , leaving some flexibility. Approximate forms of analytical solutions provide fractional loss as a function of temperature and relaxation time, using Arrhnius relation. Geometry factors are given different numerical factor in the Dodson's model, but they are expressed in different functional forms of fractional loss in approximate solutions.

In age dating, it is the primary interest to obtain the cooling age of the rock body, or to recover the age after secondary event. We call the maximum temperature which allows the recovery of the cooling age as unclosure temperature. When the time is reversed, the practical accumulation of the isotopes start below this temperature. Turner (1968) and others estimated that age could be approximately recovered from the high temperature fractions when fractional loss, *f* is about 20% for sphere and about 10% for cylinder, assuming an uniform distribution of grain size. We calculated unclosure temperature of minerals. The temperature differs depending on the relaxation time. Approximately 1 Ma of relaxation time allows reasonable agreement between closure temperature and unclosure temperature.

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