

U-Th radioactive disequilibrium dating of carbonate minerals from a fault fracture zone

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Veins of carbonate minerals precipitated from ground water are often found in fault fracture zones. The ages of the minerals reveal from what time the fault fracture zone was used as a conduit of ground water and they would put constraints on activities of the fault.

Carbonate minerals younger than 500 kyr are datable with a radioactive disequilibrium dating method between ^{234}U and ^{230}Th . U is soluble in groundwater under oxidized condition while Th is insoluble. The difference in geochemical character fractionates the two elements and when a carbonate mineral precipitates, it has often radioactive disequilibrium of ^{234}U greater than ^{230}Th . The extent of the disequilibrium decreases as time until the two elements retain equilibrium after about 500 kyr. The extent of the disequilibrium gives an age of mineral precipitation.

We applied this method to carbonate minerals in the core of UPGJ 1,800-m recovered from the Nozima fault, Hyogo. Radioactive disequilibrium measurements were carried out on carbonate mineral and bulk core material from the depth of 1484 m of the core using a MC-ICPMS.

The carbonate mineral contains 1-2 ppm of ^{238}U and ^{232}Th . The high Th abundance in the carbonate mineral indicates that the mineral is not pure carbonate but contains clay component and requires the correction of ^{230}Th from the clay component.

Radioactivity ratios of $^{234}\text{U}/^{238}\text{U}$ and $^{230}\text{Th}/^{238}\text{U}$ of the pure carbonate component have been calculated as 1.14 ± 0.08 and 1.25 ± 0.06 , respectively. The radioactivity ratio of $^{230}\text{Th}/^{234}\text{U}$ of the carbonate gives an age of 486, with uncertainty of $+380, -190$ ka. The age is close to the upper limit of the radioactive disequilibrium dating, however, because the radioactivity ratio of $^{234}\text{U}/^{238}\text{U}$ shows disequilibrium, the age of the carbonate mineral can not be older than 1 Ma.

The results show the fault fracture zone was used as a conduit of ground water since 50 ka.