Fission track thermochronology of an ancient seismogenic zone in the Shimanto accretionary complex, southwest Japan

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To better understand the mechanism of trench-type earthquakes, fission track (FT) thermochronologic analysis was performed on zircons separated from an ancient seismogenic zone in the Shimanto accretionary complex. Samples were collected from the surrounding area of the boundary fault between the Okitsu Melange and Nonokawa Formation. It is suggested that this fault was once located in the seismogenic zone, owing to the occurrence of pseudotachylyte therein (Sakaguchi et al., in prep.). For zircons from the footwall of the boundary fault, i.e., the Okitsu Melange, the observed mean FT lengths are indistinguishable from the reference mean length determined previously on unannealed spontaneous tracks in zircon age standards. The zircon FT ages are consistent with the previous data. In contrast, in the hanging wall of the fault, i.e., the Nonokawa Formation, zircon FTs show reduced mean lengths and ages not only for samples nearby the fault, but also for samples < 3 km away orthogonal to the fault. Two FT length distribution patterns are found for partially annealed samples in the hanging wall area. One is a unimodal length distribution having a peak around 7-9 microns, with no long FTs. The other is a bimodal length distribution having peaks around 10-11 microns and 5-6 microns, where the short FT component is dominant over the long one. These are likely interpreted by the secondary heating up to ZPAZ after the initial cooling below the ZPAZ. Because the degree of FT annealing is significant, with an irregular variation, throughout the hanging wall area < 3 km away orthogonal to the fault, it is likely that the zone of thermal anomaly around the fault extends as such and that the maximum paleotemperature was not uniform therein. It is also suggested that the heat was transferred or dispersed via fluids, judging from the concentration of veins nearby the fault.

CO_2 sequestration into geothermal fields: (3) Theoretical evaluation of CO_2/water/rock interaction

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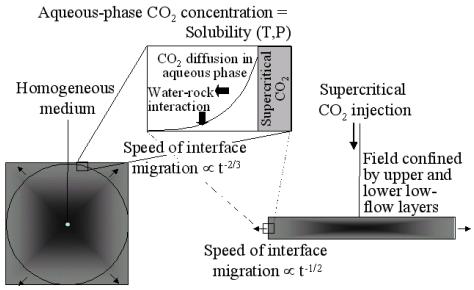
One possibility for CO_2 sequestration in Japan is to inject supercritical CO_2 into relatively high-temperature geothermal areas. High temperatures should enhance fluid-rock interaction rates and potentially favour mineral trapping.

The feasibility of high-temperature sequestration was evaluated by theoretical modeling using a purpose-designed, fully-coupled, flow-reaction code incorporating reaction kinetics. Coupled 'moving window' simulations evaluated diffusion, dispersion and water-rock interactions as CO_2 is injected into a granodiorite at 225°C and 100 bars (Figure 1).



A. Vertical, temperature and pressure vary with flow

B. Horizontal, temperature and pressure constant

Figure 1: Illustration of simulations performed in the study.

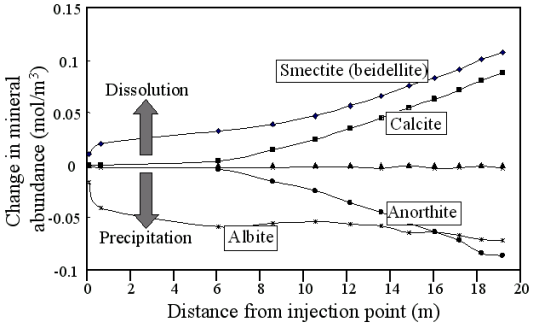


Figure 2: Example results.

There remain uncertainties, notably concerning high-temperature CO_2 solubility and thermodynamic and kinetic data for silicates such as anorthite. However, the results indicate that CO_2 trapping in calcite could occur during CO_2 migration (Figure 2). Depending on the injection conditions, trapping could be substantial. Consequently, the approach merits further consideration.