Zircon fission-track thermochronology of the Nojima fault system

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To better understand the heat generation and transfer along earthquake fault, this paper presents zircon fission-track (FT) thermochronology of Nojima fault, Awaji-shima Island, Japan, which was activated during the 1995 Kobe earthquake (Hyogo-ken Nanbu earthquake). Samples were collected from Cretaceous granitic rocks at depths using the Ogura 500 m borehole and Geological Survey of Japan (GSJ) borehole, as well as at outcrops and a treach nearby the boring sites. The Nojima fault plane was drilled at 389.4 m depth (along-core apparent depth) for Ogura and at about 625 m for GSJ.

For Ogura samples, FT lengths in zircons from localities >60 m away from the fault plane as well as those from outcrops are characterized by the mean values of ~10-11 µm and unimodal distributions with negative skewness, showing no signs of appreciable reduction of FT length. In contrast, those from nearby the fault at depths show significantly reduced mean of ~7-8 µm and distributions having a peak around 6-7 µm with rather positive skewness. A similar trend was observed for GSJ samples, in which the peak around 6-7 µm is less dominant however. In conjunction with other geological constraints, these results are best interpreted by the ancient thermal anomaly around the fault, which is primarily attributable to the heat transfer via fluids from the deep interior of the crust. Zircon FT age data coupled with the length profiles suggest that the secondary heating to (and cooling from) the zircon partial annealing zone took place at about 40 Ma for the GSJ and more recent time for the Ogura.

Experimental study of $Au(HS)_2^-$ stability in hydrothermal fluids using mineral buffers

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The thermodynamic properties of $Au(HS)_2^-$ reported in the literature have been determined via solubility measurements according to the reaction:

$$Au_{(cr)} + H_2S^0_{(aq)} + HS^- = Au(HS)_2^- + 0.5\ H_{2(g)} \qquad (1)$$

The quality of these data requires precise pH, $f(S_2)$, and $f(H_2)$ control. However, at near-critical and supercritical conditions the dissociation constants of most solution components, including HCl and H_2S, are not well known. In addition, possible leaking of highly volatile components through the reactor walls and sealings can introduce additional uncertainties. To circumvent these problems, all gold solubility experiments were performed in the presence of mineral assemblages in order to buffer simultaneously pH, $f(S_2)$, and $f(H_2)$.

Gold solubility was measured at near-neutral pH in the presence of the k-feldspar-muscovite-quartz and pyrite-pyrrhotite-magnetite buffers at 350°-400°C and 0.5-1 kbar. These experiments were performed using a flexible-cell rocking hydrothermal reactor system. Further experiments were performed at alkaline pH, buffered by the albite-corundum-nepheline and pyrrhotite-magnetite assemblages, at 450°C and 1 kbar in Ti batch reactors. At 400°C and 0.5 kbar Au concentration decreased from $10^{-6.1\pm0.15}$ to $10^{-7.4\pm0.15}$ [mol/kg H_2O] with increasing KCl concentration and a pH decrease from 6.5 to 5.6, which is consistent with the predominance of aqueous $Au(HS)_2^-$. The logarithm of the retrieved equilibrium constant of reaction (1) decreased from -1.34±0.25 at 350°C to -1.72±0.25 at 400°C and 1 kbar. These data are in close agreement with values determined by Benning and Seward (1996). Ongoing studies involve solubility measurements at 500°C, 1.5 kbar, and at more acidic conditions (andalusite-muscovite-quartz assemblage).

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