Kinetic experiments of basalt and femic minerals reacted with water at high temperatures above 300°C

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Kinetics of basalt and femic minerals reacted with water and NaCl-H_2O at high temperatures (T) plays an important role in hydrothermal processes at MOR. Steady-state dissolution rates of olivine, pyroxene, actinolite and basalts have been measured at T from 25 to 400°C at 23-35MPa. The mineral samples used in these experiments have been analyzed chemically. Their compositions and structure are also analyzed through SEM and TEM before and after reactions. All dissolution experiments were carried out in mixed-flow reactor or packed bed reactor (with Zr metal liner), and performed at far-from-equilibrium conditions. The dissolution of the minerals in water, such as olivine, pyroxene, actinolite, may require the breaking of more than one metal-oxygen bond type. Different metal elements in minerals behave different release rates, so that the dissolution product is often not stoichiometric. Experiments found that Na, Mg, Fe, Ca dissolve usually faster than Si at T <300°C, 23 MPa. In contrast, at T≥ 300°C, Si release rate is higher than other metals. For both femic minerals and basalt, the maximum release rates of Si are often present at 300°C, 23 MPa. For diopside, Ca /Si (or Mg/Si) release ratio at T near 200°C is stoichiometric. The no-stoichiometric surface layer was found by analyzing of SEM and TEM. At T<300°C, surfaces of femic minerals after reacted with water is a light Si-rich and little Fe (or/and Mg, Ca) deficient. In contrast, at T ≥ 300°C, the surfaces reacted with water is a light Fe-rich and little Si deficient. TEM study indicates that amorphic surface layer was found. Metal-H^+ exchange and hydration reaction on mineral surface will pass through this layer. Results prove that Fe-oxide precipitates at T from 300 to 400°C in near neutral solutions at MOR.

Late Cenozoic episodic uplifting in southeastern part of the Tibetan plateau — Evidence from Ar-Ar thermochronology

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The Xianshuihe fault zone, located in southeastern part of the Tibetan plateau, is a huge and active sinistral strike-slip fault zone. This fault zone is an important seismic fault in east Tibet. Earthquake geology studies and offset patterns of young geological features have shown that late Quaternary sinistral slip rate of the Xianshuihe fault zone reaches 13 mm/a. Field survey and structural measurements show two different shear deformation zones of the Xianshuihe fault: a brittle-ductile shear zone to the west and a ductile mylonite shear zone to the east. This latter is in transition with undeformed granites. Isotope chronological study on this fault zone can provide age evidence on the mass transport and uplifting history in southeastern part of the Tibetan plateau.

Ar-Ar thermochronological study show that during the late Cenozoic sustained sinistral strike-slipping of the Xianshuihe fault zone, the differential uplifting occurred in different part of the Fault zone. Comparing with the Ar isotope system closure temperature of biotite, the time of uplifting and cooling through 350°C in the westnorthern part, the middle part and the eastsouthern part of the Xianshuihe fault zone is 10.39Ma-10.13Ma, 5.70Ma-4.42Ma and 3.60Ma-3.46Ma respectively. This result prove that southeastern part of the Tibetan plateau has experienced episodic uplifting since late Cenozoic and the episodic uplifting time is~10.1Ma, 5.7Ma-4.4Ma and~3.6Ma respectively.

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