pH and Ionic strengths effects on hydrogen gas mechanochemically generated by wet grinding of single crystal and granite powders

Jun Kameda[1], Kazuko Saruwatari[2], Hidemi Tanaka[3]

[1] Earth and Planetary Sci., Tokyo Univ, [2] Univ. of Tokyo, [3] Dept. of Earth and Planet Sci., Univ. Tokyo

The relationship between the hydrogen gas anomaly and fault activity has been studied by many workers (Wakita et al., 1980; Sugisaki et al., 1983; Ito et al., 1999). Hydrogen gas may be caused by the chemical reaction between H2O and crushed rocks within a fault zone. The generation of hydrogen gas was experimentally confirmed by Kita et al. (1982). The concentration of hydrogen, however, are reported to be variable with time and space even at the neighboring locations along the active faults.

To understand the factor of controlling the amounts of hydrogen gas around active faults, we perform grinding experiments under various conditions. We especially focus on the crushing media, because crushed rock within a fault zone may react with groundwater with a variety of pH and ionic strengths.

Grinding experiments were conducted using a centrifugal ball mill (Fritsch, P-6) running at 600 rpm. Feed powders (5 g), pure water or buffer solution (10 g) and zirconia beads (70 g) were put together in the zirconia mill pot (80 cc). pH and ionic strengths of the solutions were controlled from 2 to 10 and by adding adequate amounts of NaCl, respectively. The surface area of crushed samples was measured applying BET method.

Following results are obtained.

(1) In any feed powders with pure water, the amounts of hydrogen gas increases linearly with grinding time. The amounts of hydrogen gas generated by grinding quartz and K-feldspar are almost same and half of these of granite. The highest concentration of hydrogen was observed by grinding biotite.

(2) In case of quartz, the amounts of evolved hydrogen gas increase rapidly from pH 2 to 5 where the concentration of H2 is the highest (57 ppm). Above pH 5, the concentration of hydrogen gradually decreases. Throughout the entire pH range, amounts of hydrogen gas do not depend on ionic strengths. Surface areas of crushed samples were about 4m2/g and no dependence on the pH or ionic strengths was observed. Thus it is suggested that the pH dependence of the amounts of H2 are concerned with the nature of newly created surface of quartz. On the other hand, the amounts of H2 are inversely related with pH value in case of granite. The amounts of hydrogen gas at pH 4 (1800 ppm) are about twenty times larger than those at pH 9 (75 ppm). The biotite may play an important role especially in acidic pH region.