Raman spectroscopy of indented quartz

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Point contact deformation is an ordinary phenomenon. However, detail of point contact deformation of rocks and minerals are not well defined. In this poster we present abnormality of the point contact deformation by using on quartz.

The apparatus used is a nano-indentation tester (MZT-500 RIDER, Akashi Co.) RIDER is the device which evolved the generally known Vickers hardness tester with nanotechnology, and is able to measure load (+-0.001 mN) and displacement (+-0.01 nm) with high accuracy at energy 0.1 second. We used a triangular pyramid indenter (the angular 68 degrees).

An idiomorphic Brazilian quartz crystal 9 cm long and 2.5 cm wide was cut perpendicular to the c-axis to prepare a 5 mm thick slice. The slice was polished with alumina paste (particle size: 0.06 _m) to obtain a mirror flat surface. The sample is colorless transparent, free from impurity. Its H2O content is unknown.

The indentation test was performed at the maximum load of 200 mN at room temperature. The loading rate, dwell time and the unloading time were 20 mN/s, 10 s and 10 s, respectively. Hence, indentation test took about 30 s. In the quartz sample, any fracturing and cracking had not occurred, and a triangular pyramidal indented impression reflecting the shape of the indenter was produced. Depth of the impression is ca. 370 nm. As no brittle deformation has occurred around the impression, plastic deformation is considered to occur, although plastic deformation is usually known to occur under high pressures and temperatures.

In order to observe what happened in the quartz around the indented impression, we performed Raman spectroscopy. A Laser Raman Microscope (ALMEGA, Thermo Nicolet co.) was used with a resolution of space and depth of ca. 1mm and 2mm, respectively. In this study, change in frequency and linewidth of 128, 206 and 464 cm-1 were analyzed. It is known that pressure dependence of Raman shift from these wave-numbers are well clarified by e.g. Hemley (1987), and the shifts that we observe for our indented quality correspond to be compressed at ca. 2 GPa.