Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

MIS008-03 Room: Exibition hall 7 subroom 2 Time: May 27 09:30-09:45

Activation of positive holes induced in igneous rocks under non-uniform stress

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In laboratory experiments, igneous rock samples under non-uniform stress generate electric currents flowing from the stressed volume to the unstressed volume and the positive electrification on the unstressed surface. Because quartz-less rocks such as gabbro generate electric signals stronger than quartz-bearing rocks such as granite, it is reasonable to assume positive charge carriers in the igneous rocks rather than to expect piezoelectric effect as the prim factor. Here, peroxy bonds, which are one of the most ubiquitous lattice defects in igneous rock-forming minerals, are focused to explain these carriers. When this bond is deformed under non-uniform stress, an empty energy level of the bond shifts down into the Valence band and an electron can jump in this level from an oxygen neighboring. This leads to activation of a positive hole at the neighbor oxygen site. This hole can spread away through the Valence band. It is expected that telluric currents of positive holes flow when the non-uniform stress in the Earth's crust is induced by seismic and volcanic events. In this study, this P-type semiconductor like conductive mechanism is investigated with the help of also the distributions of stress and strain by means of finite element method on results obtained in the laboratory experiments.

Keywords: Igneous rock, Lattice defect, Positive hole, Telluric current