

Activation of hole charge carriers and generation of electromotive force in gabbro blocks induced by non-uniform loading

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When one end of vacuum-dried gabbro blocks was subjected to uniaxial loading, the unloaded end became electronically positive (+80 mV at 50-MPa). Hot point probe tests using the hot-probe with 423 K of the temperature and the cold one with 293 K found that the Seebeck coefficient of the loaded volume decreased from ~ 15.8 mV/K to ~ 14.9 mV/K when loaded, while the coefficient of the unloaded end did not change remarkably (~ 15.6 mV/K). This means that this gabbro originally included a small number of hole charge carriers and the carriers in the loaded volume increased when loaded. From the viewpoint of the fundamental band model of solid state, the most reasonable mechanism of the increment is the decrease of the energy gap between the acceptors and the valence band top. Shear stress/strain would effectively shift the energy levels because early studies have found that the electronic conductivity of gabbro is almost independent of the hydrostatic pressure. Based on this idea, a generation model of the stress-induced electromotive force is proposed. Since this model is expected to be universally applicable to various types of rocks, similar electromotive forces in the crustal scale may be induced by seismic, volcanic, and tidal activities in the Earth and Moon.

Keywords: gabbro, hole charge carrier, electromotive force, Seebeck coefficient