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P-type semiconductor like conductivity of igneous rocks under non-uniform stress

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To study electric properties of Earth's crust-forming rocks, rock samples are usually placed under hydrostatic pressure at certain temperatures. However, when an igneous rock sample is placed under non-uniform pressure, new electric phenomena appear. (1) Electric currents automatically flow from the stressed volume to the unstressed volume. (2) The surface of the unstressed volume is charged positive. Quartz-less rocks such as gabbro generate electric signals stronger than quartz-bearing rocks such as granite. These results do not recommend piezoelectric effect as the primary source but indicate existence of positive charge carriers in the rocks. 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, like charge carriers in a p-type semiconductor material. In the natural scale, this hole may contribute to the electric conductivity of the Earth's crust.

Keywords: Igneous rock, Lattice defect, Positive hole, Electric conductivity