Activation of positive holes induced by deformation of peroxy links in igneous rocks

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Electric properties of rocks have been studied for a long time. In these studies, the 'whole volume' of rock samples is usually under uniaxial or triaxial pressure at a certain temperature. Obtained data are used for fitting with an Arrhenius equation to estimate parameters such as the electrical conductivity, preexponential factor, activation energy, and activation volume. However, when a 'partial volume' of igneous rock samples is under uniaxial pressure at a room temperature, new electric phenomena appear: (1) electric currents automatically flow from the stressed volume to the unstressed volume and (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 reject piezoelectric effect as the primary source and indicate existence of positive charge carriers in the rocks. To explain these carriers, we focus on peroxy links, one of the most ubiquitous defects in rock-forming minerals. When this link is deformed under load, an empty energy level of the oxygen pair shifts down into the Valence band and an electron jumps 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.