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An Experimental Study of Thermal Field Variations Associated with Deformation in a Compressive En Echelon Structure

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In the laboratory, we have measured temperature variations with time and space during deformation of a rock specimen by means of two apparatuses. One is a surface measurement system with multi-point platinum resistance thermometer. The other is an infrared thermal image system. During the experiment, the rock specimen of granodiorite which contains a compressive en echelon fault was loaded by a two-directional servo-system. The measurement results of two systems are in agreement with each other. The experimental results are summarized below:(1) During the experiment, three kinds of deformation occurred in the specimen, which are elastic deformation, frictional slide, and rupture. Correspondingly, there are three mechanisms of temperature rise with different increasing rates: the first is associated with stress growth, and the second and the third are related to friction and rupture, respectively. (2) Temperature rising processes depend on loci in the structure of the rock specimen. At the measurement point ① far away from the fault, the temperature increment is smallest, with a stable rate, reflecting a background of the stress field for the whole specimen. For the point ② near the fault, the rate of temperature rising is larger than that of the point ①. And the rising rate of temperature at the compressive jog is the largest. Such a distribution of thermal field variations implies differential stress levels at varied positions in the structure. (3) During the stick-slip stage of rock deformation, both the thermal image system and thermometer have recorded step-like rising of temperature near the fault, which is synchronous with stress drop of the rock specimen. This is different from the processes of temperature rising by compression or declining by extension during the elastic deformation. It should be attributed to frictional mechanism. (4) A larger rising rate of temperature at the rupture stage was measured at the compressive jog in the specimen. These experimental results show that the thermal field of structure has obvious responses to variations of the stress field. They are of great significance for the study of current fault activities by using data of satellite infrared images.