

Decay of ESR signals by high speed friction experiments: implications for temperature estimation and dating of fault movements

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ESR (electron spin resonance) dating method is based on quantitative measurement of unpaired electrons in minerals which have been created by natural radiation through geological time scale. Quartz is one of the minerals which can be dated by ESR, and has many applications of dating because it is abundant on the earth's surface.

Since Ikeya et al. (1982) showed that ESR dating possibly works to date fault movements, it has been a issue to develop the technique of ESR dating of fault movements and to find the actual mechanism of zeroing signals. Several studies were performed to examine how the ESR signals in quartz are zeroed by the shearing experiments (e.g., Lee and Schearcz, 1993) assuming that mechanical crushing erases the signal while Fukuchi (1989) proposed that frictional heating is one of the possible mechanism of zeroing. Unfortunately, it was not possible to simulate the actual fault movement because of the limitation of the instruments in the sense that the shearing speed is much lower than actual fault. However, recently, a machine has been developed to perform high speed friction experiments.

The quartz grains of 0.5 to 1 mm in diameter were sandwiched between two gabro columns of 2.5 cm in diameter with a tephron sleeve. One of the column rotates at a speed of 800 to 1500 rotation per minutes for 10 to 40 seconds with a vertical load of 30 kg. The quartz grains were crushed to powder by the friction. The ESR signals of impurity (Al, Ti-Li, and Ge) centers were reduced by the present experiments but not to be zeroed so far. The temperatures during the friction were estimated to be 200 to 400C by comparing the intensity with the results of heating experiments. The effect of crushing and the heating will be discussed.

References

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