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Pressure Stimulated Currents (PSC) in amphibolite rocks from KTB drilling

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1 Abstract

Laboratory experiments on rock samples have verified that the application of axial compression is escorted by the appearance of weak electric currents (Pressure Stimulated Currents –PSC). Such an experimental procedure has been denominated by the term PSC technique and it consists of recordings of electric current emissions from geomaterial samples when they suffer either an abrupt pressure variation or a prolonged pressure variation at a constant rate up to fracture.

Elaborate PSC measurements have been recorded during the application of abrupt variations of uniaxial compression on rock samples within the linear elasticity range of the material - as far as the mechanical behaviour is concerned – on amphibolite samples from KTB drilling. The material used is a fine grained amphibolite extracted from a depth of the order of 6.5km in the drilling site of the German Continental Deep Drilling program (KTB).

A basic conclusion arising from the application of the PSC technique on amhibolite rocks under abrupt pressure change is that they emit a PSC whose magnitude is related linearly with the applied stress rate. Marble rocks have shown a similar behaviour. The coefficient of proportionality between the maximum value of the emitted PSC and the uniaxial stress variation rate can be considered as a scaling factor - characteristic of the geomaterial - having a reciprocal dependence on the Young's modulus Y.

Comparing the relationship between the PSC peaks and the stress rates for the above mentioned materials it is obvious that amphibolite samples emit PSC of larger values

by approximately 1.4 times with respect to those of marble samples. It should be noted that amphibolite is characterized by higher values of the Young's modulus.

Finally, after having applied sequential cycles of loadings and unloadings on the amphibolite samples it was ascertained that in every new loading cycle after unloading, the emitted PSC exhibits lower peaks while the scaling factors that yield are also lower. This fact is consistent to the «memory effect» which is mainly reported during acoustic emissions phenomena, and is now verified for PSC emissions during loading – unloading procedures.