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Pressure Stimulated Currents (PSC) in Amphibolite rocks from KTB drilling under abrupt stepwise uniaxial compressional stress*

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In recent bibliography it is referred often that when mechanical stress is applied upon a rock sample it reacts by emitting electric current. Recent laboratory experiments have confirmed that the application of a uniaxial stress on rock samples is accompanied by the production of weak electric currents to which the term Pressure Stimulated Currents - PSC has been attributed. In this work the PSC emissions on amphibolite samples from KTB drilling are presented and commented upon. The material used is 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).

The experimental technique used in this case to show up the PSC is called Step Stress Technique (SST) and can be described as follows: while the sample is suffering a constant uniaxial stress S_k, an abrupt step-like stress increase is applied for a short period Δt and $\Delta S = S_{k+1} - S_k$ where S_{k+1} is the final state of the applied stress increase. It should be noted that the final stress state S_{k+1} is constant until a following stress increase is applied. This technique (SST) was applied in both the elastic (linear) and plastic deformation ranges of the material deformation diagram.

The results of the application of the above technique in the stress range between 5 and 30 MPa that the amphibolite samples behave following a linear stress-strain law indicate that:

The peak value of the Pressure Stimulated Current PSC_{max} is proportional to the stress rate b=ΔS/Δt of each applied abrupt stepwise stress increase if the material is subjected to an initial axial stress between the states S_k and S_{k+1}.

After having applied sequential cycles of loadings and unloadings to 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 with the «memory effect» which is reported especially during acoustic emissions phenomena, and has been verified now for PSC emissions during loading – unloading processes.

Finally, the results of exhibiting PSC phenomena, using the Step Stress Technique amphibolite samples seem to have analogies with the respective experiments on marble rock samples as well as on cement mortars.

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