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The Gutenberg- Richter b value for Anisotropic Rocks

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When stress on the rocks passes a certain level, microcracks initiate and radiate elastic waves, know as acoustic emissions (AE), in a similar way as earthquakes. As stress increases, microcracks connect and due to macrocrack nucleation, larger AE events with larger magnitudes are generated.

In this paper, the AE signals have been detected during tensile and compression (unconfined and confined) loading of an anisotropic granodiorite rock, which is a candidate rock for enhanced geothermal systems in Switzerland. Cores extracted from the Grimsel test site (GTS) in the central Swiss Alps were collected with five foliation angles of 0, 30, 45, 60 and 90 degrees. The results showed that the frequency-magnitude relation of the AE events radiated from the fracturing of the rock specimens obeys the Gutenberg-Richter power law:

$$\log N = a - bM$$

In which N is the number of events with magnitude M or greater, and a and b are constant. The parameter b, known as b value, is an indicator of magnitude distribution of AE events and investigating its dependency on foliation anisotropy is the objective of this paper.

Mapping b-value along failure processes of the tested specimens showed a slight decrease in b-value as soon as cracking starts and then it drops to its lowest value due to large cracks at the failure point. Our investigation indicated that the b-value is strongly dependent on the orientation of the foliation angle which has to be taken into account when using this parameter as a precursory indication of induced earthquakes in enhanced geothermal systems.