Geophysical Research Abstracts
Vol. 12, EGU2010-7401, 2010
EGU General Assembly 2010

Identification of crack initiation and damage thresholds in Hwangdeung granite in Korea and a new technique for crack damage threshold determination

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The excavation of underground openings in highly stressed rock masses induces excavation-damaged zone caused by stress redistribution. Establishing the initiation and development of stress-induced microfractures in the excavation-damaged zone is of interest as it could affect the stability of the excavation boundary. In this paper, crack initiation and damage thresholds in Hwangdeung granite in Korea were investigated using strain gauge and acoustic emission methodologies. A new technique to identify the crack damage threshold is suggested and verified by a long-term strength test.

Crack initiation and crack damage thresholds are 48% and 76% of uniaxial compressive strength(UCS), which was greater than crack initiation threshold and much lower than the crack damage threshold reported in a previous study by another researcher. This is because no exact criteria for identifying thresholds have been established. The count rate of acoustic emission, rather than the cumulative count as used by other researchers, and the gradient of envelope of the count rate were calculated. The crack damage threshold was clearly identified by gradient of the envelope of the count rate. To assess this new technique, the long-term strength test under stress level of 70% - 90% of UCS were performed because it is known that samples fail within 24 hours under the stress level of the crack damage threshold. All samples had failed within 24 hours with a stress level above 85% of UCS and 2, 7 and 9 samples had failed with stress levels of 70%, 75% and 80% of UCS respectively, indicating that the crack damage threshold is between 75% - 80% of UCS.