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Investigation of failure and damage processes of andesitic rocks

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In this research, failure and deformation processes of andesitic rocks are investigated through laboratory and discrete element modeling (DEM) analysis to reveal the transition of the cracking, namely from microscale to mesoscale (lab scale). For this purpose, the mechanical properties of Ankara andesites were initially investigated by performing uniaxial - triaxial compressive and indirect tensile laboratory tests. Further, these properties were used as reference parameters for the calibration process in a numerical model, generated through a three-dimensional open source code (Yade) based on the discrete element method (DEM). Our results show that during the linear-elastic region of the stress-strain curve, the major mechanism of rock behavior is driven by tensile cracks. When the crack damage threshold is reached, as a result of plastic strain, the strength related to the inherent cohesion significantly decreases and damage in the rock cannot be prevented anymore. At the peak stress of the curve, both tensile and shear cracks accumulate, intensively. Even the mesoscale failure mechanism is controlled by shearing at the residual stage of the yielding, based on the micro-scale process in the DEM model, the number of micro shear cracks is very limited compared to the tensile ones. This finding shows that the friction takes the control of the damage process as the only driving force during residual phase time.