A BIOGEOMECHANICAL APPROACH FOR ASSESSMENT OF MICROBIAL-ROCK INTERACTIONS

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Biogeomechanics is an emerging scientific field of geoscience that studies the mechanical responses due to microbial processes in sedimentary sequences. However, there is limited knowledge of mechanical changes due to microbial-rock interaction in rocks. This work investigates the time-dependent action of distinct microbial processes and how it may impact the localized and bulk mechanical responses in three types of sedimentary rocks (i.e, shale, limestone, and dolostone) using an integrated geomechanical and geophysical framework This work further explored the potential applications of these microbial-rock interactions in addressing engineering and environmental problems. Core samples extracted from shale, limestone, and dolostone at depth were treated with two microbial agents, and their mechanical properties were measured and quantified using an automated ultrasonic probe (micro-scale; geophysical method) and the uniaxial compression test (bulk-scale; geomechanical method). Using the automated ultrasonic probes, the compressional (*Vp*) and shear (*Vs*) waves were measured in an axial direction (parallel to the longitudinal axis of the core samples) with a 40mm depth step across the core sample. The measured *Vp* and *Vs* data were used for estimating the dynamic Poisson’s ratio (*ν*), and subsequently used for predicting the scratch-derived Young’s modulus (*Escr*). The uniaxial compression test was used to measure the stress-strain relationship due to the action of the microbes in the tested rock samples. This stress-strain data was used to estimate the bulk Young’s modulus and bulk Poisson’s ratio of the tested rock samples. The results show that the microbial process can cause significant time-lapse localized and bulk microbial-induced alterations in the local compressional (*Vp*) and shear (*Vs*) velocities, dynamic Poisson’s ratio (*ν*), and scratch-derived Young’s modulus (*Escr*). The results also suggest that in rocks, the treatment temperature, treatment time, inherent pore spaces, and permeable fractures are the most impact factors that can impact microbial-rock interaction to induce biogeomechanical alterations at multiscale (local and bulk scales).