Why the stress ratios are constant in the residual state of sheared granular materials regardless of the materials?

Hide Sakaguchi[1]

[1] JAMSTEC, IFREE

Generally, tri-axial compression testing results on granular materials show wide variety values in the maximum shear strength depending on the material properties, initial void volume, and confining pressure. On the contrary, the stress ratios in the residual state of granular materials are always nearly constant around the magic number 3.5. Surprisingly, this residual stress ratio is independent from material properties, initial void volume, and confining pressure. This is nothing trivial but tells us very interesting and important information to understand the frictional behavior of gouge layers in fault systems. For example, this fact indicates that the micro-friction at particle scale does not well contribute to the macro-friction at granular layer scale, which is completely opposite to what we can expect. Since physical laboratory experiments of shearing tests on granular materials are relatively unreliable for the measurements at residual state, numerical simulations using Discrete Element Method were performed. From the detailed analyses on the distribution of contact force for all the particles, a universal rule to control the stress ratio under shearing condition was found. Based on this finding, a discussion will be given to answer the question in the title of this talk.