Relationship between topographic effect on self-potential distribution and groundwater flow based on numerical experiments

Tada-nori Goto[1]; Takafumi Kasaya[1]; Sou Satou[2]; Jun Shimada[3]

[1] JAMSTEC; [2] GET; [3] Grad. Sch. of Sci. & Tech., Kumamoto Univ.

http://www.jamstec.go.jp/res/ress/tgoto/

Self-potential (SP), nearly static electrical potential on and in the earth, is mainly generated by pressure gradient of pore water, especially in no volcanic and mine area, so that SP can be a useful tool to constrain and monitor groundwater flow. The relationship between SP and pressure gradient is clearly seen in laboratory experiments, and described with a linear equation in a hand-size sample. However, in many case studies, interpretations of groundwater flow based on observed SP distributions in field data are difficult. One reason comes from complex distribution of both groundwater flow and electrical resistivity of soil and rocks. Here, we try experiments of mountain-scale models numerically to discuss the relationship between SP and groundwater. The simultaneous simulations of both groundwater flow and resultant SP distribution are done by newly developed calculation codes. The groundwater calculation is done by MODFLOW, a well-known groundwater simulator. Using our codes, effects of topographic relief to SP are tested with simple non-volcanic mountain slopes with various dipping and various water head distributions. We demonstrate how the water head has a large effect on the SP data similar to the hand-size samples, qualitatively.