A preliminary appraisal of the effect of pumping on seawater intrusion and upconing in a small tropical island using 2D resistivity technique

ABSTRACT

The existing knowledge regarding seawater intrusion and particularly upconing, in which both problems are linked to pumping, entirely relies on theoretical assumptions. Therefore, in this paper, an attempt is made to capture the effects of pumping on seawater intrusion and upconing using 2D resistivity measurement. For this work, two positions, one perpendicular and the other parallel to the sea, were chosen as profile line for resistivity measurement in the coastal area near the pumping wells of Kapas Island, Malaysia. Subsequently, water was pumped out of two pumping wells simultaneously for about five straight hours. Then, immediately after the pumping stopped, resistivity measurements were taken along the two stationed profile lines. This was followed by additional measurements after four and eight hours. The results showed an upconing with low resistivity of about 1–10 Ωm just beneath the pumping well along the first profile line that was taken just after the pumping stopped. The resistivity image also shows an intrusion of saline water (water enriched with diluted salt) from the sea coming towards the pumping well with resistivity values ranging between 10 and 25 Ωm. The subsequent measurements show the recovery of freshwater in the aquifer and how the saline water is gradually diluted or pushed out of the aquifer. Similarly the line parallel to the sea (L2) reveals almost the same result as the first line. However, in the second and third measurements, there were some significant variations which were contrary to the expectation that the freshwater may completely flush out the saline water from the aquifer. These two time series lines show that as the areas with the lowest resistivity (1 Ωm) shrink with time, the low resistivity (10 Ωm) tends to take over almost the entire area implying that the freshwater-saltwater equilibrium zone has already been altered. These results have clearly enhanced our current understanding and add more scientific weight to the theoretical assumptions on the effects of pumping on seawater intrusion and upconing.

Keyword: Pumping; Seawater intrusion; Upconing; 2D resistivity