Analytical solution for a sharp interface problem in sea water intrusion into a coastal aquifer

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Steady two-dimensional groundwater ®ow in an aquifer of constant thickness discharging into an inclined sea bottom is studied by the methods of complex analysis. The shape of an abrupt interface between moving fresh water and stagnant saline water appearing at the bottom corner of the aquifer is determined in an explicit analytical form depending on the values of the incident ®ow, hydraulic conductivity of the aquifer, its thickness, slope angle and densities of the two waters. The hodograph domain in this problem is an in- nite curvilinear triangle. Its conformal mapping on an auxiliary half-plane and the mappings of the physical domain and a priori unknown complex potential domain are obtained by the method of Polubarinova-Kochina based on the analytic theory of ordinary di¬erential equations. The solution shows that, at small values of the incident ®ow, sea water intrudes deeply landward into the aquifer. Comparisons with special cases of a horizontal bottom and vertical beach are presented.