

## COMMENT

### Aquifer – Water Table Aquitard Model for Hard Rock Areas

(A comment on the paper by K. Sridharan, M. S. Mohan Kumar and N. S. Lakshmana Rao, published in the Journal of the Geological Society of India, Vol. 29, No. 1, 1987—Trends in Groundwater Research—Special Issue)

The paper highlights the method in which the Authors seems to have perfected by numerical approach, the analysis of an aquifer-water table aquitard model considering aquitard as compressible and attempting a system of two layered nature. The model is quasi three dimensional and takes into account the vertical variations of head in the *aquitard*. The water table is treated as an unknown boundary. At the outset, I wish to congratulate the Authors for their bold venture in the field of mathematical modelling studies for hard-rocks.

The above approach numerically may be a valid solution but conceptually to think of a water-table aquifer aquitard system has its own limitation. In hard-rock aquifer system to introduce a non-dimensional aquitard is highly questionable since such a situation is inappropriate to the realities of flow domain. Even in earlier studies on Vedavati River Basin Project it was observed that the transmissivity values are not at all sensitive to the head variation in the fractured rock aquifer zones. This approach was on double porosity and permeability leaky aquifers concept. Further, similar results were obtained by using unconfined system model. This obviously leads to the conclusion that the lateral flow of groundwater in hard-rock aquifers is often of minor importance. It is only the vertical movement of water from the phreatic surface is the main source of the abstracted water. It is important, therefore, that vertical component of flow should be given cognizance. However, the effective vertical hydraulic conductivity determination is difficult to achieve. Even though leaky aquifer pumping test techniques may be appropriate to hard-rock aquifers since it indirectly evaluates the vertical hydraulic conductivity, the values can be reasonably over estimated. The three dimensional time models are not usually practicable for the reasons that large computational efforts are needed and it is difficult to obtain adequate data base. The concept of water table aquitard relation as claimed by the author is in no way superior to  $(r, z, t)$  models which represent the radial and vertical time variant flow. In this case the vertical flow is represented through weathered zone and horizontal transmission of water through the fractured zone. Moreover the interference between individual wells in hard-rock usually does not extend more than couple of metres. Moreover, the contention of the authors that vertical variations of head in the aquitard (less permeable layer) is not understandable when such a situation normally do not exist in hard-rock aquifers. Perhaps what they are referring to as an aquitard is nothing but unsaturated/desaturated weathered zone and to consider this as an aquitard is not very appropriate. The phreatic zone is highly sensitive to annual recharge changes. This uncertainty is not accounted for by the authors. Perhaps they seem to have ignored it.

Lastly, similar results can be easily obtained by adopting the radial and vertical time variant flow model which, in my opinion, is very appropriate to the hard-rock aquifer system.