NOTES

DEEP SEATED 'FRACTURED AQUIFERS' IN CRYSTALLINE ROCKS

(Gist of Talk by V.Jagannathan, Central Ground Water Board, Bangalore, delivered at the premises of the Geological Society of India on 30th Ocotober 1992)

A widely quoted reference on the subject even in present days is the one by Davis and Turk (1964). A major conclusion in the paper is "As open fractures decrease with depth in crystalline rocks, ground water flow to a well bore per foot of the well, and therefore also the well productivity, should decrease with increase in depth". In a publication brought out by UNESCO (1984) a detailed analysis of the depth discharge relationship observed in many parts of the world is given and many references are quoted. A sixty metre depth limitation is also suggested as a maximum economic drilling depth.

PRODUCTIVITY OF DEEP SEATED FRACTURES : In the last few years, deep drilling – up to 300m has been done in South Kanara, Kolar and Bangalore districts in Karnataka. In many boreholes, a distinct improvement in the yield could be observed below 100m. For example, in South Kanara district, the cumulative percentage of exceedence of obtaining discharge of more than 1 l/s increased from as low as 2% for borewells of less than 20m depth to 58% for borewells of 75m to 75% in borewells of 200m depth. In the case of 2 l/s, it increases from 30% for 75m depth to 65% for 200m depth. In the case of Kolar and Bangalore districts, similar results of improved performance at depth have been noticed. In the case of Bangalore, improvement is noted in 9 out of 12 cases and in the case of Kolar district, in 16 out of 31 cases. Similar results are available (8 out of 27 cases) from Dharmapuri district of Tamil Nadu State.

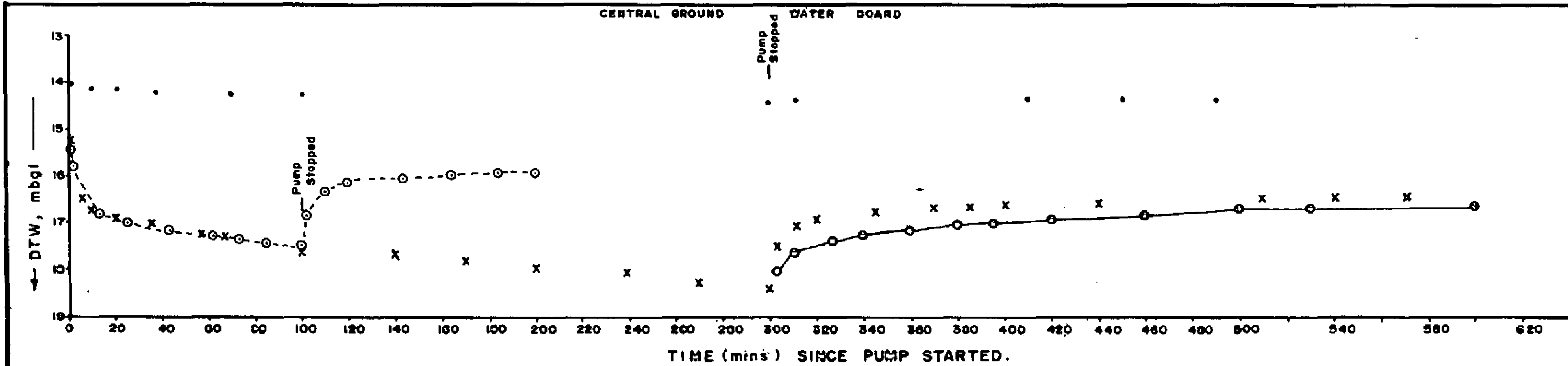
Where specific capacity results are available at two different depths, the improvement ranges from 41 to 209% in Bangalore district and 33 to as high as 675% in Kolar district. In 4 out of the 6 cases in the latter, it varied from 120 to 240%.

It may safely be concluded that productive fractures extend to deeper levels than 60m and heavy flows of ground water reported in deep levels in under groundmines are not chance occurrences.

INTER-RELATIONSHIP BETWEEN SHALLOW AND DEEP AQUIFERS: From the management point of review, it is desirable to know this inter-relationship. For example, if it is established that the deeper aquifer acts as a classical confined unit with the recharge area occurring at a distant place where there is not much development and is also not possible for economic and technical reasons. Babar and Terai belt in the piedmont region of U.P. for example - the resource available in the deeper unit can be treated as an additional resource for development.

Results available so far have not established the existence of an additional resource. Detailed pump tests conducted in the well fields, where piezometer nests were installed tapping different units, show that when the deep seated 'fractured aquifer' was pumped, measurable drawdown occurs in the phreatic zone. This is illustrated in the case of a test conducted at Marohalli.

At Marohalli, a massive horizon is encountered at depths of 50- 60m. In the borehole drilled, high yielding fractures were encountered at 134-136 and 176-179m. The specific capacity at the depth of 58m where massive horizon was met was 8.6m^3/day-m. At 180m, it was 27m^3/day-m. Toward understanding the inter- relatinoship of the deep seated fractures



INDEX	HYDROGRAPH	REMARKS
× ×	EW	When deep fracture in PZ was under pumping.
o •	WT	When deep fracture in PZ was under pumping.
⊖—⊖	PZ	Water levels of deep fractures monitered after seperating by cement seal (Only recovery data.)
⊖--⊖	EW	When PZ (prior to seperation of shallow and deep fractures) was under pumping.

Fig-1 HYDROGRAPHS OF THE TESTED WELLS IN MAROHALLI WELL FIELD, NELAMANGALA TALUK, BANGALORE - DISTRICT, KARNATAKA.

C.G.W.B/SWR - DO-NO 38/91 Drawn by R.S

with the shallow aquifer, a PM nest separating the shallow aquifer from the deeper fractures was constructed. Besides, the well field included a deep borewell of 180m and a shallow borewell to the depth of 35m.

Figure 1 depicts the effect of pumping the deeper fracture system in the P.N. on the E.W. and shallow observation well. The EW started reacting from the first minute of pumping and the shallow observation well recorded a rise in water level till the first three minutes followed by lowering of levels from fifth minute onwards. At the end of 300 minutes of pumping EW and shallow well recorded of drawdowns 3.1 and 0.31m respectively. The zone up to 63m tapped in the nest recorded drawdown of 0.099m at the end of 300 minutes of pumping and the water level continued to decline even after stopping the pumping in the deeper zone. The drawdown recorded in the shallow zone of nest after 125 minutes of recovery was 0.115m and continued to be the same, without further fall or rise till 252 mins. of recovery. This confirms the interconnection of the deeper fracture system with the shallow ones, though they are seperated by non-productive granitic gneiss of about 70m thickness.

CONCLUSIONS: Deep exploration for ground water has conclusively proved the presence of productive aquifers beyond the normally accepted depth limit of 60m. However, the present results also indicate that the deeper units are interconnected with the shallow phreatic zone and they do not appear to have independent sources of recharge away from the immediate vicinity.

References

DAVIS, S.N., TURK, L.J. (1964) Optimum depth of wells in crystalline rocks, Ground Water, 2 (2), pp.6-11.

UNESCO (1984) Ground water in hard rock, Studies and Reports in Hydrology, 32, 228p.

INDO-GANGETIC BASIN - A GROUP DISCUSSION

Identification and promotion of frontline and challenging areas of R & D in various disciplines of S & T is one of the vital activities of DST. As a part of this endeavour, the Programme Advisory Committee on Earth Sciences (PAC-ES) has identified the following 5 emerging areas having strong relevance with Indian Geology:

1. Indo-Gangetic Basin
2. The Vindhyans
3. Modelling in Earth Sciences
4. Palaeobiochemistry
5. Fluid flow in the Earth Crust

The Ganga Basin with its casual and adjoining Himalayan topographic front and subduction/collision belt forms a gigantic laboratory in which earth's dynamical processes