RADIOISOTOPE TRACING OF WATER MOVEMENT AT WAIRAKEI

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One of the key features of a geothermal field is the movement of water in the near surface region. In an undisturbed field there will be an upflow associated with the areas of highest temperatures (water movement being the dominant heat transfer mechanism), as well as cross-flows associated with lateral pressure variations and the usually heterogeneous permeability structure. An exploited field can be expected to show more local pressure variations and therefore more movement of the cross-flow type. Of particular concern in exploited fields are the possibilities of near surface recharge and short circuitry flows from cooler parts of the field to the production zones.

Despite the obvious importance of water movement in geothermal fields, little work has been done on direct measurements due to practical difficulties. Until recently, most of our knowledgo about water movement was inferred from chemical and isotopic data. This information by its very nature is about long-term water movement, with time scales ranging from months to years.

The radioisotope technique for tracing ground water has been developed steadily at the Institute of Nuclear Sciences for many years, and has now reached a stage where tracer dilution ratios of 10^{-12} and less can be monitored routinely. Used in the geothermal areas, this technique is unique in providing a direct quantitative measurement of water movement where the time scales now being probed range from hours to weeks.

We present here the results of recent work at Wairakei, in which mter travelling down the no-longer productive wells WK101 and WK107 is traced into surrounding wells discharging normally. Both the velocity and rate of spread of this cooler water loving into the production tone are significantly larger than previously suspected. The implications of this fact on the long-term stability of the field and on possible reinjection strategies, has still to be considered.

The detailed transfer functions for water movement obtained with the radioisotope tracers provide a challenge to interpretation not ret by simple models. At this stage, we are only able to show some cursory attempts to understand our results in terms of models for water movement.