FLUID FLOW TRANSIENTS DURING TECTONIC DEFORMATION AND CONCOMITANT GENERATION OF THERMAL PRECURSORS TO SEISMIC EVENTS.

HAMZA, V.M.

There are growing experimental evidences indicating that thermal precursors accompany deformation-induced hydrological perturbations in regions of seismic activity. Characteristic features of such precursory phenomena include relatively rapid build up of thermal anomalies followed by sudden return to equilibrium conditions. A convenient model that can account for such features has been developed based on the assumption that flow transients arise as a result of tectonic leakage at fault zones intersecting confined flow paths (aquifers). If the recharge of such flow systems take place through confining layers then non-isothermal mixing of fluids can be expected. The energy equation relevant in this case can be derived by evaluating enthalpy fluxes associated with lateral and vertical fluid flows as well as that due to volume changes in the permeable layer, generated by deformation-induced alterations in the hydraulic head. Results of numerical simulations indicate that thermal transients arise during the stress build-up period as a consequence of mixing of the infiltrating fluids with those in the aquifer. Steady state conditions are attained within relatively short periods of time due to energy exchange by advection. On the other hand, when deformation ceases infiltration is drastically reduced and consequently return to equilibrium thermal conditions is quite rapid. Thus, under favorable conditions, relatively small changes in deformation pattern can easily lead to abrupt and substantial changes in the local thermal regime. In addition, the size of perturbed zone may have dimensions comparable to those of local geological structures. Comparison of model results with observational records of temperatures in bore holes indicate that the characteristics of thermal precursors depend on a number of factors such as duration of stress build-up, direction of recharge flux, permeability contrast between the confining layer and the aquifer and the local geothermal gradient.