Effects of pore pressure on deformation and fluid flow processes and their interpretation based on the theory of poroelasticity

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Deformation of rock changes the pore fluid pressure conditions. Pore fluid pressure fluctuations associated with earthquakes, tides, and atmospheric loading are examples of such changes. Hydrogeologists often assume that the change of pore fluid pressure results from fluid flow through rocks, however, there exist pore pressure changes which do not associate with fluid flow.

In this presentation, the pore fluid pressure changes are discussed based on the theory of poroelasticity. The relative speed of loading versus pore pressure diffusion is emphasized to better understand the pore fluid pressure changes, and two extreme conditions, i.e., drained condition (no pore pressure change) and undrained condition (no fluid movement) are introduced. The difference of elastic properties for each condition is discussed and its effects on evaluating strain and pore fluid pressure change are explained. Finally, the importance of considering the storage capacity (specific storage) of rocks for fluid flow processes is discussed.