

Strategical roles of hydrological and geochemical methods in earthquake prediction research

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1.Introduction

Recently it is said that the contribution to making a physical fault model, especially a preseismic sliding model, is important for observation. From this point of view, I would like to think the strategical roles of hydrological and geochemical methods in earthquake prediction research.

2.Estimation of earthquake-related volumetric strain changes from groundwater data

Quantitative relationship between confined groundwater level changes and volumetric strain changes has become clear by poro-elastic theory and recent well-equipped groundwater observation. Some well water levels related to seismic activity are almost explained just by the volumetric strain changes. If we choose the wells carefully, we can estimate earthquake-related volumetric strain changes from the present and past groundwater level or discharge changes. These estimated volumetric strain changes will clearly contribute to making several fault models including pre-slip models.

3.Estimation of earthquake-related pore pressure changes from groundwater data

It is well known that pore pressure plays important role in earthquake mechanism. But the pore pressure changes has been often neglected in discussing the actual earthquake model because it is difficult to observe the pore pressure in seismic region, which is usually deeper than several kilometers. Clearly groundwater level or discharge is a direct reflection of pore pressure although we usually observe the groundwater shallower than one kilometer. But if we carefully analyze earthquake-related groundwater changes in deep wells, we can suggest some boundary conditions of the pore pressure changes related to earthquake occurrences. This information is also useful to understand postseismic long-term crustal deformation which has sometimes detected by GPS.

4.Supply of material information

The largest merit of geochemical methods is directly to detect earthquake-related chemical species if they ascend from the seismic region. But the continuous observation of such chemical species is more difficult than that of groundwater level or temperature. Besides the mechanism of preseismic changes in concentrations of them has not been clear. Therefore we should think more of supplying material information to make earthquake process clear instead of detecting preseismic chemical changes. From this point of view, long-term periodical (but not continuous) observation before and after earthquake is considered to be important.

5. Estimation of groundwater's effect on the long-term geodetic measurement

Recently geodetic measurement, especially GPS measurement has been much developed and been giving useful information for understanding earthquake process and forecasting. But those geodetic data sometimes include non-tectonic changes. For example, ground subsidence is generally caused by decrease of the shallow groundwater level as is well known. In other words, eliminating the groundwater's effect is needed to improve the resolution of geodetic measurements.