



Deterministic Earthquake Prediction deduced from Changes in Groundwater Level

S. Ehara and K. Fukuoka

Laboratory of Geothermics, Kyushu University, Fukuoka, Japan
(fukuoka@mine.kyushu-u.ac.jp)

A large earthquake of M7.0 occurred off-shore to the west of Fukuoka Prefecture, southwestern Japan, on 20 March, 2005. After that, more than ten aftershocks larger than M4 occurred in the submarine region. The groundwater level had been monitored since 50 days before the mainshock at an observation well with the epicentral distance of 20 km. The well revealed distinctive precursory changes in groundwater level, consisting of three stages. The first stage shows a groundwater level rise, the second stage shows a gradual decrease in groundwater level and the third stage shows a rapid rise. Similar patterns of groundwater level change were observed in associations with more than ten aftershocks of which magnitudes were larger than M4. We also observed very good agreement between the groundwater level changes and baseline changes from GPS data. The mechanism of the aforementioned water level changes is interpreted in terms of the dilatancy diffusion model. The total duration of the anomalous water level changes well correlates with the magnitude of the earthquake, the longer the duration, the larger the earthquake magnitude. The distinctive precursory water level changes observed in the Fukuoka area imply that it would be possible to predict the timing and magnitude of earthquakes. Earthquake prediction is a very difficult task, especially predicting the time of occurrence. The experience of the Fukuoka Earthquakes obtained in this study is considered to have been quite a rare but very useful. There must be reasons why we could detect the precursory groundwater level changes. One of the reasons is the uniformity of the underground structure with homogeneous, very shallow (20m depth) granite basement in Fukuoka area. Another possible reason is the simplicity of the stress field in the Fukuoka area, that is, almost east-west compressional stress without a vertical component. We are monitoring changes in groundwater level at fourteen observation wells in Fukuoka area.