b and p Values: Variation and Relation to Physical Processes for Earthquakes in Japan

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1. Introduction.

This work systematically reviews some results obtained already for the variations of the seismicity parameters *b* and *p* in different *seismogenic* and *tectonic* regions in Japan. We bring as well new evidence that the time and space changes in seismicity parameters are correlating well with the *crustal* structure and/or some parameters of the *earthquake process*. The use of highly accurate sets of data, including relocated earthquake catalogues, gives reliability to our findings. There are three main case studies on which we focus our attention. We also refer to other world-wide studies.

2. Results. Discussion and conclusions.

The first case is the seismic activity (Kyoto Univ. catalogue) between 1976 and 1998, in a broad area surrounding the epicentre of the *1995 Kobe earthquake* (M_w = 6.9) as well as in the source area. Our result shows that various precursors, such as quiescence followed by increased seismic activity, b-value and fractal dimension changes appear 2-3 years before the major event. These changes are correlating well with other geophysical precursors, such as crustal deformations and electromagnetic anomalies. Fig. 1 shows some of these premonitory changes. Most of the anomalies are not confined to the source area, but occur in a larger region corresponding probably to the preparation zone of the future event.

The second case is the aftershock sequence (JMA catalogue) following *the 2000 Western Tottori earthquake* (M_w = 6.6). We analysed the spatial change in b-value and the decay rate of aftershock activity as expressed by p-value in the Omori law. We found that both b and p- value are larger in an area that corresponds roughly with the highest slip during the mainshock. Our results show that both the *stress* after the mainshock and the history of *previous ruptures* may have “shaped” the pattern of the seismicity parameters. However, taking into account the regional *crustal structure* in relation with the thickness of the seismogenic layer, we conclude that the *heterogeneity* in the crust may be responsible as well for the b and p value spatial distribution. Further study and new data may clarify the role of each factor.

Finally, we shifted our attention to a volcanic region. We analysed the spatio-temporal distribution of b-values for the 1998-1999 *Hida Mountain* (central Honshu) earthquake swarms. In order to clarify the spatial change of b-value, we have *relocated* the events recorded by DPRI, Kyoto University, during a campaign of intense observation (Aug. 25 – Nov. 10). Using these relocated events, we found a b-value of 1.1-1.2 in the south and of 0.5-0.6 in the northern part of Hida Mountains. The seismicity in the north is shallower than in the south. The *higher b-value* in the south is in agreement with other previous studies (Enescu and Ito, 2001, 2002; Sakai et al., 2002) and may be related with the proximity of Yakedake volcano. We should mention that a *low Q and low-velocity structure* was revealed by Katsumata et al. (1995) beneath the southern part of Hida Mountains. However, we have also detected an important *variation of b-value with time*, in parallel with a migration of activity from south to north and than back to south. Therefore, the observed spatial difference in b-value might be caused as well by the *stress distribution during the earthquake swarm*. To clarify this important issue we are conducting further research.

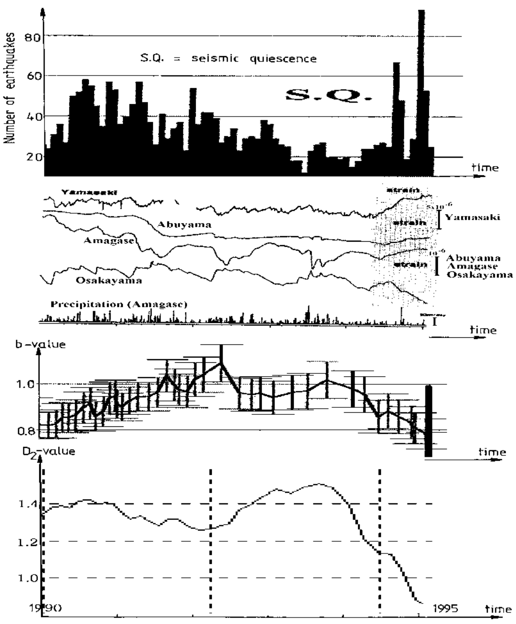

Fig. 1 From up to down: a) seismicity rate changes, with a clear seismic quiescence pattern followed by an increase in seismic activity several months before the Kobe eq.; b) strain variation and precipitation (DPRI) c) b-value changes: increase and decrease before Kobe eq.; d) changes in the fractal dimension of the epicentral distribution of earthquakes: large decrease before the large event.