A Mechanism Causing Temporal Variation in b-values Prior to a Mainshock

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Observations exhibit the temporal variation in b-values prior to a mainshock. The b-value starts to increase from the normal value at time  $t_1$ , reaches its peak one at time  $t_2$ , then begins to decrease from the peak one at  $t_2$ , and returns to the normal one at time  $t_3$ . As  $t>t_3$ , the b-value varies around the normal one or rightly decreases with time until the occurrence of the forthcoming mainshock at time  $t_{a}$ . The precursor time,  $T=t_{a}-t_{1}$ , of b-value anomalies prior to a forthcoming mainshock is related to the magnitude, M, of the event in a form: log(T)=q+rM (T usually in days) where q and r are two constants. In this study, the mechanism causing b-value anomalies prior to a mainshock is explored. From numerical simulations based on the 1-D dynamical spring-slider mode proposed by Burridge and Knopoff (1967), Wang (1995) found a power-law correlation between b and s, where the parameter s is the ratio of the spring constant (K) between two sliders to that (L) between a slider and the moving plate. The power-law correlation are b~s<sup>-2/3</sup> for the cumulative frequency and  $b \sim s^{-1/2}$  for the discrete frequency. Since L of a source area is almost constant for a long time period, b directly relates to K. Lower K results in a higher b-value. Wang (2012) found  $K=r_A v_p^2$ , where  $r_A$  and  $v_p$  are, respectively, the areal density and P-wave velocity of a fault zone. Experimental results show that  $v_{p}$  is strongly influenced by the water saturation in rocks. The water saturation in the source area varies with time, thus leading to a temporal variation in v<sub>n</sub> as well as K. This results in the temporal variation in b-values prior to a mainshock. The modeled result is consistent with the observed one.

Keywords: b-value, precursor time, spring-slider model, stiffmess ratio, saturation of water