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A Half Century since the Proposal of Seismic Doughnut Pattern - An Attempt for Prospective Observation

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It has been nearly 50 years passed since Mogi(1969) noted that a pattern of the doughnut type of the active area is a special feature in the period just before the great earthquake in comparison with patterns in other periods. It is considered that this pattern would correspond to the increase of stress in the wide area surrounding the focal area. In the focal area, the seismic quiescence comes up with the locking the fault. On the other hand, the activity in the surrounding area of the focal source increases corresponding to the breakdown of small cracks.Although after the Mogi's proposal, there were several reports about the appearance of the seismic doughnut patterns, all of them were published after the occurrence of great earthquakes. The low detectability for smaller earthquakes at that time prevented the seismic blanks to be perceived just before the great earthquakes. Since the highly sensitive seismometers have been distributed densely over inland of Japan these days, the earthquake detectability has been extremely improved. The author viewed the seismicity before the inland earthquakes, of which magnitude equal to or larger than 6.5 since 1995 (Hosono, 2009).According to the result, in the focal area before the main shock, there are some cases not only quiescent but also activated. The quiescent case is observed for Western Tottori earthquake, 2000 and West off Fukuoka earthquake, 2005. The precursory activity is observed in the quiescent period for Iwate-Miyagi inland earthquake, 2008. The quiescence is seen in a part of the focal area for Chuetsu earthquake, 2004. Activation appears in the focal area for Kobe earthquake, 1995. Estimation is impossible because of low activity for Noto-hanto earthquake, 2007 and off-Chuetsu earthquake, 2007. Whereas the various patterns in the focal area, a unique feature is found around the focal area. The focal area is surrounded by an area (or areas) of activation, which accelerate toward the occurrence of the main shock. Such feature is especially remarkable for Iwate-Miyagi inland earthquake, 2008, of which focal area had an adjacent active area in the west side. The seismic activity pattern (temporal process) of the western adjacent area looks just like the falling stone pattern which precedes the large-scale rockslide occurred at the root 229, Hokkaido in 1997. Stones start to fall in small scale at first. Then the cessation period appears, followed by second and third activity and cessation. At the last stage, the stones accelerate to fall toward the complete collapse of large rock volume (Kodera et al., 2005) . Such accelerating failure or collapse of rock and fault commonly represents a process toward the occurrence of a catastrophic phenomenon. If an observer can find such an accelerating activity, and the adjacent quiescent area, a large earthquake will be expected in the quiescent area. Although this observation procedure is not robust at the moment, the building up experiences will give us a clue to the prediction of a large earthquake.

Keywords: inland large earthquakes, stress accumulation, seismic quiescence, seismic activation, earthquake prediction, seismicity observation