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Patterns and variations of seismic data as an early sign of Merapi eruption (1984-2010)

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Merapi, is an active volcano located on the island of Java in Indonesia. Since 1984 to 2010 Merapi has erupted eight times (VEI2 -VEI4), interspersed with several small eruptions. The eruption characteristic of Merapi is dome-collapse nuée ardente but in 2010 the eruption was highly explosive, leaving 400 people dead, dozens of villages destroyed and losses of up to 4 trillion rupiah. Now, in the most vulnerable areas of Merapi, 60,000 inhabitants are living at high risk. Although the mechanical seismograph has existed since 1924, the permanent seismic telemetry network was built in 1982 in order to improve the quality of seismic monitoring. In general, a large eruption is in accordance to the intensity and the magnitude of seismicity, nevertheless the pattern, the combination and the rate of the various types of earthquakes are not always consistent with the type and size of eruptions. Increased seismicity varies between a few weeks before the eruption until several months or even several years earlier. The trend of shallowing hypocenters as a manifestation of the pressure migration upward rarely occurs. Multiphase earthquakes and rockfall can occur before or after the eruption and are associated with the formation and the stability of the lava dome. Low frequency earthquakes and low frequency tremors do not always occur before the eruption, but when high-frequency tremors do occur, they are followed by an explosion. The total value of the cumulative energy of earthquake correlates with the size of eruption. The cumulative energy of all previous volcanic earthquakes was exceeded three times by the eruption in 2010. Seismicity may not be a definitive precursor of a Merapi eruption but experience, along with, statistics and patterns of seismicity are important symptoms to recognize in order to identify increasing volcanic activity and anticipate the potential of eruption.