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Statistical analysis on relation between ULF geomagnetic anomaly at Kakioka and local seismicity

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There are many reports on earthquake-related ULF geomagnetic anomalies but there are active debates on the reliability about the anomalies and on the generation mechanism. Therefore, we investigated relation between local seismic activity and magnetic activity statistically in this study. The vertical intensities of the geomagnetic fields at 1 Hz sampling are examined at Kakioka and Kanoya (as a reference station) from 2000 to 2010. The wavelet filter is performed and the data around 0.01 Hz are focused. Nighttime data from 2:30 to 4:00 are used in the analysis to reduce contamination of artificial effects. The daily energy over the nighttime period analyzed is computed and correlation between Kakioka and Kanoya is investigated. It is found that the correlation between them is high (0.94). This is highly suggestive of the relative similarity of the underground electrical structures between Kakioka and Kanoya and enables to model computation using the Kanoya (reference station) data. The ratio between the original data at Kakioka and the idealized data at Kakioka derived from those at Kanoya is computed. An invalid assumption on the electrical structures beneath both stations gives a constant value of the ratio and it is possible to remove global changes such as magnetic storms due to upper atmospheric sources. An anomalous change in the ratio expects a local change of the underground structure or additional noise. We investigate the relationship between the anomalous changes and local seismicity. We define the criterion on the anomaly of the ratio as median+1.5IQR (IQR: inter-quantile range). Earthquakes which satisfy Es>10^8 are selected within 100 km of epicentral distance from Kakioka and within 60 km depth from earth surface. Then we perform Superposed Epoch Analysis. The results show that 5-15 days before the earthquake, geomagnetic anomaly appears significantly and there is the Es dependence. These epidemiological results show the relation between local seismicity and geomagnetic anomaly.