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Resistivity structure of a seismic gap along the Atotsugawa Fault, Japan

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Abstract

Seismicity along the Atotsugawa Fault, located in central Japan, shows a clear heterogeneity. The central segment of the fault with low-seismicity is recognized as a seismic gap, although a lot of micro-earthquakes occur along this fault. In order to elucidate the cause of the heterogeneity in seismicity, the electrical resistivity structure was investigated around the Atotsugawa Fault by using the magnetotelluric (MT) method. The regional geoelectrical strikes are approximately parallel to the fault in a low-frequency range. We constructed two-dimensional resistivity models across the fault using TM-mode MT responses to minimize three-dimensional effects on the modeling process. A smooth inversion algorithm was used, and the static-shifts on the apparent resistivity were corrected in the inversion process.

A shallow, low resistivity zone along the fault is found from the surface to a depth of 1–2 km in the best-fit model across the high-seismicity segment of the fault. On the other hand, the corresponding low resistivity zone along the low-seismicity segment is limited to a shallower depth less than 1 km. The low resistivity zone along the Atotsugawa Fault is possibly due to fluid in the fracture zone; the segment with higher levels of seismicity may have higher fluid content in the fault zone compared with the lower seismicity segment. On a view of the crustal structure, a lateral resistivity variation in a depth range of 3–12 km is found below the fault trace in the high-seismicity segment, while a resistive layer of wide extent is found at a depth of about 5 km below the fault trace in the low-seismicity segment. The resistive layer is explained by less fluid condition and possibly characterized as high rigidity. Differences in the resistivity structures between low and high-seismicity segments of the fault suggest that the seismic gap in the central part of the Atotsugawa Fault may be interpreted as a locked segment. Thus, MT is an effective method in evaluating a cause and future activity of seismic gaps along active faults.

The lower crust appears as a conductive zone beneath the low-seismicity segment, less conductive beneath the high-seismicity segment. Fluid is inferred as a preferable cause of the conductive zone in this study. It is suggested that the conductive lower

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