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Spatial variations and temporal changes of seismic anisotropy from S-wave splitting measurements around Mt Ontake, Japan

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We have done S-wave splitting measurements in order to estimate spatial variations and temporal change of seismic anisotropy associated with a small eruption in late March 2007. We collected a dataset of 539 local events (< 35 km deep) in 2007 recorded at a total of 47 stations (a total of 16, 645 source-receiver pairs), as well as 10 deeper events (between 230 and 270 km deep) between 1 998 and 2008 recorded at a total of 33 stations (a total of 106 source-receiver pairs) beneath and around Mt. Ontake. The data are processed using an automated multi-window S-wave splitting technique (Teanby et al., 2004) is used to evaluate the splitting. The splitting analysis yielded 99 good quality results from local events and 14 good quality results from deep events.
The average of the time lags between arrivals of fast and slow S-waves for local events is 0.09 s. The average of percentage anisotropy for local events is 2.28%. The average of polarization angles of fast S-waves for local events is N78E, which differs to the WNW-ESE orientation of regional principal stress by 35 degrees and is nearly perpendicular to the strike (N20W) of a tensile crack source of a very-long-period event beneath Mt. Ontake (Nakamichi et al., 2009). One possible interpretations of this is that persistent magma intrusions over a period of time are controlling the local stress regime.
The results from local events show that the anisotropy remains stable throughout the period when measurements are available. The late March 2007 eruption of Mt. Ontake was tiny, only small amounts of ash were emitted (JMA, 2007). The splitting parameters show no significant change before or after the eruption, as the eruption was so small. There is a possibility that the eruption was too small in magnitude to influence the anisotropy. An alternative explanation is that the results are restricted by a too short measuring period to allow detection of temporal changes.
A very shallow source of anisotropy (likely due to fractures) is present around Mt. Ontake and the surrounding area. This shallow anisotropic medium is restricted to about the upper 5 km. The polarization angles are path dependent and vary between stations.
Results from deep events were largely scattered, with the time lags ranging between 0.09-1.08 s (suggesting a deeper layer of anisotropy in the mantle wedge, which is stronger towards the NW of Mt. Ontake) and the polarization angles of fast S-waves showing two dominant directions (NW-SE and NE-SW).
Data from a few years before and after the eruption would be useful to see if any temporal changes associated with a gradual build up of pressure over a longer period of time have occurred. A combination of techniques for monitoring the stress regime, such as focal mechanisms, along with the S-wave splitting analysis, would help to give a more complete picture of the stress regime beneath Mt. Ontake.
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Keywords: S-wave splitting, Mt. Ontake, Stress field, eruption, magma intrusion, exchange student