Attenuation parameters in Western Nagano found from seismograms at three boreholes

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Attenuation parameters of seismic wave gives us not only information on the state of material along ray paths but also data of seismogram corrections. We showed that t*; total attenuation along paths, can be approximated by a simple formula, which does not include values of 1/Q along the ray path. We used seismograms recorded at three boreholes set up at Western Nagano, where three borehole seismometers, OT0a by AIST, OT01 and OT02 by NIED were installed at depths of 800m, 145m, and 100m, respectively. Natural periods of these velocity sensors are 0.5s, and seismograms are sampled with 10kHz. Distances between these stations are less than 2.7km. We analyzed seismograms of 84 earthquakes of which hypocentral distances are 0.8km to 11km and of which magnitudes are -0.6 to 3.6.

Firstly, we estimated corner frequencies and t* simultaneously by using the method of grid search. This result suggests that local Q is almost uniform except the zone near the borehole, or that Q increases with distance from them. Plot of theoretical lines between t* against travel time becomes straight line, if Q is constant and convex upward curve, if Q increases with distance. Obtained curves of t* do not show clear tendency that they are convex upward. Hence, we assume that t* can be expressed by the formula t*=t/Q+c, where c is a constant corresponding to the station correction. We estimate dt* by calculating logarithms of spectral ratio of seismograms recorded at two stations. Assuming t*=t/Q+c, local Q and station corrections c can be evaluated by applying an inversion method to the data of dt*. Local 1/Q obtained at frequency ranges from 80Hz to 250Hz and from 100Hz to 200Hz are 1.23e-3 and 1.85-3, respectively. Values of station corrections c for OT0a obtained at the two frequency ranges are 4.53e-3s and 1.25e-3s, respectively. Although station OT0a is located on a mountainside of an active volcano; Mt. Ontake, local Q is not low, but Q near the station is obviously lower than local Q. Station corrections at OT01 are estimated to be 4.86e-3s, 1.65e-3s, and they are 4.44e-3s and 1.28e-3s at OT02. Although the depth of OT01 is larger than the depth of OT02, the estimated station correction for OT01 is larger than that for OT02, and seismograms recorded at OT01 are more attenuated than those of OT02. However, deep borehole has a big advantage even if station correction is large because noise level decrease with depth.