

New development of a three-dimensional subsurface velocity model of the Chukyo Area, central Japan

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We newly developed a three-dimensional subsurface velocity model beneath the Chukyo area, central Japan, which is one of the most populated and industrial regions in Japan. This region expands on the Nobi sedimentary basin with sediments of over 2000 m thickness. The model fully covers the sedimentary basin, which consists of the Nobi Plain, the Ise Plain and the Ise Bay. We compiled geophysical and geological data such as well data, depth sections of seismic surveys, dispersion curves of phase velocity determined from micro-tremor array surveys, gravity anomaly, seismic records of natural earthquakes. The compiled data are almost the same as those used in the previous studies on the construction of basin models (e.g., Aichi Prefecture, 2002, 2004; Mie Prefecture, 2004), but we newly incorporated depth sections of seismic surveys conducted in the Ise Plain (Sato et al., 2007; Ishiyama et al., 2007) and dispersion curves of phase velocity determined from micro-tremor array surveys (Horikawa et al., 2006; Yoshida et al., 2007).

We first reconsidered geologic structure, focusing on distribution of basin-filled sediments and shape of the boundaries of the basin. As a result, we have modified several aspects of the preexisting models (e.g., western edge of the Nobi basin), adding new features. We then investigated difference of depth-dependence of velocity of each geologic unit considered in the previous step, and divided the basin into several parts, each of which has different depth-dependence. Using the depth-dependences, we 'converted' the geologic structure into a velocity structure model, and tuned the derived velocity model with spectral ratio of the radial component to the vertical component estimated from S-coda parts of observed seismic waves. We finally simulated the whole part of observed seismograms from moderate earthquakes, and further tuned the velocity model if necessary.

The simulated ground motions from moderate earthquakes that occurred in and near the basin principally explain the observed ground motions, but disagreement still remains. The disagreement suggests that the constructed basin model should be modified, but the disagreement may not come from the basin model alone. We should note that the simulated ground motions does not agree with the observed ground motions of several rock sites in some cases. Moreover, we verified that source parameters hypocentral depth and focal mechanism also strongly control surface waves propagating within the basin. These results suggest that assumed source parameters such as hypocenter and focal mechanism and/or velocity structure outside the basin (crust, mantle and descending slab) need to be modified. Therefore, we should carefully examine the cause of the differences in the tuning of the basin model.

Acknowledgements:

Hiroshi Sato of Earthquake Research Institute, University of Tokyo kindly provided the result of the seismic reflection survey across the Ise Plain conducted in the Special Project for Earthquake Disaster Mitigation in Urban Areas funded by Ministry of Education, Culture, Sports Science and Technology of Japan. Development of this subsurface velocity model was funded by the Ministry of Economy, Trade and Industry of Japan, and is based on discussion in the Committee for Construction of Subsurface Velocity Model of the Chukyo Region. The members of the Committee are as follows: Graduate School of Environmental Studies, Nagoya University; Disaster Prevention Office, Aichi Prefectural Government; Department of Disaster Prevention and Crisis Management, Mie Prefectural Government; Department of Disaster Prevention, Gifu Prefectural Government; Fire Bureau, Nagoya City Government, Chubu Electric Power Co., Toho Gas Co. Ltd.