Studies on Qs at the northern part of Kyushu district in Japan.

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We have reported the variability of Qs in southern part of the Kyushu district, in the previous paper. In that paper, we used seismograms, which are from the M4-5 small-adequate scale earthquake observed by K-NET and KiK-net operated by the National Research Institute for Earth Science and Disaster Resilience, for evaluating the Qs in those areas. As a result, it showed that the average apparent Qs of the line, connecting the seismic source location to the earthquake catalog of JMA and the observation point, changes significantly, depending on regions (route combination of propagations). This suggests that it is necessary to use an appropriate Qs model in the target area, for strong ground motion simulations based on the statistical Green's function method or the like, for example.

In this paper, we evaluate the Qs for the northern part of Kyushu, as the damping properties, using the twofold spectral ratio method. First, the northern part of the Kyushu district was divided into "Region A" and "Region B" as shown by the light orange hatch in Fig. 1. In addition, the area in the southwestern part of the Kyushu district was indicated as "Region C" with a light blue hatch (we had already reported the Qs to the area in our previous paper). In the figure, epicenter distributions of the events occurred after the 2016 Kumamoto earthquake (April 14, 2016 to April 30, 2016) are showed as hollow circles, and red triangles also indicate seismic observation points in NET & KiK-net. The location of the epicenter is referenced to the JMA earthquake catalog. In the area shown in the figure, the evaluation of Qs was carried out in an area having a planar spread (Area), and as a propagation route (Line) respectively. However, since it was difficult to set the Area for "Region B", only evaluation in Line was carried out. The name of each analysis case was written like "Region A-Area" or "Region A-Line".

The results are shown in Fig. 2. As can be seen from this figure, it is clear that different Qs models are evaluated in Area-case and Line-case at each region, and also, Qs models are very similar in "Region A" and "Region C". On the other hand, "Region B" is very different from other regions, Qs = 20*f^1.0 is evaluated. This model agrees to the Qs estimated by Izutani (2000), he assumes the propagation path as just under Mt. Krishima. The propagation path of "Region B" in this study is just under Mt. Aso because we want to secure the propagation distance. Lin et al. (2016) reports the existence of magma chamber from 5km to 10km depth under Mt. Aso. These facts suggest us the possibility that Qs model of "Region B" follows the same theory they pointed out. The Qs models in other regions are harmonious with the one estimated by Uchiyama and Yamamoto (2016). However, it is different from the value evaluated by Nakano et al. (2015). It seems to be due to the fact that the conditions, for example hypocentral distance, are different, and the area to be analyzed is also greatly different. In fact, we also conducted generalized spectral inversion analysis, under conditions tailored to Uchiyama and Yamamoto (2016) and Sato (2016), and confirmed that the Qs model estimated by the analysis is the same as the one proposed by Uchiyama and Yamamoto (2016).

Since our results include only small number of earthquakes and the area to be analyzed, we have to continue the investigation for studying attenuation properties to perform the analysis, considering the variability of earthquakes and propagation path. As our future tasks, we plan to develop a method for evaluating complex damping structures in order to improve the accuracy of strong ground motion prediction.

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Keywords: Qs, Propagation pass, Twofold spectral ratio method

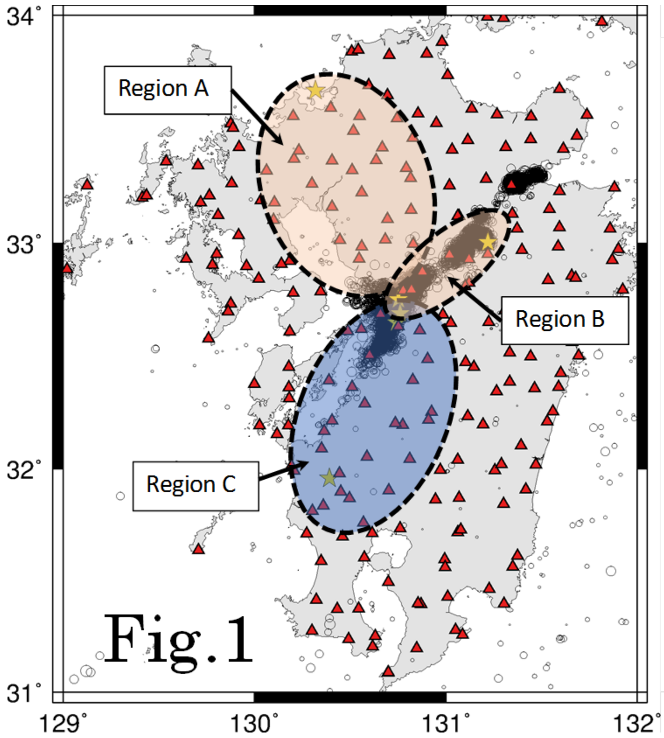

Fig.1

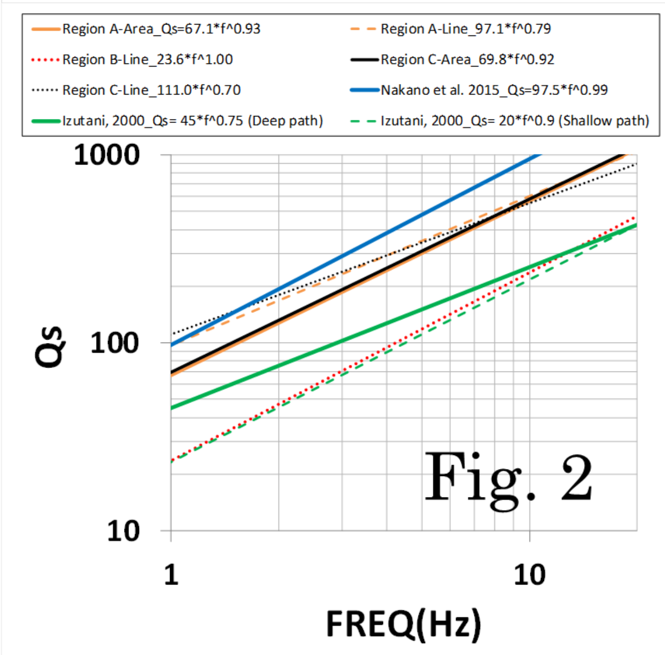

Fig. 2

