Detection of Temporal Change in Seismic Attenuation near Earthquake Source during Intense Fluid-Driven Seismicity following 2011 Tohoku-Oki earthquake

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The occurrence of earthquakes may be heavily influenced by increases in pore pressure as it decreases fault strength (Hasegawa et al., 2005; Hubbert & Rubey, 1959; Nur & Booker, 1972; Sibson, 1992). It is possible that the seismogenic zone has a larger amount of fluids than the surrounding crust (Mindaleva et al., 2020); as such, it is crucial to develop a means of monitoring the behaviour of fluid at depth to understand the mechanisms influencing earthquake occurrence.

This study uses a novel, simple approach to examine near-source attenuation in the focal region of intense swarm activity in the Yamagata-Fukushima border region, Japan, which is considered to be triggered by fluid movement following the 2011 Tohoku-Oki earthquake (Terakawa et al., 2013; Yoshida et al., 2016). Whilst the obtained *Q-1* values vary over a wide range, their median values exhibit characteristic temporal variation; *Q-1* was large for the initial ~50 days, and significantly decreased, becoming almost constant after 50 days. These temporal patterns are similar to those independently obtained for background seismicity rates, b-values, stress drops, and fault strength (Yoshida et al., 2016, 2017, 2019; Yoshida & Hasegawa, 2018). The synchronous change supports the hypothesis that swarm was triggered by fluid movement following the 2011 Tohoku-Oki earthquake, and suggest that source and seismicity characteristics and seismic attenuation were altogether affected by pore pressure.

The results from this study suggest that seismic attenuation intensity is higher near the earthquake source than in the surrounding crust in some situations. Localised higher attenuation near the source produces a systematic estimation error of earthquake source effects; the attenuation is erroneously estimated as a part of the earthquake source signal. It is therefore important to examine the intensity and the frequency dependence of near-source attenuation to accurately estimate earthquake source properties.

The method used in this study successfully detected a high attenuation anomaly in the initial period of the swarm, predicted by the fluid-diffusion model proposed in previous studies (Yoshida et al., 2016, 2017, 2019; Yoshida & Hasegawa, 2018). The present method would be helpful to monitor *Q-1* at seismogenic depths in various regions and understand the states of potential seismogenic zones and the occurrence mechanism for earthquakes.