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local- and regional-scale velocity and attenuation models for Canada for improved earthquake/explosion location, magnitude and yield estimates

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The Canadian National Seismic Network (CNSN), covering one of the largest single-network areas worldwide, plays an important role in global nuclear explosion monitoring. As such, and in light of the recent CNSN refurbishment program, we present two national-scale models of local and regional velocity and regional frequency-dependent attenuation relations for 3-D crustal and upper mantle structure. We make significant advancements in Regional Seismic Travel Time (RSTT) tomography (Myers et al., 2010) for Canada using natural and mining-related seismic event data from the Canadian National Earthquake Data Base (NEDB) in addition to a newly-assembled ground truth database of locally and regionally recorded mining events and refraction explosions of known location, depth and timing. For the attenuation model, we use regional Lg amplitude–distance relations in narrow frequency bands in the range 0.5-16 Hz across various regions of Canada and systematically invert for frequency-dependent Q. Improved velocity and attenuation models are of multi-faceted interest to the nuclear explosion monitoring community as they have the potential of 1) reducing earthquake/explosion location errors through improved travel time predictions of regional and local phases, 2) improving explosive yield estimates and 3) reducing regional magnitude bias across adjacent geologic provinces.

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