Experimental vs. Theoretical baserock to surface transfer functions at Dessel, Belgium

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At a planned site for the disposal of low- and intermediate-level radioactive waste in Dessel, Belgium, the bedrock (Cretaceous and Palaeogene limestone) is covered by 585 m of Tertiary sediments. We determined the transfer function between Cretaceous baserock and the surface with two independent methods. The theoretical transfer function was modelled using a 1-D reflectivity method based on geotechnical parameters measured in a borehole at the site (shear-wave velocity) or extrapolated from other boreholes in northern Belgium (density and shear-wave quality factor). The experimental transfer function was calculated from a combination of different types of well-recorded events including local earthquakes, induced earthquakes and explosions, regional earthquakes and not too distant teleseismic earthquakes, using SH waves recorded at the surface and in a borehole at 702 m depth in Cretaceous limestone (considered here as baserock). Their FFT spectra were smoothed and truncated to the significant frequency range where the earthquake spectra were well above the spectra of the noise before the arrival of the events. The surface–to-borehole ratio of these spectra is the experimental transfer function. The median and 84th percentile over all the events yield significant results between 0.02 and 19 Hz. After correction for the surface noise using the quality factor or the noise spectral ratio, the resulting experimental transfer function was found to be comparable to the theoretical transfer function.