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Attenuation and Velocity tomography can we join them?

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Velocity tomography, is now routinely used to image velocity distributions which are subsequently interpreted in terms of the Earth or rock-sample structure. This technique has been successfully used in detailed mapping of the Earth in various scales ranging from the whole globe until very local rock-mass structure, e.g. in mines. It is also used in geo-technical (tunnels, mines, water dams, etc.) and laboratory measurements.

The second tomography technique, namely attenuation tomography, is used to image another physical property of rocks: the acoustic attenuation structure usually describe by the parameter Q. This technique is, however, much more difficult than velocity tomography because the attenuation of seismic/acoustic waves is a much more subtle effect than a variation of delays of energy arrival times due to velocity heterogeneities. There exist a lot of factors that can easily disturb attenuation measurements so it is difficult to obtain a reliable image of the attenuation structure. For this reason, a very high quality of data used for attenuation tomography must be ensured. Nevertheless, the additional effort necessary to obtain an image of Q is worthwhile because Q is regarded to be more sensitive to the rock structure than seismic/acoustic wave velocity. Imaging the Q distribution can be achieved by inverting various characteristics of the measured signals: amplitudes, spectra decay, pulse broadening or central frequency shift. The advantages and limitations of each of these approaches are well known.

In this presentation we discuss the approach developed for the acoustic ultrasonic tomography imaging and called Enhanced Velocity Tomography and possibility of its using in a “global seismological” framework. It consists in a combination of both velocity and attenuation tomography into one scheme to maximize the advantage of the robustness of velocity and the sensitivity to the micro-structure of attenuation.