Analysis of the seismic coda in Kazakhstan by array processing

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Coda waves are usually interpreted as diffracted waves from numerous heterogeneities distributed uniformly in the earth's crust. Thus, contrary to direct arrivals composed by waves propagating directly from the source, the coda wave field is made up by waves coming from all directions. However, recent array analysis of some events in Kazakhstan has identified a non-isotropic distribution of diffracted waves with a predominant direction which evolves with time. It reaches a deviation of several ten or so degrees from theoretical azimuth of event.

In order to characterize spatio-temporal energy properties of its particular scattering in Kazakhstan, we combine an array processing technique with a statistical approach. This approach reveals a systematic atypical behavior of coda wavefield characterized by a non-isotropic distribution of scattered waves and a change in energetic content of seismic wavefield (Figure 1). Indeed, the analysis of the energy properties of coda wave field has shown an irregular decrease of coda envelope leading to a diminution of attenuation with time.

Based on this observation a preliminary forward model of a non-homogeneous distribution of scatters inside crust has been proposed to explain coda azimuth deviation. Synthetic detections derived from this model reproduce the variation of the azimuth time history according to the station position.

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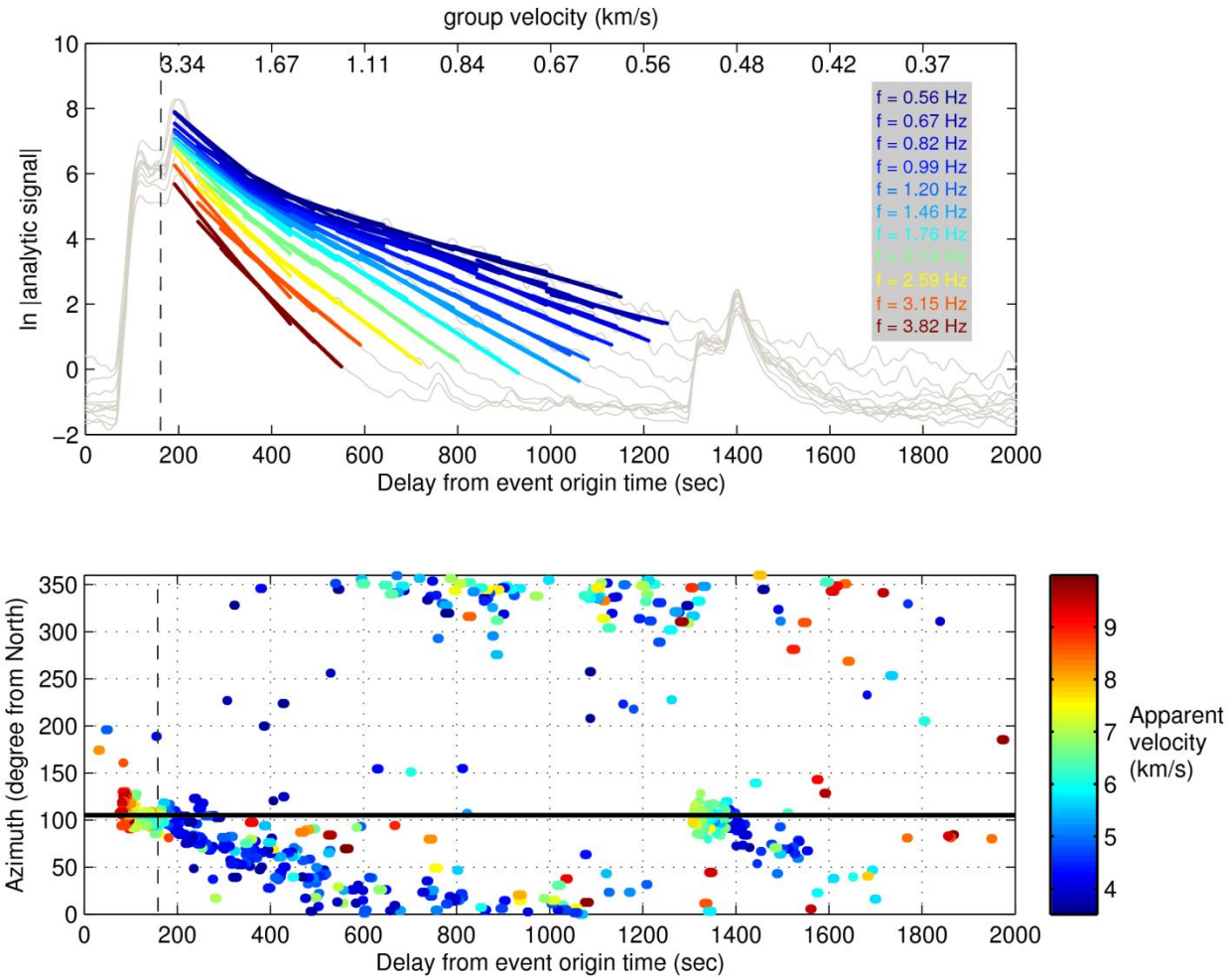

Figure 1. (Top) Envelops (thin grey lines) for 11 narrow frequency bands. Based on the diffusion model, time variations of Qcoda attenuation parameter have been estimated by linear regression on each frequency envelops with a sliding time window of 200 second length. Colored bold lines display the estimated attenuation model on each time windows. We can see an aftershock at the end of the coda around 1400s. The dotted line indicates the theoritical Lg arrival. Note the irregular decrease of coda envelopes particularly for the lower frequencies.
(Bottom) Apparent velocity and azimuth of dectected waves with time. The solid black line corresponds to the theorical back-azimuth of the event. Note the deviation with time from the theorical back-azimuth.