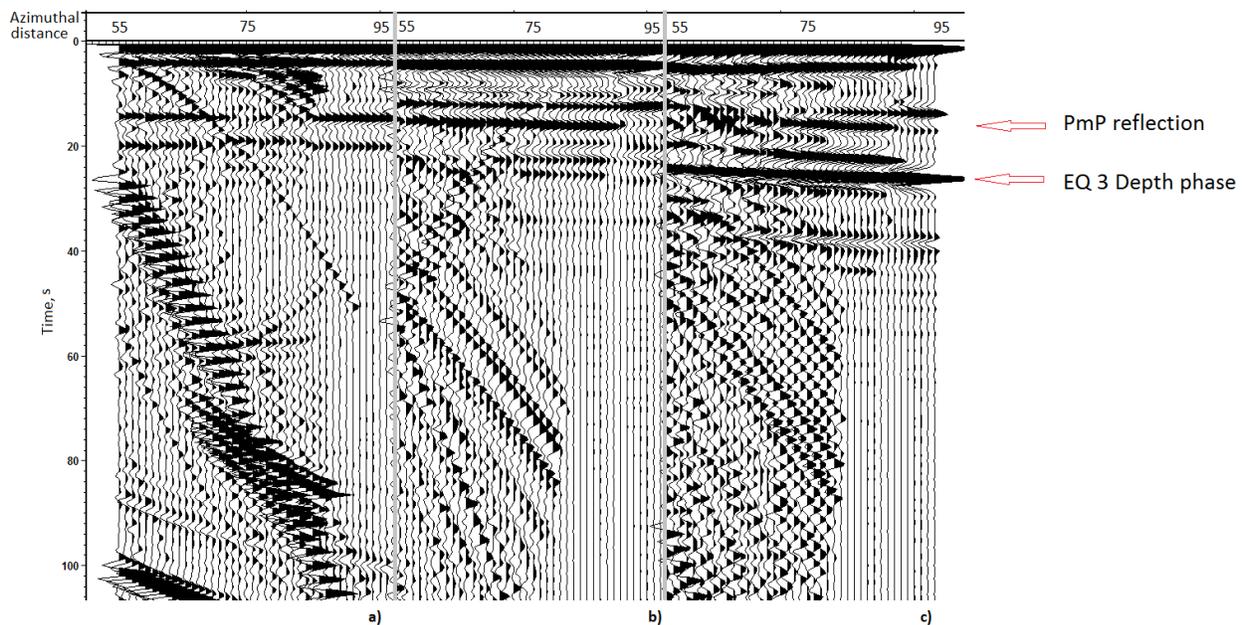


## Autocorrelation: analysis of artifacts and constructive interference using synthetic seismic data

In 1968 Claerbout was the first to propose the autocorrelation function as a theoretical technique for investigation of the subsurface. It is based on the idea that the reflection response of a layered medium can be synthesized from the transmission response, in other words a reflection profile can be obtained. However, the quality of such reflection profile is dependent on a number of factors, such as dominant frequency of seismic sources and their distribution. Generally, a prior assumption is made about some of these factors, such as azimuthal homogeneity of the ambient noise field. In other cases a source selection algorithm is used to avoid problems that can occur when this assumption is not satisfied like in recent studies where earthquakes are used as sources of seismic energy for autocorrelations (Ruigrok et al, 2012). In reality, earthquakes are located mostly along plate boundaries and using near vertical incident rays limits the geographical location of study. Both methodologies (earthquake and ambient noise interferometry) can produce artifacts in the reconstructed reflection profile if the assumption of homogeneous source distribution does not hold. It can be difficult though to distinguish between these artifacts and the real signal, especially when dealing with earthquakes with complex P and S codas. These artifacts can be studied with the help of synthetic seismograms generated for variety of impulsive sources or earthquakes at different offsets and depths. This work presents examples of how these artifacts can be misinterpreted as geologic structures and what should be done to mitigate them.



**Figure 1** Three separate earthquakes autocorrelated. For the source side a) Moho is 10 km, Earthquake at 550 km, b) Moho is 40 km, depth is 15 km, c) Moho is 40 km, and depth is 100 km. We observe PmP (reflection from Moho from the receiver side) and other phases like pP, which can dominate a stack of several earthquakes if not scaled or clipped to some average amplitude.