# The Marchenko method for imaging, multiple elimination and monitoring

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The Marchenko method has been introduced a decade ago as an efficient method to predict and eliminate internal multiples. A key feature of the method is that it is data-driven, hence, no detailed subsurface model is needed prior nor during the elimination process. During the past ten years, various versions have been developed. In all versions, so-called focusing functions play a central role.

1. When applied to the seismic reflection data, a focusing function focuses the sources at the surface onto virtual sources in the subsurface, thereby compensating for the internal multiples in the overburden. In the first developed version of the Marchenko method, this concept was used to create seismic images of the subsurface, free of imprints from internal multiples. Hence, in this approach, multiple elimination and imaging form an integrated process.

2. Later it was recognized that it would be useful to separate the internal multiple elimination process entirely from the imaging process. To this end, the focusing functions were modified in such a way that the virtual sources are extrapolated from the subsurface back to the surface. This yields reflection data at the surface, free of internal multiples. These data can be directly compared with the original reflection data, which is advantageous for quality control. These multiple-free data can subsequently be used as input for standard primary imaging schemes.

3. Building further on these concepts, a method has been developed to isolate the response of a target zone from the overburden and underburden responses. This response, which contains the isolated primaries and internal multiples of the target zone, is the ideal input for monitoring time-lapse changes in, say, a producing reservoir in the target zone.

In the presentation I will discuss the different variants of the Marchenko method and illustrate them with numerical and real data examples. Further I would like to share my views on the similarities and differences between Marchenko imaging and full waveform inversion, which will hopefully stimulate discussions for this workshop.