Quantitative Evaluation of the Quality of Seismic Repeatability: A Case Study using Differing Metrics

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Abstract

Seismic repeatability is important in time-lapse seismic monitoring. A variety of factors are involved in the seismic repeatability study, such as the depth of buried detectors small variations in water table, tides, currents and temperature, ambient noise, transition zone, subsidence, source and geophone positions, source signatures, geometry design, and CMP stack fold distribution. Some of the non-repeatability problems can be overcome by the careful deployment of source and receiver positions while other problems, such as those caused by annual near surface variations, are difficult to solve at the acquisition stage and usually can only be ameliorated in the subsequent processing stage. A good deal of literature on time-lapse surveying deals with issues of registration between older and more modern vintage data. This registration process itself can add substantial uncertainty. In the first part of this abstract, repeatability on source and geophone positions will be examined. In the second part, repeatability on the recorded source signals will be investigated. Then the three metrics including Pearson correlation (PEAR), normalized root-mean-square (NRMS), and predictability (PRED) will be described, compared, and applied to quantify the repeatability of post-stack seismic data. Meanwhile, the factors that directly affect seismic repeatability will be investigated. Eight 2-D time-lapse seismic surveys in which exceptional care was taken in repeatable seismic acquisition are used.