Near Surface Imaging by Joint Traveltime and Q-Factor Inversion

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ABSTRACT

Near surface complexities are a key challenge for seismic imaging of land data in the Middle East and North Africa. Lateral variations of P velocities between sand dunes and outcropping carbonates (jebels) may reach even a factor 5 as a contrast within a range of a few meters. However, P velocity is just one of the petrophysical parameters we need for modelling the near surface. In this paper, we propose a new method for estimating P velocity and Q factor by the joint tomographic inversion of first arrivals and shallow reflections or refractions, exploiting both traveltime and waveform of the seismic signals. The joint traveltime inversion of direct, reflected and refracted arrivals is particularly effective for building a 3D macro-model for shallow P velocities, which provides good static corrections both in areas with sharp elevation changes, as cliffs and wadis, and in areas with low-relief structures. Recently, Vesnaver et al. (2016, 2017) proposed a new method for the broadband estimation of the Q factor, by merging a macro-model obtained by Q tomography (Quan and Harris 1997) with a micro-model derived by the instantaneous frequency (Poggiagliolmi and Vesnaver 2014). This method was validated by synthetic examples, and in this paper we present an application to a real 2D survey. The profile was acquired in the United Arab Emirates in the framework of the EAGE Middle-East BootCamp, co-organized by Schlumberger and the Petroleum Institute of Abu Dhabi. Our processing goal is characterizing shallow formations for fractures and fluids' content, as both features decrease the Q factor, trying to distinguish them from others with lateral velocity changes due to facies variations. References Poggiagliolmi, E. and Vesnaver, A. [2014] Instantaneous phase and frequency derived without user-defined parameters. Geophysical Journal International, 199, 1544-1533, doi: 10.1093/gji/ggu352. Quan, Y. and Harris, J. M. [1997] Seismic attenuation tomography using the frequency shift method. Geophysics, 62, 895-905, doi: 10.1190/1.1444197. Vesnaver, A., Lin, R. and Böhm, G. [2016] Merging macro- and micro-models for a broadband estimation of the Q factor. Expanded Abstracts, SEG Annual Meeting, 3613-3617, doi: 10.1190/segam2016-13859201.1. Vesnaver, A., Lin, R. and Böhm, G. [2017] Reservoir monitoring by broadband Q factor imaging. Expanded Abstracts, EAGE Annual Meeting, Th P2 09.