Viscoacoustic FWI: A sensitivity analysis considering different errors in the initial Q model

When propagating in the rocky substrate, the seismic wave naturally suffers the attenuation process, often neglected when using an acoustic wave equation to simulate the dispersion and dissipation effects. In gas and oil reservoirs, the acoustic operators cannot correctly describe the wave propagation due to the strong attenuation of the medium that causes waveform distortion. Thus, it becomes necessary to use a viscoacoustic equation to describe the propagation in these media better.

Full waveform inversion (FWI) seeks to estimate a high-resolution velocity model through the complete wavefield. In such a procedure, when using acoustic propagation operators to fit the observed seismic data acquired from attenuating media, obtaining a high-resolution velocity model becomes complicated, being only feasible using viscoacoustic equations. The sensitivity of the FWI concerning the initial velocity model is widely studied in the literature. However, the Q factor sensitivity is rare. This work seeks to understand the effects of varying the Q factor on the viscoacoustic FWI inverse procedure. This study uses forward and adjoint second-order viscoacoustic operators based on the standard linear solid (SLS) rheological model and its respective adjoint formulas. We experimented with observed data generated from Marmousi and the Gas chimney models. We apply different minimization algorithms to analyze their behavior depending on the initial Q factor error.