Subtuning Thickness Estimation from AVO Gathers

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Summary

Thickness is one of the important parameters of a reservoir and should be estimated accurately from seismic if the resolution of seismic is high enough. But in reality, it is often required to estimate reservoir thickness correctly from seismic with low resolution. Because of tuning, reservoir thickness cannot be correctly obtained by picking seismic reflection events. The relationship of tuning thickness and wavelength has been studied in the past (Widess, 1973, Kallweit and Wood, 1982). Although these studies define the resolution limit of the traditional interpretation using event-picking, geophysicists continue looking for measures to estimate subtuning reservoir thickness with reasonable accuracy. Partyka et al (1999) proposed a spectral-decomposition technique to estimate layer thickness by observing the periodic occurrences of zeros in the amplitude spectrum. Nowak et al (2008) extend Partyka et al's methodology to improve resolution by using cross-spectrum of intercept and gradient and further introduce an optimization scheme to solve thickness from spectrum of intercept or gradient. Although the optimization approach is not limited by the reservoir thickness, the problem tends to highly unstable when the reservoir thickness is below tuning. In this paper, we extend Nowak et al's work on optimization by applying the inversion on AVO gathers. Compared with intercept or gradient only, AVO gathers provide much more data samples to solve the reservoir thickness and solution of the inversion is more reliable. The above studies assume a simple geologic setting, i.e. a uniform reservoir sits in homogeneous upper and lower formations and properties of upper and lower formations are not necessarily the same. Some reservoir geology can be roughly regarded as such a model, so that the approaches discussed above can be applied on such reservoirs to estimated reservoir thickness. The ultimate goal of the inversion should be to solve for any geological setting.