O219-006 **Room: 101B** **Time: May 27 9:48-10:00**

Seismic simulation and velocity analysis on vertical transverse isotropy (VTI) media

Kenichi Akama[1]; Isao Takahashi[2]; Mamoru Takanashi[3]

[1] JGI, Inc.; [2] INPEX; [3] JOGMEC

http://www.jgi-inc.com

1. Introduction

Seismic simulation and higher-order velocity analysis are conducted on vertical transverse isotropic (VTI) media for improving time-depth conversion of seismic reflection data in an onshore oil field.

P-wave velocity (Vp) propagating through VTI media depends on the incident angle to the vertical and is often described using Thomsen's parameters, a, e, and d(Thomsen, 1986). The parameter a represents the vertical Vp, and e, the ratio of horizontal and vertical Vp, while d governs velocity variation in oblique direction. These elastic parameters are, however, not directly obtainable from moveout velocity analysis, partly because the relation between the elastic parameters and reflection traveltime is not well understood, in particular, in layered media. For example, velocity analysis using an non-hyperbolic traveltime equation by Alkhalifah and Tsvankin (1995), only delivers two parameters in homogeneous case, stacking velocity, Vnmo [=$a*$sqrt(1+2$*d$)], and an anisotropic parameter, h[=(e-d)/(1+2$*d$)].

2. Elastic Simulation

Elastic simulation by the reflectivity method (Kennett, 1979) is carried out to understand the influence on the reflection traveltime due to fine-scale layering identified in the target field. Elastic models including fine-scale layer models consisting of thin alternation of two isotropic media and homogeneous (one coarse-layer) VTI anisotoropic models are used for the simulation. Synthetic gathers from the fine-scale layer models turn out to be almost identical to the homogeneous VTI layer models when the VTI parameters of the latter are as predicted by Backus average of the fine-scale models. That is, fine-scale models can be replaced by equivalent homogeneous and anisotropic coarse-scale models as in the effective medium theory. Besides, the d parameter is found to be negative for thin alternation of isotropic anhydrite and isotropic claystone as recognized in the field.

3. Velocity Analysis

Higher order velocity analysis using the non-hyperbolic traveltime equation by Alkhalifah and Tsvankin is conducted in the actual seismic data. By a non-linear optimization, lateral distribution of the two parameters, Vnmo and h, are estimated for two horizons. Validation with the synthetic seismograms confirms that this approach delivers sufficiently accurate Vnmo and h when the anisotropy is weak. Estimated Vnmo turns out to be smaller by several percent than stacking velocity based on conventional 2nd order velocity analysis. We estimate the d parameter at well locations where vertical velocity, a, is available from check shot survey.

By comparing the velocity analysis along the two horizons and the synthetic simulation results, we build a realistic subsurface model of the target field, consisting of thin-alteration of anhydrite and claystone overlain by VTI homogeneous layer.

4. Conclusions

We validate that the effective media theory provides a homogeneous anisotropic equivalent to fine scale, isotropic heterogeneity through elastic simulation by the Kennett's reflectivity method. We then demonstrate that Vnmo and h can be accurately estimated through velocity analysis using a non-hyperbolic equation. Finally, we construct realistic subsurface elastic model of the target field.