3D ANISOTROPIC POST STACK IMAGING ON AN OFFSHORE AFRICA CASE STUDY

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ÉTUDE DE LA MIGRATION ANISOTROPE EN 3D DES TRACES SISMIQUES SUR UN CHAMP PÉTROLIER OFFSHORE D'AFRIQUE

L'anisotropie sismique peut altérer la qualité des images sismiques et provoquer ainsi un mauvais positionnement. Les argiles se sont souvent révélées avoir des propriétés anisotropes, avec une symétrie presque hexagonale (isotropie transversale) sur un axe normal par rapport au plan de stratification. Nous étudions ici l'effet de l'anisotropie sur la migration d'un ensemble de données réelles d'un gisement offshore africain possédant d'épaisses couches d'argile. Nous réalisons en parallèle la création des modèles de vitesse isotrope et anisotrope et la migration du même volume des données « stack » en utilisant les deux modèles. Nous observons que la méthode anisotrope améliore la mise au point en profondeur et que l'augmentation de l'isotropie peut provoquer un décalage latéral et vertical des limites du réservoir, respectivement de 100 et 200 mètres, par rapport aux positions obtenues avec la méthode anisotrope.

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Seismic anisotropy may degrade the quality of seismic images and cause the mispositioning of events within them. Shales have often been observed to be significantly anisotropic, usually with approximately hexagonal symmetry (transverse isotropy) with axis normal to the bedding plane. We investigate the effect of anisotropy on imaging a real data set from offshore Africa, where there are thick shale sequences. We perform, in parallel, isotropic and anisotropic velocity model building and 3D post-stack migration of the same stack volume. We observe that the anisotropic processing improves the focussing of dipping events and that the assumption of isotropy may cause lateral and vertical displacement of the reservoir boundaries, of around 100 and 200 meters respectively, relative to the positions obtained with the anisotropic processing.

CAPTACIÓN DE IMÁGENES ANISOTRÓPICAS TRIDIMENSIONALES POST-ACUMULATIVAS: ESTUDIO DE CASOS FRENTE A LAS COSTAS DE AFRICA

La anisotropía sísmica puede degradar la calidad de las imágenes sísmicas y provocar un error en el posicionamiento de los acontecimientos dentro de las mismas. Se ha observado a menudo que los esquistos son significativamente anisotrópicos, en general con una simetría aproximadamente hexagonal (isotropía transversal) con eje normal al plano de estratificación.

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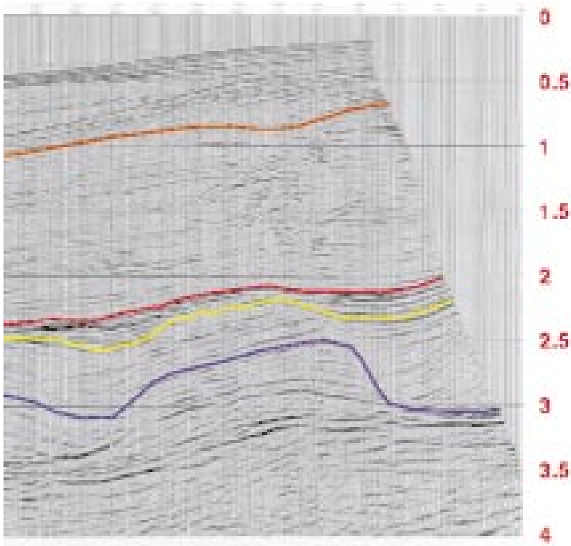
Investigamos el efecto de la anisotropía sobre las imágenes de un conjunto de datos reales obtenidos frente a la costa de Africa, donde existen gruesas secuencias de esquistos; realizamos paralelamente la construcción de un modelo de velocidad isotrópico y anisotrópico y una migración post-acumulativa tridimensional del mismo volumen acumulativo. Observamos que el procesamiento anisotrópico mejora el enfoque de los acontecimientos de buzamiento y que con la premisa de isotropía se pueden provocar desplazamientos laterales y verticales de los límites del depósito de 100 a 200 metros, respectivamente, en relación con las posiciones obtenidas con el procesamiento anisotrópico.

INTRODUCTION

The conventional assumption of seismic isotropy while processing and imaging in depth may cause mispositioning of reflectors when, in fact, anisotropy exists in their overburden (Alkhalifah and Larner, 1994). Shales often exhibit non-negligible anisotropy which may be represented as transversely isotropic with a vertical axis of symmetry (TIV), so that the *qP*-wave propagation may be characterized, to a good approximation, by two anisotropy parameters, ε and δ, in addition to the vertical velocity at any point (Thomsen, 1986). Since shales often make up much of the overburden of hydrocarbon reservoirs, taking anisotropy into account may be important for obtaining accurate images of reservoir structure. To do this it is necessary to be able to estimate an anisotropic velocity model in depth and to have anisotropic processing and imaging algorithms. In this paper we demonstrate the application of such software to a dataset from offshore Africa, where the target lies beneath a thick sequence of normally compacted Tertiary shales. Figure 1 illustrates the schematic lithology of this area superposed on an interpreted time migrated section. We investigate the impact of the anisotropic processing by repeating the processing sequence assuming isotropy; however we perform additional conventional processing steps to tie the wells in depth, which allows us to compare the anisotropic and “optimal” isotropic depth images. The comparison shows that, as expected, the main effect of accounting for the estimated TIV anisotropy is on the positioning of the dipping reservoir boundaries, but there is some change in the apparent quality of the image as well.

1 METHOD

The method we use for calculating the anisotropic velocity field within each layer is an extension of the stacking velocity inversion presented by Williamson *et al.* (1996). In their approach, depicted in Figure 2, the model is constructed layer by layer from horizons interpreted in the time-migrated block: successive horizons are time-demigrated and then map-migrated in depth by ray tracing through a trial velocity field for that layer. Stacking velocity analyses are modelled by simulating CMP gathers by ray-tracing, taking the processing (DMO or Pre-Stack Time Migration) into account, and, if wells are present, the depths of the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