

CONTROL ID: 2611053

TITLE: Interpreter-Assisted Interactive Delineation of Salt Domes Using Phase Congruency and Gradient of Texture Attributes

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ABSTRACT BODY:

Abstract Body: Subsurface object detection (e.g., faults, gas chimneys and salt domes) is a fundamental tool for reservoir exploration and production from three-dimensional (3D) seismic surveying, and a set of methods have been developed based on edge detection and/or texture analysis of seismic signals. In this work, we first present two new attributes to assist the delineation of salt domes from a 3D seismic volume, the phase congruency (PC) and the gradient of texture (GoT), both of which help quantify the variations of reflection intensity and seismic texture in the presence of salt domes. In particular, the PC attribute evaluates the congruency of phase in Fourier components and is capable of detecting the subtle discontinuities with varying contrast in seismic reflection intensity, and the GoT attribute measures the perceptual dissimilarity of seismic texture and is capable of detecting the subtle structures in the absence of strong seismic reflectors. Then, based on the generated PC and GoT maps, we further propose an interpreter-assisted workflow for salt dome delineation and demonstrate its applications to the SEAM dataset featured with salt domes as well as complex subsalt structures. The results show not only the capability of the proposed method in delineating the salt domes in an effective and accurate manner, but also its potential for computer-aided extraction of other geologic features associated with weak reflection intensity, varying texture, illumination, and contrast from a seismic volume. Compared to the GoT-based workflow, the PC-based one is computationally inexpensive and is expected to serve as a handy tool in the interpreter's toolbox for geological structure delineation from 3D seismic datasets.

SESSION TITLE: Theme 9: Seismic Stratigraphy - Techniques and Interpretation: Case Studies in Deepwater, Subsalt, Carbonates and Conventional Plays (AAPG)

SESSION TYPE: Poster

SESSION DAY & DATE: Tuesday, April 4, 2017