Geophysical Research Abstracts
Vol. 14, EGU2012-1523, 2012
EGU General Assembly 2012

Reservoir structures detection and hydrocarbons exploration using wavelet transform method in 2 oil fields in southwestern of Iran

H. Hassani and M. R. Saadatinejad

University of Amirkabir, Mining, Metallurgical and Petroleum Engineering, Tehran, Islamic Republic Of Iran (hhassani@aut.ac.ir)

Spectral decomposition provides better methods for quantifying and visualizing subtle seismic features and by decomposing the seismic signal into discrete frequency components, allows the geoscientist to analyze and map features. Through these methods, continuous wavelet transform (CWT) is an effective and widely-applied. It provides a different approach to time-frequency analysis and produces a time-scale map. The application of CWT is extensive and in this paper, we applied two major capacities of CWT in seismic investigations. It operated to detect reservoir structural characteristics and low-frequency shadows below gas reservoirs to develop a producing reservoir and discover a new petroleum reservoir in 2 oilfields in southwestern of Iran successfully.

At the first and significant application in reservoir structure study, CWT enabled to providing clear images from kind of structural systems especially to identify hidden structural features such as extensional ruptures and faults for better drilling, injection and recovery operations and be able to increase production of oilfield. According to properties of tectonic events as fault and their effect (velocity diffraction) on seismic signals, it had been observed that CWT results show some discontinuities in location of ruptures and be able to display them more obvious than other spectral results, especially on horizon slices. Then, by picking and interpretation those, we obtain map, kind, strike and deep direction of faults easily.

In petroleum exploration case, low-frequency shadows in CWT results appear due to energy attenuation of seismic signal in high frequencies by the presence of gas; this means there are no high frequencies under the gas reservoir. This phenomenon accounts as an indicator and attribute to explore reservoirs containing gas. As the frequency increases, these shadows decrease and finally disappear. The ranges of these shadows are usually between 8 to 20 Hz in gaz and 28 to 35 Hz in oil reservoirs and differ for limestone and sandstone. In this way, CWT applied on vertical sections and in 4 different iso-frequency displaying. By comparing these figures at 10, 16, 24 and 32 Hz, the presence of low frequency shadows under reservoir could be seen. These shadows have distinctly different dynamic frequency responses rather than the background, probably because the hydrocarbons have changed the reflectivity of the reservoir as the anomalies at 10 Hz are bright. In the 16 Hz section, anomalies almost stand out, and the difference between them becomes relatively weak; yet, some of them are still brighter than other anomalies at higher frequencies. Consequently, these variations of anomalies at different frequencies can consider as indicator from presence of hydrocarbons in the target reservoir.

Finally, selecting a suitable wavelet is important step of CWT method and in all mentioned usages, Morlet wavelet has beneficial properties to applying in our investigation. In fact, Morlet wavelet demonstrates velocity dispersion and energy absorption to identify fault and gas respectively.