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Reprocessing and interpretation of seismic reflection data at Messara Basin, Crete, Greece

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Abstract: *Messara sedimentary basin located at Central Crete, Greece is covered by Quaternary and Neogene formations. Seismic reflection data along a 30 km W-E seismic line acquired by the Hellenic Petroleum Company (HPC) at Messara basin is reprocessed. The Kirchoff migrated data were subsequently spectrally balanced using a Ricker wavelet. The reprocessed seismic section provides an improved image of the shallow structures delineating a number of continuous reflectors in the upper Neogene formations. The maximum depth to the top of the preNeogene basement reaches 1000 m along seismic line Z1. Two structures are also imaged, the former consists of several thrust sheets and the latter is regarded as a positive flower structure. These reprocessed seismic data depict for the first time the subsurface structure of an extended area.*

Key words: *Messara basin, Seismic reflection, Migration, Zero-phase deconvolution.*

INTRODUCTION

The seismic reflection technique has been used at several scales from some meters (Bachrach and Reshef, 2010) up to several hundreds of meters or kilometers (Barley and Summers, 2007; Howard, 2007) for the delineation of the subsurface. Intermediate or large depths seismic reflection studies around the world are mostly related to the tectonic evolution, indirectly leading to the evaluation of the georesources potential (Drummond et al., 2000). Processing of seismic reflection data aims at the signal enhancement. Signal processing methods, such as deconvolution and migration, can improve the interpretability of the seismic sections.

Increasing the resolution of seismic data has always been a quest for geophysicists. Deconvolution methods applied before or after stacking (Yu et al, 2006; Gray et al., 2001) increase the temporal resolution if the data are stationary. The seismic data are usually stationary in time gates. Time gates do not provide sufficient amount of data for the calculation of the inverse operator from statistical methods like spiking deconvolution. Time-varying deconvolution (van der Baan, 2012), spectral balancing (Lazaratos and Finn, 2004) and spectral whitening techniques (Taner et al., 2003) improve seismic resolution. Deterministic deconvolution needs the phase information of the propagating wavelet. Lazaratos and Finn (2004) used a near the source trace for the calculation of a reference amplitude spectrum in order to apply spectral shaping, while Taner et al. (2003) enhanced the higher frequency amplitudes in the t-f domain. Recently, Economou and Vafidis (2010) and Economou et al., (2012) introduced a time varying deconvolution technique.

Most of the migration techniques apply the principle of downward continuation (Yilmaz, 1987). Downward continuation of the seismic wave field can be considered equivalent to lowering the receivers into the earth. By applying the imaging principle at each depth, the entire wave field is imaged. Finite difference (FD) migration techniques apply the principle of downward continuation and utilize the scalar wave equation. The phase shift or Gazdag migration is implemented in the frequency-wavenumber (f-k) domain. The downward continuation is equivalent