AGOCO Enhances 3D Surface Seismic Resolution for Better Subsurface Illumination

Collaborating on vertical seismic profile interpretation helps to determine Q factor, improve subsurface imaging, and optimize data reprocessing

**CHALLENGE**
Improve the resolution of surface seismic data to support more accurate subsurface image interpretation and better understanding of subsalt reservoir sections.

**SOLUTION**
Collaborate with Schlumberger borehole seismic experts to
- obtain and process vertical seismic profile (VSP) data
- accurately determine the attenuation factor (Q) for inverse application on the surface seismic line passing the well.

**RESULTS**
Reprocessed surface seismic data with greatly improved subsurface image resolution.

“The results of the Schlumberger borehole seismic services helped us achieve our objectives with Q estimation and interpretation, which has been needed for surface seismic data reprocessing.”

Adel Y. Al-Marimi
Exploration Manager,
AGOCO

**Improve seismic resolution for subsurface characterization**
Surface seismic data quality can be affected by legacy datasets, poor fidelity, geological complexity, and strong local subsurface attenuation. The surface seismic data acquired in Libya is generally characterized by poor resolution and signal/noise ratio, making reliable, high-resolution subsurface illumination a challenge in the region.

While operating in Libya, Arabian Gulf Oil Company (AGOCO) was interested in techniques and solutions that would help improve its seismic data resolution for more accurate reprocessing and interpretation. To develop and implement such a solution, AGOCO collaborated with Schlumberger.

**Integrate characterization software with seismic expertise**
The Schlumberger team recommended obtaining vertical seismic profiles (VSPs) and performing spectral ratio evaluation to derive the dimensionless quality factor Q, a modeling parameter that describes the anelastic attenuation of seismic waves. This Q determination technique is an advanced VSP application that improves seismic resolution and brings clarity to subsurface imaging; the process can be used on both VSP and surface seismic data.

Estimating the attenuation factor from the VSP data gave AGOCO insight into compensating losses in the resolution of the surface seismic lines. The team estimated the Q value and then preliminarily applied it on the seismic line passing the well, improving the subsurface image. Finally, to reprocess the surface seismic data, the collaborating experts used GeoFrame® reservoir characterization software, which provides integrated geological and geophysical workflows that optimize prospect generation and field development.

Amplitude spectrum ratio comparing the first (green) and the last (red) trace VSP data. The amplitude of the last trace is less than the first trace because of natural Earth mechanisms acting as a low band-pass filter.
CASE STUDY: Collaborating with Schlumberger on VSP interpretation helps to determine Q factor, Libya

Increase exploration and development success
Petrotechnical interpretation enabled AGOCO to recover the resolution of their surface seismic data, enabling improved subsurface imaging of the study area to support better-informed drilling decisions. AGOCO was able to clearly see and monitor subsurface hydrocarbon targets and improve well ties for both seismic inversion and accurate reservoir characterization.

Results of the spectral ratio evaluation method, including attenuation (black curve), the slope of the line of best fit (red line), and an estimated Q value of 75.

Surface seismic imaging before (left) and after (right) Q inversion. Subsurface illumination greatly improved after performing Q inversion.