Simultaneous Joint Inversion of Seismic and Gravity Data for Long Offset Pre-Stack Depth Migration in Northern Oman

D. Colombo[1], M. Mantovani[2], M. De Stefano[2], D. Garrad[3], and Hussain Al Lawati[4]
[1]Geosystem Canada Inc., Calgary, AB, Canada; dcolombo@geosystem.net
[2]Geosystem S.R.L., Milan, Italy
[3]Indago Petroleum Ltd., Dubai, United Arab Emirates
[4]Ministry of Oil and Gas, Oman

Abstract/Excerpt

The problem of data-driven velocity model building for depth-imaging applications is approached from the point of view of simultaneous joint inversion of separate geophysical domains. For this purpose a general formulation of the joint inversion problem is provided. The method is Then applied to a real (long offsets) seismic dataset from Omani thrust-belt where seismic travel-time residuals (first-break and Common Image Gather residuals) are jointly inverted with gravity data (in the form of Bouguer anomaly) for improving velocity model building and the corresponding depth-domain seismic image.

Effective depth imaging through migration can be achieved only if a precise estimate of interval velocity in depth is available. The definition of a reliable velocity model for depth imaging is a difficult task especially when sharp lateral and vertical velocity variations are present. The problem becomes even more serious when the seismic data are noisy giving little chance to extract useful velocity information from the data. Geologic models can provide a guide to the velocity model building and data integration with other geophysical methods can also be extremely important.

Several different approaches to geophysical data integration were proposed in the past but in a very few cases the data integration problem has been handled in terms of simultaneous joint inversion of geophysical data. No applications to date, however, attempted the simultaneous joint inversion of non-seismic geophysical data and pre-stack seismic migration residuals for the improvement of seismic images in depth domain.