A Geological 3D Velocity Model in Keathley Canyon and Walker Ridge, Gulf of Mexico

Sharon Cornelius and Pete Emmet

Department of Earth and Atmospheric Sciences, University of Houston,
Science & Research Bldg. 1, Rm. 312, 3507 Cullen Blvd., Houston, Texas 77204–5007

GCAGS Explore & Discover Article #00058*
http://www.gcags.org/exploreanddiscover/2016/00058_cornelius_and_emmet.pdf
Posted September 13, 2016.

*Article based on an extended abstract published in the *GCAGS Transactions* (see footnote reference below), which is available as part of the entire 2016 *GCAGS Transactions* volume via the GCAGS Bookstore at the Bureau of Economic Geology (www.beg.utexas.edu) or as an individual document via AAPG Datapages, Inc. (www.datapages.com), and delivered as an oral presentation at the 66th Annual GCAGS Convention and 63rd Annual GCSSEPM Meeting in Corpus Christi, Texas, September 18–20, 2016.

EXPANDED ABSTRACT

A 3D velocity model, using high resolution 2D seismic data with 15 km offsets, 22 seconds (40 km or 130,000 ft) of record, sonic logs from 92 wells, 19 vertical seismic profiles (VSP) or borehole seismic velocity surveys, and 38 calculated time versus depth tables derived from mudlogs, has been created. All forms of sonic information were transformed into interval velocities versus depth (in feet) and loaded into Vel Pro velocity modeling software. This is a very non-traditional velocity model in that the salt bodies were not defined separately and then later interjected into a 3D sediment velocity model; and no 3D seismic data were used. The well data velocities were entered continuously from sea level to the well total depth as interval velocities with the depth intervals varying between 10 ft and 1000 ft, depending upon lithology consistency. The workflow is described in Figure 1. The goal was to develop as geological a representation of the subsurface as data permitted. The resultant 3D velocity model evidences regional geological trends and relatively accurate velocity profiles in the areas where seismic data is in close proximity to a borehole (see Figure 2).

Zones of overpressure and intermittent zones of Cenezoic limestone, most often occurring below salt, are discernible (see Figure 3 for limestone presence in the velocity model and Figure 4 showing the mudlog confirmation). Stratigraphic layers of equal interval velocities are visible throughout the 3D velocity volume and tie reasonably well on intersection with either borehole sonic data or the seismic checkshot velocities (see Figures 5 and 6). Synthetic seismograms were performed at 11 well locations in close proximity to the seismic data with good agreement to the actual seismic data. In overpressure zones below salt, agreement between well data velocities and the velocity model is within 2%. Comparisons of seismic interval velocities for salt compared to salt interval velocities from borehole data differ by less than 2% for 12 wells nearby the seismic lines. More important than distance between the well and the seismic line is the shape of the salt: if the salt has steep flanks close to the borehole, then the interval velocities between seismic data and borehole data could differ by more than 5%. The velocity model integrates well data and seismic data seamlessly. Figure 5 is an arbitrary line connecting two seismic interval velocity lines and a walkaway VSP. Figure 6 is the same line but

Originally published as: Cornelius, S., and P. Emmet, 2016, A geological 3D velocity model in Keathley Canyon and Walker Ridge, Gulf of Mexico: Gulf Coast Association of Geological Societies Transactions, v. 66, p. 727–730.

inside the velocity model. Note how the velocity model has corrected the slower seismic interval velocities, easily visible in the allochthonous salt.

…