Extracting 3D Structure From 2D Marine Multichannel Seismic Reflection Data Collected Over the Eastern Nankai Trough

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2D marine multichannel seismic reflection data acquisition is frequently conducted with a component of ocean current across the survey profile. When the normal component of the current is a significant fraction of the ships's speed it forces the streamer far to one side of the ship's trajectory and the direction of the hydrophone streamer is different from that of the survey profile. This configuration allows 2D marine seismic data collection to become a very limited swath 3D survey to one side of the ship track. The obtained 3D data volume is characterized by a very low trace fold, irregular midpoint distribution, variable swath width, and narrow source-receiver azimuth range. Commonly, data from such swath 3D marine surveys are processed by assuming a 2D straight-line geometry and by using standard 2D seismic imaging procedures. This approach is effective when the targeted geologic structures have a 1D geometry, and often very useful for studying mildly dipping 2D features. However, when the dip of the reflectors is steep, or the structures are 3D, accurate imaging can be achieved only by taking into account the 3D character of the data.

We present a method for improved signal alignment before stack and extraction of local 3D structure from swath 3D marine data. The method requires the true source and receiver coordinates and is based on a traveltime equation that takes into account the three dimensionality of the data. We show the results obtained by applying this method to seismic reflection data acquired over the eastern Nankai Trough during Kaiko-Tokai French-Japanese project. For this survey the Kuroshiro current had a similar speed to that of the ship and for much of the survey the streamer was at nearly 45 degrees to the survey line. The resulting average swath width is about 1 km. The extracted 3D information and increased resolution of the images put better constraints on the geometry of the accretionary prism decollement and thrust structure. The obtained results also help define more precisely the position and geometry of the seismogenic part of the subduction thrust.