

## **Adventures in Pre-Stack Depth Migration**

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Pre-stack depth migration (PSDM) has made significant progress in the past several years, but some problems still resist complete resolution. One problem is the fault-shadow, exposed by Tucker and Yorston in 1971, where strong velocity contrasts across faults can produce time maps that do not correspond to true depth and sometimes disrupt reflectivity severely. An excellent detailed description of the fault shadow problem and its solution has been published by Fagin (1996).

It should be noted that sometimes the fault shadow can create the opposite effect illustrated above. A time map might show a closure against the fault when none exists, due to velocities on the downthrown side of the fault being faster than on the upthrown side. Other examples of PSDM, both successful and not, are used to demonstrate the following conclusions:

- 1.) PSDM requires a detailed and accurate velocity model, although this means that a PSDM result is actually a verification of the interpretation of velocities. Fagin (1995) says, "Valid depth imaging results are only possible with a velocity model accurate to within a few percent." Consequently, smoothing the velocities across faults can cause erroneous results.
- 2.) Modern PSDM usually works well when reflectivity is good, but performs poorly when reflectivity in the fault shadow is poor. Consequently, using the best pre-stack time imaging available is suggested.
- 3.) The choice of PSDM method, Kirchhoff or Wave-Equation, can be a factor. Li et al. (2003) provide guidelines for choosing.
- 4.) While modern PSDM can often resolve large velocity problems in general, detailed accuracy is sometimes missing. In the Wilcox, 50' of closure can provide profitable traps, but PSDM is usually not that accurate. Allen et al. (1993) demonstrated such inaccuracy using PSDM methods of that era on synthetic data. Recent examples show the same problems persist. However, Hall and See (2009) have shown outstanding results with modern anisotropic Kirchhoff PSDM.