geLOGIC News

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VELOCITY
The Missing Link

What is the most important connection between geology and geophysics

What is the most important connection between geology and geophysics? How is real world depth related to seismic time measurement? The link is that long ignored, much misunderstood, and often miscalculated entity called VELOCITY. It is the most fundamental, and also the most elusive, of all earth science parameters. Unfortunately, the subject of velocity, and its attendant role in depth conversion, has been a pariah for as long as any of us can remember. What we heard for depth conversion was -"Use the nearest checkshot survey". We knew it wasn't that simple, and inevitably mistakes were made.

The three dimensional interpretation of velocity is every bit as important as the interpretation of seismic times. These two interpretations meld to give the final I structural depth picture. And as a bonus, the interpretation of velocity can give usi much more. The top and bottom of abnormal subsurface pressure can be mapped. Coefficients derived from the detailed analysis of interval velocities, and related to sand/shale ratios, can be displayed in an aerial sense. The integrated study of-seismic sonic and checkshot velocities, together with correctly processed and interpreted time horizons and faults, is the key to deriving accurate depth models, as shown in Figure 1

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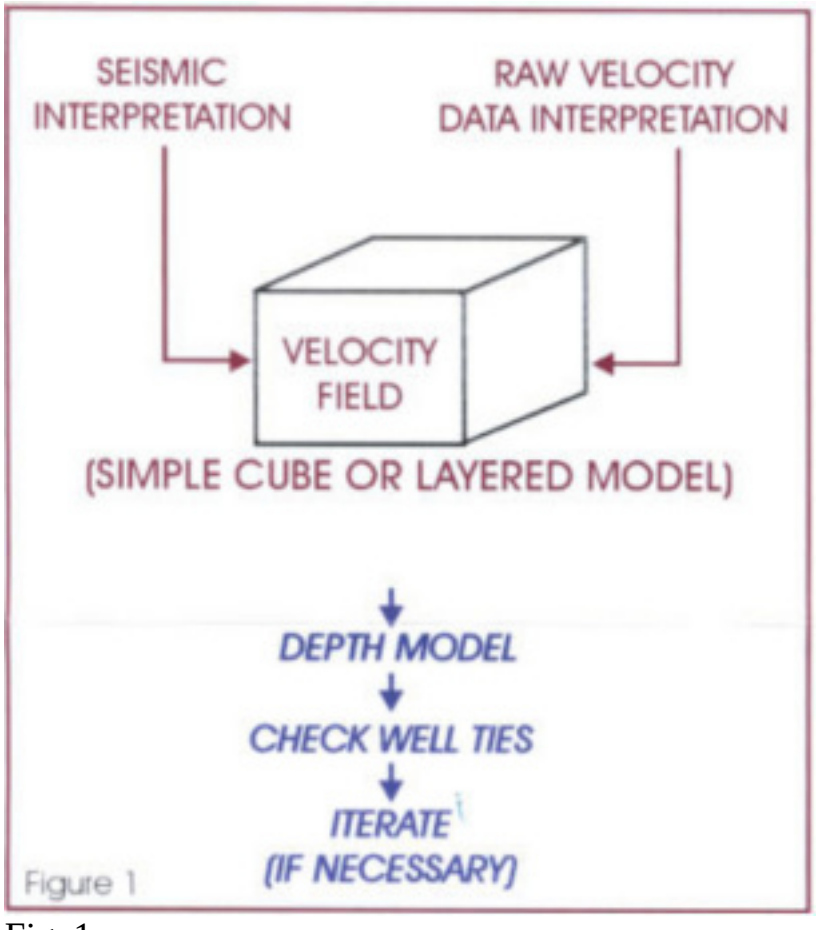

Fig. 1

As an example, consider the problem of converting three dimensional time surfaces and fault planes to depth. The success of this operation depends on:

1. The correctness of the time interpretation and the accuracy with which the seismic data were processed.

2. The intelligence which went into the building of an accurate earth velocity model.

It is this second aspect which has been neglected for so many years. However, we now possess, courtesy of recently developed software packages, computer tools specifically designed to perform the manipulations that we should have been doing all along. We are able, for instance, to 'insert' a time horizon or fault surface from an interpretation -workstation into a three dimensional cube of velocity, and then directly make the depth conversion (See Figure 2). However, what is needed before this can be done, is the velocity model itself.

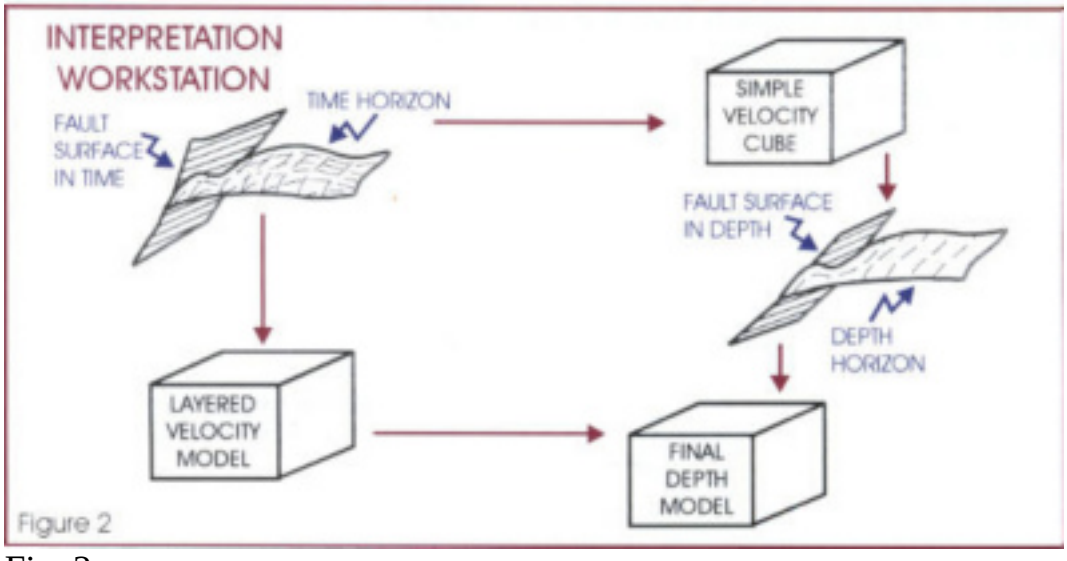

Fig. 2

In order to transform a time horizon to depth, we need to use a field comprised of accurate vertical propagation velocities. It is incorrect to use raw processing derived velocities, even if they happen to come from the processing of a pre-stack depth migration. Appropriate velocity fields are formed in the computer from carefully scrutinized and edited vertical checkshots. Any horizontal component in the checkshot will compromise the result. The problem, even with vertical checkshot derived velocities, is that wells are often drilled in non-ideallocations for the purposes of good velocity work. Structural highs and fault zones, which involve localized anomalies in interval velocity, do not provide perfect velocity measurement conditions. However, the checkshots are still the best data we have for depth conversion purposes.

The construction of an accurate velocity model requires that the time interpretation be i an integral part of its formation. Whether the derived velocity field is a simple cube or a more complex layered model, the success of depth work still relies on the interpretation of the geologically well informed geoscientist. In the end, exploration success depends more than anything else on the accuracy of the depth model, and that model is derived from interpretations of both time AND velocity.

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