



FAQ Guide

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1. Processing

- Q:** Is it a 'time' migration of duplex waves, since time migration has well-known shortcomings in dealing with lateral heterogeneity?

A: We do not use time migration, but are using (pre-stack) depth isotropic and anisotropic one.
- Q:** Is DWM relying on knowledge of the exact location of interfaces and contrast values to produce appropriate duplex- (prismatic-) wave migration response?

A: We do not assume prior knowledge about sub-vertical objects, we require only knowledge of the sub-horizontal reflection element (base boundary) as our technology follows standard depth migration, and we generally do not have the problems with structural boundaries.

2. Interpretation

- Q:** On the interpretation of field data results: if there are 5 to 8 meter wide fracture systems, size-wise this is usually well beyond seismic resolution for P-wave dominant wavelength. So to appear as a reflection these should yield extremely large property contrasts (as larger, or larger than, e.g., salt-sediment contacts). Finally, you rely on the amplitudes for the duplex images for your interpretation: these are known to be highly sensitive to model parameters, and without knowing more about the details of your method, I am inclined to distrust these amplitudes.

A: It is right that for the signal 30-50 Hz to receive the reflected signal from a 5 m thick layer, and a second reflection is very problematic. However, there is one important duplex wave energy feature, which consists in the fact that significant two-way wave energy we have only at large angles of incidence on the target sub-horizontal boundary (60-85 degrees). At these angles, length of the wave path running within the thin layer is not already 5m but about 50-60m. It is enough for reflections from the two walls of a thin layer to not destroy each other. This fact we have shown in the articles, such as the Vienna EAGE (2011) dedicated to the AVO-DWM.

2. **Q:** How the amplitude and sign of DWM image may relate to prediction of the fracture zone (corridor) productivity?

A: Regarding the sign of the signal, we have to deal with the seismic image, where there are positive and negative phases of the same reflection. Thus wavelength considered in this case along horizontal may be at least 100m. In general, if the impedance of the enclosing medium is higher than within the fracture zone, it is possible with high probability expect a negative reflection coefficient of the permeable corridor positive and vice versa if the impedance of the disturbance within a zone higher than the host rock. We have published evidence of this fact. However, if a permeable corridor is filled with small cracks, there may be other relationships, for which there are examples in the literature. So clearly you can only talk about the absolute value of the reflection and its relation to productivity. Our experience suggests that an open fracture has bigger reflection coefficients than healed fracture zone.

3. **Q:** Does the properties of fracture zone (permeable corridor) must be always supported by the relevant logs that back up the DWM based interpretation?

A: When this information is available – Yes. But because properties of high permeability corridors in carbonate rocks are still very poorly studied, therefore any additional information derived from DWM results about the objects in the area of the search for such bodies may be very important to practice.

3. Using seismic Modeling for DWM Interpretation

1. **Q:** On the relation between the synthetic model and the field data. It is not clear that the synthetic model offers a good proxy for what the reader is expected to see in the field data. Presumably the only thing they have in common is that they contain duplex waves. While the synthetic model may contain duplex waves to due a large-scale structure with a strong velocity contrast, faults and fractures are often altogether different as they yield relatively weaker contrasts over "thin" (compared to wavelength) features, which can often be in the limit of seismic resolution. It certainly does not help when synthetic example and field data results are visually quite different.

A: Properties of the fracture zones of the permeable corridors type have been studied much worse than the sub-horizontal heterogeneities as much rarely opened by wells. However, field studies in some cases show strong contrast of properties between rocks within permeable corridor and in the surrounding rocks. In the simulation may be used even lower contrast as a more typical one.

4. References

1. **Q:** How DWM refer to the literature on using primastic, duplex and multiple-scattering imaging (in e.g. RTM and other methods): see Jones et al., Malcolm et al., and other for examples.

A: We know these works, as well as publications by McMachan, 1983, Volreven et al, 2005, Farmer et al, 2006, Kozlov et al, 2009, Koren and Ravve, 2011, etc. Many of these authors cite our work. It should be noted that the technology implemented on our approach has allowed, first show on practical examples that the information contained in the duplex waves is useful for practical purposes, and at modern systems of 3D observations it is possible to use it and, second, to perform a large number of successful practical projects for various oil companies.

2. **Q:** Could you show some of the seismic modeling (synthetic) data? What is ratio of signal to noise? Could you elaborate on the phase of the event?

A: You can find published papers and DWM client documentation relating to theory behind DWM supported by examples based on seismic modeling on our website <http://www.tetraseis.com/> .