

Applying New Technologies to Old Areas: Relative Geologic Time, Wheeler Diagrams and Near Field Exploration in Faulted Plays -- by Steve Tobias, NearFX, LLC (April 17, 2019)

On April 17, I had the pleasure of enjoying the fine hospitality of the Corpus Christi Geological Society – and some good local cuisine – while I shared stories of some of the newer interpretation technologies that are starting to impact our industry.

Some background first. I started off in this industry in the late 1970's, doing seismic interpretation in the state waters offshore Texas. Over the years I worked much of the onshore Gulf, as well as the offshore and deep offshore, including subsalt plays.

I also spent about half of my career traipsing around the world, doing exploration in SE Asia, Australia, South America and West Africa. From 2014 through 2017 I worked the North Sea, searching for stratigraphic chalk deposits for Hess. The best part – a three-year stint in beautiful Copenhagen!!

Over the decades, I've learned a lot about the differences between the way different nationalities do exploration. What's probably most relevant to the CCGS is that nobody understands growth faults like we do! Not even close.

And so, the talk I gave was about bringing European technologies to growth fault exploration. This type of cross pollination is really very fruitful, and has served me well over the years. It's also helped the Europeans, who have recently taken a 65 year old tool from American geologist Harry Wheeler and run with it. Two companies (one Dutch, the other French) have developed very intriguing technologies with which they can turn 3D seismic surveys into 3D Wheeler diagrams!

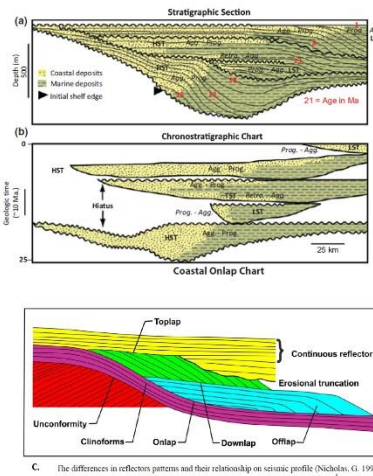
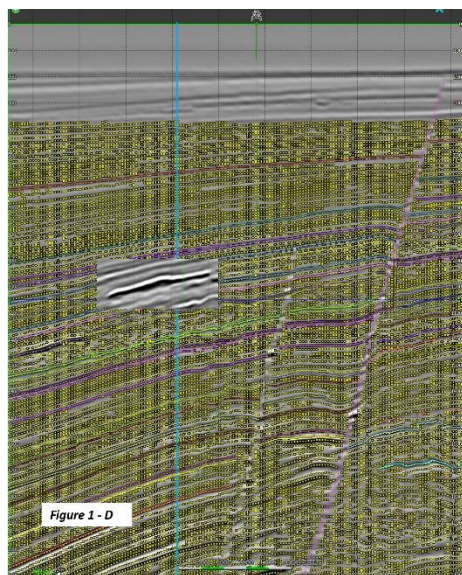


Figure 1 shows what that is all about. The seismic on the left shows a small “clean” rectangle of seismic data, surrounded by hundreds of connected nodes that the computer software used to “autotrack” every single seismic wiggle. This was done through a combination of human supervision and machine learning. The result? Using the software, every single place on the 3D seismic can

now be assigned a “relative” geologic time, or RGT.

Why is this important? Because it enables the user to turn the 3D seismic data into a 3D Wheeler diagram. Figure 1a (upper right) is a cartoon-like representation of a hypothetical piece of the earth, complete with different facies and unconformities. Figure 1b represents the Wheeler diagram that is

associated with it. Figure 1c (bottom right) shows the “Vail-like” seismic terminations that we normally like to find on the seismic when doing this type of study, since it helps us to draw in all the sequence boundaries with confidence.

The idea here is to use these seismic termination patterns to help break out the different geological facies. This is very important – if you can break out the geology into different packages, it becomes much easier to predict reservoir and seal presence, which is more important now that most of the bumps have been drilled. Figure 2 shows the same idea more or less, only this time with real data.

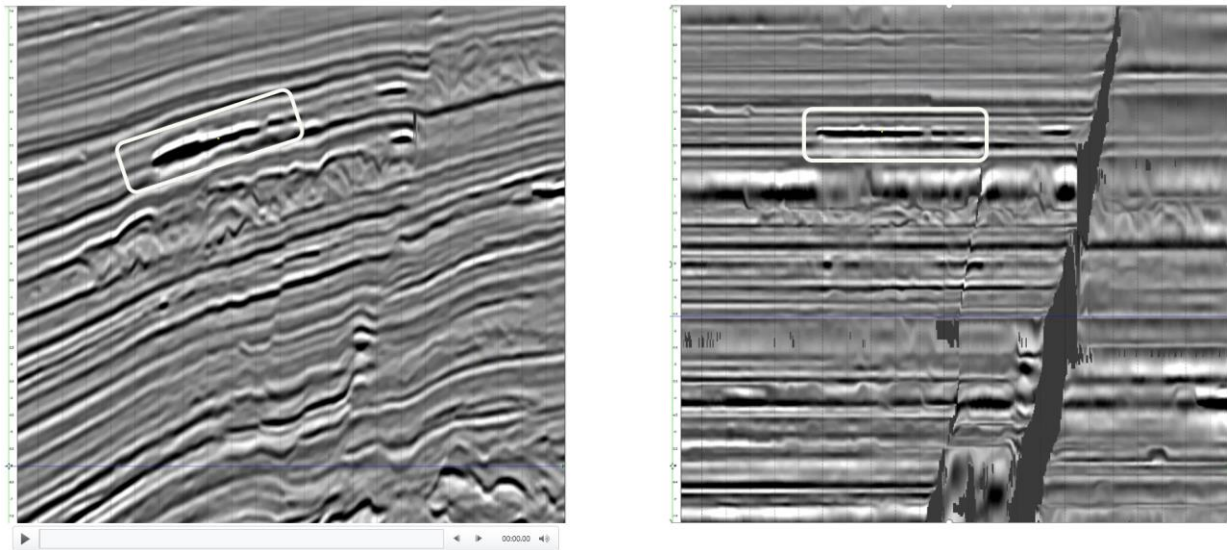


Figure 2: Original seismic, left, versus the same seismic after application of the Wheeler Transform. The vertical axis is now relative geological time (RGT), and all deposits of the same age line up on the same horizontal line.

But let's get real – how does all this this help find oil and gas? The answer is hinted at in figure 3. This is perhaps a typical seismic vignette from somewhere in Texas or Louisiana that is not subsalt, lying in deep water or on top of a salt dome. What do you see? Faults and reflectors. What don't you see? You don't see the type of onlaps, offlaps on downlaps that we saw above, in figure 1d.

Huh? Why not?

The answer is that in the good old GOM, far away from our rigid European colleagues with their more rigid rocks, our growth faults affect our ability to see the “laps” that Vail and his buddies wrote about. They did most of their research on rigid shelf margins like the North Atlantic and West Africa. The GOM is about as rigid as a bowl of jello on a roller coaster. Sure, we also have seismic terminations or “laps” in our data, but ours terminate against the growth faults, and not in plain sight on underlying rocks for everyone to see. To see ours, you need to use expansion profiles, another American invention, but that's another story. And so the basic techniques of the 40 year old Seismic Stratigraphy revolution had little impact on the every day work habits of the hard working Corpus Christi geoscientist, or their cousins in Houston, New Orleans or elsewhere.

Until now.

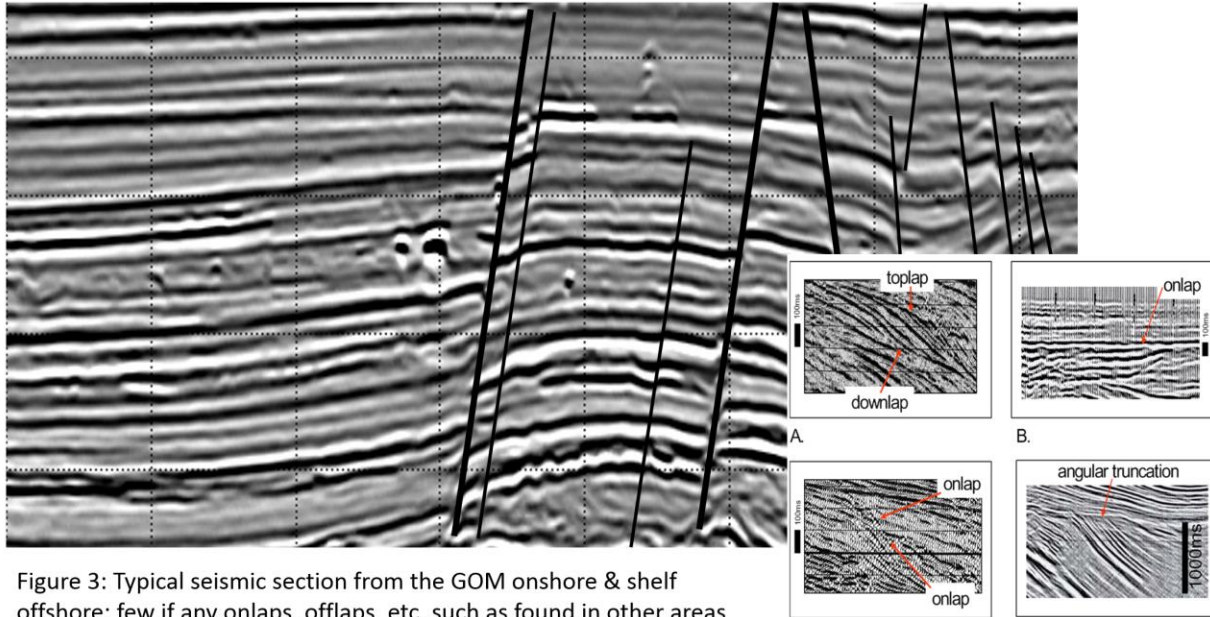


Figure 3: Typical seismic section from the GOM onshore & shelf offshore: few if any onlaps, offlaps, etc. such as found in other areas (right). This is characteristic of syn-kinematic sediments.

If you take another look at figure 1b (the Wheeler diagram), it becomes obvious that in “Wheeler space”, all stratigraphic sequences are clearly separated, plain as day. No downlaps need apply. And so if what is holding you back from understanding where that elusive pinch out is in the lower 40, ask the Dutch or the French. They just may have a tool that can help you.

That pretty much sums up the main parts of the talk I gave. What’s pretty cool about this approach is that it is really a geology thing, more than a geophysics thing. You don’t need bright spots, you don’t need a PhD in geophysics. It is the next step in interpretation, and it summons back Harry Wheeler in all his glory. This is healthy—with all the high technology floating around, sometimes GOM’s working the GOM worry that people have lost the big picture when it comes to exploration (the first GOM stands for grumpy old men for those that don’t know). A friend in Canada warns against “Nintendo Geophysics”.

Now don’t get me wrong, I’m a big believer in high tech. I started using neural networks to find oil in Matagorda County and elsewhere when that technology first came out some 20 years ago (Hampson Russell Emerge and GeoQuest SeisClass), and swear by Reverse Time Migration. That stuff really has its place. But so does good solid geological thinking.

Since I’ve moved back from Europe, I’ve been working with a variety of clients to use a variety of technologies to find overlooked oil and gas near existing fields. That’s how I named my company: Near Field Exploration.

Thanks for giving the chance for a GOM GOM to get on his soapbox. And good hunting!

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