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# Seismic window

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## Funny methods work – innovation and jerks

Although I now spend my days working with seismic data, I started my career acquiring data in the search for minerals. I still have a soft spot for methods like IP, EM, gravity and magnetics - lovingly called funny methods. But at the recent EAGE conference in Vienna three things occurred that had me rethinking the terminology and sent me searching through my funny methods files when I got back home. First, the EMGS booth was quiet. For the past 10 years they have had a magician doing tricks almost non-stop in an entertaining but loud show. When I asked where he was the President said they no longer wanted to be associated with magic because their methods were proven. This was reinforced by the exploration manager of a large European oil company who told me they had a recent success using CSEM. In fact, in a recent Barents Sea well they had not only predicted the presence of hydrocarbons but had predicted the depth of the oil-water contact to within a metre. Last, I was shown some results of airborne EM traverses across known oil fields located both onshore and offshore Australia. All these fields had an anomalous response. Maybe there is something in these methods after all. For more information on EM I'm sure Jim Dirstein (+61 4 0334 6688) would be happy to share some of the successful pre-drill predictions made in the last twelve months using this patented, home grown airborne technology.

The last entry in my funny methods file was a paper put together in 1984 when the technology sold to the oil industry was a type of 'black box' and the vendors gave very little detail. So how does it work? I'm still suspicious of the direct detection approach, which is said to respond to the presence of a hydrocarbon accumulation thousands of metres below the surface and to accurately predict depths and thicknesses. This method still requires some control from seismic and well data to constrain the results. On the other hand, the mid 80s view was that leaking hydrocarbons altered the mineralogy of shallow, iron rich sediments (i.e. most of Australia) to form pyrite and marcasite which produce an anomalous electrical response (Figure 1). The latest view is that leaking hydrocarbons (no seal is perfect) carry a charge and actually behave like a battery (remember SP logs?). This moving current then induces a measurable EM effect.

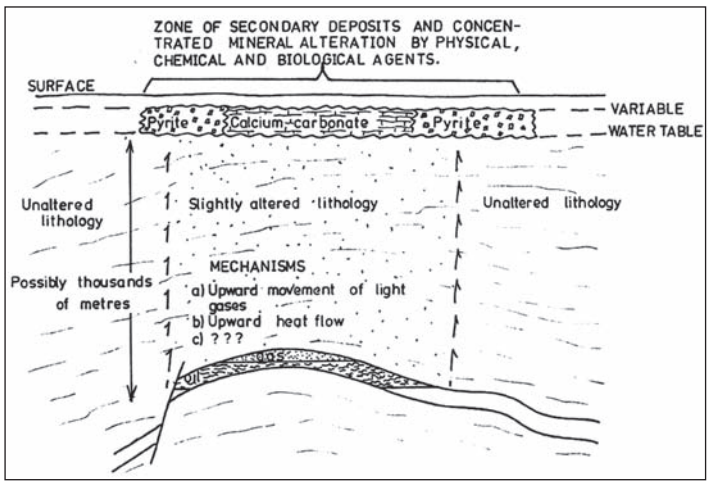


**Figure 1.** *Illustration from Rutter (1983) showing possible environment around a hydrocarbon accumulation.*

Back to seismic. I attended the launch of DUG Insight 4 in the DownUnder GeoSolutions offices in June. This software has certainly come a long way with this release. At the launch DUG processing geophysicist Helen Debenham told me about the second derivative of velocity (I suggested that this is the acceleration of acceleration but apparently its correct name in the physics world is Jerk: https://en.wikipedia.org/wiki/Jerk_(physics)). Helen suggested I try it and explained it turns velocity fields into something akin to seismic with mappable events. I'm not sure how to use this yet but I gave it a try. The results are shown below (Figure 2). Indeed, the second derivative produces mappable events that correlate well with seismic reflections even where the actual velocity cuts across reflections. Using average or interval input velocity doesn't make any difference because the inflexion points are in the same place but Helen suggests using interval velocity because the process works best on velocities that have been derived meaningfully from the seismic, for example from tomography. Jerk is an example of how modern seismic interpretation packages can be used to calculate anything we can think of – and I just have to work Jerk into my next presentation.

### Reference

Rutter, H., 1983, A report on the application of electrical methods to hydrocarbon exploration for AMIRA Ltd. Geophysical Exploration Consultants Pty Ltd.

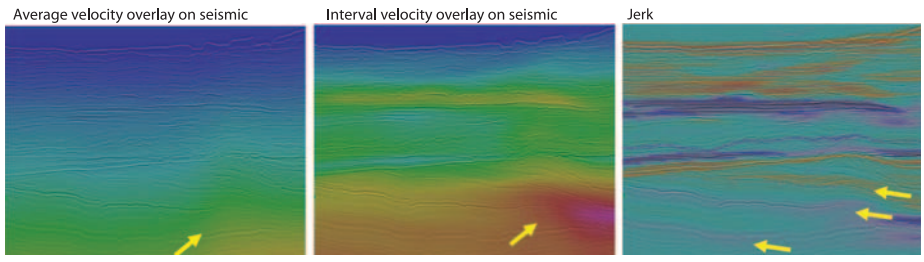


**Figure 2.** *Input to jerk – average (left) or interval (centre) velocity shows little conformance with geology in some places (arrow). Jerk attribute (right) shows conformance with deep reflectors (arrows), which was not apparent on the interval or average velocity displays. The horizonatal striping results from interpolating the velocity profile. This striping should not be apparent if the original, uninterpolated sample interval is used in the input velocity.*