Pseudo Gamma Ray Log

BELVEDERE MAORPET

Well Log Extrapolation: an extension to the acoustic impedance inversion

At Belvedere Maorpet Inc we have several years of experience with the extrapolating of sonic logs by the use of seismic time sections.

Beside the extrapolated sonic log time sections it was a frequent request to have an extrapolated gamma ray log as well. By using the sonic and the gamma ray log together even the sequence boundaries might be identified on the seismic time sections.

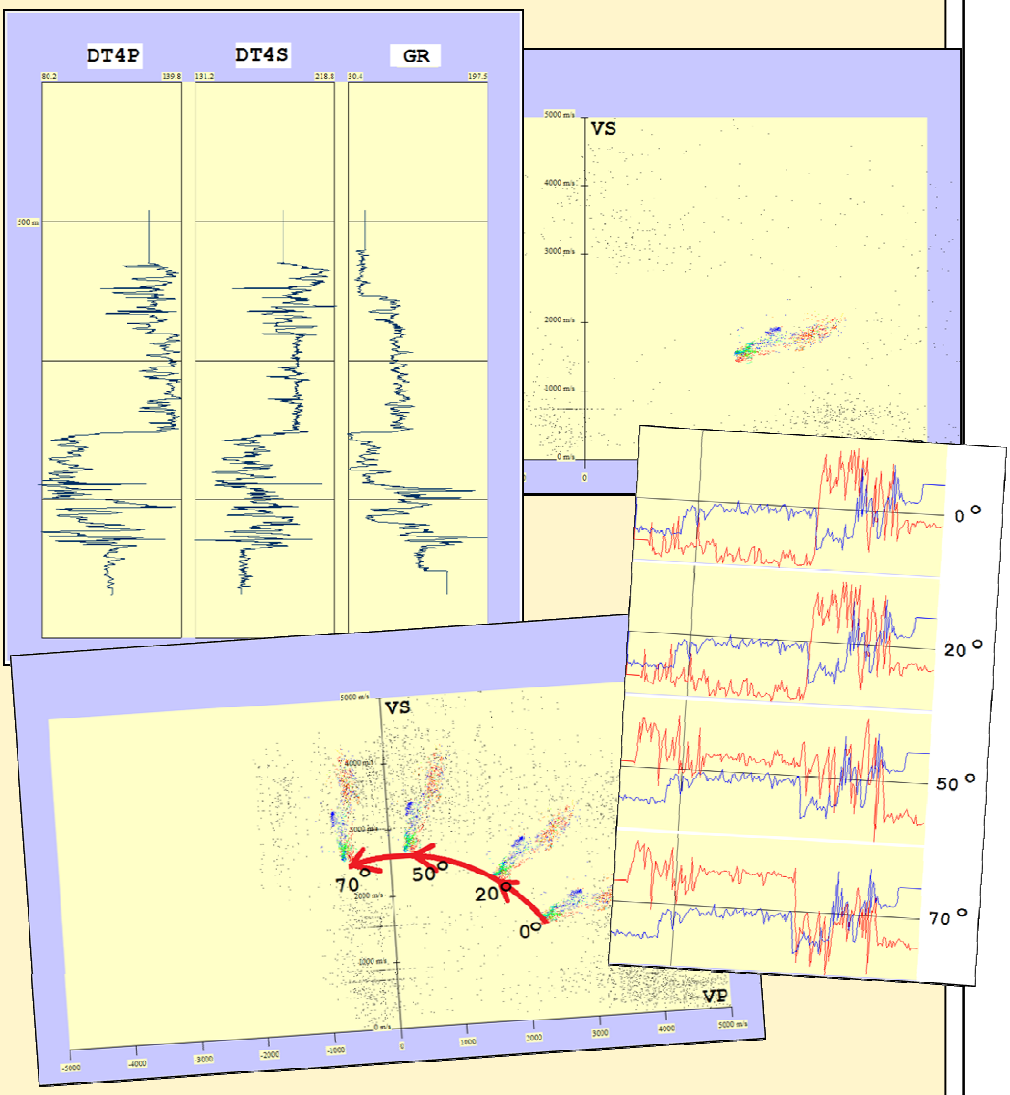
The problem is: to extrapolate the sonic log, we can use the seismic, because the seismic reflectivity and the sonic velocity are some kind of relatives. But to extrapolate the gamma ray, we have to do some more work.

To understand, what we are going to do, first forget the seismic and let's stay with the well logs. Let's have a look at the "P" wave versus "S" wave velocity cross plot first. We will color the dots on the cross plot according to the value of the corresponding gamma ray log. We see that the different colors of the gamma ray nicely separate on the cross plot. The only problem is that they are plotted in a wrong direction.

Let's start to rotate the coordinate system. We see, that at one point, the coloration becomes nearly continuous, red dots (large gamma ray values) accumulate on one side and blue dots (small gamma ray values) on the other side.

So, if we apply this coordinate rotation to our P and S wave seismic section, we receive something similar to the gamma ray log values.

On the presented picture the blue curve is the original gamma ray log, the red curve is the rotated and projected P wave velocity. At a rotation somewhere between 50-70 degree they fit quite well to each other. This rotational angle must be verified every time, since it might change from area to area.



Why do we follow this deviant practice?

Because this gives us a chance to obtain a seismic section, which will be a relative of the gamma ray log. Using this seismic section we will be able to perform the gamma ray log extrapolation.

Using the AVO technology, we obtain the RP and RS reflectivity seismic time sections. Next we apply the so called acoustic inversion to both sections. The result is the P and S wave acoustic impedance section, which is just the velocity multiplied by the density. Since we will use the cross plot of the two, the density will not bother us.

BELVEDERE MAORPET

1461 A First Avenue, #360
New York, NY 10075-2201
USA

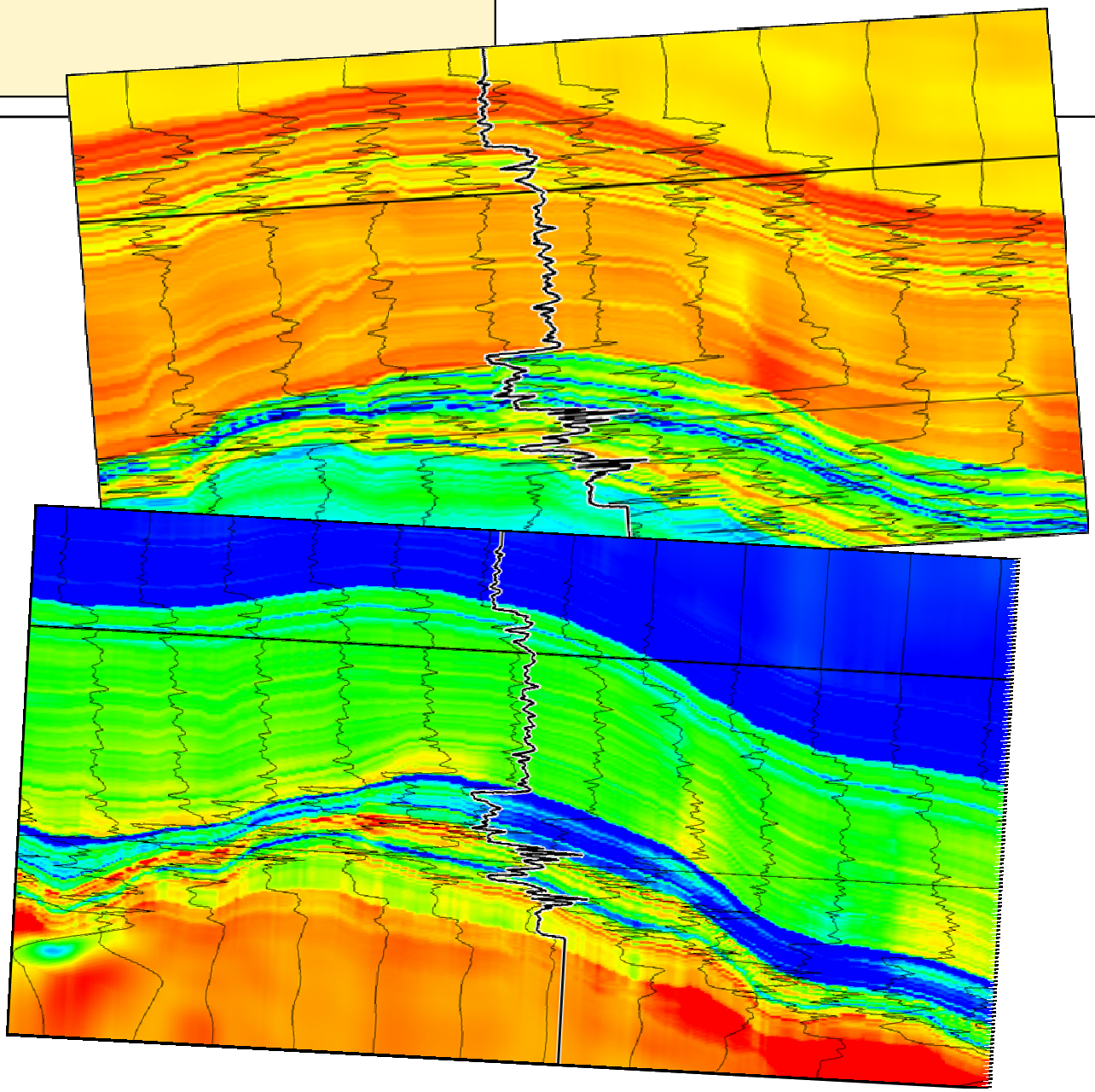
Phone : +1 (815) 425 8982
Fax: +1 (815) 550 8908
E-mail: info@maorpet.com

Some authors call this seismic section as “lithological impedance” section. We don’t call it to anything, but we say; we have now a time section, which is some kind of a relative of the Gamma Ray log. So, we can expect that we might be able to use it as interpolator operator to extrapolate the measured Gamma Ray log curves.

On the picture below; the gray curves are the rotated seismic traces. The black curve is the original gamma ray log.

Interesting to see, that the obtained seismic traces are really similar to the Gamma Ray log, although we did not use any information from that log to obtain them. (Except to verify the rotational angle).

We used (and rotated) only the extrapolated RP and RS acoustic impedances, what we got from the AVO analysis.



And, finally, this is the extrapolated gamma ray seismic section.

Please notice; we arrived to the point, what a reservoir analyst might dream of. Beside the P and S wave sonic log sections we have also the Gamma Ray section. We call it “Pseudo Gamma Ray” section. (The original gamma ray log is plotted over as the thick black line. Colors from blue to red represent gamma ray values.)