Sonic Transit Time (Df):

The sonic transit time (Df) for different wells was determined from the measured sonic transit time (t, ms/ft) of core samples at specified depths. The sonic transit times at the corresponding depths were then correlated with the measured porosities using (Df) a tool developed by D. Hayba using Excel's macro programming language to facilitate efficient analysis of the geophysical log data. The two plots below are examples of output from (Df) a well log program.

The data shown above for laboratory porosity measurements made on core samples at specified depths. The sonic transit times at the corresponding depths were then correlated with the measured porosities using (Df), a tool developed by D. Hayba using Excel's macro programming language to facilitate efficient analysis of the geophysical log data. The two plots below are examples of output from (Df) a well log program.

The relationship developed by Ritter (1980) was used to transform sonic transit time (Df) to porosity (Df) as follows:

\[ D_f = 1 - \frac{1}{\rho_w} \times C_{sh} \times (1 - \phi) \]

\[ D_f \text{ the sonic transit time at zero porosity, was determined from the proximate of the curve shown above for sand and shale. This formation factor, a controls moisture, and was adjusted to fit our data to within the range of published values.} \]

The parameters that we use are as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>(Df)</th>
<th>(Df)</th>
<th>(Df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.54</td>
<td>0.39</td>
<td>2.05</td>
</tr>
<tr>
<td>Shale</td>
<td>0.87</td>
<td>0.21</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Individual Well Profiles

The sandstone, silt, and shale compaction curves that we have defined can now be applied to individual wells. A spreadsheet named (Df) a well log data program was developed by D. Hayba using Excel’s macro programming language to facilitate efficient analysis of the geophysical log data. The two plots below are examples of output from (Df) a well log program.

The plot in the right shows sonic porosity data for the (Df) a well with the sand, silt, and shale compaction curves superimposed.

New-pearl (silt + shale) silt is highlighted in green and near-pure sand (silt + silt) in orange. The spreadsheet, RDLOG, allows one to shift the compaction curves up or down relative to the data. The best match of the curves to the data allows an estimate of erosion. No significant erosion has been noted in the (Df) a well.

This plot shows the difference between the sonic-derived porosities and porosities predicted by our compaction curves (computationally averaged at each point among the sand, silt, and shale measurements). The plot essentially shows the error or deviation of our curves from this benchmark. A positive deviation from the zero line indicates overestimation. A negative deviation to the left of the zero line is an indication of underestimation. The compaction curves (top figure) are then shifted up (representing erosion) and the error in the difference plot is increased and centered around the zero line. In practice, it is more accurate to visually judge when the data set is centered around the zero line in the difference plot rather than to judge an ideal fit to the curve in the top figure.