“Log Petrophysics of the Lower Permian Chase Group in the Hugoton Gas Field of southwestern Kansas”

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Kansas Geological Survey
Spectral Gamma-ray log of a Chase Group section
Examples of spatial variation of uranium in Chase Group units

From Luczaj (1998)
Permeability versus porosity and uranium
Lithodensity neutron logs of a Chase Group section
Chase Group RHOMaa – Umaa crossplot
Compositional profile computed from gamma-ray, density, neutron porosity, and photoelectric factor logs.
## Council Grove core porosity calibration data set

<table>
<thead>
<tr>
<th>facies</th>
<th>plugs</th>
<th>core</th>
<th>total</th>
<th>outliers</th>
<th>final</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM Silt &amp; Sand</td>
<td>156</td>
<td>106</td>
<td>262</td>
<td>9</td>
<td>253</td>
</tr>
<tr>
<td>NM ShlySilt</td>
<td>167</td>
<td>31</td>
<td>198</td>
<td>2</td>
<td>196</td>
</tr>
<tr>
<td>Mar Shale &amp; Silt</td>
<td>70</td>
<td>33</td>
<td>103</td>
<td>0</td>
<td>103</td>
</tr>
<tr>
<td>Mdst/Mdst-Wkst</td>
<td>67</td>
<td>22</td>
<td>89</td>
<td>0</td>
<td>89</td>
</tr>
<tr>
<td>Wkst/Wkst-Pkst</td>
<td>147</td>
<td>59</td>
<td>206</td>
<td>2</td>
<td>204</td>
</tr>
<tr>
<td>Sucrosic (Dol)</td>
<td>35</td>
<td>19</td>
<td>54</td>
<td>1</td>
<td>53</td>
</tr>
<tr>
<td>Pkst/Pkst-Grnst</td>
<td>116</td>
<td>64</td>
<td>180</td>
<td>11</td>
<td>169</td>
</tr>
<tr>
<td>Grnst/PA Baff</td>
<td>34</td>
<td>28</td>
<td>62</td>
<td>2</td>
<td>60</td>
</tr>
</tbody>
</table>

**Total:**
- Plugs: 792
- Core: 362
- Total: 1154
- Outliers: 27
- Final: 1127
Non-marine (facies 1 & 2) and marine (facies 3 and 4) siltstones
Gas effects: Invasion and depth of investigation of density and neutron tools
Example of gas effect in the Towanda Limestone

![Graph showing gamma ray, neutron/density porosity limestone equiv., and photoelectric factor barns/electron values.]
Towanda Limestone gas effect on neutron – density crossplot
Relationship between Xplot porosity, averaged neutron-density porosity, and gas effect

\[ \Phi_t = \frac{\Phi_{\text{NPHI}} + \Phi_{\text{PHID}}}{2} \]
Common porosity estimations with gas correction:

(1) Approximation of the Gaymard-Poupon equation

\[ \Phi = \sqrt{\frac{(\Phi_n + \Phi_d)^2}{2}} \]

(2) Empirical

\[ \Phi = 0.33\Phi_n + 0.67\Phi_d \]
Chase Group/ Council Grove statistical analysis of neutron density porosities calibrated to core porosity (accommodating gas effect)

Limestones (n = 786):

\[ \Phi = 0.399 \Phi_n + 0.610 \Phi_d \]

Dolomites (n = 513):

\[ \Phi = 4.63 + 0.259 \Phi_n + 0.523 \Phi_d \]
Acknowledgements

We thank our industry partners for their support of the Hugoton Asset Management Project and their permission to share the results of the study.

BP America Production Company
Cimarex Energy Co.
ConocoPhillips Company
E.O.G. Resources Inc.
Medicine Bow Energy Corporation
Osborn Heirs Company
OXY USA, Inc.
Pioneer Natural Resources USA, Inc.