AAPG Search and Discovery Article #90187 © CSPG/CSEG/CWLS GeoConvention 2013, Integration: Geoscience Engineering Partnership, 6-12 May 2013, Calgary, AB, Canada

Modified Approach for Probabilistic Petrophysical Software Used for Evaluation of Shale Reservoirs

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Abstract

Most stochastic or probabilistic petrophysical analysis softwares are designed to correct for effects of shale contained in the reservoir rocks. However, when shale reservoirs are to be evaluated with these programs difficulties are encountered since now it is required to correct the non-shale fraction in the shale “reservoir” for the effect of clays in the shale. The end points for clays in the shale reservoir have to be inferred indirectly since adjacent “clay” beds are almost never met with in the course of field development.

This presentation describes how the original GRI approach may be used to infer the ***clay*** end points for the Gamma Ray, Compressional and Shear Acoustic travel times, Volumetric Cross-section, U, as also for the Potassium, Thorium and Uranium measurements. This is accomplished by extrapolation from the end-points of the predominant non-shale mineral and that of the zero porosity shale to obtain the clay point based on an *a priori* knowledge of the ratio of the non-clay fraction in the shale “reservoir”.

Once the appropriate clay end points are obtained, they may be used in the probabilistic/stochastic petrophysical analysis software to obtain realistic answers in producing shale reservoirs. Information to the system may be readily supplemented by furnishing constraints based on local geologic information and from the log-core relationships often available for Pyrite, Apatite, TOC, porosity, etc.

A major advantage of using this technique is that the *TOC* is determined simultaneously with other minerals without the need to resort to separate empirical procedures based on differences in the log responses of organic-lean and organic-rich shales. These approaches are quite subjective and, often an organic-lean shale may not be present in the same stratigraphic unit as the organic-rich shale that is to be evaluated – leading to the necessity for sheer guess work.

Results presented here testify to the fact that standard probabilistic petrophysical analysis platforms perform very well for unconventional reservoirs where proper clay parameters are input. The available constraints lend themselves to improvement of results by providing a means for incorporating geological information to supplement the well log data. Comparisons with deterministic approaches and with core data are presented to establish the veracity of the computed data.