Determination of Connate Water Salinity from Preserved Core

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ABSTRACT
One of the parameters needed to calculate hydrocarbon in place from wireline logs is the resistivity of connate water (Rw) in a formation of interest. The most accurate method of determining this value is by measuring the resistivity or chemical composition of uncontaminated connate water produced from the formation. In case that the formation does not produce any connate water, e.g., deep basin and tight gas plays, or the produced water is contaminated it is difficult to determine accurate Rw necessary for reliable hydrocarbon-in-place calculation from logs. This paper presents the results of a laboratory study aiming at determining connate water resistivity/salinity from preserved core. Controlled experiments were conducted on core samples, one Berea sandstone core, one tight sandstone core from the Bluesky formation , and one tight carbonate core from the Jean Marie formation, with air permeability varying from 1 mD to 80 mD. Several methods, i.e., electrical properties measurement (back calculating Rw), extraction of salts by flow through leaching of intact core, and extraction of salts by leaching crushed core, are compared and the pros and cons of each method are discussed.

Archie's parameters of the samples, the cementation exponent 'm' and saturation exponent 'n', were measured using porous plate air/brine desaturation method. After re-saturating the samples and desaturating to known water saturation, the resistivity of the samples were measured again. The resistivity of the water within the samples can be calculated from the Archie's equation in the following form:

$$R_w = R_t \phi^m S_w^n$$

Back-calculated Rw values were plotted against the true Rw values of the saturating water and the result is shown in *fig1*.

Keywords: formation water resistivity, connate water, core analysis, electrical properties, water saturation, commutation.

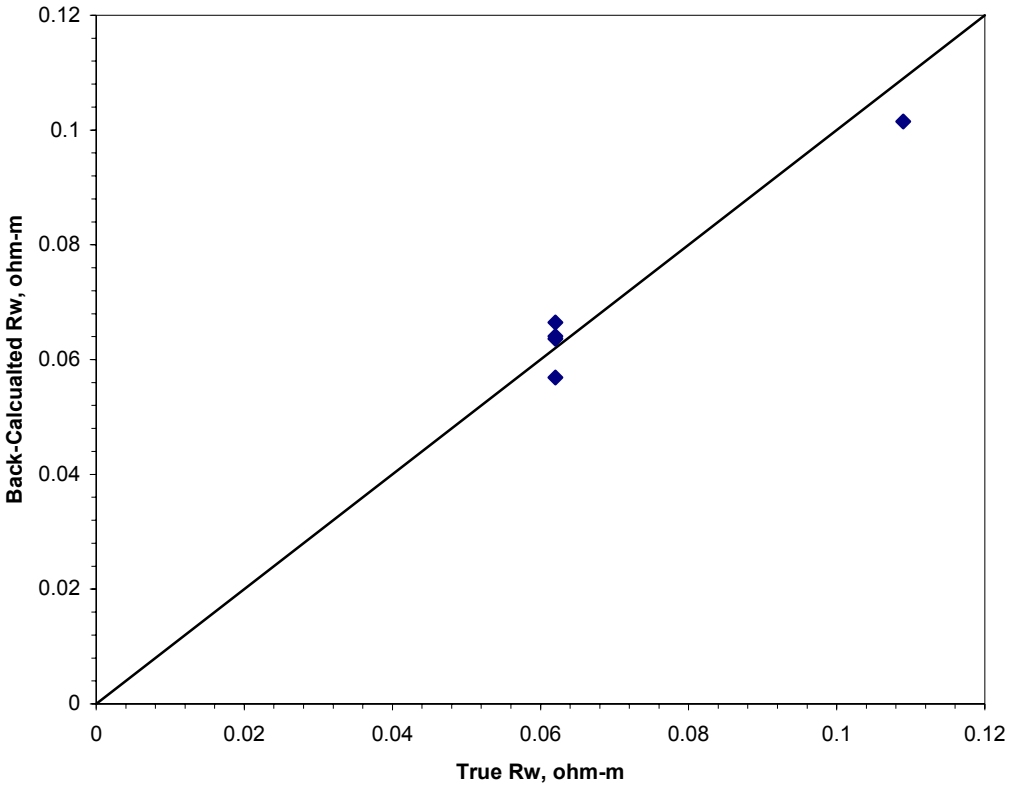

Figure 1. Comparison of back-calculated Rw and true Rw