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QUALITY CHECKS FOR GEOPHYSICAL BOREHOLE LOGGING RESULTS

K.BUCKUP*, G.SIDERIS**

ABSTRACT

The adoption of common quality testing to check various physical parameters, in common terms, has many advantages. Measurements must not be any longer purely relative, with a limited basis of comparison. Well bore readings can be gathered at different times with different instruments and have to be compared systematically. Instrument sensitivities and malfunctions must be recognized, more readily.

There must be greater confidence in identifying small, but possibly significant differences, in borehole geophysical parameters which can be followed, through methodically established periodically quality checks.

INTRODUCTION

For the user of geophysical borehole logging results it is very important to know on which degree the logs reflect the real situation of the well bore. As a rule for that purpose the quality of log results will be checked.

"Log quality" is a term which is discussed for a long time and inspite of a lot of investigation the understanding differs on a wide scale.

The pure technical quality may be very high. but the information will be low. the log efficience may be not important, but the solution of the problem is the goal.

To get an understanding it is necessary to control numerous parameters in relation to the actual geological task.

A guide-line for quality control is needed, which concentrates on the borehole logging results.

1. Log quality as a complex geophysical parameter.

Speaking about log quality the following terms may be related to the problem(THEYS, P.,1988):

2.1 accuracy,
2.2 resolution,
2.3 depth of investigation,

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* "Der Bohrlochmesser", Geophysical Company, Spielhagenstr. 91, Magdeburg O-3031, Germany.
** Department of Geophysical Exploration, Institute of Geology and Mineral Exploration (IGME), Messogion 70, 11527 Athens.

2.4 repeatibility,
2.5 calibration,
2.6 verification,
2.7 metrology,
2.8 statistical check,
2.9 depth-matching.

The above mentioned terms are connected w :h different stages of the information-obtaining-process.

Basically, two phases may be taken under cc sideration:

A. Log Performance, and
B. Log Processing.

For log performance the tool characteri: :ic is very important, therefore in quality terms the technical quality must be checked. Technicalwise a high degree of performance may be achieved. The check of the technical quality has mainly the following goals (BUCKUP, K. and SCHLOSSER, P., 1990):

2.a. Control of tool parameters,
2.b. Control of tool functions,
2.c. Stability control.

The majority of checkings under that category is performed in the workshop.

On the well-site a verification is carried out, that may be a statistical check or a repeat section or both of them. Under normal conditions, after satisfying checks were taken place, the technical quality is practical ensured, in some cases arising deflections which may be caused by well properties and a second try is recommended (fig. 1). Such intervals are mostly characterized by washouts. Often, decentralized tools deliver such effects.

Log processing quality depends on different parameters (FRICKE, S., 1980):

- depth-matching,
- depth of investigation,
- calibration and metrology,
- vertical and horizontal resolution,
- tool and model errors.

The above mentioned shows, that, potentially high technical accuracy hardly can be realized methodically.

Independently there exists the problem of comparing the obtained results with the same parameters, estimated by methods, based on other physical principles. It is hardly a correct approach if core analysis, testing results or geological descriptions are taken as a normal to prove the accuracy of logging results. The correspondence may be high, but a discrepancy does not signalize obligatory a wrong log, in opposite can be treated as an additional information, caused by the formation, by well conditions, different physical response. Additional investigations are required. An example is shown on fig. 2.

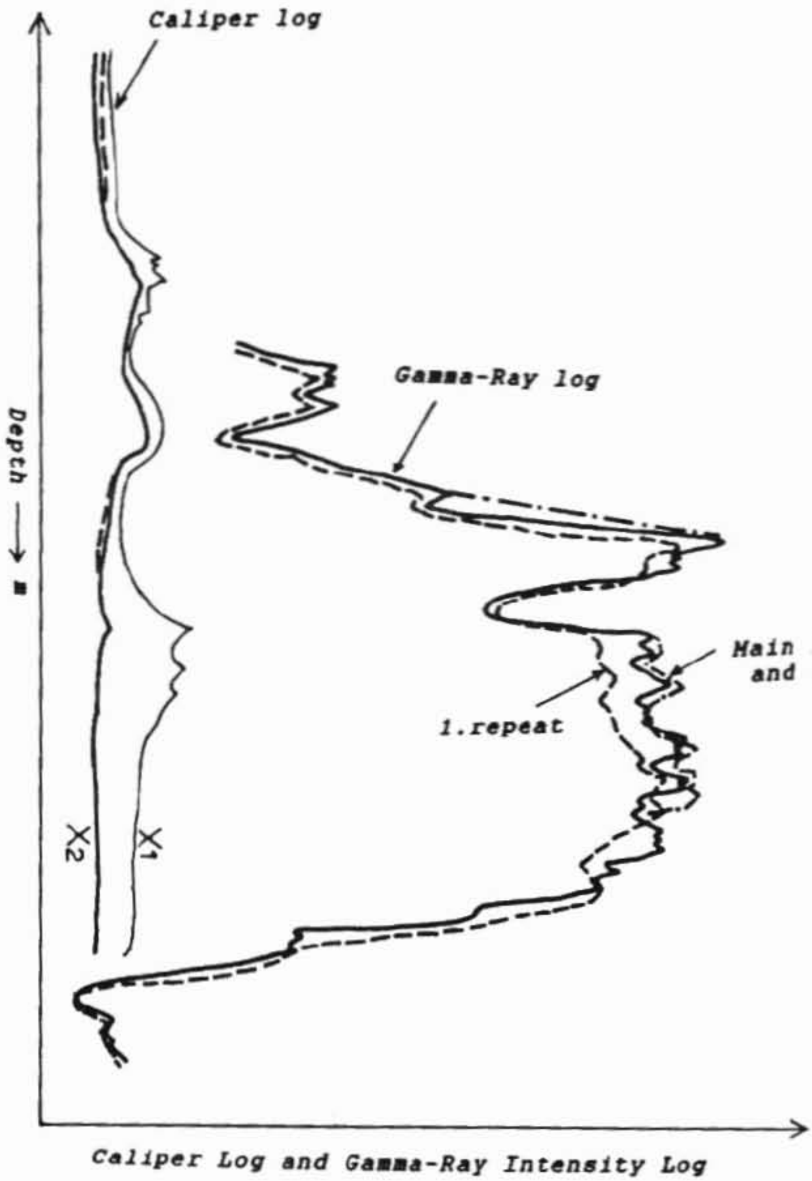

Fig. 1. A repeated section. X1 - Caliper for the first repeat. X2 - Caliper for the main log and the second repeat.

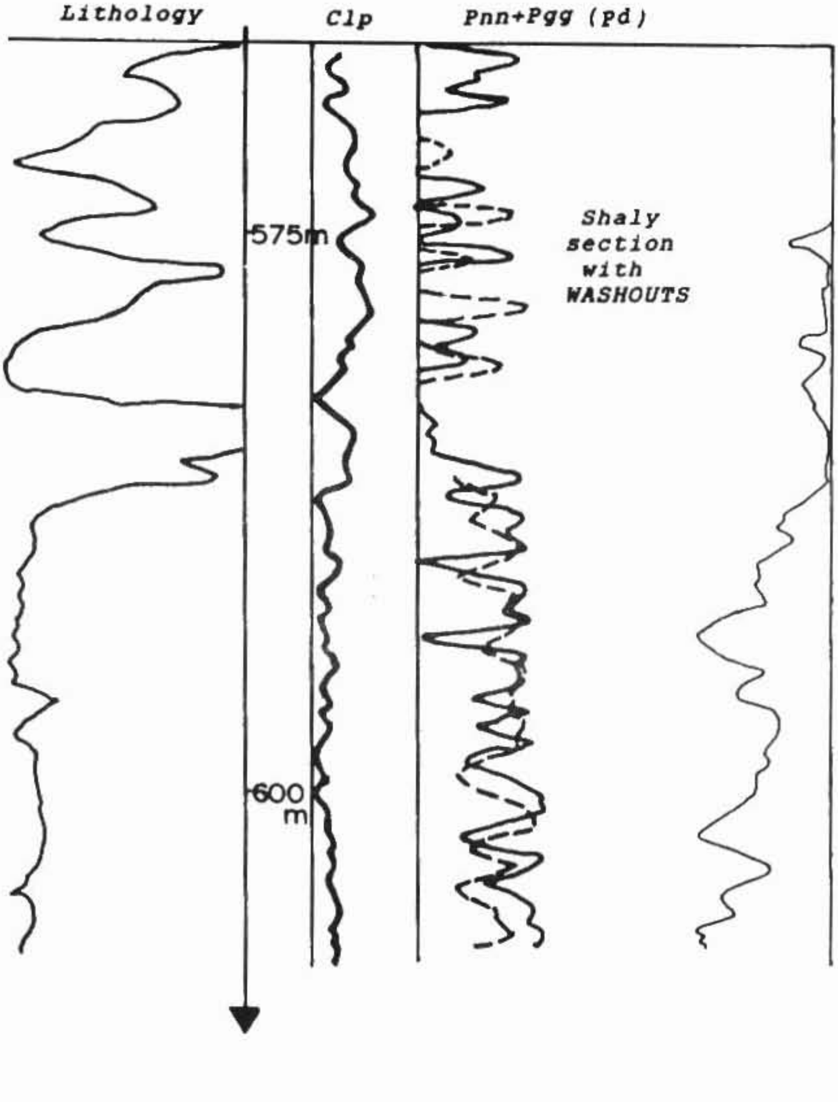

Fig. 2. Logging results with core data in a shale section with washouts.

2. Control of the Technical Quality.

We can clearly state that the technical quality depends on the tool characteristics and increases by the manufacture's skill and experience. The introduction of digital techniques in the logging industry led to a better log performance, from the technical point of view, excluding, for instance, operator errors. For the technical characteristic accuracy values about 0.1 % are normal, resolution is dictated by the word length (8, 12, 16 bits or even more), but is that relevant to the geological result ?.

The interesting practical problem for the user is the question about the normal functioning of the tool in accordance to the announced technical parameters. As a rule manufactures announce only these parameters which are under their control, therefore a verification to check stability and correspondence is requested during each job, the repeatibility is a rough measure of the tool-functions, also the so-called statistical check (KILLEEN, P.G., et al.,1978). If both of them are satisfying, the log can be counted correctly, on this stage other possibilities are not available. A quality-controling parameter recorded during the log, basically does not respond to the quality itself, but to the well conditions, it helps to eliminate intervals, where log readings due to bad borehole conditions (situations) are under doubt (fig. 3).

3. Interpretation Quality.

There is a well-known rule according to which: "the interpretation quality can not be better than the technical quality". In practice, quality usually is higher than the log analyst is able to realize methodically. If a quality control on interpretation results is required, it is necessary to know the response of the methods applied for the solution of the given task. Each method will be recommended for a certain diapason of parameter variations, because undergoing a certain value the noise will be comparable to the searched information and the calculation is simply senseless. On the other hand the interpretation result depends on the correctness of the selected model. To create the best fitting model, outside information is needed.

To get an idea on the accuracy of the final result, in the simplest version, a statistical approach may be sufficient, although individual values can differ on a wide scale (fig. 4).

In the following table an overview of technical quality, interpretation accuracy and, for comparison purposes, the equivalent core values for different methods and parameters are given. The picture is inhomogeneous. Basically it will be always a problem for the user to decide from where to receive the necessary information. Well-logging is fast and reliable in the most cases, but complexity seems to be a good solution to rely on another independent method.

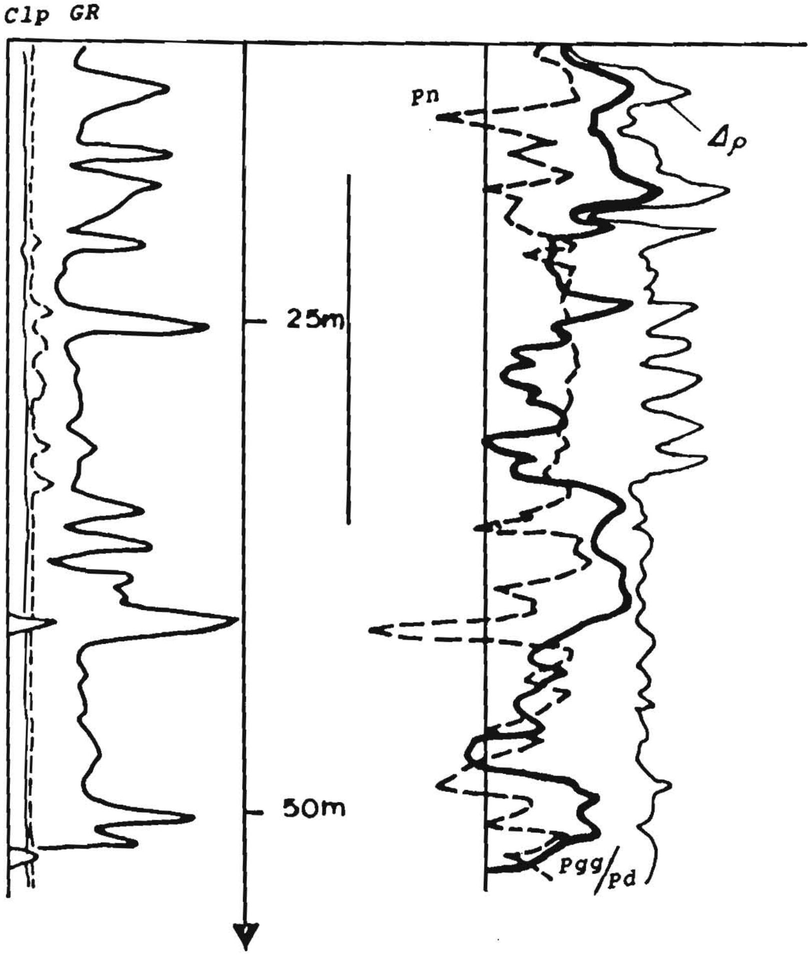

Fig. 3. Δρ as indicator for wrong porosity values due to caliper effects.

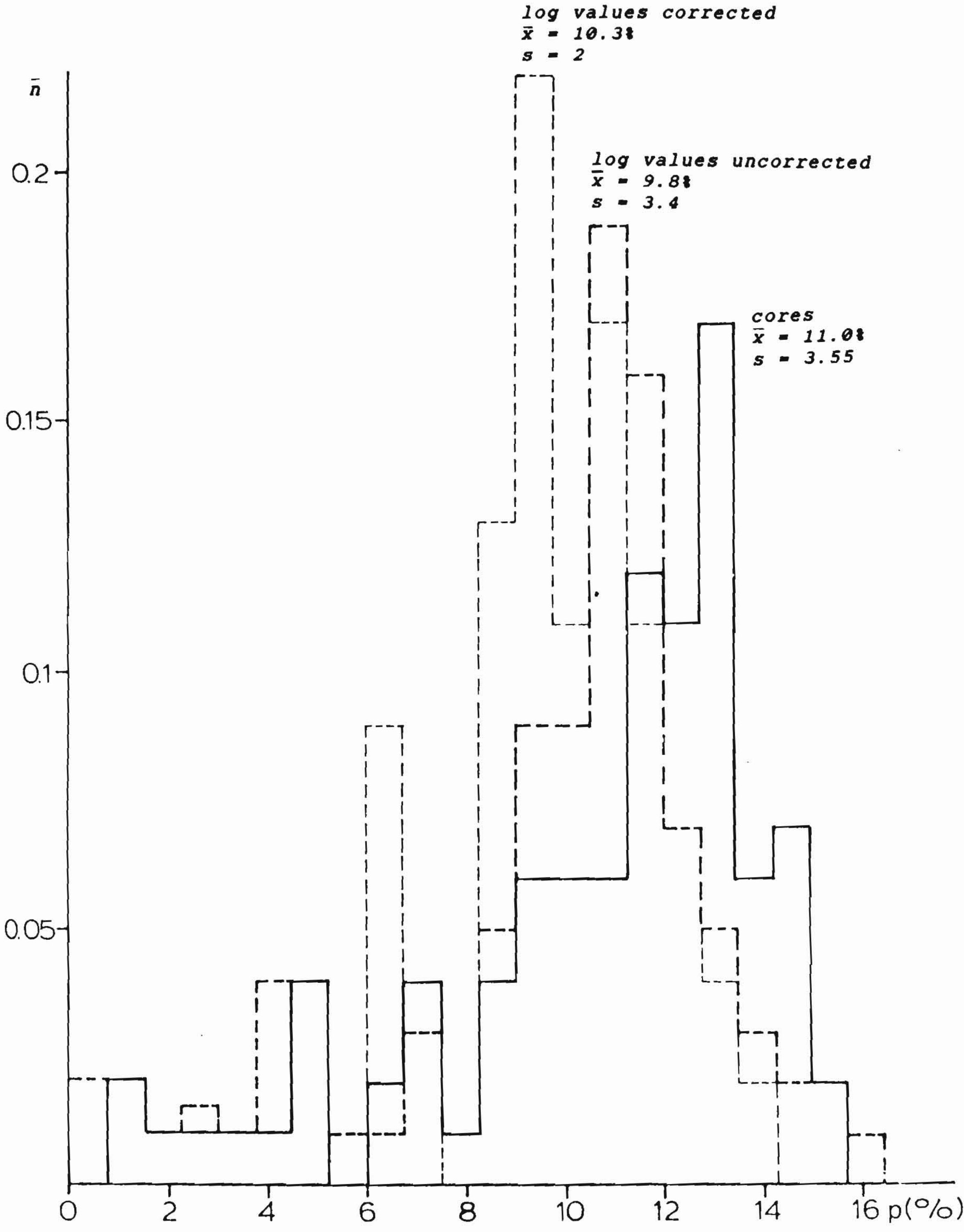

Fig. 4. Histograms for log and core derived porosity.

TABLE : Comparison of porosity values, calculated by different methods of given accuracy.			
Method	Assumed Accuracy (%)	p (%)	Technical Quality
Sonic	± 2	4.5	± 1 μs
Density	± 3	6.0	± 0.05 g/cm
Neutron	± 2	7.0	± 2 %
Resistivity	± 1	5.0	± 0.5 Ohmm
Core value	≤ 1	4.7	

Basically it will be always a problem for the user to decide from where to receive the necessary information. Well-logging is fast and reliable in the most cases, but complexity seems to be a good solution to rely on another independent method.

4. Summary and Conclusion.

The quantitative interpretation, in a high degree, depends on technical quality.

The interpretation itself delivers, for practical applications, very helpful informations, but uncertainity never can be fully excluded.

Borehole logging results must be controlled by other methods unless they are used on the obtained level, taking into account a possible inaccuracy, which can be decreased by complexity.

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