ARCHIVAL GAMMA RAY LOGS STANDARDIZATION BY NON-DESTRUCTIVE CORE LOGGING OF THE LOW-RADIOACTIVITY ROCKS

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Introduction

Nowadays all the gamma ray logging tools are standardized in API units and enables obtain spectrometric data containing information about real potassium, uranium and thorium concentration, what allows for comparison levels of natural radiation in specific rock types. Archival boreholes made in Poland until 1994 year, were measured by gamma ray probes in CPM (Counts Per Second) units. These data were not comparable because of different counts level in different boreholes. Logs standardization was based on the minimum and maximum count rates and interpreter intuition. Still in core repositories are well maintained archival drill cores from hundreds of boreholes, what can be used to get new spectrometric data from stored geological materials and change quality of archival logs. Area of our study is localised in the Zielona Góra Basin and involves Rotliegend strata. This region is well recognized by many old exploration and production wellbores but has not enough log data to draw new conclusions. Back to efficient exploration work in this area requires new basic log data as spectral gamma ray.

Samples and methods

Our research was focused on the material from two boreholes. One of them named **J-1** have spectral gamma ray logs (K, U, Th) and was used to check data quality derived from standard gamma logger - GL (Skupio et al., 2015) and new gamma logger to the rocks of low radioactivity (GLGT). Second borehole named **L-7** is an example of application API standardization to archival GR log. Core intervals were chosen from Rotliegend sandstones with low radioactive elements content. Stored cores, in most cases were preserved in good condition, only a few segments were destroyed. For this research 50 meters of the core from J-1 was analized by GL/GLGT and 30 meters from L-7 by GLGT. 17 additional samples were collected for laboratory analyses. GLGT spectrometer was built on the basis on double 2 inch BGO detectors (bismuth germanate) and lead shielding from MAZAR spectrometer. Two high efficiency BGO detectors allows for a reduction of the measurement time (Hendriks et al., 2001, Van der Graaf, 2007, Skupio et al., 2017). Thickness of the shielding wall reaches 10 cm, total length of shielding is about 40 cm and detectors are placed in the middle, it allows to measure cores with diameter up to 7 cm. To obtain real concentration K, U and Th set of standards with the shape of cylinder was applied. Time of core measurements was set for 5 min for both devices, step in GL was 10 cm, whereas in GLGT step was various. Standardization of the archival borehole L-7 was made on the GR_GLGT curve, which was calculated from real concentration of K, U and Th in the cores, by formula: API = 4Th + 8U + 16K (Ellis et al., 2008). Calculation of CPM units to API standard was performed on the basis of GR_GLGT curve shape and regression formula.

Results

Results from our research are shown in the Fig.1. Part A is a log composition of J-1 borehole where obtained data from GL/GLGT and laboratory are demonstrated with spectral well logs. It shows that our methods and calibration standards are correct as well calculation method for API standard is acceptable. GLGT has better accuracy than GL and curves needs no filtration to correspond to logs, improvement of data quality is visible especially for uranium and thorium. For GL average filtration (F=5) was applied. Potassium results from cores showed lower values, probably because of the potassium mud in the borehole. Part B shows results from L-7 borehole for GLGT spectrometer and curves before and after standardization process to API units.

A (J-1) **B (L-7)**

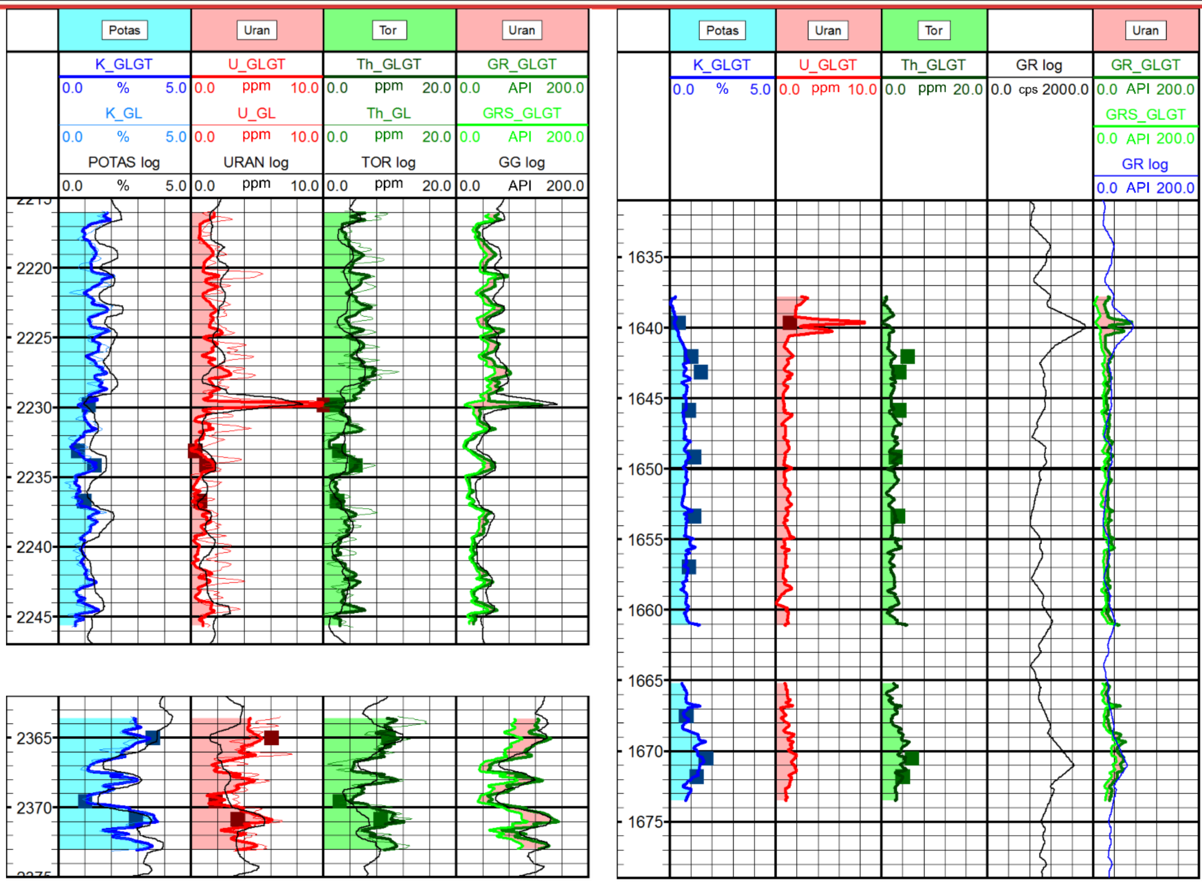

Figure 1. *A. Composition of the results from J-1 borehole, used to check applied methods and standards. B. Composition of the core measurements from L-7borehole and GR curve standardization to API units.*

Conclusions

GLGT apparatus enable to obtain high quality spectral data from cores of low content of radioactive elements. On the basis of gamma core measurements it is possible to recalculate GR curve in CPM units to GR curve in standard API units with high accuracy. Gamma core measurements allows for exact depth matching, application of the potassium mud correction, increasing vertical resolution and receive accurate information about K, U, Th and curve without uranium content (GRS) to shale volume calculation.

References

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