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Quality control of density logging equipment using 20-year-old 100 mCi Cs source

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For slim hole density logging equipment, generally, 100mCi 137Cs are used. Quality control of density logging, which continuously measures the in situ bulk density of the formation, is very important as it is in general physical property measuring equipment. This study introduces the measurement reliability of density logging equipment using 100mCi 137Cs source that has been used for more than 20 years after purchase. The quality control of the density logging equipment was performed by calibration facilities of the Korea Institute of Geoscience and Mineral Resources (KIGAM) and Kangwon University. The motivation of the study is that the measured values are slightly different from those expected. Calibration of density logging equipment generally consists of three steps: the primary calibration is performed by the manufacturer, the secondary calibration by the manufacturer and user, and the tertiary calibration is performed by the user. In the primary calibration, the master calibration curve of the equipment is created, and the secondary calibration is a process for conveniently using it. Secondary calibration is mainly performed after calibration of the radioactive decay of the radioactive source and after equipment repair. Therefore, the accuracy of the secondary calibration, which the user mainly performs, affects the measurement of the in situ density of the formation. The quality control of the density logging was carried out using a calibration facility (Water tank: 3 m in height, 2 m in diameter; Aluminum block: 70 m in diameter and 1.5 m in height) of the KIGAM. KIGAM's calibration facility has the same material and size as the manufacturer's calibration facility. Calibration facility of Kangwon University consisted of three calibrators with density values of 1.90, 2.18, and 2.59 g/cc, and the size is 506 cm high and 140 cm wide and 140cm high respectively. The density calibrators were composed of cement and fine gravel. Secondary calibration of density logging was performed in KIGAM' calibration facility, and in order to confirm the reliability of the measured values, density logs also was measured in Kangwon University. The electron density measured by density logging was converted to bulk density using water and limestone density. The density logs measured at calibration facility of Kangwon University showed a maximum difference of 0.035 g/cc from the core test results of the calibration bodies. And the difference between the measured counting rate and the theoretical counting rate calculated in consideration of the radioactive decay for the water and aluminum materials coincides with the square root of the measured value. This result suggests that it is possible to use some of them considering the theoretical radioactive decay when the secondary calibration is difficult. In summary the density log using the 137Cs source that has been in use for 20 years has proved that it is possible to calculate the reliable density value by performing the accurate calibration of the equipment irrespective of the radioactive decay. Also it is found that the continuous quality control of the density logging equipment is important for measuring the reliable bulk density of the formation.