DUAL ENERGY COMPUTED TOMOGRAPHY (DECT) APPLICATION IN ROCK CORE EXAMINATION

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Introduction

One of the first applications of X-ray computed tomography in geology took place in 1974. X-ray tomography (CT) allows non-invasive imaging of the examined objects. The result of a tomographic measurement is a spatial image, showing the changes in X-ray absorption value for each point of the examined object, which are a result of calculation during the reconstruction process.

An important advantage of computer tomographs is the ability to test large objects (meter sections of the core) in a very short time, while the disadvantage is the relatively low resolution of the measurement.

Each voxel in the tomographic image has a specific grey value proportional to the linear attenuation coefficient, depending on the electron density and the effective atomic number averaged in the imaged space (the averaging range is determined by the resolution of the tomographic image). Two tomographic images registered at two different energies, allows the deconvolution of the images into two components: the first – dependent on the electron density and the second – dependent on the effective atomic number. The aim of this study is to show the possibility of using dual energy computed tomography (DECT) to litho-density characterization of rock cores.

Samples and methods

In order to use tomographic images to obtain the above-mentioned physicochemical values, it is necessary to standardize CT images. The paper presents the process of determining calibration coefficients, which are necessary to convert the values of absorption coefficients, which are a direct result of CT reconstruction, into density values and effective Z atomic number (Z_{eff}). The article presents the calibration process with the use of reference rock fragments.

Results

The values of the standard samples computed from the analysis of images were compared with the values determined by laboratory methods. An example of the application of results is presented on Fig. 1. Figure 1 represents a cross section of sandstone core where darker parts refer to its matrix (mainly quartz) and the brighter part is calcite filled fracture. Two top images show 80kV and 140kV core cross section. Lower images are calculated images which contain core density and Z_{eff} number. The values obtained by low and high energy images calculation are close to table values (Tab. 1).Two top images show 80kV and 140kV core cross section. Lower images are calculated images which contain core density and Z_{eff} number. The values obtained by low and high energy images calculation are close to table values (Tab. 1).

Conclusions

Obtained result shows potential in dual energy computed tomography (DECT) applications for rock core testing. It appeared that the values obtained by low and high energy images calculation are close to table values.

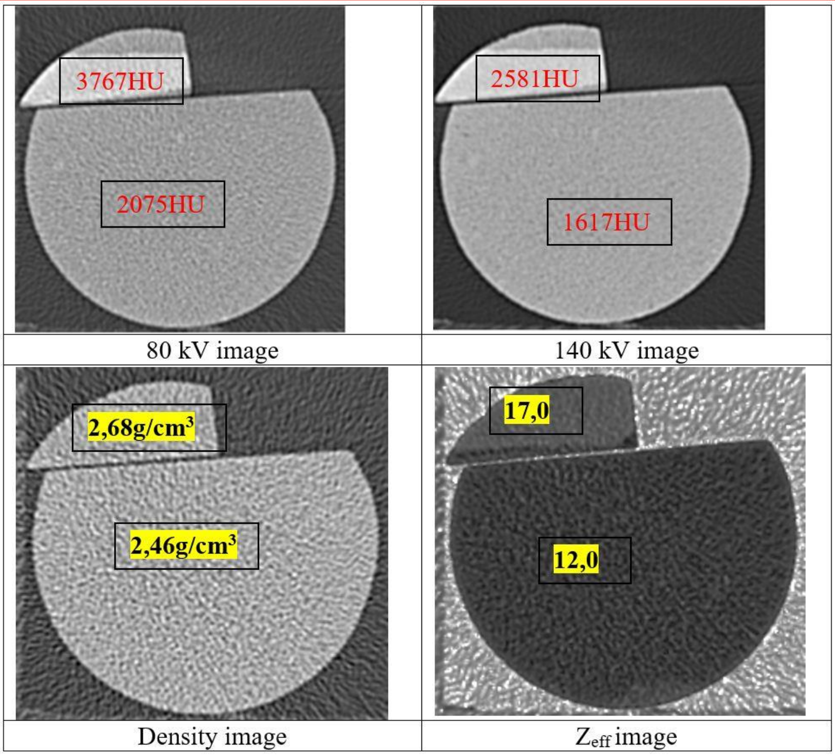

Figure 1. *Cross section of a sandstone core containing calcite filled fracture. Symbol: HU – Hounsfield unit.*

Table 1. *Comparison of the table and calculated density values for quartz and calcite minerals.*

Mineral	**Table density [g·cm^{-3}]**	**Z_{eff}**	**CT density [g·cm^{-1}]**	**Z_{eff} CT**
Quartz	2,62	11,53	2,46	12,0
Calcite	2,68	15,71	2,68	17,0

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