Quantifying fracture intensity (P21 values) in drill cores of the Hauptdolomit Formation using digital image analysis (ImageJ)

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As part of the "Geotief EXPLORE 3D" project, a research borehole was drilled in rocks of the Hauptdolomit Formation in an exposure in equivalent position to reservoir rocks in the subcrop of the Vienna Basin. The dolostones of the Hauptdolomit Formation are considered as potential exploration targets for deep geothermal energy. The Hauptdolomit Formation is a typical fractured and faulted reservoir in which porosity and permeability are supported by fractures with areas and lengths varying over several orders of magnitude. In support of porosity and permeability analysis from logs and drill hole tests, computed tomography (CT) scans of drill core were taken and analyzed. The aim of the digital image analysis was the computer-aided determination of the fracture intensity (P21 values in m/m²) in the drill cores, with the P21 value being defined as the length of the fracture traces per unit area. The P21 values are compared to porosity data. The computer-assisted P21 analysis method can use both microscopic images of scanned thin section images and images from CT scans. The analysis was performed with a software freely available on the Internet, ImageJ (Fiji, version v1.53s). The images were filtered using a segmentation plugin (WEKA segmentation) so that a distinction can be made between fracture trace and matrix. WEKA segmentation is a Fiji plugin that combines a collection of machine learning algorithms with a set of selected image features to create pixel-based segmentations. WEKA (Waikato Environment for Knowledge Analysis) includes a collection of visualization tools for data analysis and graphical user interfaces for easy access to these functions. The images were then converted into 8-bit grayscale images for further processing and then into binary images. The conversion of a grayscale image into a binary image, where black represents the region of interest and white represents the matrix, was done by defining a global threshold within the grayscale histogram with 255 levels. In a last step, the areas to be examined were converted into a line display (skeleton), in which all the fractures determined by the program are displayed as lines in order to subsequently determine the P21 value. The results of the image analysis show a good correlation of the P21 values with porosity data determined from logs. P21 values from a total of 32 CT scans show a correlation factor of about 82 % with the porosity data from the respective depth interval. The image analyzes carried out thus show a very good correlation between fracture intensity and porosity.