Determining the formation of kaolinite mineralization using mineralogical analyses in Motajica granite complex, Bosnia and Herzegovina

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prior to testing the algorithms, the data were standardized, normalized, or transformed depending on the algorithms used (SEMENIKHIN & BELOZEROV, 2019).

Based on the correlation matrix, 14 variables (logs) were determined for the calculation of the forecast model. A total of six regression models were used to predict the acoustic logs and porosity values. The base model was calculated using the Support Vector Regression (SVR) algorithm (Fig. 1), as the goal was to determine the boundaries of acceptable predictions.

The measure of accuracy for regression models, amongst others, is the coefficient of determination R^2, which indicates how well the predicted and measured values correlate. For the base model, at the shallower depths the predicted values follow the trend of the measured ones but at the greater depths the predictions fall out of the trend, which makes the results unreliable. The most accurate model was generated using the K-Nearest Neighbour (KNN) algorithm, where the coefficient of determination was over 0.9 (Fig. 1).

The greatest advantages of predicting the values using trained models are the ability to fill in missing logging data and the short time required to get the initial image of the subsurface. Based on the predicted values, the further processing and interpretation methods are determined more quickly.

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DETERMINING THE FORMATION OF KAOLINITE MINERALIZATION USING MINERALOGICAL ANALYSES IN MOTAJICA GRANITE COMPLEX, BOSNIA AND HERZEGOVINA

UTVRĐIVANJE MEHANIZMA NASTANKA KAOLINITA KORIŠTENJEM MINERALOŠKIH ANALIZA U MOTAJIČKOM GRANITNOM KOMPLEKSU, BOSNA I HERCEGOVINA

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The aim of this abstract is to present the formation mechanism of the kaolinite and kaolin deposits in the Motajica Mt. Although several projects and investments are currently being carried out in the Motajica Mt. area, the development and formation of kaolinite mineralisation is still relatively poorly known. Kaolinite deposits are associated with the Motajica granite pluton, which is characterised by syncollisional granite of Eocene age (JURKOVIĆ, 2004). Numerous papers have been published on the Motajica kaolinites (STANGAČILOVIĆ, 1956; JURKOVIĆ & ŠINKOVEC, 1960; VARIĆAK, 1966; TRUBELJA & BARIĆ, 1979), with different authors proposing different formation mechanisms for the kaolinites. Some authors believed that kaolinitisation occurred during Tertiary marine transgression, others suggested that kaolinitisation occurred through superficial weathering, while in some cases it was considered to be the result of hydrothermal solutions.

The focus of this work is mineralogical analysis of the kaolinitised granites in the Motajica area aiming at determination of clay minerals and definition of the kaolinite deposits origin. The following analyses were performed on the samples: macroscopic determination of mineral composition, X-ray diffraction analysis on original samples, samples treatment with ethylene glycol, heating at 350 °C and 550 °C and treatment with dimethyl sulphoxide (DMSO), Fourier transformed infrared spectroscopy (FTIR) and geochemical analysis on three samples.

The semi-quantitative mineral composition of the kaolinitised granites of the original samples revealed typical granite mineralisation, including quartz, K-feldspars, plagioclase and mica minerals. Diffractograms obtained after treating the samples with different treatment methods show a relatively strong diffraction peak of illite at 10 Å and a diffraction peak of kaolinite at 7 Å in all samples (Fig. 1). In addition, some samples indicate chlorite, possibly due to alteration of biotite granite. Faint indicative peaks of topaz and dickite were also noted. The presence of these minerals suggests that hydrothermal activity in the temperature range 100–350 °C played an important role in the formation of the kaolinite mineralisation. FTIR spectrum indicates characteristic absorption bands of kaolinite between 3500 and 3700 cm-1. When four characteristic bands (approx. 3700, 3670, 3650 and 3620 cm-1) are well defined, the structure of kaolinite is considered to be ordered (TIRONI *et al.*, 2012). Kaolinitised samples exhibit slightly higher Al contents than the locally occurring various granite types. Based on TiO2/Zr and Cr+Nb/Ti+Fe ratios, two samples are consistent with purely hydrothermal kaolinitisation, while one sample shows signs of mixed type of formation (DILL *et al.*, 1997).

This hypothesis is consistent with the geochemical analysis of quartz veins occurring in the Bosanski Kobaš kaolin deposit in the north-eastern part of Motajica. Elevated contents of bismuth (Bi) in locally occurring quartz veins, similar to the results of RAMOVIĆ *et al.* (1982),

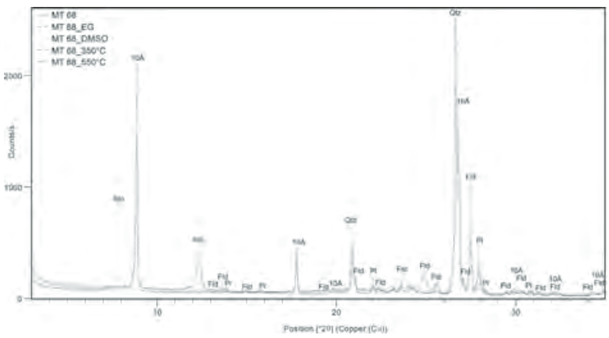

Figure 1. X-ray diffractogram of one Motajica sample with sample treatments

indicate strong hydrothermal activity in this area. The presence of hydrothermal veins in the samples studied clearly indicates a hydrothermal phase that played an important role in the formation of the kaolinites studied. Furthermore, several studies (FLEURENCE & NICOLAS, 1964; ESTÉOULE-CHOUX, 1981; SHOVAL *et al.* 1999) confirmed that hydrothermal kaolinites tend to have higher crystallinity when compared to supergene kaolinites. The presence of a supergene phase of kaolinisation cannot be completely ruled out because the deposits are at the surface, but it can be safely assumed that there was initial hydrothermal kaolinitisation.

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