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The Application of Artificial Intelligence for the Identification of the Maceral Groups and Mineral Components of Coal

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Abstract

The correct and consistent identification of the petrographic properties of coal is an important issue for researchers in the fields of mining and geology. As part of the study described in this paper, investigations concerning the application of artificial intelligence methods for the identification of the aforementioned characteristics were carried out. The methods in question were used to identify the maceral groups of coal, i.e. vitrinite, inertinite, and liptinite. Additionally, an attempt was made to identify some non-organic minerals. The analyses were performed using pattern recognition techniques (NN, kNN), as well as artificial neural network techniques (a multilayer perceptron – MLP). The classification process was carried out using microscopy images of polished sections of coals. A multidimensional feature space was defined, which made it possible to classify the discussed structures automatically, based on the methods of pattern recognition and algorithms of the artificial neural networks. Also, the authors of the study assessed the impact of the parameters for which the applied methods proved effective upon the final outcome of the classification procedure. The result of the analyses was a high percentage (over 97%) of correct classifications of maceral groups and mineral components. The paper discusses also an attempt to analyze particular macerals of the inertinite group. It was demonstrated that using artificial neural networks to this end makes it possible to classify the macerals properly in over 91 percent of cases. Thus, it was proved that artificial intelligence methods can be successfully applied for the identification of selected petrographic features of coal.

Keywords: artificial intelligence, pattern recognition, neural networks, coal petrography, quantitative analysis of macerals.

1. Introduction

Coal is not a homogeneous substance. It is built of elementary components known as macerals, which can be distinguished only with a microscope. The term “macerals” was first defined by M. Stopes for the constituent of coal isolated by maceration (Stopes, 1935). They are identified across three main groups: vitrinite, inertinite and liptinite (ICCP, 1998, 2001), that differ with respect to their genesis – and, what follows, to their optical and strength

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