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# Analysis, Origin and Significance of Mineral Matter in Coal: An updated review

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## Abstract

The material classed as “mineral matter” in coal embraces crystalline mineral materials as well as a range of inorganic elements that occur in non-crystalline form. This review outlines the methods that may be used to evaluate the percentage of mineral matter for a coal sample, as opposed to the ash yield, and to identify the minerals, their individual percentages, and their modes of occurrence within the coal. The principal techniques include low-temperature oxygen-plasma ashing; quantitative evaluation of X-ray diffraction data; observation using optical microscopy; and a combination of observation, chemical analysis and, in some cases, mapping based on scanning electron microscopy and related methods. A range of other techniques may also be used to provide additional information on particular mineral matter components.

Processes responsible for mineral matter formation include detrital input, biogenic activity, and authigenic precipitation at different stages of the coal’s depositional and post-depositional history. Differential migration of non-mineral inorganic elements may also occur in lower-rank coals, and expulsion of non-mineral inorganics may take place with rank advance. Knowledge of the mineral matter may be of assistance in understanding the modes of trace element occurrence, with implications for assessing possible environmental impacts and also the potential for recovery of economic products from coal. The behaviour of different mineral matter components at high temperatures is also discussed, as well as methods for mineralogical analysis of ashes and other coal utilization products. Information from mineral matter studies may provide an improved basis for understanding coal formation, and for evaluating the response of particular coals to different combustion, gasification and coking processes.

**Keywords:** Minerals in coal; non-mineral inorganics; mineral matter determination; mineralogical analysis; mineral formation; trace element occurrence; coal utilization products.

## 1. Introduction

For many purposes coal can be regarded as consisting of two classes of material: organic components or macerals on the one hand, and a range of minerals and other inorganic constituents, broadly referred to as “mineral matter”, on the other. The organic components are fundamental in defining the nature of coal (e.g. Taylor et al., 1998; O’Keefe et al., 2013), and in establishing its value for different utilisation processes (e.g. Suárez-Ruiz and Crelling, 2008; Ward, 1984, 2013). Almost all of the benefits derived from coal, including its energy

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