



Petrographic and geochemical characterization of coal from Santa Susana Basin, Portugal



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ABSTRACT

The current and future importance of coal as a geological resource is related with the production of coke, carbon materials, carbon derivatives and other chemical products as well as a promising alternative source of critical trace elements. This study aims the comprehensive characterization of coals from the Santa Susana Basin (SSB), SW of Portugal. The SSB is a Pennsylvanian continental basin located along the Santa Susana Shear Zone that separates two tectonostratigraphic zones of Iberian Massif. Samples of coal and coaly silt-claystone from the main outcrops, Jongeis and Vale de Figueira, were collected for this study. The methodologies used for the petrographic and geochemical characterization included: optical microscopy, scanning electron microscopy with energy dispersive X-ray spectrometry, proximate and elemental analysis and inductively coupled plasma mass spectrometry (ICP-MS). The results demonstrate that the organic matter of coal from SSB is essentially composed of vitrinite and small amounts of inertinite. The mineral matter includes detrital minerals (mainly quartz and clay minerals), iron oxides and oxidized and non-oxidized framboidal pyrite. Epigenetic carbonates (dolomite and ankerite) were only observed in samples from Jongeis outcrop. Vitrinite random reflectance of the samples ranges between 0.90% and 1.25%, indicating a bituminous coal rank. The slightly higher vitrinite reflectance and the occurrence of epigenetic carbonates in samples from Jongeis can be related with differentiated burial history of the basin and post-depositional processes including fluids circulation that may have promoted the enhancement of the thermal maturity. When compared with the geochemical composition of worldwide hard coals, samples from Vale de Figueira are significantly enriched in Cs and In, while samples from Jongeis are significantly enriched in In and Mn. Considering the elements' mode of occurrence, the majority of elements are preferentially associated with mineral matter. The elements S, Cd, Mo, Pb and Se have organic affinity. The strong positive correlation between Ca and Mg, Mn and Te indicates their association with carbonate phases, which is in accordance with the carbonate composition.

1. Introduction

Considering the disregard of coal exploration to be used as fuel and the decarbonisation general policies in Europe and other countries, the future and importance of coal as a geological resource will be related with the production of coke, carbon materials, carbon derivatives and other chemical products. The coking coal and graphite are included, among other elements in the list of critical raw materials for Europe (European Commission 2017). In addition, the interest of coal deposits

as promising and alternative sources of some critical trace elements has becoming increasingly important in recent years (Seredin and Finkelman 2008; Dai et al. 2016; Dai and Finkelman 2017).

Considering the above mentioned, the present study aims the comprehensive petrographic and geochemical characterization of coals from the Santa Susana Basin (SSB; SW of Portugal). It is considered that this research work is significant because, despite the fact that coal from the SSB was exploited during the last century, petrography and geochemistry studies of the SSB coal are very scarce (with exceptions of

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