



Romanian coal reserves and strategic trends

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ABSTRACT

This paper aims to provide an up-to-date, realistic picture of the Romanian coal sector based on four interconnected perspectives: geological, economical, energy, and strategical. It reviews the latest data, evaluations, and reassessments regarding the potential of current resources and reserves, geological and petrographic aspects, current status of the coal mining industry, resource management, and analyzes the present national strategies in this field. This review provides some perspectives towards key aspects of the Romanian coal sector and builds a foundation for a more in-depth analysis and strategical development of the Romanian coal mining and management.

1. Introduction

The Romanian geological key feature is its diversity: the simultaneous occurrence of several useful resources, ranging from limestone, gold and salt to crude oil, gas and coal, all gathered on a relatively small area of approximately 240,000 km² (Constantinescu et al., 2015; Popescu and Anastasiu, 2016).

These underground resources represent a crucial component of the national patrimony and security, and their judicious management and valorization establish a solid basis for a successful long-term development strategy of the country, as long as their exploitation and use are performed considering environmental protection and ecological safety (Anastasiu, 2016). The need for both metals and non-metals, oil, gas and coal still is and will remain high and any missing data in the knowledge of these elements will seriously inhibit the spiral of economic growth. Therefore, it is necessary to reconsider the status of the Romanian underground's useful resources, their characteristics, territorial distribution, geological and economical reserves, end users, environmental, and recovery costs. As a consequence, the research of these aspects from different standpoints makes a reliable foundation for this strategic approach.

Following the above concept, the present article gives a review of the Romanian coal reserves, from geological, economical, energy and strategic perspectives.

Considered here are the results of several evaluations covering: (i) the latest available data in the field, (ii) the re-assessment of the

national mineral reserves (especially coal), taking into account the current economic situation, technological development, and market trends, (iii) the systematization and interpretation of these data according to the present economic situation and current sectorial strategies.

2. The geological and economic perspectives. Coal resources and reserves

Romania is the long-term beneficiary of a broad spectrum of useful minerals and the contemporary, dynamic global economic situation and modern concepts in the field of earth sciences impose an in-depth re-evaluation of their occurrence, quality, and quantity in the Carpatho-Danubian area. The main resources of Romania's underground are:

- mineral resources (useful minerals): non-metallic resources (industrial minerals, useful rocks and building materials, decorative or ornamental rocks), metallic resources (ferrous, non-ferrous, light, noble-precious metals), critical minerals (minerals with rare and dispersed elements or minor elements, like indium, thallium, gallium, cobalt, germanium, arsenic etc.)
- energy resources (hydrocarbons – oil and natural gases, coal, radioactive substances, non-conventional resources).

The indigenous coal is one of the key fossil fuels of Romania's natural patrimony, since it represents the second energy resource in the

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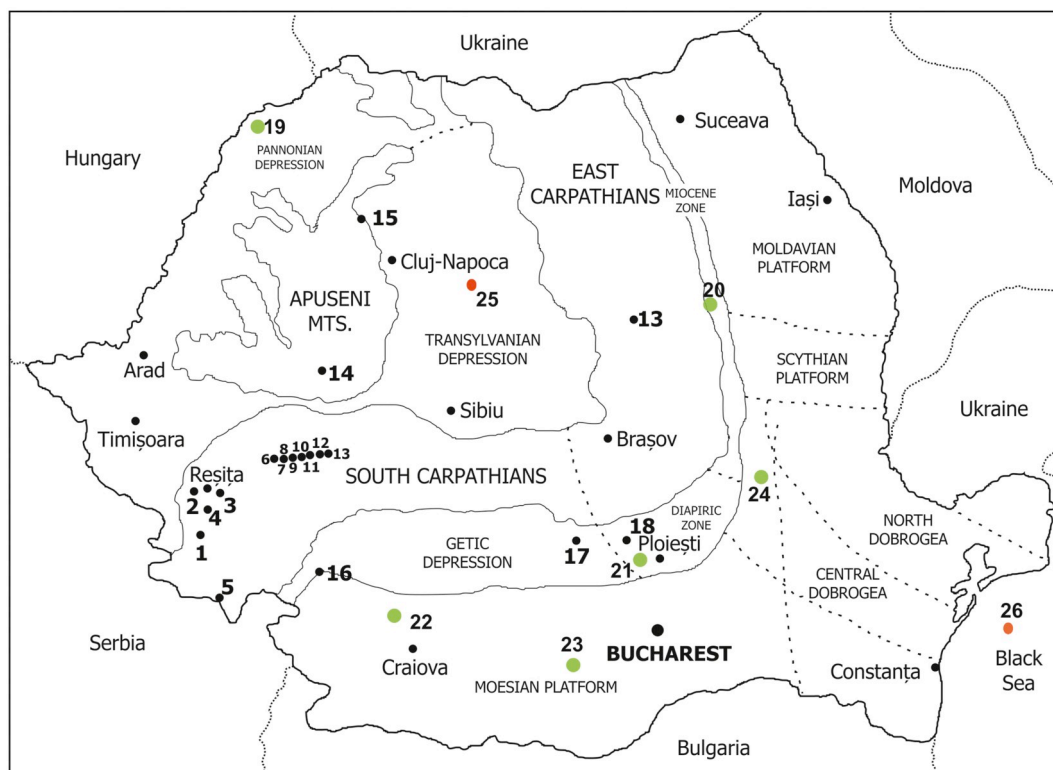


Fig. 1. Examples of coal mining localities in Romania (black dots). *Reșita Basin*: 1. Anina; 2. Lupac; 3. Secu; 4. Doman; *Sirinia Basin*: 5. Cozla; *Petroșani Basin*: 6. Uricani; 7. Lupeni; 8. Paroșeni; 9. Vulcan; 10. Livezeni; 11. Petrila; 12. Lonea; *Comănești Basin*: 13. Comănești; *Țebea-Brad Basin*: 14. Țebea; *Almaș Basin*: 15. Ticu-Tâmașa (Șorecani); *Dacian Basin*: 16. Motru; 17. Șotânga; 18. Filipeștii de Pădure; Examples of oil fields in Romania (green dots): 19. Marghita-Abrămuț; 20. Moinești; 21. Moreni; 22. Bălteni; 23. Videle; 24. Bordeiu Verde. Examples of gas fields (red dots): 25. Deleni; 26. Histria. (modified after Popa et al., 2017). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

national production of primary energy, after gas, as mentioned by the National Institute of Statistics (NIS) (2018). The Romanian underground hosts various coal resources of different geological origin and age as presented in Fig. 1, which occur in almost 300 deposits spread across the country, ranging from anthracite and bituminous to sub-bituminous, lignite, and peat, according to the *International Classification of In-seam Coals* (1998). Accordingly, Romania also has a long coal mining tradition, of more than 200 years (Popa and Predeanu, 2018).

Coal resources have a harmonious and balanced distribution as compared to large urban, industrial or tertiary infrastructure centers, and there are premises for in-depth and at-large development of the existing deposits. These resources are characterized by particular geological contexts as tectonics and resources potential (Tables 1 and 2) and are identified, explored, and exploited using different methods and technologies (Popa and Predeanu, 2018). As a consequence, they present specific energetic and economic characteristics (including calorific values and prices) and have distinct beneficiaries or potential users.

The ranks of Romanian coals, their maceral composition and average calorific value, can be observed in Table 2, which depicts the physical-chemical and petrographic characteristics on the main coal basins.

Besides revealing the complexity of the indigenous geological and mining peculiarities and mineralogical characteristics of the Romanian coal, one must underline the slightly lower qualitative parameters of the current reserves (in terms of energy output and sulphur content), as compared to similar deposits worldwide. For example, despite the lower or comparable prices, the calorific value of the local lignite (between 7.2 and 8.2 GJ/t, according to Euracoal, 2017) is lower as compared to the one in Germany (7.8–11.5 GJ/t) or the Czech Republic (11.6–20.56 GJ/t).

The main bituminous coal deposits are located in south-western

Romania, in the Banat region (the Reșita Basin, which includes the Lupac, Secul, Doman, Anina mines) and Sirinia Basin (Cozla mine), and in the central Romania Petroșani Basin (where only Lupeni, Vulcan, Livezeni, and Lonea mines are still operational, while Uricani, Petrila and Paroșeni are under closing preparations). Sub-bituminous coal reserves are mainly present in the Comănești, Codlea, Borod, and Țebea deposits.

Lignite deposits occur in the East Carpathians (Borsec and Baraolt Basins), in the Dacian Basin of South Carpathians, in Muntenia (Ceptura, Șotânga, and Filipeștii de Pădure coalfields) and Oltenia regions (Rovinari, Tismana and Motru coalfields) as detailed by Popa and Predeanu, 2018.

Peat deposits are confined to some smaller basins in the East Carpathians (Bilbor and Vatra Dornei Basins), in Ciuc Depression, and Făgăraș Depression.

Total bituminous coal resources are estimated to exceed 1400 Mt. (million tons), of which almost half is of economic value, while the total sub-bituminous coal and lignite geological resources are close to 9650 Mt., one sixth (1490 Mt), being considered economical reserves, after Constantinescu et al. (2015) (Table 3). The majority of the lignite deposits are situated in a relatively small, 250 km² area: 95% of them are placed in the south-central Oltenia mining area (Dacian Basin) and almost 80% of them can be surface mined, in 12 opencast mines (which are licensed for the next approximately 50 years). Geological resources of higher coal rank are considerably smaller and outside the economic circuit.

Coal production was severely diminished (by > 50%) in the last 25 years, due to the several major changes in the national energy sector, which lead to a sharp decrease in the coal consumption and thereby a great reduction of the mining activity. The downward trend currently remains, however at a much slower rate, as it can be observed in Fig. 2.

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