

Uranium ore mineralization at the Western Carpathians / Slovakia (conditions and social aspects)

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Abstract. Uranium ore mineralisation occurrences at the Western Carpathians/Slovakia are deposited within Permian volcano-sedimentary sequences. The mineralisation principally consists of two genetic types, the stratiform one and U-Mo vein mineralization linked to andesite volcanites. Geological exploration of uranium mineralization in Slovakia is subject to rigorous assessment of Ministry of Environment and municipalities. The limited energy sources and dependence to foreigner, open space for prospection of new energy sources (renewable, uranium or traditional from coal, oil, gas).

1 Introduction

Slovak territory covers the main part of the Western Carpathians forming the central segment of the European/ALCAPA arcuate belt. Similarly as other geological units of the Earth also structure of the Western Carpathians has been formed by several and multistage orogenic cycles. The Paleozoic evolution terminated in the Carboniferous and Permian (360 - 250 Ma.) by significant Hercynian orogenic cycle. Folded, metamorphosed and by granitoid bodies penetrated rock complexes had produced new mountain belts and their clastic material successively filled post-orogenetically modelled depressions. Basal parts of the depressions usually fill dark grey, bituminous Carboniferous sediments, i.e. the product of a humid and warm climate. They are sometimes interlayered with basic extrusive volcanic rocks. Most of pit-coal basins in the world are filled by Carboniferous stratas.

The onset of dry, semi-arid to arid climate in the Permian period was reflected in contrasting i.e. reddish coloration of the sediments and volcanites filling either top of the Carboniferous basins, or new depressions formed on crystalline basement respectively. of Permian arid climate reflected also into regular evaporites presence in Permian successions. Some of them (e.g. Germany, Poland) are major European producers of potassium and rock salt. Accompanying sediments are mainly formed by weathered material with high content of mica and feldspar transported to Permian basins from uplifted and eroded blocks of crystalline basement. Therefore these sediments contain increased phons of radioactive

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elements, as well as plant cuttings. The mentioned sedimentary filling together with the significant volume of Ca-alkaline volcanites (mainly rhyolites, andesites and lesser possibly andesite-basaltic rocks) are the primary (stratiform) source of the mentioned mineralization in Slovakian Permian rock sequences [6, 7]. Hence the Permian stratas of the Western Carpathians contain elevated uranium mineralization.

2 Origin of uranium mineralization

Creation of uranium mineralization in Slovakia associates with two possible processes. The first relates to acidic volcanism, which is evidenced by the U-Mo stratiform deposits related to metaryolites and meta - andesites tuffs and tuffs. Such type of U- deposits are known from the Novoveská Huta near Spišská Nová Ves town and Jahodná area near Košice. The second type probably relates to the sorption effect of a coal flora during diagenetic-metamorphic processes. The last genetic type forms relatively small uranium deposits mainly from the Švábovce, Spišský Štiavnik, Kraviany and Vikartovce villages and Považský Inovec Mts. [2, 4].

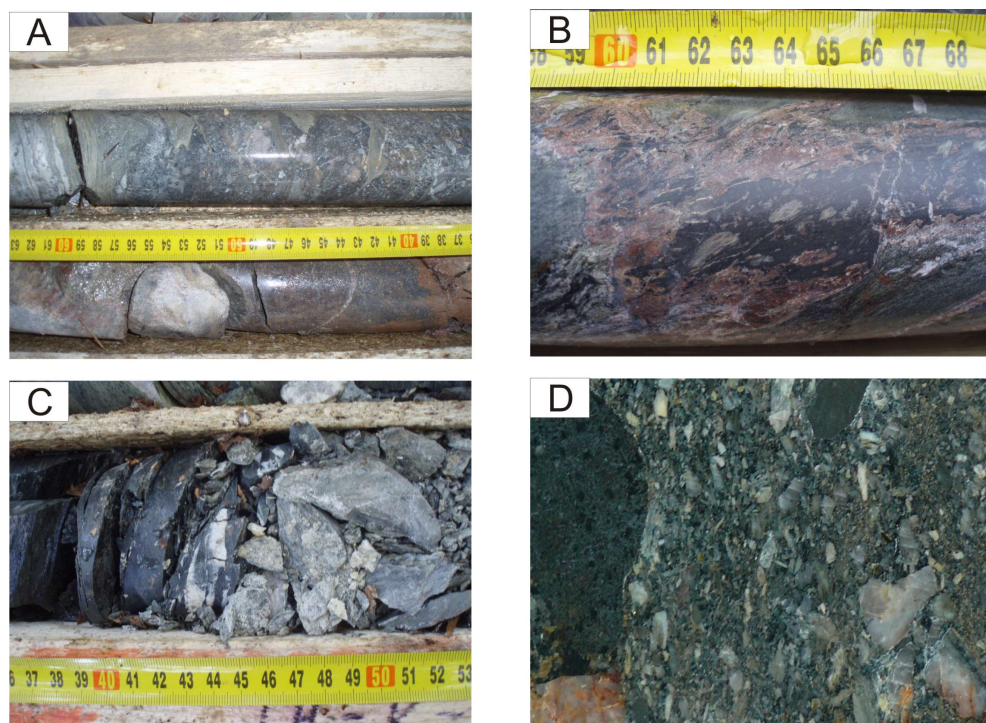


Fig. 1. Uranium mineralization varieties: a) In the Jahodná ore deposit near Košice A – stratiform type, B – vein type, C – as a fault filling. b.) Novoveska huta ore deposit D - breccia

Uranium mineralization performs in several mineral forms, but mostly as the uraninite and coffinite minerals forming a relatively lesser extent in the uranium ore deposit than the U-Ti oxides (especially orthobrannerite). More abundant uranium ore deposits are usually accompanied by increased molybdenite impregnations. Separate U-Mo mineralization forms either a filling in younger tectonic structures or an independent deposit segments. A younger i. e. the Alpine remobilization significantly contributes to all known U-mineralization localities. A good example of these relationships demonstrate the mentioned

Novoveská Huta and the Košice - Jahodná deposits [5, 10]. Discussed evidences suggest that we can't currently expect a relatively homogeneous distribution of uranium mineralization (Fig. 1.). This is also reflected in the calculation of deposit reserves. Geological conditions of the U- mineralization in Slovakia are generally favorable in Permian sequences and - potentially, at their footwall in several areas containing at least rudimentary occurrence of uranium minerals (Fig. 2.).

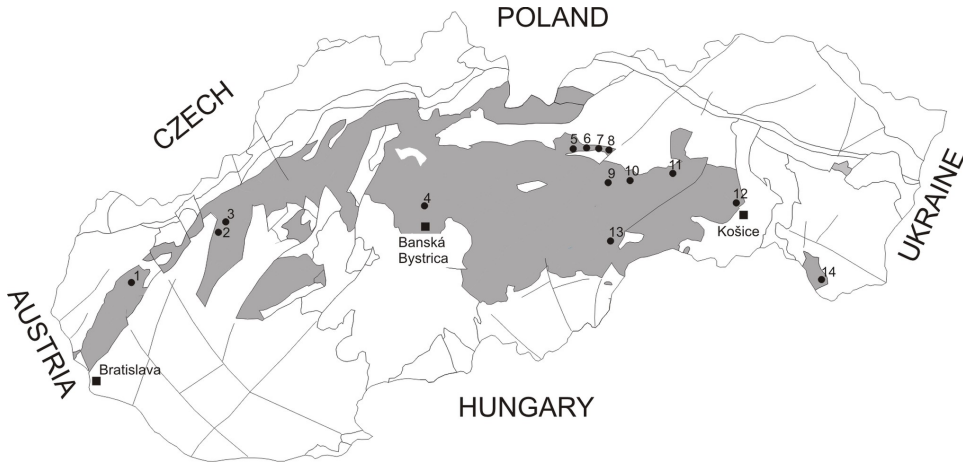


Fig. 2. Geological schetch of pre – Tertiary units and localities with uranium mineralization in the Western Carpathians (part Slovakia): 1 – Malé Karpaty, 2 – Kálnica, 3 – Selec, 4 – Špania Dolina, 5 – Vikartovce, 6 – Kravany, 7 – Spišské Bystré, 8 – Spišský Štiavnik, 9 – Novoveská Huta, 10 – Markušovce nad Hornádom, 11 – Spišské Vluchy, 12 – Košice-Jahodná, 13 – Gočaltovo, 14 – Zemplínske vrchy [1, 3].

3 Prospecting conditions

Prospecting history of uranium mineralization extends into the middle of the last century, when post-war Czechoslovakia utilizes energy and resource security. Since 1947 to 1992 y. exploration activities have been realized by the State Uranium Prospecting Company. The company has identified U- mineralization deposits occurring in the whole territory of the Western Carpathians [1]. In the nineties of the last century prospecting of uranium ores almost completely stopped. However industry boom and economic growth in the Slovakia started renewed interest in this ore material. After state companies privatization, exploration activities are carried out exclusively by private companies. Currently geological prospecting of U- mineralization being conducted at zero survey areas.

Companies providing exploration on the territory of Slovakia must full fill several criteria, which are listed in the geological Law No. 569/2007 [8]. Obtaining any prospection licence requires a favorable opinion either of the Regional Environmental Office or its subordinate offices. The request must also include statements of other organizations (eg Ministry of Health, Ministry of Defence, the District Mining Office, the Regional Monuments Board, etc.).

The geological prospecting is realized on the base of the geological project where all geological operations have to be approved by the Ministry of Environment. The most common an usually the introducing case is geophysical prospecting in orders to identify the geological structure, its basement and filling below the present surface. This non - invasive method has no negative impact on the environment and population. The second group of geological prospecting methods relates to prospection drilling. Their purpose is to collect

rock samples from different depths, which are then analyzed at certified laboratories. From the collected samples they determine the mineralization and other relevant parameters, depending on the purpose of exploration. Any exploration must be terminated by the final report, presented before the Ministry of Environment commission for reserves calculation. The permission is granted only in the case if the report contains all the requirements for declared economical reserves. Geological exploration calculated total reserves of the uranium deposits in volume 19 452t [9].

4 Social aspects of U-mineralization

Present discussions about uranium mineralization in Slovakia are mainly focused to security of exploration and economic reserves verification of this type of raw material for energy resources. This problem can be appreciated from two aspects. The first one, presented by environmental organizations, citizens and some municipalities resulted from premise that each survey will be followed by exploitation creating a potential risk to the environment, health and development of the region. The environmental impact to government forbid any mining activities related with extraction of radioactive ore deposits, without consensus of village residence leaving in the prospection area [8].

The second view presented mostly by professional geological community emphasizes the importance of each geological prospection for the state as the owner of the mineral resources and thus also for a particular community forming a part of the country population.

However Slovakia admittedly depends on an import of energy sources. The only perspective energy resource that we can economically evaluate is particularly the uranium. Its extraction and subsequent processing is quite difficult at current conditions. This is due to the lack of optimal technologies, impact studies, as well as long-term contracts to uranium import from Russia.

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