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RADIOACTIVE ELEMENTS IN COAL AND THEIR POSSIBLE IMPACTS

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Coal is notorious for containing virtually every element in the Periodic Table, some, such as uranium, can be present in extraordinarily high concentrations. For example, uranium in U.S. coal ash has been reported as high as 10 wt. % [9], Russia 7 wt. % [8], and in China up to 700 ppm in the coal [3]. In the USA, Russia, Kazakhstan, Mongolia, China, and other countries, numerous, predominantly small, uranium-coal deposits are known. In many of these deposits, hydrogeneous uranium anomalies are formed in the areas of interaction with the organic matter and ground water [1]. Uranium in coal has the distinction of having a positive economic impact as one of the few elements that has been profitably extracted from coal.

During the 1960s–1970s uranium was extracted from the low rank coals in the Northern Great Planes of the U.S. [4] where unregulated mining practices, such as burning the coal in place, resulted in mine-site contamination. Extraction of uranium from coal has also been reported from several regions of the former Soviet Union, China, and North Korea. Monnet et al. [7] report that by 1995 the US had produced more than 1000 tons of uranium from lignite, East Germany produced 3700 tons between 1947 and 1989 and two site in China were reported to produce uranium from coal.

Uranium in coal also has the reputation of having negative health impacts. Despite the low mean uranium content in the coals of the world (2.4 ppm) [5], the ash, forming during the combustion, is enriched with U in comparison with the mean U content in the upper continental crust by a factor of 6. In some cases its content in the ash and slag of the coals can reach commercially significant values. There have been cases when such wastes were used for the construction of living houses, industrial buildings and roads. Ash-slag disposal sites of modern power stations have from 2 to 3 times higher U contents than the mean U content in the coals of the world and higher Th-U ratio than the initial coal. This fact points to the leaching and loss of uranium in the process of ash-slag removing and the combustion waste disposal [2]. The influence of this leached uranium on ground and surface water is evident.

McBride, et al., [6] postulated that radioactivity emitted from coal combustion was greater that of nuclear power plants but offered no proof that it presented negative health impacts. Radioactivity from coal-burning power plants and coal combustion byproducts has been shown to generally be below acceptable health safety limits [11] (Fig. 1 and 2). Radon emitted from coal in poorly ventilated mines has been linked to lung cancer of the coal miner [10].

Other naturally occurring radioactive elements such as Th, K, Rn, Ra, etc. are present in coal in exceeding low levels. There are exceptions to these statements and high uranium coals and coal byproducts must be handled, and disposed of, with appropriate care. In short, radioactive elements in coal can have a positive economic impact and, if handled properly, the radioactive elements in coal and in coal byproducts should have little environmental and health impacts.

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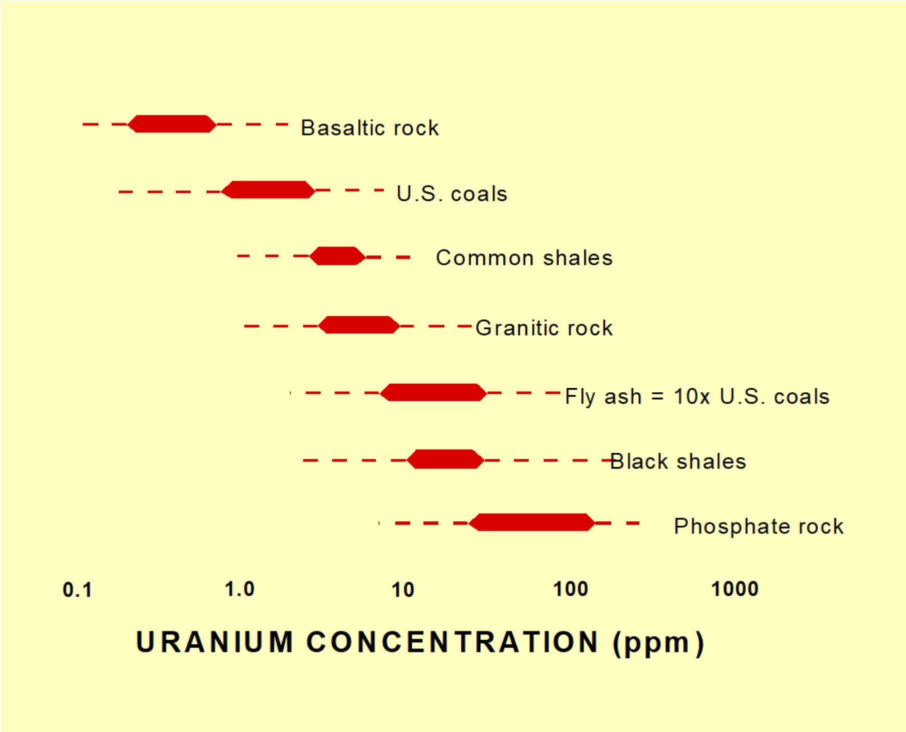

Figure 1. Uranium concentration ranges in U.S. coals, fly ash, and common rocks

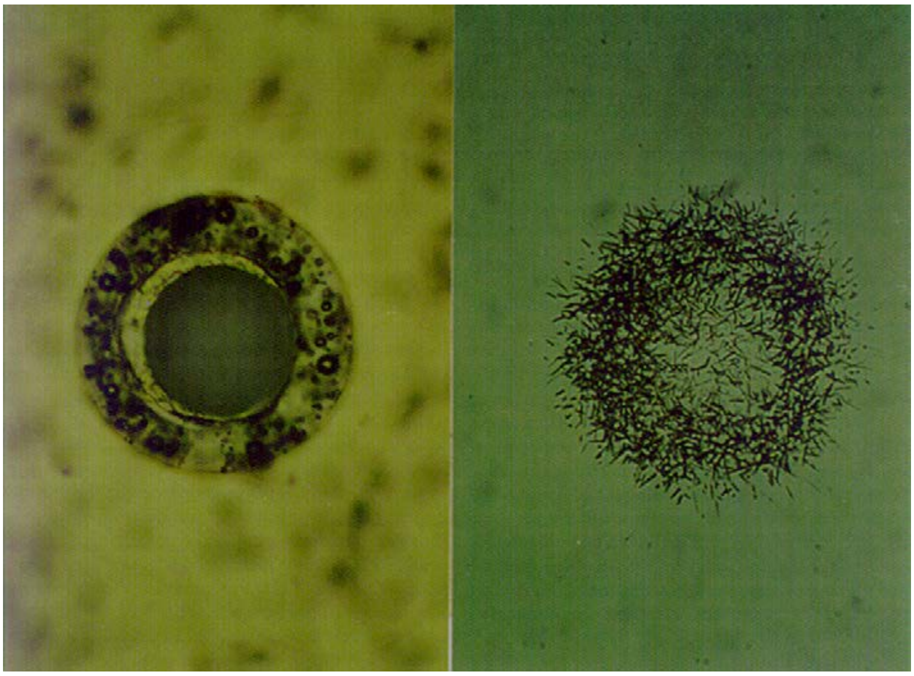

Figure 2. Left: Photograph of hollow glassy fly ash particle with a diameter of about 0.01 cm. Right: Fission track radiograph of the same particle illustrating that the uranium is uniformly distributed throughout the particle

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ОЦЕНКА ЭКОЛОГИЧЕСКОЙ БЕЗОПАСНОСТИ ДОБЫЧИ УРАНА МЕТОДОМ СПВ С ТОЧКИ ЗРЕНИЯ ВОЗМОЖНОСТИ САМООЧИЩЕНИЯ ПОДЗЕМНЫХ ВОД НА ПРИМЕРЕ ДОБРОВОЛЬНОГО МЕСТОРОЖДЕНИЯ УРАНА

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THE ENVIRONMENTAL SAFETY ASSESSMENT OF THE IN SITU LEACHING URANIUM MINING TECHNOLOGY IN TERMS OF THE GROUND WATER SELF-PURIFICATION POSSIBILITY ON THE EXAMPLE OF DOBROVOLNOYE URANIUM DEPOSIT

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The analysis of the possibility of self-purification of ground water after in situ leaching uranium mining on the example of the Dobrovolnoye uranium deposit is carried out. The possibility of a significant dilution of the main pollutants (sulfate- and nitrate-) due to the sorptive properties and acid consumption of host rock and the vital activity of bacteria thirty years after two-hole in situ leaching experiment has been established.

Введение

Добровольное месторождение относится к Зауральскому урановорудному району и расположено на территории Звериноголовского района Курганской области. Месторождение локализовано в палеоаллювиальных отложениях средне-верхнеюрского возраста, выполняющих депрессионную эрозионную структуру (Убаганскую палеодолину) на глубинах 480–600 м от земной поверхности [1]. По классифи-