

Identification of Radiometric and Mineragraphy Analysis of Uranium and Sulfide Mineral at BM-179 Kalan-West Kalimantan Uranium Ore

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Abstract

The BM-179 uranium ore is the ore rock from Kalan that derived shaft 179 m at Ekoremajaja Hill in Kalan-West-Kalimantan Indonesia that has uranium and sulphide minerals and mineral complex combinations. This study aims to identify of radiometric and mineragraphy analysis qualitatively against sulfide and uranium minerals at BM-179 Kalan-West-Kalimantan uranium ore. The method of research begins done by cutting 3-8 cm ore using a grandsaw cutlery, sample selection using the ROS (radiometric ore sorting) by SPP-NF and mineral identification using mineragraphy analysis (polishes method) through the use of mount press for microstructural analysis, polisher ecomet III grinder tool and reflectance microscopy. The results obtained are BM-179 Kalan uranium ore size 3-8 cm has radiometric less than 1000 cps as much as 75% by weight of the ore and has radiometric more than 1000 cps as much as 25% by weight of the ore. From the results of the identification of mineragraphy ore known that many uranium minerals contained in the ore by radiometric more than 1250 cps, while there are many sulfide minerals in the ore which has a radiometric less than 1250 cps. Qualitatively known that the sulfide content of up to 5 % contained at the BM-179 ore with radiometric 150-500 cps, and the highest uranium content reaches 3 % contained at the BM-179 ore with radiometric 5000-15000 cps.

Keywords: Radiometric; Mineragraphy analysis; BM-179 uranium ore; Sulfide; Uranium.

1. Introduction

Uranium ore in nature generally formed due to hydrothermal processes, and also because of the type of mesothermal (medium temperature and pressure) that occurs in igneous and metamorphic rocks, and the expanse of sedimentary rocks.

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Compounds of uranium in the ore containing uraninite (UO_2 and UO_3 combined; 50-85% U_3O_8). Uraninite is natural uranium oxide with cubic or octahedral crystalline form.

It has a specific gravity of 8.0 to 10.5 (g / mL), the color of grayish-black with violence 5-6 of Mohs scale. In almost all over the world all uranium ore deposits containing U_3O_8 primary. U_3O_8 is uranium oxide that is composed of three atoms of uranium with eight oxygen atoms. Chemical testing for uranium content of about 85 percent expressed in U_3O_8 . Triuranium octoxide and uranium dioxide is a compound of uranium oxide are the most common, and many are produced from ore to produce yellowcake (U_3O_8). Both solid oxide has a low solubility in water and relatively stable under various environmental conditions. Triuranium octoxide generally a stable compound that is found in nature. Uranium oxide is a common form used for nuclear fuel, and in a certain temperature can be turned into a more stable triuranium octoxide [1,2,3,4].

Uranium ore is generally associated with one or more minerals main ore such as iron, copper, cobalt, tin, silver, and bismuth; and the presence of this mineral in the mineral deposit is one indication of favorable conditions for uranium ore. Other minerals that are commonly associated with the mineral quartz, silica and others such as carbonates, fluorite, barite, and hydrocarbons. Quartz, calcite and dolomite are usually the most abundant [5,6,7].

Ekoremaja Hill in Kalan is one of the sectors with the most potential uranium mineralization in West Kalimantan which is an area of hills with a height of about 600 meters above sea level. This area in the form of rock lithology metasediment permo-carbon old, mainly consisting of metapelite, metapelite has skistose and metalanau. In general, the layers of rocks in the east-west direction, sloping to the south, with a total thickness of 80-100 m [8]. BM-179 uranium ore is the uranium ore that comes from the depths of the tunnel as deep as 179 in Ekoremaja Hill at Kalan West Kalimantan has a uranium minerals are not single, but it is a complex combination with other elements.

Mineralization of BM-179 uranium ore in the form of tectonic breccias and stuffing spasticity in 19 fields which are estimated to have reserves of approximately 6150 tonnes of U_3O_8 comprising 553 tonnes of measured and 5597 tonnes indicated. Uranium minerals contained in the Ekoremaja-Kalan is a mineral uraninite, autunite, brannerite, gummite and contains minerals other associations such as pyrite, pitchblende, kalkopirit, cobaltite, lollingite, pentlandite, gerdorsfite, saflorite, sphalerite, molybdenite, ilmenite, magnetite and chlorite [9,10]. The content of uranium each region has minerals that change depending on geology, regolith, geomorphic setting, history, hydrology and climate constituent territories, and ore contents can be calculated by integrating data analysis and data uranium geology [11]. Uraninite occur as sediment in pyrobitumen or are bound in pyrite occur as nanoparticles that occur at oxidation conditions sufficient for the formation of hydrothermal uranium [12]. Ekoremaja-kalan uranium minerals in the region in which it contains a lot of sulfide and oxide minerals contained as filler veins and fractures with a range of centimetric thickness up to 1 meter in the form of "bondinage" [13,14].

BM-179 Uranium ore is a complex combination with other elements. Therefore, there is a difficulty in separation chemistry, and should begin with the identification of physics.

Through physical preparation methods ROS (radiometric Ore Sorting) is assumed to be used to separate of the ore that containing high sulfide minerals and high-grade uranium ore. Radiometric research related to the identification and analysis of sulfide minerals and mineragraphy of uranium minerals at BM-179 Kalan West Kalimantan uranium ore has not been widely publicized, so research has novelty and needs to be done. This study aims to identify radiometric and mineragraphy qualitatively analyze against sulfide minerals and uranium minerals at BM-179 Kalan West Kalimantan uranium ore with sample selection tool using the ROS-NF SPP and mineral identification using mineragraphy analysis (polishing method).

2. Materials and Methods

Materials: Na_2CO_3 , ZnO, CaCl_2 10%, silicon carbide with mesh sizes: 240, 400, 600 and 1000 mesh, transopticTM powder, alpha alumina micropolish 1.0 and 0,3 microns, kodak detecteur CN 85 celluloid. Equipment: Grandsaw cutting machine, mount press tool for microstructural analysis, ecomet III polisher grinder tool, ultra sonic cleaner, reflectance microscope.

Working procedure

- Physical Preparation: Thirty kilograms of BM 179 uranium ore was cut with jaw crusher to form a gravel rock sized 30-80 mm, then sorted radiometric based with SPP-2F tool form a group radiometric <150 cps, 150-500 cps, 500-1000 cps , 1000-1500 cps, 1500-3000 cps, 3000-5000 cps, and 5000-15000 cps.
- Making the incision polished for mineragraphy analysis: rock ore was cut to the size of $\pm 3 \text{ cm} \times 3 \text{ cm} \times 0.5 \text{ cm}$ using the mower Grandsaw (Geoservices Apparcil No. 112-037). The surface of rock polishing results was leveled on the glass grindstones by silicon carbide powder with a certain particle, the first stage polishing with silicon carbide powder with a size of 120 mesh, having average washed thoroughly, grinding subsequently leveled with silicon carbide powder 240 mesh size, 400 mesh and 600 mesh. Each stage scrubbing takes 3-5 minutes and must pass through the stages of washing with water. Once the surface is flat and smooth, sample placed on the sample holder that has been sprayed release agent on the Spacement Mount Press-Buehler Ltd-Apparatus tools for Microstructural Analysis to be printed, rocks were added 5 grams of powdered TransopticTM, closed sample holder, heated and pressed with a pressure of 3.0-4.2 Ksi / Mpa for 20 minutes at a temperature of 138-149 °C. After a rock cold with TransopticTM powder coated, the sample is removed and polished back with silicon carbide powder 1000 mesh and cleaned with water.

So that its surface is very smooth and shiny, polished back with ecomet III polisher grinder tool using a 1.0 micron alpha alumina micropolish with the addition of water 1: 1 for approximately 5-10 minutes. Polished rocks washed with water using ultrasonic cleaner for 15 minutes. Then put back into the rock polisher Econit tool using alpha alumina micropolish 0.3 microns with the addition of water 1: 1 for 5-10 minutes. Polished rocks subsequently washed with water with ultrasonic vibrations for 15 minutes and allowed to dry [15].

- Determination of radioactive traks with autoradiography method on polished rock: the rock surface labeled kodak film-detector detecteur CN 85 celluloid (France). Film layer on the surface of rocks that are characterized by a nail scratches, rock and film coating bonded with scotch tape so that a constant position. Then allowed 3 nights with foam mikroskopish preparete-press. Film layer is removed and heated to a temperature of 50-60 °C in a solution of KOH 2.5 M, left to stand for 30 minutes, then removed. Furthermore, polished rocks and films containing radioactive trak ready to be examined under a reflectance microscope..

3. Results and Discussion

3.1 Identify the percentage of Radiometric BM-179 uranium ore

Before to the identification of the percentage of radiometric then need treatment given of BM-179 uranium ore, by cutting with crusser jaw equipment, then used for sampling for further analysis. Pieces of ore with 3-8 cm size is classified based characteristics of radiometric, then the weight and percent sample in each group conducted radiometric calculations and derived data such as Table 1 below.

Table 1: The weight and percent of each radiometric class on pieces of BM-179 ore with 3-8 cm size

No.	Radiometric (cps)	Median radiometric (cps)	Section examples (%)
1	< 150	75	29,5
2	150 – 500	225	32,2
3	500 - 1000	750	13,3
4	1000-1500	1250	3,8
5	1500 - 3000	2250	10,6
6.	3000 - 5000	4000	5,4
7.	5000 – 15000	10000	5,2
Total weight			100

From Table 1 obtained information that the BM-179 kalan uranium ore through cutting slabs with a size of 3-8 cm will have a radiometric of 75% weight ore with less than 1000 cps and 25% by weight ore will have a radiometric over 1000 cps. Therefore, uranium can be obtained from uranium ore that high radiometric, only from a quarter of the existing slabs. While the other three quarters chunks had low radiometric and necessary efforts in finding a solution for the utilization, in order to generate efficiency in the uranium processing as a whole.

3.2 Mineragraphy identification of sulfide minerals and uranium

Mineragraphy identification is a physical identification was done by the polishing method. In this study, the identification was done to obtain conclusive of information that the BM-179 ore contained uranium and sulphide minerals prior to further analysis.

The presence of uranium minerals were observed on the drawings mineragraphy and traces of alpha particles in the ore of BM-179 Ekoremaja Kalan West Kalimantan observed on reflectance microscope [15] and obtained an image as shown in Figure 1 to Figure 6 below:

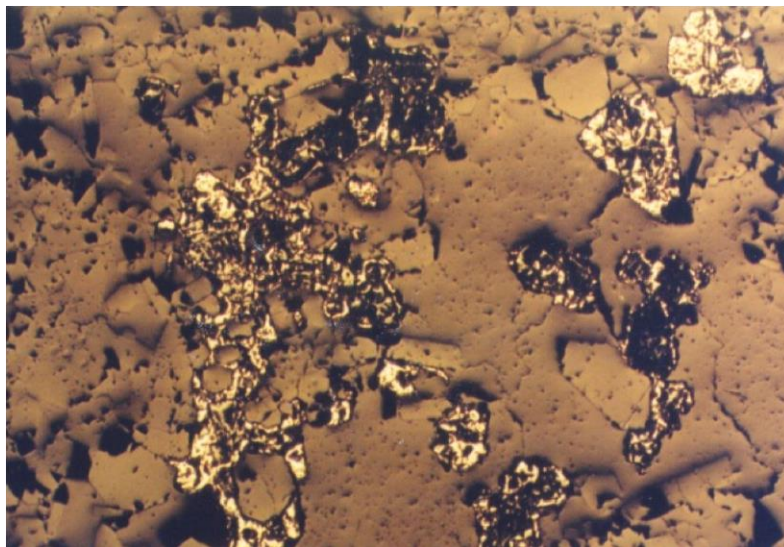


Figure 1a: Mineragraphy results of BM-179 ore with radiometric 150-500 cps

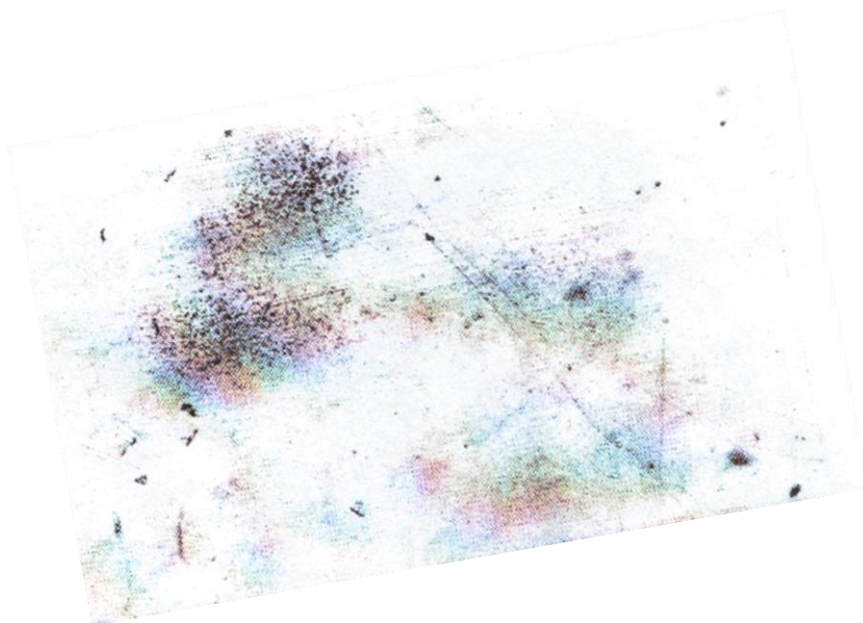


Figure 1b: Traces of radiation of BM-179 ore with radiometric 150-500 cps 150-500 cps at CN-85

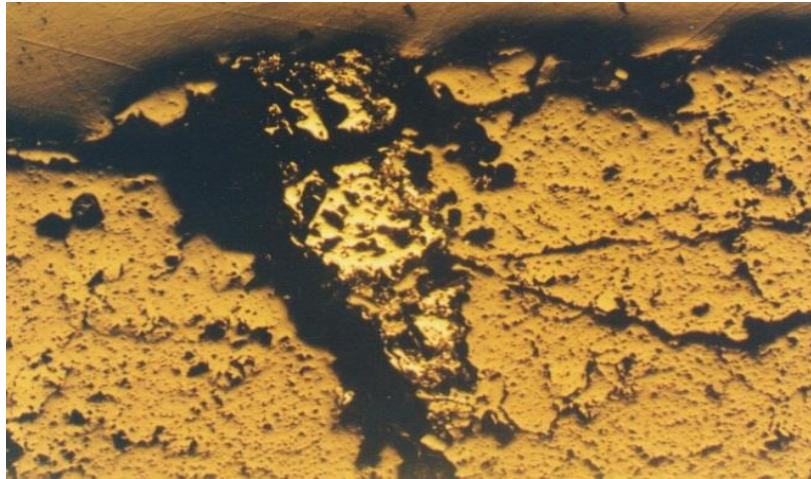


Figure 2a: Mineragraphy results of BM-179 ore with radiometric 500-1000 cps

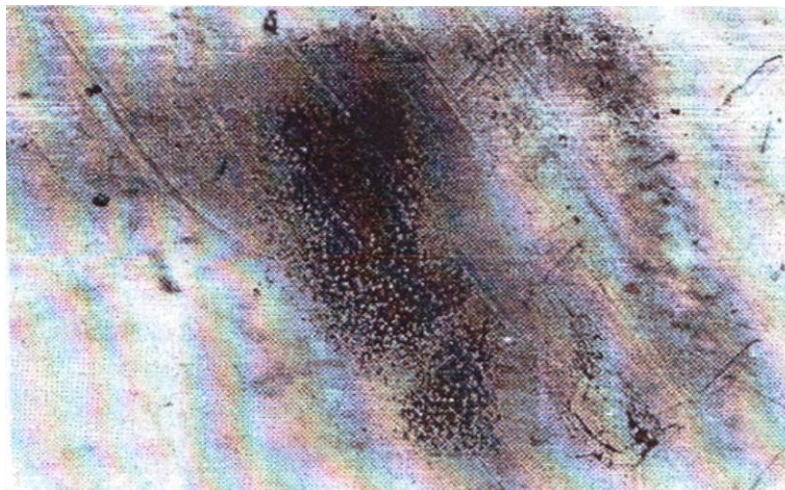


Figure 2b: Traces of radiation of BM-179 ore with radiometric 500-1000 cps at CN-85

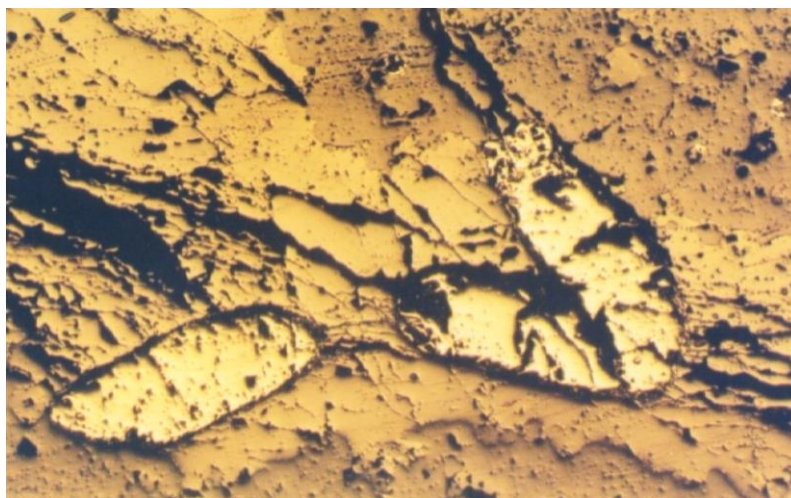


Figure 3a: Mineragraphy results of BM 179 ore with radiometric 1000-1500 cps

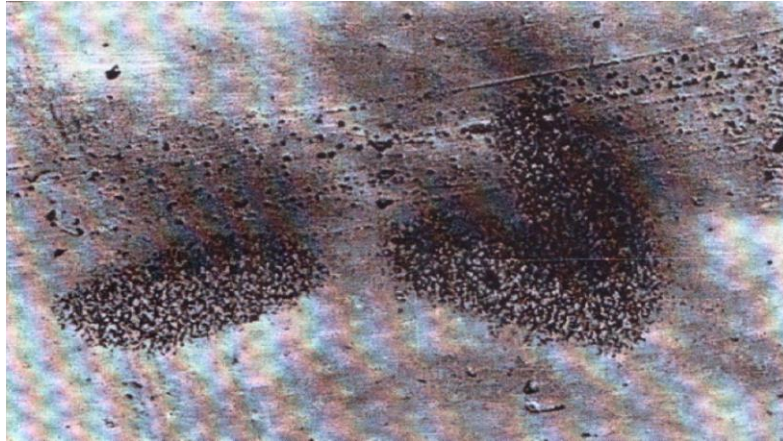


Figure 3b: Traces of radiation of BM-179 ore with radiometric 1000-1500 cps at CN-85

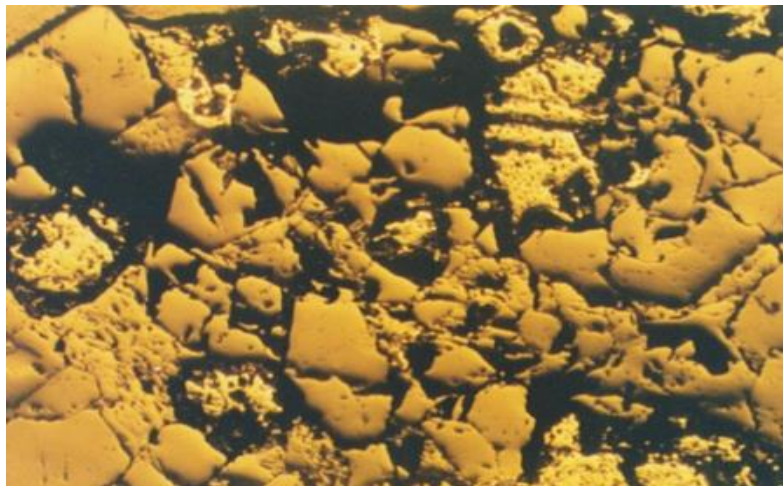


Figure 4a: Mineragraphy results of BM 179 ore with radiometric 1500-3000 cps

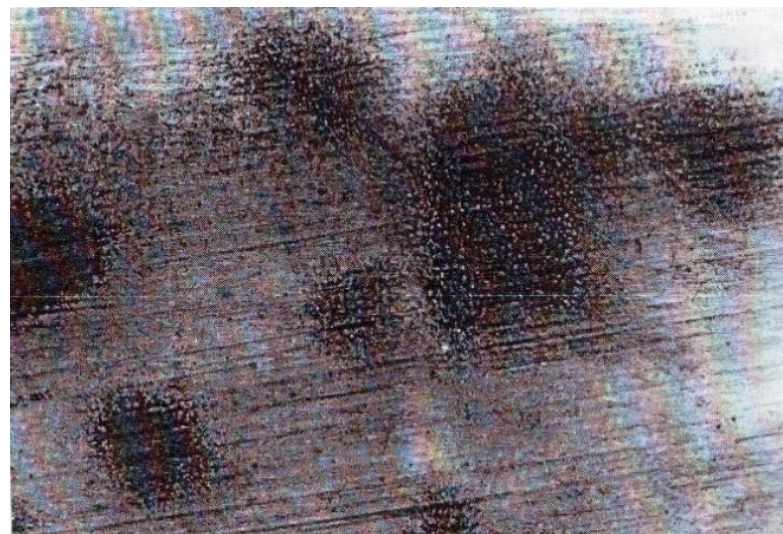


Figure 4b: Traces of radiation of BM- 179 ore with radiometric 1500-3000 cps at CN-85

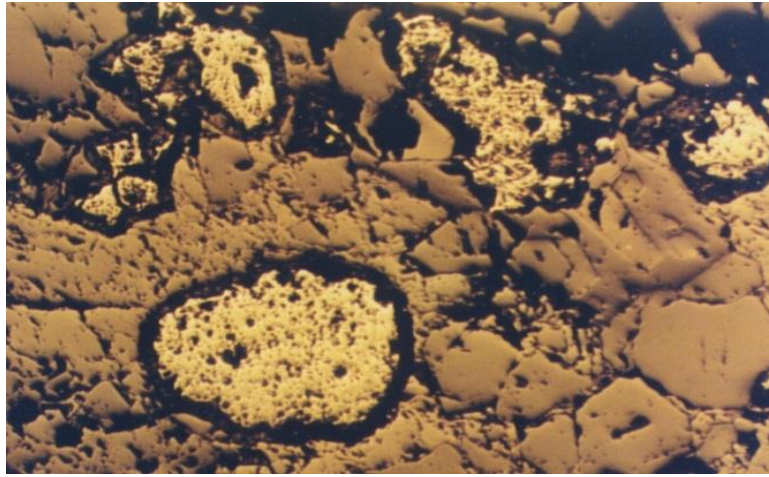


Figure 5a: Mineragraphy results of BM 179 ore with radiometric 3000-5000 cps

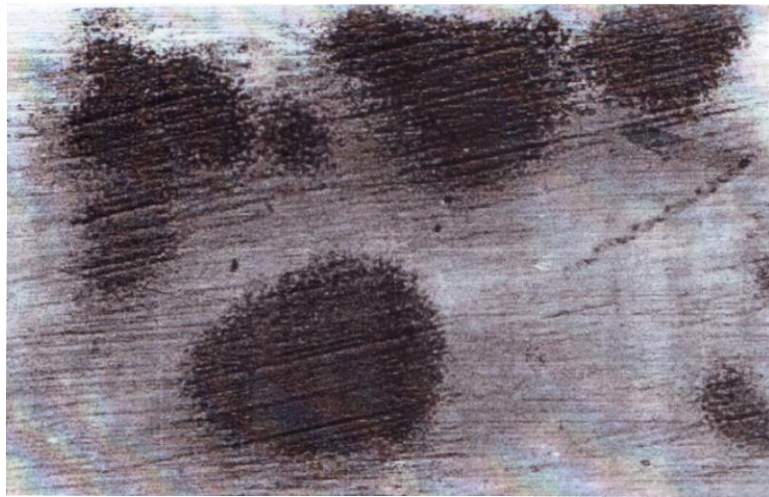


Figure 5b: Traces of radiation of BM- 179 ore with radiometric 3000-5000 cps at CN-85

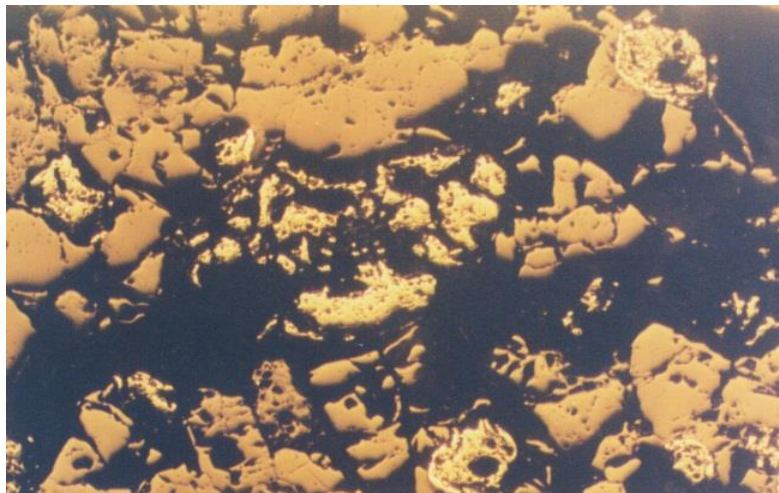


Figure 6a: Mineragraphy results of BM 179 ore with radiometric 5000-15000 cps



Figure 6b: Traces of radiation of BM-179 ore with radiometric 5000-15000 cps at CN-85

Observations of mineragraphy analysis om reflectance microscopy to observe the sulfide and uranium minerals as well as to be able to distinguish between them can be exemplified as shown in FIG 1-6. From these images was observed that uranium minerals can be characterized by gray color of yellow, and sulphide minerals are characterized by a bright yellow color that is surrounding the uranium mineral. Mineragraphy identification results on BM-179 uranium ore of Ekoremaja-Kalan West Kalimantan was known that there are uranium minerals contained in the ore by radiometric more than 1250 cps, while there are many sulfide minerals in the ore which has a radiometric less than 1250 cps.

The 13 times of the observation was done on the surface of each example with the polishing method on reflectance microscope obtained estimates of uranium and sulfide content qualitatively. Data sulfide and uranium minerals content qualitatively are presented in Table 2.

Table 2: Qualitative identification of sulfide and uranium minerals

No.	Radiometric (cps)	Median radiometric (cps)	Qualitative percentage (%) of 13 times measurement	
			Mineral Uranium	Mineral sulfida
1	< 150	75	≈ < 1 %	≈ 0 %
2	150 – 500	225	≈ 5 %	≈ < 1 %
3	500 - 1000	750	≈ 2,3 %	≈ 1 %
4	1000-1500	1250	≈ < 1 %	≈ < 1 %
5	1500 - 3000	2250	≈ < 1 %	≈ < 1 %
6.	3000 - 5000	4000	≈ < 1 %	≈ 1,8 %
7.	5000 – 15000	10000	≈ 1 %	≈ 3 %

Table 2 shows that the qualitative content of sulphide in the BM-179 ore approximately 5% with radiometric 150-500 cps, and the highest uranium content of the BM-179 ore approximately 5% with radiometric 5000-15000 cps.

Analysis of uranium and sulfide mineral content above was based on a qualitative analysis which have low precision, and it would be better that element analysis using the chemical analysis method. Analysis of uranium is chemically can be done through the stages of dissolution with a mixed solution (HCl + HBF₄) added a solution of HF 40% excess, and stirred for 60 minutes without heating at 50 ° C, the use of HF solution are minimized or replace with HF(g) so that the effect of H₂O as little as possible [16]. In addition, the results of uranium content can be optimized according the research G. Widodo upon addition of the chelating agent TOPO using pH 4, and the time is extended to several hours [17].

4. Conclusions

The study results of BM-179 uranium ore from Ekoremajaja-Kalan West Kalimantan has given some conclusions that BM-179 uranium ore with 3-8 cm chunk size would have radiometric less than 1000 cps as much as 75% by weight of ore and 25 % by weight of ore having radiometric over 1000 cps. Mineragraphy identification results on BM-179 Kalan West Kalimantan uranium ore was known that uranium minerals contained in the ore by radiometric more than 1250 cps, while there are many sulfide minerals in the ore by radiometric less than 1250 cps. The qualitative content of the BM-179 ore approximately 5% sulphide with radiometric 150-500 cps, and the highest uranium content of the BM-179 ore approximately 3% with radiometric 5000-15000 cps..

Acknowledgements

The research results can be obtained because a lot of support from many parties including: BATAN which has given aid research site, UNTAN and colleagues as well as students throughout the academic community. Thank you to all of the relevant agencies in the provincial government of West Kalimantan.

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