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Denpasar - Bali, 15 - 16 Oktober 2015

PUSAT TEKNOLOGI DAN KESELAMATAN REAKTOR NUKLIR (PTKRN)
PUSAT KAJIAN SISTEM ENERGI NUKLIR (PKSEN)
BADAN TENAGA NUKLIR NASIONAL

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Pusat Teknologi dan Keselamatan Reaktor Nuklir

Pusat Kajian Sistem Energi Nuklir

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KATA PENGANTAR

Puji syukur kami panjatkan kehadirat Tuhan Yang Maha Esa, yang telah melimpahkan rahmat dan hidayah Nya sehingga Prosiding Seminar Nasional Teknologi Energi Nuklir 2015 dapat diselesaikan. Prosiding ini memuat makalah yang dipresentasikan pada Seminar Nasional Teknologi Energi Nuklir, dengan tema Kontribusi Teknologi Energi Nuklir bagi Kemandirian dan Keberlanjutan Pembanguan Nasional, yang diselenggarakan pada hari Kamis – Jumat, 15 – 16 Oktober 2015 di Gedung Pascasarjana Universitas Udayana, Denpasar, Bali. Seminar tersebut terselenggara atas kerjasama Pusat Teknologi dan Keselamatan Reaktor Nuklir (PTKRN-BATAN) dengan Pusat Kajian Sistem Energi Nuklir (PKSEN-BATAN) didukung oleh Fakultas Teknik dan Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Udayana.

Penerbitan Prosiding ini dimaksudkan untuk menyebarluaskan hasil penelitian dan pengembangan iptek energi nuklir. Diharapkan dengan terbitnya prosiding ini dapat menggalang kesinambungan komunikasi di antara para peneliti, akademisi, dan pemerhati terkait dengan iptek energi nuklir di Indonesia, dalam rangka mengantisipasi pesatnya perkembangan iptek energi nuklir di dunia.

Panitia menerima sebanyak 83 makalah teknis dari berbagai instansi. Setelah melalui seleksi dan evaluasi oleh Dewan Editor, Panitia memutuskan 77 makalah dapat diterima untuk dipresentasikan dalam Seminar Nasional Teknologi Energi Nuklir 2015. Hasil seleksi ulang dan evaluasi oleh Dewan Editor terhadap makalah yang dipresentasikan, memutuskan sebanyak 74 makalah dapat diterbitkan dalam Prosiding Seminar Nasional Teknologi Energi Nuklir 2015. Ke 74 makalah tersebut terdiri dari : 67 makalah dari BATAN, masing-masing 2 makalah dari BAPETEN dan Universitas Udayana, dan masing-masing 1 makalah dari Universitas Sriwijaya, ATK Kemenperin Yogyakarta, dan STKIP Sumedang.

Kami menyadari bahwa prosiding ini tentu saja tidak luput dari kekurangan, untuk itu segala saran dan kritik kami harapkan demi perbaikan prosiding pada terbitan tahun yang akan datang. Akhirnya kami berharap semoga prosiding ini bermanfaat bagi yang memerlukan.

Jakarta, Maret 2016

Dewan Editor

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NOMOR: 77/KA/III/2015

TENTANG

PERUBAHAN LAMPIRAN KEPUTUSAN KEPALA BATAN NOMOR 41/KA/II/2015 TENTANG PENYELENGGARAAN SEMINAR NASIONAL TEKNOLOGI ENERGI NUKLIR 2015 DAN PEMBENTUKAN PANITIA

KEPALA BADAN TENAGA NUKLIR NASIONAL,

Menimbang: a. bahwa dengan Keputusan Kepala BATAN Nomor 41/KA/II/2015 telah ditetapkan Penyelenggaraan Seminar Nasional Teknologi Energi Nuklir 2015 dan Pembentukan Panitia;

b. bahwa untuk kepentingan dinas, maka perlu mengubah Lampiran Keputusan sebagaimana dimaksud pada huruf a;

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2. Keputusan Presiden Nomor 72/M Tahun 2012;

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MEMUTUSKAN:

Menetapkan : KEPUTUSAN KEPALA BADAN TENAGA NUKLIR NASIONAL TENTANG PERUBAHAN LAMPIRAN KEPUTUSAN KEPALA BATAN NOMOR 41/KA/II/2015 TENTANG PENYELENGGARAAN SEMINAR NASIONAL TEKNOLOGI ENERGI NUKLIR 2015 DAN PEMBENTUKAN PANITIA.

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KESATU : Mengubah Lampiran Keputusan Kepala BATAN Nomor 41/KA/II/2015 tentang Penyelenggaraan Seminar Nasional Teknologi Energi Nuklir 2015 dan Pembentukan Panitia menjadi sebagaimana tersebut dalam Lampiran Keputusan ini.

KEDUA : Keputusan ini mulai berlaku pada tanggal ditetapkan.

Ditetapkan di Jakarta
pada tanggal 25 Maret 2015
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GEOLOGY AND RADIONUCLIDE RATIO MAPPING FOR RADIOACTIVE MINERAL EXPLORATION IN MAMUJU, WEST SULAWESI

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ABSTRACT

GEOLOGY AND RADIONUCLIDE RATIO MAPPING FOR RADIOACTIVE MINERAL EXPLORATION IN MAMUJU, WEST SULAWESI. Mamuju is an exploration area for uranium (U) and thorium (Th) which has been conducted since 2012. The anomaly of radioactivity are in wide area with significat of uranium and thorium grade. Uranium and thorium mineralization occurrences in Mamuju area associated with the distribution of volcanic rocks, which are grouped into volcanic rocks Adang. This study aims to identify the distribution of radioactive minerals source rocks and deposits of in Mamuju Region. The study was conducted by geological mapping, mapping of radionuclide and rocks chemical analysis. Geological mapping indicates that the volcanic rocks Adang consists of seven volcanic complex which is Tapalang, Ampalas, Adang, Malunda, Karampuang, Sumare and Labuan Rano. Radionuclides Mapping using gamma rays survey meter (RS-125 models) in Mamuju shows the variation of the dose rate (nSv / h), the levels of radionuclides potassium (% K), uranium (ppm eU) and thorium (ppme Th) at each measurement point were measured continuously. Radionuclide data processing using radionuclide ratio Th / K, U/K may provide an overview of different distribution of volcanic rocks between older volcanic complex (Tapalang, Ampalas and Malunda) with younger (Adang, Karampuang, Sumare and Labuan Rano). Radioactive mineralization are controlled by several factors, which are the distribution of lithology ultrapotasik / shosonitik especialy complex Adang volcanic rocks as radioactive mineral source rocks and pavourable volcanic rocks the Tapalang, Ampalas and Malunda complex, hydrothermal process which fills the structure northeast-southwest, north-south and east-west trending, and also supergene enrichment process which includes the of weathering, leaching and deposition process of radioactive elements.

Keywords: volcanic, radionuclide, uranium, thorium, Mamuju.

ABSTRAK

GEOLOGI DAN PEMETAAN RASIO RADIONUKLIDA UNTUK EKSPLORASI MINERAL RADIOAKTIF DI MAMUJU, SULAWESI BARAT . Mamuju merupakan daerah eksplorasi uranium (U) dan thorium (Th) yang telah dilakukan sejak tahun 2012. Anomali radioaktivitas berada pada daerah yang cukup luas dengan kadar uranium dan thorium cukup signifikan. Keterdapatan mineralisasi uranium dan thorium di daerah Mamuju sangat berkaitan dengan sebaran batuan vulkanik yang dikelompokkan ke dalam batuan gunungapi Adang. Penelitian ini bertujuan untuk mengidentifikasi sebaran batuan sumber dan cebakan mineral radioaktif di Daerah Mamuju. Penelitian dilakukan dengan pemetaan geologi, pemetaan radionuklida dan analisis kimia batuan. Pemetaan geologi menunjukkan bahwa batuan vulkanik Adang terdiri dari 7 kompleks vulkanik yaitu Tapalang, Ampalas, Adang, Malunda, Karampuang, Sumare dan Labuan Rano. Pemetaan radionuklida menggunakan surveymeter sinar gamma (tipe RS-125) secara regional di Mamuju menunjukkan variasi nilai laju dosis (nSv/jam), kadar radionuklida potassium (%K), uranium (ppm eU) dan thorium (ppm eTh) pada setiap titik pengukuran yang diukur secara menerus. Pengolahan data radionuklida dengan menggunakan rasio radionuklida Th/K, U/K dapat memberikan gambaran sebaran batuan gunungapi yang berbeda antara batuan kompleks vulkanik yang lebih tua (Tapalang, Ampalas dan Malunda) dengan yang lebih muda (Adang, Karampuang, Sumare dan Labuan Rano). Tipe mineralisasi mineral radioaktif yang terbentuk dikontrol oleh beberapa faktor yaitu sebaran litologi ultrapotasik/ shosonitik terutama batuan vulkanik kompleks Adang sebagai batuan sumber pembawa mineral radioaktif dan batuan pavorabel pada vulkanik kompleks Tapalang, Ampalas dan Malunda, proses hidrotermal yang mengisi struktur berarah timurlaut-barat daya, utara-selatan dan barat-timur, dan proses pengkayaan supergen yang meliputi proses pelapukan, pencucian dan pengendapan unsur radioaktif.

Kata kunci: Gunungapi, radionuklida, uranium, thorium, Mamuju.

INTRODUCTION.

Mamuju is the capital of West Sulawesi Province which is the result of the expansion of the new province of South Sulawesi in 2004. West Sulawesi province is located in the western part of the island, where several districts in Mamuju district is an area that has the value of dose rate radiation (radioactivity) High (Iskandar et al., 2007). High values of radioactivity found in the area composed of volcanic rocks, particularly volcanic rocks Adang. The estimated value of high radioactivity comes from natural radioactive mineral occurrences (Syaeful et al., 2014).

Since 2007 has been prepared maps gamma radiation dose rates throughout Indonesia (Iskandar et al., 2007) including the Mamuju. The map shows that the area Mamuju has the highest value of the radiation dose rate than other regions in Indonesia, which reached a value of 2.800 nSv/h. Radioactivity measurements carried out by the method-carborne radiometric surveys using Exploranium GR-130 on the main road network throughout the island of Sulawesi and in other areas in Indonesia. The findings in more detail in Mamuju found in the village Takandeang, the radiation dose rate reaches 2,844 nSv / h, and some points are found at that location with a dose rate of 2.250 and 2.200 nSv / h, much higher than the average radiation dose rate in Java island about 25-50 NSV / h. In general, the southern arm Sulawesi to the middle, has a radiation dose rate is higher than other areas on the island of Sulawesi, and not continuous to the north. Other locations that have high levels of radiation dose rate is relatively high is found in Mamasa with a radiation dose rate of 250 nSv/ h (Syaeful et al., 2014). Conditions of dose rate certainly an implication of the geological conditions both on the lithology and regional geology.

Value of natural high dose rate in a region reflect occurrences radioactive elements contained in rocks, such as uranium (U), thorium (Th) and potassium (K) and or the doughter element occurrences. In general, radioactive mineral occurrences, especially U and Th is closely associated with acid igneous rocks either plutonic rocks (granitic) or volcanic rocks (riolitik), the estimated average concentration of U and Th content in some parts of the earth's crust is closely linked to the type of rock constituent (Hazen et al., 2009)

Table 1.1. Estimates of the average level of U and Th content in several different parts of the earth's crust (Hazen et al., 2009)

Reservoir	U (ppm)	Th (ppm)	References
Cl Carbonaceous Chondrites	0.0074	0.002*	Plant et.al. (1999)
Eucrite meteorites	0.07 to 0.15	0.3 tp 0.8	T. McCoy and L Nittlers, pers.com.
Bulk silicate earth	0.02	0.06*	Plant et.al (1999); Palme and O'Neill (2003)
Crust	1 to 2.7	~10	Taylor (1964); Plant, et al, (1999); Emsley (1991)
MORB	0.05 to 0.15	~0.15 to 0.45	Lunstrom (2003); Workman and Hart (2004)
OIB	1	3*	Plant, et.al (1999)
Granite	10	30	Plant, et.al (1999)
High-Grade Ore Deposits	10^{1} to 10^{5}	10^{1}	Plant, et.al (1999), Deer et.al, (1997)
Average Seawater	3×10^{-3}	9×10^{-6}	Miyake et.al, (1970); Emsley (1991); Chen and Wesserburg (1986)
Avarage river water	$\sim 10^{-4}$	$\sim 2.5 \times 10^{-4}$	Bertine et.al (1970); Moore (1967); Windom et.al, (2000)

*Estimation from known U concentration and average U:Th ~1:3

Mamuju district that has the most western position and composed of volcanic rocks with affinity ultrapotasik / soshonitik berkomposisi basaltic-andesitic are grouped into volcanic rock units Adang (Ratman and Atmawinata, 1993). Occurrences value of high radiation dose rates have a spread almost evenly in accordance with the distribution of volcanic rocks Adang (Syaeful et al., 2014). Radioactive mineral occurrences on the basaltic-andesitic rocks have never been found in Indonesia, so it becomes very interesting to do research primarily in the source and favorable of these radioactive minerals occurencess.

THEORY

Sulawesi island have a very complex geological settings. Very complex of tectonic setting caused by the interaction of the three plates that move actively, i.e. straigh tforward Australian continent moving northward, the movement of the Pacific Plate is moving to the west and the Eurasian continental plate moves relative to the South-East. Regionally, Sulawesi Island which has a shape like the "K" letter are generally divided into Geological Province of East Sulawesi (non-volcanic arch) and Geological province of West Sulawesi (volcanic arch) (Surono and Hartono, 2013). Wilson and Moss (1998), shows that the western part of Sulawesi, which consists of an arc-volcanic plutono result of a compressive force north - south, and produces a thick Tertiary sedimentary and volcanic sequences (Figure1).

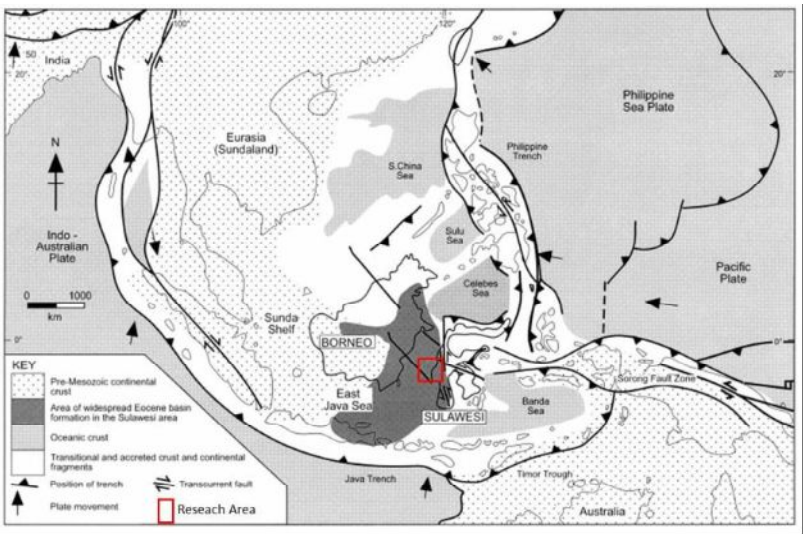

Fig. 1. Regional tectonic setting of the Sulawesi and Borneo island and distribution of pre-Mesozoic cratonic area as well as the formation of depressions in Sulawesi (Wilson and Moss, 1998).

Based on research conducted by Ratman and Atmawinata (1993), Mamuju and surrounding geological area (Figure 2) composed by Latimojong Formation, Talaya Volcanic rocks, Adang Volcanic rocks, Intrusion rock, Mamuju Formation, Tapalang Member of Mamuju Formation and alluvium deposit.

Latimojong formation; the oldest rocks exposed, composed by moderate metamorphosis, slate, quartzite, Phylite, altered quartz sandstone, altered siltstone and marble, local altered claystone, with an alkaline intrusion occurrences-intermediates and found several folds in metamorphic rocks, as well as inserts in the form of sandstone, limestone, chert, siltstone and sandy volcanic rock measuring, with a thickness of rocks is not known, the Middle-Late Eocene age. Talaya volcanic rock: in the form of volcanic breccia, tuff, including pillow lava and andesite-basalt lava to get a structure, with inserts sandstone and marl, local coal, Middle Miocene-Pliocene age, with a thickness of 500-1000 m, covered from Mamuju to Pasangkayu. Adang volcanic rocks; composed of; tuff, lava, and volcanic breccia get a structure leusite-basalt, mica and other volcanic eruptions products basaltic-andesitic composition. Intrusion rock Middle-Late Miocene; Intrusion rock composed of granite, granodiorite, rhyolite, diorite, and aplit. Mamuju formation; composed by marl, calaarenite, tuff and intercalation with coral limestone and sandstone also local conglomerate. Tapalang member of Mamuju formation,as reef limestone, tuff, and marl. Composition of leusite-volcanic rocks are basalt volcanic rocks formed in environments with potassic magma is composed of continental origin. The group is composed of ultra potassic rocks have the potential to contain radioactive minerals such as uranium and thorium, as an element of U and Th will be bound to the acid composition rock and a high potassium content. Volcanic rocks in West Sulawesi, has almost identical composition and affinity, but have significant difference of the radiation dose rate (Syaeful et al., 2014), thus mapping the distribution of volcanic rocks Adang are realy needed.

Comparation the distribution of the value of gamma radiation exposure and regional geological maps, gamma radiation exposure high enough on the distribution of Adang

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volcanic rocks and intrusion rock located in West Sulawesi. Outside the region, the value of gamma radiation exposure is quite low. Therefore, the study will focus on areas that have high value of gamma radiation exposure, around Adang volcanic rock and intrusion rock surrounding Mamuju area, West Sulawesi.

Regional geological structures in general Sulawesi island shaped zone faults and folds, such as Palu-Koro Fault, Walanae Fault, Matano Fault, Batui Fault, Poso Fault, Balantak Fault, Gorontalo Fault, North Sulawesi Subduction and Bone Bay.

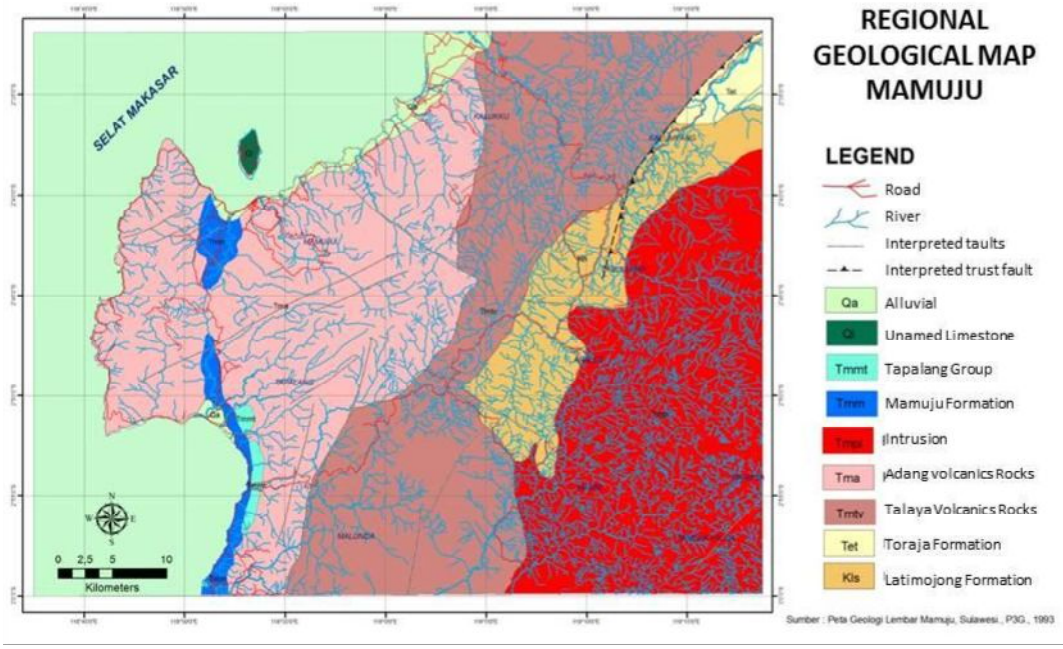

Fig. 2. Regional geological map of the study area (modification from Ratman dan Atmawinata, 1993)

Radioactive mineral occurrences generally associated with acid plutonic and volcanic igneous rocks. One of the uranium deposits are found in Indonesia is in Kawat Area, Upper Mahakam, East Kalimantan (Djokolelono, et al., 1985 and Sukadana, et al., 2008). Uranium is formed in this area found in acid rhyolite rock. This type of magma contained uranium associated with other elements. Uranium is usually found in facies that has many holes as well as the air and flow structures in the volcanic breccia and glass sperulith. Enrichment of radioactive elements, in other rocks type also can occur in alkaline rocks. Research conducted on some volcanic rocks indicate that the olivine basalt volcanic rock taken from the Simpson Island dyke (Burwash and Cavell, 1978), shows the enrichment of uranium and thorium are quite significant, in line with the increase in K_2O (Figure 3-4).

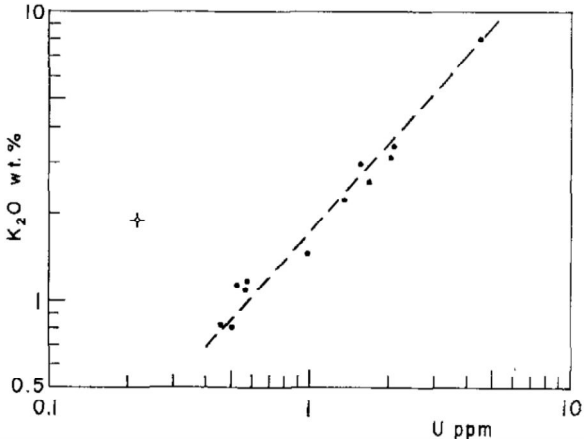

Fig. 3. The relationship between K_20 and U of example dyke Simpson Island, with a correlation coefficient +0985

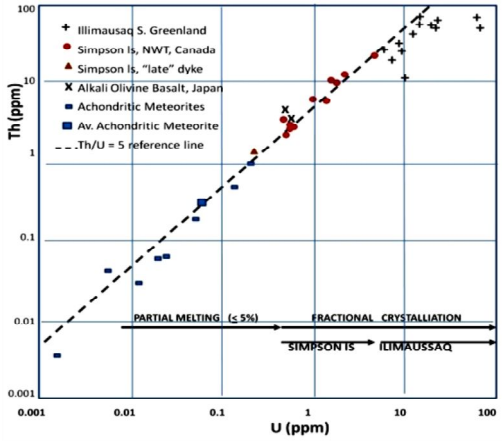

Fig.4. the relationship between U and Th in the example alkali olivine basalt (Burwash and Cavell, 1978)

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METHODOLOGY

Methodology that used in this research are interpretation of satellite image, field work as geological mapping, radionuclide measurement using gamma ray spectrometer (RS-125 model), sample collection and laboratory analysis. Furthermore the general analysis has been conducted to combine all data.

RESULT AND DISCUSSION

Beside the natural color image, the composite image can be used to help geology interpretation. RGB composite image 567 band is used to display the characteristics of the surface geology, among other lithological boundaries, geological structure, pattern straightness, and a circular shape. This composition will produce a false color (figure 3) for the third channel is the channel used infrared waves, the near infrared and short wave infrared.

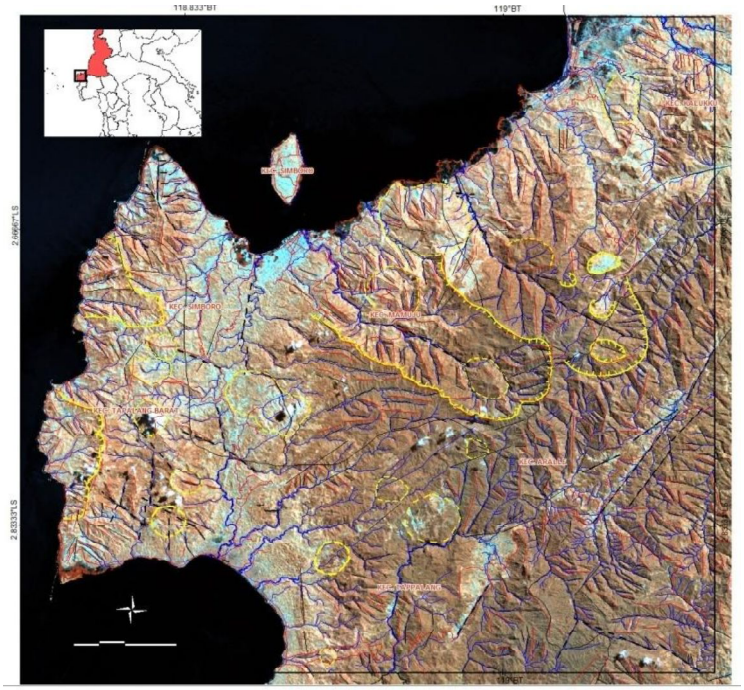

Fig 3. RGB composite image channel 567 provides an overview pseudo color, is used for the geology interpretation

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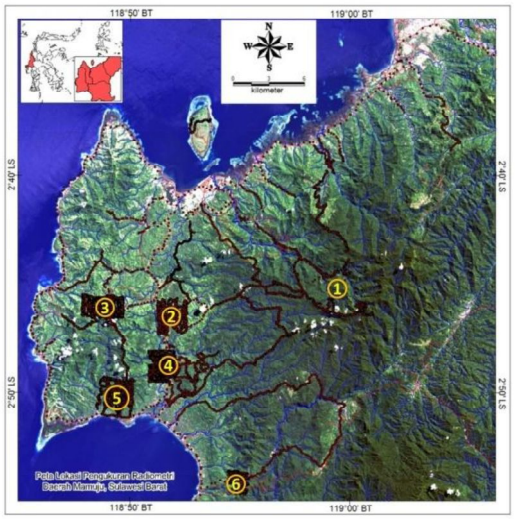

Fig. 4. Route of radiometric measurement

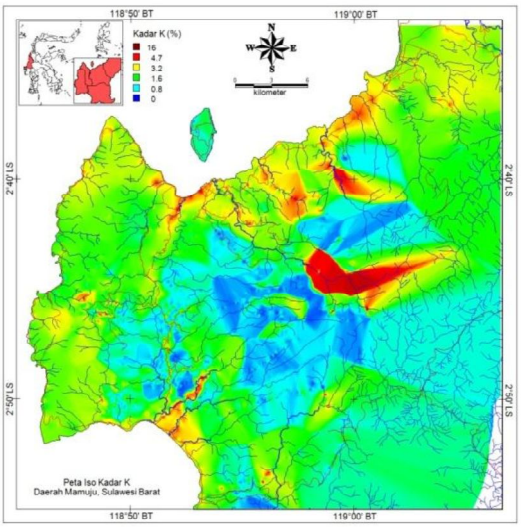

Fig.5. Potassium grade from measurement.

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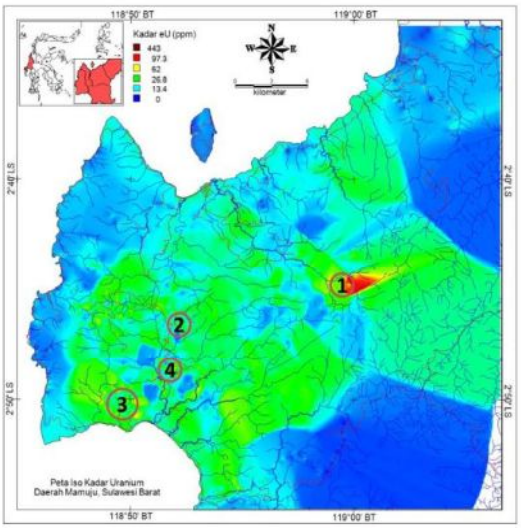

Fig. 6. The map of U content

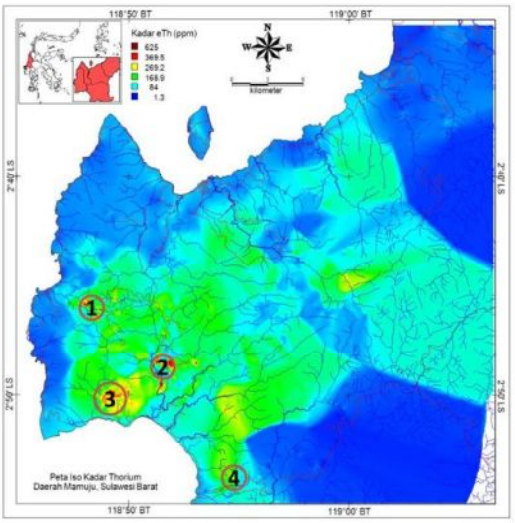

Fig.7. The map of Th content

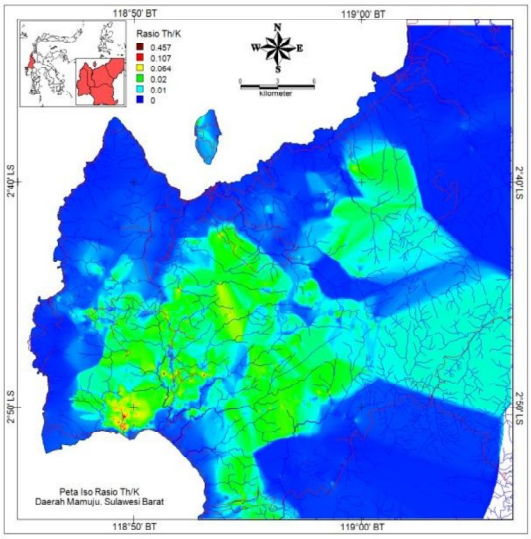

Fig. 8. The map of Th/K content ratio

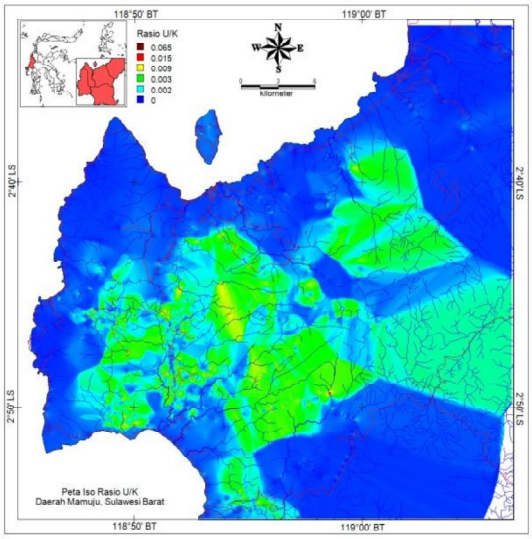

Fig.9. The map of U/K content ratio

Fig.10. Geological map of research area

CONCLUSION

Occurrences of radioactive elements in basaltic rock-intermediates (phonolite - trachyandesite) are more affected by the process metasomatisme on the mantle and lower continental crust and experience the process of enrichment in the continental crust as source rocks is Adang volcanic complex and favorable complex are Tapalang, Ampalas and Malunda teht shown by ratio of radionucide U/K and Th/K. Radioactive mineralization that may be formed in this area is volcanic related uranium deposits structural bound type, which is controlled by several factors which are the distribution lithology containing ultrapotasik /shosonitik, hydrothermal processes, especially in structures trending northeast-southwest, north-south and east-west, and a supergene enrichment process which includes the process of weathering, leaching and precipitation process radioactive elements.

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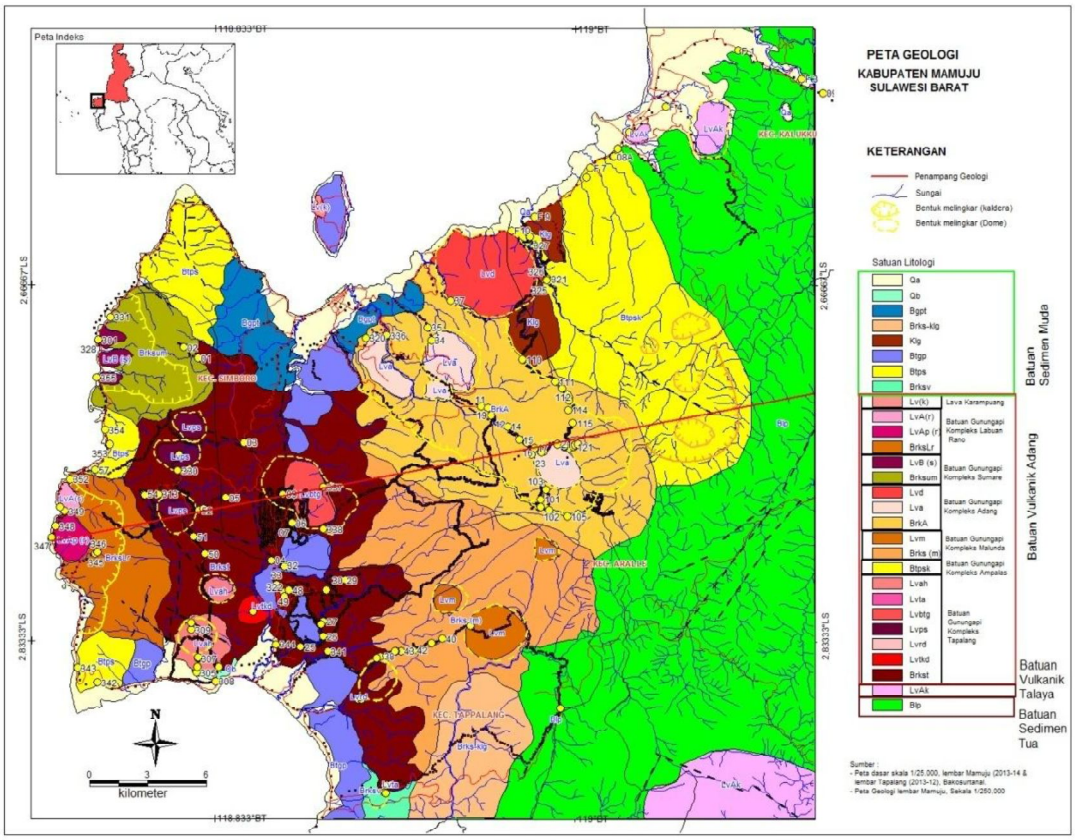

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REFERENCES

1. Iskandar, D., Syarbaini and Kusdiana, "Map of Environmental Gamma Dose Rate of Indonesian", PTKMR-BATAN, Not Published, (2007).
2. Syaeful, H., Sukadana, I.G., and Sumaryanto, A., "Radiometric Mapping for Naturally Occurring Radioactive Materials (NORM) Assessment in Mamuju, West Sulawesi", Atom Indonesia Vol. 40 No. 1, BATAN, Jakarta (2014)
3. Hazen, R.M., Ewing, R.C., and Sverjensky, D.A., "Evolution of uranium and thorium minerals", American Mineralogist, Volume 94, pages 1293–1311(2009).
4. Burwash, R.A. and Cavell, P.A., 1978, "Uranium-Thorium Enrichment in Alkali Olivine Basalt Magma – Simpson Island Dyke, Northwest Territories Canada", Contributions to Mineralogy and Petrology, Springer-Verlag.
5. IAEA-TECDOC-1363, "Guidelines for Radioelement Mapping Using Gamma-ray Spectrometry", IAEA, Viena-Austria (2003).
6. Ratman, N. dan Atmawinata, S., , "Peta Geologi Indonesia Lembar Mamuju dan sekitarnya, Sulawesi", Skala (1:250.000), Pusat Penilitian dan Pengembangan Geologi, Bandung (1993).
7. Wilson, M.E.J., Moss, S.J., "Cenozoic paleogeographic evolution of Sulawesi and Borneo". Palaeogeography, Palaeoclimatology and Palaeoecology 145, 303–337 (1999)
8. Sukadana, I.G., Ngadenin, Widana, K.S., Widito, P., Paimin, Sutriyono, A. Dan Sriyono., 2008, "Inventarisasi Potensi Sumberdaya Uranium Sektor Kawat, Mahakam Hulu, Kalimantan Timur, Tahapan Prospeksi Sistematik", Prosiding

Seminar Geologi Nuklir dan Sumberdaya Tambang Tahun 2008, Pusat Pengembangan Geologi Nuklir-BATAN, Jakarta.
9. Surono dan hartono, U., (2013), Geologi Sulawesi, Pusat Survei Geologi, Badan Geologi, Kementerian Energi dan Sumber Daya Mineral, LIPI Press., Jakarta, 352 p.
10. Wilson, M., 1989, Igneous Petrogenesis, Springer, Netherlands.