JURNAL TEKNOLOGI ACADEMIA ISTA ISSN: 1410-5829
Vol. 12 No. 2 Februari 2008

ANALYSIS THE KINDS AND COMPOSITIONS OF RADIOISOTOPE ELEMENT WITHIN THE MINE SAMPLES BY MCA SPECTROMETRY IN WEST TIMOR ISLAND NUSA TENGGARA TIMUR

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ABSTRACT

The problems analyzed in the research are the kinds and compositions of radioisotope within the mining substance in the West Timor Island. The purposes of the research : 1) to investigate and determine the kinds of radioisotope elements in the mining substance, 2) to determine the radiation energy, counts, half life, and percentage of radioisotope element deposit within the mining substance.

The methods of the research include observation, survey, sampling, spectrometry, analysis, and interpretation. On the observation, survey, and sampling steps, the 50 samples taken are distributed at the survey location. Those samples are analyzed with the several steps including: to dry the samples, to refine, to burn until temperature 800^o C, to stabilize and dry again. All samples are analyzed with spectrometry system on the multi-channel analyzer (MCA) that can separate element of the samples.

The results obtained are that the kinds of radioisotope element deposit within the samples of mining substance consist of Actinium series component and other association elements, also energy radiation, counts, half life, and percentage of radioisotope element deposit within the mining substance respectively revolved between 26.6 keV to 1562.3 keV,1 cps to 24867cps, 3.16 minutes to 1.405 x 10^{10} years, and 0.19% to 99.00%. The main elements on Actinium series within the samples of mining substance comprise of U-235, Th-231, Pa-231, Th-227, Bi-211, and Rn-219, and other isotopes Bi-212, Th-232, Pb-212, Pa-234, Ac-228, Ra-226, and Pb-214, with energy radiation, counts, half life, and percentage of radioisotope element deposit respectively revolved between 26.6 keV to 426.9 keV, 1 cps to 24867 cps, 7.038 x 10^8 years to 1.405 x 10^{10} years, and 1.0% to 18.7 %.

The association elements consist of Am-241, Cs-134, Cs-136, Cs-138, Ce-141, Ce-144, Ba-133, Ba-140, Cd-109, Se-75, Te-132, Co-57, Mo-99, Fe-59, Kr-85, Kr-88, Kr-89, Sb-122, Sb-124, Sb-125, Xe-125, Xe-131m, Xe-133m, Xe-135, Xe-135m, Xe-138, I-124, I-125, I-130, I-131, I-132, I-134, I135, Br-82, Y-91m, Y-92, Y-93, Y-94, W-187, Sr-91, Sr-92, Sr-93, Zr-97, Rb-89, Rh-105, Ni-65, Sn-133, Be-7, Nb-94, Nb-96, Nb-97, Ag-110m, As,76, Cr-51, Eu-152, and Tc-96.

Key words: *Analysis, kind, composition, radioisotope, mine*

INTISARI

Masalah yang dianalisis dalam penelitian ini adalah jenis dan komposisi unsur radioisotop dalam bahan tambang di Pulau Timor Barat NTT. Tujuan penelitian: 1) menyelidiki dan menentukan jenis unsur radioisotop dalam bahan tambang, 2) menentukan energi radiasi, cacah, waktu paruh, persentase deposit unsur radioisotop dalam bahan tambang.

Metode penelitian terdiri atas observasi, survei, sampling, spektrometri, analisis, dan interpretasi. Pada tahap observasi, survei, dan sampling, diambil 50 sampel yang terdistribusi merata di lokasi survei. Sampel-sampel tersebut dianalisis dengan langkah-langkah sebagai berikut: mengeringkan sampel, menyaring, membakar sampai temperatur 800^o C, menstabilkan dan mengeringkan kembali. Semua sampel dianalisis dengan sistem spektrometri pada *multichannel analyzer (MCA)* yang dapat memisahkan jenis unsur dalam sampel.

Hasil yang diperoleh, jenis unsur radioisotop dalam sampel bahan tambang terdiri dari komponen deret actinium dan unsur-unsur asosiasi lainnya, juga energi radiasi,

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cacah, waktu paruh, dan persentase deposit unsur radioisotop dalam bahan tambang berturut-turut berkisar antara 26,6 keV – 15620,3 keV, 1 cps – 24867 cps, 3,16 menit – 1,405 x 10^{10} tahun, dan 0,19% - 99,00%. Unsur-unsur pokok deret *actinium* dalam sampel bahan tambang terdiri atas: U-235, Th-231, Pa-231, Th-227, Bi-211, and Rn-219, serta isotop lainnya adalah: Bi-212, Th-232, Pb-212, Pa-234, Ac-228, Ra-226, and Pb-214, dengan energi radiasi, cacah, waktu paruh, dan persentase deposit unsur radioisotop dalam bahan tambang berturut-turut berkisar antara 26,6 keV – 426,9 keV, 1 cps – 24687 cps, 7,038 x 10^{8} tahun – 1,405 x 10^{10} tahun, dan 1,0% - 18,7%.

Unsur-unsur asosiasinya meliputi: Am-241, Cs-134, Cs-136, Cs-138, Ce-141, Ce-144, Ba-133, Ba-140, Cd-109, Se-75, Te-132, Co-57, Mo-99, Fe-59, Kr-85, Kr-88, Kr-89, Sb-122, Sb-124, Sb-125, Xe-125, Xe-131m, Xe-133m, Xe-135, Xe-135m, Xe-138, I-124, I-125, I-130, I-131, I-132, I-134, I135, Br-82, Y-91m, Y-92, Y-93, Y-94, W-187, Sr-91, Sr-92, Sr-93, Zr-97, Rb-89, Rh-105, Ni-65, Sn-133, Be-7, Nb-94, Nb-96, Nb-97, Ag-110m, As,76, Cr-51, Eu-152, and Tc-96.

Kata kunci: Analisis, jenis, komposisi, radioisotop, tambang

INTRODUCTION

The territory or area is located in Nusa Tenggara Timur Indonesia, visible barren if it is inspected or seen spontaneously, however when the area is investtigated carefully, we can see that the area is rich with the various mining minerals which have the high economic value.

On observation and pre survey, it appears that at Nusa Tenggara Timur Indonesia there are several natural radioisotope sources, that are still hidden or buried within the rock minerals. It is not yet investigated carefully. The symptom on the land surface show that, at Flores Island Ngada and Larantuka, and at West Timor Island there are distribution of natural radioisotope element contents which are very large. That is estimated or presumed that the contents of radioisotope element at those places are prospect enable for exploration to support the development rate of region specially and nationally general.

Pre survey have been generally done to give description or image that the distribution of radioisotope element contents within the mining substance in the West Timor Island, a large part at Subdistrict of Amarasi, Middle Kupang, and East Kupang, It is started from West Kupang and spread out to east direction through a part of Middle Kupang, Amarasi, until to a part of East Kupang with the distance 35 km approximately. On the pre survey at Oesuu village Sub-district of Amarasi West Timor Island is obtained the result that the distribution of radioisotope elements there are on the area around 12 kilometers x 15 kilometers with the area that some time dangerous is around 2 kilometers x 3 kilometers (Pasangka,1998). The composition of lands constitutes the aluvial and coluvial area those are formed from sedimentary rocks because compression of the highest pressure and corrosion, and other part of this area are metamorphic rocks.

The neutron activation analysis of radioisotope element concentration on several samples citation at the area on pre survey, give the result revolve between 2 ppm to 27 ppm (Pasangka, 1997) That result assumption that the rock minerals at West Timor Island Nusa Tenggara Timur Indonesia, contents prospect of radioisotope element.

Based on observation and pre survey result at West Timor Island Nusa Tenggara Timur Indonesia, the researcher wishes to study or investigate and express clearly about the kind or various element, half life, counts, percent of atom residue after decay, and radiation energy of radioisotope element within mining substance, as a pre step for exploration.

The main problem studied or investigated in these research is natural radioisotope is focused on the kind or various element, half life, percent of atom residue after decay, and radiation energy of radioisotope element within mining substance.

The problems specification will be studied or researched consist of: the kind or various of radioisotope element, half life, percent of atom residue after decay, and radiation energy.

The general aims of these research comprises of study or investigate of radioisotope element deposits or contents within mining substance. The specific aims that will be studied on these research consist of: to investigate and determine the kinds element, half life, radiation energy, and percent of atom residue after decay within mining substance in the West Timor Island NTT.

The layer composition of the earth's crust consists of the earth's outer crust, cover, and mantle which can be characterized of solid, liquid, and gas. Solid material is called rocks in composition of minerals. Based on it's formed, the rocks consist of: igneous rocks, sedimentary rocks, and metamorphic rocks. The composition of rocks on the earth surface, generally is dominated by sedimenttary rocks 66% approximately on the surface, extrusion rocks 8%, intrusion rocks 9%, and metamorphic rocks 17% (Munir,1996).

In composition of rocks is contained natural radioisotope elements which are present do simultaneously with forming of the earth and universe. The primordial radionuclide which have been present do simultaneously with forming of the earth and rocks, generally consists of Potassium-40 and a row of nuclide as product of radionuclide decay occur in natural like as series of Uranium (4n+2), Thorium (4n), and Actinium (4n+3). The other primordial radionuclide are found in natural include Rb-87, La-136, Lu-176, Ln-115, Re-187, and C-14 (Munir, 1996).

Burnett et al (1988) give expression that the abundance of radioisotope elements like as Potassium, Thorium, and Uranium can be found within the several kind of rocks like as Meteorites, Terrestrial that consist of Olivine-Hornblende, Plagioclase(Granite), and Basalt.

Another that, Langford proposes that the accumulation of radioisotope element like as Uranium, there are within several rock minerals like as Pegmatites, Carnotite, Tazin Gneiss (Langford, 1987).

The research result from Hanson et al give the report that the anomaly of radioisotope element contents, is accumulated at the aluvial area that rich of Granite, Carnotite, Tyuyamunite, Asphaltic Sandstones, Moccasin Creek Gypsum, Carbonate, and generally in sedimenttary rocks (Hanson, et al, 1987).

Accumulation anomaly of radioisotope element contents within the rock mineral, physically is influenced by the several factors like as: depth, permeability of rocks, rainfall, flow dynamic, and it's associate with non radioisotope rocks (Huang, 1988).

Radioactivity is an incident that is caused by the changing process in unstable atomic nucleus with processing go on spontaneous. The nucleus stabilization of an atomic is established by combination of proton number and neutron. The stable light in weight element, the ratio n/Z equal to 1.00 and the stable heavy element, n/Z until 1.50. On the changing process n/Z, is accompanied with alpha and beta emission and is followed with gamma emission. The emission event of radiation is added with electron capture is called radioactive decay (Krane, 1988).

The spontaneous change of element can directly produce the stable daughter and can also on series process like as series of Uranium, Thorium, Actinium, and Neptunium.

Initial decay produces direct a stable daughter fulfill equation (Meyerhof, 1989):

$$N = N_o e^{-\lambda t} \text{ .....(1)}$$

where N is the number of rest atomic after decay in t second time, N_o is the number of initial atomic, t is decay time, and λ is decay constant.

Decay reaction which go on series fulfill an equation (Faure,1986., Krane,1988., Tsoulfanidis,1983., Telford et al, 1976):

The series decay until to the second daughter:

$$N_2 = \frac{\lambda_1}{\lambda_2 - \lambda_1} N_1^o (e^{-\lambda_1 t} - e^{-\lambda_2 t}) \text{ ...(2)}$$

The series decay until to the third daughter:

$$N_3 = N_1^o \left(1 + \frac{\lambda_1}{\lambda_2 - \lambda_1} e^{-\lambda_2 t} - \frac{\lambda_1}{\lambda_2 - \lambda_1} e^{-\lambda_1 t} \right)$$

.....(3)

The series decay until to the n daughter:

$$N_n = c_1 e^{-\lambda_1 t} + c_2 e^{-\lambda_2 t} + ... + c_n e^{-\lambda_n t} \quad (4)$$

and activities : A = **c**λN or $A = A_o e^{-\lambda t}$ ……..(5)

where: N, N_1, N_2, N_3, and N_n the number of atom after decay on t sec, t_1 sec, t_2 sec, t_3 sec, and t_n sec respectively, t : time, $\lambda, \lambda_1, \lambda_2, ..., \lambda_n$: decay constants, A : activity of sample after decay on t sec, A_o : initial activity ,and ***c****:* detection coefficient.

$$c_1 = \frac{\lambda_1 \lambda_2 .....\lambda_{n-1} N_1^0}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)(.....)(\lambda_n - \lambda_1)} \quad ... \quad .....(6)$$

$$c_2 = \frac{\lambda_1 \lambda_2 .....\lambda_{n-1} N_1^0}{(\lambda_1 - \lambda_2)(\lambda_3 - \lambda_2)(.....)(\lambda_n - \lambda_2)},$$

etc.....(7)

The methods are used in the research consists of observe/survey, sampling, spectroscopy/spectrometry, and analysis. Procedures of the research as follow: 1) to prepare and calibrate equipments necessary, 2) to dry and refine the samples, 3) the samples are filtered and put into the planset, 4) the samples are burned until 800^{o}C, so that, the all samples are changed to the dust. After the samples cold, they are put into the platinum crucible and add distillation water and dry again by hot plate, 5) the last process is analyzed the samples on Multi-channel Analyzer (MCA). By using Genie 2000 program which consist of alpha and gamma acquisition and analysis, will be obtained the kinds of radioisotope element and the quantities of: counts, radiation energy, half life, percent of atom residue after decay, and also the complete spectrum, 6) interpretation and conclusion. Procedure upon, can be shown clearly on Figure 1.

MCA Setting:
1. Acquire Setup : Live time : 1000s, Comp. Preset : none. 2. Adjust: 2.1 ADC (Analog to digital converter): * Conversion gain (0 to 1024) : 512. * Lower level discriminator threshold (%): setting limits the energy range: 3.44%. * Lower lever discriminator (LLD): 1.18%. * Upper level discriminator (ULD) : 1000%. * Zero (%) – Stored in channel 3.* Exit. 2.2 Stabilizer.* Gain Centroid: 521 channel. 2.3 Amplifier: * Coarse gain: x 140, * Input polarity: Positive, * Exit. 2.4 HPVS: *. Status: on. *. Voltage (600-1300)V: 900V. 2.5 Power Manager: * Stand by delay (:Min): 10 min. 2.6 MCS: * Dwell time: 20 ms. * Disc mode: Integral. * ROI start:1 channel, * ROI end : 1024 channel, (ROI : regions of interest). 2.7 Input: * Input name: DSA-2000, * Detector Type: NaI Crystal. 2.8 Filter:* Pre-amplifier type: RC.* Rise time: 5.6. 2.9 Calibration setup (Menu): * Preferences: Enegy Unit s(eV, keV, MeV, other): keV. * Tolerance units (energy, FWHM): energy.
* Calibration setting: - Tolerance: energy cal: 1.500e +000 keV, eff.match: 1.000e + 000 keV (autoatically). - Tail curves: (None, low): low.- Continuum: (step, linear, none): step. * Analysis sequence description: (none, channel): channel. 2.10 Display: * Expand: (on, off, expand spectrum). * Scale: (Manual, auto, linear, log). *. Compare.

DISCUSSION

The results of spectrometry analysis with multi-channel analyzer system for 50 samples citation of mining substance which are taken from radioisotope source at Sub-district of Amarasi, Middle Kupang, and East Kupang West Timor Island, included in the Table 1, Table 2, and Table 3 as below.

The composition of elements within the samples of mining substance, a large part is classified within Actinium series (U-235) like as in Table 1, and the others are isotopes and association elements (Table 2 and Table 3). The compsition of the elements within the samples of mining substance, mineral association possibility comprises of Uraninite (UO_3,UO_2), Braunnerite ($UFeO_6$), Torianite (ThO_2), Dumontite [$Pb_2(UO_2)(PO)_2$. $5H_2O$], Galenite (PbS), Platnerite (PbO_2), Plumboferite($PbFe_4O_7$), Gummite [$Pb(UO_2)_2$ okside, Stelsite ($PbWO_4$), Masuyite ($UO_3.2H_2O$ Pb), Ianthinite ($2UO_2$. $7H_2O$), Epiianthinite ($UO_3.2H_2O$), Shoepite (UO_3. $2H_2O$), Curite ($Pb_3U_8O_{27}$. $4H_2O$), Fourmarite ($PbU_4O_{13}.7H_2O$), Wolsendorfite (PbU_2O_7. $2H_2O$), and Clarkeite $(Pb,Th)_2$ $U_2(O,H_2O)_7$. $2H_2O$), and Clarkeite $(Pb,Th)_2$ $U_2(O,H_2O)_7$.

The form of mineral association structure in the mining substance can be ascertained through physical and chemical analysis. The number of kinds of element are deposited within the rock samples in the West Timor are complex.

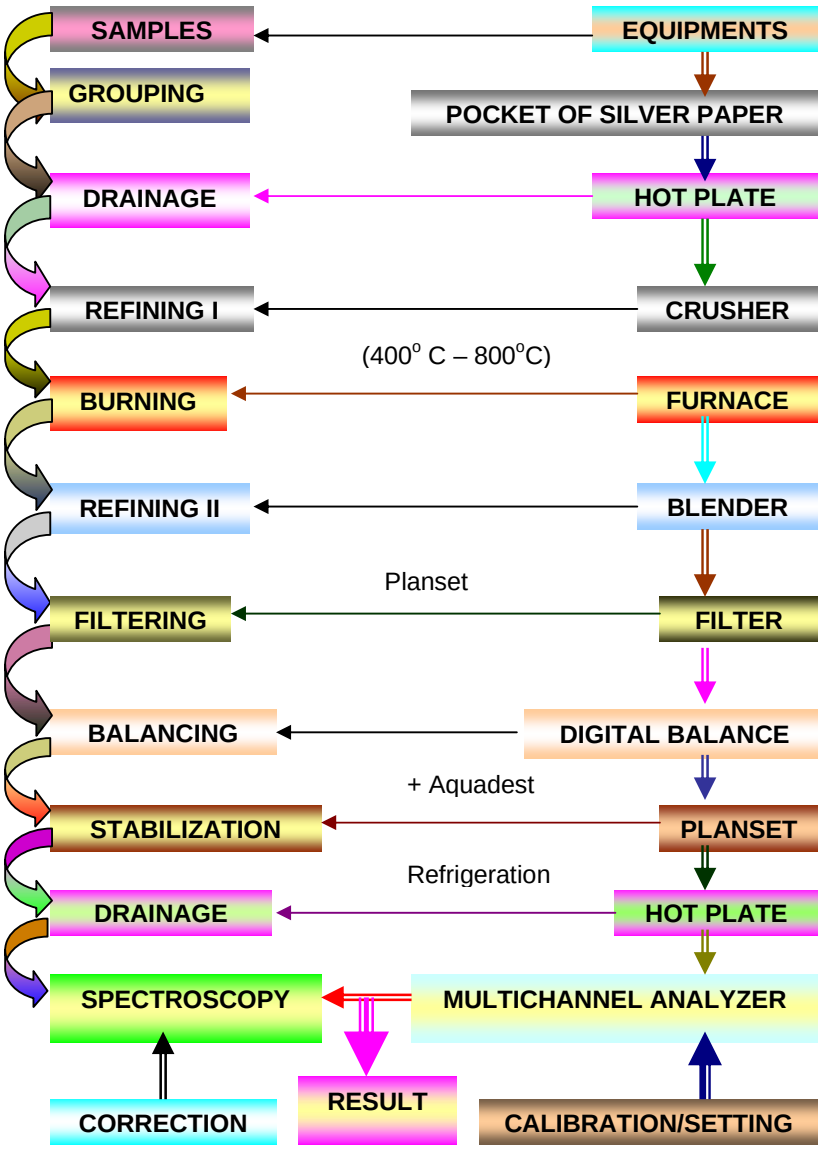

Figure 1. The systematic sketch of sample analysis

Table 1. The Composition of elements in actinium series within 50 samples (spectrometry analysis with multi-channel analyzer system)

Series elements	Half life	Energies revolving (keV)	Deposit residue revolving (%)
U-235	7.038 x 10^8 years	90.0., 105.0., 109.1., 143.8., 202.1., 205.3	1.00., 1.00., 1.50., 10.50., 1.00., 4.70
Th-231	7.038 x 10^8 years	26.6., 84.2	18.70., 8.00
Pa-231	7.038 x 10^8 years	27.4., 300.1., 302.7., 330.1	9.30., 2.30., 4.60., 1.30

Th-227	7,038 x 10^8 years	50.2., 94.0., 210.6., 236.0.,	8.50., 1.40., 1.13., 11.20., 6.80.,
		256.3., 286.1., 334.4	1.58., 1.00
Bi-211	7.038 x 10^8 years	72.9., 404.8., 426.9	1.20., 4.10., 1.90
Rn-219	7.038 x 10^8 years	401.8	6.60

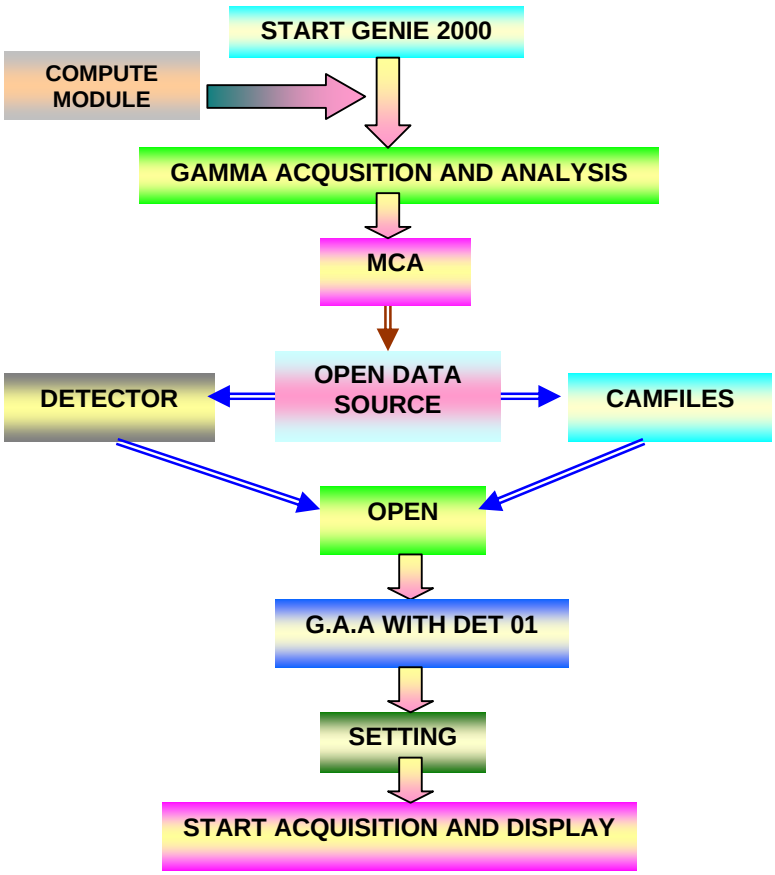

Figure 2. The systematic sketch of Genie 2000 program is operated by MCA and computer system.

Table 2. The isotopes of actinium series are composed within 50 samples

Isotope	Half life	Energies revolving (keV)	Deposit residue revolving (%)
Bi-212	1.405 x 10^{10} years	39.9	1.10
Th-232	1.405 x 10^{10} years	59.0	0.19
Pb-212	1.405 x 10^{10} years	74.8., 77.1., 238.6	9.60., 17.50., 44.60
Pa-234	4.468 x 10^9 years	98.4., 131.3., 152.7., 226.9	25.10., 20.00., 7.20., 6.50
Ac-228	1.405 x 10^{10} years	129.1., 270.2., 327.6., 338.3	2.80., 3.60., 3.20., 11.40.,
		., 409.5	2.13
Ra-226	1600 years	186.2	3.28
Pb-214	1600,01 years	242.0., 295.2., 351.9.,	7.49., 19.20., 37.20.,
		768.4., 785.9., 934.1.,	5.04., 1.10., 3.21.,
		11155.2.,	1.69

Table 3. The composition of association elements within 50 samples

Elements	Half life	Energies revolving (keV)	Deposit residue revolving (%)
Am-241	2.277 x 10^8 minutes	59.5	36.30

Cs-134	2.062 years	801.9	8.73
Cs-136	13.16 days	66.9., 86.3., 273.6., 340.6	12.50., 6.30., 12.66., 48.50
Cs-138	32,2 minutes	138.1., 409.0., 1147.2.,	1.40., 4.66., 1.24.,
		1343.6., 1435.9	1.14., 76.30
Ce-141	32,5 days	145.4	48.40
Ce-144	284.3 days	80.1	1.60
Ba-133	10.5 years	81.0., 276.4., 356.0., 383.9	33.00., 6.90., 60.00., 8.70
Ba-140	12.789 days	162.6., 437.5., 537.3	6.70., 2.00., 25.00
Cd-109	464 days	88.0	3.72
Se-75	119.78 days	96.7., 136.0., 264.7., 279.5.,	3.41., 59.50., 59.80., 25.20.,
		303.9	1.32
Te-132	78.2 hours	111.8., 116.3., 228.2	1.85., 1.94., 88.00
Co-57	270.9 days	122.1	85.51
Mo-99	66.02 hours	140.5., 181.1	88.70., 6.20
Fe-59	44.63 days	142.6., 192.3., 1291.6	1.03., 3.11., 43.20
Kr-85	3915.4 days	514.0	0.43
Kr-88	2.84 hours	166.0., 196.3., 362.2.,	3.10., 26.00., 2.25.,
		1179.5	1.00
Kr-89	3.16 minutes	197.5., 345.0., 369.3., 416.4	1.82., 1.18., 1.38., 2.56.,
		., 585.8., 696.2	1.78., 16.60
Sb-122	2.7 days	563.9., 692.8	70.60., 3.70
Sb-124	60.2 days	968.2	1.92
Sb-125	2,77 years	176.3., 380.4., 427.9., 463.4	6.89., 1.50., 29.33., 10.50
Xe-125	16.8 hours	188.4., 243.4	55.10., 28.20
Xe-131m	11.84 days	163.9	1.96
Xe-133m	2.19 days	233.2	10.30
Xe-135	9.11 hours	249.8	89.90
Xe-135m	15.36 minutes	526.6	81.00
Xe-138	14.13 minutes	153.8., 258.3., 396.4., 434.7	5.95., 31.50., 6.30., 20.30
I-124	4.18 days	1509.5	2.91
I-125	12.93 days	388.6	29.10
I-130	12.36 hours	536.1	99.00
I-131	8.04 days	284.3., 364.5	6.05., 81.20
I-132	2.295 hours	522.7., 630.2., 667.7	16.10., 13.170., 98.70
I-134	52.6 minutes	405.5., 847.0	7.30., 95.41
I-135	6.61 hours	220.5., 288.5	1.75., 3.09
Br-82	2118 minutes	221.4	2.26
Y-91m	49.71 minutes	557.6	95.08
Y-92	3.54 hours	448.5., 561.1	2.30., 2.40
Y-93	606 minutes	266.9	6.90
Y-94	18.7 minutes	381.6., 550.9., 618.4	2.20., 4.93., 6.70
W-187	23.83 minutes	134.2., 479.5., 685.8	9.50., 23.40., 29.20
Sr-91	9.5 hours	620.1., 652.3	1.72., 2.89
Sr-92	2.71 years	430.6	3.30
Sr-93	7.3 minutes	168.7., 260.1., 710.4	18.20., 7.30., 21.50
Zr-97	16.9 hours	254.1., 507.6	1.25., 5.30
Rb-89	15.44 minutes	272.5	1.42
Rh-105	2121.6 minutes	306.1., 318.9	5.13., 19.20
Ni-65	2.52 hours	366.3	4.61
Sn-133	115.1 days	391.7	64.90
Be-7	7.695×10^4 minutes	477.6	10.42
Nb-94	20300 years	702.6	90.00
Nb-96	23.35 hours	568.9	55.70
Nb-97	72.1 minutes	657.9	98.09
Ag-110m	3.598×10^5 minutes	446.8., 706.7., 818.0	3.64., 16.68., 7.30
As-76	1579.2 minutes	559.1	44.70
Cr-51	27.704 days	320.1	9.83
Eu-152	13.6 years	344.3., 444.0	26.50., 3.11
Te-96	21.28 days	1126.8	15.20

It is appropriate with the opinion from any geologists that the rock composition in the West Timor is formed from the complex rocks in several blocks. That is formed by collision between Australian continental shelf and Banda Arc that cause the appointment upward of the rock layer and also formation and deformation of rock in the form of break thrusts (Asikin, 1998).

The deposit of the radioisotope elements within the sample of mining substance at Amarasi, Middle Kupang, and East Kupang West Timor Island, generally is composed in Actinium series (U-235) and the others are association elements with counts, radiation energy, deposit percentage, and half life respectively revolved between 1 cps to 24867 cps, 26.6 keV (Th-231) to 1562.3 keV (Ag-110m), 0.19% (Th-232) to 99.00% (I-130), and 3.16 minutes (Kr-89) to 1.405 x 10^{10} years (Bi-211, Th-232, Pb-211, and Ac-228).

The deposit composition of radioisotope elements are dominated by the elements concluded in the Actinium series (U-235, Th-231, Pa-231, Th-227, Bi-211, and Rn-219), other isotopes: Bi-212, Th-232, Pb-212, Pa-234, Ac-228, Ra-226, and Pb-214, and also association elements like as Am-241, Cs-134, Cs-136, Cs-138, Ce-141, Ce-144, Ba-133, Ba-140, Cd-109, Se-75, Te-132, Co-57, Mo-99, Fe-59, Kr-85, Kr-88, Kr-89, Sb-122, Sb-124, Sb-125, Xe-125, Xe-131m, Xe-133m, Xe-135, Xe-135m, Xe-138, I-124, I-125, I-130, I-131, I-132, I-134, I135, Br-82, Y-91m, Y-92, Y-93, Y-94, W-187, Sr-91, Sr-92, Sr-93, Zr-97, Rb-89, Rh-105, Ni-65, Sn-133, Be-7, Nb-94, Nb-96, Nb-97, Ag-110m, As,76, Cr-51, Eu-152, and Tc-96.

The radioisotope elements are included in Actinium series have the radiation energy, counts, deposit percentage, and half life respectively revolved between 26.6 keV to 426.9 keV, 1 cps to 24867 cps, 1.0% to 18.7 %, and 7.038 x 10^{8} years.

Five examples of element composition spectrum in the samples of mining substance are shown on Figure 3, 4, 5, 6, and Figure 7.

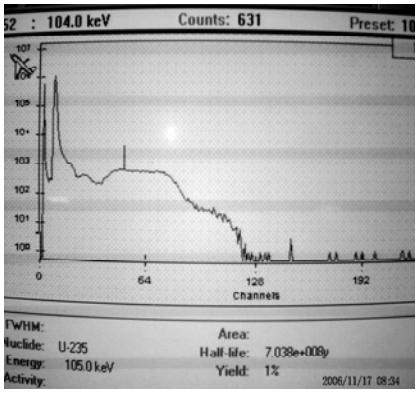

Figure 3. Radiation spectrum on sample 5b (Spl.5b.CNF)

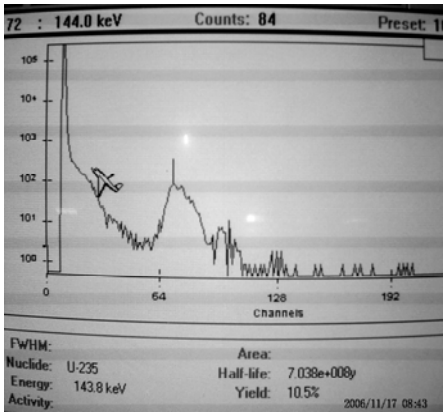

Figure 4. Radiation spectrum on sample 7b (Spl.7b.CNF)

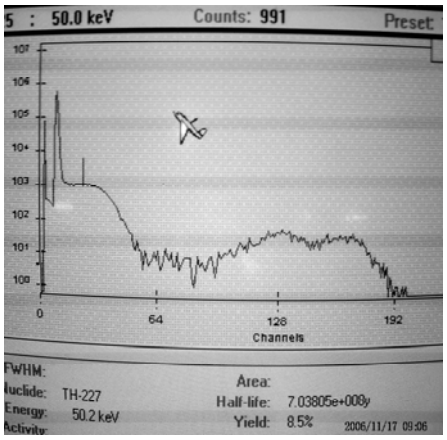

Figure 5. Radiation spectrum on sample 8e (Spl.8e.CNF)

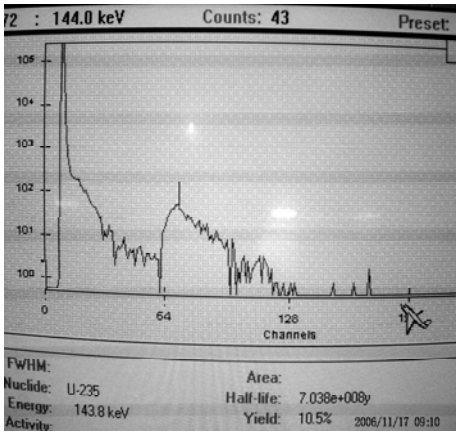

Figure 6. Radiation spectrum on sample 9e (Spl.9e.CNF)

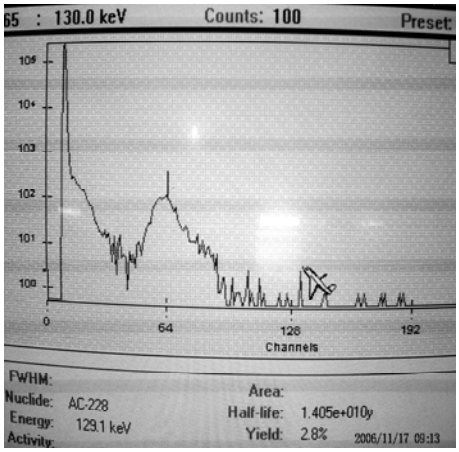

Figure 7. Radiation spectrum on sample 10d (Spl.10d.CNF)

CONCLUSION

The composition of radioisotope elements deposit within the sample citation at Amarasi, middle Kupang, and east Kupang west Timor island, a large part is concluded in Actinium series (U-235).

The main elements of U-235 series components within the samples citation of mining substance consist of: U-235, Th-231, Pa-231, Th-227, Bi-211, and Rn-219, with other isotopes Bi-212, Th-232, Pb-212, Pa-234, Ac-228, Ra-226, and Pb-214, also the association elements comprise: Am-241, Cs-134, Cs-136, Cs-138, Ce-141, Ce-144, Ba-133, Ba-140, Cd-109, Se-75, Te-132, Co-57, Mo-99, Fe-59, Kr-85, Kr-88, Kr-89, Sb-122, Sb-124, Sb-125, Xe-125, Xe-131m, Xe-133m, Xe-135, Xe-135m, Xe-138, I-124, I-125, I-130, I-131, I-132, I-134, I135, Br-82, Y-91m, Y-92, Y-93, Y-94, W-187, Sr-91, Sr-92, Sr-93, Zr-97, Rb-89, Rh-105, Ni-65, Sn-133, Be-7, Nb-94, Nb-96, Nb-97, Ag-110m, As,76, Cr-51, Eu-152, and Tc-96.

The quantity of radiation energy, counts, half life, and deposit percentage of radioisotope element within the samples citation respectively revolved between 26.6 keV to 1562.3 keV,1 cps to 24867cps, 3.16 minutes to 1.405 x 10^{10} years, and 0.19% to 99.00%. For elements that are concluded in Actinium series (U-235) and their's isotopes have the radiation energies, counts, half life, and deposit percentage respectively revolved between 26.6 keV to 426.9 keV, 1 cps to 24867 cps, 7.038 x 10^{8} years to 1.405 x 10^{10} years, and 1.0% to 18.7 %.

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