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GOLD ABUNDANCES IN BASALTIC LATERITIC SOIL OF KUANTAN PAHANG

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ABSTRACT. *Lateritic soil produced from the weathering of basaltic rocks is widely exposed in Kuantan, Pahang. Sections of the soil are found at road cuttings and housing projects. Twenty soil samples were collected and analysed for Au and Fe abundances. The Neutron Activation Analysis (NAA) and X-ray flourescence (XRF) were respectively used for Au and Fe. The data obtained shows that the average abundances of Au is 4.3ppb, and Fe as* Fe_2O_3 *is 20.23%. Geochemical correlation between Au and Fe is weak. Au probably exist together with the Fe in the oxidation zone of the basaltic soil. The gold abundance obtained in the present data is in agreement with the global crustal average.*

INTRODUCTION

Lateritic soil may result from chemical weathering of basaltic rocks under humid tropical conditions. Such soil is found in Kuantan, Pahang. Association of gold with lateritic basaltic soil is known and reported from Australia (Wilson 1983) and Brazil (Porto & Hale, 1996). Data for gold abundance in Malaysian basaltic laterite is unknown. This paper presents the data of gold abundances in the Kuantan basaltic soil.

The Late Cainozoic Kuantan basalt is distinguished into three lava groups, namely alkali olivine basalt, limburgite and olivine nephelinite (Chakraborty & Kameneni, 1978). Of this the alkali olivine basalt is the most widespread, followed by olivine nephelinite, while the limburgite is negligible in volume. There are many studies of basaltic rock in Kuantan area, especially in geochemistry and petrology (Chakraborty et al. ,1980; Abdul Hanif Hussien, 1975). Weathering processes produced enrichment of aluminium and iron oxides, as reported in Baba Musta *et al.* 1996. Abundance of trace elements in basaltic soil was studied by Baba Musta & Mohamad Md. Tan (1995).

Outcrops of the Kuantan basalt rock are found in the north and west of Kuantan. The localities of weathering profiles and sampling stations for this study are from road cuts and housing projects. The localities are also sampling stations and marked as KKgP, 35KSgL, 37KSgL, KPG, 20KKT, 202KKT and, KPBH in Figure 1.

METHODOLOGY

Field observation and sample collection

Field observations show that most of the weathering profiles are completely weathered forming thick soil. No fresh rock at the bottom of the profile is seen. Soil from the top to the

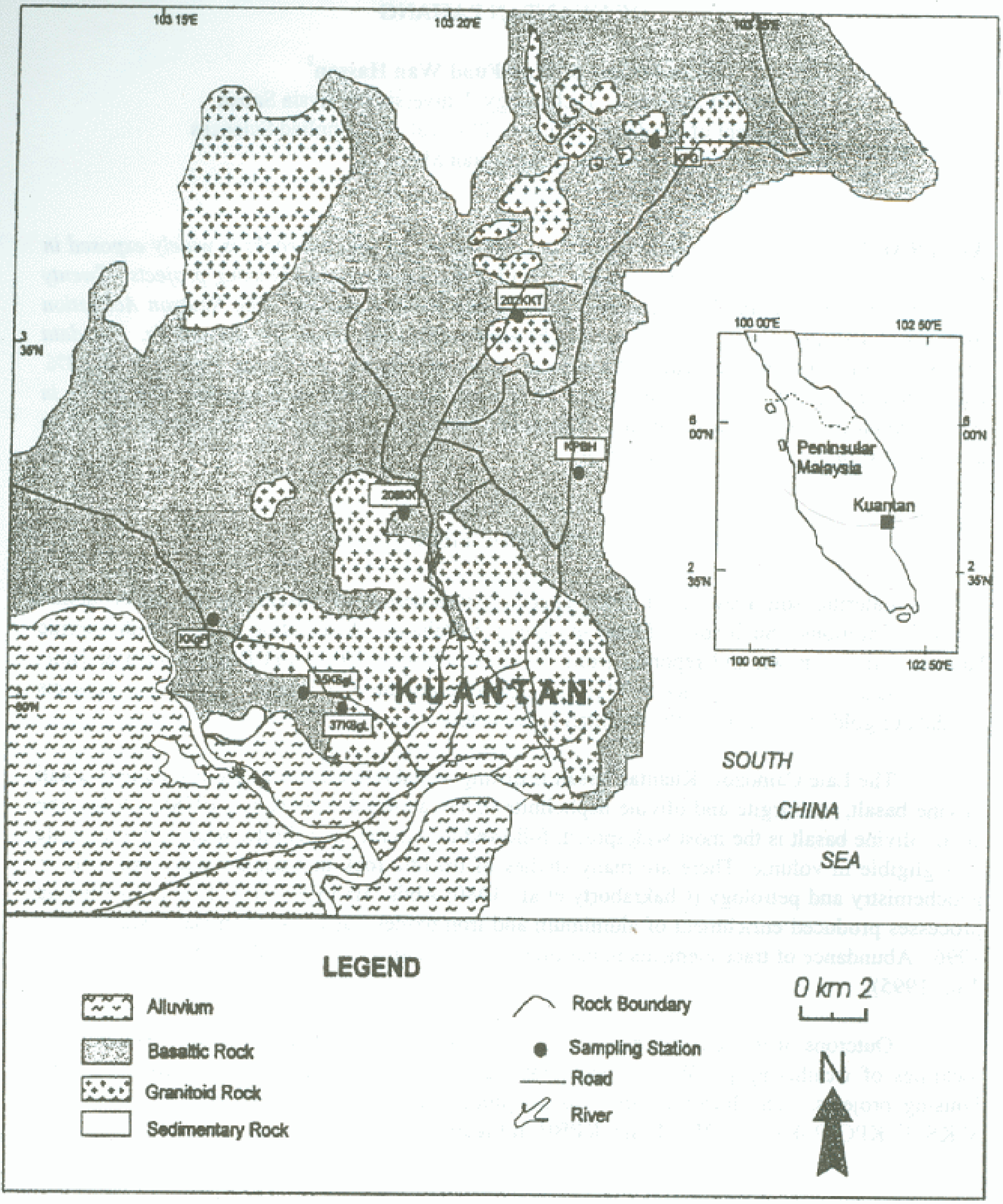


Figure 1: Map of the area study showing the sampling station and distribution of rock types at Kuantan (Modified from Haile et. al 1983).

bottom of the profiles shows a clear colour changed, from dark-gray at the top to light-yellow at the bottom. This colour change is similar in all profiles observed. The soil colour is controlled by the content of secondary minerals such as goethite and kaolinite as well as organic matter (Baba Musta & *et. al*, 1996). The content of minerals and major elements in soil are shown by the type of lateritic soil.

The samplings have been made at depths of 0.0m to 2.0m. However, locality 35KSgL was sampled from 0.0m 12.0m to measure the distribution of Au in the vertical profile.

Sample analysis

Neutron Activation Analysis (NAA)

Gold values in the soil samples were analysed by neutron activation analysis (NAA). The principle of this technique is to activate the gold atom in the sample using neutron-ray. Gamma-ray is emitted by the radio nuclides, formed from the neutron-ray at certain voltage level. NAA is presently considered the best method for trace gold analyses as it has a very high detection limit, is free of matrix influence, involves simple sample preparation, multi-element analysis, does not need added chemical for analysis and it is effectively not polluted by any chemical (Das et al. 1989).

In this study, standards method used in MINT described in Mohd Suhaimi Hamzah *et. al* (1989) is adopted. Analyses based on 1.0 gm powdered, evenly ground sample. Ultramafic Ore Tailings UM T-1 from Canmet is used as standards. The standards and samples are irradiated in reactor from 6 to 12 hours followed by 'cooling' for 5 to 6 days. The nuclide formed from radiation is ^{198}Au with a half-life of 2 to 7 days. The Au is detected at 412 KeV spectrum peaks of gamma-ray.

The Reactor model is `TRIGA MKII' and `Spectrometer gamma'. `TRIGA MKII' reactor is the neutron sources, while gamma spectrometer is the detector. The computer model and software for analyses are `ND6680' and `NAA package Nuclear Data'. Radiation of reactor is used at 750kW power. The hyper- pure Germanium is used as an active counting detector.

X-ray florescence (XRF)

X-ray Flouresence (XRF) is used for the analysis of Fe_2O_3. The samples are made into fused discs. L.O.I is determined by heating 1 gm sample for 1 hour at 1000°C. The model of instrument is 'Philips Pw 1480 X-ray Digital'. The spectrometer is controlled by 'Digital Software X 44' microcomputer (Norrish & Hutton 1969), while the calibrations used 'Program on line' (De Jongh 1973 & 1979). International standards are used for this analysis.

RESULT AND DISCUSSION

Table 1 shows the abundance of gold in twenty soil samples from seven localities. The average gold abundance is 4.3ppb, while the average for Fe_2O_3 is 20.23%. The vertical

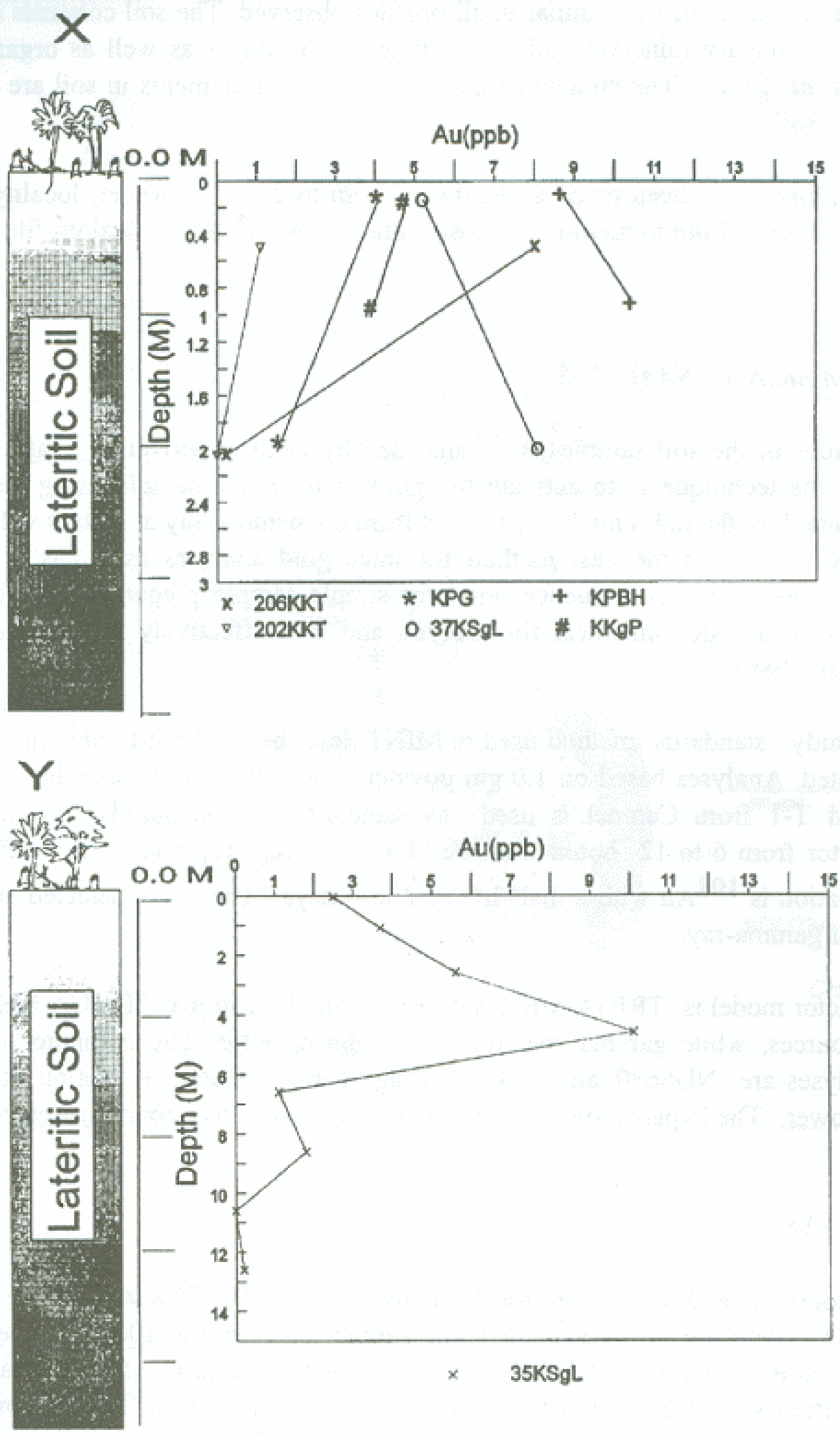


Figure 2 X: The graph showing the vertical distribution of Au contents in 12 samples of the 6 lateritic soil profiles from Kuantan, Pahang.

2Y: The graph showing the vertical distribution of Au in 8 samples of the lateritic soil profile from locality 35KSgL Kuantan, Pahang.

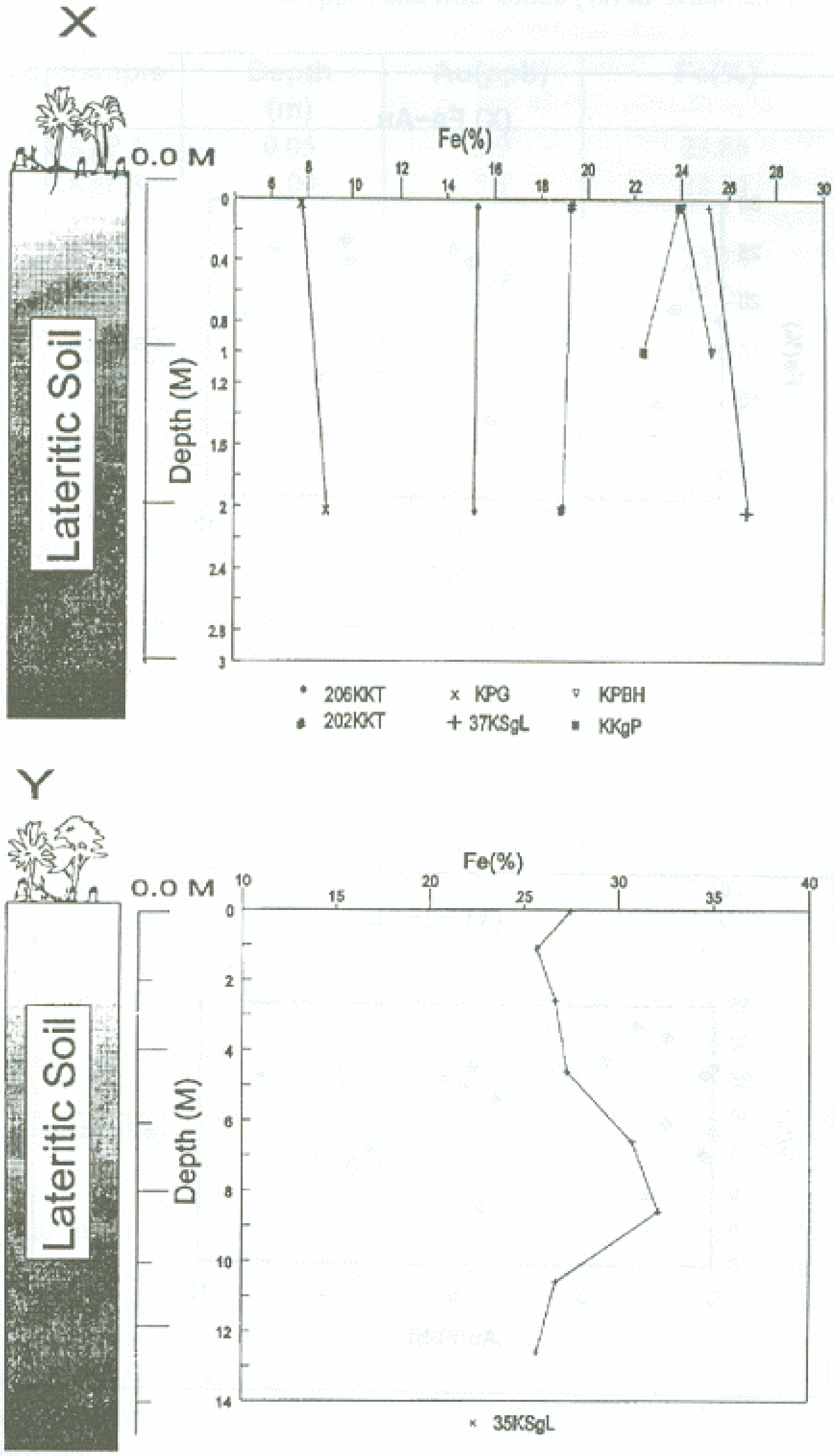
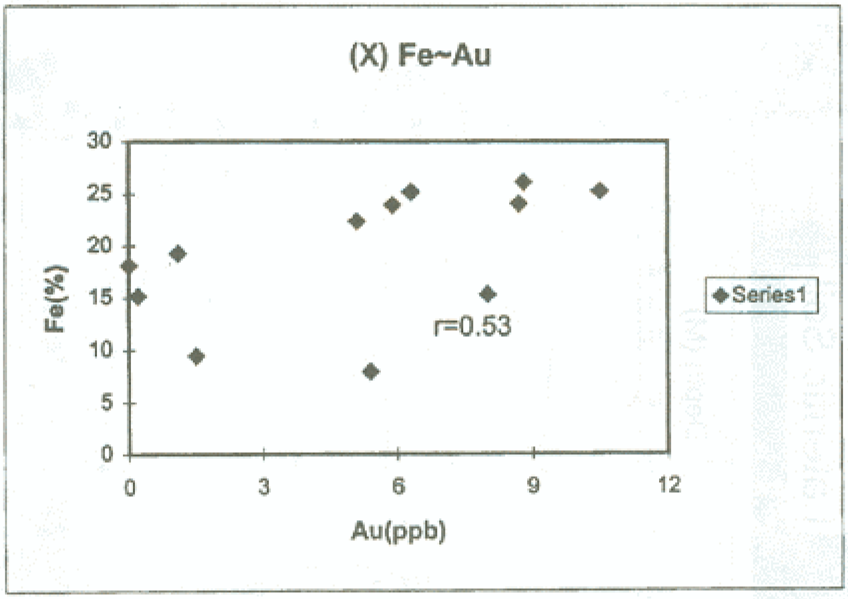


Figure 3 X: The graph showing the vertical distribution of Fe contents in 12 samples of the 6 lateritic soil profiles from Kuantan, Pahang.

3Y: The graph showing the vertical distribution of Fe in 8 samples of the lateritic soil profile from locality 35KSgL Kuantan, Pahang.



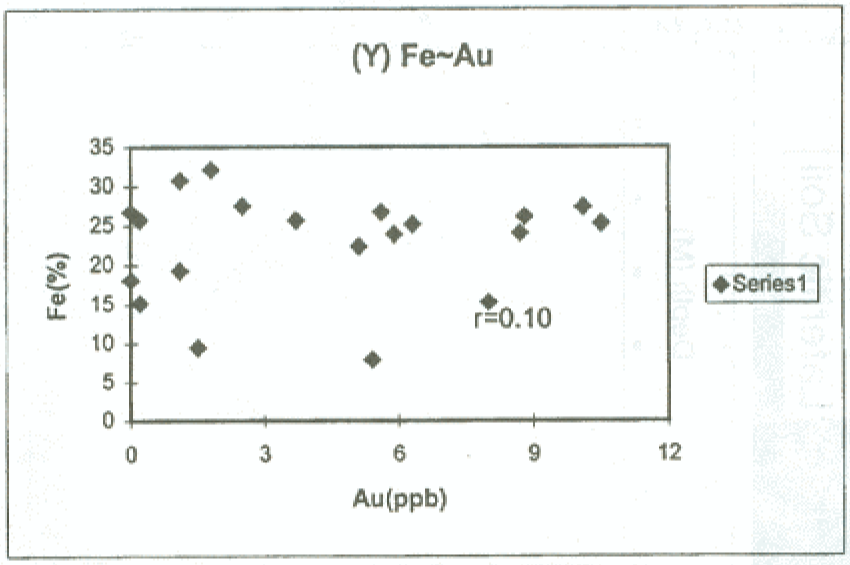


Figure 4 X: The correlation of Au to Fe in the soil samples with depth until 2.05m.
4Y: The correlation of Au to Fe in the 20 soil samples from Kuantan, Pahang.

Table 1: The abundance of gold (ppb) and iron oxide (%) in Kuantan, Pahang.

No. Sample	Depth (m)	Au(ppb)	Fe(%)
KKgP 1	0.05	5.9	23.88
KKgP 3	1.00	5.1	22.34
37KSgL1	0.05	6.3	25.14
37KSgL3	2.05	8.8	26.09
35KSgL 1	0.03	2.5	27.46
35KSgL 3	1.10	3.7	25.66
35KSgL 5	2.60	5.6	26.67
35KSgL 7	4.60	10.1	27.27
35KSgL 9	6.60	1.1	30.73
35KSgL 11	8.60	1.8	32.13
35KSgL 13	10.60	0.0	26.71
35KSgL 15	12.60	0.2	25.72
206KKT 1	0.50	8.0	15.27
206KKT 3	2.05	0.2	15.16
202KKT 1	0.05	1.1	19.27
202KKT 3	2.05	0.0	18.11
KPG 1	0.05	5.4	7.90
KPG 3	2.05	1.5	9.46
KPBH 1	0.05	8.7	24.03
KPBH 3	1.05	10.5	25.23
Average		4.3	20.23

distributions of gold in the soil horizons are irregular; there may be an increase with depth in samples 37KSgl and KPBH, or a decrease, as observed in samples KKgP, 206KKT, 202KKT and KPG. These distribution patterns are shown in Figure 2X. The vertical distributions of Fe_2O_3 in soil horizons are same as vertical distribution of Au in depth, except samples KPF, which increase with depth. Their distribution patterns of Fe_2O_3 are shown in Figure 3X. A more detailed study of gold distribution in 35KSgL profile shows an increase with depth until 4.6m, followed by a decrease to the end depth of 12.6m, as indicated in Figure 2Y. Whereas the Fe_2O_3 distribution shows a decrease with depth until 1.10m, followed by an increase to the depth of 8.6m and decrease again to the end depth (Figure 3Y). The highest gold abundance obtained is about 10.0ppb, shown by sample 35KSgL7 (10.1ppb) and sample KPBH3 (10.5ppb). The highest Fe_2O_3 abundance is about 32.13% as shown by sample 35KSgL11.

The present study shows that the Kuantan basaltic—lateritic soil has a low gold content (Table 1). This abundance value corresponds to the normal crustal abundance of 4.0 ppb. The abundance of gold in magmatic rock for Au:100Fe is 0.000002:0.00000057 (Goldschmidt, 1970).

In this studied area the Au:100Fe is 0.0000000043:0.00000020. During the weathering process of rocks, Au is difficult to react due to its habit of occurrence as native element compared to the other metals in earth crust. Some previous studies indicated that the Au tends to be retained in oxidation zone (Goldschmidt, 1970) and in the lateritic soil (Porto & Hale, 1996). The correlation of Au to Fe in the soil samples with depth until 20.5m of the present study is strong (r=0.53, Figure 4X). However, the correlation in the 20 soil samples with depth until 12.6m is weak (r=0.10, Figure 4Y). The gold in the soil probably occurs together with iron oxide such as goethite.

CONCLUSION

In conclusion, the result of the study shows that the abundance of gold in the Kuantan lateritic basalt soil derived from the weathering of basaltic rock is 4.3ppb. This abundance is similar to the average crustal abundance of Au. Gold is believed to occur in the soil and associated with iron oxide in the oxidation zone.

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