Gold dispersion in a tropical rainforest weathering profile at Dondo Mobi, Gabon

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ABSTRACT

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At Dondo Mobi in the gold district of Eteke, south Gabon, gold mineralization was studied in a tropical forest setting. The mineralization occurs in quartz veins within amphibolites of an Archaean gneiss-amphibolite series. Gold distribution patterns were studied in the different horizons of the weathering profile and in the different grain-size fractions of the materials sampled from three pits sunk in the weathered zone: upslope (pit P1), directly overlying (pit P2) and downslope (pit P3) of the mineralization.

The weathering profile consists of an upper, thick, loose sandy argillaceous horizon (H1), an irregular nodular horizon with laterite nodules or blocks (H2) and a saprolite layer (H3) up to 70 m thick. In each pit, the specific geochemical signature of the bedrock is recognized in the three horizons of the weathering profile. Some groups of elements, e.g., Cr-Ni or Ba-V-P_2O_5, characterize amphibolite or black shale, respectively. Signal attenuations in the upper horizon can be explained by a homogenization effect. That can be related to a mushroom supergene dispersion, simultaneously inducing vertical decrease and lateral enrichment in element contents. Gold also mushrooms extensively in the different horizons of the weathering profile. The dispersion pattern is somewhat anisotropic, a strong enlargement being observed in the upper (H1) and intermediate nodular (H2) horizons alike. However, the evolution of Au distribution is not the same for all grain-size fractions: (a) in the finest fraction, Au is regularly distributed in the weathering profile at the anomalous top and tends to preserve an equivalent level of concentration laterally; (b) in the coarsest fraction, the maximum Au content is found in the upper horizon just above the mineralized structure; it is rapidly decreases laterally, in the surface halo.

The Au geochemical dispersion halo consists mainly of fine-grained gold developed from rather coarse-grained mineralization. Its characteristics suggest that Au dispersion was produced as a result of Au dissolution together with collapse of the weathering profile causing gold migration over short distances.

The minimal volumetric reduction of saprolite in the upper horizon can be estimated to be in the range of 60%, on the basis of the content of the different grain-size fractions and the density variations in the various horizons.

In exploration, geochemical techniques, even using wide sample spacing, are proving quite adequate to prospect for Au in tropical rainforest weathering environment. Indeed, significant, well-contrasted dispersion haloes facilitate detection of rather confined mineralization.

INTRODUCTION

In the gold district of Eteke (south Gabon), the "Or Eteke" Joint Venture discovered an Au deposit at Dondo Mobi, long.$=11035'$E, lat.$=1017'$S (BRGM, unpublished internal reports between 1981 and 1986).

Many vast tropical areas are widely covered by a lateritic weathering mantle. In a recent review, Bocquier et al. (1984) report that lateritic profiles usually consist of three main units, differing in their organization as well as in their lateral continuity: the saprolitic lower unit, the glebular/nodular medial unit and the loose upper unit.

In the equatorial forest of Gabon, such *sensu lato* lateritic profiles have from top to bottom: a very thick sandy-argillaceous surface unit, an irregular nodular unit ("stone line") and a saprolite layer (up to 70 m thick) (Colin et al., 1987; Lecomte, 1988).

In relation to geochemical gold exploration, the complex story of such profiles sets the problem of determining how the parental chemical signatures are preserved and how the dispersion of Au is induced towards this type of weathering profile.

Granier et al. (1963) found that, in profiles overlying Au mineralization in the Ity gold area, Ivory Coast, similar to those of this paper, the Au contents are variable (8–25 g t^{-1}) and are strongly depleted at the surface (around 1 g t^{-1}). They noticed that Au particles are fine (<10 microns) in the saprolite and become larger in the nodular horizon. Toom's (1982) reports that Au in the lateritic profiles of Surinam and Liberia is essentially located at the interface of B and C horizons and primary gold dispersion is clearly evident up to the surface. Davy and El Ansary (1986) have shown that the highest Au values in the laterite of the Boddington gold deposit (Western Australia) occur over mineralized bedrock. However, fine secondary Au (<5 microns) can be observed up to about 500 m from the known deposit and is concentrated in three levels of the profile, in relation to the previous water table (Mann, 1984; Webster and Mann, 1984).

The aim of this paper is to study (a) the Au dispersion pattern in the weathering profile of the Dondo Mobi gold area and (b) the evolution of trace-element contents characterizing the bedrock, from the saprolite to the surface.

AREA DESCRIPTION – METHODS USED

Topography and climate

The landscape is made of flattened hills covered with evergreen forest and locally savannah, close to villages. The altitude varies from 500 to 800 m. The climate is of equatorial type, warm and humid; the annual average temperature is 26 °C with a range of 12–37 °C. The relative humidity varies from 60 to 100%

and the mean annual rainfall is around 2000 mm; the rainfall mainly occurs in March–April and October–November, whereas the driest months are in January–February and July–August.

Geology

The geological series shows three main units roughly oriented 340° (BRGM, unpublished internal reports): (1) an alkaline leucogranite with textures ranging from fine- to coarse-grained, of anatectic origin; (2) a dark gneissic series, consisting of fine-grained gneisses with biotite and muscovite, interpreted to be metatrondjemites and of dark green fine-grained ultrabasic amphibolites; (3) black shales (and quartzites), sometimes graphitic or a little phosphatic.

The two first units have a later Archaean age, whereas the third is younger (Lower Proterozoic).

Gold is located inside small quartz or quartz-carbonate veins within the amphibolites of the central unit. These veins are related to extension fractures which conform with the schistosity (BRGM, unpublished internal report). This schistosity is roughly parallel to the main lithological contacts in gneisses and amphibolites. The thickness and length of the veins vary from a few centimetres to a few metres and their Au content reaches several grammes per ton. The Au mineralization is usually located in amphibolite; these rocks have a rather high background (greater than 100 ppb) in Au than the other formations and could be the initial source of Au.

Surface geochemistry

The Au anomaly of Dondo Mobi was defined by soil sampling on a grid of 10×100 m or 20×200 m. It is situated along a topographic crest 700 m high; the halo is 650×100 m, with Au values ranging from 0.2 to 1.0 ppm (Fig. 1).

During follow up work, a gold deposit was found some tens of metres below the surface. In the light of these data, three pits (P1, P2, P3) were excavated along a traverse of augerholes, perpendicular to the axis of the anomaly (Fig. 1). The pits were bored at different levels along the slope.

Methods

In the field, the detailed macroscopic relationships and structures were studied *in situ* for each horizon of the weathering profile. At the same time, a large number of 3-kg samples was taken from each horizon.

In the laboratory, the samples were dried at 60°C and sieved to separate the following grain size fractions: minus 63 microns, 63–125 microns, 125–250 microns, 250–500 microns and above 500 microns; the sieving was performed under water. Each grain-size fraction was weighed and quartered. The samples

Au IN SOILS

0.2 to 0.4 ppm

0.4 to 0.6 ppm

0.6 to 1.0 ppm

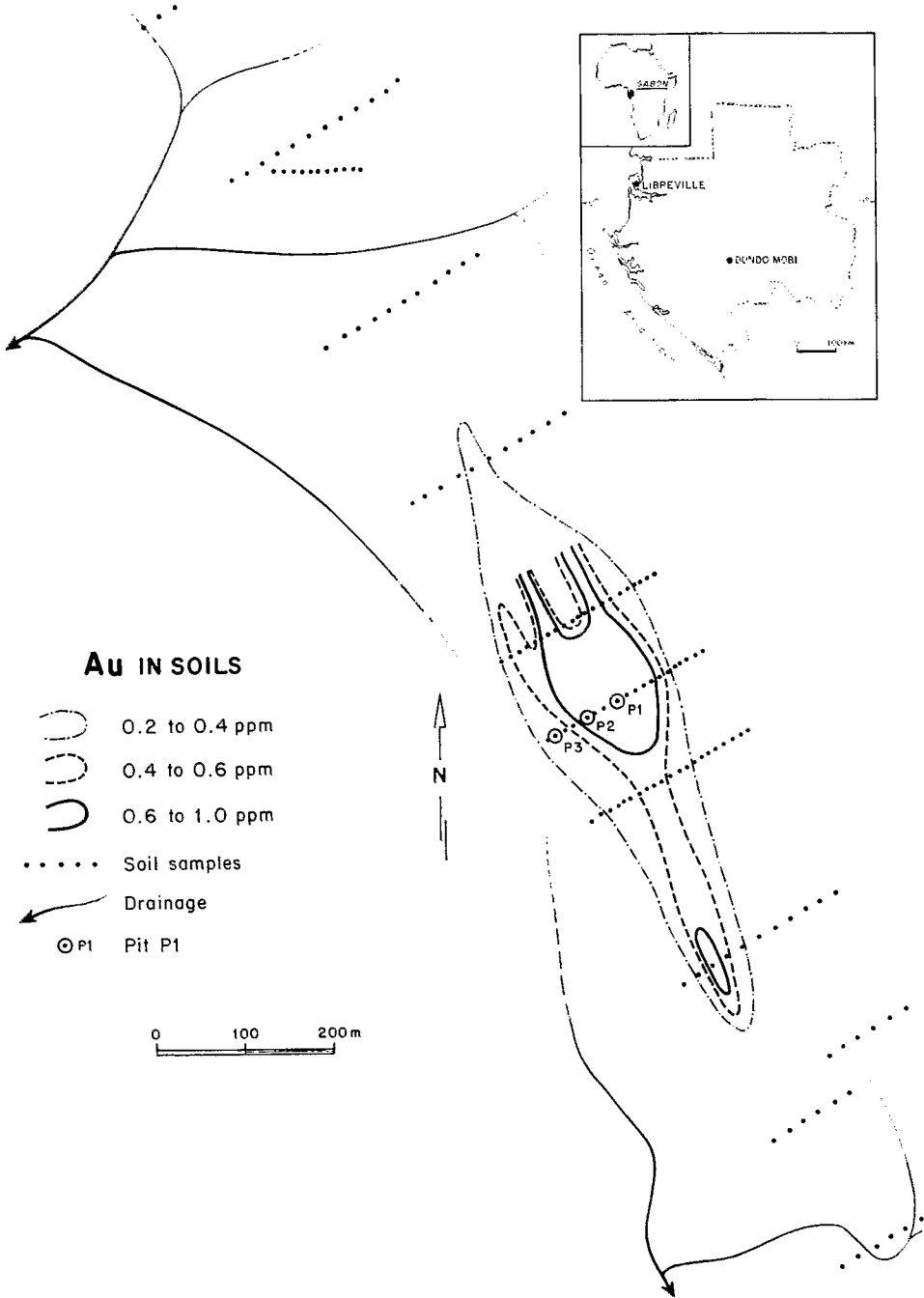Soil samples

Drainage

⊙P1   Pit P1

Fig. 1. The Dondo Mobi area, Gabon, showing the dispersion anomaly for Au in soils and the location of the 3 studied pits.

of the finest fraction were analyzed for 34 elements, 8 major (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, K_2O, MnO and TiO_2) and 26 trace elements (As, La, Nb, Y, Zr: detection limit of 20 ppm; B, Ba, Bi, Ce, Cr, Li, Ni, Pb, Sb, Sn, V, W: detection limit of 10 ppm; Be, Cd, Co, Cu, Mo, Sr, Zn: detection limit of 5 ppm; Ag, 0.2 ppm and P_2O_5, 100 ppm) by inductive plasma spectroscopy (ICP). For this study, the contents of numerous traces, below the detection limit, could not be taken into account.

All the fractions were analyzed for Au by atomic absorption spectrophotometry (AAS) using the graphite furnace technique. The samples were dissolved completely in a strong acid mixture (HCl, HNO_3, HF) and Au was extracted from the acid phase into an organic solvent (MIBK). The detection limit for this method is 20 ppb.

RESULTS

Field description of the weathering profile

Figure 2 shows the cross section of the series of pits and illustrates each pit in detail. The pit P1 is situated in the black shale, the pit P2 in quartz veins in amphibolites and the pit P3 in an acid portion of the gneissic series.

Three main units can be distinguished from the top to the base:

(1) The surface unit H1 (1–7 m thick) is composed essentially of a yellow-brown, sandy argillaceous matrix enriched in kaolinite crystals and quartz grains. The typical sample contains around 75% by weight of the minus 63 microns fraction. The sand contains a few ferruginous nodules of 3–4 mm diameter. Along the cross section, the thickness of this unit decreases downslope.

(2) The nodular unit H2 (1–3 m thick) is made up of a very similar matrix to that of the upper unit, with numerous packed lateritic nodules or blocks ("stone line"). This unit, containing 70% by weight of the coarsest fraction, can be divided in some horizons which differ, for each pit, in their thickness as well as in their material components:

– Pit P1: upper nodular horizon (0.50 m thick), rich in pseudo-pisolites (spheric Fe nodules without a concentric structure, Nahon, 1976).
: hardcap (1 m thick), with close-packed lateritic blocks of 50-cm diameter,
: lower nodular horizon (1.4 m thick), enriched in small ferruginous plates, showing a layered texture.

– Pit P2: upper nodular horizon (0.70 m thick) and lower nodular horizon (0.90 m thick) with identical Fe-components to the corresponding horizons of pit P1. Numerous quartz pebbles are scattered in the matrix of the lower nodular horizon.

– Pit P3: single nodular horizon (0.20 m thick) with a small quantity of mixed small ferruginous plates and pseudo-pisolites.
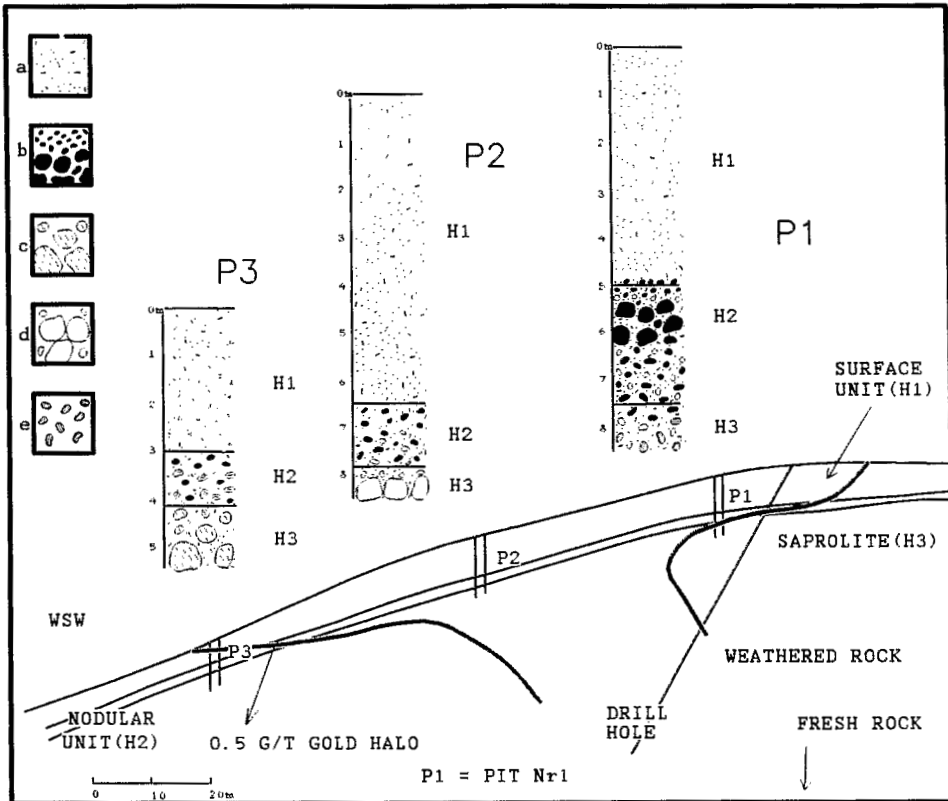
Fig. 2. Cross section of the studied topographic sequence above the ore deposit; schematic representation of the weathering profiles (a = sandy argillaceous surface unit; b = lateritic nodular unit; c = gneissic saprolite; d = quartz blocks saprolite; e = black shale saprolite).

(3) The saprolite H3 is made up of a sandy matrix within which are dispersed rock fragments whose composition varies in the three pits:
– Pit P1: black or reddish shale remnants and a little quartz;
– Pit P2: angular quartz fragments or blocks;
– Pit P3: weathered gneissic relicts.

A few metres below the interface with the nodular unit, the bedrock structure can be recognized. The thickness of saprolite can reach 60–70 m.

Grain-size evolution of the weathering material

Initially, five grain-size fractions were isolated but the three fractions between 63 microns and 500 microns were combined because of their low abundance levels. In Table 1, the size composition of each unit is listed in terms of percentages of the three main size fractions (fine, medium and coarse):

TABLE 1

The distribution of material between size fractions (in weight percent) for the H1, H2 and H3 units of the pit P2 (d: specific gravity)

Unit	Grain size fraction			d	Depth (m)
	$<63\,\mu m$	$63-500\,\mu m$	$>500\,\mu m$		
H1	75	21	4	1.5	0.6
H2 upper	24	4	72	2	6.7
H2 lower	21	5	75	2	7.7
H3	44	5	51	2	8

(a) in the saprolite (H3), the proportions of the fine and coarse fractions are similar (44–51% each); there is no significant medium fraction;

(b) in the nodular unit (H2), coarse material is prevalent (72–75%);

(c) in the surface unit (H1), the proportions are reversed, with the prevalence of the finest fraction (75%) and only a small amount of coarse material.

Geochemistry

Table 2 presents the mean contents of some major and trace elements by unit and by pit.

In pit P1 located in weathered shale, values of V, Ba and P_2O_5 are significatively higher than in the two other pits. In pit P2, the relatively high Cr and Ni contents reflect the more basic character of the amphibolites interlayed in the gneisses. In pit P3, the rather more potassic and aluminous trend is related to more acid gneissic facies.

Thus, in each pit, the chemical characteristics of the bedrock are reflected

TABLE 2

Mean contents, by unit and by pit, of some oxides and elements (in % for the 3 first ones, in ppm for the other ones); a star means the element is specific of the geochemical spectrum for a studied pit)

Pit	Unit	SiO_2	Al_2O_3	Fe_2O_3	V	Mo	Cr	Ni	Ba	K_2O	P_2O_5
P1	H1	43.7	36.3	12.3	430*	9	490	60	3100*	0.4	3200*
	H2	43.2	38.2	14.8	450*	7	410	60	3000*	0.4	3200*
	H3	43.4	39.4	11.2	580*	1	235	40	3500*	0.9	3900*
P2	H1	45.3	38.4	12.6	340	23*	630*	100*	1700	0.3	1700
	H2	42.7	38.7	13.5	340	29*	730*	110*	1400	0.3	1650
	H3	44.8	38.9	12.9	320	29*	700*	110*	1400	0.3	1450
P3	H1	45.9	38.1*	11.5	290	22	500	90	1100	0.8*	1400
	H2	42.7	44.5*	10.2	240	16	440	80	900	0.8*	1100
	H3	42.1	48.3*	6.0	130	6	200	50	500	1.4*	600

in the three main regolith units and the variation between units within each pit is less than the variation between pits. Moreover, the values of Ba and P_2O_5, in pit P1, and Cr and Ni, in pit P2, decrease from the saprolite to the ground surface (Fig. 3a,b). In compensation, the Ba and P_2O_5 values increase vertically to the surface in the P2 and P3 profiles, and Cr and Ni values increase to the surface of the P1 and P3 profiles.

The chemical signature of each weathering profile is vertically preserved, but the geochemical response evolves to a surface homogenization. This tendency is stronger for major elements (Fig. 3c) than for the trace elements shown.

On the other hand, the geochemical study of the drill hole samples located in Figure 2 showed that each geological unit has a specific chemical signature:
– the gneissic series can be divided into two facies: a gneissic trend characterized by K_2O plus CaO, MgO, and Sr contents and a basic trend characterized by the Cr and Ni contents, reflecting the amphibolites;
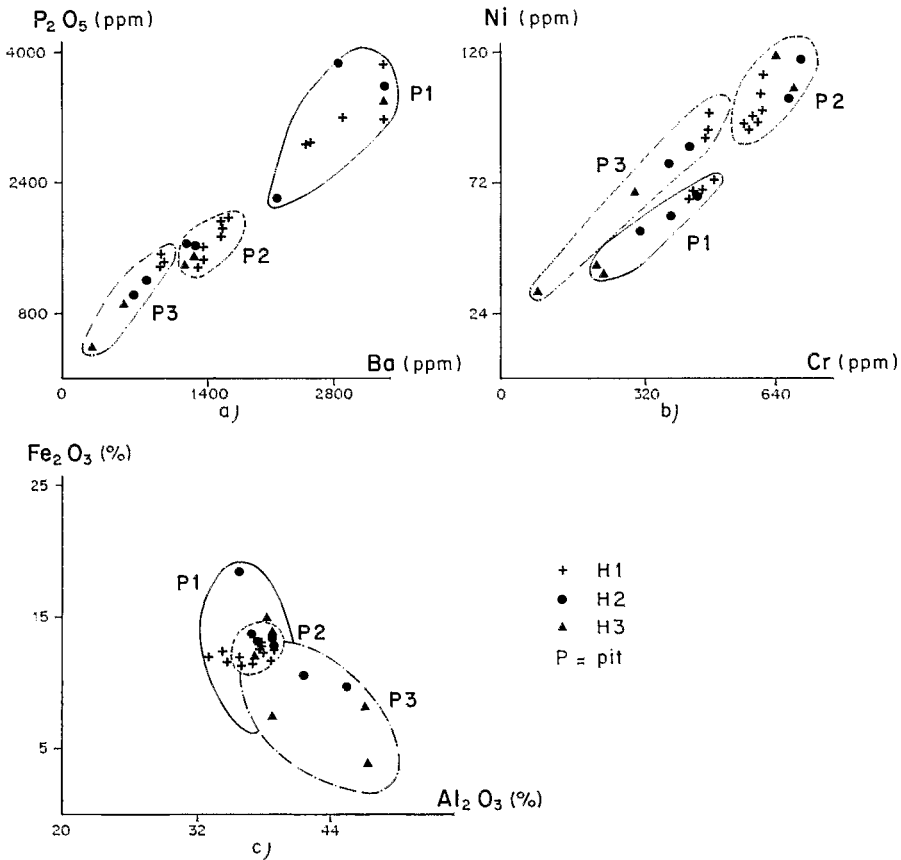

Fig. 3. Scattergrams of some elements contents (in the minus 63 microns fraction), according to each pit (P1, P2, P3) and each unit (H1, H2, H3).

– the black shales are chemically typified by higher contents of P_2O_5, V, Ba, TiO_2.

In relation to those data and to rock fragments found in the saprolite of the three pits, we can assume that the weathering profiles are:

– formed *in situ* respectively from black shales (in pit P1), from quartz and/or amphibolitic facies (in pit P2) and from gneissic rocks (in pit P3);

– reflecting the inherited bedrock chemical signature up to the surface.

It is thus possible to characterize a specific chemical spectrum for each studied profile, when the lithologies are sufficiently chemically differentiated.

Distribution of gold along the studied cross section

Table 3 and Figure 4 show the partition of Au in the three pits for the studied grain-size fractions.

In the finest fraction (minus 63 microns), the distribution is rather regular. In the pit P2 profile, just above the mineralization, the Au content is the highest and the anomaly is clearly marked from the saprolite up to the surface. Laterally, gold is well dispersed, upslope and downslope in the surface unit and

TABLE 3

Gold contents (in ppb) of the different size fractions of each sample

| Pit	Unit	Depth (m)	$<63\,\mu m$	$63{-}125\,\mu m$	$125{-}250\,\mu m$	$250{-}500\,\mu m$	$>500\,\mu m$
P1	H1	0.500	1300	1500	2200	55	120
		2.500	1100	1800	5500	50	95
		4.500	1000	1400	1500	1500	30
	H2	5.300	1100	985	30	40	20
		5.800	950	315	1300	4400	115
		7.000	335	400	30	55	65
	H3	8.000	215	275	210	75	110
		8.500	205	175	10	10	20
P2	H1	0.500	1500	2200	5000	1200	52800
		3.500	1400	2000	4800	5800	530
		5.500	1700	1400	1900	21300	33700
	H2	6.800	1100	5500	4900	100	205
		7.600	760	3600	2600	715	90
	H3	8.200	1400	3800	45	205	100
P3	H1	0.500	695	1000	740	45	50
		1.500	535	1100	590	65	45
	H2	3.200	505	215	1800	60	40
		3.600	335	190	10	10	270
	H3	5.500	80	5	5	5	10
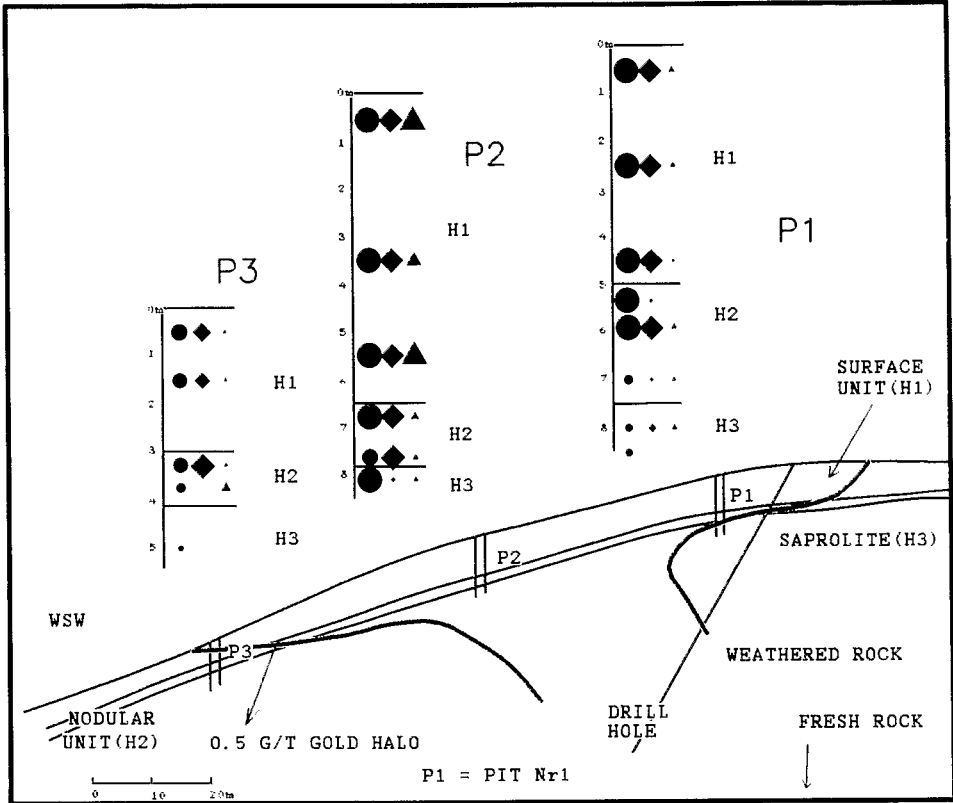
Fig. 4. Cross section of the studied topographic sequence above the ore deposit showing the partition of gold in the finest fraction (circles), the medium fractions (lozanges) and the coarsest one (triangles) in each unit of different pits. The content varies from 30 to 1000 ppb, corresponding to a progressive increase in the size of the symbols.

in the upper nodular horizon. No lateral dispersion is recorded in the saprolite. That surface halo defines a mushroom pattern with a spreading effect in the H1 and H2 units (Lecomte, 1988). The Au distribution in the 63–125 microns grain-size fraction is very similar to that of the minus 63 microns fraction, but the spreading effect is not so well marked in the upper nodular horizon. In the 125–250 microns grain-size fraction, the Au content is less homogeneous but the trend observed in both fine size fractions remains visible. In the plus 250 microns fractions, the heterogeneity in the Au distribution is greatest, with an important "nugget effect" in the pit P2 for the plus 500 microns fraction.

Gold grain size in the weathering profile

Taking into account the three main size fractions (minus 63, 63–500 and plus 500 microns), the weight of Au present in each fraction of the sample can

TABLE 4

Percentages of the total amount of gold of the different size fractions and total Au content in ppb ("total") of each sample

Pit	Unit	Depth (m)	< 63 μm	63–125 μm	125–250 μm	250–500 μm	> 500 μm	Total
P1	H1	0.500	72	8	20	0	0	1300
		2.500	53	7	35	2	3	1530
		4.500	72	9	15	5	0	975
	H2	5.300	91	4	0	0	4	290
		5.800	54	1	8	30	7	470
		7.000	68	6	0	3	24	155
	H3	8.000	56	4	7	4	30	155
		8.500	81	5	5	0	10	100
P2	H1	0.500	34	5	14	2	44	3300
		3.500	54	7	23	15	1	1930
		5.500	30	2	4	24	40	4200
	H2	6.800	48	11	15	0	26	685
		7.600	51	11	13	4	21	310
	H3	8.200	89	5	0	1	6	800
P3	H1	0.500	76	11	11	1	1	630
		1.500	79	18	10	1	1	460
	H2	3.200	54	3	37	2	6	800
		3.600	57	4	0	0	39	230
	H3	5.500	100	0	0	0	0	15

be calculated and thus their percentages in relation to the total gold content (Table 4 and Fig. 5). In the weathering profile inherited from the mineralized gold host rock (pit P2), the total Au contents increase from the saprolite to the surface unit, whereas the percentage of fine gold regularly decreases; thus it seems that the coarsest fraction is enriched in the surface unit just above the mineralization.

In the pits P1 and P3 located in barren rocks, the Au contents in the saprolite are very low, but a part of the gold, laterally dispersed from the mineralized pit P2, is accumulated in the nodular unit and particularly in the surface unit.

From the central point of the anomaly halo, the coarse gold percentage tends to decrease and progressively to disappear in favour of a fine-grained gold. So, in the pit P1 located upslope inside the 0.5 g t^{-1} Au halo, Au is distributed in the medium and fine fractions and the percentage of coarse gold in negligible. Outside the 0.5 g t^{-1} Au halo (pit P3), the medium and coarse gold disappeared and the total Au content is in the minus 63 microns fraction.
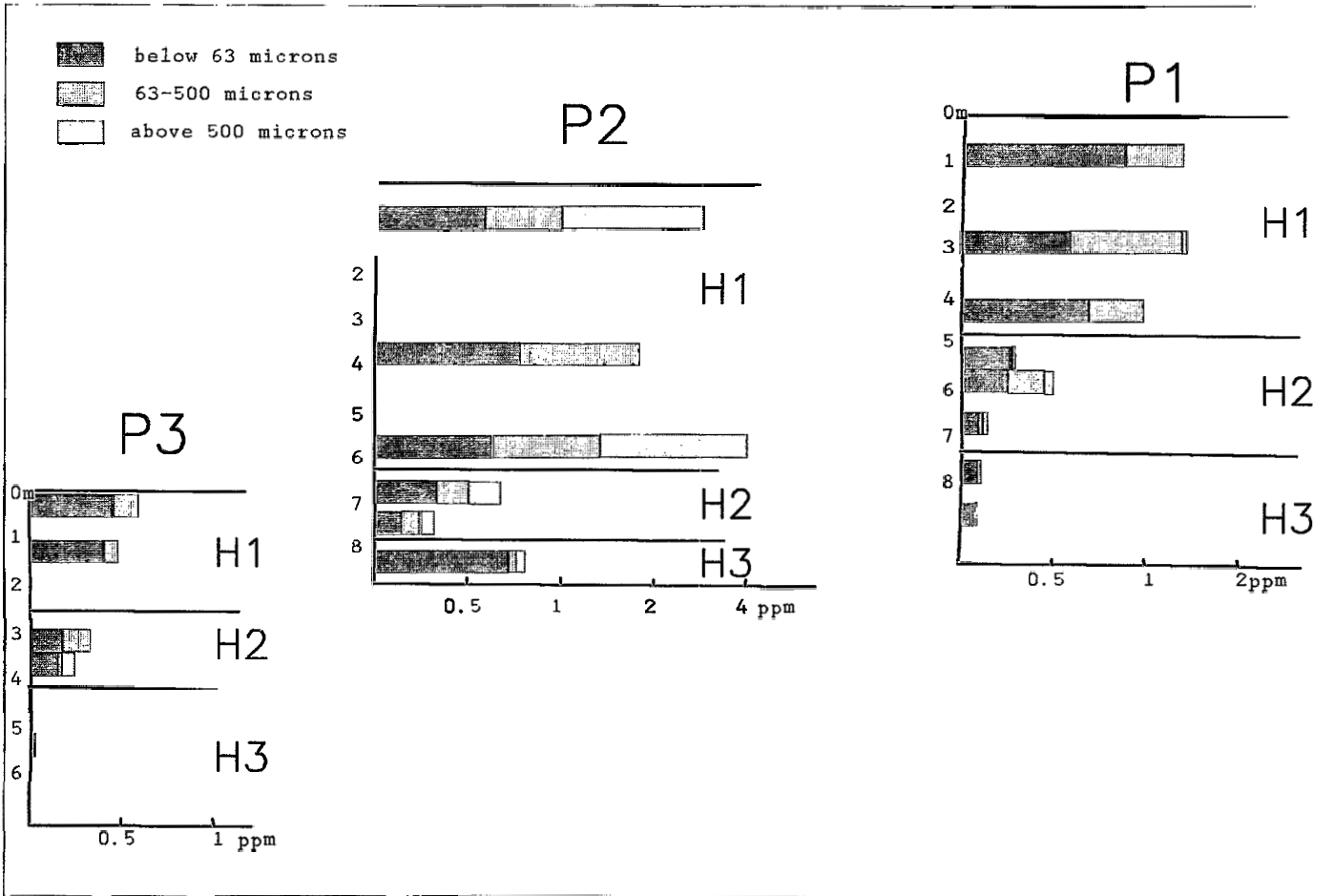
The study confirms the following features:

Fig. 5. The distribution of Au in three size fractions for pits P1, P2 and P3, related to the total content of each pit.

- gold is accumulated in the surface unit of the pit P2, above the mineralized structure and the coarse grain size fraction is enriched;
- gold becomes more fine-grained laterally when the distance from the mineralized axis increases.

DISCUSSION

Studying the supergene distribution of metal patterns in tropical terrains, it is usual to refer to the general lateritic weathering model (Bocquier et al., 1984). Composed of three main units, the tropical weathering profile integrates a series of complex processes, recent or former, making it difficult to understand the behaviour of various elements.

While Nahon (1976), Leprun (1979), or Ambrosi and Nahon (1987), for instance, describe in detail the close structural and chemical filiations between the different units and components of a lateritic weathering profile in dry climate zones, in tropical rainforest, and more particularly in Central Africa, such examples are unfortunately rather scarce (Muller et al., 1981).

Surficial transfer of the parental chemical signature

In the Dondo Mobi area, each saprolite profile clearly includes inherited remnants of the primary materials (black shales, gneisses, ...). Moreover, the chemical analyses of the finest size fraction can be interpreted in terms of a direct relationship to bedrock.

Developed from different lithologies, each of the three profiles has a specific chemical composition depending on the bedrock chemical spectrum. It is verified in the saprolite (unit H3) but also in both other units of the profile (H1 and H2).

In spite of the great thickness of the surface unit H1 (1–7 m), the parental spectrum can still be recognized on surface, particularly using trace elements.

However, an homogenization effect is evidenced in the surface unit H1. Indeed, when an element has an high content in the saprolite and the bedrock, it tends to decrease in the surface unit; conversely, when its content is low in the saprolite and the bedrock, it tends to increase in the surface unit (Fig. 3). Considering the mushroom dispersion pattern, it can be assumed that, for each element, the surficial lateral dispersion induces a content decreasing in relation to the bedrock content at the halo centre, and a content increasing in relation to the barren rock underlying the halo periphery.

Gold behaviour in the weathering profile

In comparison with the other trace-element behaviour studied here, Au shows some differences; indeed, although its dispersion follows the same mushroom

pattern, in the pit P2, it accumulates vertically at surface in relation to the saprolite Au contents. Taking into account the density variation between units (Table 5), gold is about 3.5 times more concentrated in the surface unit than in the saprolite (or in the nodular unit). It seems clear that this accumulation in pit P2 is linked to the concentration of the coarse fraction near surface in relation to the saprolite content (Table 4). However, this calculation is not quite isovolumetric, as one cubic metre of the surface unit (H1) represent the weathering product of several cubic metres of the saprolite (H3) by compaction and leaching (Sutherland, 1985; Brimhall and Dietrich, 1987; Lecomte, 1988), and after a complex polycyclic weathering process. Indeed, the iron nodules of the H2 unit give evidence of one – or more – former lateritic episodes, prior to the recent rainforest climate (Muller et al., 1981). According to the mean contents observed in each unit (Table 5), the surface unit would represent a volumetric reduction of about 60% of the saprolite. But this rate is minimal and it would be necessary to consider the dispersed and leached gold.

When the distance from the mineralized area laterally increases, the total Au content decreases, whereas the proportion of fine-grained gold (minus 63 microns) increases. At surface, at the limit of the 0.5 g t^{-1} halo, there are no Au particles greater than 250 microns. Conversely, the fresh ore testing results (BRGM, unpublished internal report) argue in favour of a coarse character of the Au deposit with more than 50% Au recovered by gravimetry and only 19% of the total Au minus 63 microns.

Mode of supergene dispersion

Considering a supergene halo of fine-grained gold, dispersed from a rather coarse primary ore deposit, we can try to understand the mode of gold dispersion within the weathering profile, by chemical or mechanical processes.

It has been observed that the halo is slightly asymmetric and extends in the same way upslope and downslope. We can conclude therefore that the halo formation is little dependent on the current topography and that mechanical processes do not play a major role in the gold dispersion. More likely, the col-

TABLE 5

Comparison of mean gold contents by weight and by volume in each unit of the pit P2 (d: specific gravity)

Pit P2	d	Au (g t^{-1})	Au (g m^{-3})
H1	1.5	3.1	5.7
H2 upper	2	0.7	1.4
H2 low	2	0.3	0.6
H3	2	0.8	1.6

lapse effect of the weathering, related to a volume reduction of the profile, could be an important dispersion factor.

On the other hand, the more the distance from the halo centre increases, the more the portion of fine-grained gold increases. In this case, we hypothesize that the gold dispersion is also dependent on the progressive dissolution of particules in the weathering profiles (Colin and Lecomte, 1988; Colin et al., 1989) and that the lateral dispersion would be controlled by a series of chemical divisions of particles and transfers of gold over short distances, from the centre to the periphery of the anomalous halo (Mossmann and Haaron, 1983; Wilson, 1983).

CONCLUSIONS

The weathering profile of the Dondo Mobi gold area in south Gabon is characterized by three main units:
  (a) a sandy argillaceous surface unit (H1),
  (b) a lateritic nodular unit (H2),
  (c) the saprolite (H3).
Along the whole profile, the specific geochemical signatures of the bedrock are preserved, particularly for the trace elements; some attenuation of the contents is, however, observed in the sandy argillaceous surface unit. That attenuation can be explained by a homogenization effect in relation to the weathering process.

For gold, the surface geochemical anomaly is situated above the mineralized structure and a dispersion halo is developed around it. But the evolution of the Au dispersion is not the same in the different size fractions of the weathered materials:
  – in the minus 63 microns size fraction, the Au content is regular in the weathering profile at the top of the anomaly and tends to persist laterally;
  – in the plus 500 microns size fraction, the Au content, greatest in the surface unit immediately above the mineralized structure, rapidly decreases laterally, in the surface halo.
  – in the medium size fractions, the evolution of the Au content is intermediate between the fine and coarse size fractions.
We can thus assume that the surface halo of Au essentially is a halo of fine-grained gold developed from rather coarse-grained gold in the primary mineralization. If the gold is considered residual, we can estimate that the surface unit would represent a minimum volumetric reduction of about 60% of the saprolite.

According to the characteristics of the surface halo, the gold dispersion seems to result essentially from a dissolution effect of particles and from the collapse of the weathering profile, providing a series of gold migrations over short distances.

It has been concluded that geochemical techniques are suitable for gold exploration in such environments and a significant and well-contrasted secondary dispersion halo aids the detection of even narrow deposits by using a rather large sampling interval. As such haloes are mostly generated by fine-grained gold, they are hard to detect by simple panning of soil samples.

REFERENCES

Ambrosi, J.P. and Nahon, D., 1987. Petrological and geochemical differentiation of lateritic iron crust profiles. Chem. Geol., 57: 371–393.
Bocquier, G., Müller, J.P. and Boulangé, B., 1984. Les laterites. Connaissances et perspectives actuelles sur les mécanismes de leur differenciation. In: Livre jubilaire du Cinquantenaire, A.F.E.S., Paris, pp. 123–138.
Brimhall, G.H. and Dietrich, W.E., 1987. Constitutive mass balance relations between chemical composition, volume, density, porosity, and strain in metasomatic hydrochemical systems: results on weathering and pedogenesis. Geochem. Cosmochim. Acta, 51: 567–587.
Colin, F. and Lecomte, P., 1988. Le profil d'altération du prospect aurifère de Mébaga-Mvomo. Chron. Rech. Min., 491: 55–65.
Colin, F., Lecomte, P. and Edou Minko, A., 1987. Pétrologie et géochimie des formations superficielles du Gabon. Revue du Ministère des Mines et du Pétrole, Editeurs Formule 13, Libreville, Gabon (Abstract).
Colin, F., Lecomte, P. and Boulange, B., 1989. Dissolution features of gold particles in a lateritic profile at Dondo Mobi, Gabon. Geoderma, in press.
Davy, R. and El-Ansary, M., 1986. Geochemical patterns in the laterite profile at the Boddington gold deposit, Western Australia. J. Geochem. Explor., 26: 119–144.
Granier, C., Lajoinie, P. and Vitali, C., 1963. Géochimie de l'or et du cuivre dans les formations latéritiques argileuses du Mont Flotouo (Ity, Côte d'Ivoire). Bull. Soc. Fr. Mineral. Cristallogr., 86: 252–258.
Lecomte, P., 1988. Stone line profiles: importance in geochemical exploration. J. Geochem. Explor., 30: 35–61.
Leprun, J.C., 1979. Les cuirasses ferrugineuses des pays cristallins de l'Afrique de l'Ouest sèche. Genèse, transformation, dégradation. Sci. Geol., Strasbourg, Mem. 58, 224 pp.
Mann, A.W., 1984. Mobility of gold and silver in lateritic weathering profiles: some observations from Western Australia. Econ. Geol., 79: 38–49.
Mossmann, D.J. and Harron, G.M., 1983. Origin and distribution of gold in the Huronian Supergroup, Canada. The case for Witwatersrand-type paleoplacers. Precambrian Res., 20: 543–583.
Muller, D., Bocquier, G., Nahon, D. and Paquet, H., 1981. Analyses des différenciations minéralogiques et structurales d'un sol ferralitique à horizons nodulaires du Congo. Cah. ORSTOM, Sér. Pédol., 18(2): 87–109.
Nahon, D., 1976. Cuirasses ferrugineuses et encroûtements calcaires au Sénégal occidental et en

Mauritanie. Systèmes évolutifs. Géochimie, structures, relais et coexistence. Sci. Geol., Stras-
bourg, Mem. 44, 242 pp.

Sutherland, D.G., 1985. Geomorphological controls on the distribution of placers deposits. J. Geol.
Soc. London, 142: 727–737.

Toom's, J.S., 1982. Exploration for gold in the humid tropics. Int. Geochem. Explor. Symposium,
Toronto, Canada. Abstr., p. 90.

Webster, J.G. and Mann, A.W., 1984. The influence of climate geomorphology and primary geol-
ogy on the supergene migration of gold and silver. J. Geochem. Explor., 22: 21–42.

Wilson, A.F., 1983. The economic significance of non-hydrothermal transport of gold, and of the
accretion of large gold nuggets in laterite and other weathering profiles in Australia. Spec. Publ.
Geol. Soc. S. Afr., 7: 229–234.