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Prospection of Gold in the Area of the Mentebah and Tenungun Rivers on the Island of Kalimantan (Borneo, Indonesia)

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In the area of the Mentebah and Tenungun rivers the Upper Cretaceous Age has been determined in a part of clastic sediments. Among the magmatic rocks there have been found the rhyolites, rhyodacites, andesites and basalts. The intensive tectonic movements have also been determined.

Along the mentioned rivers there are well developed older alluvions and recent river deposits. In them, by the method of panning and by chemical analyses a high content of gold has been found which can be of a commercial value. In addition to gold there have been determined also other elements some of which have the increased concentration.

U području rijeka Mentebah i Tenungun jednom dijelu klastičnih naslaga utvrđena je gornjokredna starost. Od magmatskih stijena dokazani su rioliti, riodaciti, andeziti i bazalti. Također su utvrđena intenzivna tektonska gibanja.

Duž spomenutih rijeka dobro je razvijen stariji aluvijon i recentni riječni nanos. U tim sedimentima metodom ispiranja (metoda šliha) i kemijskim analizama utvrđen je sadržaj zlata koji može imati značajnu ekonomsku vrijednost. Pored zlata registrirani su i drugi elementi od kojih neki imaju povećanu koncentraciju.

INTRODUCTION

In the area of the Mentebah and Tenungun rivers on the island of Kalimantan (Borneo) during the summer months of the year 1986 a prospection of gold was carried out. The aim of prospection was to evaluate the prospectivness of the explored terrain on the basis of field explorations and sample analyses for the purpose of further detailed explorations as well as a possible exploration of gold.

Besides the authors, the field exploration i. e. prospection was attended by Ir. K. Sulisyadi Sbroong, geologist working with the firm »Gondvana«, Bandung, and Bachtiar Butar-Butar, who is in charge of the work and life organization in the field. From the local population, the hands were provided too for transportation, carrying of samples and equipment. On this occacion we thank them again most cordially for a successful cooperation. We express our gratitude also to Ir. B. E. R. Mogot, who has been one of the iniciators of these explorations.

Chemical analyses of samples for determination of the content of gold were performed by L. Palinkaš, M. Sc. (Geol.), micropaleontological determination carried out by Z. Velimirović, B. Sc. (Geol.), and petrological and X-ray analyses were performed by V. Marci, prof. D. Sc., S. Šćavničar, prof. D. Sc. and B. Šćavničar, D. Sc. We are expressing here our most sincere thanks to all of them.

GEOGRAPHICAL POSITION OF THE AREA EXPLORED AND ACCESS TO IT

The area explored is situated in the central part of the island of Kalimantan (Fig. 1). The Mentebah and Tenungun rivers, along which the geological prospection has been carried out, flow through a relatively flat terrain with average altitudes between 200 and 300 m and are surrounded by a well-indented and mountaineous relief the heights of which exceed 1000 m in places. Both rivers flow generally in the north-west direction and join at a place called Nangah Duwa (Encl. 1). The area along the rivers is covered with a thick vegetation and therefore it represents a typical jungle.

The access to the area explored requires several days of travelling. From Jakarta to Pontianak the flight is by a regular line plane, while from Pontianak to Putusibau a small Cessna type plane is used. From Putusibau to Suruk the journey continues on the rivers Kapuas and Suruk by a boat, and further on up to the village Nangah Duwa a field vehicle land-rover is used.

EXPLORATION MADE SO FAR AND TECHNICAL DOCUMENTATION PERTAINING

The area of the Mentebah and Tenungun rivers has been very poorly explored until now, therefore the most essential technical documentation is missing. From topographic data sheets we had at our disposal only the topographic maps in the scale 1 : 250.000, however, of inadequate quality. The geological documentation is also very unsatisfactory, the only available document we had was a general geological map in the scale 1:250.000 without explanation from the year 1939. There practically does not exist any written technical documentation on the area explored. Several published reports on the regional geological relations on the island of Kalimantan did not provide any signification help during our prospection activity. Z. V. Emmichoven (1939) on the page 93 wrote that Enthoven had explored gold on the island of Kalimantan and he mentioned the Mentebah river as one of the interesting locations. J. A. Katili (1974) wrote about the mineral resources in Indonesia in the context of plate tectonics where he mentioned the island of Kalimantan as the least tectonically disturbed area among all major Indonesian islands. Slightly more on the south from the explored area the Japanese geologists in 1977 performed the explorations by remote sensing techniques (analyses of satellite images and aerial photographs as well as the aeromagnetic surveys), and so were obtained the basic geological data for the major part of the central Kalimantan.

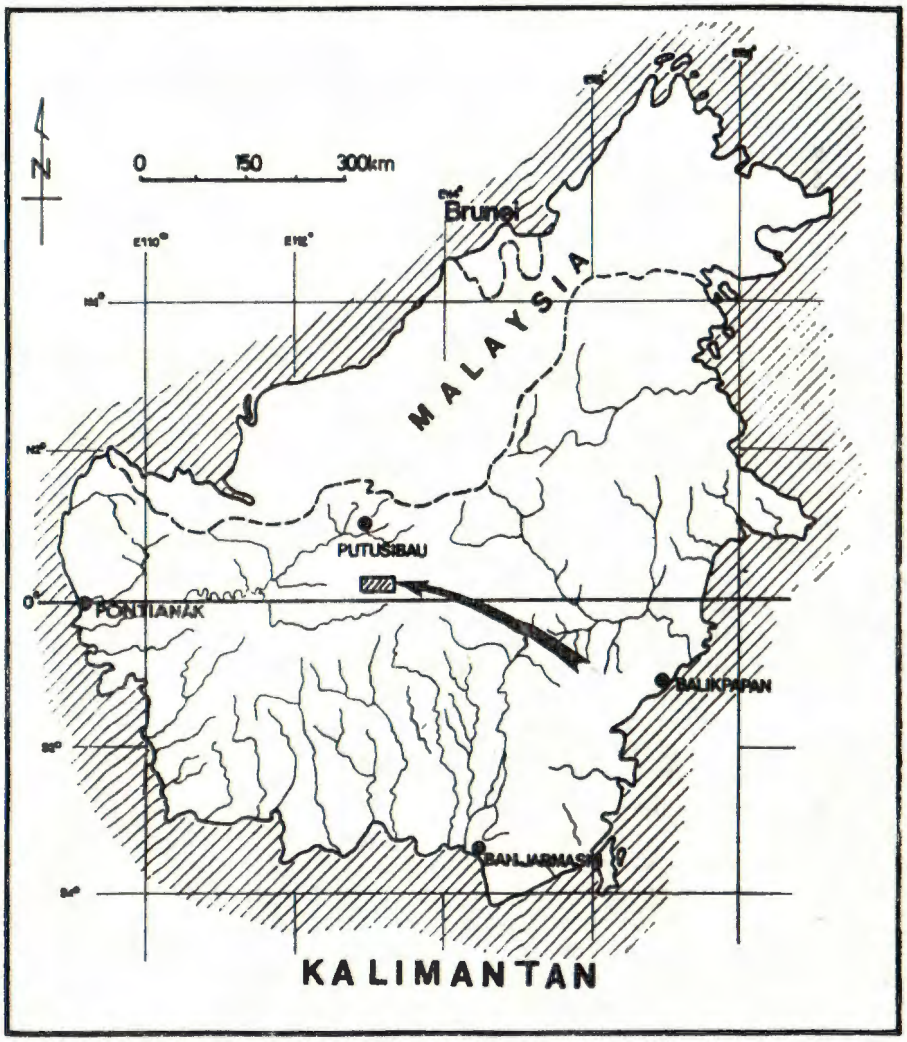

Fig. 1. Location map of the explored area.
Sl. 1. Položaj istraživanog terena.

GEOLOGICAL STRUCTURES OF TERRAIN PROSPECTED

On the general geological map (Geologische Oversichtskaart van de Westraufeeling von Borneo) in the scale 1 : 250.000 from the year 1939 by C. P. Z. Emmichoven and R. W. Bemmelen (1939) which covers a large part of west and central Kalimantan there is slown also the area of the Mentebeh and Tenungun rivers.

According to this map the area of the rivers mentioned above is composed of the Cretaceous and Paleogenic sediments and magmatic rocks.

Cretaceous sediments are composed mainly of clastic rocks (mudstone, sandstone) and rarely of limestone.

By the macroscopic observation we have found that within the Cretaceous sedimens there appear most frequently finely laminated mudstones interbedded with sandstones.

By the microscopic examination of mineral composition in the sandstones we have found graywacks and arenaceous quartz. Graywacks consists of quartz, plagioclase and pyroxene, chlorite and opaque minerals, and frequently also the fragments of hornfels, syllites and effusives. Arenaceous quartz contains quartz, plagioclase and hornfels. Matrix is mainly calcareous. Micropaleontological analyses made from the light-grey mudstones have shown a rather poor and badly preserved fossil content. On the basis of several samples of Rotalipor rocks the Upper Cretaceous Age has been proven.

Tertiary sediments are extended in a much vaster area and they are repesented by fine to medium grain carbonate sandstones and mudstones. In clay-marl of olive-grey to olive-green colours, considered Paleogenic, by means of micropaleontological analysis the species of Globotruncana has been determined which indicates the Cretaceous Age. However, in the same sediments also the species of Globigerina has been found which indicates the Tertiary Age. Thus, the age of these sediments seems to be problematic for the time being. They should probably be attributed the Paleogenic Age with pre-sedimented Cretaceous fossils, although the possibility of Cretaceous Age should not be completely discarded.

Magmatic rocks are represented mainly by acidous eruptive rocks from granites to grandiorites, the penetration of andesites was also determined (Emmichoven and Bemmelen, 1939).

During the field observation we have at a number of places registered extrusive volcanic rocks occurring as smaller penetrations and dykes, and the presence of skarns has been noticed as well. By the microscopic examination of taken samples we have determined the rhyolites, rhyodacites, andesites and basalts (Plate 1). The rhyodacite basis consists of sanidine, quartz and haematite, while melanocrystals are the biotite foils. Rhyodacites are distinguished by poorly expresed porphyric texture and their basis is holocrystalline. They consist of irregularly distributed phenocrystals of plagioclase, while in the basis there are many small grains of opaque minerals (haematites, limonites and pyrites) as well as the chlorite foils. Andesite has poorly expressed porphyric texture. Its basis consists of the plagioclase sticks, small foils of chlorite and small quantitiy of quartz. Basalt has the porphyric texture with holocrystalline basis. The plagioclase stricks prevail in the basis, while the interspaces are filled with pyroxene and chlorite as well as the opaque minerals (pyrite, haematite).

Quarternary formations are represented mainly by older river alluvions of meander type as well as the recent river deposits. They are distinguished by the specific structural characteristics resulting from the sedimentological features of sedimentation environment. So the meandric type of sedimentation is distinguished by sudden changes of lithological composition mainly consisting of gravel, sand and clays. A number of meanders has been registered which differ in

dimensions and internal composition. On the basis of difference in the composition of roundstones and the degree of their consolidation it can be assumed that the meanders are of different generations having three basic facies: river bed facies, sloodplain facies and facies of deserted river beds (oxbow facies). The bottom part of older river alluvions is made of gravels and sands pertains to the river bed deposits, while the upper part pertains to the sloodplain facies and is composed of sand-clay deposits.

From the commercial viewpoint, important are both older alluvion sediments and recent river deposits.

The bottom part of older river alluvions is composed mainly of gravels with roundstones of 2—25 cm approximate size (Plate 3, Fig. 1) and in places there are also the blocks of larger sizes. Roundstones are well rounded which indicates their long transportation and they are built of acidous and intermedial magmatic rocks, the minerals of which are resistant to wear and tear. The upper part of these sediments consists of fine sand and silty clay. The carriers of greater enrichment of gold are lower gravel-sand sediments, while going upwards the content of gold particles is considerably decreased.

Recent river deposits of the Mentebah and Tenungun river are represented by gravels and sands. From these deposits the sieved samples for chemical-mineralogical analyses have been taken. By the method of defraction of X-rays the following mineral contents has been determined: — light minerals — quartz (predominant), plagioclase (small quantity) and chlorite (accessory); — heavy minerals — haematite, ghetite, amphibole and pyroxene, as well as the remaining — chlorite, plagioclase and mica.

The separated heavy and light fractions have been analysed by means of a polarizing microscope and examined in the reflected light. Quartz has been determined as predominant within the light fractions, guartz grains being angular and subangular. Then there are present the feldspates, mostly plagioclase. Of the heavy minerals there have been found zircon, turmaline, magnetite, pyroxene, ilmenite, horblend, rutil and chlorite. In the composition of heavy minerals in the area of the river Mentebah the rhombic pyroxene has been found to be predominant associated with ilmenite, while in the river of Tenungun the dominant mineral is zircon. This indicates the existence of two different groups of mother rocks i.e. acid and basic eruptive rocks which are the resource of the minerals and sediments described.

On the mentioned geological map there almost do not exist the indicated structural elements. However, very strongly expressed morphology in the river wider area and fragmently sharp meanders point to the intensive tectonic movements. Furthermore, on the rare rocks outcrops intensive tectonic movements could also be noticed, and thus, their activity has caused the appearance of plicative and disjunctive structural forms. (Plate 2, Fig. 1).

FIELD PROSPECTION

Field prospection of gold has been carried out along the rivers Mentebah and Tenungun in the river beds themselves and afterwards also in

the tributaries of these rivers and in the old meanders and river terraces. During the prospection, the sample have been taken for gold analyses, then rock samples for petrological analyses and for paleonthological determinations, as well as the sieved samples for chemical-mineralogical analyses (Encl. 1).

Samples for the gold content analyses have been taken from the various locations of alluvial and recent river sediments being, as follows;

— where the power of waterstream rapidly decreases,
— after torrents and cascades,
— after the massive rock blocks,
— on the internal convex bank of curve,
— outside the main current of waterstream.

The mentioned locations represent the places where usually the speed and transportation power of waterstream are decreased and where the sedimentation of transported heavier mineral fractions is carried out. However, because of a possibility to compare the data, samples have been in places taken also from the river itself in the main current area. The sampling and examination of gold content has been carried out by the panning method.

Here the sampling has been most frequently performed »by furrow« of 0.5—1.5 m length, approximately in the equal quantites of material weighing 7 or 14 kg. In order to determine the influence of sample quantity the panning samples have been distributed almost regularly through the hydrographic network so that they cover the whole river course.

Panning of material has been carried out by means of metal and wooden pans (Plate 2, Fig. 2). During the panning, the minerals with lower specific gravity have been removed by the waterstream, and on the principle of the gravity concentration the mineral concentrate of increased specific weight remained — a panned sample (over 3 g/cu. cm), such as the native gold and platinum, cassiterite, wolframite, scheelite, cinnabarite, barite, zircon and others. We have been mostly interested in gold which is relatively easily released from its associtaed minerals. In a sample panned of 14 kg of material, 15 to 20 gold grains or foils, size smaller than 2 mm could be macroscopically counted.

The gold particles which have lost during the transportation their crystal, dendritic and irregularly prolonged shapes have acquired the new rounded or plate forms. Taking into consideration the forms and large size of gold particles it can be assumed that the primary or mother rocks are not located very far away.

PROSPECTION OF THE MENTEBAH RIVER

Sampling and panning have been started in the eastern part of the site (the upper river course) and continued downstream to the village Nangah Duwa (Encl. 1). Observations have been carried out at 26 places i.e. points distributed along the river. At different observation points different gold contents have been macroscopically registered in the panned samples, ranging from only a few very minute particles all the way to some twenty foils — grains of gold up to 2 mm diameter.

SKETCH MAP OF THE SAMPLING LOCATION IN THE AREA OF THE RIVERS MENTEBAH AND TENUNGUN

SKICA LOKACIJA UZORKOVANJA U PODRUČJU RIJEKA MENTEBAH I TENUNGUN

N

0 2.5km

R. Mentebah

NANGAH DUWA

R. Jelihai

R. Tenungun

R. Mentebah

R. Bangka

LEGEND:
LEGENDA:

- X SAMPLES FOR GOLD ANALYSIS
  UZORCI ZA ANALIZE ZLATA
- ▲ SAMPLES FOR PETROGRAPHIC ANALYSIS
  UZORCI ZA PETROGRAFSKE ANALIZE
- ■ SAMPLES FOR PALEONTOLOGIC ANALYSIS
  UZORCI ZA PALEONTOLOŠKE ANALIZE
- ● SIEVED SAMPLES FOR CHEMICAL - MINERAL ANALYSIS
  PROSIJANI UZORCI ZA KEMIJSKO - MINERALOŠKE ANALIZE
- ⊠ PIT
  OKNO
- LOCAL MINING
  LOKALNI RUDNIK

Encl. 1
Prilog 1

The largest gold content has been found in the alluvial medium grain and coarse grained gravels and sands immediately above the bedrock (Fig. 2). So, for instance, at the point 5 (Encl. 1) in the sample taken from the alluvial deposit of 14 kg weight 15 foils — grains of gold up to 2 mm diameter have been macroscopically determined. By chemical analysis as well it has been found that in the analyzed sample from that point there is 818 grams of gold per ton in concentrate (Table 1, Smpl. 5c). Approximately 1 km downstream, at the point 7, in the panned sample composed of the recent stream sediment 20 foils — grains of gold have been registered. By chemical analysis it has been found that in the analyzed sample from that point there are 702 g/t of gold (Table 1, Smpl. 7c).

Table 1. Determination of Gold in Heavy Mineral Fractions

Tabela 1. Determinacija zlata u teškim mineralnim frakcijama

No. Smpl.	Concentration g/t Au
2 a	265
4 b	6
5 c	818
7 b	47
7 c	702
9 a	1594
15	82
16 a	390
17 a	1243
17 b	555
17 b'	30
17 d	1930
18 b	385
28	219

Gold determination was done by Pye — Unicam atomic absorber, model SP 9, Philips, Cambridge (Great Britain) with precision of 10% and sensitivity 0,1 μg/ml (0,1 ppm).

A certain number of samples (Table 2) have been also analyzed on gold and silver content using the Fire Assay Method and the following results were obtained.

The extremely increased gold content has been determined in the area of the Jelihai tributary emptying into the Mentebah river (Encl. 1, Points 9 and 17) in the heterogeneous contents built mostly from the alluvial gravels and sands. So, at the point 9 in the panned sample there have been macroscopically registered 20 foils of gold (14 kg of material), and at the point 17 in the same quantity of material there have been registered 15 gold foilds of up to 2 mm diaemter. Chemical analyses have also proven an extremely increased gold content in those areas. The analysis of the point 9a, sample has proved the gold centent of 1594 g/t, while in the concentrate of the point 17 there have been proved 1243 i.e. 1532 g/t of gold (Table 1 and 2, Smpls. 9a, 17a and 17). Here, it is necessary to point out that the analyzed samples have been taken from the

Table 2. Determination of Silver and Gold by the Fire Assay Method in Heavy Mineral Fractions

Tabela 2. Determinacija srebra i zlata metodom kupelacije u teškim mineralnim frakcijama

No. Smpl.	Element Ag g/t	Error of method	Element Au g/t	Error of mtd.
5	45	(± 5)	252	(± 3)
7b	26,5	(± 5)	58,5	(± 2)
9	105	(± 5)	550	(± 5)
17	250	(± 10)	1532	(± 10)

gravel — sand deposits immediately above the bedrock, so the obtained gold values do not apply to the total quantity of deposits at these locations. So, for instance, at the same location in the sample taken from the upper part of gold-bearing deposits the gold content is considerably smaller. Thus, at the point 17 in the lower part of deposits there have been determined 1243 g/t of gold, in the upper part 555 g/t, and in the uppermost only 30 g/t (Table 1, Smpls. 17a, 17b and 17b', and Fig. 3).

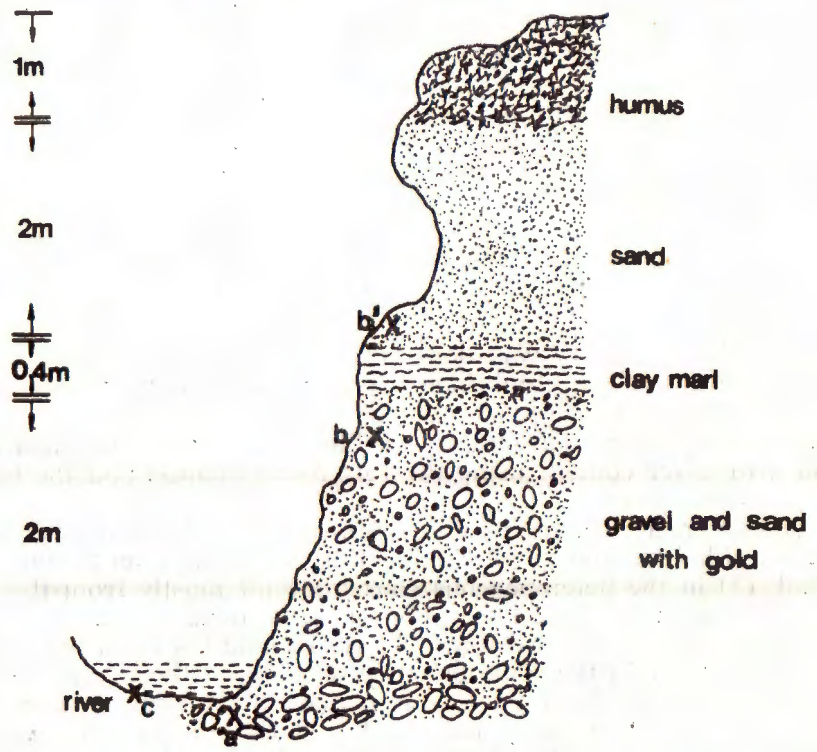

Fig. 3. Profile of the river terrace (river Mentebah, loc. 17); X — sampling point.
Sl. 3. Profil kroz riječnu terasu (rijeka Mentebah, lok. 17); X — mjesto uzorkovanja

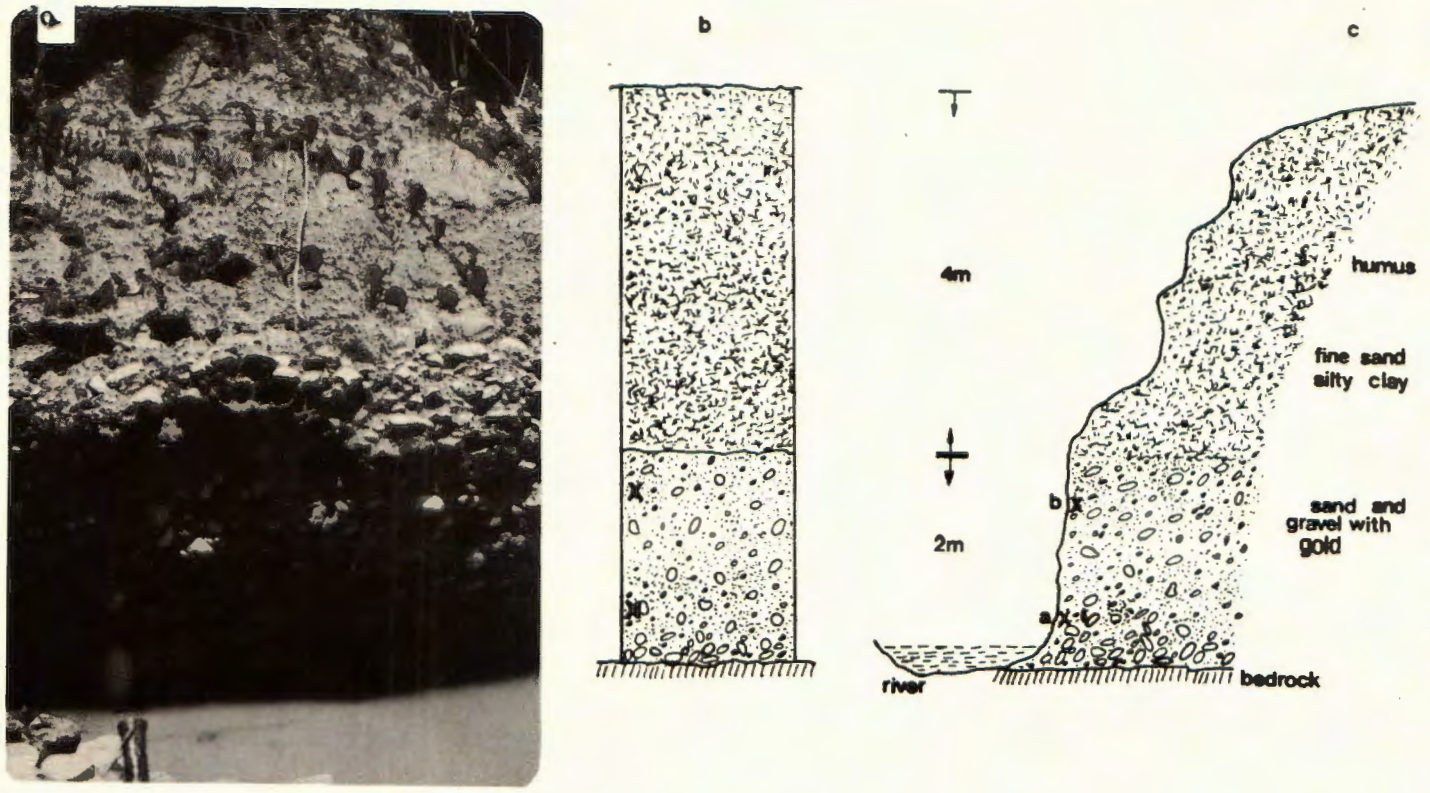

Fig. 2. Outcrop of alluvial gravel and sand near the river mouth of the Serohok river in the Mentebah river:
photo (a), column (b), and profile (c); X-sampling point

Sl. 2. Izdanak aluvijalnog šljunka i pijeska u blizini ušća Serohoka u Mentebah:
fotografija (a), stup (b) i profil (c); x — mjesto uzorkovanja.

To witness an irregular content of gold in the older river alluvion and recent river deposits there are also the data found e.g. at the points 4, 7b and 15. In the panned samples of these points very small quantities of gold have been macroscopically found, or the gold has not been registered at all, which has been shown also by chemical analyses (Table 1, Smpls. 4b, 7b and 15).

Besides sampling directly from the river bed and from the open outcrops of fossil alluvial deposits on the river banks, the samples have been taken in places also from the river terraces which can here and there be more than 100 m wide. So, at the point 18b (Encl. 1) approximately 100 m far from the river there has been dug an exploration pit 1.5 m deep and a sample has been taken immediately above the bedrock. The panned sample has shown the presence of gold, and the chemical analysis has proved the gold content of 385 g/t in the concentrate. This points to the assumption that all the older river terraces along the Mentebah river can be considered potentially gold-bearing.

The thicknesses of gold-bearing horizon are different at particular observation points and they range from 0.8 to 2.5 m. However, for the determination of total quantity of gold deposits detailed explorations will have to be carried out.

PROSPECTION IN THE AREA OF THE TENUNGUN RIVER

During the field prospection the water level of both the Mentebah and Tenungun rivers was very low which made considerably difficult the sailing by boat and going round the outcrops of alluvial deposits. While the navigation on the Mentebah river was possible, however, with considerable efforts, on the other hand, down the Tenungun river it was possible to reach the Jarov tributary only. The low water level and knocked-down and flooded trees made impossible the navigation upstream of the mentioned tributary (Plate 3, Fig. 1). Going on foot was impossible, too. Due to the above problems, observations on that river were made only in the part of the Jarov tributary up to the mouth of the Mentebah river.

In the prospected part of the river the observations were made in nine locations that is in the older alluvial deposits discovered on the river banks and in the recent deposits in the riverbed itself. In the panned samples on two observation points (Encl. 1, Point 22 and 30) no gold particles were recorded. On other points of observation a small number of very fine, hardly macroscopcially noticeable particles of gold were recorded in the panned sample. Only on the Point 28 (Encl. 1) in the panned sample made of 14 kg of material taken from the riverbed itself at the depth of 50 cm 8 gold foils smaller than 1 mm were macroscopically recorded. It could be stated, in general, that along the Tenungun river open outcrops of older alluvion could be rarely found in the river is more cut-in and less meandres than the Mentebah. In the samples taken from the old alluvion and the recent river deposits significantly smaller gold quantities were macroscopically recorded in the panned sample, and the recorded foils and grains are of smaller dimensions than those ascertained in the Mentebah river. By chemical analysis of

the samples taken from the above-mentioned points gold was ascertained in all samples. However, the gold content significantly varies in individual samples and ranges from 20 g/t to 220 g/t in the concentrate. Hereby, the biggest gold content was proved on the Point 28, where also the biggest number of particles was macroscopically recorded.

GOLD CONTENT IN THE ALLUVIONS OF THE MENTEBAH AND TENUNGUN RIVERS

Based on the data obtained through field prospetion and chemical analyses of samples (43 samples) it can be stated that the content of gold considerably varies in individual locations. It has been macroscopically noticed that the size and numer of gold particles in the panned samples considerably vary as well.

It has been ascertained that in the area of the Mentebah river a significantly higher gold content was found in the deposits than it was the case along the Tenungun river. By chemical analyses it has been proved that the gold content in the analyzed samples ranges form 6 g/t to 1930 g/t.

Hereby, it has been ascertained that the considerably higher gold content was found in the lower part of gold-bearing deposits amounting on the average to about 510 g/t. The gold content decreases towards the upper part of the deposits to approx. 70 g/t of concentrate on the average. It has been also ascertained that the higher gold content was found in the older alluival deposits (approx. 360 g/t) than in recent river deposits (approx. 257 g/t).

It has been proved that in three locations the gold content was increased and that to 1594 g/t, 1930 g/t and 1243 g/t i.e. 1532 g/t.

The locations with so high gold contents have been found in the area of the Asompotah, Jelihai and Tebuk rivers emptying into the Mentebah river. The gold content so increased in these locations should be probably attributed to the above-mentioned tributaries. It can be concluded that the primary — mother rocks are located near the springs of these rivers i.e. in the north-east and eastern part of the explored field.

In the area of the Tenungun river a considerably lower gold content has been recorded. A considerably smaller number of gold particles and their smaller size were macroscopically recorded in panned samples. By chemical analyses of samples it has been determined that the gold content amounts to 60 g/t of concentrate on the average. One of the reasons for a lower gold content could be that the observations were made in the lower river course.

Data on gold content obtained by chemical analysis represent the gold content in the concentrate (panned sample) and cannot be considered an average gold content in the deposit. They point out to a great variability of gold content and its distribution in the area.

Three locations with extremely increased gold concentration are distinguished here. According to the data obtained the gold content of appr. 0.5—3.5 g/m^3 of ore can be expected in the sediments on these locations.

OTHER MINERALS AND ELEMENTS RECORDED

In addation to gold analyses, a chemical (silicate) analysis of heavy mineral fractions has been carried out in panned samples from three locations: from the upper, medium and lower course of the Mentebah river (Encl. 1, Points 2, 13 and 17 d). The following content in percentage has been obtained (Table 3).

Table 3. Chemical Analysis of Heavy Mineral Fraction
Tabela 3. Kemijske analize teške frakcije

Loc. No	2	13	17d
SiO_2	85,72	34,25	12,22
TiO_2	0,96	7,79	9,32
FeO	1,25	9,49	8,43
Fe_2O_3	1,60	7,00	12,56
R_2O_3	8,23	51,04	85,89
MnO	—	—	—
MgO	tr	4,75	tr
CaO	0,28	2,37	0,63
Na_2O	1,25	1,25	1,21
K_2O	0,30	—	—
P_2O_5	tr.	tr.	tr.
L.o.i.	1,82	1,25	0,93
H_2O	0,17	0,38	0,08

The analysis results show that the content of R_2O_3 and SiO_2 distinctly varies. While the R_2O_3 content is considerably lower in the upper course than that in the lower river course, the SiO_2 content is fully opposite. This proves that the transportation of heavy mineral fractions with a distincly increased R_2O_3 content is for its major part in connection with right tributaries in particular with the Jelihai river.

Microanalyses of the content of the panned sample have been carried out, too. By analysis of the panned sample from the location 17 (Encl. 1) by X-ray fluorescence method the following composition has been ascertained as shown in Table 4.

Table 4. Composition of the panned sample from the location 17
Tabela 4. Sastav šliha uzorka lokacije 17

Ca	4275,1 ppm	Zn	37,7 ppm
Ti	3,35 %	Pb	81,9 ppm
Cr	5791,7 ppm	Sr	1,9 ppm
Mn	425,8 ppm	V	33,6 ppm
Fe	4,41 %	Zr	1256,0 ppm
Ni	7,3 ppm	Sn	105,0 ppm
Cu	234,2 ppm	Ba	30,0 ppm

By the panned sample microanalyses through the atomic absorption spectrometry method the presence of the following elements has been recorded as shown in Table 5.

Table 5. Concentrations g/t
Tabela 5. Koncentracije g/t

No. Smpl.	2a	16a	17d
Cu	3.8	8.4	13.0
Zn	58.1	288.9	376.9
Pb	5.8	24.3	34.6
Pt	21.2	81.2	179.2
Ag	40.4	54.1	267.1
Cr	23.2	196.9	423.5

By the panned sample content microanalyses it has been ascertained that, in addition to gold, there are also intersting concentrations of other associated elements in the analyzed samples. To which extent the recorded elements will have a commercial significance depends upon an average content, their distribution in a deposit and a possibility and effect of their concentration and exploitation.

CONCLUSION

For clastic rocks (mudstone and sandstone developed in the valleys of the Mentebah and Tenungun rivers, which have been attributed to belong to the Cretaceous age so far, it has been proved through fossiles that they belong to the Upper Cretaceous age. Among magmatic rocks there have been ascertained rhyolites, rhyodacites, andesites and basalts, most frequently occuring in the form of smaller intrusions and dykes. It has been also ascertained that the tectonic movements were intensive in the investigated area so that they conditioned the development of plicative and disjunctive structural shapes.

Along the above-mentioned rivers, particularly along the Mentebah rivers, the alluvial sediments are well developed and made of three basic groups of facies being the facies of riverbed, facies of sloodplain and facies of oxbows. The sediments are represented through various formations consisting of rougher sediments (gravel-sand rocks) and finer materials (aleurolite-clay sediments). The rougher fraction of the alluvium consists of various minerals and elements, among which gold is the most significant.

The prospection of gold has been carried out by method of panning. Almost in all panned samples (43 samples) the presence of gold particles has been macroscopically recorded. In individual samples made of 14 kg of material up to 20 gold foils or grains up to 2 mm in size have been recorded. On that occasion a much higher gold content has been ascertained in the alluvial deposits of the Mentebah river than in the sediments located in the valley of the Tennungun river. By chemical analysis of samples from the alluvial deposits of the Mentebah river it has been ascertained that the gold content ranges from 6 g/t to 1930 g/t in concentrate. In three locations of the alluvial deposits in the area of the rivers Asompotah, Jelihai and Tebuk emptying into the Mentebah river an exceptionally increased gold content has been ascertained.

It has been proved that a significantly higher gold content can be found in the lower gravel-sand part of the alluvial deposits, directly above the bedrock (approx. 510 g/t on the average), however, towards the upper part of the deposit the gold content decreases (about 70 g/t on the average). It has been also ascertained that the higher gold content can be found in the older alluvial deposits than in recent river deposits. A much lower gold content has been recorded in the alluvial deposits of the Tenungun river.

In the analyzed samples only 60 g/t in concentrate on the average have been recorded.

In addition to gold, through microanalysis of panned samples there have been recorded also other elements, some of which having a significantly increased concentration.

Through chemical-mineralogic analyses of sand samples it has been proved that from the heavy minerals in the alluvial deposits of the Mentebah river there prevails rhombic pyroxene associated with ilmenite, while in the valley of the Tenungun river zircon prevails.

This points to the existence of two mother-rocks — basic and acid eruptives.

Through field prospection and chemical analyses it has been proved that the investigated area can be considered interesting and promising for further detailed explorations and exploitation of gold. This can be supported by the fact that today in the world the alluvial sediments are considered exploitable if they contain more than 0,10 g/m³ of gold in ore.

The determination of the total quantity of gold-bearing deposits and average quantity of gold in the deposit as well as a possibility of using some of the associated elements constitute the subject of further explorations.

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Prospekcija zlata u području rijeka Mentebah-a i Tenungun-a na otoku Kalimantanu (Borneo, Indonezija)

M. Oluić i Đ. Bodrožić

Područje rijeka Mentebaha i Tenunguna smješteno je u centralnom dijelu otoka Kalimantana. Obraslo je veoma gustom vegetacijom pa predstavlja tipičnu džunglu. To je vjerovatno bio jedan od razloga da je do sada veoma slabo geološki istraženo.

Uže područje navedenih rijeka izgrađeno je od klastita u kojima su mikropaleontološki utvrđene foraminifere iz roda Rotalipora i time im je dokazana gornjokredna starost. Od magmatskih stijena utvrđeni su rioliti, riodaciti, andeziti i bazalti, koji se najčešće pojavljuju u obliku manjih proboja i dajkova. Također su zastupljeni tercijarni i kvartarni sedimenti.

Tektonski pokreti u tom području bili su intenzivni pa su uvjetovali nastanak plikativnih i disjunktivnih strukturnih oblika.

Duž spomenutih rijeka, osobito duž rijeke Mentebaha, veoma dobro su razvijeni aluvijalni sedimenti, koji su izgrađeni od tri osnovne grupe facijesa, i to facijesa korita, facijesa poloja i facijesa napuštenih korita (mrtvica). Obzirom na vrstu facijesa zastupljene su različite tvorevine koje se sastoje od krupnozrnatih sedimenata (šljunkovito-pjeskovite stijene) i sitnozrnatih materijala (alevritsko-glinoviti sedimenti). Debljina grublje frakcije aluvijona iznosi u prosjeku oko 1,5 m a slojevitost joj je slabo izražena. Aluvijum priobalskih gredica najčešće je prekriven sitnozrnatim pijescima, te grubim i sitnozrnim alevritima i alevro-pelitima, prosječne debljine oko 3 m.

Razvijeni aluvijoni bogati su različitim mineralima i elementima, među kojima je najznačajnije zlato.

Prospekcija zlata obavljena je metodom šliha ili ispiranja. Ukupno su uzeta 43 uzorka iz kojih su urađeni šlihovi i kemijske analize. Gotovo u svim šlihovima makroskopski je zapaženo prisustvo zlatnih čestica. U pojedinim šlihovima, urađenim od 14 kg materijala registrirano je do 20 listića i/ili zrna zlata promjera do 2 mm. Pritom je utvrđeno da se znatno veće količine aluvijona nalaze duž rijeke Mentebaha, nego u dolini rijeke Tenunguna. Također je zapaženo da su nanosi u području rijeke Mentebaha izrazito bogatiji sadržajem zlata, kako po količini tako i po veličini čestica.

Kemijskom analizom uzoraka iz aluvijona rijeke Mentebaha utvrđeno je da se sadržaj zlata kreće od 6 g/t do 1930 g/t u koncentratu (šlihu). Na tri lokacije u aluvijonu utvrđen je izrazito povećan sadržaj zlata i to više od 1500 g/t u šlihu. Te su lokacije smještene na ušćima rijeka Asompotaha, Jelihai i Tebuk-a u rijeku Mentebah. Ovo upućuje na konstataciju da se matične (zlatonosne) stijene nalaze pretežno u izvorišnom dijelu tih pritoka, odnosno u sjeveroistočnom i istočnom dijelu istraživanog terena. Također je utvrđeno da se znatno veći sadržaj zlata nalazi u donjem dijelu zlatonosnih naslaga i to neposrdno iznad podine (bedrock) aluvijona (u prosjeku 510 g/t u šlihu), dok idući prema gornjem dijelu naslaga sadržaj zlata značajno opada (u prosjeku 70 g/t u šlihu). Istovremeno je dokazano da starije aluvijalne naslage sadrže mnogo veću količinu zlata od recentnih riječnih nanosa.

Sadržaj zlata u nanosima rijeke Tenunguna izrazito je manji u odnosu prema naslagama rijeke Mentebaha, te u analiziranim uzorcima iznosi u prosjeku svega 60 g/t u šlihu.

Pored zlata mikroanalizom šliha registrirani su i drugi elementi, od kojih neki imaju znatno povećanu koncentraciju.

Kemijsko-mineraloškom analizom uzoraka pijeska dokazano je da od teških minerala u nanosima rijeke Mentebaha dominira rompski piroksen praćen ilmenitom, dok u rijeci Tenungun prevladava cirkon. To upućuje na postojanje dviju grupa izvorišnih stijena i to bazičnih i kiselih eruptiva.

Rezultati terenske prosjekcije i kemijskih analiza dozvoljavaju zaključak da se razmatrano područje može smatrati interesantnim i perspektivnim za daljnja detaljna istraživanja i eventualno eksploataciju zlata.

PLATE — TABLA I

Microphotos of determined rocks in the valley of the Mentebah river. Crossed nicols.

1. rhyolite
2. rhyodacite
3. andesite
4. basalt

Mikrofotografije determiniranih stijena u dolini rijeke Mentebah: Ukršteni nik.

1. riolit
2. riodacit
3. andezit
4. bazalt


1
0.25mm


2
0.25mm


3
0.25mm

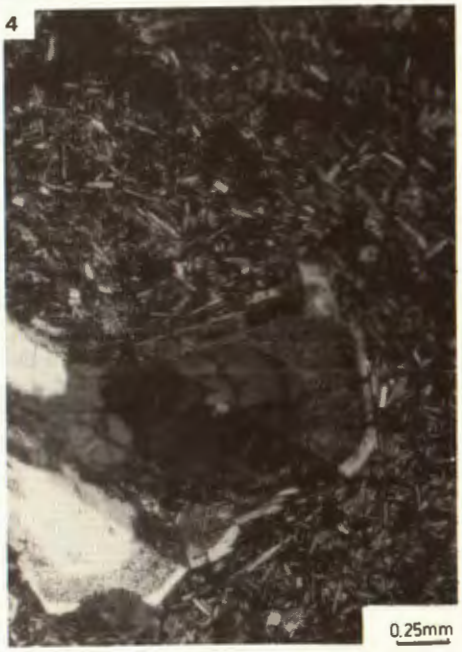
4
0.25mm

PLATE — TABLA II

Figure 1. The dislocated fold is composed of marls and sandstones, located on the left bank of the Tenungun river (in the vicinity of the mouth of the Betingkur brook)

Slika 1. Dislocirana bora izgrađena od laporovitih i pješčenjačkih naslaga na lijevoj obali rijeke Tenungun (u blizini ušća potoka Betingkura).

Figure 2. Panning made by wooden pan.

Slika 2. Ispiranje šliha pomoću drvene ispitke.

1

2

PLATE — TABLA III

Figure 1. Older river alluvion with gold content in the vicinity of the Tebuk river mouth into the Mentebah river.

Slika 1. Recentni riječni aluvij sa sadržajem zlata u blizini ušća rijeke Tebuka u Mentebah.

Figure 2. Recent river alluvion in the Tenungun river. Knocked-down and flooded trees could be also seen, which obstruct free river navigation.

Slika 2. Recentni riječni nanos u rijeci Tenungun. Također se vidi oboreno i naplavljeno drveće koje ometa plovidbu rijekom.

1

2