

## Chapter 2 Data Analysis

### 2-1 Purpose of the Data Analysis

The data analysis is intended to outline the ore deposits and showings and to ascertain the mode of occurrence in the survey area by collecting, compiling and analyzing the existing data.

### 2-2 Geology

#### 2-2-1 Data collection

The collected data include among others the INGEMMET geological reports, the Petroperu's geologic maps and reports, and the ONERN survey reports. For details of the collected data, refer to the list of reference and data collected, at the end of this volume.

#### 2-2-2 Summary of Geology

##### (1) Stratigraphy

The survey area is underlain by the Precambrian, the lower and upper Paleozoic formations, the Mesozoic and Cenozoic rocks, and intrusive rocks. The Sira range, which is situated in the west of the survey area and constitutes a part of the Sub-Andes, is composed of Precambrian, Lower and Upper Paleozoic, Mesozoic, and intrusive rocks. The Ucayali-Urubamba rivers, which run northward while meandering along the east margin of the Sira range, form the Ucayali sedimentary basin with N-S trending axis, composed of the Paleozoic and Mesozoic rocks.

In the central to eastern part of the survey area, the Selva spreads extensively from the Ucayali basin to the Brazilian border, forming flatlands chiefly underlain by the Cenozoic rocks. Figure 12 demonstrates a schematic geologic column of the survey area.

The geologic units of the survey area are described, in ascending order, in the following paragraphs:

##### *1) [Sira complex and Marañon complex] - Precambrian*

These complexes occur as the inliers within the Upper Paleozoic Copacabana Group which corresponds to the anticline east of the Sira range (Quadrangles 21-ñ and 22-ñ). These are the oldest strata in the survey area, forming the basement of the Ucayali sedimentary basin. The Sira complex (Quad. 21-ñ) is composed of gneiss and slate whilst the Marañon complex (Quad. 22-ñ) is mainly of dioritic gneiss.

Figure 12 Schematic geologic column

Geological Age		Formation Name	Thick- ness m	Lithology		
C E N O Z O O L I C	Quaternary	Holocene	Aluvial Deposit, Talus	Sand, Gravel [Unconformity]		
		Pleistocene	East Selva Area: Madre de Dios Formation	20	Brownish Sand, Clay, Gravel	
	West Selva Area: Ucayali Formation		30	Brownish Sand, Clay, Gravel [Angular Unconformity]		
	Neogene	Pliocene	Ipururo Formation (West Sira Area: 500m thick -ness)	1,200	Calcareous Sandstone (Sandstone with lignite layer) [Unconformity]	
		Miocene				
	Paleogene	Oligocene	East Sira: Huayabamba Group West Sira: Chambira Formation Poza Formation Yahuarango Formation	1,600 (400) (400) (800)	Sandstone, Mudstone, and Limestone Reddish violet Claystone Tuff, Shale Calcareous Claystone [Unconformity]	
		Eocene				
	M E S O Z O O L I C	Cretaceous	Upper	Cachiyacu-Huchpayacu Formation	150	Shale, Sandstone
				Vivian Formation	350	Siliceous Sandstone
				Chonta Formation	650	(Shaly) Limestone with thin Limonite Layer
Oriente Group				600	Siliceous Sandstone with thin Limonite Layer [Unconformity]	
Jurassic	Upper	Sarayaquillo Formation	600	Feldspasic Sandstone with Basal Conglomerate [Angular Unconformity]		
	Lower	Pucara Group	1,500	Limestone Shaly Limestone		
Triassic	Upper					
	Lower	Ene Formation	700	(Calcareous) Sandstone [Unconformity]		
P A L E O Z O O L I C	Permian	Upper	Copacabana Group	500	Dolomitic Limestone	
		Lower				
C A R B O N I F E R O U S	Carboniferous	Upper	Tarma Group	500	Siliceous Sandstone with thin Coal layer	
		Lower	Anbo Group	600	Sandstone with Limonite layer [Angular Unconformity]	
Ordovician		Contaya Formation	400	Limonitic Shale [Angular Unconformity]		
Proterozoic		Sira Complex Marafon Complex		Gneiss, Semischist Dioritic Gneiss		

2) [*Contaya Formation*] - *Ordovician*

The formation lies in a small area to the south of the Bajo Pichanaqui (Quad. 22-n) at the southwest end of the survey area. It is about 400 m thick, in unconformable covered by the Ambo Group.

3) [*Ambo Group*] - *Early Carboniferous*

The Carboniferous to Permian overlies the Ordovician in angular unconformity, constituting the Ambo Group, Tarma Group and Copacabana Group in ascending order. In Quad. 22-n, the formations lie in a small area at Autiki. The Group consists of gray colored, medium to coarse grained sandstone containing mica, accompanied by thin layers of dark gray colored limonite containing fossil flora. The Group is 600 m thick.

4) [*Tarma Group*] - *Late Carboniferous*

In Quad. 21-n, 22-n and 22-ñ, the formations lie in Obenteni. The layer consists of greenish white-colored, coarse grained quartzitic sandstone. In the lower horizon, gray colored sandstone including coal layers is observable. The Group is 500 m thick.

5) [*Copacabana Group*] - *Early Permian*

The Group is widespread over the entire area of the Sira range (Quad. 20-n, 20-ñ, 21-n, 21-ñ, 22-n, 22-ñ and 22-o). The layer is mainly composed of limestone, partially dolomitic. The upper horizons are dominated by fossil-rich marl. The Group is 500 m thick, in unconformable covered by the Ene Formation.

6) [*Ene Formation*] - *Late Permian to Early Triassic*

The Formation lies northwest of Bajo Pichanaqui (Quad. 22-n) in the southwest end of the survey area. The Formation is composed of fine to medium-grained sandstone accompanied by limonite and thin layers of poorly sorted calcareous sandstone. The thickness of the Formation is 700 m.

7) [*Pucara Group*] - *Late Triassic to Early Jurassic*

The Group lies in the vicinity of Bajo Pichanaqui (Quad. 22-n) in the southwest end of the survey area. The Group is mainly composed of thick beds of neritic limestone, accompanied by thin layers of marl. The upper horizons abound in fossils. The Group is 1,500 m thick, covered by the Sarayaquillo Formation in angular unconformity.

8) [*Sarayaquillo Formation*] - *Late Jurassic*

The Formation lies in a small area to the south of Puerto Bermudez (Quad. 21-n). The Formation is composed of somewhat thick beds of feldspathic sandstone, accompanied by limonitized basal conglomerate. The Formation is 600 m thick, in unconformable covered by the Oriente Formation.

9) [*Oriente Group*] - *Early Cretaceous*

Cretaceous in unconformable covers Jurassic, constituting the Oriente Group, Chonta Formation, Vivian Formation and Cachiyacu-Huchpayacu Formation, in

ascending order. The Group spreads most broadly over the entire area of the Sira range in the survey area. (Quad. 20-n, 20-ñ, 21-n, 21-ñ, 22-n, 22-ñ, 22-o and 22-p) The Group is composed mainly of white-colored siliceous sandstone accompanied by thin layers of reddish feldspathic sandstone and limonite. The Group is 600 m thick.

*10) [Chonta Formation] - Late Cretaceous*

The Formation extends in strip north to south along the east and west flanks of the Sira range. (Quad. 20-n, 20-ñ, 21-n, 21-ñ, 22-n, 22-ñ, 22-o and 22-p) The Formation is composed mainly of somewhat thick beds of yellowish gray colored marl and limestone which yields abundant fossils, accompanied by thin layers of limonitized shale. The thickness of the Formation is 650 m.

*11) [Vivian Formation] - Late Cretaceous*

The Formation extends north to south along the west flank of the Sira range in Quad. 20-n, 21-n and 22-n, whilst, in Quad. 22-ñ, 22-o and 22-p, it extends along the southeastern part of the range. The Formation is composed of somewhat thick beds of fine to medium-grained siliceous sandstone. The Formation is 350 m thick.

*12) [Cachiyacu-Huchpayacu Formation] - Late Cretaceous*

In the quadrangles 20-n and 21-n, the Formation extends in strip along the west flank of the Sira range. The Formations are mainly gray colored shale and medium-grained sandstone including coal layers. In the upper horizons, "carofitas (small plant fossil)", are observed. The Formation is 150 m thick, in unconformable covered by the Huayabamba Group.

*13) [Huayabamba Group] - Eocene to Oligocene*

The Group lies in strip north to south along the Pachitea, Pichis and Autiki basins (Dwgs. 20-n, 21-n and 22-n) on the west side the the Sira range, whilst, on the east side of the range, it extends on the west banks of the Ucayali and Urubamba rivers (Dwgs. 10-ñ, 21-ñ, 22-ñ, 22-o and 22-p). On the west side of the Sira range, the Group is classified into the three formations: the Eocene Yahuarango Formation, the late Eocene Pozo Formation and the Oligocene Chambira Formation. The total thickness is 1,600 m.

*[Yahuarango Formation]*

The lower to middle part of the Formation is composed of reddish violet-colored claystone in thick beds which intercalates thin layers of greenish gray colored sandstone, whereas the upper part is of reddish violet-colored, massive claystone which intercalates thin layers of limestone including limonite and fossils. The Formation is 800 m thick.

*[Pozo Formation]*

The Formation consists of the lowermost part composed of yellowish gray colored tuff, the middle part of greenish gray colored shale including fossils, and the upper part of reddish gray colored claystone including fossils. The thickness

of the Formation is 400 m.

**[Chambira Formation]**

The lower part is composed of reddish brown-colored, massive calcareous claystone including coarse grained sandstone in lenses, while brick red-colored, massive calcareous claystone including calcareous nodules comprises the upper part. The Formation is 400 m thick.

The lithofacies on the east side of the Sira range is of red-colored, fine-grained sandstone, reddish brown-colored mudstone accompanied by limonite in thin layers, limonitized claystone, dark gray colored limestone, dark gray colored conglomeratic sandstone, clayish sandstone, etc. The total thickness is 1,500 m.

**14) [Ipururo Formation] - Pliocene to Miocene**

On the west side of the Sira range, the Formation extends in strip north to south along the Pachitea and Pichis Rivers (Quad. 20-n and 21-n) while, on the east side of the range, it spreads broadly over the Selva from the Ucayali-Urubamba basin to the Brazilian border.

The Formation of the west side of the Sira range comprises reddish to grayish white-colored, coarse grained sandstone in thick beds, accompanied by a horizon of clayish mudstone, and is 500 m thick.

The Formation on the east side of the Sira range comprises sandstone accompanied by reddish brown-colored mudstone and lenticular calcareous rocks, yellowish brown-colored, fine-grained sandstone accompanied by reddish brown-colored limonite and fossil plants, dark gray colored calcareous sandstone accompanied by thin layers of reddish brown-colored mudstone including fossil tortoises, conglomerate accompanied by thin layers of tuff, breccia assuming various colors, etc. The thickness of the Formation reaches 1,200 m. The Formation is covered by the Pleistocene Ucayali and Madre de Dios Formations in angular unconformity.

**15) [Ucayali Formation] - Pleistocene**

The Pleistocene Series in unconformable overlies the Ipururo Formation of Miocene to Pliocene age, spreading over the Selva on the east side of the Sira range from the Ucayali-Urubamba basin to the Brazilian border. The portion west of the long. 73°30' W is called Ucayali Formation whereas the eastern portion is called Madre de Dios Formation. The lithofacies of the Ucayali Formation comprise red-colored clay, coarse grained sand, and pebble including thin layers of gravel. The thickness of the Formation is about 30 m.

**16) [Madre de Dios Formation] - Pleistocene**

The Formation comprise limonitized sand, yellowish brown-colored clay and yellowish brown-colored, unconsolidated pebble. The Formation is 20 m thick.

### 17) [Alluvium] - Holocene

The Alluvium spreads over the Sira range and river basins in the Selva, comprising unconsolidated sand, pebble, etc.

### (2) Intrusive rocks

Two types of stocks presumably of different intrusion stages lie in the Sira range in the west of the survey area. One of the stocks comprising gneissic granite, diorite, etc., which is inferred to have intruded in the Permian time, is situated in the center of the anticline of the Sira range (Quad. 21-ñ and 22-ñ) and intrudes into Precambrian metamorphic rocks. The other stock, situated in the north of the range (Quad. 19-n), comprises monzodiorite inferred to have intruded in the Paleogene time and is altered by contact metasomatism and mineralization. (Although the latter is situated outside the survey area, reference is herein made in view of its necessity for the evaluation of potential ore deposits.)

The characteristics of the intrusive rocks in and around the survey area are summarized as follows:

#### 1) Southeastern part of the Sira range (I)

Locality: southeastern part of Quad. 21-ñ: "Bolognesi"

Rock types: gneissic granite, diorite

Occurrence: gneissic granite (EW: 2 km, NS: 5 km), diorite (EW: 0.5 km, NS: 1.5 km)

Altitude: 500 m to 1,200 m

Wall rock: Precambrian slate and gneiss (Sira Complex)

Age: Permian

Mineral indications: none

Source: INGEMMET geological report (4)

#### 2) Southeastern part of the Sira range (II)

Locality: northeastern part of Quad. 22-ñ: "Obenteni"

Rock types: amphibolite, basalt, granite

Occurrence: small scale (undescribed in the 1:100,000-scale geologic map)

Altitude: about 500 m to 800 m

Wall rock: Precambrian dioritic gneiss, etc. (Marañon complex)

Age: Permian

Mineral indications: none

Source: INGEMMET geological report (5)

#### 3) Northern part of the Sira range

Locality: southwestern part of Quad. 19-n: "Puerto Inca"; 13 km east of Puerto Inca, Dept. Huanuco, on the right bank of the Rio Pachitea; UTM coordinates (N 8,963,000; E 517,000); the placer gold deposit in the Negro River is located about 23 km southward.

Rock type: Monzodiorite

Occurrence: E-W: 3.5 km; N-S: 1.5 km

Altitude: about 300 m

Wall rocks: sandstone of the lower Cretaceous Oriente Group, limestone-sandstone beds (gently dipping west) of the upper Cretaceous Chonta Formation, limestone of the Chonta Formation in the vicinity of the stock; the sandstone of the Oriente Group is altered to hornfels.

Age: Paleogene

Mineral indications: In some limestone of the Chonta Formation, contact metasomatic alteration with Au-Cu dissemination occurs. Au-Cu anomalies (Au 0.02 to 0.18 g/t) are detected in the stream sediments in the vicinity of the stock.

Source: INGEMMET geological report (9)

### (3) Structure

#### *1) Geologic structure near the surface*

The survey area is situated north of the structurally transitional zone called the "Abancay" bend in southern Peru, and represents the NNW-SSE direction, the typical Andean trend.

The western part of the survey area is called Sub-Andes where the Cordillera Oriental shifts into the Selva. The Sira range, alt. 2,000 m, is formed within the Sub-Andes.

The Sira range, composed of the Paleozoic including the Precambrian and the Mesozoic, constitutes an anticline thrust on the west and east margins of the range while, internally, anticlinal and synclinal structures develop with the Andean trend.

On the east side of the Sira range, the Selva composed of the Neogene to Quaternary spreads extensively up to the Brazilian border, while the Ucayali-Urubamba rivers are situated on the western margin of the Ucayali sedimentary basin. The Ucayali basin has the Precambrian basement which constitutes the Brazilian shield, underlain by the Paleozoic, Mesozoic and Paleogene rocks, extending in the N-S direction and reaching 6,000 m in depth. Oil and natural gas prospecting have long since been conducted in the sedimentary basin.

As regards intrusive rocks, granite stocks are observed in the Sira range in the west of the survey area, which have caused contact metamorphism to the Mesozoic of the Sira range.

#### *2) Deep geologic structure*

An overview of the geotectonic framework of the survey area, based on the survey data of the Petroperu, indicates the following structural units from west to east.

Figure 13 exhibits the deep geologic structure of the survey area.

*a. Vilcabamba-Sira anticline, Sira thrust zone and Ucayali depression*

The Vilcabamba-Sira anticline represents a large-scale anticlinal structure extending from Agua Caliente in the northwest of the survey area to the Vilcabamba range in the south of the survey area. The total extension reaches 400 km. The anticlinal axis generally trends N10°W. In the north, it plunges northward and sinks into the Tertiary System while, in the south, it is bounded by the Abancay bend. In the survey area, the anticline forms the Sira range. Its east and west flanks are asymmetric, the former dipping steeply while the latter gently. The anticline is bounded by the thrust zone in the east.

The northern area of the anticlinal structure is called Sira high, where sudden ascension of the basement is inferable from gravity and seismic data. At the northern end of the anticlinal structure, out of the survey area, there is the Agua Caliente gas field. In the Vilcabamba-Sira anticline, many fractures develop in NE-SW direction, which are interpreted to be left-lateral faults. The hot spring at Agua Caliente is presumed to ascend through one of such fractures as the path. Besides the thrust zone bounding the east flank of the anticlinal structure, there is a parallel thrust zone in the interior of the anticlinal structure. In these thrust zones, a block structure consisting of the normal and reverse faults is formed.

Along the Ucayali river east of the Sira thrust zone which bounds the east flank of the anticlinal structure, a sudden subsidence of basement caused by the development of the thrust is observed, which is called the Ucayali depression. From seismic prospecting data and well logs, the amount of vertical displacement is inferred to exceed 2,000 m.

*b. Ucayali sedimentary basin*

The Ucayali sedimentary basin broadly extends in the NNW-SSE direction over the Selva in eastern Peru within the approximate area of lat. 6°30' - 12°S and long. 72° - 76°W. It has the Precambrian basement, overlain by the lower Paleozoic to Cretaceous. In the survey area, the Ucayali sedimentary basin is located outside the both flanks of the Vilcabamba-Sira anticline and bounded in the east by the Fitzcarral arch. The depth of the basement reaches 6,000 m in the vicinity of Sepa in the lower reach of the Urubamba river.

*c. Atalaya fault zone, Sheshea high and Sepa high*

About 10 km north of Atalaya, in the south of the survey area, presence of a fault zone striking N70°E, 15 km wide, has been inferred, which is called the Atalaya fault zone. The fault zone, as a whole, is inferred to have a left-lateral displacement. The occurrence of the Atalaya fault zone is not necessarily clear from the surface geology.

The ascension of the basement with the N-S trend observable at around long. 73°20' W is cut by the Atalaya fault zone. The north side of the fault zone is





called the "Shoshea high" while the south side is called the "Sepa high." The latter forms an anticlinorium, where the anticlinal structures such as Sepa, Pucacuro, Leigh and Victor lie intercalating a small synclinal structure. The depth of the basement is inferred to be 5,000 m in the vicinity of the Sepa anticline.

*d. Inuya-Yurua high*

The high represents an ascending portion of the basement observable at around long. 72°30' - 73°W and is inferred, as a whole, to assume a horst-like structure bounded in the east and west by normal faults. The depth of the basement is about 2,000 m in shallow portions.

*e. Fitzcarral arch*

From around long. 71° to 72°30'W, there is an ascending portion of the basement with the NE-SW trend, called the Fitzcarral arch. The arch bounds between the Ucayali sedimentary basin and the Madre de Dios sedimentary basin.

*f. Madre de Dios sedimentary basin*

The sedimentary basin spreads from the southwest part of the Fitzcarral arch to Brazil and Bolivia, its southern limit being at lat. 13°20' S. Similar to the Ucayali sedimentary basin, it has the Precambrian basement, overlain by the Lower Paleozoic to Cretaceous rocks.

*g. Others*

An anticlinal structure with the NE-SW trend is inferred to extend along the Alto Purús river in the northeast of the survey area, but its details are unknown.

## 2-3 Ore Deposits

### 2-3-1 Data collection

The collected data include the INGEMMET geological reports and data base of ore deposits and showings, the data of the Mine Inspection Bureau (la Dirección de Fiscalización Minera) of The Ministry of Energy and Mines and the Mining Registry (Registro Público de Minería), the Banco Minero's financing-related technical reports, Petroperu's geologic maps and reports and ONERN's survey reports. For details of the collected data, refer to the list of reference and data collected, at the end of this volume.

### 2-3-2 Mineralization

From the geologic-metallogenic point of view, the survey area is situated east of the East Andean metallogenic province, and where few deposits have so far been developed because of the poor accessibility and the lack of information on ore

deposits and showings. Mineralization in the survey area is described below, on the basis of the topographic division, into the Sira range division, the Ucayali-Urubamba division and the eastern Selva division.

The Sira range division, alt. 2,000 m, is a part of the Sub-Andes area where the Cordillera Oriental shifts into the Selva, and is underlain by Paleozoic including Precambrian and by Mesozoic. The area has the best accessibility in the survey area from the Andes Mountains side; therefore, small placer gold mining has long since been conducted on the western margin of the Sira range. The INGEMMET's recent geological survey has verified occurrence of intrusive rocks accompanied by Au-Cu mineral indications, and new applications for mining claims are being filed.

The Ucayali-Urubamba division is situated on the west margin of the Ucayali basin stretching in the central part of the survey area, bounded by the thrust fault trending N-S on the east edge of the Sira range. The Ucayali basin, with the 6,000 m-deep Precambrian basement, is composed of the Paleozoic and Mesozoic rocks. The area has high potentials of petroleum and natural gas, where seismic prospecting and long-hole drilling have been conducted long since, in an effort to examine geological structure of the Ucayali basin. As for metallic minerals, however, sufficient prospecting and development have not yet been done, owing to the poor accessibility to the Selva zone. Nonetheless, information on showings of placer gold deposits has been increasing recently, near small towns along the Ucayali-Urubamba rivers which serve as the major transportation routes.

The eastern Selva division covers the Selva up to the Brazilian border, a sparsely populated area of hard access. Descriptions of ore deposits and showings are scarce, as well as information on mineral resources development. From the topographical and geological points of view, occurrence of placer gold deposits is considered to be possible.

### 2-3-3 Ore deposits and showings

Table 8 lists ore deposits and mineral indications in the survey area extracted from the INGEMMET data base. Location, geology, mineralization and source described in the existing data are summarized below, in respect of the topographic division.

#### (1) Sira range

##### 1) *Piraje Pintuyacu*

a. Locality: Quad. 19-n: "Puerto Inca", 13 km east of Puerto Inca, Dept. Huanuco, in the northwest of the Sira range; UTM coordinates (N 8,963,000, E.517,0000; alt. about 300 m. The locality -- out of the survey area -- is about 23 km north of the placer gold deposit in the Negro river referred below.

b. **Geology:** Sandstone of the Oriente Group of the Lower Cretaceous System and limestone-sandstone of the Chonta Formation of the Upper Cretaceous System are overlying with a gentle dip westward. Monzodiorite intrude in stock (2 km $\phi$ ) into the Cretaceous. Limestone of the Chonta Formation and sandstone of the Oriente Group around the stock are metamorphosed to hornfels.

c. **Mineralization:** Contact metasomatic portions exist in part of limestone of the Chonta Formation, accompanied by dissemination with Au, Cu, etc. In stream sediments around the stock, Au and Cu anomalies (Au: 0.02 to 0.18 g/t; Cu: 10 to 27.5 ppm) are detected. Assay of rock samples collected in the surroundings of the intrusive rock indicates max. Au: 0.567 g/t and Cu: 900 ppm.

d. **Source:** INGEMMET geological report (9)

*2) Negro River (HUA 0071, 0072, 0073, 0074)*

a. **Locality:** Quad. 20-n: "Rio Palcazu," in the Negro river at Puerto Inca, Dept. Huanuco, in the northwest of the Sira range; UTM coordinates (N 8,937,522, E 506,827); alt. about 300 m.

b. **Geology and mineralization:** The placer gold deposits occur in the Lhullapichis river and the Negro river, tributaries of the Pachitea. Mining dates back to 1935-45, when 2,000 to 2,500 miners were engaged in gold production at a monthly rate of 100 kg. From 1970 to 80, gold prospecting was active. At the two claims, Oro del Río Negro and El Shira, 10 km east of the Pachitea river, 37 pits were dug and resource-geological evaluation had been done. It indicated 300,000 m $^3$  (Au: 1.55 g/m $^3$ ; 465 kg) of confirmed reserves, 460,000 m $^3$  (Au: 1.48 g/m $^3$ ; 680 kg) of probable reserves and 1,500,000 m $^3$  (Au: 1 g/m $^3$ ; 1,500 kg) of possible reserves (Moya, R. Carlos, 1974). At present, some 200 people are engaged in panning to produce gold of 1 g per man-day.

c. **Source:** Reference (11), INGEMMET geological report (1)

*3) Inti Mantaro (JUN 0320, 0319)*

a. **Locality:** Quad. 22-n: "Baja Pichanaqui," Chanchamayo Huachiriki, Dept. Junin, in the southwest of the Sira range; UTM coordinates (N 8,800,600, E 520,038); alt. 900 m to 1,000 m.

b. **Geology and mineralization:** In the small mining claims of Inti Mantaro and Villa El Sol, minor-scale tunnel prospecting is ongoing to examine occurrence of the Pucara Group and Chonta Formation of Mesozoic. It has been reported, however, that the mineral indications and alteration are weak. No intrusive rocks are observable in the nearby areas.

c. **Source:** INGEMMET geological report (2)

#### 4) *Autiki*

- a. **Locality:** Quad. 22-n: "Baja Pichanaqui," Chanchamayo Autiki, Dept. Junin, in the southwest of the Sira range; UTM coordinates (N 8,789,000, E 541,0000); alt. 500 m.
- b. **Geology and mineralization:** A foreign company is conducting geological survey to examine an paleo-placer deposit which occur in the basement of the Oriente Formation of the Lower Cretaceous System.
- c. **Source:** INGEMMET geological report (2)

#### (2) Ucayali-Urubamba division

##### 1) *Cumaria valley*

- a. **Locality:** Quad. 20-o: "Cumaria," 105 km north of Atalaya, Dept. Ucayali, in one of the Ucayali tributaries; UTM coordinates (N 8,912,000, E 622,000); alt. 210 m.
- b. **Geology and mineralization:** Fluvial sediments (sand) around the Cumaria valley, a tributary of the Ucayali on the right bank, assay Au: 0.025 g/t. The Ipururo Formation of the Neogene System is exposed in the area. No intrusive rocks nor the Mesozoic-Paleozoic rocks are existent in the vicinity or upper streams; it has been pointed out that the Ipururo Formation possibly contains gold.
- c. **Source:** INGEMMET geological report (3)

##### 2) *Vicinity of Atalaya*

- a. **Locality:** Quad. 22-o: "Atalaya," Dist. Atalaya, Dept. Ucayali, near the confluence of the Tambo and Urubamba river; an island near Mardonadillo (UTM coordinates: N 8,812,500, E 642,000) and the Tambo river near Atalaya (UTM coordinates: N 8,815,000, E 636,500)
- b. **Geology and mineralization:** In the Ucayali river and its tributaries north of Atalaya, occurrence of placer gold deposits and heavy minerals has been reported, but exact localities of many mineral indications are unknown and many are not covered by mining claims. However, the placer gold deposits at the two localities indicated above are well known.
- c. **Source:** INGEMMET geological report (4)

##### 3) *The Urubamba*

- a. **Locality:** Quad. 22-p: "Rio Inuya," Dist. Atalaya, Dept. Ucayali. M-8, near the

Mapalija Island on the right bank of the Urubamba river (UTM coordinates: N 8,813,000, E 678,000; alt. 285 m; 12 km northwest of Sepa, and M-7, at Esperanza on the right bank of the Urubamba river (UTM coordinates: N 8,799,000, E 694,000); alt. 286 m; 9 km southeast of Sepa.

b. Geology and mineralization: placer gold showings are observable in the gravel beds mixed with clay along the Urubamba river from Sepa to Camisea. Panning samples of stream sediments at the mentioned M-8 and M-7 are reported to assay 1.6 g/t and 0.8 g/t of Au, respectively. It has been pointed out that places where current velocity is abruptly reduced, such as confluences, and curvatures of meanders are important as locations where placer gold deposits tend to be formed. The gold is thought to be originated from gold-bearing quartz lenses and veinlets which fill bedding planes and fissures in Paleozoic sedimentary rocks such as slate and quartzite in Andes mountains, which are accompanied with acidic intrusions. 0.17% of Sn contained in a panning sample has also been reported.

c. Source: Reference (10)

### (3) Eastern Selva division

#### *1) East of the Ucayali*

a. Locality: Quad. 20-p, 20-q, 20-r, 21-p and 21-q

b. Geology and mineralization: The area is the Selva zone from the right bank of the Ucayali to the Brazilian border, having hard access and sparse population. Descriptions and information on placer gold deposits and mineral resources development are hardly available.

c. Source: Reference (12) and INGEMMET geological reports (6) and (7)

#### *2) Districts of Purus, Department of Ucayali (the east margin of the survey area)*

a. Locality: Quad. 21-r, 22-r, 21-s, 22-s, 20-t, 21-t, 22-t, 19-u, 20-u, 21-u and 22-u (the Selva zone up to the Brazilian border)

b. Geology and mineralization: The area being hardly accessible and sparsely populated, few descriptions and information on placer gold deposits and mineral resources development are available.

c. Source: INGEMMET geological reports (7) and (8)

### 2-4 Considerations

The survey area consists of Precambrian, Lower Paleozoic, Upper Paleozoic,

Mesozoic, Cenozoic and intrusive rocks. In recent years, geological survey of the extensive area including this survey area has been undertaken by the INGEMMET and its geological reports were published in 1997 and 98.

The survey area is situated in the remote region beyond the Andes Mountains and the access is impeded by the Selva zone. Such constraints have obstructed progress of systematic surveys. At present, there is no operating mines of metallic minerals in the survey area.

Considerations on the geology and ore deposits in the survey area, based upon the data collected during the Phase I survey, may be summarized as follows.

On the western margin of the Sira range, which has relatively good access from the Andes side, placer gold mining has been carried out long since. In the Negro river, a tributary of the Pachitea river in the north of the Sira range (Quad. 20-n), placer gold mining was conducted since the 1930's to produce gold of 100 kg a month. In the 1970's, prospecting including pitting was done, which indicated 1.2 tons of gold content in the confirmed and probable ore reserves. At present, some 200 people are engaged in panning operation.

As the INGEMMET geological survey in recent years in the area 13 km east of Puerto Inca (Quad. 19-n), or about 23 km north of the Negro river, verified presence of an intrusive rock accompanied by Au-Cu indication, a number of applications for mining claims have been filed. This indication is similar with the placer gold deposit in the Negro river in structural setting, whereas the indication is considered to be a source (primary deposit) of placer gold. Therefore, it may be said that to discover both primary and secondary (placer) types of ore deposit might be possible, depending on a systematic prospecting in future.

Gold and tin concentration in stream sediments are reported in a eastern tributary of the Ucayali river in Quad. 20-o, near Atalaya (Quad. 22-o) and Sepa (Quad. 22-p) along the Ucayali itself. A report says that, near Sepa, some panning sample assays 1.6 g/t of Au, which suggests a high probability of occurrence of placer gold deposits. At present, mining contractors seem to inactively engage placer gold mining at this prospect. It is possible that minable placer gold deposits can be discovered by future surveys in the unexplored Selva zone east of the Ucayali-Urubamba rivers, as well.

Table 8 List of ore deposits and mineral indications (1)

ID	NOMBRE	DEPARTAMENTO	UBICACION	LATITUD	LONGITUD	CUADRANGULO	ELEMENTO	MINERAL	FORMA	DEPOSITO
HUA0071	ORO DEL RIO NEGRO, MINA	HUANUCO	PUERTO INCA, PROVINCIA DE PACHITEA	09-36-42S	074-56-16W	RIO PALCAZU 20-N	AU	ORO	IRREGULAR	ALUVIAL
HUA0072	LORENA, MINA	HUANUCO	PUERTO INCA, PROVINCIA DE PACHITEA	09-36-42S	074-56-06W	RIO PALCAZU 20-N	AU	ORO	IRREGULAR	ALUVIAL
HUA0073	EL SHIRA, MINA	HUANUCO	PUERTO INCA, PROVINCIA DE PACHITEA	09-35-00S	074-50-36W	RIO PALCAZU 20-N	AU	ORO	IRREGULAR	ALUVIAL
HUA0074	MISTERIO, MINA	HUANUCO	PUERTO INCA, PROVINCIA DE PACHITEA	09-34-24S	074-44-24W	RIO PALCAZU 20-N	AU	ORO	IRREGULAR	ALUVIAL
JUN0319	VILLA EL SOL, PETITORIO	JUNIN	BAJO PICHANAQUI, PROVINCIA DE CHANCHAMAYO	10-53-00S	074-51-00W	BAJO PICHANAQUI 22-N	AU	ORO		
JUN0320	INTI MANTARO, CONCESION	JUNIN	BAJO PICHANAQUI, PROVINCIA DE CHANCHAMAYO	10-51-00S	074-49-00W	BAJO PICHANAQUI 22-N	AU	ORO		

ID : CODIGO INGENMET





Table 8 List of ore deposits and mineral indications (2)

ID	COMENTARIO DE EXPLORACION	COMENTARIO DE EXPLOTACION	COMENTARIO DE LA EXPLORACION Y DESARROLLO	COMENTARIO GENERAL	COMENTARIOS MINERALES	REFERENCIAS BIBLIOGRAFICAS	COMENTARIOS RESERVAS	COMENTARIOS DE UBICACION	COMENTARIO GEOLOGICO
HUA0071	EL YACIMIENTO CONSISTE EN DEPOSITOS AURIFEROS EXISTENTES EN TERRAZAS ALUVIALES (CUATERNARIO) EL ORO SE ENCUENTRA DENTRO DE UNA CAPA DE GREDA QUE CONTIENE TAMBIEN RODADOS (40 CM A 0.5 CM DE DIAMETRO). LA SECUENCIA DE LAS CAPAS DE ARRIBA HACIA ABAJO ES C	EXISTEN HUELLAS DE ZONAS TRABAJADAS EN UNA EXTENSION DE 20 X 30 M HOY CUBIERTA DE MALEZAS (ZONA A). ADEMAS SE HA ENCONTRADO UNA TRINCHERA DE 20 X 2.0 M (ZONA B) SEGUN MANIFESTACION DE LOS MINEROS DE LA ZONA TAMBIEN HAN SACADO DEL LECHO DEL RIO	DESPUES QUE FUERON CONOCIDOS LOS DEPOSITOS FUERON INTENSAMENTE EXPLOTADOS Y ASEGURAN MINEROS DE LA ZONA QUE HAN SACADO HASTA 7 KG EN UN AÑO	EL DENUNCIO "ORO DEL RIO NEGRO" ABARCA UN AREA DE 8.000 X 1.200 M. QUE EN UN INICIO PERTENECIO A LA SEÑORITA NELLY LOPEZ GALLARDO Y QUE LUEGO TRASPASO EL 5 DE SETIEMBRE DE 1973 A LOS ACTUALES PROPIETARIOS. EN LA FECHA DE LA INSPECCION, EL LABOREO MINER	EL ORO SE HALLA EN FORMA DE CHARPAS, LAMINILLAS Y FINOS GRANOS	MOYA FERRADAS, CARLOS, ANTEPROYECTO DE EXPLOTACION DE ORO Y AURIFERAS "RIO NEGRO", BNP 1974, COD 8875, GALVAN J. MIGUEL, INFORME TECNICO MINA "ORO DEL RIO NEGRO", BNP 1972, COD 87642		SE UBICA EN EL PARAJE DE YANAYACU, ENTRE LOS DENUNCIOS "LORENA" Y "EL SHIRA", EN LA CONFLUENCIA DEL RIO YUYAYICHIS CON EL RIO NEGRO. AL CUAL SE ACCDE DE ACUERDO AL SIGUIENTE ITINERARIO: PUCALLPA - PUERTO INCA 120 KM (VIA AEREA), PUERTO INCA - PARAJE M	EN LA ZONA DE LOS DEPOSITOS AURIFEROS EXISTEN TERRAZAS ALUVIALES (CUATERNARIO) EN LAS MARGENES DEL RIO NEGRO. EL RIO TIENE UN ANCHO PROMEDIO DE 15 M Y UN CAUDAL APROXIMADO DE 30 LITROS/SEG Y SU LECHO SO PAQUETES DE ARENISCAS CUARCIFERAS EN LAS QUEHEDADE
HUA0072	EL YACIMIENTO CONSISTE EN DEPOSITOS AURIFEROS EXISTENTES EN TERRAZAS ALUVIALES (CUATERNARIO) EL ORO SE ENCUENTRA DENTRO DE UNA CAPA DE GREDA QUE CONTIENE TAMBIEN RODADOS (40 CM A 0.5 CM DE DIAMETRO). LA SECUENCIA DE LAS CAPAS DE ARRIBA HACIA ABAJO ES C	EXISTEN HUELLAS DE ZONAS TRABAJADAS EN UNA EXTENSION DE 20 X 30 M HOY CUBIERTA DE MALEZAS (ZONA A). ADEMAS SE HA ENCONTRADO UNA TRINCHERA DE 20 X 2.0 M (ZONA B) SEGUN MANIFESTACION DE LOS MINEROS DE LA ZONA TAMBIEN HAN SACADO DEL LECHO DEL RIO	DESPUES QUE FUERON CONOCIDOS LOS DEPOSITOS FUERON INTENSAMENTE EXPLOTADOS Y ASEGURAN MINEROS DE LA ZONA QUE HAN SACADO HASTA 7 KG EN UN AÑO	EL AREA DEL DENUNCIO "LORENA" ES DE 8.000 M X 1.200 M. EN LA FECHA DE LA INSPECCION, EL LABOREO MINERO ESTABA PARALIZADO DE SEDE HACE 2 AÑOS APROXIMADAMENTE Y SE TRABAJABA EN FORMA EMPIRICA. EL MAYOR PROBLEMA PARA LAS OPERACIONES MINERAS RESIDE EN LA DIFIC	EL ORO SE HALLA EN FORMA DE CHARPAS, LAMINILLAS Y FINOS GRANOS	GALVAN J. MIGUEL, INFORME TECNICO MINA "ORO DEL RIO NEGRO", BNP 1972, COD 87642		SE UBICA EN EL PARAJE DE YANAYACU Y SE ENCUENTRA ADYACENTE AL OESTE DEL DENUNCIO "ORO DEL RIO NEGRO" Y AL CUAL SE ACCDE DE ACUERDO AL SIGUIENTE ITINERARIO: PUCALLPA - PUERTO INCA 120 KM (VIA AEREA), PUERTO INCA - PARAJE MAQUISAPAYOC 18 KM (DESILZADOR).	EN LA ZONA DE LOS DEPOSITOS AURIFEROS EXISTEN TERRAZAS ALUVIALES (CUATERNARIO) EN LAS MARGENES DEL RIO NEGRO. EL RIO TIENE UN ANCHO PROMEDIO DE 15 M Y UN CAUDAL APROXIMADO DE 30 LITROS/SEG Y SU LECHO SO PAQUETES DE ARENISCAS CUARCIFERAS EN LAS QUEHEDADE
HUA0073	EL YACIMIENTO CONSISTE EN DEPOSITOS AURIFEROS EXISTENTES EN TERRAZAS ALUVIALES (CUATERNARIO) EL ORO SE ENCUENTRA DENTRO DE UNA CAPA DE GREDA QUE CONTIENE TAMBIEN RODADOS (40 CM A 0.5 CM DE DIAMETRO). LA SECUENCIA DE LAS CAPAS DE ARRIBA HACIA ABAJO ES C	EN EL AREA CORRESPONDIENTE AL DENUNCIO "EL SHIRA" SE HAN EJECUTADO 78 POZOS EXPLORATORIOS CON EL FIN DE EVALUAR EL AREA MINERALIZADA Y SE HA DETERMINADO UN AREA MAS FAVORABLE DE NOMINADO "ZONA A" Y TIENE 25 HAS. DE EXTENSION	DESPUES QUE FUERON CONOCIDOS LOS DEPOSITOS FUERON INTENSAMENTE EXPLOTADOS Y ASEGURAN MINEROS DE LA ZONA QUE HAN SACADO HASTA 7 KG EN UN AÑO	EL AREA DEL DENUNCIO "EL SHIRA" ES DE 3.000 M X 3.000 M. E INICIALMENTE PERTENECIO A LA SEÑORITA NELLY LOPEZ GALLARDO (1972) QUE LUEGO LA TRASPASO A LOS ACTUALES PROPIETARIOS. TIENE UN CLIMA CALUROSO Y EL 80 % DE LA PROPIEDAD SE ENCUENTRA CUBIERTA POR	EL ORO SE HALLA EN FORMA DE CHARPAS, LAMINILLAS Y GRANOS FINOS	CARLOS MOYA, FERRADAS, ANTEPROYECTO DE EXPLOTACION DE LAS GRAVAS AURIFERAS "ORO NEGRO", BNP 1974, COD 88875 GALVAN J. MIGUEL, INFORME TECNICO MINA "ORO DEL RIO NEGRO", BNP 1972, COD 87642	ESTOS DATOS ESTAN REFERIDOS A RESERVAS PROBABLES UNICAMENTE CON UN CONTENIDO FIJO DE 800 KG DE AU	SE UBICA EN EL PARAJE DE YANAYACU Y SE ENCUENTRA ADYACENTE AL NE DEL DENUNCIO "ORO DEL RIO NEGRO" Y AL CUAL SE ACCDE DE ACUERDO AL SIGUIENTE ITINERARIO: PUCALLPA - PUERTO INCA 120 KM (VIA AEREA), PUERTO INCA - PARAJE MAQUISAPAYOC 18 KM (DESILZADOR), MA	EN LA ZONA DE LOS DEPOSITOS AURIFEROS EXISTEN TERRAZAS ALUVIALES (CUATERNARIO) EN LAS MARGENES DEL RIO NEGRO. EL RIO TIENE UN ANCHO PROMEDIO DE 15 M Y UN CAUDAL APROXIMADO DE 30 LITROS/SEG Y SU LECHO SO PAQUETES DE ARENISCAS CUARCIFERAS EN LAS QUEHEDADE
HUA0074	EL YACIMIENTO CONSISTE EN DEPOSITOS AURIFEROS EXISTENTES EN TERRAZAS ALUVIALES (CUATERNARIO) EL ORO SE ENCUENTRA DENTRO DE UNA CAPA DE GREDA QUE CONTIENE TAMBIEN RODADOS (40 CM A 0.5 CM DE DIAMETRO). LA SECUENCIA DE LAS CAPAS DE ARRIBA HACIA ABAJO ES C	EXISTEN HUELLAS DE ZONAS TRABAJADAS EN UNA EXTENSION DE 20 X 30 M HOY CUBIERTA DE MALEZAS (ZONA A). ADEMAS SE HA ENCONTRADO UNA TRINCHERA DE 20 X 2.0 M (ZONA B) SEGUN MANIFESTACION DE LOS MINEROS DE LA ZONA TAMBIEN HAN SACADO DEL LECHO DEL RIO	DESPUES QUE FUERON CONOCIDOS LOS DEPOSITOS FUERON INTENSAMENTE EXPLOTADOS Y ASEGURAN MINEROS DE LA ZONA QUE HAN SACADO HASTA 7 KG EN UN AÑO	EL AREA DEL DENUNCIO "MISTERIA" ES DE 3.000 M X 2.000 M. TIENE UN CLIMA CALUROSO. EN LA FECHA DE LA INSPECCION, EL LABOREO MINERO ESTABA PARALIZADO DE SEDE HACE 2 AÑOS APROXIMADAMENTE Y SE TRABAJABA EN FORMA EMPIRICA. EL MAYOR PROBLEMA PARA LAS OPERACIONE	EL ORO SE HALLA EN FORMA DE CHARPAS, LAMINILLAS Y GRANOS FINOS	GALVAN J. MIGUEL, INFORME TECNICO MINA "ORO DEL RIO NEGRO", BNP 1972, COD 87642		SE UBICA EN EL PARAJE DE YANAYACU Y SE ENCUENTRA ADYACENTE AL NE DEL DENUNCIO "EL SHIRA" Y AL CUAL SE ACCDE DE ACUERDO AL SIGUIENTE ITINERARIO: PUCALLPA - PUERTO INCA 120 KM (VIA AEREA), PUERTO INCA - PARAJE MAQUISAPAYOC 18 KM (DESILZADOR), MA	EN LA ZONA DE LOS DEPOSITOS AURIFEROS EXISTEN TERRAZAS ALUVIALES (CUATERNARIO) EN LAS MARGENES DEL RIO NEGRO. EL RIO TIENE UN ANCHO PROMEDIO DE 15 M Y UN CAUDAL APROXIMADO DE 30 LITROS/SEG Y SU LECHO SO PAQUETES DE ARENISCAS CUARCIFERAS EN LAS QUEHEDADE
JUA0319	EL PROPOSITO DE ESTE PETITORIO ES DESARROLLAR TRABAJOS DE EXPLORACION POR ELEMENTOS METALICOS		EL PETITORIO ABARCA UNA EXTENSION DE 800 HAS	EN EL CATASTRO MINERO SE REGISTRAN DOS AREAS UBICADAS EN EL CUADRANGULO DE BAJO PICHANAQUI CERCA AL ROSLADO DE HUACHIRKE, UNO DE ESTOS PETITORIOS ES VILLA EL SOL		INGENMET, GEOLOGIA DE LOS CUADRANGULOS DE BAJO PICHANAQUI Y PUERTO BERMUDEZ, BOLETIN 85 DE LA CARTA GEOLOGICA NACIONAL, 1997		EL PETITORIO VILLA EL SOL SE UBICA EN LA QUEBRADA HUACHIRI, DISTRITO DE BAJO PICHANAQUI, PROVINCIA DE CHANCHAMAYO, DPTO. DE JUNIN	EL AREA COMPRENDE ROCAS DE LAS UNIDADES PUCARA Y CHONTA, NO HABIENDOSE DETECTADO ROCAS INTRUSIVAS NI INDICIO DE MINERALIZACION Y/O ALTERACION
JUA0320	LAS CIAS HAN HECHO MUESTREO DE SECCIONES DE QUEBRADA		EL AREA HA SIDO SOLICITADA PARA HACER TRABAJOS DE EXPLORACION POR ORO	LA CONCESSION COMPRENDE UNA EXTENSION DE 1000 HAS. HA SIDO SOLICITADA PARA REALIZAR TRABAJOS DE EXPLORACION POR ORO		INGENMET, GEOLOGIA DE LOS CUADRANGULOS DE BAJO PICHANAQUI Y PUERTO BERMUDEZ, BOLETIN 85, 1997		SE UBICA LA CONCESSION EN EL DISTRITO DE BAJO PICHANAQUI, PROVINCIA DE CHANCHAMAYO, DPTO. DE JUNIN	EL AREA COMPRENDE ROCAS DE LAS UNIDADES PUCARA Y CHONTA, NO HABIENDOSE DETECTADO LA PRESENCIA DE ALGUN INTRUSIVO NI INDICIO DE MINERALIZACION Y/O ALTERACION HIDROTHERMAL

ID: CODIGO INGENMET

## Chapter 3 Integrated Analysis

Following findings have been obtained by the integration of the survey results in Phase I (Ref. Figure 14).

- (1) The data suggesting presence of anticlinal or dome structures in the Ucayali sedimentary basin have been obtained from the drainage patterns delineated by JERS-1 SAR image interpretation. As it has been confirmed with the Sira anticline, anticlinal structures and dome structures tend to be accompanied by a stockwork intrusive rock nearby those central portion. Generally, presence of an intrusive rock suggests possible presence of the thermal source for formation of ore deposits; the anticlinal or dome structures are of particular importance from the viewpoint of prospecting not only for petroleum or gas but for metallic mineral resources, as well.
- (2) In the east part of the quadrangle 21-p, there is an area in which an anomalous drainage pattern - a distinctive trellis pattern - is observed. As the anomaly is possibly reflecting the presence of intrusive rocks, the area is also considered important for exploration of mineral resources.
- (3) In the thrust zone trending NNW-SSE located in the east of the Sira range, many parallel lineaments to the thrusts, considered to reflect small faults accompanying the thrusts, and many intersecting lineaments to the thrust trending ENE-WSW, possibly reflecting tension fractures or strike-slip faults, have been extracted and those lineaments form high density zones of lineament in this zone. Generally, tension fractures are likely to be accompanied by intrusive rocks and hydrothermal activity having the intrusive rocks as the thermal source. At Agua Caliente in the northeast of the study area, there are thermal springs accompanying faults with the NE-SW trend. Therefore, the high concentration zone of lineaments in the thrust fault zone east of the Sira range is considered to be important for metallic mineral resources exploration.
- (4) Analysis of the existing geologic data indicates the possibility that primary gold deposits occur in the vicinity of the alluvial gold deposits in the Negro river in the quadrangle 20-n.
- (5) Minalable alluvial gold deposits are possibly present in the fluvial sediments along the Urubamba river near Atalaya (Quad.22-o) and Sepa (Quad. 22-p).

As to the above items (1) and (2), it is hard to evaluate the possibilities since no ground verification has been made. Therefore, the following are considered to be promising areas for future exploration:

- The area along the Negro river where occurrence of alluvial gold deposits is known.
- The area stretching from around Atalaya and Sepa, where alluvial gold showings are present, to the eastern part of the Sira range on the west bank of the Ucayali river, where the intrusive rock is present and the high density zones of lineament have been extracted.

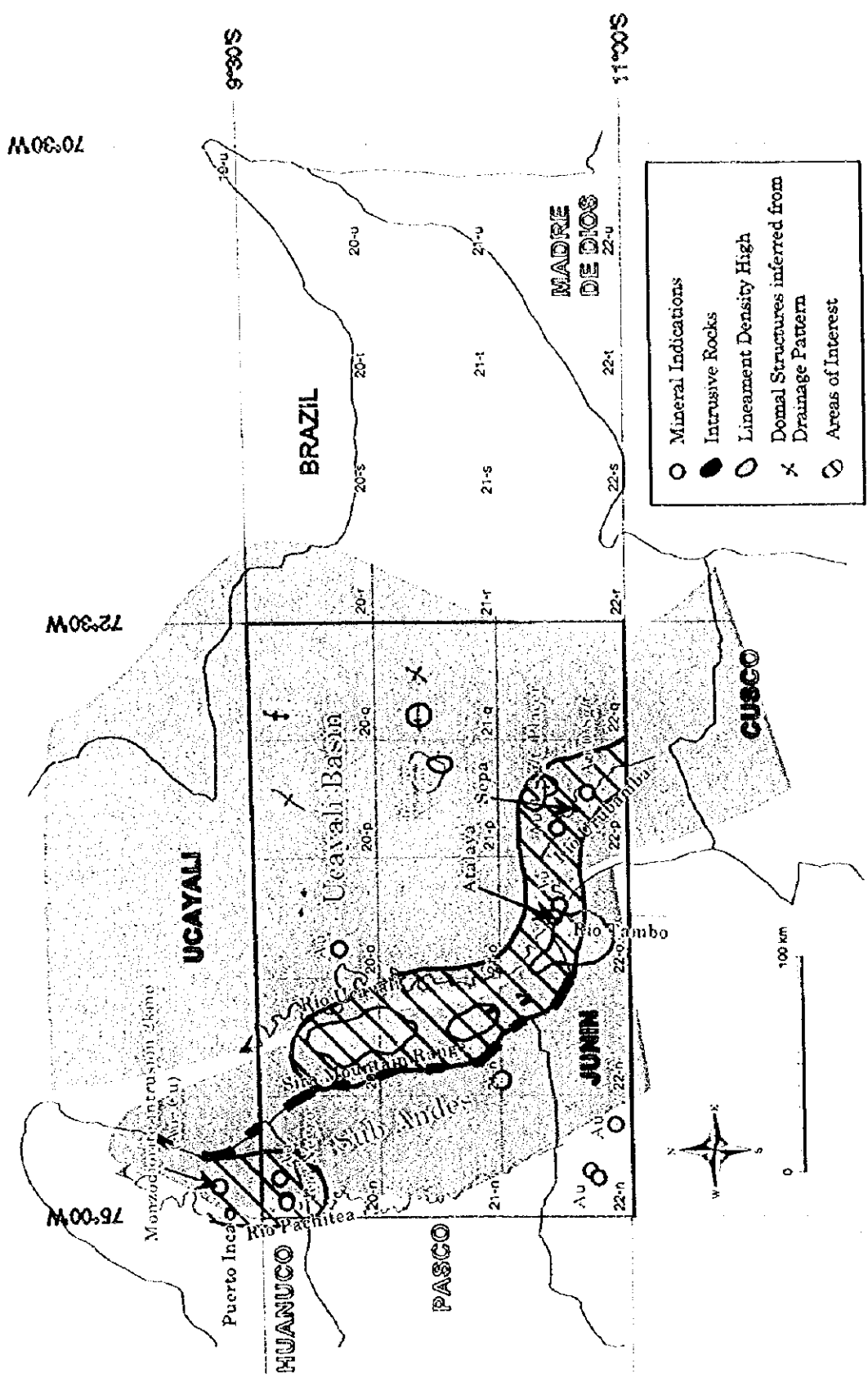


Figure 14 Potential evaluation map

**PART III**

**CONCLUSIONS  
AND  
RECOMMENDATIONS**

## Chapter 1 Conclusions

The following conclusions are drawn from the Phase I study.

### (1) Satellite image analysis using JERS-1/SAR data

- a. From the analysis of drainage patterns in the Ucayali sedimentary basin, data suggesting presence of anticlinal structures or dome structures and possible presence of intrusive rocks were obtained. In the Selva zone in eastern Peru as represented by the Ucayali sedimentary basin, drainage analysis utilizing satellite images is effective for the interpretation of geology and geologic structure.
- b. In the thrust zone trending NNW-SSE located in the east of the Sira range, many parallel lineaments to the thrusts, considered to reflect small faults accompanying the thrusts, and many intersecting lineaments to the thrust trending ENE-WSW, possibly reflecting tension fractures or strike-slip faults, have been extracted and those lineaments form high density zones of lineament in this zone. Generally, tension fractures are likely to be accompanied by intrusive rocks and hydrothermal activity having the intrusive rocks as the thermal source. At Agua Caliente in the northeast of the study area, there are thermal springs accompanying faults with the NE-SW trend. Therefore, the high concentration zone of lineaments in the thrust fault zone east of the Sira range is considered to be important for metallic mineral resources exploration.

### (2) Analysis of the existing data

- a. It was ascertained by recent geological survey conducted by INGEMMET that an intrusive rock accompanied by gold and copper ore showings is present 13 km east of Puerto Inca in the quadrangle 19-n of the 1:100,000-scale topographic map. This indication is similar with the placer gold deposit in the Negro river (located in Quad. 20-n) in structural setting, whereas the indication is considered to be a source (primary deposit) of placer gold. It may be said that to discover both primary and secondary (placer) types of ore deposit might be possible, depending on a systematic prospecting in future.
- b. In the Ucayali sedimentary basin, gold and tin concentration have been reported in heavy minerals in stream sediments along the Urubamba river near Atalaya (Quad. 22-o) and Sepa (Quad. 22-p). Especially, near Sepa, panning samples of heavy minerals is reported to assay Au: 1.6 g/t, which suggests high possibility of occurrence of alluvial gold deposits.

In view of the results of analysis, the following areas are extracted as promising areas:

- The area along the Negro river where occurrence of alluvial gold deposits are

known.

- The area stretching from around Atalaya and Sepa, where alluvial gold showings are present, to the eastern part of the Sira range on the west bank of the Ucayali river, where the intrusive rock is present and the high density zones of lineament have been extracted.



## Chapter 2 Recommendations for the Phase II

Based on the survey findings summarized above, the following recommendations may be made for the second phase:

- (1) **Satellite image analysis:** Execute in collaboration with the Peruvian engineers the JERS-1 SAR data processing to prepare mosaic images which are to cover the 13 quadrangles in the east part of the Urubamba river inferior area, in an effort to ensure the transfer of the SAR image processing technology. Successively, image interpretation including mapping of the geologic interpretation and lineaments, digitizing of interpretation results, preparation of the GIS data set and analysis of such data as lineament density.
- (2) **Existing data analysis:** Collect and compile additional data prepared in Peru after the Phase I survey (mainly mining claims-related information).
- (3) **Field survey:** Consider the possibility to execute field survey aimed to ascertain mineralization, with the base camp at Atalaya, situated in the east piedmont of the Sira range where the Tertiary intrusive rocks are present and relatively close to the placer gold mineral indications in the Urubamba-Ucayali rivers. The survey will include the following items:
  - Geochemical sampling of stream sediments, heavy minerals and rocks.
  - Investigation of mineral indications.
  - Verification of lithofacies along survey routes.

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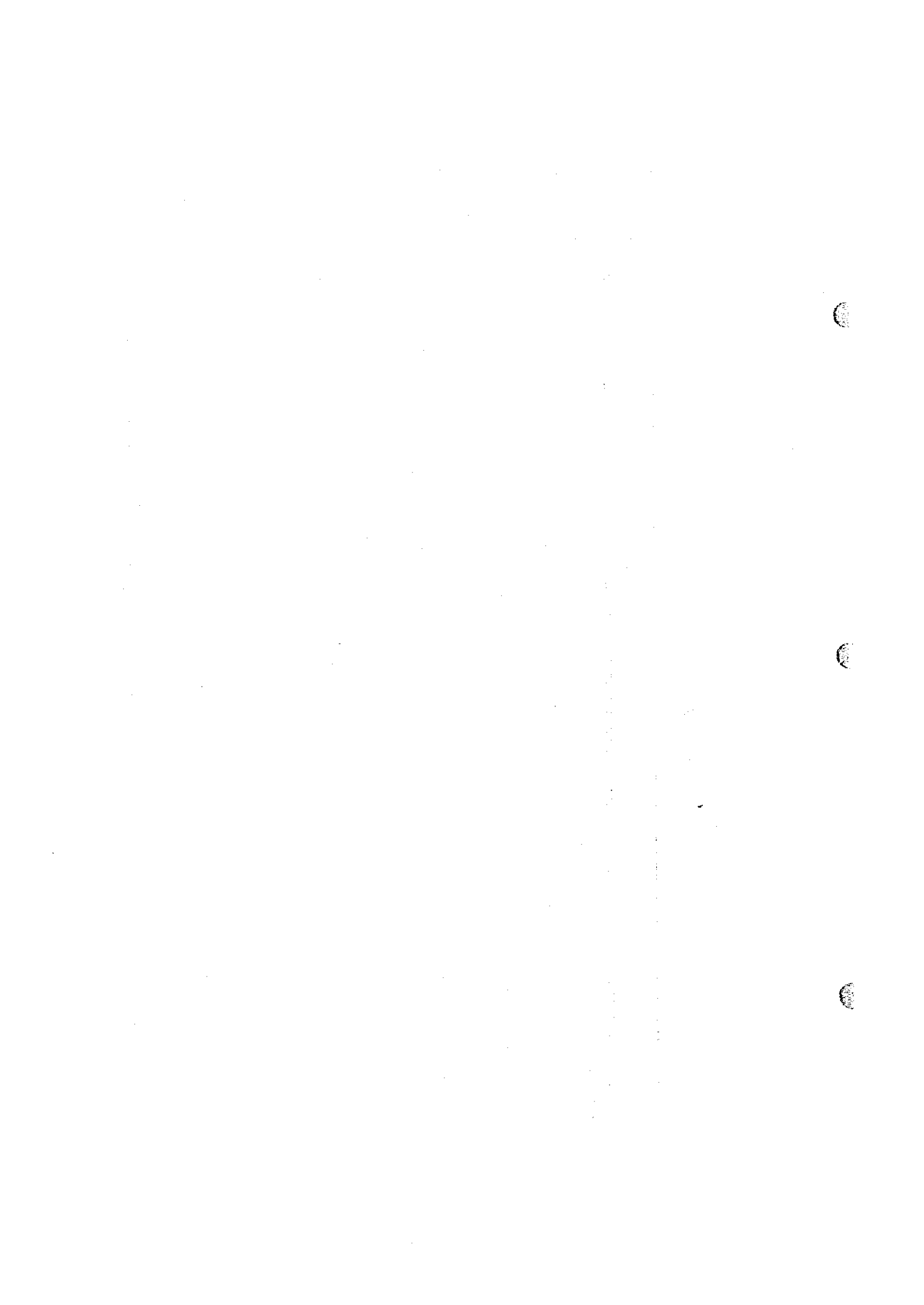
Geological Data of PERUPETRO S.A. (1)

Title	Scale	Year	Reference number	Researcher
<b>Figures &amp; Maps</b>				
Columna Estratigrafica Generalizada del Area del Maranon		1974	GB-9467	Petroleos del Peru
Columna Estratigrafica Generalizada del Area del Rio Ucayali		1974	GB-9468	Petroleos del Peru
Mapa de Rasgos Estructurales del Ucayali Sur	1/500,000	1976	GB-9622	Petroleos del Peru
Seccion Estructural A'-C Lotes - 38 y 39	1/1,000,000	1967	GB-9627	Petroleos del Peru
Mapa Isopaco del Cretacico Total, Hoja-C	1/1,000,000	1976	GB-9724	Petroleos del Peru
Mapa Isopaco del Cretacico Total, Hoja-G	1/1,000,000	1976	GB-9726	Petroleos del Peru
Mapa Isopaco del Cretacico Total, Hoja-G	1/1,000,000	1976	GB-9726	Petroleos del Peru
Mapa Geologico, Hoja-G	1/2,000,000	1977	GB-9731	Petroleos del Peru
Bosquejo de Los Elementos del Marco Tectonico Regional del Centro y Sur del Peru en el Paleozoico Inferior, Hoja-C	1/1,000,000	1977	GB-9733	Petroleos del Peru
Bosquejo de Los Elementos del Marco Tectonico Regional del Centro y Sur del Peru en el Paleozoico Superior, Hoja-C	1/1,000,000	1977	GB-9735	Petroleos del Peru
Bosquejo de Los Elementos del Marco Tectonico Regional del Centro y Sur del Peru en el Paleozoico Superior, Hoja-G	1/1,000,000	1977	GB-9736	Petroleos del Peru
Seccion Estructural Regional a Traves de las Sub-Cuencas del Pachitea, Sierra del Shira y Sub-Cuenca del Ucayali Area Sur	1/500,000	1977	GB-9740	Petroleos del Peru



Geological Data of PERUPETRO S.A. (2)

Title	Scale	Year	Reference number	Researcher
Reports				
Estudio Geologico Regional Sector Sur - Cuenca Ucayali		1995	PP0054	Murphy Peru Oil Co., Sucursal del Peru
Informacion Geologica del Lote 38, p.6-8		1970	PP0057	Petroleos del Peru S.A.
Informe Preliminar del Area del Sepa		1991	PP0070	Petroleos del Peru S.A.
Informacion Geologica Basica, Lote 37 Cuenca Ucayali		1987	PP0072	Petroleos del Peru S.A.
Evaluacion Geologica Lotes 39 y 43 (Cuenca Ucayali)		1992	PP0077	Petroleos del Peru S.A.
Evaluation Final del Lote 36 Cuenca Ucayali Peru		1992	PP0084	Occidental Petroleum Corp. of Peru
Evaluacion de Posibilidades Petroliferas del Lote 39, Cuenca Ucayali		1992	PP0106	Petroleos del Peru S.A.
Geological Reconnaissance in the Upper Ucayali Basin		1972	PP0118	
Other				
Seismic Reflexion Data			PP0123	Total Peru - Sucursal del Peru







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