area. The unit resembles the Unit T2 but has deeper valleys, characterized by the parallel drainage pattern presumed to reflect the strike of the bed. The tone is light on the east side of the slopes and dark on the west side. (Middle Tertiary)

(7) Unit T2
Tertiary unit is predominant especially in the east part of the interpretation area. On flat portions, it has fine, dendritic drainage pattern. The tone is somewhat light. In images, bedding planes are partially traceable but generally unclear, probably because the unit is composed of alternation of thin beds. It is inferred that the unit is chiefly composed of fine-grained, pelitic rocks, intercalating conglomerate beds, sandstone beds, etc. (Lower Tertiary)

(8) Unit T1
The unit, underlain by the Unit T2, is observable at valley portions in areas dominated by the T2. The bed is inferred to be considerably thick. At steep slopes or valleys, fine, parallel drainage patterns develop, and bedding planes in well continuity are occasionally observable but, in general, it appears massive. (Lower Tertiary)

(9) Unit K4
The unit is rarely seen overlying the Unit K2 at flat portions or on gently dipping slopes. The surface texture is smooth but weak undulation develops. As for the tone, light and shade are repeated in a spotted pattern. Bedding is not clear. (Upper Cretaceous)

(10) Unit K3
The unit is often seen forming extensive, moderately dipping slopes while, in some cases, it forms large or small fold structures. As the bedding planes develop and include members which have strong resistance to erosion, steep scarps are frequently formed in the peripheries of the unit. The tone is dark but, at places, there are light patches due to thin covers of the Unit T2, etc. Basically, the drainage shows dendritic patterns but parallel patterns are observed at steep slopes. The unit contacts the Unit J with thrust faults in many portions. (Middle Cretaceous)

(11) Unit K2
The unit is underlain by the Unit K3. These units form fold structures accompanying thrust faults. The K2 has relatively smooth surface texture, though somewhat coarse on gentle slopes. Drainage patterns are not so well developed, and only parallel drainage patterns are observable especially on steep slopes. The tone is somewhat dark but light dots are seen all over. (Middle Cretaceous)

(12) Unit K1
The unit is dominated by joints and the surface texture is coarse. The tone ranges widely from light to dark. Bedding planes are recognizable but not so clearly.

(Lower Cretaceous to Upper Jurassic)

(13) Unit J
The surface texture is rough and banding with light and dark tonal portion is observed. Bedding and joint are generally well developed and dipping northeast. NNW-SSE to NW-SE trending large range is developed in the portion showing clear bedding planes. ENE-WSW to NE-SW trending joints are dominant, that is perpendicular to bedding. NNE-SSW trending large-scale thrust is seems to be developed at the boundary between this unit and Cretaceous. Massive portions without clear bedding plane are partly observed and where dominant range direction does not appear. (Jurassic)

(14) Unit P
Fissures parallel to bedding planes or joint planes are well developed and surface texture is generally coarse. The tone is light, except the dark slope in the west. Bedding planes are occasionally visible but they are generally unclear. The unit is often seen as inliers in K2 or K1, presumably accompanied with thrust faults. The unit is inferred to be mainly composed from hard rocks such as sandstones or limestones. (Paleozoic)

The geological interpretation of images is partially exhibited in Fig. 7-2(quadrangle 20-u) and Fig. 8-2(21-r), respectively, while Fig. 7-3(20-u) and Fig. 8-3 (21-r) display the respective lineament interpretation maps.

The area of Phase II analysis is underlain by the Neogene T2 to T4 units and the Holocene Q3 to Q4 units. The Holocene lies only along main drainage systems and is mostly underlain by the Neogene. The T2 unit is exposed in the west part of the Quadrangles 20-r and 21-r in the northwest. From the fact that the T3 unit contacts the T2 generally forming scarps, it is presumable that upper part of the T3 consists of rocks of high erosion resistance such as sandstone. The T4 lies in topographically elevated portions in the central and south parts of the subject area of analysis, and its boundaries with the T3 also form scarps in many instances. Therefore, the uppermost part of the T4 is also presumed to be composed of facies of high erosion resistance, similarly to the T3.

The interpretation of the respective quadrangles is given in the following paragraphs:

(1) 19-u
A major part of the quadrangle is occupied by the Brazilian territory, while the Peruvian territory only covers a small part in the southeast end. The geology is composed of fluvial deposits of the Alto Purús River (Q4) and the Tertiary rocks (T3). Although bedding is barely discernible in the Tertiary, the formation is inferred to be

nearly horizontal.

(2) 20-r
The eastern half of the quadrangle is the Brazilian territory. The west part of the Peruvian territory is underlain by the Middle Tertiary (T2) whereas the east part is by the Upper Tertiary (T3). The T3, compared with the T2, lies in topographically elevated areas, which tend to have somewhat strong relief. Scarps are often formed on boundaries between the T3 and T2. From these facts, the T3 is presumed to be composed of rocks of high resistance to erosion, compared with the T2.

(3) 20-t
Most part of the quadrangle is the Brazilian territory and the Peruvian territory barely occupies the southeast end, where the Curanja River, a tributary of the Alto Purús, meanders and runs northeast. The both river banks are underlain by the fluvial deposits, about 2 km in width. The northwest and southeast parts, intercalating the Q4, are underlain by the Tertiary (T3), where the bed is presumed to be nearly horizontal in the light of tracing of the bedding.

(4) 20-u
A JERS-1 SAR image and a geological interpretation map of the quadrangle are exhibited in Figs. 7-1 and 7-2, respectively. The east and northeast parts of the quadrangle are included in the Brazilian territory. The Alto Purús meanders, running from northwest to northeast in the central part of the quadrangle. This NE-SW trend is concordant with the direction of the high of basement in depths of the area, possibly reflecting it. The both banks of the Alto Purús are covered with fluvial deposits (Q4) of 3 km in average width, and intercalated by the Tertiary (T3). The T3 has relatively strong relief and has a tendency that ridges and valleys trending NE-SW are dominant. From the barely interpretable tracing of the bedding, the formation is presumed to be nearly horizontal. The relatively low portion in the south of the quadrangle is underlain by the uppermost Tertiary (T4).

(5) 21-r
A JERS-1 SAR image and a geological interpretation map are displayed in Figs. 8-1 and 8-2, respectively. The Envira River flows from WSW to ENE, meandering near the center of the quadrangle. The Curanja River, a tributary of the Alto Purús, also meanders running almost in parallel with the Envira in the southeastern end of the quadrangle. This suggests the possibility that the flow of rivers in the area is controlled by the underground structure in the depths as discussed above.

The northwest to westernmost part of the quadrangle is mostly underlain by the Middle Tertiary rocks (T2). In the central part of the quadrangle, the Middle Tertiary (T3) that overlies the T2 is widespread, stretching NE-SW. On the boundaries between the T2 and T3, the T3 clearly forms scarps, which suggests that the T3 is composed of rocks of high resistance to erosion, compared with the T2. The southeast part of the quadrangle is underlain by the uppermost Tertiary (T4). The T4 also forms clear scarps on its boundaries with the T3.

It is inferred from the drainage pattern that an aticlinal structure stretching nearly in the E-W direction is present in the southeast part of the quadrangle. The axis of the anticlinal structure is higher in elevation than the flanks, showing coarse structure. The northern flank is bounded by drainage systems with the E-W trend whereas the southern flank is by those with the WNW-ESE trend. Apparently, therefore, the anticlinal structure is presumed to plunge westward. The boundary between the T3 and T4 to the north of the anticlinal structure is cut by two faults in the NEN-SWS to N-S direction. These faults appear to show right lateral movement. However, the formation is presumed to dip nearly horizontal. In case a fault movement includes vertical slip, horizontal slip is exaggerated. Presumably, the lateral movement is not as large as the apparent displacement of approx. 1.5km.

(6) 21-s

Crossing a near-center of the quadrangle in the E-W direction, the Curanja River runs meandering generally from west to east. The northern half of the quadrangle is mostly underlain by the Upper Tertiary (T3) whilst the other part of the northern half and the whole southern half are extensively underlain by the uppermost Tertiary (T4). On the boundary between the T3 and T4, the latter often forms scarps. The Curanja changes its flow from the NE to ESE direction near the center of the quadrangle. This may suggest possible presence of an anticlinal structure stretching E-W to the south of the river, but it is not necessarily clear. Some fluvial deposits (Q4) are observed on the both banks of the Curanja River.

(7) 21-t

Both the Alto Purús and its tributary, the Curanja, flow meandering generally toward northeast. The quadrangle is extensively covered by the Upper Tertiary (T3) while the southwest part is underlain by the uppermost Tertiary (T4). As the T4 often forms scarps on its boundaries with the T3, the border lines are relatively clear. Fluvial deposits (Q4) lie rather extensively on the both banks of the two rivers.

(8) 21-u

The Brazilian border runs in the east of the quadrangle. The quadrangle is mostly underlain by the Upper Tertiary (T3) while the other parts including the southwest portion is underlain by the uppermost Tertiary (T4). As compared with the T3, the T4 lies on topographically elevated lands but boundaries between them are not necessarily clear. On the banks of the Alto Purús, which meanders in the northwestern tip of the quadrangle, fluvial deposits spread rather extensively.

(9) 22-r
The quadrangle is situated in the headwaters of the Alto Purús system; its west side belongs to the Urubamba system. Starting from the northwest of the quadrangle, the Ronsoco and Curiuja Rivers of the Alto Purús system, as well as the Inuya River of the Urubamba system, flow in radial directions -- east, southwest and south, respectively. It is clear that the area is the center of topographic elevation. Possible presence of a dome structure centering around the headwaters of these river systems can be pointed out. The east to south parts of the quadrangle is underlain mainly by the Upper Tertiary (T3) which, in turn, is extensively covered by the uppermost Tertiary (T4) from the central to east parts. The T4 often forms scarps on its boundaries with the T3, and the boundary lines are relatively clear.

(10) 22-s
The Curiuja River flowing northeast from the southwest tip of the quadrangle while the Ronsoco flowing southeast from the western tip merge into the Alto Purús in the central part of the quadrangle and meanders northeastward. The southeast side of the Curiuja and Alto Purús Rivers is underlain chiefly by the extensive Upper Tertiary (T3) whereas the northeast side is extensively underlain by the uppermost Tertiary (T4). The banks of major rivers are covered by belts of fluvial deposits.

(11) 22-t
An extensive area of the quadrangle is underlain by the Upper Tertiary (T3) while the uppermost Tertiary (T4) overlies the south and northwest parts. On the boundaries between the T3 and T4, the latter forms scarps; the boundary lines are very clear. Especially, the T4 in the south of the quadrangle has little erosion, forming a broad mesa-type topography. Belts of fluvial deposits cover the both banks of major rivers.

(12) 22-u
The east part of the quadrangle comes under the Brazilian domain. Winding like an S and passing near the center of the quadrangle, the Iaco River runs from west to east flowing into the Brazilian territory. An extensive area of the quadrangle is underlain by the Upper Tertiary (T3) while the uppermost Tertiary (T4) overlies the south and the north parts. The T4 in the south forms an extensive mesa-type topography, similarly to the Quadrangle 22-t. From tracing of the bedding, it can be inferred that an anticlinal structure is present to the north of the portion where the Iaco River bends like an S protruding southward. The bend of the Iaco can be interpreted to reflect the anticlinal structure.

1-4-2 Lineament analysis

The results of lineament interpretation of the respective quadrangles are described in the following paragraphs:

(1) 19-u
In the southeast end of the quadrangle covered by the Brazilian territory, several lineaments with the NNW-SSE and NE-SW trends were extracted.

(2) 20-r
Lineaments with the NE-SW to ENE-WSW trends and with the N-S to NNW-SSE trends tend to be dominant. Those with the NNE-SSW trends are intermittent, especially near the Brazilian border a little to the east of the south part of the quadrangle, where the lineament density is high.

(3) 20-t
Lineaments with the N-S trend are intermittent and those with the NE-SW trend tend to predominate in the Upper Tertiary (T3) lying on the left bank of the Curanja River in the southeast part of the quadrangle, which comes under the Peruvian domain.

(4) 20-u
Fig. 7-3 displays a lineament map of the quadrangle. Lineaments with the NE-SW trend are dominant in the area northwest of the Alto Purús which flows from southwest to northeast meandering near the center of the quadrangle. The direction is interpreted to reflect the geologic structure in the depths. In a zone vertically traversing a near-center of the quadrangle, high concentration of lineaments with the N-S trend is discerned. A circular structure, 1.2km in diameter, was extracted in the north of the quadrangle. To the southeast of the Alto Purús, lineaments with the N-S trend are dominant. High density zones of lineament are formed in the vicinity of intersections of those with the NE-SW trend and those with the N-S trend.

(5) 21-r
On the northeast side of the Envira River which flows from WSW to ENE meandering near the center of the quadrangle, observed are intermittent lineaments with the ENE-WSW trend running almost in parallel with the mentioned river. In general terms, there is a tendency that lineaments with the same trend predominate on the north side of the intermittent lineament zone whereas, on the south side, those with the N-S trend are predominant. The fault that cuts the boundary between the T3 and T4 is included in the lineaments with the N-S trend. High density zones of lineament are formed at intersections of those with the ENE-WSW trend and those with the N-S trend.

(6) 21-s
This quadrangle has higher lineament density, compared to the others. Dominant trends are NNE-SSW, NE-SW to ENE-WSW, NNW-SSE, etc. Especially, the river systems within the uppermost Tertiary (T4) which has high resistance to erosion

have flow directions controlled by these lineaments, often assuming trellis-like drainage patterns.

(7) 21-t
Lineaments with the NE-SW and NNW-SSE trends are dominant in the area intercalated by the Alto Purús and its tributary, the Curanja. High density zones are formed at intersections of these lineaments. Two of circular structures, though incomplete, were extracted from the northwest side of the area where the Alto Purús gently changes its direction from ENE to NE in the southeast part of the quadrangle. To the northeast of the Curanja, rather dominant are lineaments with the NW-SE trend, whereas, to the southeast of the Alto Purús, those with the NNW-SSE and NE-SW trends are conspicuous.

(8) 21-u
Intermittent zones of lineament with the N-S trend are present in the east part of the quadrangle whilst those with the NE-SW trend traverses a little to the northwest of the center of quadrangle, both stretching in the same direction as those of the lineaments. At the northeastern end of the intermittent zones with the NE-SW trend, observed is a portion in which lineaments with the N-S trend concentrate. Intermittent zones of lineaments with the NE-SW trend appear in the southeast end of the Peruvian territory. High density zones of lineament are formed in the vicinity of intersections of these zones.

(9) 22-r
An intermittent zone of lineaments with the NNE-SSW trend is discerned, which passes a little to the east of the center of the quadrangle. The northern half of the quadrangle has an area in which lineaments with the ENE-WSW trend predominate. The lineament density tends to be especially high in the northwest part where presence of a dome structures is inferred. This conforms to the results of analysis of drainage patterns, as well. It is presumed that tension fractures accompanying formation of the dome structure were extracted as lineaments.

(10) 22-s
The quadrangle has relatively high density of lineament. The main trends are the NE-SW, NW-SE and N-S, and lineaments with the same trend to be intermittent. In the eastern half of the quadrangle, the N-S trend is especially conspicuous. An incomplete circular structure was extracted in the east of the confluence of the Curiuja and Ronsoco Rivers.

(11) 22-t
Intermittent zones of lineaments with the ENE-WSW trend traverse the central part of the quadrangle nearly east to west. Intermittent zones with the NE-SW trend are distributed from the south-central end to the northeast end of the quadrangle. The

northwest part of the quadrangle has an area where lineaments with the ENE-WSW trend paralleling with the flow of major rivers are dominant while, in the north part, there is an area where those with the NW-SE trend predominate.

(12) 22-u
To the north of the Iaco River which gently meanders like an S around the center of the quadrangle and traverses it west to east, lineaments with the NE-SW and NW-SE trends tend to be intermittently present. To the south of the same river, intermittent lineaments with the ENE-WSW trend are dominant, as well as those with the NE-SW and N-S trends.

1-5 Considerations

A comparative study on the results of the Phase I and II image analysis and the 1:100 000-scale geological map published by the INGEMMET in 1997-98(List of references and data collected, 1) has revealed the following aspects:

a. The interpretation findings and the existing geologic map are in substantial agreement, in terms of the general division of geologic unit.

b. Due to the lack of ground data for the verification of interpretation findings, the respective geologic time units are hard to identify and, precision-wise, the interpretation results are inferior to the geologic map, in terms of detailed division of the geologic unit.

c. Owing to the distortion particular to a radar image, the fault lines and geologic boundary lines in the interpretation map tend to be distorted, especially in mountainous zones with high specific altitude.

d. In the Tertiary zone in the east where bedding planes are observable all over in spite of its flat topography, a verification survey, if conducted, is expected to be able to clarify the large and small folding structures more in detail.

e. The geologic map and the interpretation map do not agree as to the geologic division of Permian in the quadrangles 20-ñ, 20-n, etc. of the geologic map. In the map, the unit underlain by the horizontal to moderately dipping Cretaceous that constitutes the main body of the Sira range and apparently conforming to the overlying stratum is classified into the Permian. Since it is clear from the SAR images that Cretaceous is composed of a number of members (alternation of beds of high and low resistance to erosion), the unit is dealt with in the interpretation map to be the lowest member of Cretaceous.

f. The unit with rough texture and with well developed lineaments, lying in the vicinity of the Sira anticlinal axis in the quadrangles 20-ñ and 20-n, is classified in the geologic map into Proterozoic, whereas the interpretation map classifies it into Paleozoic in conformity to the division of the 1:2,000,000-scale geologic map, since no reference to Proterozoic have so far been found in the Sub-Andes studies and in view of the mentioned relations with Cretaceous.

g. The eastern part of the study area (Phase II survey area) tends to have low density of lineaments in comparison with the western part (Phase I survey area). From the tendency, it is considered that the eastern area has lesser potentials for metallic mineral resources compared with the western area.

h. In the eastern part of the study area, lineaments with the NNE-SSW trend are predominant. Different tendency is observed when compared with the Selva zone in the eastern part, underlain by the Neogene rocks, where the NE-SW trend is dominant. The difference possibly reflects difference in the orientation of the basement structures in the depths.

The western part of the interpretation area on the left bank of the Ucayali- Tambo rivers, where the Sira range is formed, is mainly composed of Paleozoic to Cretaceous, whilst the Ucayali sedimentary basin area in the eastern part, Tertiary to Quaternary are widespread forming relatively moderate landforms. The two areas are clearly divided by the thrust faults in NNW-SSE direction which serve as the boundary. In Paleozoic to Cretaceous in the Sub-Andean region, large to small-scale fold structures with axes parallel to the strike of the thrust faults are formed.

In Tertiary to Quaternary in the Ucayali sedimentary basin area, presence of a number of anticlinal structures or dome structures are inferred from drainage patterns. These structures are likely to reflect concealed Cretaceous or lower depths structures. The anomalous drainage pattern discerned in the quadrangle 21-p -- a distinctive trellis pattern -- appears interesting as it possibly suggests presence of an intrusive rock. In the Selva zone as represented by the Ucayali sedimentary basin area, drainage analysis is effective for interpretation of geology and geologic structure.

Figure 9 demonstrates a lineament density map. 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. In general, tension fractures are possibly accompanied by intrusive rocks and hydrothermal activity related with the intrusive rocks; therefore, they are considered important for exploration.

The presence of small-scale intrusive rock bodies in Paleozoic in the southeast of the Sira range has been confirmed from the field data by INGEMMET, which suggests that similar rock bodies possibly lie in the zone. Although a zone of intrusive rocks cannot be interpreted from SAR images, the most part of the Phase I study area is covered by Jurassic to Quaternary sedimentary rocks or unconsolidated sediments and therefore fissures are presumed not to be well developed. It is also inferable that, in such an area, intrusive rocks and metamorphic rocks are likely to be present in portions of high lineament density.

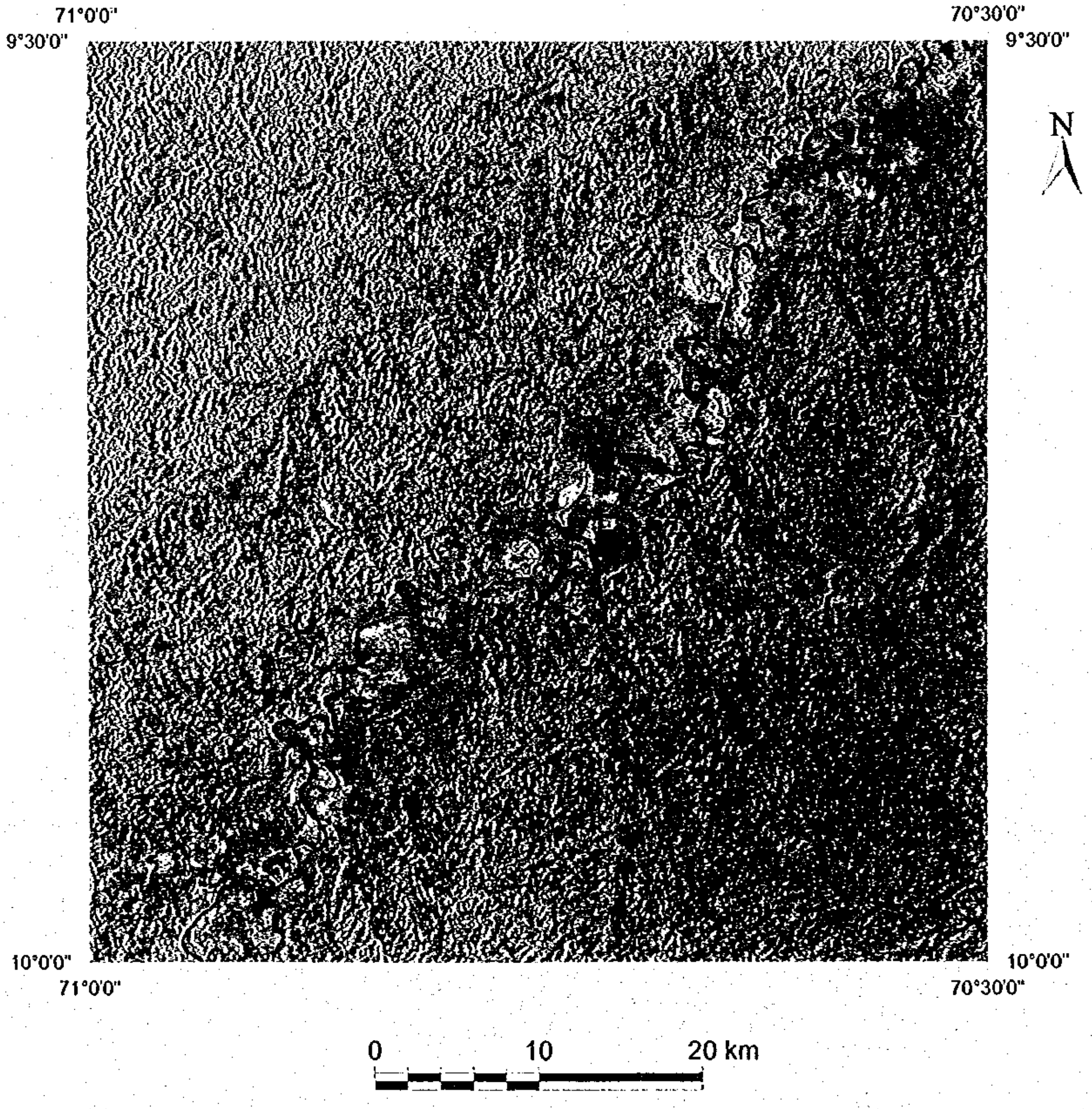

Figure 7-1 Puerto Esperanza (20-u) JERS-1 SAR image

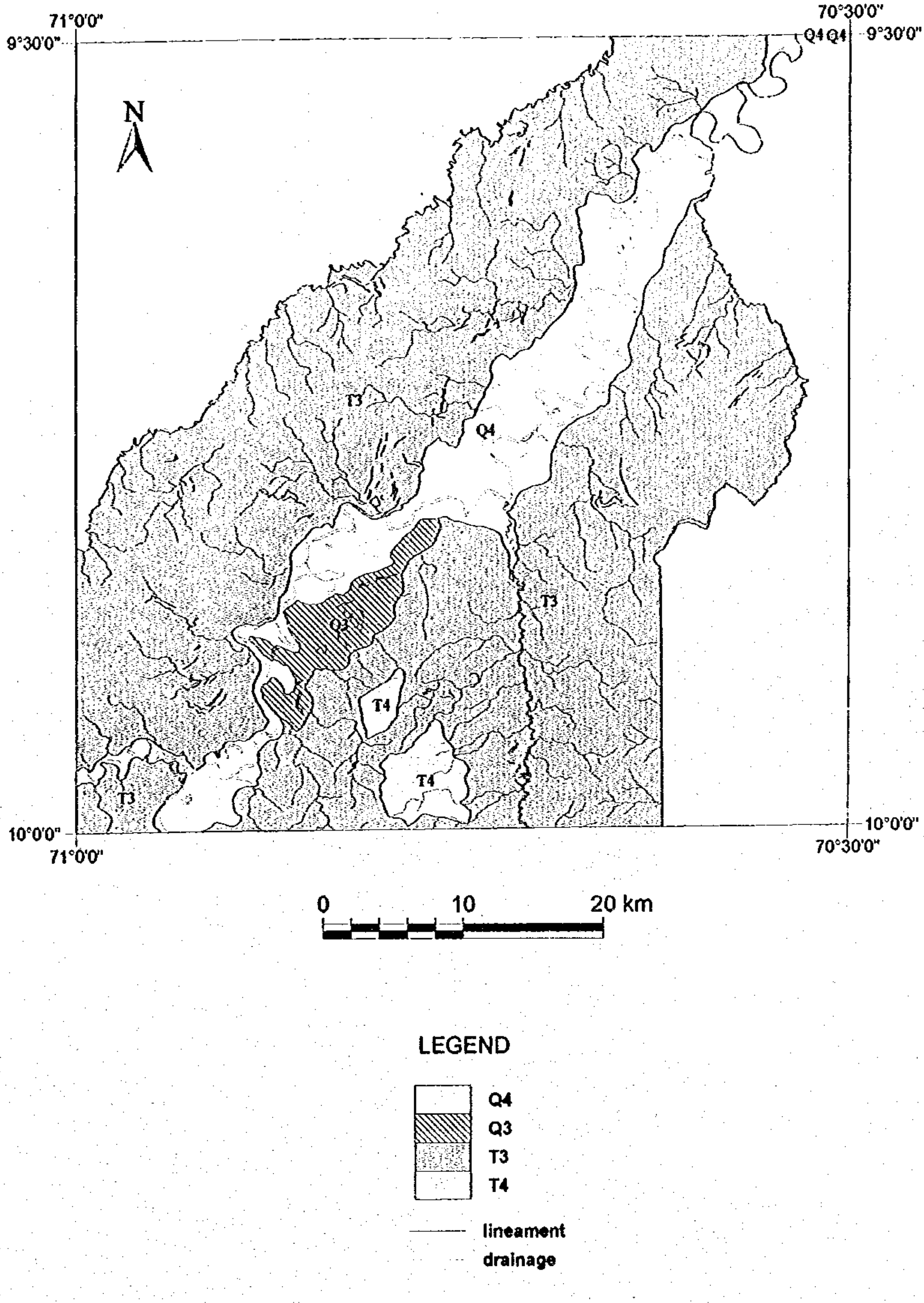

Figure 7-2 Puerto Esperanza (20-u) Geologic Interpretation Map

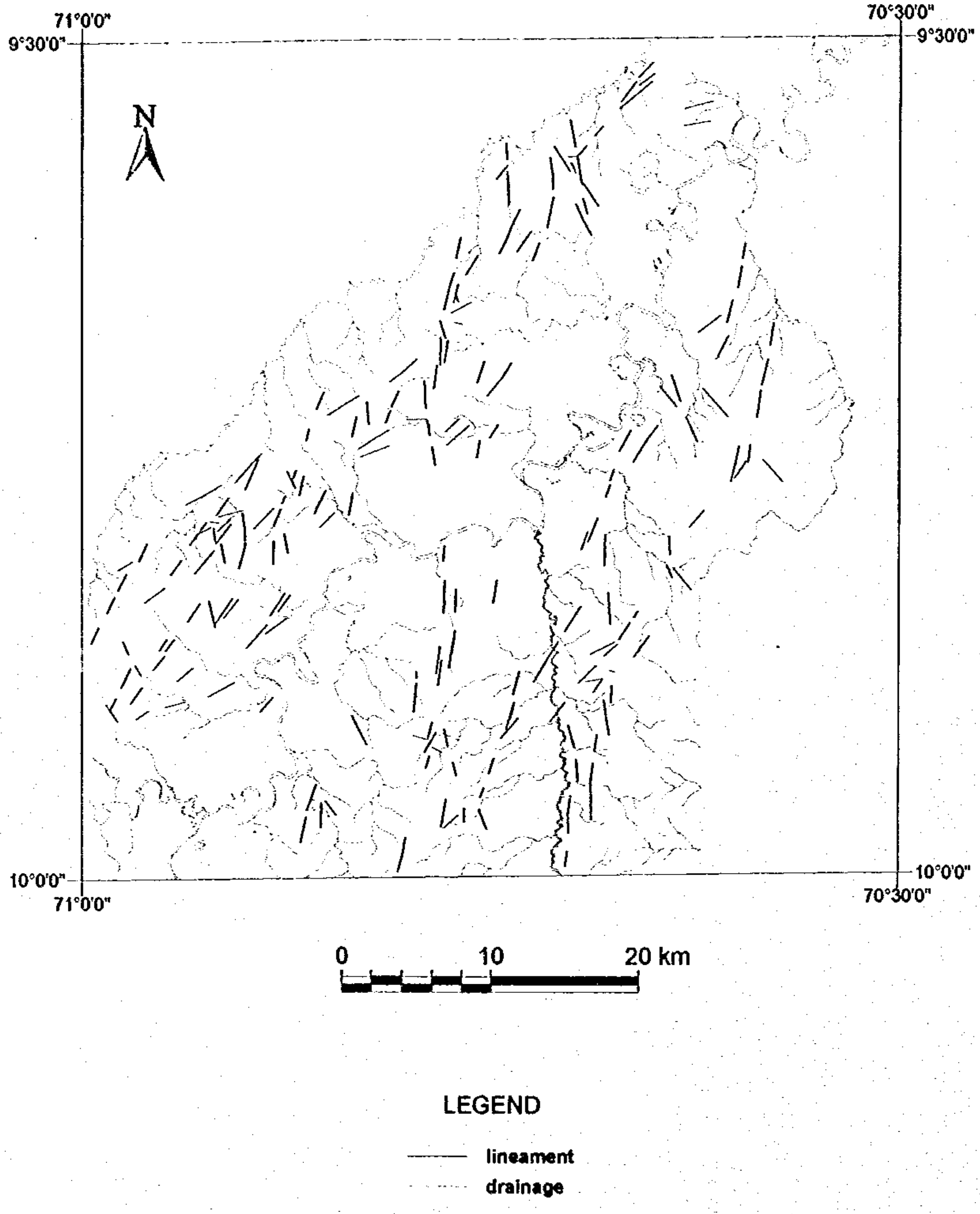

Figure 7-3 Puerto Esperanza (20-u) Lineament Map

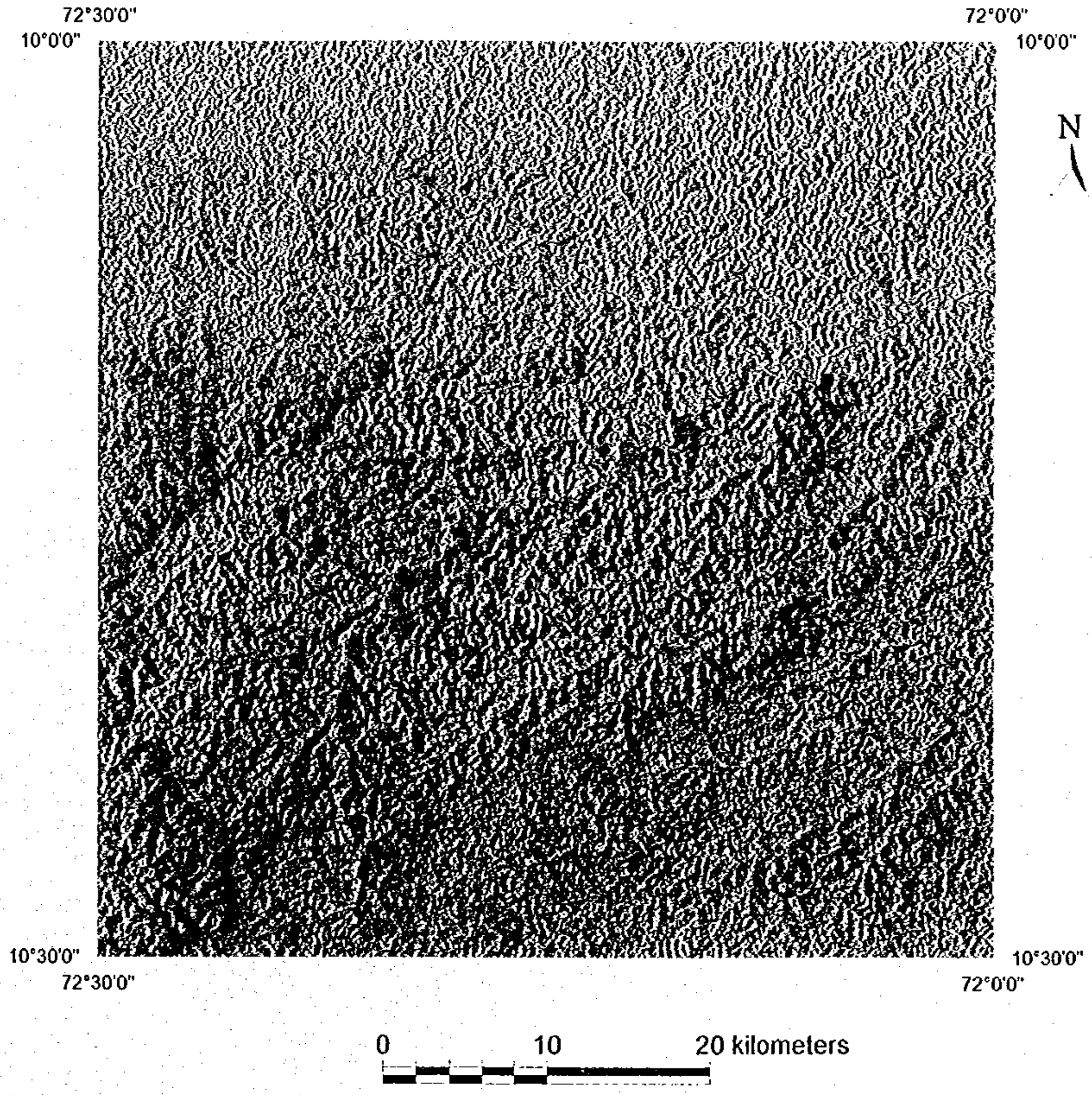

Figure 8-1 La Reparticion (21-r) JERS-1 SAR Image

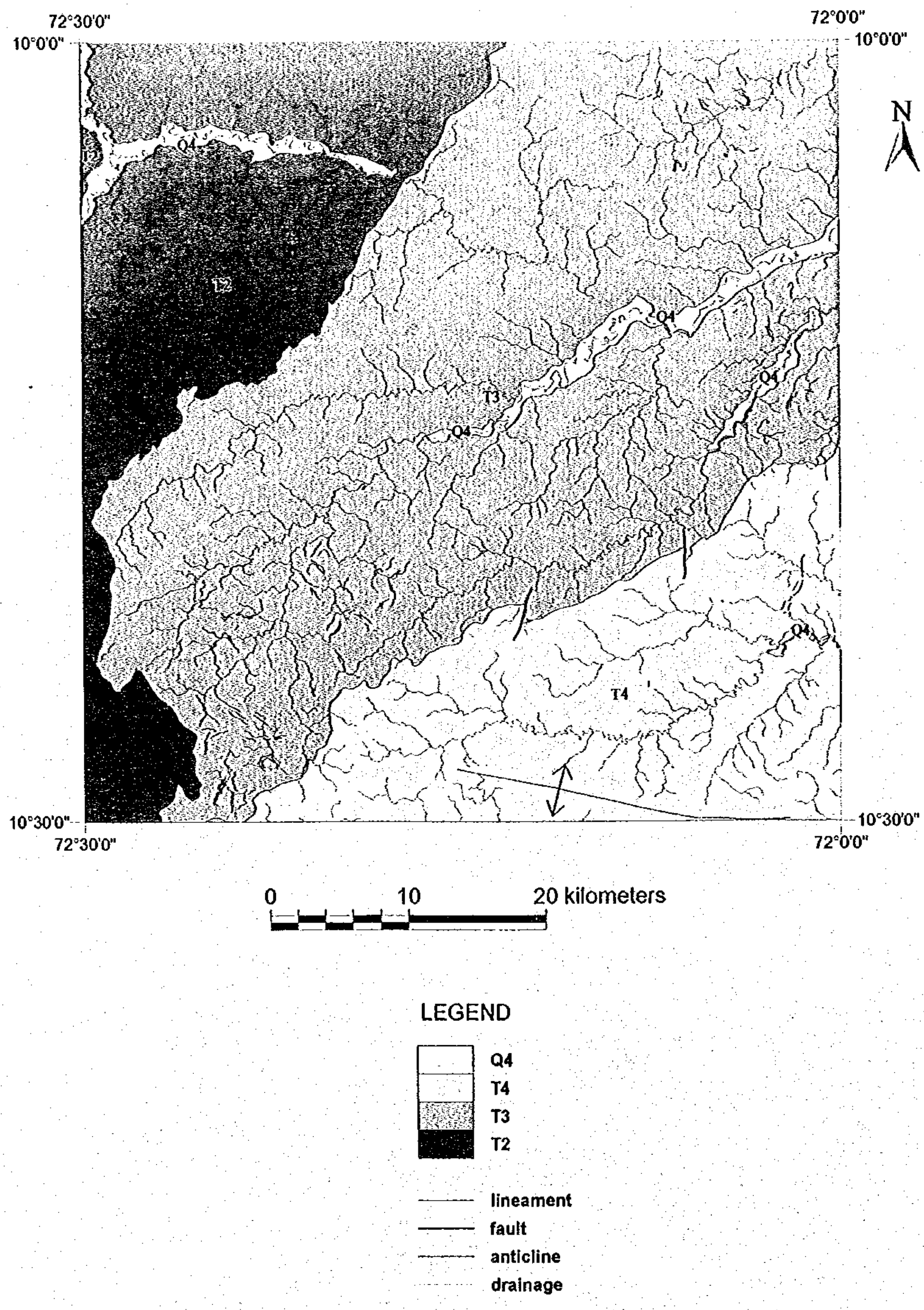

Figure 8-2 La Reparticion (21-r) Geologic Interpretation Map

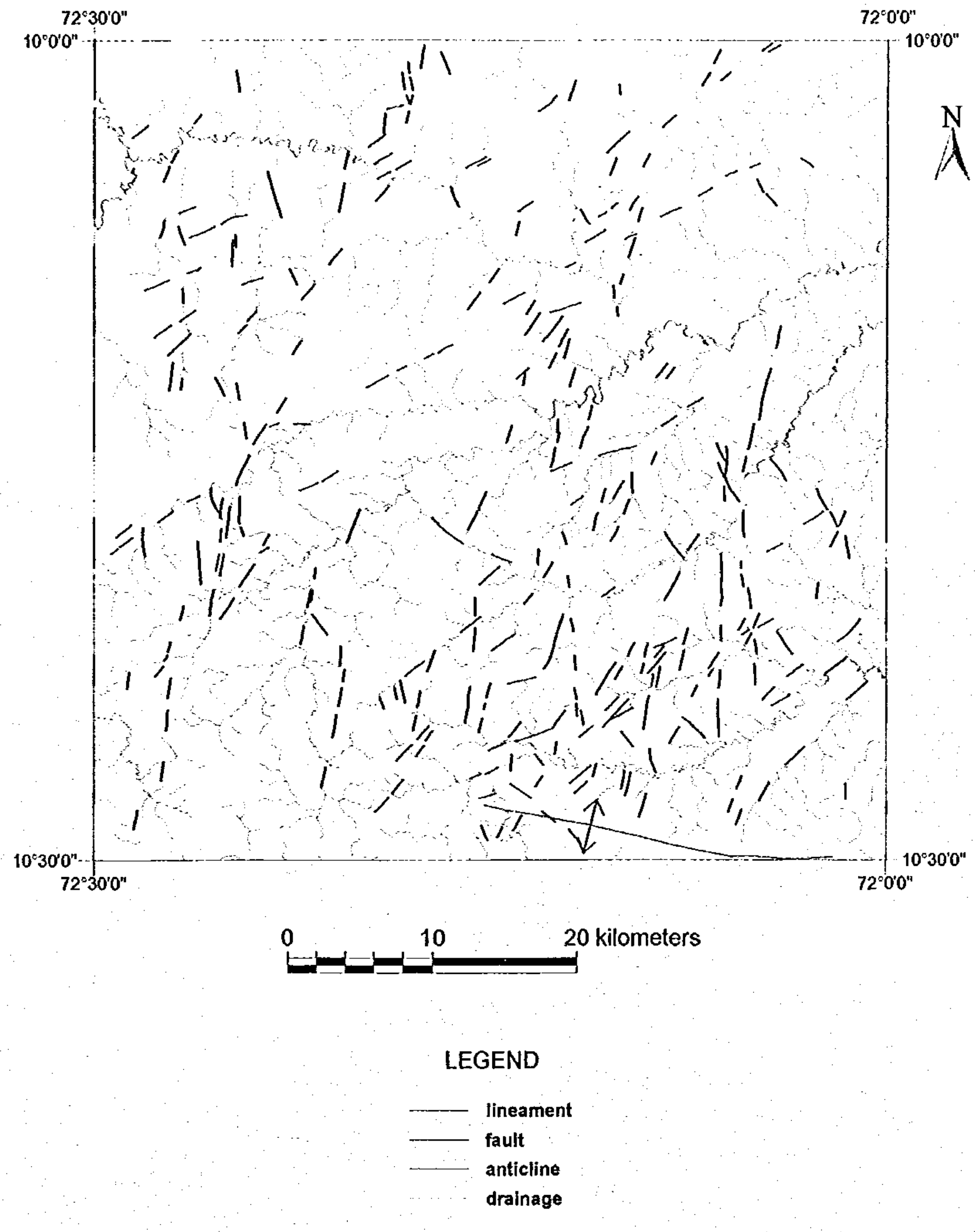

Figure 8-3 La Reparticion (21-r) Geologic Interpretation Map

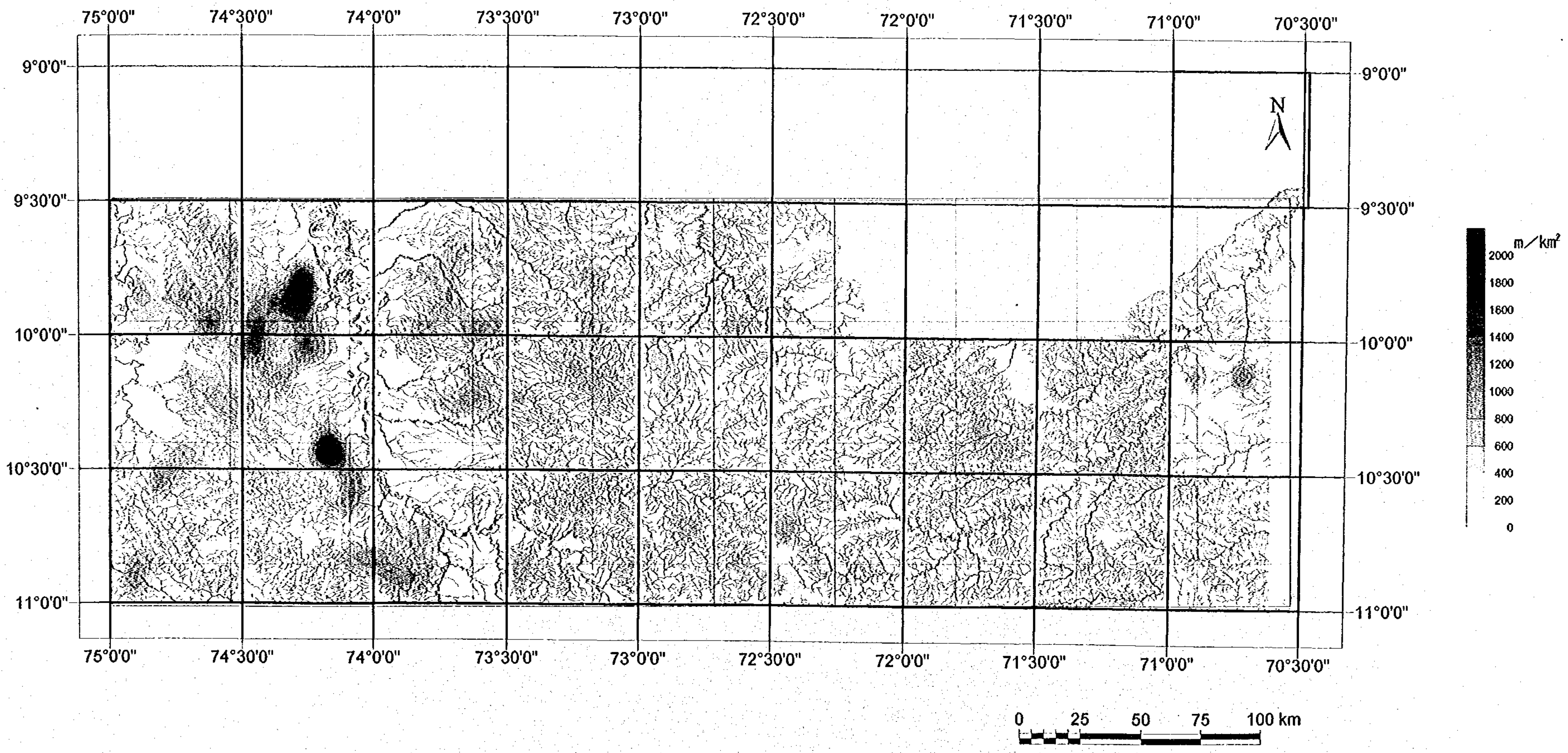

Figure 9 Lineament Density Map

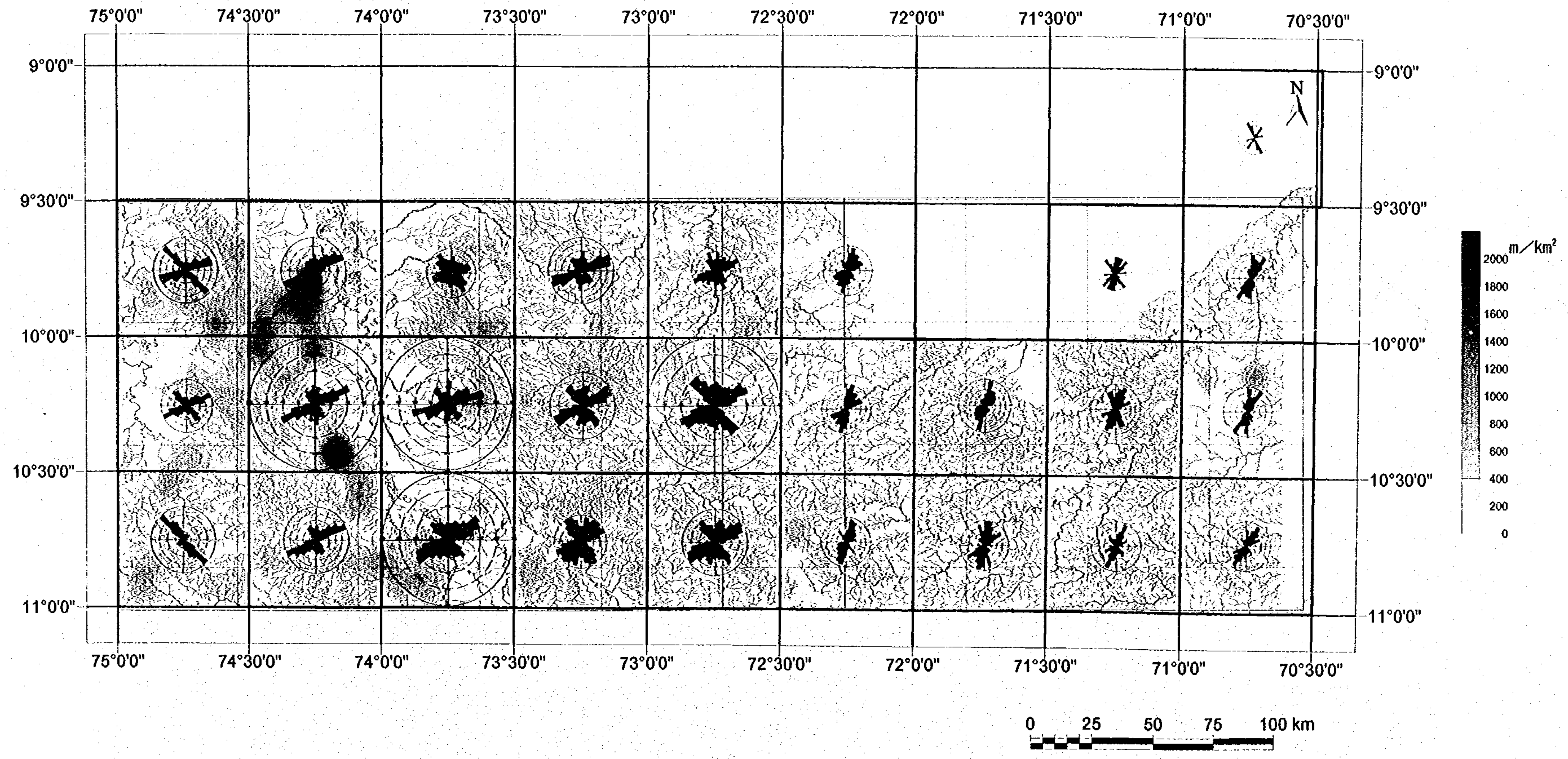

Figure 10 Lineament rose diagram

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.

The Phase-I descriptions on the analysis of the existing data that covers the whole inferior areas of the Urubamba River, are reproduced in the paragraphs below, since the data are essential for extraction of promising ore-bearing zones, combined with the satellite image analysis in Phase II :

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 11 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:

Figure 11 Compiled Geological Column

Geological Age			Formation Name	Thickness m	Lithology
CENOZOIC	Quaternary	Holocene	Aluvial Deposit, Talus		Sand, Gravel [Unconformity]
		Pleistocene	East Selve Area: Formation Madre de Dios	20	Brownish Sand, Clay, Gravel
			West Selva Area: Formation Ucayali	30	Brownish Sand, Clay, Gravel [Angular Unconformity]
	Neogene	Pliocene Miocene	Formation Ipururo (West Sira Area: 500m thickness)	1,200	Calcareous Sandstone (Sandstone with lignite layer) [Unconformity]
	Paleogene	Oligocene	East Sira: Group Huayabamba	1,600	Sandstone, Mudstone, and Limestone
		Eocene	West Sira: Formation Chambira	(400)	Reddish violet Claystone
			Formation Pozo	(400)	Tuff, Shale
			Formation Yahuarango	(800)	Calcareous Claystone [Unconformity]
MESOZOIC	Cretaceous	Upper	Formation Cachiyacu-Huchpayacu	150	Shale, Sandstone
			Formation Vivan	350	Siliceous Sandstone
			Formation Chonta	650	(Shaly) Limestone with thin Limonite Layer
			Group Oriente	600	Siliceous Sandstone with thin Limonite Layer [Unconformity]
	Jurassic	Upper	Formation Sarayaquillo	600	Feldspasic Sandstone with Basal Conglomerate [Angular Unconformity]
		Lower	Group Pucara	1,500	Limestone~Shaly Limestone
	Tiassic	Upper			
		Lower	Formation Ene	700	(Calcareous) Sandstone [Unconformity]
PALEOZOIC	Permian	Upper			
		Lower	Group Copacabana	500	Dolomitic Limestone
	Carboniferous	Upper	Group Tarma	500	Siliceous Sandstone with thin Coal layer
		Lower	Group Ambo	600	Sandstone with Limonite layer [Angular Unconformity]
	Ordovician		Formation Contaya	400	Limonitic Shale [Angular Unconformity]
	Proterozoic		Complex Sira Complex del Marannon		Gneiss, Semischist Dioritic Gneiss

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.

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 of 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.

<u>(2) Intrusive rocks</u>

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 Precambrian, Paleozoic, Mesozoic and Paleogene, constitutes an anticline thrusted 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 Precambrian and 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 12 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°-

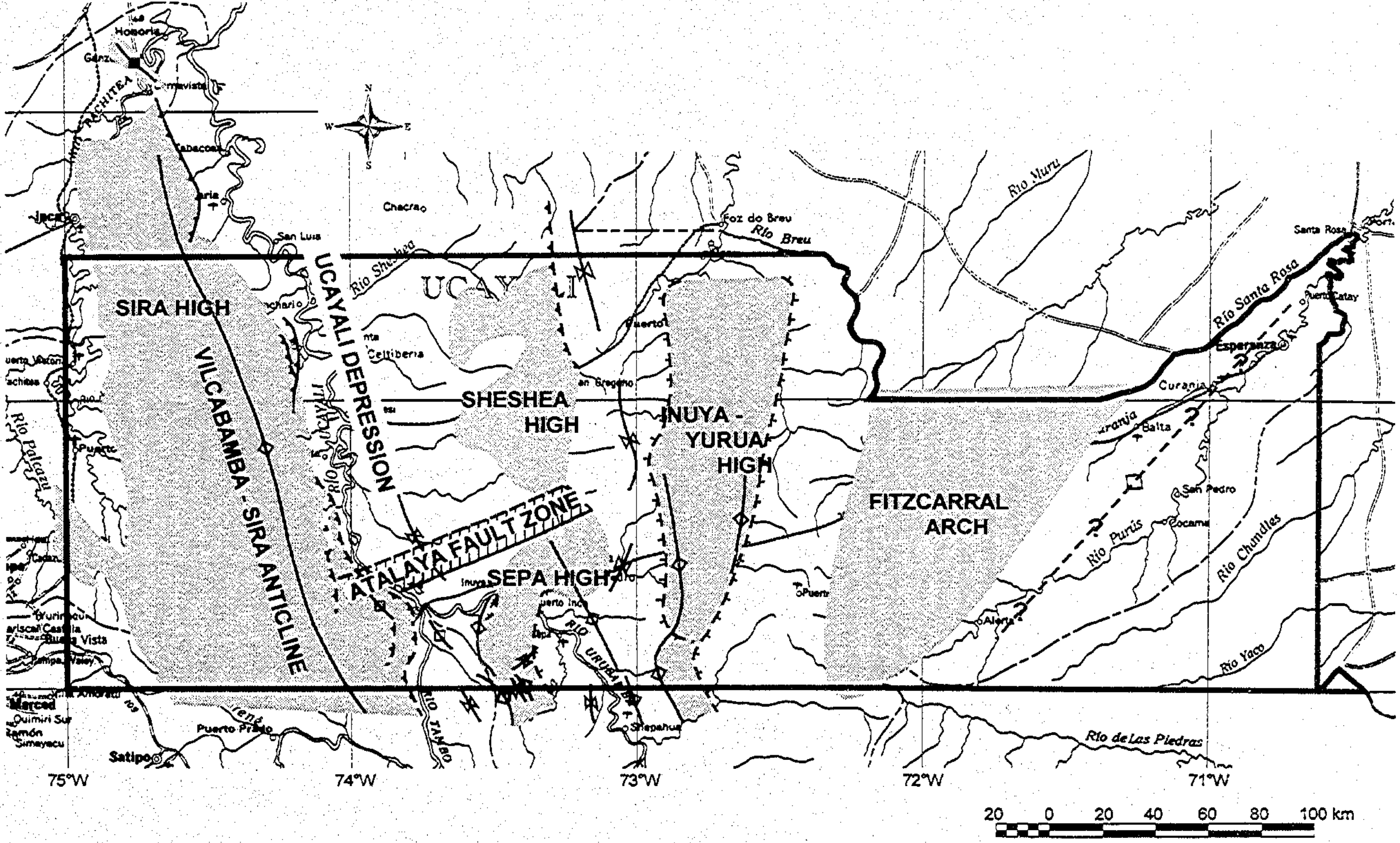

Figure 12 Deep geologic structure map

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 "Sheshea 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 7 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 ϕ) 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 Llullapichis 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 Sira, 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 a paleo-placer deposit which occur in the basement of the Oriente Formation of the Lower Cretaceous System.

c. Source: INGEMMET geological report (2)

<u>(2) Ucayali-Urubamba division</u>

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 confluence, 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)

<u>(3) Eastern Selva division</u>

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 Purús, 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.