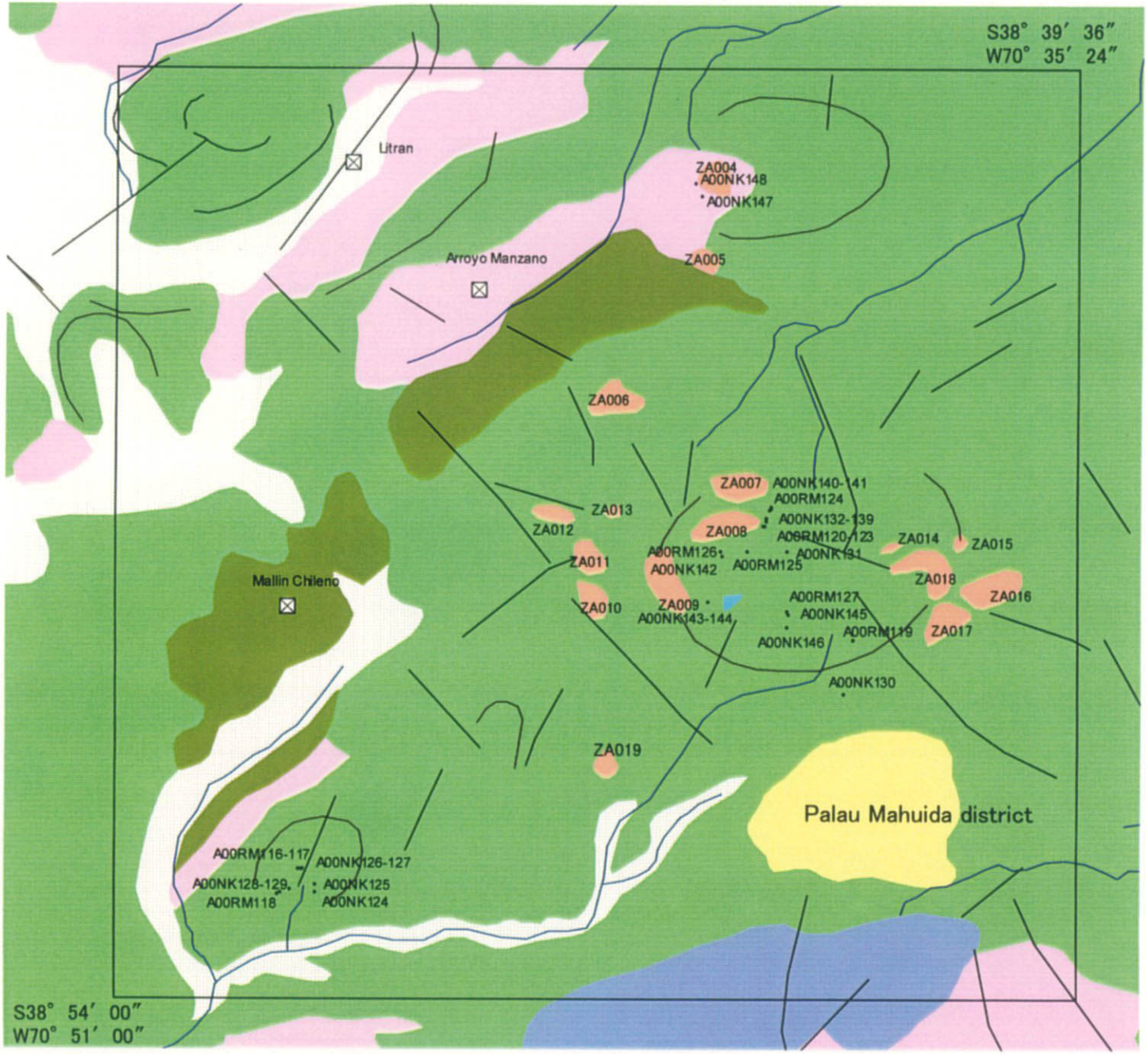


Known mineral occurrence
Sampling point
Lineament
Circular structure
Lake
River

Geology
Quaternary sediments
Pliocene to Pleistocene basalt
Tertiary volcanic rocks
Jurassic to Cretaceous sedimentary rocks
Permian to Triassic igneous rocks
Proterozoic metamorphic rocks
Alteration zone (Phase 1)

Fig. II-3-2-14 Geological map with sampling points of the Palau Mahuida district.

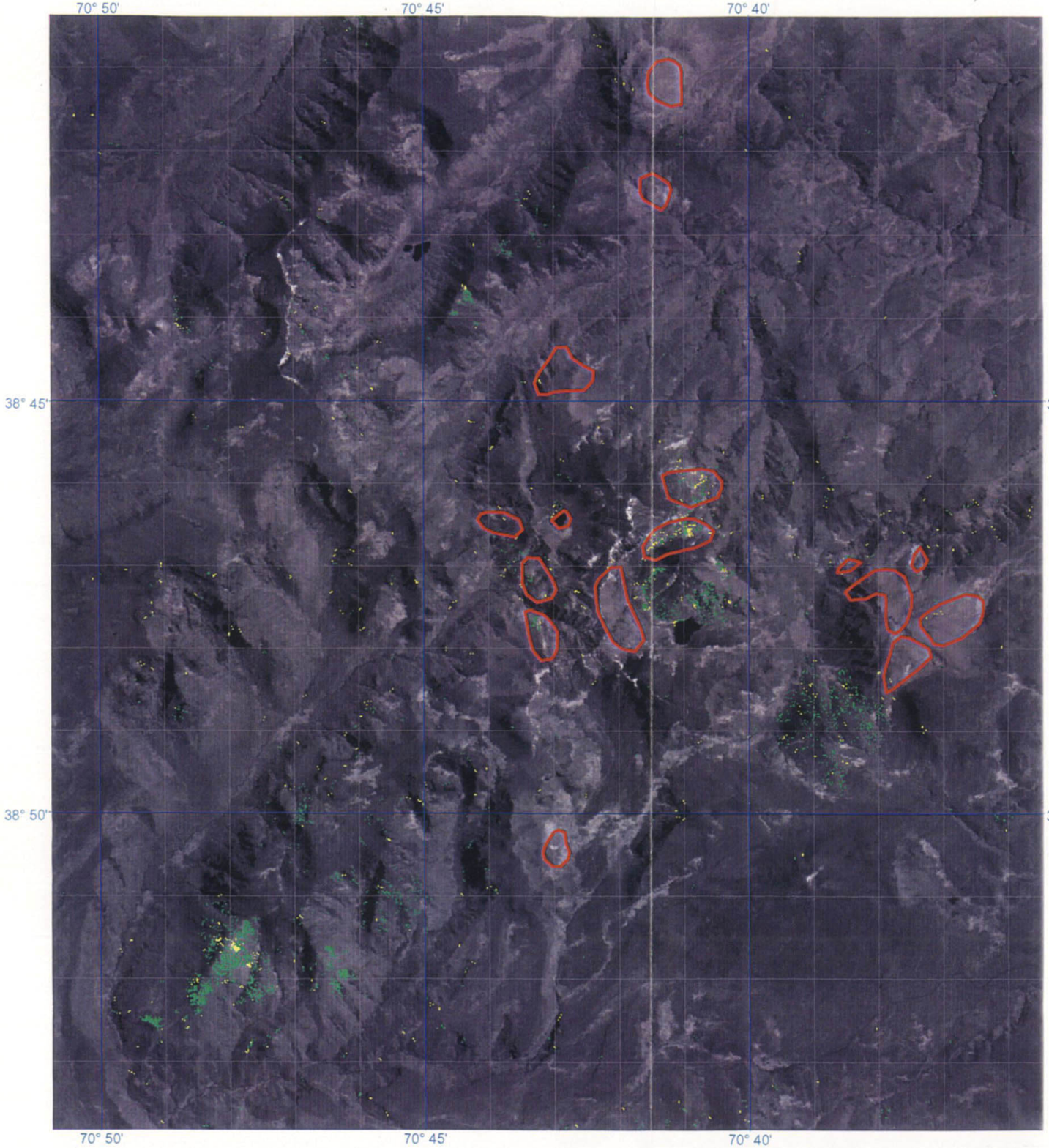


Fig. II-3-2-15
Satellite image
of the Palau
Mahuida district.

Access to the alteration zone around Cerro Las Lajas (hereafter, called the Cerro Las Lajas alteration zone) can be obtained via Kilca located to the southwest of this diatrict or Primero Pinos located to the southeast of this district. In the case of access from Puesto Kilca (a pasture management hut), a one-hour drive westward from Zapala city on No. 13 provincial road will reach Kilca. In the case of going on horseback from Puesto Kilca, a six-hour trip via Arroyo Cochico Chico will reach an unattended hut on the southern slope of Cerros Las Lajas. This hut was utilized as the base camp, the field survey was conducted within the scope of a day's trip on horseback. A good approach is available from this place to the alteration zones ZA006 to ZA019.

For access to the alteration zone ZA004, the vehicle should travel 98 km on No. 22 national road northwestward for about two hours from the Zapala city, and pass the pasture gate. From there, the vehicle must travel farther about one hour on the mountain road, and then the survey team must go on foot for about three hours to reach the survey site.

For access to the Cochico Grande alteration zone, the team must ride on horseback from Puesto Kilca located along No. 13 provincial road. About three hours' riding reaches the center of the alteration zone.

4) Previous surveys

Placer Exploration Inc. conducted geochemical exploration for porphyry Cu ore deposits around Cochico Grande alteration zone in 1995, and RTZ Mining and Exploration Limited conducted geochemical exploration along Arroyo Cochico Grande on the northern part of Puesto Kilca. No remarkable anomaly was obtained in either survey.

5) Mining properties

Four mining properties are established in Cerro Las Lajas alteration zones (near ZA007 and ZA008) as of December 2000.

6) Geology and geological structure

According to "Geologia y Metalogenesis del Orogeno Andino Central" (Mendez et al., 1995), the geology of this district, in ascending order, consists of metamorphic basement of the Cambrian to Ordovician (partially including the Precambrian), volcanic rocks of Choiyoi group of the Permian to Triassic, Molle volcanic rocks that are volcanic complex of the Incaico period of early Tertiary, Palaoco volcanic rocks that are volcanic complex of the Pehuenchico period of Tertiary, effusive rock that is volcanic complex of the Quechuico period, and volcanic rocks of the Diaguitico period of Quaternary. Metamorphic rocks are distributed from the place along Arroyo Cochico Grande to Arroyo Mansano and on the south side of the Cerro Palau Mahuida. Choiyoi group is distributed along Arroyo Cochico Grande and around

the alteration zone ZA004. The Quarternary volcanic rocks are distributed in the southern part of Cerro Las Lajas and in the whole place on the eastern side of the area.

The vicinity of Cerro Las Lajas alteration zones in the central part is composed of metamorphic rocks of the lower Paleozoic, volcanic rocks of the Cajon Negro formation equivalent of Neogene, and basalt of Quarternary. The Neogene volcanic rocks are made up of rhyolite containing obsidian and andesitic lava to pyroclastic rocks. The Quarternary basalt forms a scoria cone.

On the southern side of the alteration zone ZA004, andesite of Choiyoi group is distributed. It is composed of lava, tuff breccia, lapilli tuff and intrusive rock with distinct plagioclase phenocryst in which flow structures develop. As to alteration, propylitic altaeration with silicification and epidotization is observed on the whole. Granite in the central part seems to be the Permo-Triassic granite. Granite is widely distributed around the mountaintop and forms rocky area. In the flat part, sand after weathering of granite is distributed and it is seen in distant view as white color.

In Cochico Grande alteration zone, rhyolite and andesite of Choiyoi group are distributed. Rhyolite is composed of lava, tuff and tuff breccia with flow structures. Rhyolite to rhyolitic pyroclastic rocks are widely accompanied by silicification and white argillization. In the north from a border on lat. 38° 51' 44.4" and long. 70° 47' 28.6", basaltic pyroclastic rocks with distinctive amygdale structure is distributed. Plagioclase phenocryst is apparent with the naked eye, and alteration is weak.

7) Mineralization and alteration

Cerro Las Lajas alteration zones spread on the south and north slopes of the Cerro Las Lajas mountain body. The range of it is about 1 km x 2 km on the southern side and about 2 km x 2 km on the northern side. It is presumed that these are the central part of hydrothermal activity of the eroded Tertiary volcano. Places higher than 2,450 m above sea level are covered by rhyolite lava without alteration and considered to be places where products of volcanic activity in post-hydrothermal activity or hydrothermal activity did not reach. The alteration zone on the north side develops centering in places 2,100 m above sea level. This alteration zone is characterized by silicification (leaching, addition), white argillization and limonitization. There are silicified rock accompanied by massive limonite and pyrite, and network quartz veins (width <5 mm) (A00NK134). Hydrothermal breccia like rock (A00NK139) also exists locally. Leached silicified rocks are distributed on the valley bottom at the relative lower height, and the possibility can be considered that these places are where the mountain body collapsed. In the alteration zone on the southern side, silicification, white argillization and limonitization are observed although the degree is weak than those on the northern side, and collapse of the mountain body is also confirmed. It is

considered that Laguna Palau Mahuida is a dammed lake generated by this collapse of the mountain body. Source rock includes andesite, andesite porphyry and rhyolite.

Cochico Grande alteration zone extends to the direction of NNE-SSE and spreads in the area of approximately 4km x 1.5km. Original rocks are rhyolite and andesite. It has affected by silicification, white argillization and limonitiation on the whole. Porous parts indication leaching were partially observed. Strong silicification forms a ledge extending to the E-W direction. Breccia that cuts flow structures and is considered as hydrothermal breccia is uncommonly observed. Although quartz veinlets are also uncommonly observed (A00NK126), none of sulfides were observed.

Andesitic rocks of Choiyoi group near the alteration zone ZA004 have affected by propylitic alteration and partial silicification. Epidote and chlorite were observed there, but none of sulfides were not observed. On the other hand, it was judged that granitic rocks of the Permian to the Triassic have affected little alteration.

8) Characteristics of the satellite images

There are concentrations of lineaments tending to the NE-SW and NW-SE on the false color image. The alteration zones ZA006 to ZA019 are presumed from the ratio composite image analysis around the place where these lineaments are entangled. Although a ring structure was interpreted around Cerro Las Lajas alteration zones, it is erosion topography and does not indicate any caldera structures. Horseshoe-shaped lineaments were interpreted in the vicinity of Cochico Grande alteration zone and the alteration zone ZA004. The former corresponds to the outline of an alteration zone (Fig. II-3-2-14).

In the satellite image of spectral patterns analysis (Fig. II-3-2-15), pixels indicating neutral alteration are distributed with high density in the whole place around Cochico Grande alteration zone. Pixels indicating neutral and acid alteration concentrate on the slope on the north and south sides of Cerro Las Lajas. Those on the south side spread in a circle of about 1.5 km in diameter to the north bank of Laguna Palau Mahuida. Those on the north side almost correspond to ZA007 and ZA008. Pixels indicating neutral alteration exist sporadically and almost conformably in the mountain body (about 2 km in diameter) about 3 km south-southwest of Cerro Palu Mahuida. Because the geology is composed of gneiss of the lower Paleozoic, it is considered that muscovite in it was extracted as neutral alteration. On the other hand, in the alteration zone ZA004 presumed from the ratio composite image analysis, pixels indicating alteration zones do not exist in the satellite image of spectral patterns analysis.

9) Laboratory work results

Concerning the argillized rock samples from Cerro Las Lajas alteration zones,

montmorillonite (A00NK131, 133, 140, 141, A00RM125, 127), kaolin (A00NK135) and jarosite (A00RM121) were identified as a result of the powdery X-ray diffraction. There were remained plagioclase and potassium feldspar in many samples, and alteration degree is weak. In altered rock on the slope on the south side, cristobalite and kaolin (A00NK143) were identified. As a result of the microscopic observation, altered volcanic rock (A00NK137) distributed in the alteration zone ZA007 were identified as porphyritic andesite, and remained glass is also observed although secondary minerals of quartz, sericite and chlorite have generated. A00NK144 of tuff was judged as dacitic welded tuff but has remained glass in the matrix. In the chemical analysis, remarkable anomalous values were not obtained in any of A00NK131 (white argillized rock), A00NK132 (strongly silicified rock with pyrite dissemination), A00NK134 (quartz-pyrite veinlets), A00NK136 (massive limonite), A00NK138 (white argillized and silicified rock), A00RM121 (jarosite network), A00RM122 (white argillized and leached and silicified rock), and A00RM123 (white argillized, leached and silicified rock). As a result of the chemical analysis for quartz veins (A00NK130, A00RM119) in biolite geniss of basement, remarkable values were not also obtained.

Concerning the Cochico Grande alteration zone, sericite was identified for white altered rock as a result of the powdery X-ray diffraction (A00RM116, A00NK127, 128). In the chemical analysis, no remarkable anomalous values were obtained in any of A00NK124, 126, 127, 128, 129, A00RM116, 117 (silicified rocks with limonitization).

Concerning the alteration zone ZA004, A00NK147 (granite rocks) was identified as augite bearing hornblende biotite granodiorite, and secondary minerals of montmorillonite and chlorite are replacing biolite. A00NK148 (andesite) was judged as hornblende syenite porphyry, and a large amount of quartz has been generated as secondary mineral.

10) Assessment

Cerro Las Lajas alteration zones were formed by volcanic-geothermal activities from the upper Neogene to the Quarternary with local collapse of the mountain body. In these alteration zones, although leached and additional silicification is developed, it is considered that the alteration was formed in a low-temperature environment near the paleo-water table because the assemblage of alteration minerals are montmorillonite, kaolinite, quartz, cristobalite and jarosite. Although in these alteration zones, mineralization of Mo and As are marked on the map of "Geologia y Metalogenesis del Orogeno Andino Central" (Mendez et al., 1995), no anomalous metal contents, even same elements, were obtained in the results of this chemical analysis. It is judged from the results mentioned above that there is a low possibility for the existence of economical ore deposits.

Cochico Grande alteration zone is characterized by sericitization. Although there were hydrothermal activities, concentration and deposition of metal elements were not confirmed.

It is judged that there is a low possibility for the existence of economical ore deposits.

Andesite of the alteration zone ZA004 has been affected by propylitic alteration, but granide is relatively fresh. Therefore, it is judged that there is a low possibility for the existence of economical ore deposits.

3-2-12 Carreri Malal district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 50 km to the west of Zapala city, in the west of Neuquen province (Fig. II-3-1-1). The area is lat. 38° 54' 36" to 38° 59' 24" S and long. 70° 32' 24" to 70° 38' 24" W (Fig. II-3-2-8a), and about 100 km^2. The representative coordinate is lat. 38° 57' 56.1" S and long. 70° 36' 44.2" W at Carreri Malal deposits.

2) Previous surveys

Carreri Malal deposit is classified as a mesothermal polymetallic vein type deposit. The possibility was mentioned that it was formed by mineralization in twice. The first one was before the climax of Hercynian orogeny, then it was affected by cataclastic movement, and the second one was hydrothermal activities of Eocene to Oligocene (Danieli et al., 1979). JICA and MMAJ (1984) reported 222±1.1 Ma of K-Ar radiometric age for tonalite in about 10km south of the district. R.T.Z. Mining Exploration Ltd. conducted geochemical survey by medium of stream sediments and rocks in 1996 and then they withdrew without any promising results.

3) Outline of the survey results

The geology of this district comprises, in ascending order, the Chachil plutonic complex and volcanic rocks of the Choiyoi group of Permian to Triassic, Cuyo group of Jurassic sedimentary rocks and Cajon Negro formation of Neogene andesitic rocks.

Chachil plutonic complex is composed of granite, granodiorite and tonalite. Choiyoi group is made up of rhyolitic to andesitic lavas and pyroclastics. Cuyo group consists of black shale, sandstone and limestone.

Carreri Malal vein deposits are hosted along the contact zone between granitic batholith of Chachil plutonic complex and Choiyoi group of Triassic. The veins strike NW-SE and dip vertical. Silicified breccia dykes of 10 cm to 1.5 m width intruded into granite at three sites. Mineralization of galena, pyrite, chalcopyrite, bornite, malachite and pyrrhotite were

observed. Galena is dominant quantitatively. Quartz and calcite were observed as gangue. Alteration of granite is weak. Well mineralized sample revealed 321 g/t Ag, 15.35% Fe, 9.92% Pb and 2.43 % Zn (Appendix-10). Hydrothermal alteration is weak and small amount of chlorite, sericite and mixed layer of sericite-montmorillonite were identified by powdery X-ray diffraction (Appendix-5).

4) Assessment

Although the polymetallic vein deposits is hosted in this district, it is considered that the hydrothermal alteration is not developed and the scale of mineralization is not significant. While ore shows high grade for silver, lead, iron and manganese, the gold grade is low. Therefore, there is no necessity to include this district in Phase-2 survey.

3-2-13 Nireco district

Concerning the alteration zones ZA026, ZA027, ZA028 and ZA029 where the phase-1 field survey was conducted, see the Phase-1 report.

1) Location

This district is located about 47 km west-southwest of Zapala City in the west of Neuquen province (Fig. II-3-1-2). The area is lat. 39° 00' 00" to 39° 06' 36" S and log. 70° 29' 24" to 70° 34' 48" W, and about 170 km^2 (Fig. II-3-2-16). Presumed alteration zones extracted from the satellite image by the ratio composite image analysis and spectral patterns analysis are distributed over the northern area of Arroyo Nireco (Fig. II-3-2-17).

2) Topography and vegetation

This district is situated northeast of Cerro Chachil of 2,839 m above sea level, with the Arroyo Nireco flowing in the center in the direction of E-W to NW-SE. On the southern side of Arroyo Nireco is Cordon del Chachil consisting of steep mountains of about 2,000 m above sea level. On the other hand, the northern side of Arroyo Nireco forms relatively mildly sloped hills toward Lagna Branca in the northeast. Vegetation of pino grows near Arroyo Nireco, but away from Arroyo Nireco only the sparse growth of neneo, coiron and other grasses is seen.

3) Access

Access to the Nireco district is gained by driving down No. 46 national road about one hour from Zapala city, changing course to a north-northwestern direction at the Nireco primary school and then, in about 20 minutes, by reaching the Puesto (pasture management

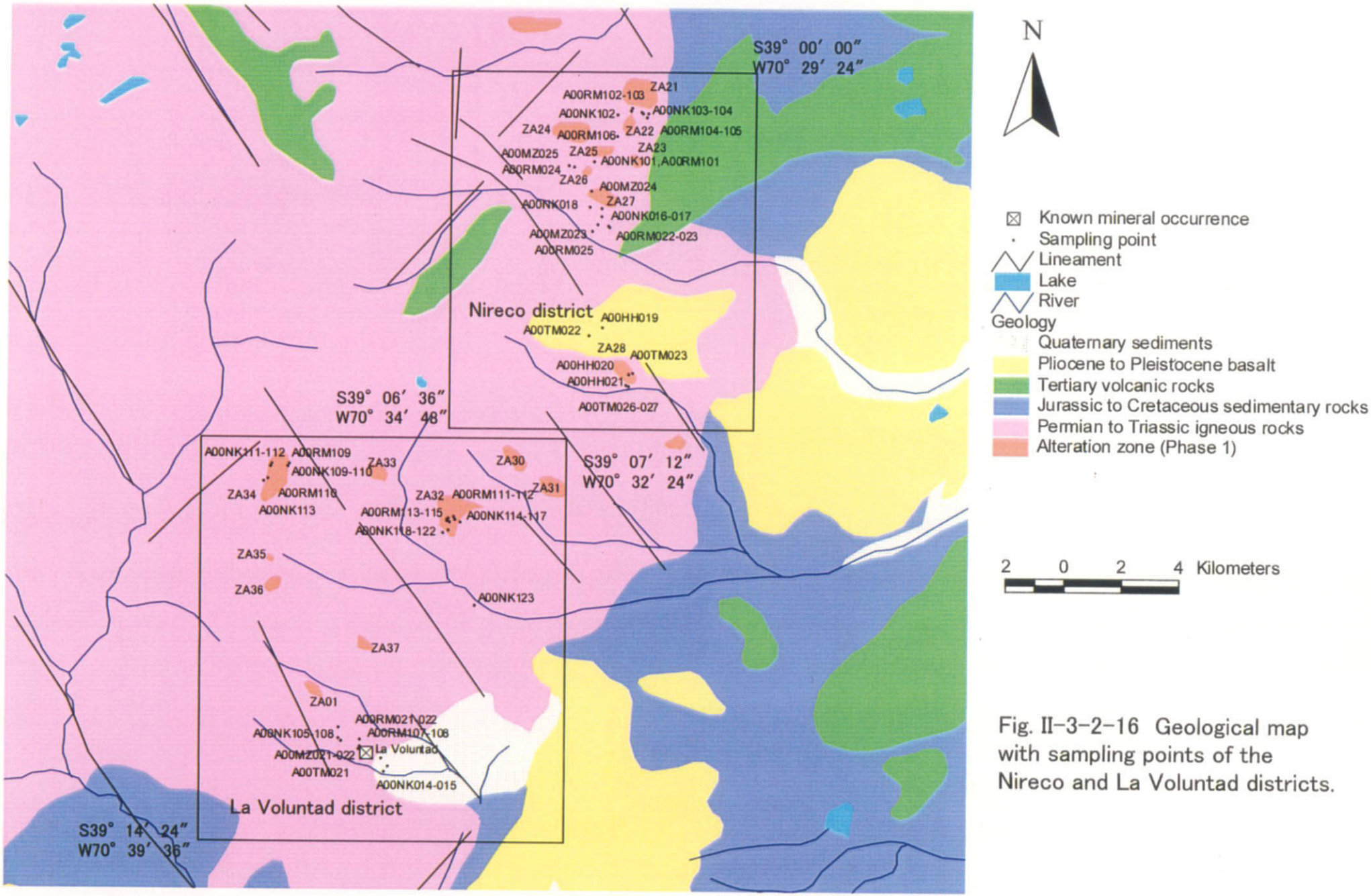


Fig. II-3-2-16 Geological map with sampling points of the Nireco and La Voluntad districts.

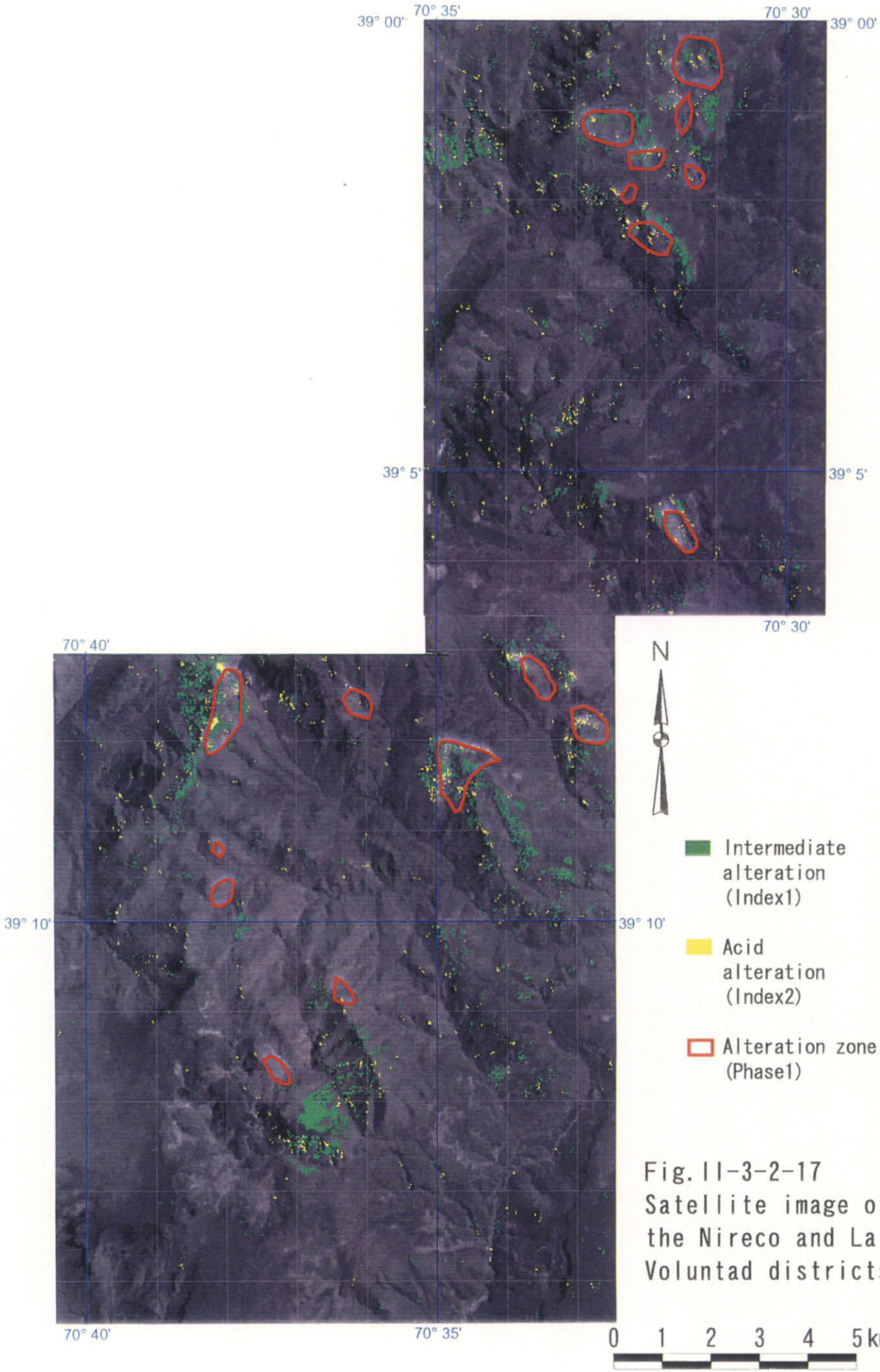


Fig. II-3-2-17 Satellite image of the Nireco and La Voluntad districts.

hut). Farther on, the drive will continue along the Arroyo Nireco riverside for about one hour, followed by riding on horseback for about two hours to finally arrive at the alteration zone ZA021.

4) Previous surveys

The Secretaria de Mineria (SM) carried out a geological survey in this area (Leanza, 1985). After that, a geological survey was executed to explore manganese deposits accompanied by the chert formation.

5) Mining properties

No mining properties are established in this area.

6) Geology and geological structure

In this district, there is wide distribution of Choiyoi group (PTR) made up of andesitic to rhyolitic volcanic rocks of the Permian to Triassic, and Chachil granidic rocks (PTRg) of the Permian to the Triassic. In the northeastern part, Cuyo group (J) that is Jurassic sedimentary rocks in the Neuquen basin is distributed. In the southern and eastern parts, basalt of the Pliocene to Pleistocene (Campos Basalticos de Zapala) covers these unconformably. Andesite rocks of Choiyoi group are composed of homogenous lava to pyroclastic rocks and show reddish-brown to green spots. In many cases, fine flow structures of several millimeters in width have developed in rhyolitic rocks.

Among boulders in Arroyo Nireco, those with a cone together with lamina developing are observed. Disturbance structure is also observed partially (alteration zones ZA026 and ZA027). The strike of representative outcrops is N25°E to N60°W, and dip is NW to NE 30° to 60°. Although breccia is partially observed, it cannot be judged whether it is hydrothermal breccia or tuff breccia because it has received alteration. The rocks are silicifed on the whole. The strongly silicified part forms a ledge because it is erosion-proof. It is considered in broad prospective that andesite rocks and rhyolite rocks form alternation of strata. Quaterbary basalt forms plateaus around 1,800 m above sea level.

7) Mineralization and alteration

Andesite rocks have received propylitic alteration, and chlorite is observed. Rhyolite rocks have received silicification and white aggilliaceous alteration, and show white color (A00NK102). Limonitization is strong on the whole. Outcrops of quartz veins could not be observed but floats were observed (A00NK101, 103). Sulfide minerals were not observed by the naked eye.

8) Characteristics of the satellite images

On the false color images, one of the major characteristics is development of NW and NE oriented lineaments, and it can be understood from shadow that ridges and valleys are steep. In the sedimentary rocks distribution area, fold axes and sedimentary structures are clear. The dominant color tones are brown, pink and white, while the western part of the survey sites look clear green, which reflects a difference in vegetation. Blue distributed in valley lines indicates lakes and marshes. On basaltic lava plateaus, many scoria cones looking orange are recognized. Color tones of the ratio composite images are pink, reddish purple, yellow, green, dark color and a mixture of these. Places showing bright reddish purple are interpreted as hydrothermal alteration zones and as the alteration zones ZA021 to ZA028. These do not correspond much to alteration zones presumed from the satellite image of spectral patterns analysis (Fig. II-3-2-17). Clear reddish purple on the ratio composite image represents the large-sized area including the alteration zones ZA021 to ZA028. It is also observed by the ground truth survey that there is distribution of a mixture of rhyolite with white argillization and silicification and relatively fresh andesite in this area. It is reasonable to consider this part as a large-sized alteration zone on the ratio composite image. It can be interpreted that, in this area, there are alteration zones presumed from the satellite image of spectral patterns analysis.

9) Laboratory work results

In the powdery X-ray diffraction, kaolin was identified in A00NK102, A00RM101 and 102 (white rhyolite). Albite and potassium feldspar remain in all of them, and alteration is weak. As a result of the geochemical analysis, no remarkable anomalous values were obtained in any of A00NK101, 103 (quartz vein float), A00NK102, A00RM101, and 106 (rhyolite). In the thin section observation, A00NK104 (crystalline tuff) was identified as conglomerate or sandstone and was observed to contain quartz, chlorite, clay mineral and iron hydroxide as secondary minerals. A00RM103 (rhyolite) was judged as hornblende rhyolite and contains quartz and chlorite as secondary minerals.

10) Assessment

In the vicinity of the alteration zones ZA021, ZA022 and ZA033 and the alteration zones ZA026 and ZA027 surveyed in the Phase-1, rhyolite of Choiyoi group as original rock is distributed and altered as weak white argillization and silicification.

The content of gold was, however, under the detection limit in the chemical analysis of quartz veins, and rhyolite and other metallic minerals were not observed. Therefore, the possibility of the existence of metallic ore deposits is judged as low.

3-2-14 La Voluntad district

Concerning La Voluntad mineral occurrence where the phase-1 field survey was conducted, see the Phase-1 report.

1) Location

This district is located about 60 km southwest of Zapala City in the west part of Neuquen province (Fig. II-3-1-2). The area is lat. 39° 07' 12" to 39° 14' 24" S and long. 70° 32' 24" to 70° 39' 36" W, and about 240 km^2 (Fig. II-3-2-16). The alteration zones ZA001 and ZA030 to ZA037 are extracted by ratio composite image analysis. Alteration zones extracted from the satellite image of spectral patterns analysis are also distributed near the La Voluntad mineral occurrence and the alteration zones ZA032 and ZA034 (Fig. II-3-2-17).

2) Topography and vegetation

This district situated from the north of the La Voluntad mineral occurrence to south of Cerro Chachil (2,839 m above sea level), covers the southern half of the N-S trend range of Sierra del Chachil, and the topography is steep. In particular, the western side is a continuation of sharp cliffs toward Arroyo de Chachil flowing from north-northeast to south-southwest. The climate is the Patagonia-Andean cool climate. The vegetation is an expanse of low-tree steppe and the pino forest.

3) Access

Access to the La Voluntad mineral occrrence is gained by driving along No. 46 provincial road about 1.5 hours southwestward from Zapala City and further driving along the branched access road one more hour northward. To go to the alteration zones ZA032 and ZA034, it is necessary to ride on horseback from Puesto located along the provincial road, detour west of the La Voluntad mineral occurrence from the access road, then to go up northward for about seven hours. It will take about three hours from ZA032 to ZA034 on horseback.

4) Previous surveys

There are no particular records that detailed surveys were carried out except for those of La Voluntad mineral occurrence.

5) Mining properties

The mining property of La Voluntad mineral occurrence is owned by CORMINE S.E.P., a public mining corporation in Neuquen province, and its name is Chachil.

6) Geology and geological structure

In this district, Choiyoi group (PTR) composed of andesitic to rhyolitic volcanic rocks of the Permian to the Triassic and granitic rocks (PTRg) of the Permian to the Triassic are widely distributed. In the southeastern part, Cuyo group (J), which is Jurassic sedimentary rocks of Neuquen basin, is distributed. Moreover, basalt of the Pliocene to the Pleistocene (Campos Basalticos de Zapala) covers these unconformably. In particular, plutonic rocks such as granodiorite, which is host rock of La Voluntad porphyry Cu deposits, are called La Voluntad complex. In the outcrop along the provincial road in southwest of La Voluntad mineral occurrence, a boundary (unconformity?) between weathered granitic rocks (PTRg) and overlying turbidite of Cuyo group (J) is observed.

The alteration zone ZA001 adjoins the northern side of La Voluntad mineral occurrence and composed of granodiorite of La Voluntad complex. The alteration zone ZA034 is made up of granite (A00NK109), aplite (A00NK110) and rhyolite (A00NK113) and basalt dykes. The alteration zone ZA032 is composed of rhyolitic lava and pyroclastic rocks, and andsitic pyroclastic rocks of Choiyoi group. In rhyolite, fine flow structures with horizontal strike to N8°E strike and 45°E dip are developed although it is not representative of the whole structure, and there are some places showing the like-folding structure. On the western slope of the alteration zone ZA032, rhyolite overlies andesitic tuff breccia.

7) Mineralization and alteration

The alteration zone ZA001 is an argillized alteration zone (A00NK107, 108) accompanied by limonite but copper oxide that is observed at La Voluntad minela occurrence is not observed. The alteration zone ZA034 is formed by alteration of granite and a little white argillization (A00NK112) is only observed along a small-sized faults. Pyrite dissemination and weak limonitization is observed for rhyolite dykes. The alteration zone ZA032 has distribution of rhyolite and andesite and the whole rhyolite has affected by silicification, white argillization, and limonitization (A00NK115, 120, 122). The whole zone shows white to brown, and strongly silicified zones form ledges. Many limonite veinlets develop. Quartz veins of several millimeters in width are uncommonly observed (A00NK119). On the other hand, andesitic tuff shows green to reddish brown and alteration is weak.

8) Characteristics of the satellite images

Characteristics of the images for mineral occurrence and alteration zones selected for the ground truth survey in the Phase-2 are as follows. The alteration zone ZA001 was extracted from the ratio composite image analysis as an alteration zone but the response is not seen in the satellite image of spectral patterns analysis. In the satellite image of spectral

patterns analysis, the alteration zone ZA032 corresponds to pixels indicating neutral and acid alteration in almost same range as extracted from the ratio composite image. The alteration zone ZA034 corresponds to scattered pixels indicating neutral and acid alteration in the rage wider than extracted from the ratio composite image. La Voluntad mineral was not extracted as an alteration zone from the ratio composite image analysis, however, pixels indicating neutral alteration are concentrated in the range of about 1 km in diameter. It forms most distinct alteration zone among whole alteration zones in this district. On the southwestern side of La Voluntad mineral occurrence, pixels indicating acid alteration are seen sporadically.

9) Laboratory work results

In the alteration zone ZA001, sericite was identified in granodiorite (A00NK107, 108) by the powdery X-ray diffraction. As a result of the microscopic observation, quartz porphyry (A00NK105) was observed as strongly altered rock with secondary minerals of quartz and sericite.

In the alteration zone ZA032, sericite was identified in rhyolite and andesitic pyroclastic rock (A00NK116, 118, 120, 121) by the powdery X-ray diffraction. No remarkable anomalous values were obtained by the chemical analysis for rhyolitic tuff in the alteration zone ZA032 (A00NK114, 117, A00RM111), rhyolitic tuff containing quartz veinlets (A00NK119, A00RM113), hydrothermal breccia (A00RM114, 115) and argillized rock (A00NK123).

In the alteration zone ZA034, sericite and kaolin were identified by the powdery X-ray diffraction for granite (A00NK112) and aplite (A00RM109, 110). In the chemical analysis, no remarkable anomalous values were obtained for rhyolite dykes (A00NK113) with pyrite dissemination.

10) Assessment

The alteration zone ZA001 is considered to correspond to the vicinity of the porphyry system that formed La Voluntad ore deposits. The alteration zone ZA034 is a place of local alteration associated with rhyolite dykes. Therefore, it is judged that there is no possibility of the existence of economical ore deposits. In the alteration zone ZA032, silicification and argillization with sericite develop in rhyolite of Choiyoi group, however, mineralization is not observed. Therefore, it is judged that there is no possibility of the existence of economical ore deposits. White argillized and silicified rhyolite resembles the rocks in Cochico Grande alteration zone in Palau Mahuida district and alteration zones of ZA021, 22, 23, 26 and 27 in Nireco district.

3-2-15 Rio Foyel district

1) Location

This district is located about 50 km south of San Carlos de Bariloche city in the southwest part of Rio Negro province (Fig. II-3-1-2). The area is lat. 41° 28' 48" to 41° 38' 24" S and long. 71° 06' 00" to 71° 22' 48" W, and about 430 km^2 (Fig. II-3-2-18). The representative coordinate is lat. 41° 30' 17.2" S and long. 71° 12' 08.3" W at the place of quartz vein in the alteration zone (SB68) that is in the east of Cerro Carreras.

2) Topography and vegetation

This district is situated within 38 to 65 km from the Chilean border in the western side and has a relatively large height difference between 1,300 and 2,300m above sea level. The mountains have a sharp landform of steep cliffs while the U-shaped valleys are formed by glacial processes. This district includes Rio Foyel flowing into the Pacific Ocean and the upper reaches of Rio Chubut and Rio Negro flowing into the Atlantic Ocean with the ridge running through Cerro Carreras serving as a watershed of the continent. The climate is the Patagonia-Andean cool humid climate. The vegetation is an expanse of low-height plants and the conifers forest. It snows much from May to September. The quantity of river water is large from spring to early summer due to thawing.

3) Access

There are two means of access. One is to drive eastward on No. 23 national road from Bariloche, turn south on No. 40 national road from Pilcaniyeu, take the westbound dart road along the river from Chenqueniyén, and finally arrive at the terminus of Puesto (pasture management hut). It takes about five hours up to this point. From there, the Puest at the foot of Cerro Carreras can be reached in about four hours. The survey sites are situated within a range of one day's trip on horseback from the Puest used as the base camp. The second means of access is to drive south about two hours on No. 258 national road from Bariloche, pass the gate of a private estate from near the Establ. Moran S.A. and enter the logging road. Passing through the logging road eastward, the vehicle will face the main stream of Rio Foyel. From there, the car can drive northward to upstream for about one hour to the point of 17 km from the logging road inlet. Though the survey was conducted within the scope of a one hour walk from that point, it is necessary to go on horseback for the survey of the upper reaches of Arroyo Turbio, which is an upstream branch of Rio Foyel, and the upper reaches of Arroyo Rincón del Diablo. Field survey is possible in summer only.

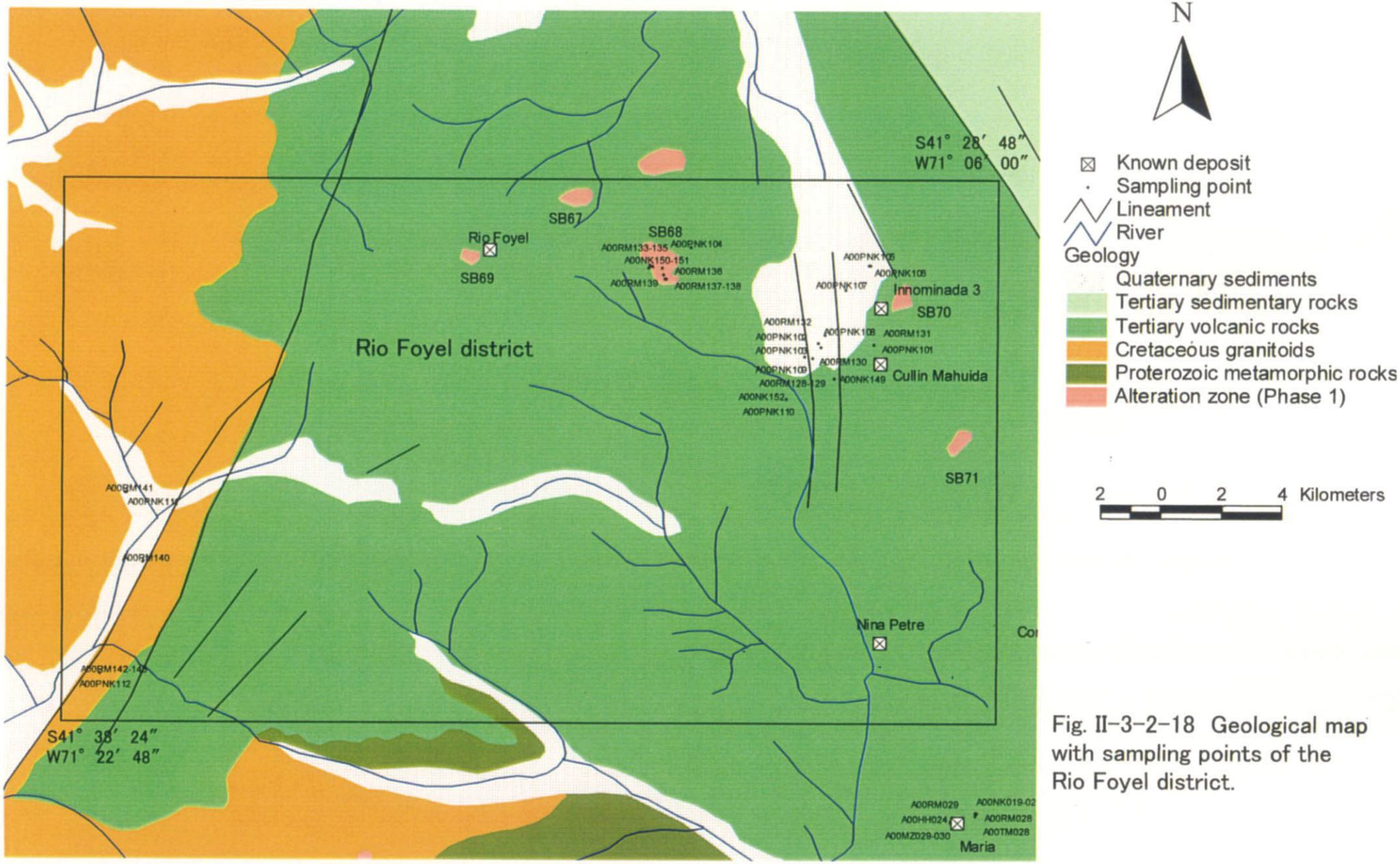


Fig. II-3-2-18 Geological map with sampling points of the Rio Foyel district.

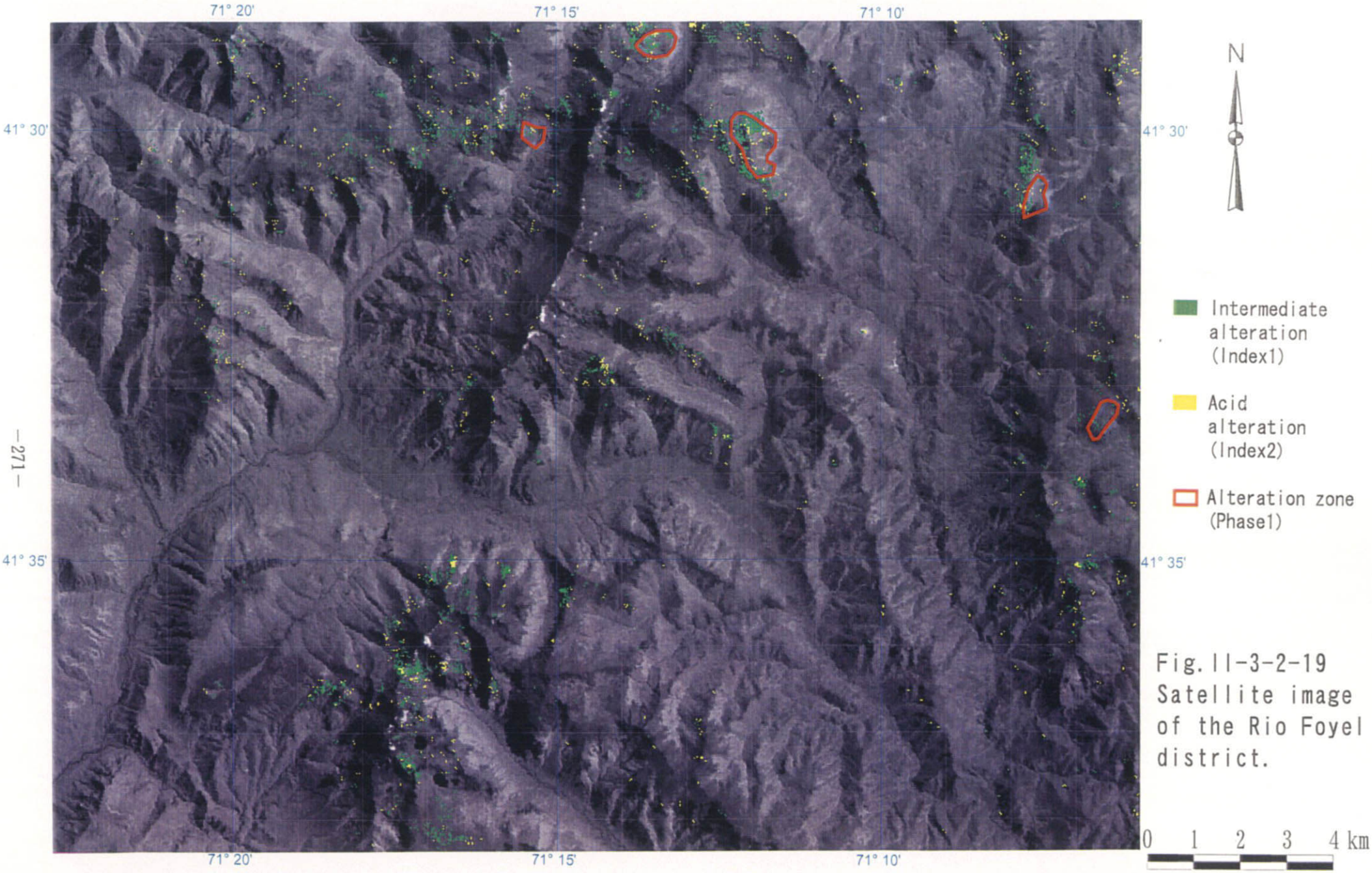


Fig. II-3-2-19 Satellite image of the Rio Foyel district.

4) Previous surveys

As the first survey, Gonzalez Bonorino, F. made a geological map in scale of 1: 200,000 of Hoja Geológica 41b, Rio Foyel, Rio Negro and described the geology and petrography of this district. Herrero (1977b) carried out the survey for resource geology of this whole district as Mosaico 4172-IV-10a Project of Plan Patagonia Comahue. Giacosa (1982) made geochemical survey by medium of rock sample for Cu, Pb and Zn in the upstream part of Rio Foyel as part of Plan Patagonia Comahue. Although a slight anomaly was recognized, such mineralization that would lead to continuous survey was not discovered. According to Directory of Mining Investment Opportunities Argentine Republic (Mining Secretary, 1993), the existence of polymetallic veins and placer gold deposits originating in disseminated sulfides are described briefly. According to Mapa de Recursos Minerales del Area Fronteriza Argentino-Chilena entre los 34° y 56°S by SEGEMAR and SERNAGEOMIN (1:1,000,000, issued in 1998), there are mineral occurrences of Innominada 3 (Cu-Au vein), Cullin Mahuida (Au vein) and Nina Petre (Pb-Zn-Cu vein) in this district. Rio Nergro provincial government and SEGEMAR issued the CD-ROM including GIS information as to geology, mineral resources, geophysics and geochemistry of the province, as part of Project Minero Rio Negro in 1998. According to the geochemical data, anomalies of Cu, Pb, Zn are distributed in Arroyo Turbio and Arroyo Golondrino that are upstream branch of Rio Foyel. Giacosa et al. (1999) issued reports, Hoja 4172-IV and Hoja 4172-II summarizing the geology and mineralization for the areas of San Carlos de Bariloche and San Martin de los Andes.

5) Mining properties

Several mining properties are established by Minamerica S.A. and Opawica Minerals Arg. S. A., but the details are unknown.

6) Geology and geological structure

The geology of this district, in ascending order, consists of Lago Mascardi formation of metamorphic rocks of the Precambrian, granitic rocks of Andean batholith of the Cretaceous, Ventana formation of volcanic rocks and pyroclastic rocks of Tertiary, Nirihuau formation of Tertiary continental sedimentary rocks, and Quaternary glacial sediments. Metamorphic rocks of the Precambrian are mainly distributed in places between mountains in the eastern and southern parts of this district. They are composed of hornblende geniss, quartz mica schist, biotite hornblende amphibolite and migmatite. Granitic rocks of Cretaceous are made up of biotite hornblende granodiorite to tonalite, biotite granodiorite to granite, and micro granite. These rocks are mainly distributed in the western part of this district and also distributed in a small scale in other places, for example, the alteration zone SB68. Ventana formation is distributed most widely in this district consisting of andesite, rhyolite and

pyroclastic rocks, there is the relationship of contemporaneous heterotopic facies with Nirihuau formation distributed in the northeastern part of this district.

7) Mineralization and alteration

Hydrothermal alteration and mineralization extend mainly to Cretaceous granitic rocks and partially to volcanic rocks of Ventana formation. In the alteration zone SB68, white silicification and argillization were confirmed on adjoining outcrops of granitic rocks and rhyolitic rocks, but no mineralization was observed except limonite dissemination. It was confirmed that quartz vein of 50 to 60 cm in width hosted in this granite (A00NK150, A00RM133), and granite on the margin of the quartz veins has somewhat remained mafic minerals and has been chloritized. According to the landowner, there are lead veins along the valley about 2 km west of SB68. This is considered to be Rio Foyel mineral occurrence, and supposed to be vein ore deposits similar to Mina Maria deposit existing about 20 km southeast.

Around Cullin Mahuida mineral occurrence, veins of green copper oxides, tenorite and yellowish-green uranium minerals exist in volcanic rock dykes that have received propylitic alteration (A00NK149, A00RM128, 129; according to the landowner, there were two veins of about 10 to 20 cm in width, but these are buried now.

Among the main and branch streams of Rio Chubut and Rio Foyel, floats investigation and panning were carried out in the riverside where the streams run down from the alteration zones. When the pebbles with limonite on surface were crushed by hammer, white silicified and argillized volcanic and granitic rocks with pyrite dissemination were observed.

8) Characteristics of the satellite images

The geology interpreted in district is Ps (Paleozoic metamorphic rocks), αK (plutonic rocks of Cretaceous to Tertiary), Tiv (andesitic rocks of Eocene to Oligocene) and Tis2 (Oligocene sedimentary rocks). The color tone on the false color images is green on lowlands and light pinkish gray and light blue on highlands. The lowlands have vegetation, while the highlands have poor vegetation and fallen snow in part. The structures due to topographical undulations are rough. The water systems are somehow arborescent to orthogonal with middle to high densities. The ridgelines are semi-clear to clear, and the resistance level is middle to high. Bedding planes are not observed. NNW-SSE oriented lineaments are dominant, and N-S oriented and NE-SW oriented lineaments are interpreted. On the ratio composite images, several small-scale hydrothermal alterations showing light reddish purple are interpreted on highlands (SB67 to SB71).

On the satellite image of spectral patterns analysis in the Phase-2, distribution of the extracted alteration zones are almost concordant with SB67, 68, 70 that were extracted in

the Phase-1. Regarding SB69, 71, however, pixels indicating alteration zones in the spectral patterns analysis are dispersed. Conversely, in the upmost stream part of Arroyo Rincón del Diablo, pixels indicating alteration zones relatively concentrated are observed in the spectral patterns analysis, although alteration zones were not extracted from the results of the Phase-1. White silicification and argillization for granitic and rhyolitic rocks was confirmed in SB68 by the field survey.

9) Laboratory work results

As a result of the chemical analysis for the quartz vein samples A00NK150 and A00RM133, and the argillized and silicified rhyolite sample A00RM133, all of which are from the northern margin of SB68, no noticeable anomalies were detected. Granitic rock at the side of the quartz vein, A00RM134 was clarified by the powdery X-ray diffraction to have received chloritization. It was clarified by the thin section observation that the granitic rock at the side of the quartz vein, A00NK151 is hornblende biotite quartz monzonite and, as secondary minerals, there are a large amount of chlorite accompanied by quartz, sericite and carbonate mineral. The samples A00RM135 to 138 of other white silicified and argillized granitic and rhyolitic rocks inside the alteration zone SB68 indicate weak silicification and argillization by results of the powdery X-ray diffraction. The sample with green copper oxide veins in Cullin Mahuida mineral occurrence, A00RM128 was judged from the results of the microscopic observation as andesite dyke that has received strong mineralization and silicification. Plagioclase as the primary mineral, quartz, epidote and chlorite as secondary minerals, bornite and chalcocite as ore minerals were recognized. As a result of the ore grade assay, 0.42g/t Au, 1,585g/t Ag, 25.4% Cu and 1,640ppm Sr were obtained, but almost no lead, zinc and molybdenum were contained. It was judged from the thin section observation that the sample A00RM129 from the wall rock of veins of A00RM 128 is olivine basalt, and calcite, chlorite and clay mineral were observed as secondary minerals. It was judged from the polished thin section observation that the sample A00RM141 of granite gravel taken in Arroyo Golondrino, a branch stream of Rio Foyel, is biotite granite that had received quartz-sericite alteration, and dissemination of pyrite was observed. The chemical analysis was done for other samples A00NK152, A00RM131, A00RM139 to 146, but no noticeable anomalies were obtained. Concerning the panning samples A00PNK101 to 112 which were taken in various riversides of Rio Foyel and Rio Chubut, no noticeable anomalies were not obtained. According to the results of the chemical analysis, the blackish brown samples A00RM130 and A00RM132 taken on lowlands of the Rio Chubut contain a large amount of manganese and iron and are considered to be sedimentary wad.

10) Assessment

The existence of polymetallic vein deposits, the supply source of placer gold deposits, had been expected in this district at the beginning. However, no mineralization and anomalies of commodity metals were confirmed in this field survey except in Cullin Mahuida mineral occurrence. In the satellite image analysis, several alteration zones were extracted on the several mountaintops. It was then confirmed by the field survey that SB68 has distribution of granitic and rhyolitic rocks with white silcification and argillization. In Cullin Mahuida mineral occurrence, the chemical analysis resulted in confirmation of vein ores indicating high concentration of silver and copper. These vein ores, however, are very-small-sized ones in shallow places on the ground surface and expansion to underground is not expected much. Therefore, it is judged that the possibility of the existence of ore deposits with economic efficiency is low in this district.

3-2-16 Mina Maria district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 40 km to the northeast of El Bolson city, in the southwest of Rio Negro province (Fig. II-3-1-1). The area is lat. 41° 35' 24" to 41° 43' 48" S and long. 71° 00' 36" to 71° 09' 36" W, and about 230 km^2. The representative coordinate is lat. 41° 40' 05.0" S and long. 71° 06' 21.7" W at the adit entrance of Mina Maria.

2) Previous surveys

The first description on Mina Maria was made in 1948. In 1972, the Direccion de Mineria of Rio Negro province conducted mapping in scale of 1/500. According to the report, the vein is lenticular and has extension of 52 m, the average width of 1.57 m. The strike is N 10° to 30° E and dip is west in steep to vertical. Average grades are 11.75 % Pb, 12.7 % Zn, 1.80 % Cu and 45.41 g/t Ag (Greco and Bernabo de Greco, 1973).

Mineralization in extensions and deep parts of veins was not surveyed, nor ore reserves were not calculated. At present, adit entrance and old cableway are left on halfway of a steep cliff, and there is a keeper's house in foot of the mountain.

3) Outline of the survey results

In this district, Cretaceous granitic rocks and Ventana formation of Paleogene andesitic rocks are distributed. Ventana formation comprises andesite lavas and tuff that are the host

rocks of Maria deposits. Granite is medium-grained and fresh, and is accompanied by potassium feldspar veins and tourmaline.

Inside of adit of Maria deposits was not observed. Quartz veins and network quartz veinlets were observed near the adit entrance. The quartz veins have the width of 1 to 3 cm and strike of N 35° E at vertical. Host rock andesite shows pale green color of propylitic alteration. Mined ores stored in open air in front of the keeper's house are network veins in andesite, mainly made up of galena and sphalerite. These are accompanied by a small amount of pyrite and chalcopyrite in addition to quartz as gangue. The average of ore grade assay results for four samples are 0.16 g/t Au, 85.5 g/t Ag, 0.86 % Cu, 7.98 % Pb and 17.09 % Zn (Appendix-10). The sulfur isotopic composition of galena is -0.3‰, and this value indicates that the sulfur originated in magma (Appendix-12, 15).

4) Assessment

Maria deposits are located in this district. It is considered from the sulfur isotopic composition that vein deposits of lead and zinc were formed by magmatic activity. However, the veins are network type and the scale seems not to be large. Besides, gold grades are low. In addition, host rock andesite is propylitic and hydrothermal alteration is weak. For these reasons, this district is considered to have a low possibility that promising ore deposits will be discovered.

3-2-17 El Bolson district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located in the west of El Bolson city, in the southwest of Rio Negro province (Fig. II-3-1-1). The area is lat. 41° 53' 24" to 42° 00' 00" S and long. 71° 32' 24" to 71° 42' 00" W, and about 200 km^2. The hydrothermal alteration zones, SB022 to SB024, were extracted by satellite image analysis. The representative coordinate is lat. 41° 58' 05.9" S and long. 71° 34' 30.0" W at Rio Lindo riverside.

2) Previous surveys

It is said that alluvial gold mining was attempted in the Rio Azul near El Bolson. Andesite dykes in granite rocks of Cerro Lindo located at the headwaters of Rio Lindo are accompanied by mineralization of pyrite and chalcopyrite (Marquez and Giacosa, 1989).

3) Outline of the survey results

The geology of this district comprises, in ascending order, Piltriquitron formation of Jurassic sedimentary rocks, Divisadero formation of Cretaceous volcanics, Cretaceous granitoids, Ventana formation of Paleogene volcanics, and Quaternary glacial sediments and alluvium.

In this survey, hydrothermal alteration zones from satellite image on wastern highland were not surveyed in-situ because of limited time and difficult access. Floats were investigated in the riversides of the Rio Azul and Rio Lindo. Floats were granite, granodiorite, syenite, andesite, basalt, sandstone, mudstone, etc., silicification was often found for granitic rocks and andesitic rocks. The surface of silicified rocks with pyrite dissemination is limonitized. Granite float with pyrite dissemination revealed 355 ppm Cu (Appendix-6).

4) Assessment

The presence of silicified floats was confirmed, and slight copper mineralization for granite float with pyrite dissemination was also confirmed. Sufficient exploration was not executed in past because the alteration zones are in the steep mountains. If the schedule is permitted, the survey for the alteration zones is desired although it takes a lot of time.

3-2-18 Cerro Coihue district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located near the border with Rio Negro province in the northwest of Chubut province (Fig. II-3-1-1). The area is lat. 42° 07' 12" to 42° 10' 12" S and long. 71° 16' 48" to 71° 21' 36" W, and about 55 km^2. The representative coordinate is lat. 42° 08' 42.5" S and long. 71° 18' 30.4" W at Quebrada Baya.

2) Previous surveys

Geological survey was conducted by JICA/MMAJ. The chemical analysis for six samples of altered rock with pyrite and a small amount of chalcopyrite revealed 265 ppm Cu and 990 ppm Zn as maximum values among them (JICA/MMAJ, 1983). Detailed geological survey was conducted by SEGEMAR. According to the report, the Cretaceous granitoids were affected by silicification, argillization and propylitization with tourmaline. Mineralization of disseminated pyrite, arsenopyrite, chalcopyrite, molybdenite, tetrahedrite and copper oxides were reported (Genini and Grizinic, 1999).

3) Outline of the survey results

The geology of this district comprises, in ascending order, Piltriquitron formation of Jurassic sedimentary rocks, Cretaceous granitoids, Ventana formation of Paleogene volcanics and Quaternary glacial sediments, colluvium and alluvium. Dacite to basalt dykes also exist. Cretaceous granitoids consist of granite, granodiorite and tonalite. Andesite to basalt dykes intruding into granitoids show relatively horizontal structure. Ventana formation consists of andesitic rocks.

Outcrops of Quebrada Baya are silicified and whitened-argillized with potassium feldspar, tourmaline and pyrite. Tourmaline and pyrite occur as veins and dissemination, and maximum width of tourmaline and pyrite veins are about 20 cm and 1.5 m respectively. The area of pyrite mineralization is well limonitized.

In the chemical analysis, noticeable values were not obtained except the granodiorite with pyrite dissemination revealed 235 ppm Cu (Appendix-6). In the powder X-ray diffraction, chlorite and sericite were identified as alteration minerals (Appendix-5). According to the chemical analysis for granodiorite of Quebrada Ferreyro and tonalite of Quebrada Baya, these are classified as calc-alkaline and island arc type granitoid.

4) Assessment

In Quebrada Baya, alteration zone of silicification and whitened-argillization is distributed. It is thought to be the porphyry Cu type alteration because of the existence of chlorite, sericite and potassium feldspar. However, no significant copper mineralization was confirmed. Therefore, it is considered that this district has low potentiality of mineralization and does not deserve to be surveyed in Phase-2.

3-2-19 Condorcanqui district

1) Location

This district is located about 5 km north of Epuyen town in the southwest part of Chubut province (Fig. II-3-1-2). The area is lat. 42° 07' 48" to 42° 12' 36" S and long. 71° 22' 12" to 71° 25' 12" W and about 50 km^2 (Fig. II-3-2-20). The representative coordinate is lat. 42° 09' 46" S and long. 71° 24' 04" W at an outcrop of the Condorcanqui ore deposit.

2) Topography and vegetation

This district is at a distance of about 30 km from the Chilean border and is located in area of the Andean cordillera. The Lago Epuyen of glacial lake is located in the east. The height above sea level is between 300 and 2,000 m. While the mountains are called Cerro,

which means a hill, in reality they form a mountainous landform of large specific height difference. Vegetation is thick enough to make a wooded region. In some places, though, vegetation is sparse with only the growth of bushes.

3) Access

Driving north about 5 km on No. 258 national road from Epuyen town of Chubut province, and then walking about 20 minutes on the slope will allow access to an outcrop of the Condorcanqui ore deposit.

4) Previous surveys

Condorcanqui copper deposits were discovered in 1945. From 1951 to 1953, DGFM carried out geological surveys (Tabachi, 1953). They conducted drilling survey for 22 holes of 626m in total, and trench surveys for 12 lines of 485 m in total. As a result of these surveys, ore reserves were calculated to be 431,350 t and the average grade of copper was calculated to be 1.02%. Genini (1976) mentioned that the mineralization is related to an andesite layer of 30 m in thickness and a small amount of granitic rocks intruding into the andesite. Amentrano et al. (1979) executed mapping in scale of 1/1,000 and geochemical exploration of copper, lead and zinc. However, it was concluded that no promising mineralization requiring further exploration were discovered. Lizuain (1983) made geological descriptions regarding the area including this district as a thesis for a degree from Buenos Aires University, and prepared a geological map in scale of 1/100,000.

5) Mining properties

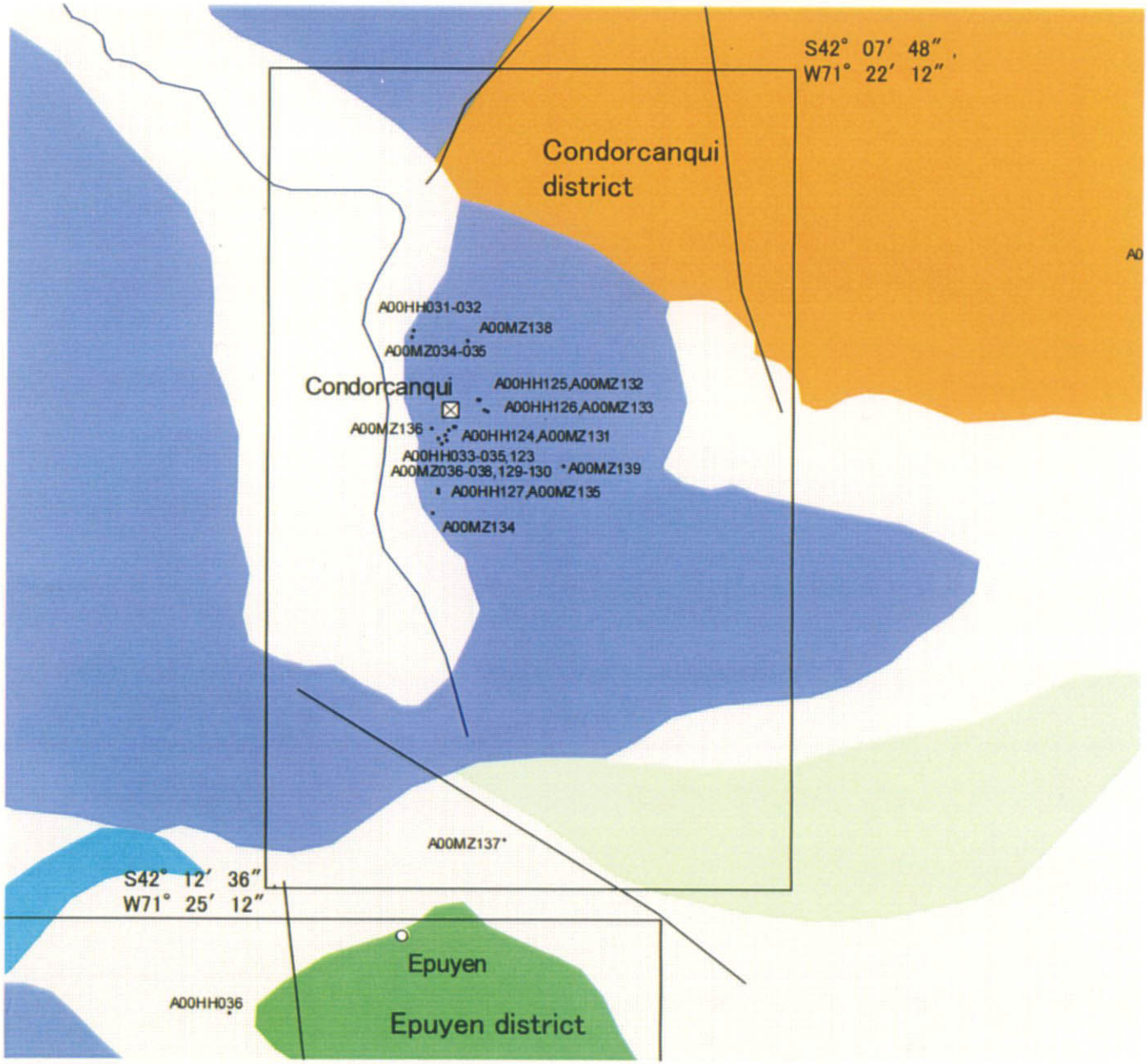
Minera del Atlantico, an Argentine private company, has mining properties for exploration and exploitation.

6) Geology and geological structure

The geology of this district, in ascending order, consists of Jurassic volcanic rocks and sedimentary rocks, Cretaceous granitic rocks, Paleogene volcanic rocks and sedimentary rocks, and Quaternary glacial sediments, colluvium and alluvium (Fig. II-3-2-20).

Piltriquitron formation of Jurassic is composed of mudstone, sandstone, limestone, rhyolite and andesite, and is made up of andesite lava and pyproclastic rocks in this district. Cretaceous granitic rocks consist of granodiorite, tonalite and granite. Ventana formation of Eocene is made up of andesitic rocks, and Ñorquinco formation of Oligocene is composed of conglomerate and sandstone.

Andesitic rocks, which are host rock of Condorcanqui ore deposits, have been regarded as Ventana formation of the Paleogene so far. As a result of the age determination mentioned



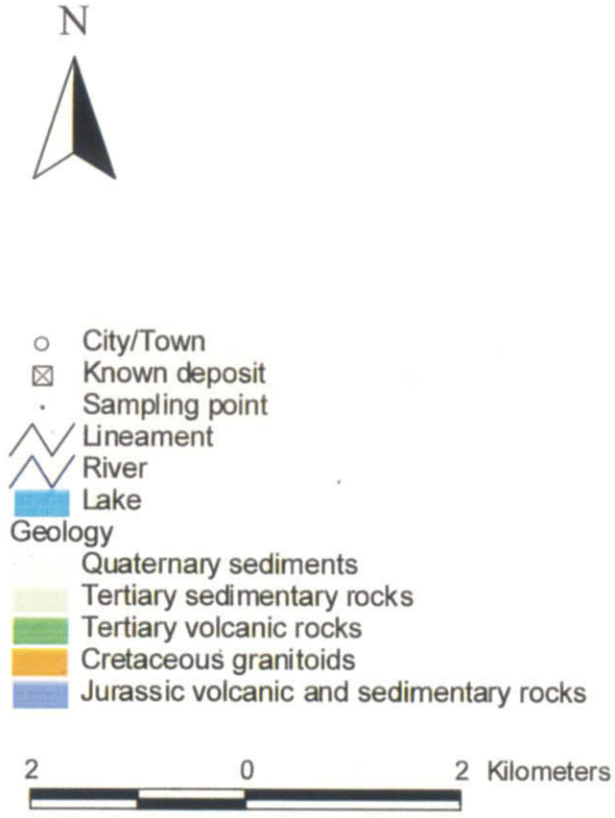


Fig. II-3-2-20 Geological map with sampling points of the Condorcanqui district.

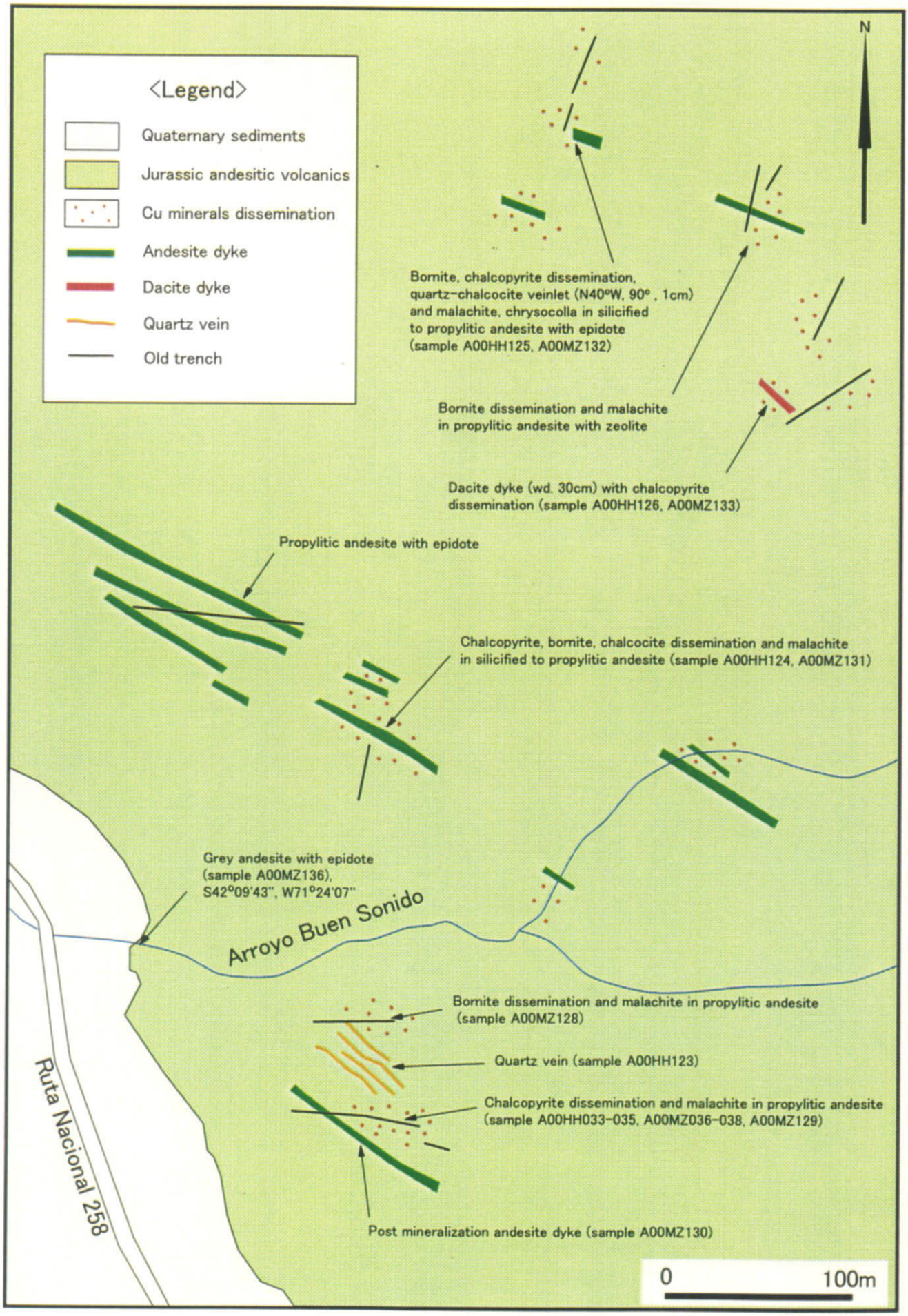


Fig. II-3-2-21 Plan of main mineralized zone of the Condorcanqui Cu deposits, after Ametrano et al. (1979).

later, however, it is proven to be Piltriquitron formation of Jurassic. This andesite is massive and fine, showing a color tone ranging from gray to green. Andesitic tuff has no bedding, and small faults in directions of N-S, 60°E and E-W 60°S are observed. Fig. II-3-2-21 shows a geological map of the main part of Condorcanqui copper deposits. Andesite dykes intruding into andesitic rocks, which are host rock of the ore deposits, show directions of intrusion such as N55°W and vertical dip, and dacite dyke similarly shows N55°W and vertical dip. The southern part of this district has distribution of small-scale stocks of granodiorite of about 60 m in diameter.

7) Mineralization and alteration

According to Ametrano et al. (1979), Condorcanqui ore deposits have 15 places of copper mineralization scattered in the range of about 1.4 km from south to north and 0.3 km from east to west. Fig. II-3-2-21 shows a geological map of the main mineralized zones among these places. In dissemination of copper minerals whose host rock is andesitic rocks, chalcopyrite is recognized as the primary mineral, and chalcocite, bornite, malachite and chrysocolla are observed as the secondary minerals. Andesite is locally accompanied by amygdale epidote and zeolite, where chalcopyrite is selectively disseminated. Quartz veins of 5 to 10 centimeters in width are distributed and show structures of N45°W, 70°NE to N70°W. Although most of these quartz veins are barren, a part of them are accompanied by dissemination of chalcopyrite.

Andesite dykes and dacite dyke are distributed in this district. Andesite dykes are barren in mineralization, and an outcrop where fresh andesite dyke cuts mineralized zone clearly is observed. On the other hand, dacite dyke that has received propylite alteration is accompanied by dissemination of chalcopyrite and extends dissemination of chalcopyrite to andesitic host rock.

Andesitic rocks, the host rock, are fresh to propylite with green color. Propylitic alteration is also dominant in mineralized zones, while silicification with light gray color is locally observed.

8) Characteristics of the satellite images

The color tone of the false color image is green, which means vegetation is thick. The structure due to topographical undulations is rough. Water systems are slightly dendritic with low densities. Ridgelines are unclear with low resistance. This makes a contrast to Cerro Coihue in the northeast, which shows clear ridgelines. Bedding planes are not recognized. NE and NW trend lineaments are interpreted. On the ratio composite image, hydrothermal alteration zones are not interpreted. In the satellite image of spectral patterns analysis, which was made in the Phase-2, no concentration of pixels indicating alteration

zones were found inside this district.

9) Laboratory work results

The sample A00MZ130 from fresh andesite dyke cutting and intruding into mineralized zone of Condorcanqui ore deposits revealed 108±5 Ma as a result of K-Ar radiometric dating (Appendix-14). This corresponds to the middle Cretaceous and indicates that the ages of ore deposit host rock and mineralization are before this. Andesitic rocks, which are ore deposit host rock, can be considered to be Jurassic Piltriquitron formation. It is considered that mineralization is related to activity of granitic rocks of the very last period of the Jurassic to the early Cretaceous because granodiorite located about 20 km northeast of Condorcanqui revealed 147 Ma, the age of the very last period of the Jurassic (JICA/MMAJ, 1983).

The sample A00MZ139 from andesite lava taken at the location about 1.5 km east of Condorcanqui ore deposits revealed 28.1±1.4 Ma. This corresponds to the age of Oligocene, and this rock is considered to be Ventana formation of Paleogene (Appendix-14). Fig. II-3-2-22 shows a spider diagram based on the results of the chemical analysis of the same sample (Appendix-8). Normalized values by primitive mantles are smaller in Nb than in La and Ce and larger in Th. This is a characteristic of island arc volcanic rocks (Swinden, 1996) and conforms to this andesite lava being of Paleogene.

The sample A00MZ137 from small-sized granodiorite stocks in the southern part of this district was judged from the microscopic observation as quartz gabbro (Appendix-3). It is shown in the Rb-(Y+Nb) diagram based on the results of the chemical analysis that this rock is island arc type granitoid (Fig. II-3-2-23).

Ore grade assay was done for the samples of copper ore hosted in andesitic rocks: A00HH124, A00HH127, A00MZ036, A00MZ037, A00MZ132 and A00MZ134 . As a result, the range of Cu content was from 0.87% to 4.72%. The result of the ore grade assay of the sample A00HH126 taken from dacite dyke accompanied by chalcopyrite dissemination was 1.07% Cu. The highest values of gold and silver of these were 0.06 g/t Au and 32 g/t Ag (Appendix-10). It is confirmed that gold and silver contents are low grade.

In the microscopic observation of the sample A00MZ038 taken from andesite that is general host rock of ore deposits, chlorite, epidote and calcite were observed (Appendix-4). As a result of the powdery X-ray diffraction of the samples A00MZ132 and A00MZ134 taken from andesite that has received silicification locally, quartz, chlorite and albite were identified (Appendix-5). These are characterized by propylitic alteration. Epidote was observed in the microscopic observation of dacite accompanied by chalcopyrite dissemination (Appendix-4).

The results of measurement of sulfur isotopic composition of chalcopyrite, andesite that is host rock of the ore deposit, and granodiorite stock is shown in Appendix-12. In the

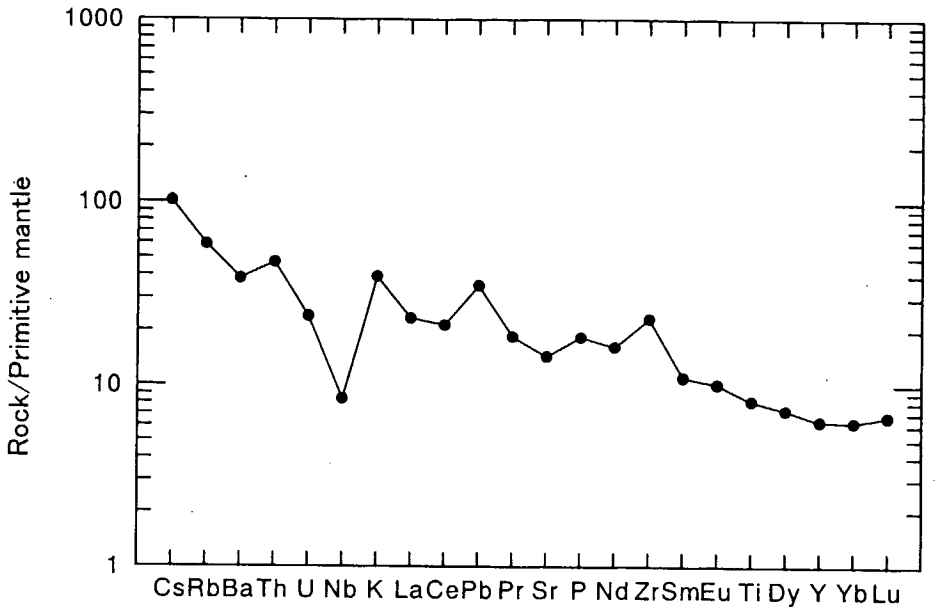


Fig. II-3-2-22 Primitive mantle normalized pattern for Oligocene andesite lava of the Condorcanqui district. Normalizing values from Sun and MacDonough (1989).

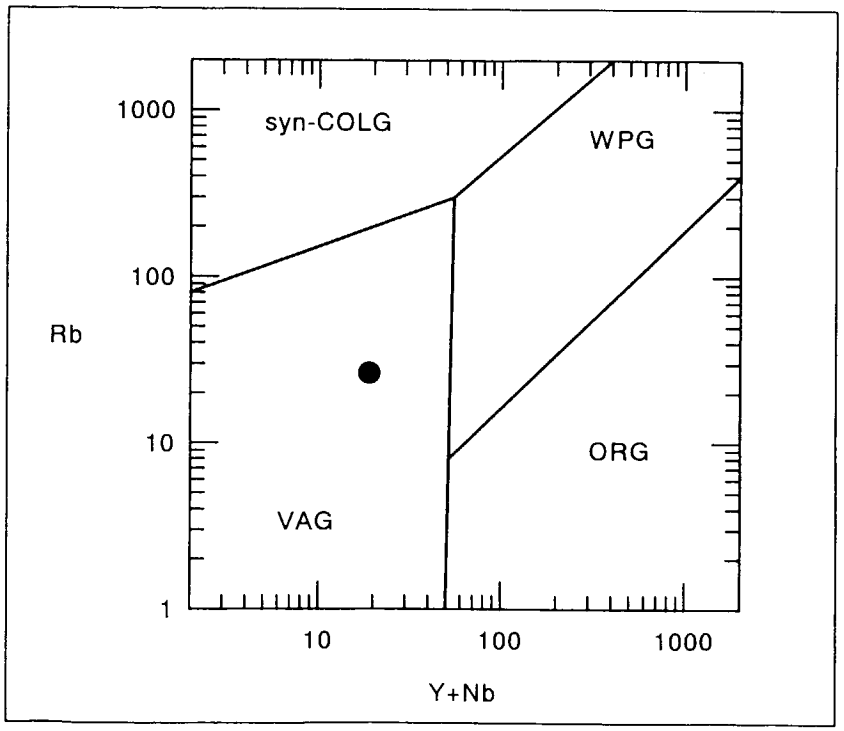


Fig. II-3-2-23 Rb - (Y+Nb) diagram for granodiorite of the Condorcanqui district. VAG : volcanic arc granites, syn-COLG : syn-collision granites, WPG : within-plate granites, ORG : ocean ridge granites, (Pearce et al. 1984).

Phase-1, chalcopyrite of sample A00MZ036 revealed -26.7‰ that is an extraordinary low value. However, in the Phase-2, chalcopyrite of sample A00MZ131 and A00MZ135 revealed +1.9‰ and +4.1‰ respectively, and these values are reasonable for the sulfur that is originating in the magmatic components. Then, andesite sample of A00MZ136 and granodiorite sample of A00MZ137 revealed +11.4‰ and +11.1‰ respectively, and these values represent the total sulfur isotopic composition of the magmatic components. It is considerd that there was a isotopic exchange between reduced sulfur and oxidized sulfur to form the chalcopyrite of +1.9‰ to +4.1% from the magmatic components of about +11‰ as total sulfur isotopic composition(Appendix-15). Meanwhile, -26.7‰ of chalcopyrite obtained in the Phase-1 is thought to be a result of kinetic isotope effect during the chalcopyrite is oxidizing to secondary minerals such as malachite.

10) Assessment

The full view of copper mineralization reported by the previous surveys was grasped by the field surveys in the Phase-1 and Phase-2. Although copper mineralization is high grade locally, mineralized zones exist sporadically on a small scale and are judged poor in the possibility of mining development. In the Phase-1 analysis, high sulfidation gold mineralization by oxidized sulfur was expected from the sulfur isotopic composition of chalcopyrite because the value implied the isotopic exchange between reduced sulfur and oxidized sulfur. However, such gold mineralization was not confirmed by the field survey in Phase-2. Extraordinary low value of sulfur isotopic composition of chalcopyrite is thought to be a result of kinetic isotope effect during the chalcopyrite is oxidizing to secondary minerals such as malachite.

As new knowledge, it has been grasped from the age determination that andesitic rocks, which are host rock of Condorcanqui ore deposits and were considered to be of the Paleogene, are of the Jurassic. It is considered that mineralization was caused by replacement related to dacite dykes deriving from granitic rocks of the very last period of Jurassic to the early Cretaceous.

3-2-20 Cushamen district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located near the border with Rio Negro province, in the northwest of Chubut province (Fig. II-3-1-1). Cushamen deposit is also called Cura Limay deposit. The

area is lat. 42° 06' 00" to 42° 13' 48" S and long. 70° 26' 24" to 70° 34' 12" W, and about 200 km^2. The representative coordinate is lat. 42° 09' 40.7" S and long. 70° 30' 33.2" W.

2) Previous surveys

Regional geological mapping was conducted in past. Silicification and argillization were reported in the metamorphic basement and rhyolite intrusions. Molybdenum, lead and zinc mineralization is known with quartz veins in the silicified zone. In the area surveyed, there is an old pit of about 20 m in diameter excavated for kaolin exploitation.

3) Outline of the survey results

In this district, Precambrian granitoids and metaedimentary rocks of gneiss and schist are distributed as window. The gneiss is accompanied by small dykes of pegmatite. Rhyolite dykes of Huitrera formation of early Tertiary intruded into Precambrian rocks. Overlying them unconformably, Neogene Tertiary sedimentary rocks are distributed.

Alterations of potassium feldspar and tourmaline zone, acid argillized zone, silicification and quartz veins zone are zonally arranged from center of rhyolite intrusion to outer. The potassium feldspar and tourmaline zone is defined in central part of rhyolite intrusion, accompanied by quartz veinlets and hydrothermal breccia. The acid argillized zone is distributed in peripheral of rhyolite intrusion with sericite and kaolin. Silicification and quartz veins zone is distributed in schist of basement over 50 m from the boundary with rhyolite intrusion. Major quartz veins have the width of 1 to 2 m and structure of NW strike and vertical dip. Quartz veins zone extends about more than 100m in direction of NW with significant limonitization.

In the chemical analysis, silicified rhyolite revealed 364 ppm Cu, and the quartz vein revealed 709 ppm Mo, as maximum values. No noticeable values of gold and others were obtained (Appendix-6). In the powdery X-ray diffraction, sericite and kaolin were identified (Appendix-5).

In the fluid inclusion study for white quartz vein, homogenization temperatures of 215 to 283℃, salinities of 28.3 to 30.9 wt% were obtained (Appendix-11). The oxygen isotopic composition of same quartz sample was +9.7‰, and calculated oxygen isotopic composition of hydrothermal water was + 1.2‰ (Appendix-13). This value for hydrothermal water suggests the large contribution of magmatic components (Appendix-15).

4) Assessment

Rhyolite intrusion is thought to be concerned with formation of alteration zones and quartz veins. However, no noticeable mineralization of gold or molybdenum was confirmed. This district is judged to have low potentiality of mineralization. It is not necessary to

conduct the survey in Phase-2.

3-2-21 Epuyen district

1) Location

This district is located southwest of Epuyén town in the northwest part of Chubut province (Fig. II-3-1-2). The area is lat. 42° 12' 54" to 42° 22' 12" S and long. 71° 22' 48" to 71° 30' 00" W and about 240 km^2 (Fig. II-3-2-24). The hydrothermal alteration zones SB081 to SB083 were extracted by the satellite image analysis in the Phase-1. The representative coordinate is lat. 42° 13' 52" S and long. 71° 25' 18" W at the point where the sample A00MZ039 was taken in the riverside of Arroyo Pedrogoso.

2) Topography and vegetation

This district is at a distance of about 25 km from the Chilean border and is located in the area of the Andean cordillera. The land is made up of glacial landform with Lago Epuyen, a glacial lake, in the north. Although the Epuyén town is as low as 300 m above sea level, Cordon de Cholia, occupying the majority of this district, is a block of steep mountains, the highest peak of which is 2,082 m above sea level. The rivers include Arroyo Pedregoso flowing north from within Cordon de Cholila, and Rio Blanco flowing south-southeast on the western fringe of Cordon de Cholila. Vegetation in lower lands is forest, but vegetation is sparse at higher places.

3) Access

The alteration zones extracted by the satellite image analysis in the Phase-1 were also extracted by the satellite image analysis in the Phase-2, as shown in Fig. II-3-1-8. These alteration zones are extracted at the top of Condon de Cholila where no vegetation is seen. This Cordon de Cholila forms a steep configuration peculiar to the glacial topography with mountains capped with snow. Thus, climbing was given up until top of these mountains, and alternative survey was conducted for the rivers and the shores of the Lago Epuyen in the north, where access is possible by walking on foot. There is a trail on the shores of the Lago Epuyen and in the downstream of Arroyo Pedregoso. For access to the rivers in the south of Cordon de Cholila, it is necessary to drive a car from No. 258 national road or No. 71 provincial road in the east, and then to walk about one to two hours.

4) Previous surveys

There is the Pedregoso mineral occurrence of placer gold. Petersen and Bonorino (1974) described the geology of the western part of Chubut province. Beltramone (1978) reported the

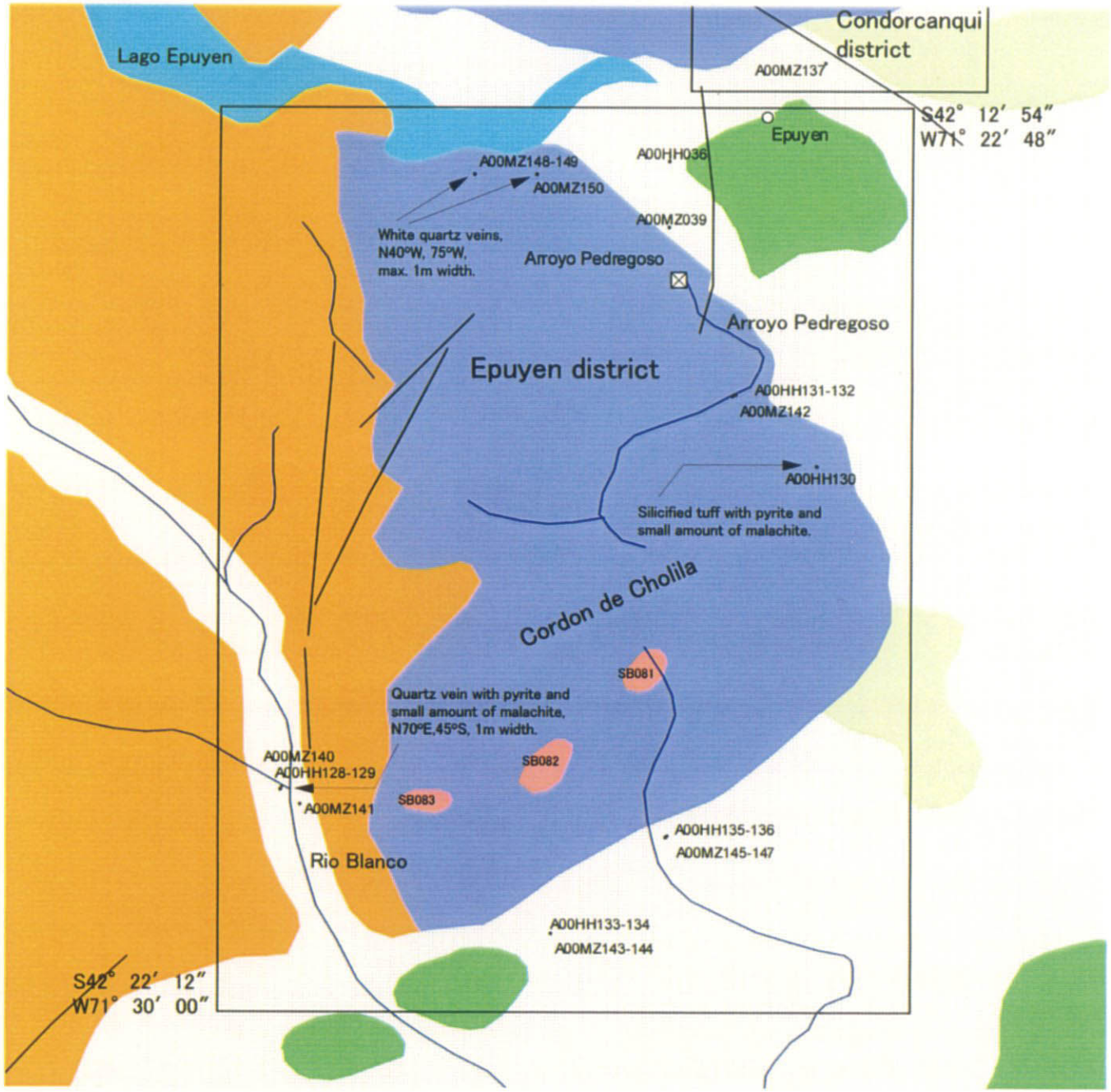


Fig. II-3-2-24 Geological map with sampling points of the Epuyen district.

results of geological survey and geochemical survey of Lago Epuyen area as a part of the Plan Patagonia Comahue. The survey area was 1,400 km^2 from lat. 42° to 42° 30' S and from long. 71° W to the border with Chile. Six hydrothermal alteration zones were reported. In addition, geochemical survey was conducted for copper, lead and zinc by stream sediments and rocks chips samples. As the result, a geochemical anomaly of 320 ppm Cu of rock sample was detected. Lizuain (1983) described the geology of the area including this district as a thesis for a degree from Buenos Aires university, and prepared a geological map in scale of 1/100,000.

5) Mining properties

Several individual mining properties are established for gold and placer gold.

6) Geology and geological structure

The geology of this district, in ascending order, consists of Jurassic sedimentary rocks, Cretaceous granitic rocks, Paleogene volcanic rocks and sedimentary rocks, and Quaternary glacial sediments, colluvium and alluvium (Fig. II-3-2-24).

Piltriquitron formation of Jurassic is made up of mudstone, sandstone, limestone, rhyolite and andesite, and forms the central part of Cordon de Cholila. Siltstone on the bank of Lago Epuyen shows strike and dip of N10°E, 10°E, while silicified tuff in Cordon de Cholila shows strike and dip of N70°W, 65°NE. Cretaceous granitic rocks are composed of granite and accompanied by intrusive rock of quartz porphyry. Ventana formation of Eocene is made up of andesitic rocks, and Ñorquinco formation of Oligocene is composed of conglomerate and sandstone.

7) Mineralization and alteration

Mineralization in this district were confirmed in the following four places: the bank of Lago Epuyen, Arroyo Pedregoso, Rio Blanco, and the streams running down southward from the alteration zones SB081 to 083 (Fig. II-3-2-24).

On the bank of Lago Epuyen, there are quartz veins whose host rock is fine-grained sandstone to siltstone of the Piltriquitron formaton with silicification. The quartz veins consist of white quartz of 1 m and of 10 cm in the maximum width and are accompanied by many other parallel veinlets. These show strike and dip of N50°W, 80°SW to N10°W, 70°W. Although the quartz veins do not contain sulfide minerals, silicified rock that is host rock is accompanied by limonite after pyrite.

There is a placer gold mining place at the point where the sample A00MZ142 was taken in the downstream of Arroyo Pedregoso, to which there is a trail to walk. The nearby riverbed has distribution of light green tuff of Pitriquitron formation, which locally shows light gray

due to silicification. This tuff is accompanied by limonite and quartz veinlets, both of which show structures N25°W, vertical to N50°W, 80°NE. It was confirmed that, at the point where the sample A00HH130 was taken on the ridge part, there is the existence of silicified tuff disseminated by euhedral pyrite and a small amount of malachite.

Rio Blanco watershed has distribution of Cretaceous granitic rocks. At the point where the sample A00MZ140 was taken, a silicified zone of about 1 m in width exists in quartz porphyry intruding into granite, and is accompanied by quartz veins with pyrite dissemination and a small amount of malachite. The quartz veins are about 20 cm in width and shows structures of N70°E, 45°SE. On the riverside in the vicinity, boulders of silicified granite, the diameter of which reach about 1 m, are observed and are accompanied by quartz veinlets of 2 to 3 cm in width and a large amount of pyrite dissemination.

In the watershed of the rivers running down southward from the alteration zones SB081 to 083, dacite to andesite of Piltriquitrón formation are cataclastic at the point where the sample A00MZ145 was taken and are accompanied by calcite veins that have poor continuity and show various strikes and dips. The calcite veins are about 10 cm in the maximum width and are accompanied by limonite. The calcite vein, which seems to be of the latest period, shows strike and dip of N70°E and 50°SE. As floats, silicified rock and quartz veins, both of which have pyrite dissemination, are frequently observed.

8) Characteristics of the satellite images

On the false color image, the mountainous zone looks green, and places higher than this zone look white to blue. This means that the area is forest and has fallen snow in the higher places. Arroyo Pedregoso watershed looks pink, white and light green. In the vicinity, N-S and NW-SE trend lineaments of 5 to 10 km in length are interpreted. On the western margin of Cordon de Cholila, N-S to NNE-SSW trend lineaments are interpreted.

On the ratio composite image, yellow is dominant in low places. The area along high ridges of Cordon de Cholila looks dark color and reddish purple on the whole. Relatively bright reddish purple is recognized along ridges in the southeast part, which are interpreted as hydrothermal alteration zones (SB081, 082, 083).

In the satellite image of spectral patterns analysis, green and yellow pixels indicating neutral and acid alteration are extracted harmoniously with alteration zones from the ratio composite image along high ridges of Cordon de Cholila.

9) Laboratory work results

The sample A00MZ148 taken from the bank of Lago Epuyem revealed the following analysis results: 0.025g/t Au, 0.2g/t Ag, 452ppm Pb and 1050ppm As. On the other hand, A00MZ150 revealed the analysis results of 0.01 g/t Au and <0.2 g/t Ag (Appendix-6).

Homogenization temperatures of fluid inclusions of the sample A00MZ148 range from 195 to 242℃ and average is 218℃ (Appendix-11). Oxygen isotopic composition of quartz in the sample A00MZ148 was +11.7‰ (Appendix-13). Calculated oxygen isotope composition of hydrothermal water from the values of 218℃ and +11.7‰ is +1.2‰. This value is relatively heavy and suggests that hydrothermal water had the contribution of magmatic water or had the sufficiently reaction with surrounding rocks. As there is no remarkable mineralization here, the possibility of the latter is higher (Appendix-15). In the powdery X-ray diffraction of the sample of silicified rock A00MZ149, which is host rock, alteration minerals of quartz, chlorite and sericite were identified (Appendix-5).

Among tuff of Piltriquitron formation in the downstream of Arroyo Pedregoso, as a result of the chemical analysis, the sample A00HH130 accompanied by pyrite and malachite revealed <0.03g/t Au, 2g/t Ag, and 2100ppm Cu (Appendix-10), while the sample A00HH132 accompanied by pyrite dissemination revealed 0.005g/t Au and <0.2g/t Ag (Appendix-6). In the powdery X-ray diffraction of these samples, alteration minerals of quartz, sericite and kaolin were identified (Appendix-5). The sample A00MZ142 taken from floats of the quartz vein reveled 0.08 g/t Au as a result of the chemical analysis.

The sample A00MZ140 taken from a quartz vein accompanied by pyrite dissemination in quartz porphyry in Rio Blanco revealed the following results of chemical analysis: 9.14g/t Au, 12.4g/t Ag and 606ppm Cu (Appendix-6). In the powdery X-ray diffraction of the sample A00HH128 taken from quartz porphyry, which is host rock, alteration minerals of quartz, sericite and kaolin were identified (Appendix-5).

In the watershed of the rivers running down southward from the alteration zones SB081 to 083, a sample of silicified rock float, A00HH136, revealed the 0.43g/t Au as maximum value by the chemical analysis (Appendix-6).

10) Assessment

Although this district has been known as a placer gold zone, the existence of mimneralization on the outcrop has not been reported. It was grasped by this survey that a quartz vein of 20 cm in width that is accompanied by pyrite dissemination has gold mineralization of 9.14 g/t Au in Rio Balanco, in the southwestern part of this district. As this quartz vein is hosted in quartz porphyry intruding into granite batholith, it is considered to be related to activity of this quartz porphyry.

3-2-22 Lago Cholila district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This distirict is located about 30 km to the southwest of Epuyén town, covering from a part of the Lago Cholia to its north part, in the northwest of Chubut province (Fig. II-3-1-1). The area is lat. 42° 15' 36" to 42° 28' 12" S and long. 71° 31' 12" to 71° 41' 24" W, and about 440 km^2. The hydrothermal alteration zones, SB050 to SB057, were extracted by satellite image analysis. The representative coordinate is lat. 42° 28' 03.8" S and long. 71° 35' 53.2" W at the point where the Arroyo Pedregoso joins to the Rio Carrileujú coming from the Lago Cholila.

2) Previous surveys

Petersen and Bonorino (1974) described the geology of the western part of Chubut province. Beltramone (1978) reported the results of geological survey and geochemical survey of Lago Epuyen area as a part of the Plan Patagonia Comahue. The survey area was 1,400 km^2 from lat. 42° to 42°30' S and from long. 71° W to the border with Chile. Six hydrothermal alteration zones were reported. In addition, as the result of geochemical survey for copper, lead and zinc by stream sediments and rocks chips samples, a geochemical anomaly of 320 ppm Cu of rock sample was obtained.

3) Outline of the survey results

The geology of this district mainly consists of Cretaceous granitoids. Divisadero formation of Cretaceous volcanic rocks is distributed on the south bank of Lago Cholila. Ventana formation of Paleogene volcanic rocks is distributed in the eastern part of Lago Cholila.

In this district, hydrothermal alteration zones were extracted by the satellite image analysis. However, it was not accessible to alteration zones by restrictions of time and difficult conditions. Therefore, floats were investigated at Pedregoso riversides running down from the alteration zones. Floats mainly consist of granodiorite with minor andesite, basalt, quartz porphyry and silicified limonitic breccia. Chemical analysis for the breccia revealed 2,490 ppm Cu, although gold and silver were in low grades (Appendix-6).

4) Assessment

Hydrothermal alteration zones were extracted by the satellite image analysis. The presence of hydrothermal alteration zones was also reported by Beltramone (1978). In addition, copper mineralization was confirmed for the float of silicified breccia by chemical analysis. Although the alteration zones were not surveyed in-situ because of the restriction of time and accessibility, it is necessary to conduct the survey in Phase-2 to investigate the

alteration nature and to find the outcrops of copper mineralization.

3-2-23 Huemules district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 18 km to the northwest of Esquel city, in the northwest of Chubut province (Fig. II-3-1-1). The area is lat. 42° 42' 36" to 42° 51' 00" S and long. 71° 26' 24" to 71° 33' 00" W, and about 180 km^2. The hydrothermal alteration zones, LM014 and LM015, were extracted by satellite image analysis. The representative coordinate is lat. 42° 47' 32.1" S and long. 71° 29' 45.9" W at adit entrance of Huemules Sur deposit.

2) Previous surveys

The Huemules deposits are auriferous polymetallic vein deposits. In 1973, the Pan Patagonia-Comahue Project was started. This district was included in priority survey areas because hydrothermal alteration and disseminated mineralization were observed. In 1977, UN Revolving Fund project was started and geological survey, geochemical survey, drilling survey, etc. were conducted. In 1983, the final report was submitted, and ore reserves were calculated as total 2,975,000 t. Among these, ore reserves with average grade of 9 g/t Au were re-calculated later as 750,000 t (Viera and Hughes, 1999).

In 1985, the Huemules deposits were included in Plan de Expansión Minera (PEN) of Secretaría de Mineria, and drilling and underground surveys were conducted. The mining right was transferred to the provincial government in 1988, and general public tender for development was made in 1990. A company named EACA (Empresa Argentina de Cement Armado) had explored until 1993, and then conducted joint venture exploration with Sunshine Mining. This company continued exploration until 1994, then withdrew. Currently, Minera el Desquite S.A. owns the mining properties.

3) Outline of the survey results

The geology of this district comprises, in ascending order, Cañadón Huemules formation (Viera, 1980) of Jurassic to Lower Cretaceous volcanic rocks, Ventana formation of Paleogene volcanic rocks and Ñorquinco formation of Paleogene sedimentary rocks, and Quaternary glacial sediments, colluvium and alluvium.

Cañadón Huemules formation is made up of rhyolitic to andesitic rocks, accompanied by continental sediments. These are the host rocks of Huemules deposits and intruded by basalt

to andesite dykes. Ventana formation is made up of rhyolitic to basaltic rocks and in fault contact with Cañadón Huemules formation in the western part. Ñorquinco formation distributed on the lowland in the southeast is composed of continental and marine epiclastic sandstone, mudstone and pyroclastic rocks.

The Huemules deposits are vein type deposits along faults oriented to the NW-SE, and the total intermittent extension reaches 3,600 m. The deposits are divided into three deposits of Norte, Centro and Sur for the convenience of exploration. Only Huemules Sur deposit was surveyed in this survey. Old adit entrance of Huemules Sur deposit is located at about 1,600 m above sea level. Mineralized zones continue in direction of N 20° W along the streams. Several silicified zones of 1 to 30m widths and N20° to 30° W directions are distributed in parallel with concentrated network of quartz and galena veinlets. Quartz veinlets in the silicified zones have a maximum width of 15 cm and are accompanied by pyrite and galena.

Ore grade assay revealed 0.12 to 4.11 g/t Au, 3 to 17 g/t Ag, 0.03 to 0.74 % Cu, 0.06 to 3.82 % Pb and 0.11 to 19.95 % Zn (Appendix-10). Sericite was identified by powdery X-ray diffraction for altered rocks (Appendix-5).

Average homogenization temperature of fluid inclusions in quartz of ore samples was 121℃ to 130℃ and the average salinity was 1.8 to 2.2 wt% (Appendix-11). Oxygen isotopic compositions of same quartz were +9.2‰ and +8.5‰, and calculated oxygen isotopic compositions of hydrothermal water were -8.1‰ and -9.7‰ (Appendix-13). These values for hydrothermal water suggest the meteoric water origin (Appendix-15). Sulfur isotopic composition of galena was -1.8‰ (Appendix-12), and this value suggests that the sulfur originated in magmatic components (Appendix-15).

4) Assessment

Huemules ore deposits were fully explored in the past, and ore reserves have been already calculated. Minera el Desquite S. A., a mining property owner, also owns a mining property of Joya del Sol deposits that is located about 25 km to the east of Huemules deposits. If the Joya del Sol promising deposits are to be developed, probably development of Huemules deposits will be also considered.

The high potentiality of this district has been already proven. With consideration given to the purpose of this survey, that new promising areas should be extracted, it is considered that this district is not necessary to be surveyed in Phase-2.

3-2-24 Joya del Sol district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 10 km to the northeast of Esquel city, in the northwest of Chubut province (Fig. II-3-1-1). The area is lat. 42° 45' 36" to 42° 55' 48" S and long. 71° 06' 00" to 71° 15' 36" W, and about 320 km^2. The hydrothermal alteration zones, LM022 to LM024, were extracted by satellite image analysis. The representative coordinate is lat. 42° 52' 22.1" S and long. 71° 12' 09.6" W at Gradriel vein of Joya del Sol deposits.

2) Previous surveys

Geological survey in scale of 1/100,000 was conducted as a part of the Plan Patagonia Comahue (Herrero, 1981). Although the presence of hydrothermal alteration zones was recognized by the survey, geochemical analysis was not conducted. In 1990, Empresa Argentina de Cemento Armado SA obtained the mining right. In 1997, Sunshine Mining obtained the mining right. Sunshine Mining reported 209,000 oz Au and 1,410,000 oz Ag at average grades of 5.8 g/t Au and 39.5 g/t Ag for auriferous quartz veins. Minera el Desquite S.A. obtained the option right from Sunshine Mining in October 1998, and started systematic drilling survey in 1999. According to internet information of February 2000, it was announced that 1,000,000 oz gold of which 75 % is in the measured and inferred categories was obtained.

3) Outline of the survey results

The geology of this district comprises, in ascending order, Tepuel formation of Carboniferous sedimentary rocks, Lago la Plata formation of Jurassic volcanic rocks and Piltriquitron formation of Jurassic sedimentary rocks, Ventana formation of Paleogene volcanic rocks and Ñorquinco formation of Paleogene sedimentary rocks, and Quaternary glacial sediments, colluvium and alluvium. Intrusions of microdiorite and dacite also exist.

Tepuel formation of Carboniferous consists of marine and continental clastic sedimentary rocks. Lago la Plata formation of Jurassic consists of andesitic rocks. Piltriquitron formation of Jurassic consists of marine black mudstone. Ventana formation of Paleogene consists of rhyolitic to basaltic rocks. Ñorquinco formation of Paleogene consists of continental and marine epiclastic sandstone, mudstone and pyroclastic rocks.

Andesitic rocks of Lago la Plata formation that are host rocks of auriferous quartz veins are silicified on the whole. Chlorite and sericte were identified as alteration minerals by powdery X-ray diffraction (Appendix-5). There are many outcrops of auriferous quartz veins. In this survey, observation was done for main veins named Galadriel, Elena Sur, Julia and Antonio. The dominant strike is N-S, and it changes from N 20° E to N 15° W . The inclination is mostly vertical, but it changes from 60° W to 80° E . Quartz veins are

frequently transferred by NW-SE direction faults. The maximum width is about 20 m in Galadriel and Antonio veins.

Auriferous quartz veins are composed of black and white quartz. Black quartz is called "Black Chalcedony". There are places where one of them is dominant and places where both form banded structure. In the latter, rhythmic banded structure with the order of several millimeters was also observed. In addition, there are places where the structure of veins is disturbed due to boiling phenomena and places where clay fills up cavities after boiling. Sulfide minerals were scarcely observed in auriferous quartz veins.

Concerning the Galadriel vein, white quartz revealed 42.72 g/t Au and black quartz of revealed 0.12 g/t Au. Concerning the Elena Sur vein, white quartz revealed 2.94 g/t Au and black-white banded quartz revealed 14.4 g/t Au. From these results, it is indicated that gold is contained mainly in white quartz. Iron grades were low as 0.05% to 0.85% Fe, regardless of white quartz or black quartz (Appendix-10). This means the black quartz does not contain iron sulfides. It is assumed that the black color of black quartz resulted from graphite originating in black mudstone of the Carboniferous or Jurassic.

In the fluid inclusion study for the quartz vein samples, average of homogenization temperatures were 131℃ to 147°C, and average of salinity were 0.7 wt% to 1.4 wt% (Appendix-11). Oxygen isotopic compositions of same quartz were +4.1‰ and +7.5‰, and calculated oxygen isotopic compositions of hydrothermal water were -11.5‰ and -9.7‰ (Appendix-13). These values for hydrothermal water indicate the meteoric water origin (Appendix-15).

Andesite lava hosting the quartz veins revealed 119.0±6.0 Ma of middle Cretaceous by K-Ar radiometric dating (Appendix-14).

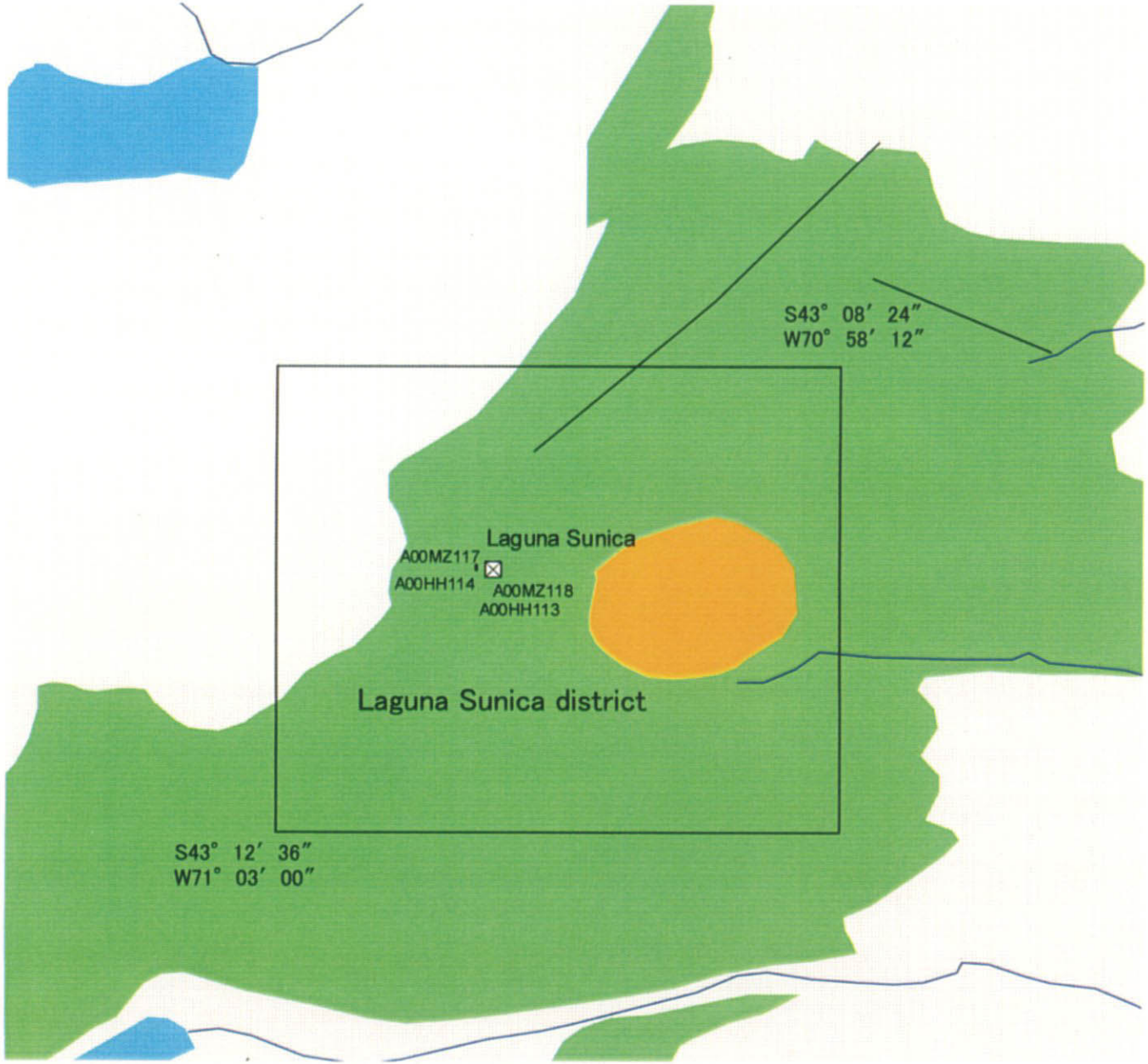
4) Assessment

The existence of epithermal auriferous quartz veins resulted from hydrothermal water that originated in meteoric water was confirmed in this district. Exploration activities are being actively conducted by private company in this district, and the high potentiality has been already proven. With consideration given to the purpose of this survey, that new promising areas should be extracted, it is judged unnecessary to include this district for Phase-2 survey.

3-2-25 Laguna Sunica district

1) Location

This district is located about 40 km southeast of Esquel city and about 40 km northwest of Tecka town in the middle-west part of Chubut province (Fig. II-3-1-2). The area is lat. 43°



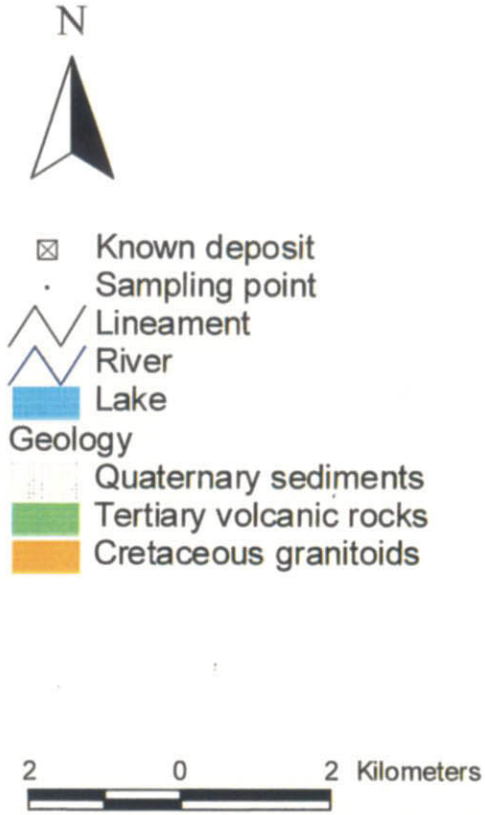


Fig. II-3-2-25 Geological map with sampling points of the Laguna Sunica district.

08' 24" to 43° 12' 36" S and long. 70° 58' 12" to 71° 03' 00" W and about 60 km^2 (Fig. II-3-2-25). Although no hydrothermal alteration zones were extracted by the satellite image analysis in the Phase-1, hydrothermal alteration zones mainly consisting of neutral alteration were extracted by the satellite image of spectral patterns analysis in the Phase-2 (Fig. II-3-1-9). The representative coordinate is lat. 43° 10' 11" S and long. 71° 01' 21" W at the point where the sample A00MZ117 was taken in the alteration zone.

2) Topography and vegetation

This district forms a configuration of plains and mountains apart from the Andean cordillera to the east. Mountains with the highest peak of 1,434 m above sea level are distributed in NE-SW direction within the plains of 600 to 700m above sea level where it is accompanied by glacial lakes such as Lago Sunica. Hydrothermal alteration zones are distributed in the streams at the foot of the northwestern slope of these mountains. Vegetation is relatively thick with growth of short grasses, but no vegetation is seen in the alteration zones.

3) Access

Access is gained by first driving along No. 40 national road running in N-S direction in the east and then branching to the farm road to the Jorge Pablo farm. From there, a walk of about 1.5 km will make it possible to arrive at the hydrothermal alteration zone.

4) Previous surveys

Although the existence of hydrothermal alterations has been known, no systematic explorations have been carried out. According to Zappettini ed. (1998), this district is classified as epithermal gold-copper mineral occurrence.

5) Mining properties

No mining properties are established in this district.

6) Geology and geological structure

The geology of this district, in ascending order, consists of granitic rocks of the Cretaceous, volcanic rocks of the Paleogene, and glacial sediments, colluvium and alluvium of the Quaternary (Fig. II-3-2-25). Hydrothermal alteration zones are distributed in the area with distribution of Ventana formation of Eocene. Ventana formation in this district is composed of basalt lavas and pyroclastic rocks. Cretaceous granitic rocks were not surveyed this time.

7) Mineralization and alteration

According to the satellite image of spectral patterns analysis in the phase-2, there are alteration zones along two valleys running parallel in the direction of E-W. Those on the northern side have a total length of about 1 km with neutral alteration as the main, while those on the southern side have a total length of about 200 m with acid alteration as the main. Alteration zones on the northern side were surveyed this time. It was observed on the site that the scale of the hydrothermal alteration was larger than that extracted on the satellite image. The considered reason for this is that the whole hydrothermal alteration zone was not extracted in the satellite image analysis due to the influence of vegetation.

Silicified rocks altered from basalt of Ventana formation show light gray to gray and are accompanied by a small amount of pyrite dissemination and by network of laumontite veinlets. On the other hand, neither copper ores nor quartz veins were observed.

8) Characteristics of the satellite images

The color tone on the false color image is reddish gray or green, which means that vegetation is somewhat dense. The roughness of structures due to topographical undulations is moderate, and water systems are comb-like with moderate densities. The ridgelines are relatively clear, and the resistance level is moderate. No bedding planes are recognized. NE and WNW trend lineaments are interpreted. Although hydrothermal alteration zones were not extracted on the ratio composite image, reddish purple parts suggesting hydrothermal alteration are recognized. As mentioned above, green and yellow pixels indicating neutral and acid alterations are observed in the Phase-2 satellite image analysis.

9) Laboratory work results

Remarkable chemical analysis results were not obtained for the samples of altered rock with pyrite dissemination, A00HH114 and A00MZ117 (Appendix-6). In the powdery X-ray diffraction for these samples, alteration minerals of chlorite and sericite were identified. In the powdery X-ray diffraction for the sample of white minerals forming veinlets network, A00MZ118, laumontite was identified (Appendix-5).

10) Assessment

In this district, there are neutral hydrothermal alterations characterized by chlorite-sericite that are accompanied by pyrite dissemination and network of laumontite veinlets. Gold and copper mineralization, however, could not be confirmed. Therefore, it is considered that hydrothermal alteration in this district was not accompanied by mineralization.

3-2-26 Cerro Gonzalo district

1) Location

This district is located about 50 km southeast of Esquel city and about 30 km northwest of the Tecka town in the middle west of Chubut province (Fig. II-3-1-2). The area is lat. 43° 15' 36" to 43° 23' 24" S and long. 70° 57' 36" to 71° 08' 24" W and about 300 km^2 (Fig. II-3-2-26). Porphyry Cu mineralization consisting of Sector 1 to 6 is known in this district as shown in Fig. II-3-2-26 (Marquez, 1980). Sector 1 is named as the Arroyo Lugue mineral occurrence with representative coordinate of lat. 43° 17' 01" S and long 70° 59' 21" W. Sector 2 is named as the Cerro Gonzalo mineral occurrence with representative coordinate of lat. 43° 18' 53" S and long. 71° 02' 26" W.

2) Topography and vegetation

This district forms a configuration of hills and mountains apart from the Andean cordillera to the east. The altitude is about 800 to 1,400m above sea level. Rivers originating from the south-to-north oriented ridges in the west run east, changing their flow in the northeast or northwest direction, and finally join Rio Tecka which runs north in the eastern region. Vegetation shows growth of short grasses on the hillside and forests on some mountainside.

3) Access

Access can be gained by first driving along the No. 40 national road running in N-S direction in the east and then branching west to the farm road to the Arroyo Luque farm hut or to the Don Bonito farm in the southeast of Cerro Gonzalo. Farther on from these points, the roads are now too bad to allow driving by car. To Sector 3 or Sector 6, located deepest in the mountain, the only means of access is to rent a horse at the Don Bonito farm and to ride on horseback about two hours one way.

4) Previous surveys

In this district, SEGEMAR conducted geological surveys and geochemical survey from 1980 (Marquez, 1980 etc.). In 1984, IP method geophysical survey with three traverse lines was carried out in Arroyo Luque of Sector 1 (Fig. II-3-2-27), and IP method geophysical survey with six traverse lines and E.M. Turam method geophysical survey with three traverse lines were carried out in Cerro Gonzalo of Sector 2 (Pancetti, 1984). In 1989, based on the results of the geophysical survey, a drilling survey with two holes was conducted for Cerro Gonzalo. In Cerro Gonzalo, there are massive quartz pipe of about 50 m in diameter in granodiorite and it is accompanied by malachite. The hole No. 1 was done 71 m in depth at

the dip of -65° from the side of the quartz pipes; secondary enriched zone accompanied by chalcopyrite, chalcocite and covelline were intersected from about 38 to 50 m depths, and sulfide zone with chalcopyrite and molybdenite was intersected in more deep part. The hole No. 2 was done 39.5 m in depth at dip of -59° from place 40 m distant from the quartz pipes; although granodiorite, host rock, was intersected, no remarkable mineralization was intersected (Marquez, 1989). For the results of this drilling survey, the following estimation was made: ore reserves of 670,000 t and the average grade of <5g/t Au, 92g/t Ag, 0.05% Mo and 0.05% Cu (Mining Secretary, 1993).

In Arroyo Luque, no drilling surveys have been conducted although IP anomalies were detected by the geophysical survey.

5) Mining properties

In this district, Petrominera Chubut S. E. run by Chubut provincial government establishes exploration and exploitation mining properties. This company mainly mines petroleum and does not promote the exploration for metallic ore deposits although they hold mining properties.

6) Geology and geological structure

The geology of this district is composed of Jurassic volcanic rocks, Cretaceous granitic rocks, Paleogene volcanic rocks, and Quaternary glacial sediments, colluvium and alluvium (Fig. II-3-2-26).

Lago la Plata formation of Jurassic is made up of andesitic volcanic rocks. Cretaceous granitic rocks intruding into these rocks are composed of batholith of granodiorite, and stocks of tonalite, granodiorite porphyry and quartz porphyry. Ventana formation of Paleogene is composed of basaltic volcanic rocks.

As to granodiorite distributed about 10 km northeast of Arroyo Luque, the age of 85.4± 7.1 Ma was obtained by K-Ar radiometric dating for separated amphibole (JICA/MMAJ, 1983).

7) Mineralization and alteration

In Arroyo Luque of Sector 1, granite and granodiorite are distributed and stocks of quartz porphyry intrude into them. In the area of these rocks, quartz-sericite alteration zone of about 3 km x 2 km is distributed. Places ① to ③ shown in Fig. II-3-2-27, are relatively low places along the streams about 900 m above sea level. Hypogene porphyry Cu mineralization with dissemination of pyrite, chalcopyrite and molybdenite is observed in granite of place ①, granodiorite of place ② and quartz porphyry of place ③. Meanwhile, places ④ and ⑤ are on the hill about 1,020 m above sea level. In these places, strongly

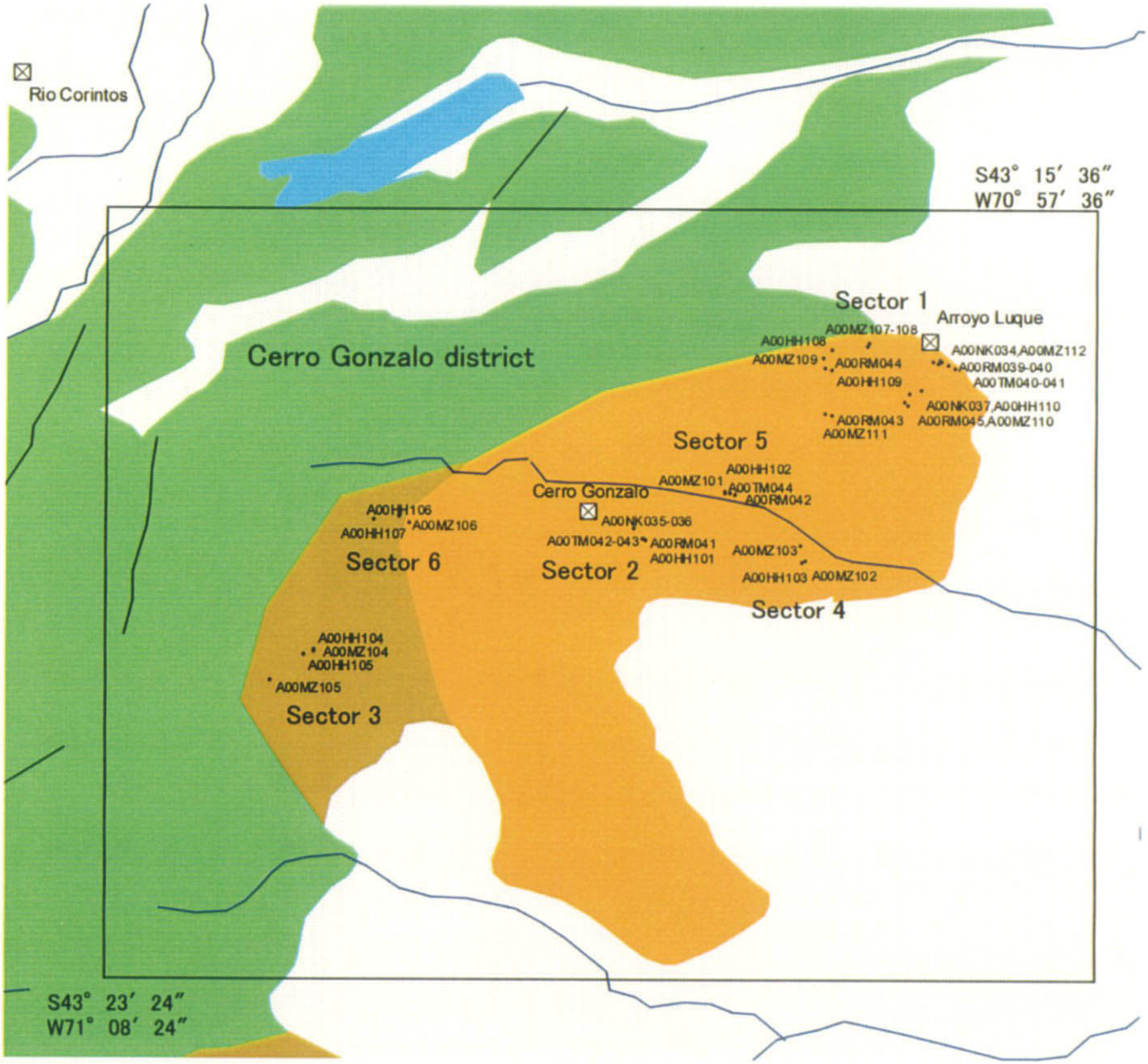
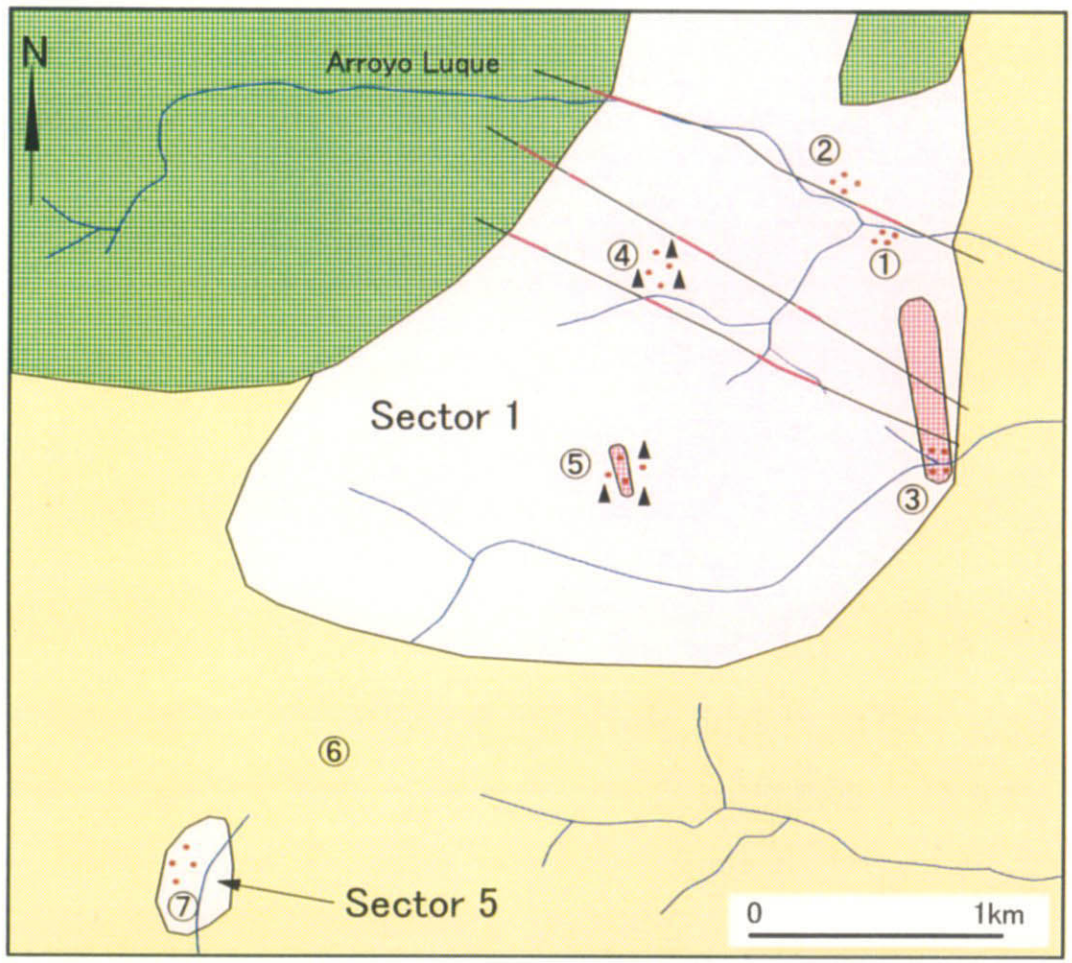


Fig. II-3-2-26 Geological map with sampling points of the Cerro Gonzalo district.



〈Legend〉

- Paleogene andesite (Fm. Ventana)
- Cretaceous granitoids (Batholith)
- Quartz porphyry
- Quartz-sericite alteration zone
- Cu mineralization
- Intensive limonitic zone
- IP line (black) and IP anomaly (red)

① : Hypogene chalcopyrite dissemination in granite, about 900m above sea level, S43°17'01", W70°59'21" (sample A00NK034, A00RM040 etc.)
② : Hypogene chalcopyrite dissemination in granodiorite (sample A00MZ108)
③ : Hypogene chalcopyrite, molybdenite dissemination in quartz porphyry (sample A00RM045, A00MZ110)
④ : Intensive limonitic zone with malachite, Limonite shows brown yellow color, about 1020m above sea level (sample A00HH109 etc.)
⑤ : Intensive limonitic zone with malachite, Limonite shows red color, about 1015m above sea level (sample A00RM043, A00MZ111)
⑥ : Leucocratic granite with tourmaline
⑦ : Rounded hydrothermal breccia pipe and secondary Cu minerals (sample A00TM044, A00RM042, A00MZ101)

Fig. II-3-2-27 Plan of the Cerro Gonzalo Sector 1 (Arroyo Luque) Cu mineralized zone, after Marquez (1980).

limonitized altered rocks are distributed and accompanied by a small amount of malachite. Limonite shows yellowish brown, black and red. It is considered that these limonitic zones on the hill resulted from secondary supergene oxidation for hypogene porphyry Cu mineralization which is observed along the streams. Therefore, it is possible to expect the existence of secondary enrichment zone beneath the limonitic zones. As shown in Fig. II-3-2-27, since IP method geophysical survey conducted in the past did not cover the whole mineralized zones, it is desired to plan a drilling survey after execution of additional IP method geophysical survey.

Cerro Gonzalo of Sector 2 has distribution of massive quartz pipes of about 50 m in diameter in granodiorite. This massive quartz is accompanied by malachite, and cavities after leaching out of coarse-grained sulfides are frequently observed. Geophysical and drilling surveys were conducted in the past, and the results were as mentioned above in the section on previous surveys.

Sector 3 is a distribution area of Jurassic andesitic rocks and has also distributions of hydrothermal breccia and quartz porphyry stock. Hydrothermal breccia is composed of angular rock fragments of silicified rocks and is accompanied by quartz veinlets, limonite and tourmaline. Quartz porphyry has received quartz-sericite alteration and is accompanied by pyrite dissemination. Jurassic andesite has also received silicification and is accompanied by pyrite dissemination.

In Sector 4, there is a hydrothermal breccia in the granodiorite distribution area, and quartz-sericite alteration zone is formed. Hydrothermal breccia is accompanied by malachite, and the malachite shows dot-like occurrence.

In Sector 5, there is a hydrothermal breccia of granodiorite and quartz-sericite alteration zone is formed. The hydrothermal breccia has been rounded off, and the diameter of rock fragments reaches about 30 cm. Secondary copper minerals of malachite, chalcocite and black copper pitch are observed.

Sector 6 is located on the border between granodiorite and Jurassic andesite, and quartz-sericite alteration zone exists in the granodiorite distribution area. Alteration zone are accompanied by hydrothermal breccia, and quartz veinlets, red colored limonite and cavities after leaching of sulfides are frequently observed. Quartz veinlets show structures of N60° E, 75° S. Jurassic andesite is propylitic near the part contacting with granitic rocks, showing green color and having a large amount of magnetite concentration. Sector 6 is on highland of 1,340 to 1,400 m above sea level, which is the highest in this district. As alteration zone distributed in granodiorite appears to be supergene oxidized leaching zone, it is presumed that there is the possibility that secondary enrichment zone is formed underground. It is desired to plan a drilling survey after execution of IP geophysical survey.

8) Characteristics of the satellite images

Color tones of the false color image are reddish gray, reddish green and green. It means the thick vegetation in green part. Structures due to topographical undulations are rough. Water systems are dendritic with moderate densities. Ridgelines are slightly unclear with slightly low resistance. In the distribution area of Tertiary volcanic rocks, NE-NNE trend lineaments are interpreted. The dominant color tones of the ratio composite image show dark reddish purple and yellow, and no hydrothermal alteration zones are extracted. In the satellite image of spectral patterns analysis, no pixels indicating alteration zones are recognized.

9) Laboratory work results

On the level of the streams in Arroyo Luque of Sector 1, hypogene porphyry Cu deposits are exposed. Among places ① to ③ shown in Fig. II-3-2-27, the samples of ①, A00NK034 and A00RM040, revealed the copper content of 1635 to 1655ppm Cu, the sample of ②, A00MA108, revealed 1295ppm Cu, and the samples of ③, A00RM045 and A00MZ110, revealed 75 to 93ppm Cu. On the other hand, the sample A00RM043 taken from the place accompanied by malachite locally in the oxidized leaching zone on the hill showed the copper content of 2.57% Cu, and the sample A00HH109 showed 13.25% Cu. The sample taken from a general oxidized leaching zone, A00MZ111, however, revealed a content of 28ppm Cu (Appendixes-6, 8). Based on these results, difference of the copper content between the primary ores on the level of the streams and the oxidized leaching zones on the hill is 47 to 1627ppm Cu. There is the possibility that copper reserves equivalent to this descended and formed a secondary enrichment zone. As a result of the powdery X-ray diffraction, quartz and sericite were identified in all five samples but biotite was not identified. From this, it is considered to correspond to phyllic alteration. The result of K-Ar radiometric dating for whole-rock sample of A00MZ108 taken from granodiorite, which is fresh but accompanied by chalcopyrite dissemination, was 77.0±3.9 Ma. This age indicates that mineralization of porphyry Cu deposit occurred in the late Cretaceous. In the Qz-Or-Pl diagram (Fig. II-3-2-28) and the Rb-(Y+Nb) diagram (Fig. II-3-2-29) based on the results of the chemical analysis of the same sample (Appendix-8), it is shown to be island arc type granodiorite (Appendix-15).

In Cerro Gonzalo of Sector 2, the sample of rock fragment of granodiorite accompanied by copper oxide in the quartz pipes, A00RM041, revealed the analysis result of 1.72% Cu (Appendix-6). Homogenization temperatures of fluid inclusions in the quartz sample A00TM042 taken from the quartz pipe were 241 to 295℃ with the average of 274℃. The average value of salinity was 3.7 wt % (Appendix-11). Oxygen isotopic composition of quartz in the same sample was +10.7‰. calculated oxygen isotopic composition of hydrothermal water from the values of 274℃ and +10.7‰ is +2.8‰ (Appendix-13). It is indicated from

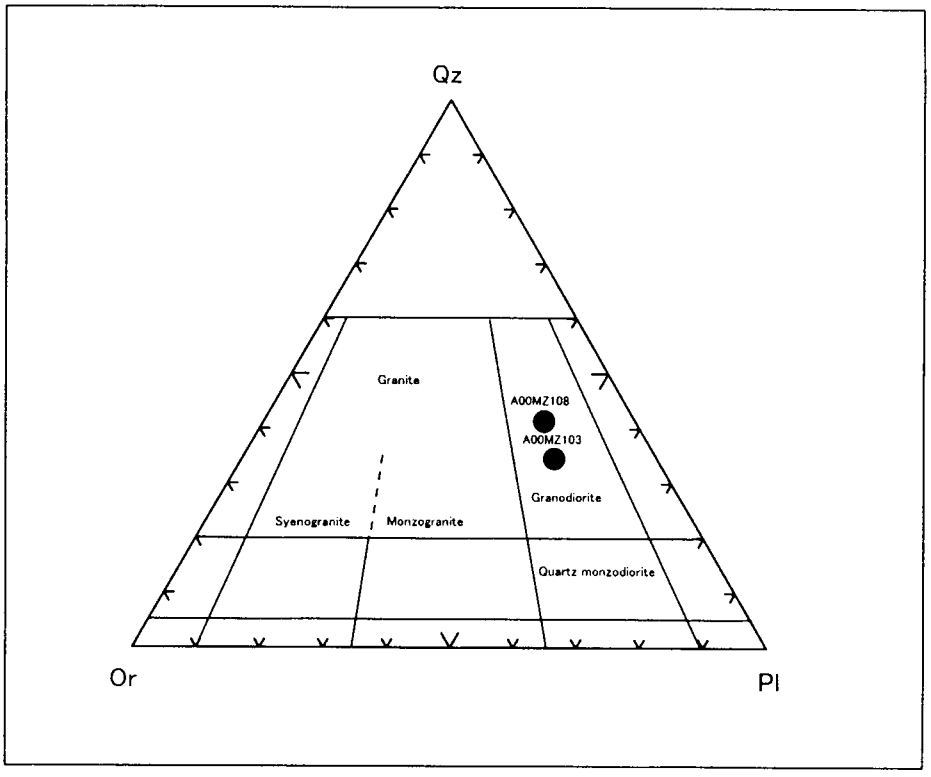


Fig. II-3-2-28 Ternary variation diagram of Qz-Or-Pl CIPW normative compositions for granitic rocks of the Cerro Gonzalo district.

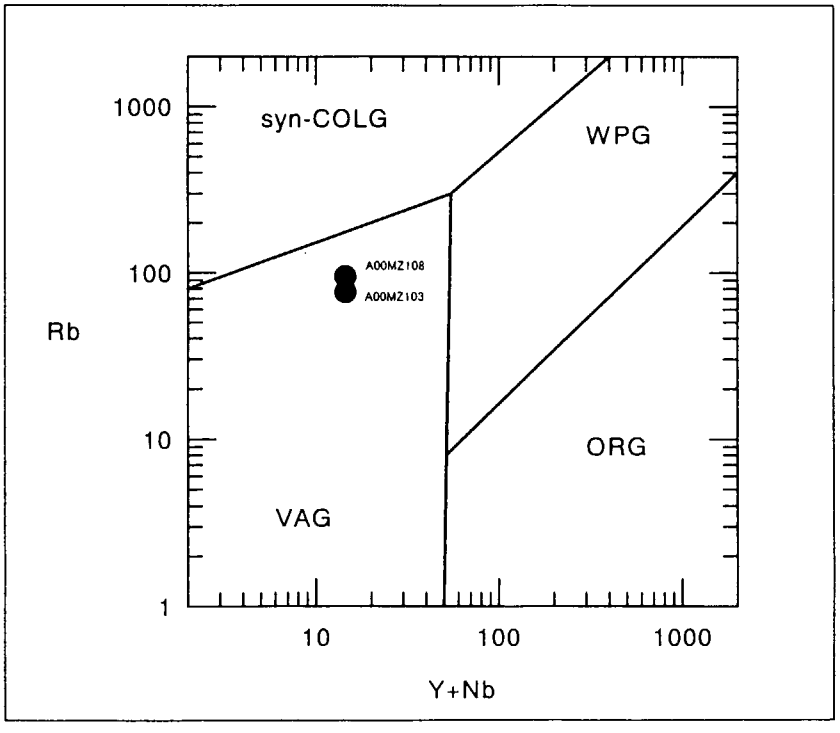


Fig. II-3-2-29 Rb - (Y+Nb) diagram for granodiorite of the Cerro Gonzalo district. VAG : volcanic arc granites, syn-COLG : syn-collision granites, WPG : within-plate granites, ORG : ocean ridge granites, (Pearce et al. 1984).

this value that hydrothermal water which formed the quartz pipe was mixture of magmatic water and meteoric water, and the contribution of magmatic water was large (Appendix-15).

The sample A00MZ104 taken from hydrothermal breccia in Sector 3 revealed an analysis result of 72ppm Cu, while the sample A00MZ105 from quartz porphyry revealed an analysis result of 332ppm Cu. From the powdery X-ray diffraction, quartz and sericite were identified (Appendixes-5, 6).

The sample A00MZ102 taken from silicified rock accompanied by malachite in Sector 4 revealed the copper content of 1.44% Cu, and quartz, potassium feldspar and sericite were identified by the powdery X-ray diffraction (Appendixes-5, 6). In the Qz-Or-Pl diagram (Fig. II-3-2-28) and the Rb-(Y+Nb) diagram (Fig. II-3-2-29) based on the results of the chemical analysis for the sample of fresh granodiorite (Appendix-8), A00MZ103, it is shown to be island arc type granodiorite (Appendix-15).

The sample A00MZ101 taken from silicified rock accompanied by black copper pitch in Sector 5 revealed an analysis result of 808ppm Cu, and quartz, sericite and chlorite were identified by the powdery X-ray diffraction. The sample of silicified rock accompanied by malachite, A00TM044, revealed the copper content of 1.54% Cu (Appendixes-5, 6).

The sample of silicified rock accompanied by red limonite in Sector 6, A00MZ106, revealed the analysis result of 35ppm Cu, and quartz and sericite were identified by the result of the powdery X-ray diffraction (Appendixes-5, 6).

The highest content of gold in all samples was 0.29g/t Au for the sample A00RM043, while that of molybdenum was 167ppm Mo for the sample A00MZ110. Both were taken in Sector 1.

10) Assessment

In this district, there is porphyry Cu type mineralization releted to granodiorite that intruded in the late Cretaceous and quartz porphyry intruding into granodiorite. An age of 77.0±3.9 Ma was obtained as the age of mineralization. Mineralization zones are made up of Sectors 1 to 6. Among these, Arroyo Luque in Sector 1 and Sector 6 are noticed.

On the streams level of Arroyo Luque in Sector 1, hypogene porphyry Cu deposit is exposed. On the other hand, on the hill, there is distribution of limonitic zones generated by oxidized leaching that are locally accompanied by malachite. Therefore, it is possible to expect the existence of secondary enrichment zone of copper beneath the limonitic hill. It is desired to plan a drilling survey here after additional IP method geophysical survey carried out besides that of previous survey.

Alteration zones in Sector 6 appear to be supergene oxidized leaching. This place is 1,340 to 1,400 m above sea level, which is the highest in this district. Therefore, it is presumed that there is the possibility that secondary enrichment zone is formed

underground. It is desired to plan a drilling survey after conducting of IP method geophysical survey.

3-2-27 Arroyo Cascade district

1) Location

This district is located about 25 km west of the Tecka town in the middle-west part of Chubut province (Fig. II-3-1-2). The area is lat. 43° 27' 00" to 43° 31' 48" S and long. 71° 01' 48" to 71° 07' 48" W and about 100 km^2 (Fig. II-3-2-30). This district has the Arroyo Cascada mineral occurrence and the Princess mineral occurrence. The representative coordinates are lat. 43° 30' 17" S and long. 71° 06' 10" W at the Arroyo Cascada mineral occurrence, and lat. 43° 27' 59" S and long. 71° 03' 31" W at the Princess mineral occurrence.

2) Topography and vegetation

This district forms a configuration of hills and mountains apart from the Andean cordillera to the east and is located at the southeastern foot of Cordon Kaquel, of which Cerro Cuche at 1,988 m above sea level is the highest peak. The altitude of survey area is between 1,000 and 1,250 m above sea level and slopes are relatively moderate. The environs are farm and pasture zones with thick growth of short grasses in low lands. Places higher than 1,200 m above sea level are forests. The Princess mineral occurrence, about 1,015 m above sea level is a grassland while the Arroyo Cascada mineral occurrence, about 1,210 m above sea level, forms a border between the grassland and the forest.

3) Access

Access to the Arroyo Cascada mineral occurrence is available by first driving north on the paved No. 40 national road from the Tecka town and then branching west to the farm road until the Arroyo Cascada. For accesses to the Princess mineral occurrence, it is possible to drive on another farm road until just in front of the Kaquel farm, and from that point make a trip of about 3 km on foot southeast to arrive at the destination.

4) Previous surveys

It is said that placer gold had been mined since the end of the 19th century in Arroyo Cascada mineral occurrence. SEGEMAR conducted geological survey in 1988 and reported gold mineralization in this district (Genini, 1988). Canyon Resources, an American company, obtained the mining right in 1994. Then in 1997, Puma Minerals, a subsidiary of Bema Gold, concluded an option contract to acquire 50% of the mining rights and interests from Canyon Resources, and conducted geophysical and drilling surveys. Puma Minerals, however, decided

to withdraw without execution of the right of option in 1998. It is said that gold was also mined at the end of the 19th century in Princess mineral occurrence.

5) Mining properties

In this district, Petrominera Chubut S. E. run by Chubut provincial government establishes mining properties. This company mainly mines petroleum.

6) Geology and geological structure

This district has distribution of Lago la Plata formation consisting of andesitic rocks belonging to Jurassic volcanic rocks. On topographical lowlands, glacial sediments, colluvium and alluvium of the Quaternary are distributed (Fig. II-3-2-30).

7) Mineralization and alteration

A simple map of Arroyo Cascada mineral occurrence is shown in Fig. II-3-2-31. Quartz-sericite alteration zones accompanied by quartz veins are distributed in the distribution area of Jurassic propylitic andesite. The extension of this alteration zone is about 2 km in NW-SE direction.

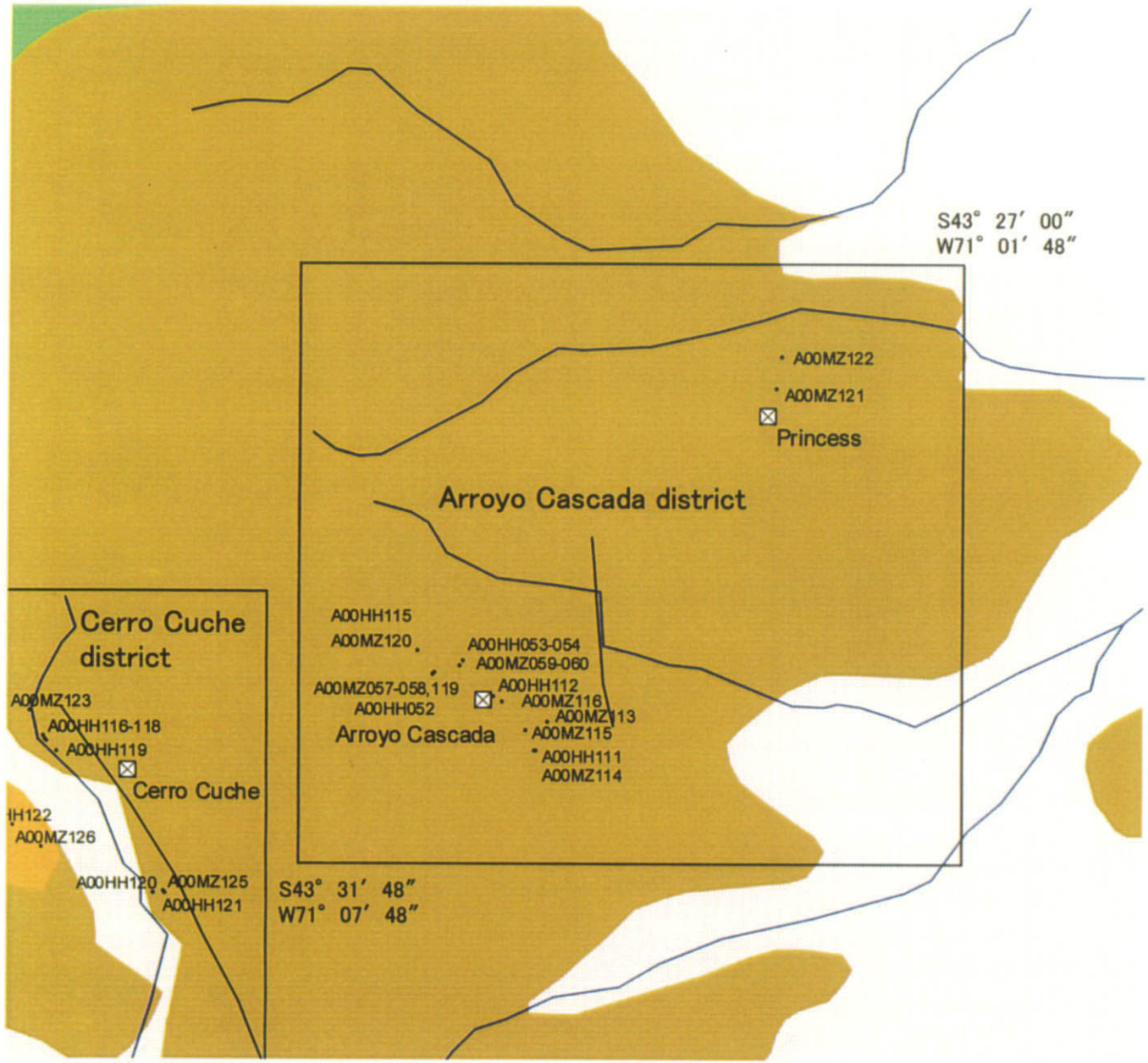
Quartz veins observed on outcrop are distributed in place ③ shown in Fig. II-3-2-31. A pit of 3 m x 2 m was excavated here, and several quartz veins of 8 cm in the maximum width are observed inside the pit. The quartz veins show structures of E-W, 35°S and are characterized by a gentle dip. There are five places where quartz vein floats are observed, as shown with QF in Fig. II-3-2-31. The quartz veins are made up of white quartz and are accompanied by euhedral pyrite and dissemination of coarse-grained pyrite reaching several millimeters in diameter. Host rock of these quartz veins are light gray silicified rocks and are accompany by pyrite dissemination. Old mining pits exist in these places, and there is buried adit that were excavated northward in place ②.

In the southeast of alteration zone of Arroyo Cascada mineral occurrence, stock of micro granodiorite is distributed, and accompanied by quartz veins network and malachite dissemination. The quartz veins network has the maximum width of about 10 cm and shows general structures of N30°W, 60°W. Alteration of micro granodiorite is propylitic.

Princess mineral occurrence is located in the silicified zone along the valley, and there is a place seems to be buried adit by the tailings. Surrounding silicified rock is disseminated by pyrite. Although quartz veins do not exist in the silicified zone, boulders of quartz veins are frequently observed on the flat hill in the northern part.

8) Characteristics of the satellite images

Color tone of the false color image are reddish gray, reddish green and green. It means



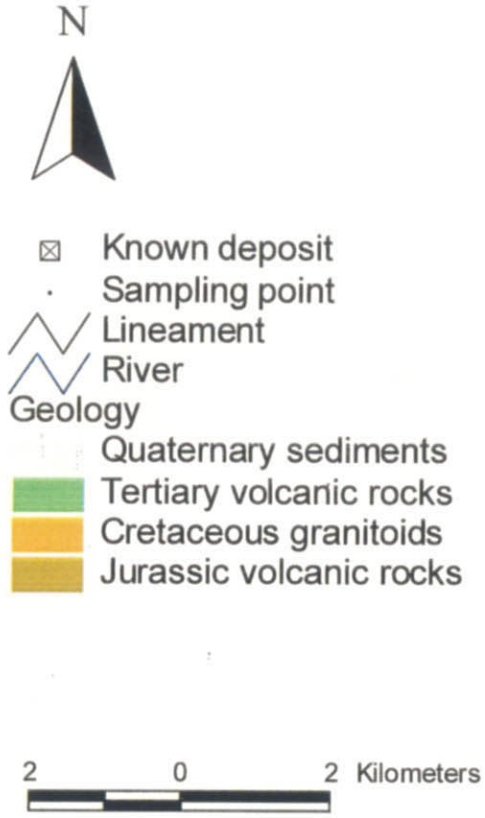
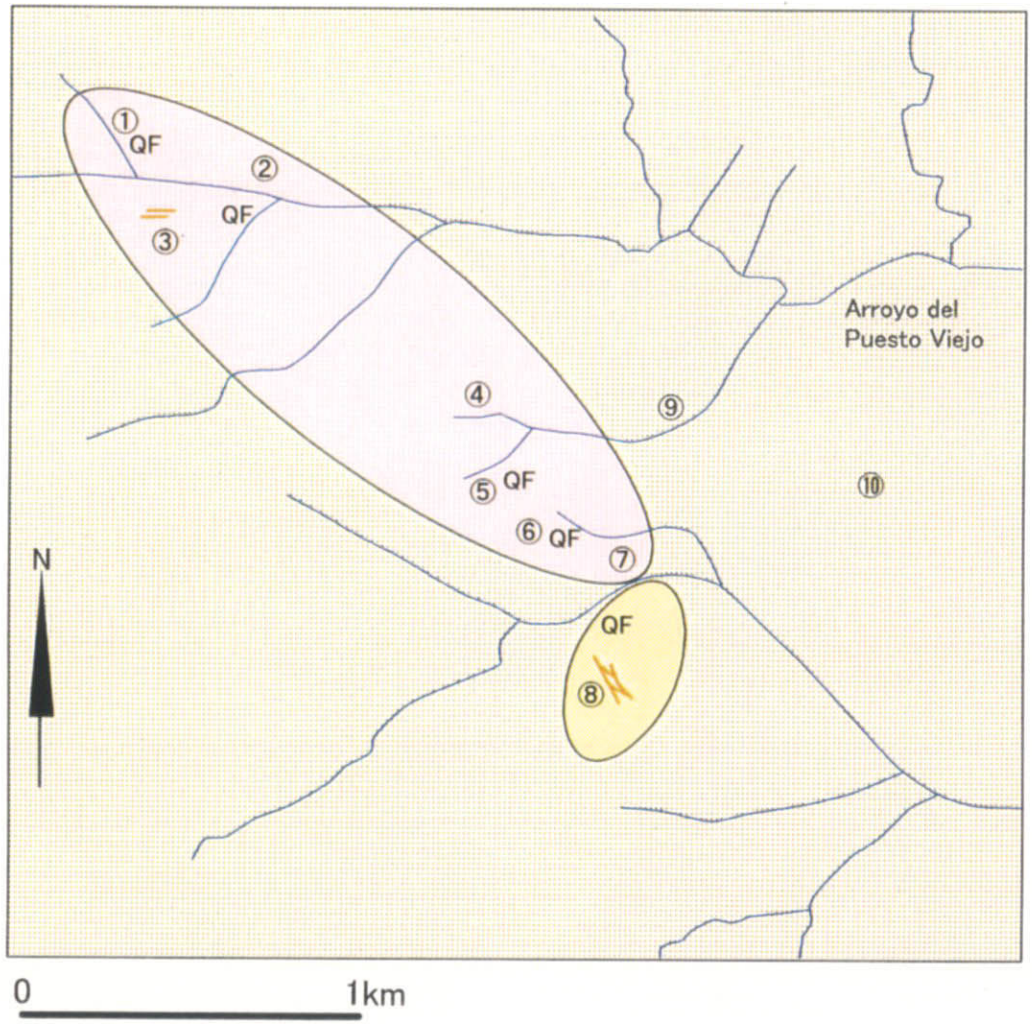


Fig. II-3-2-30 Geological map with sampling points of the Arroyo Cascada district.



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- Jurassic andesite (Fm. Lago la Plata)
- Micro granodiorite
- Quartz-sericite alteration zone
- Quartz vein
- QF — Quartz vein floats

① : Gray silicified volcanic rock with pyrite, quartz vein of A00MZ120 revealed 0.19 g/t Au.
② : Buried old gallery in N-S direction, light gray silicified rock with quartz veinlets and pyrite, silicified rock of A00MZ059 revealed 13.87g/t Au, S43°30'17", W71°06'10".
③ : Old mining pit, light gray silicified rock with pyrite, quartz veins of E-W, 35°S, max 8cm width, quartz vein of A00MZ057 revealed 4.07g/t Au.
④ : Light gray silicified volcanic rock with pyrite, the sample of A00HH112 revealed 0.045 g/t Au.
⑤ : Old mining pit, white altered rock and quartz veins with abundant coarse pyrite, quartz vein of A00MZ116 revealed 0.48 g/t Au.
⑥ : Old mining pit, silicified volcanic rock, the sample of A00MZ115 revealed 0.02 g/t Au.
⑦ : Altered rock with limonite, the sample of A00MZ113 revealed 0.1 g/t Au.
⑧ : Micro granodiorite stock, quartz veins network with malachite, quartz veins show maximum width of 10cm and general structure of N30°W, 60°W, quartz vein of A00HH111 reveled 0.18 g/t Au.
⑨ : Green propylitic andesite.
⑩ : Green propylitic andesite.

Fig. II-3-2-31 Plan of the Arroyo Cascada Au mineralized zone.

the thick vegetation in green part. Structures due to topographical undulations are slightly rough. Water systems are dendritic with moderate densities. Ridgelines are somewhat unclear with somewhat low resistance. Short N-S trend lineament is interpreted. The dominant color tones of the ratio composite image are dark reddish purple and yellow, and no hydrothermal alteration zones are extracted. In the satellite image of spectral patterns analysis, the concentration of pixels indicating alteration zones is hardly observed.

9) Laboratory work results

Regarding the quartz veins in Arroyo Cascada mineral occurrence, although the sample A00MZ057 revealed 4.07g/t Au, the gold content of the samples A00MZ116 and A00MZ120 was low, revealing 0.48g/t Au and 0.19g/t Au, respectively. As to the samples of silicified rocks, although the sample A00MZ059 revealed 13.87g/t Au, the samples A00HH112, A00HH115, A00MZ113 and A00MZ115 revealed <0.005 to 0.1 g/t Au, which are low grades (Appendix-6). In the powdery X-ray diffraction of silicified rock samples, alteration minerals of chlorite and montmorillonite were identified in addition to quartz and sericite (Appendix-5). Homogenization temperatures of fluid inclusions in the quartz vein sample A00MZ119 was 189 to 238℃ with the average of 219℃, and the average salinity was 1.4 wt% (Appendix-11). Oxygen isotopic composition of the same quartz sample was +11.3‰. Calculated oxygen isotopic composition of hydrothermal water from the values of 219℃ and +11.3‰ was + 0.8‰ (Appendix-13). This value is a relatively heavy and suggests that there is contribution of magmatic water to the hydrothermal water (Appendix-15). Sulfur isotopic composition of the euhedral pyrite sample A00MZ060 in the quartz vein was measured, and the result of +6.6‰ was obtained (Appendix-12). This value suggests that the sulfur in pyrite originated in igneous rocks (Appendix-15).

In the chemical analysis of the quartz vein sample A00HH111 in micro granodiorite stocks southeast of Arroyo Cascada mineral occurrence, result of 0.18g/t Au, 4g/t Ag and 3440ppm Cu were obtained (Appendix-10).

In the chemical analysis for the silicified rock sample A00MZ121 in Princess mineral occurrence, the result of 0.015g/t Au was obtained, while alteration mineral of chlorite was identified in the powdery X-ray diffraction (Appendixes-5, 6). In the chemical analysis for the quartz vein sample A00MZ122, which is a boulder taken on the hill on the north side, the result of 0.55 g/t Au was obtained (Appendix-6).

10) Assessment

In Arroyo Cascada mineral occurrence, quartz-sericite hydrothermal alterations is distributed and the existence of gold mineralization was confirmed. Although quartz veins revealed the grade of 4.07 g/t Au and silicified rock revealed the grade of 13.87 g/t Au as the

highest grades, it was confirmed that these mineralization is very limited to specific quartz veins and silicified rocks, and the grade is low on the whole. Therefore, it is considered that the possibility of mine development for this mineralization is low.

It was also confirmed that the grade of gold was low in quartz veins accompanied by micro granodiorite southeast of Arroyo Casacada mineral occurrence and quartz vein boulders near Princess mineral occurrence.

3-2-28 Cerro Cuche district

1) Location

This district is located about 30 km west of the Tecka town in the middle-west part of Chubut province (Fig. II-3-1-2). The area is lat. 43° 30' 00" to 43° 34' 12" S and long. 71° 07' 48" to 71° 11' 24" W and about 60 km^2 (Fig. II-3-2-32). Although no hydrothermal alteration zones were extracted by the ratio composite image analysis in the Phase-1, neutral alteration zones were extracted from the satellite image of spectral patterns analysis in the Phase-2 (Fig. II-3-1-9). The representative coordinate is lat. 43° 31' 52" S and long. 71° 09' 44" W at the point where the quartz porphyry sample A00MZ126 was taken.

2) Topography and vegetation

This district forms a configuration of hills and mountains apart from the Andean cordillera to the east and is located at the southern foot of Cordon Kaquel, of which Cerro Cuche at 1,988 m above sea level is the highest peak. Steep cliffs of tremendous height difference more than 500 meters continue in the NW-SE direction between the northeastern mountains and the southwestern hills. The altitude of the survey area is in a range of 900 to 1,250 m above sea level. For vegetation, the hills are covered with a thick growth of short grasses on the surface but surrounded by marshes and shrubs around their circumference. The steep cliffs bordering between the mountains and hills have the growth of grasslands and forests. Vegetation at higher places is extremely sparse.

3) Access

Access is available by first driving northward about 5 km on the paved No. 40 national road from the Tecka town, branching west to drive on No. 17 provincial road toward Corcovado town, and then branching again at a point before Puesto Barranca to the farm road to arrive at the destination. On this road, it is necessary to drive about 2.5 km and then to make a trip of about 2 km on foot to reach the north section of this district. To the south section of this district, it is necessary to drive about 4 km and to make a trip of 2 km on foot.

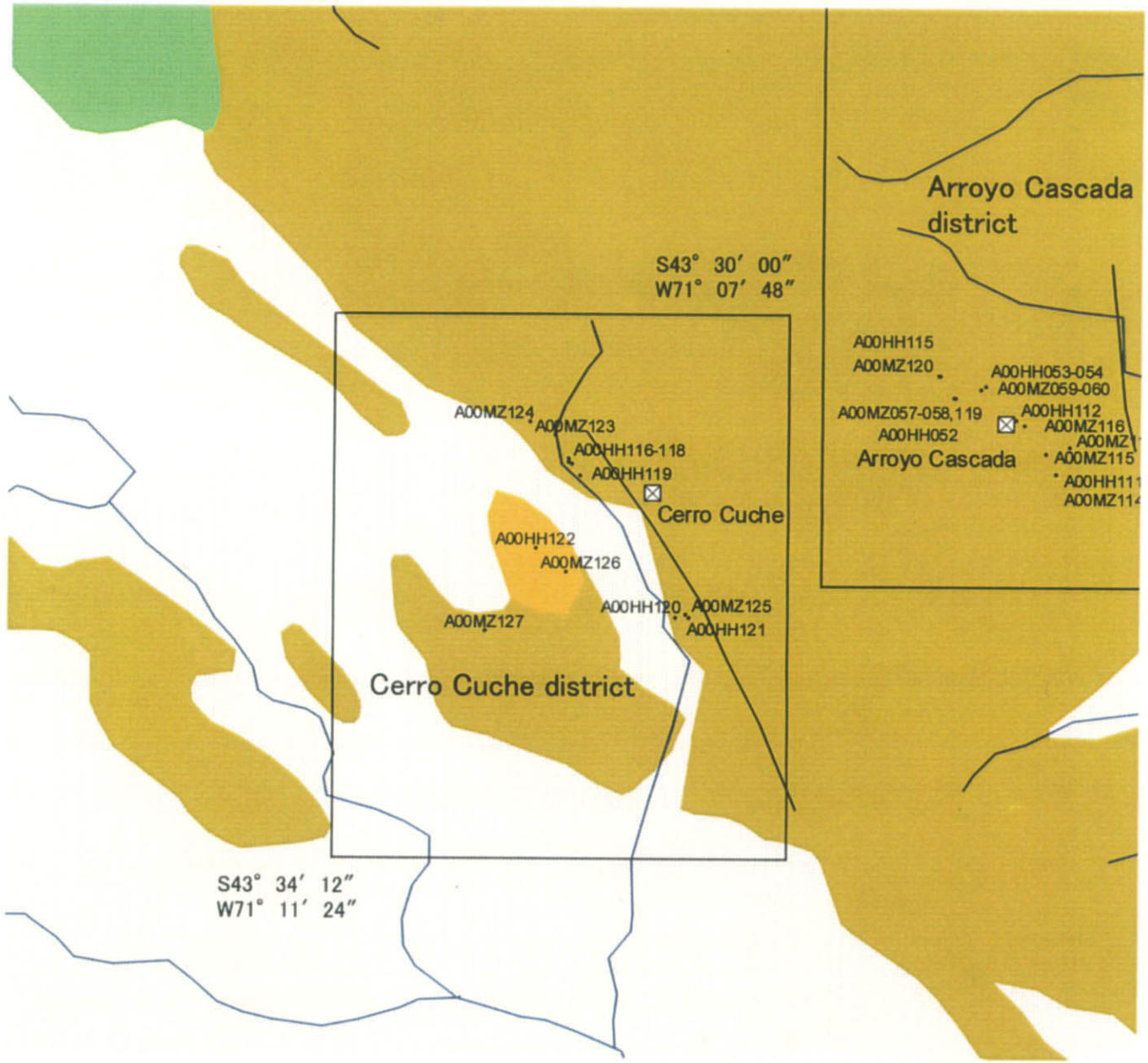

Fig. II-3-2-32 Geological map with sampling points of the Cerro Cuche district.

4) Previous surveys

The Northern Area cooperative survey by JICA/MMAJ was conducted in the Catamarca province from 1977 to 1980. In the final year of this survey, a reconnaissance geological survey was made for three districts in Patagonia region (JICA/MMAJ, 1981). This district is one of three districts of above-mentioned survey. According to JICA/MMAJ (1981), quartz porphyry of about 2 km in diameter intrudes into Jurassic sandstone, and, in relation to this, hydrothermal alteration zones of the porphyry Cu deposit type are distributed, extension of which reaches about 5 km.

Hydrothermal alteration zones are zonally distributed, and, in the core part of quartz porphyry, have potassic alteration zone surrounded by silicified zone. A dense pyrite concentration zone is formed in the contact zone between quartz porphyry and sandstone. The silicified zone is accompanied by tourmaline. Although remarkable copper mineralization does not exist, there are distributions of quartz veins accompanied by pyrite, chalcopyrite, molybdenite, galena and arsenopyrite from the marginal part of quartz porphyry to the contact zone in sandstone. These show the tendency that chalcopyrite and molybdenite are more common in locations nearer to the central part of quartz porphyry. The maximum width of these veins is 20 cm and the highest grades are 0.84% Cu and 4 g/t Au.

5) Mining properties

In this district, Petrominera Chubut S. E. run by Chubut provincial government establishes mining properties. This company mainly mines petroleum.

6) Geology and geological structure

The geology of this district is composed of Jurassic volcanic rocks and sedimentary rocks, quartz porphyry stocks intruding them, and glacial sediments, colluvium and alluvium (Fig. II-3-2-32).

Lago la Plata formation of Jurassic generally consists of andesitic rocks, but in this district, it is accompanied by major sandstone and minor siltstone and conglomerate. Conglomerate is of pebble size and is poorly sorted, and is composed with pebbles of volcanic rocks and granite rocks. On highlands northeast of this district, andesitic rocks are distributed similarly to Arroyo Cascada district. The quartz porphyry is relatively coarse-grained, and the diameter of quartz phencocryst reaches several millimeters. Characteristically, quartz porphyry is accompanied by tourmaline.

7) Mineralization and alteration

Jurassic sedimentary rocks have received silicification generally. They are accompanied by dissemination of pyrite in the place near quartz porphyry. Quartz porphyry has received

quartz-sericite alteration and is accompanied by dissemination of pyrite and tourmaline. At the point where the sample A00MZ125 shown in Fig. II-3-2-32 was taken, several quartz veins with pyrite and galena are observed. The maximum width is about 10 cm, and structures of N45°W, 65°SW are shown. At the point where the sample A00MZ123 was taken, a quartz vein of 5 m or more in width is distributed at strike of N40°W and forms prominent outcrops topographically. This quartz vein is accompanied by dissemination of galena.

8) Characteristics of the satellite images

Color tones of the false color image are reddish gray, green and blue. It means thick vegetation in green part. The blue parts are located on highlands of mountains and indicate the covers of fallen snow. Structures due to topographical undulations are somewhat rough. Water systems in the hill part lie in a zigzag line, and those in the mountain part are radial with Cerro Cuche as the center. Densities of water systems are moderate. Steep cliffs bordering the hill and mountain parts are remarkable, and NW-SE trend lineament is interpreted along the cliff.

Color tones of the ratio composite image in the phase-1 are reddish brown, yellow, reddish purple and blue. Although alteration zones were not extracted in the reddish purple parts, it was shown that these are neutral alteration zones from the satellite image of the spectral patterns analysis in the Phase-2 (Fig. II-3-1-9).

9) Laboratory work results

In the chemical analysis for the samples of quartz porphyry accompanied by pyrite dissemination, A00HH117, A00HH119, A00HH122 and A00MZ126, results of <0.005 to 0.015g/t Au, 0.2 to 6.4g/t Ag, 15 to 171ppm Cu and 1 to 192ppm Mo were obtained (Appendix-6). In the powdery X-ray diffraction, alteration minerals of quartz and sericite were identified for A00HH122 and A00MZ126 (Appendix-5).

In the chemical analysis for the sample A00MZ124 taken from silicified siltstone with pyrite dissemination, no noticeable results were obtained. In the powdery X-ray diffraction, alteration minerals of quartz, chlorite and sericite were identified (Appendixes-5, 6).

Among veins, the sample of quartz-galena veins, A00MZ123, revealed analysis results of 0.87g/t Au, 4g/t Ag and 0.184% Pb, while the sample of quartz-pyrite veins, A00MZ125, revealed analysis results of 0.42g/t Au and 6g/t Ag (Appendix-10).

10) Assessment

In this district, there is formation of large-scale quartz-sericite hydrothermal alteration zones related to the intrusion of quartz porphyry. Remarkable copper mineralization, however, does not exist on the ground surface. And secondary enrichment could not be

expected because the implication of supergene leaching was not observed. Therefore, this district is judged to be barren of copper.

On the other hand, the possibility of porphyry gold mineralization in quartz porphyry was examined, however, the gold contents of analysis results were low. Moreover, it was confirmed that the gold contents of veins in the alteration zones was low. It is considered from these results that the possibility of the existence of promising ore deposits is low in this district.

3-2-29 Gabros de Tecka district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 25 km to the southeast of Tecka town, in the west of Chubut province (Fig. II-3-1-1). The area is lat. 43° 37' 48" to 43° 50' 24" S and long. 70° 32' 24" to 70° 42' 00" W, and about 430 km^2. The representative coordinate is lat. 43° 41' 46.5" S and long. 70° 34' 03.5" W.

2) Previous surveys

SEGEMAR has been conducted surveys since 1998. It was found that platinum group metals content was more than 200 ppb, and natural gold was observed microscopically, for the samples from the rim of layered gabbro. Besides that, anomalous gold values were obtained by stream sediments geochemical survey.

3) Outline of the survey results

Layered gabbro with 50km extension in N-S direction intruded into Jurassic sandstone of Osta Arena formation. Gabbro is complex of several laccolith bodies. Each lacolith dip 30° to 50° W, and thickness is about 1.5km. Sandstone contacting with gabbro has undergone thermal metamorphism. Chilled margin of gabbro is wehrlite facies containing olivine, plagioclase, phlogopite and clinopyroxene. Inside of gabbro is norite or noritic gabbro cumulate facies containing bronzite, clinopyroxene and plagioclase. Layered structure due to mineral assemblage was observed in cumulate facies, although it was not so distinctive.

According to SEGEMAR's survey, maximum 400 ppb of anomalous platinum group metals content was obtained in chilled margin of gabbro containing olivine and phlogopite.

Chemical analysis was done for five samples from chilled margin, main part and later intrusion of gabbro. However, contents of platinum group metals of Pt, Pd and Rh were less

than the detection limits for all five samples. Anomalous contents of other heavy metals were not obtained as well (Appendix-7).

4) Assessment

Mineralization of platinum group metals was not confirmed in this survey. However, the survey was conducted for limited area within the wide distribution of layered gabbro bodies. Therefore, systematic survey is desired to classify the rock facies in detail, and to understand the concentration mechanism of platinum group metals through the magmatic evolution. This kind further survey is expected for other projects, not this project. Because objectives of this project is potentiality evaluation for gold and basemetals mineralization that are observed in other districts. It is concluded that this district will not be surveyed in Phase-2.

3-2-30 Pozones de Navarro district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 20 km to the west-southwest of Trevelin town, in the west of Chubut province (Fig. II-3-1-1). The area is lat. 43° 08' 24" to 43° 15' 36" S and long. 71° 37' 12" to 71° 43' 48" W, and about 160 km^2. The representative coordinate is lat. 43° 10' 38.2" S and long. 71° 40' 51.4" W. at the outcrop of copper mineralization. Parque Nacional de Los Alerces is distributed in the north of this district.

2) Previous surveys

Airplane survey was conducted as part of the Plan Patagonia Comahue in 1976, covering the whole area of Cordillera Patagonia, and color-tone anomalies were recognized. Based on this result, a geological survey in scale of 1/150,000 was conducted for the Esquel-Trevelin area in 1980 (Marquez, 1980b). Pozones de Navarro deposit is included in south end of the Esquel-Trevelin area. From 1977 to 1982, geological, geochemical and geophysical survey was conducted by UN Revolving Fund as "Area II: Esquel-Corcovado" including this district. According to the survey results for Pozones de Navarro deposit, chalcopyrite mineralization was described, but significant geochemical anomalies were not obtained, nor geophysical anomalies were not detected by Slingram EM method conducted at small vein outcrop.

3) Outline of the survey results

The geology of this district comprises Jurassic andesite lava and tuff of Lago la Plata formation, accompanied by quartz porphyry intrusion. Andesitic rocks of Lago la Plata formation are green colored propylite with development of columnar joint. Quartz porphyry is distributed in a steep cliff at the back of Estancia el Triunfo with direction of N 20° E.

Quartz veins with disseminated pyrite and chalcopyrite are hosted in andesite and andesitic lapilli tuff at the roadside of No. 259 national road. Maximum width of quartz veins is 12 cm with strike of N 20° W to N 20° E and vertical dip. General alteration is propylitic, and silicification with pyrite is limited to quartz vein side. Andesite with quartz-chalcopyrite veinlets revealed 1.68% Cu and 0.43g/t Au (Appendix-6)

Quartz porphyry that intrudes into andesite at the back of El Triunfo farm is silicified with secondary biotite. Pyrite disseminates in biotite selectively. Andesite intruded by quartz porphyry is also silicified, and small-sized alteration zones are observed in several parts. Silicified quartz porphyry revealed 92ppm Cu and under the detection limit of Au (Appendix-6).

4) Assessment

Mineralization of quartz-chalcopyrite veinlets in andesite was confirmed. However, the veinlets are small-sized and the scale of hydrothermal activity is assumed to be also small because alteration of the host rock is propylitic. In addition, gold mineralization is in low grade. This district is not considered to be promising.

3-2-31 Las Mentas district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 30 km to the south of Trevelin town, in the west of Chubut province (Fig. II-3-1-1). The area is lat. 43° 21' 00" to 43° 27' 36" S and long. 71° 29' 24" to 71° 36' 00" W, and about 140 km^2. The representative coordinate is lat. 43° 24' 09.3" S and long. 71° 32' 33.1" W at the outcrop of galena vein.

2) Previous surveys

This area district was covered by the UN Revolving Fund Project executed from 1977 to 1982. Galena-chalcopyrite veins were discovered at two points by the geological survey. Although geophysical survey and trench survey were conducted for the geochemical

anomalous area detected by soil geochemical survey, it was concluded that further exploration is not necessary for the mineralized area, because poor continuation of the veins was confirmed and anomalies of chargeability and resistivity were not detected (UNDP, 1983).

3) Outline of the survey results

The host rock of vein is andesitic tuff. It is considered to be Lago la Plata formation of Jurassic or Ventana formation of Paleogene. The outcrop is very small. On the periphery, Quaternary glacial sediments and colluvium are distributed in thick. According to UNDP (1983), Quaternary thickness reaches several tens meters.

One of two veins, which is located nearer to the provincial road, was observed. The host rock is silicifed andesitic tuff showing pale green color. The vein comprises quartz, galena, chalcopyrite and malachite with width of 25 cm, strike of N 80° W and dip of 80° S. Ore sample from the vein revealed 0.54g/t Au, 18 g/t Ag, 0.63% Cu, 10.9% Pb and 1.29% Zn (Appendix-10).

4) Assessment

A vein deposit mainly composed of galena was confirmed, but gold mineralization is in low grade. Poor continuation of basemetals vein was confirmed by previous survey. Therefore, this district is not considered to be promising.

3-2-32 Poncho Moro district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 15 km to the south of Corcovado town, in the west of Chubut province (Fig. II-3-1-1). The area is lat. 43° 36' 36" to 43° 43' 12" S and long. 71° 22' 48" to 71° 29' 24" W, and about 150 km^2. The representative coordinate is lat. 43° 37' 55.1" S and long. 71° 25' 30.7" W at Pedrogoso riverside where the floats were investigated.

2) Previous surveys

Previous surveys in this district are unknown, although northern area from lat. 43° 30' S and southern area around south bank of Lago General Vintter were surveyed as parts of the Plan Patagonia Comahue. The UN Revolving Fund Project was conducted for northern area from lat. 43° 36' S and it is also outside of this district.

3) Outline of the survey results

The geology of this district comprises andesitic rocks of Lago la Plata formation of Jurassic or Divisadero formation of Cretaceous, and Cretaceous granitoids. Andesitic rocks are propylitic showing green color. Granitoids are made up of granite and granodiorite.

Hydrothermal alteration zone was extracted by satellite image analysis. In this survey, however, only floats were investigated in the riverside of Arroyo Pedregoso and Arroyo Poncho Moro running down from the alteration zone, because of restriction of time and accessibility. As the results, silicified andesite with pyrite dissemination and quartz veins were frequently observed. Meanwhile, altered floats of granitic rocks were not recognized.

As the results of chemical analysis for float samples, altered andesite revealed 149 ppm Cu, quartz vein revealed 0.02g/t Au, 1.6g/t Ag and 84 ppm As.

4) Assessment

A hydrothermal alteration zone was extracted by satellite image analysis. Although the alteration zones could not be reached due to poor access, silicified andesite and quartz veins were recognized by float investigation in riversides where the rivers running down from the alteration zone. Arsenic content obtained for quartz vein float shows the influence of hydrothermal alteration. It is desired to survey the alteration zone in-situ in Phase-2. However, the priority is judged to be low.

3-2-33 Cerro Colorado district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located near the border with Chile, in the west of Chubut province (Fig. II-3-1-1). The area is lat. 43° 55' 48" to 44° 05' 24" S and long. 71° 31' 48" to 71° 40' 12" W, and about 260 km^2. Cerro Colorado deposit and Cerro Riñon deposit are located in the south of Lago General Vintter. The representative coordinate is lat. 43° 57' 47.7" S and long. 71° 34' 9.4" W at the point where floats were investigated.

2) Previous surveys

At Cerro Riñon, JICA/MMAJ conducted geological survey in 1983. As the results of chemical analysis, 108 ppm Cu and 120 ppm Pb were obtained among five samples of silicified rocks with pyrite (JICA/MMAJ, 1983).

At Cerro Colorado, high-sulfidation epithermal gold deposit at around the summit of Cerro Colorado is known by exploration activities of Billiton Argentina. It is reported as hydrothermal breccia and silicified zone in Jurassic andesite of Lago la Plata formation. Rock chips were taken from the bulldozer trenches, and average 4.7g/t Au was obtained in 10m intervals sampling. In addition, 66 rock chip samples taken from 2,200 m^2 revealed average 7.95g/t Au (Peréz and Sureda, 1999).

3) Outline of the survey results

In this district, batholith of tonalite and granite of late Cretaceous, and Jurassic andesite of Lago la Plata formation as roof pendant in the batholith are distributed. And Quaternary glacial sediments are distributed in the eastern part.

In the field, a collapse of slope across the road prevented to reach Cerro Colorado deposit. Therefore, floats were investigated on the shores of Lago General Vintter. Some of granitic floats are strongly silicified with disseminated pyrite. Pyrophyllite was identified by POSAM measurement for these samples. However, no noticeable chemical analysis results were obtained.

4) Assessment

Cerro Colorado deposit was not surveyed in-situ because of the problem of accessibility. It is considered that high potentiality of this district had been already proven, because the high-sulfidation gold mineralization was reported by exploration activities of a major company. With consideration given to the purpose of this project, that new promising areas should be extracted, it is judged unnecessary to include this district in Phase-2 survey.

3-2-34 Estrella Gaucha district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 7 km from the border with Chile and about 35 km to the northeast of the Lago Fontana, in the southwest of Chubut province (Fig. II-3-1-1). The area is lat. 44° 37' 48" to 44° 46' 48" S and long. 71° 03' 00" to 71° 10' 12" W, and about 230 km^2. The representative coordinate is lat. 44° 41' 24.0" S and long. 71° 06' 49.3" W at the sampling point of A00RM060.

2) Previous surveys

Hayase (1970) reported for the Estrella Gaucha kaolin deposit. According to the report, alteration zones of silicification, alunite and kaolin were observed, and minerals of kaolin, dickite, alunite, barite and quartz were described. At that time, exploitation of kaolin had been ceased.

This district was included in the areas of UN Revolving Fund Project from 1977 to 1982, as the Apeleg area (UNDP, 1983). Maximum 112 ppm Ag for rock, and 6,900 ppm Pb, 876 ppm Zn, 530 ppm Cu and 82 ppm Ag for soil were detected by geochemical survey. It was considered that these are original nature of sedimentary rocks containing heavy metals or secondary enrichment by underground water from low-grade basemetals deposits.

Cayetano et al. (1993) reported the results of chemical analysis for 134 rock samples taken in Cerro Baya. However, any noticeable contents of gold, silver, copper and zinc were not obtained.

3) Outline of the survey results

The geology of this district comprises sedimentary rocks of Apeleg formation and volcanic rocks of Divisadero formation of lower Cretaceous. Apeleg formation consists of tuffaceous sandstone, conglomerate and mudstone. Divisadero formation consists of andesitic welded tuff and ignimbrite. Intrusions of rhyolite and basalt intruded into Apeleg formation.

Hydrothermal alterations develop mainly in Apeleg formation, and reach even welded tuff in the upper Divisadero formation. Alteration zones consist of sericite-chlorite zone, kaolin zone, alunite zone and silicified zone in ascending order, and silicified zone forms the summit of the Cerro Baya. As the results of powdery X-ray diffraction, kaolin and a small amount of anatase and alunite were identified for samples taken near kaolin deposits (Appendix-5). However, no noticeable chemical analysis results were obtained.

There are two brecciated quartz veins in parallel with width of about 50 cm, strike of N 35° W and vertical dip, near basalt dyke at 2 km east from the kaolin pit. Fluid inclusion study for quartz indicated average homogenization temperature of 136℃, and average salinity of 1.2 wt% (Appendix-11). Oxygen isotopic composition of same quartz was +7.3‰, and calculated oxygen isotopic composition of hydrothermal water was -9.4‰ (Appendix-13). This value for hydrothermal water suggests the meteoric water origin (Appendix-15).

4) Assessment

In this district, high-sulfidation epithermal mineralization was expected because of the existence of kaolin deposit and silicified zone. However, none of noticeable chemical analysis results were obtained. It is considered that hydrothermal activities formed kaolin deposit, but these were not accompanied by metallic mineralization. Therefore, this district is judged

not to have the necessity to be surveyed in Phase-2.

3-2-35 Mina Gato district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 35km northwest of Alt Rio Senguerr town, in the southwest of Chubut province (Fig. II-3-1-1). The area is lat. 44° 47' 24" to 44° 53' 24" S, and long. 71° 05' 24" to 71° 10' 48" W, and about 100km^2. The representative coordinate is lat. 44° 50' 13.6" S, and long. 71° 08' 30.6" W at old kaolin exploitation pit.

2) Previous surveys

In 1970, the geology and alteration was described for kaolin deposits of Estrella Gaucha in north and Susana in west by an agreement between Chubut provincial government and Nacional Sur university (Hayase, 1970). Maiza (1981) described the geology and alteration for Gato kaolin deposit of this district and other two deposits mentioned above. Temperature of alteration was estimated as between 200°C and 300°C based on the phase equilibrium diagram of alternation minerals.

3) Outline of the survey results

The geology of this district comprises, in ascending order, Cretaceous sedimentary and volcanic rocks, Pliocene basalt and Quaternary glacial sediments, colluvium and allvium. A small gabbro intruded into Cretaceous sedimentary rocks.

Cretaceous sedimentary rocks of Apeleg formation consists of black mudstone and tuffaceous sandstone, etc. Cretaceous volcanic rocks of Dividasero formation consist of andesite, rhyolite and pyroclastic rocks. Flow structure observed in silicified rhyolite shows strike of N50° E and dip of 25° SE.

There is an old kaolin exploitation pits in the area of Cretaceous volcanic rocks. Kaolinized rocks retain the flow structure of rhyolite and are soft, light grey in color and with a silky sheen. Strongly silicified rocks are distributed on highlands to northwest of the kaolin pit. Alunite was identified by POSAM measurement. Meanwhile, on lowlands to northeast of the kaolin pit, propylitic rocks with disseminated pyrite are distributed. Sericite was identified by POSAM measurement. No noticeable chemical analysis results were obtained.

4) Assessment

It was confirmed that acid alteration of silicification and kaolinization, and neutral alteration of sericitization are distributed in different places of this district. However, gold and copper contents were proved to be in low grades. It is considered that hydrothermal activities formed kaolin deposit, but these were not accompanied by metallic mineralization. Therefore, this district is judged not to have the necessity to be surveyed in Phase-2.

3-2-36 Estancia Arroyo Victoria district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This area is located 40km to northwest of Alt Rio Senguerr town, in the southwest of Chubut province (Fig. II-3-1-1). The area is lat. 44° 48' 36" to 44° 54' 36" S, and long. 71° 13' 12" to 71° 21' 00" W, and about 160km^2. The representative coordinate is lat. 44° 54' 11.1" S, and long. 71° 14' 43.6" W at riverside of Arroyo Huemul where floats were investigated.

2) Previous surveys

This district was surveyed, as A. Pescado-A. Gato area, by the UN revolving fund project, executed from 1977 to 1982. However, any geochemical anomaly was not detected, although small-scale mineralized zones were recognized (UNDP, 1983)

3) Outline of the survey results

The geology of this district comprises, in ascending order, sedimentary and volcanic rocks of Cretaceous, basalt of the Pliocene, and glacial sediments, colluvium and alluvium of Quaternary. Small granitic intrusions intruded into Cretaceous sedimentary rocks.

Cretaceous sedimentary rocks of Apeleg formation consist of black mudstone, sandstone, etc. The Cretaceous volcanic rocks of Dividasero formation consist of dacite, rhyolite and pyroclastic rocks.

Although alteration zones were not extracted by satellite image analysis, color anomaly of reddish purple is recognized in northern mountains on the ratio image. It was not possible to reach the color anomaly zone because of the restriction of time and accessibility. Therefore, floats in the riversides of Arroyo Huemul and Arroyo Victoria were investigated where the rivers run down from the northern mountains. As the result, floats of silicified rocks with limonite and pyrite, and quartz veins were observed. Alunite was identified by POSAM measurement for whitened silicifed rock. However, no noticeable chemical analysis results

were obtained.

4) Assessment

Existence of alteration zone was implied by color anomaly of the ratio image. Although it was not possible to reach the implied alteration zone because of the restriction of time and accessibility, existence of silicifed rocks and quartz veins were confirmed by floats investigation where the river run down from the implied alteration zone. However, none of noticeable results of chemical analysis were obtained. The priority to conduct the Phase-2 survey is judged to be low.

3-2-37 Ferrocarrilera district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 60km to west of Alt Rio Senguerr town, in the southwest of Chubut province (Fig. II-3-1-1). And it is 2 to 3 km to south of southern shore of Lago Fontana, and about 5 km to north of the border with Chile. The area is lat. 44° 53' 24" to 44° 57' 36" S, and long. 71° 33' 36" to 71° 37' 48" W, and about 50km^2. The representative coordinate is lat. 44° 56' 21.8" S, and long. 71° 35' 05.4" W at Ferrocarrilera deposits.

2) Previous surveys

Ferrocarrilera polymetallic vein deposits were discovered in 1939. A shaft of 30m depth and 4 adits of total 450m were excavated by Ferrocarrilera de Comodoro Company from 1940 to 1942. Additional underground works and 20 holes drilling of total 2,000m were conducted from 1947 to 1948. When the company was nationalized, the mining rights were restored to the original owner and the name of deposits was changed to La Illusion.

In 1979 through an agreement between the rights owner and the government, channel sampling, soil geochemical survey and geophysical survey were conducted under the UN revolving fund project. High grades obtained by the channel sampling for a vein of width 2.5m were 0.05% Cu, 1.25% Pb, 6.17% Zn, 2.8g/t Ag and 55g/t Au. Total 465 soil samples of A- and B-horizons were taken at 40m intervals of total 8,600m sampling lines. However, all of few geochemical anomalies corresponded to known mineralization, and any geochemical anomalies suggesting the concealed mineralization were not detected. Concerning the geophysical survey, Turam and Sligram methods electromagnetic survey and magnetic survey were conducted. 11 lines of each 600m length and 200m intervals were set in direction

across the veins. Detected resistivity anomalies were slight, and any of them did not continue to another line. Meanwhile, anomaly in excess of 1,000 γ was detected by magnetic survey, but it was considered to be related with basic dyke rock.

In 1985, ore reserves were calculated by SEGEMAR based on the exploration data of previous surveys. As the results, 708,630t with average grades of 1.63% Pb, 4.49% Zn, 0.61% Cu, 0.1g/t Au and 14g/t Ag were reported (Zubia, 1985). At the present time, no exploration works are being conducted, because the lower extensions can not be expected based on the previous data. 4 adit entrances and old shaft are left now.

3) Outline of the survey results

In this district, Jurassic volcanic rocks of Lago la Plata formation is distributed. There are also distributions of Quaternary glacial sediments on the lowlands.

Andesitic rocks of Lago la Plata formation are the host rock of Ferrocarrilera deposits. Intermittent total extension of veins is about 1,200 m in N30° E direction. There are several veins of width 2cm to 5m within a mineralized zone of width 100 to 200m. The veins strike N30° E and dip 70° to 80° W, and transferred by E-W direction faults. Ore minerals comprise galena, sphalerite, pyrite and small amount of chalcopyrite. Sphalerite is light brown in color indicating low iron contents. There are two types of veins of quartz veins with disseminated sulfides and sulfides dominant veinlets. In latter case, it locally forms a wide lens-like vein with concentration of galena. Sample of galena-sphalerite vein revealed 0.93g/t Au, 14g/t Ag, 0.115% Cu, 3.56% Pb and 13.4% Zn (Appendix-10). Sulfur isotopic composition of pyrite in quartz vein was -0.4‰ (Appendix-12). This value suggests that the sulfur originated in magmatic components (Appendix-15).

Hydrothermal alteration is not significant, even the rock fragments in the veins are green colored propylite. Microscopically, chlorite, sericite and smecite were observed (Appendix-3).

4) Assessment

Ferrocarrilera is lead and zinc vein deposits, and it is thought to be formed by magmatism based on the sulfur isotopic composition of pyrite. However, alteration is propylitic, even if it is close to veins. This phenomenon means that the scale of hydrothermal activities were not large. Besides that, gold mineralization was proved to be in low grades. Therefore, it is judged that this district has not necessity to be surveyed in Phase-2.

3-2-38 Cerro Blanco district

This district was only surveyed in Phase 1. Therefore, outline of Phase 1 survey results are described here. Phase 1 report is the reference for details of the survey results.

1) Location

This district is located about 40km to west of Alt Rio Senguerr town, in the southwest of Chubut province (Fig. II-3-1-1), And it is located to south of the southern shore of Logo Fontana. The area is lat. 44° 55' 48" to 45° 02' 24" S, and long. 71° 25' 12" to 71° 33' 00" W, and about 130km^2. The representative coordinate is lat. 45° 00' 24.7" S, and long. 71° 27' 31.8" W at the sampling point of A00TM066.

2) Previous surveys

The survey sites are the area where Billiton Argentina conducted the exploration activities. There are 5 trenches with direction of N80° E, and 100 to 150m intervals. In addition to the survey sites, Cerro Katterfeld, Cerro Katterfeld East, Arroyo de las Minas and Arroyo de las Alevinas deposits are distributed.

Cerro Katterfeld and Cerro Katterfeld East deposits are quartz veinlets with small amount of galena and chalcopyrite hosted in andesite and andesitic tuff. Chemical analysis results of 238 ppm Pb and 510 ppm Zn were reported. Arroyo de las Minas deposit is quartz veinlets with pyrite, chalcopyrite and galena in the silicified sandstone and conglomerate. Arroyo de las Alevinas deposit is lens-shaped alteration zone with sinter-like silicified rocks and limonitization. These mineralization are interpreted as epithermal or mesothermal polymetallic vein deposits related to volcanic activities of late Cretaceous (UNDP, 1983; Marquez and Parisi, 1995).

3) Outline of the survey results

The geology of this district comprises, in ascending order, Jurassic volcanic rocks of Lago la Plata formation and Jurassic sedimentary rocks of Coyhaique formation, lower Cretaceous sedimentary and volcanic rocks of Katterfeld formation, middle Cretaceous sedimentary rocks of Apeleg formation, and Quaternary glacial sediments. Granitic rocks intruded into Cretaceous and Jurassic rocks.

Around trenches excavated by the Billiton Argentina, sandstone and mudstone are widely distributed with intrusions of quartz porphyry. The quartz porphyry is considered to have the relation with mineralization. Silicified and argillized alteration with limonite was observed in and around the trenches. Strongly silicifed rocks are accompanied by quartz veins with pyrite. Maximum width of quartz veins is 20cm with strike of N-S direction.

Chemical analysis revealed 1.575g/t Au, 26 g/t Ag, 1,485 ppm Pb, 596 ppm Zn, 3,660 ppm As and 2,670 ppb Hg (Appendix-6).

At a point to several kilometers from the trenches, sinter-like silicified rocks are scatteredly distributed within a zone of 300m in N40° E extension and 50m width. Quartz in silicified rocks are white to clear, and partially chalcedonic, with texture in parallel to sedimentary structure.

As the results of powdery X-ray diffraction for silicified and argillized sedimentary rocks, which are the host rocks of quartz veins, potassium feldspar, sericite, chlorite and kaolin were identified (Appendix-5).

4) Assessment

In this district, existence of auriferous polymetallic vein deposits are expected based on the previous exploration results and the laboratory work results of this survey. It is considered that high potentiality of this district has been already proven. With consideration given to the purpose of this project, that new promising areas should be extracted, it is judged unnecessary to include this district in Phase-2 survey.