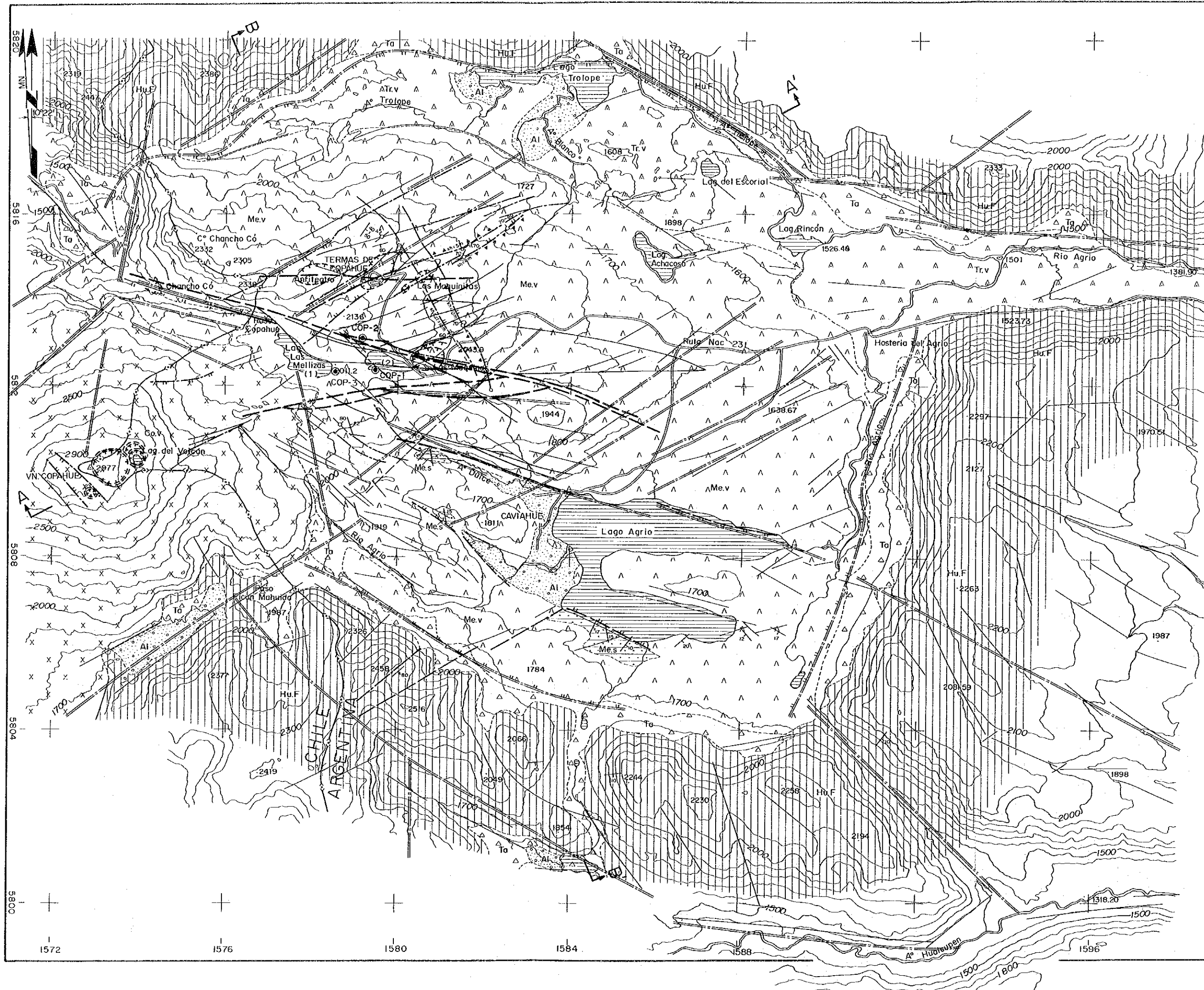
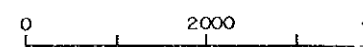


Fig. 5-5 Geologic Columnar Section of Caldera Wall



LEGEND

- | | | |
|-------------|------|---|
| Quaternary | Al | Alluvium
Gravel, Sand and Mud |
| | Ta | Talus
Gravel, Sand and Mud |
| | Cov | Copahue Volcanic Rocks
Pyroxene Olivine Basalt, Lipari c.
Pyroclastic Rocks |
| | Tr.v | A ¹ Trolope Volcanic Rocks
Pyroxene-bearing Plagioclase Andite |
| Pleistocene | Me.v | Las Mellizas
Olivine Pyroxene Basaltic Andes
Pyroxene Andesite and Agglomerate |
| | Me.s | Lake Sediments and Glacial Deposits
Conglomerate, Sandstone and Tuff |
| Tertiary | Hu.F | Hualcupen Formation
Fine Pyroxene Andesite, Agglomerate
Tuff Breccia, Tuff etc. |
| | | |
-
- Geologic Boundary
 - ↘ Strike and Dip of Strata
 - Fault sh; Shear Zone(m)
cl; Fault Clay(m)
 - Fault (Assumed)
 - ↘ Strike and Dip of Normal Fault
 - ↘ Strike and Dip of Reverse Fault
 - Lineament (from LANDSAT)
 - Ring Structure (from LANDSAT)
 - Lineament (by Aerial Photographs)
 - ⊙ Fumaroles and Hydrothermal Alteration
 - ⊙ Crater
 - Location of Section
 - ⊙ Exploratory Well



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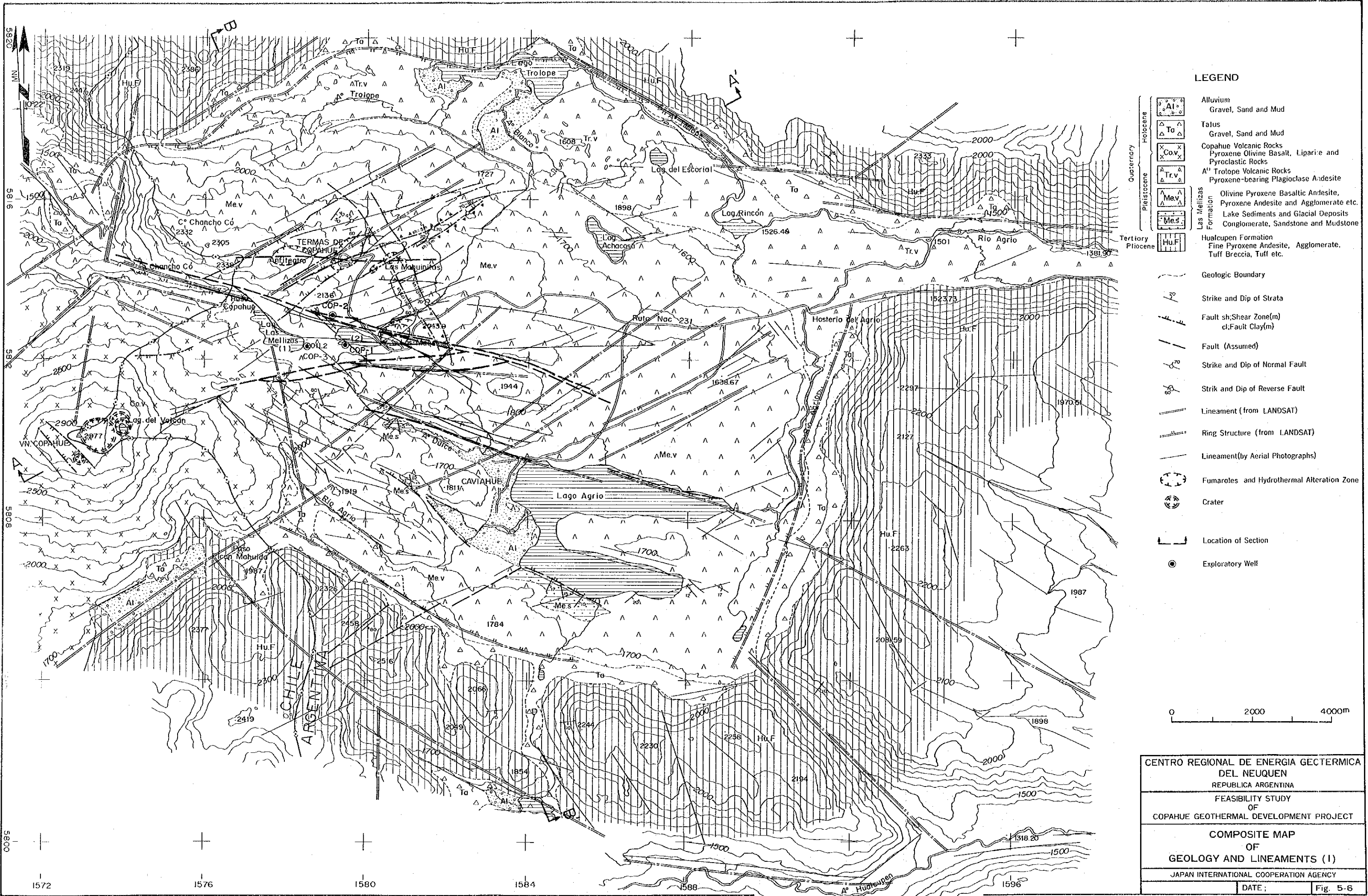
**COMPOSITE MAP
OF
GEOLOGY AND LINEAMENTS**

JAPAN INTERNATIONAL COOPERATION AGENCY

DATE: _____ Fig. _____

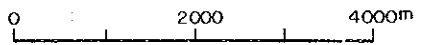
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1572 1576 1580 1584 1588 1596



LEGEND

- | | | | |
|------------|-------------|--|---|
| Quaternary | Holocene | | Alluvium |
| | | | Talus |
| | Pleistocene | | Copahue Volcanic Rocks
Pyroxene Olivine Basalt, Liparite and
Pyroclastic Rocks |
| | | | A' Trolope Volcanic Rocks
Pyroxene-bearing Plagioclase Andesite |
| Tertiary | Pliocene | | Las Mellizas
Formation
Olivine Pyroxene Basaltic Andesite,
Pyroxene Andesite and Agglomerate etc.
Lake Sediments and Glacial Deposits
Conglomerate, Sandstone and Mudstone |
| | | | Huacupen Formation
Fine Pyroxene Andesite, Agglomerate,
Tuff Breccia, Tuff etc. |
-
- Geologic Boundary
 - Strike and Dip of Strata
 - Fault sh/Shear Zone(m)
cl:Fault Clay(m)
 - Fault (Assumed)
 - Strike and Dip of Normal Fault
 - Strike and Dip of Reverse Fault
 - Lineament (from LANDSAT)
 - Ring Structure (from LANDSAT)
 - Lineament (by Aerial Photographs)
 - Fumaroles and Hydrothermal Alteration Zone
 - Crater
 - Location of Section
 - Exploratory Well



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**COMPOSITE MAP
OF
GEOLOGY AND LINEAMENTS (1)**

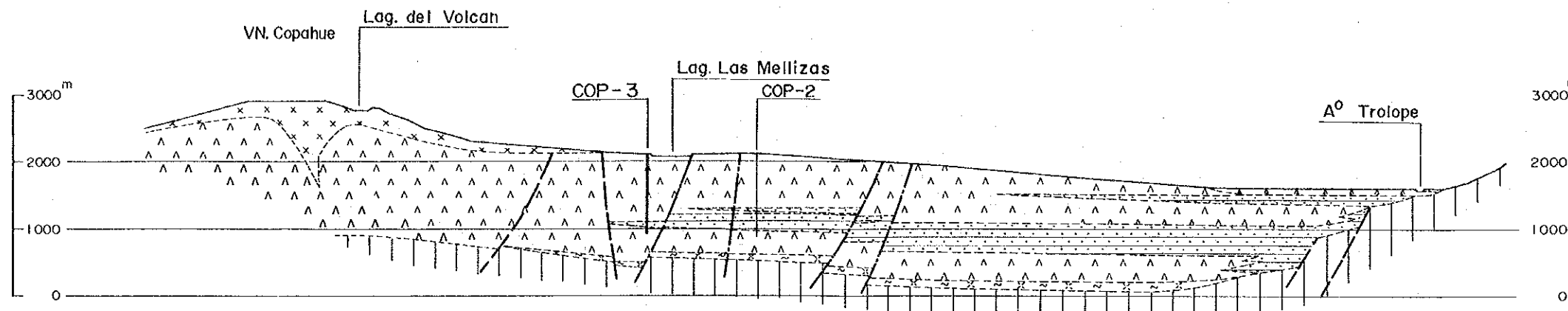
JAPAN INTERNATIONAL COOPERATION AGENCY

DATE: _____ Fig. 5-6

5830
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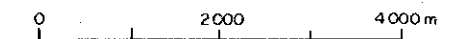
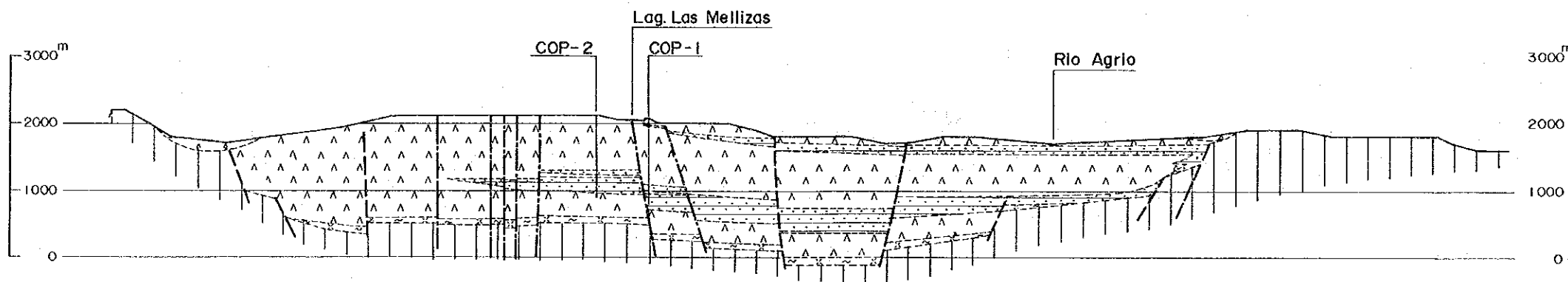
Profile A - A'



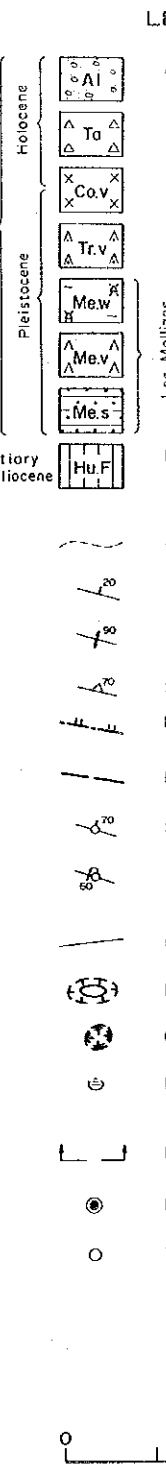
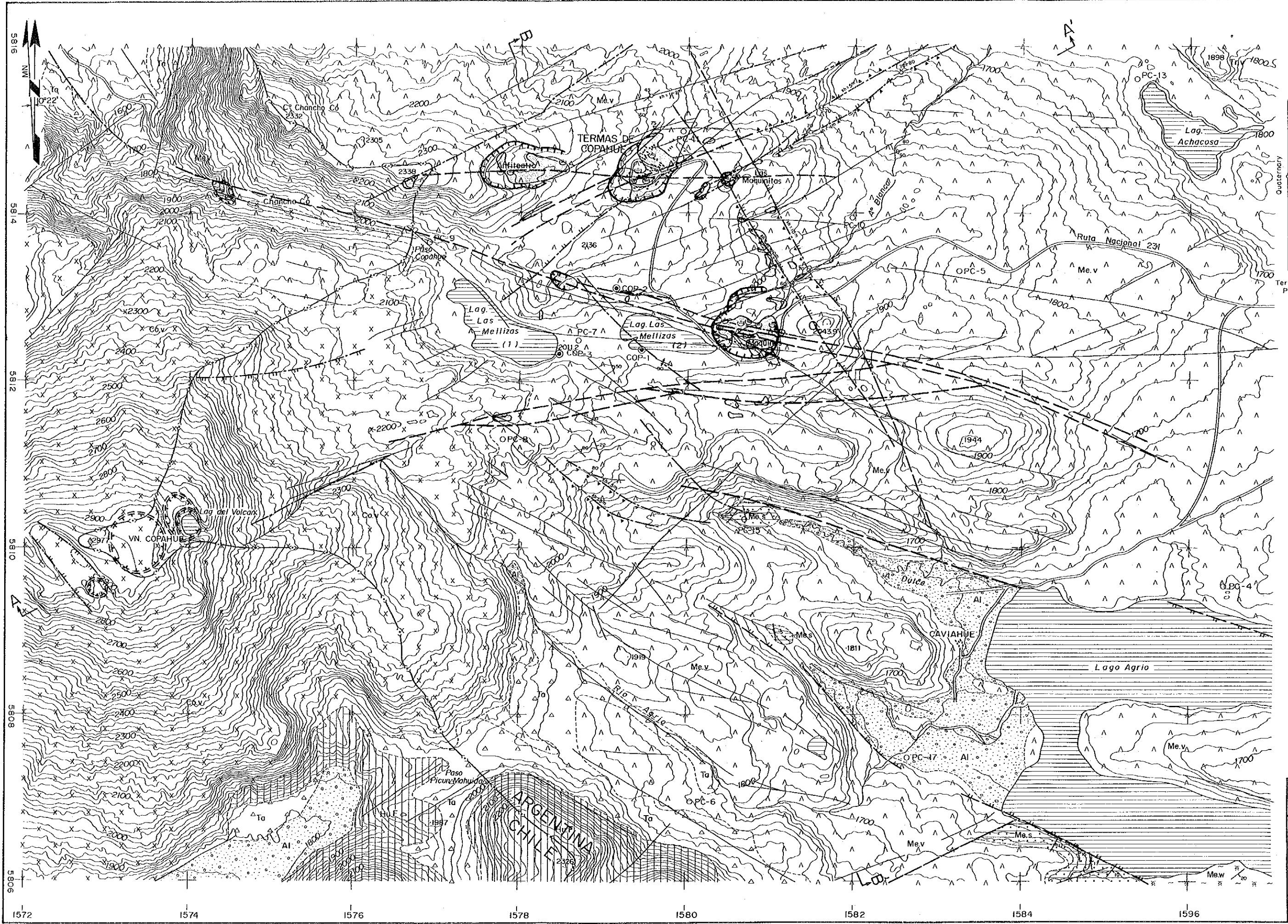
LEGEND

- △ Ta △ Talus
- X Cov X Copahue Volcanic Rocks
- △ Tr.v △ A' Trolope Volcanic Rocks
- △ Me.v △ Las Mellizas Formation
- Ma.s Cavihue Conglomerate Member
- R.B.P Riscos Bayos Pyroclastic Flow Deposits
- Hu.F Hualcupen Formation
- Geologic Boundary
- Fault
- Fault (Assumed)

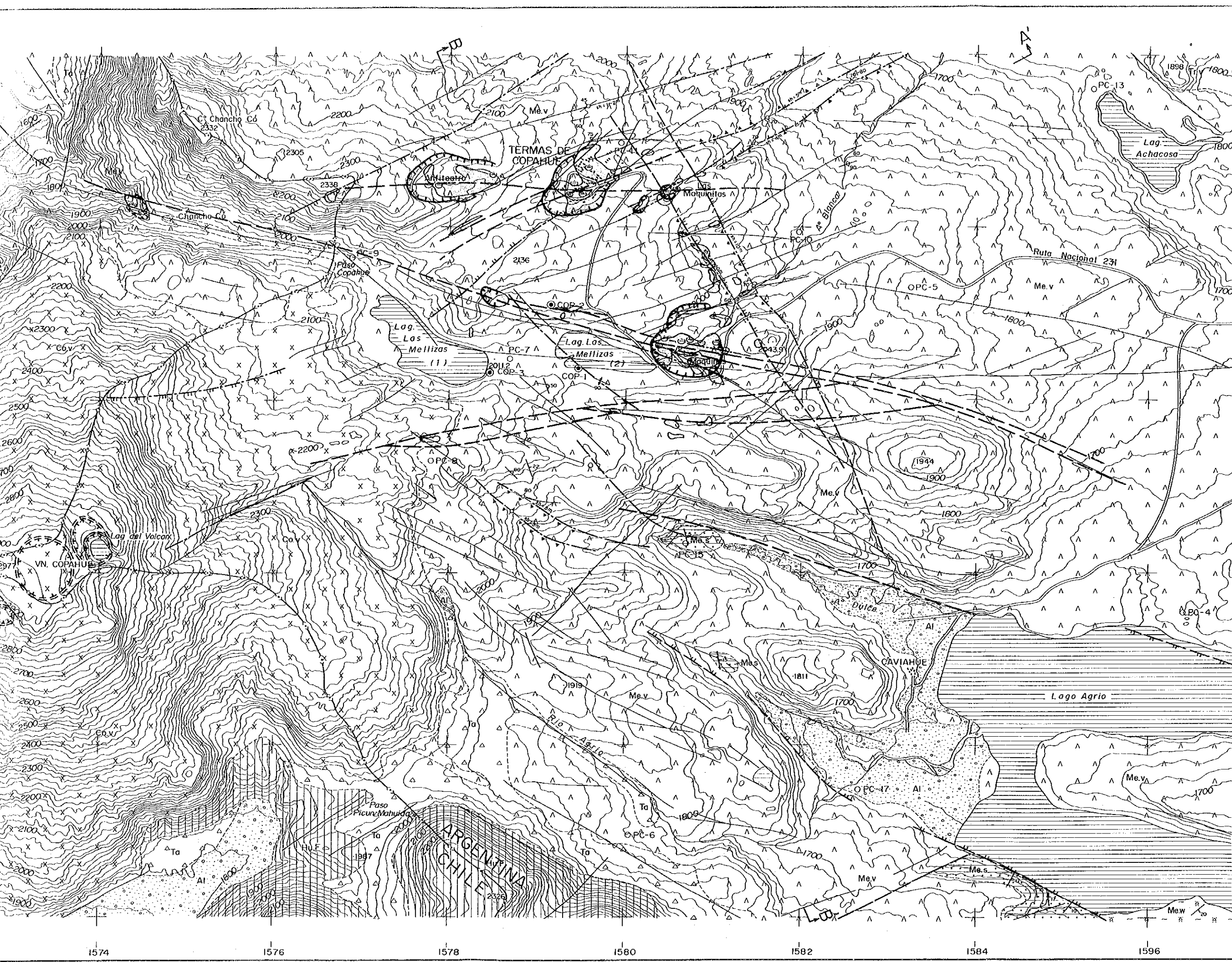
Profile B - B'



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FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT	
GEOLOGIC PROFILE	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE :	Fig. 5-7

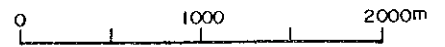


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LEGEND

- | | | |
|-------------|------|--|
| Holocene | Al | Alluvium
Gravel, Sand and Mud |
| | Ta | Talus
Gravel, Sand and Mud |
| Quaternary | Co.v | Copahue Volcanic Rocks
Pyroxene Olivine Basalt,
and Pyroclastic Rocks |
| | Tr.v | A ¹ Trolope Volcanic Rocks
Pyroxene-bearing Plagioclase Andesite |
| Pleistocene | Me.w | Welded Tuff |
| | Me.v | Olivine Pyroxene Basaltic
Andesite, Pyroxene Andesite and
Agglomerate etc. |
| | Me.s | Lake Sediments and Glacial
Deposits: Conglomerate, Sandstone
and Mudstone |
| Tertiary | Hu.F | Hualcupen Formation
Fine Pyroxene Andesite, Agglomerate,
Tuff Breccia, Tuff etc. |
| Pliocene | | |
-
- Geologic Boundary
 - ↘ Strike and Dip of Strata
 - ↘ Strike and Dip of Intrusive Rocks
 - ↘ Strike and Dip of Joints
 - Fault sh, Shear Zone(m)
cl, Fault Clay(m)
 - Fault (Assumed)
 - ↘ Strike and Dip of Normal Fault
 - ↘ Strike and Dip of Reverse Fault
 - Lineament (by Aerial Photographs)
 - ⊗ Hydrothermal Alteration zone
 - ⊙ Crater
 - ⊕ Fumarole
 - ⊥ Location of Section
 - ⊙ Exploratory Well
 - Thermal Gradient Hole



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DEL NEUQUEN
REPUBLICA ARGENTINA

FEASIBILITY STUDY
OF
COPAHUE GEOTHERMAL DEVELOPMENT PROJECT

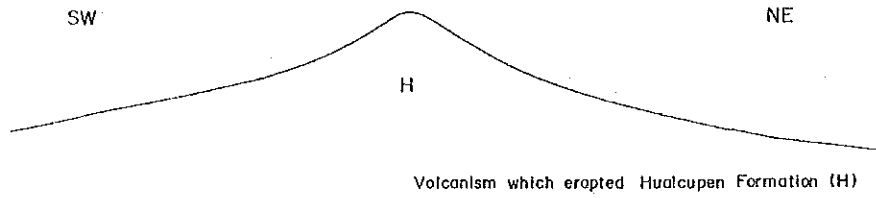
COMPOSITE MAP
OF
GEOLOGY AND LINEAMENTS (2)

JAPAN INTERNATIONAL COOPERATION AGENCY

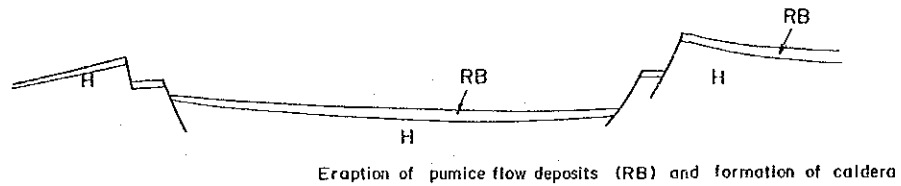
DATE :	Fig. 5-8
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1574 1576 1578 1580 1582 1584 1596

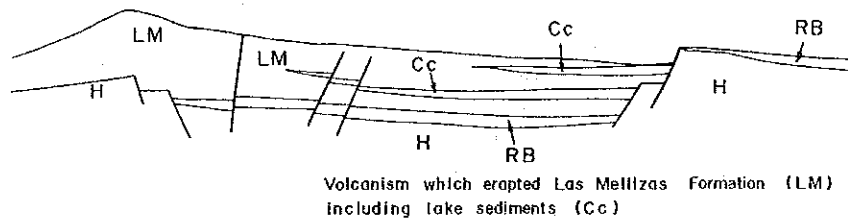
1. Pliocene



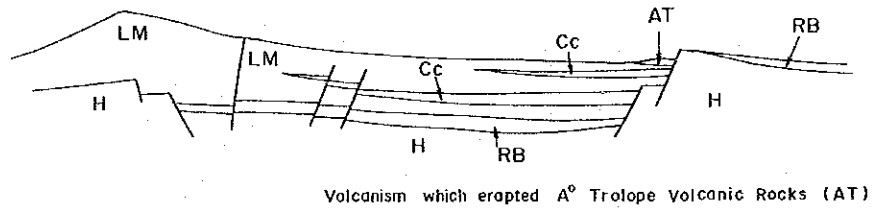
2. End of Pliocene to Beginning of Pleistocene



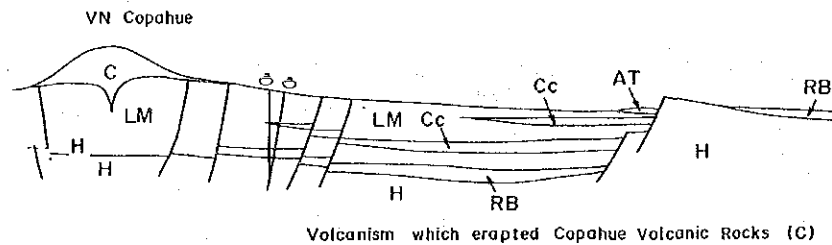
3. Early to Middle Pleistocene



4. Middle Pleistocene

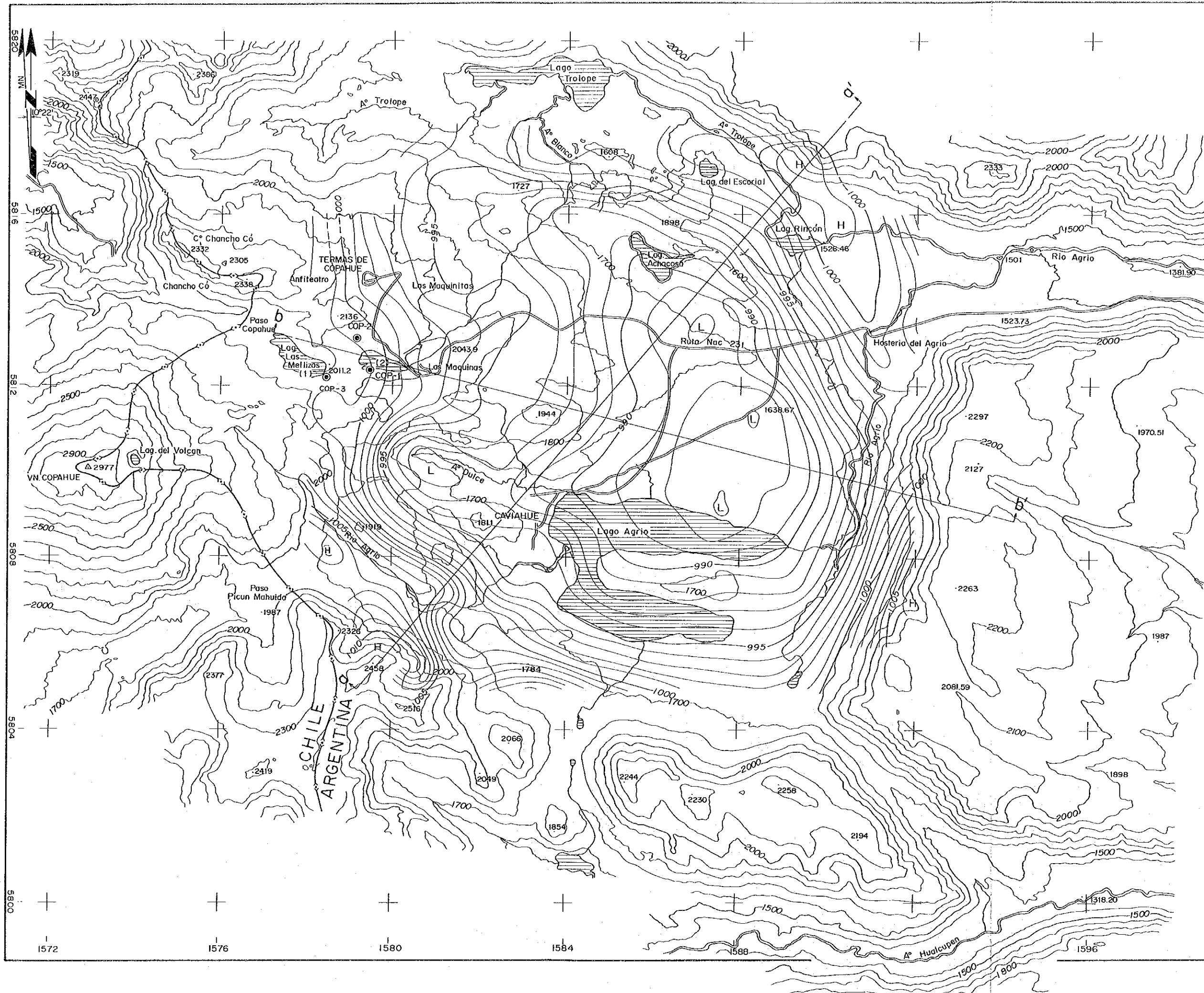


5. Late Pleistocene to Holocene



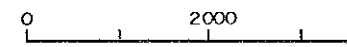
- | | |
|--------------------------------|---|
| C : Copahue Volcanic Rocks | Cc : Cavihue Conglomerate Member |
| AT : A° Trolope Volcanic Rocks | RB : Riscos Bayos pyroclastic Flow Deposits |
| LM : Las Mellizas Formation | H : Hualcupen Formation |

Fig. 5-9 Schematic Profile Showing Geologic Structural History

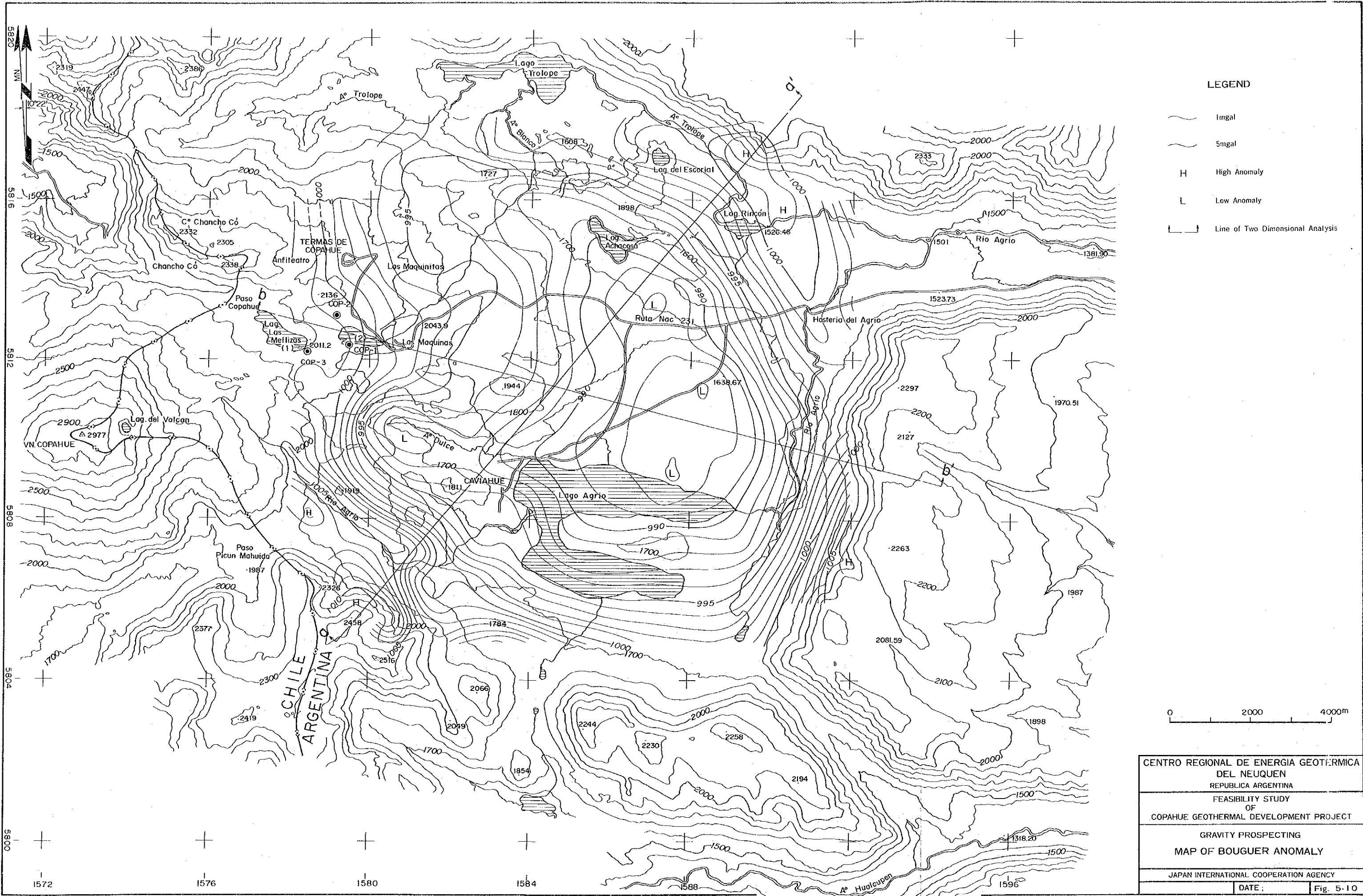


LEGEND






- 1mgal
- 5mgal
- H
- L
- Line of Two Dimensional Anomaly



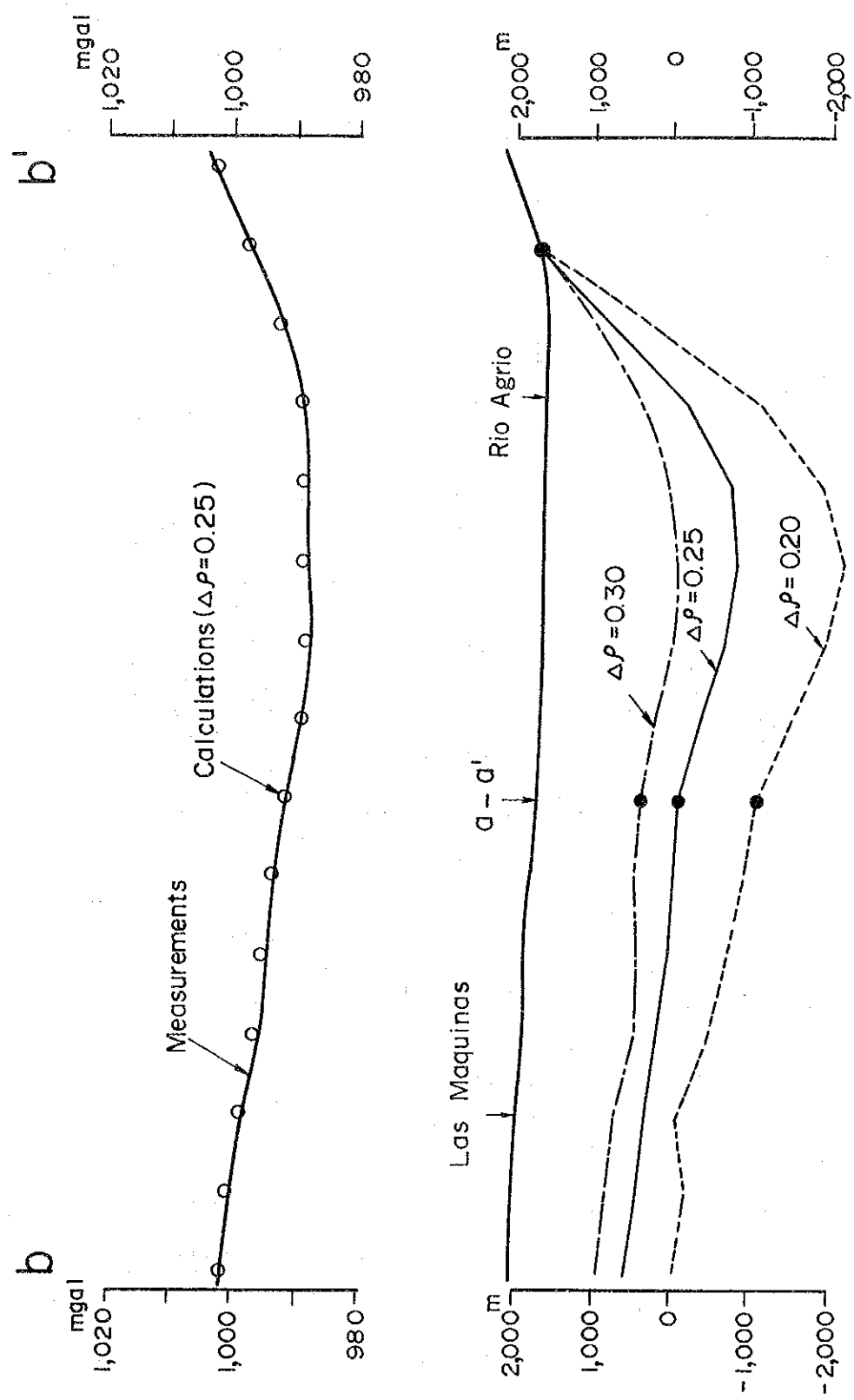
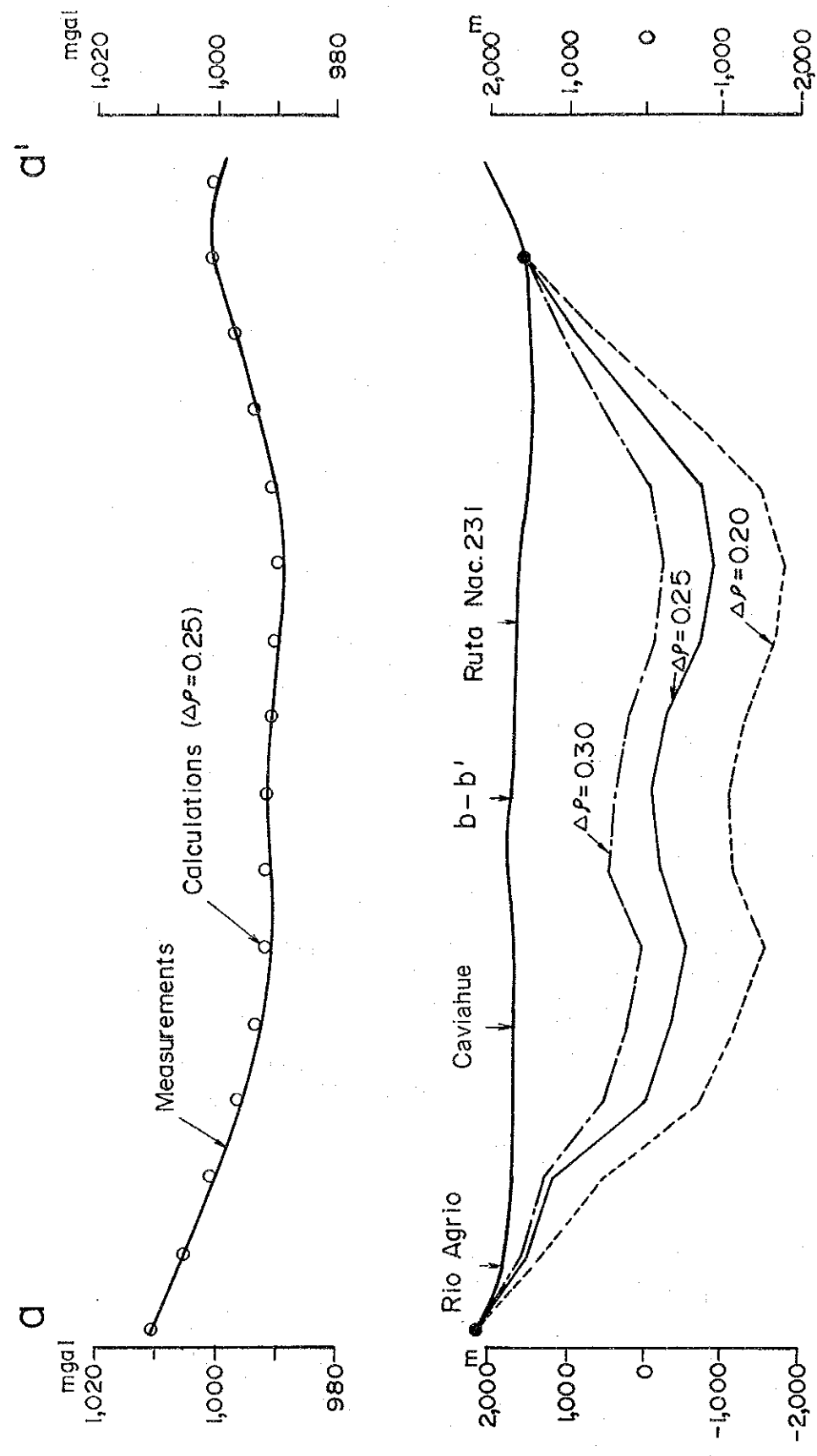
CENTRO REGIONAL DE ENERGIA GEO
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 FEASIBILITY STUDY
 OF
 COPAHUE GEOTHERMAL DEVELOPMENT F
 GRAVITY PROSPECTING
 MAP OF BOUGUER ANOMAL
 JAPAN INTERNATIONAL COOPERATION AGI
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LEGEND

-  1mgal
-  5mgal
-  High Anomaly
-  Low Anomaly
-  Line of Two Dimensional Analysis

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FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT	
GRAVITY PROSPECTING MAP OF BOUGUER ANOMALY	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE:	Fig. 5-10



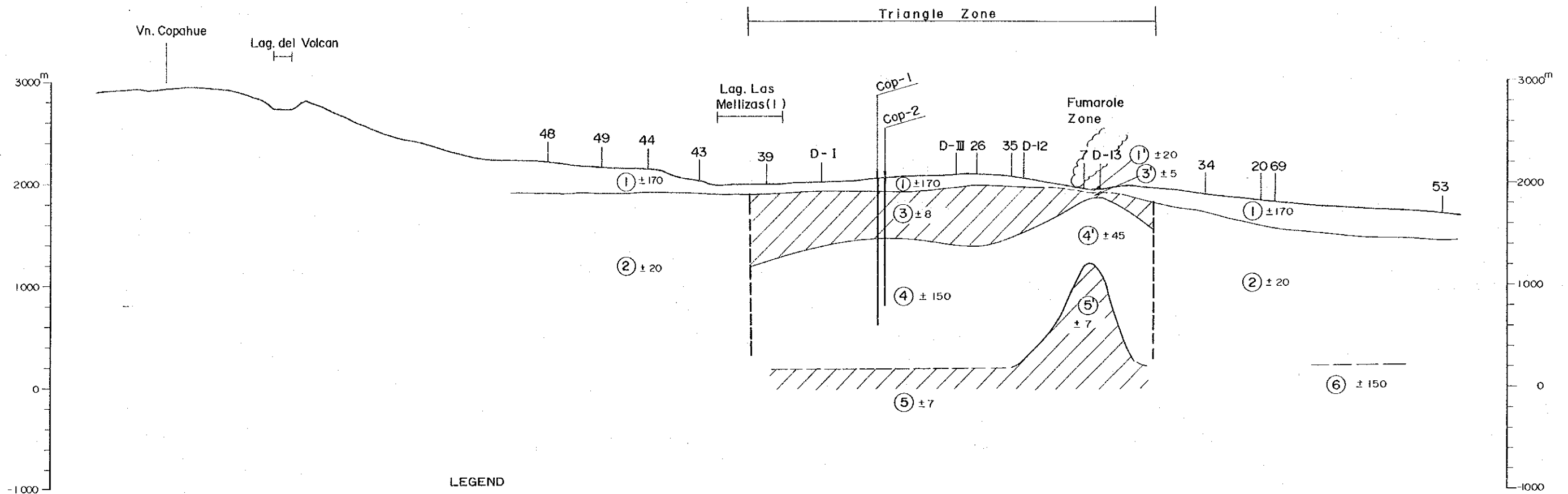
● Control Point

0

5 km

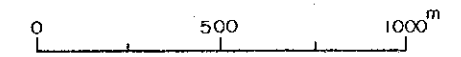
Fig. 5-11 Two Dimensional Analysis of Gravity Prospecting

Profile A - A'

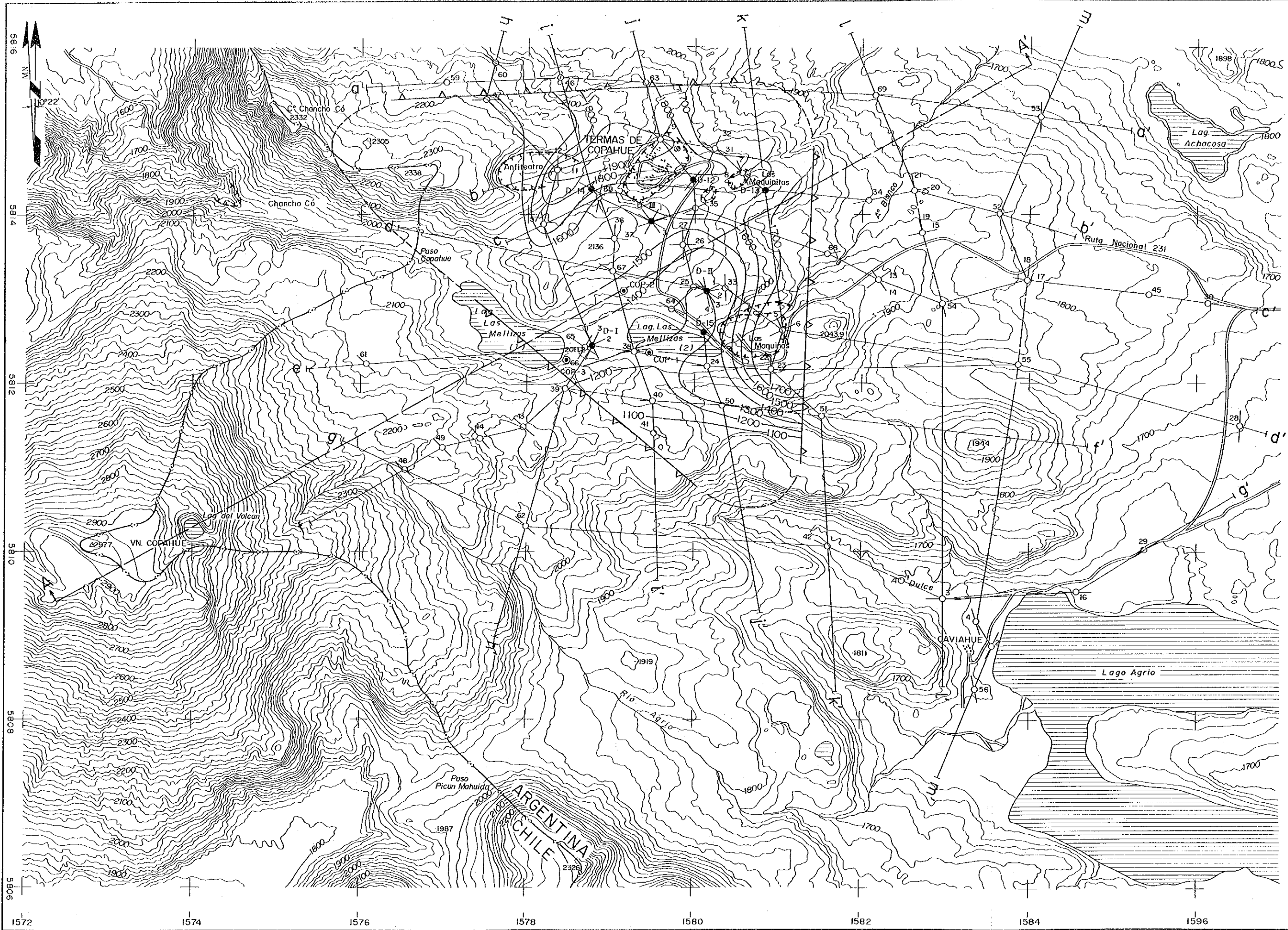


LEGEND

- 48 ↓ Measurement Point Near Profile Line (Projection)
- ① Surface High Resistivity Layer
- ② Peripheral Medium Resistivity Layer
- ③ Shallow Low Resistivity Layer
- ④ Intermediate Depth High Resistivity Layer
- ⑤ Deep Low Resistivity Layer
- ⑥ Deep High Resistivity Layer
- Horizontal Discontinuity of Resistivity Layer
- ① ± 170 Average Resistivity Value of Each Resistivity Layer
- ①' ~ ⑤' Average Resistivity Value in Vicinity of Fumarole Zone
- ▨ Low Resistivity Layers



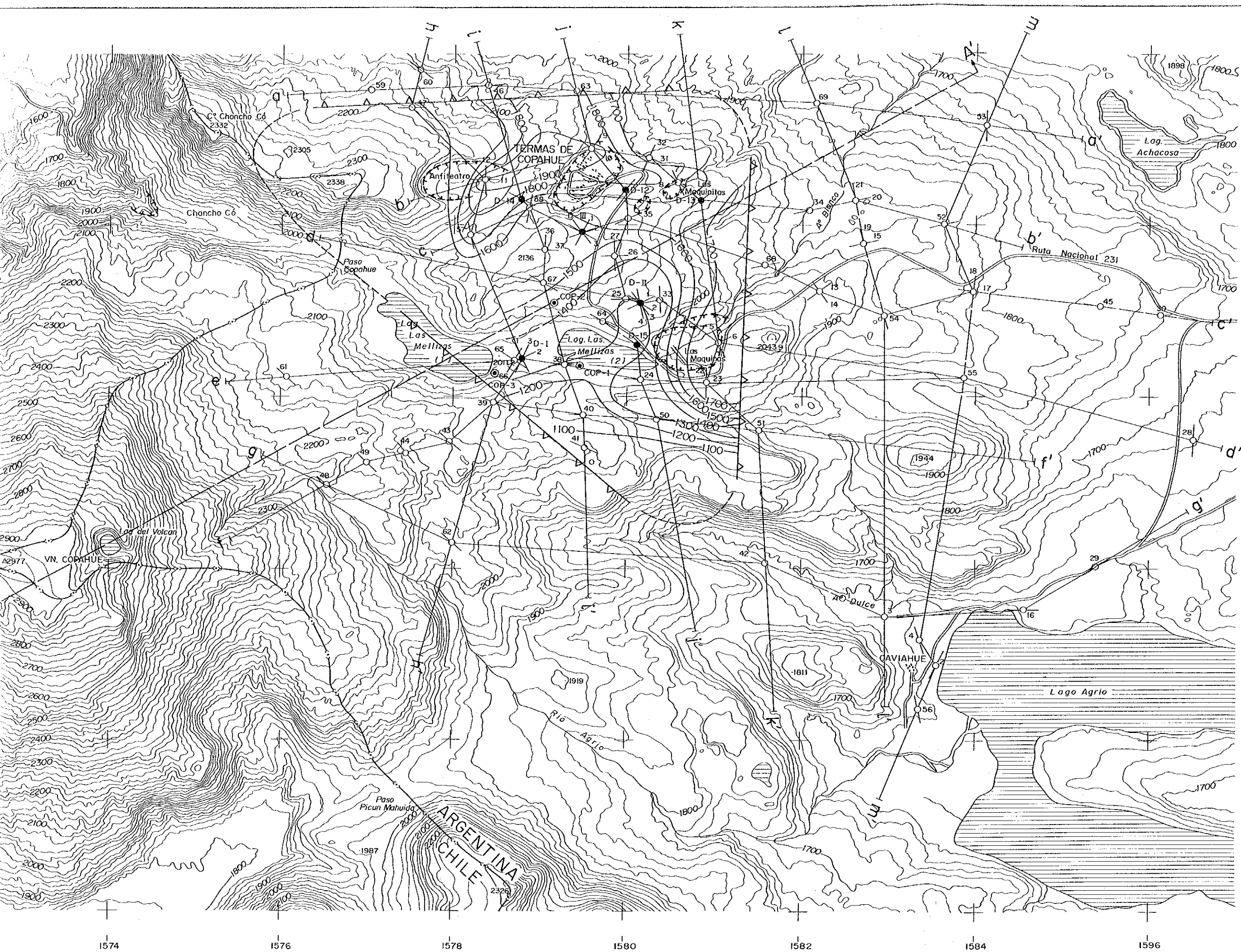
CENTRO REGIONAL DE ENERGIA GEOTERMICA DEL NEUQUEN REPUBLICA ARGENTINA	
FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT	
ELECTRICAL PROSPECTING IDEALIZED PROFILE OF RESISTIVITY LAYERS	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE :	Fig. 5-12



LEG

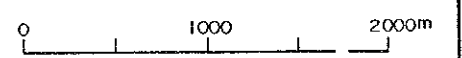
- 25 Meas. Line
- D-1 Deep
- 1200 Cont. Res.
- Uphe. Base
- Hydr. Zone
- 0 0' Profil.
- A A' Ideal Laye

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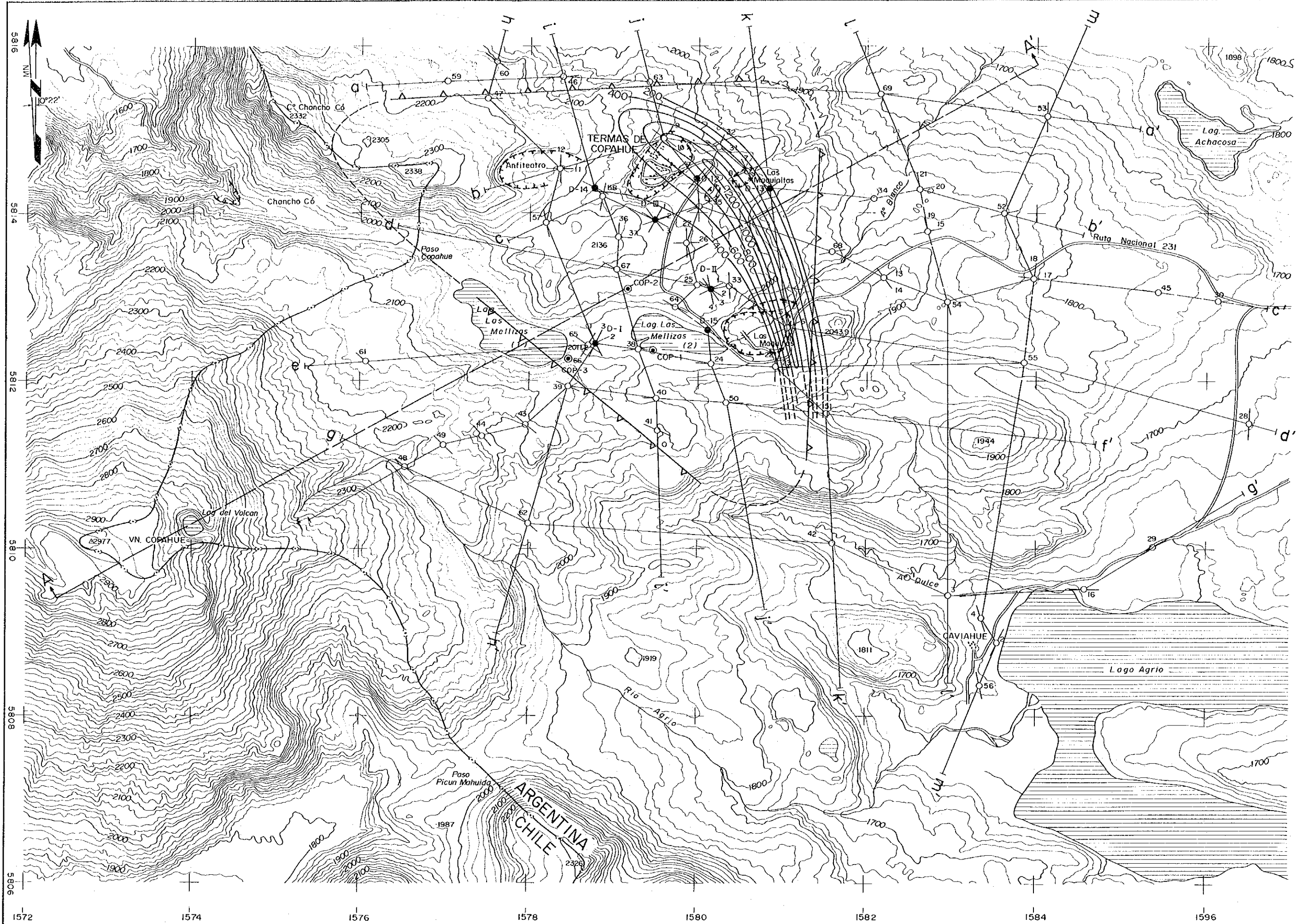
LEGEND

- 25 Measurement Point and Direction of Line(AB/2=2000m)
- D-1 Deep Measurement Point(AB/2=5000m)
- ⌒ 1200 Contour of Top of Intermediate Depth High Resistivity Layer (EL, m)
- ▭ Upheaval Zone of High Resistivity Basement
- ⊖ Hydrothermal Alteration Zone with Fumaroles
- a— a' Profile line of Resistivity Layers
- A— A' Idealized Profile Line of Resistivity Layers



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FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT	
ELECTRICAL PROSPECTING MAP OF TOP OF INTERMEDIATE DEPTH HIGH RESISTIVITY LAYER	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE :	Fig. 5-14

1574 1576 1578 1580 1582 1584 1596

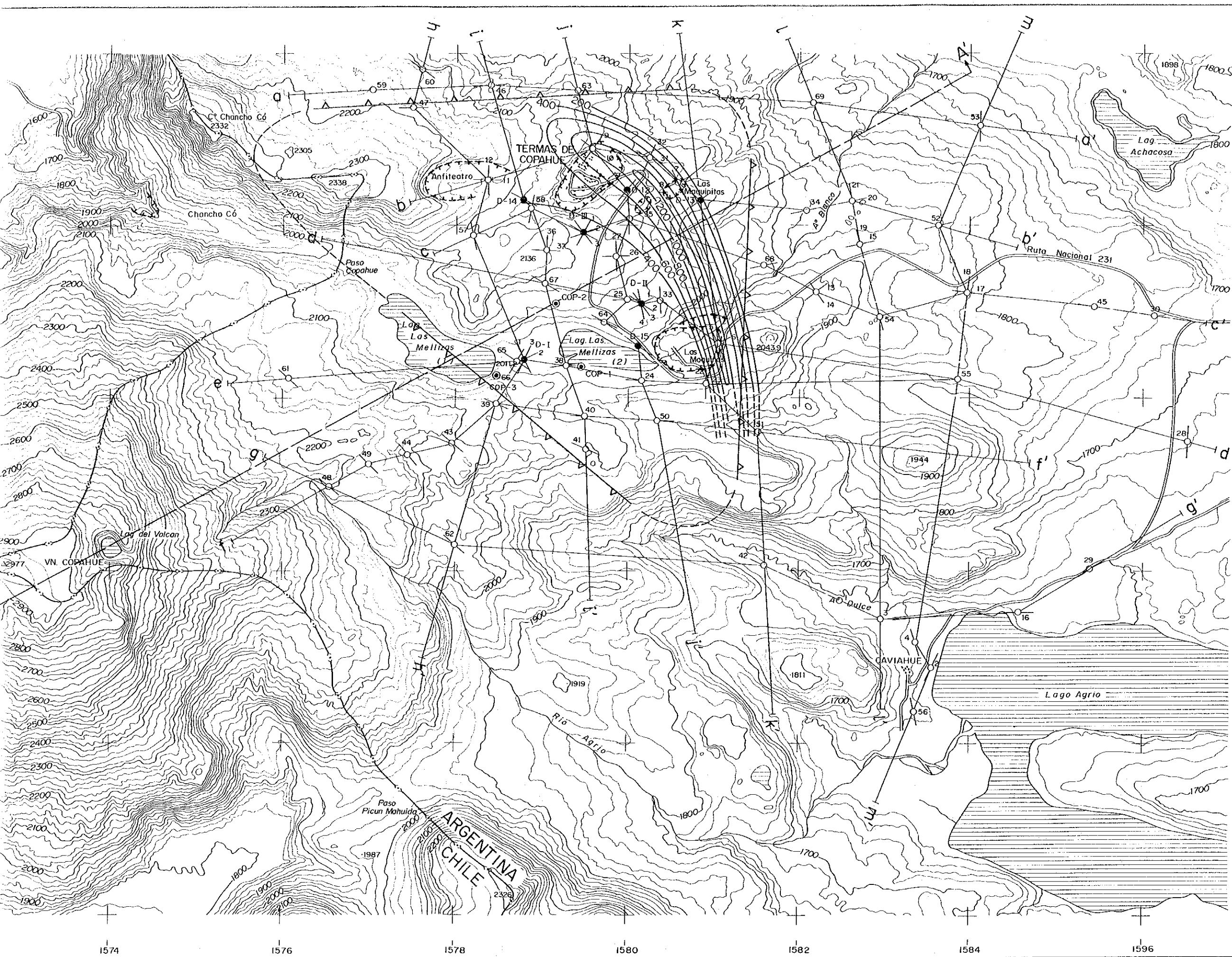


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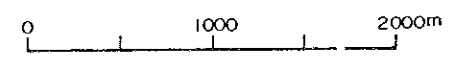
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- 25 Measurement Point and Direction of Line (AB/2=2000m)
- D-1 Deep Measurement Point (AB/2=5000m)
- ⌒ Contour of Detected Depth of Deep High Resistivity Layer (EL, m)
- ▭ Upheaval Zone of High Resistivity Basement
- ⊖ Hydrothermal Alteration Zone with Fumaroles
- 0 9' Profile line of Resistivity Layers
- A A' Idealized Profile Line of Resistivity Layers



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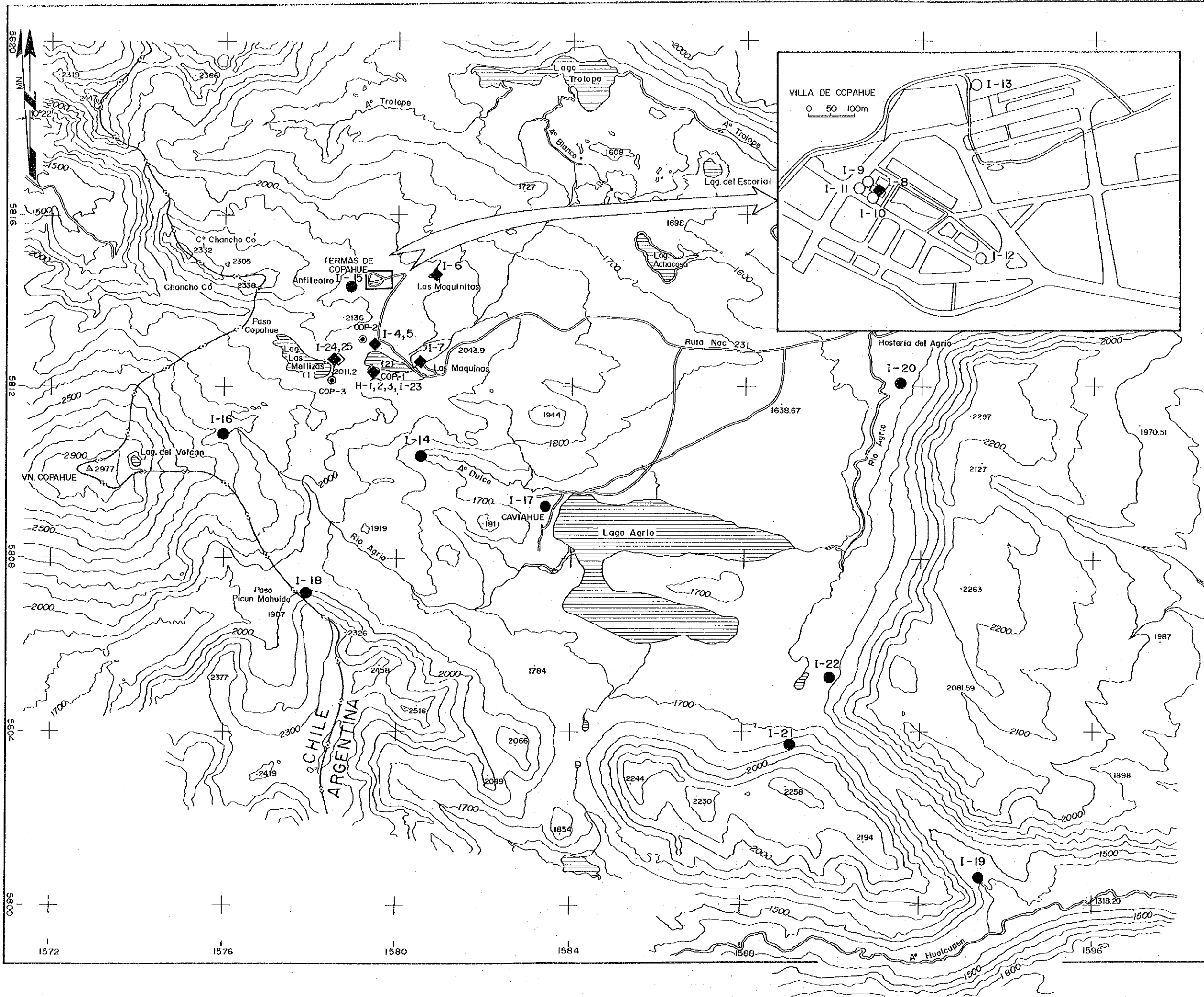
FEASIBILITY STUDY
 OF
 COPAHUE GEOTHERMAL DEVELOPMENT PROJECT

ELECTRICAL PROSPECTING
 MAP OF DETECTED DEPTH
 OF DEEP LOW RESISTIVITY LAYER

JAPAN INTERNATIONAL COOPERATION AGENCY

DATE : _____ Fig. 5-15

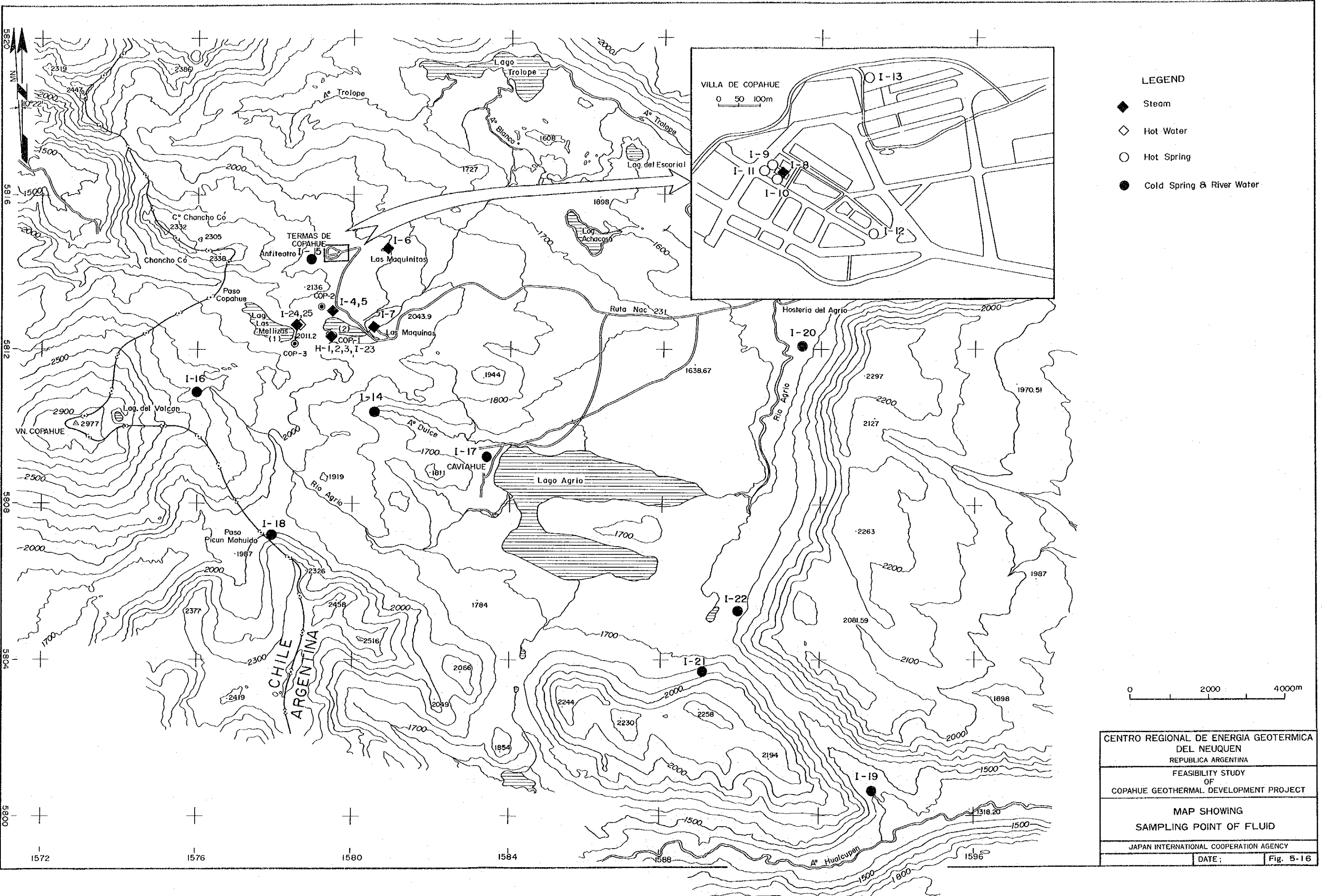
1574 1576 1578 1580 1582 1584 1596



LEGEND

- ◆ Steam
- ◇ Hot Water
- Hot Spring
- Cold Spring & River Water

CENTRO REGIONAL DE ENERGIA GEOTERMICA DEL NEUQUEN
 REPUBLICA ARGENTINA
 FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT
 MAP SHOWING SAMPLING POINT OF FLUID
 JAPAN INTERNATIONAL COOPERATION AGENCY
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- LEGEND**
- ◆ Steam
 - ◇ Hot Water
 - Hot Spring
 - Cold Spring & River Water

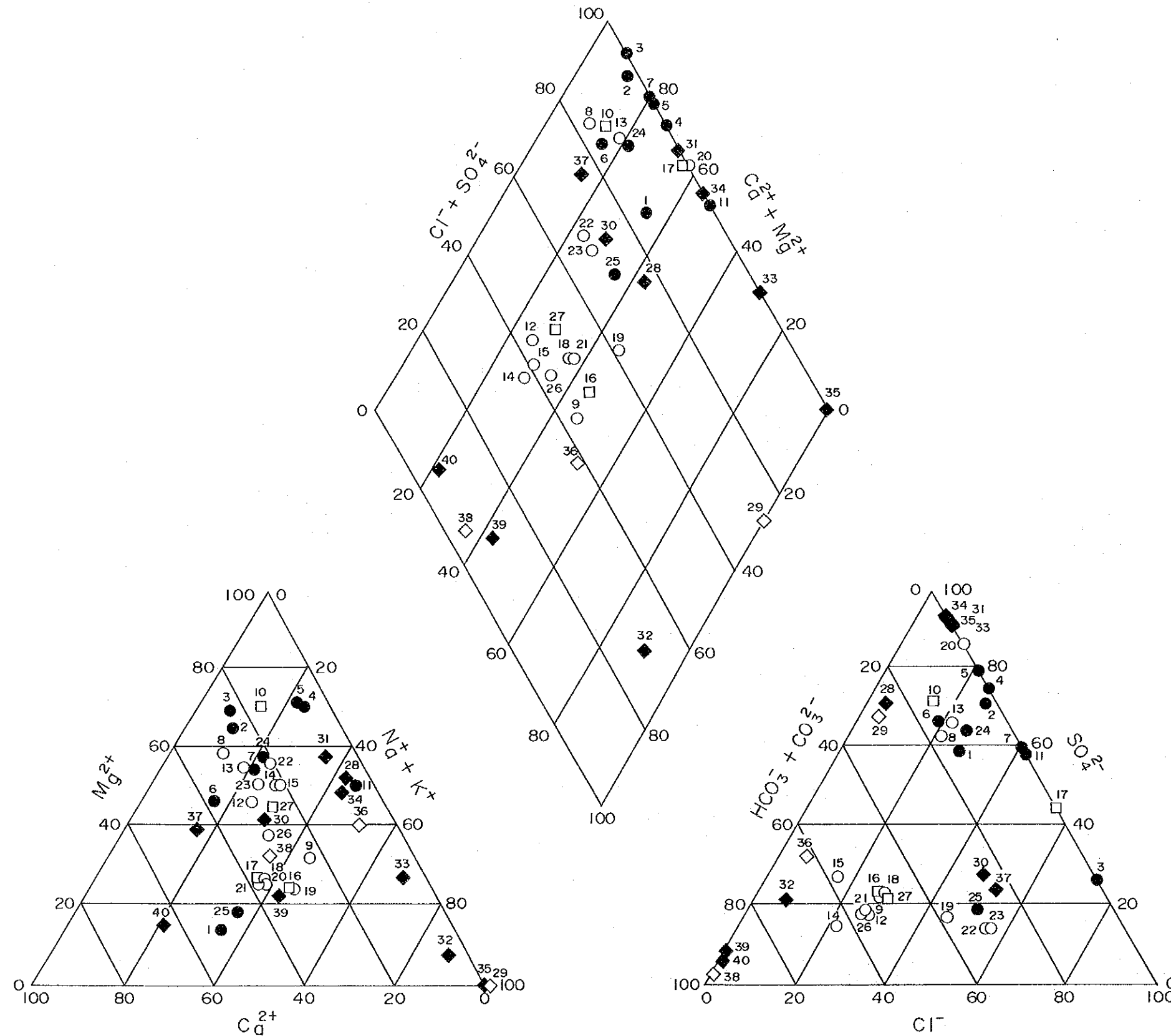
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DEL NEUQUEN
REPUBLICA ARGENTINA

FEASIBILITY STUDY
OF
COPAHUE GEOTHERMAL DEVELOPMENT PROJECT

MAP SHOWING
SAMPLING POINT OF FLUID

JAPAN INTERNATIONAL COOPERATION AGENCY

DATE: _____ Fig. 5-16



LEGEND

No. in Fig.	Sampling Number in Original Data	No. in Fig.	Sampling Number in Original Data
1	Agrio 1	21	CO 8
2	Agrio 2	22	CO 10
3	Agrio 3	23	CO 11
4	CAV 1	24	CO 12
5	CAV 2	25	CO 15
6	CAV 5	26	RHCP 3
7	CAV 6	27	HA 3
8	CAV 7	28	MA 2
9	ARA 2	29	MA 3
10	ARA 4	30	MA 5
11	ARA 6	31	MA 7
12	HU 5	32	MA 9
13	HAC 3	33	MAT 4
14	IT	34	MAT 6
15	3T	35	ANF 3
16	CO 1	36	ANF 5
17	CO 2	37	ANF 6
18	CO 4	38	COPA 5
19	CO 5	39	COPA 6
20	CO 7	40	COPA 7

Nos. 1~37 are from Reference C-1 (ANEXO-2)
 Nos. 38~40 are from Reference C-18.

	Acidic pH < 6	Neutral 6 ≤ pH < 7.5
River & Lake	●	○
Cold Spring	■	□
Hot Spring	◆	◇

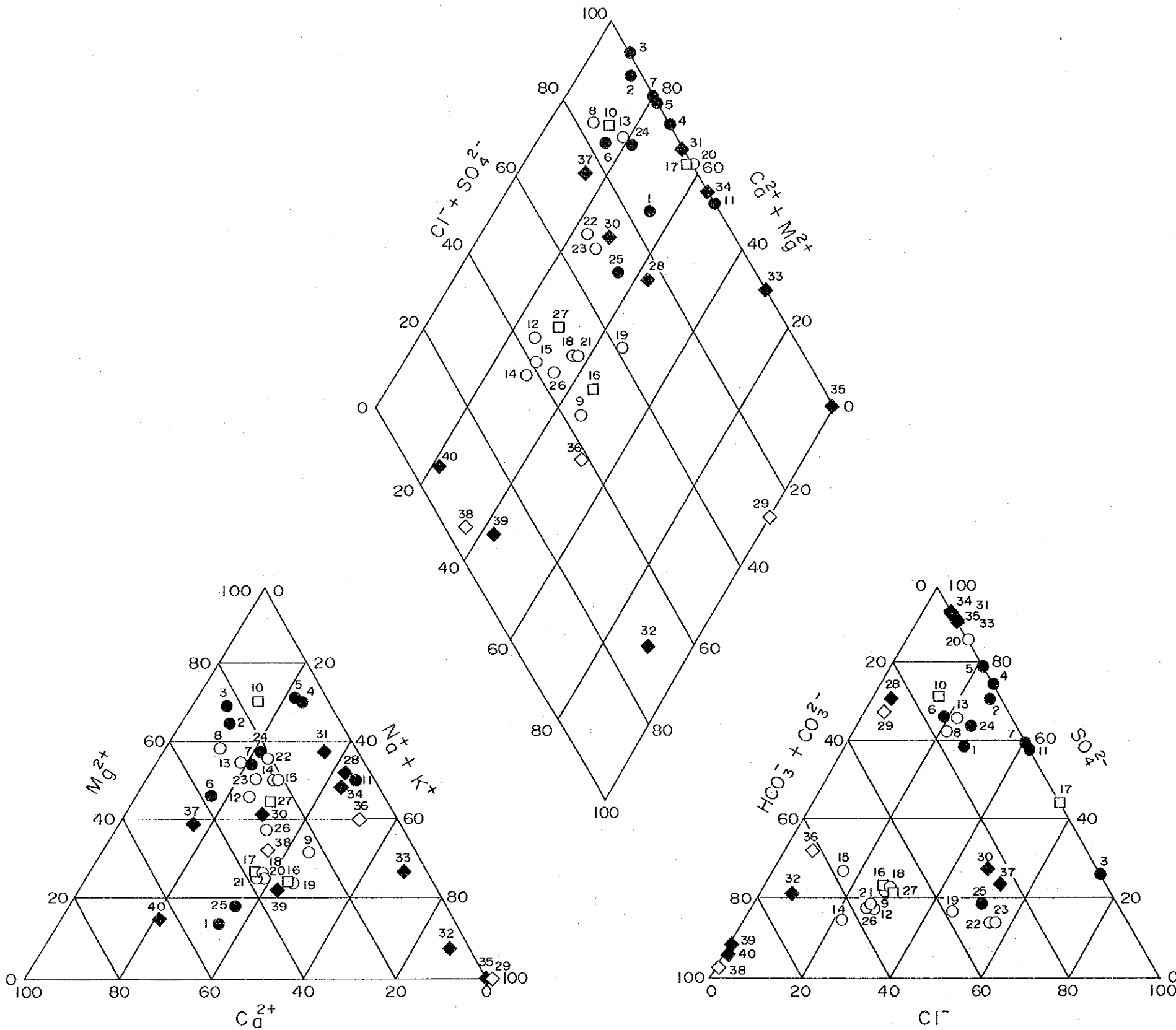
LEGEND

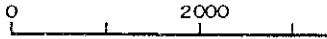
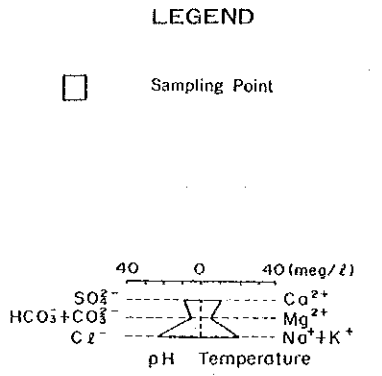
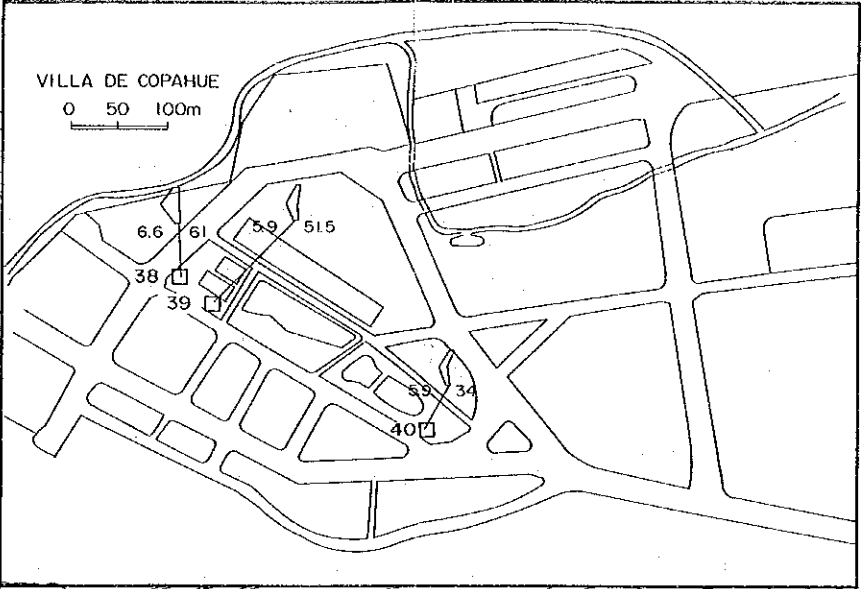
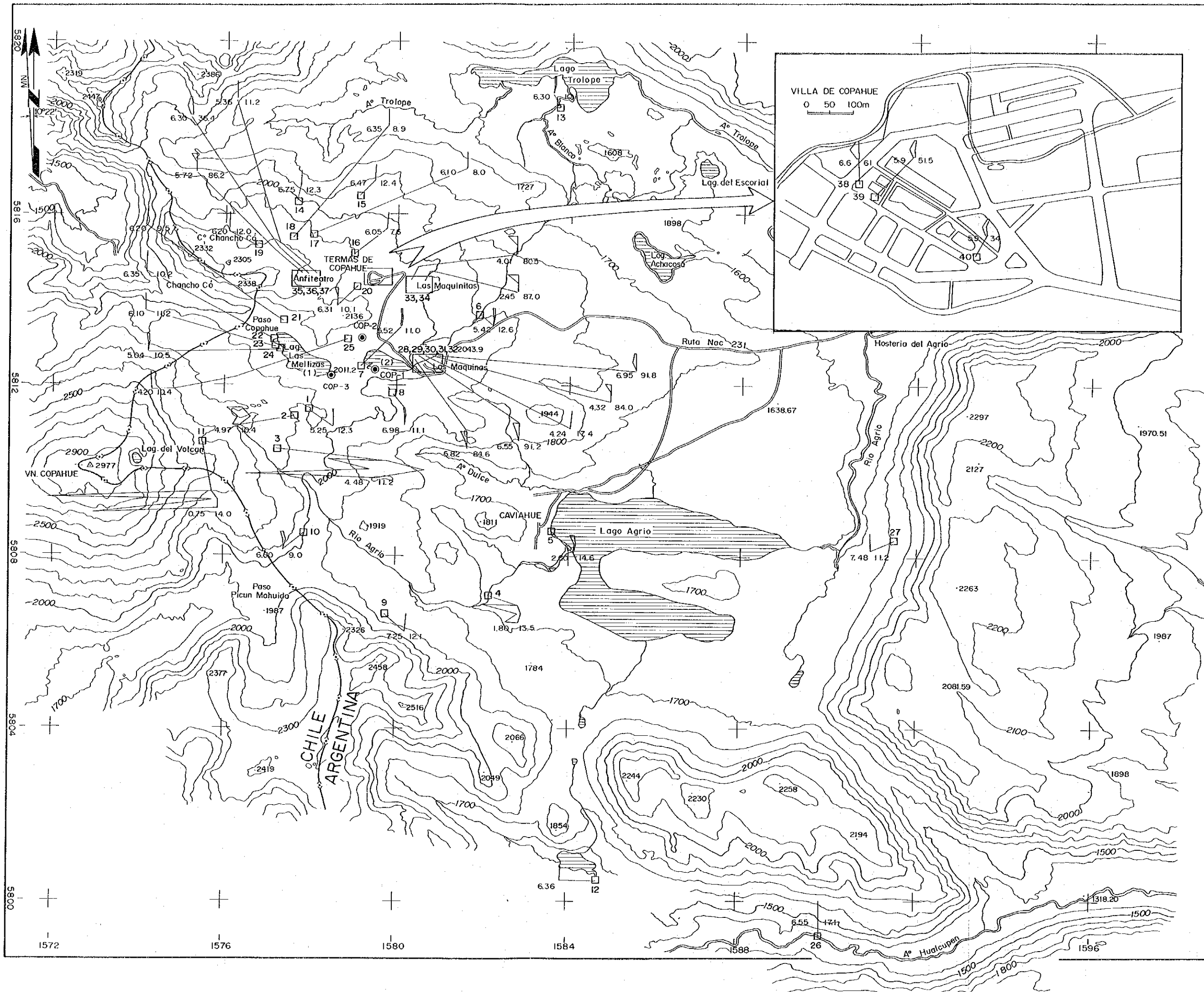
No. in Fig.	Sampling Number in Original Data	No. in Fig.	Sampling Number in Original Data
1	Agrio 1	21	CO 8
2	Agrio 2	22	CO 10
3	Agrio 3	23	CO 11
4	CAV 1	24	CO 12
5	CAV 2	25	CO 15
6	CAV 5	26	RHCP 3
7	CAV 6	27	HA 3
8	CAV 7	28	MA 2
9	ARA 2	29	MA 3
10	ARA 4	30	MA 5
11	ARA 6	31	MA 7
12	HU 5	32	MA 9
13	HAC 3	33	MAT 4
14	IT	34	MAT 6
15	3T	35	ANF 3
16	CO 1	36	ANF 5
17	CO 2	37	ANF 6
18	CO 4	38	COPA 5
19	CO 5	39	COPA 6
20	CO 7	40	COPA 7

Nos. 1~37 are from Reference C-1 (ANEXO-2)
 Nos. 38~40 are from Reference C-18.

	Acidic pH < 6	Neutral 6 ≤ pH < 7.5
River & Lake	●	○
Cold Spring	■	□
Hot Spring	◆	◇

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 OF
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 KEY DIAGRAM OF
 CHEMICAL COMPOSITION
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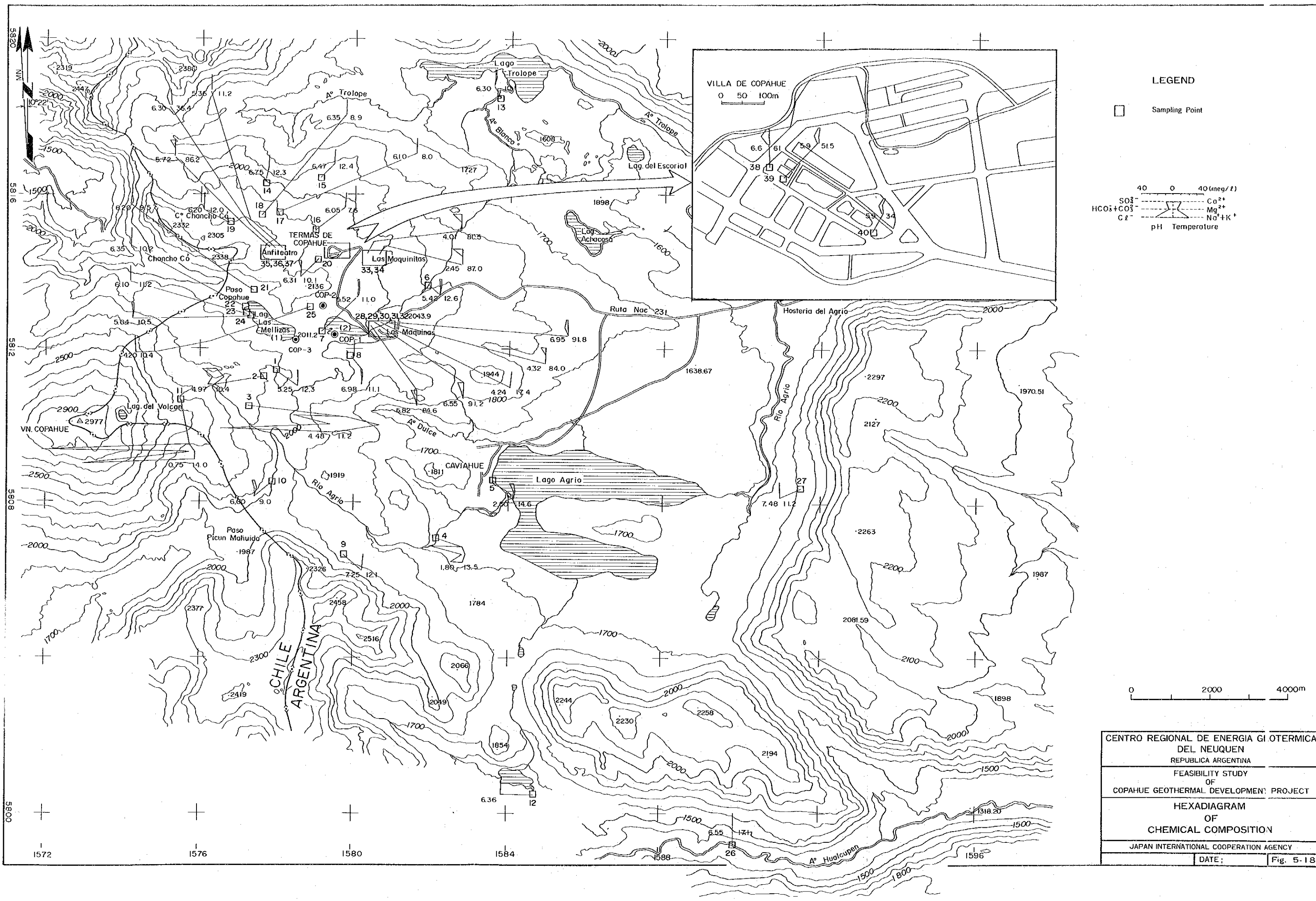
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 DEL NEUQUEN
 REPUBLICA ARGENTINA

FEASIBILITY STUDY
 OF
 COPAHUE GEOTHERMAL DEVELOPMENT

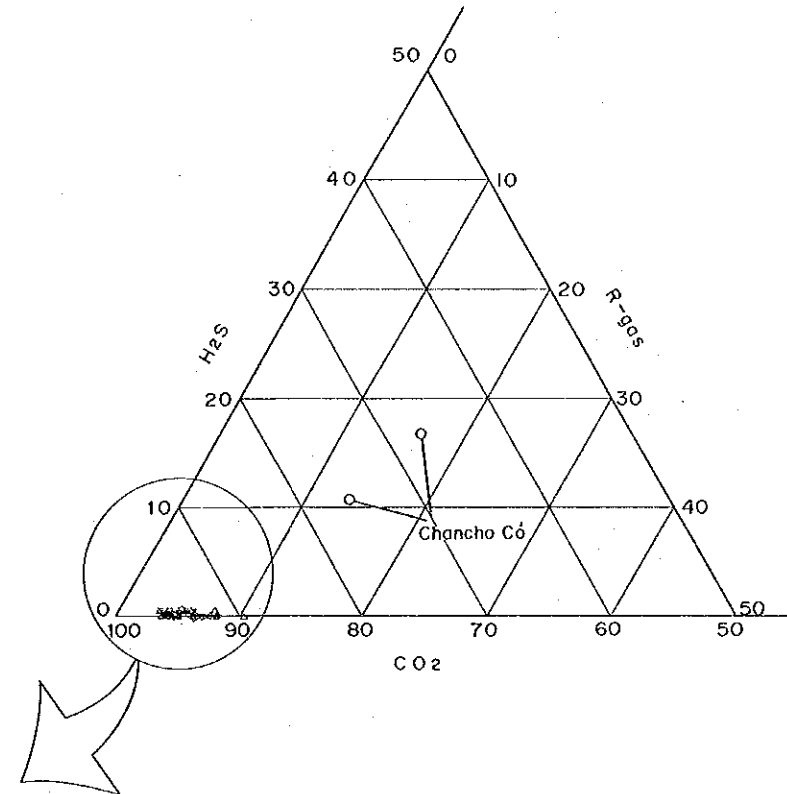
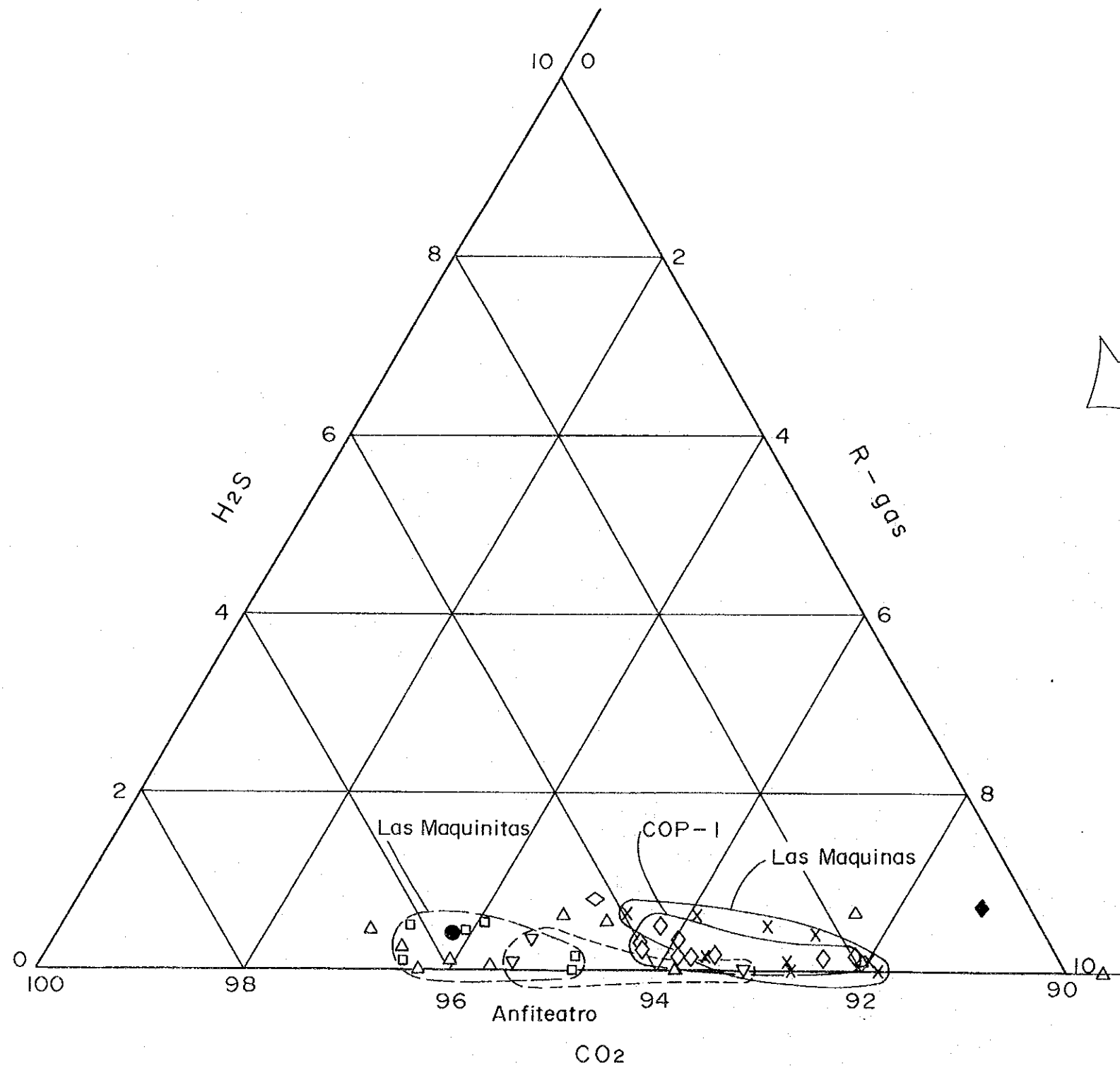
HEXADIAGRAM
 OF
 CHEMICAL COMPOSITION

JAPAN INTERNATIONAL COOPERATION AGENCY

DATE:



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 DEL NEUQUEN
 REPUBLICA ARGENTINA
 FEASIBILITY STUDY
 OF
 COPAHUE GEOTHERMAL DEVELOPMENT PROJECT
 HEXADIAGRAM
 OF
 CHEMICAL COMPOSITION
 JAPAN INTERNATIONAL COOPERATION AGENCY
 DATE: _____ Fig. 5-18

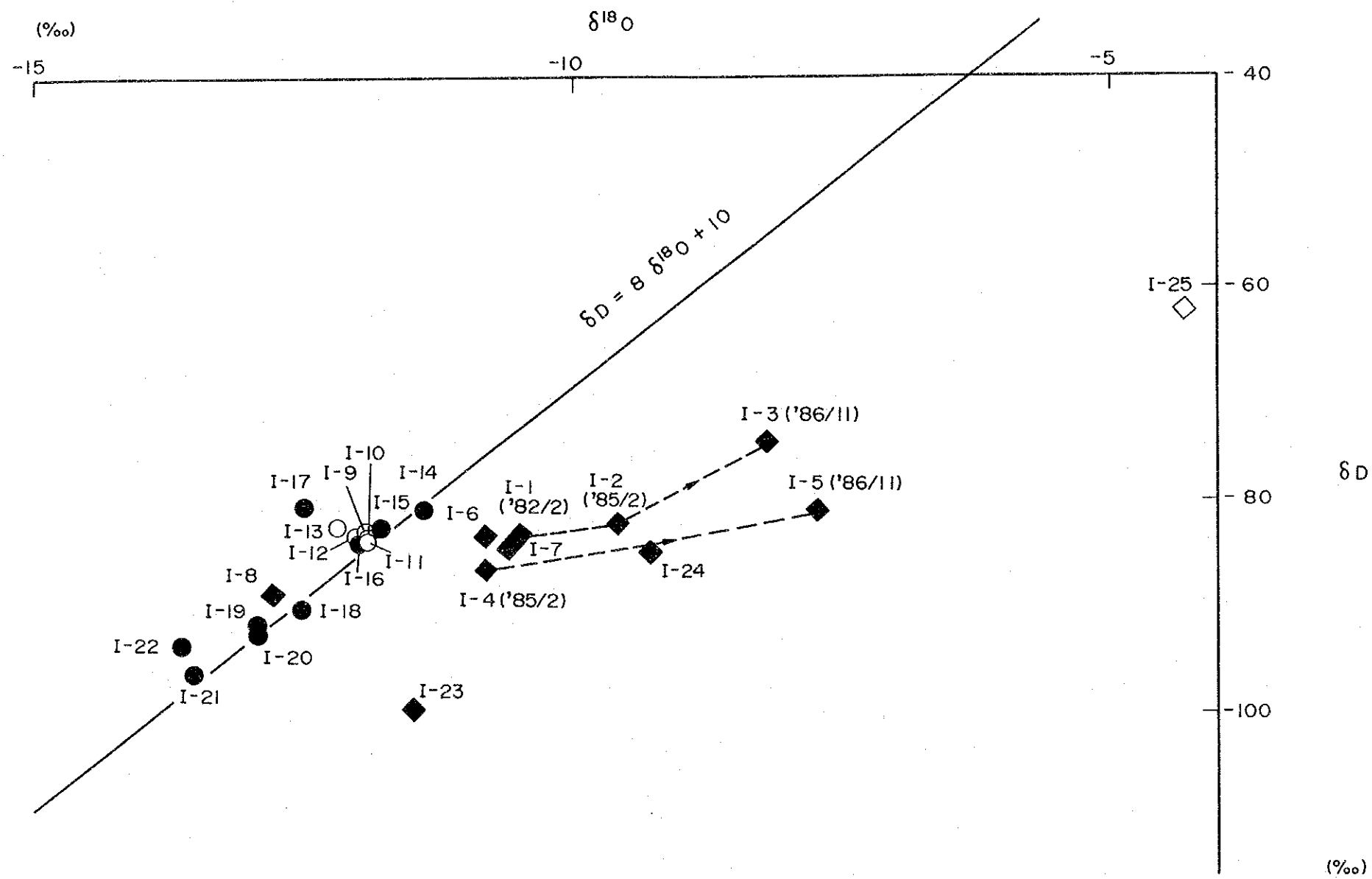


LEGEND

- △ Termas de Copahue
- X Las Maquinas
- Las Maquinitas
- ▽ Anfiteatro
- ◇ COP-1
- ◇ COP-2
- COP-3

Note: Solid Symbol Shows Analysis of June 1991.

CENTRO REGIONAL DE ENERGIA GEOTERMICA DEL NEUQUEN REPUBLICA ARGENTINA		
FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT		
TRILINEAR DIAGRAM FOR H ₂ S, CO ₂ AND R-GAS		
JAPAN INTERNATIONAL COOPERATION AGENCY		
DATE:		Fig. 5-19



LEGEND

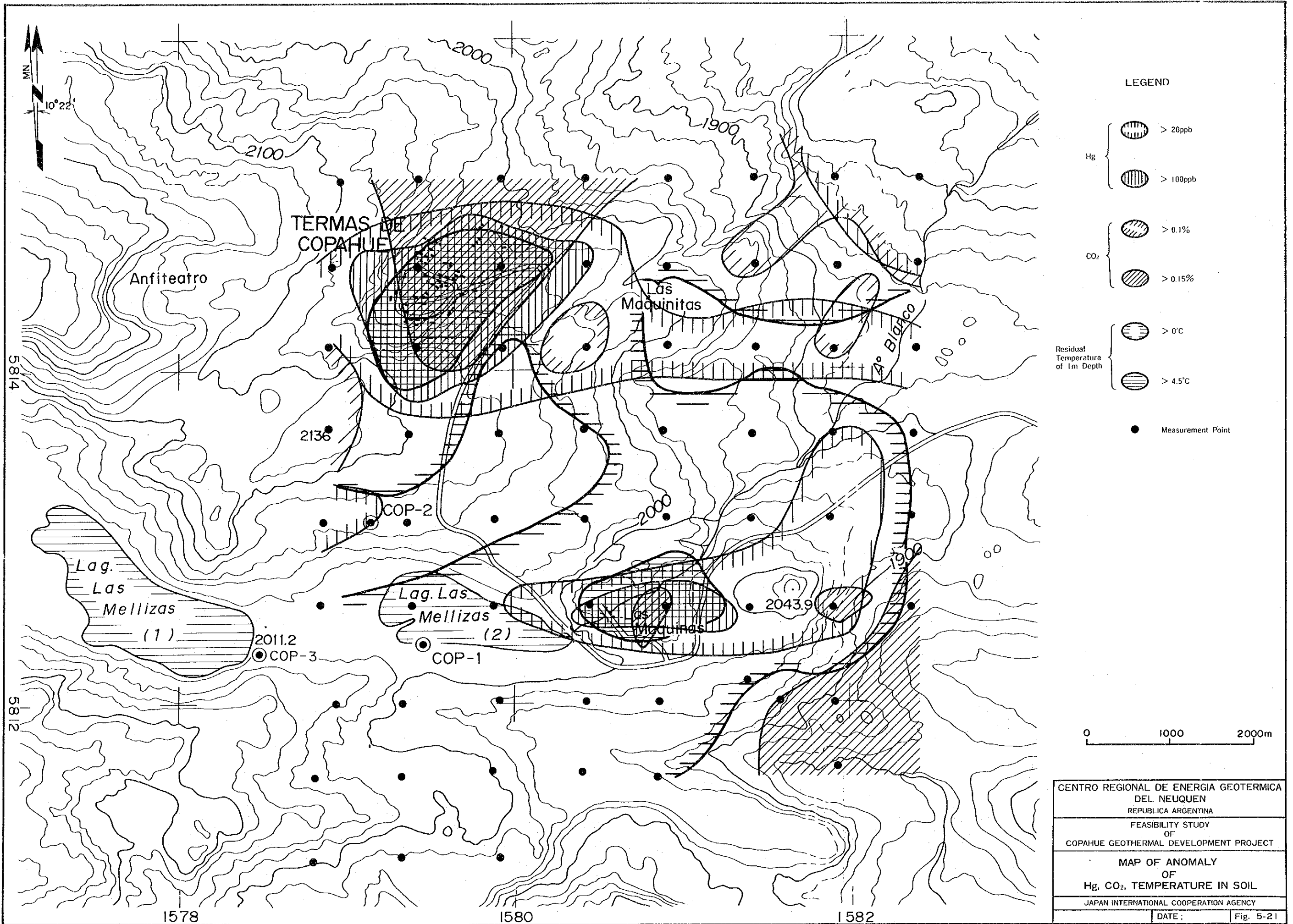
- ◆ Steam
- ◇ Hot Water
- Hot Spring
- Cold Spring and River Water

No. in Fig.	Sampling number in original data
I- 1	COP - I
I- 2	COPA-2(=COP-I)
I- 3	COP - I
I- 4	COP - II
I- 5	COP - II
I- 6	COPA-I
I- 7	COPA-3
I- 8	COPA-20
I- 9	COPA-5
I-10	COPA-6
I-11	COPA-4
I-12	COPA-7
I-13	COPA-9
I-14	CAVI-4
I-15	COPA-8
I-16	COPA-12
I-17	CAVI-1
I-18	VAF - 1
I-19	CAVI-3
I-20	VAF - 2
I-21	CAVI-2
I-22	VAF - 3
I-23	COP-I (JICA, '91/6)
I-24	COP-3(JICA, '91/6)
I-25	COP-3(JICA, '91/6)

Note :

No.I-1 ~ 22 ; D' Amore et al. (1987)
 (Reference No : C - 18)

CENTRO REGIONAL DE ENERGIA GEOTERMICA DEL NEUQUEN REPUBLICA ARGENTINA	
FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT	
ISOTOPIC COMPOSITION OF WATER	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE :	Fig. 5-20



LEGEND

- Hg {
 - > 20ppb
 - > 100ppb
- CO₂ {
 - > 0.1%
 - > 0.15%
- Residual Temperature of 1m Depth {
 - > 0°C
 - > 4.5°C
- Measurement Point

CENTRO REGIONAL DE ENERGIA GEOTERMICA
 DEL NEUQUEN
 REPUBLICA ARGENTINA

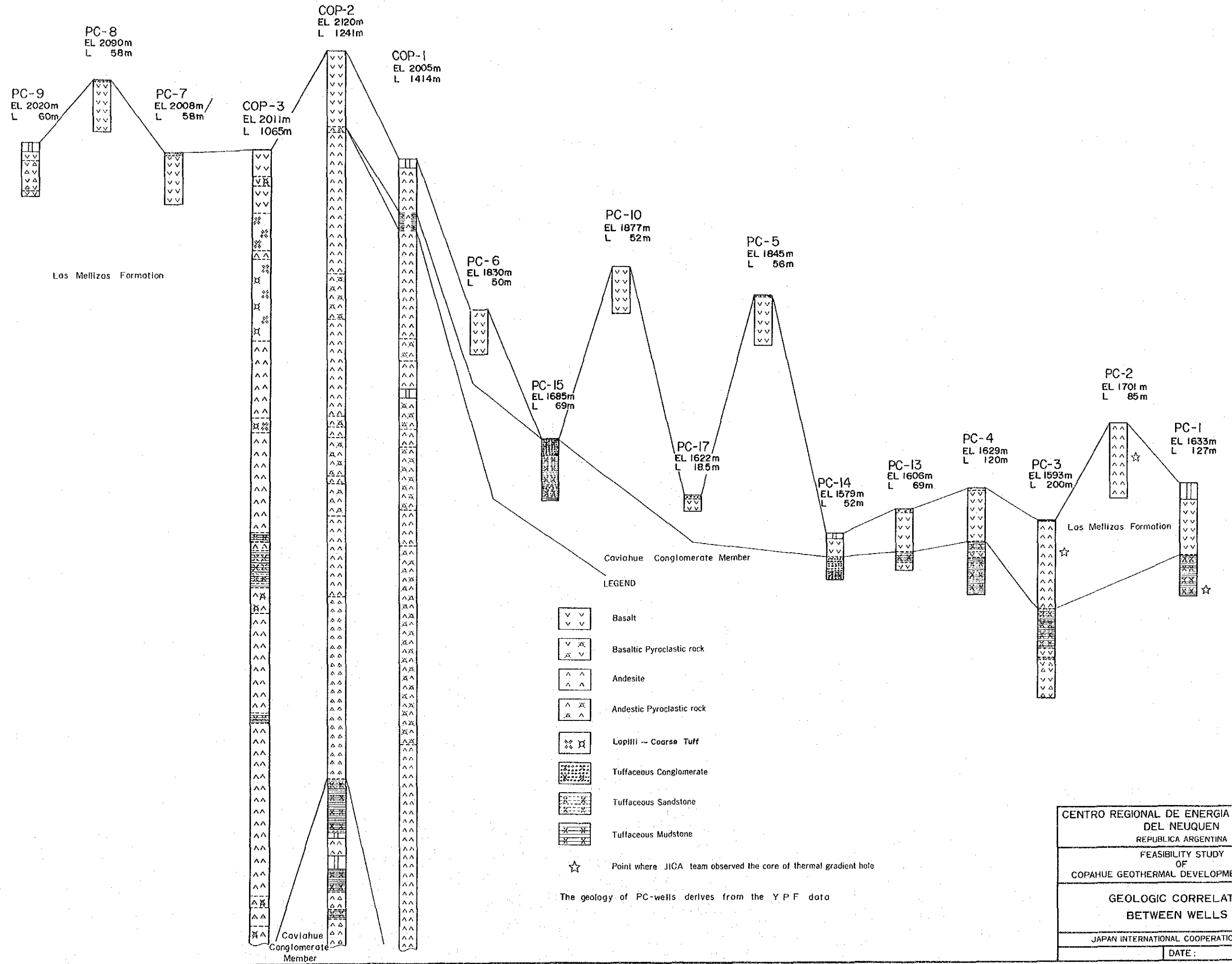
FEASIBILITY STUDY
 OF
 COPAHUE GEOTHERMAL DEVELOPMENT PROJECT

MAP OF ANOMALY
 OF
 Hg, CO₂, TEMPERATURE IN SOIL

JAPAN INTERNATIONAL COOPERATION AGENCY

DATE: Fig. 5-21

ALTITUDE



LEGEND

- Basalt
- Basaltic Pyroclastic rock
- Andesite
- Andestic Pyroclastic rock
- Lapilli ~ Coarse Tuff
- Tuffaceous Conglomerate
- Tuffaceous Sandstone
- Tuffaceous Mudstone
- Point where JICA team observed the core of thermal gradient hole

The geology of PC-wells derives from the Y P F data

CENTRO REGIONAL DE ENERGIA GEOTERMICA DEL NEUQUEN REPUBLICA ARGENTINA	
FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT	
GEOLOGIC CORRELATION BETWEEN WELLS	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE:	Fig. 5-22

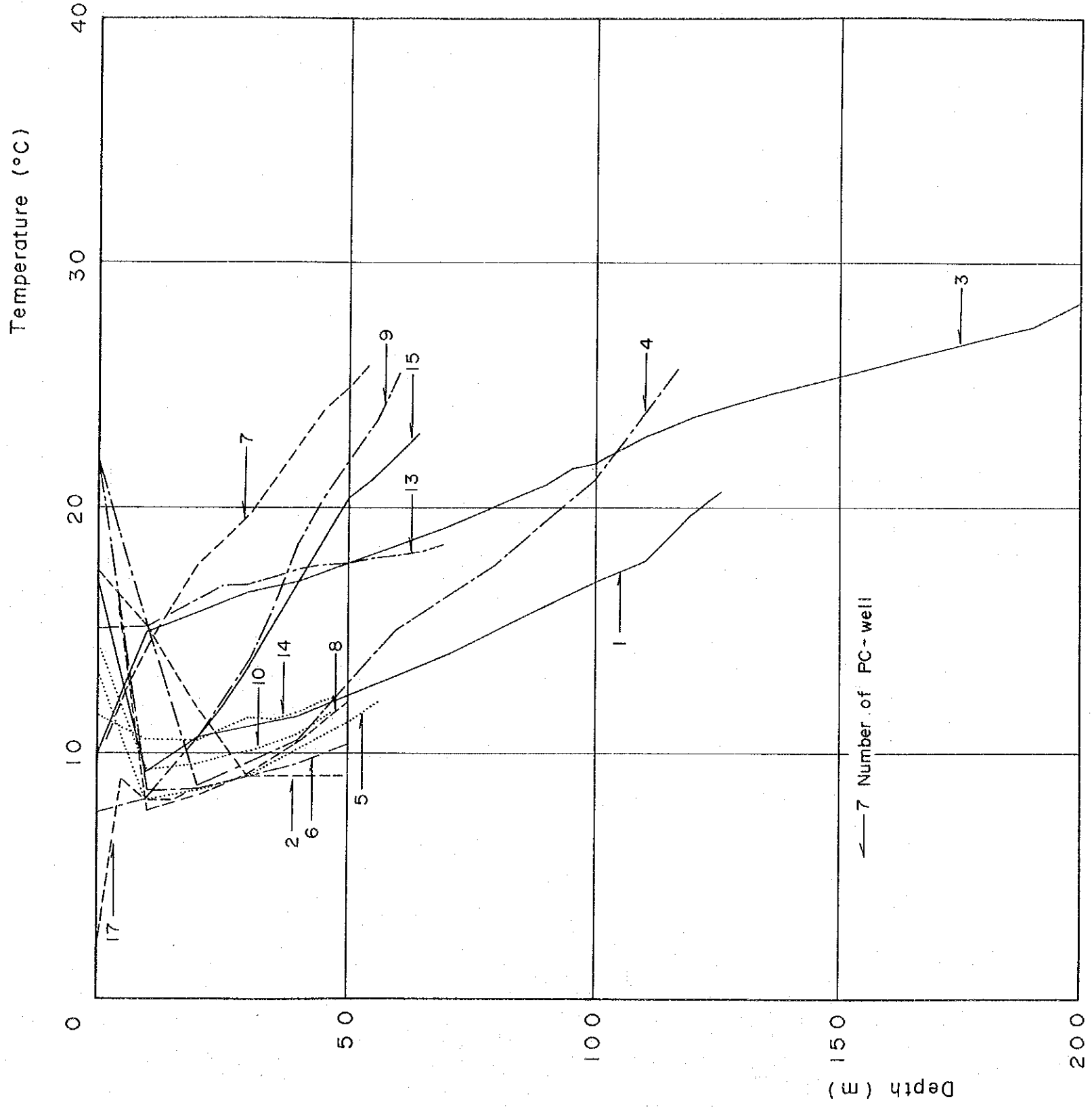
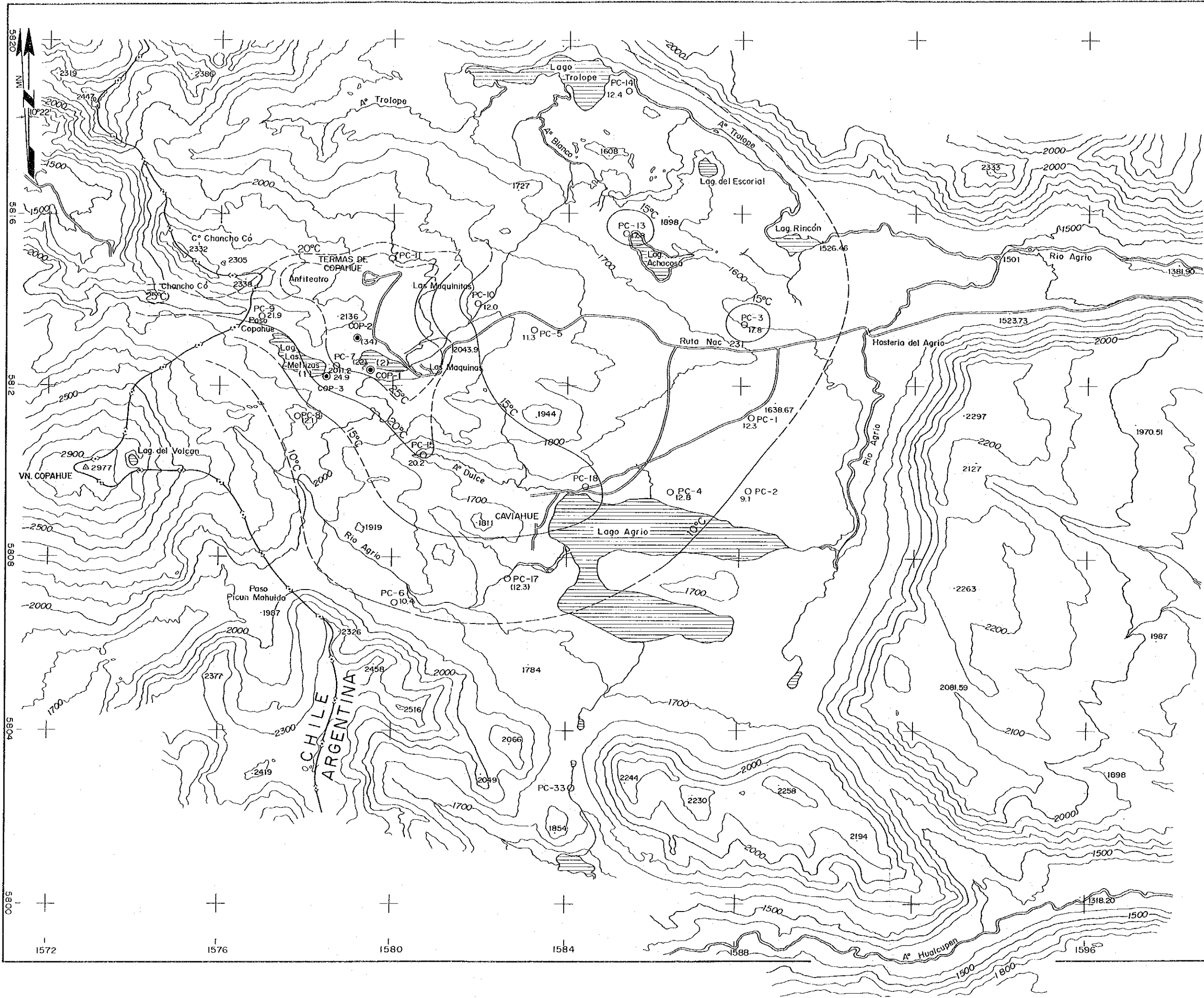
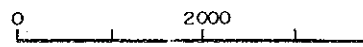


Fig. 5-23 Temperature vs Depth Diagram of Thermal Gradient Holes



LEGEND

- ⊙ (22) Exploratory Well
Inferred Temperature (°C)
- (24.9) Thermal Gradient Hole
Measurement Temperature (°C)
- 20°C Isotherms



CENTRO REGIONAL DE ENERGIA GEOTERMICA DEL NEUQUEN
 REPUBLICA ARGENTINA
 FEASIBILITY STUDY OF COPAHUE GEOTHERMAL DEVELOPMENT PROJECT
 ISOTHERMS AT 50M DEPTH
 JAPAN INTERNATIONAL COOPERATION AGENCY
 DATE: _____ Fig. _____

5820
5816
5812
5808
5804
5800
1572 1576 1580 1584 1588 1596