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ARGENTINE REPUBLIC
INTERIM REPORT ON THE NORTHERN NEUQUEN GEOTHERMAL DEVELOPMENT PROJECT

FIRST•SECOND PHASE SURVEY

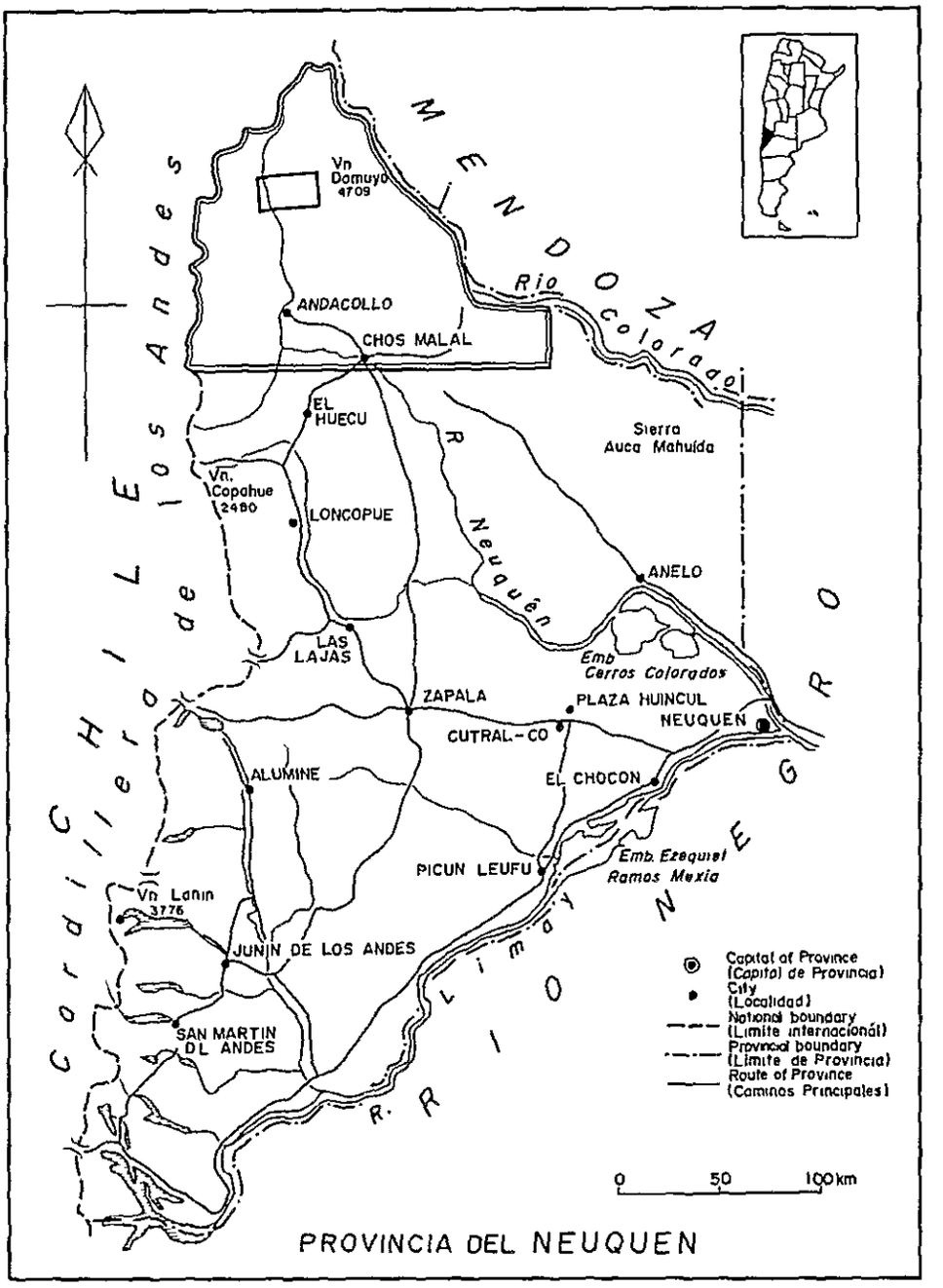
(SEPARATE VOLUME: FIGURES)

NOVEMBER 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

List of Figures

1. General Remarks



15,000 km^2 — First phase survey area (Area estudiada en la primera etapa)

200 km^2 — Second phase survey area (Area en estudio segunda etapa)

Fig.1-1 Location map of the survey areas

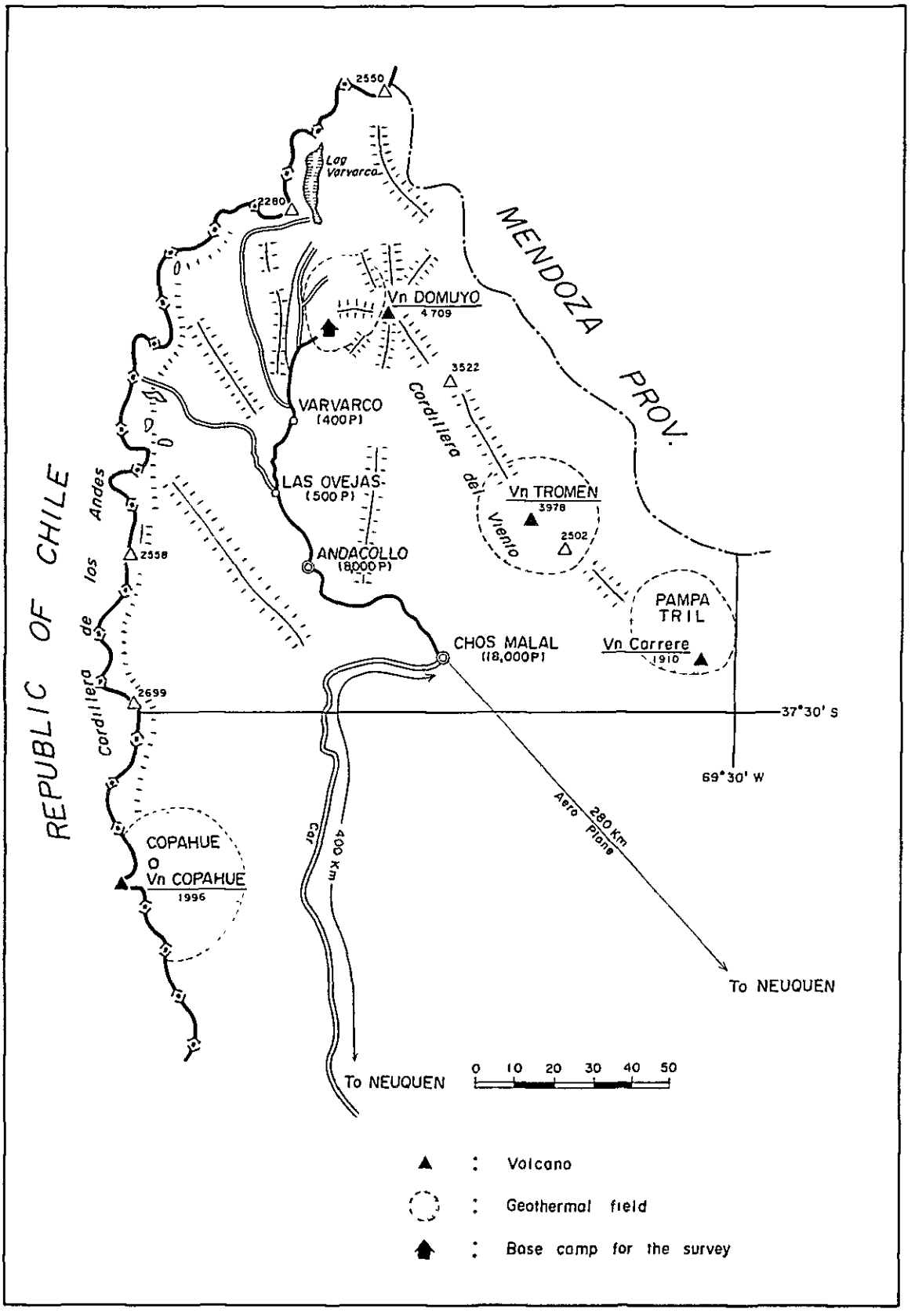


Fig.1-2 Explanatory map of northern parts of the Province of Neuquen

2. Outlines of the First Phase Survey

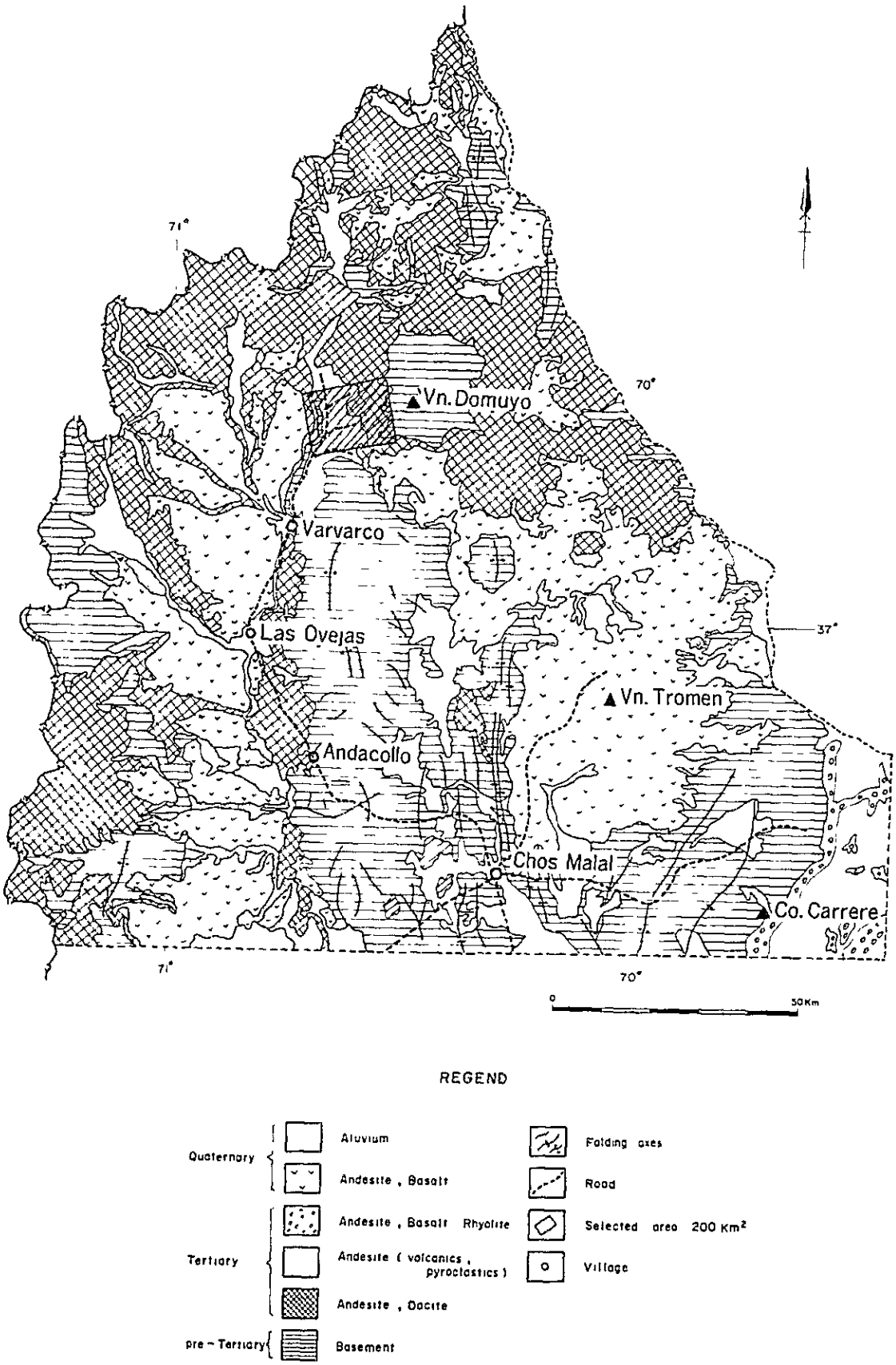


Fig.2-1 Geological interpretation map of Landsat image

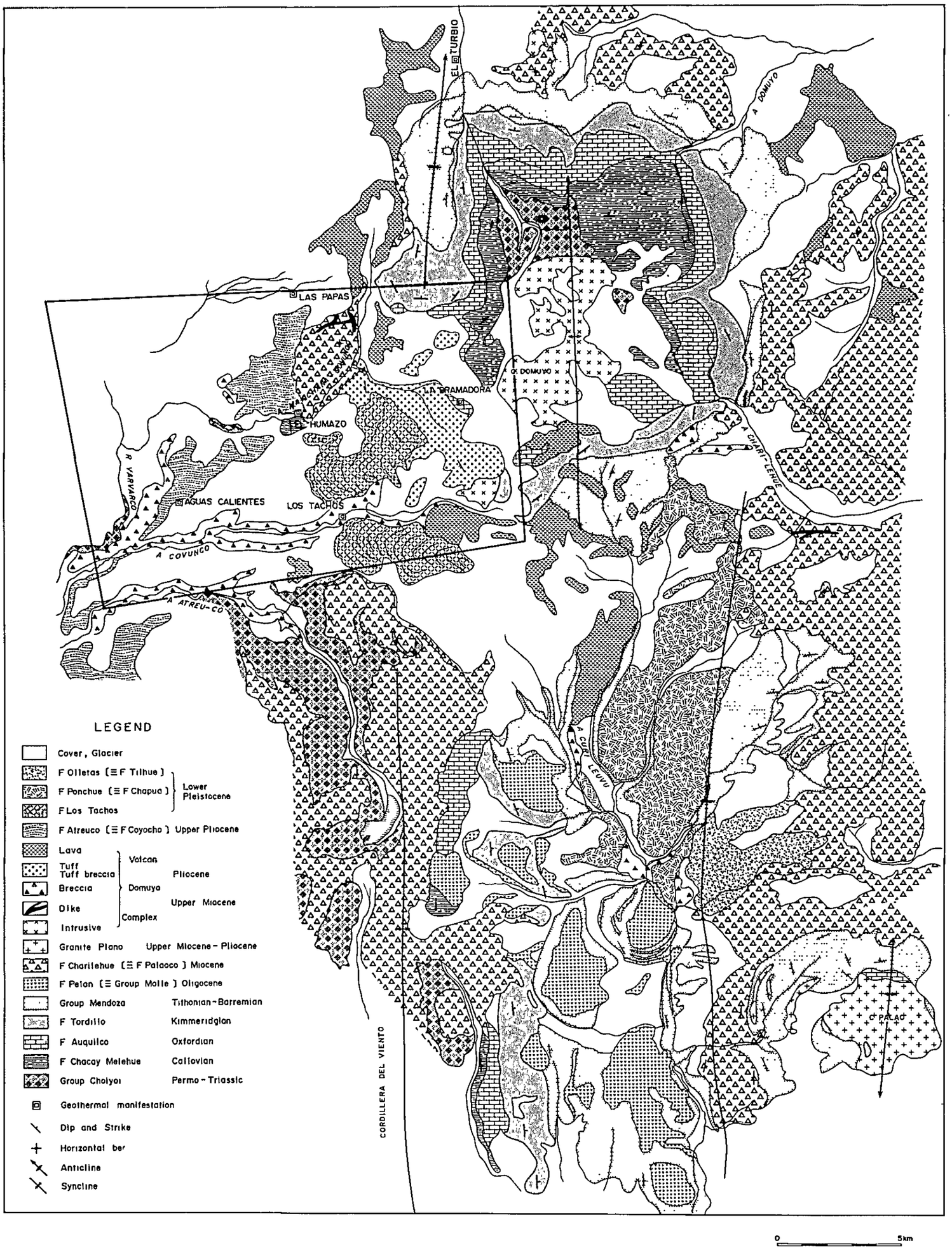


Fig.2-2 Regional geological map

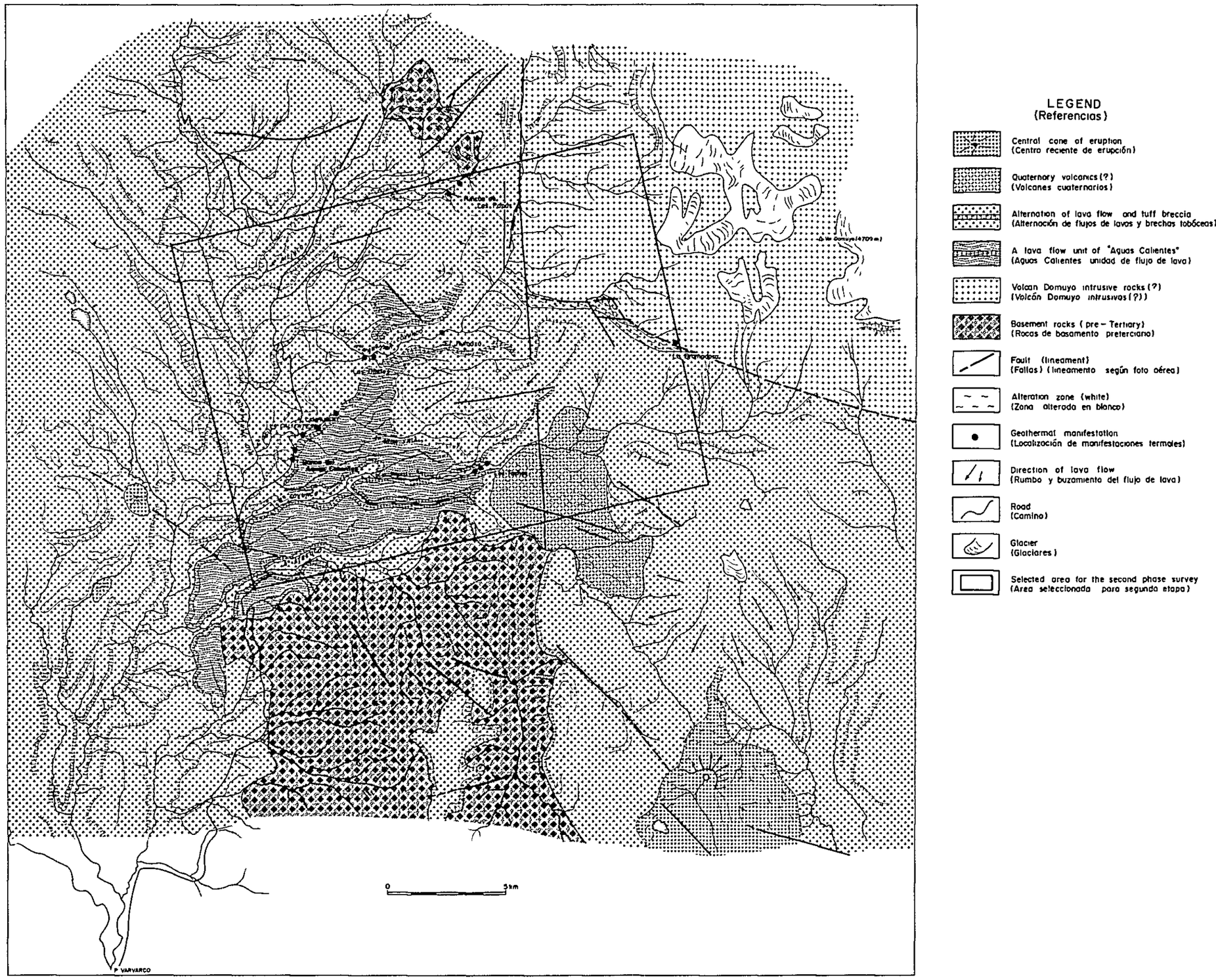
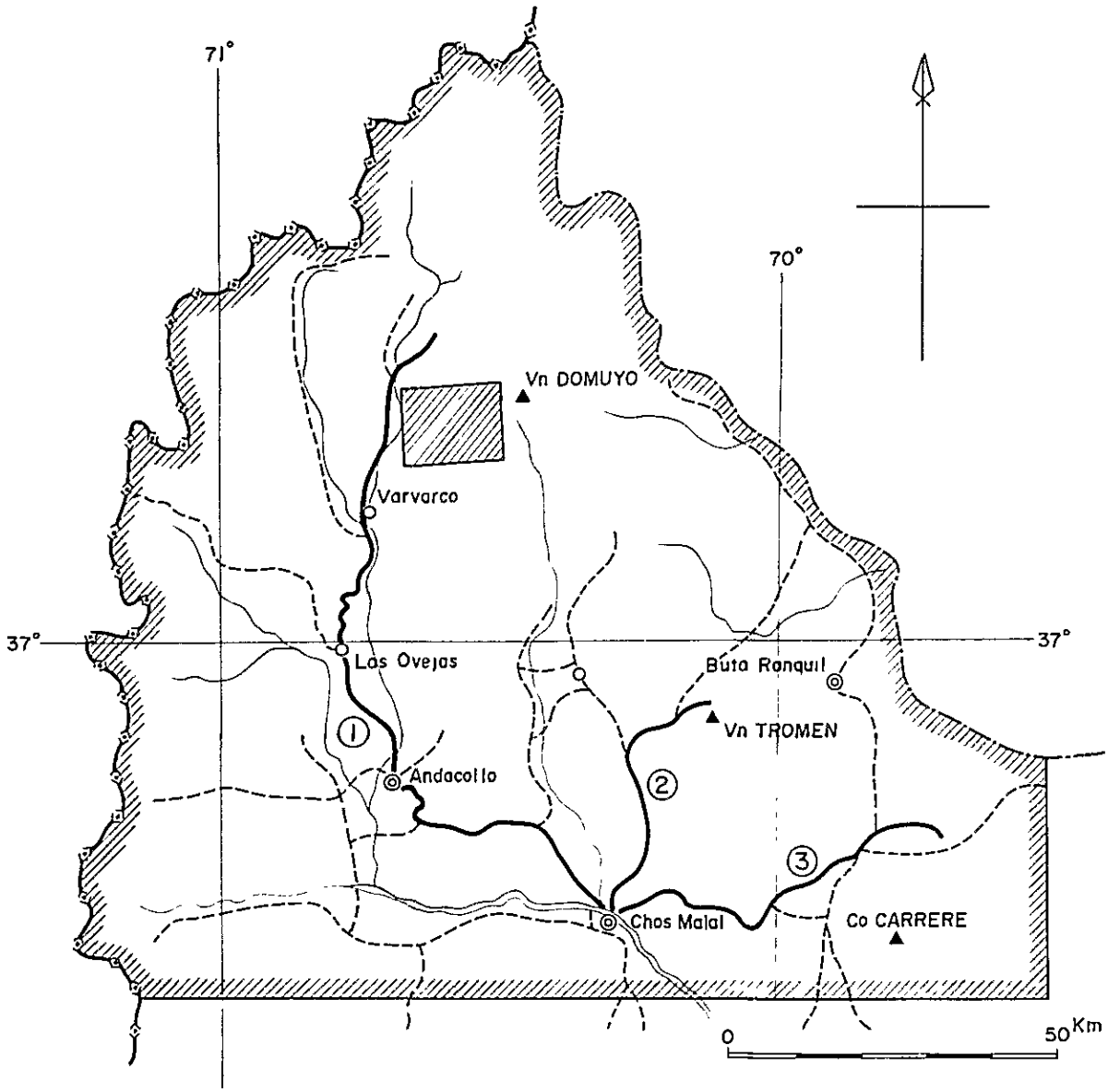


Fig.2-3 Geological interpretation map of aerial photographs



First phase survey area : 15,000 Km^2
(Limite del area de 15,000 Km^2)

Second phase survey area : 200 Km^2
(Area seleccionada de 200 Km^2)

Routes of reconnaisance geological survey
(Rutas de reconocimiento efectuadas)

Roads
(Rutas y accesos a la zona)

Rivers
(Detalle de drenaje)

Fig.2-4 Map of the survey areas and routes of reconnaissance geological survey

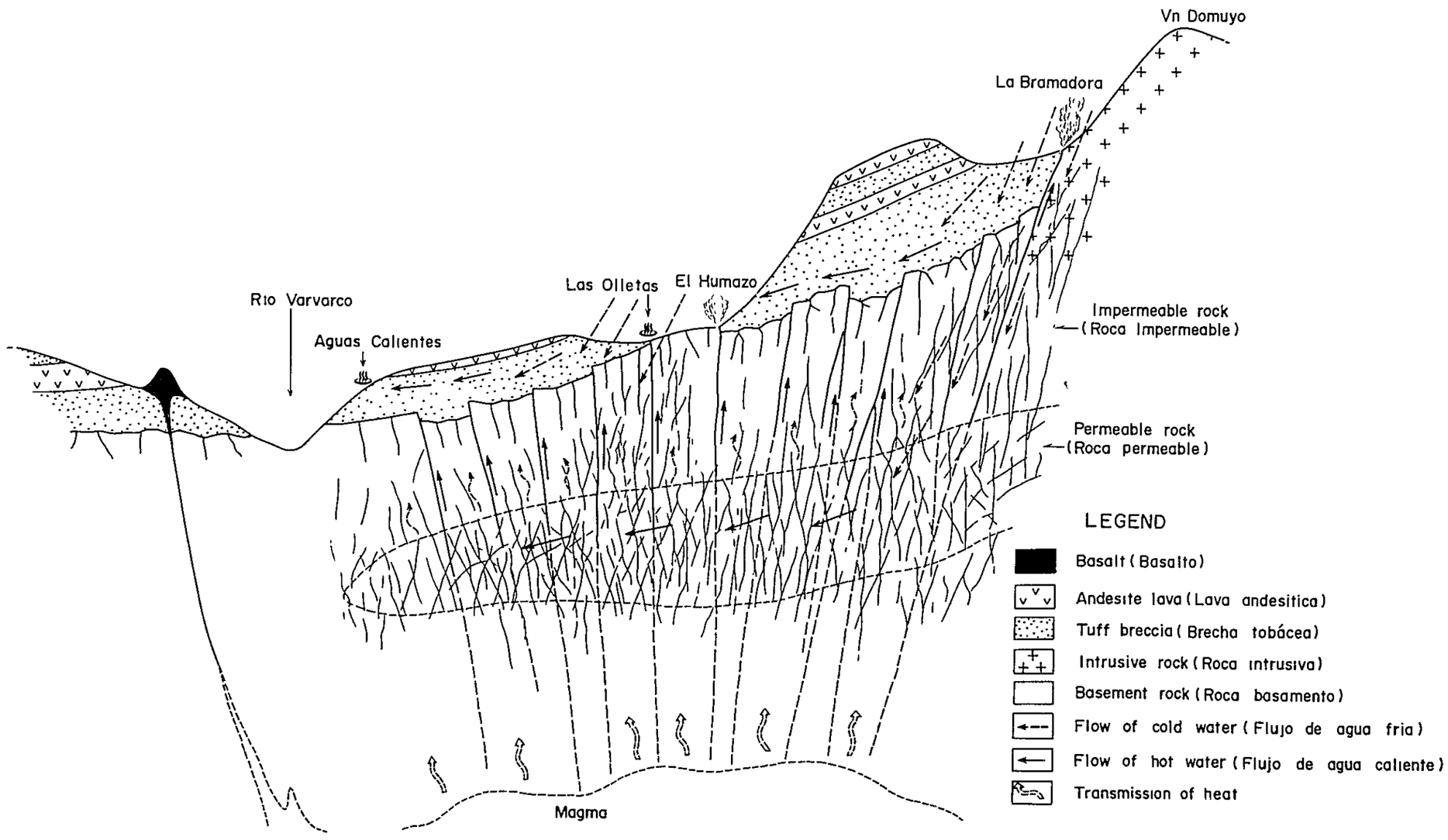


Fig.2-5 Schematic profile of geology and geothermal system

3. Geology in the Investigation Area

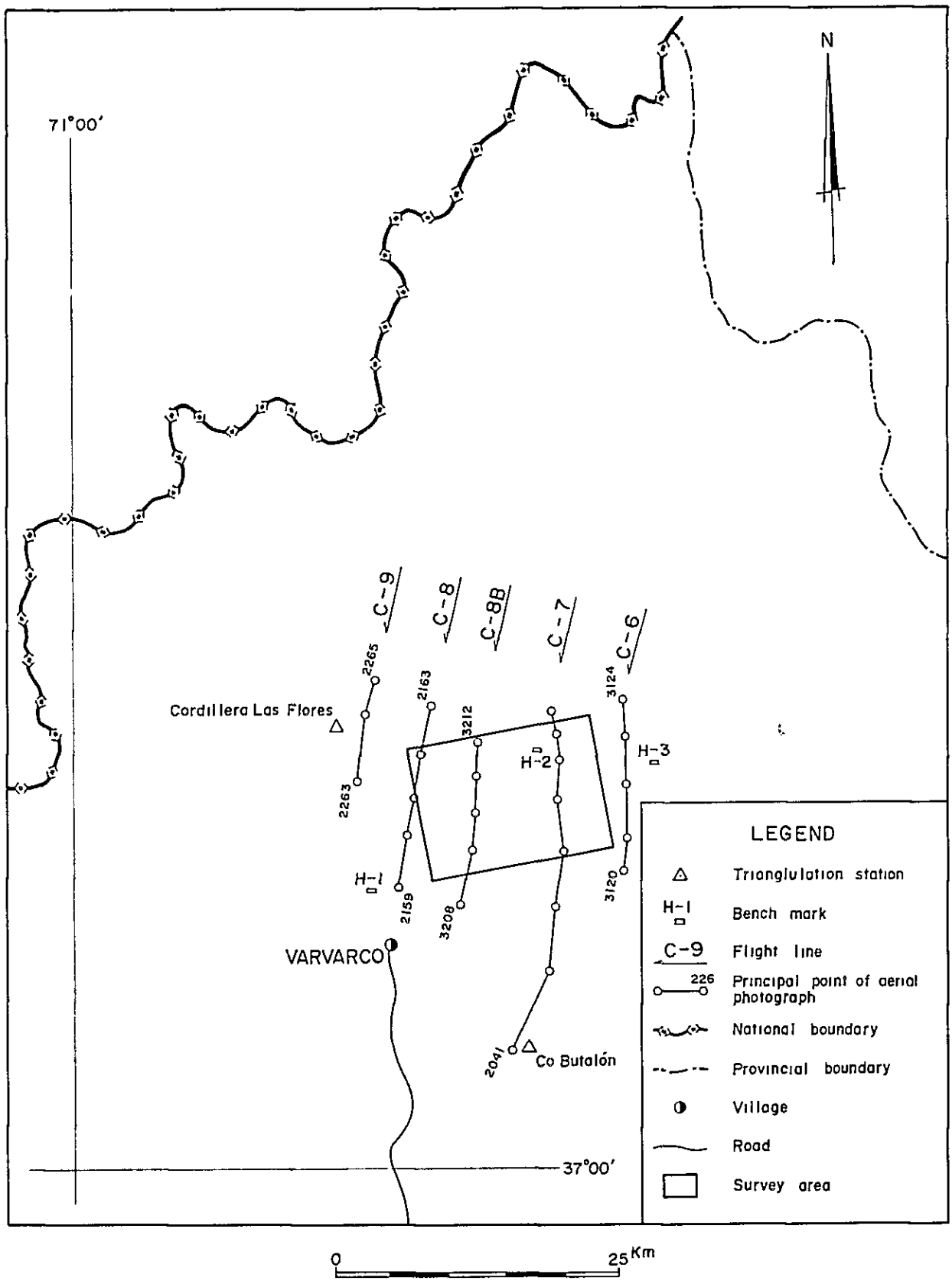


Fig.3-1 Principal points of aerial photographs and topographic standard points

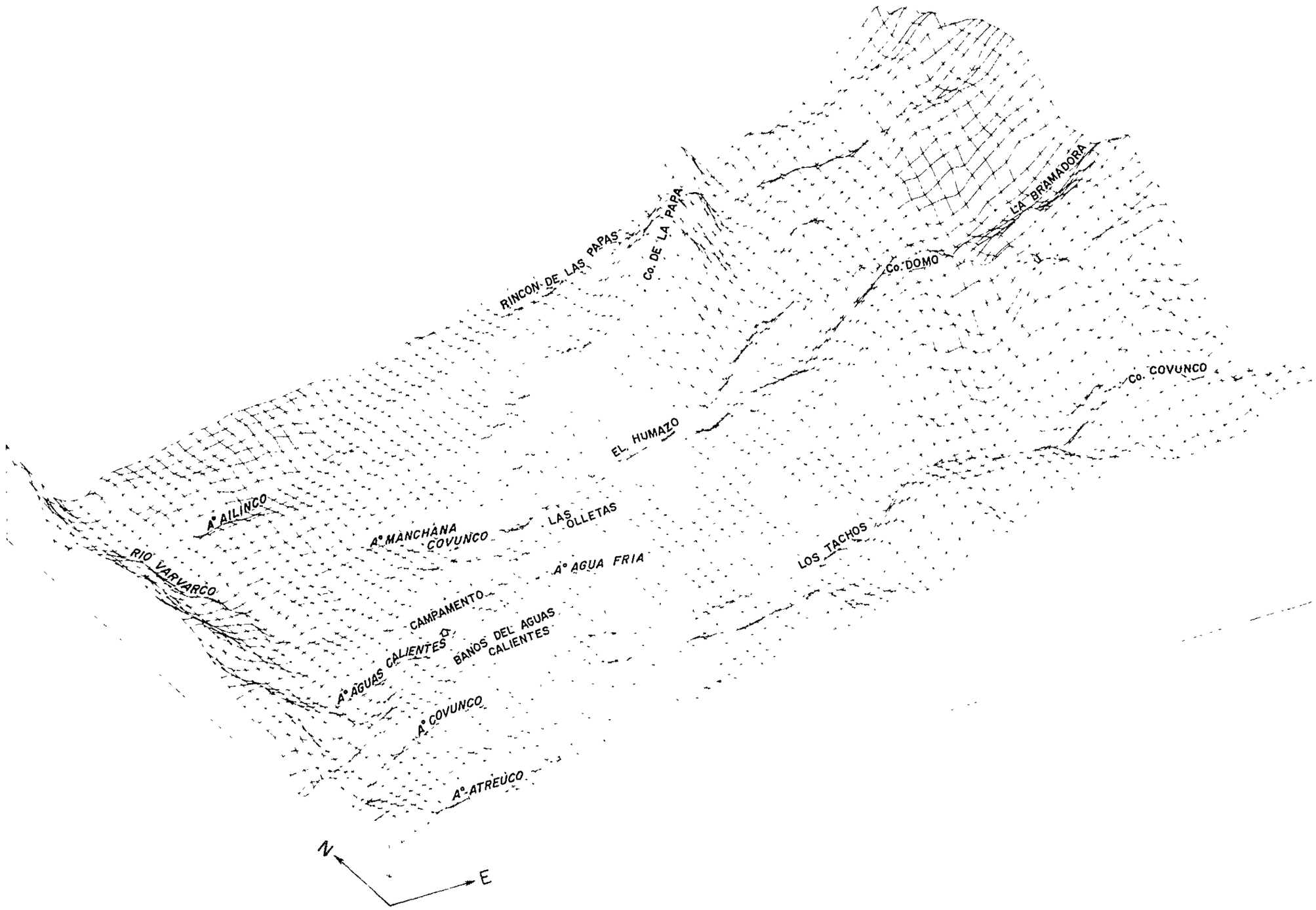


Fig.3-2 Bird's-eye view map of the survey area

Age		Formation	Geological Column	Thickness	Lithology	Remarks
Quaternary	Holocene				Sand, Gravel (Terrace) Glacial deposits	
Quaternary	Pleistocene	Volcanics of Co Domo		200 m ~ 1200 m+	Rhyolite lava, Partially pumiceous Dacite lava (including Perlitic layers) Dacitic tuff breccia	F T Age { 0.11±0.02, 0.29±0.07, 0.55±0.10 } Distribution Southern half of the survey area
Tertiary – Quaternary	Pliocene – Pleistocene	Acidic Pyroclastics F Sierra de Flores F Atreuco		200 m ~ 1000 m	Pumiceous tuff Andesitic volcanic breccia Andesite (dike) Welded tuff Andesitic tuff breccia (Scoria tuff) Andesite lava	F T Age 0.11±0.03 Distribution Northern half of the survey area
Tertiary	Pliocene – Miocene	andesite		100 m ~ 500 m	Andesite lava Granodiorite – porphy (intrusive) Andestic tuff breccia	Locality Co Domo and Los Tachos
Jurassic	Malm – Dogger	F Tordillo		100 m ~ 450 m	Dacitic tuff, Sandy tuff (thin beds) Limestone, Calcareous siltstone Red ~ green sandstone, shale	Locality La Bramadora
Jurassic	Malm – Dogger	F Auquilco		100 m ~ 500 m	White mudstone, green sandstone Limestone Gypsum beds	Locality La Bramadora
Jurassic	Malm – Dogger	F Chacay Melehue		550 m ~ 1000m+	Black mudstone Andesitic tuff breccia Black mudstone Andesite lava Andesitic lapilli tuff Red sandstone (thickness 1~2cm) Basalt lava Basaltic lapilli tuff ~ andesitic tuff	Locality El Humazo La Bramadora Rincón de Las Papas
		Basement			Pelitic hornfels, Psammitic hornfels Basic hornfels (Partially sandy) Pelitic schist, Psammitic schist Granite, aplite Granodiorite (including xenoliths of silicified rock) Basalt (dyke)	K-Ar Age { 227±16, 259±13 } Locality El Humazo Rincón de Las Papas Locality Rio Varvarco A° Atreuco, A° Covunco A° Manchona Covunco

Fig.3-3 Geological columnar section of the survey area

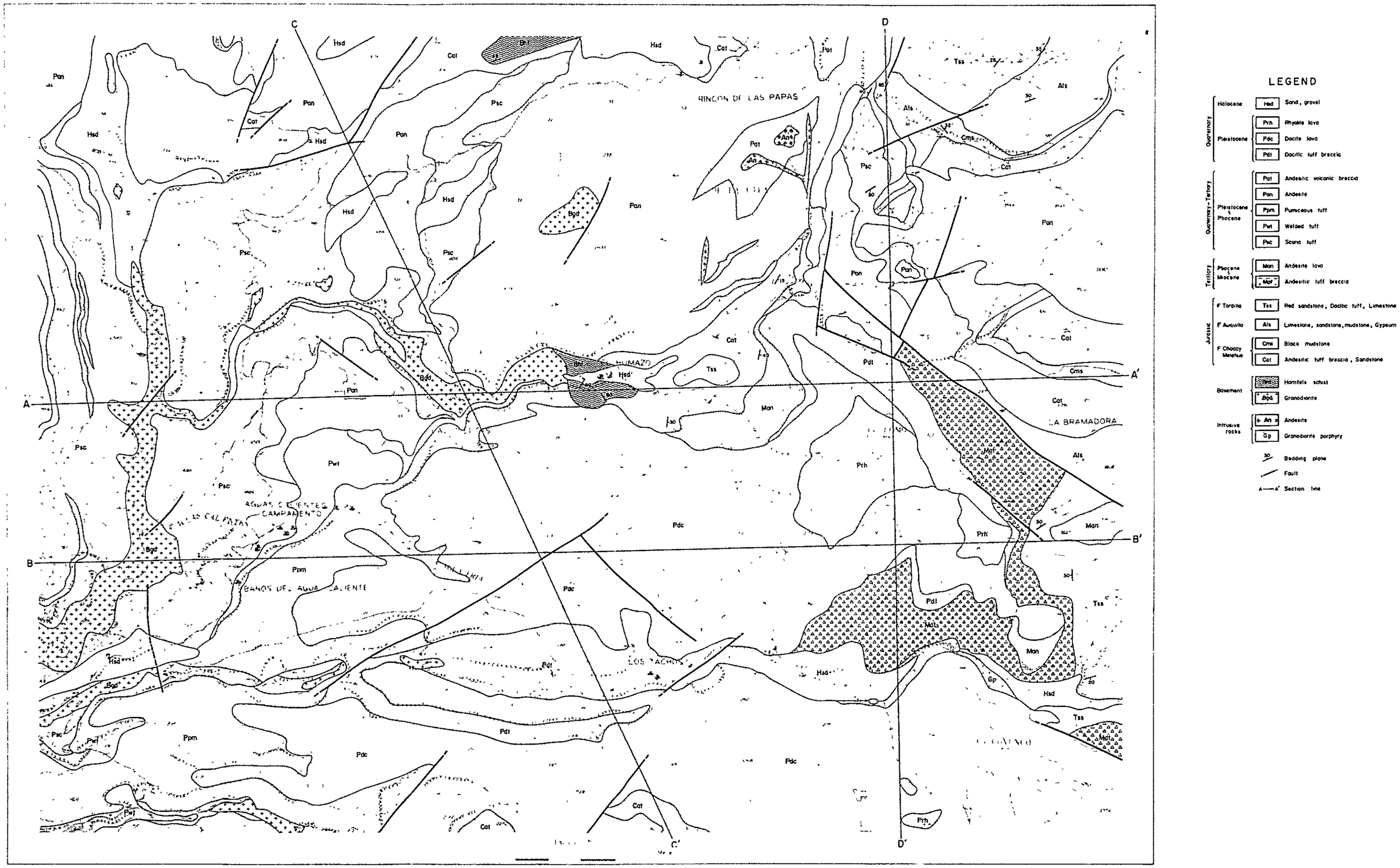


Fig.3-4 Geological map of the survey area

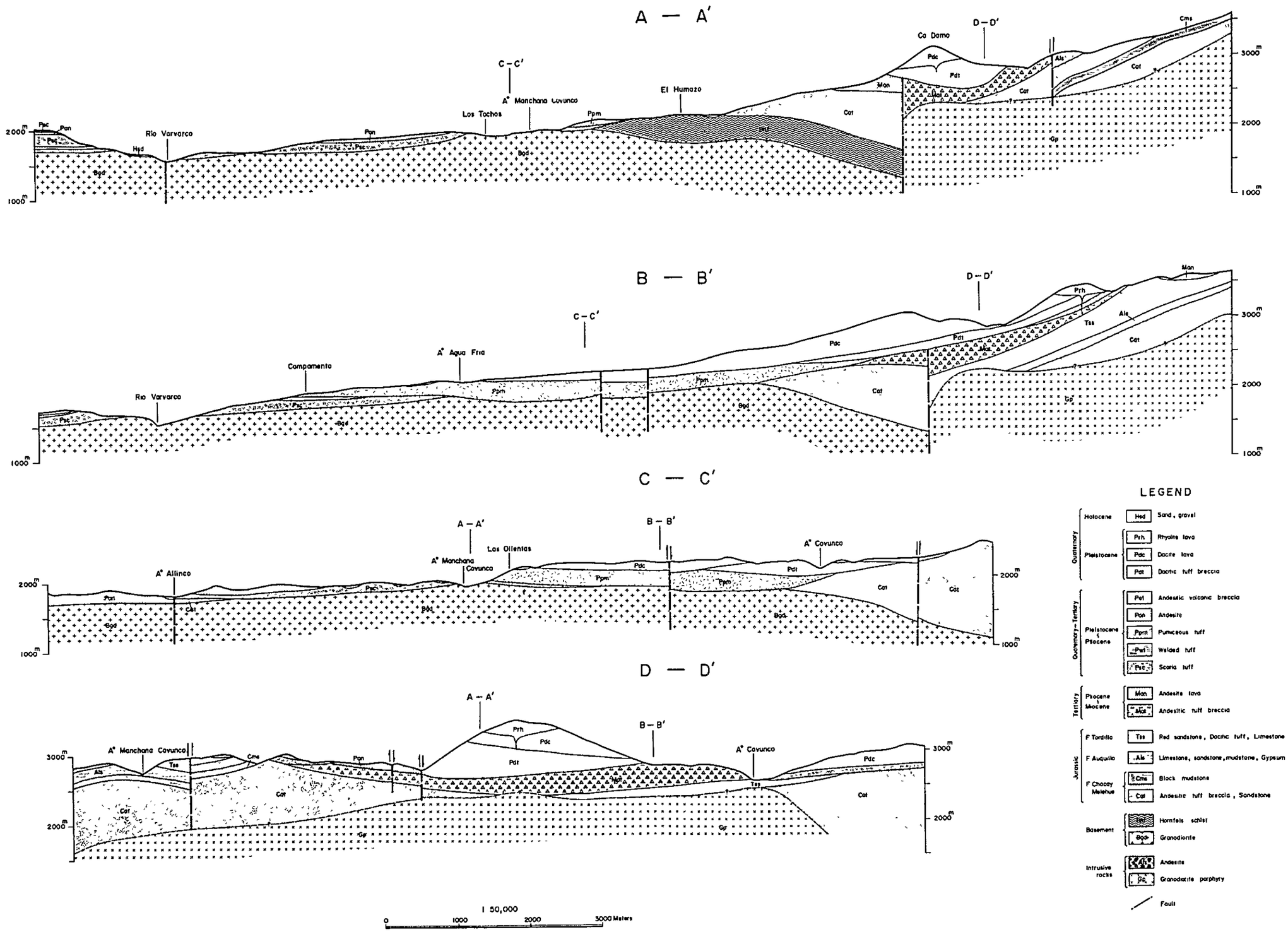
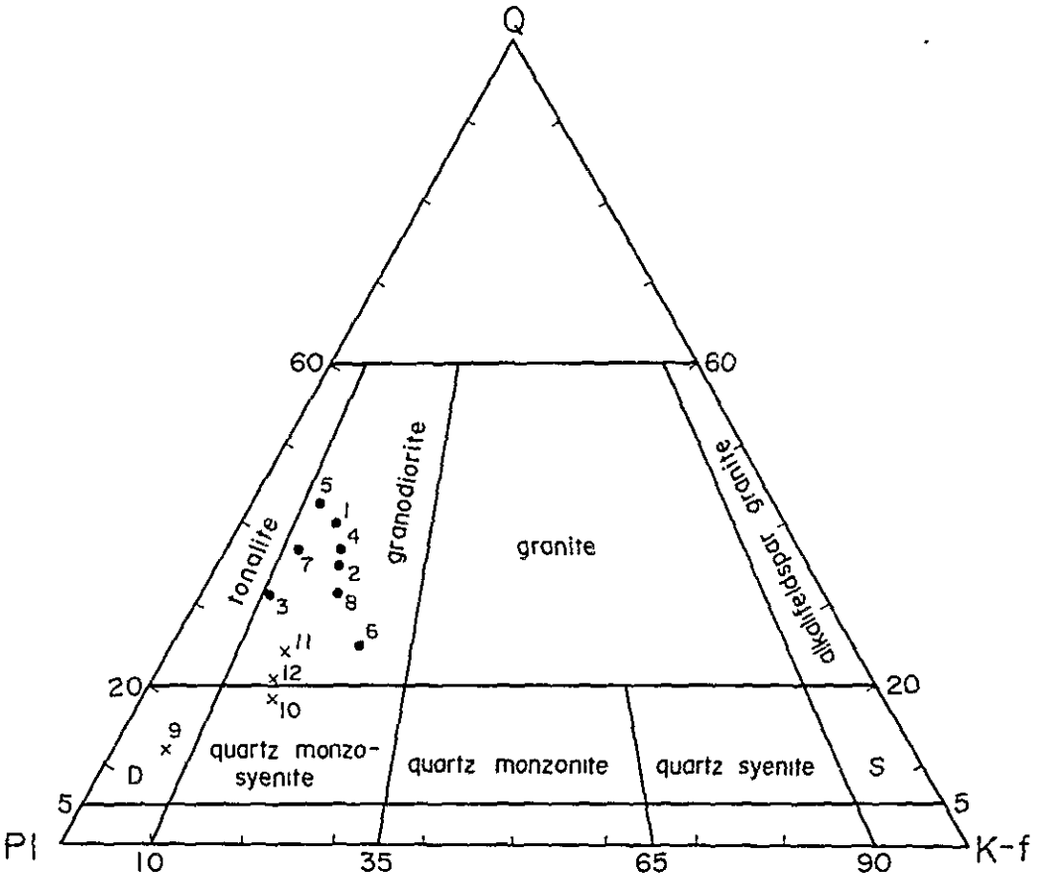


Fig.3-5 Geological cross-sections



Varvarco intrusive	1 : F-1	5 : TM-11
	2 : F-26	6 : TM-16
	3 : F-42-2	7 : TM-27
	4 : TM-8	8 : 83-2-12-5
Domuyo complex	9 : F-14	10 : TM-12
	11 : TM-48	12 : TM-201

D : quartz diorite etc

S : alkalifeldspar-quartz syenite

Fig.3-6 Modal diagram of quartz - potash feldspar plagioclase

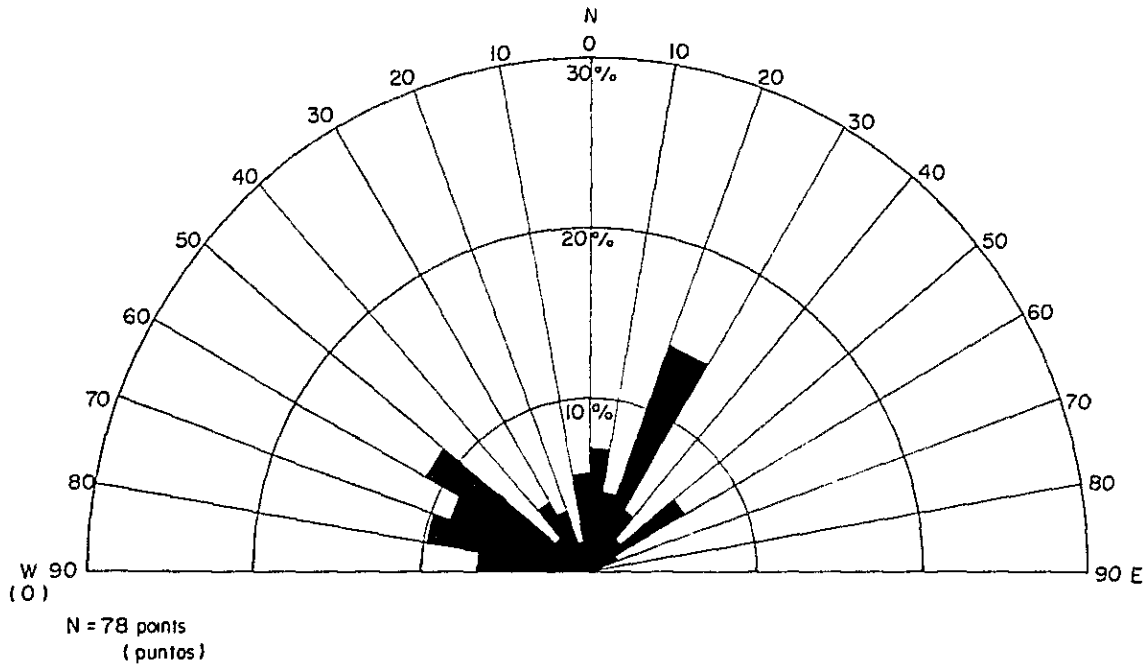
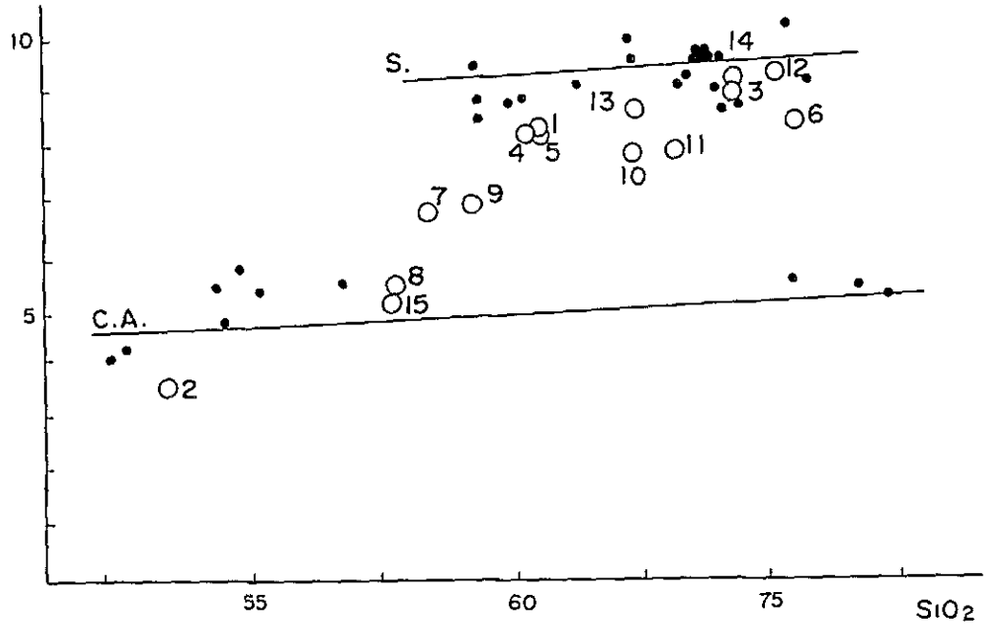


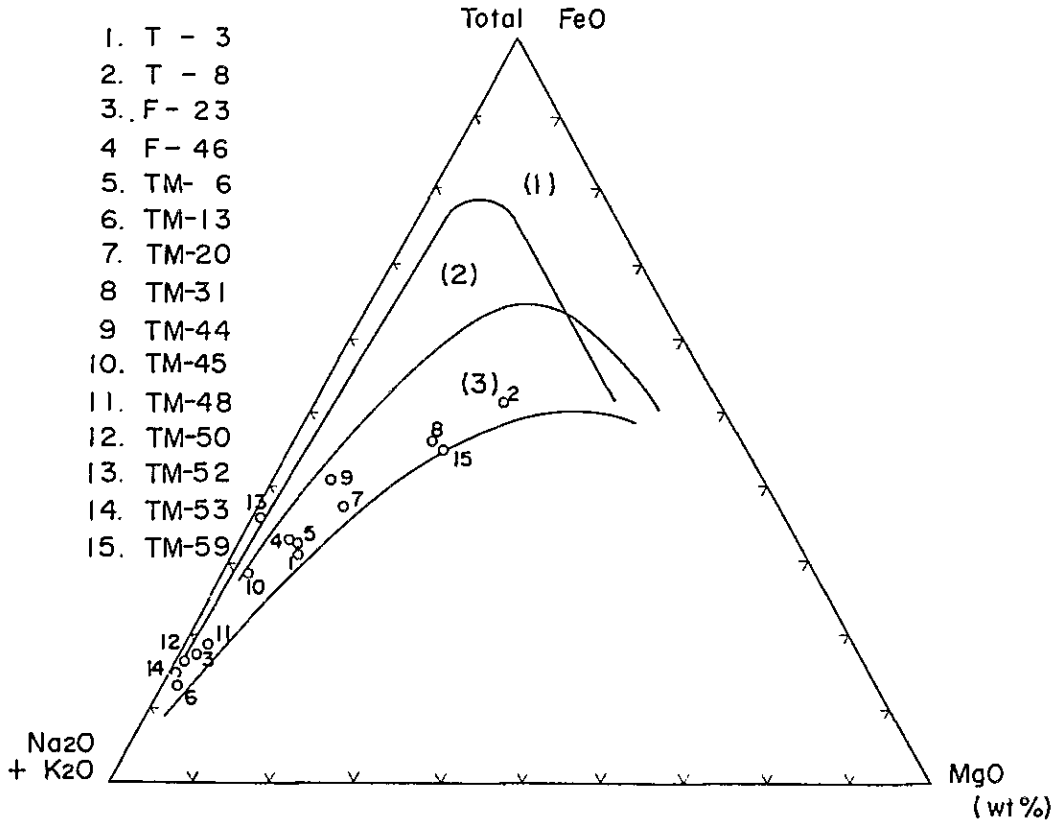
Fig.3-7 Rose diagram of joints in granodiorite



○	1 F-3	9 TM-44		S	Shoshonitic series (Serie shoshonitica)
	2 F-8	10. TM-45		C A	Calc-alkaline series (Serie calco-alca lina)
	3. F-23	11 TM-48			
	4 F-46	12 TM-50			
	5. TM-6	13. TM-52			
	6 TM-13	14. TM-53			
	7 TM-20	15 TM-69			
	8 TM-31				

• Brousse, Pesco (1982)

Fig.3-8 Alkali - silica diagram of younger volcanic rocks



(1) Chemical variation in rocks of Skaergaard intrusion

(2) Chemical variation in tholeiitic volcanics of Izu-Hakone area, Japan

(3) Chemical variation in calc-alkaline volcanics of Izu-Hakone area, Japan

Fig.3-9 MgO - total FeO - (Na_2O + K_2O) diagram of younger volcanic rocks

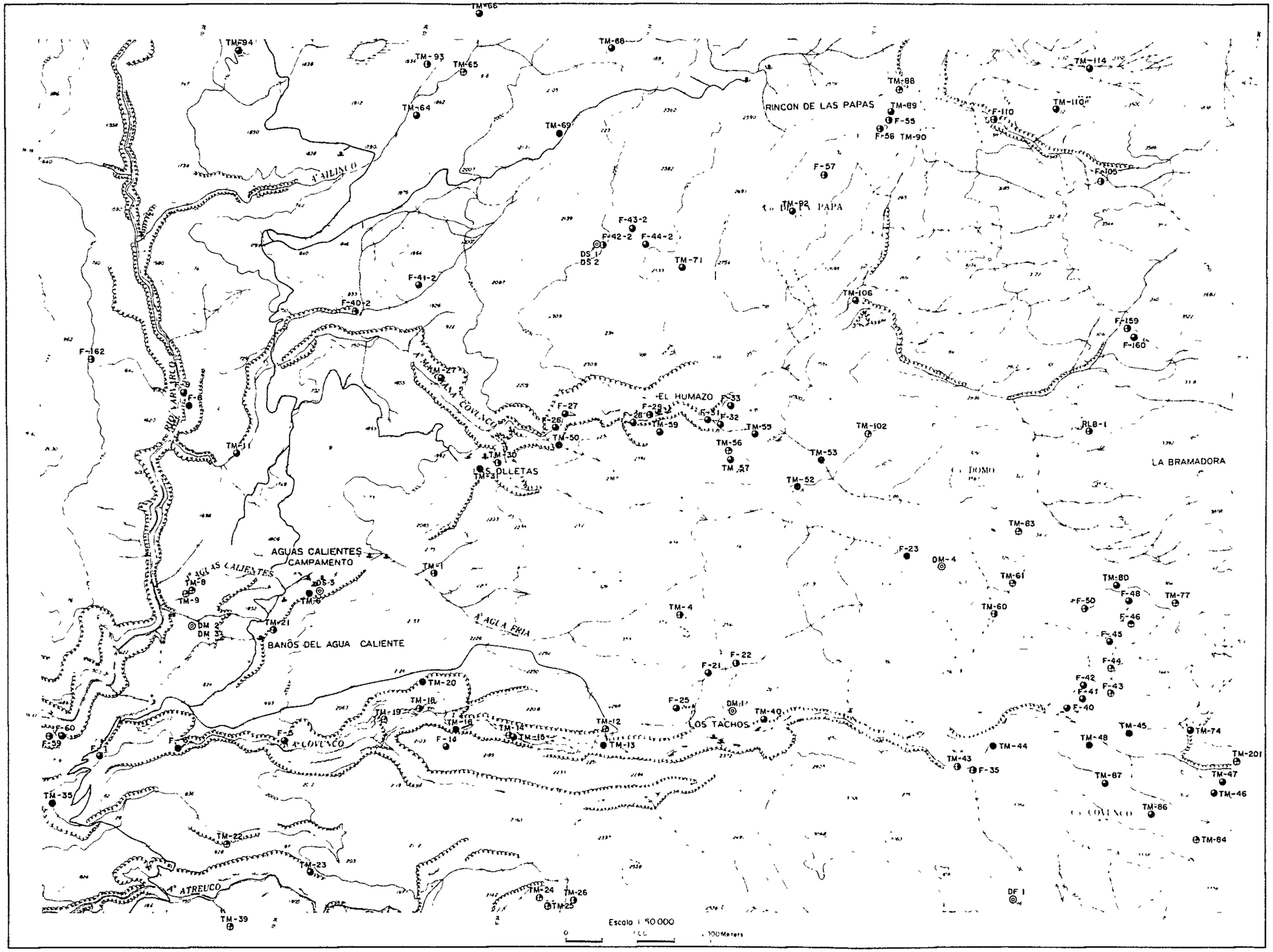
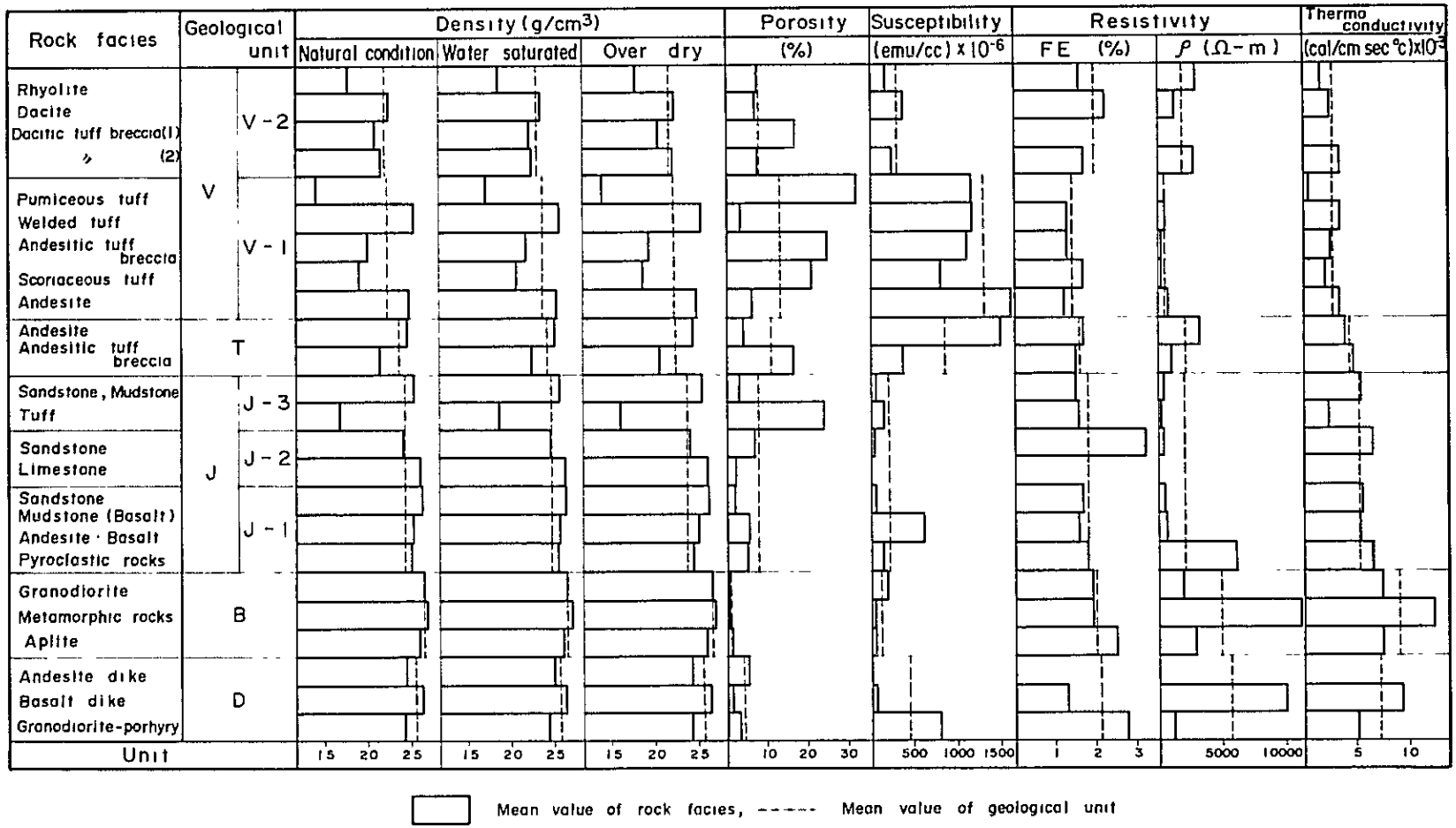


Fig.3-10 Location map of rock sampling



Mean value of rock facies, ------ Mean value of geological unit

V Quaternary – Tertiary
- V-2 Pleistocene, Volcanics of Co Domo
- V-1 · Pleistocene – Pliocene, Acidic Pyroclastics, Sierra de Flores Formation, Atreuco Formation

T Tertiary, Pliocene – Miocene, Andesite

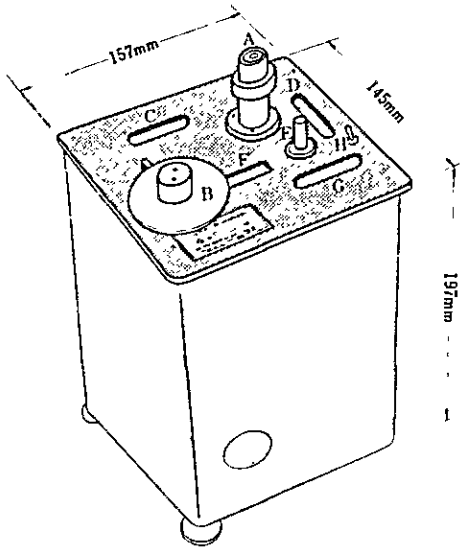
J Jurassic, Dogger – Malm,
- J-3 Tordillo Formation
- J-2 Auquilco Formation
- J-1 · Chacay Melehue Formation

B Basement

D Dike rock etc

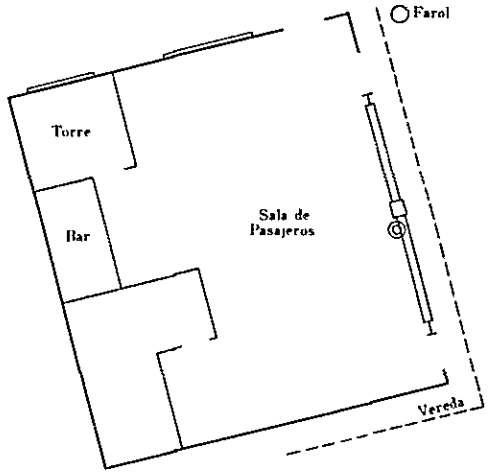
Fig.3-11 Physical properties of rocks

4. Geologic Structure in the Investigation Area



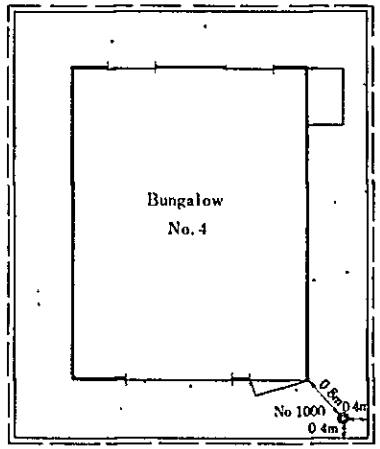
A : Eyepiece
B : Dial
C : Long Level
D : Cross Level
E : Arrestment Knob
F : Counter
G : Thermometer
H : Light Switch

Fig.4-1 LaCoste & Romberg gravity meter Model - G



(NEUQUEN AEROPUERTO)

(a) Reference station (No 9310 − 68)



(CAMPAMENTO)

(b) Base station (No.1000)

Fig.4-2 Sketches of reference station(a) and base station(b)

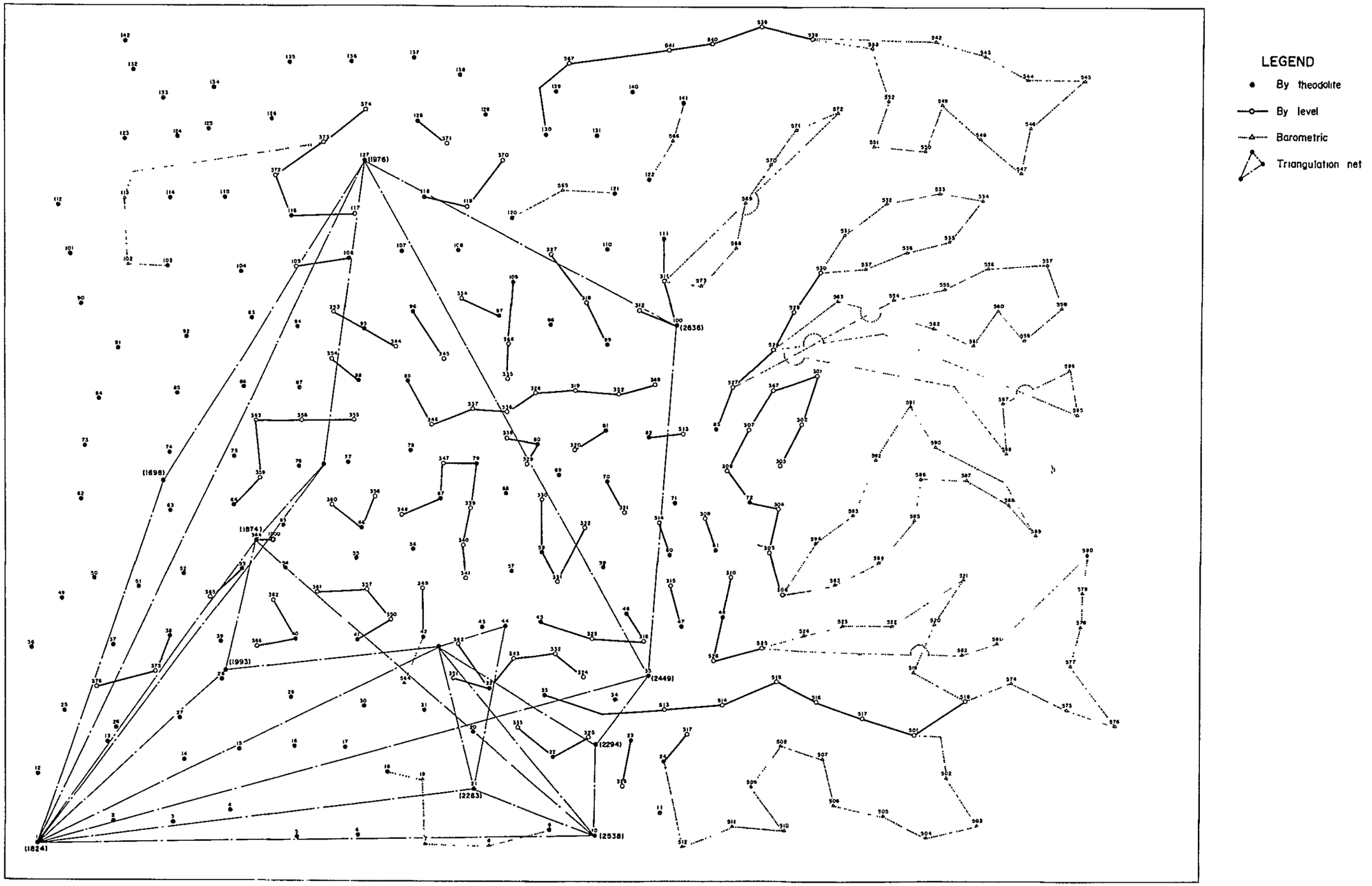


Fig.4-3 Network of leveling

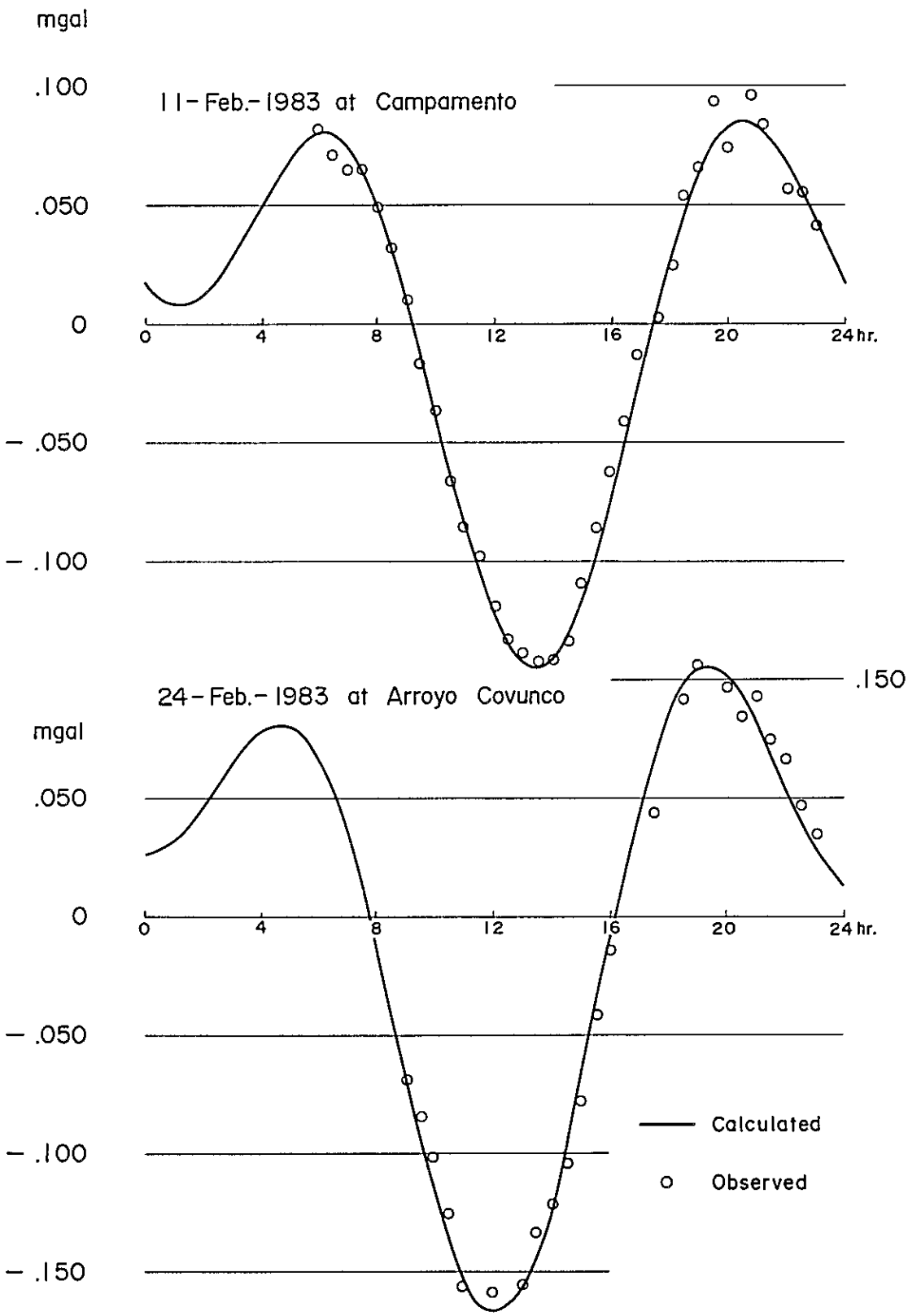


Fig.4-4 Observations of diurnal gravity variation

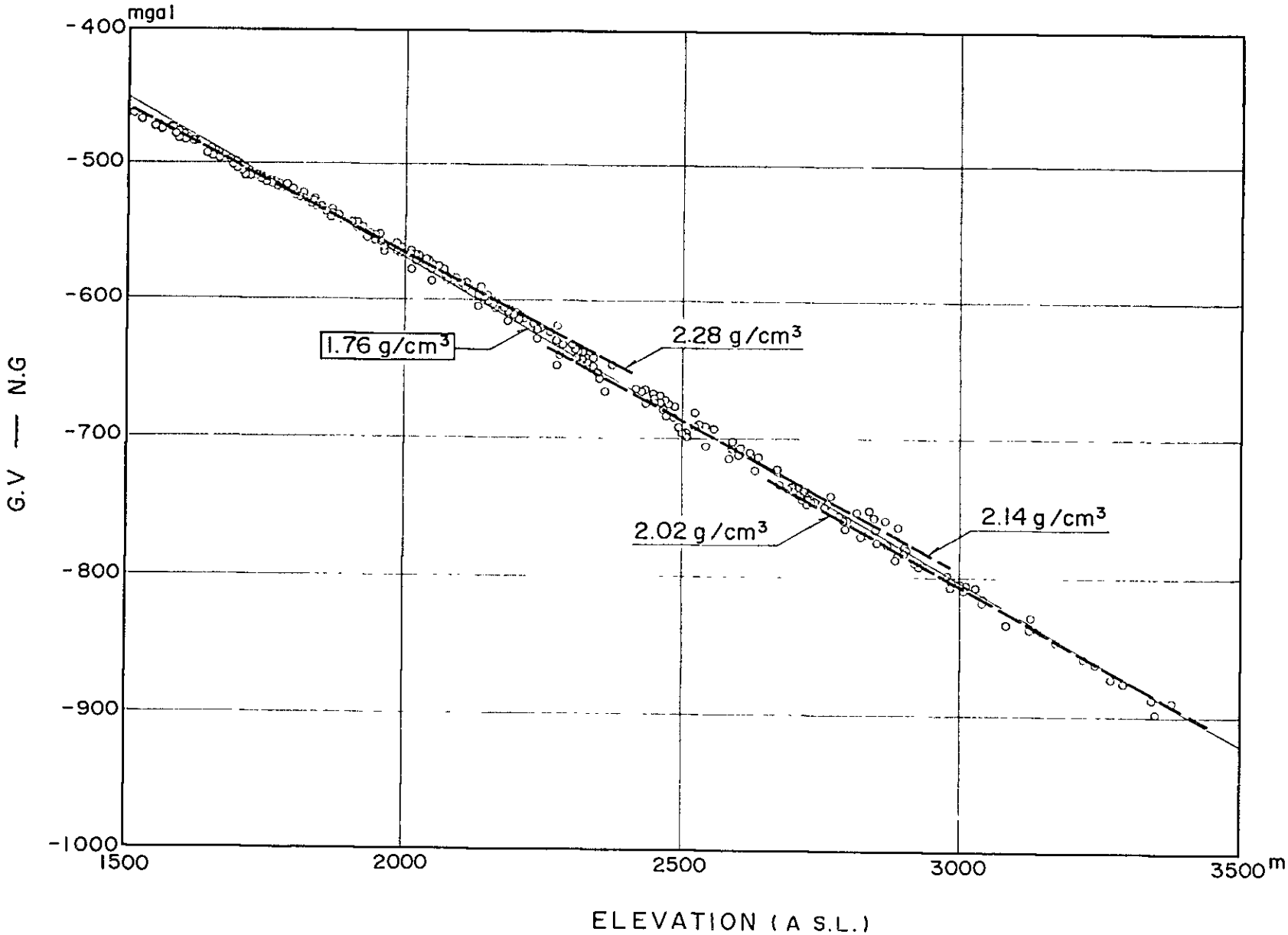


Fig.4-5 Relation between gravity and altitude

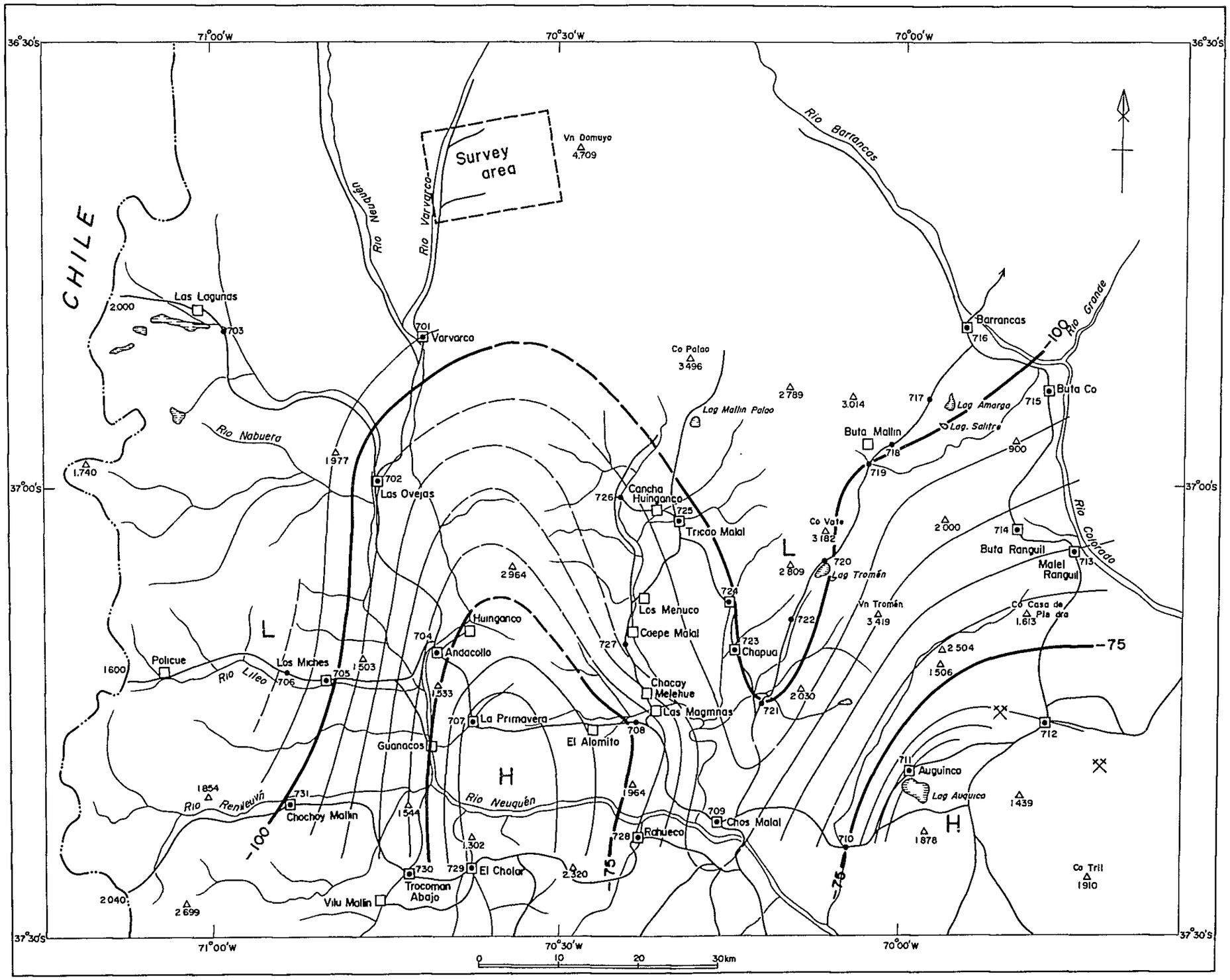


Fig.4-6 Regional Bouguer anomaly map (ρ = 2.30 g/cm^3)

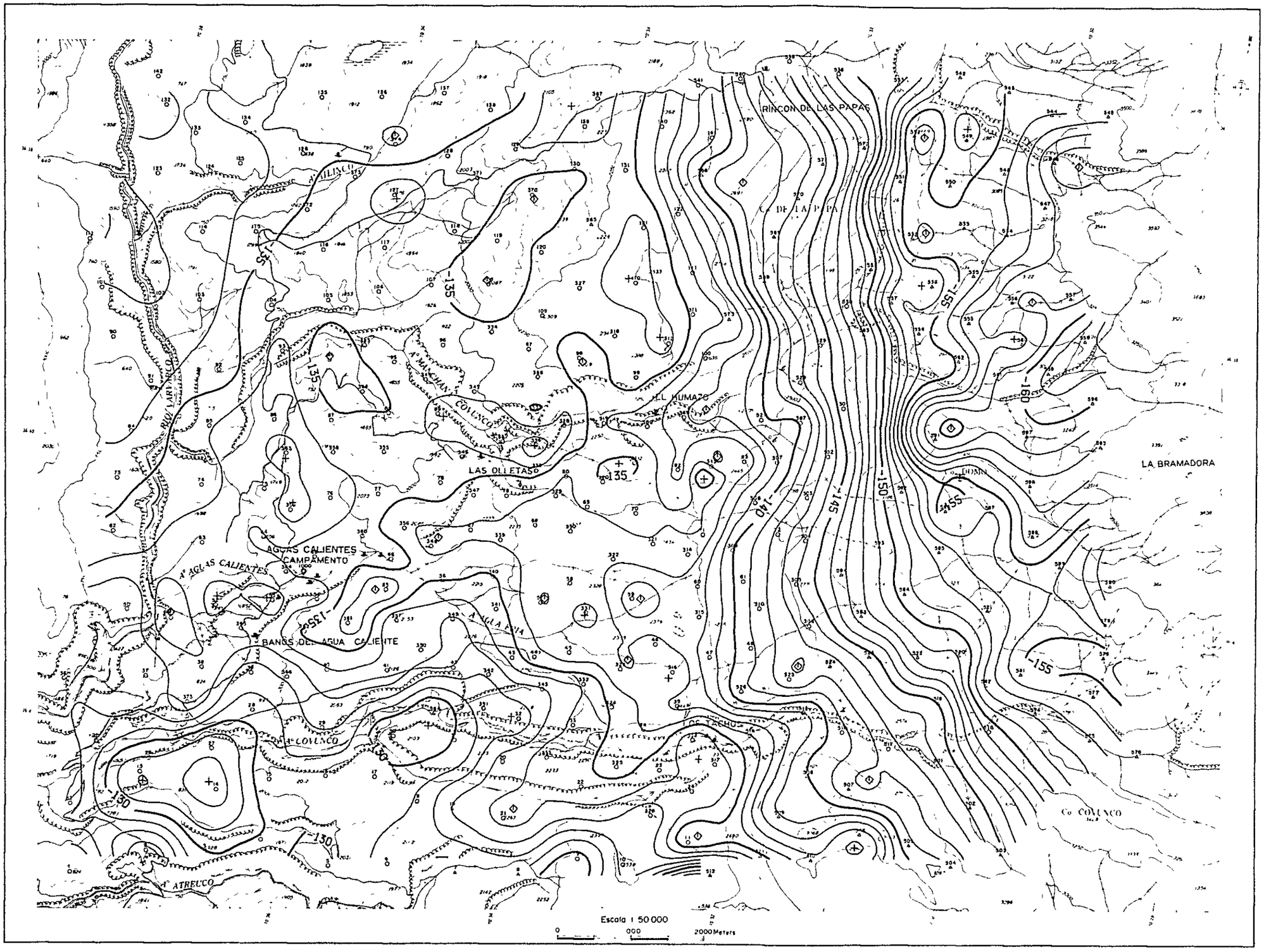


Fig.4-7 Bouguer anomaly map (ρ = 2.30 g/cm^3)

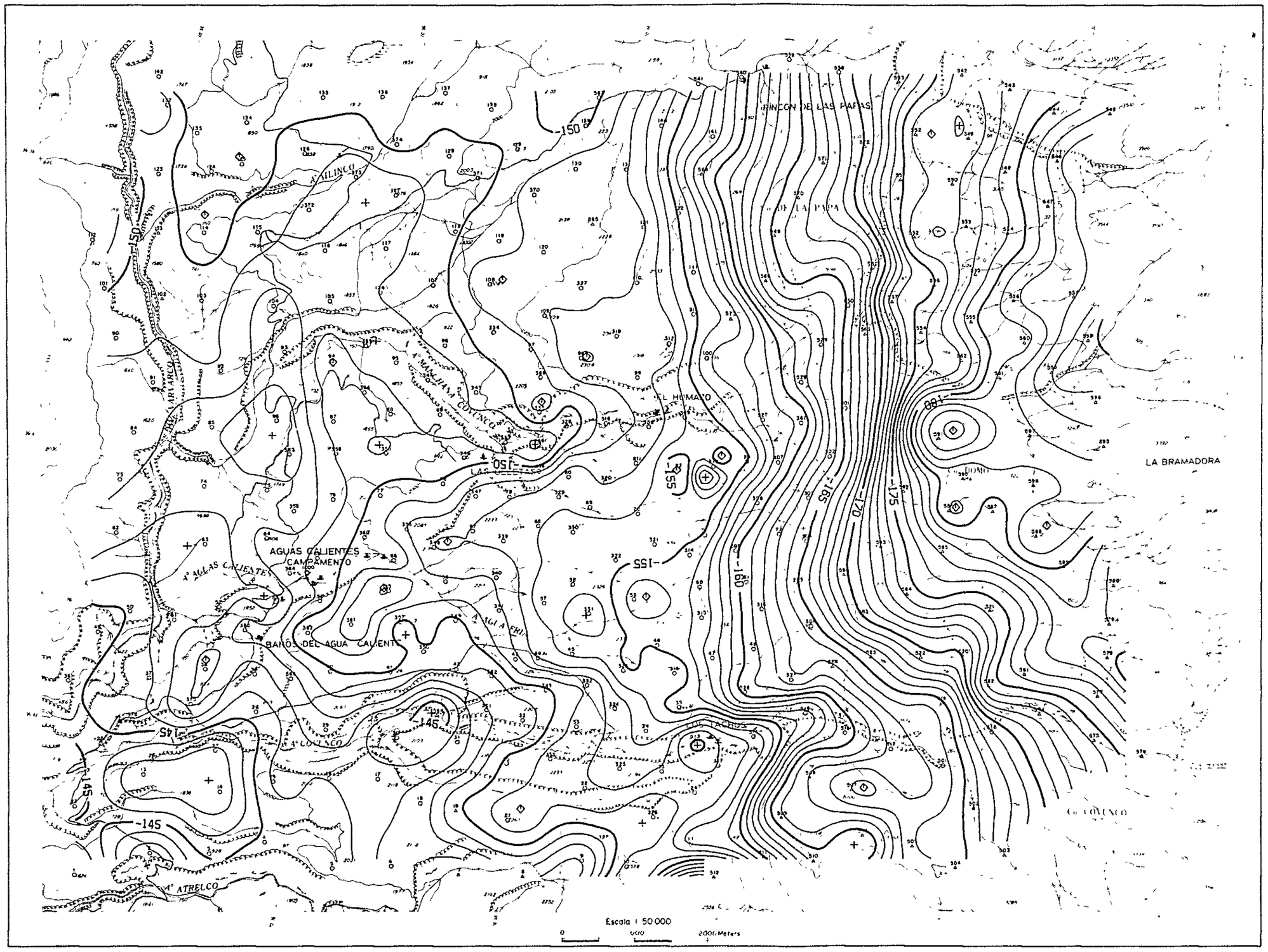


Fig.4-8 Bouguer anomaly map (ρ = 2.00 g/cm^3)

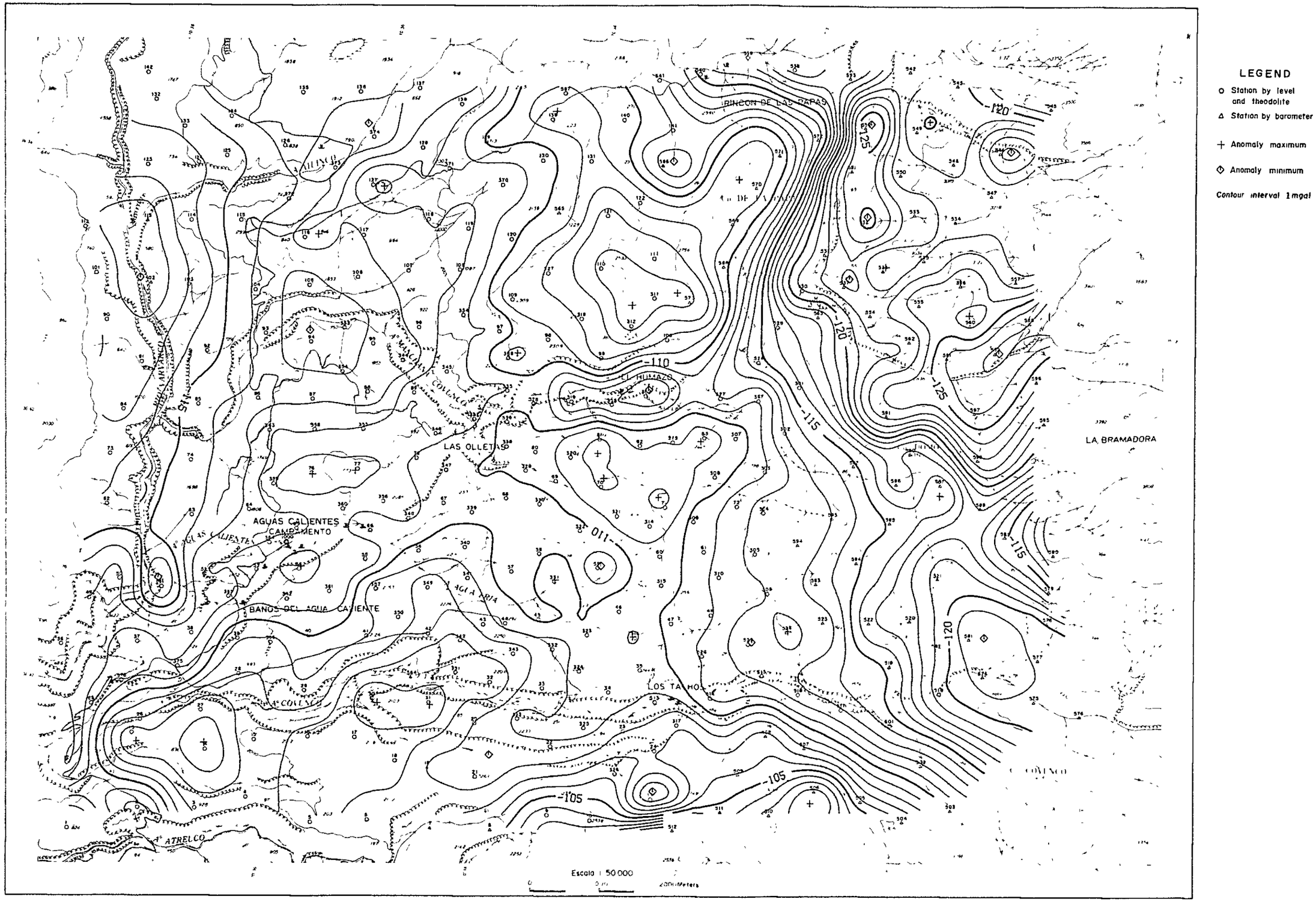


Fig.4-9 Bouguer anomaly map (ρ = 2.50 g/cm^3)

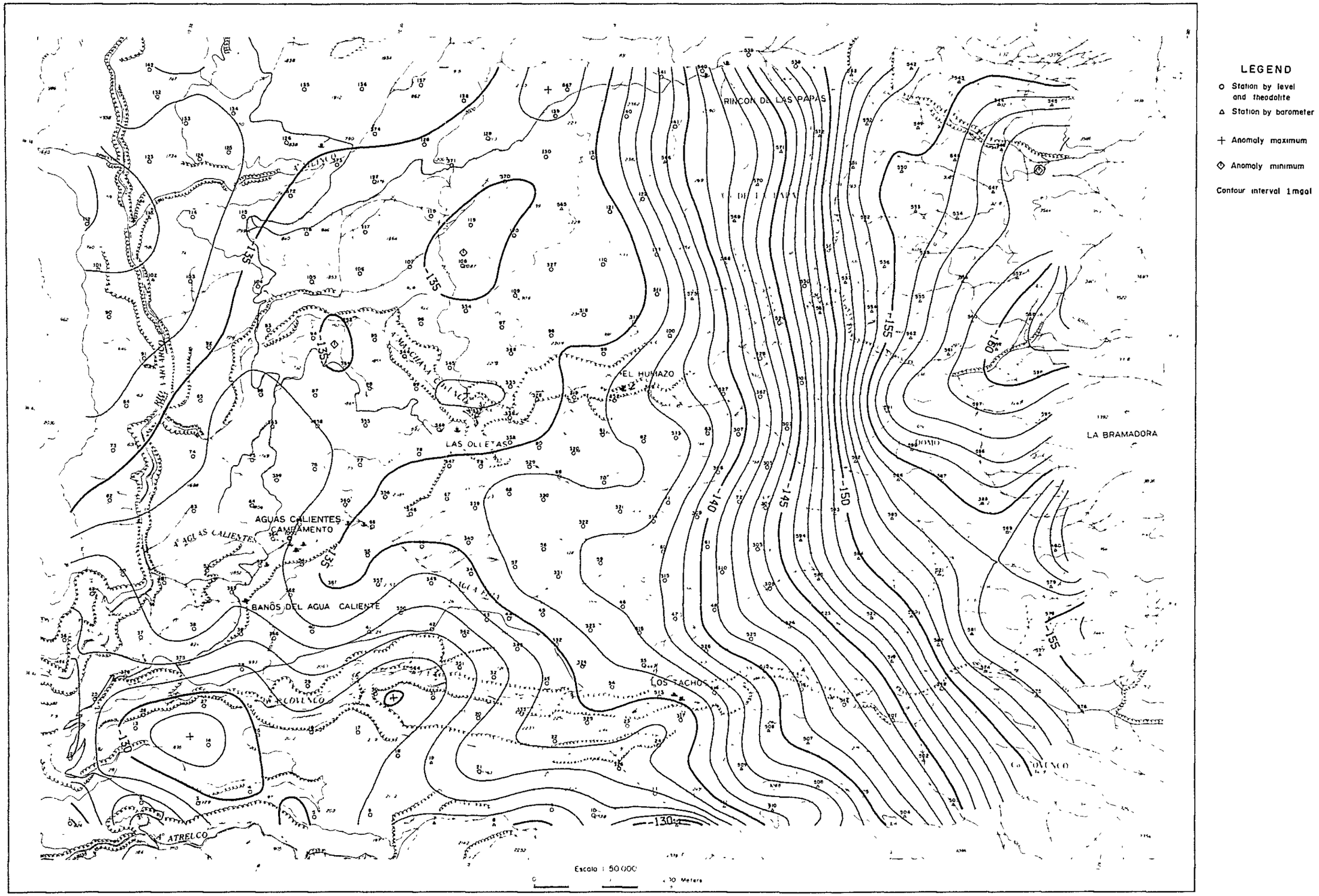


Fig.4-10 Long-wave Bouguer anomaly map (ρ = 2.30 g/cm^3)

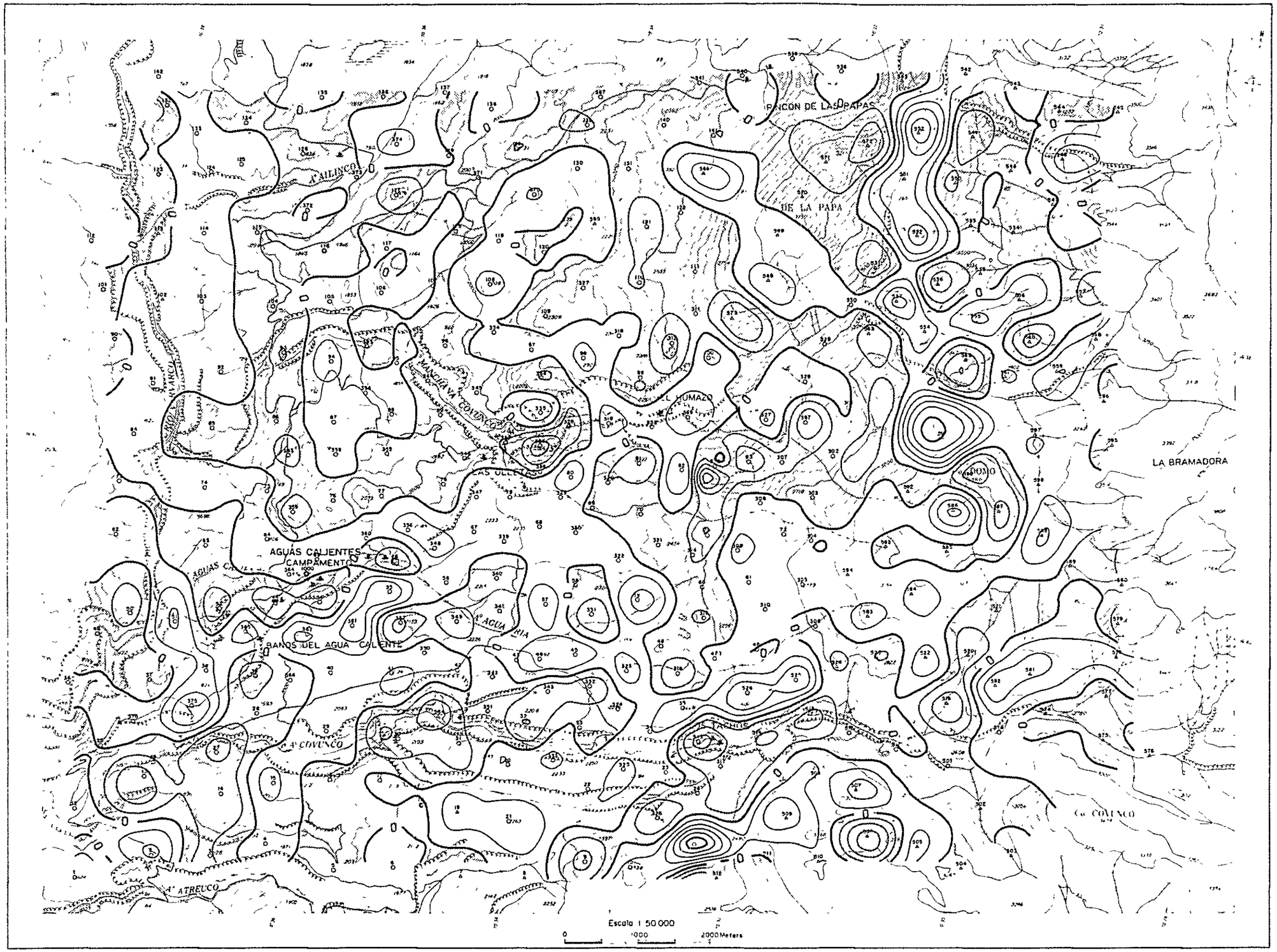


Fig.4-11 Short-wave Bouguer anomaly map (ρ = 2.30 g/cm^3)

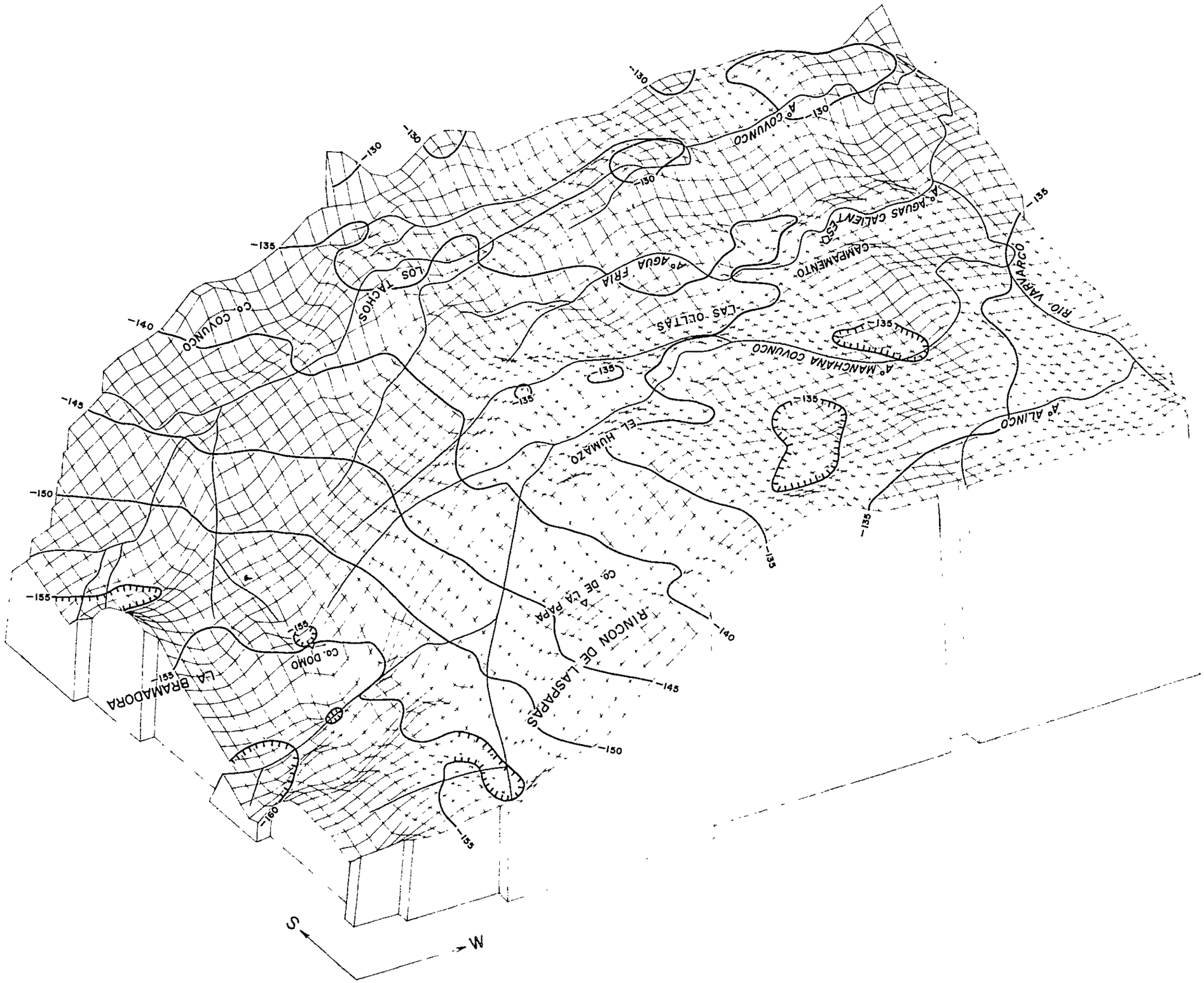


Fig.4-12 Three-dimensional image of Bouguer anomaly map (ρ = 2.30 g/cm^3)

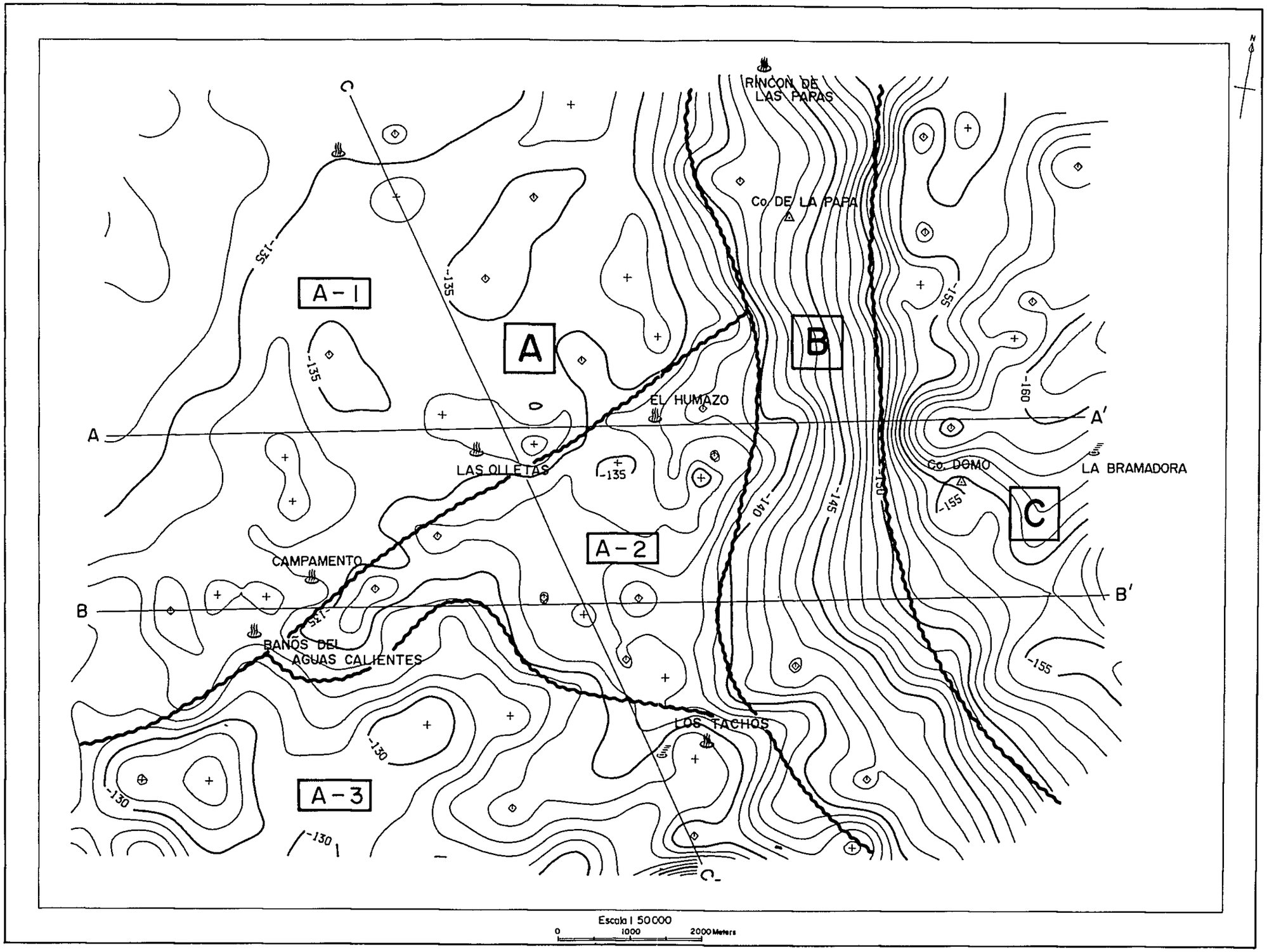


Fig.4-13 Zoning of Bouguer anomaly map

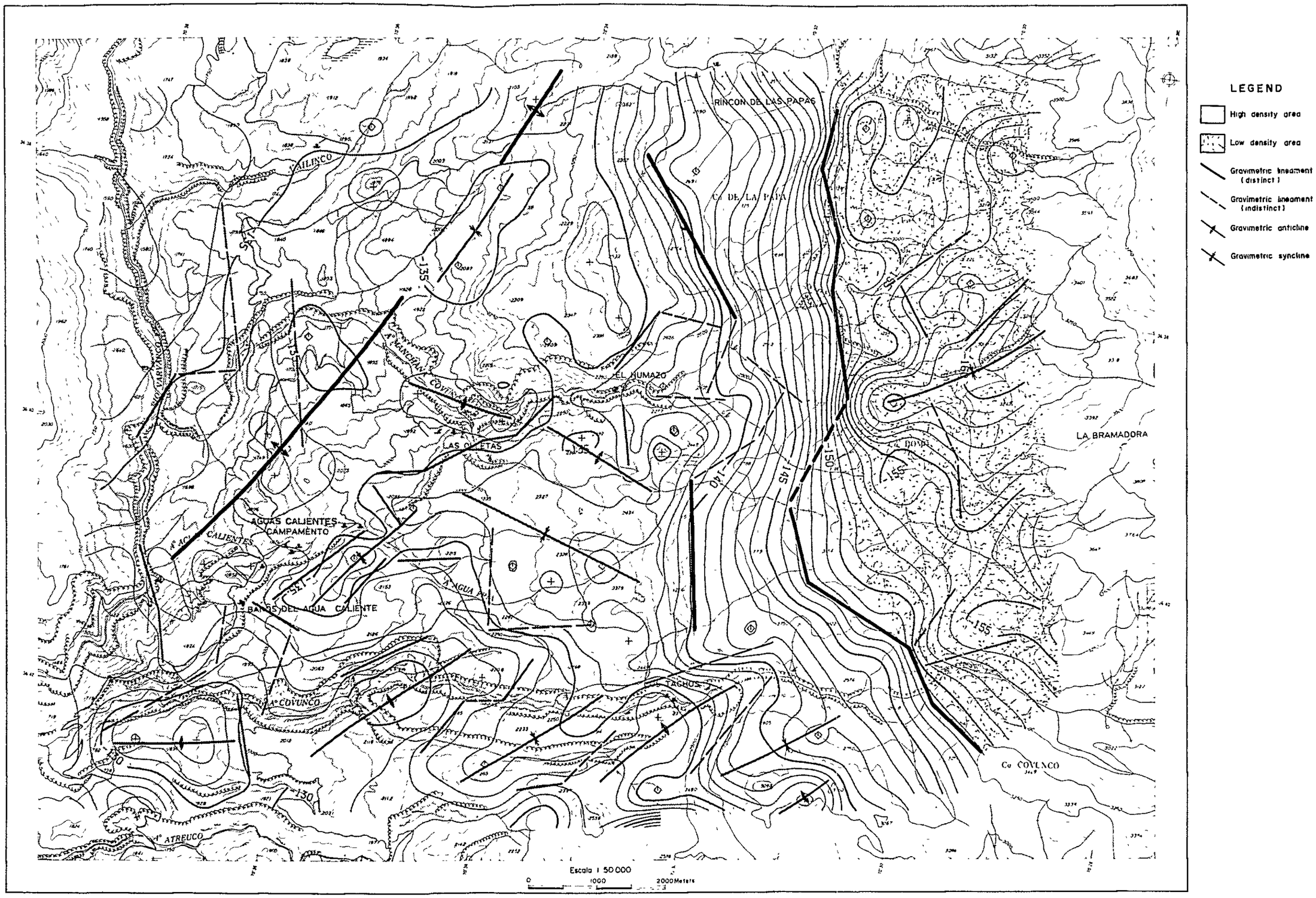


Fig.4-14 Gravimetric interpretation map

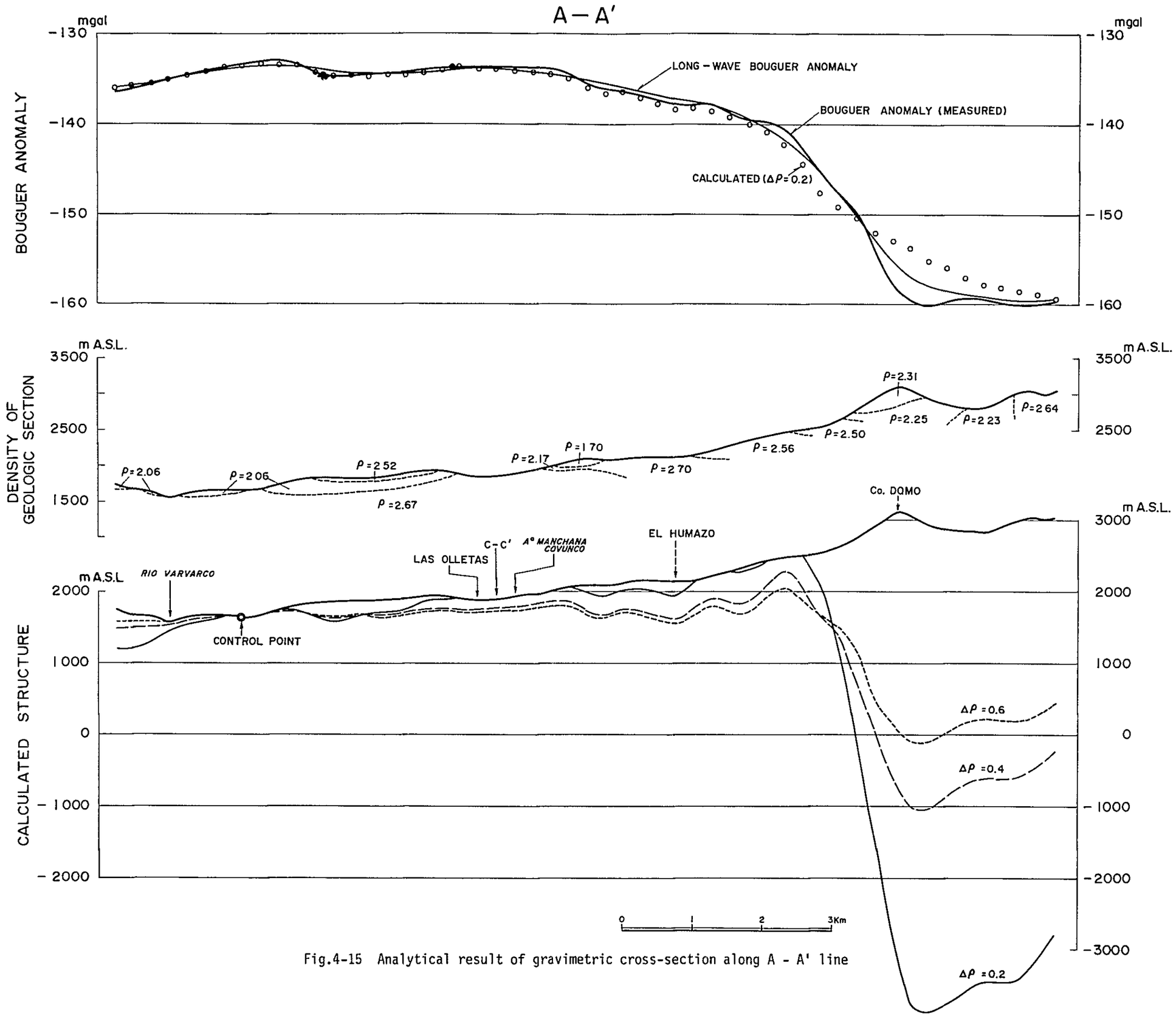


Fig.4-15 Analytical result of gravimetric cross-section along A - A' line

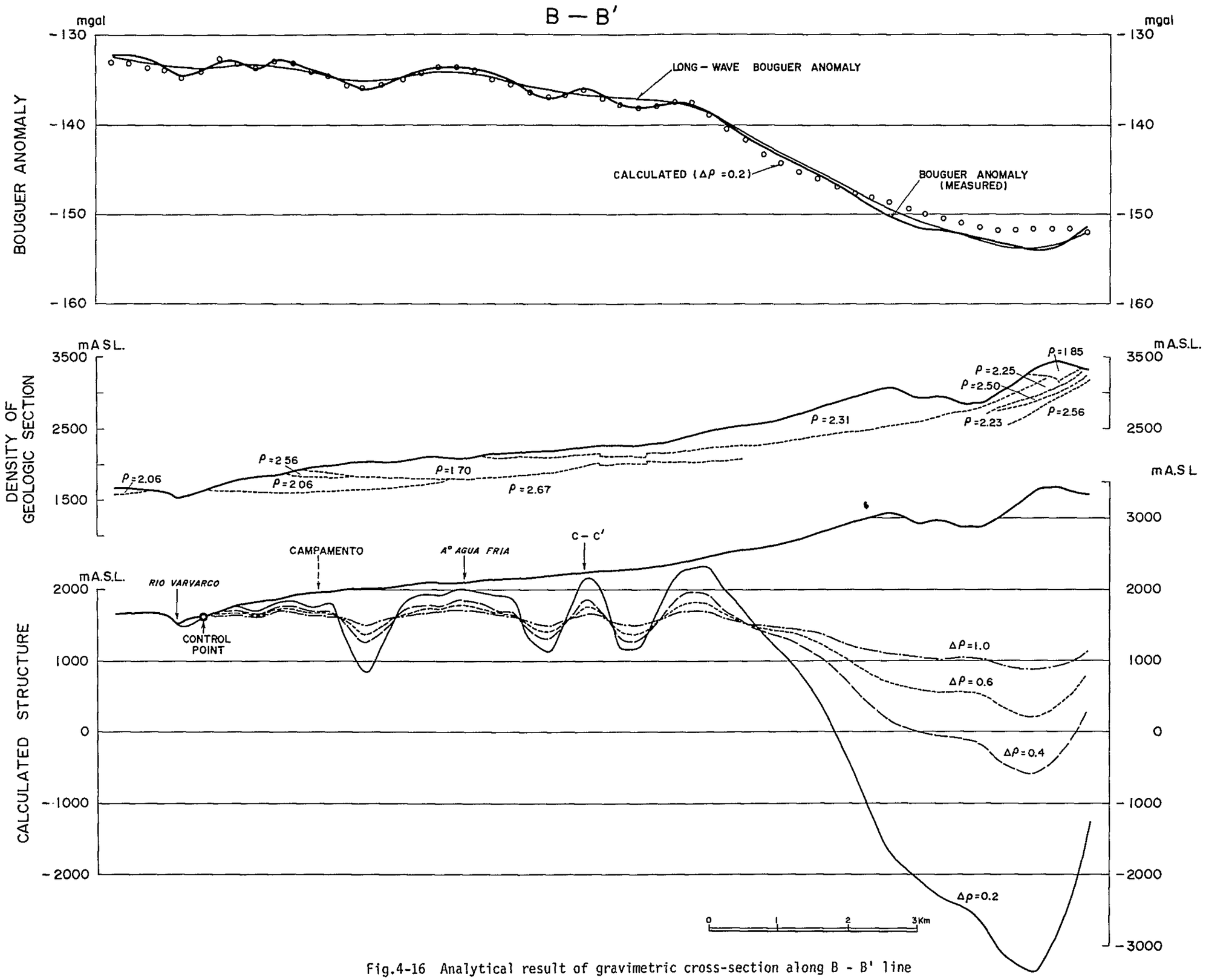


Fig.4-16 Analytical result of gravimetric cross-section along B - B' line

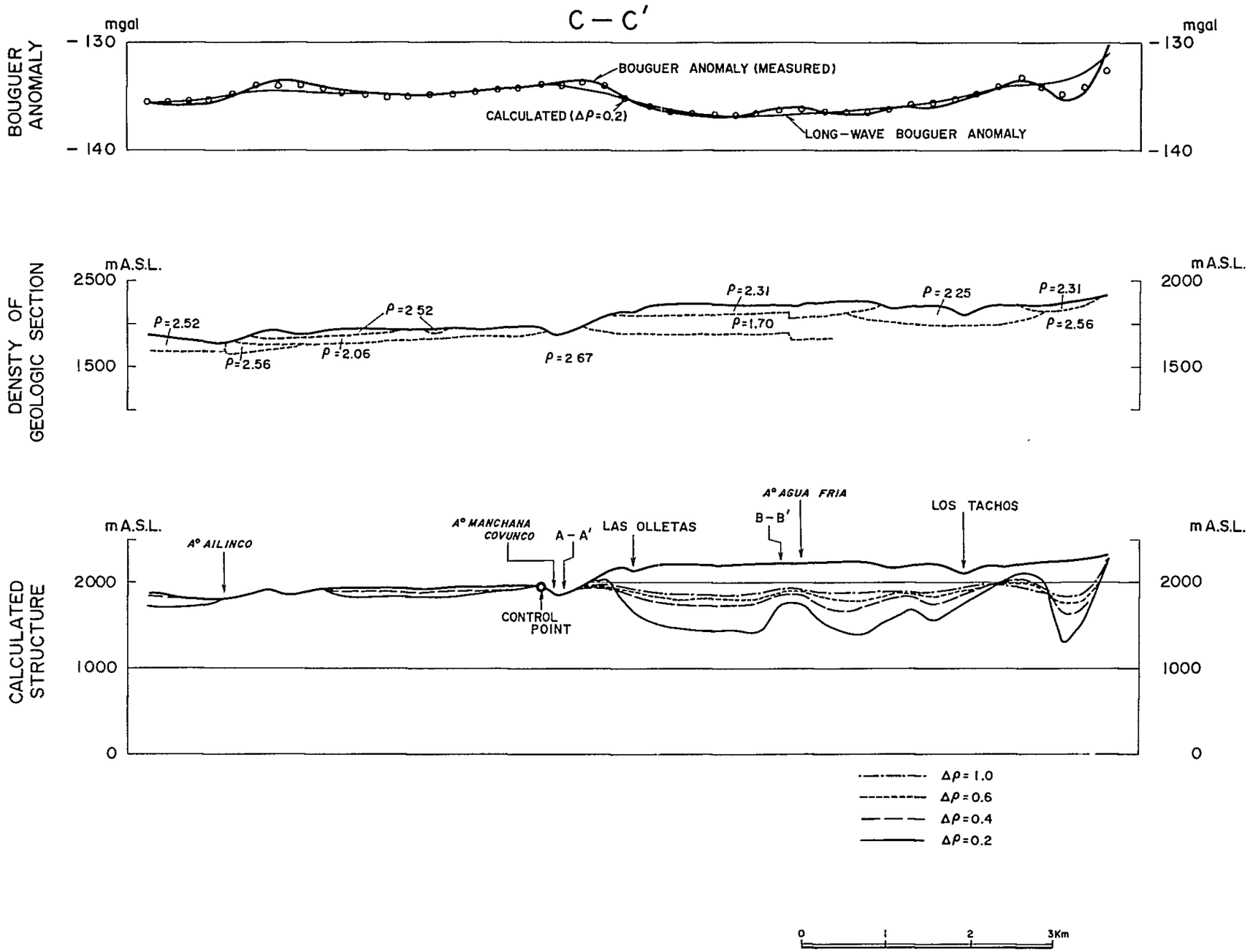


Fig.4-17 Analytical result of gravimetric cross-section along C - C' line