PRIMER CONGRESO GEOLOGICO CHILENO (2 - 7 Agosto 1976, Santiago).

EXCURSION B

GEOLOGICAL EXCURSION TO THE MAIPO AND EL VOLCAN VALLEYS

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The Maipo river crosses the Central Valley depression a few kilometers south of Santiago; its main tributaries in the high Andes are the Colorado, Yeso and Volcán rivers which allow access to excelent rocks exposures representing an important part of the stratigraphic column and typifying the main structural features of the Andean region of Central Chile. A traverse through the Maipo and Volcán valleys gives a fair picture of the lithologic character, structure and stratigraphic sequence of the units exposed; this can properly be projected for hundreds of kilometers south and north of this strip, where they show practically no facies changes but some differences in structure (Fig. 1).

On this excursion you will observe therefore the typical formations of the eastern part of the Andean Geosyncline developed during the span Early Jurassic-Early Cenozoic, which in many aspects differs from synchronous rock units exposed in the Coastal Range at this latitude, accumulated in the western part of the basin. The western edge of the geosyncline, well exposed in the Coastal Range of Central Chile, is marked by transgressive conglomerates and sandstones of Sinemurian age overlaying a basement of Triassic, Paleozoic and probably older rocks.

Marine sediments of the same age constitute the first deposits accumulated on the eastern part of the basin where they overlie unconformably a Permo-Triassic basement. At this latitude the eastern margin of the trough is at about 20 km east of the Chile-Argentine boundary.

The stratified units exposed from the vicinity of Santiago up to the headwaters of the Volcán river, which represent the transition between the western and eastern facies of the basin are, from youngest to oldest, the following:

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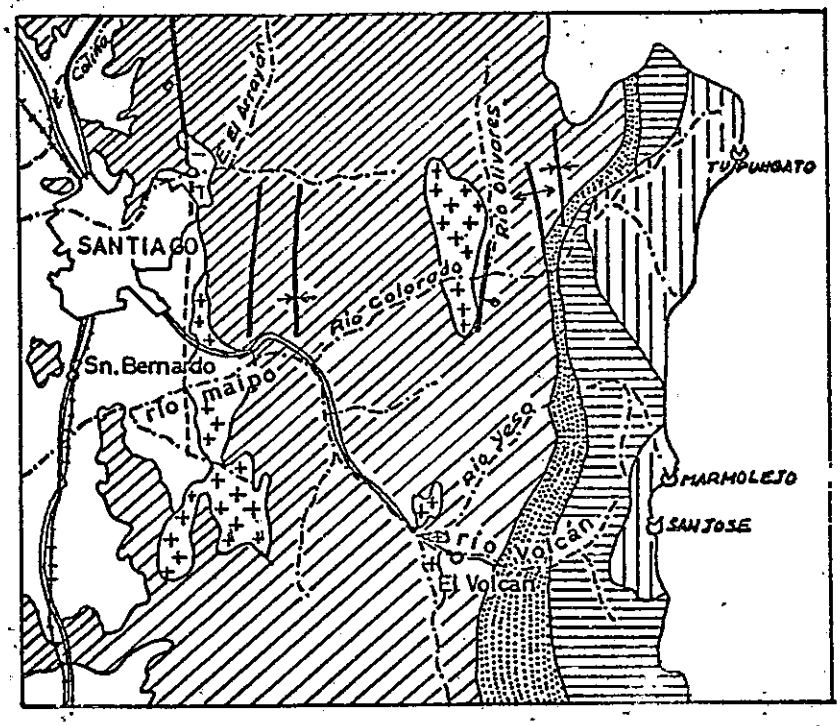

LEGEND

SEDIMENTS OF THE CENTRAL VALLEY	QUATERNARY
ANDESITIC-BASALTIC FLOWS AND PYROCLASTIC ROCKS	QUATERNARY
INTRUSIVE ROCKS; QUARTZ MONZONITE TO DIORITE	EARLY TERTIARY to LATE CRETACEOUS
CONTINENTAL VOLCANIC AND SEDIMENTARY ROCKS PREDOMINANTIY ANDESITES; ALSO BASALTS AND SILICIC PYROCLASTIC ROCKS MOSTLY IGNIMBRITES.	EARLY TERTIARY to LATE CRETACEOUS
MARINE AND CONTINENTAL SEDIMENTARY ROCKS	EARLY CRETACEOUS
MARINE AND CONTINENTAL SEDIMENTARY ROCKS; THICK GYPSUM DEPOSITS	LATE JURASSIC

FAULT ANTICLINE SYNCLINE

0 10 20 30 Km.

1:1.000.000

FIG.- 1

Farellones Formation	Continental; mostly andesitic volcanic rocks. Early Cenozoic (Eocene?)
Unconformity	
Abanico Formation	Continental; mostly andesitic volcanic rocks. Late Cretaceous (Campanian-Maestrichtian)
Unconformity	
Colimapu Formation	Continental; predominantly clastic sedimentary rocks (red beds). Aptian-Albian?
Gradational Contact	
Lo Valdés Formation	Marine; limestones and shales. Middle Tithonian-Hauterivian.
Gradational Contact	
Rio Damas Formation	Continental; clastic sedimentary rocks and andesitic volcanic rocks. Kimmeridgian-Early Tithonian.
Conformable Contact	
Rio Colina Formation	Marine and evaporite facies; gypsum, limestones and lutites. Oxfordian.

Farellones Formation. 800 to 3.000 m thick.

Predominantly andesitic to rhyolitic and basaltic volcanic rocks. Interbedded continental subaereal and lacustrine sediments.

Characteristic features of this unit are: very slight folding, generally good stratification, presence of rhyolitic ignimbrites in its base, usually affected only by very low grade burial metamorphism (zeolite facies); mineral assemblages observed are: zeolite montmorillonite, chlorite, calcite, albite (LEVI, 1970). The age is inferred to the Early Cenozoic mostly Eocene, based on the following: (1) it overlies unconformably the Abanico formation of probably Late Cretaceous (Campanian-Maestrichtian) age; (2) the unconformity separating the two units is assigned to the Laramian orogeny (KLOHN,1960); (3) it underlies, unconformably, andesitic-basaltic volcanic rocks of probable Mio-Pliocene age; (4) it is intruded by gran

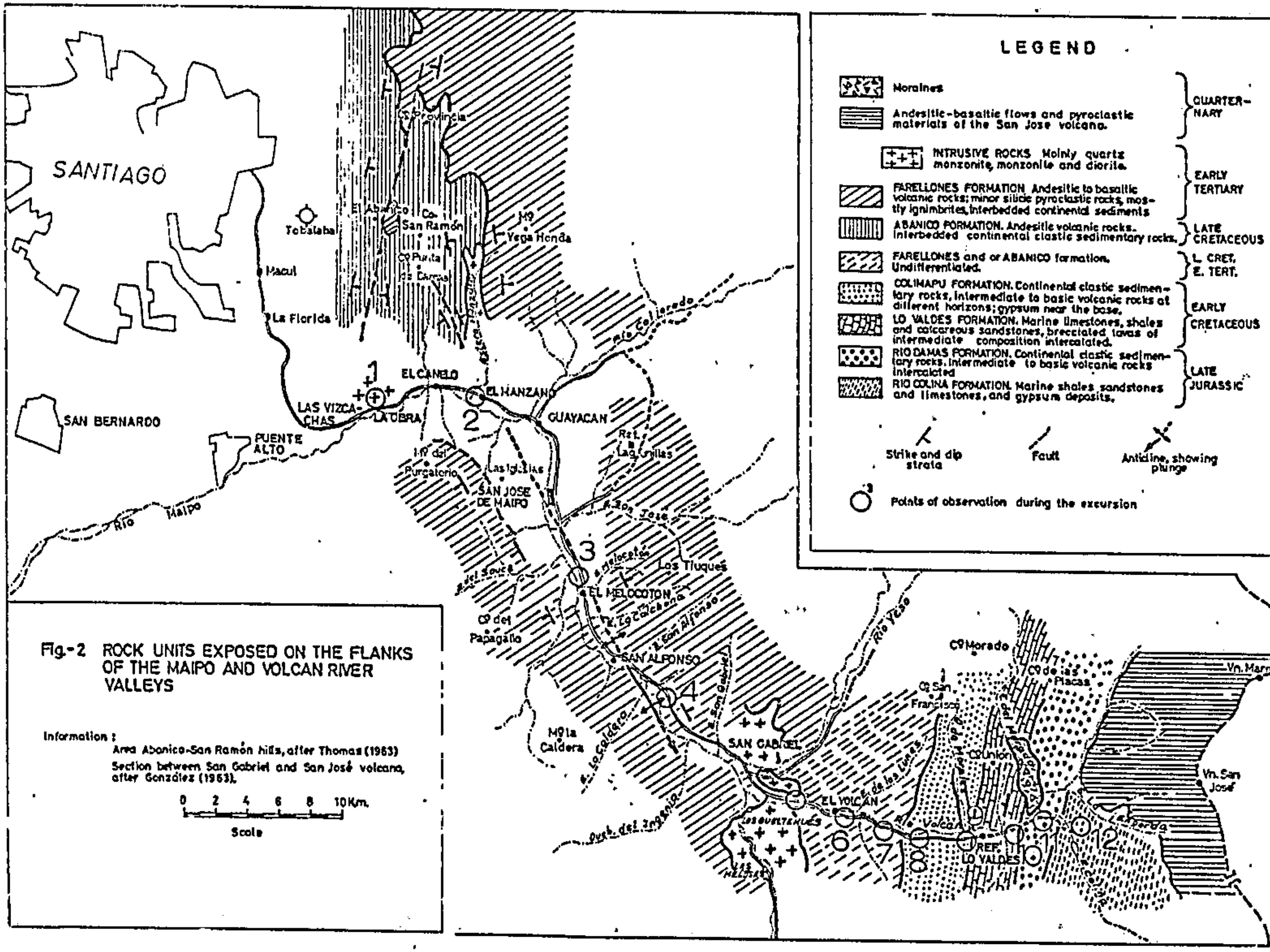

Fig.-2 ROCK UNITS EXPOSED ON THE FLANKS OF THE MAIPO AND VOLCAN RIVER VALLEYS

itic rocks of 40 to 60 m.y.; (5) clasts interpreted to be derived from this unit are present in the Middle Eocene marine sedimentary rocks exposed on the coast at this latitude.

Angular unconformity. (Laramian orogeny?).

Abanico Formation. 1800 to 3.600 m thick.

Andesitic volcanic rocks and interbedded continental sedimentary rocks. The unit is more intensely folded than the overlaying Farellones formation; stratification is usually bad or massive; the rocks are affected by burial metamorphism varying from prehnite-pumpellite facies at the bottom to zeolite facies at the top; corresponding mineral assemblages are albite, pistacite, quartz, chlorite, calcite, white mica, sphene, adularia, prehnite, pumpellite, and zeolite-albite, chlorite, calcite, prehnite, pumpellite, respectively (LEVI, 1970).

The age of the Abanico formation is indirectly inferred to be Late Cretaceous, possibly Campanian-Maestrichtian. This age inferrence is based on: (1) stratigraphic correlation; the unit is considered the lithostratigraphic equivalent of the Viñita formation exposed about 300 km north of this area, which near of its top contains dinosaur bones of Maestrichtian age (CASAMIQUELA et al., 1969); (2) the unconformity separating this unit from the overlaying Farellones formation is considered to be the result of the Laramian orogeny; (3) the Abanico formation overlies the Aptian-Albian Colimapu formation, with angular unconformity; according to KLOHN (1960), this break marks the first and most important orogenic deformation of the geosynclinal pile and it is assigned to the Subhercynian orogenic phase, well dated in the Magallanes region and in the Argentinian Patagonia.

Angular unconformity. Subhercynian (Intersenonian) Orogeny.

Colimapu formation. 800 to 3.000 m thick.

Continental clastic sedimentary rocks (red beds sequence). Mostly sandstones, lutites and conglomerates, partly lacustrine sediments. Intermediate to basic breccias, lavas and pyroclastic rocks at different horizons. Subordinate gypsum layers underlies with angular unconformity the Abanico formation and overlies, conformably and with gradational contact, the Lo Valdés formation, of Neocomian age. Carophyte oogonia found in the lower half of the unit (MARTINEZ and OSORIO, 1963) and contact relationships permit to assign an Aptian-Albian age to this formation.

Rio Colina Formation. 750 m thick.

Marine sedimentary rocks. GONZALEZ (1963) describes this unit as a sequence of evaporites, mostly gypsum, with intercalations of dark gray calcareous sandstones and lutites, limestones, greenish sandstones and fine conglomerates. The section exposed at the type locality is quite disturbed because of the mobility of the gypsum. South of this area, the normal stratigraphic sequence equivalent to the Rio Colina formation consists of gypsum (up to 200 m thick) underlain by predominantly gray shales. The unit underlies, conformably, the continental Rio Damas formation; its base is not known in this area but eastward, in Argentinian territory at this latitude, sediments of the same age overlie a Permo-triassic basement. Ammonites found in the marine beds of Rio Colina formation (specially Perisphinctes aff. P. andium Steinmann) and its lithostratigraphic equivalents, permit to assign an Oxfordian age to this unit. The Rio Colina formation represents only the upper part of the marine sequence accumulated since Liassic (Sinemurian) time in the eastern part of the Andean basin.

Preliminary studies on the nature of alteration of the rocks of the Rio Colina, Rio Damas, Lo Valdés and Colimapu formations, all concordant units show that they have been affected by burial metamorphism varying from the zeolite to the transition between prehnite-pumpellite and greenschists facies (LEVI, 1970).

The Excursion

Among stratified units above characterized, the volcanic Abanico and Farellones formations constitute most of the exposures on both flanks of the Maipo Valley, for a distance of about 60 km between Las Vizcachas and the vicinity of El Volcán (Fig. 2). Except for the westernmost outcrops north of the Maipo Valley, which are strongly faulted, the strata are gently dipping and conform a wide open anticline whose axis, trending NW-SE, approximately coincides with the direction of the Maipo Valley between El Manzano and San Alfonso. East of San Gabriel, along the rio Volcán, the east dipping limb the anticline, first becomes nearly horizontal and then inclined to the west as it can be observed near El Volcán. From this locality up to the observation point 7, the Farellones, Abanico and Colimapu formations are affected by rather light folds, the most prominent of which is an overturned fold, possibly faulted, affecting the Farellones and/or Abanico formations, exposed on the northern flank of the Volcán Valley in the vicinity of point 7.

In the upper course of the Volcán river, the strata of the Colimapu, Lo Valdés, Rio Damas and Rio Colina formations conform a monocline strongly inclined to the west (Fig. 3).

Because of the general structure of the units exposed, as the excursion proceeds we will descend stratigraphically.

Observation Points during the excursion.
Starting point (Km. 0) Las Vizcachas.

View of the Maipo Valley, terraces and valley fill. Resistivity profiles done across the Maipo Valley have shown that here the sedimentary fill is about 170 m thick, being composed of fine-grained sediments in the lower part and coarse clastic sediments in the upper part; fluvio-glacial deposits are recognized.

Point 1 (Km 3) La Obra.

Granitic rocks intrusive into the volcanic Abanico (?) formation.

A modal analysis for a representative sample from this locality (granodiorite) is as follows:

Quartz	30 %
Orthoclase	15,6%
Plagioclase	44,4%
Biotite	6,7%
Amphibole	2,8%
Opaques	0,7%

Point 2 (Km 13).

Distinction between Abanico and Farellones formations, view to the north, San Ramón and Vega Honda hills. Approximate contact following the upper course of Estero Manzano. Massive and thickly bedded strate of the Abanico formation at San Ramón hill, are notably more inclined to the east than the Farellones formation exposed on Vega Honda hill.

Point 3 (Km 28) El Melocotón.

Anticlinal structure of the Abanico-Farellones formations.

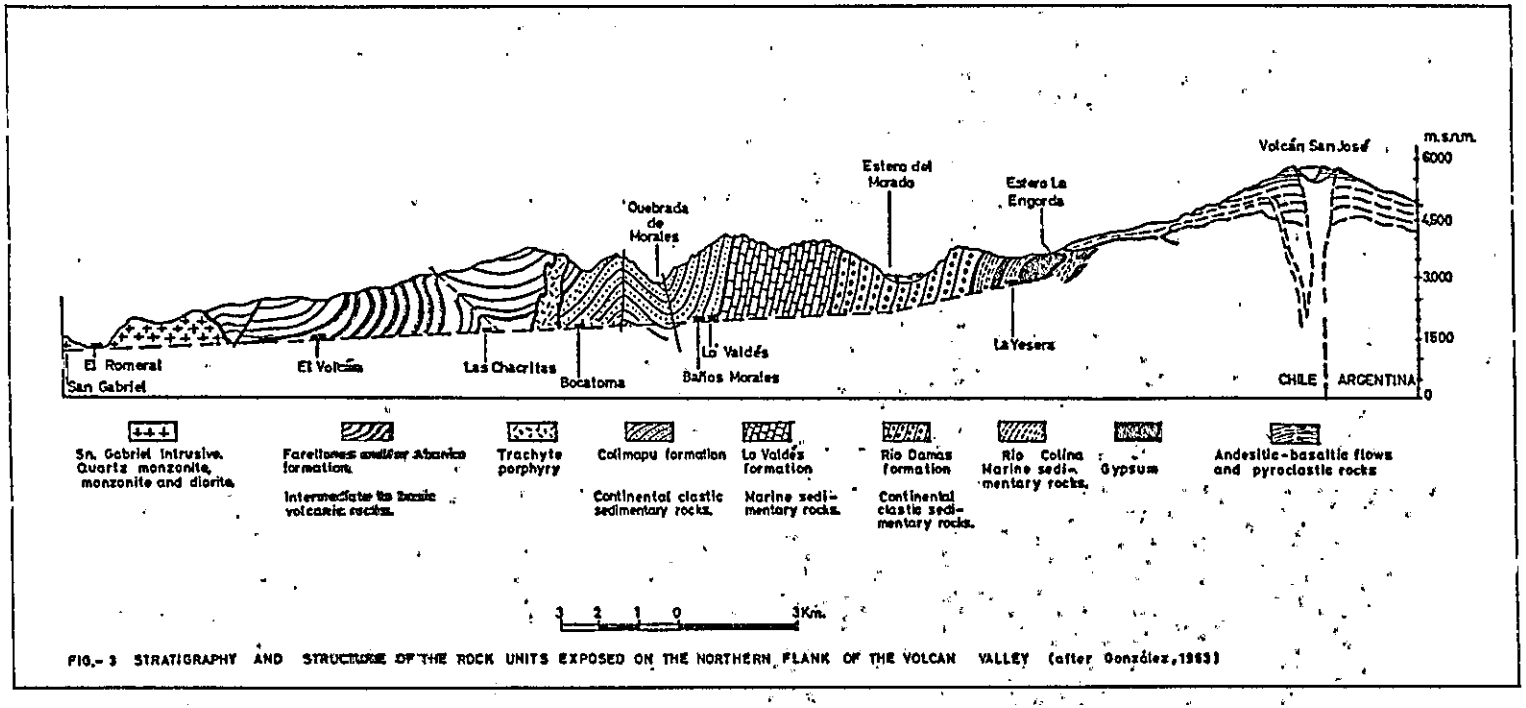

FIG.- 3 STRATIGRAPHY AND STRUCTURE OF THE ROCK UNITS EXPOSED ON THE NORTHERN FLANK OF THE VOLCAN VALLEY (after González, 1963)

Point 4 (Km 36).

View of the south plunging anticline. The axis of the NNW trending anticline approximately coincides with the direction of the valley.

Point 5 (Km 52).

View of the northern flank of El Volcán valley, east of San Gabriel. Contact between volcanic rocks of Farellones? (Abanico) formation and the San Gabriel intrusive. Pb-alpha values obtained for the intrusive (monzonite to diorite) are of $23^{+}_{-}1$ and $30^{+}_{-}10$ m.y.

Preliminary studies done on the San Gabriel intrusive (SAAVEDRA, 1971) have shown that it includes three petrographic types, that appear to be distributed at different levels. Thus, monzonite is predominant in the lower levels; olivine gabbro occurs in higher levels of emplacement, near the contact with the stratified rocks, and diorite is found surrounding the gabbro.

The modal analysis of a representative rock from the lower level is as follows (SAAVEDRA, 1971):

Plagioclase (An_{34})	39,2%
K feldspar	27,2%
Quartz	7,6%
Hornblende	19,5%
Magnetite	6,0%
Accesories	0,5%

The gabbros are with or without olivine and contain labradorite, hornblende and biotite; the diorite shows the same constituents but the plagioclase is andesine.

Point 6 (Km 55)

From here to the east, the volcanic rocks of the Farellones (?) formation become gradually more steeply dipping west.

Point 7 (Km 57)

Main fold, possibly faulted, developed in the volcanic sequence.

Point 8 (Km 59)

View of the stocks and sills of trachyte porphiry cutting through the volcanic units. Well developed columnar jointing.

Looking to the east, notice the predominantly red-colored strata of the Colimapu formation.

Point 9 (Km 64)

To the north, Quebrada Morales; red-beds of the Colimapu formation. On the background, Cerro Morado (5.060 m).

Point 10 (Km 66). Lo Valdés.

Steeply dipping, marine sedimentary strata of Lo Valdés formation (Middle Tithonian-Neocomian).

Point 11 (Km 70).

Red-beds sequence of the Rio Damas formation (Kimmeridgian-Early Tithonian in this area) underlaying with gradational contact the Lo Valdés formation. Mud cracks and raindrop prints are common in these sediments.

Point 12 (Km 72) Gypsum mine.

This gypsum represents evaporites of the Oxfordian regressive facies. It underlies, conformably, the continental Rio Damas formation and constitutes most of the Rio Damas formation in this area, of Oxfordian age.

These units are seen looking south through estero Colina.

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