ALMA Memo # 418

REPORT GEO 01/57

GEOTECHNICAL STUDY
CHAJNANTOR SITE, II REGION
2002 CAMPAIGN

ATACAMA LARGE MILLIMETER ARRAY
SITE CHARACTERIZATION AND DEVELOPMENT
CERRO CHASCON SCIENCE PRESERVE

EUROPEAN SOUTHERN OBSERVATORY

(Geo Ambiental Consultores Ltda.)

March 2002

FINAL REPORT

GEOTECHNICAL STUDY
CHAJNANTOR SITE, II REGION
2002 CAMPAIGN


European Southern Observatory

March, 2002

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1. INTRODUCTION

The present report is written by ***Geo Ambiental Consultores Ltda.*** for the ***European Southern Observatory*** and summarizes the findings at the Chajnantor Site of the so called Cerro Chascón Science Preserve. At this site, a total of 22 borings were drilled between January 6 and January 24 of year 2002 to help in the geotechnical characterization for the development of the Atacama Large Millimeter Array (ALMA) project.

The following Sections summarize the field and laboratory work developed during this campaing. The results are incorporated to the data gathered during two earlier campaigns (GEO 99/37, March 2000 and GEO 98/51, December 1998) to make recommendations for foundation design. Boring logs and photographs of the rock cores are presented in the Appendix.

2. LOCATION AND SITE DESCRIPTION

The area of interest is located in the Second Region of Antofagasta, at approximately 40 km East of the village of San Pedro de Atacama, within the so called Puna de Atacama (Figure 1). It is a flat area situated between the Purico and Chajnantor hills on the North, the Chascón hill on the East and Cerro Negro Norte on the South.

The access to the site is by Route 27, a paved road from San Pedro de Atacama to the Jama pass. A dirt road connects the pampa with Route 27 at kilometre 60.

The Chajnantor site is a pampa, that is, a fairly flat and extensive area, with a gently slope to the South. It shows a number of depressions and other topographic features that make it uneven in many places. Some of these depressions have been formed by erosion by wind and incipient water flows which occur with rainfall mostly during the summer months (January and February).

The surface shows a thin layer of gravel and pebbles followed by a few centimetres of sand, although rock outcrops are notorious at the site. Vegetation is almost non-existing due to the high altitude and the very little rainfall experienced in the region.

A gas pipeline recently constructed crosses the area in a North-West to South-East direction from Argentina to the South of the Chajnantor and Agua Amarga hills, cutting this area at a 30° angle from an East-West imaginary line.

A few dirt roads are present. Three small scientific camps, and facilities are already installed in the area.

Figure 1. General Location Map

3. **GEOLOGIC DESCRIPTION**

The rocks outcropping the area belong to the Purico Superior Ignimbritic formation, which is a member of the Purico Ignimbrites (Figure 2), formely known as the Cajon Ignimbrite (Guest 1968 in Ramirez and Gardeweg, 1982). The formation corresponds to a series of dacites rich in crystals, their radiometric age (k/Ar) varying between 1.38 ± 0.07 and 0.87 ± 0.52 My (Schimtt et. al., 2001).

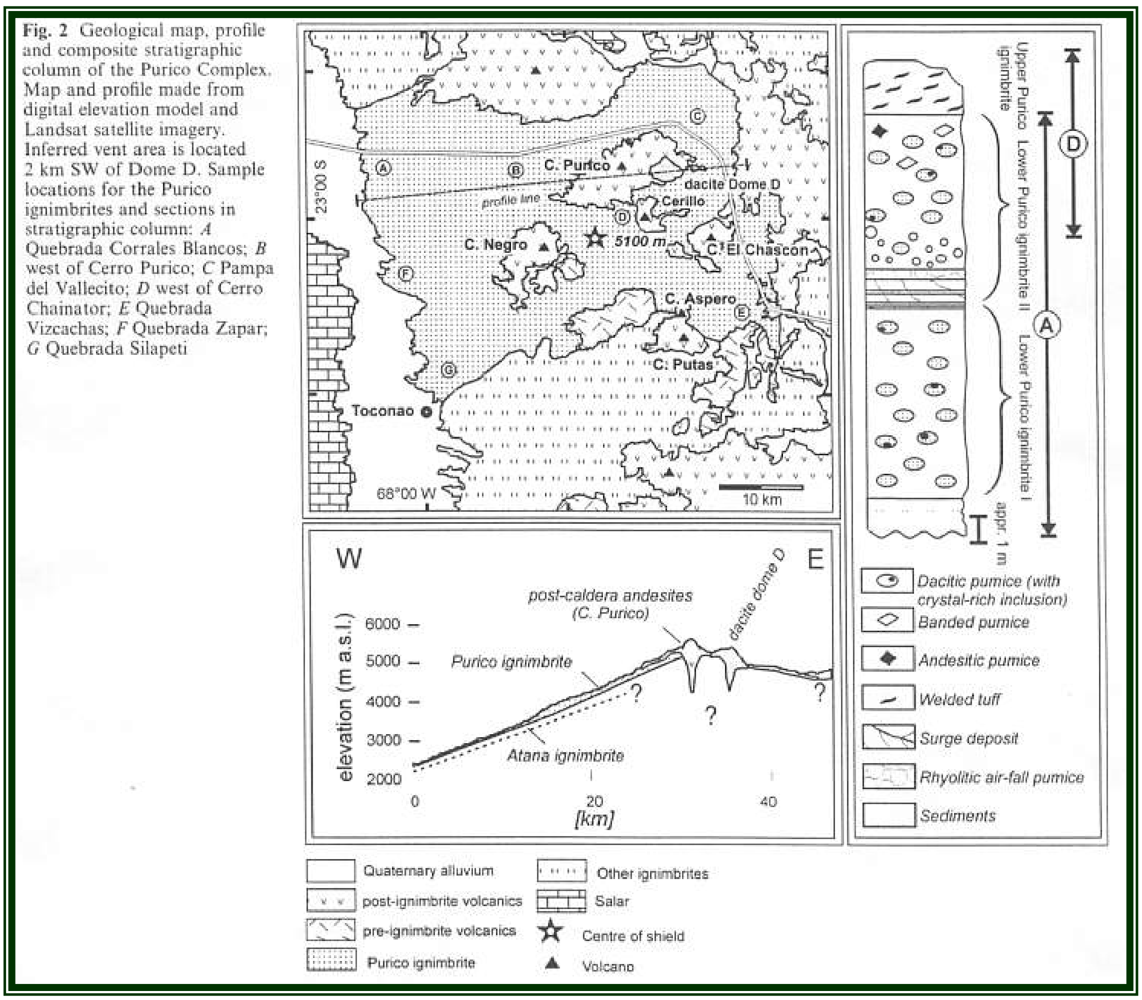

Figure 2. Geologic Map, Profile and Composite Stratigraphic Column of the Purico Complex (From Schmitt et. al., 2001)

Electric resistivity geophysical studies done by Yashima et. al. (2001) and Sakamoto (2002), show the existence of three horizons with specific resistivity: the first with a thickness of approximately one meter and a resistivity of 1,513.16 ohm * m; the second with a depth of about 18 m and resistivity of 8,858.12 ohm * m; and the lower and third with a resistivity of 16,183.92 ohm * m.

The first horizon can be matched with metheorized cover of low resistivity due to its secondary permeability which is a product of the numerous fractures and of the lesser grain size of the material, all of it partially saturated with water. The second horizon is correlated with the sound rock composed by the Purico Superior Ignimbrite (welded tuff), having a high resistivity due to its impervious character. The third horizon is related with the Purico Inferior II ignimbrite (pumices) that show levels with greater porosity and thus a lower resistivity.

An open fracture was observed with a width of approximately 20 cm and magnetic bearing of N 30º W which developed with light truck traffic (Figure 3). In the vicinity and at about 800 m to the North-West, another cavity was observed with a circular shape and magnetic bearing N 20º W (Figure 4). Within the same zone, but approximately 400 m to the South, another crack is forming (it can be detected due to a depression on the surface as seen in Figure 5).

It is estimated that the origin of theses discontinuities is thermal contraction after deposition and cooling of the welded tuff. It could also be due to a fracturing as a response to tectonic effects. In any case, these fractures do not seem to present movement at this time and their discovery is due to the collapse of the surface cover on vehicle traffic.

Figure 3. Open Fracture N 30º W At N 7,453,350; E 627,007

Figure 4. Open Fracture N20ºW At N 7,453,291; E 627,657

Figure 5. Forming Crack At N 7,453,291; E 627,657

According to observations on the road (km 38.6) and by the cores of some borings (P20, P24, C180 and C183, among others), the ignimbrite shows a metheorized cover of about one meter, formed by small fragments over massive rock (Figure 6 and 7) with little or no fractures. As an example, boring P20 recognized 7,5 m of unfractured rock under a cover of 1,0 m of highly fractured rock.

The drainage network observed corresponds to subparallel and radial "patterns of" or depressions which would be showing a topographic control. The lack of angular features on the drainage path is an evidence of the non existence of other forms of control such as a structural one.

Figure 6. Slope Cut on the Road (km 38,6)

Figure 7. Example Rock Cores, Borings P20 and P24

Observing the aerial photographs, two distinctive features are observed: a parallel set of "bands" and a rectangular "grid". They are shown in Figures 8, 9 and 10, and could reflect sets of fractures. These fractures are present in the entire area of study and are reflected in the boring samples and road cuts in the vicinity (see Figure 6 and 7). It is believed that these fractures were formed during the deposition time due to heat release and/or movements. The fractures found during the drilling campaign are closed and do not show signs of metheorization or weathering but at or close to the surface. These fractures do not present a problem for the foundation of the structures being considered.

A brief geologic development review of the area is presented in GEO Report 99/37.

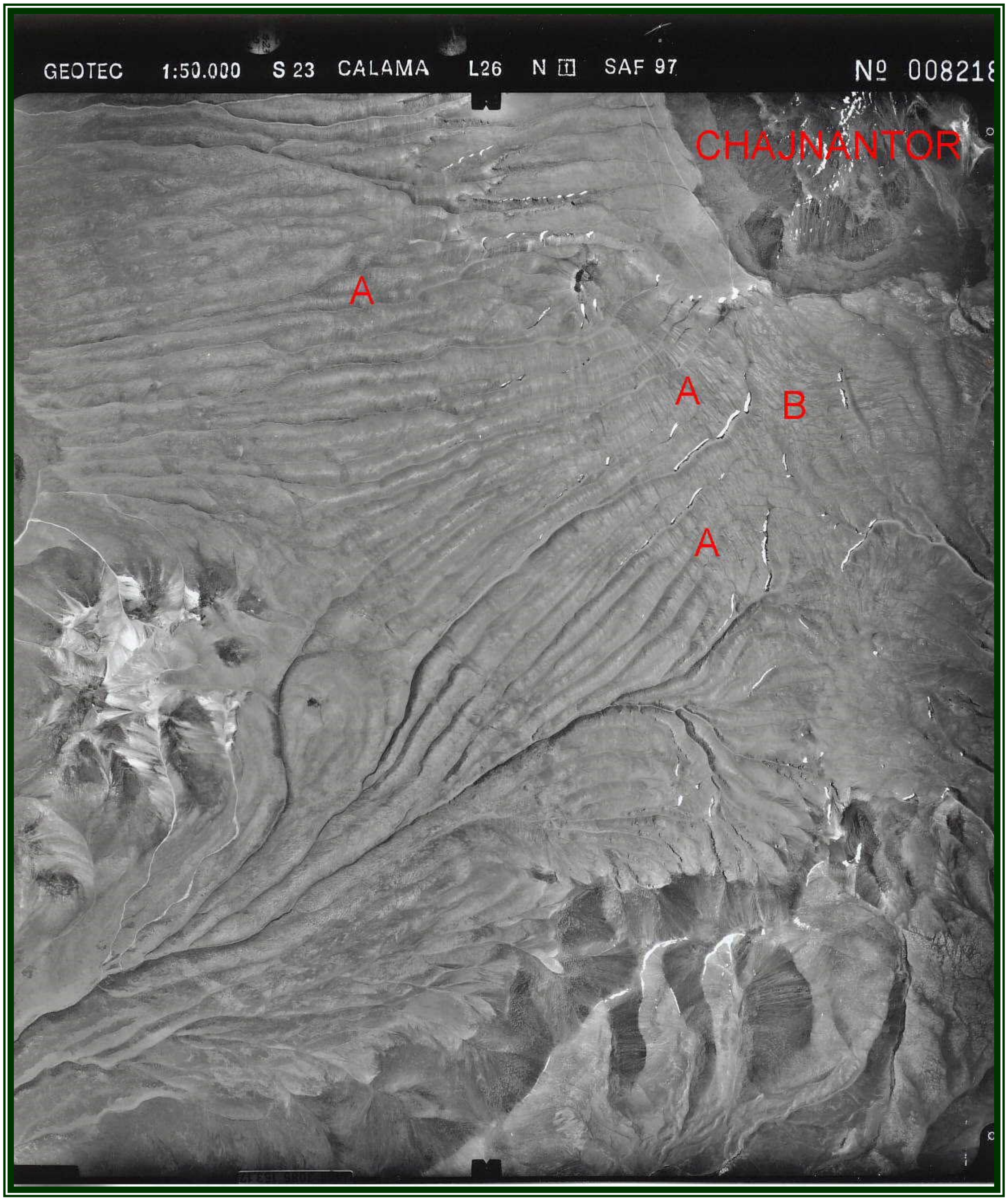

Figure 8. Aerial Photograph with Distinctive Features

Figure 9. Feature A: Parallel "Bands"

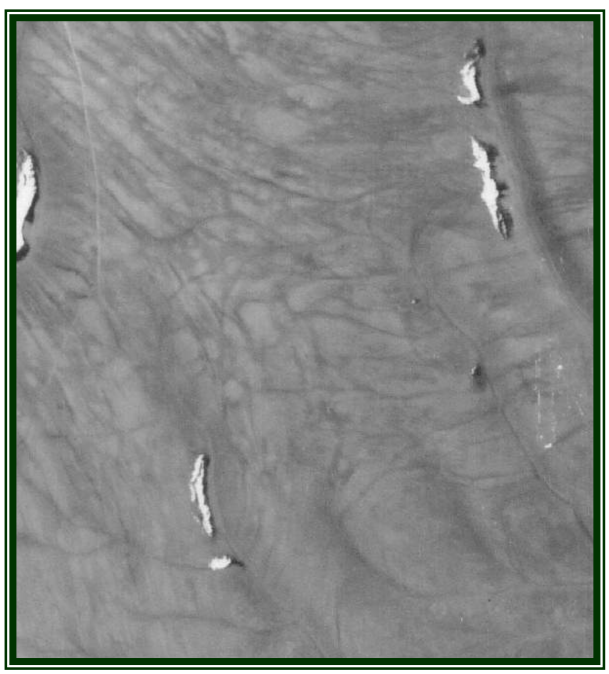

Figure 10. Feature B: Radial "Grid"

4. FIELD EXPLORATION AND LABORATORY PROGRAMA

4.1. Field Exploration

A total of 22 borings were drilled at locations specified by ESO as shown in Table 1 and in Figure 11. Drilling was done with N-size tools to obtain 4.7 cm dia. quality cores with a wire line type double-wall sampler. No additives were used during the drilling operation and only fresh water was applied as a coolant to the cutting tool at the bottom of the drilling rod.

The drilling activities started on January 6, and ended on January 24, 2002. A coordination meeting with representatives of ESO was conducted on January 6 and a site visit followed on January 7. A second site visit with GEO´s geologist and geotechnical engineer was organized on January 13 and 14.

Details of the borings with core sample pictures, percent recovery records and determination of Rock Quality Designation (RQD) are presented in the Appendix for each boring.

Overall the subsurface is characterized by a thin layer of residual soil (gravel over sand) over very broken rock. The depth to massive rock (rock with very few discontinuities, cracks or fissures) is on the average 1.2 m. The estimated value for each boring is presented on Table 2.

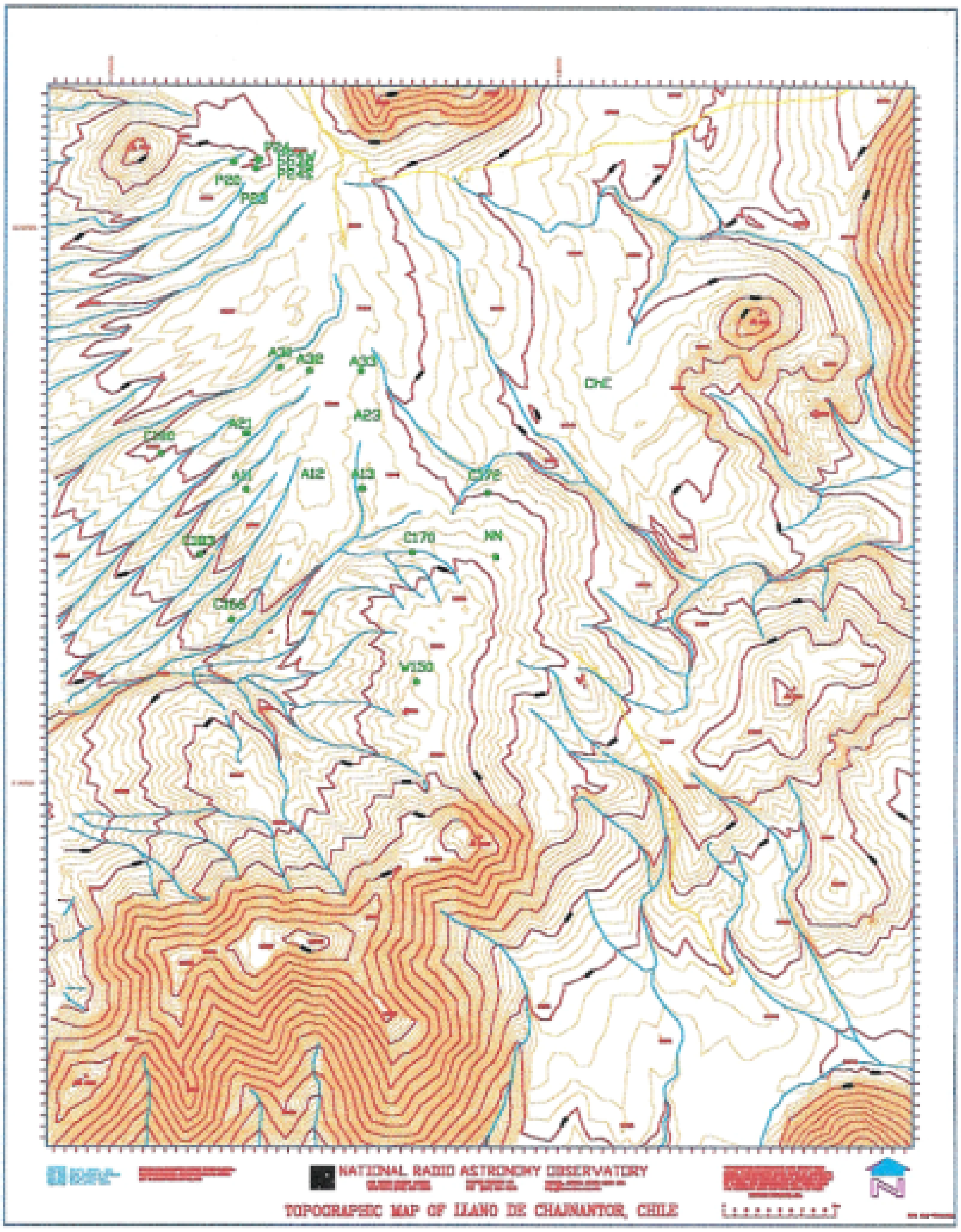

Figure 11. Boring Locations

Table 1

Borings Locations

Nº	BORING	Coordinates (SAM 56)	
		North	East
1.	A11	7,452,710	627,327
2.	A12	7,452,710	627,827
3.	A13	7,452,710	628,327
4.	A21	7,453,252	627,264
5.	A23	7,453,210	628,327
6.	A31	7,453,714	627,528
7.	A32	7,453,710	627,827
8.	A33	7,453,710	628,327
9.	C166	7,451,512	627,018
10.	C170	7,452,114	628,705
11.	C172	7,452,605	629,443
12.	C180	7,453,061	626,392
13.	C183	7,452,023	626,709
14.	CHE	7,453,550	630,400
15.	NN	7,452,054	629,486
16.	P20	7,455,599	627,227
17.	P23	7,455,551	627,305
18.	P24	7,455,646	627,376
19.	P24N	7,455,649	627,377.75
20.	P24S	7,455,643	627,372.5
21.	P24W	7,455,646	627,372.5
22.	W150	7,450,978	628,753

Table 2

Depth to Massive Rock

Nº	Boring	Total Depth of Boring (m)	Depth to Massive Rock (m)
1.	A11	5.5	1.3
2.	A12	5.5	1.3
3.	A13	5.5	1.2
4.	A21	5.5	1.4
5.	A23	5.5	1.3
6.	A31	5.5	1.2
7.	A32	5.5	1.2
8.	A33	5.5	1.5
9.	C166	5.5	1.2
10.	C170	5.5	1.5
11.	C172	5.5	1.7
12.	C180	5.5	1.0
13.	C183	5.5	1.2
14.	CHE	5.5	1.2
15.	NN	5.5	1.5
16.	P20	8.5	1.0
17.	P23	5.5	1.0
18.	P24	5.5	1.0
19.	P24N	5.5	1.0
20.	P24S	5.5	1.1
21.	P24W	5.5	1.2
22.	W150	5.5	1.3

Total Cored: 124 m at 22 locations.

The rock at all locations was ignimbrite (welded tuff), reolithic with quartz and some small fragments of volcanic rocks. The rock is in general medium hard, abrasive and stable. The rock cores show weakness planes which are coincident with depositing planes in which the rock is weakly welded or might indicate different events. This is shown by the breaking (generally in subhorizontal planes) during coring.

4.2. Laboratory Testing and Test Results

Due to the homogeneity of the subsurface material (ignimbrite), the laboratory testing of the rock samples from the borings consisted of a limited number of unconfined compression tests. A total of six rock cores were chosen from different boring and from depth that were representative of the rock and amenable with the foundations to be designed.

The tests were conducted at the laboratories of the Universidad Técnica Federico Santa María in Valparaíso. The samples were prepared in the laboratory so that the length to diameter ratio was equal to two. The corresponding laboratory certificate for the tests is kept in *Geo Consultores* project files.

The results of the unit weight as well as of the value measured for the ultimate load for the six tests performed are indicated in Table 3.

Table 3

Unconfined Compression Tests on Selected Rock Specimens

Boring	Specimen Depth (m)	Unit Weight (kg/m^3)	Ultimate Axial Resistance (kg/cm^2) (1)
A13	3.0	2,050	187
A23	4.0	2,097	227
A32	3.8	2,016	147
A33	3.8	1,987	303
P24 W	4.3	1,991	283
P24 S	2.5	1,922	255

Note (1) : $1\ kg/cm^2 = 98.07\ kPa$

Adding the data obtained previously (see GEO Report 99/37) the mean value of the ultimate axial resistance for 14 data points is 223.5 kg/cm^2 with a standard deviation of 76 kg/cm^2.

5. GEOTECHNICAL CHARACTERISTICS OF THE SUBSURFACE

As previously indicated, the subsurface at the site is characterized by a thin layer of residual soil over very broken rock. This horizon is believed to have formed by action of frost-defrost cycles of the water infiltrated in the crevices and cracks over many years.

Due to the extreme load conditions imposed by the equipment to the foundations, this Consultant considers necessary to locate the foundations at a depth below the broken rock horizon and at least 2 m below the surface. This is a requisite to isolate the foundation from the uplifting forces of frost-heave effects.

Being the massive ignimbrite rock the foundation material, it has been classified according to the Rock Mass Rating (RMR) system proposed by Bieniawski, which is presented in Table 4.

Table 4

Rock Mass Rating System For Jointed Rock Masses
(Bieniawski)

A. Classification Parameters and Their Ratings

	PARAMETER		RANGES OF VALUES						
1	Strength of intact roack material	Point-load strength index	> 10 MPa	4 - 10 MPa	2 - 4 MPa	1 - 2 MPa	For this low range -uniaxial compressive- test is preferred		
		Uniaxial compressive strength	>250 MPa	100-250 MPa	50-100 MPa	25 - 50 MPa	5-25 MPa	1-5 MPa	< 1 MPa
	Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% - 100%	75% - 90%	50% - 75%	25% - 50%	< 25%		
	Rating		20	17	13	8	3		
3	Spacing of discontinuities		> 2 m	0,6 - 2 m	200 - 600 mm	60 - 200 mm	< 60 mm		
	Rating		20	15	10	8	5		
4	Condition of discontinuities		Very rough surfaces. Not continuous No separation Unweathered wall rock	Slightly rough surfaces. Separation < 1 mm Slightly weathered walls	Slightly rough surfaces. Separation < 1 mm Highly weathered walls	Slickensided surfaces OR Gouge < 5 mm thick OR Separation 1-5 mm. continuous	Soft gouge > 5 mm thick OR Separation > 5 mm Continuous		
	Rating		30	25	20	10	0		
5	Ground water	Inflow per 10 m tunnel length	None	< 10 litres/min	10 - 25 litres/min	25 - 125 litres/min	> 125		
			OR	OR	OR	OR	OR		
		Ratio Joint water pressure / mayor principal stress	0	0,0 – 0,1	0,1 – 0,2	0,2 – 0,5	> 0,5		
			OR	OR	OR	OR	OR		
		General conditions	Completely dry	Damp	Wet	Dripping	Flowing		
	Rating		15	10	7	4	0		

B. Rating Adjustment for Joint Orientations

Strike and dip orientations of joints		Very favourable	Favourable	Fair	Unfavourable	Very Unfavourable
Ratings	Tunnels	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

C. Rock Mass Classes Determined from Total Ratings

Rating	100 ← 81	80 ← 61	60 ← 41	40 ← 21	< 20
Class N°	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock

D. Meaning of Rock Mass Classes

Class N°	I	II	III	IV	V
Average stand-up time	10 years for 15 m span	6 months for 8 m span	1 week for 5 m span	10 hours for 2,5 m span	30 minutes for 1 span
Cohesion of the rock mass	> 400 kPa	300 - 400 kPa	200 – 300 kPa	100 – 200 kPa	< 100 kPa
Friction angle of the rock mass	> 45°	35° - 45°	25° - 35°	15° - 25°	< 15°

Under the RMR system, the designer can also apply the following correlations:

Table 5

Geotechnical Parameter Correlations

(Hoeck and Brown)

RMR	Friction Angle (°)	c-intercept (kPa)
20	30	96
40	35	144
60	40	201
80	45	306

$Ei = 0.564\ RMR^{1.958}$ (ksi) (RMR ≤ 60)

$Ei = 290\ RMR - 14{,}500$ (ksi) (RMR > 60)

1 ksi = 6.9 MPa

This Consultant has classified the upper broken rock and the lower massive rock as shown in Table 6, characterizing the materials with the values of the geotechnical parameters indicated in this Table.

Table 6

Geotechnical Parameters For the Site

Total Unit Weight = 2 Ton/m^3

Poisson Ratio = 0.2

Parameter	Broken Rock	Massive Rock
RMR	35	70
Friction Angle (°)	35	42
c-intercept (kPa)	134	250
E_i (MPa)	10,000	40,000

The values of the friction angle and the c-intercept correspond to applying the Mohr-Coulomb strength model with a straight failure envelope.

It should be noted that the cyclic loading of the foundation will come from the wind and thus, it will produce little deformation in the rock. Under these circumstances the material will have an elastic behaviour with very little hysteretic effect. The dynamic modulus will be at least 10 times higher than that indicated for Ei and the damping ratio will probably be less than that for dry sands and gravel, that is < 0.03.

Since the exploration developed during this campaign has corroborated that carried out for GEO Report 99/37, the geotechnical parameters have been maintained unchanged.

6. CLOSURE

As presented in this Report, a total of twenty two sites were investigated. The results show that the upper horizon of broken to very broken changes somewhat in depth with location. None-the-less the depth to massive rock is not high, varying from 1.0 to 1.7 m. considering that it has been suggested that a minimum excavation of 2 m be developed for the projected foundations, in all places the bottom of the foundations will occur close to or at the massive rock horizon.

7. REFERENCES

The following documents were considered when developing GEO Repot 99/37.

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During this campaign, the following additional references have been used:

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APPENDIX A

Boring Logs

BORING A11

COORDINATES : N 7,452,710
E 627,327

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	30	0
1.0 – 2.5	54	34.3
2.5 – 4.0	100	10
4.0 – 5.5	100	86.6

BORING A12

COORDINATES	:	N	7,452,710
		E	627,827
TOTAL DEPTH	:	5.5 m	
SAMPLE DIAMETER	:	4.7 cm (N)	

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	18.6	0
1.0 – 2.5	100	86.6
2.5 – 4.0	100	100
4.0 – 5.5	100	76.6

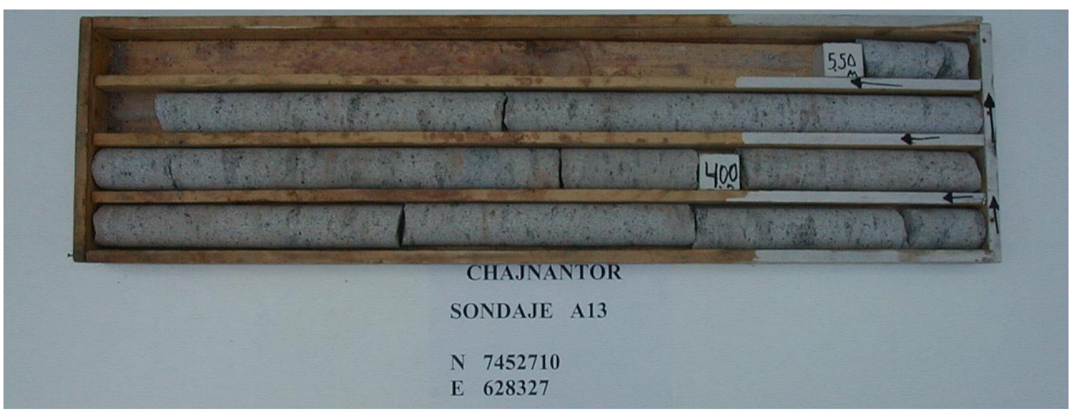
BORING A13

COORDINATES : N 7,452,710
E 628,327

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	33.3	0
1.0 – 2.5	97.3	71.6
2.5 – 4.0	93.3	93.3
4.0 – 5.5	100	100



BORING A21

COORDINATES : N 7,453,252
E 627,264

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	60	0
1.0 – 2.5	100	89.2
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING A23

COORDINATES	:	N	7,453,210
		E	628,327
TOTAL DEPTH	:	5.5 m	
SAMPLE DIAMETER	:	4.7 cm (N)	

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	24.6	0
1.0 – 2.5	100	56
2.5 – 4.0	100	100
4.0 – 5.5	100	95.5

BORING A31

COORDINATES : N 7,453,714
E 627,528

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	40	0
1.0 – 2.5	98	67.3
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING A32

COORDINATES : N 7,453,710
E 627,827

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	25.3	0
1.0 – 2.5	96.6	84.6
2.5 – 4.0	100	100
4.0 – 5.5	100	100

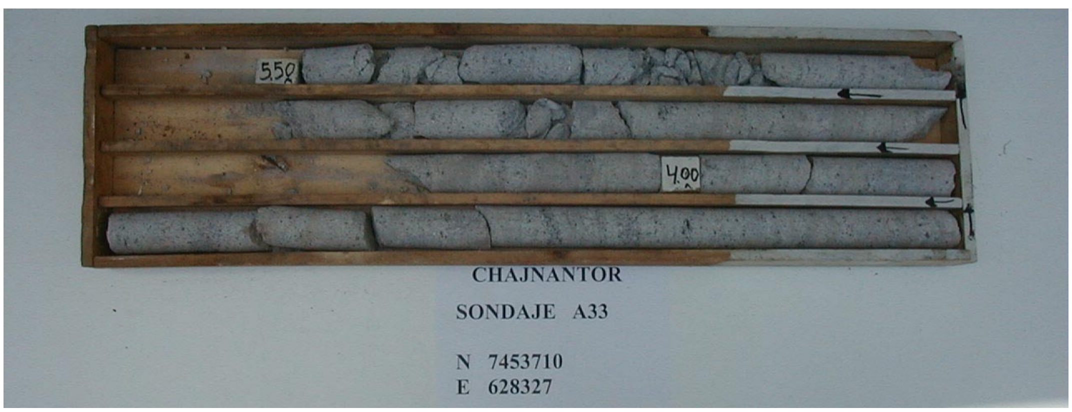
BORING A33

COORDINATES : N 7,453,710
E 628,327

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	16	0
1.0 – 2.5	100	76
2.5 – 4.0	100	92
4.0 – 5.5	100	63.7



BORING C166

COORDINATES	:	N	7,451,512
		E	627,018
TOTAL DEPTH	:	5.5 m	
SAMPLE DIAMETER	:	4.7 cm (N)	

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	30	0
1.0 – 2.5	85.3	85.3
2.5 – 4.0	100	100
4.0 – 5.5	100	100

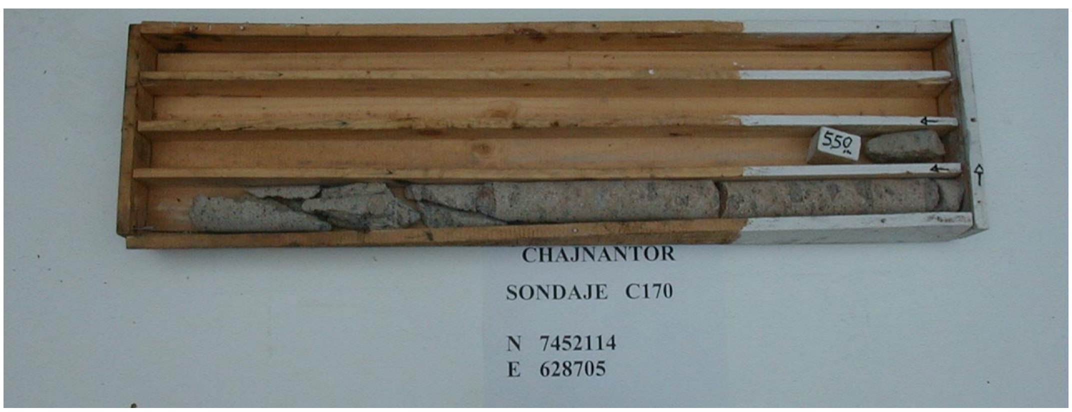
BORING C170

COORDINATES : N 7,452,114
E 628,705

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	28	0
1.0 – 2.5	49.3	31.6
2.5 – 4.0	100	74.6
4.0 – 5.5	85.3	71



BORING C172

COORDINATES : N 7,452,605
E 629,443

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	36	25.3
1.0 – 2.5	100	79.3
2.5 – 4.0	98.6	70
4.0 – 5.5	100	94.6

BORING C180

COORDINATES : N 7,453,061
E 626,392

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	53.3	0
1.0 – 2.5	100	100
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING C183

COORDINATES : N 7,452,023
E 626,709

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	46.6	0
1.0 – 2.5	100	100
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING CHE

COORDINATES : N 7,453,550
E 630,400

TOTAL DEPTH : 5,5 m

SAMPLE DIAMETER : 4,7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	10	0
1.0 – 2.5	93.3	46
2.5 – 4.0	100	66
4.0 – 5.5	100	100

BORING NN

COORDINATES : N 7,452,054
E 629,486

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	60	0
1.0 – 2.5	100	100
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING P20

COORDINATES	:	N	7,455,599
		E	627,227
TOTAL DEPTH	:	8.5 m	
SAMPLE DIAMETER	:	4.7 cm (N)	

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	(Sandy Soil)	0
1.0 – 2.5	82	69
2.5 – 4.0	100	94.3
4.0 – 5.5	94	94
5.5 – 7.0	100	58.3
7.0 – 8.5	100	81


8.50 m
CHAJNANTOR
SONDAJE P20
N 7455599
E 627227


7.00 m
5.50 m
CHAJNANTOR
`SONDAJE P20
N 7455599
E 627227


4.00
2.50
1.00 m
CHAJNANTOR
SONDAJE P20
N 7455599
E 627227

BORING P23

COORDINATES	:	N 7,455,551 E 627,305
TOTAL DEPTH	:	5.5 m
SAMPLE DIAMETER	:	4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	(Sandy Soil)	0
1.0 – 2.5	100	100
2.5 – 4.0	94.6	94.6
4.0 – 5.5	100	100

BORING P24

COORDINATES	:	N 7,455,646 E 627,376
TOTAL DEPTH	:	5.5 m
SAMPLE DIAMETER	:	4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	(Sandy Soil)	0
1.0 – 2.5	100	100
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING P24N

COORDINATES : N 7,455,649
E 627,377.75

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	40	0
1.0 – 2.5	100	100
2.5 – 4.0	100	100

BORING P24S

COORDINATES : N 7,455,643
E 627,372.5

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	40	0
1.0 – 2.5	100	37
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING P24W

COORDINATES : N 7,455,646
E 627,372.5

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	(Sandy Soil)	0
1.0 – 2.5	97.3	78
2.5 – 4.0	100	100
4.0 – 5.5	100	100

BORING W150

COORDINATES : N 7,450,978
E 628,753

TOTAL DEPTH : 5.5 m

SAMPLE DIAMETER : 4.7 cm (N)

DEPTH (m)	RECOVERY (%)	RQD (%)
0.0 – 1.0	43.3	0
1.0 – 2.5	100	73.3
2.5 – 4.0	100	100
4.0 – 5.5	100	100