

GEOTECHNICAL INVESTIGATION AT MATJIESFONTEIN FOR THE NEW SPACE GEODESY STATION

By

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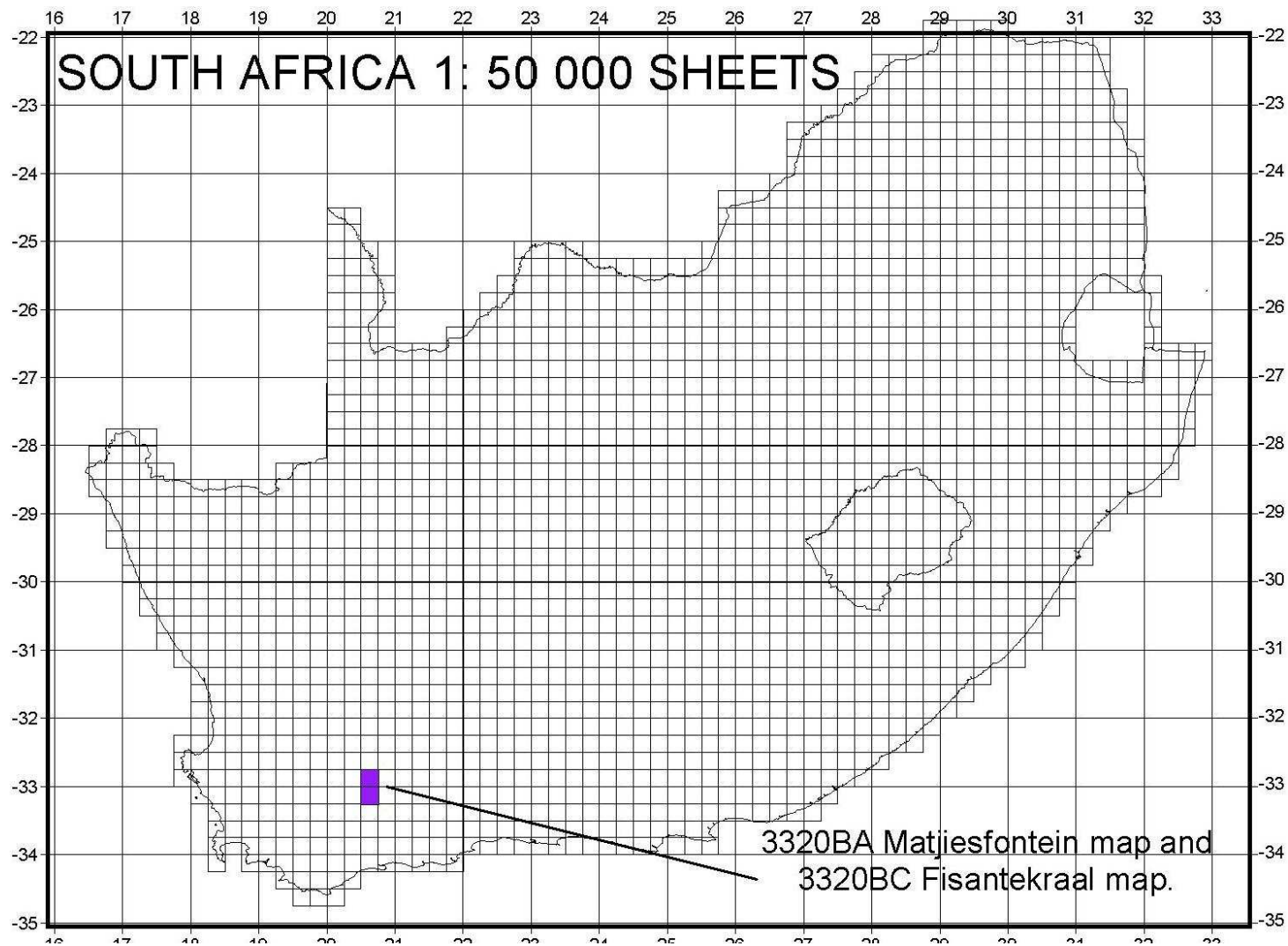
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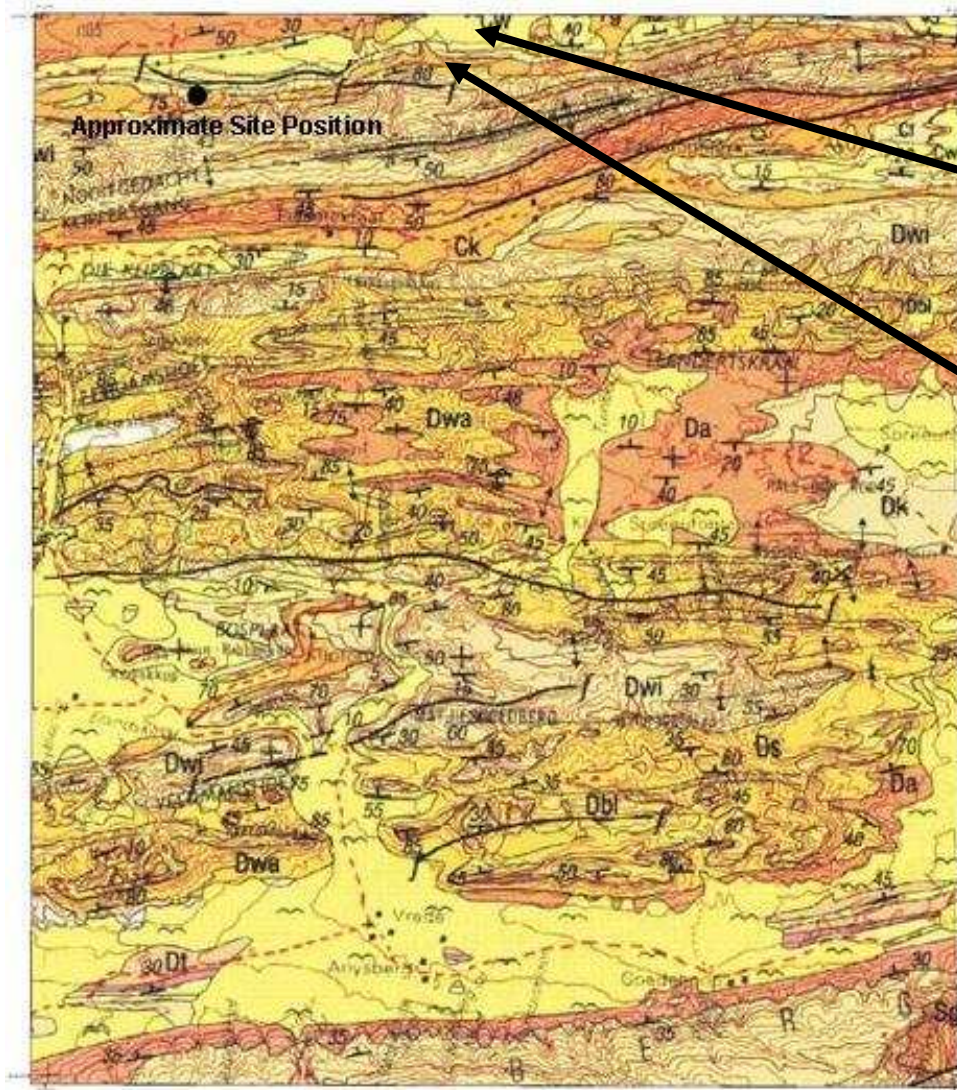
Council for Geoscience

Geological Setting of site at Matjiesfontein



Geological Setting of site at Matjiesfontein

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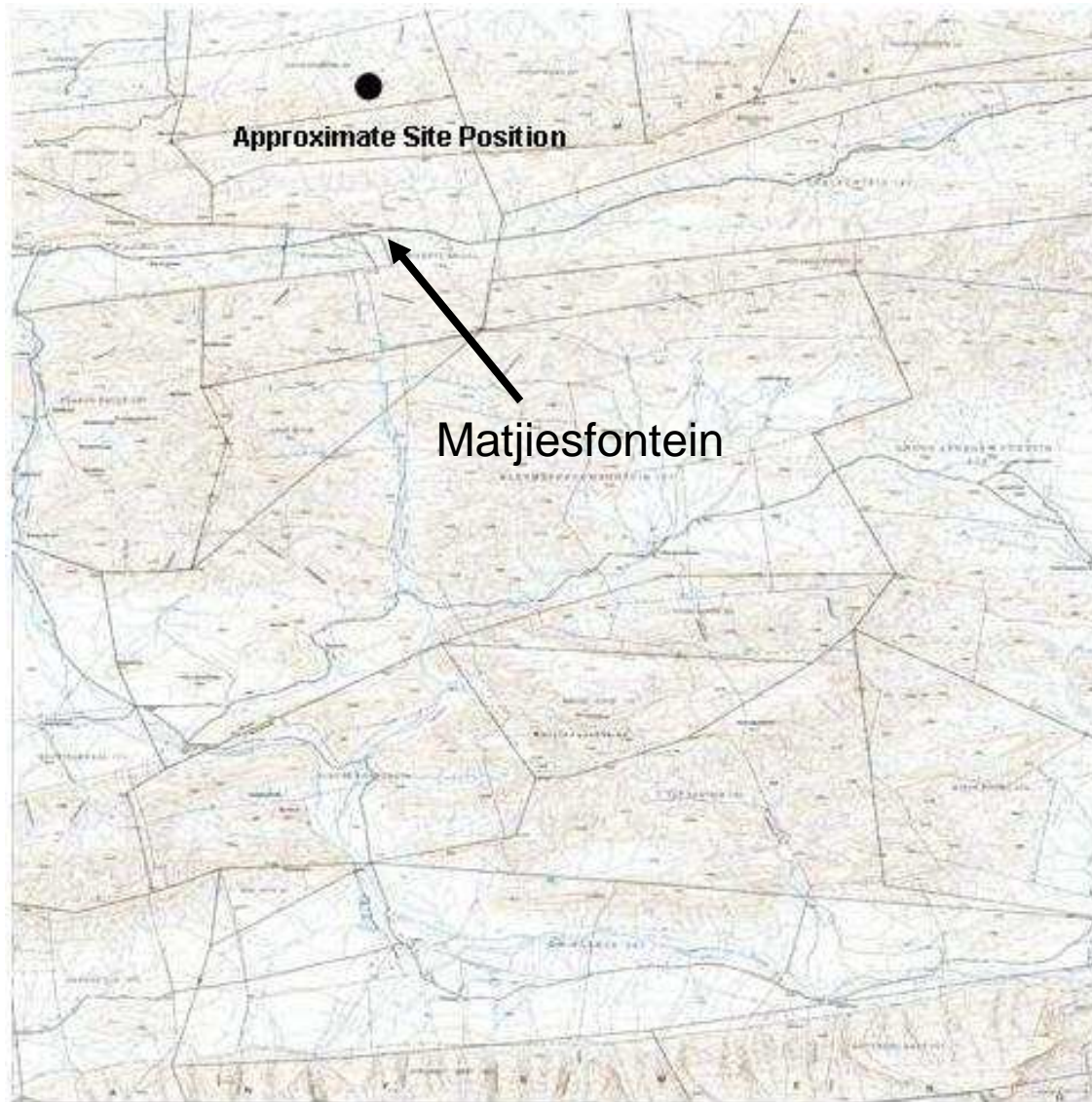


Witpoort Formation:
Sandstones & Quartzites

Floriskraal & Kweekvlei Formation:
Shales & Mudstone

Geology map of the 3320BC 1:50 000 Fisantekraal map

Geological Setting of site at Matjiesfontein



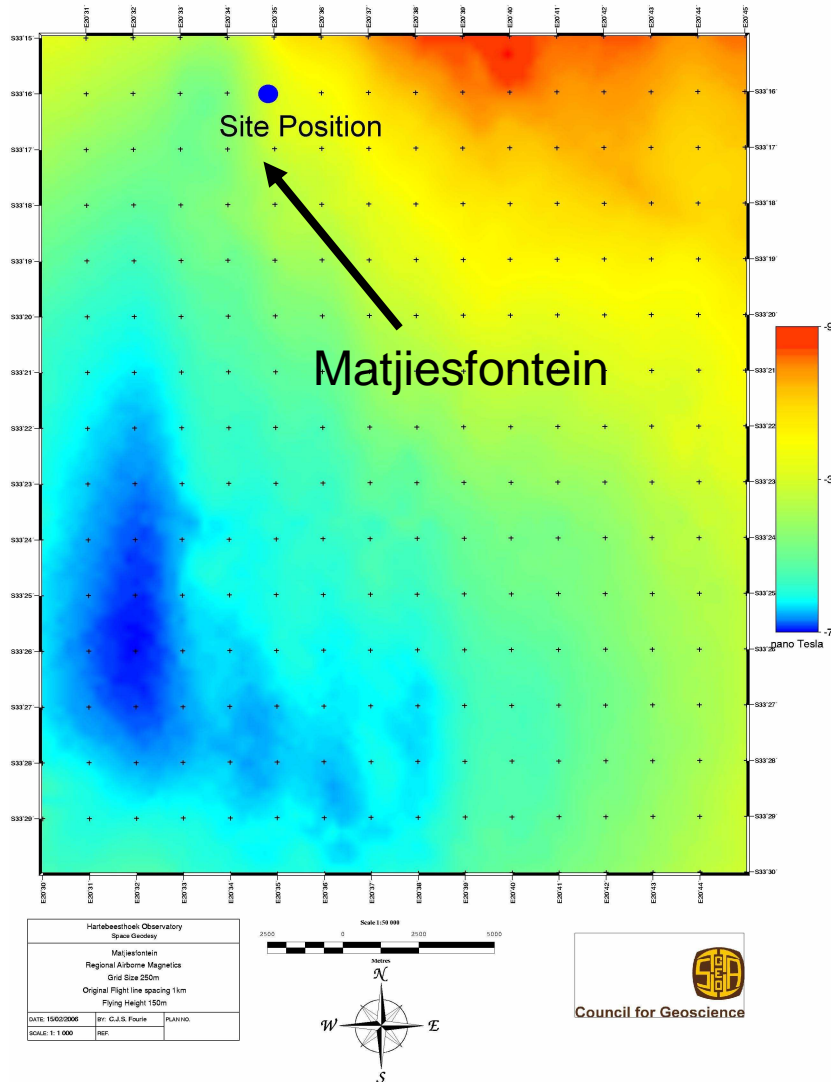
Topographic map of the 3320BC 1:50 000 Fisantekraal map

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Geological Setting of site at Matjiesfontein

3320BC Fisantekraal



Airborne Magnetic map of the 3320BC 1:50 000 Fisantekraal map

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Geological Setting of site at Matjiesfontein



Aerial Photograph of the area. Proposed Site indicated in Black

Geological Setting of site at Matjiesfontein



General Geological Setting of the Site area

Geological Setting of site at Matjiesfontein



General Geological Setting of the Site area

Geological Setting of site at Matjiesfontein



Witteberg Group Sandstone



Shale of the Witteberg Group
Floriskraal Formation

General Geological Setting of the Site area

Geological Setting of site at Matjiesfontein



Shales of the Witteberg Group
Floriskraal Formation

Sandstones of the Witteberg Group
Witpoort Formation



General Geological Setting of the Site area

Geological Setting of site at Matjiesfontein



Dip of Shales almost vertical



General Geological Setting of the Site area

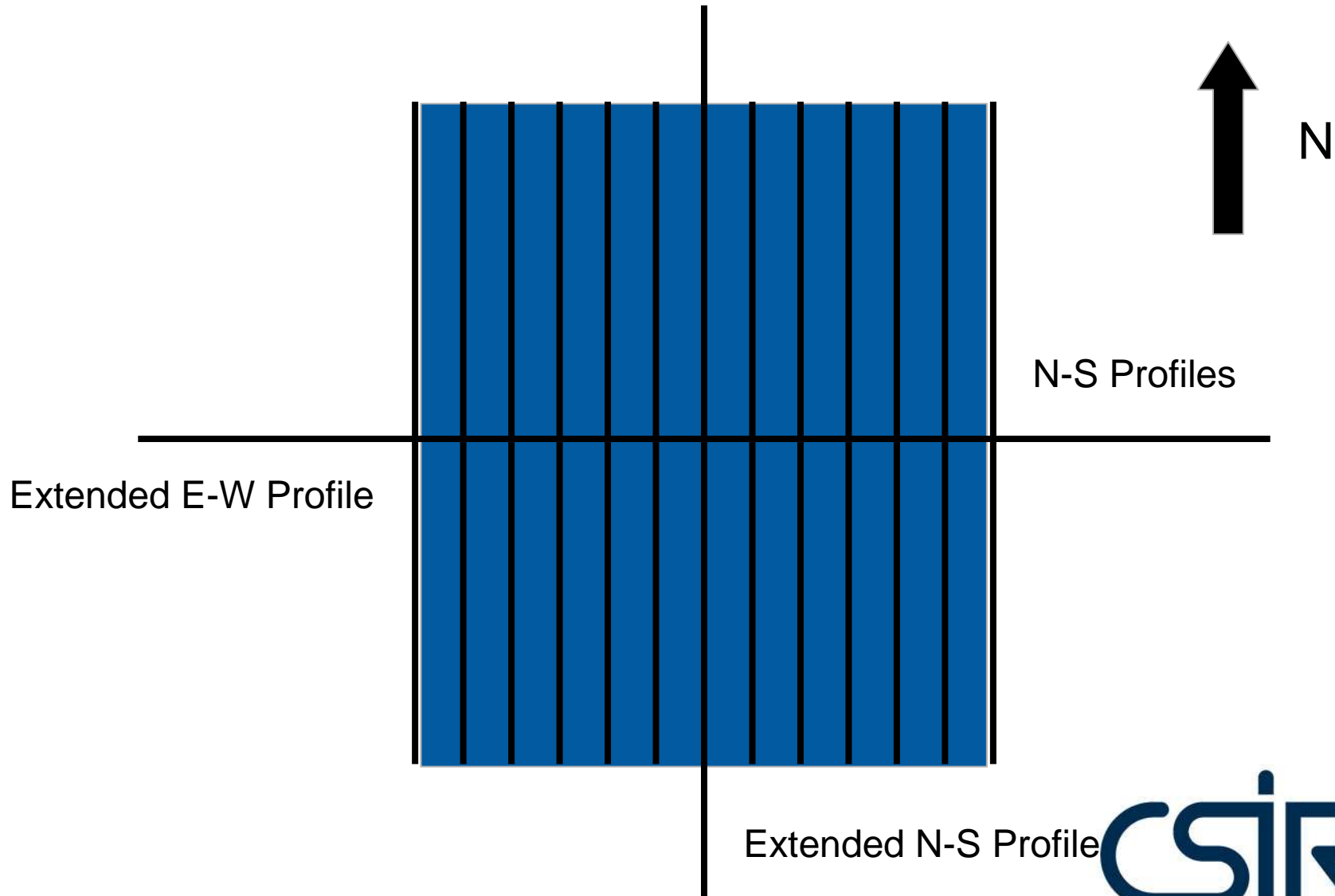
Geophysical Investigation of site at Matjiesfontein

Geophysical Investigation

Geophysical methods used at a 1m spacing:

- Magnetic method
- Electromagnetic method (EM-34)
- Seismic refraction method

Geophysical Investigation



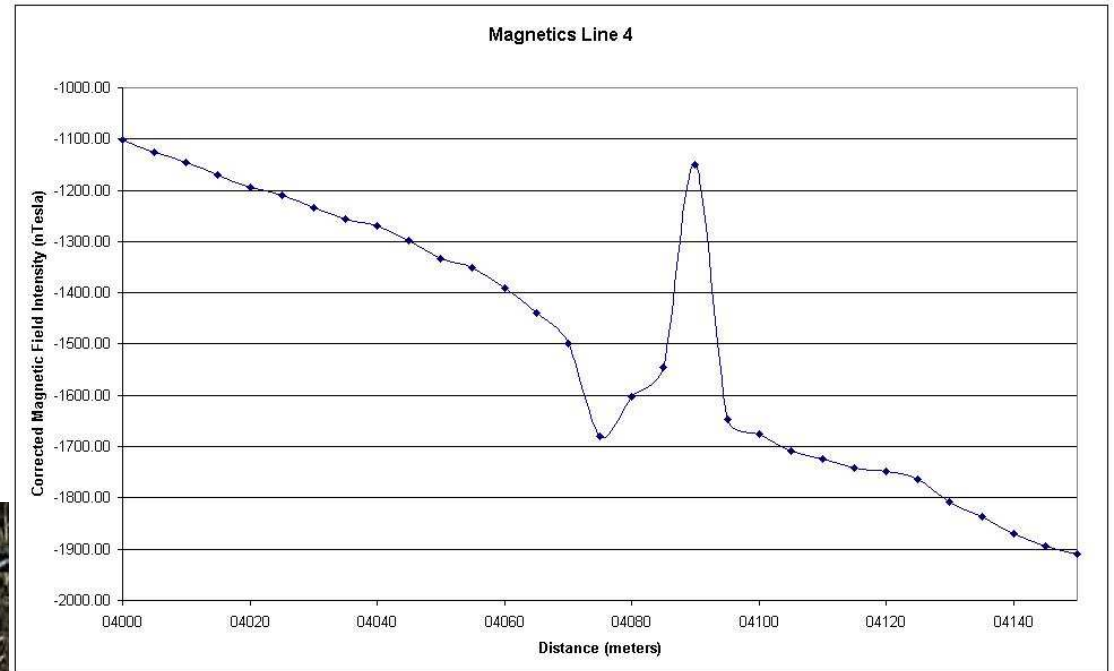
Geophysical Investigation Magnetics

Geophysical Investigation - Magnetics



Geotron Total field Magnetometer

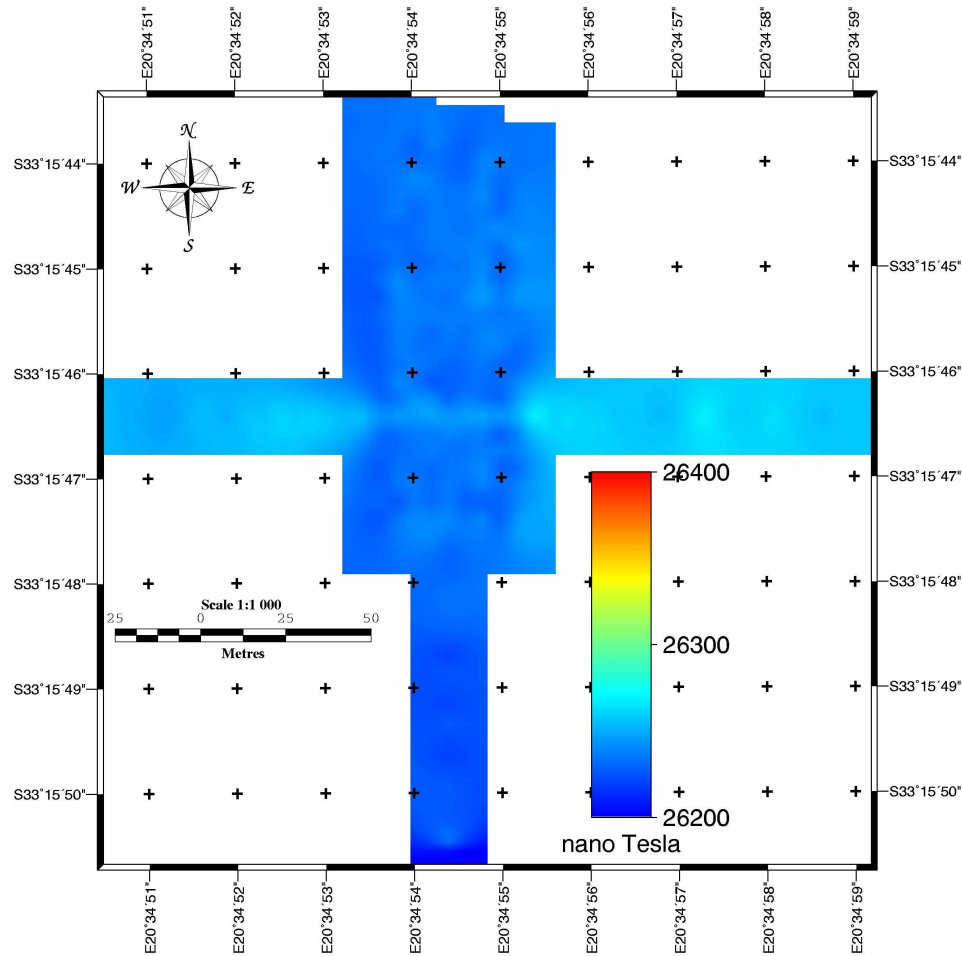
Geophysical Investigation - Magnetics



Geotron Total field Magnetometer

Geophysical Investigation - Magnetics

Matjiesfontein Ground Magnetics

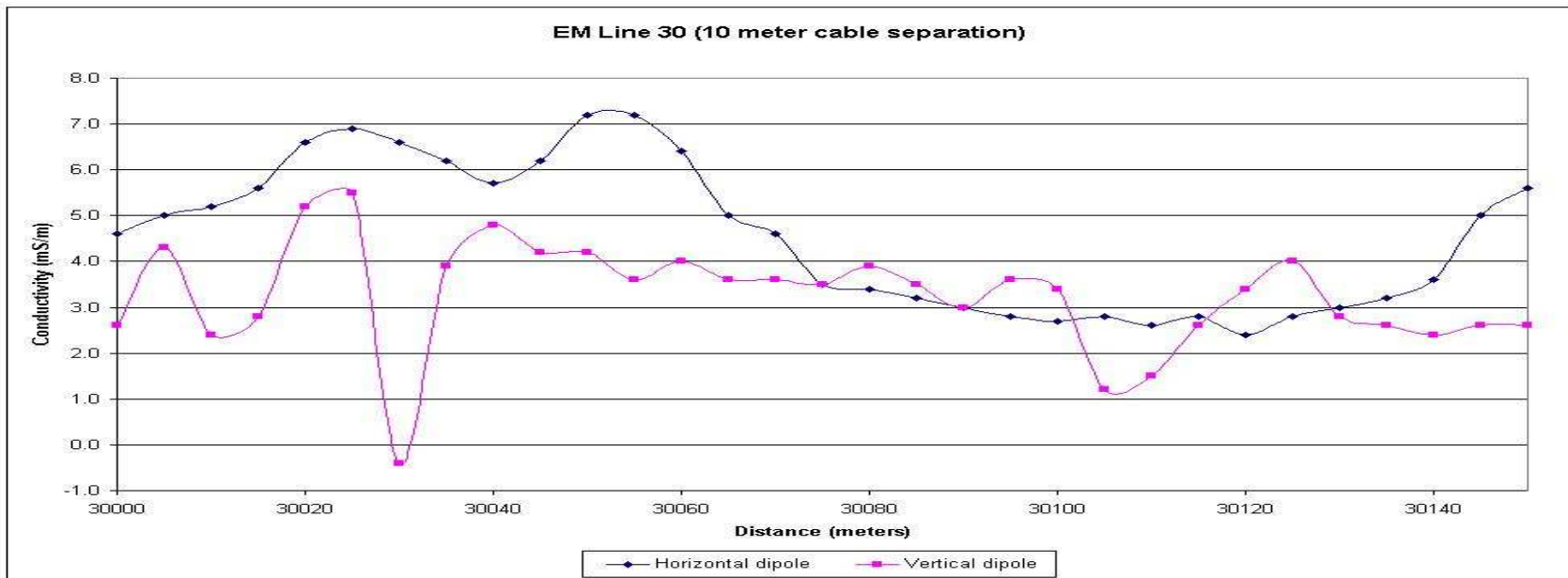


Hartebeesthoek Observatory Space Geodesy		
Matjiesfontein Ground Magnetics Instrument: CGS Magnetometer Technician: I. Saunders		
DATE: 15/02/2006	BY: C.J.S. Fourie	PLAN NO.
SCALE: 1: 1 000	REF:	



Geophysical Investigation Electromagnetics –EM31

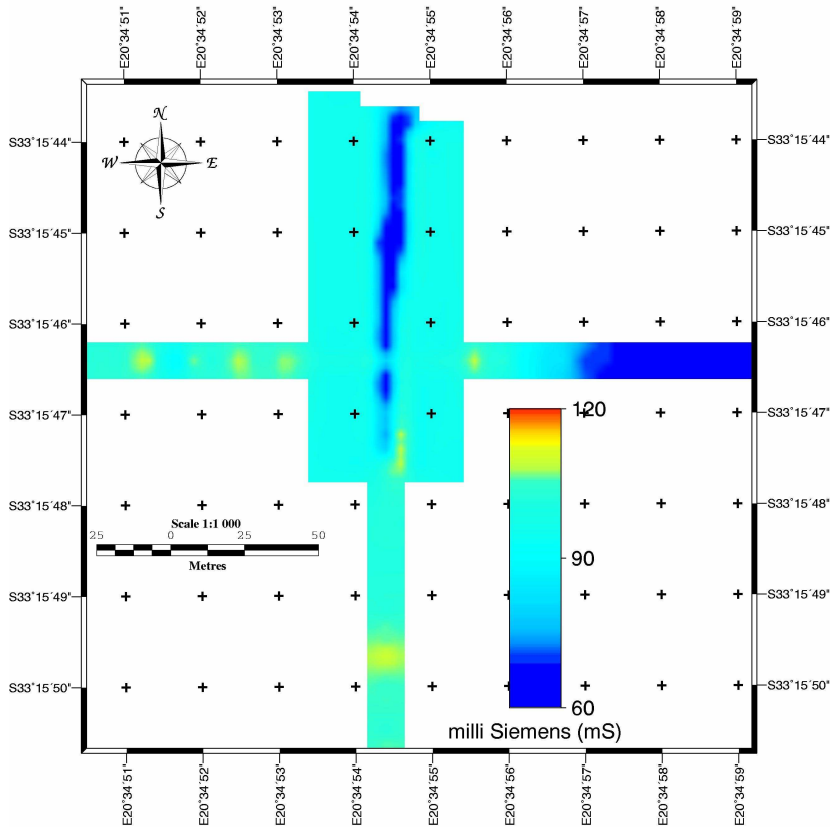
Geophysical Investigation – EM31



Geonics EM31

Geophysical Investigation – EM31

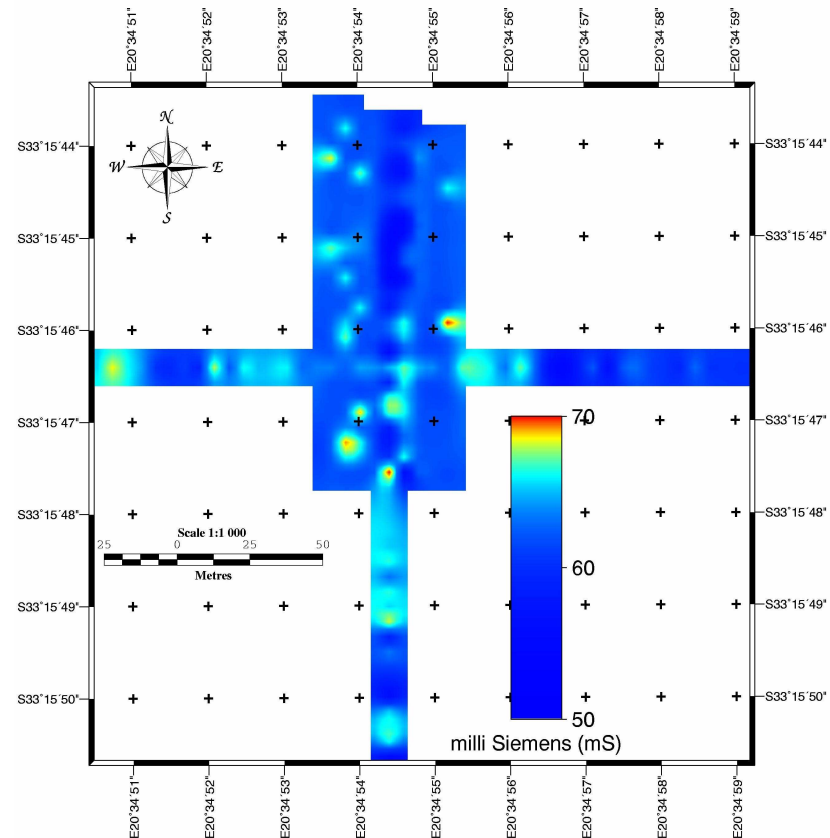
Matjiesfontein Ground Electromagnetics
Q-Phase Vertical Dipole



Harlebeesthoek Observatory Space Geodesy		
Matjiesfontein Ground Electromagnetics Instrument: Geonics EM-31 Geophysicist: C.J.S. Fourie		
DATE: 15/02/2006	BY: C.J.S. Fourie	PLAN NO.
SCALE: 1: 1 000	REF.	



Matjiesfontein Ground Electromagnetics
Q-Phase Horizontal Dipole

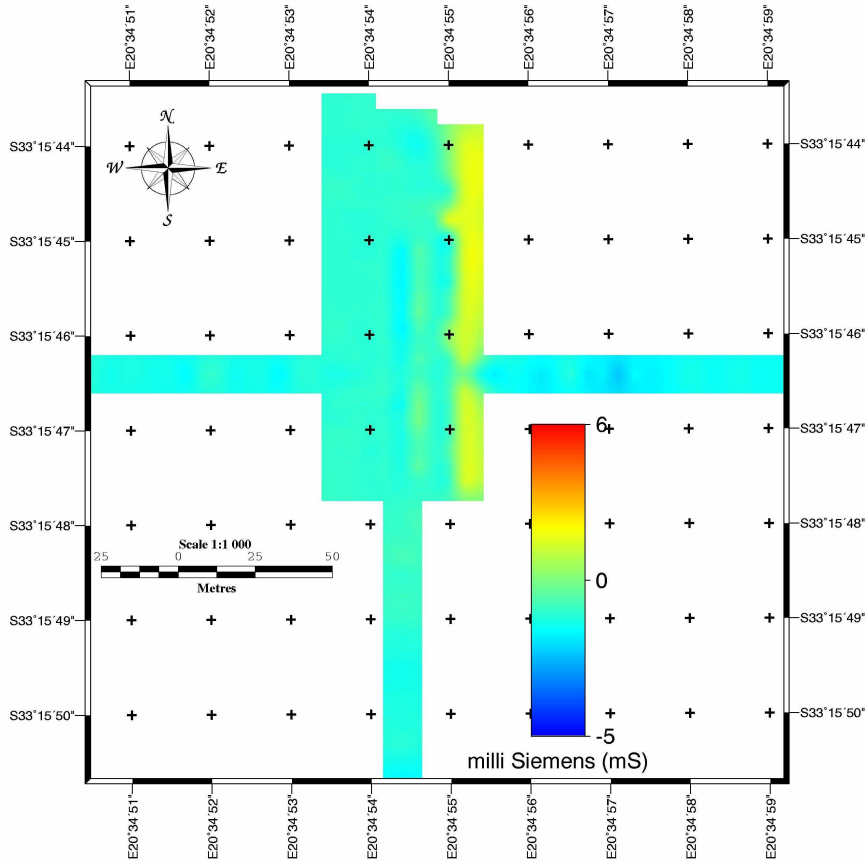


Harlebeesthoek Observatory Space Geodesy		
Matjiesfontein Ground Electromagnetics Instrument: Geonics EM-31 Geophysicist: C.J.S. Fourie		
DATE: 15/02/2006	BY: C.J.S. Fourie	PLAN NO.
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Geophysical Investigation – EM31

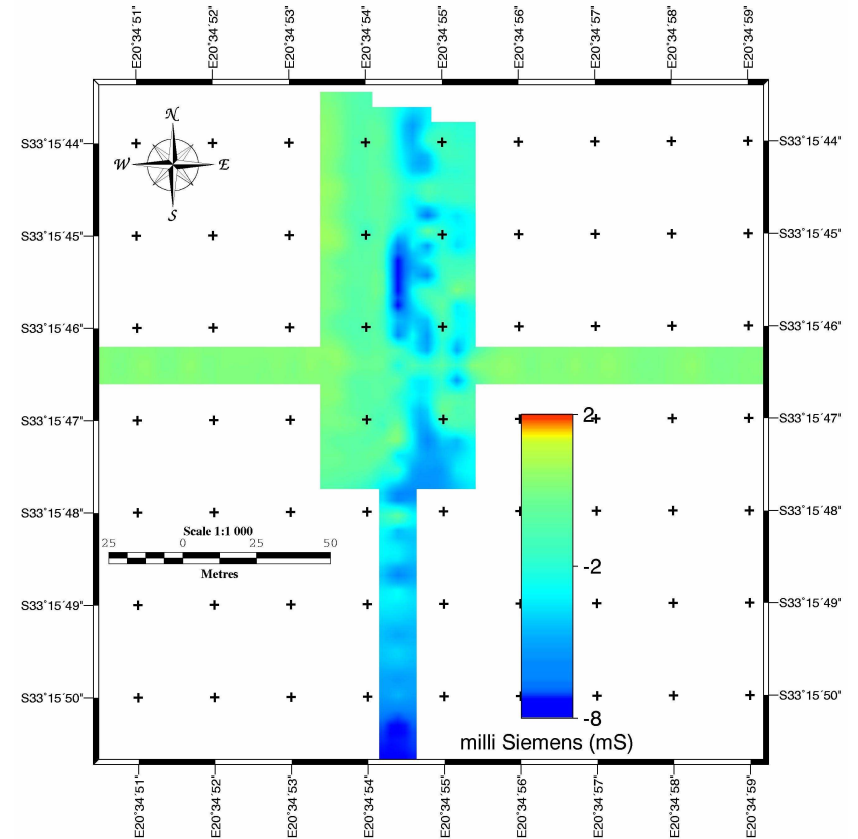
Matjiesfontein Ground Electromagnetics
In-Phase Vertical Dipole



Hartebeeshoek Observatory Space Geodesy		
Matjiesfontein Ground Electromagnetics Instrument: Geonics EM-31 Geophysicist: C.J.S. Fourie		
DATE: 15/02/2006	BY: C.J.S. Fourie	PLAN NO.
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Matjiesfontein Ground Electromagnetics
In-Phase Horizontal Dipole

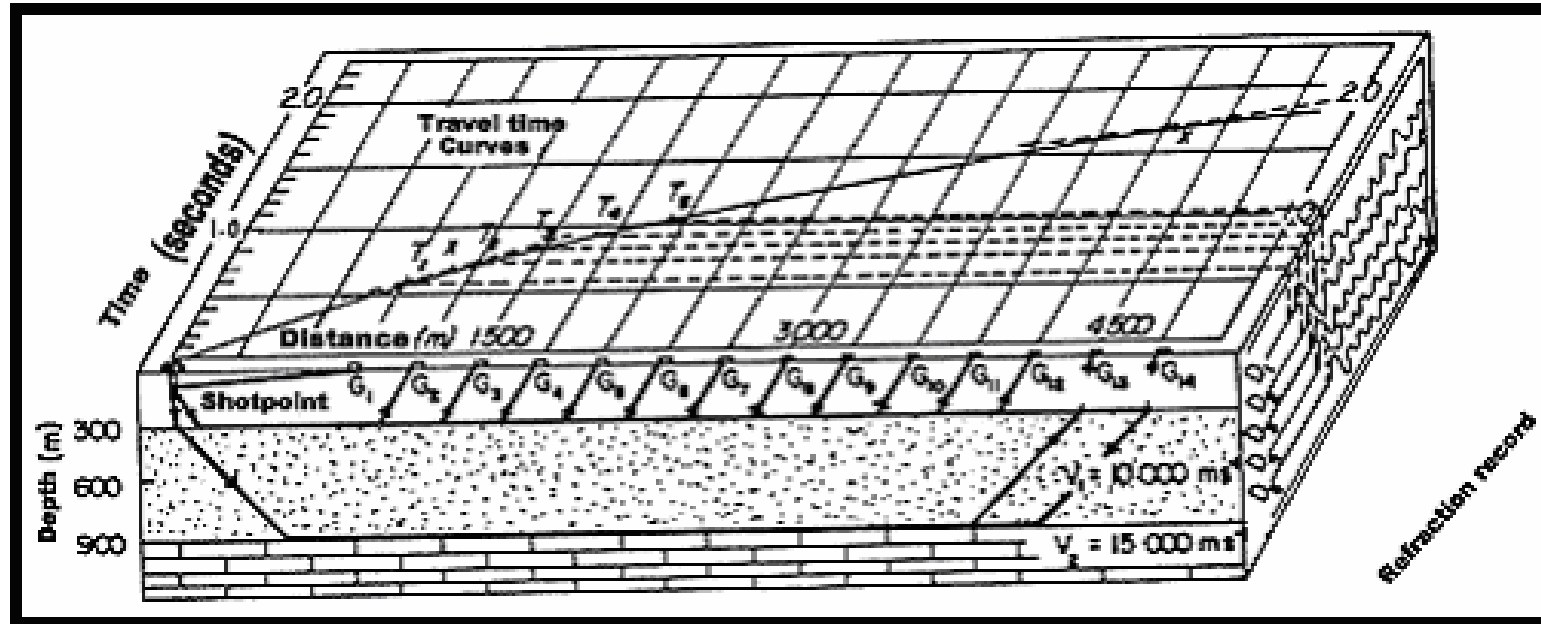


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Geophysical Investigation Seismic Refraction

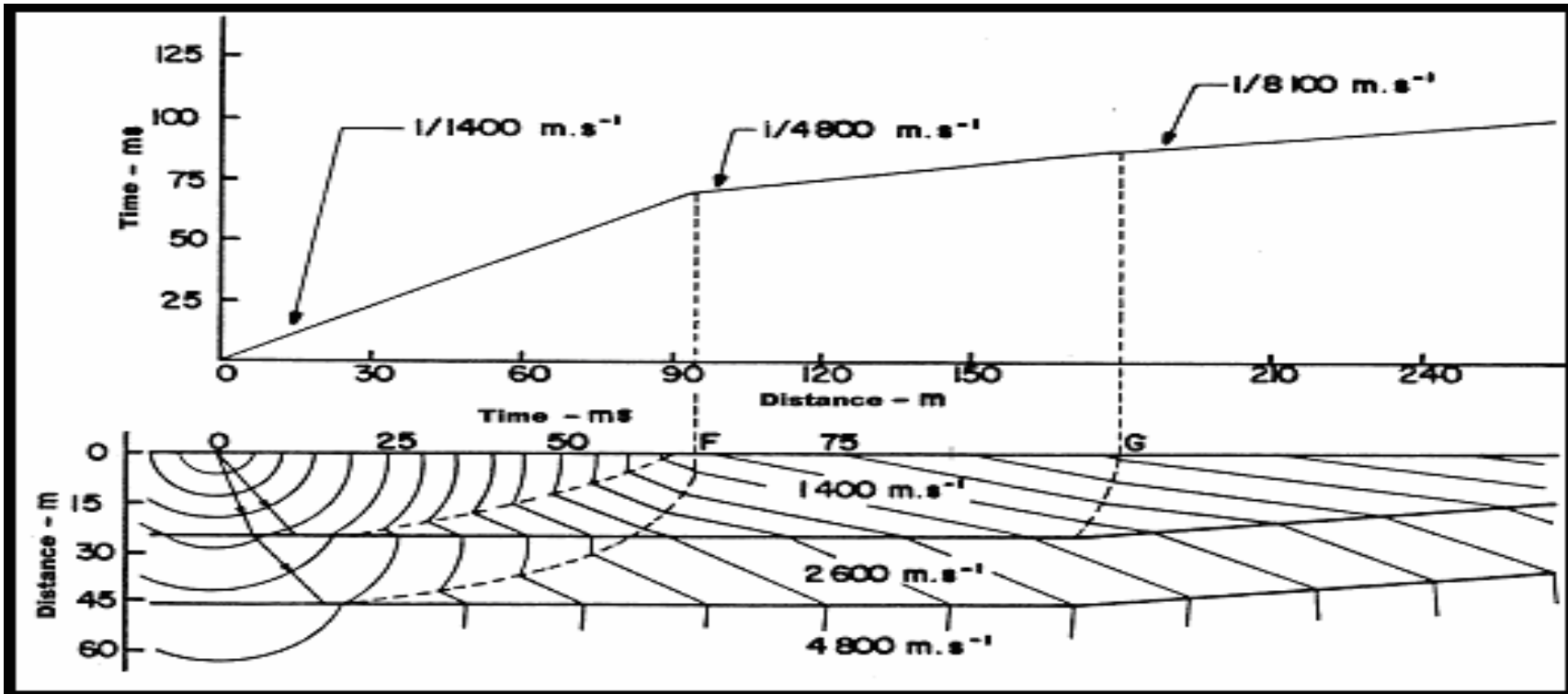
Geophysical Investigation – Seismic Refraction



- Left off-shot
- Left end-on shot
- Split-spread shot
- Right end-on shot
- Right off-shot

Source is a Hammer

Geophysical Investigation – Seismic Refraction



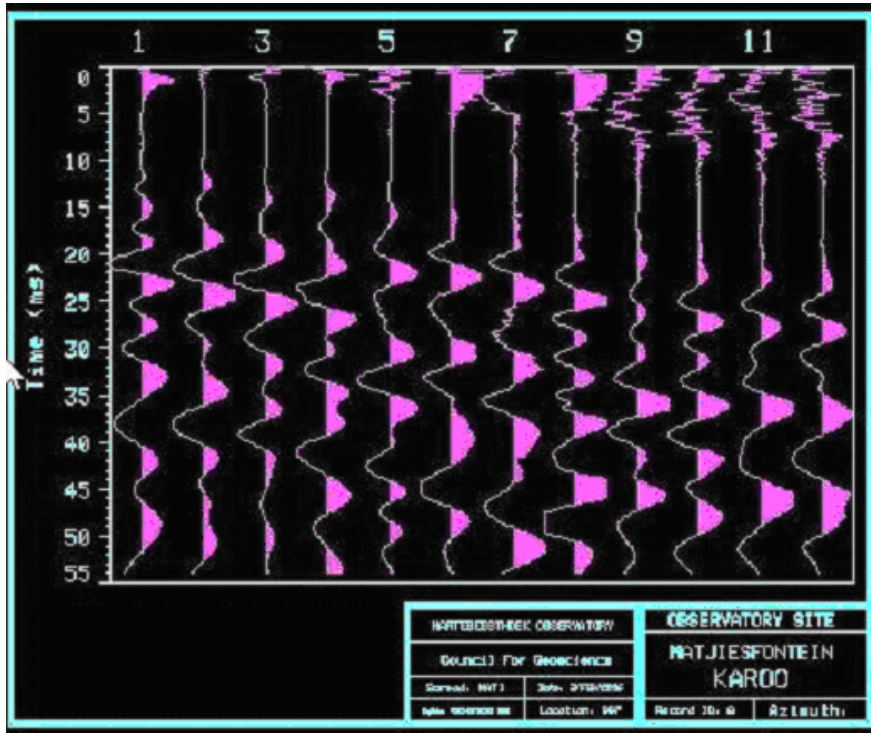
The depth to the refractor is obtained by:

$$D = K \times T_{plus}$$

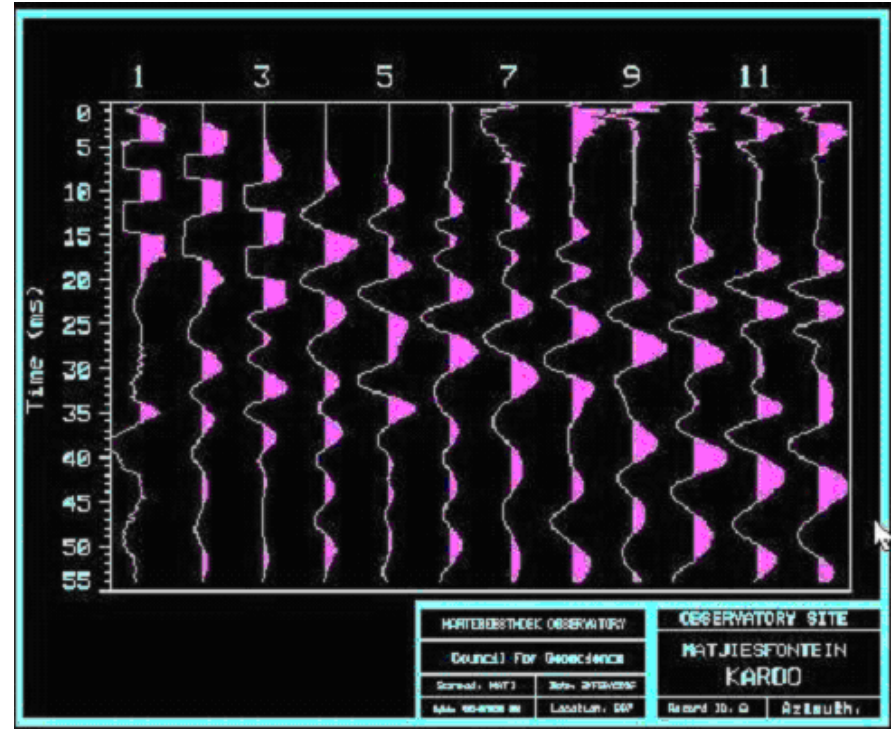
The “Plus” time values at each receiver are obtained from:

$$T_{plus} = T_{forward} + T_{reverse} - T_{total}$$

Geophysical Investigation – Seismic Refraction

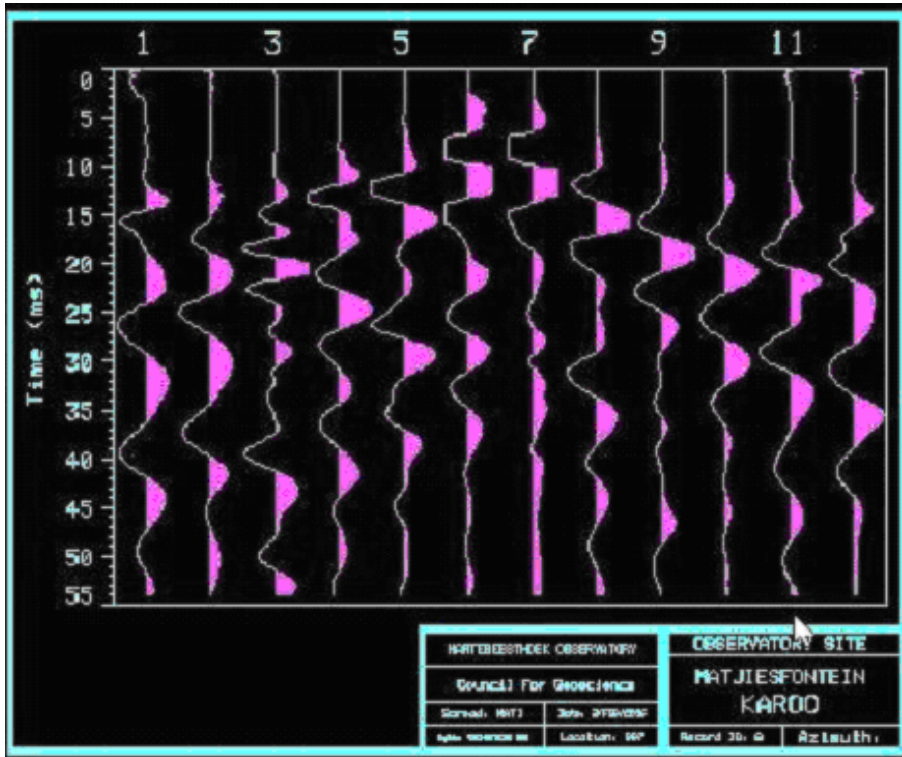


Left Off shot

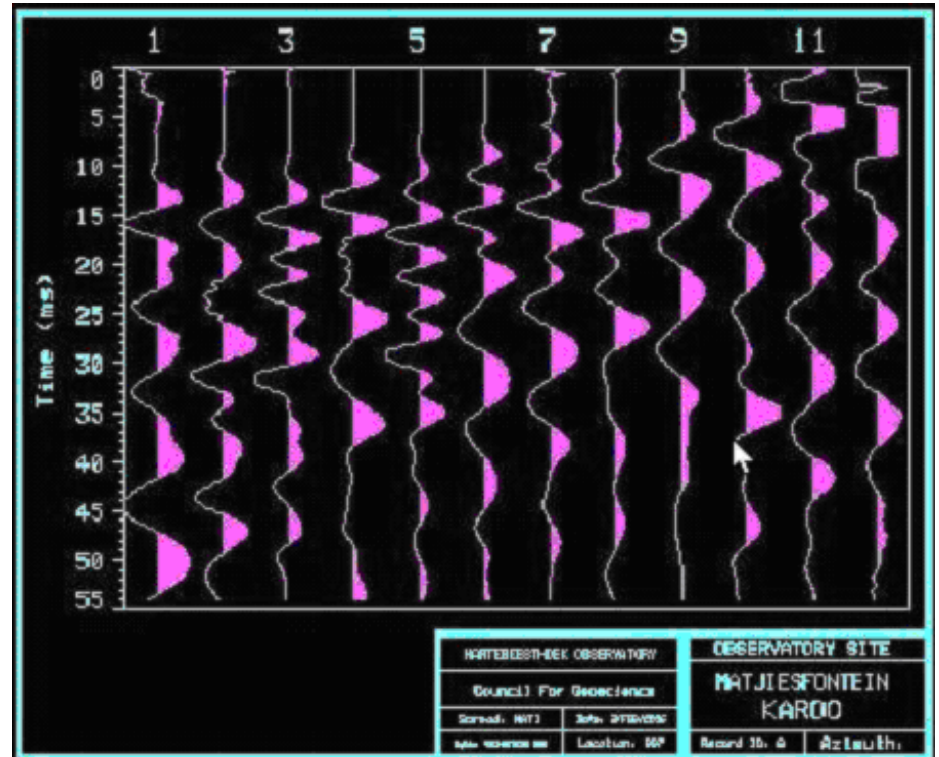


Left End-on Shot

Geophysical Investigation – Seismic Refraction

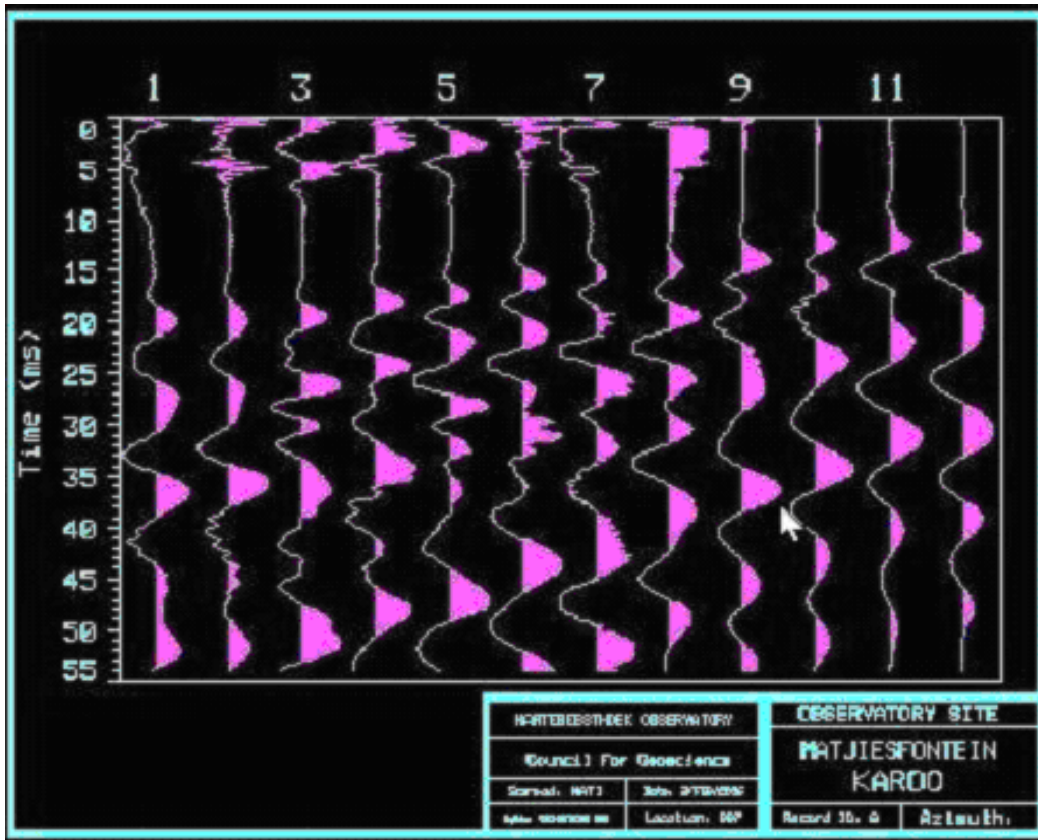


Split-spread shot



Right End-on Shot

Geophysical Investigation – Seismic Refraction

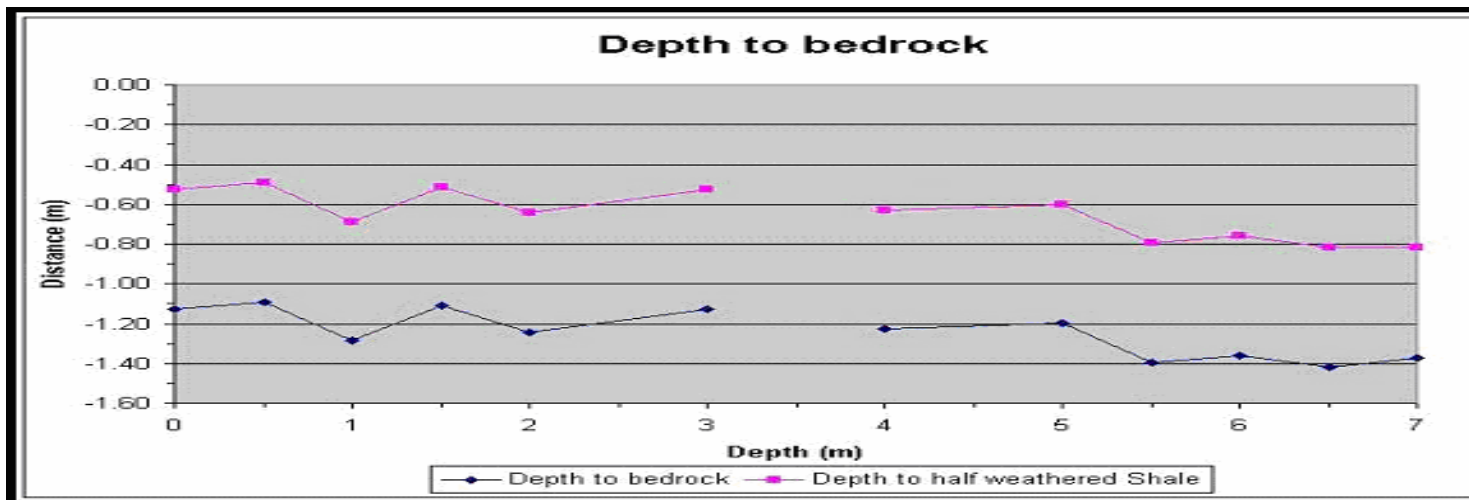
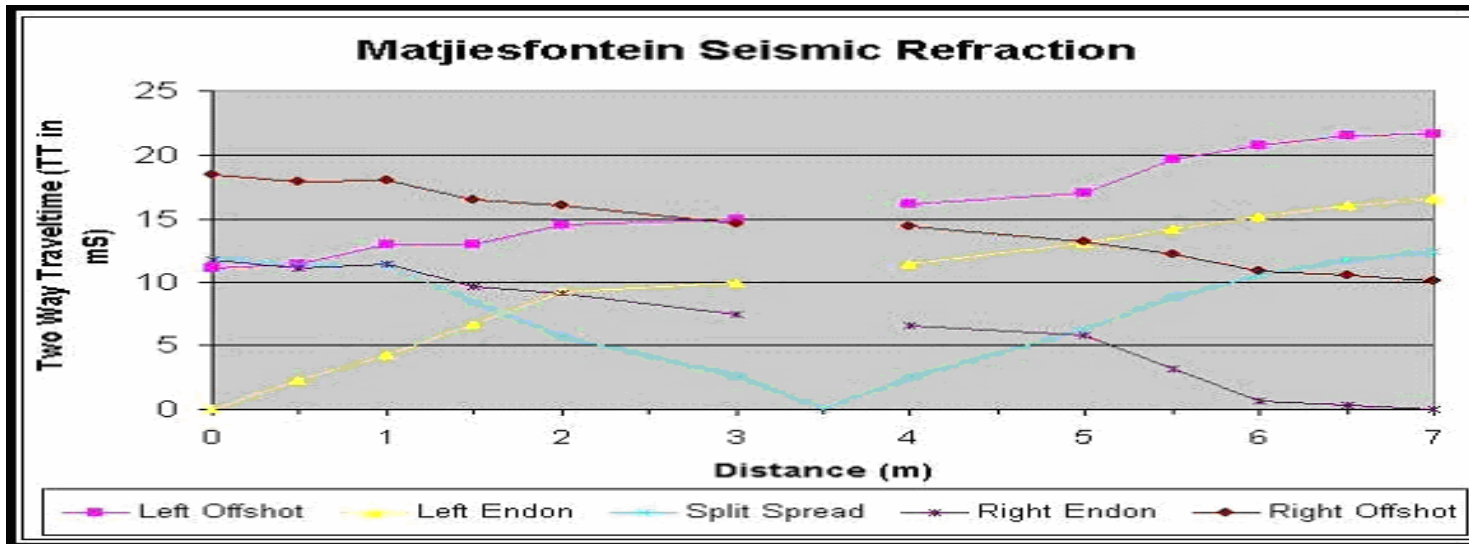


Right Off-Shot



Geometrics 24-channel seismograph

Geophysical Investigation – Seismic Refraction



Geophysical Investigation Physical Properties

Geophysical Investigation – Physical Properties

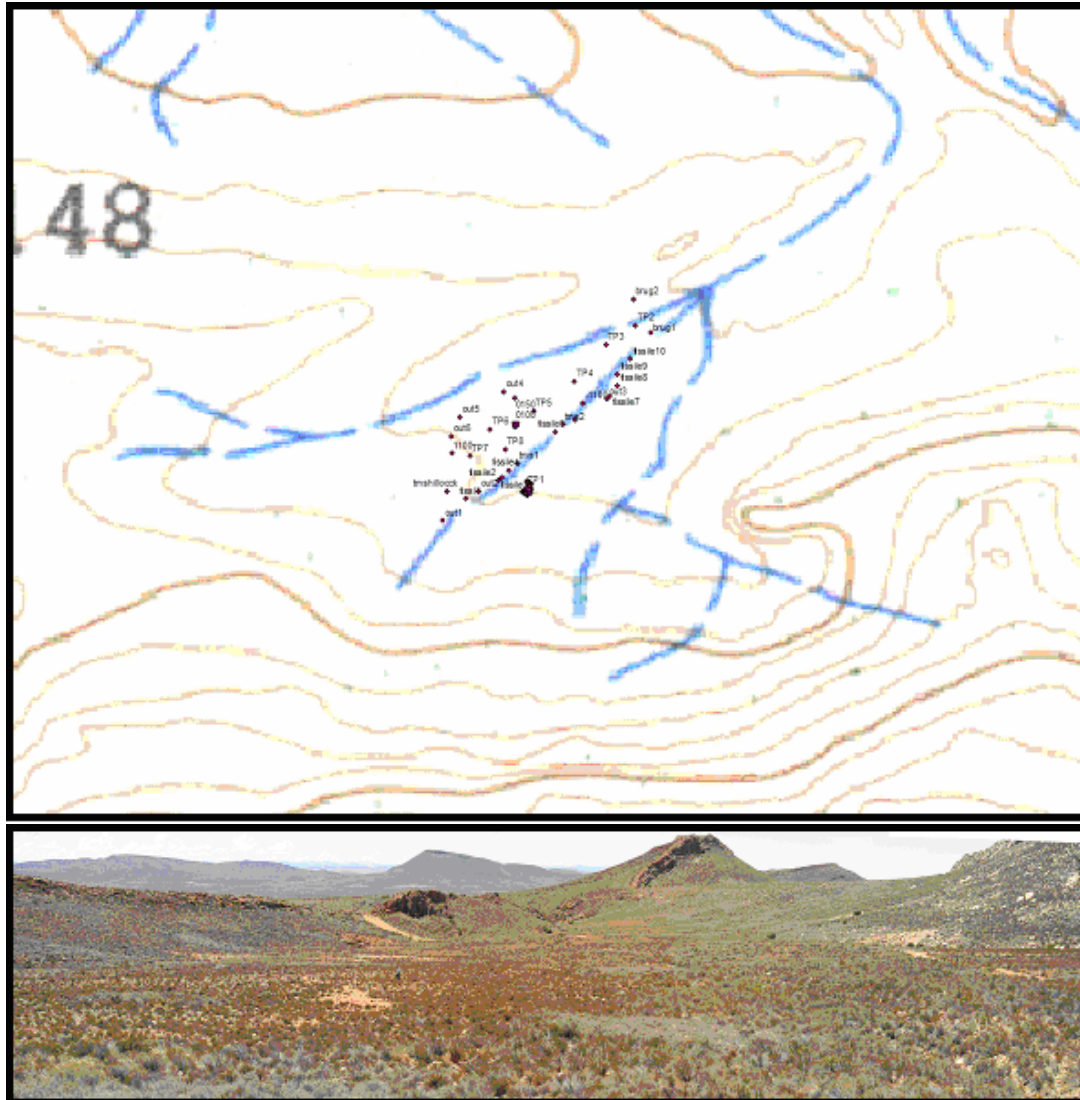
SAMPLE	LATITUDE	LONGITUDE	ELEVATION	FORMATION	ROCKTYPE	DENSITY	NRM	SUSCEPTIBILITY
#	°	°	m			g/cm ³	(10 ⁻³) A/m	(10 ⁻⁶) SI
MAT1	-33.26566	20.58125	1035	WITPOORT FORMATION	SHALE	2.570	1.27	237.46
MAT2	-33.24144	20.57804	918	KAROO DOLERITE SUITE	DOLERITE	2.603	2.71	269.59
MAT3	-33.26530	20.58126	1030	FLORISKRAAL FORMATION	SANDSTONE	2.632	1.92	39.00

SAMPLE	LATITUDE	LONGITUDE	ELEVATION	FORMATION	ROCK TYPE	P-wave	IP	RESISTIVITY
#	°	°	M			m/s	Discharge %	Ohm.m
MAT1	-33.26566	20.58125	1035	WITPOORT FORMATION	SHALE	1888	16	1019
MAT2	-33.24144	20.57804	918	KAROO DOLERITE SUITE	DOLERITE	4616	7	4132
MAT3	-33.26530	20.58126	1030	FLORISKRAAL FORMATION	SANDSTONE	3276	7	12581

Layer	Velocity	Layer	Velocity	Layer	Velocity
Weathered	225 m/s	Unconsolidated	775 m/s	Bedrock	2000 m/s

Geotechnical Investigation

Geotechnical Investigation



Two drainage channels cross the site

Geotechnical Investigation



- Eight Test pits by Backacter
- Classification to the MCCSSO system by Jennings *et al* (1973).

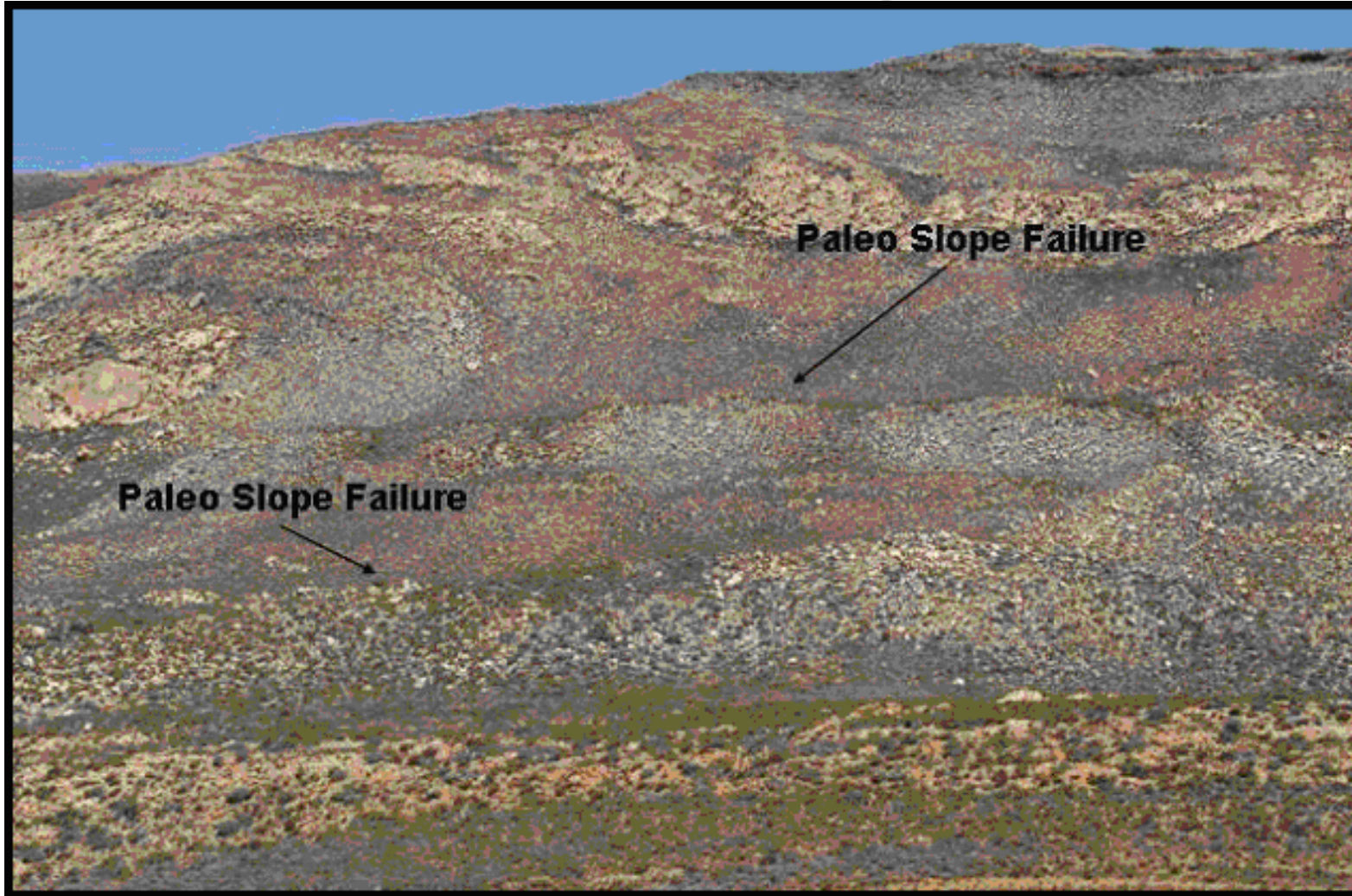
Geotechnical Investigation

TYPICAL TEST PIT LOG

- 0.2m: Dry, Light Brown, Loose, Intact, Boulders and gravel in a sandy matrix. Hill wash.
- 0.5m: Slightly moist, Dark Reddish Orange, Dense, Intact, Boulders and gravel with limited sandy matrix. Hill wash.
- 0.6m: Refusal on highly to moderately weathered thinly bedded shale or mudstone. Bedding planes turned vertical.
- No water was encountered in any trail pit.



Geotechnical Investigation



Slope Stability

Conclusions and Recommendations after initial Survey

Conclusions and Recommendations after initial Survey

- It is recommended that a detailed site inspection down to solid bedrock be done for each of the foundations of buildings to be erected.
- Foundations should be founded in solid rock.
- Care should be taken not to disturb the slope failure on the southern side of the site.
- Care should be taken not to excavate into the toe of the ridge on the northern side of the site.
- The potential for very large rocks rolling down the mountain is not excluded and as such it might be required to move some of the larger more unstable rocks prior to construction on the site.

Future Surveys

Future Surveys



Detail Digital Terrain Model – After Workshop (2007)

Future Surveys

Detail Digital Terrain Model – After Workshop (2007)



Total Station

Future Surveys

Detail Digital Terrain Model – After Workshop (2007)



To hide receivers such as VLBI from interference

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Future Permanent Geophysical Instrumentation

Future Permanent Geophysical Instrumentation Permanent Seismology Station



Constructed Seismic Vault on Bedrock

Future Permanent Geophysical Instrumentation

Permanent Seismology Station



Guralp Systems CMG 40T Broadband Seismometer
60s to 100Hz



24 – Bit Digitiser

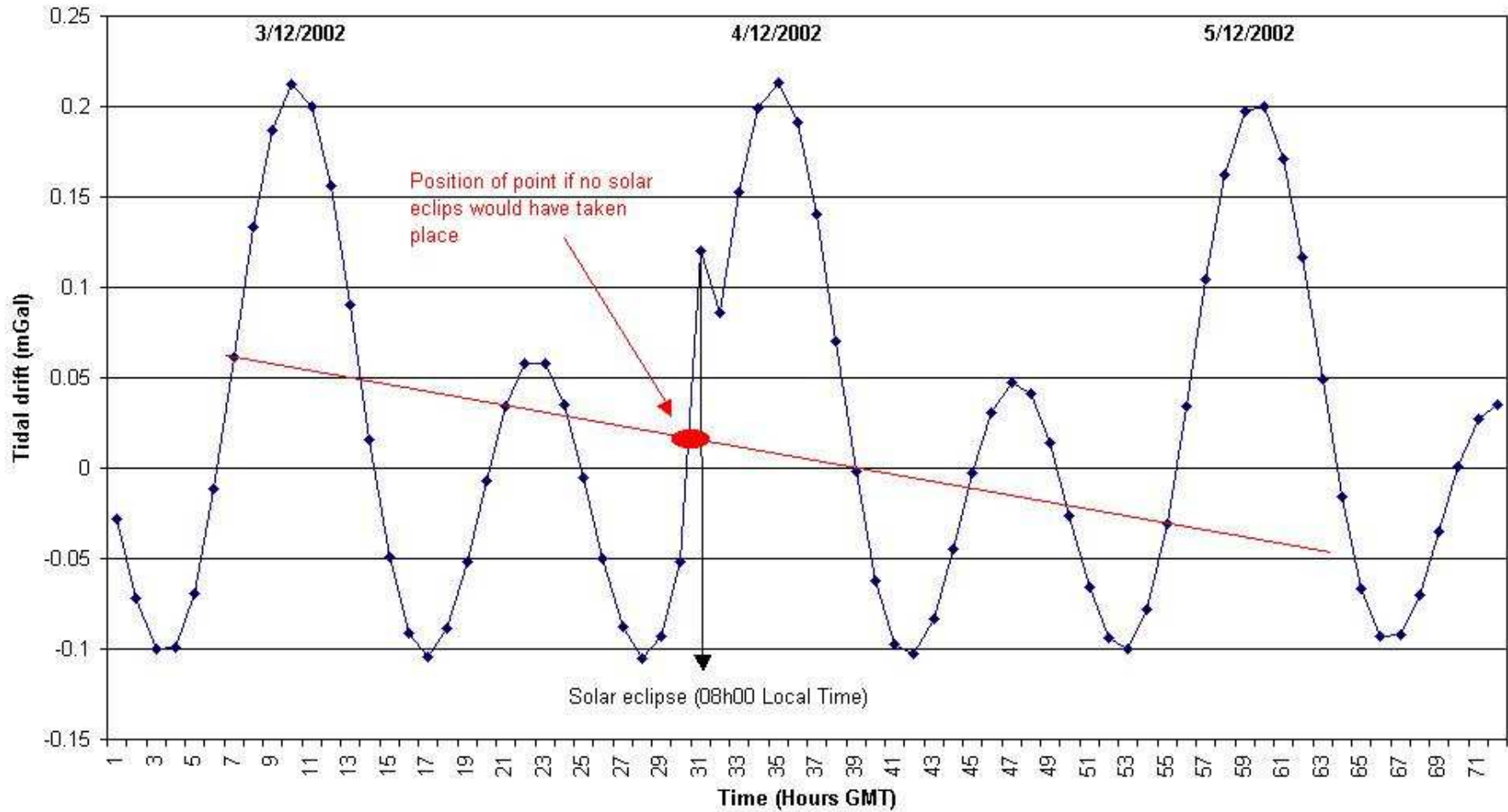
Future Permanent Geophysical Instrumentation Permanent Gravity Station



Geometrics CG-5 Gravity meter

Future Permanent Geophysical Instrumentation Permanent Gravity Station

The effect of the solar eclipse on the gravitational earth tide.



Future Permanent Geophysical Instrumentation Permanent Gravity Station



Correlation with Tidal meters

Thank you

