

APPENDIX D

LABORATORY TESTING RESULTS

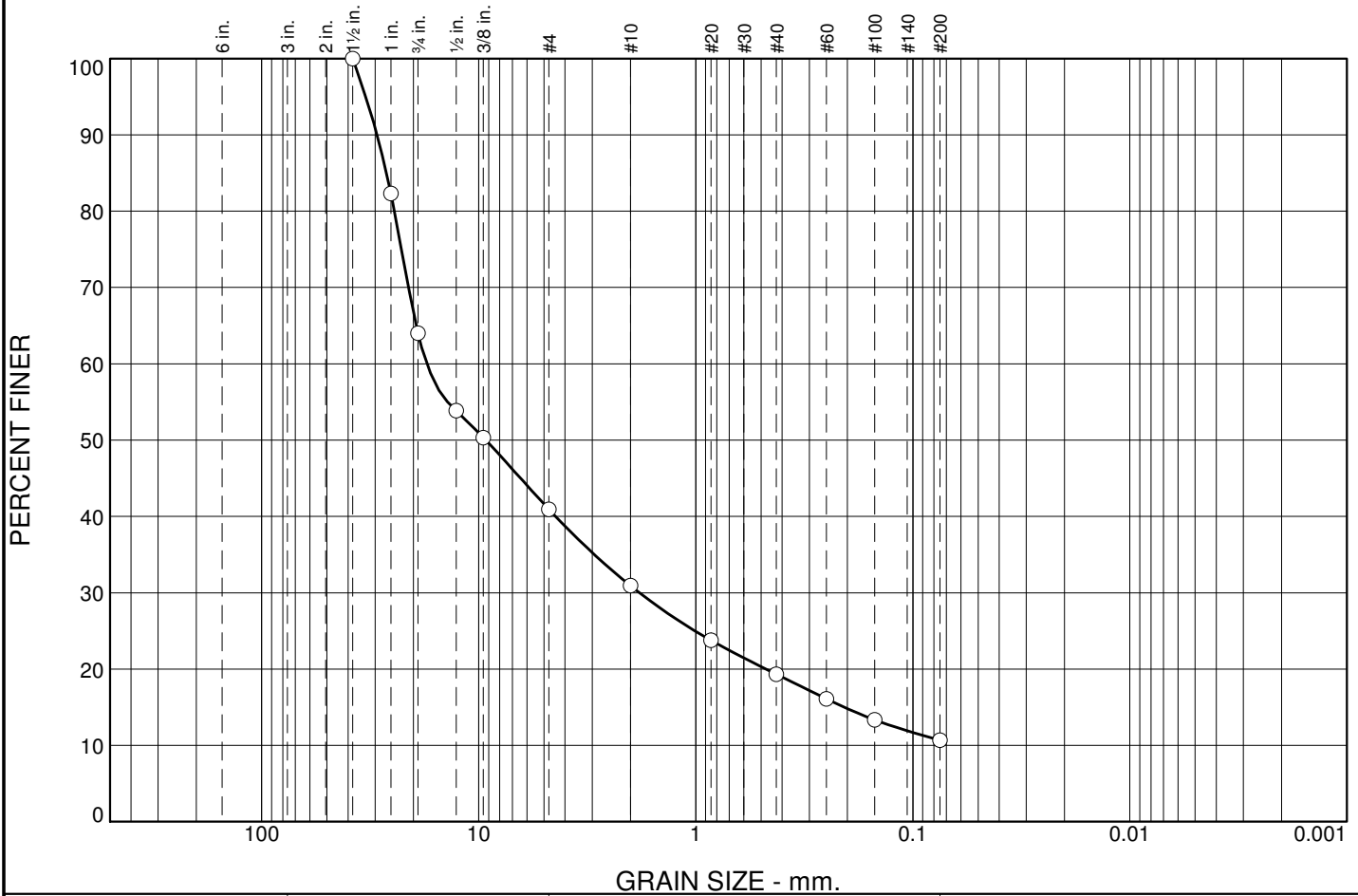
- Appendix D1 Test Pit and SPT Laboratory Index Testing Results
- Appendix D2 Unconfined Compressive Strength Laboratory Testing Results
- Appendix D3 Petrographic Study of Trachyandesites and Sediments

APPENDIX D1

TEST PIT AND SPT LABORATORY INDEX TESTING RESULTS

(Page D1-1 to D1-12)

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	36	23	10	12	8	11	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	82		
.75	64		
.5	54		
0.375	50		
#4	41		
#10	31		
#20	24		
#40	19		
#60	16		
#100	13		
#200	11		

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 26.6039 D₆₀= 17.3434 D₅₀= 9.2772

D₃₀= 1.8154 D₁₅= 0.2065 D₁₀=

C_u= C_c=

Classification

USCS= AASHTO=

Remarks

* (no specification provided)

Sample No.: SPT-05-1
Location: K10-05GT

Source of Sample:

Date: 11/17/10
Elev./Depth:



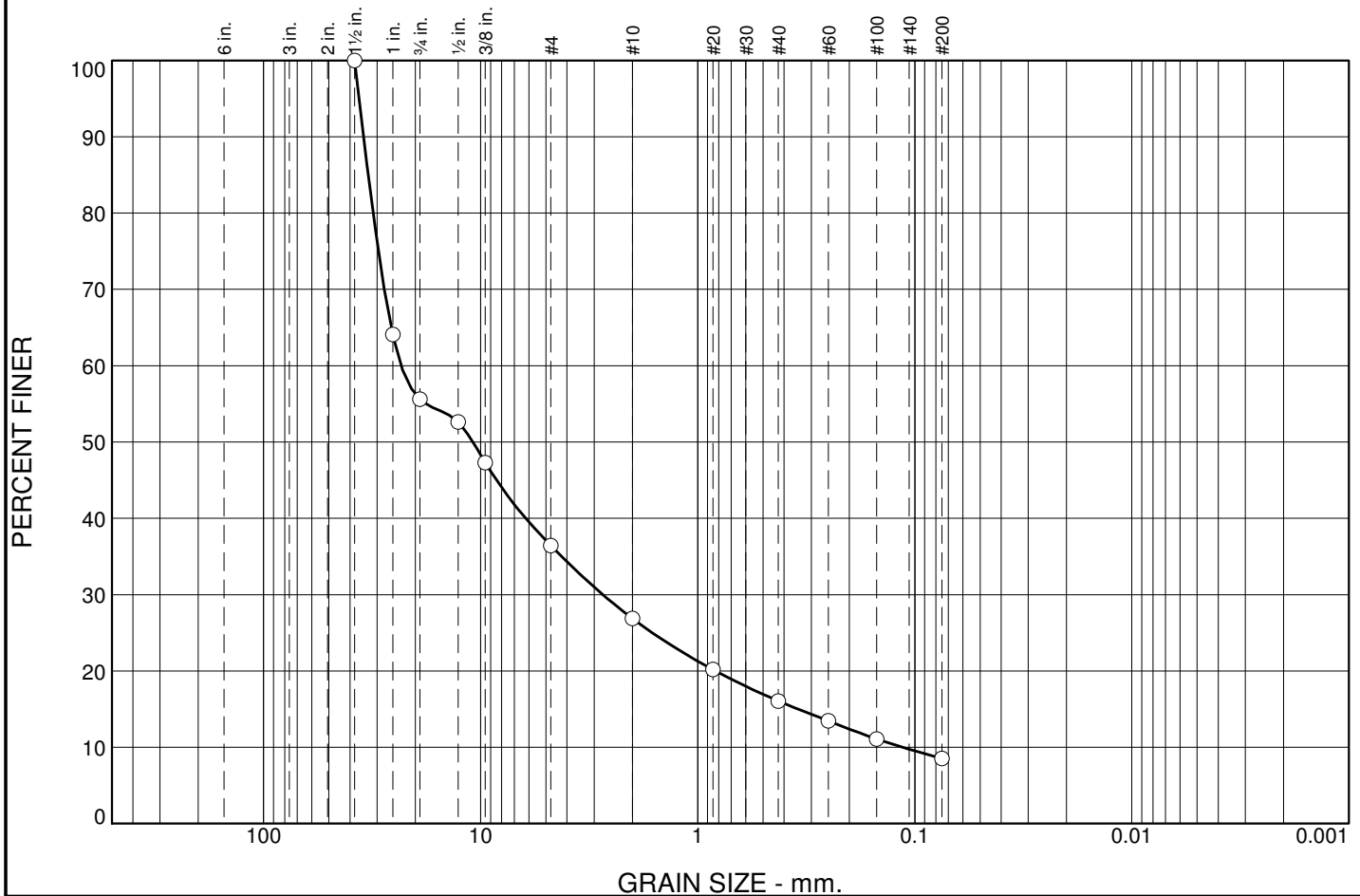
Client: Knight Piésold Ltd.

Project: Kitsault

Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	44	20	9	11	7	9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	64		
.75	56		
.5	53		
0.375	47		
#4	36		
#10	27		
#20	20		
#40	16		
#60	13		
#100	11		
#200	8.5		

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 32.9304 D₆₀= 23.2429 D₅₀= 10.8611
D₃₀= 2.7334 D₁₅= 0.3445 D₁₀= 0.1138
C_u= 204.32 C_c= 2.83

Classification

USCS= AASHTO=

Remarks

* (no specification provided)

Sample No.: SPT-05-2
Location: K10-05GT

Source of Sample:

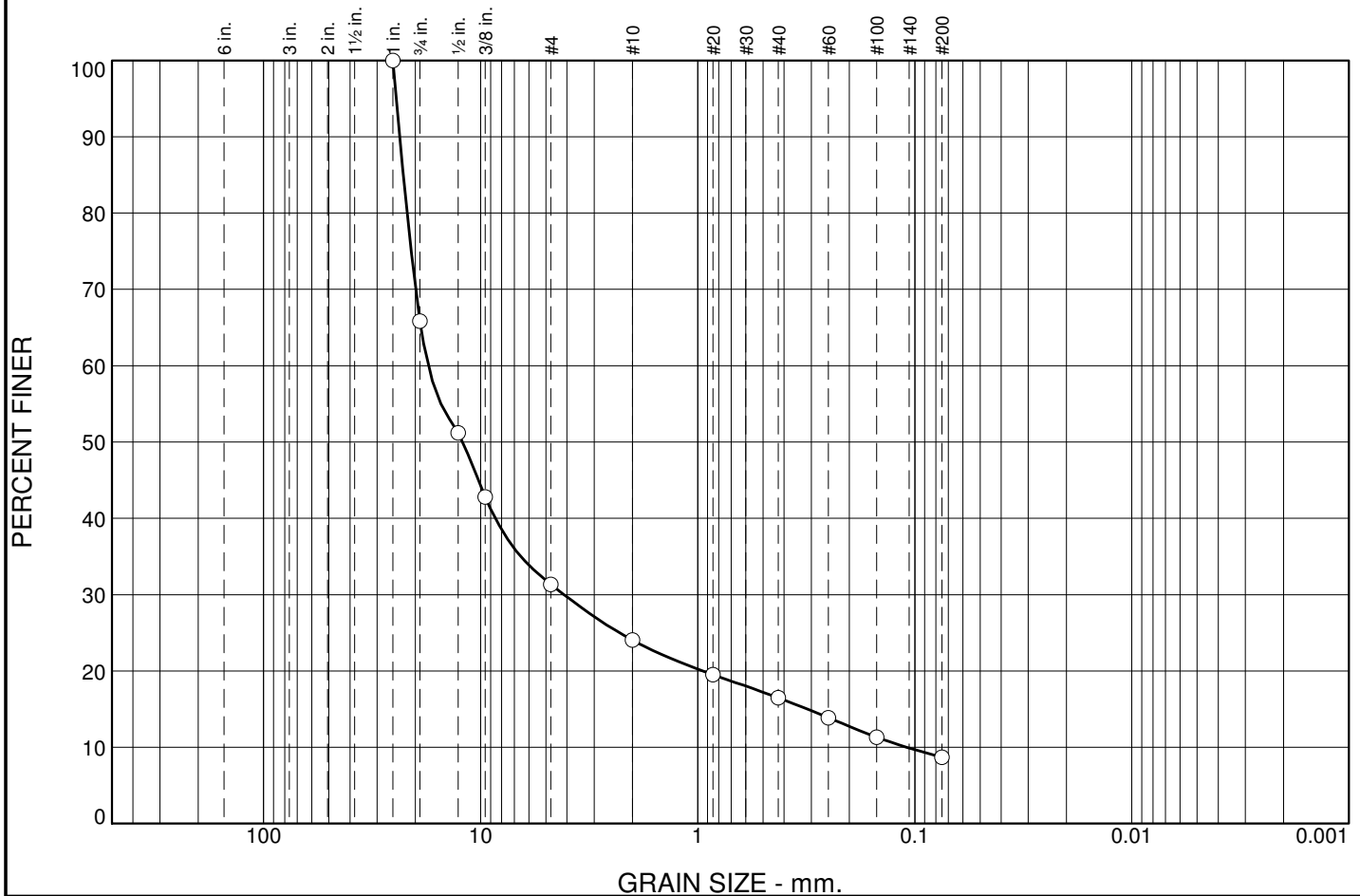
Date: 11/17/10
Elev./Depth: 10-12'



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	34	35	7	8	7	9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	66		
.5	51		
0.375	43		
#4	31		
#10	24		
#20	20		
#40	16		
#60	14		
#100	11		
#200	8.7		

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 22.7165 D₆₀= 17.4416 D₅₀= 12.1029
D₃₀= 4.1293 D₁₅= 0.3120 D₁₀= 0.1086
C_u= 160.59 C_c= 9.00

Classification

USCS= AASHTO=

Remarks

* (no specification provided)

Sample No.: SPT-05-5
Location: K10-05GT

Source of Sample:

Date: 11/17/10
Elev./Depth: 22-24'



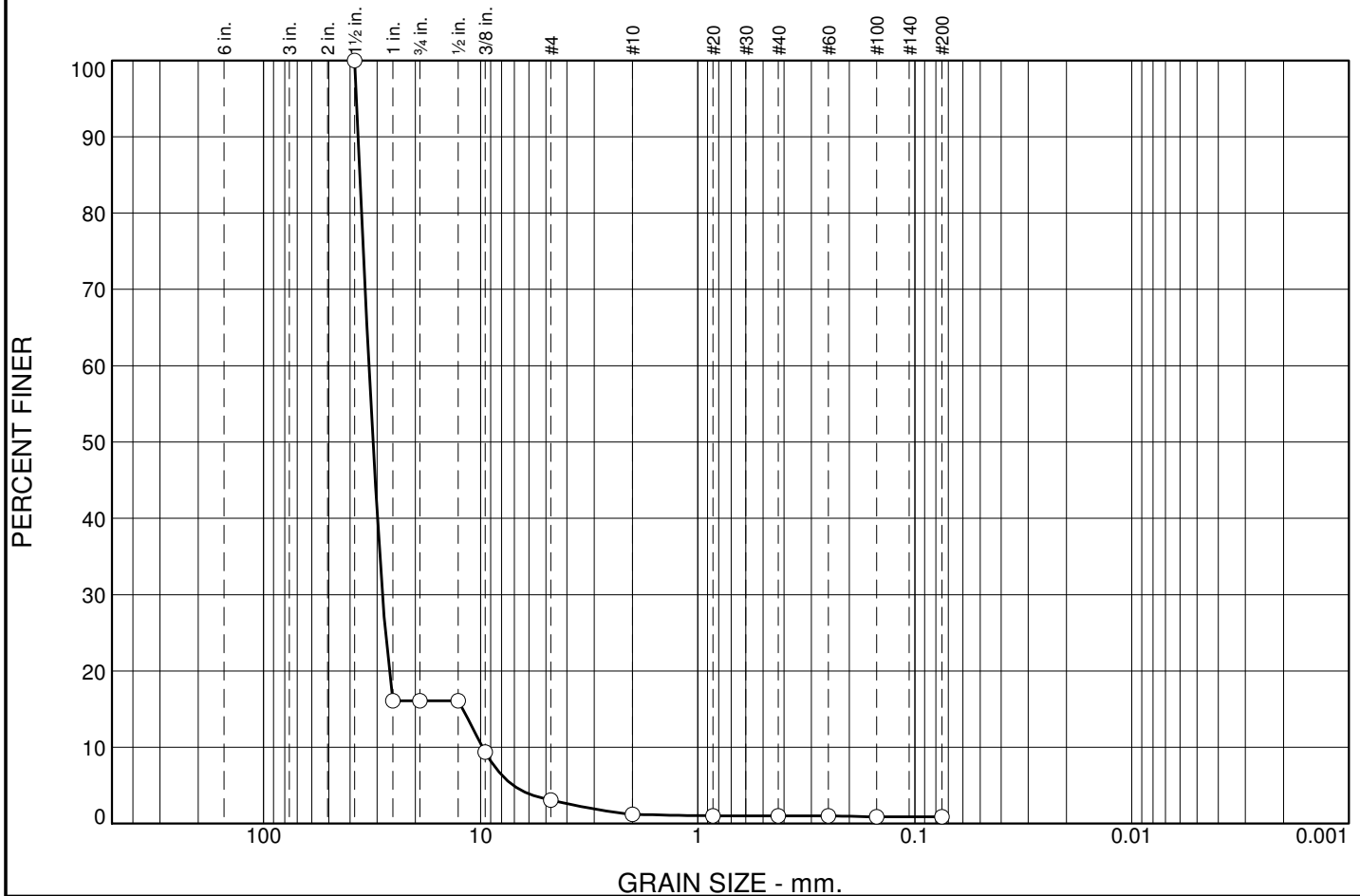
Client: Knight Piésold Ltd.

Project: Kitsault

Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	84	13	2	0	0	1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	16		
.75	16		
.5	16		
0.375	9		
#4	3		
#10	1		
#20	1		
#40	1		
#60	1		
#100	1		
#200	0.9		

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 36.0315 D₆₀= 32.6845 D₅₀= 31.3211
D₃₀= 28.3312 D₁₅= 12.0675 D₁₀= 9.8086
C_u= 3.33 C_c= 2.50

Classification

USCS= GP AASHTO=

Remarks

* (no specification provided)

Sample No.: SPT-05-6
Location: K10-05GT

Source of Sample:

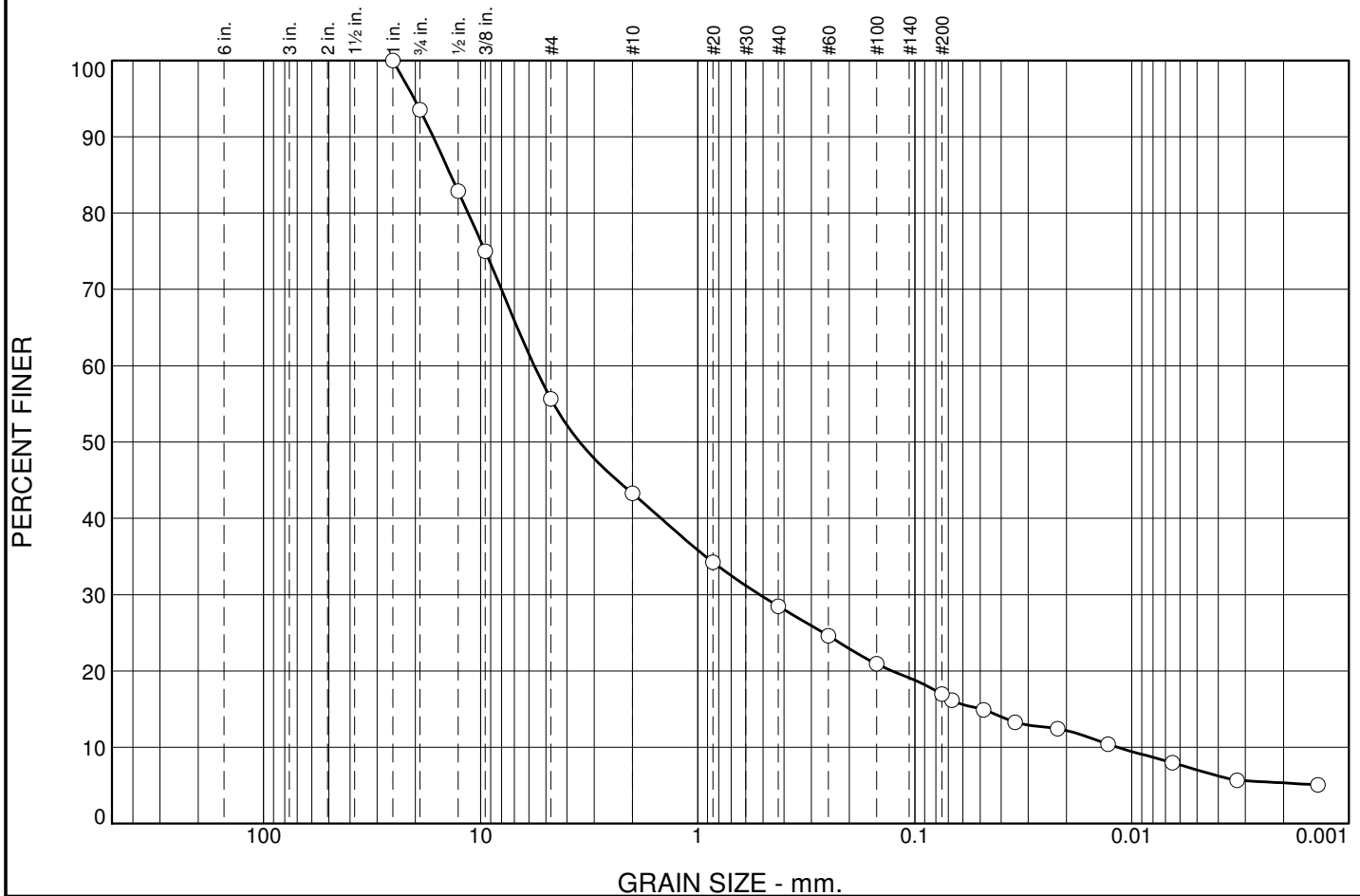
Date: 11/17/10
Elev./Depth: 34-36'



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	6	38	13	15	11	12	5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	94		
.5	83		
0.375	75		
#4	56		
#10	43		
#20	34		
#40	28		
#60	25		
#100	21		
#200	17		
0.0674 mm.	16		
0.0481 mm.	15		
0.0345 mm.	13		
0.0219 mm.	12		
0.0128 mm.	10		
0.0065 mm.	8.0		
0.0033 mm.	5.7		
0.0014 mm.	5.1		

Soil Description

clayey gravel with sand

Atterberg Limits

PL= 16 LL= 30 PI= 14

Coefficients

D₈₅= 13.7348 D₆₀= 5.6639 D₅₀= 3.5024
D₃₀= 0.5183 D₁₅= 0.0492 D₁₀= 0.0116
C_u= 486.64 C_c= 4.07

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

* (no specification provided)

Sample No.: SPT-05-3
Location: K10-05GT

Source of Sample:

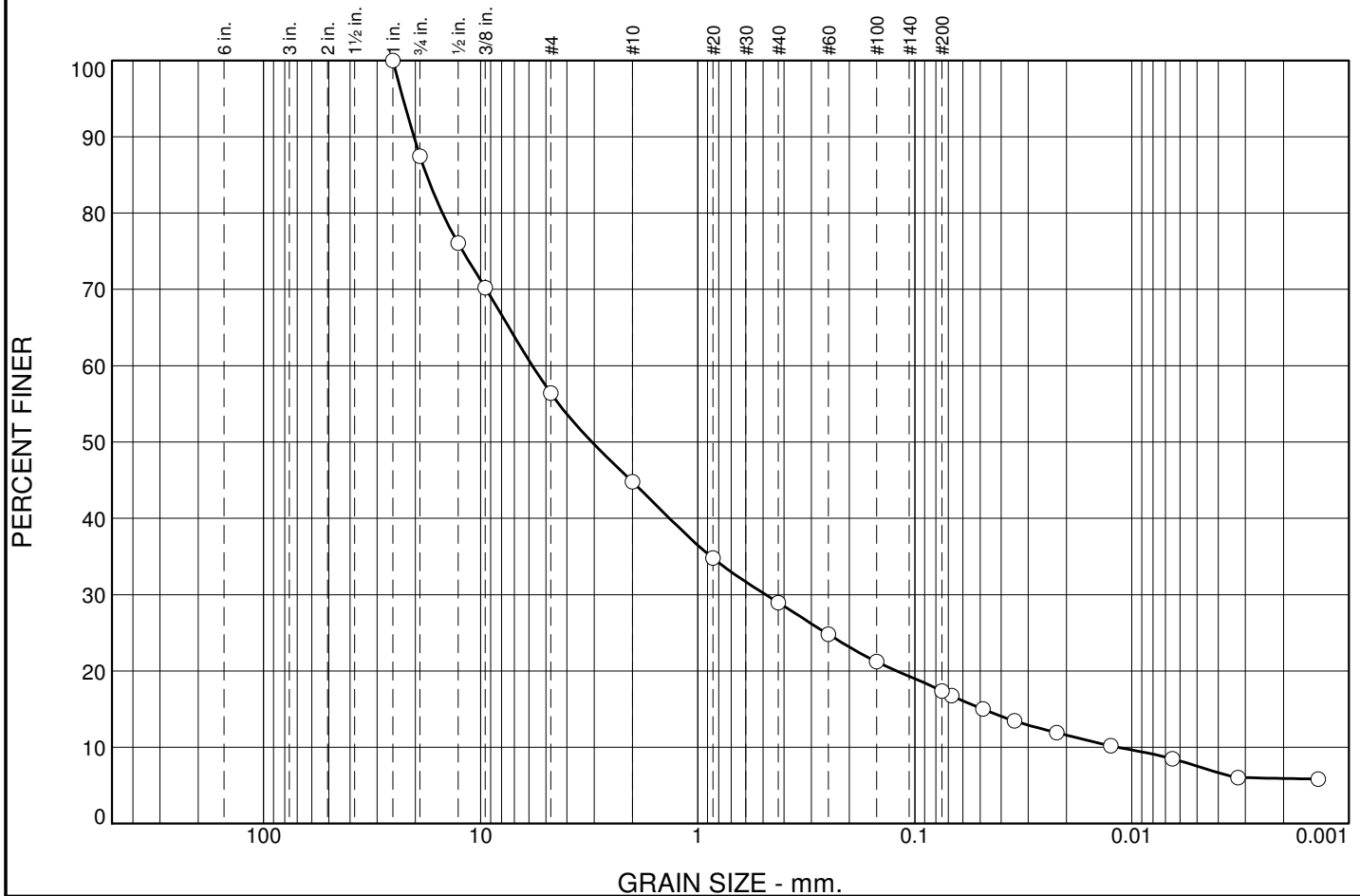
Date: 11/17/10
Elev./Depth: 16-18'



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	13	31	11	16	12	11	6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	87		
.5	76		
0.375	70		
#4	56		
#10	45		
#20	35		
#40	29		
#60	25		
#100	21		
#200	17		
0.0677 mm.	17		
0.0485 mm.	15		
0.0347 mm.	13		
0.0222 mm.	12		
0.0125 mm.	10		
0.0065 mm.	8.5		
0.0032 mm.	6.0		
0.0014 mm.	5.8		

Soil Description

clayey gravel with sand

Atterberg Limits

PL= 18 LL= 31 PI= 13

Coefficients

D₈₅= 17.7725 D₆₀= 5.7776 D₅₀= 3.0724
D₃₀= 0.4864 D₁₅= 0.0485 D₁₀= 0.0116
C_u= 499.25 C_c= 3.54

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

* (no specification provided)

Sample No.: SPT-05-4
Location: K10-04GT

Source of Sample:

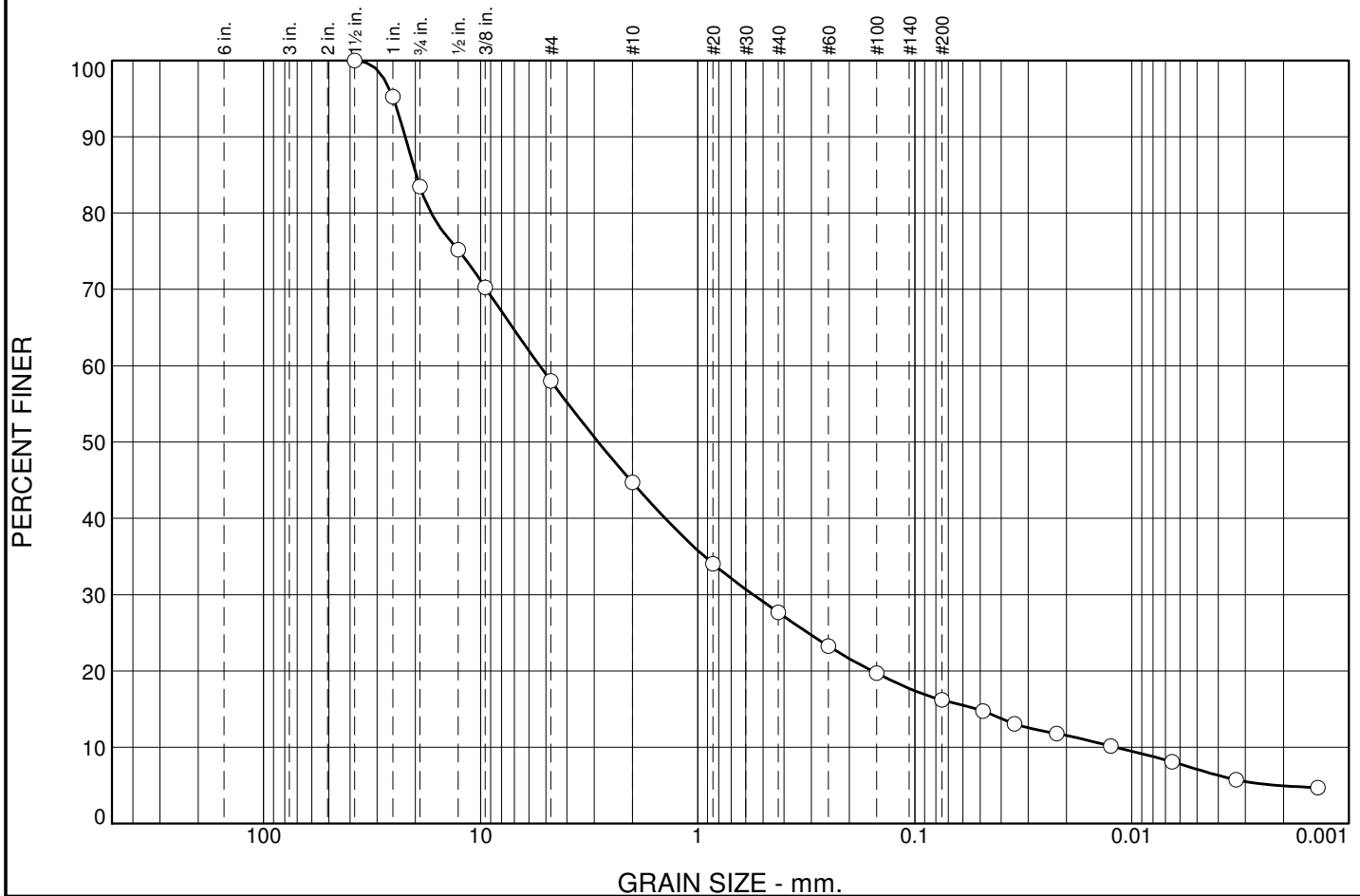
Date: 11/17/10
Elev./Depth: 18-22'



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	17	25	13	17	12	11	5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	95		
.75	83		
.5	75		
0.375	70		
#4	58		
#10	45		
#20	34		
#40	28		
#60	23		
#100	20		
#200	16		
0.0485 mm.	15		
0.0347 mm.	13		
0.0222 mm.	12		
0.0125 mm.	10		
0.0065 mm.	8.1		
0.0033 mm.	5.7		
0.0014 mm.	4.7		

* (no specification provided)

Soil Description
clayey sand with gravel

Atterberg Limits
PL= 18 LL= 27 PI= 9

Coefficients
D₈₅= 19.8206 D₆₀= 5.3451 D₅₀= 2.8729
D₃₀= 0.5559 D₁₅= 0.0515 D₁₀= 0.0118
C_u= 452.14 C_c= 4.89

Classification
USCS= SC AASHTO= A-2-4(0)

Remarks

Sample No.: SPT-05-7
Location: K10-05GT

Source of Sample:

Date: 11/17/10
Elev./Depth: 44-46'

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CONSULTING

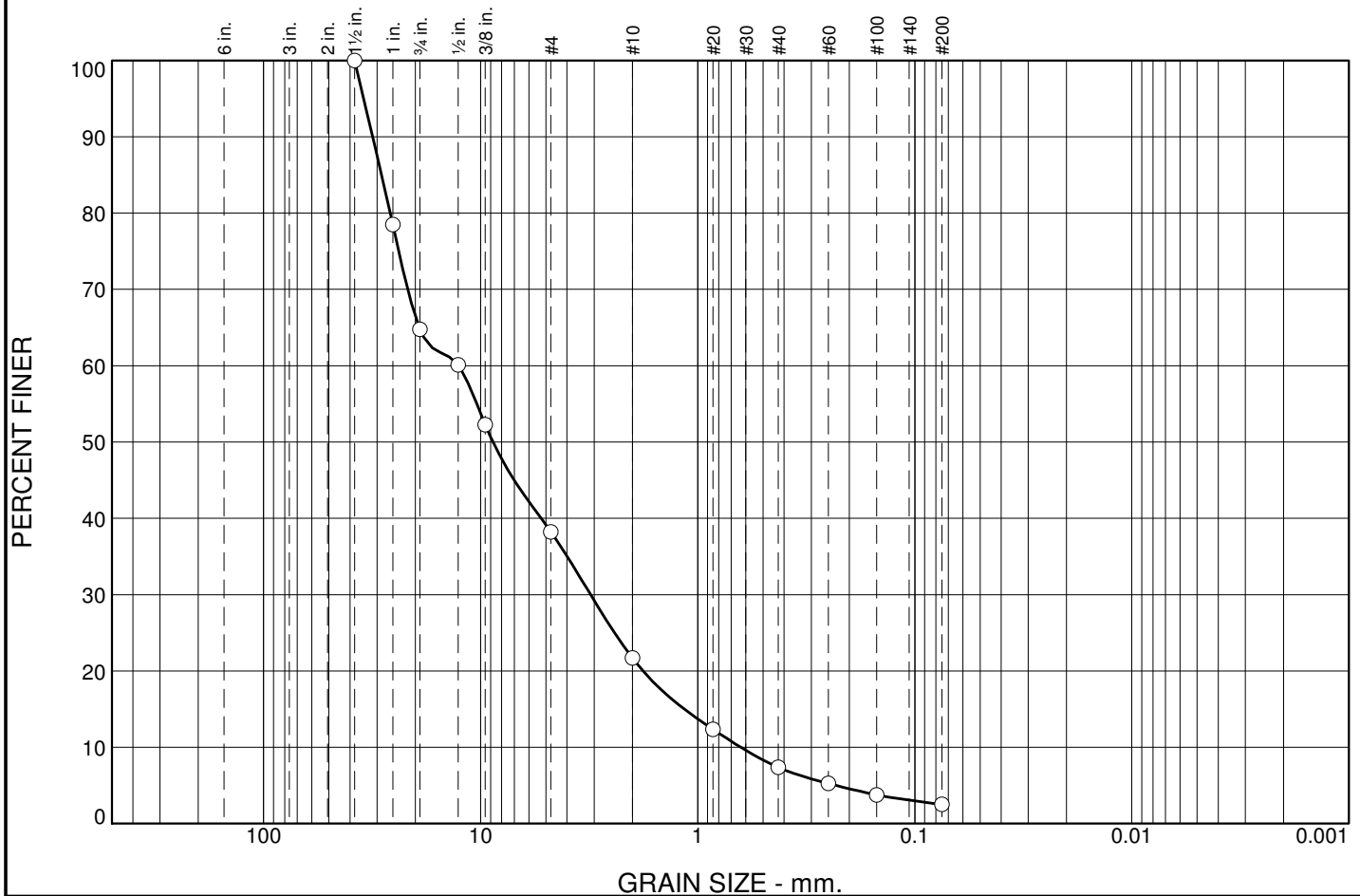
Client: Knight Piésold Ltd.

Project: Kitsault

Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	35	27	16	15	4	3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	78		
.75	65		
.5	60		
0.375	52		
#4	38		
#10	22		
#20	12		
#40	7		
#60	5		
#100	4		
#200	2.5		

Soil Description

well-graded gravel with sand

Atterberg Limits

PL= 17 LL= 26 PI= 9

Coefficients

D₈₅= 28.6203 D₆₀= 12.6057 D₅₀= 8.7760
D₃₀= 3.1155 D₁₅= 1.1523 D₁₀= 0.6327
C_u= 19.92 C_c= 1.22

Classification

USCS= GW AASHTO= A-2-4(0)

Remarks

* (no specification provided)

Sample No.: SPT-05-9
Location: K10-05GT

Source of Sample:

Date: 11/17/10
Elev./Depth: 65-67'



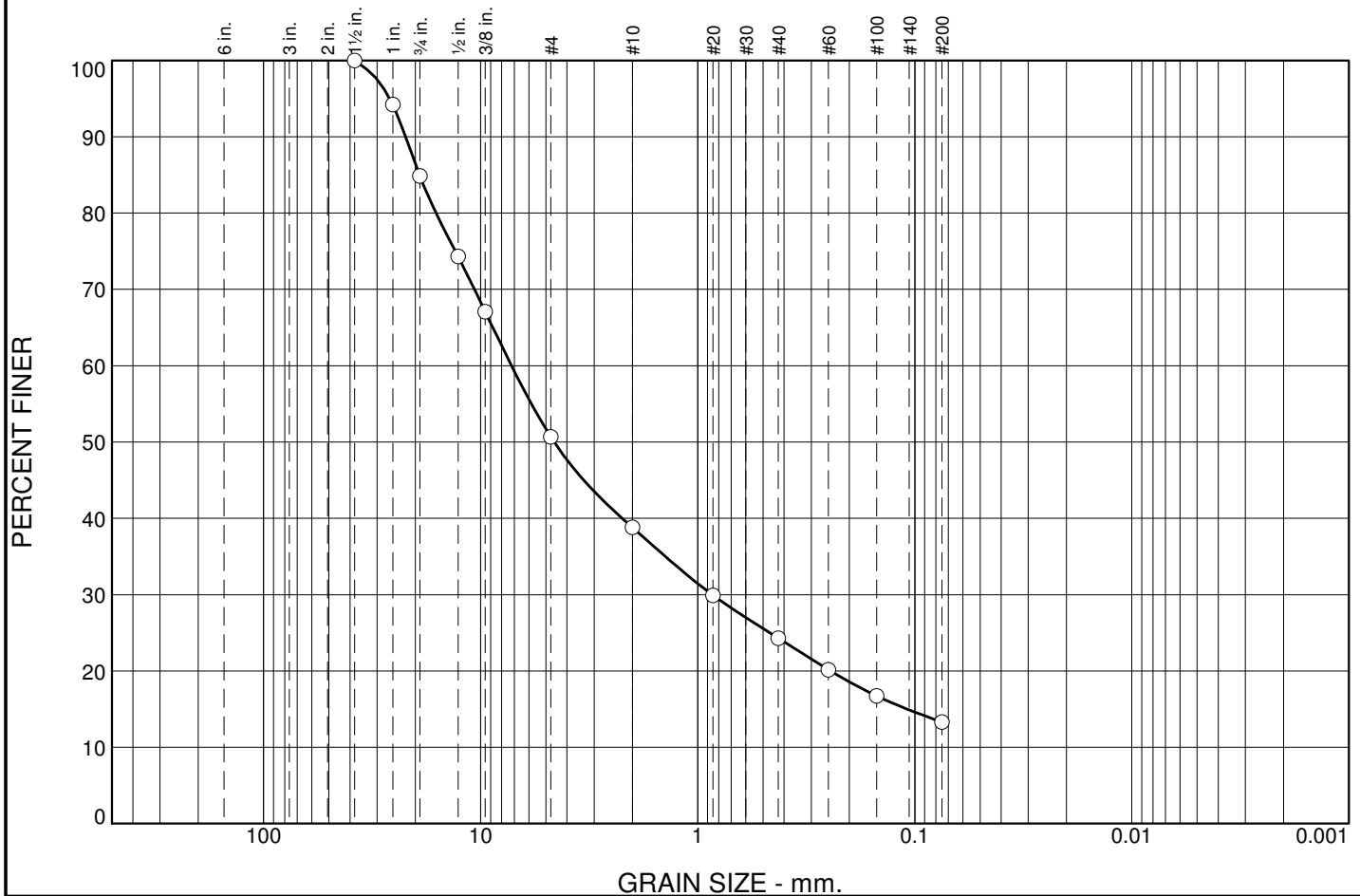
Client: Knight Piésold Ltd.

Project: Kitsault

Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	15	34	12	15	11	13	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	94		
.75	85		
.5	74		
0.375	67		
#4	51		
#10	39		
#20	30		
#40	24		
#60	20		
#100	17		
#200	13		

Soil Description

clayey gravel with sand

Atterberg Limits

PL= 21 LL= 30 PI= 9

Coefficients

D₈₅= 19.1397 D₆₀= 7.2094 D₅₀= 4.5801
D₃₀= 0.8571 D₁₅= 0.1083 D₁₀=
C_u= C_c=

Classification

USCS= GC AASHTO= A-2-4(0)

Remarks

* (no specification provided)

Sample No.: SPT-06-1
Location: K10-06GT

Source of Sample:

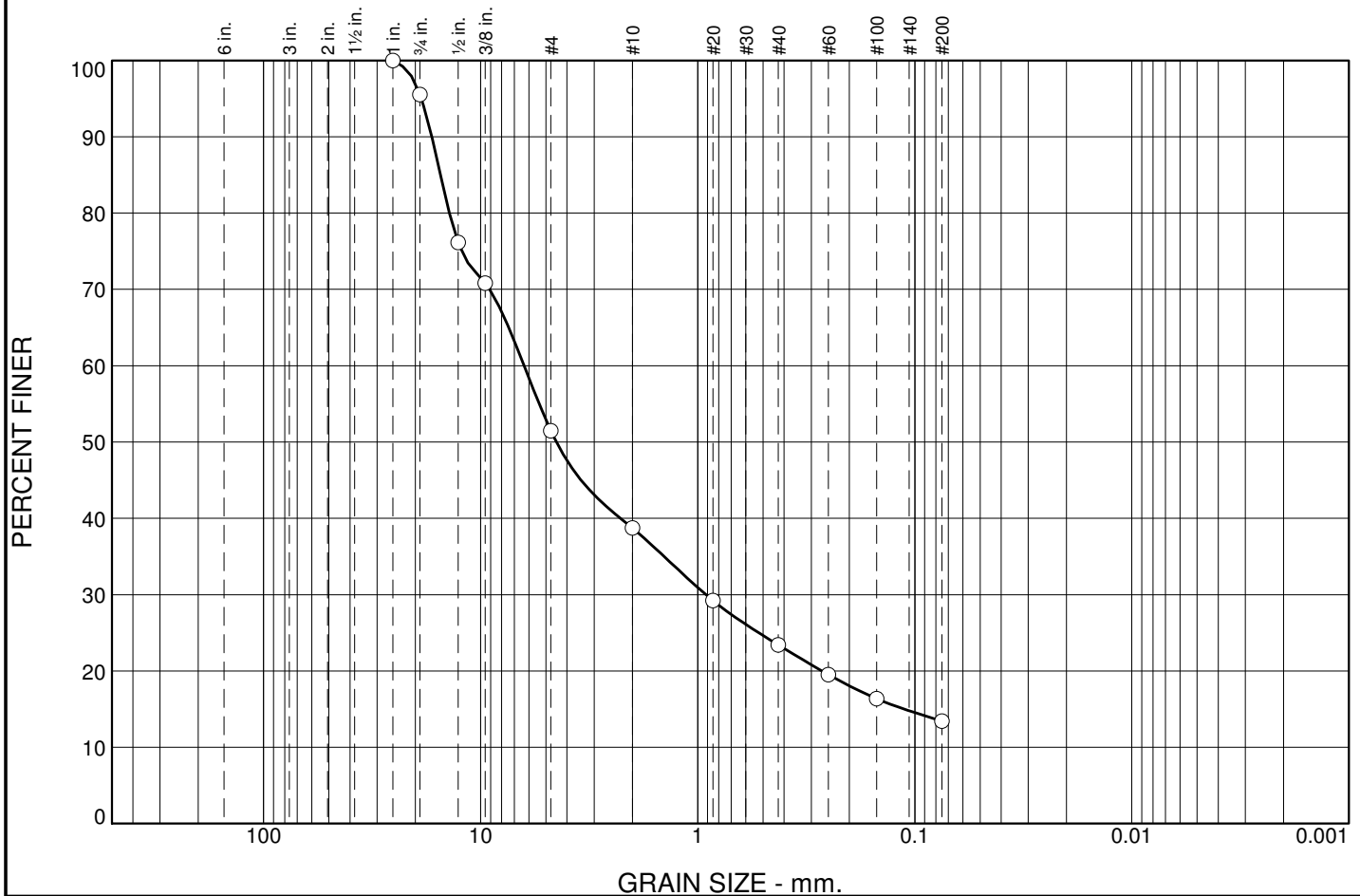
Date: 11/17/10
Elev./Depth: 10-12'



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	4	45	12	16	10	13	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	96		
.5	76		
0.375	71		
#4	51		
#10	39		
#20	29		
#40	23		
#60	20		
#100	16		
#200	13		

Soil Description

clayey gravel with sand

Atterberg Limits

PL= 18 LL= 31 PI= 13

Coefficients

D₈₅= 15.3154 D₆₀= 6.3054 D₅₀= 4.4742
D₃₀= 0.9166 D₁₅= 0.1117 D₁₀=
C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

* (no specification provided)

Sample No.: SPT-06-2
Location: K10-06GT

Source of Sample:

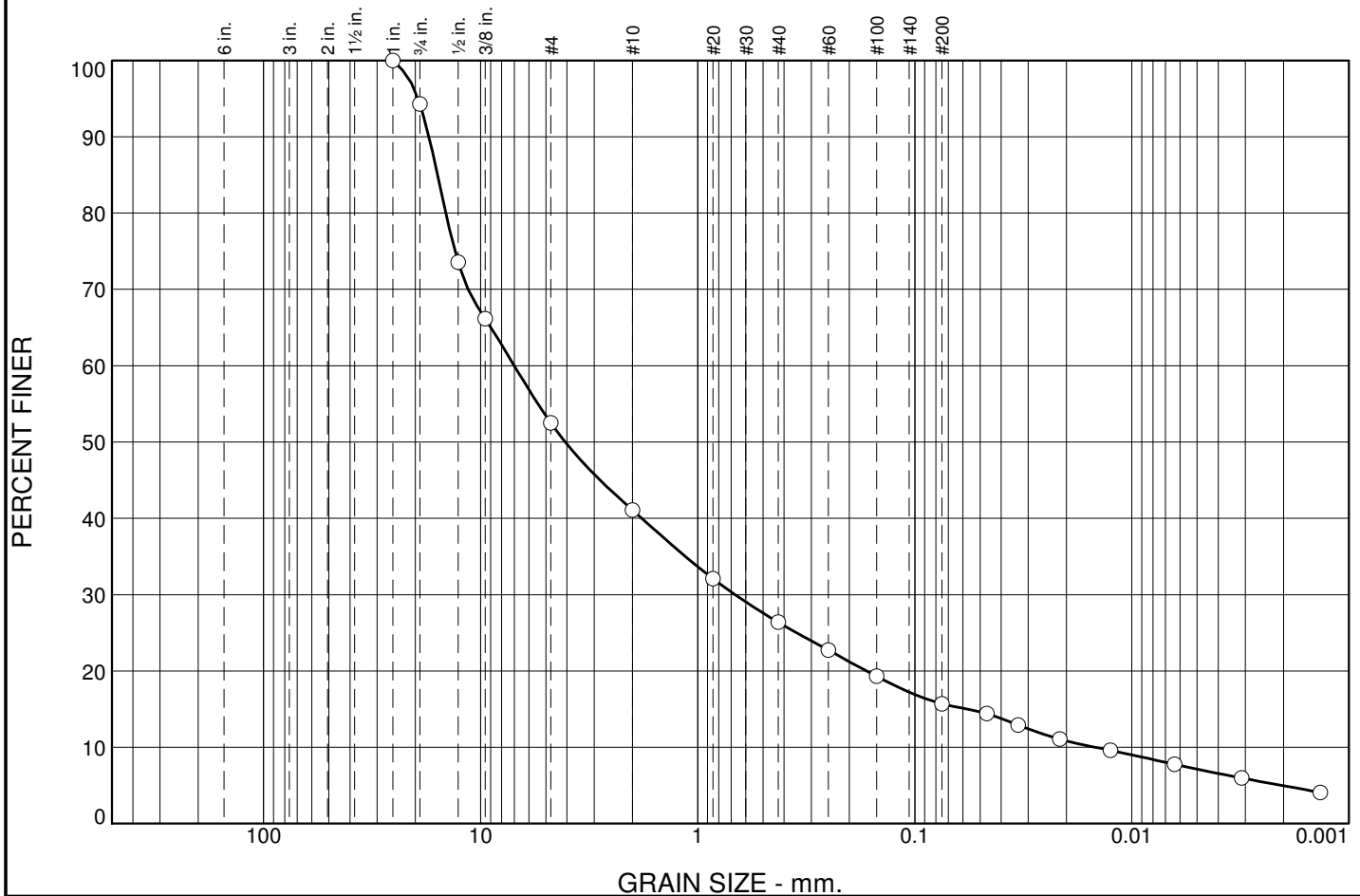
Date: 11/17/10
Elev./Depth: 20-22'



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	6	42	11	15	10	11	5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	94		
.5	74		
0.375	66		
#4	52		
#10	41		
#20	32		
#40	26		
#60	23		
#100	19		
#200	16		
0.0466 mm.	14		
0.0334 mm.	13		
0.0215 mm.	11		
0.0125 mm.	9.6		
0.0064 mm.	7.8		
0.0031 mm.	6.0		
0.0014 mm.	4.1		

Soil Description

clayey gravel with sand

Atterberg Limits

PL= 18 LL= 43 PI= 25

Coefficients

D₈₅= 15.7985 D₆₀= 6.9983 D₅₀= 4.0765
D₃₀= 0.6733 D₁₅= 0.0572 D₁₀= 0.0147
C_u= 476.32 C_c= 4.41

Classification

USCS= GC AASHTO= A-2-7(0)

Remarks

* (no specification provided)

Sample No.: SPT06-3
Location: K10-06GT

Source of Sample:

Date: 11/17/10
Elev./Depth: 30-32'



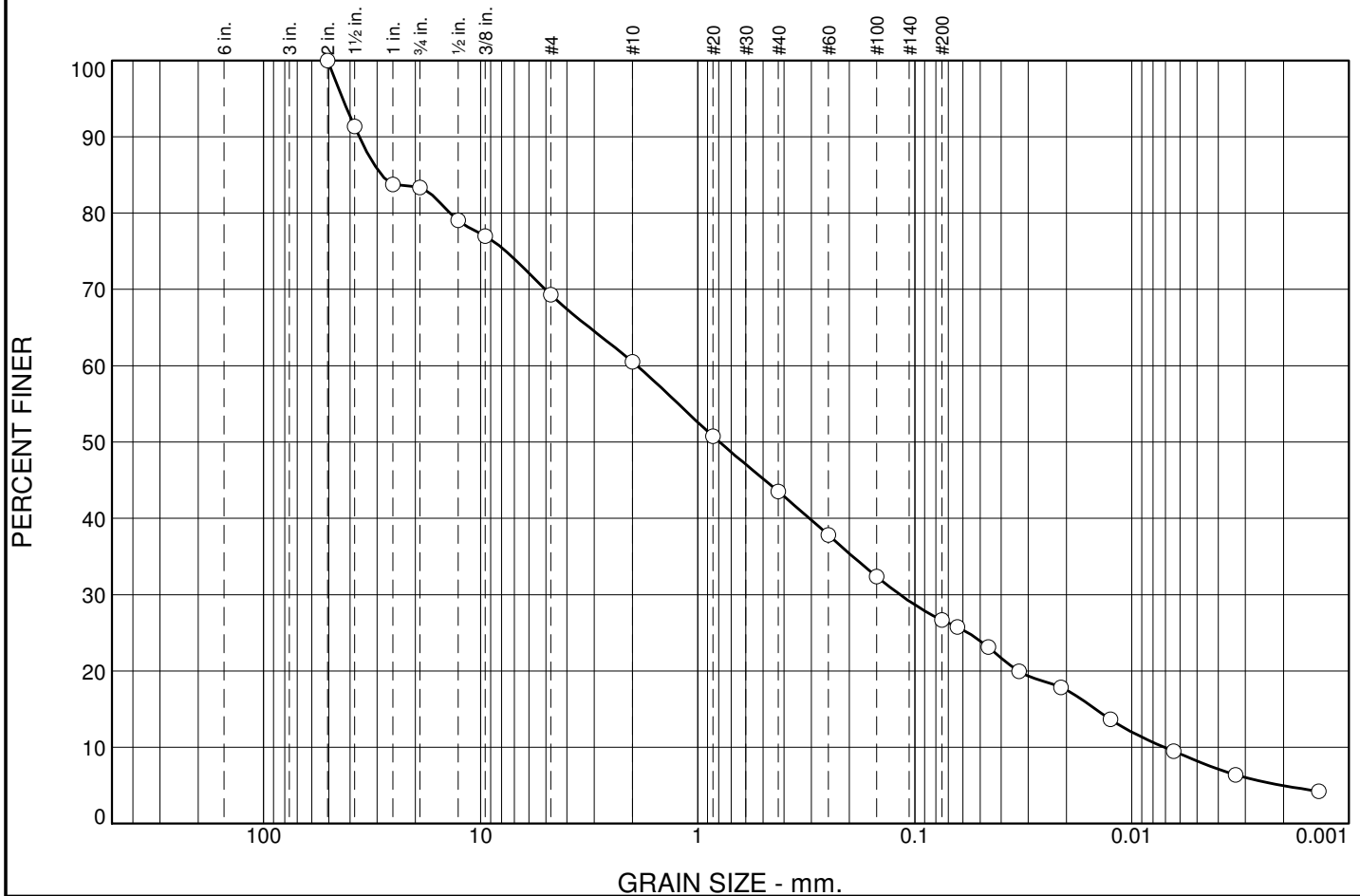
Client: Knight Piésold Ltd.

Project: Kitsault

Project No: DV101-77/11

Fig.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	17	14	8	17	17	22	5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100		
1.5	91		
1	84		
.75	83		
.5	79		
0.375	77		
#4	69		
#10	61		
#20	51		
#40	44		
#60	38		
#100	32		
#200	27		
0.0637 mm.	26		
0.0458 mm.	23		
0.0331 mm.	20		
0.0212 mm.	18		
0.0125 mm.	14		
0.0064 mm.	9.5		
0.0033 mm.	6.4		
0.0014 mm.	4.2		

Soil Description

silty sand with gravel

Atterberg Limits

PL= NP LL= 23 PI= NP

Coefficients

D₈₅= 28.5797 D₆₀= 1.9040 D₅₀= 0.7932
D₃₀= 0.1168 D₁₅= 0.0147 D₁₀= 0.0071
C_u= 268.78 C_c= 1.01

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

* (no specification provided)

Sample No.: _____ **Source of Sample:** _____ **Date:** 11/19/10
Location: TP10-1 **Elev./Depth:** 3.7-5.0m



Client: Knight Piésold Ltd.
Project: Kitsault
Project No: DV101-77/11

Fig. _____

APPENDIX D2

UNCONFINED COMPRESSIVE STRENGTH LABORATORY TESTING RESULTS

(Page D2-1 to D2-69)



NORMAN B. KEEVIL
INSTITUTE OF MINING ENGINEERING

Knight Piésold Ltd.

Kitsault Project
Laboratory Rock Strength Testing Report

November 18, 2010

LABORATORY TESTING

October 2010

- Testing Date:** September 2- 30, 2010
- Tested by:** Paul Hughes & Cristian Caceres
- Tested at:** Norman B Keevil Institute of Mining Engineering,
University of British Columbia
- Testing Program:** In total sixty-four UCS tests with Elastic Modulus recordings tests and eight point load tests were completed.
- Equipment:** MTS Electro-Hydraulic Testing Machine
- Method:** UCS and Elastic Modulus: ISRM-1979; Point load testing: ISRM-1989
- Procedure:** UCS Samples identified as competent were wet cut and polished and tested per ISRM specifications.
- Comments:** Samples UCS02-3, UCS22-5 and, UCS25-2 did not arrive in the shipment sent to UBC.
- Sample UCS24-4 was not included on the shipping manifest but arrived at UBC. The sample was tested and included in the report.
- Samples UCS01-1, UCS01-2, UCS03-2, UCS05-3, UCS16-1, UCS22-1, UCS23-4 and, UCS24-1 were damaged or too short to be tested to ISRM standards. Instead, point-load strength index was performed on these samples.
- Samples UCS01-4, UCS15-4, UCS16-7 and, UCS17-7 recorded large circumferential measurements due to crack propagation during testing. As such, large jumps are shown in the stress-strain curves on the individual data sheets.
- Circumferential measurements for sample UCS13-3 and UCS16-3 were in error and as such not reported.
- Samples UCS16-6 has no photograph of the sample after testing and UCS23-7 has no photograph of the sample before testing.

Summary

Unconfined Compressive Strength and Elastic Modulus Test

Borehole #	Sample #	Depth (m)	Rock Type	Diameter d	Height H	Ratio H/d	UCS		Young Modulus E (GPa)	Poisson Ratio v ()
							(MPa)	(psi)		
K10-01GT	UCS 01-3	22.56 - 22.76	Greywacke	60.51	128.80	2.13	69.2	10032	14.63	0.20
K10-01GT	UCS 01-4	31.70 - 31.95	Greywacke	60.72	129.84	2.14	218.7	31716	70.49	0.29
K10-02GT	UCS 02-1	4.42 - 4.67	Greywacke	60.60	129.97	2.14	89.8	13021	30.90	0.25
K10-02GT	UCS 02-2	8.53 - 8.71	Greywacke	60.73	129.57	2.13	167.5	24284	58.30	0.27
K10-02GT	UCS 02-4	29.87 - 30.15	Argillite	60.75	129.49	2.13	50.5	7319	35.20	0.37
K10-03GT	UCS 03-1	12.80 - 12.98	Greywacke	60.71	128.95	2.12	128.2	18589	60.54	0.32
K10-03GT	UCS 03-3	20.42 - 20.68	Greywacke / Argillite	60.78	127.12	2.09	82.2	11921	51.46	0.41
K10-03GT	UCS 03-4	28.35 - 28.65	Argillite	60.81	127.75	2.10	137.3	19907	60.73	0.37
K10-04GT	UCS 04-1	17.98 - 18.24	Greywacke	60.78	133.49	2.20	78.5	11384	69.75	0.33
K10-04GT	UCS 04-2	22.56 - 22.86	Greywacke	60.80	135.44	2.23	79.2	11485	44.82	0.28
K10-04GT	UCS 04-3	32.00 - 32.20	Argillite	60.82	132.74	2.18	126.8	18390	88.32	0.36
K10-04GT	UCS 04-4	48.77 - 48.97	Greywacke	60.70	131.68	2.17	80.4	11657	42.11	0.25
K10-04GT	UCS 04-5	56.69 - 56.92	Greywacke	60.86	131.17	2.16	41.4	6000	54.70	0.42
K10-04GT	UCS 04-7	70.41 - 70.70	Greywacke / Argillite	60.92	133.88	2.20	45.9	6655	48.24	0.33
K10-04GT	UCS 04-8	88.39 - 88.70	Greywacke	60.54	131.71	2.18	99.6	14444	51.31	0.29
K10-04GT	UCS 04-9	97.84 - 98.04	Greywacke	60.86	133.23	2.19	109.5	15874	46.35	0.27
K10-05GT	UCS 05-1	24.69 - 24.93	Argillite	60.83	128.47	2.11	21.0	3044	26.11	0.33
K10-05GT	UCS 05-2	28.65 - 28.83	Argillite	60.86	129.58	2.13	29.8	4320	27.96	0.27
K10-09GT	UCS 09-1	21.34 - 21.54	Trachyandesite	60.61	130.93	2.16	221.0	32040	52.27	0.44
K10-09GT	UCS 09-2	12.50 - 12.90	Trachyandesite	60.93	126.01	2.07	303.0	43934	74.65	0.41
K10-12GT	UCS 12-1	3.35 - 3.65	Trachyandesite	60.71	129.81	2.14	214.8	31150	43.66	0.33
K10-12GT	UCS 12-2	19.81 - 20.05	Trachyandesite	60.67	130.61	2.15	23.9	3470	54.95	0.41
K10-12GT	UCS 12-3	28.65 - 28.88	Trachyandesite	60.41	129.99	2.15	177.6	25751	37.62	0.33
K10-13GT	UCS 13-1	3.35 - 3.53	Trachyandesite	60.89	131.32	2.16	197.4	28617	50.08	0.38
K10-13GT	UCS 13-2	10.73 - 11.03	Trachyandesite	61.02	133.02	2.18	269.6	39088	56.33	0.44
K10-13GT	UCS 13-3	15.24 - 15.44	Trachyandesite	60.94	129.16	2.12	278.9	40446	72.67	0.57
K10-13GT	UCS 13-4	22.86 - 23.10	Trachyandesite	60.83	130.55	2.15	231.3	33535	39.59	0.36
K10-13GT	UCS 13-5	31.70 - 31.90	Trachyandesite	60.72	131.06	2.16	27.8	4029	13.09	0.28

Summary

Unconfined Compressive Strength and Elastic Modulus Test (continued)

Borehole #	Sample #	Depth (m)	Rock Type	Diameter d	Height H	Ratio H/d	UCS		Young Modulus E (GPa)	Poisson Ratio v ()
							(MPa)	(psi)		
K10-13GT	UCS 13-6	39.38 - 39.69	Trachyandesite	60.71	130.22	2.14	62.8	9110	22.15	0.35
K10-14GT	UCS 14-1	3.08 - 3.26	Trachyandesite	60.92	130.64	2.14	195.2	28306	47.86	0.42
K10-15AGT	UCS 15-1	2.16 - 2.38	Greywacke	60.55	130.10	2.15	125.9	18262	30.89	0.31
K10-15AGT	UCS 15-2	9.63 - 9.80	Greywacke / Argillite	60.57	131.73	2.17	97.5	14142	76.72	0.29
K10-15AGT	UCS 15-3	14.02 - 14.12	Greywacke / Argillite	60.56	131.15	2.17	86.3	12511	61.99	0.27
K10-15AGT	UCS 15-4	21.37 - 21.52	Argillite	60.53	133.73	2.21	75.8	10986	65.24	0.24
K10-15AGT	UCS 15-5	27.46 - 27.64	Argillite	60.61	124.11	2.05	66.4	9628	51.10	0.33
K10-15AGT	UCS 15-6	38.71 - 38.93	Greywacke / Argillite	60.58	138.80	2.29	160.4	23258	51.06	0.22
K10-16GT	UCS 16-2	6.10 - 6.37	Greywacke / Argillite	60.71	133.62	2.20	129.8	18826	30.58	0.35
K10-16GT	UCS 16-3	11.28 - 11.58	Greywacke / Argillite	60.79	132.27	2.18	123.8	17949	37.86	0.52
K10-16GT	UCS 16-4	16.15 - 16.35	Greywacke / Argillite	60.78	121.53	2.00	91.5	13265	75.74	0.31
K10-16GT	UCS 16-5	23.77 - 23.97	Greywacke / Argillite	60.81	131.58	2.16	66.6	9659	73.35	0.29
K10-16GT	UCS 16-6	29.26 - 29.46	Greywacke / Argillite	60.82	131.05	2.15	188.6	27350	44.07	0.24
K10-16GT	UCS 16-7	40.84 - 41.06	Greywacke / Argillite	60.86	133.20	2.19	137.9	19996	39.70	0.19
K10-17GT	UCS 17-1	6.71 - 6.91	Greywacke / Argillite	60.95	125.98	2.07	70.1	10168	26.23	0.24
K10-17GT	UCS 17-2	12.80 - 13.02	Greywacke / Argillite	60.85	128.61	2.11	46.4	6734	27.00	0.30
K10-17GT	UCS 17-3	16.76 - 16.98	Greywacke / Argillite	60.88	119.34	1.96	31.2	4529	32.92	0.14
K10-17GT	UCS 17-4	23.77 - 23.99	Greywacke / Argillite	60.93	131.04	2.15	55.5	8046	58.20	0.34
K10-17GT	UCS 17-5	29.87 - 30.12	Greywacke / Argillite	60.95	130.43	2.14	50.9	7382	42.43	0.20
K10-17GT	UCS 17-6	40.23 - 40.43	Argillite	60.94	132.16	2.17	48.0	6966	30.97	0.25
K10-17GT	UCS 17-7	54.10 - 54.30	Greywacke	60.97	130.11	2.13	66.6	9663	36.25	0.37
K10-22GT	UCS 22-2	28.87 - 29.05	Greywacke	60.45	134.71	2.23	152.1	22057	61.35	0.27
K10-22GT	UCS 22-3	45.28 - 45.54	Greywacke	60.32	135.18	2.24	207.7	30123	68.42	0.22
K10-22GT	UCS 22-4	67.26 - 67.46	Greywacke	60.31	134.26	2.23	117.8	17077	57.94	0.23
K10-22GT	UCS 22-6	88.91 - 89.18	Argillite	60.33	131.82	2.18	104.2	15116	58.35	0.32
K10-23GT	UCS 23-1	15.91 - 16.13	Greywacke	60.65	131.32	2.17	40.4	5857	36.37	0.17
K10-23GT	UCS 23-2	26.25 - 26.47	Greywacke	60.66	134.74	2.22	103.0	14938	45.04	0.26
K10-23GT	UCS 23-3	32.81 - 33.10	Greywacke	60.63	131.92	2.18	119.7	17357	56.08	0.28

Summary

Unconfined Compressive Strength and Elastic Modulus Test (continued)



Borehole #	Sample #	Depth (m)	Rock Type	Diameter d	Height H	Ratio H/d	UCS		Young Modulus E (GPa)	Poisson Ratio v ()
							(MPa)	(psi)		
K10-23GT	UCS-23-5	53.15 - 53.40	Greywacke	60.35	135.08	2.24	80.6	11694	35.39	0.28
K10-23GT	UCS-23-6	62.83 - 63.09	Greywacke	60.35	134.47	2.23	66.3	9607	43.17	0.24
K10-23GT	UCS-23-7	70.47 - 70.77	Greywacke	60.33	143.87	2.38	62.3	9030	53.36	0.31
K10-24GT	UCS-24-2	15.09 - 15.31	Trachyandesite	60.91	134.27	2.20	197.3	28614	42.96	0.43
K10-24GT	UCS-24-3	22.80 - 22.98	Trachyandesite	60.93	131.56	2.16	207.3	30066	48.59	0.44
K10-24GT	UCS-24-4	36.00 - 36.20	Trachyandesite	60.94	134.86	2.21	72.4	10499	21.20	0.40
K10-25GT	UCS-25-1	4.57 - 4.90	Trachyandesite	60.46	133.57	2.21	141.6	20533	45.99	0.37
K10-25GT	UCS-25-3	22.8 - 22.98	Trachyandesite	60.86	132.60	2.18	191.2	27717	30.01	0.30

Point Load Test

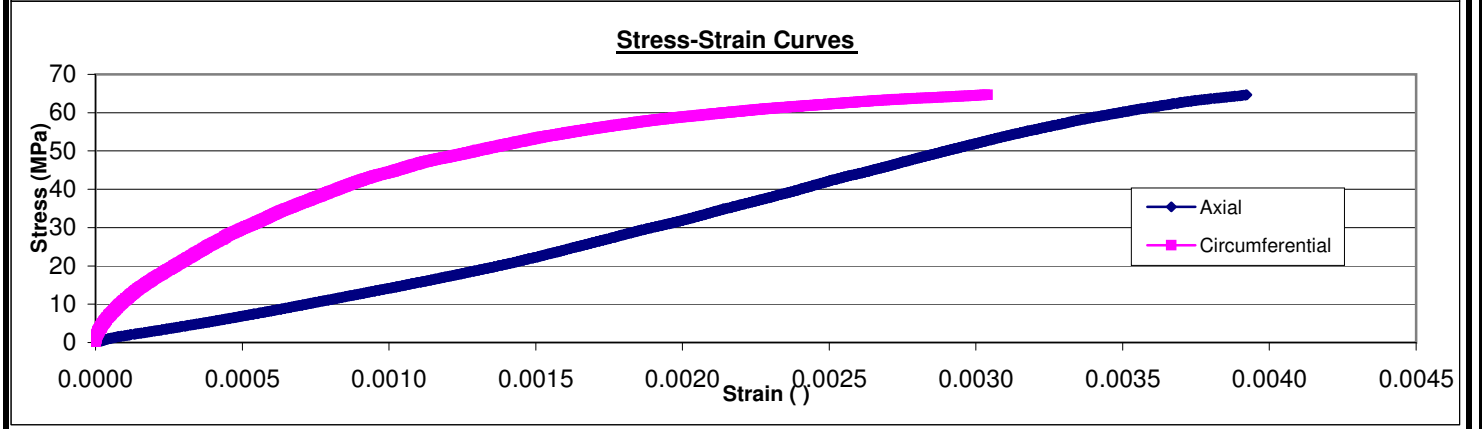
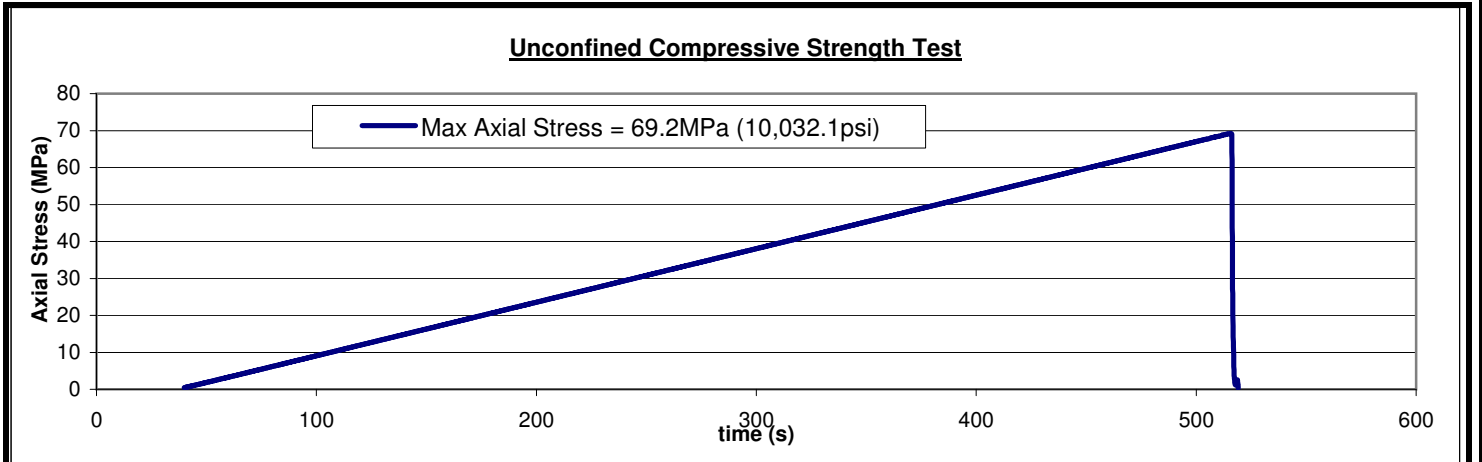
Borehole ID	Sample Number	Rock Type	Depth (m)	Type (D)iametral/(A)xial	Diameter (mm)	D _e (mm)	Load		I _s (MPa)	F	I _{s50} (MPa)	UCS* (MPa)
							(lbs-force)	(kN)				
K10-01GT	UCS 01-1	Greywacke	13.41 - 13.55	D	60.57	60.6	2768	12.31	3.36	1.09	3.66	80.5
K10-01GT	UCS 01-2	Greywacke	18.29 - 18.48	D	60.47	60.5	2369	10.54	2.88	1.09	3.14	69.1
K10-03GT	UCS 03-2	Argillite	15.85 - 16.05	D	60.77	60.8	4365	19.42	5.26	1.09	5.74	126.3
K10-05GT	UCS 05-3	Greywacke	37.64 - 37.81	D	60.93	60.9	4798	21.34	5.75	1.09	6.28	138.2
K10-16GT	UCS 16-1	Greywacke / Argillite	1.22 - 1.42	D	60.87	60.9	4798	21.34	5.76	1.09	6.29	138.5
K10-22GT	UCS-22-1	Greywacke	8.53 - 8.68	D	62.05	62.1	5503	24.48	6.36	1.10	7.01	154.1
K10-23GT	UCS-23-4	Greywacke	37.73 - 38.01	D	60.6	60.6	3380	15.03	4.09	1.09	4.46	98.2
K10-24GT	UCS-24-1	Trachyandesite	3.44 - 3.66	D	60.45	60.5	5545	24.67	6.75	1.09	7.35	161.7

* A scaling factor of 22 has been used to scale the I_{s50} value to the theoretical UCS values

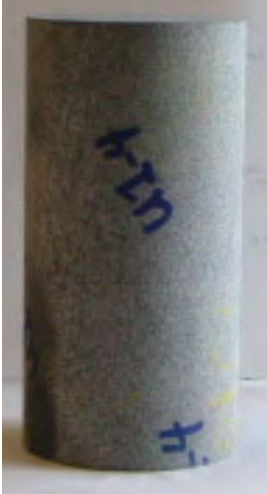

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-01GT	Before Test 	After Test 
Sample #:	UCS 01-3		
Depth (m):	22.56 - 22.76		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	14.63		
Poisson Ratio, ν	0.20		
Failure Mode:	Shear		

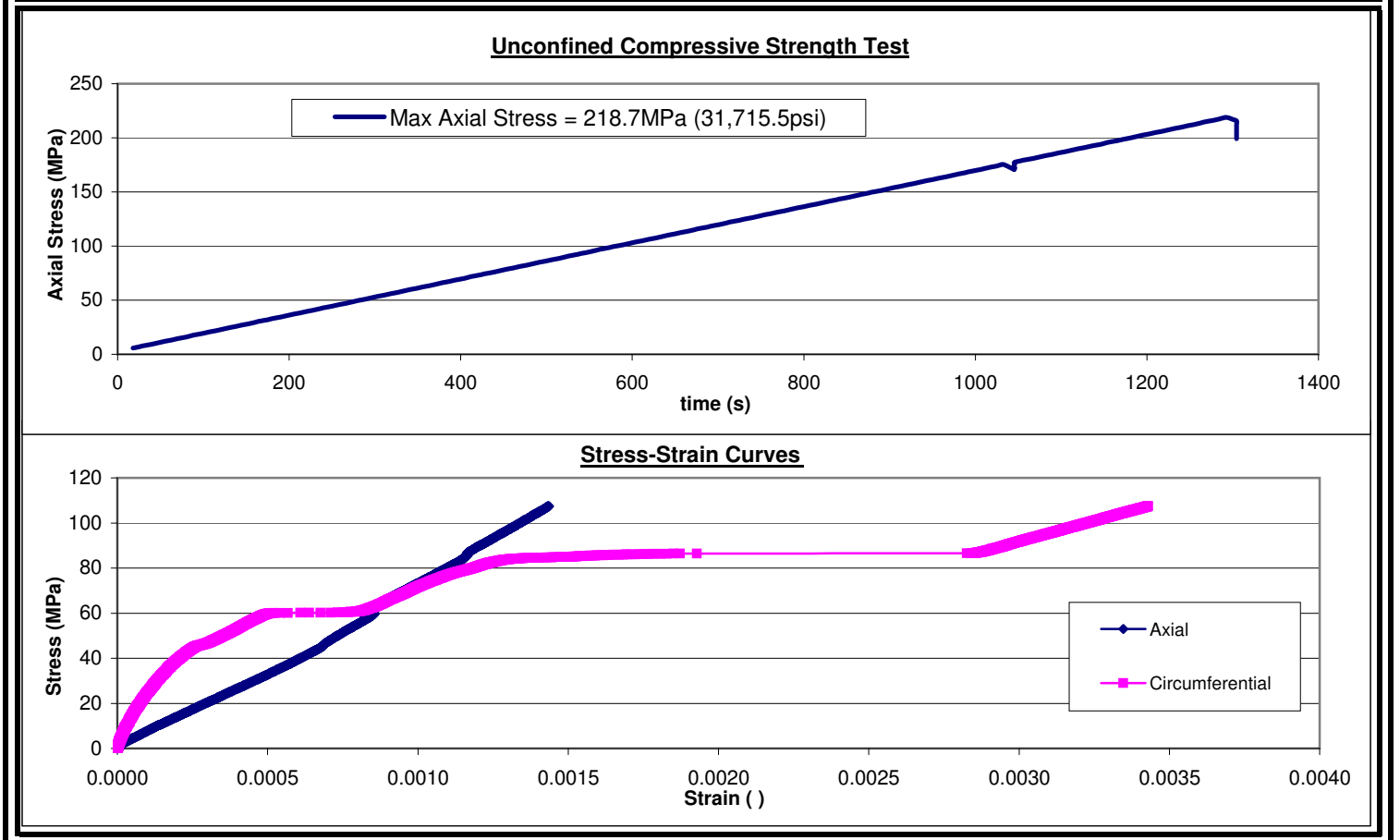
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.51	2875.7	128.80	2.1	199.0	69.2	10,032.1



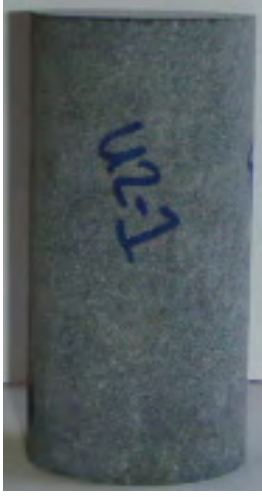

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-01GT		
Sample #:	UCS 01-4		
Depth (m):	31.70 - 31.95		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	70.49		
Poisson Ratio, ν	0.29		
Failure Mode:	Shear		

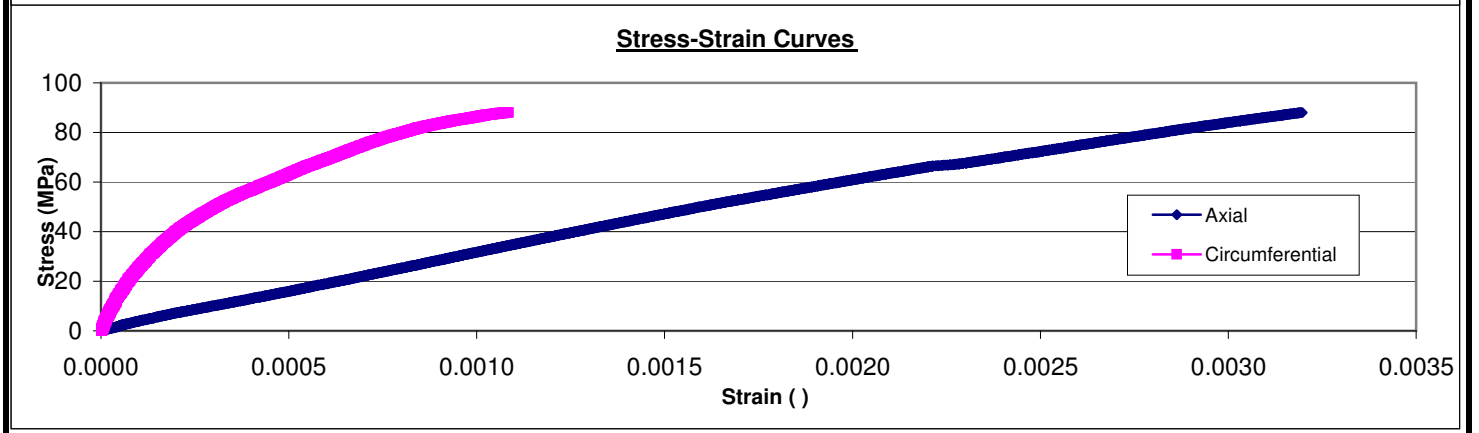
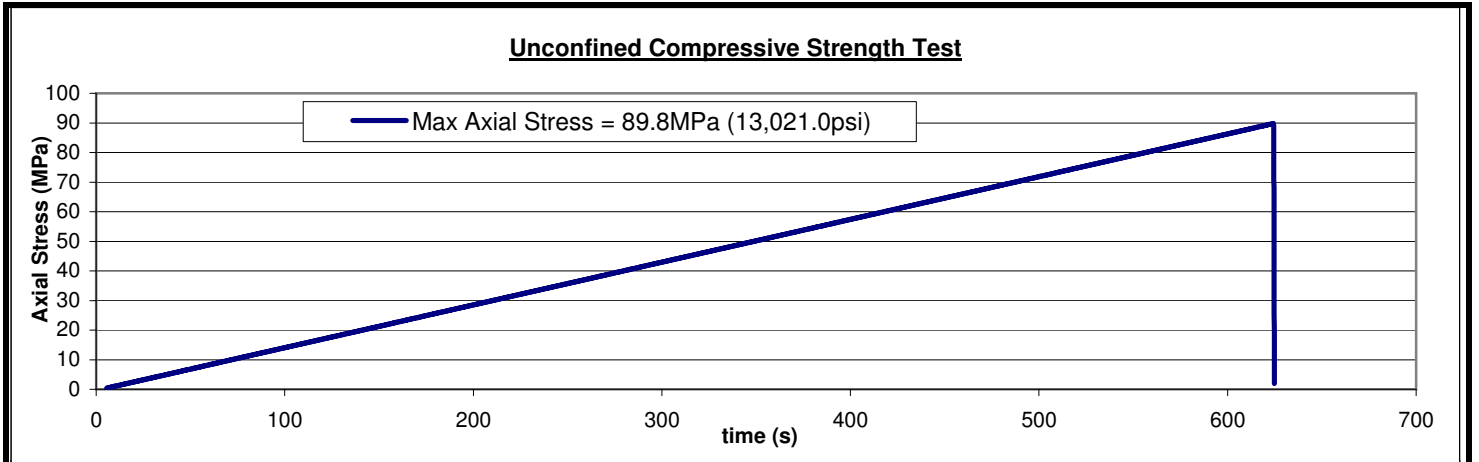
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.72	2895.7	129.84	2.14	633.4	218.7	31,715.5



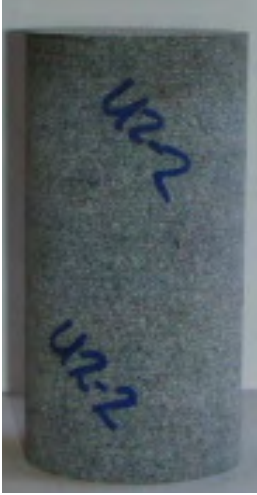

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-02GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 02-1	
Depth (m):	4.42 - 4.67	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (GPa)	30.90	
Poisson Ratio, ν	0.25	
Failure Mode:	Shear	

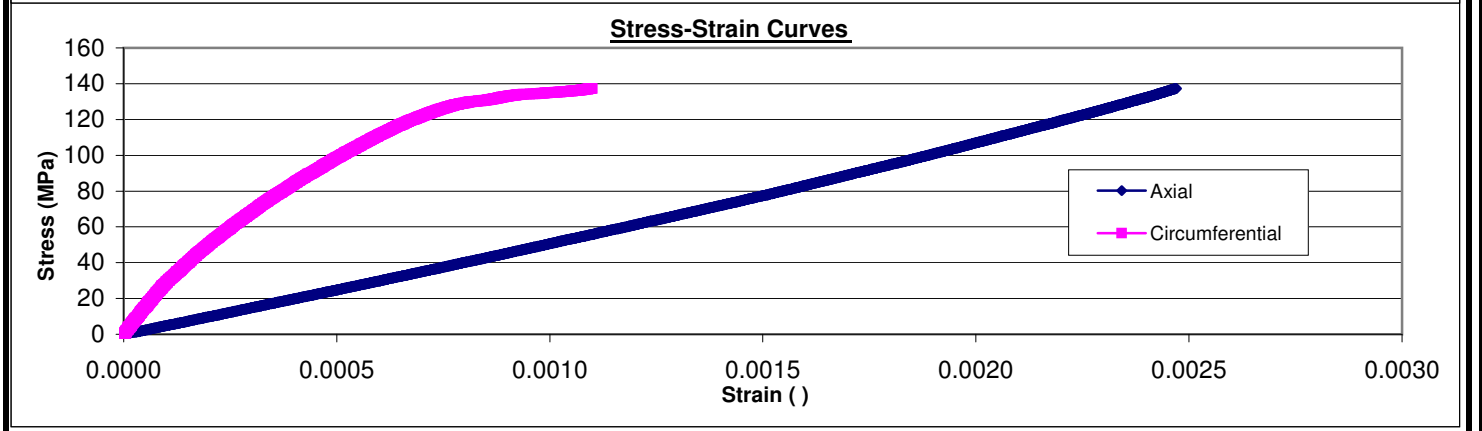
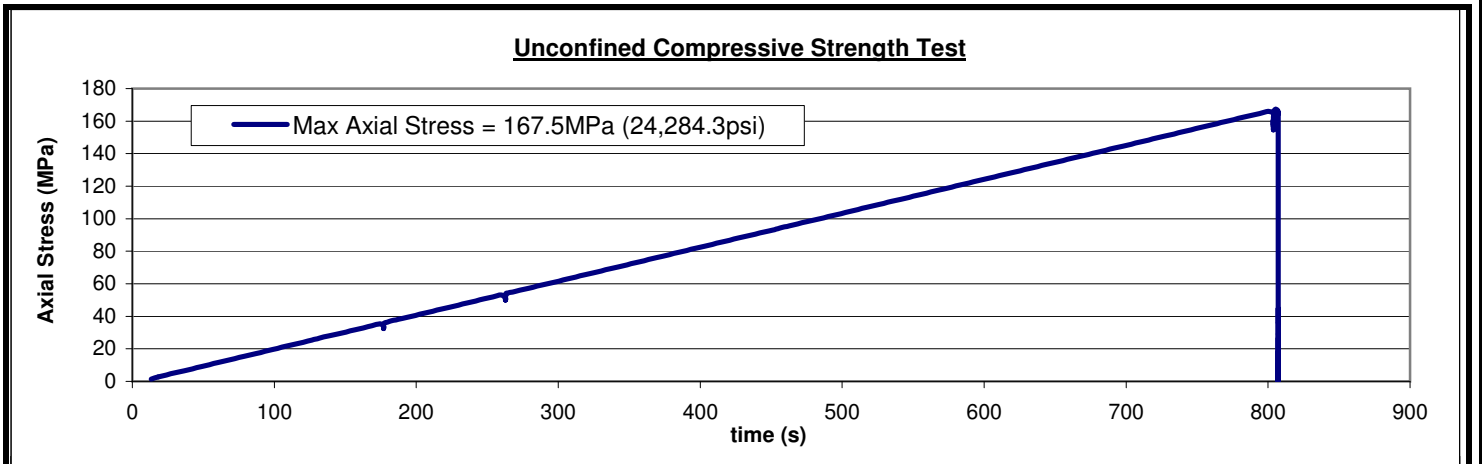
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.60	2884.3	129.97	2.1	259.0	89.8	13,021.0





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-02GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 02-2	
Depth (m):	8.53 - 8.71	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	58.30	
Poisson Ratio, ν	0.27	
Failure Mode:	Shear	

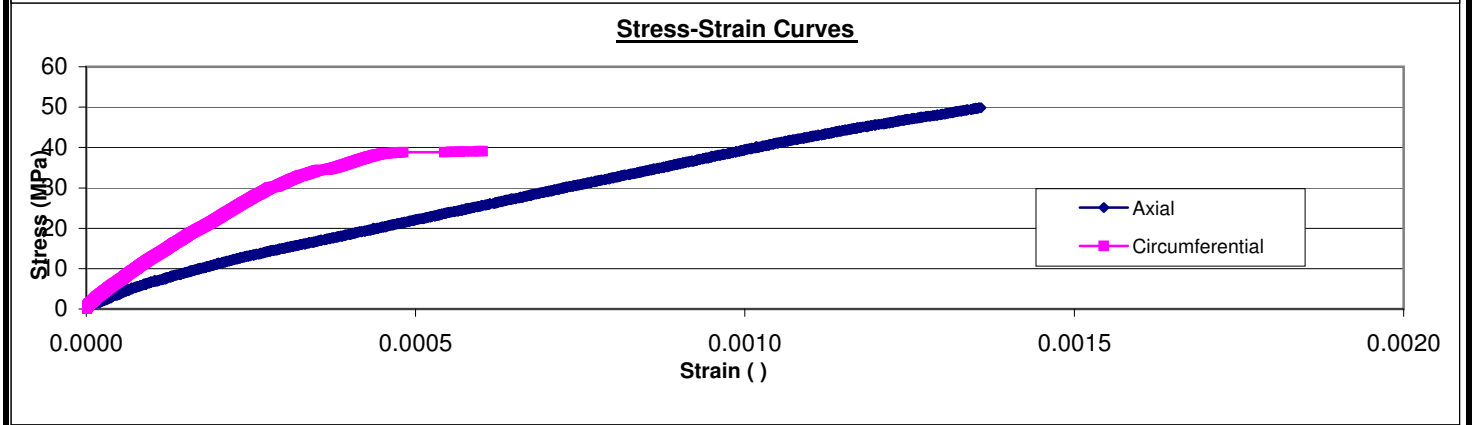
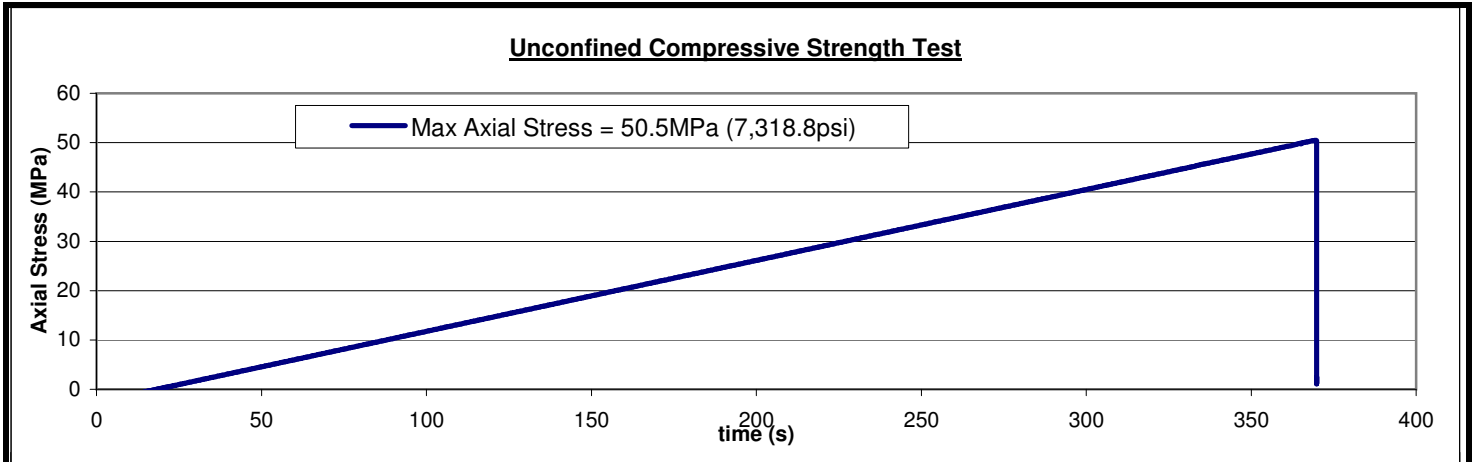
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.73	2896.7	129.57	2.13	485.1	167.5	24,284.3



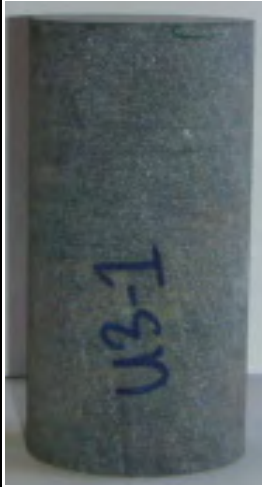

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-02GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 02-4	
Depth (m):	29.87 - 30.15	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	35.20	
Poisson Ratio, ν	0.37	
Failure Mode:	Shear	

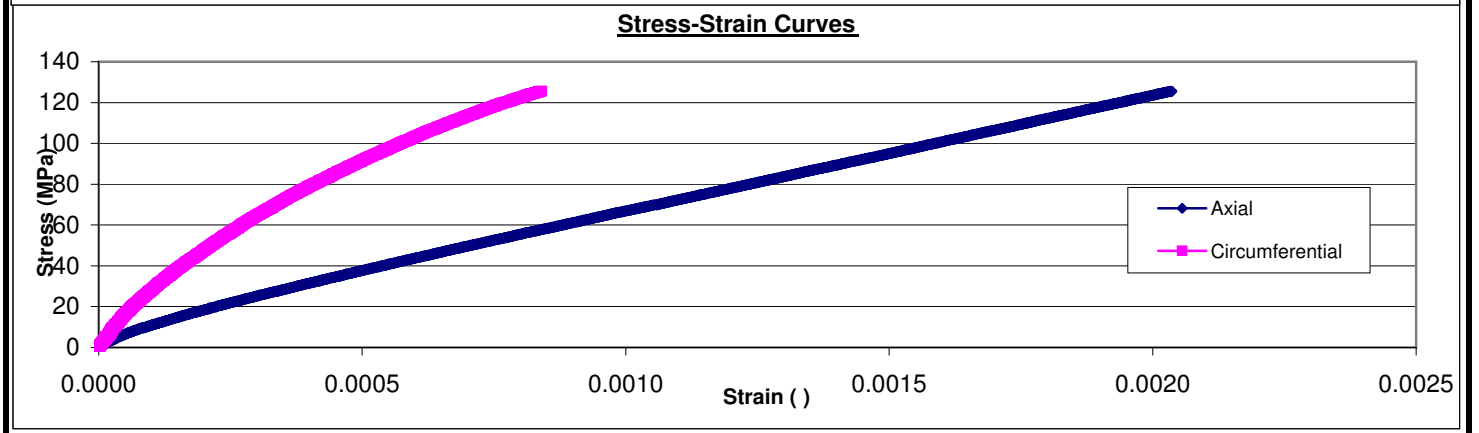
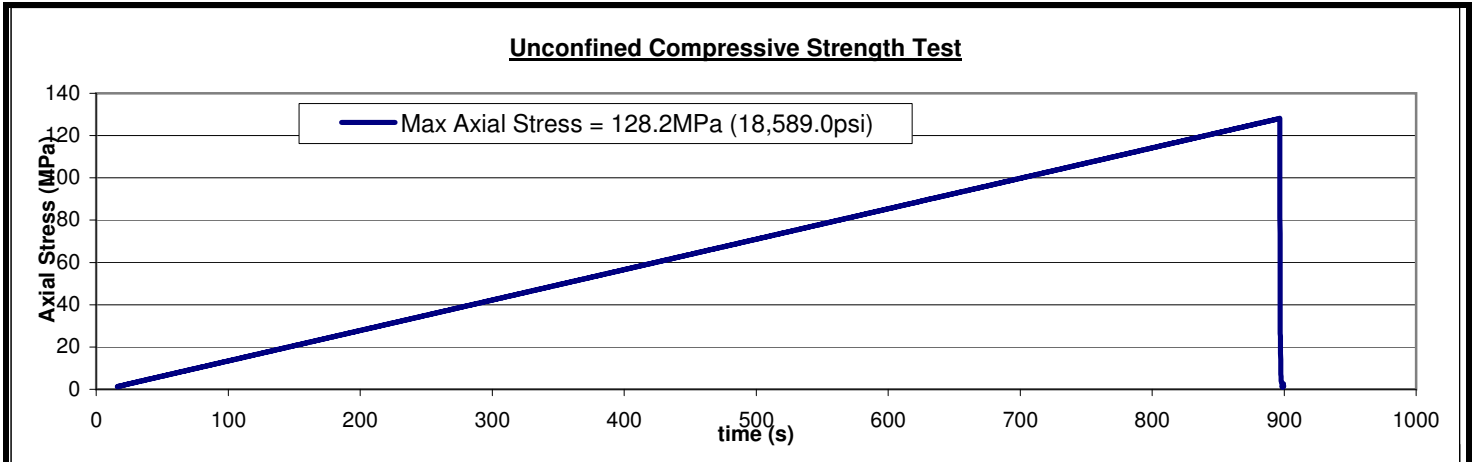
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.75	2898.6	129.49	2.1	146.3	50.5	7,318.8





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-03GT	Before Test 	After Test 
Sample #:	UCS 03-1		
Depth (m):	12.80 - 12.98		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	60.54		
Poisson Ratio, ν	0.32		
Failure Mode:	Tensile		

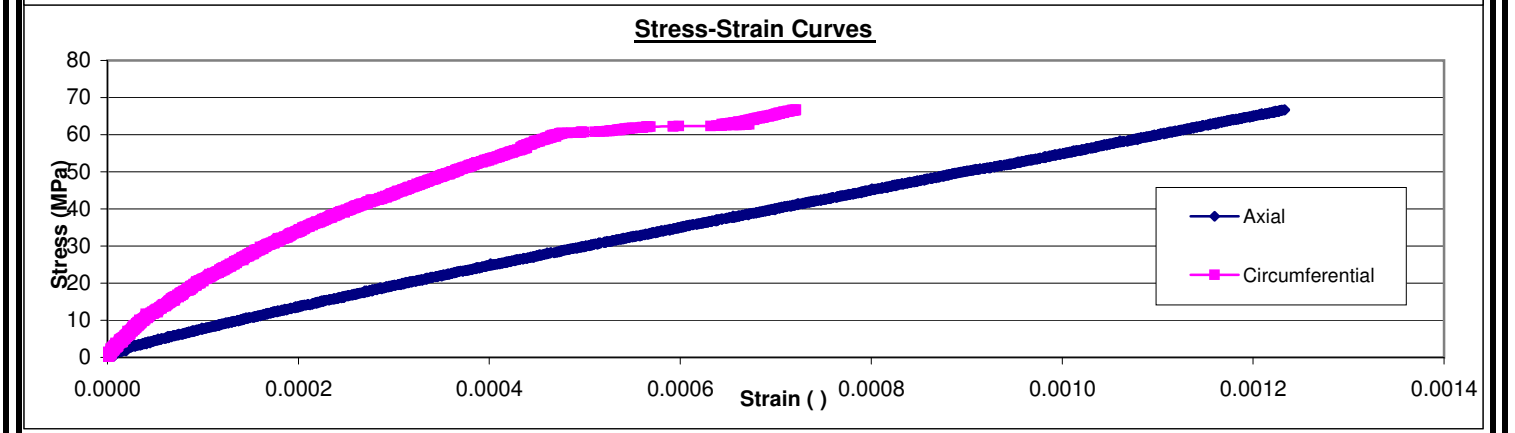
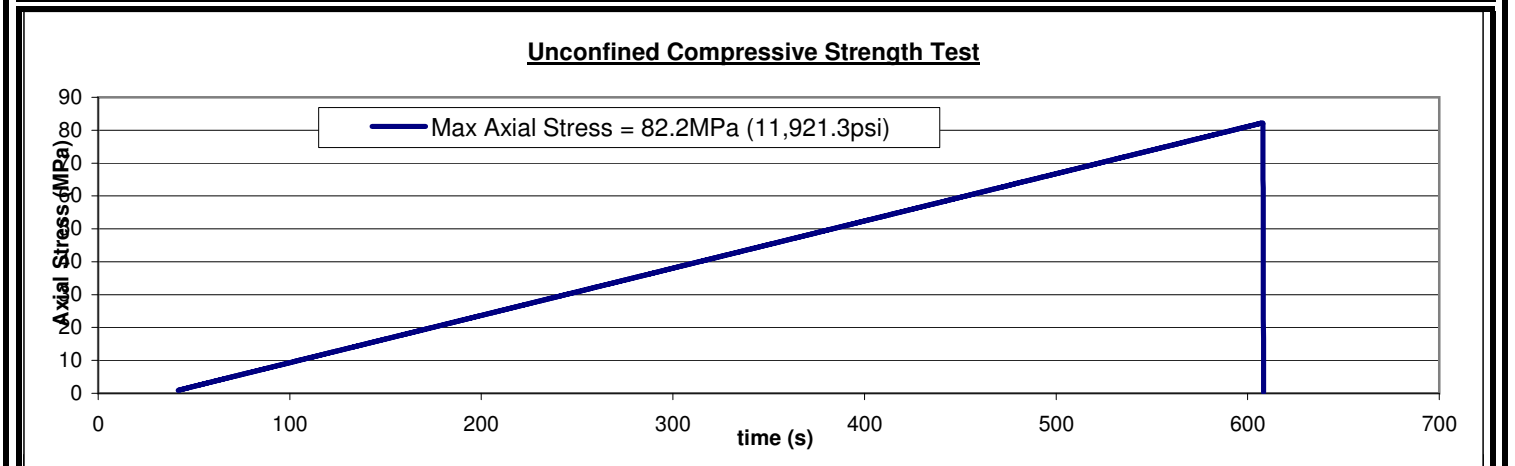
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.71	2894.7	128.95	2.1	371.1	128.2	18,589.0





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-03GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 03-3	
Depth (m):	20.42 - 20.68	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	51.46	
Poisson Ratio, ν	0.41	
Failure Mode:	Shear	

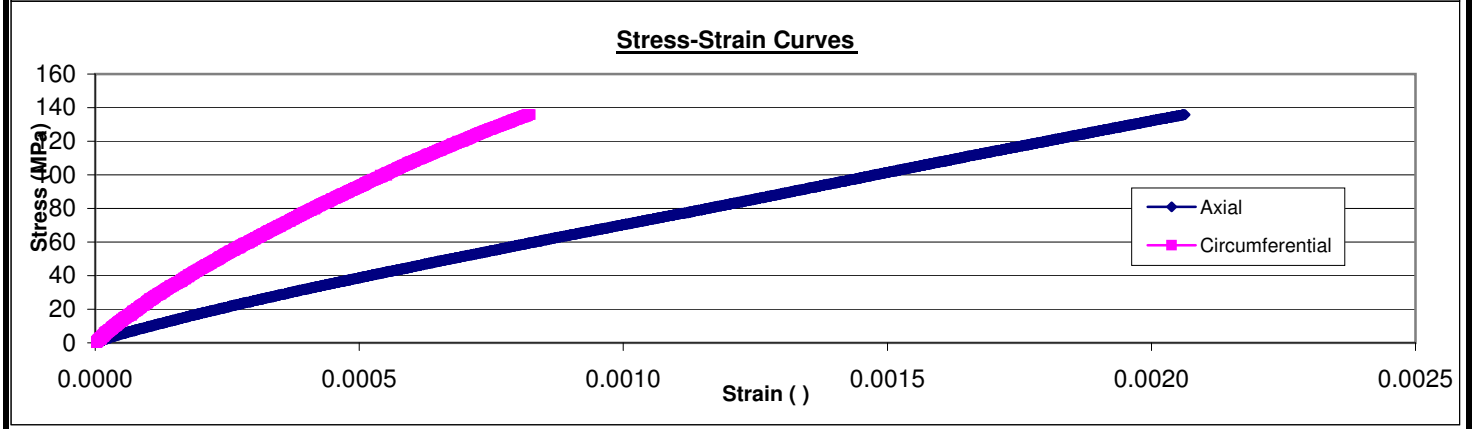
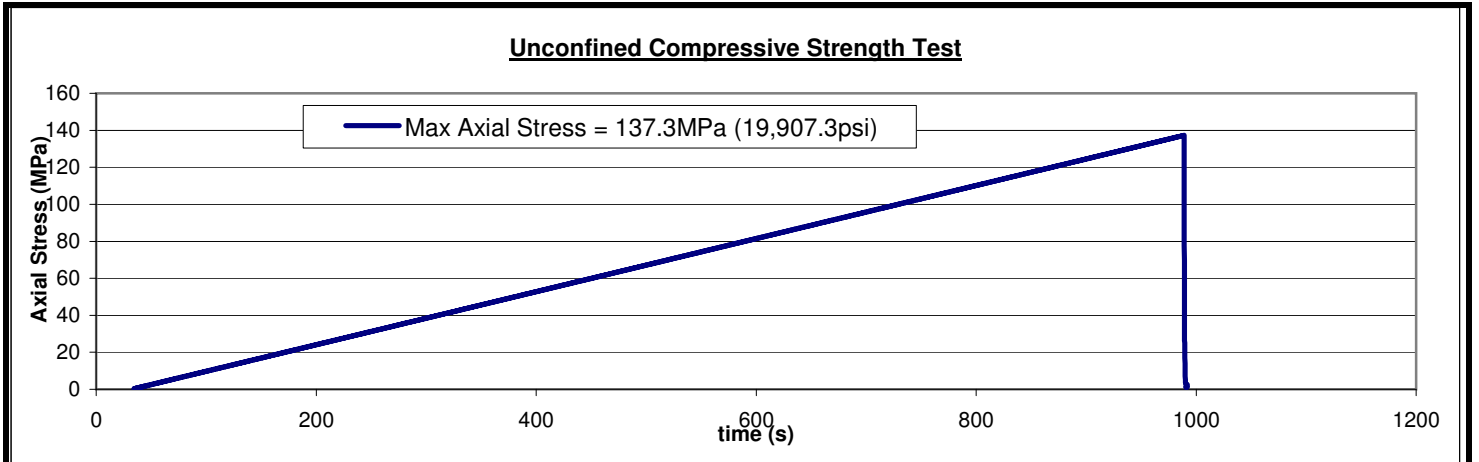
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.78	2901.4	127.12	2.1	238.5	82.2	11,921.3



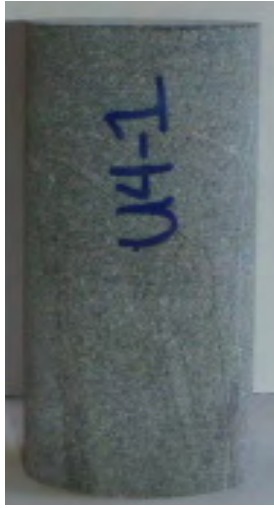
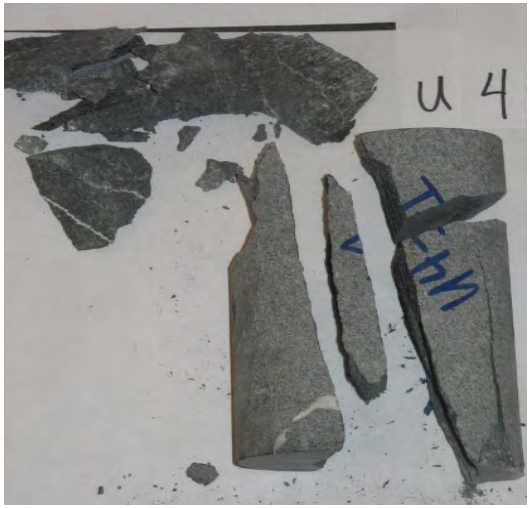
**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-03GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 03-4	
Depth (m):	28.35 - 28.65	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	60.73	
Poisson Ratio, ν	0.37	
Failure Mode:	Shear	

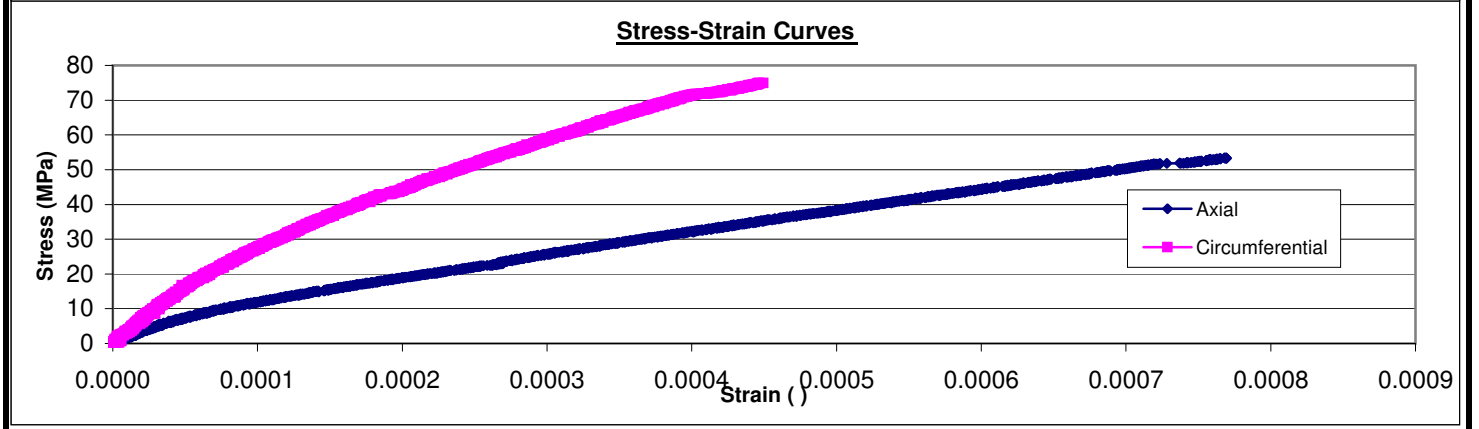
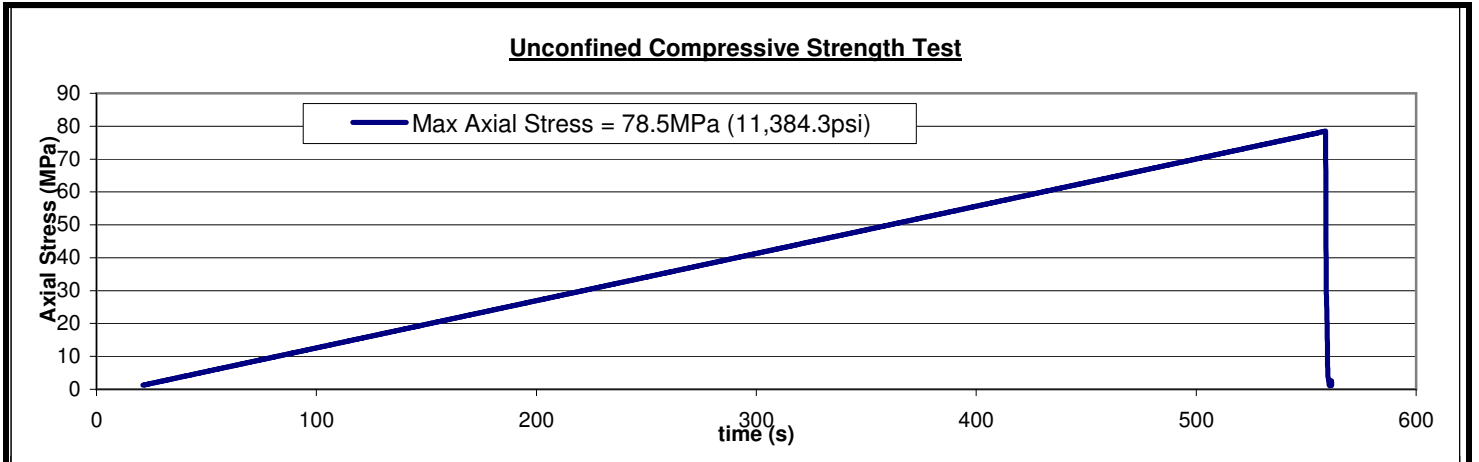
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.81	2904.3	127.75	2.1	398.7	137.3	19,907.3





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	Before Test 	After Test 
Sample #:	UCS 04-1		
Depth (m):	17.98 - 18.24		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	69.75		
Poisson Ratio, ν	0.33		
Failure Mode:	Shear		

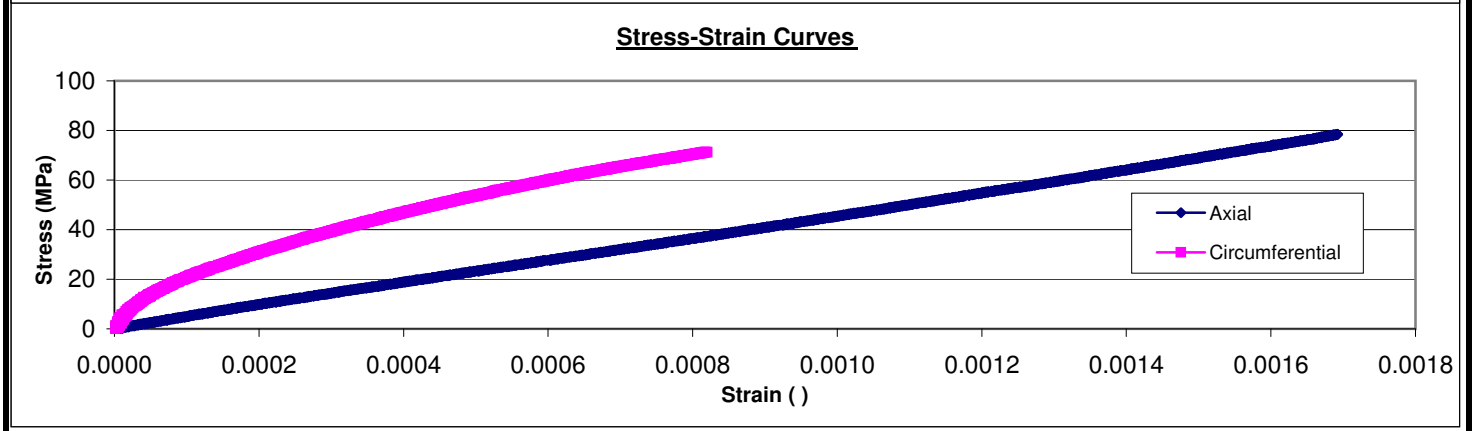
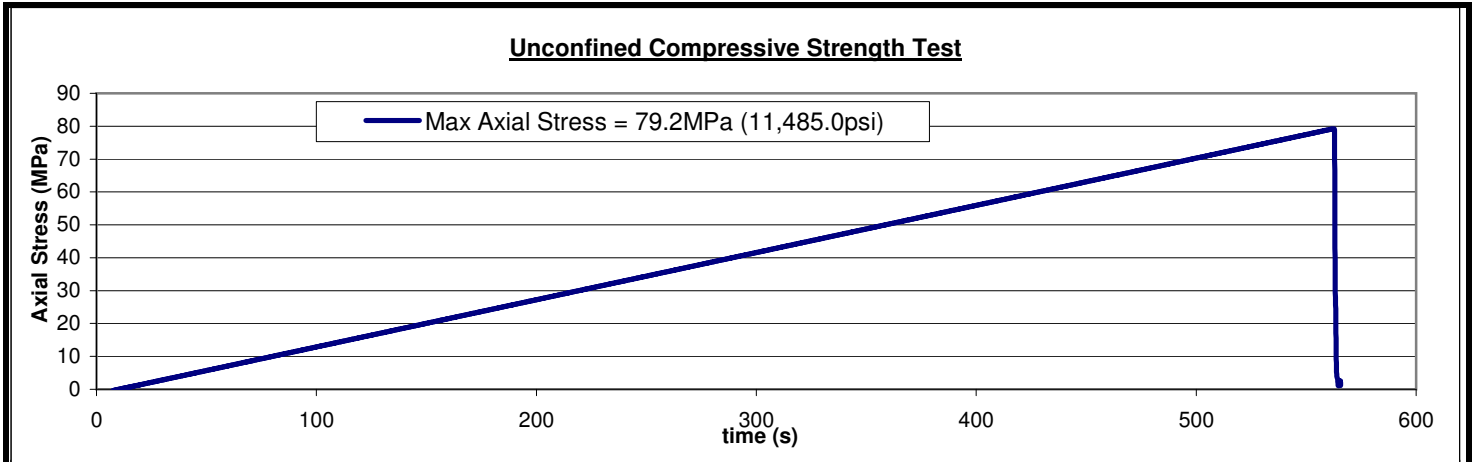
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.78	2901.4	133.49	2.2	227.8	78.5	11,384.3





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 04-2	
Depth (m):	22.56 - 22.86	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (GPa)	44.82	
Poisson Ratio, ν	0.28	
Failure Mode:	Shear	

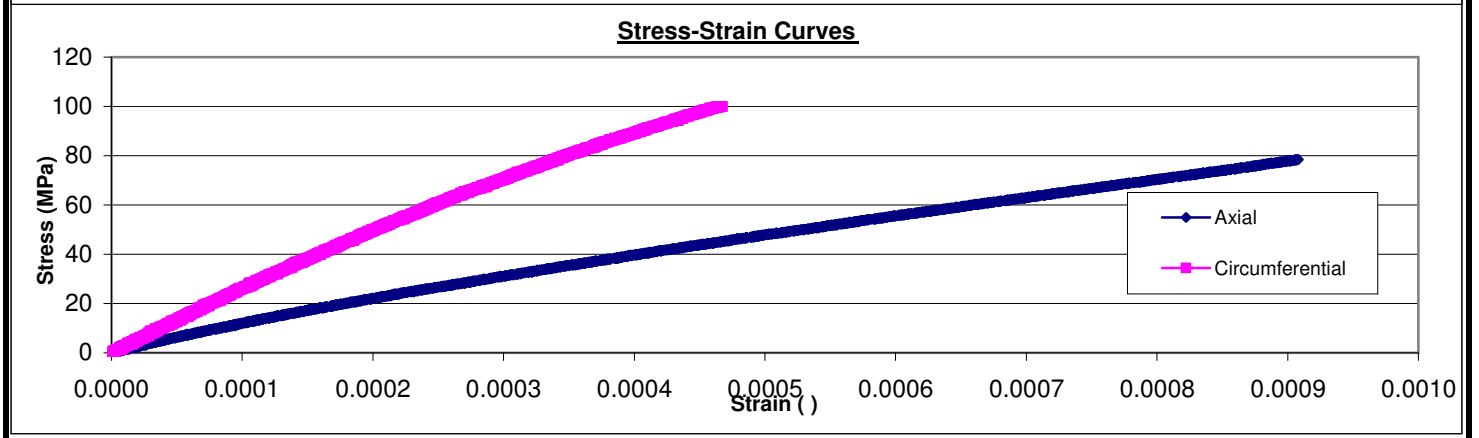
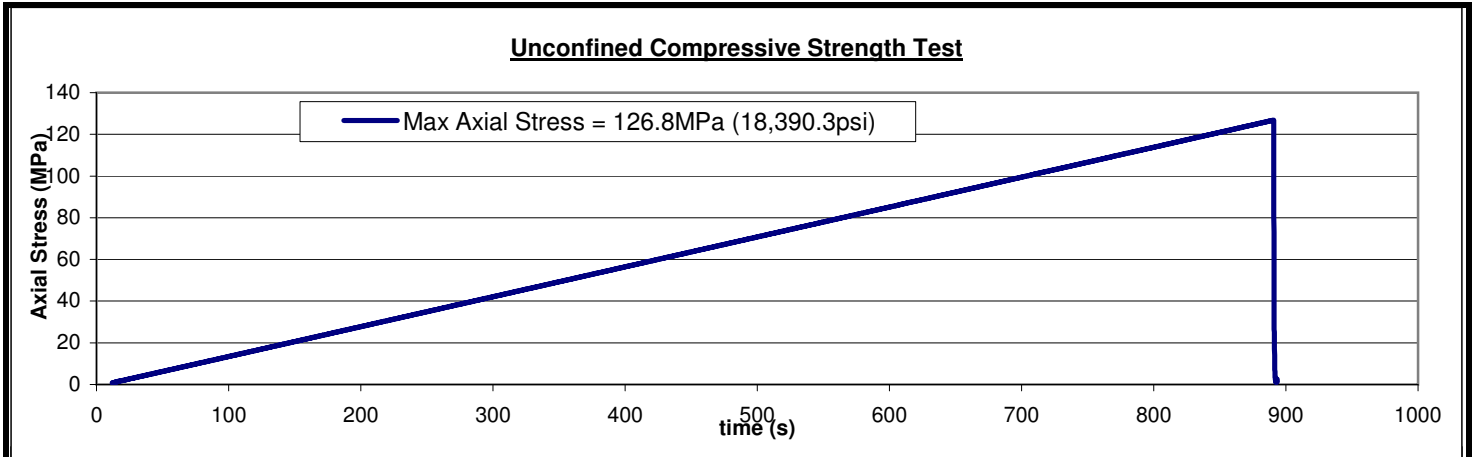
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.80	2903.3	135.44	2.2	230.0	79.2	11,485.0





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 04-3	
Depth (m):	32.00 - 32.20	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	88.32	
Poisson Ratio, ν	0.36	
Failure Mode:	Shear	

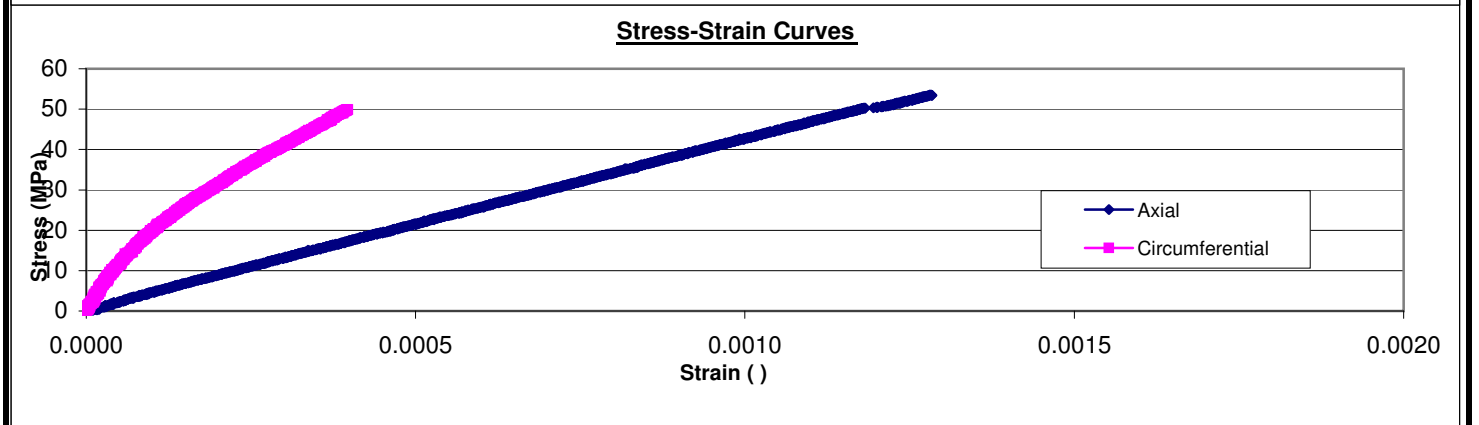
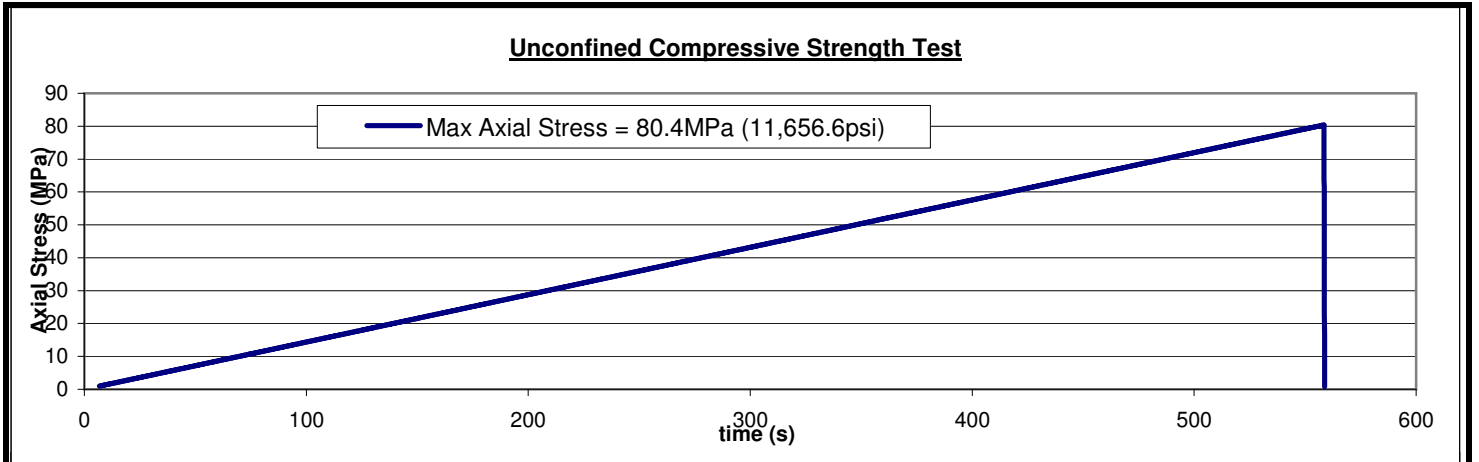
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.82	2905.2	132.74	2.2	368.5	126.8	18,390.3



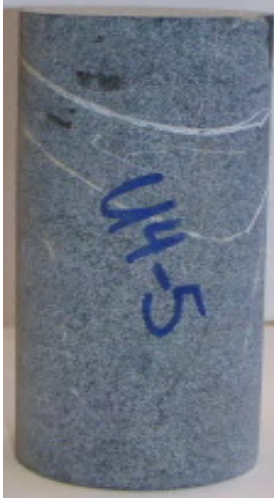

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	Before Test	After Test
Sample #:	UCS 04-4		
Depth (m):	48.77 - 48.97		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	42.11		
Poisson Ratio, ν	0.25		
Failure Mode:	Shear		

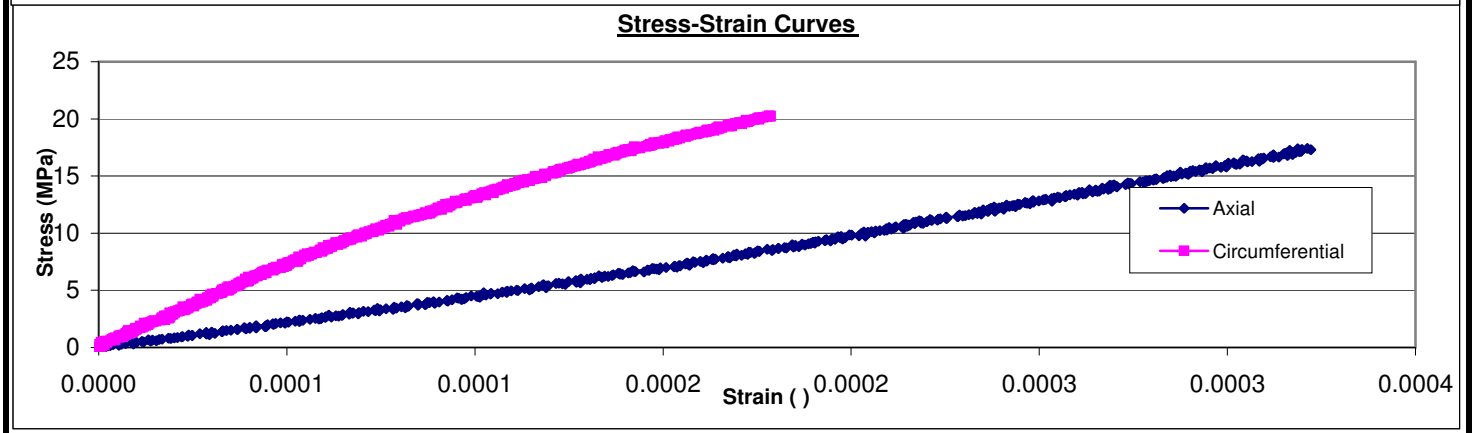
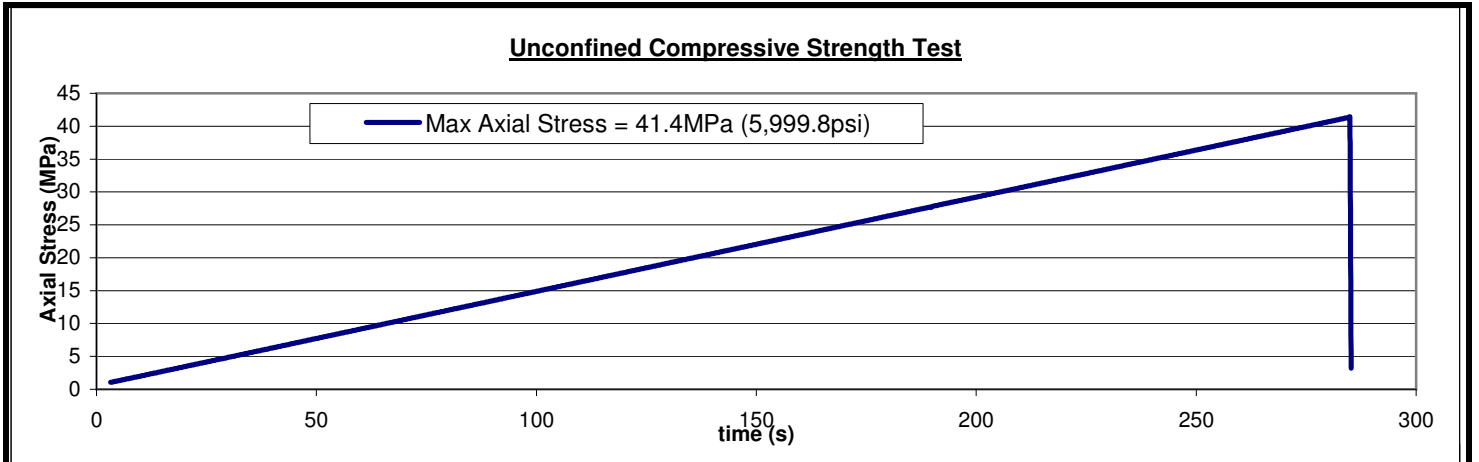
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.70	2893.8	131.68	2.2	232.6	80.4	11,656.6





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	Before Test 	After Test 
Sample #:	UCS 04-5		
Depth (m):	56.69 - 56.92		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	54.70		
Poisson Ratio, ν	0.42		
Failure Mode:	Shear		

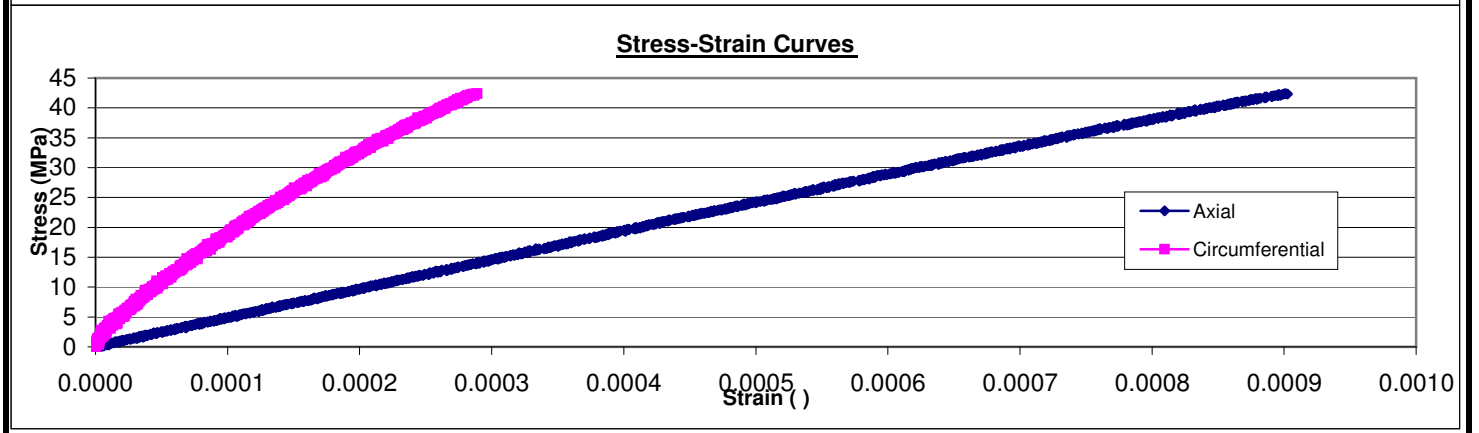
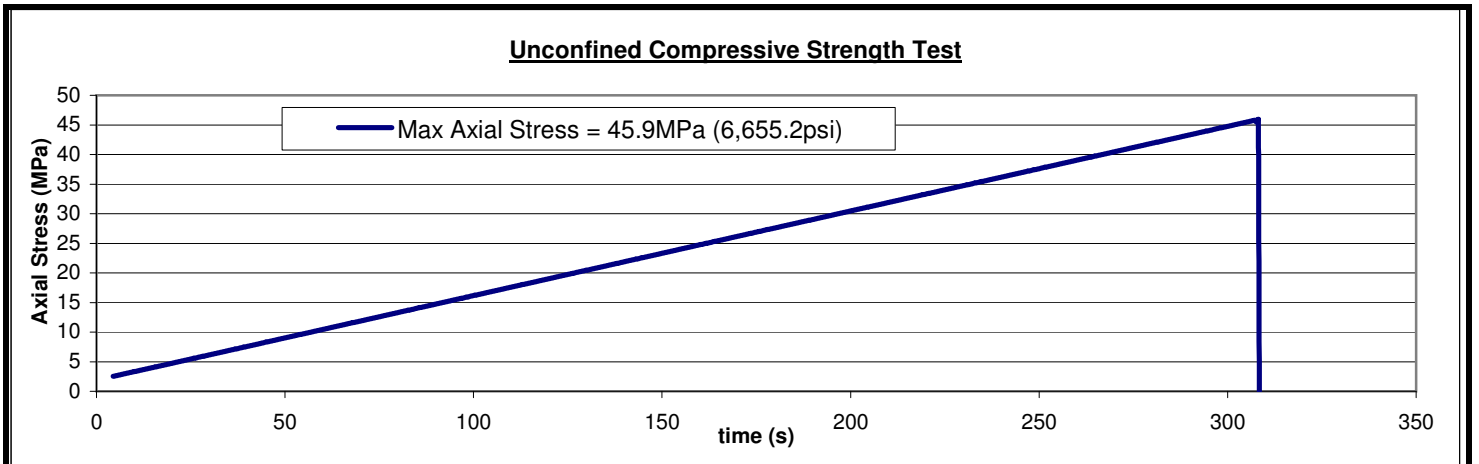
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.86	2909.1	131.17	2.2	120.4	41.4	5,999.8





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 04-7	
Depth (m):	70.41 - 70.70	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	48.24	
Poisson Ratio, ν	0.33	
Failure Mode:	Shear	

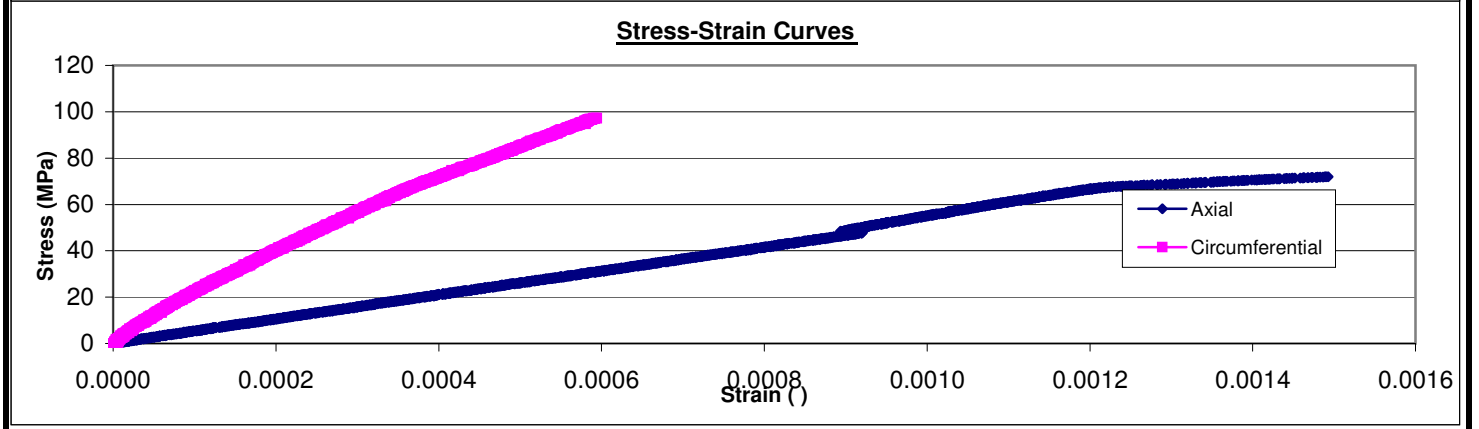
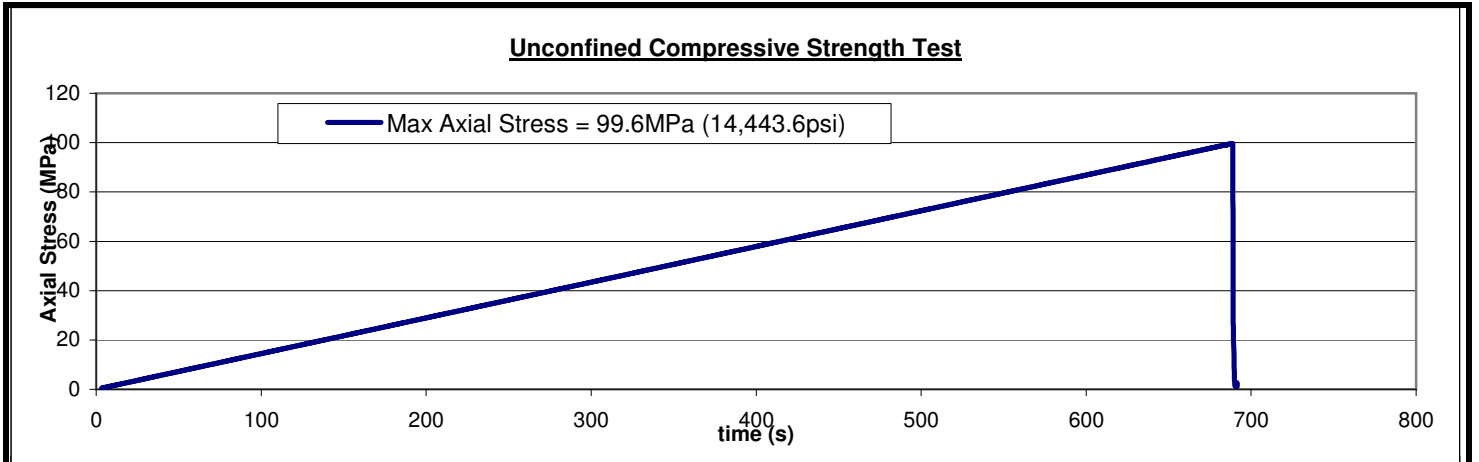
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.92	2914.8	133.88	2.2	133.8	45.9	6,655.2



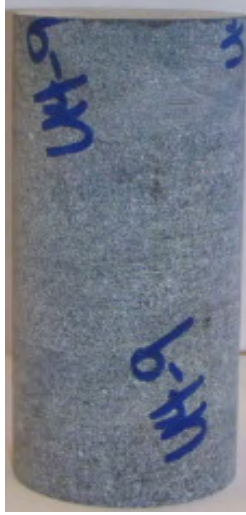

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 04-8	
Depth (m):	88.39 - 88.70	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (GPa)	51.31	
Poisson Ratio, ν	0.29	
Failure Mode:	Shear	

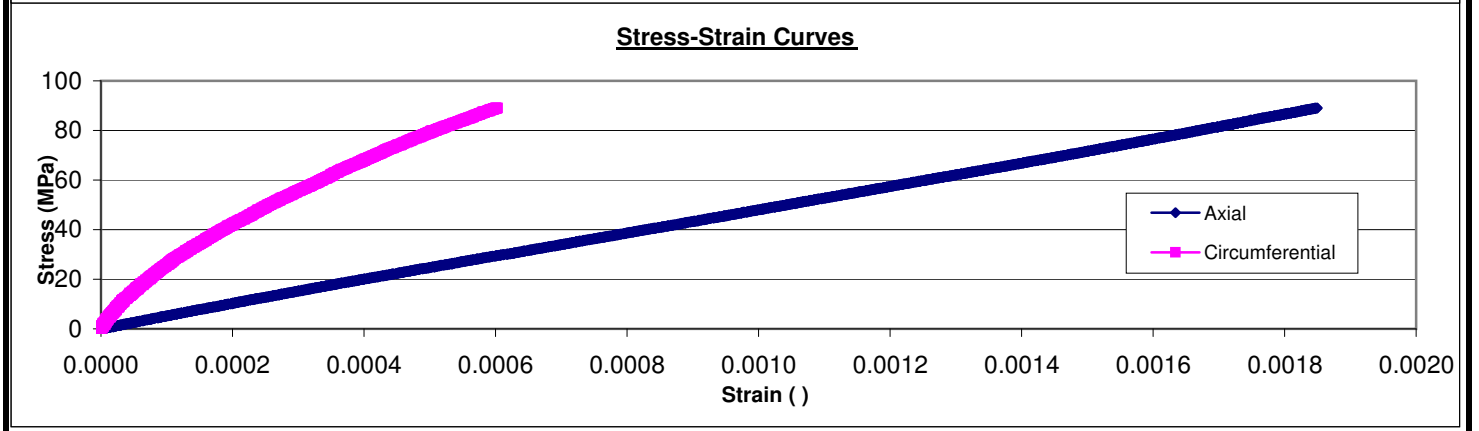
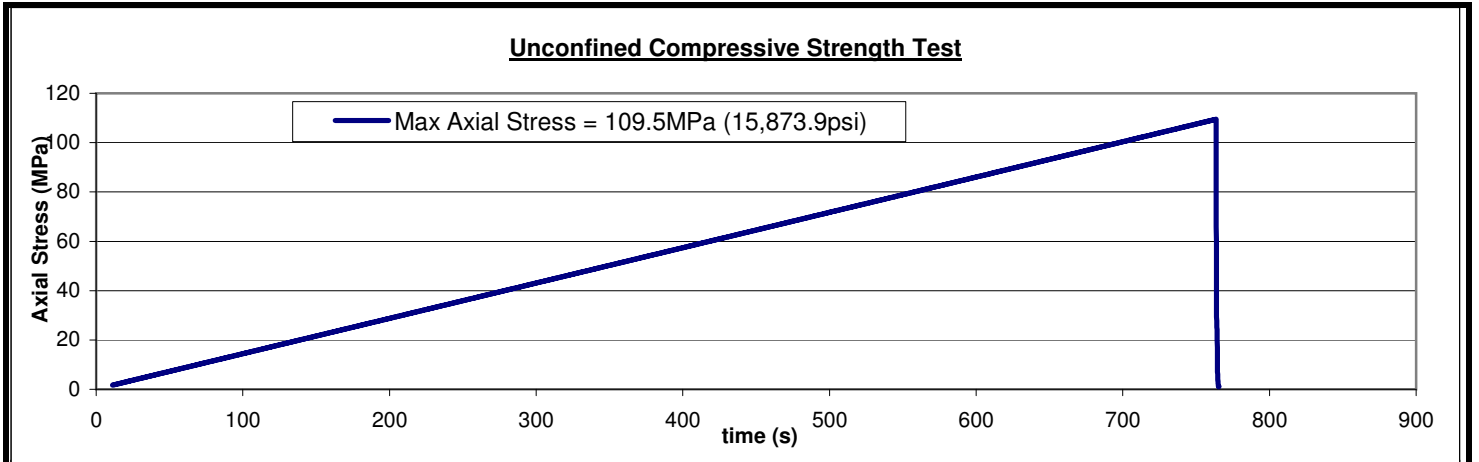
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.54	2878.6	131.71	2.2	286.7	99.6	14,443.6





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-04GT		
Sample #:	UCS 04-9		
Depth (m):	97.84 - 98.04		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	46.35		
Poisson Ratio, ν	0.27		
Failure Mode:	Shear		

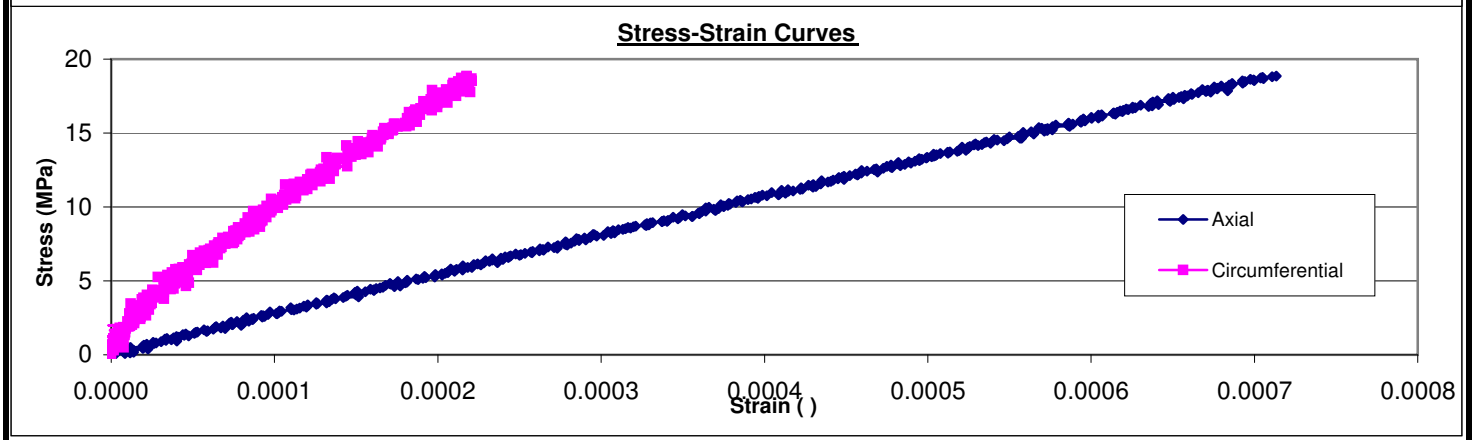
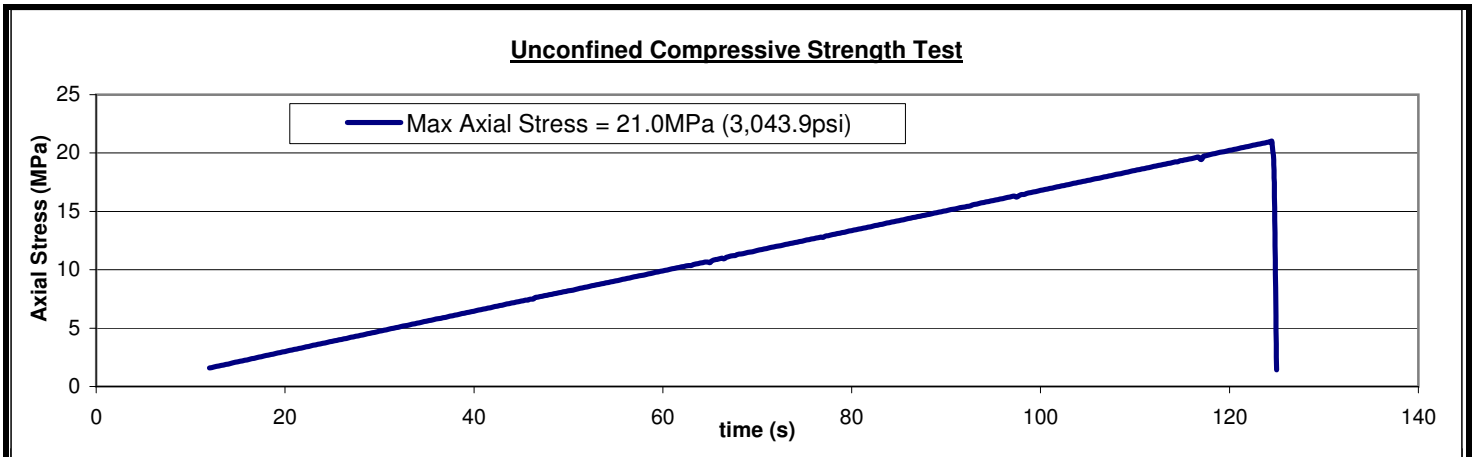
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.86	2909.1	133.23	2.2	318.5	109.5	15,873.9



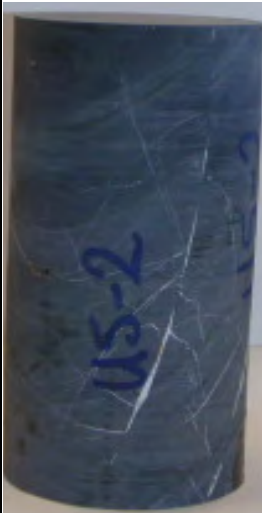

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-05GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 05-1	
Depth (m):	24.69 - 24.93	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	26.11	
Poisson Ratio, ν	0.33	
Failure Mode:	Shear	

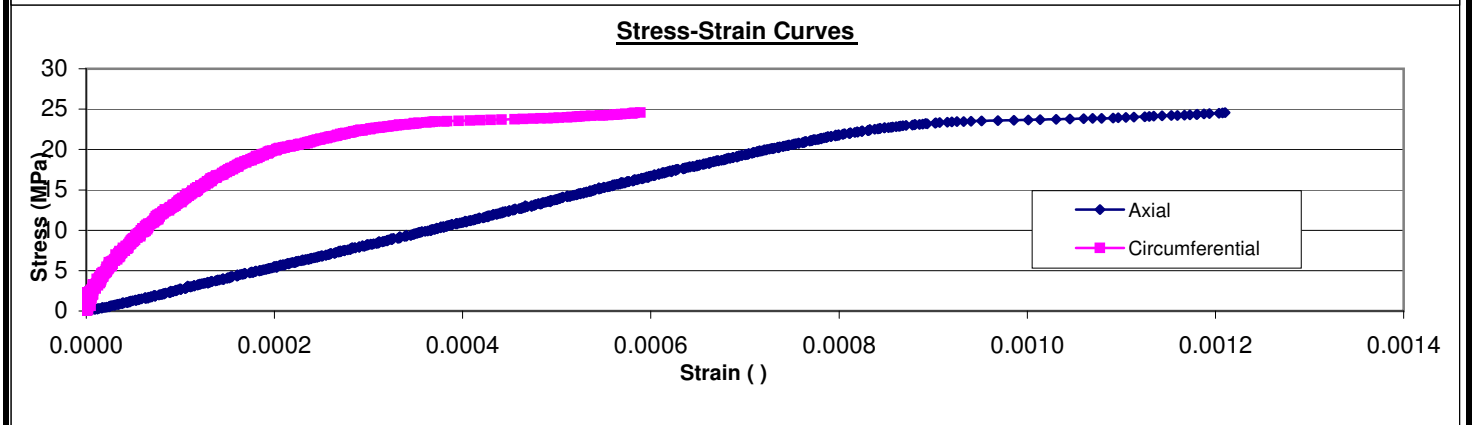
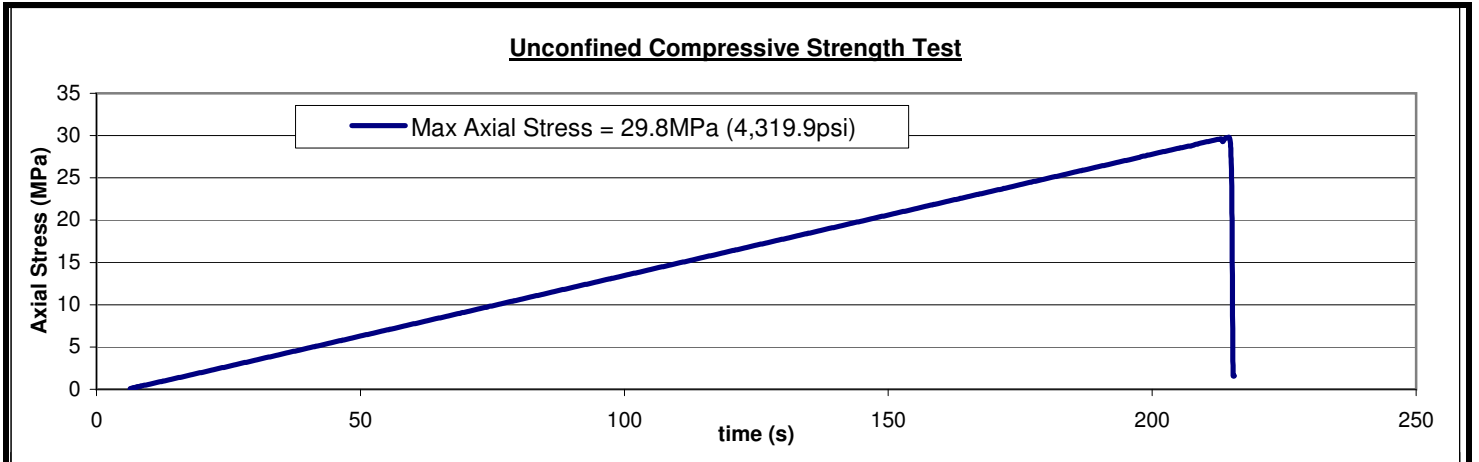
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.83	2906.2	128.47	2.1	61.0	21.0	3,043.9



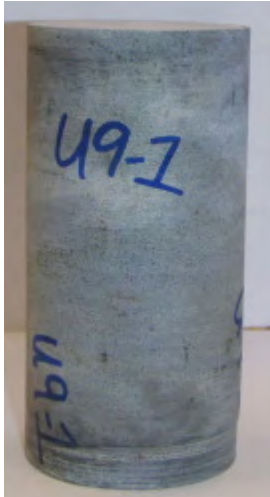

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-05GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 05-2	
Depth (m):	28.65 - 28.83	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	27.96	
Poisson Ratio, ν	0.27	
Failure Mode:	Shear	

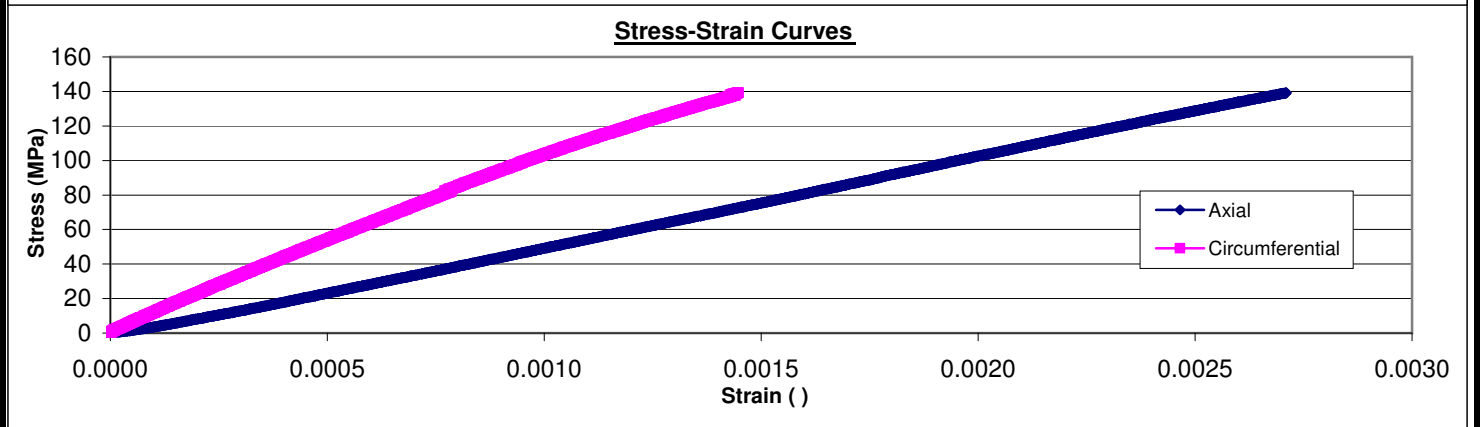
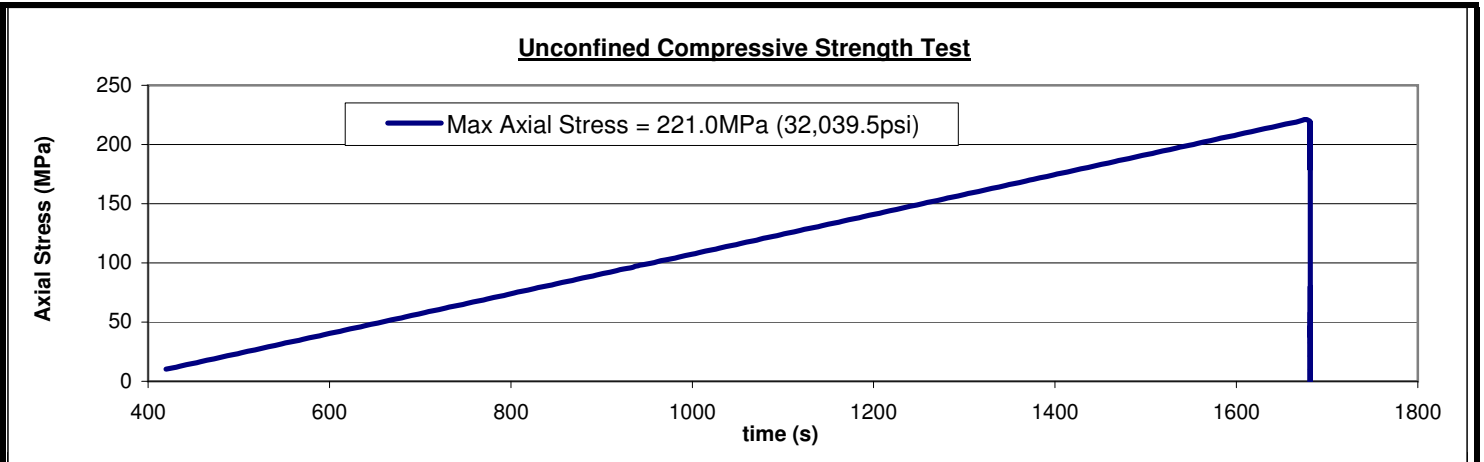
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.86	2909.1	129.58	2.1	86.7	29.8	4,319.9



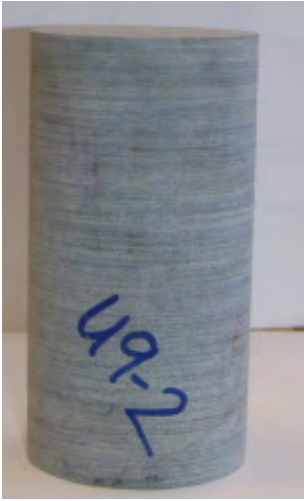

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-09GT	Before Test 	After Test 
Sample #:	UCS 09-1		
Depth (m):	21.34 - 21.54		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	52.27		
Poisson Ratio, ν	0.44		
Failure Mode:	Explosive		

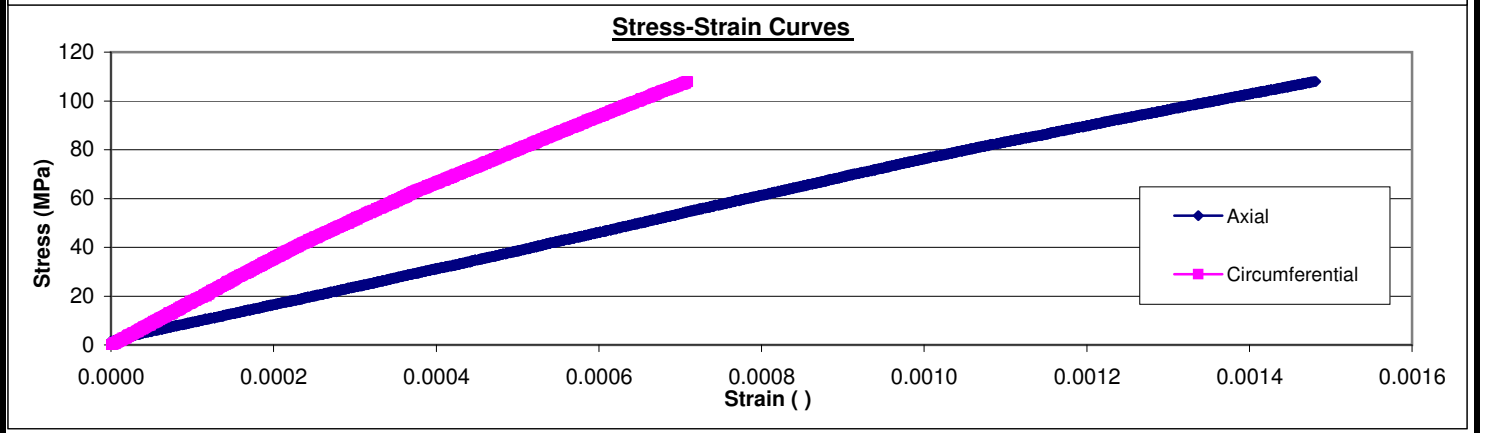
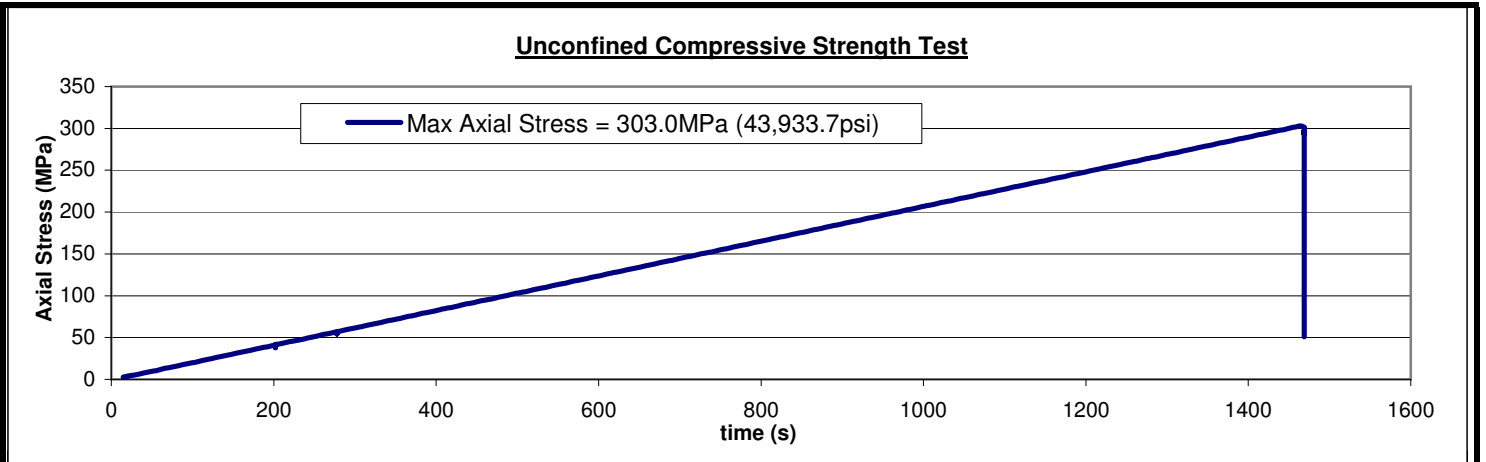
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.61	2885.2	130.93	2.16	637.5	221.0	32,039.5



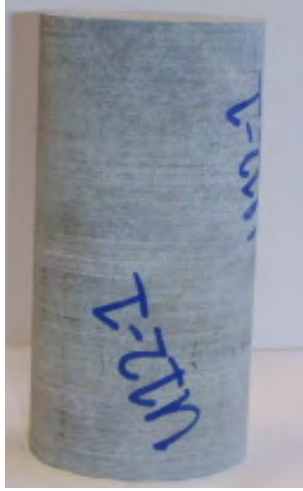

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-09GT	Before Test 	After Test 
Sample #:	UCS 09-2		
Depth (m):	12.50 - 12.90		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	74.65		
Poisson Ratio, ν	0.41		
Failure Mode:	Explosive/Shear		

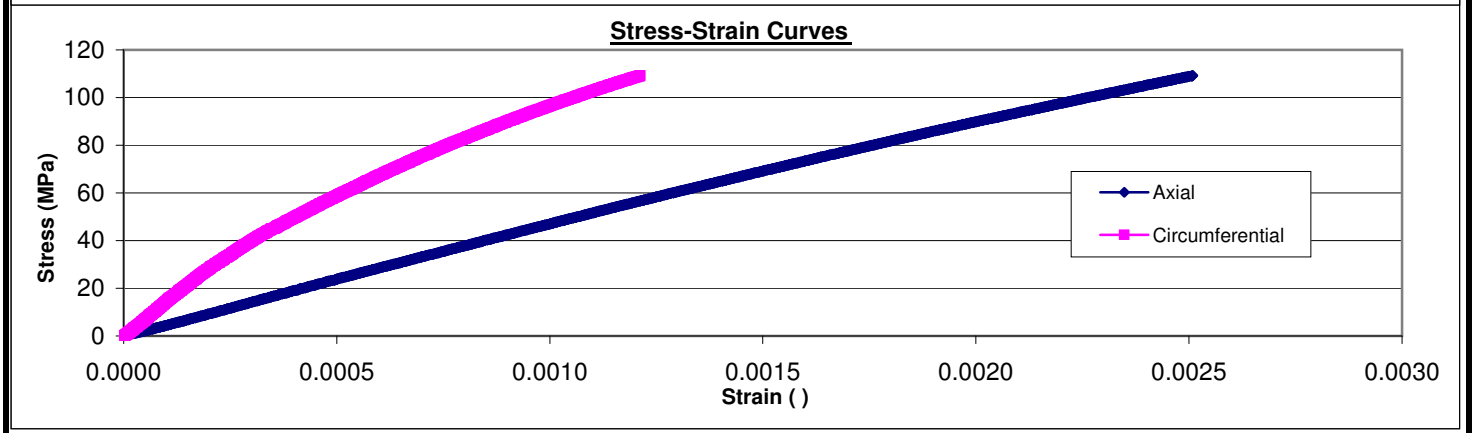
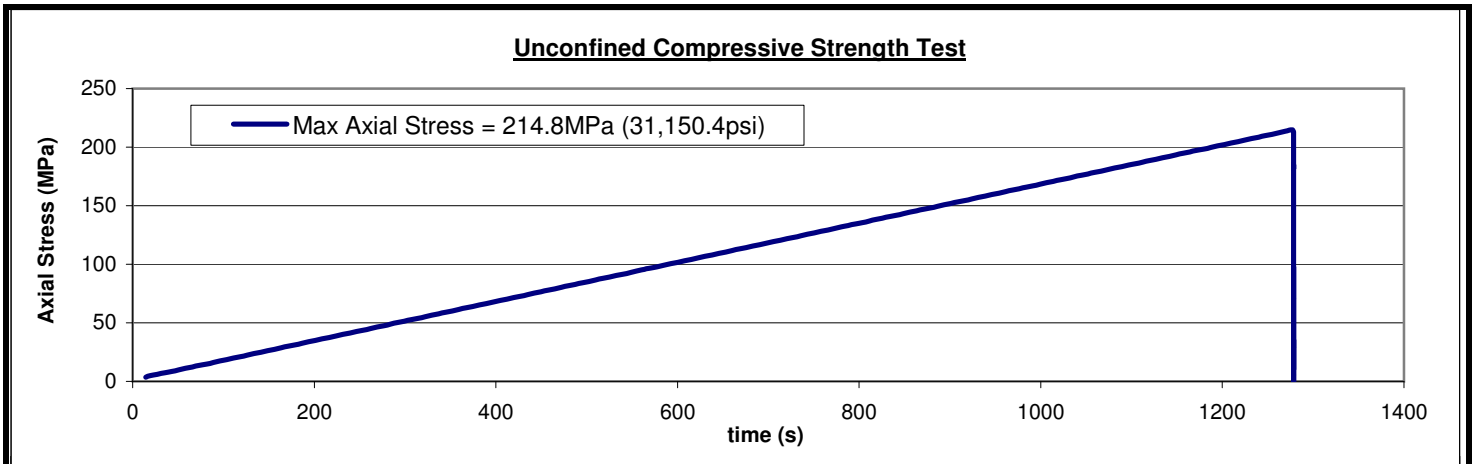
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.93	2915.8	126.01	2.07	883.4	303.0	43,933.7



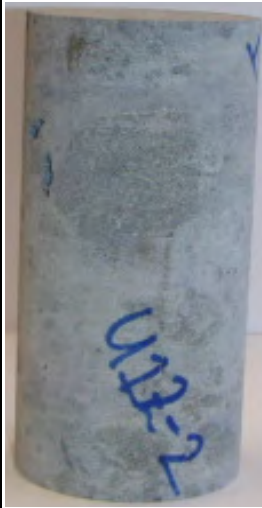

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-12GT	Before Test 	After Test 
Sample #:	UCS 12-1		
Depth (m):	3.35 - 3.65		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	43.66		
Poisson Ratio, ν	0.33		
Failure Mode:	Explosive		

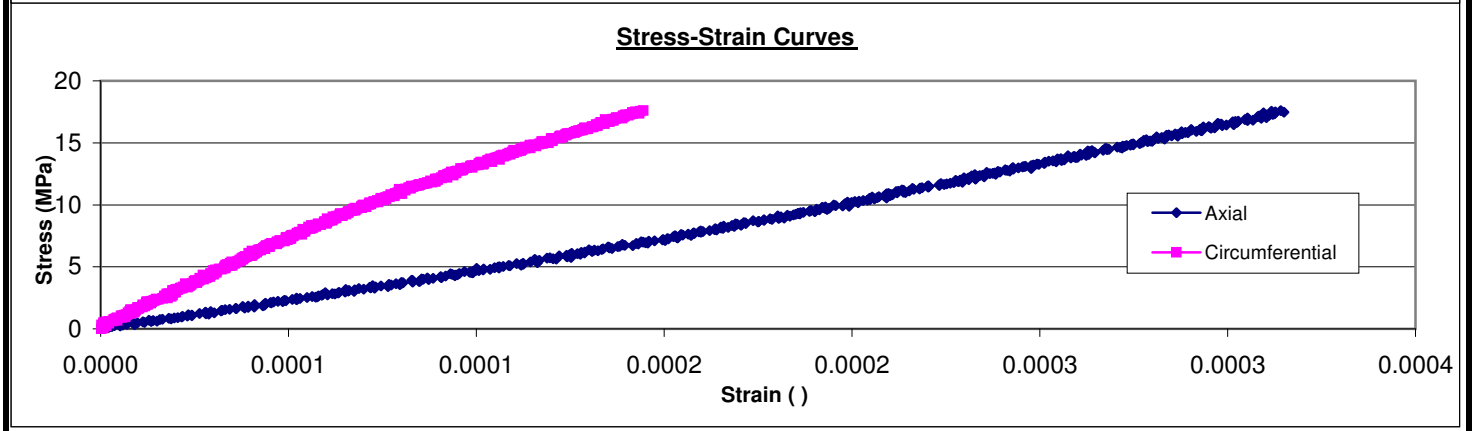
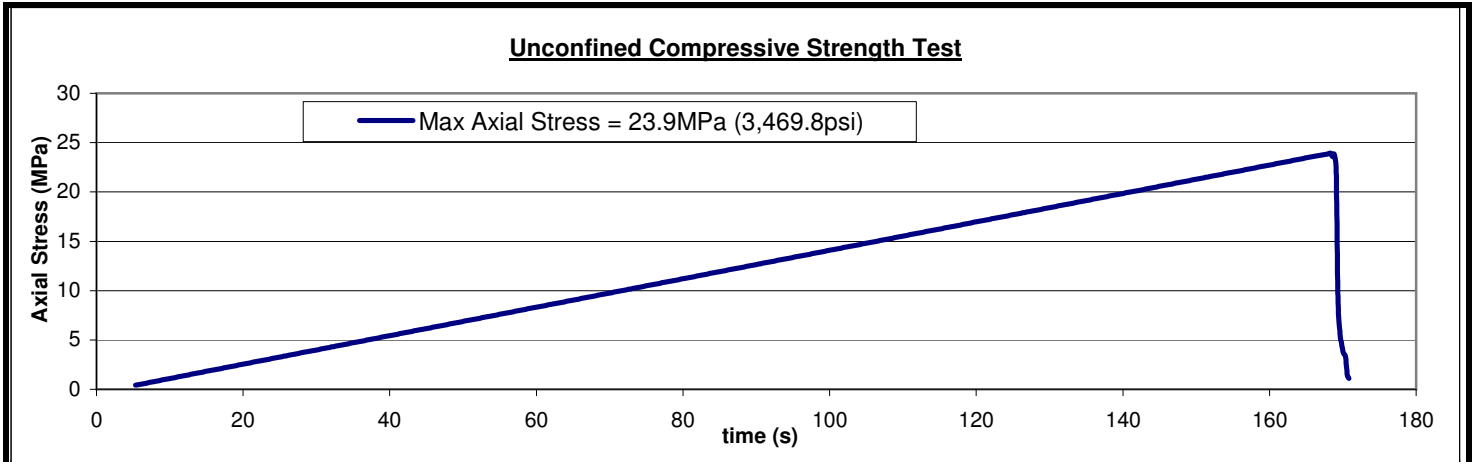
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.71	2894.7	129.81	2.14	621.9	214.8	31,150.4



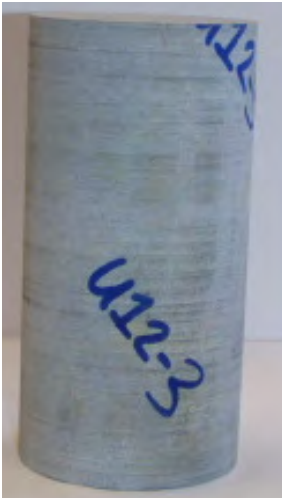

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-12GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 12-2	
Depth (m):	19.81 - 20.05	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	54.95	
Poisson Ratio, ν	0.41	
Failure Mode:	Shear	

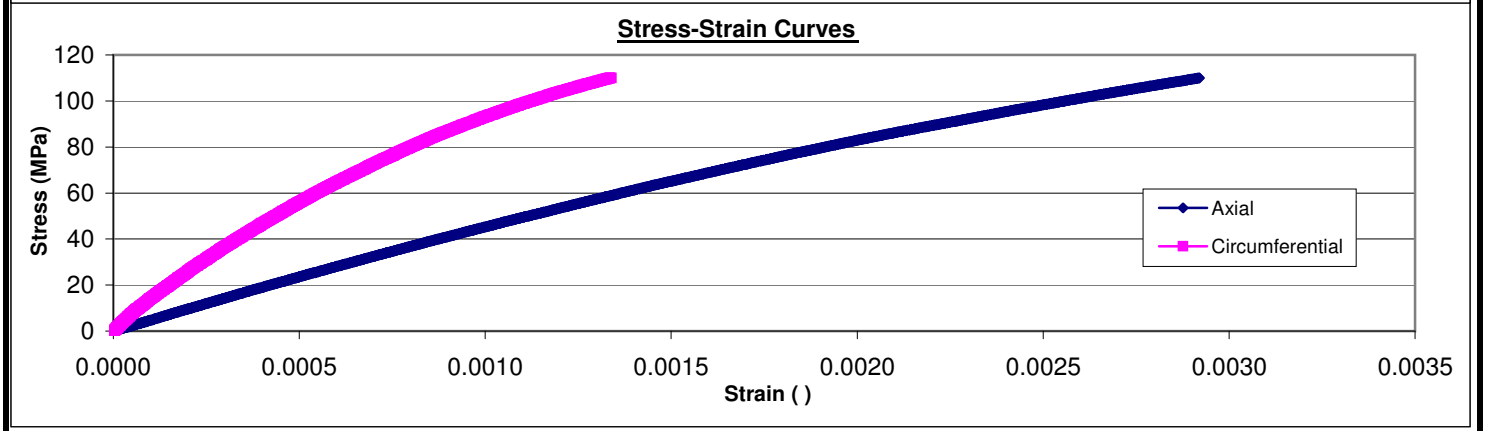
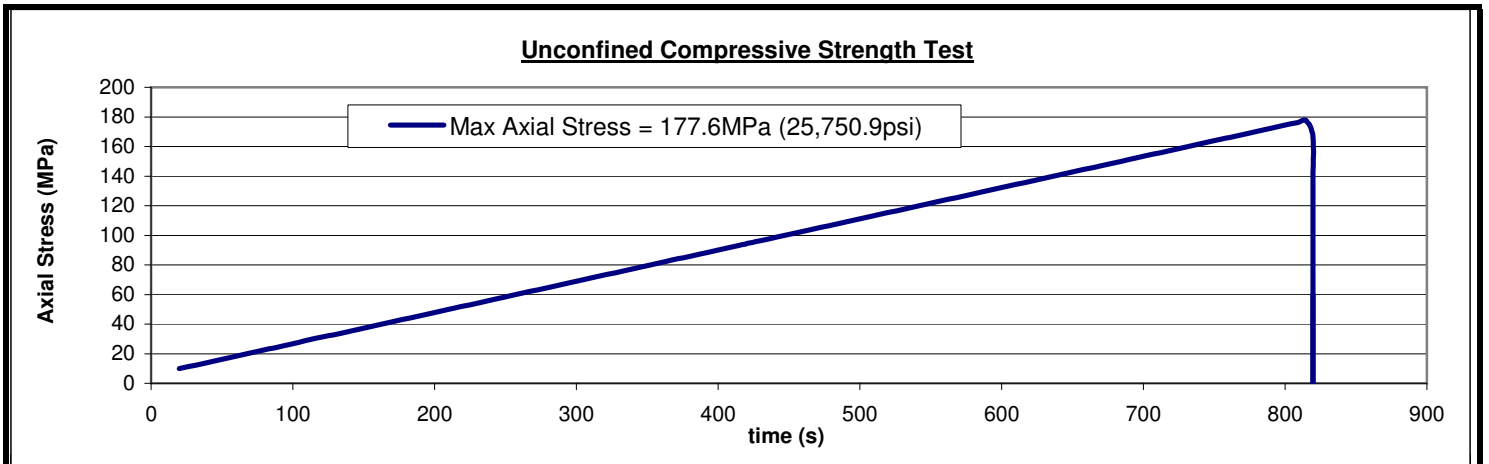
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.67	2890.9	130.61	2.2	69.2	23.9	3,469.8



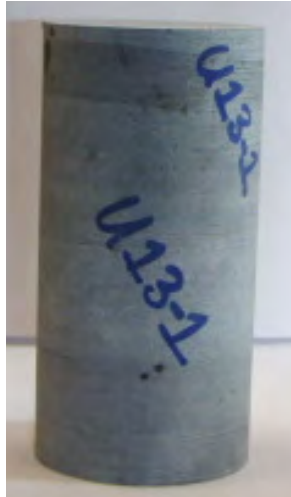

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-12GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 12-3	
Depth (m):	28.65 - 28.88	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	37.62	
Poisson Ratio, ν	0.33	
Failure Mode:	Explosive	

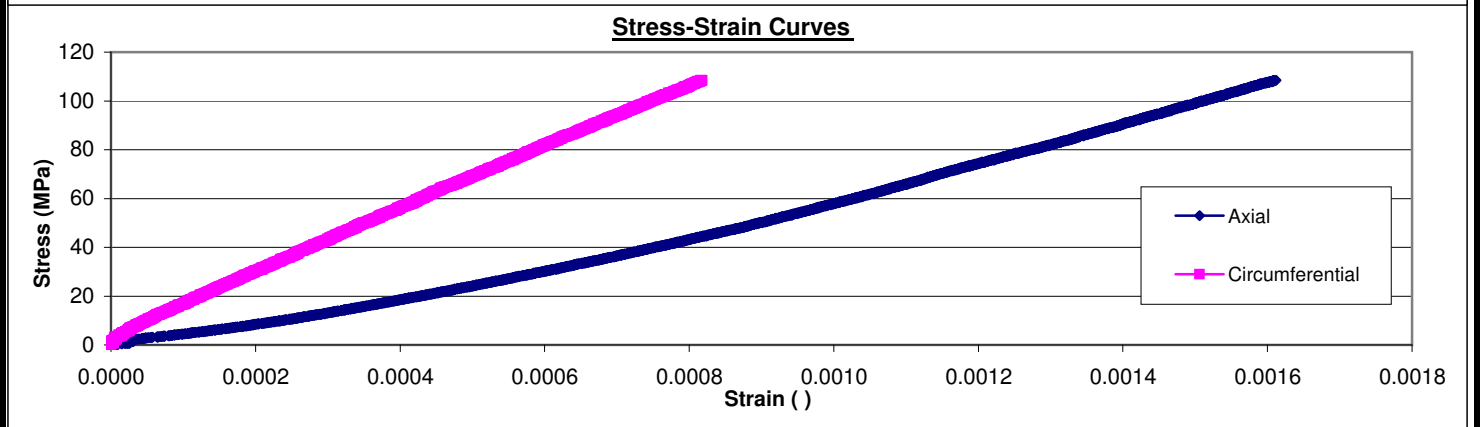
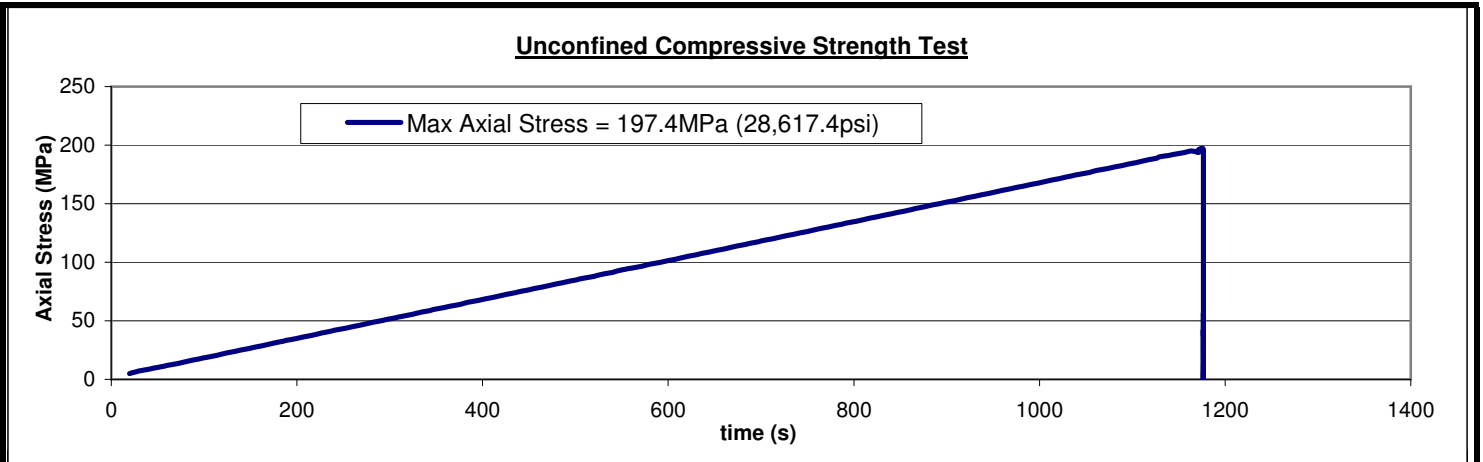
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.41	2866.2	129.99	2.15	509.0	177.6	25,750.9



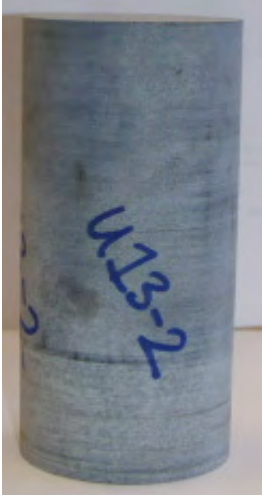

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-13GT	Before Test 	After Test 
Sample #:	UCS 13-1		
Depth (m):	3.35 - 3.53		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	50.08		
Poisson Ratio, ν	0.38		
Failure Mode:	Explosive/Shear		

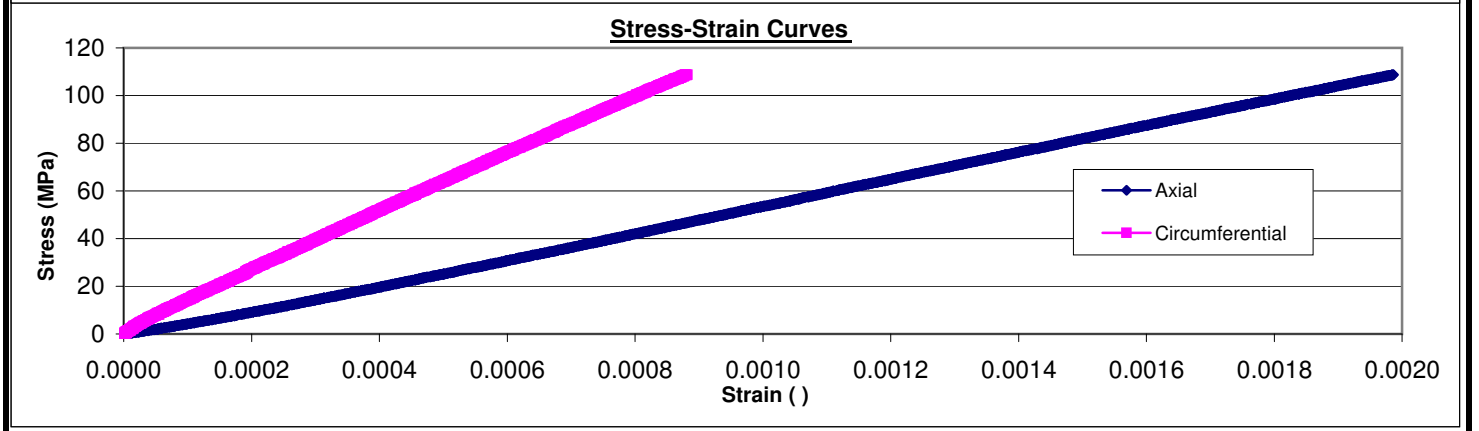
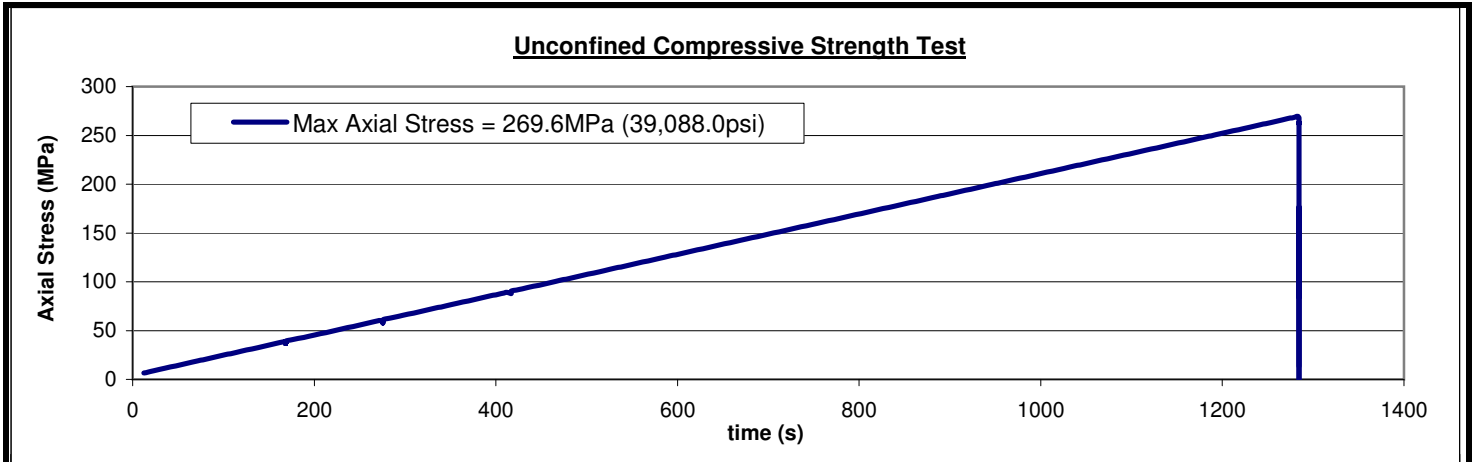
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.89	2911.9	131.32	2.16	574.7	197.4	28,617.4



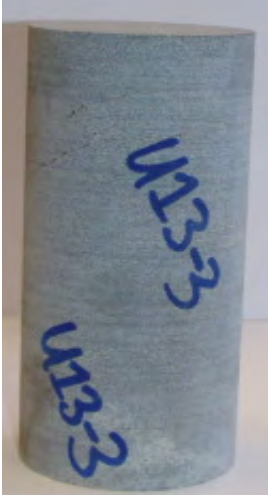

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-13GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 13-2	
Depth (m):	10.73 - 11.03	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	56.33	
Poisson Ratio, ν	0.44	
Failure Mode:	Explosive	

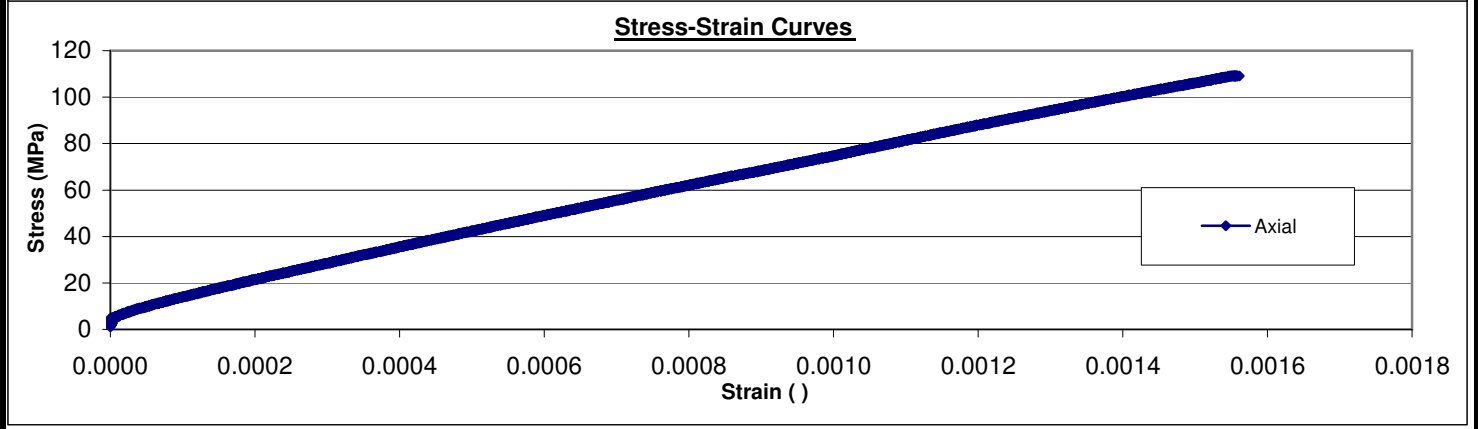
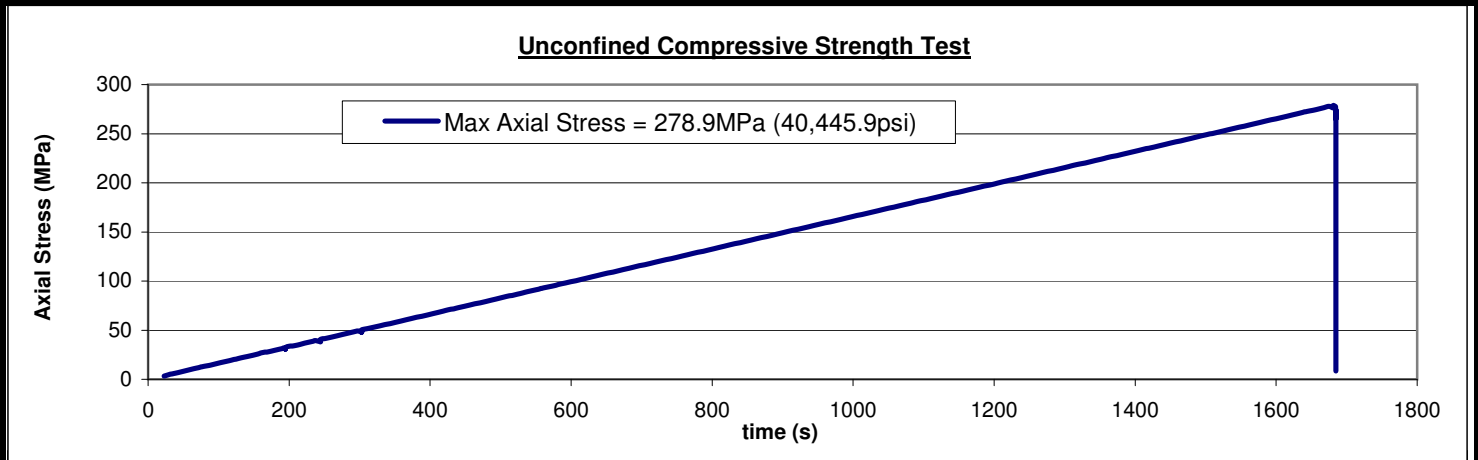
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
61.02	2924.4	133.02	2.18	788.3	269.6	39,088.0




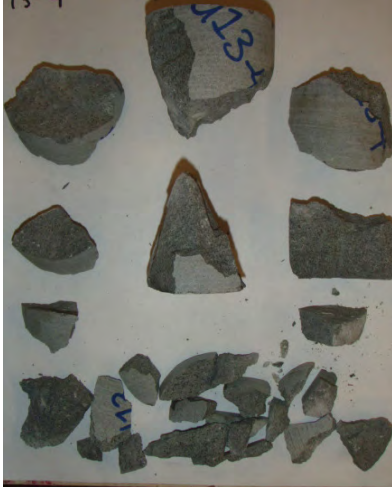
**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-13GT	Before Test 	After Test 
Sample #:	UCS 13-3		
Depth (m):	15.24 - 15.44		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	72.67		
Poisson Ratio, ν	N/A		
Failure Mode:	Explosive		

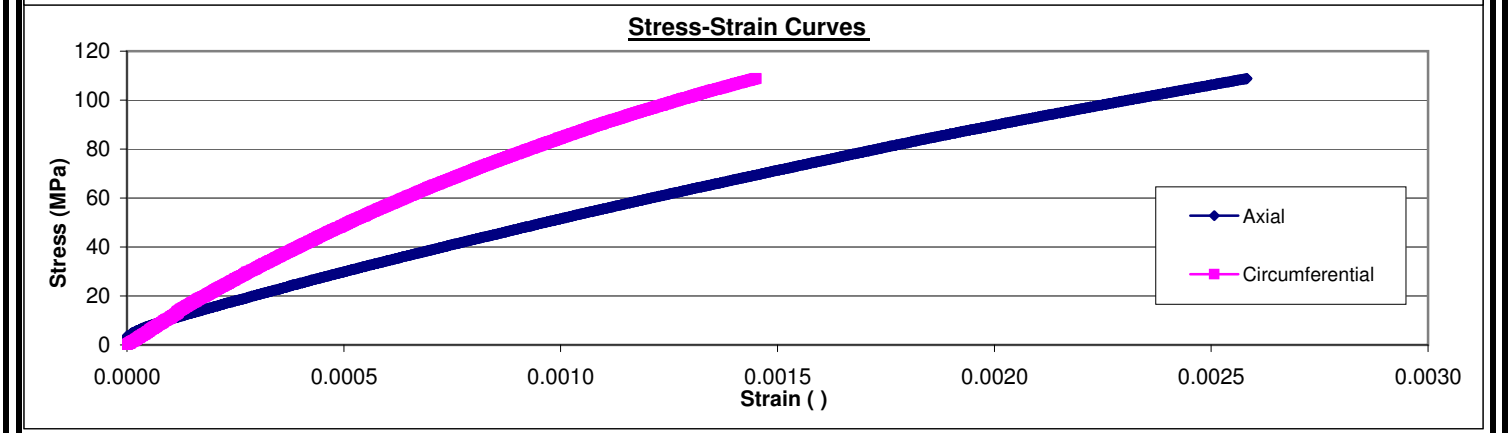
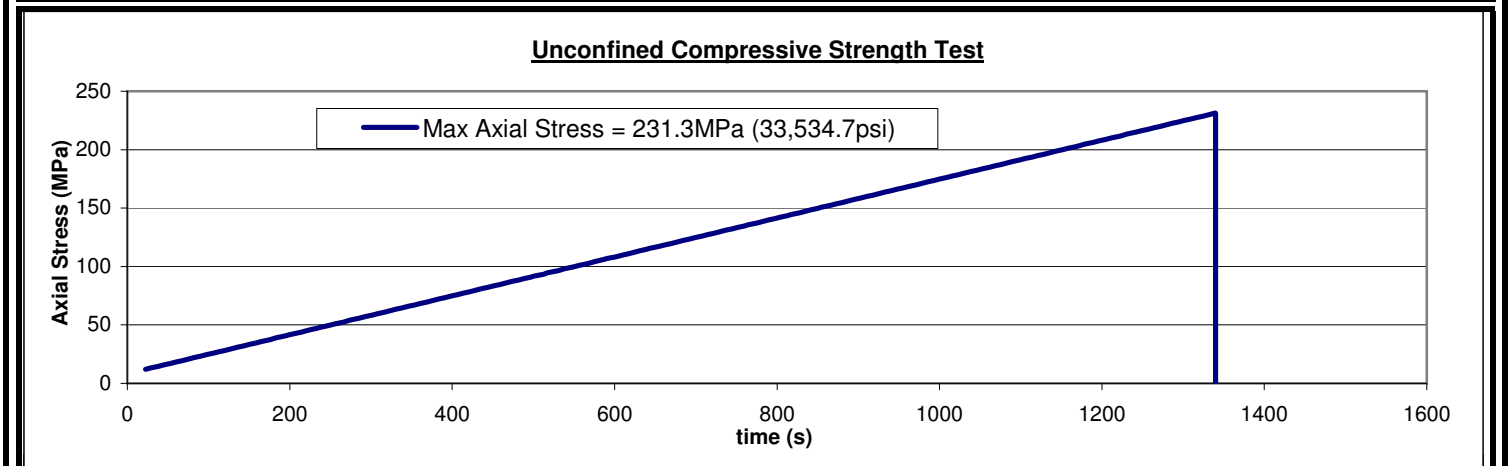
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.94	2916.7	129.16	2.12	813.6	278.9	40,445.9



**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-13GT	Before Test 	After Test 
Sample #:	UCS 13-4		
Depth (m):	22.86 - 23.10		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	39.59		
Poisson Ratio, ν	0.36		
Failure Mode:	Explosive/Shear		

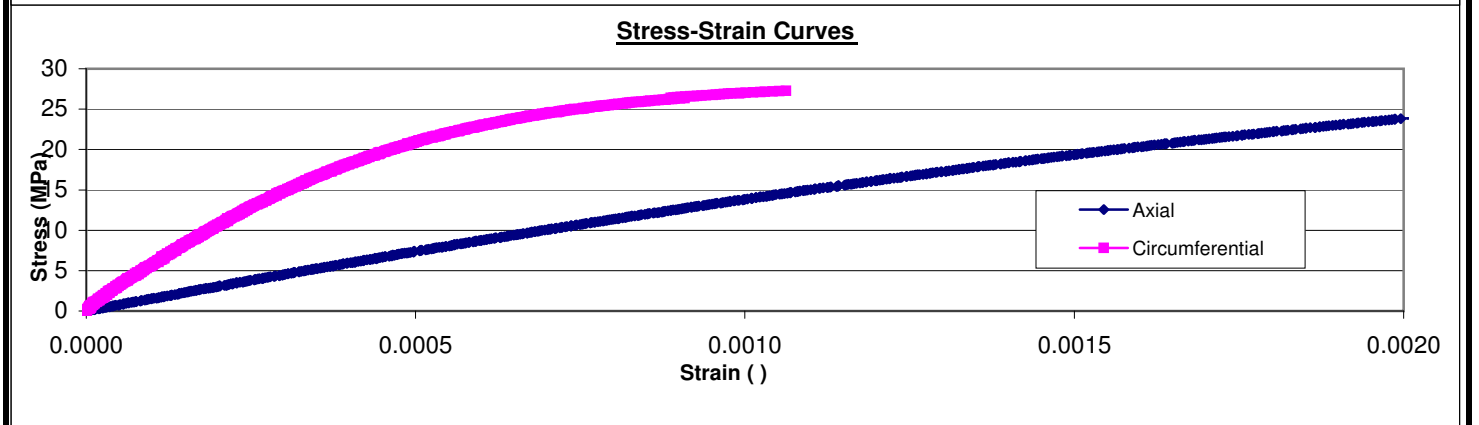
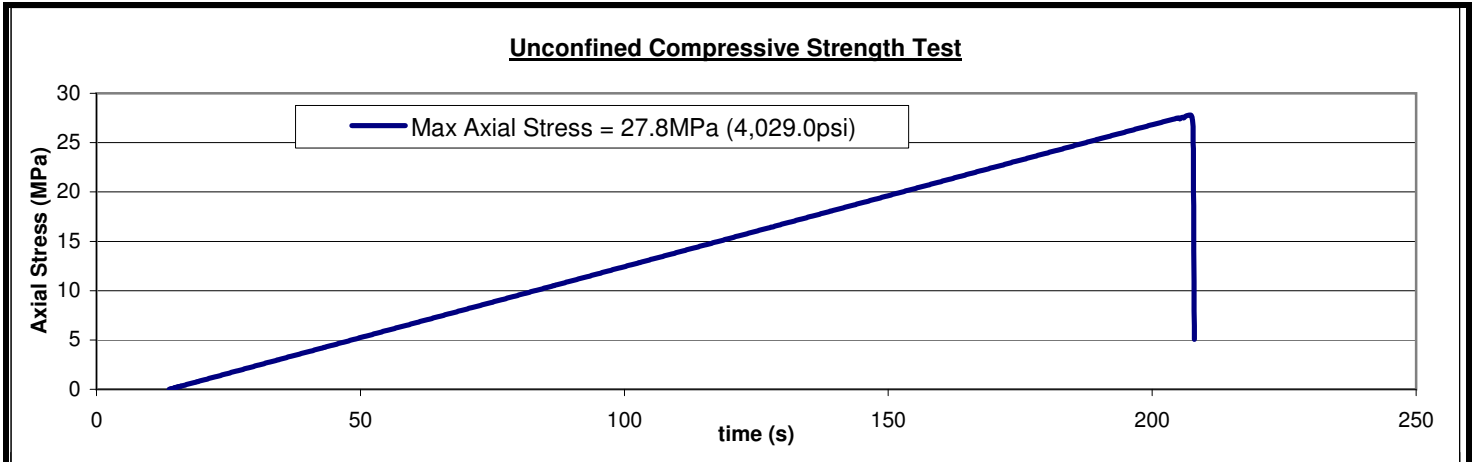
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.83	2906.2	130.55	2.15	672.1	231.3	33,534.7



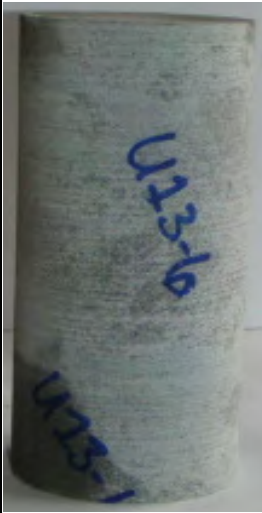

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-13GT	
Sample #:	UCS 13-5	
Depth (m):	31.70 - 31.90	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	13.09	
Poisson Ratio, ν	0.28	
Failure Mode:	Shear	

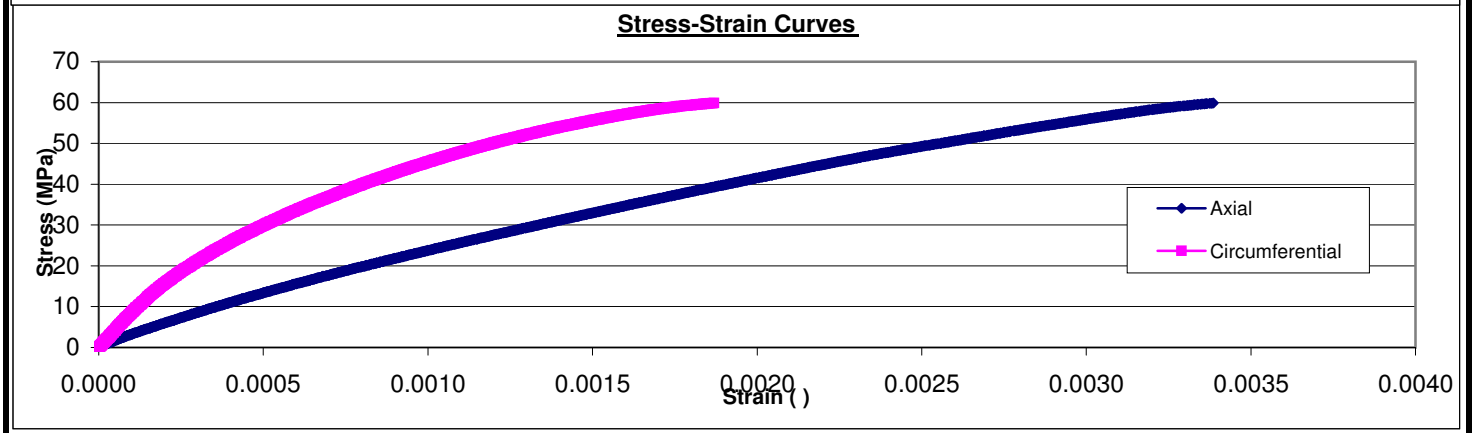
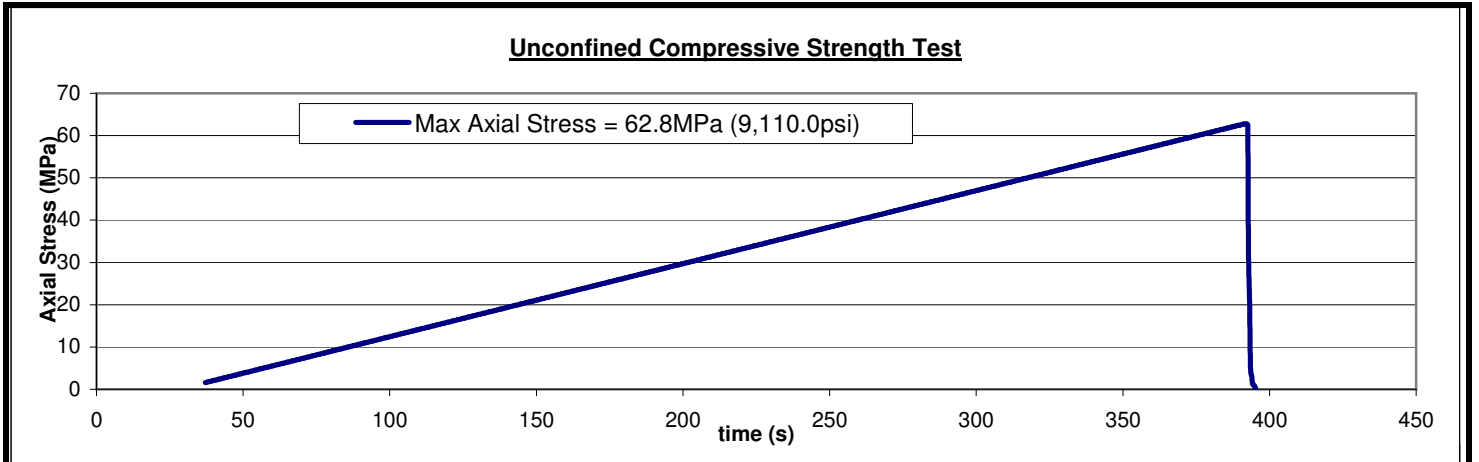
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.72	2895.7	131.06	2.2	80.5	27.8	4,029.0



**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

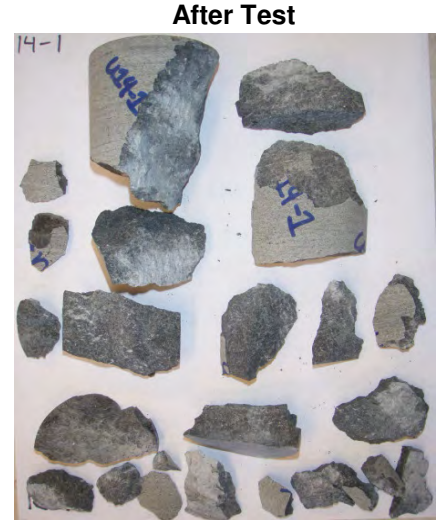
Borehole ID:	K10-13GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 13-6	
Depth (m):	39.38 - 39.69	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	22.15	
Poisson Ratio, ν	0.35	
Failure Mode:	Shear	

Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.71	2894.7	130.22	2.1	181.9	62.8	9,110.0

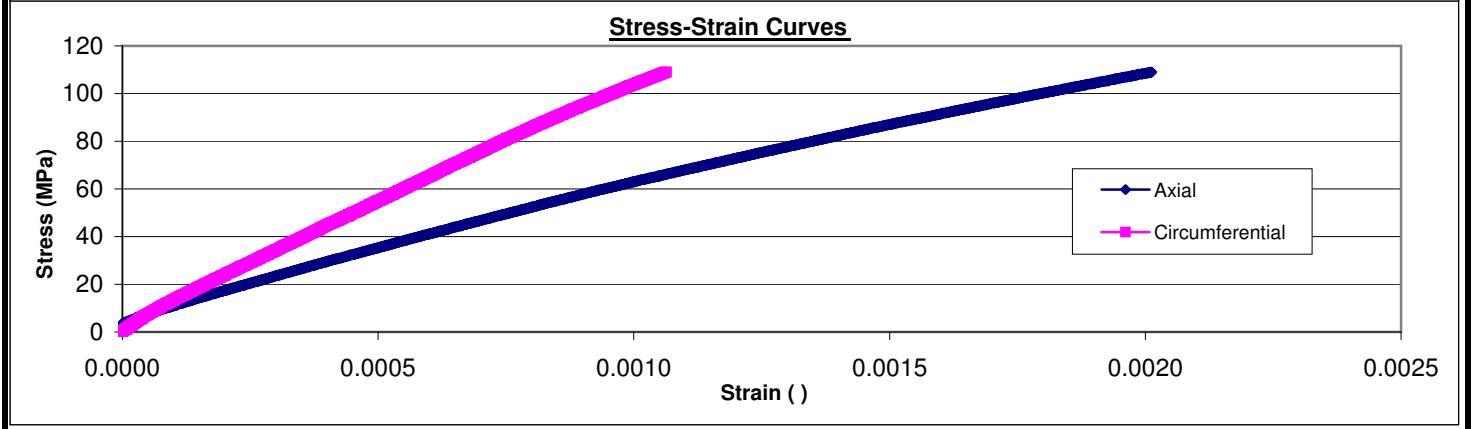
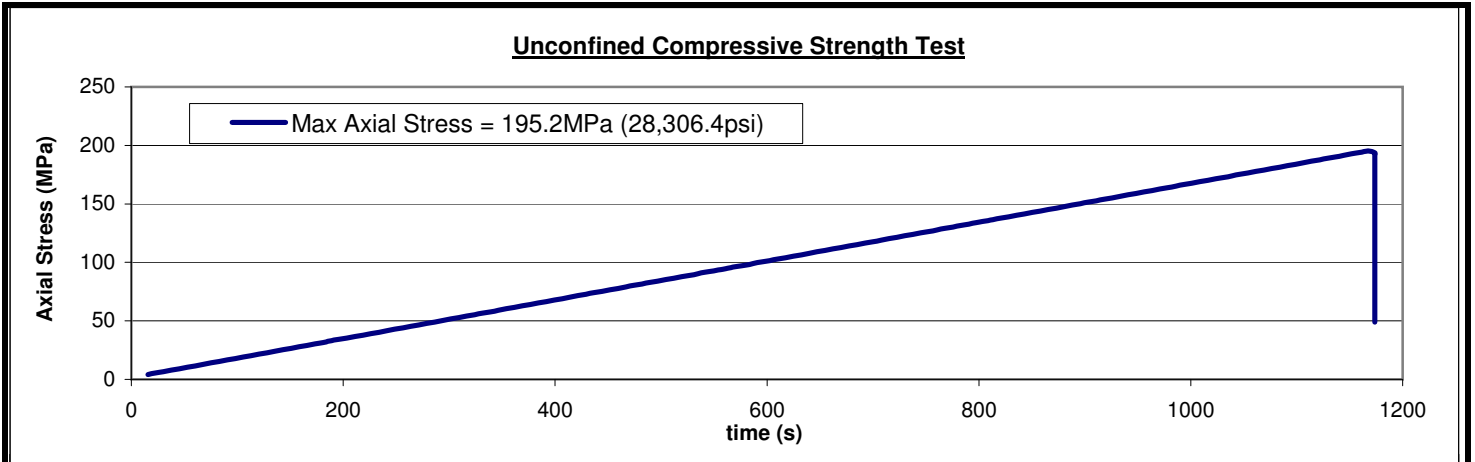


**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

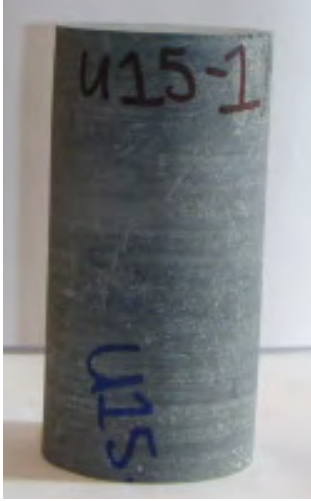

Borehole #:	K10-14GT
Sample #:	UCS 14-1
Depth (m):	3.08 - 3.26
Rock Type:	Trachyandesite
Test Date:	September, 2010
Young Modulus, E (Gpa)	47.86
Poisson Ratio, ν	0.42
Failure Mode:	Explosive



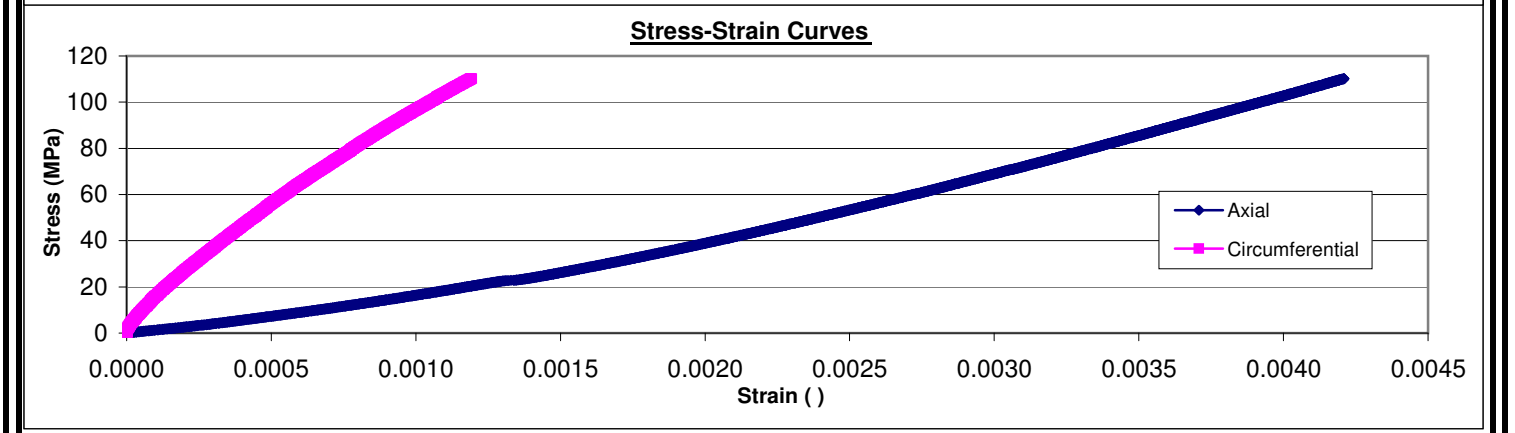
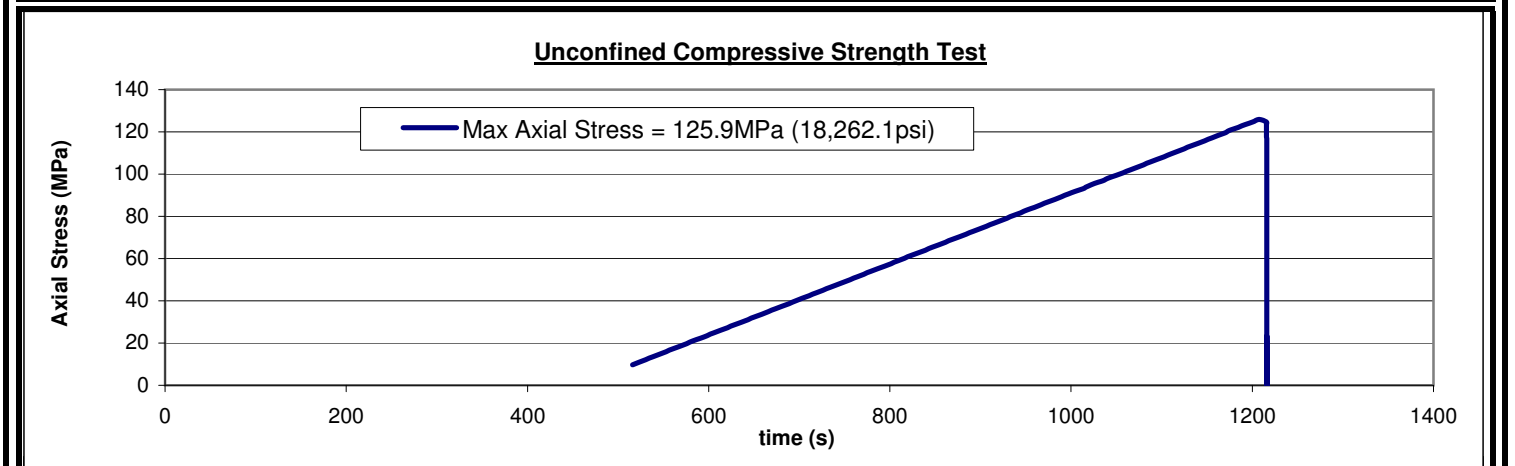
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.92	2914.8	130.64	2.14	569.0	195.2	28,306.4





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-15AGT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 15-1	
Depth (m):	2.16 - 2.38	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	30.89	
Poisson Ratio, ν	0.31	
Failure Mode:	Explosive	

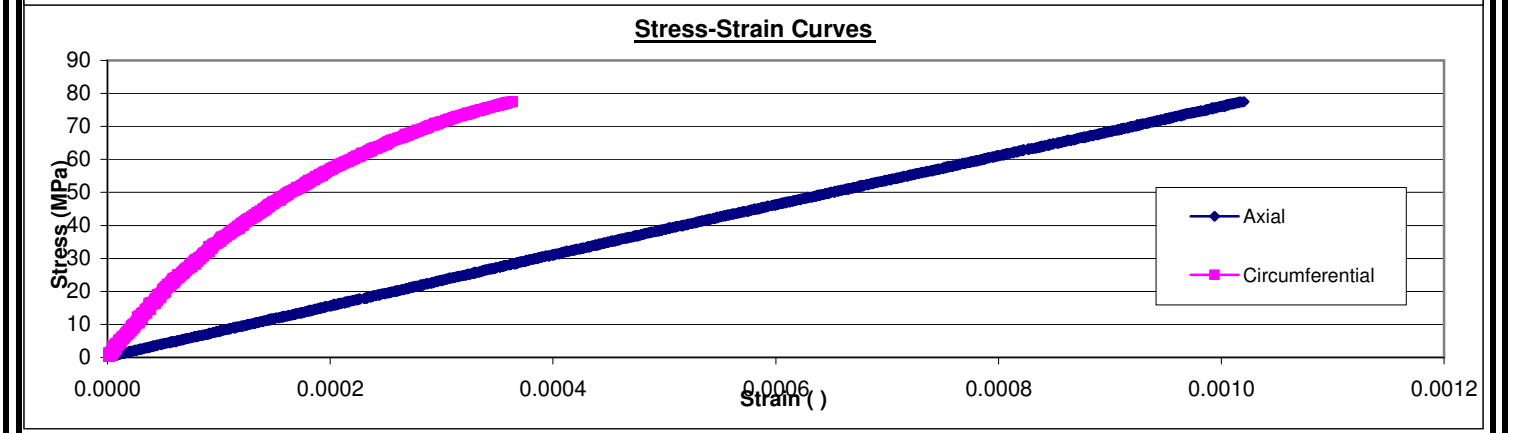
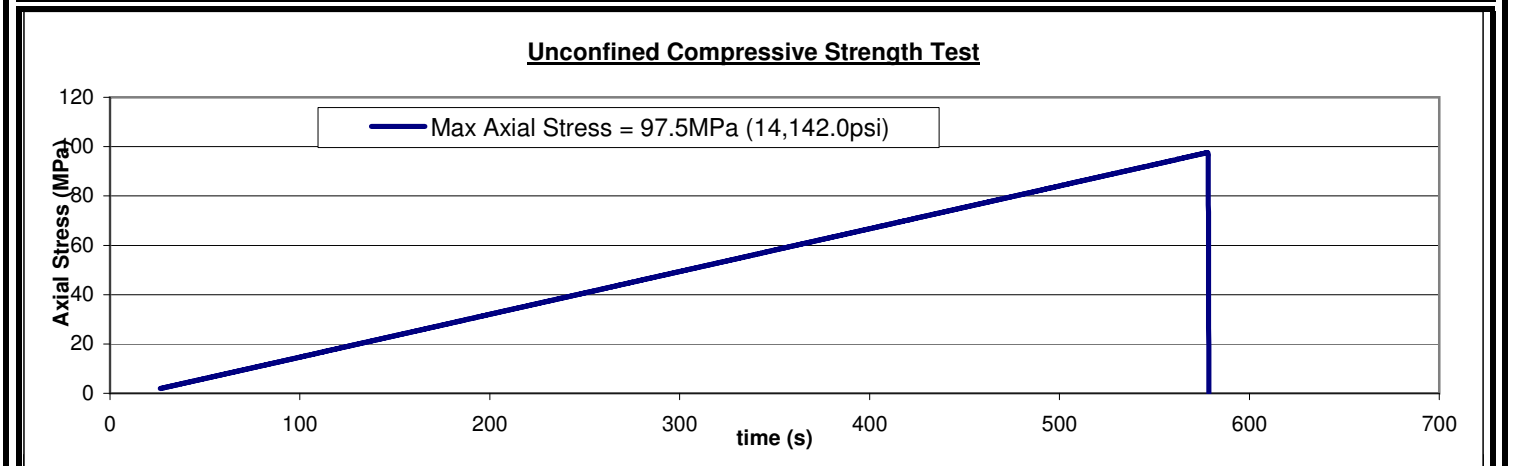
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.55	2879.5	130.10	2.15	362.7	125.9	18,262.1



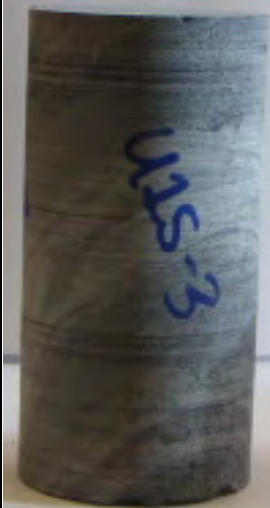

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-15AGT		
Sample #:	UCS 15-2		
Depth (m):	9.63 - 9.80		
Rock Type:	Greywacke / Argillite		
Test Date:	September, 2010		
Young Modulus, E (GPa)	76.72		
Poisson Ratio, ν	0.29		
Failure Mode:	Shear		

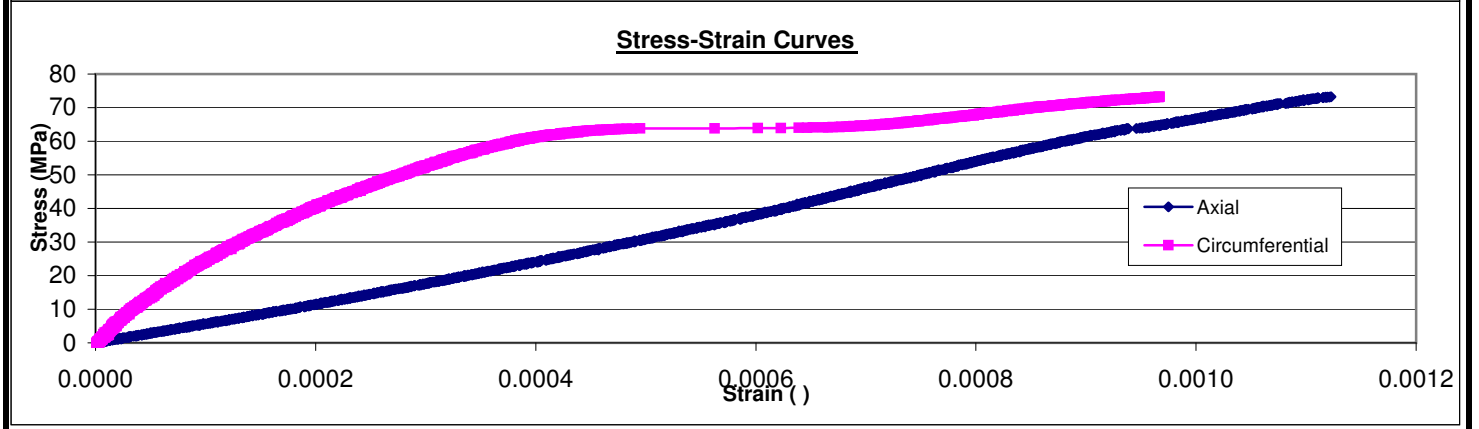
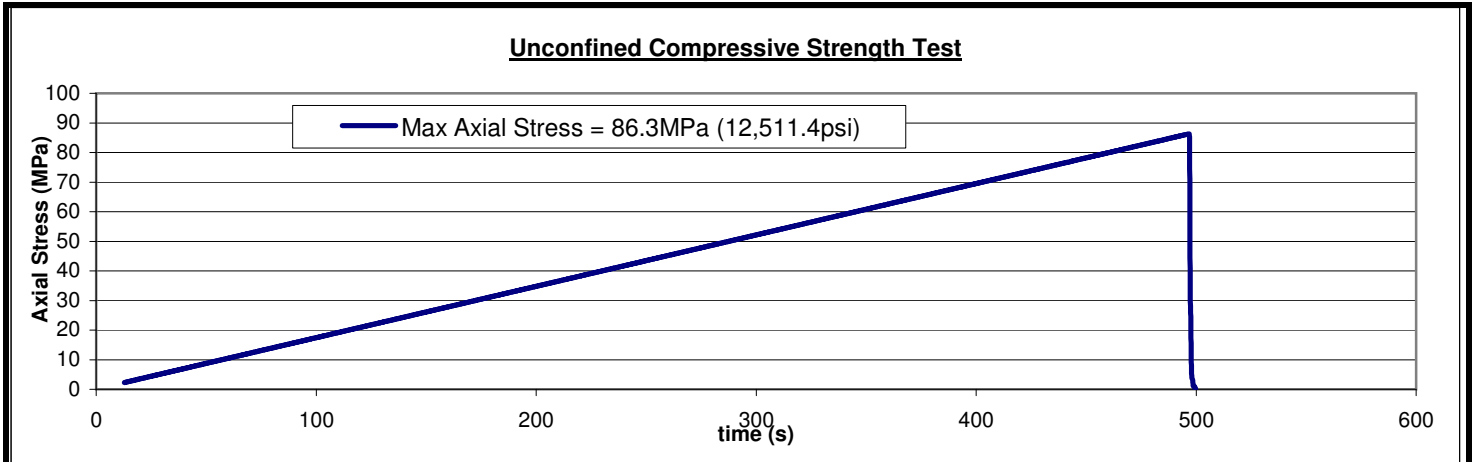
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.57	2881.4	131.73	2.2	281.0	97.5	14,142.0





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-15AGT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 15-3	
Depth (m):	14.02 - 14.12	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	61.99	
Poisson Ratio, ν	0.27	
Failure Mode:	Shear	

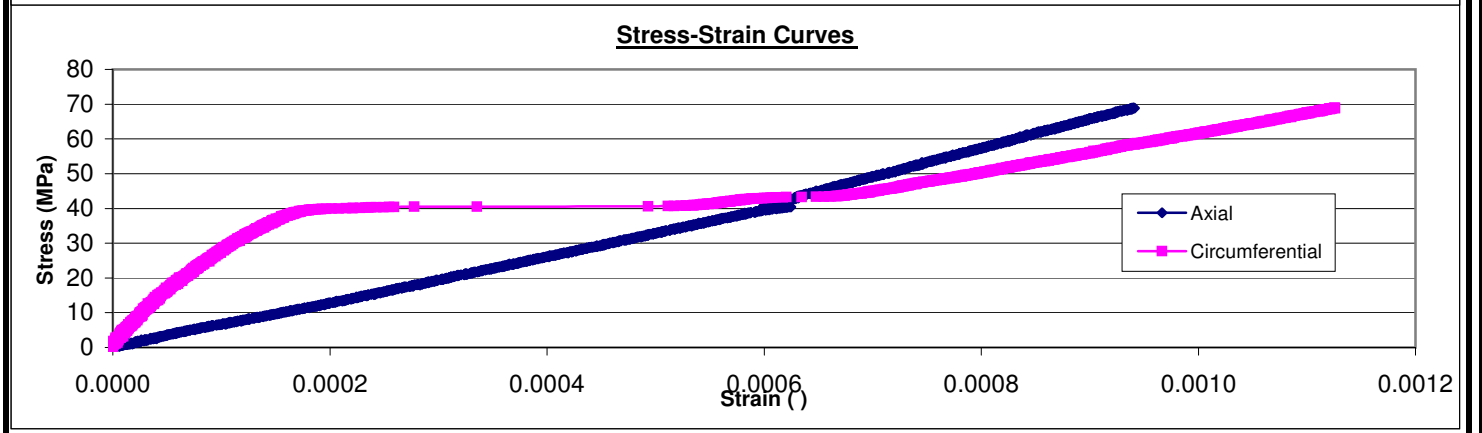
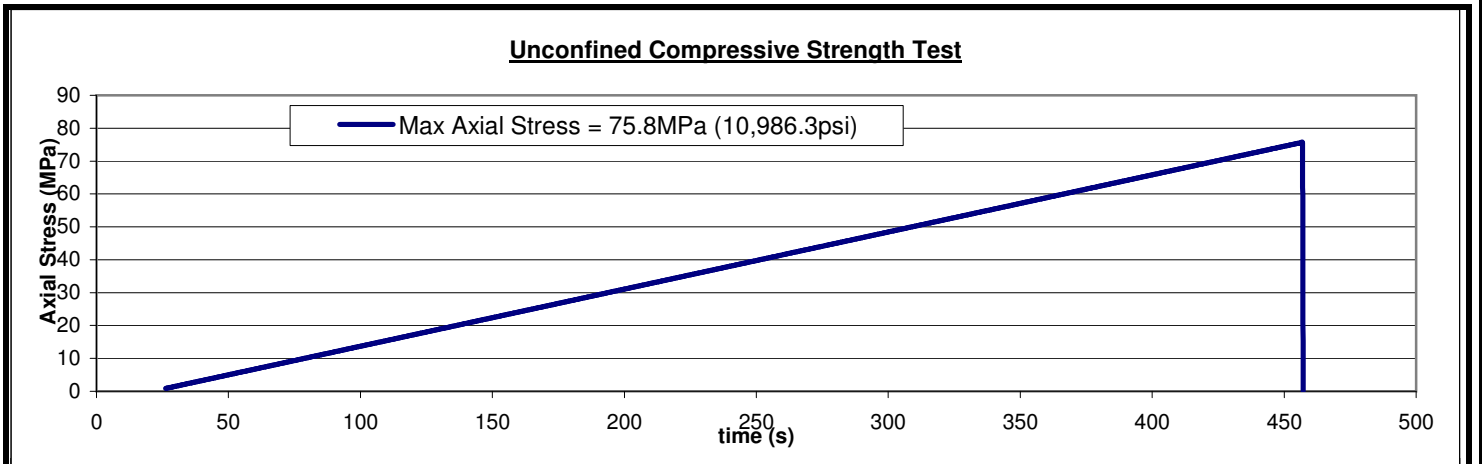
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.56	2880.5	131.15	2.2	248.5	86.3	12,511.4



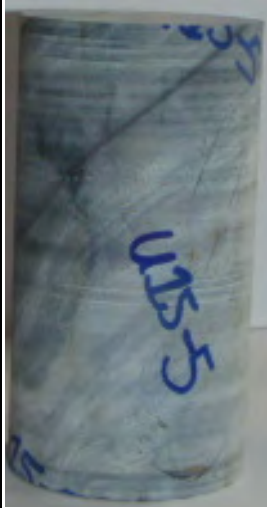

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-15AGT	Before Test 	After Test 
Sample #:	UCS 15-4		
Depth (m):	21.37 - 21.52		
Rock Type:	Argillite		
Test Date:	September, 2010		
Young Modulus, E (GPa)	65.24		
Poisson Ratio, ν	0.24		
Failure Mode:	Shear		

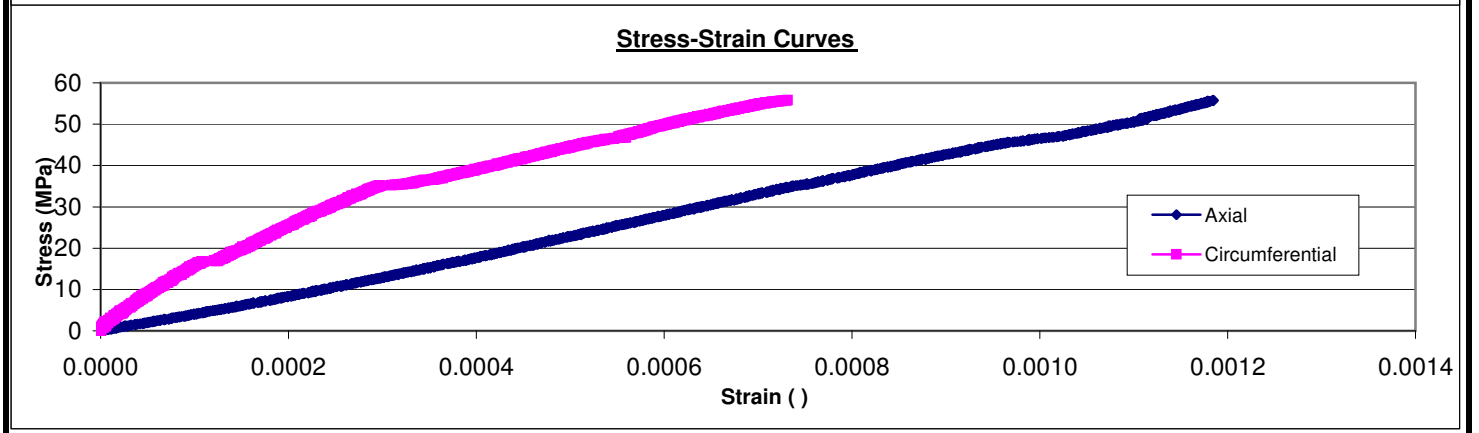
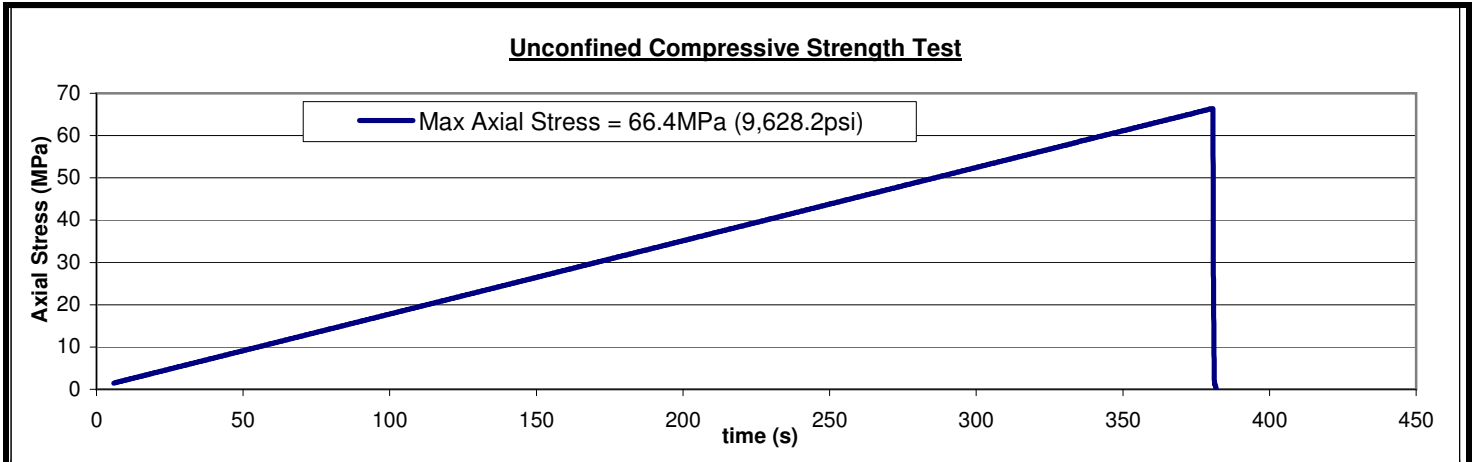
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.53	2877.6	133.73	2.2	218.0	75.8	10,986.3



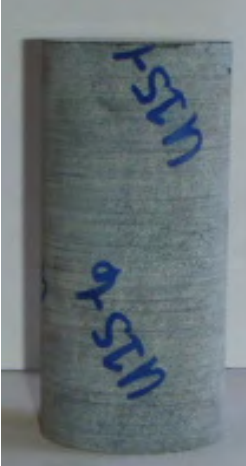

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-15AGT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 15-5	
Depth (m):	27.46 - 27.64	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	51.10	
Poisson Ratio, ν	0.33	
Failure Mode:	Shear	

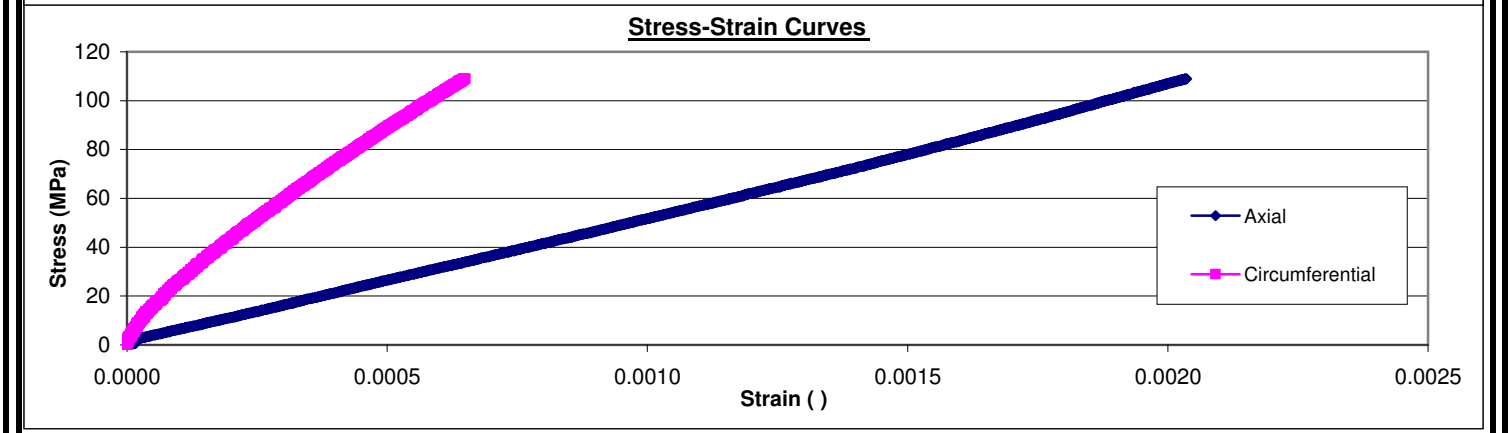
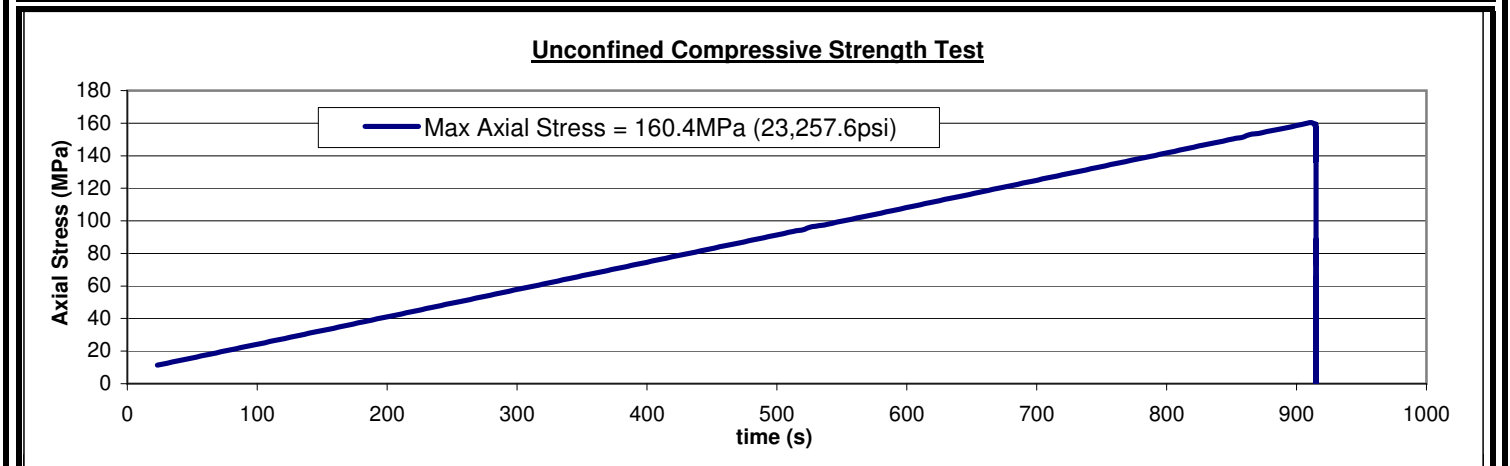
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.61	2885.2	124.11	2.0	191.6	66.4	9,628.2





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-15AGT	Before Test  After Test 
Sample #:	UCS 15-6	
Depth (m):	38.71 - 38.93	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	51.06	
Poisson Ratio, ν	0.22	
Failure Mode:	Explosive/Shear	

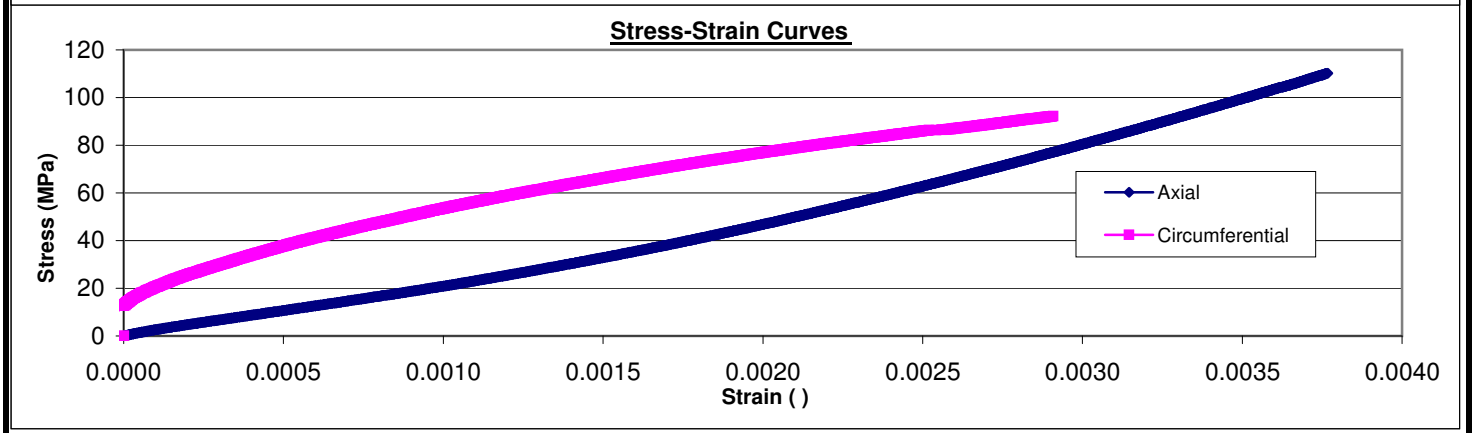
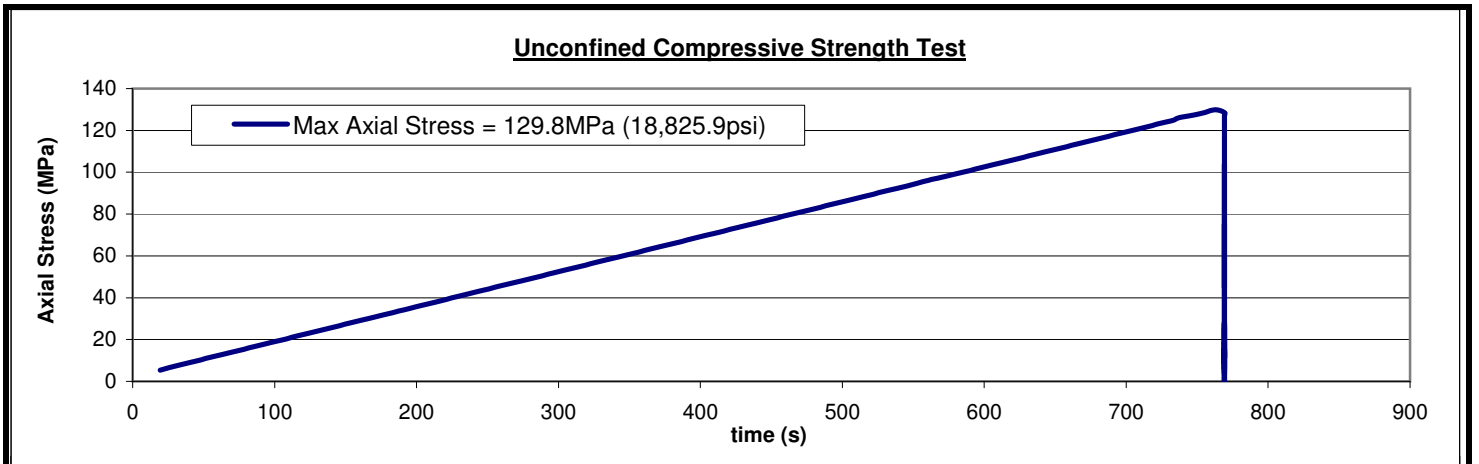
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.58	2882.4	138.80	2.29	462.3	160.4	23,257.6



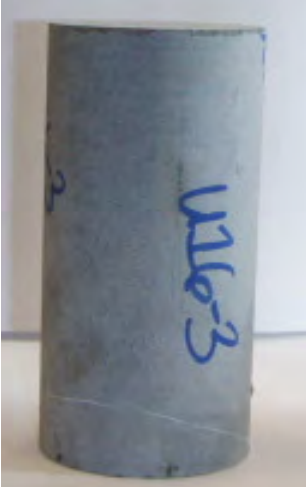

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-16GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 16-2	
Depth (m):	6.10 - 6.37	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	30.58	
Poisson Ratio, ν	0.35	
Failure Mode:	Explosive	

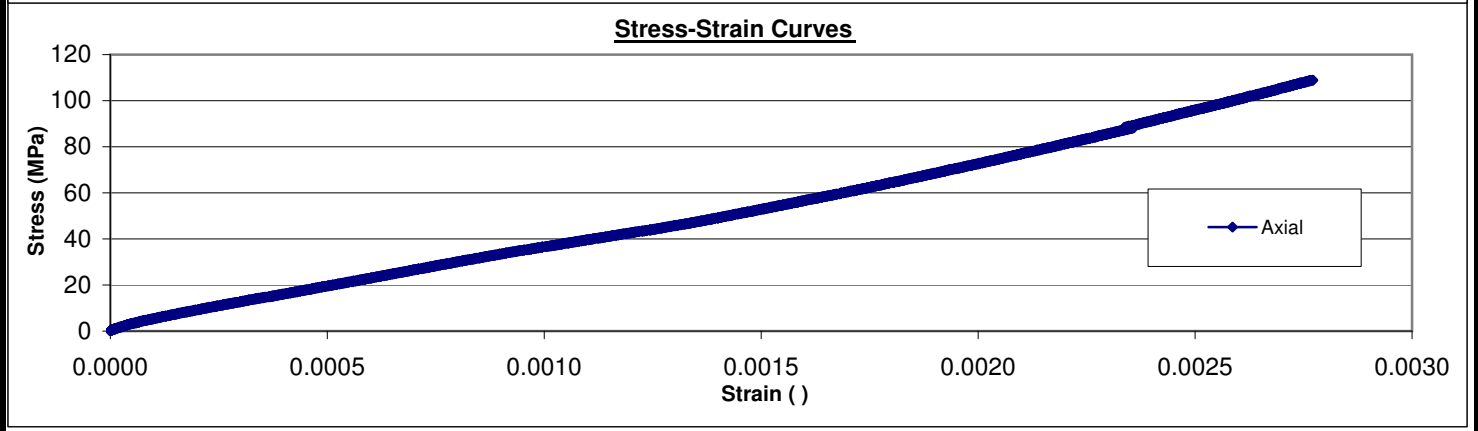
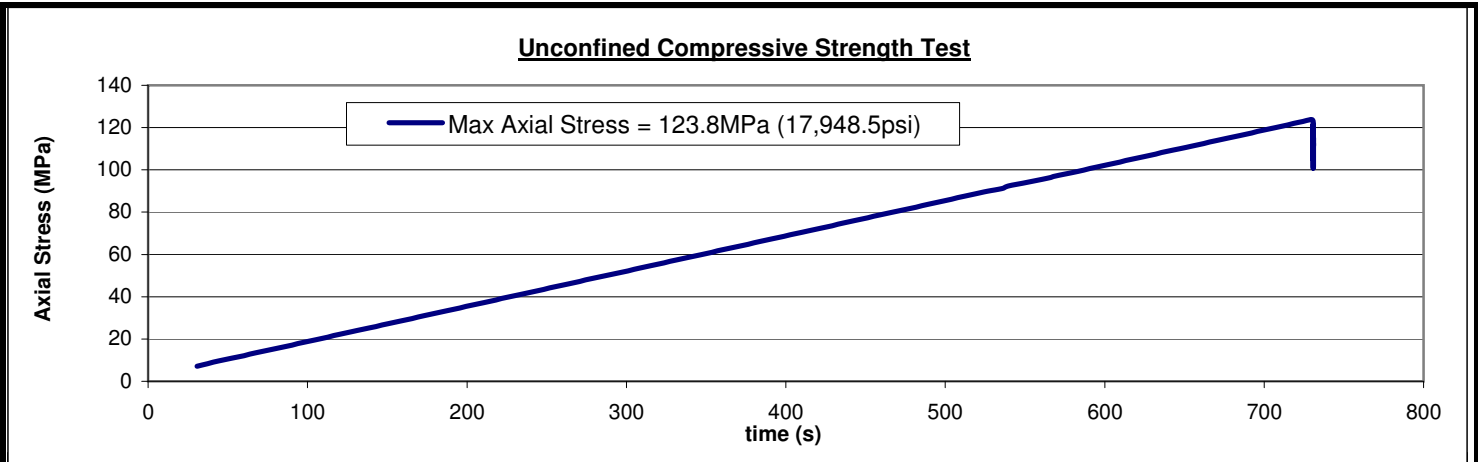
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.71	2894.7	133.62	2.20	375.8	129.8	18,825.9



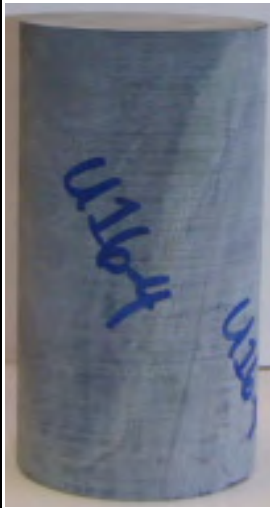

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-16GT	Before Test 	After Test 
Sample #:	UCS 16-3		
Depth (m):	11.28 - 11.58		
Rock Type:	Greywacke / Argillite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	37.86		
Poisson Ratio, ν	N/A		
Failure Mode:	Shear		

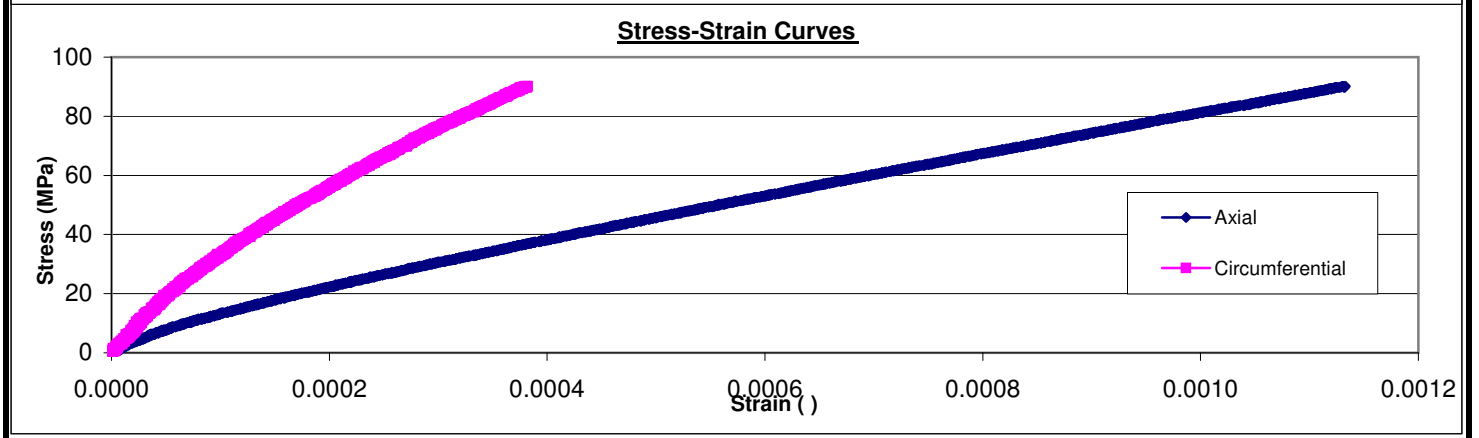
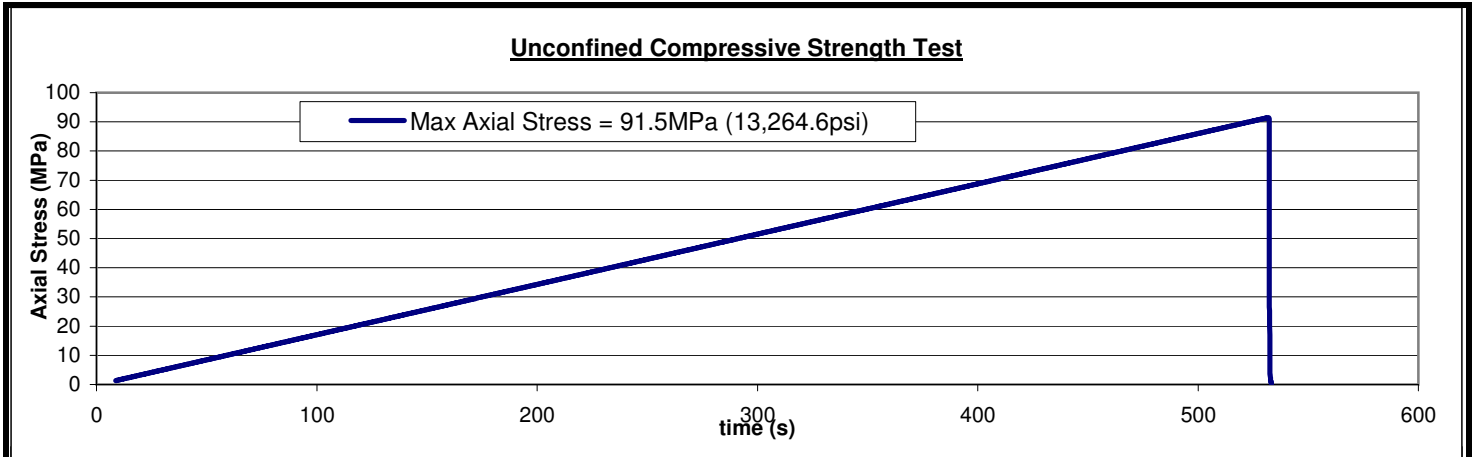
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.79	2902.4	132.27	2.18	359.3	123.8	17,948.5



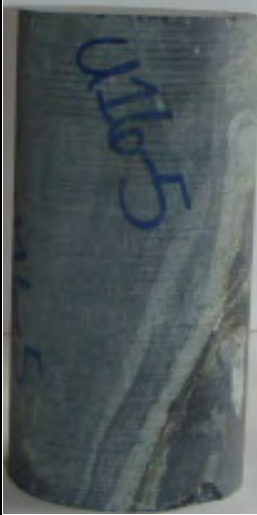

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-16GT		
Sample #:	UCS 16-4		
Depth (m):	16.15 - 16.35		
Rock Type:	Greywacke / Argillite		
Test Date:	September, 2010		
Young Modulus, E (GPa)	75.74		
Poisson Ratio, ν	0.31		
Failure Mode:	Shear		

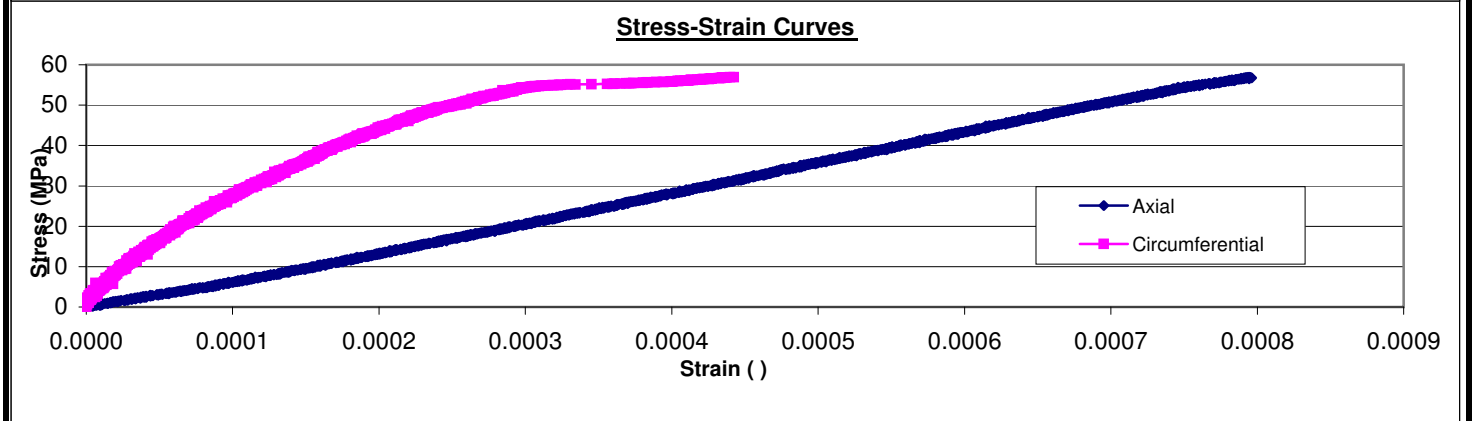
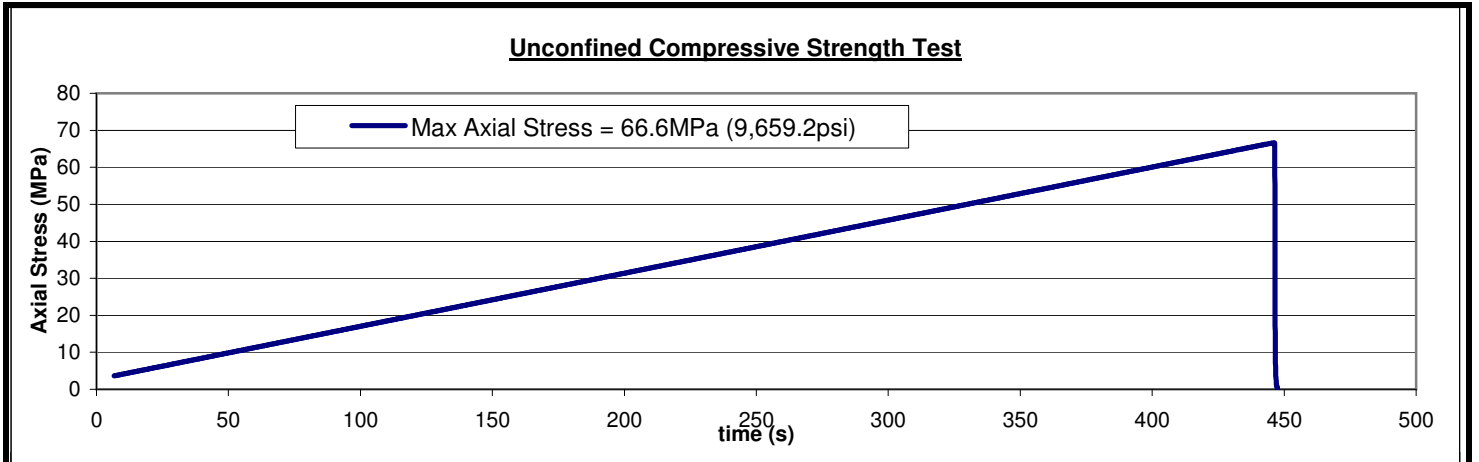
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.78	2901.4	121.53	2.0	265.4	91.5	13,264.6




**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-16GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 16-5	
Depth (m):	23.77 - 23.97	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	73.35	
Poisson Ratio, ν	0.29	
Failure Mode:	Shear	

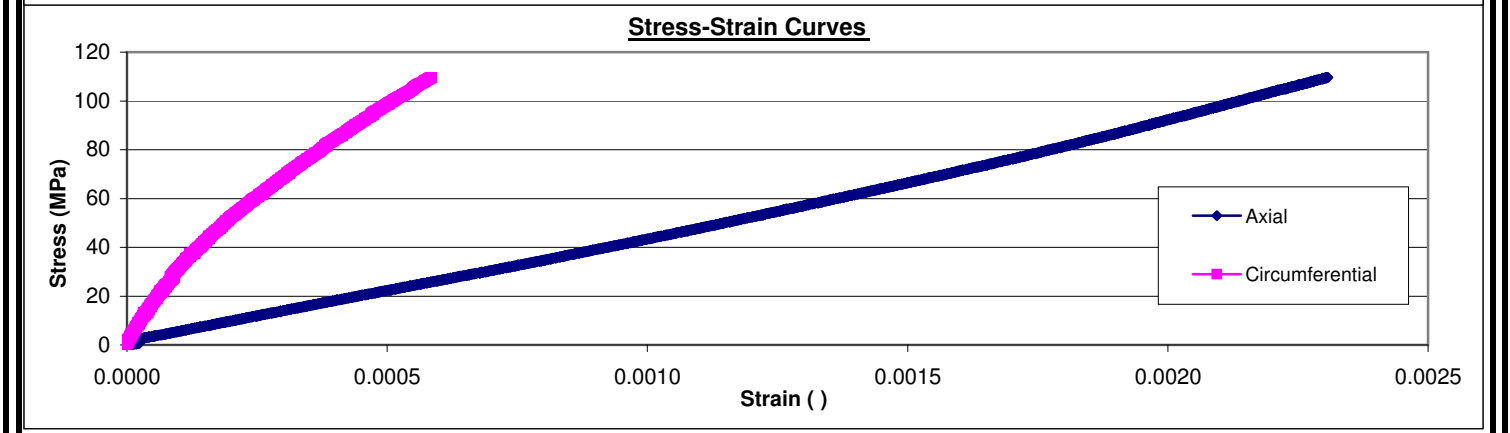
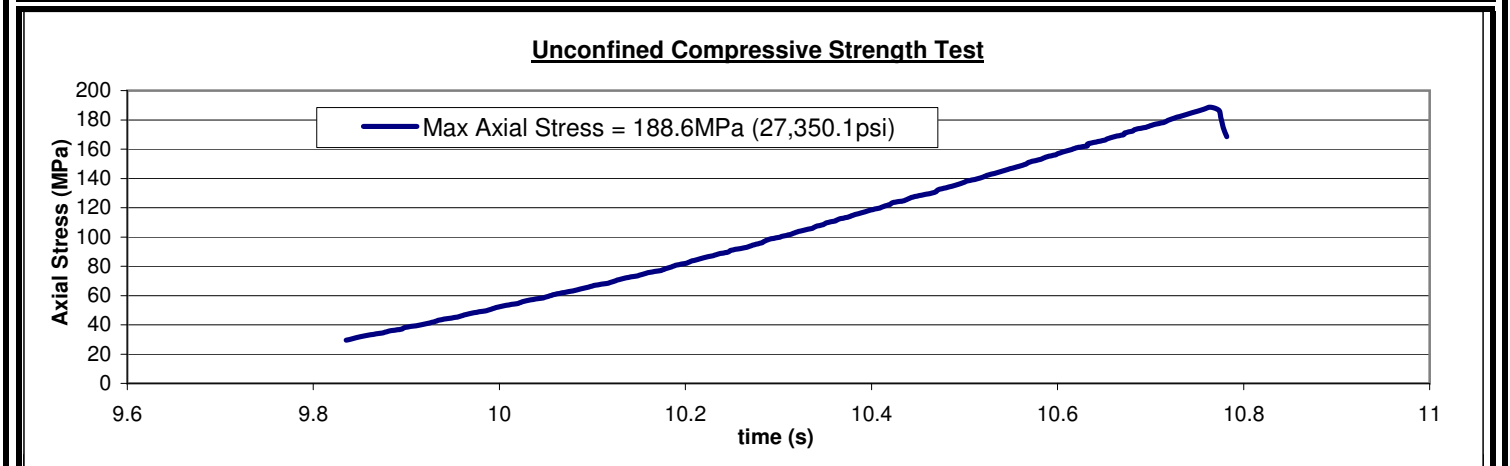
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.81	2904.3	131.58	2.2	193.5	66.6	9,659.2





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-16GT	Before Test 	After Test <div style="border: 1px solid black; width: 100px; height: 100px; margin: 0 auto; text-align: center; padding: 5px;"> No Photo Available </div>
Sample #:	UCS 16-6		
Depth (m):	29.26 - 29.46		
Rock Type:	Greywacke / Argillite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	44.07		
Poisson Ratio, ν	0.24		
Failure Mode:	Explosive/Shear		

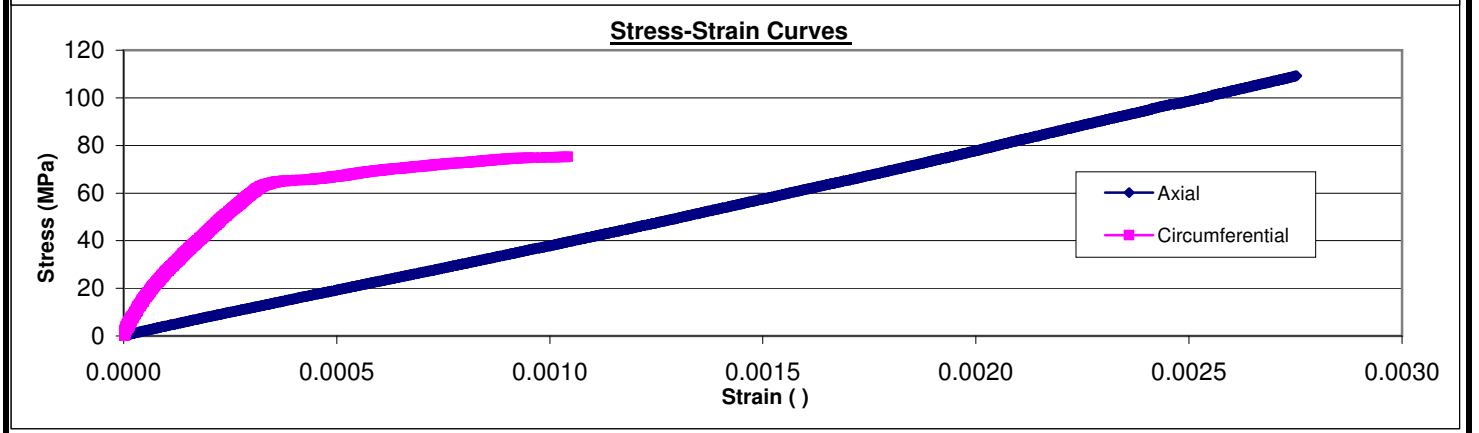
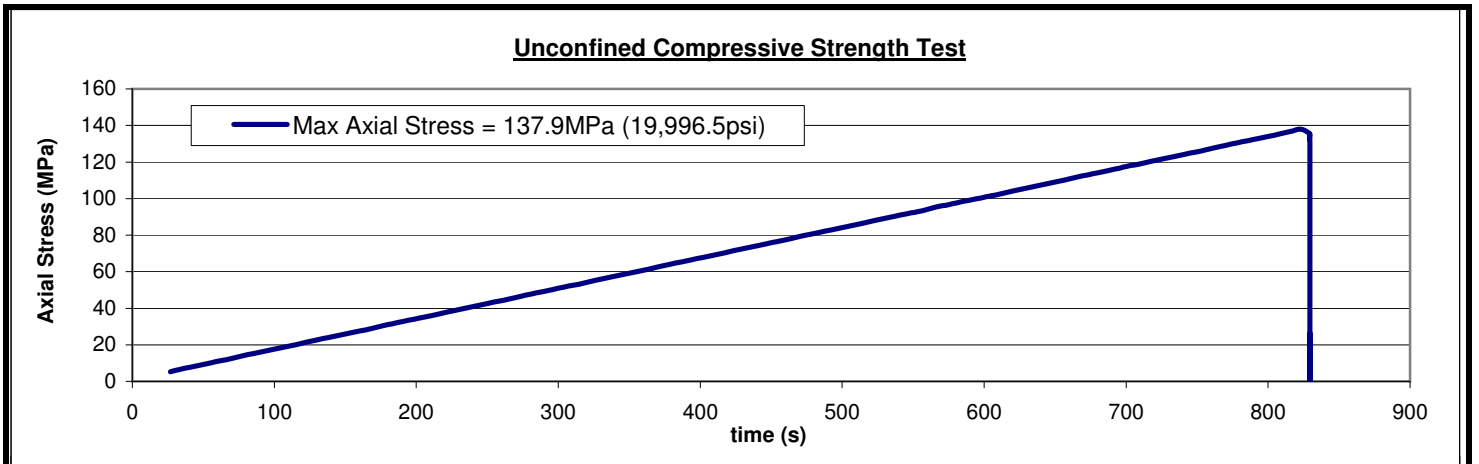
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.82	2905.2	131.05	2.15	548.0	188.6	27,350.1



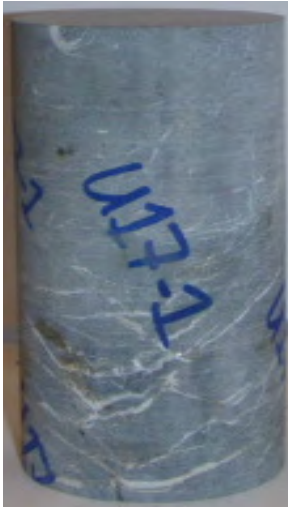

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-16GT	Before Test 	After Test 
Sample #:	UCS 16-7		
Depth (m):	40.84 - 41.06		
Rock Type:	Greywacke / Argillite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	39.70		
Poisson Ratio, ν	0.19		
Failure Mode:	Explosive		

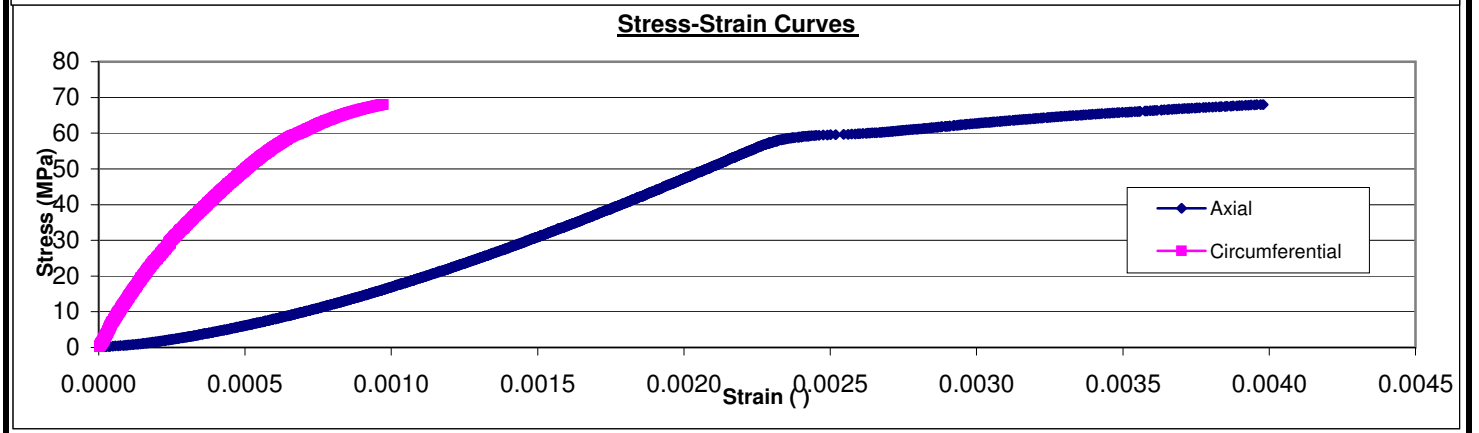
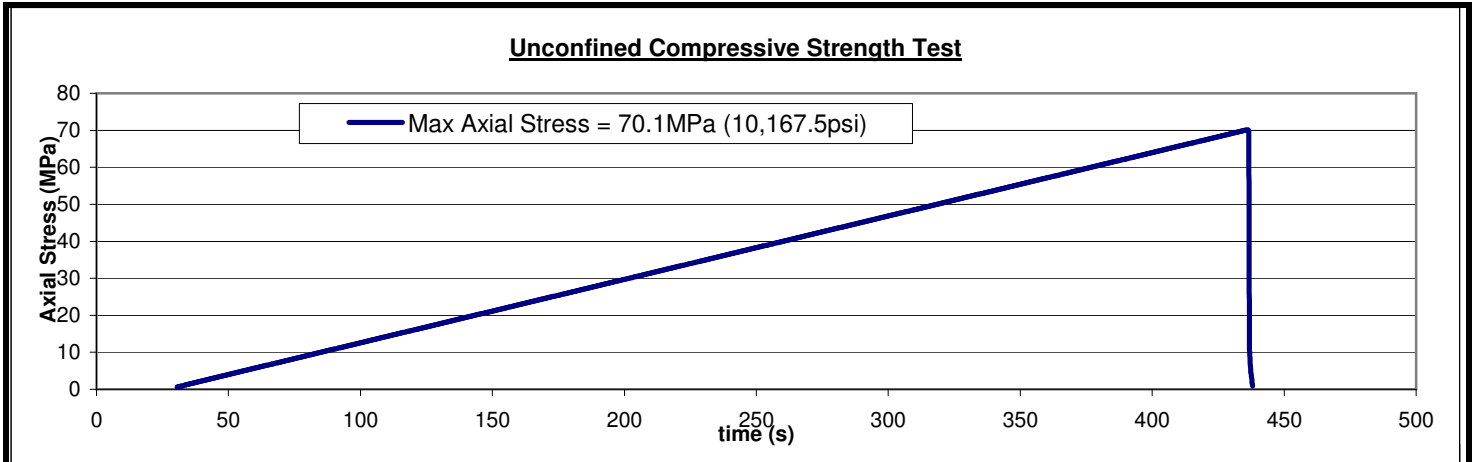
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.86	2909.1	133.20	2.19	401.2	137.9	19,996.5



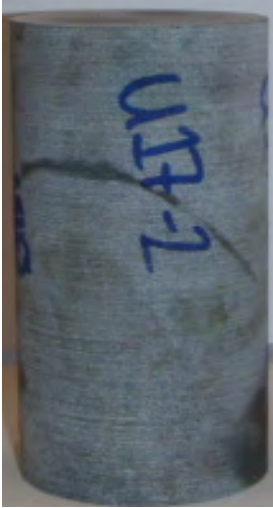

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 17-1	
Depth (m):	6.71 - 6.91	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	26.23	
Poisson Ratio, ν	0.24	
Failure Mode:	Shear	

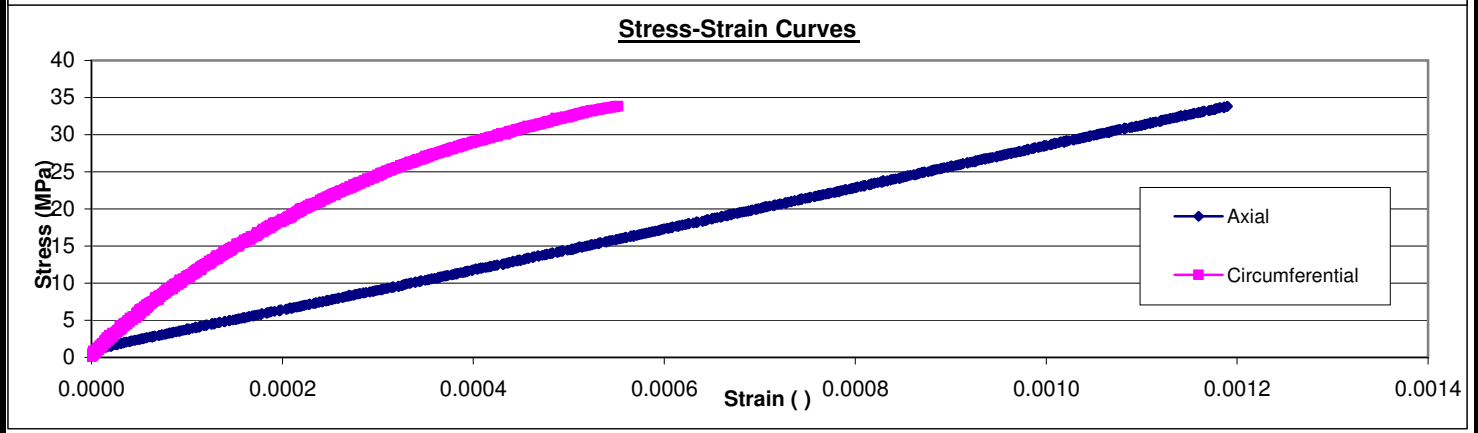
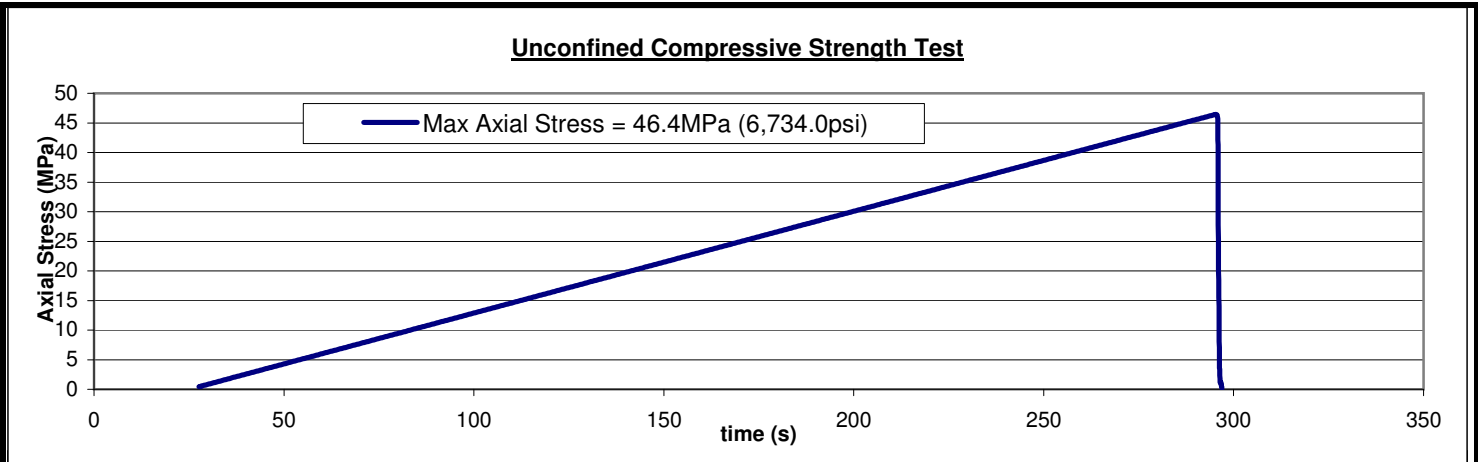
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.95	2917.7	125.98	2.1	204.6	70.1	10,167.5





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 17-2	
Depth (m):	12.80 - 13.02	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	27.00	
Poisson Ratio, ν	0.30	
Failure Mode:	Pre-existing feature	

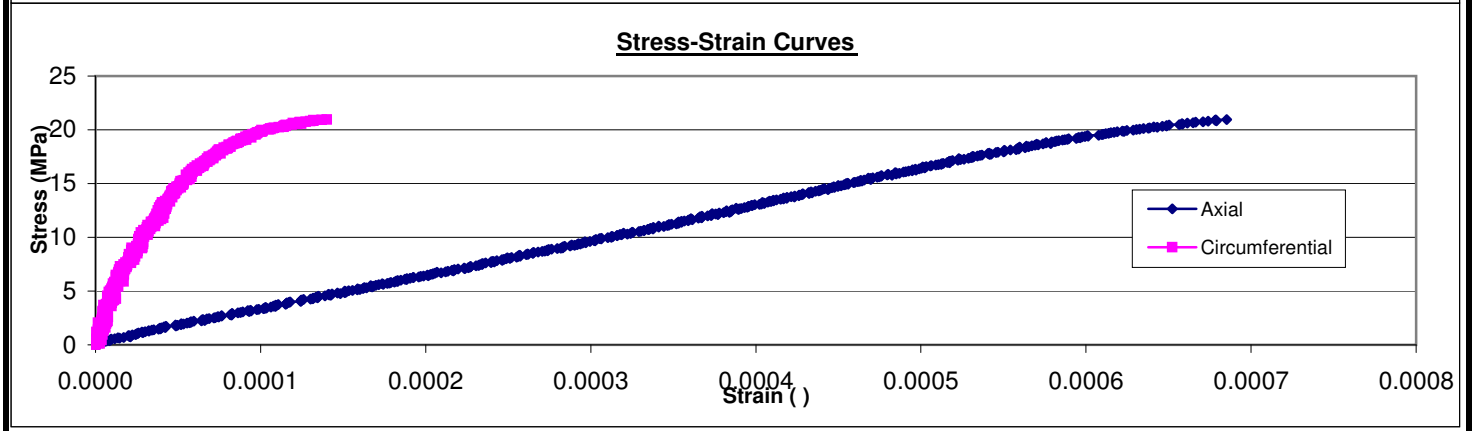
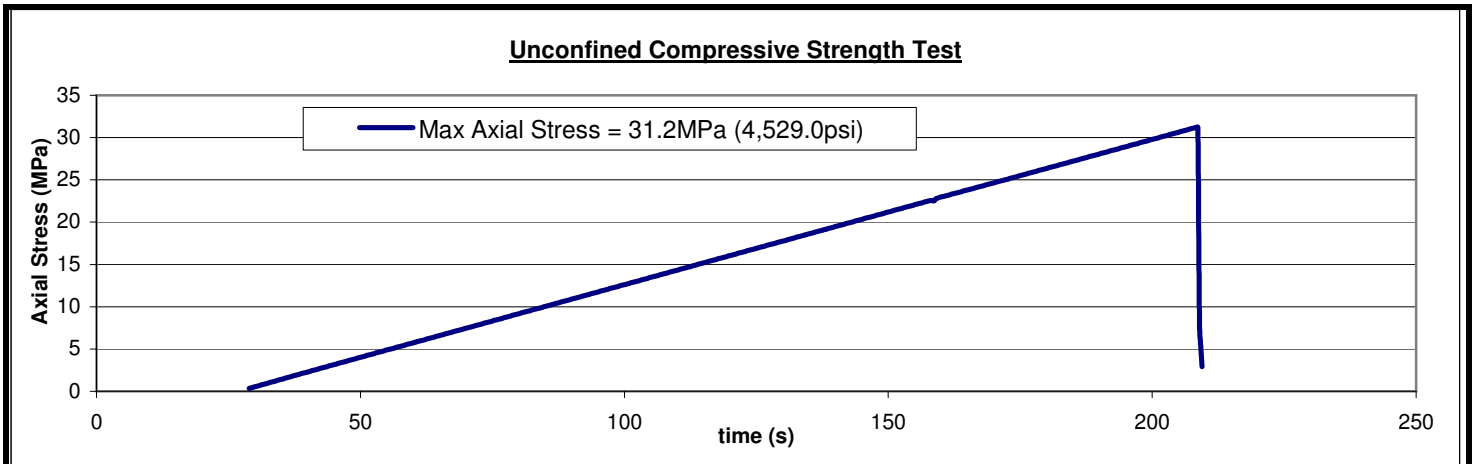
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.85	2908.1	128.61	2.1	135.1	46.4	6,734.0



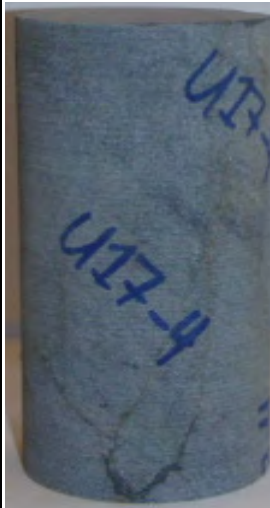

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 17-3	
Depth (m):	16.76 - 16.98	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	32.92	
Poisson Ratio, ν	0.14	
Failure Mode:	Pre-existing feature	

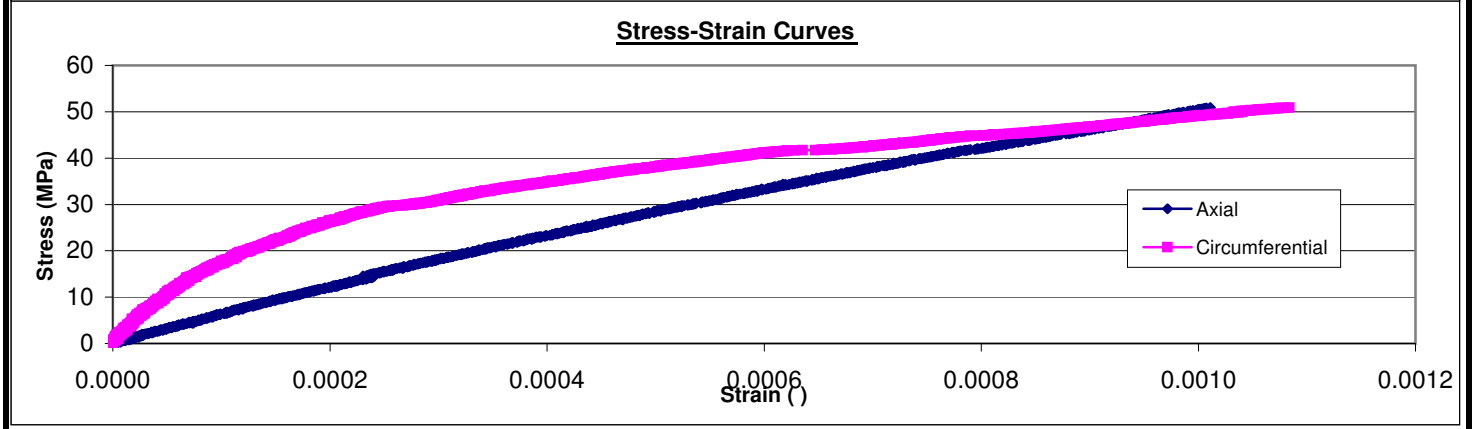
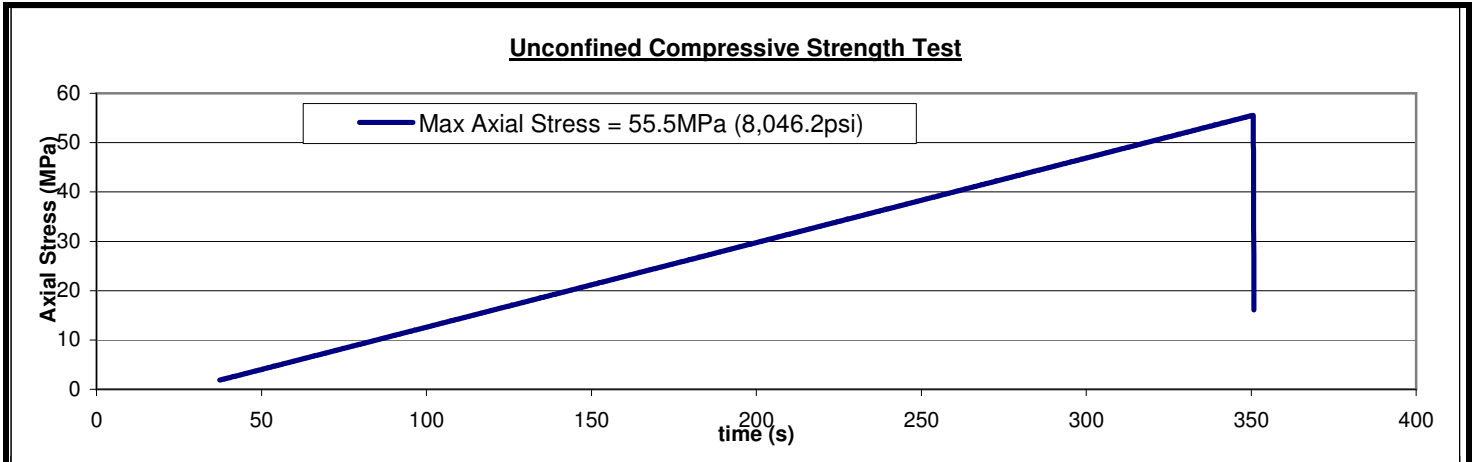
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.88	2911.0	119.34	2.0	90.9	31.2	4,529.0





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 17-4	
Depth (m):	23.77 - 23.99	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	58.20	
Poisson Ratio, ν	0.34	
Failure Mode:	Shear	

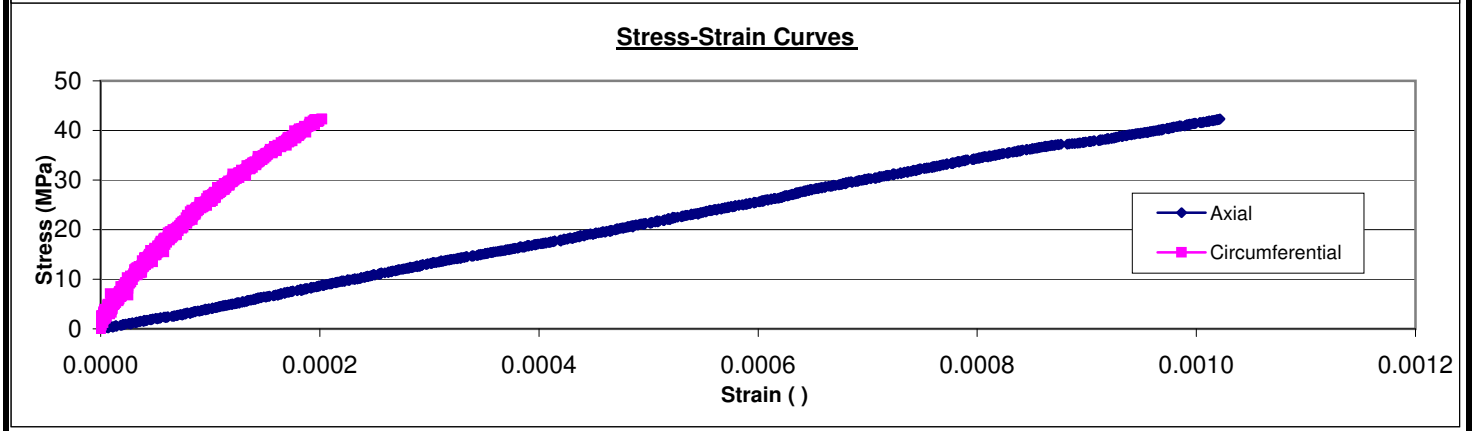
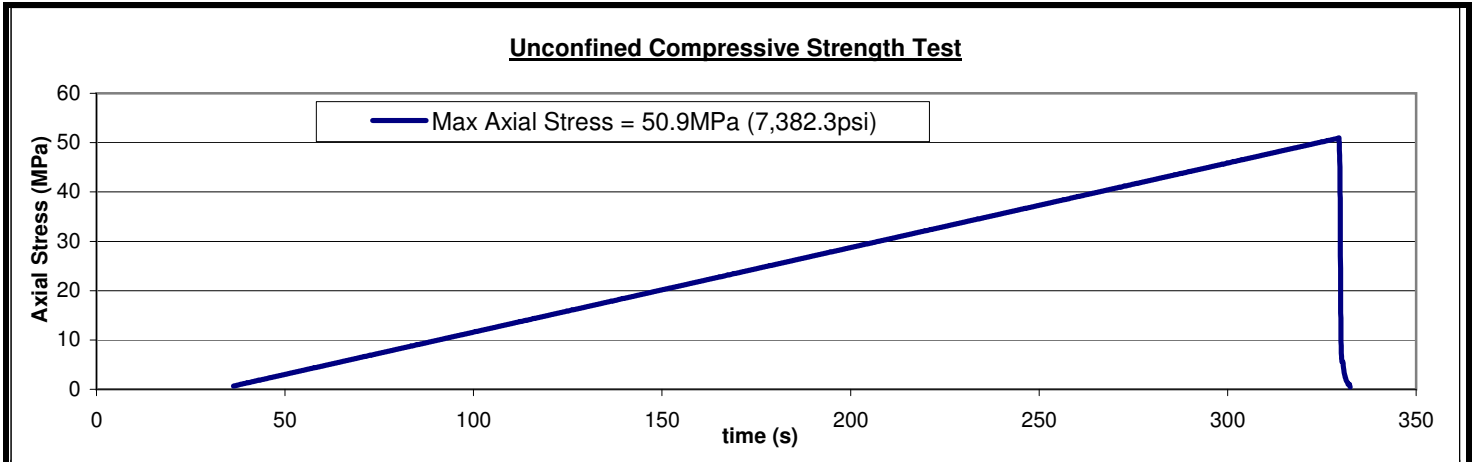
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.93	2915.8	131.04	2.2	161.8	55.5	8,046.2



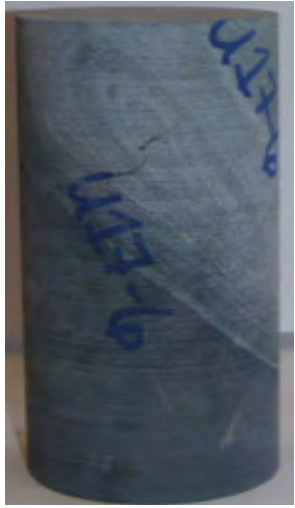
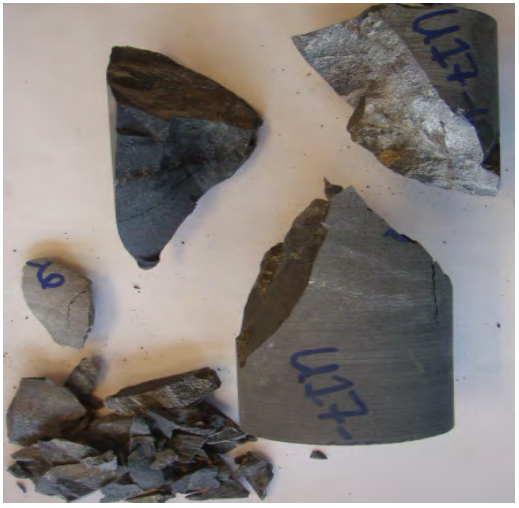
**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 17-5	
Depth (m):	29.87 - 30.12	
Rock Type:	Greywacke / Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	42.43	
Poisson Ratio, ν	0.20	
Failure Mode:	Shear	

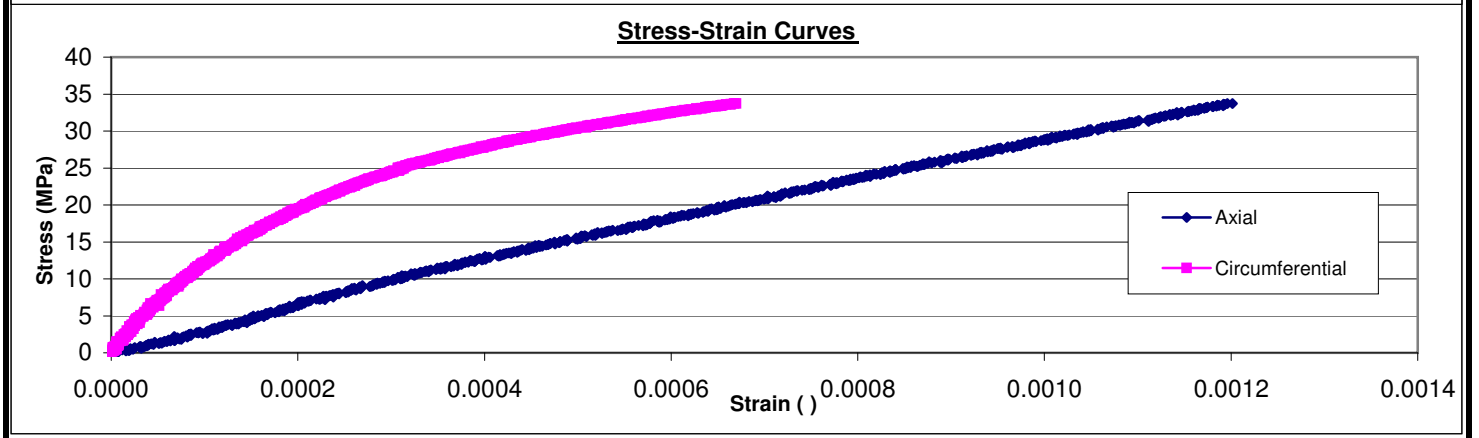
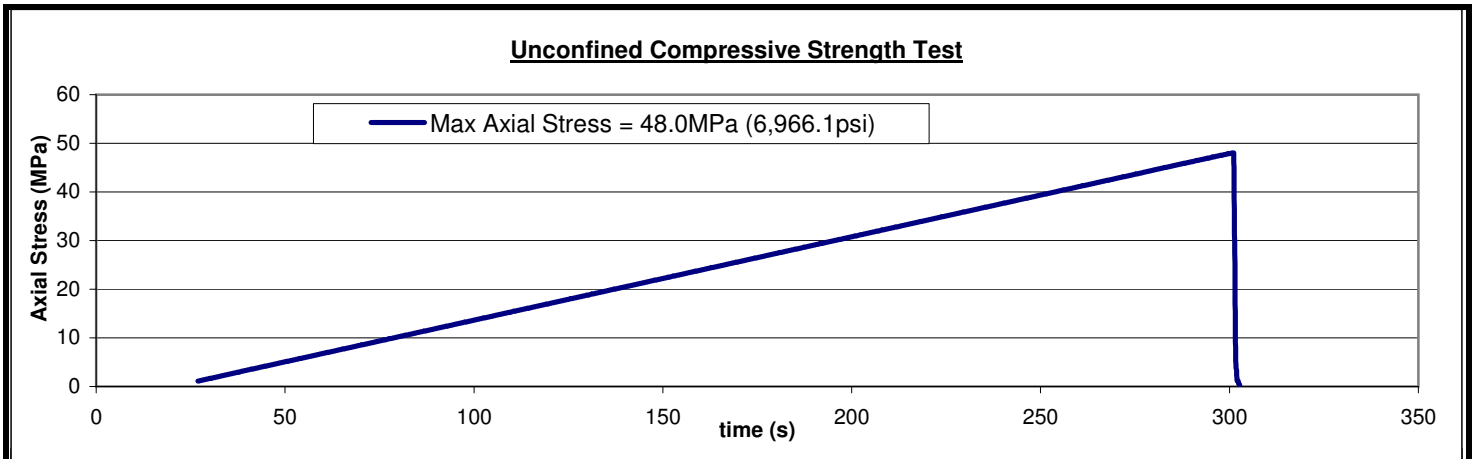
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.95	2917.7	130.43	2.1	148.5	50.9	7,382.3



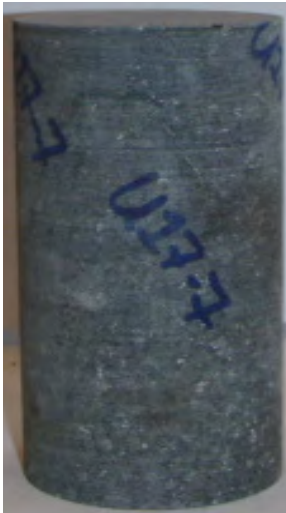

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	Before Test 	After Test 
Sample #:	UCS 17-6		
Depth (m):	40.23 - 40.43		
Rock Type:	Argillite		
Test Date:	September, 2010		
Young Modulus, E (GPa)	30.97		
Poisson Ratio, ν	0.25		
Failure Mode:	Shear		

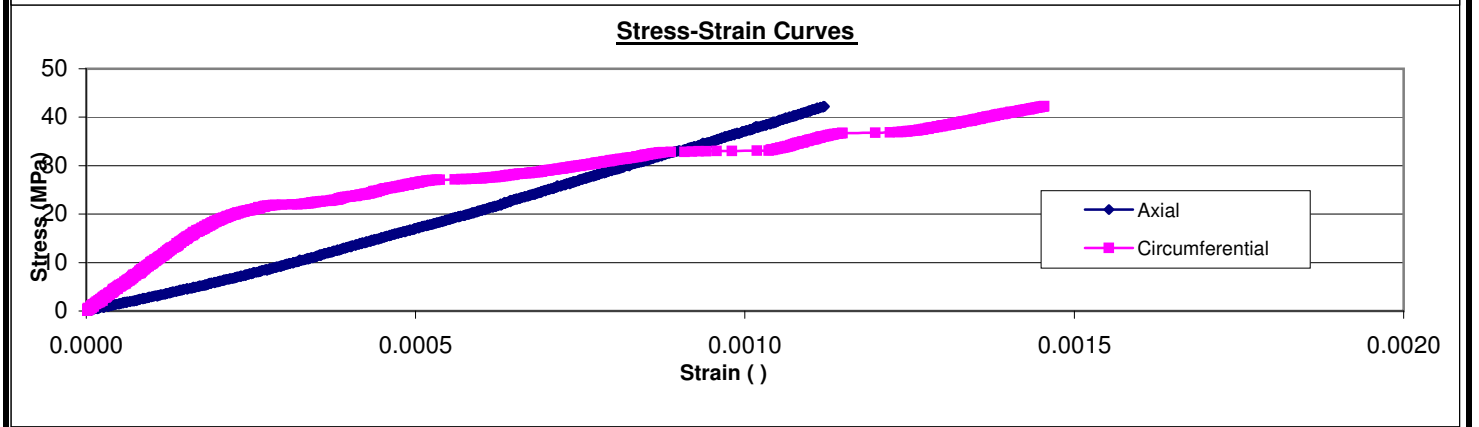
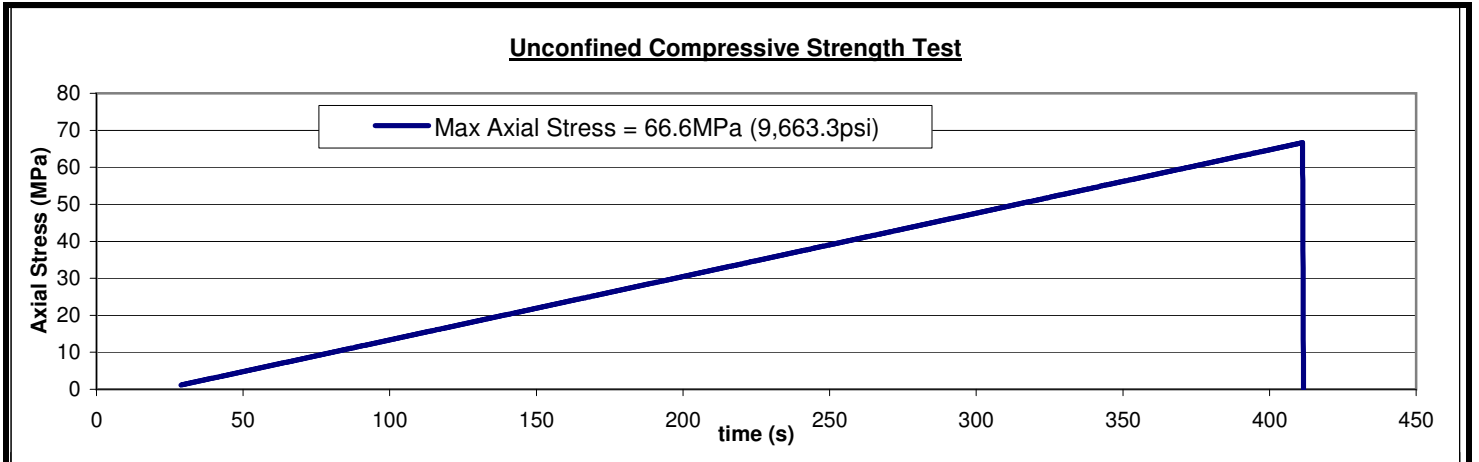
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.94	2916.7	132.16	2.2	140.1	48.0	6,966.1



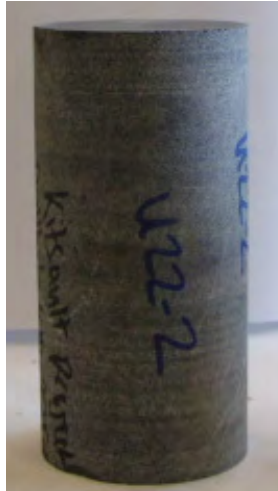

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-17GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS 17-7	
Depth (m):	54.10 - 54.30	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (GPa)	36.25	
Poisson Ratio, ν	0.37	
Failure Mode:	Shear	

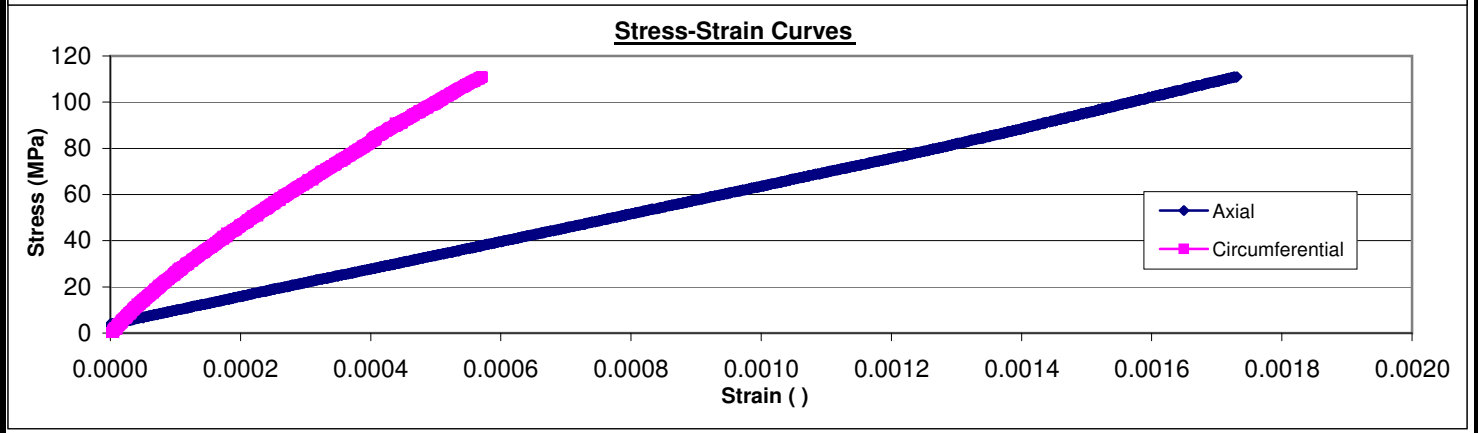
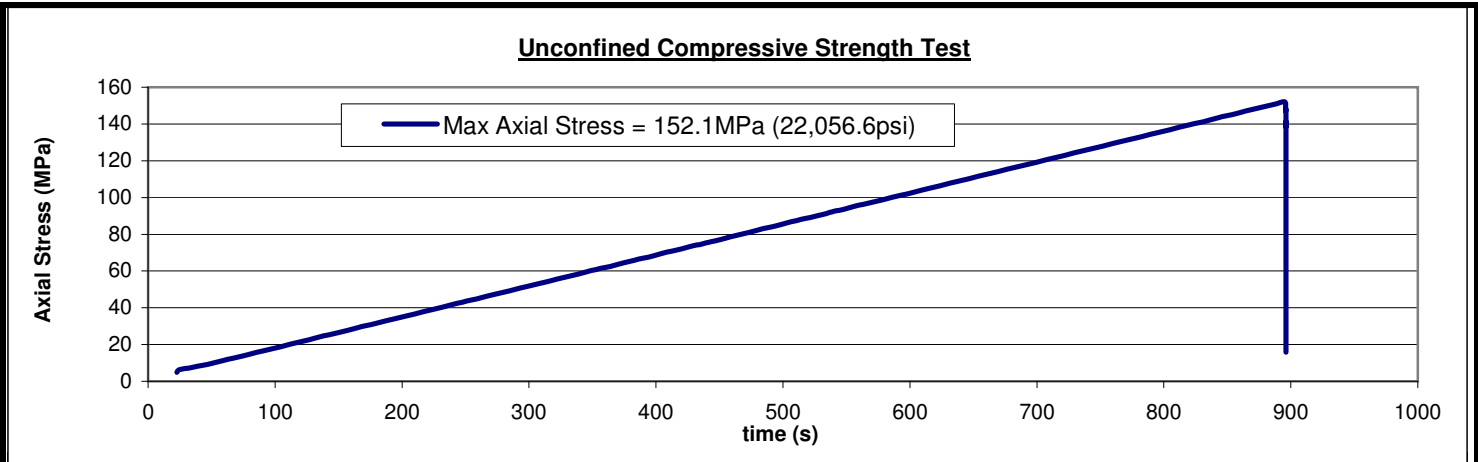
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.97	2919.6	130.11	2.1	194.6	66.6	9,663.3





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-22GT	Before Test 	After Test 
Sample #:	UCS-22-2		
Depth (m):	28.87 - 29.05		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	61.35		
Poisson Ratio, ν	0.27		
Failure Mode:	Pre-existing Feature		

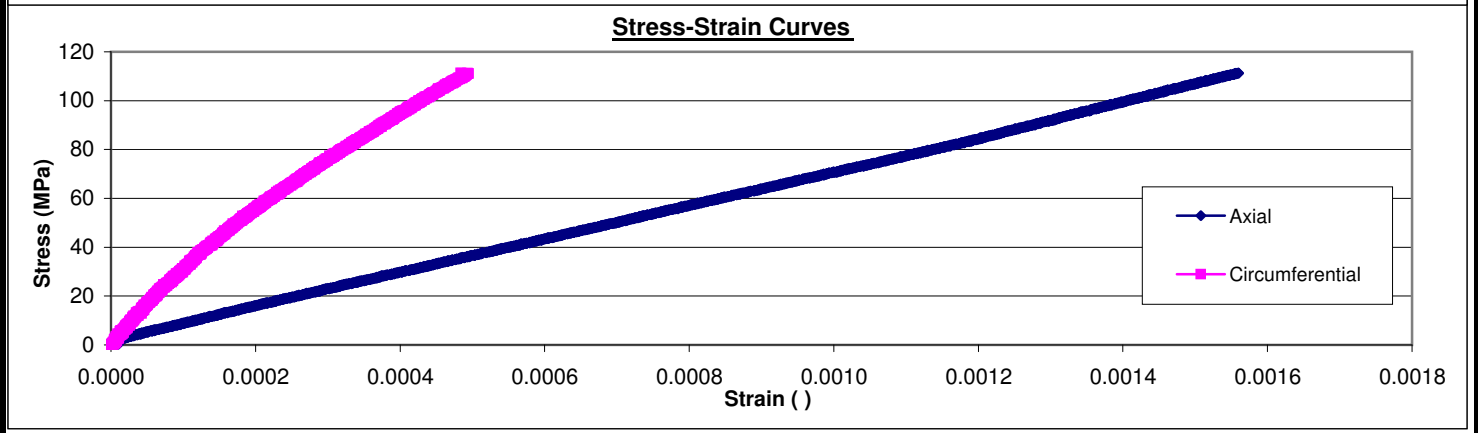
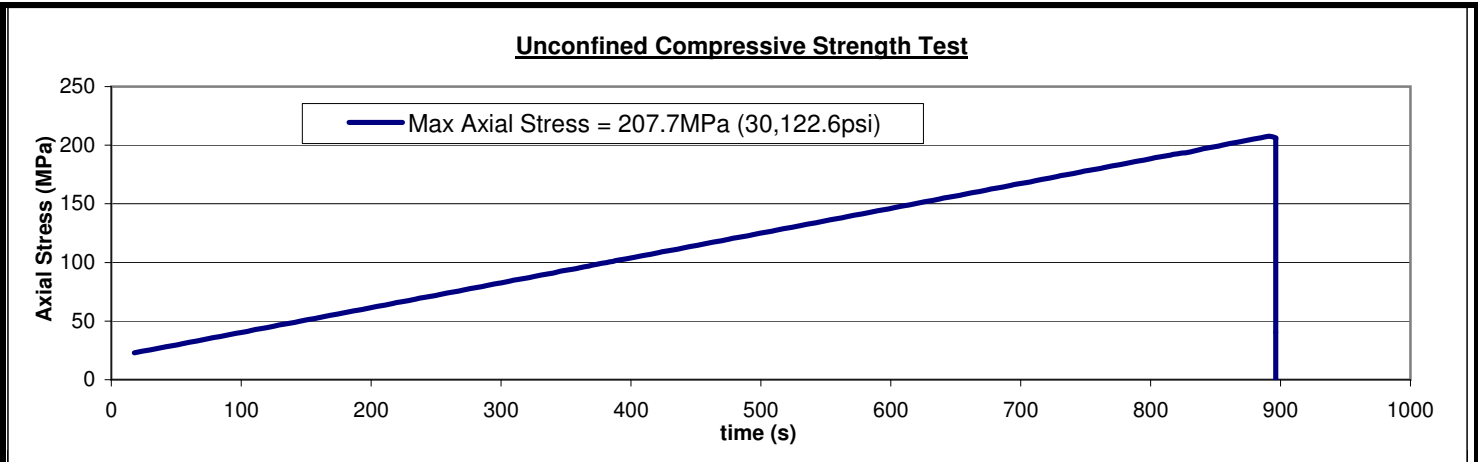
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.45	2870.0	134.71	2.23	436.6	152.1	22,056.6




**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-22GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-22-3	
Depth (m):	45.28 - 45.54	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	68.42	
Poisson Ratio, ν	0.22	
Failure Mode:	Explosive/Shear	

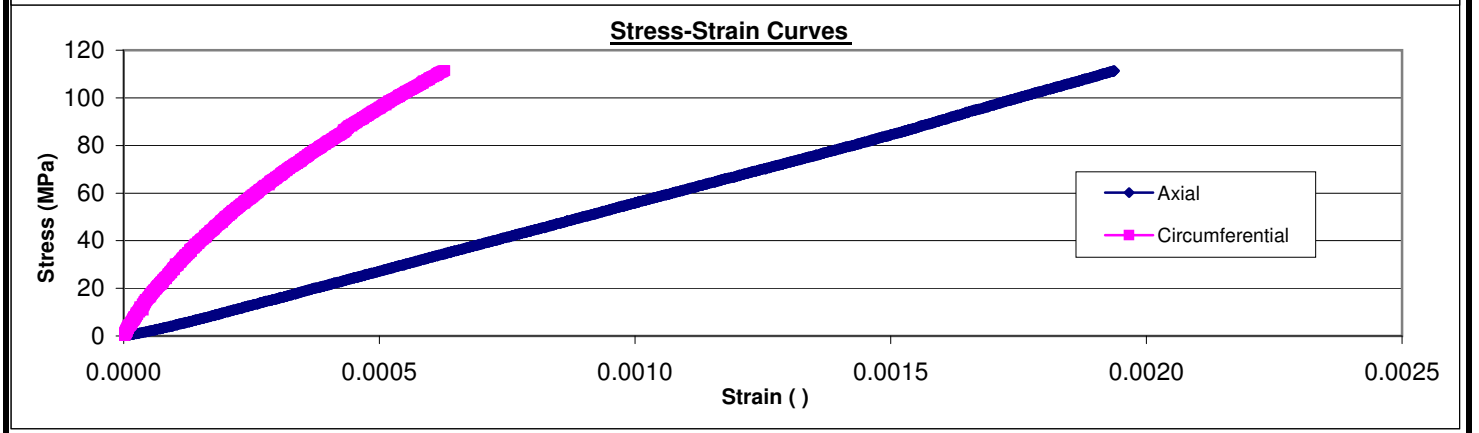
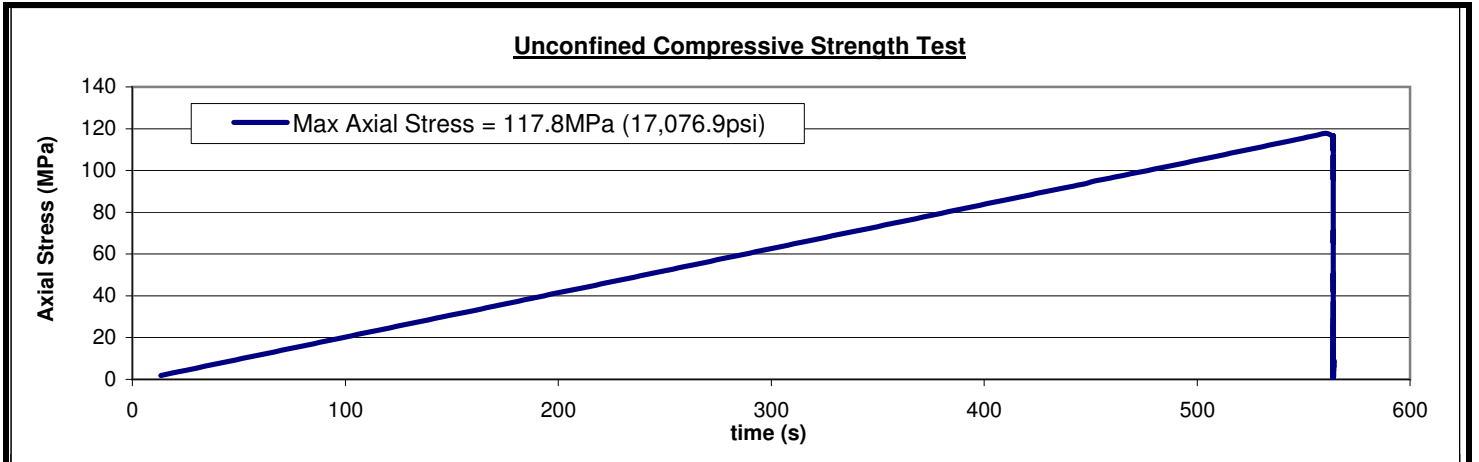
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.32	2857.7	135.18	2.24	593.7	207.7	30,122.6



**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-22GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-22-4	
Depth (m):	67.26 - 67.46	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	57.94	
Poisson Ratio, ν	0.23	
Failure Mode:	Explosive	

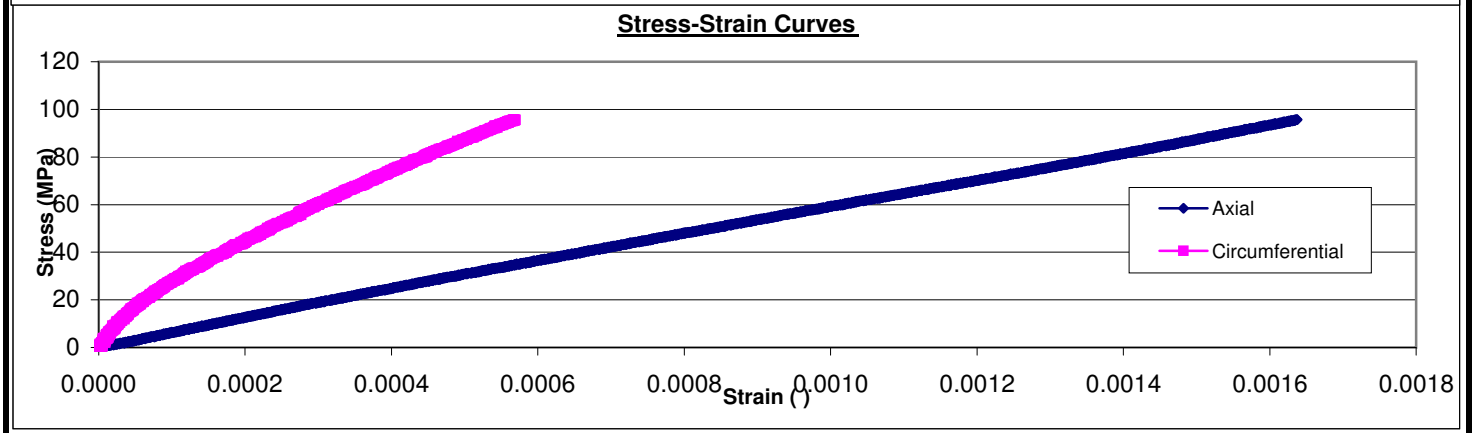
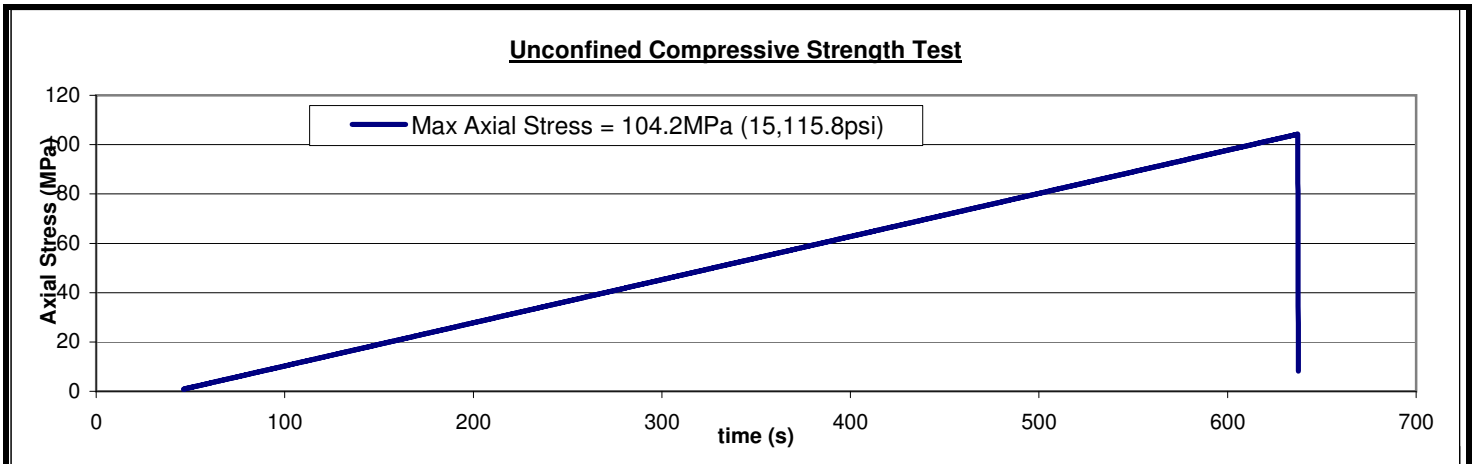
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.31	2856.7	134.26	2.23	336.4	117.8	17,076.9



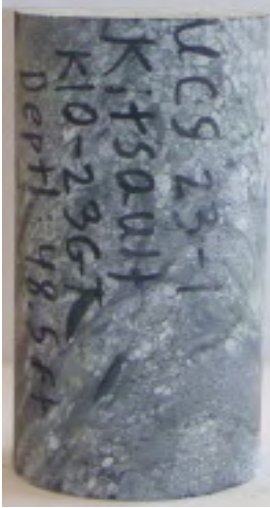

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-22GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-22-6	
Depth (m):	88.91 - 89.18	
Rock Type:	Argillite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	58.35	
Poisson Ratio, ν	0.32	
Failure Mode:	Shear	

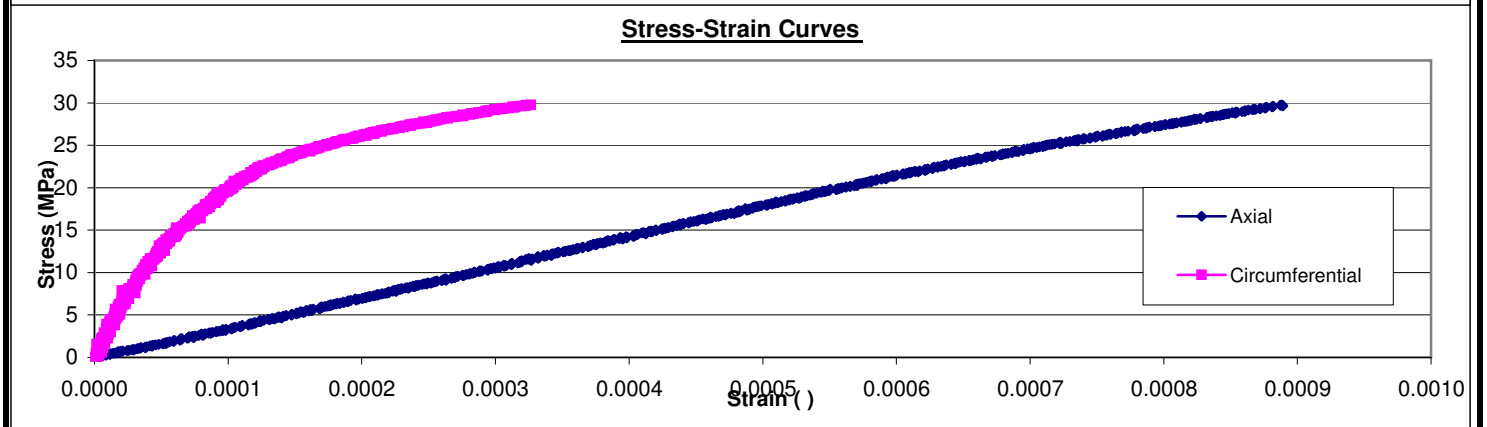
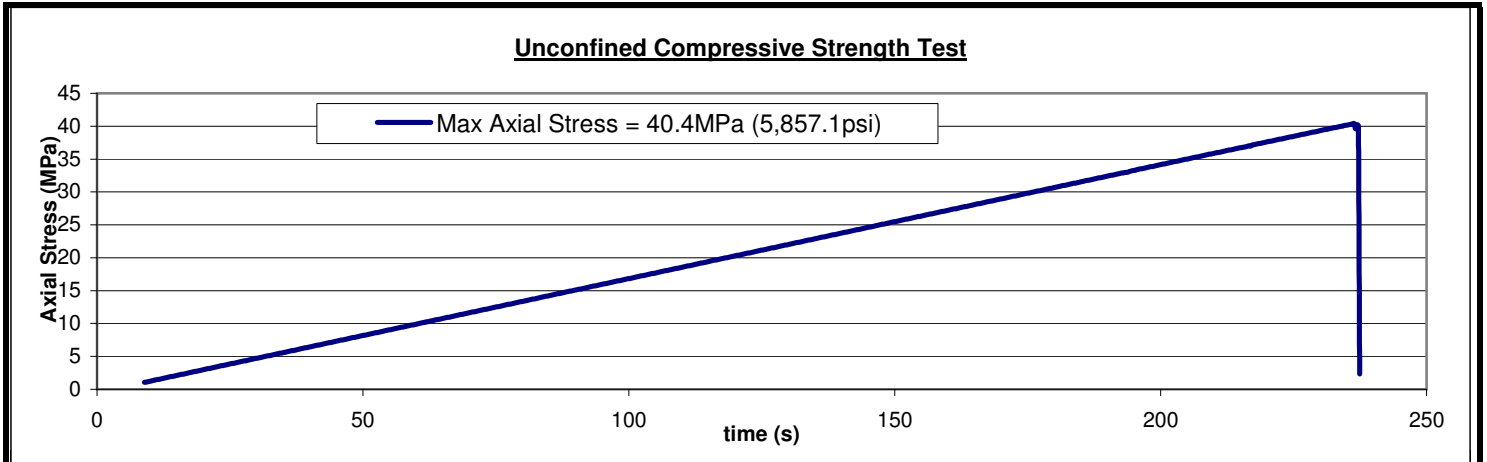
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.33	2858.6	131.82	2.2	298.0	104.2	15,115.8



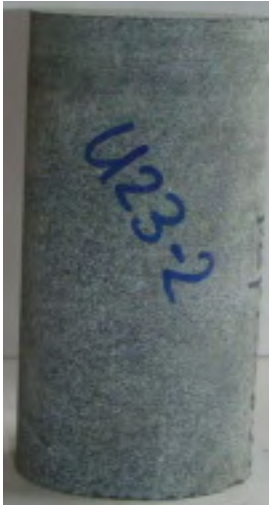

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-23GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-23-1	
Depth (m):	15.91 - 16.13	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (GPa)	36.37	
Poisson Ratio, ν	0.17	
Failure Mode:	Shear	

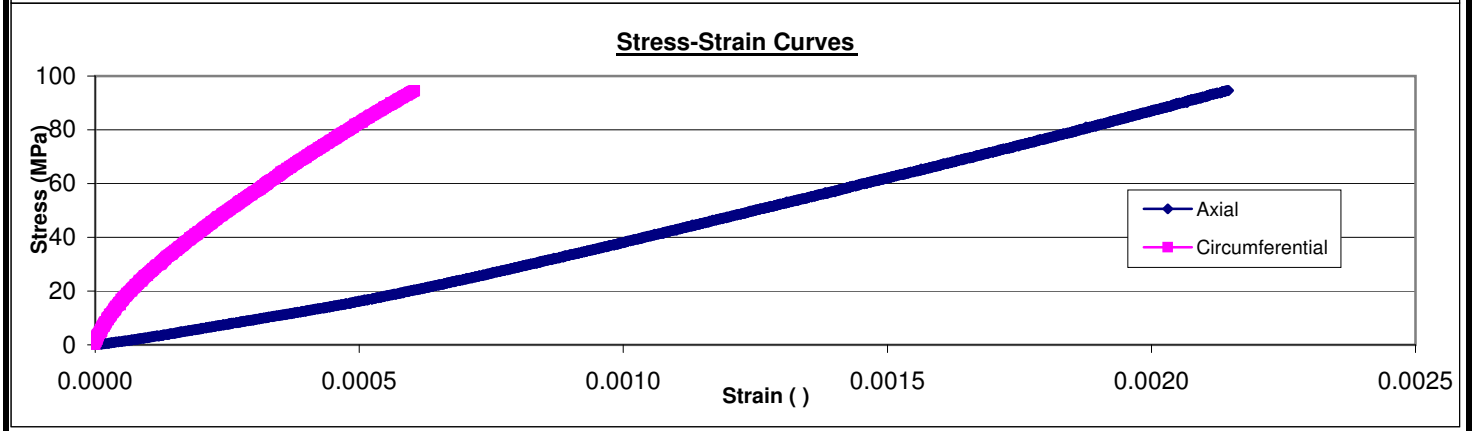
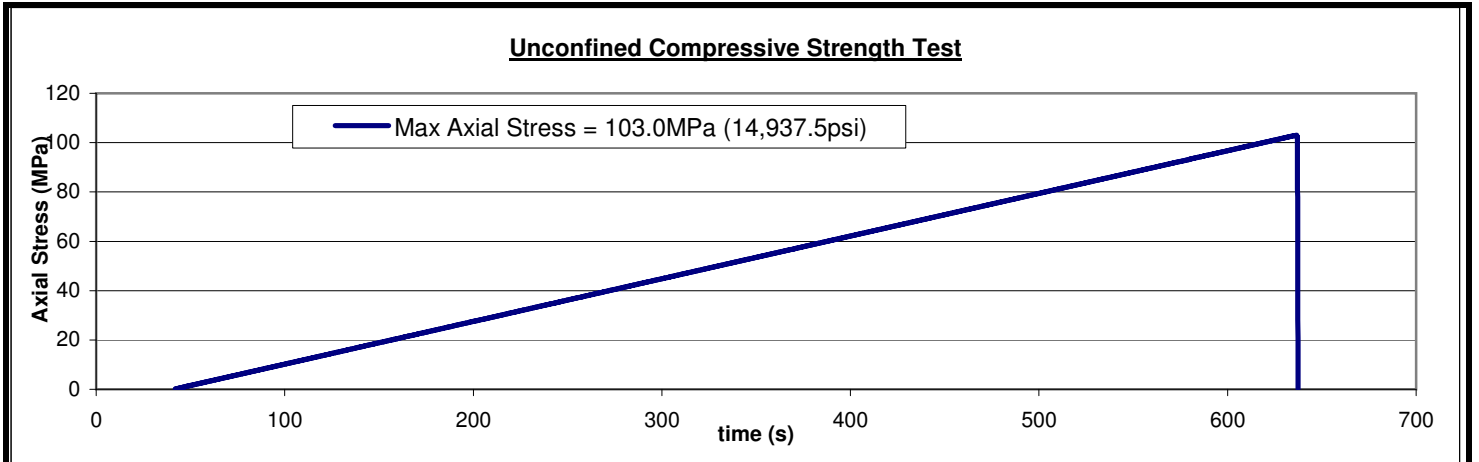
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.65	2889.0	131.32	2.2	116.7	40.4	5,857.1





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-23GT	Before Test 	After Test 
Sample #:	UCS-23-2		
Depth (m):	26.25 - 26.47		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	45.04		
Poisson Ratio, ν	0.26		
Failure Mode:	Shear		

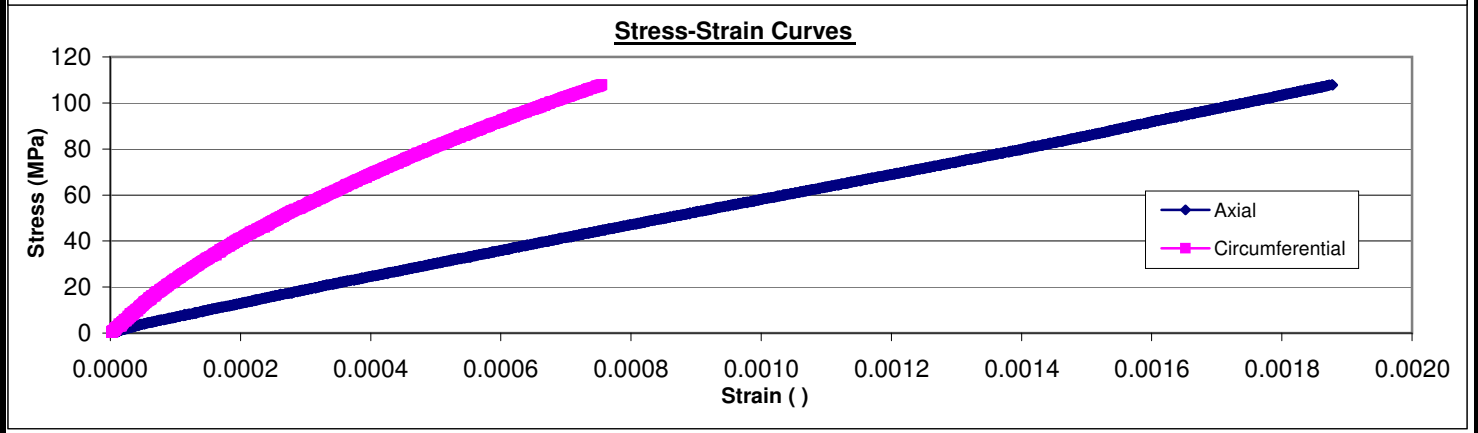
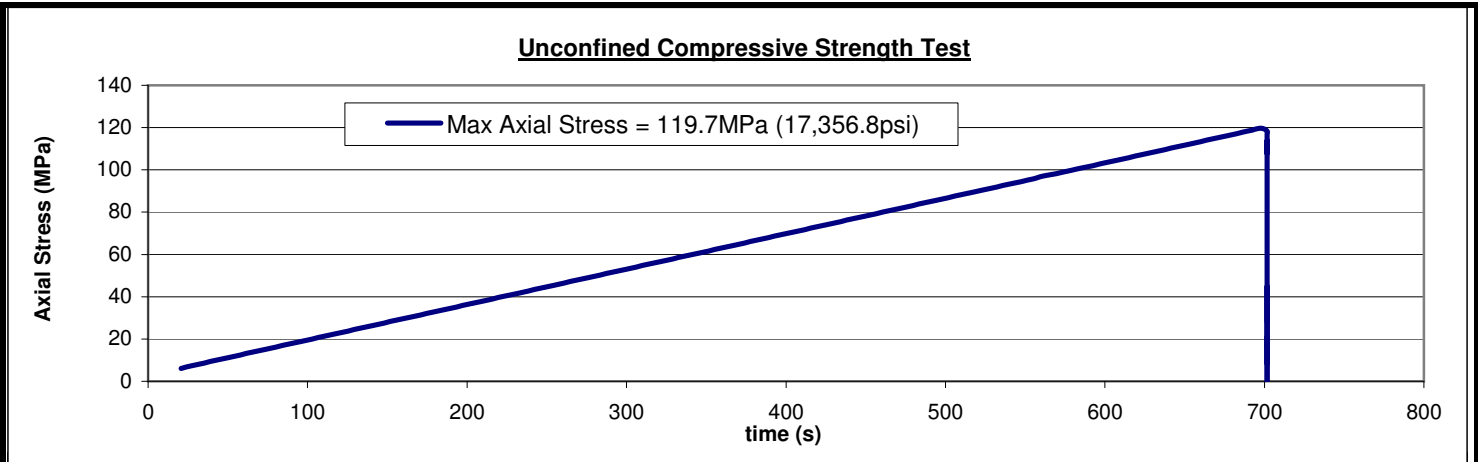
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.66	2890.0	134.74	2.2	297.7	103.0	14,937.5



**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-23GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-23-3	
Depth (m):	32.81 - 33.10	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	56.08	
Poisson Ratio, ν	0.28	
Failure Mode:	Explosive	

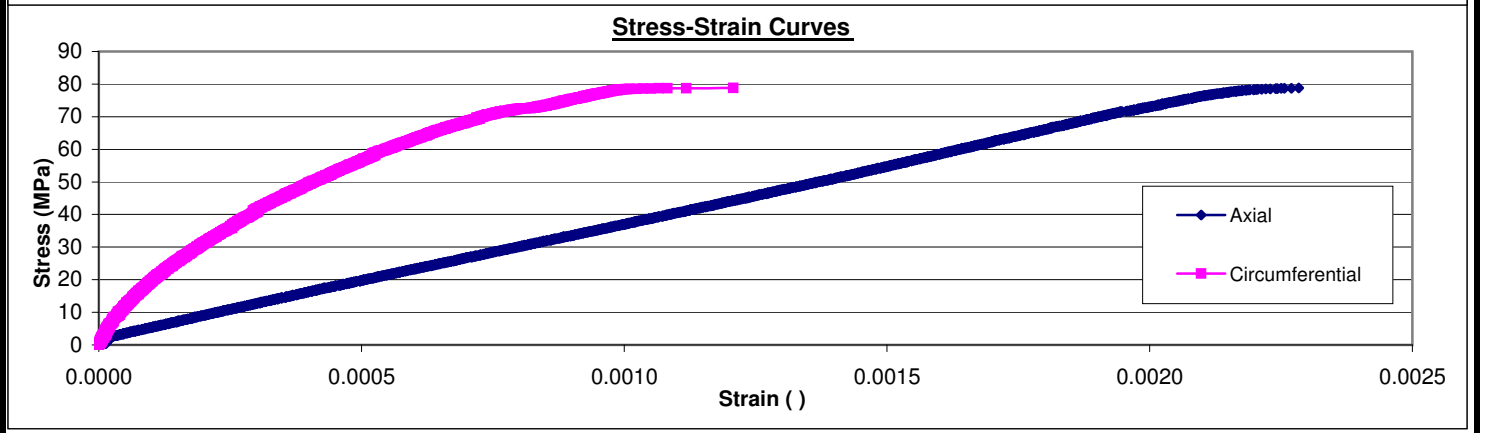
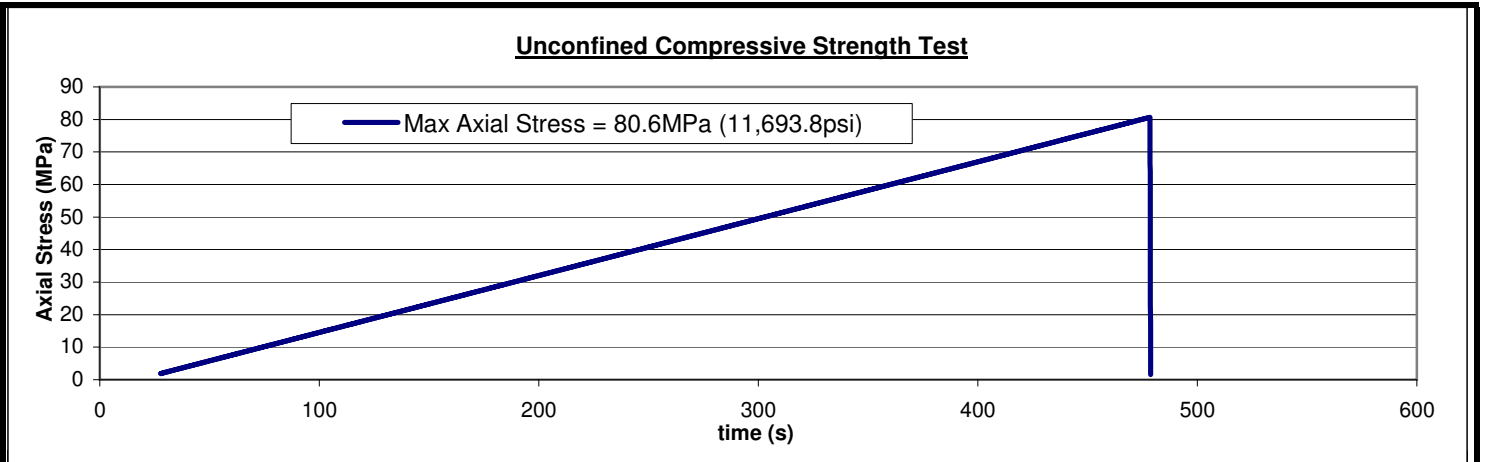
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.63	2887.1	131.92	2.18	345.6	119.7	17,356.8



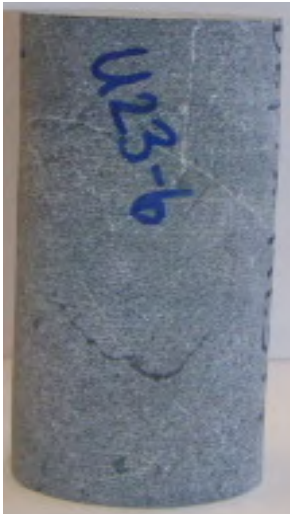

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-23GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-23-5	
Depth (m):	53.15 - 53.40	
Rock Type:	Greywacke	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	35.39	
Poisson Ratio, ν	0.28	
Failure Mode:	Explosive/Shear	

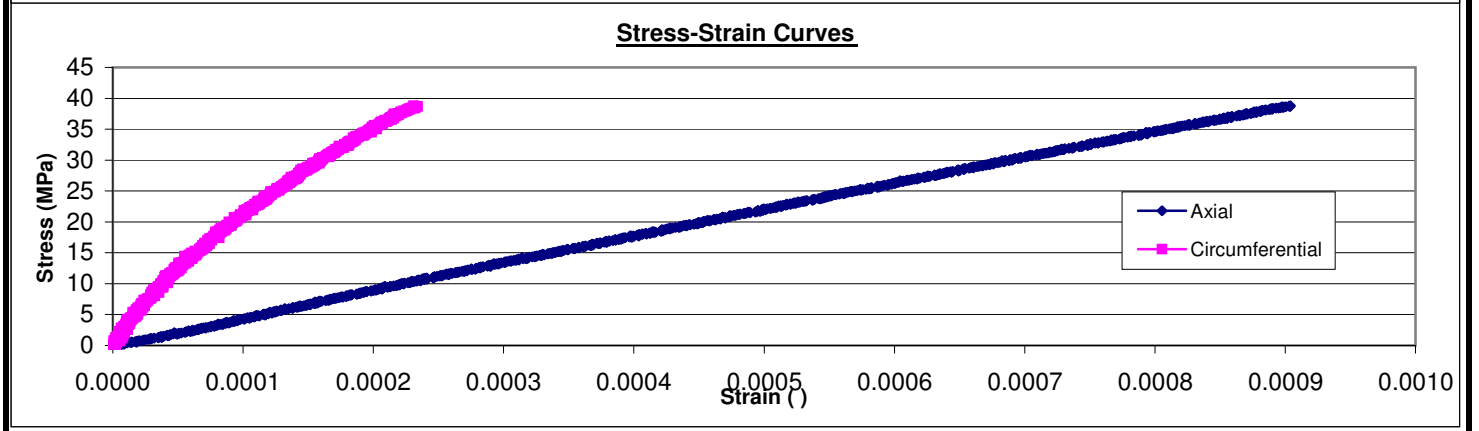
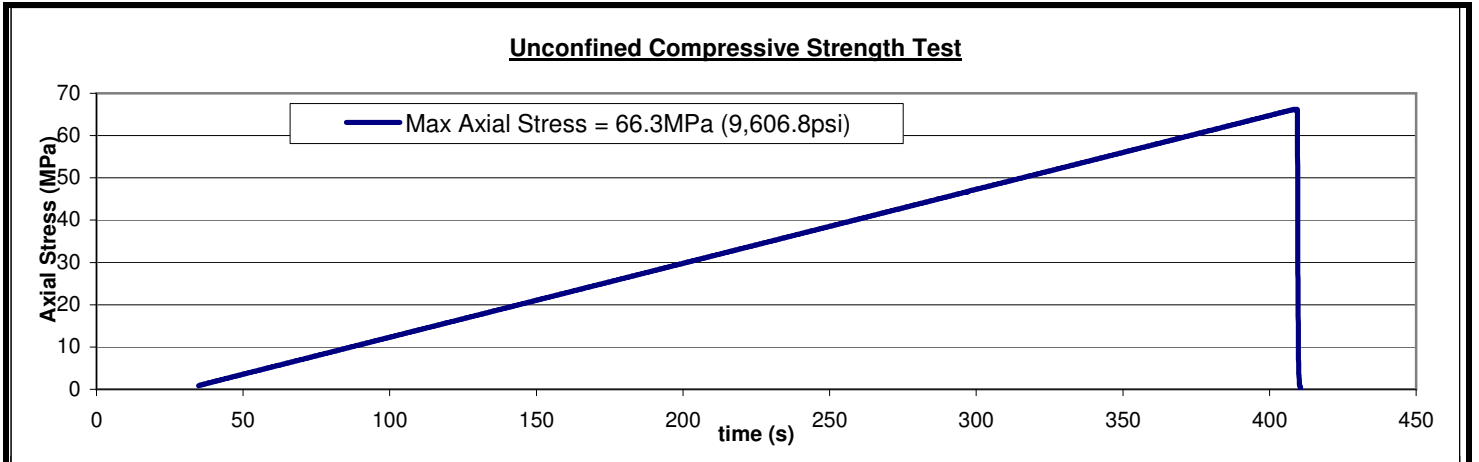
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.35	2860.5	135.08	2.24	230.7	80.6	11,693.8




**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-23GT		
Sample #:	UCS-23-6		
Depth (m):	62.83 - 63.09		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	43.17		
Poisson Ratio, ν	0.24		
Failure Mode:	Shear		

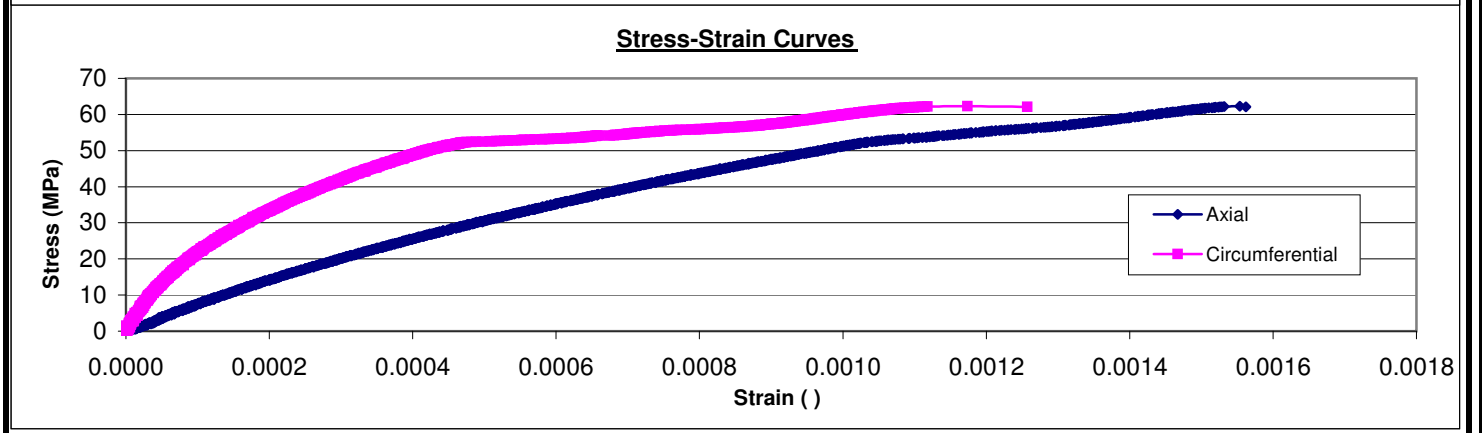
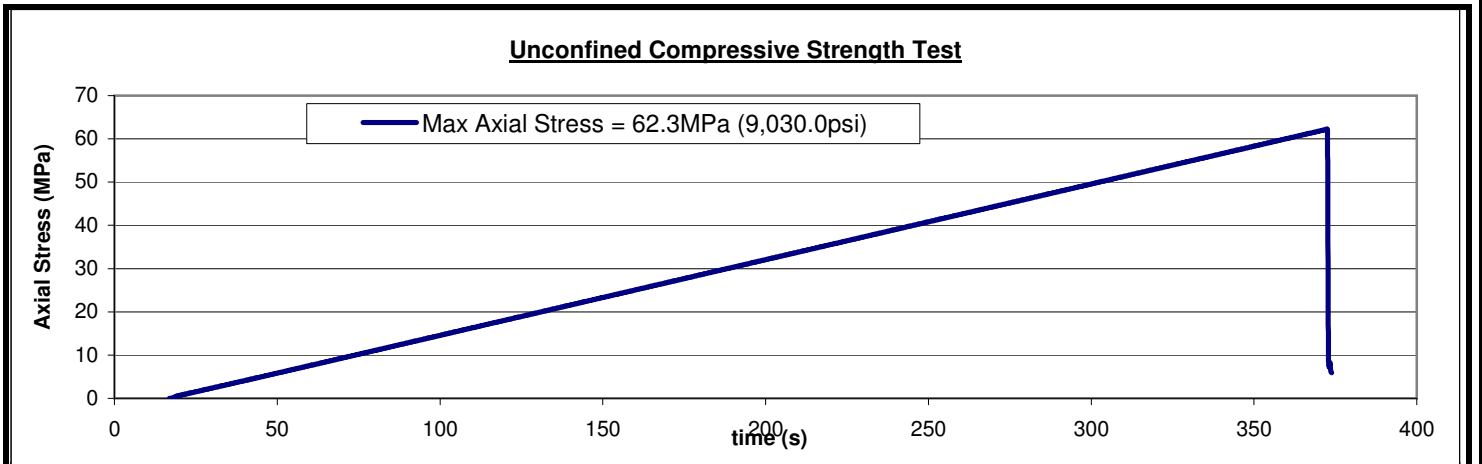
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.35	2860.5	134.47	2.2	189.5	66.3	9,606.8





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-23GT	Before Test No Photo Available	After Test 
Sample #:	UCS-23-7		
Depth (m):	70.47 - 70.77		
Rock Type:	Greywacke		
Test Date:	September, 2010		
Young Modulus, E (GPa)	53.36		
Poisson Ratio, ν	0.31		
Failure Mode:	Shear		

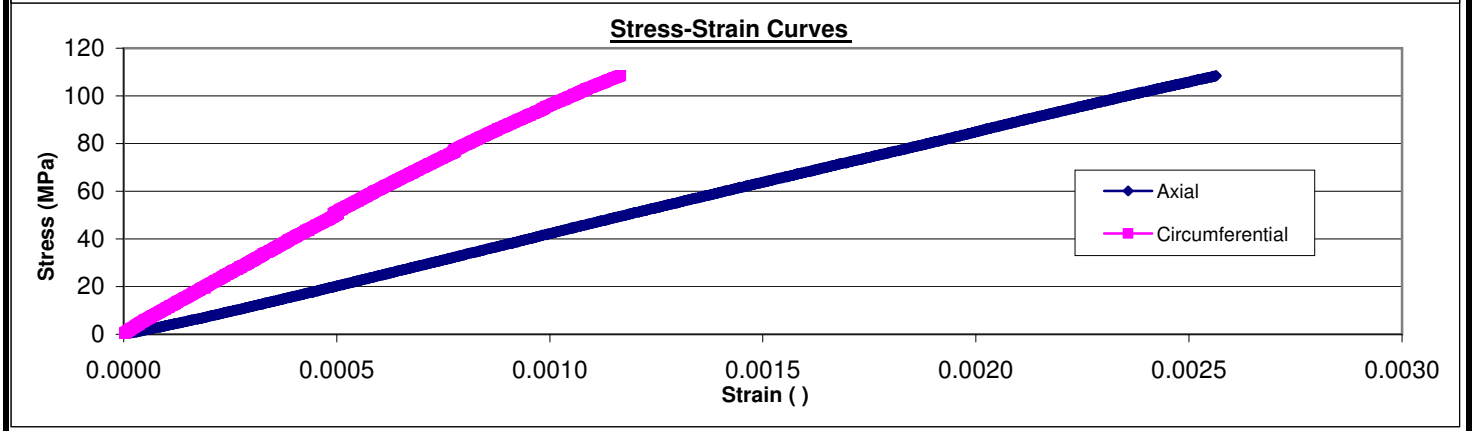
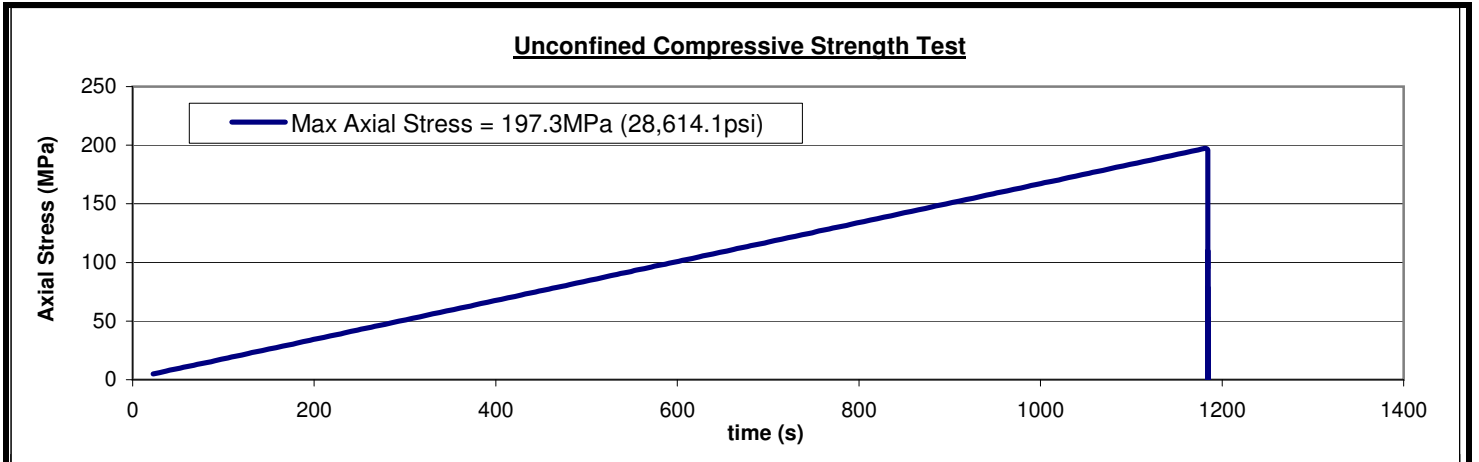
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.33	2858.6	143.87	2.4	178.0	62.3	9,030.0





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-24GT	Before Test  After Test 
Sample #:	UCS-24-2	
Depth (m):	15.09 - 15.31	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	42.96	
Poisson Ratio, ν	0.43	
Failure Mode:	Explosive	

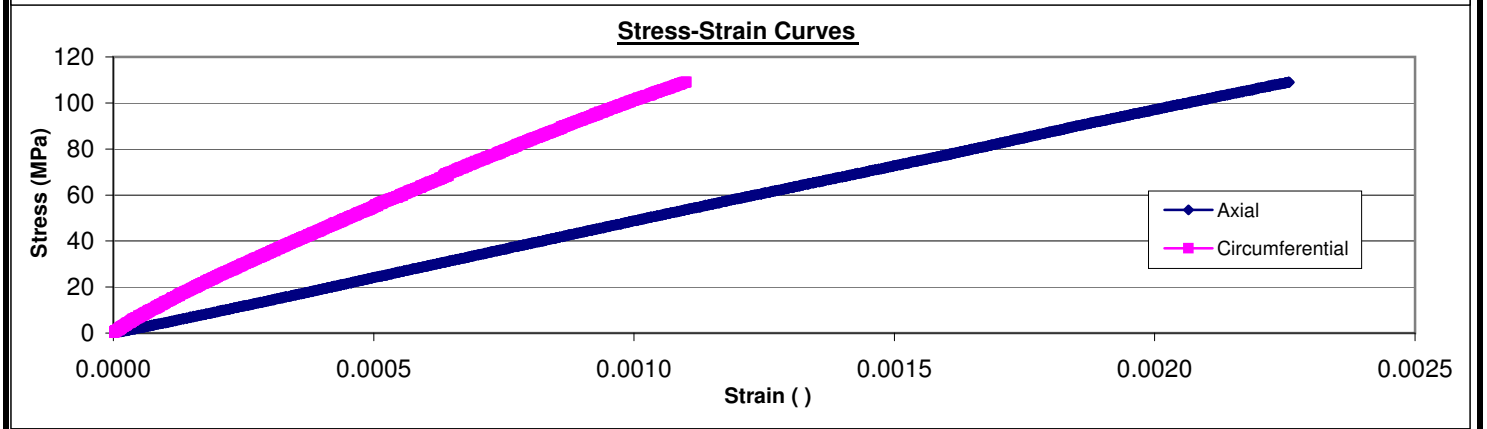
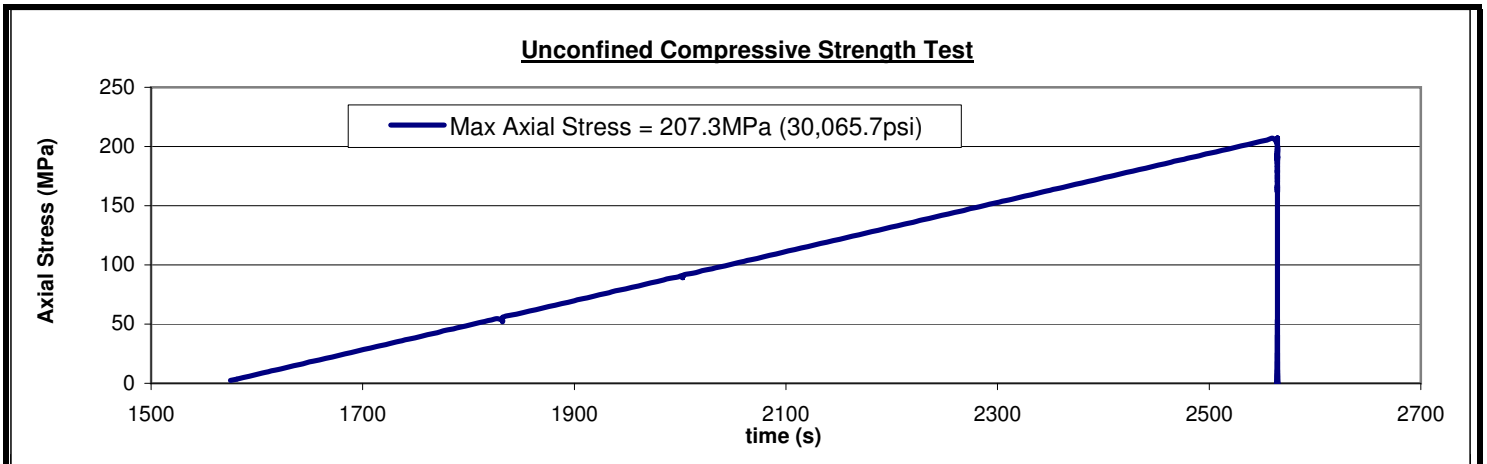
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.91	2913.8	134.27	2.20	575.0	197.3	28,614.1





**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-24GT	Before Test 	After Test 
Sample #:	UCS-24-3		
Depth (m):	22.80 - 22.98		
Rock Type:	Trachyandesite		
Test Date:	September, 2010		
Young Modulus, E (Gpa)	48.59		
Poisson Ratio, ν	0.44		
Failure Mode:	Explosive		

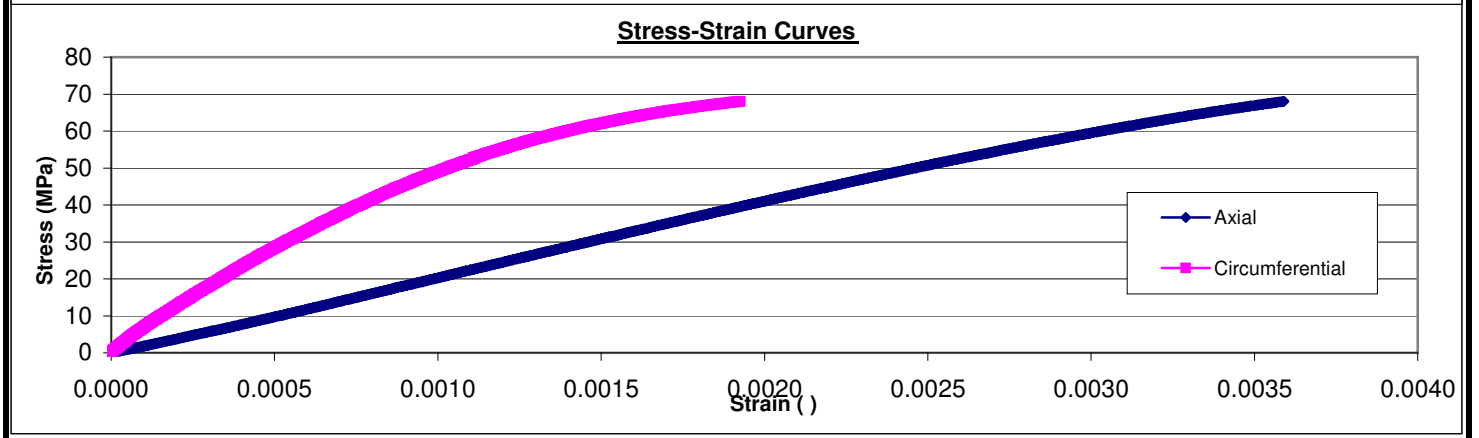
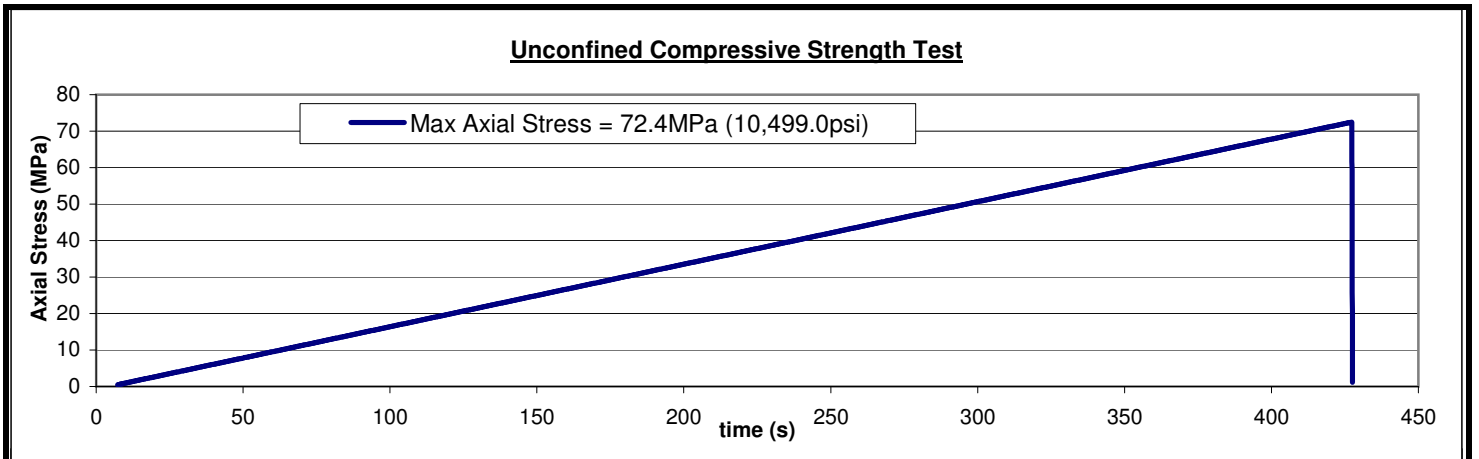
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.93	2915.8	131.56	2.16	604.6	207.3	30,065.7



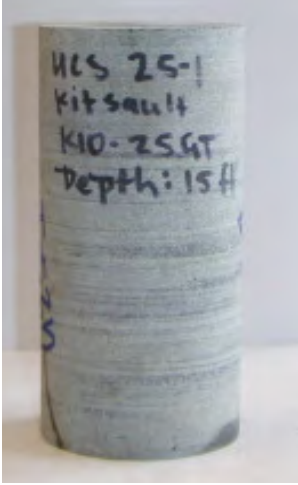

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole ID:	K10-24GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-24-4	
Depth (m):	36.00 – 36.20	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (GPa)	21.20	
Poisson Ratio, ν	0.40	
Failure Mode:	Shear	

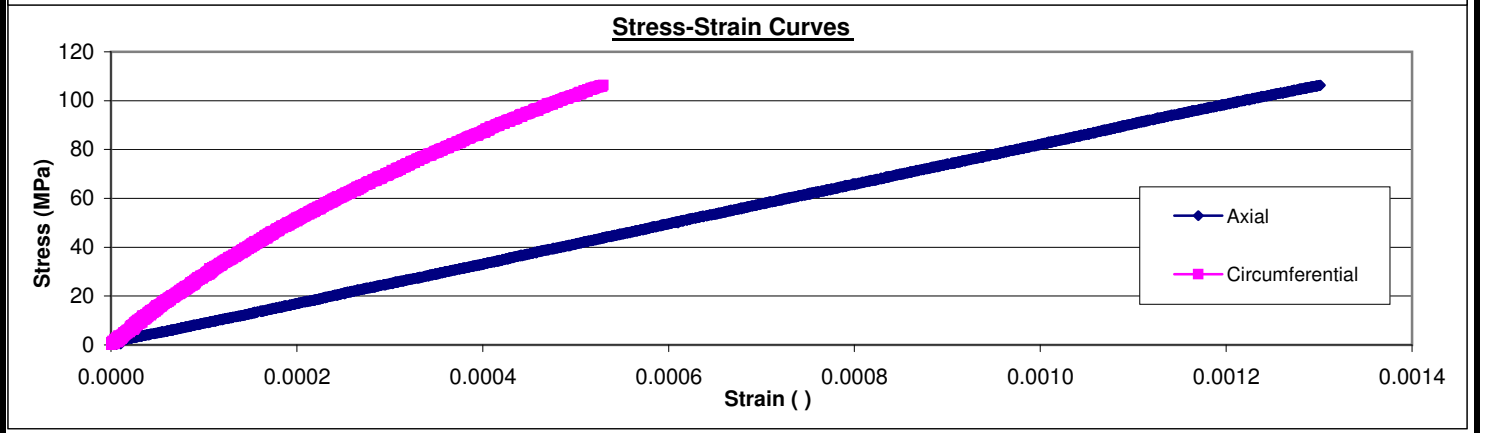
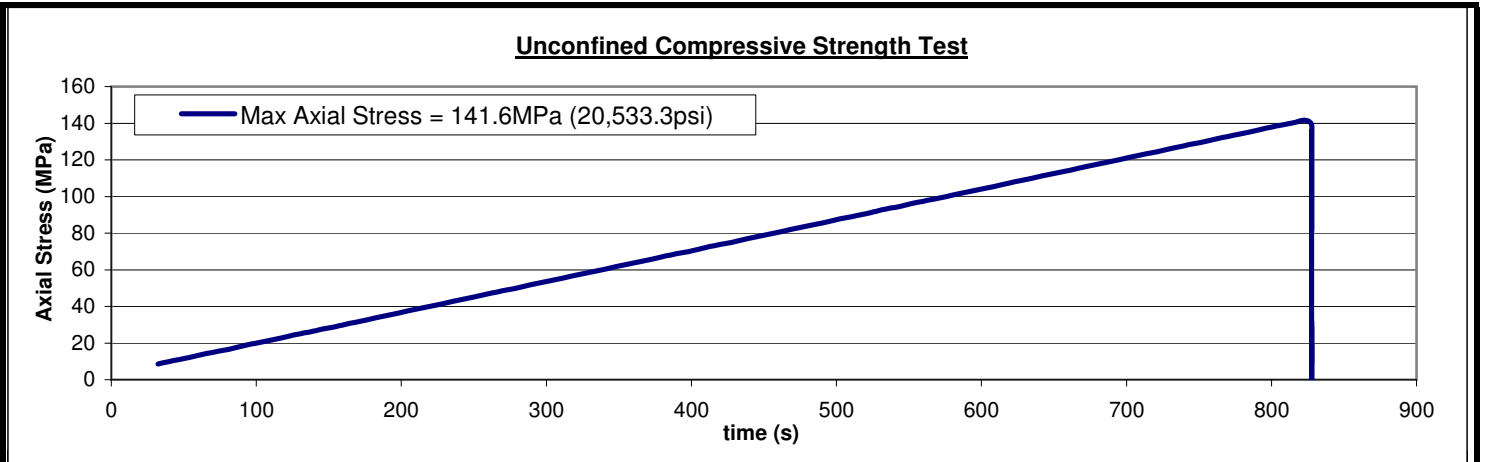
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.94	2916.7	134.86	2.2	211.2	72.4	10,499.0



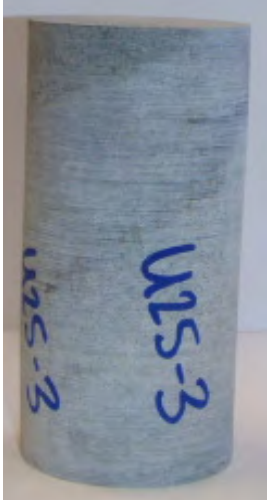

**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-25GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-25-1	
Depth (m):	4.57 - 4.90	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	45.99	
Poisson Ratio, ν	0.37	
Failure Mode:	Explosive/Shear	

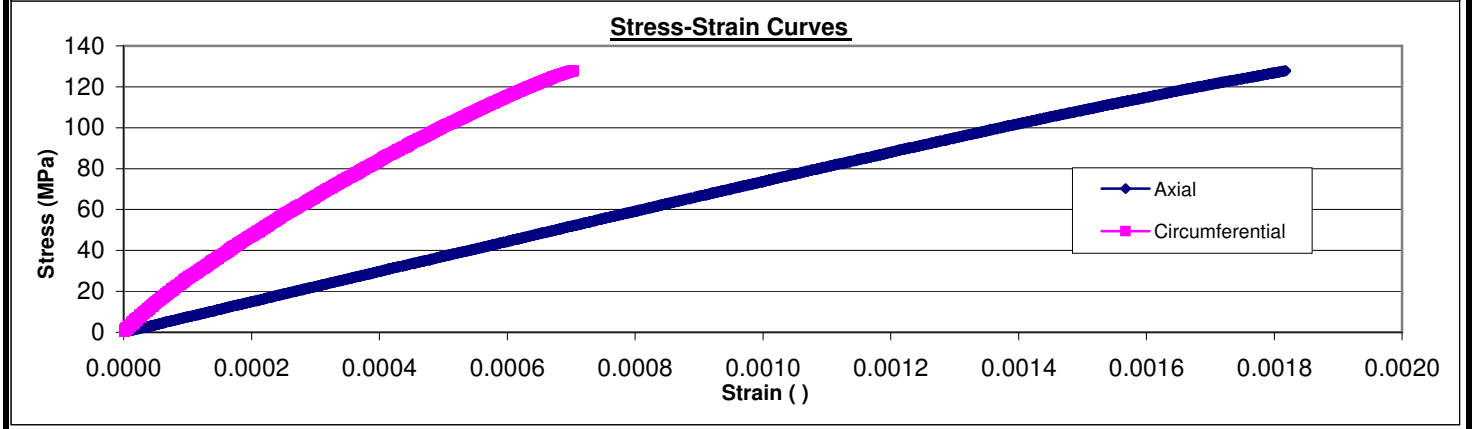
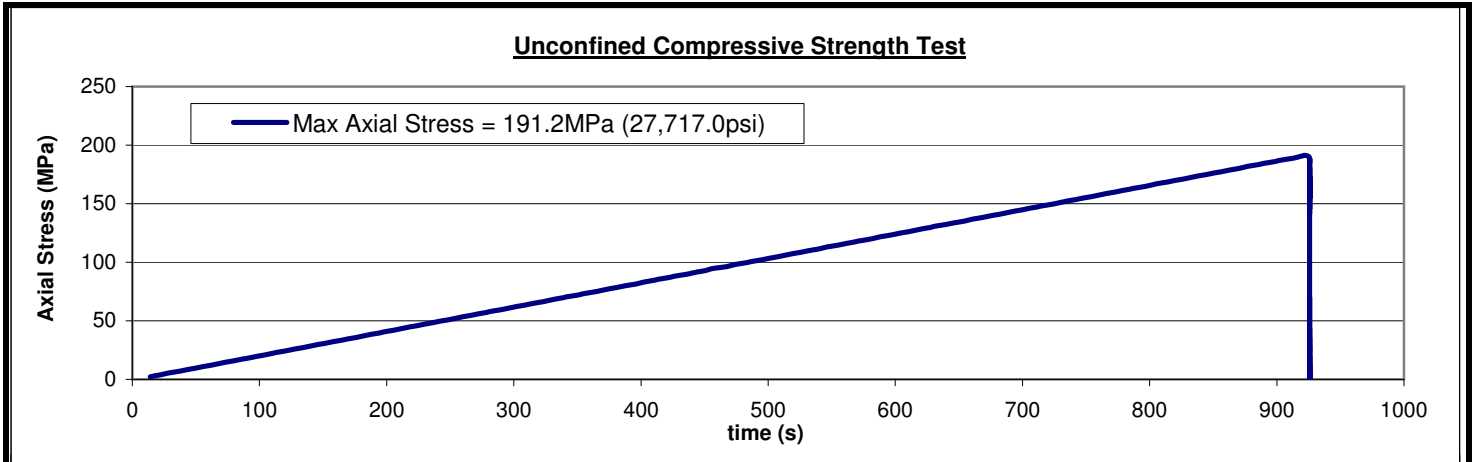
Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.46	2871.0	133.57	2.21	406.6	141.6	20,533.3



**ELASTIC MODULUS AND UNCONFINED COMPRESSIVE STRENGTH TEST
(ISRM-1979)**

Borehole #:	K10-25GT	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before Test</p>  </div> <div style="text-align: center;"> <p>After Test</p>  </div> </div>
Sample #:	UCS-25-3	
Depth (m):	22.8 -22.98	
Rock Type:	Trachyandesite	
Test Date:	September, 2010	
Young Modulus, E (Gpa)	30.01	
Poisson Ratio, ν	0.30	
Failure Mode:	Explosive	

Diameter, (ϕ)	Area, (A)	Height, (h)	Ratio	Peak Load	σ_{UCS}	
(mm)	(mm ²)	(mm)	h/ ϕ	(kN)	(MPa)	(psi)
60.86	2909.1	132.60	2.18	556.1	191.2	27,717.0



APPENDIX D3

PETROGRAPHIC STUDY OF TRACHYANDESITES AND SEDIMENTS

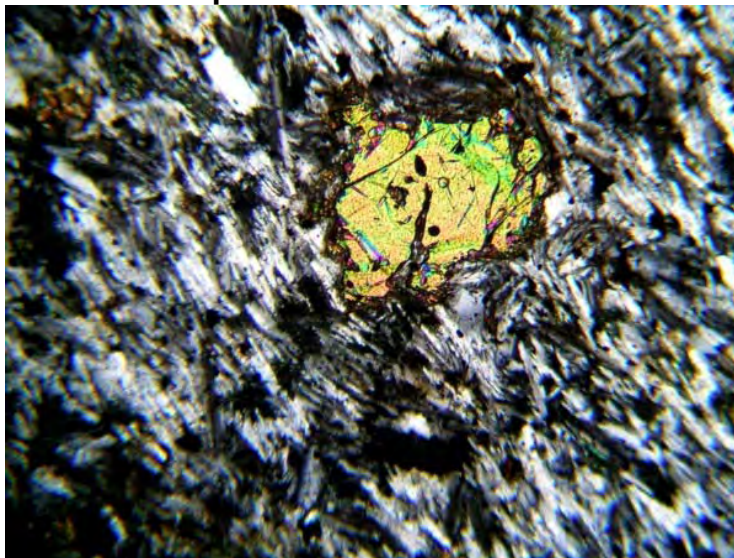
(Page D3-1 to D3-45)

PETROGRAPHIC STUDY OF A SUITE OF
TRACHYANDESITES AND SEDIMENTS
ADJACENT TO THE KITSAULT MOLYBDENUM
DEPOSIT, BRITISH COLUMBIA

Prepared For:
Robert G. Blair
Vice President Exploration
AVANTI MINING SERVICES INC.

June 22, 2010

**5-27-3. Olivine (fayalite) phenocryst in anorthoclase matrix of trachyandesite.
X-axis of photo: 1.5mm. Crossed nicols.**



Prepared by:
Eva S. Schandl Ph.D
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INTRODUCTION

The present petrographic study is based on a set of eleven samples, collected adjacent to the Kitsault molybdenite deposit in British Columbia. The suite includes seven unaltered volcanic rocks, three sediments, and one extensively altered feldspar porphyry.

The objectives of the study are:

1. To determine the mineralogy of the volcanic rocks
2. To identify the volcanic rocks
3. To determine if the sediments are crystal tuffs,
4. To describe the style of alteration in the intrusive porphyry.

Analytical Techniques

The suite of polished thin sections were examined under a petrographic microscope, using reflected and transmitted lights. Selected minerals from the thin sections were analyzed by an ETEC electron microprobe to positively identify some of the key minerals, and to determine the composition of the matrix and phenocrysts in the volcanic rocks. The above were essential for the accurate classification of the volcanics.

DISCUSSION

The mineralogy and texture of the rocks are described in detail in the "Petrography" section, and important features are demonstrated by photomicrographs. The visually estimated % minerals in individual samples are shown in Table 1, and microprobe analysis of selected minerals, in Table 2.

Lithology

Three rocks types were identified; trachyandesite, greywacke, and an altered feldspar porphyry. The trachyandesite is an extensively fractionated alkalic rock that consists predominantly of anorthoclase matrix, having trachytic texture, with lesser interstitial fine-grained aegirine-augite, phenocrysts of fayalite olivine, sanidine, minor nepheline, and aegirine-augite. The mineralogy and texture of the trachyandesite suggests, a) deep-seated source for a very hot magma, and b) long-time residence of magma in the magma chamber, where extensive crystallization produced the highly fractionated Fe-rich olivine. The low TiO₂, MgO, the high alkalis and Fe₂O₃ concentrations would be consistent with a highly fractionated magma. The rocks are variably oxidized.

The sediments are greywacke (of variable grain size). They consist of angular quartz and feldspar clasts and an abundance of lithic fragments. One sample is coarse-grained and consists of large, unsorted clasts and lithic fragments, reaching the grain size of a conglomerate (3mm).

One coarse-grained, extensively altered (sericite/illite and carbonate) feldspar porphyry is included in the suite of 11 samples.

Mineralogy

The trachyandesite has unusual mineralogy. The matrix microlitic **anorthoclase** composition is often transitional between sanidine and anorthoclase, and small, **nepheline** phenocrysts are associated with **sanidine** phenocrysts. The most common phenocrysts are subhedral / euhedral **olivine**, and the olivine is the Fe-rich end member, fayalite. **Aegirine-augite** mostly occurs as fragmented aggregates interstitial to the trachytic anorthoclase, and less commonly, as phenocrysts. Fine-grained **titanomagnetite** is disseminated through the matrix.

The greywackes all have comparable mineralogy, although there is a difference in grain size and sorting. The rocks consist of angular **quartz**, **plagioclase** and **orthoclase** clasts, and **lithic fragments** of chert, minor volcanics and sediments. Interstitial **carbonaceous / graphitic material** is relatively common, and **sericite / illite** is present in variable proportion (not abundant). Samples 5-29-9(1), and 5-25-5A have comparable mineralogy and grain size, although 5-29-9(1) is more closely packed. All contain minor interstitial black, carbonaceous material. Although several of the quartz are angular with sharp termination, the tentative conclusion is, that, the rocks do not seem to have the chaotic mineralogy and the abundance of broken mineral clasts typical of crystal tuffs.

The feldspar porphyry is a pervasively altered rock. **Sericite or illite, carbonate** and amorphous **brown clays** are intercalated with minor **chlorite**. All **plagioclase** phenocrysts were replaced by one, or all of the above secondary minerals. **Rutile** occurs as aggregates within the chlorite-rich domains. A few grains of pyrite and chalcopyrite were identified in the matrix.

Chemistry

Whole rock geochemistry of the volcanic rocks is consistent with the geochemistry of fractionated trachyandesites. They have high alkalis (Na+K), high Fe₂O₃, intermediate SiO₂, and low MgO and TiO₂ concentrations. The high La content (50ppm or 150 times chondrite) is comparable to the steep patterns of alkali basalts / andesites.

CONCLUSIONS

The suite of 11 samples from the vicinity of the Kitsault molybdenite deposit consist of 7 volcanic rocks, 3 sediments and 1 feldspar porphyry.

The highly fractionated volcanic rocks are trachyandesite. Their mineralogy, texture and geochemistry are consistent with a fractionated alkalic rock. The rocks have trachytic texture, and the microlitic matrix consists predominantly of anorthoclase,

phenocrysts of fayalite (olivine), sanidine and nepheline. The rock has high concentration of Na₂O (5 wt%), K₂O (5 wt%), Fe₂O₃ (6-7 wt%), and La (50ppm), and low concentration of TiO₂ and MgO – all of which are consistent with the geochemistry of highly fractionated alkalic rocks. Columnar jointing is not uncommon in trachybasalts and trachyandesites.

The sediments are clast-supported greywackes having variable grain size. Sample 5-27-1 is a coarse-grained, unsorted sediment with the grain size of conglomerate, and the other two (5-29-9(1) & 5-25-5A) are more fine-grained, have comparable grain size, and are better sorted. All sediments contain minor sericite and interstitial graphite.

The feldspar porphyry is pervasively altered, and much of the plagioclase phenocrysts and matrix are replaced by sericite / illite, carbonate and amorphous, brown clays.

Table 1. Visual estimation of % minerals in individual rocks

Sample No.	5-26-1 trachy andesit e	5-26-5A sedimen t	5-26-5B trachy andesit e	5-26-6 trachy andesit e	5-27-1 sedimen t	5-27-3 trachy andesit e
Anorthoclase	80		75	85		70
Sanidine				5		6
Nepheline			3			
Quartz		30			24	
Plagioclase		60			10	
Orthoclase		5			8	
Olivine (fayalite)			3	x		6
Aegirine-augite	17		15	7		8
Sericite / illite		2			3	
Chlorite		3			x	
Carbonate			x	x	x	
Apatite				x		x
Zircon					x	
Rutile		x		x		x
Titanite		x				
Magnetite	3		2	3	x	3
Fe-hydroxide			3			7
Pyrite		x				
Chalcopyrite						
Pyrrhotite		x				
Pentlandite		x				
Graphite					x	
Lithic fragments					55	

x = trace amount

Table 1. Visual estimation of % minerals in individual rocks

Sample No.	5-27-5(1) trachy andesite	5-27-5(2) trachy andesite	5-27-5A trachy andesite	5-29-4 feldspar porphyry	5-29-9(1) sediment
Anorthoclase	80	75	82		
Sanidine		5			
Nepheline					
Quartz				x	50
Plagioclase				35	20
Orthoclase					25
Olivine (fayalite)	3	2			
Aegirine-augite	15	5	10		
Sericite / illite				25	5
Chlorite				5	x
Carbonate			x	20	
Apatite	x	x	x	x	x
Zircon				x	
Rutile	x	x			
Titanite					
Magnetite	2	3	3	5	
Fe-hydroxide	x	10	5		
Pyrite				x	x
Chalcopyrite					
Pyrrhotite					
Pentlandite					
Graphite					
Lithic fragments					
Amorphous clays				10	

x = trace amount

TABLE 2. MICROPROBE ANALYSIS OF SELECTED MINERALS

5-26-1 aegirine-augite
 ZAF cycles 5 bc drift= .942

	fac	%el	%ox	stfm
SiO2	.73	24.16	51.70	2.022
Al2O3	.60	.00	.00	.000
TiO2	.81	.00	.00	.000
FeO	.84	9.55	12.28	.402
MnO	.82	.91	1.18	.039
MgO	.52	6.02	9.98	.582
CaO	.87	15.28	21.37	.896
Na2O	.37	.70	.94	.071
Total		56.62	97.45	6

5-26-1 anorthoclase groundmass
 ZAF cycles 6 bc drift= .945

	fac	%el	%ox	stfm
SiO2	.71	30.97	66.25	11.743
Al2O3	.71	10.73	20.27	4.235
Na2O	.49	6.00	8.09	2.780
K2O	.83	3.69	4.45	1.006
CaO	.82	.56	.79	.149
FeO	.83	.61	.79	.117
Total		52.56	100.63	32

5-26-1 sanidine lath
 ZAF cycles 6 bc drift= .935

	fac	%el	%ox	stfm
SiO2	.72	30.77	65.82	11.799
Al2O3	.72	10.41	19.66	4.155
Na2O	.48	5.22	7.03	2.445
K2O	.83	5.81	6.99	1.600
CaO	.81	.23	.32	.062
FeO	.83	.43	.55	.082
Total		52.86	100.38	32

5-26-5b nepheline phenocryst
 ZAF cycles 7 bc drift= .971

	fac	%el	%ox	stfm
SiO2	.64	22.29	47.69	8.977
Al2O3	.67	16.43	31.04	6.888
Na2O	.51	13.04	17.58	6.416
K2O	.84	2.64	3.18	.764
FeO	.84	.61	.78	.123
Total		55.01	100.27	32

5-26-5b anorthoclase lath

ZAF cycles	7	bc drift=	.959	
	fac	%el	%ox	stfm
SiO2	.71	31.49	67.36	11.928
Al2O3	.72	10.30	19.46	4.062
Na2O	.49	6.20	8.35	2.867
K2O	.83	4.02	4.84	1.095
FeO	.83	.36	.46	.068
Total		52.36	100.48	32

5-26-5b anaorthoclase lath

ZAF cycles	7	bc drift=	.946	
	fac	%el	%ox	stfm
SiO2	.71	31.74	67.90	11.870
Al2O3	.72	10.60	20.02	4.126
Na2O	.49	6.58	8.88	3.009
K2O	.83	3.76	4.53	1.009
FeO	.83	.32	.41	.059
Total		52.99	101.73	32

5-26-5b anorthoclase lath

ZAF cycles	6	bc drift=	.944	
	fac	%el	%ox	stfm
SiO2	.72	31.77	67.96	11.920
Al2O3	.72	10.32	19.49	4.030
Na2O	.49	5.23	7.06	2.399
K2O	.83	6.40	7.71	1.726
FeO	.83	.27	.34	.051
Total		53.99	102.57	32

5-26-5b fayalite phenocryst

ZAF cycles	4	bc drift=	.942	
	fac	%el	%ox	stfm
SiO2	.63	14.20	30.38	.993
FeO	.90	47.38	60.95	1.666
MgO	.37	2.80	4.65	.226
MnO	.89	2.50	3.22	.089
CaO	.92	.68	.95	.033
Total		67.56	100.15	4

5-26-5b fayalite (olivine) phenocryst

ZAF cycles	4	bc drift=	.939	
	fac	%el	%ox	stfm
SiO2	.63	14.33	30.65	.987
FeO	.90	47.36	60.93	1.641
MgO	.37	3.38	5.60	.269
MnO	.89	2.35	3.03	.083
CaO	.92	.71	.99	.034
Total		68.12	101.20	4

5-26-5b aegerine-augite

ZAF cycles	5	bc drift=	.934	
	fac	%el	%ox	stfm
SiO2	.72	23.05	49.30	1.992
Al2O3	.59	.56	1.06	.050
TiO2	.83	.22	.37	.011
FeO	.85	17.36	22.33	.754
MnO	.83	.54	.70	.024
MgO	.48	2.24	3.72	.224
CaO	.88	14.23	19.91	.862
Na2O	.33	1.02	1.37	.107
K2O	.90	.00	.00	.000
Total		59.21	98.75	6

5-26-6 anorthoclase phenocryst

ZAF cycles	6	bc drift=	.941	
	fac	%el	%ox	stfm
SiO2	.71	30.06	64.31	11.601
Al2O3	.72	11.00	20.78	4.419
Na2O	.48	5.21	7.02	2.457
K2O	.83	4.11	4.95	1.140
CaO	.82	1.23	1.72	.332
FeO	.83	.19	.24	.037
Total		51.80	99.02	32

5-26-6 anorthoclase phenocryst

ZAF cycles	6	bc drift=	.956	
	fac	%el	%ox	stfm
SiO2	.72	30.38	64.98	11.789
Al2O3	.72	10.33	19.52	4.175
Na2O	.48	4.81	6.48	2.281
K2O	.84	6.16	7.43	1.719
CaO	.81	.40	.56	.108
FeO	.83	.26	.33	.050
Total		52.34	99.31	32

5-26-6 sanidine

ZAF cycles	6	bc drift=	.956	
	fac	%el	%ox	stfm
SiO2	.72	30.38	64.98	11.789
Al2O3	.72	10.33	19.52	4.175
Na2O	.48	4.81	6.48	2.281
K2O	.84	6.16	7.43	1.719
CaO	.81	.40	.56	.108
FeO	.83	.26	.33	.050
Total		52.34	99.31	32

6-26-6 groundmas sanidine/anorthoclase

ZAF cycles 6 bc drift= .951
fac %el %ox stfm
SiO2 .71 30.39 65.02 11.645
Al2O3 .72 10.89 20.57 4.344
Na2O .48 5.29 7.13 2.475
K2O .83 4.66 5.61 1.282
CaO .82 .87 1.22 .234
FeO .83 .41 .53 .079
Total 52.51 100.07 32

6-26-6 fayalite phenocryst

ZAF cycles 4 bc drift= .942
fac %el %ox stfm
SiO2 .63 14.82 31.70 8.037
FeO .90 44.48 57.23 12.134
MnO .88 2.47 3.20 .686
MgO .38 4.61 7.64 2.886
CaO .91 .58 .81 .219
Total 66.96 100.57 32

6-26-6 fayalite phenocryst

ZAF cycles 4 bc drift= .935
fac %el %ox stfm
SiO2 .62 14.61 31.26 .983
FeO .90 45.28 58.26 1.532
MnO .88 2.47 3.19 .085
MgO .38 5.00 8.29 .388
CaO .91 .60 .84 .028
Total 67.97 101.84 4

5-27-3 fayalite phenocryst

ZAF cycles 4 bc drift= .942
fac %el %ox stfm
SiO2 .63 14.53 31.08 .996
FeO .90 46.54 59.88 1.604
MnO .89 2.64 3.41 .093
MgO .37 3.46 5.74 .274
CaO .92 .79 1.10 .038
Total 67.96 101.21 4

5-27-3 sanidine

ZAF cycles 6 bc drift= .953
fac %el %ox stfm
SiO2 .72 30.98 66.28 11.813
Al2O3 .72 10.45 19.74 4.148
Na2O .49 5.44 7.34 2.535
K2O .83 6.14 7.40 1.682
CaO .81 .00 .00 .000
FeO .83 .22 .28 .042
Total 53.23 101.04 32

5-27-5(2) sanidine/anorthoclase phenocryst

ZAF cycles 6 bc drift= .937

	fac	%el	%ox	stfm
SiO2	.71	31.11	66.56	11.735
Al2O3	.72	10.69	20.20	4.198
Na2O	.48	5.45	7.35	2.512
K2O	.83	5.22	6.29	1.416
CaO	.82	.58	.81	.153
FeO	.83	.60	.77	.114
Total		53.66	101.98	32

5-27-5(2) nepheline phenocryst

ZAF cycles 7 bc drift= .944

	fac	%el	%ox	stfm
SiO2	.63	21.83	46.71	8.822
Al2O3	.66	16.66	31.48	7.008
Na2O	.51	13.33	17.97	6.582
K2O	.84	2.41	2.90	.699
CaO	.83	.00	.00	.000
FeO	.84	.99	1.28	.202
Total		55.22	100.34	32

5-27-5(2) sanidine/anorthoclase

ZAF cycles 6 bc drift= .941

	fac	%el	%ox	stfm
SiO2	.72	30.75	65.79	11.724
Al2O3	.72	10.78	20.37	4.278
Na2O	.48	5.16	6.96	2.403
K2O	.83	5.47	6.58	1.497
CaO	.82	.46	.64	.122
FeO	.83	.32	.41	.060
Total		52.93	100.74	32

PETROGRAPHY

(with photomicrographs)

Ppl = Plane polarized light

XN = crossed nicols

Refl. light = Reflected light

Sample Number: 5-26-1

Rock Type: Trachyandesite

Petrographic Description:

Fine-grained, weakly oxidized, slightly porphyritic rock with trachytic texture. The rock is unaltered, and consists predominantly of slender prisms of anorthoclase, a few small phenocrysts of aegirine-augite, interstitial, fine-grained aegirine-augite as groundmass, and fine-grained magnetite. The anorthoclase occur as slender microlitic prisms, they form platy aggregates and have a stacked arrangement. Some occur as radiating aggregates and the crystals are often bent, and have flow texture. The highly pleochroic green clinopyroxene phenocrysts are subhedral to anhedral stubby grains, and the fine-grained anhedral clinopyroxene are interstitial to the plagioclase.

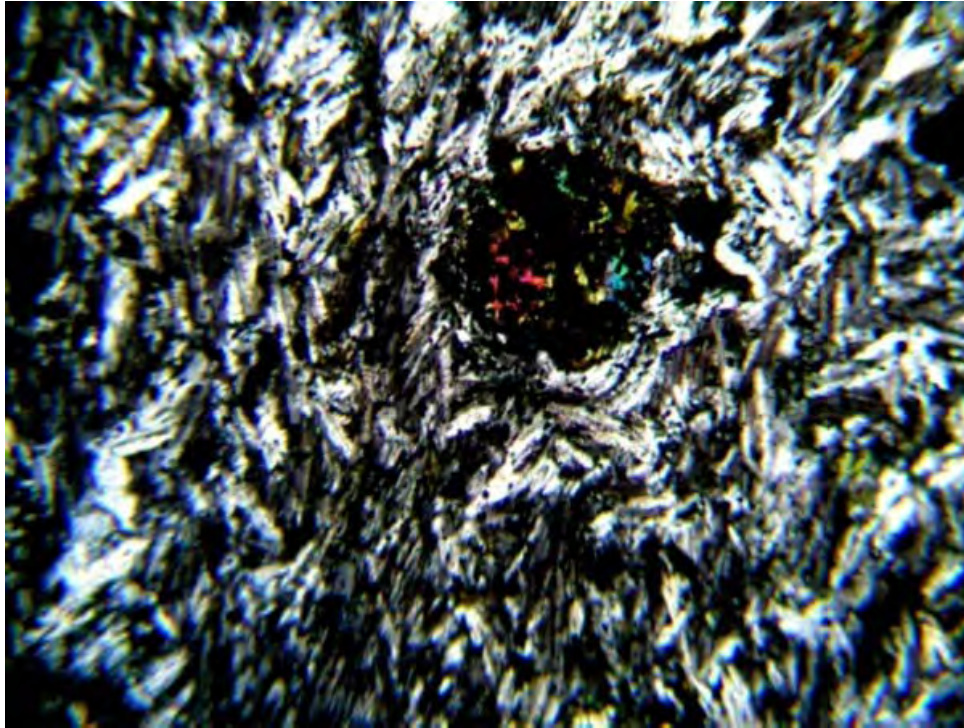
Magnetite is relatively abundant. Fine-grained titanomagnetite is disseminated through the thin section. Some of the subhedral grains have the size of phenocrysts, but most occur as small, anhedral grains interstitial to the feldspars. Most clinopyroxene phenocrysts are partly replaced by fine-grained magnetite.

Detailed mineralogy

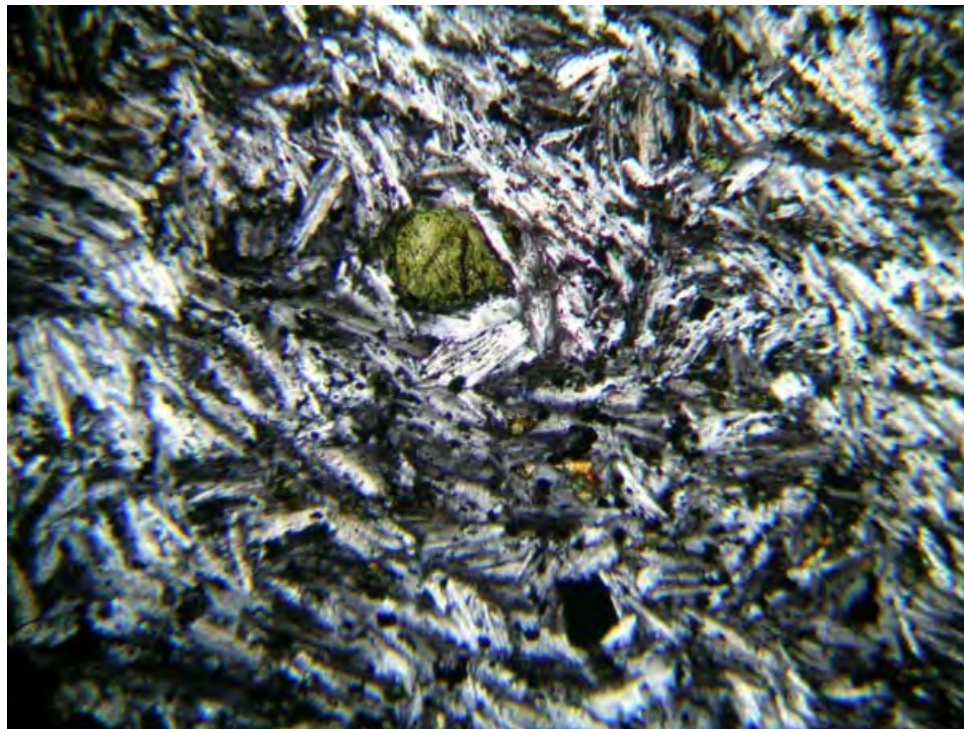
Mineral	%	Grain size(mm)	Comments
Anorthoclase	80	Av. 0.3	Slender prisms of anorthoclase resemble plagioclase, but they have poorly defined twinning. Some are zoned, and most are slightly bent. Small, needle-shaped apatite occurs as inclusions in some anorthoclase.
Aegirine-augite	17	0.05-0.3	Subhedral, highly pleochroic green aegirine-augite phenocrysts are randomly distributed through the thin section. Most are rimmed by or partly replaced by fine-grained magnetite. Matrix aegirine-augite is also strongly pleochroic (green), and vary in size between <0.05 to 0.1 mm. The larger, anhedral grains are elongate prisms and parallel the texture of the anorthoclase.
Magnetite	3	0.05-0.15	Very fine-grained titanomagnetite is disseminated through the thin section. They are interstitial to the anorthoclase, and the somewhat larger grains partly replace the pyroxene phenocrysts. Some magnetite occur as up to 0.15mm size

subhedral 'phenocrysts' interstitial to the trachytic anorthoclase.

Accessory minerals: apatite



Aegirine-augite phenocryst in center is partly replaced by magnetite (black). Matrix is anorthoclase. X-axis of photo: 1.5mm. XN.



Aegirine-augite (green) and sanidine (arrow) phenocrysts in anorthoclase matrix. X-axis of photo: 1.5mm. XN.

Sample Number: 5-26-5A

Rock Type: Greywacke

Petrographic Description:

A relatively well sorted sediment. The rock consists predominantly of plagioclase, K-feldspar, quartz, lesser pyrite, and pyrrhotite. The anhedral crystals are stubby, anhedral, and mostly angular. Some of the feldspars contain minute grains of illite and some partly recrystallized to fine-grained aggregates. Angular quartz is interstitial to the feldspars, and several have embayed grain boundaries. The rock also contains poorly defined lithic fragments that consist of quartz and feldspars. Carbonaceous material (graphite-like) is interstitial, and the microcrystalline 'graphite' over-prints some of the feldspar aggregates. This fine-grained 'graphite' dust is also intergrown with fine-grained chlorite. The chlorite-graphite domains occur as cement between crystals in some domains of the thin section. Minute, poorly defined veinlets and aggregates of muscovite are interstitial to the quartz and feldspars. A few small grains of rutile and titanite are also interstitial to the quartz and feldspars.

Anhedral pyrite (mottled, sedimentary) and anhedral pyrrhotite with minor pentlandite are interstitial to the silicates. Some pyrite are framboids.

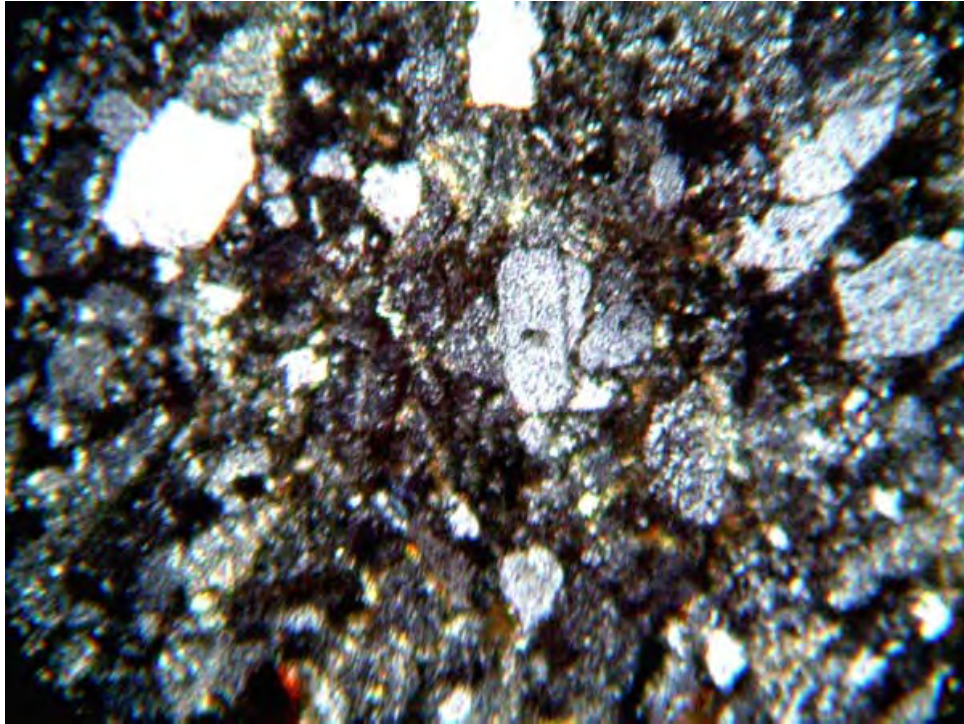
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Plagioclase	60	0.05-0.3	Small, anhedral grains of plagioclase occur as equant, stubby grains. Their faint twinning suggests oligoclase composition. Some of the grains contain an abundance of microcrystalline illite as replacement. Some plagioclase are partly recrystallized to fine-grained, blocky, angular aggregates.
K-feldspar	5	Av. 0.1	K-feldspars are less common than the plagioclase, but the texture and mode of occurrence are similar. The K-feldspars (most likely orthoclase) also contain a relative abundance of fine-grained inclusions of illite. They have single twinning.
Quartz	30	Microcrystalline-0.3	Quartz generally occurs as angular grains, some with embayed grain boundaries. Some quartz partly or completely recrystallized to fine-grained aggregates.

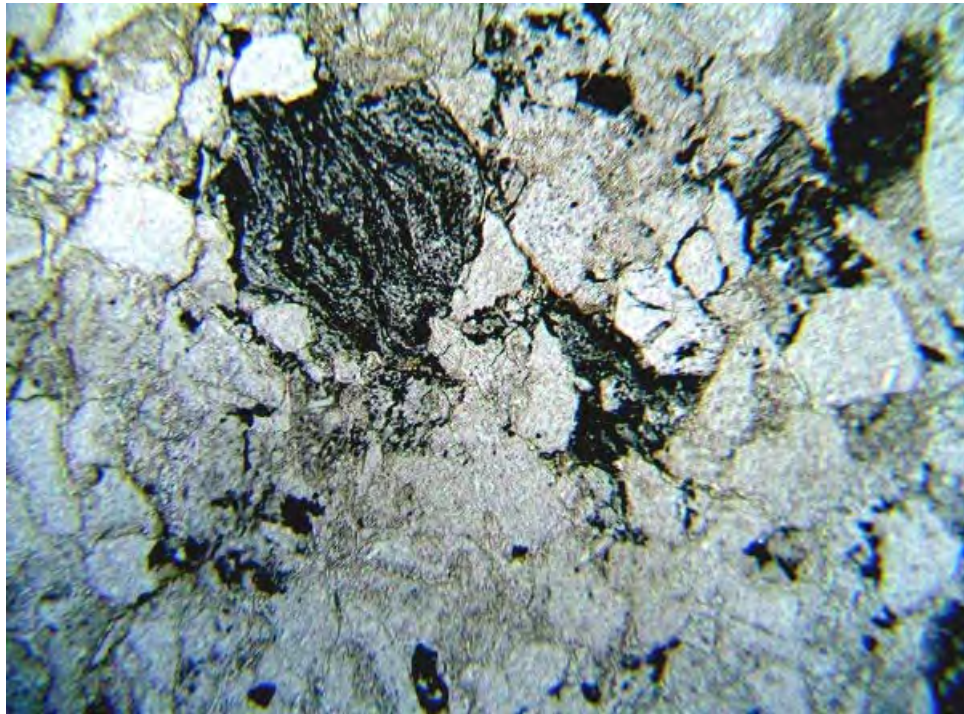
Aggregates of mosaic quartz are also interstitial to the quartz and feldspar crystals.

Illite	2	Microcrystalline	Microcrystalline illite occurs as inclusion in the feldspars, and some form small veinlets interstitial to the quartz and feldspars.
Chlorite	3		Nearly isotropic chlorite is interstitial to the quartz and feldspars, and most are intergrown with black 'graphite'. Lithic fragments are partly replaced by chlorite and by black, microcrystalline 'graphite'.
'Graphite'	trace		Black, carbonaceous material, 'graphite' is interstitial to the silicates, and is intergrown with the chlorite. Together, they occur as cement between some of the quartz and feldspars.

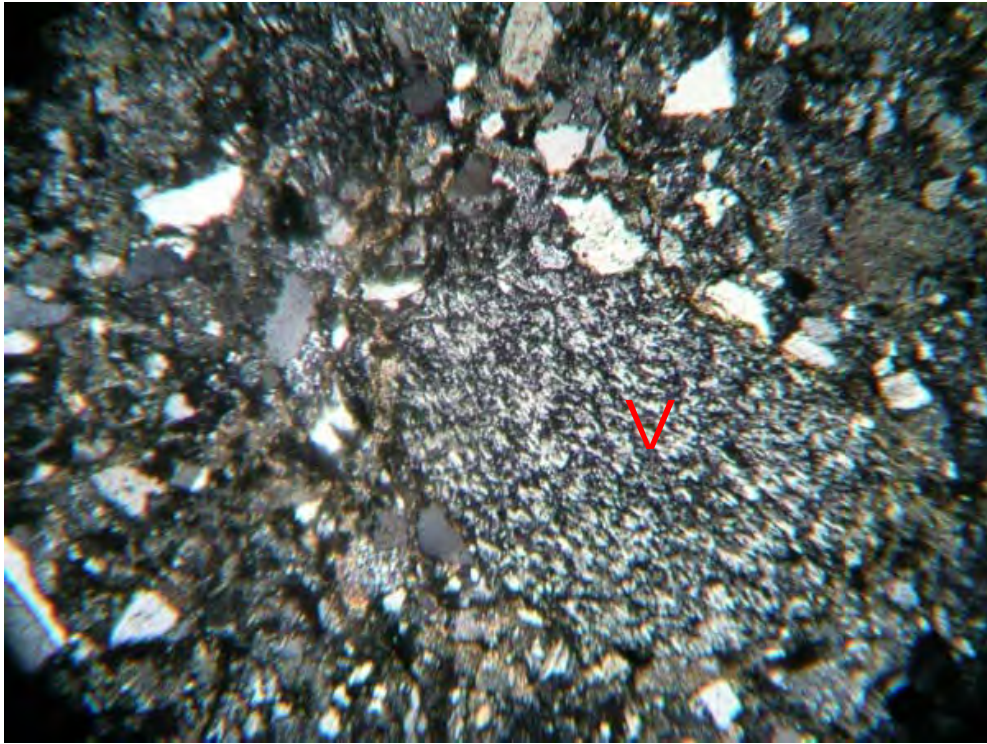
Accessory minerals: pyrite, pyrrhotite, pentlandite, rutile, titanite, muscovite, apatite



Greywacke with angular clasts. X-axis of photo: 3.0mm. XN.



Graphite -rich domains (dk. grey) in greywacke. X-axis of photo: 1.5mm. Ppl.



Volcanic fragment (V) in greywacke. X-axis of photo: 3.0mm. XN

Sample Number: 5-26-5B

Rock Type: Trachyandesite

Petrographic Description:

Trachyandesite with trachytic texture. The texture of the rock is comparable to sample 5-26-1, but the mineralogy is slightly different, as it contains a relative abundance of fine-grained aegirine-augite interstitial to the slender anorthoclase prisms, and nepheline and olivine phenocrysts. The rock is flow-banded and contains an abundance of elongate, fine-grained, fragmented aegirine-augite, and disseminated fine-grained titanomagnetite. A few small, equant, anhedral and oxidized grains of olivine (fayalite) and nepheline occur as phenocrysts. The rock is unaltered, but oxidized, and several of the olivine are rimmed by a wide rim of Fe-hydroxide. Fine-grained, granular aegirine-augite interstitial to the feldspars are oriented in the direction of the anorthoclase (the flow).

Fine-grained titanomagnetite are disseminated through the thin section

Detailed mineralogy

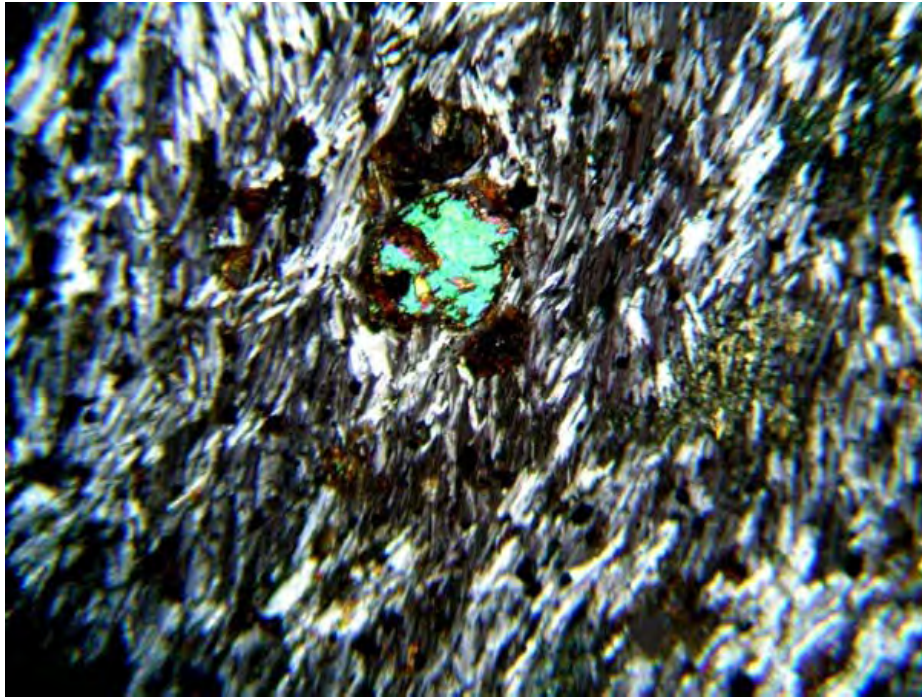
Mineral	%	Grain size(mm)	Comments
Anorthoclase	75	Av. 0.2	Anorthoclase has trachytic texture, the slender prisms are stacked and show flow-banding. Many of the prisms are bent and some wrap around the olivine and nepheline phenocrysts.
Nepheline	2-3	0.1-0.2	Clear grains of nepheline occur as single, subhedral / euhedral phenocrysts or in aggregates, forming small glomerocrysts. They are generally rimmed by Fe-hydroxide. The low birefringence and mostly uniaxial –ve interference figure are diagnostic. Microprobe analysis confirmed the composition (Table 2).
Aegirine-augite	15	Up to 0.2	Granular to elongate pleochroic green aegirine-augite are interstitial to the anorthoclase prisms. The slender, anhedral grains follow the habit of the anorthoclase, but also occur as fine-grained, granular aggregates interstitial to the anorthoclase.
Olivine	3	0.1-0.2	Small phenocrysts of olivine (fayalite) are

stubby, equant grains. They are often rimmed by amorphous Fe-hydroxide, which partly replace the olivine. Some also occur as minute, granular grains interstitial to the anorthoclase.

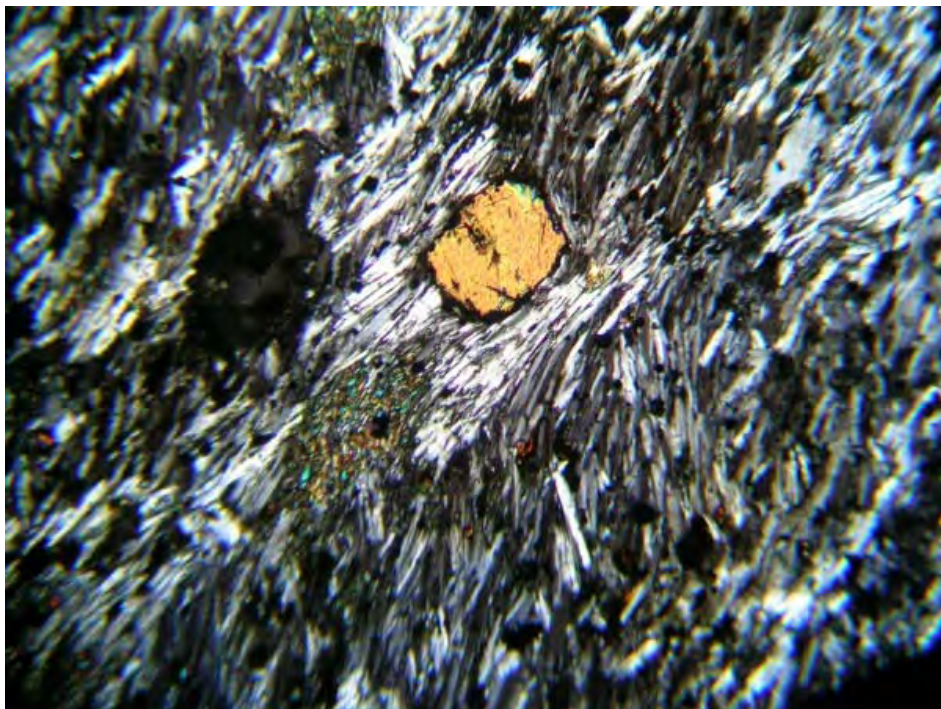
Magnetite + 2+3 Av. 0.03
Fe-hydroxide

Titanomagnetite is disseminated through the thin section. The small, anhedral to subhedral grains are interstitial to the feldspar prisms.

Accessory minerals: apatite, carbonate



Olivine (green) phenocryst in anorthoclase matrix. X-axis of photo: 1.5mm. XN.



Olivine phenocryst in center. Matrix consists of slender prisms of anorthoclase.
X-axis of photo: 1.5mm. XN.

Sample Number: 5-26-6

Rock Type: Trachyandesite

Petrographic Description:

Fine-grained trachyandesite. The rock is comparable in texture to 5-26-1, and 5-26-5B. It contains a few small phenocrysts of olivine, and also sanidine. Slender prisms of anorthoclase have parallel orientation, they are stacked, and their arrangement suggests slight crenulation. Flow-banding is similar to the other volcanic rocks, and they wrap around some of the small olivine phenocrysts. Very fine-grained, granular, pleochroic green aegirine augite is interstitial to the anorthoclase matrix, but slightly less abundant than in the previous rocks.

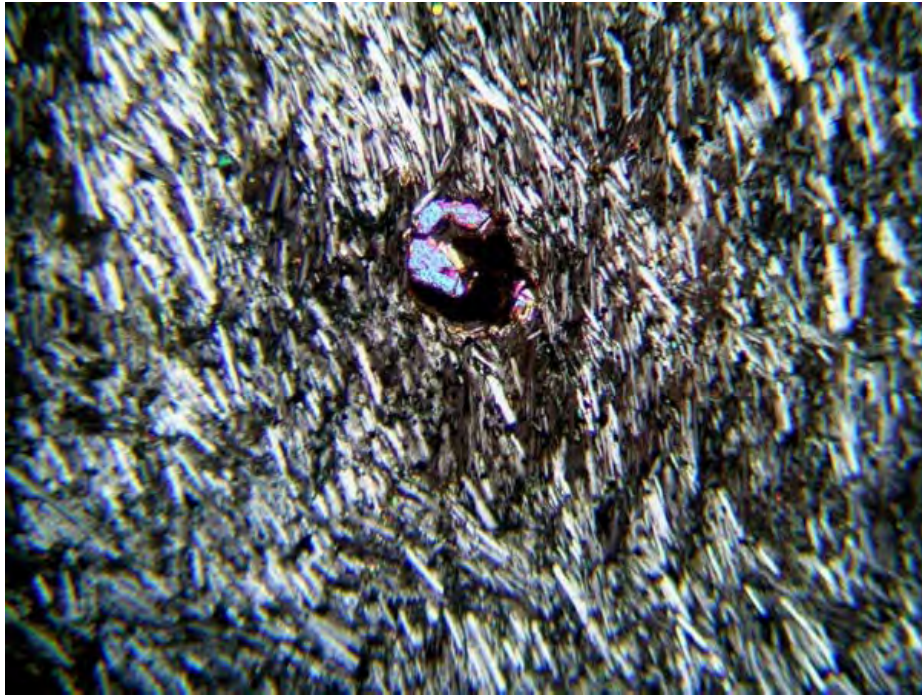
Fine-grained titanomagnetite is disseminated through the thin section. The slightly subrounded and anhedral minute (0.02mm) grains are interstitial to the feldspars and occur with the olivine. A few larger grains of magnetite are subhedral, angular grains, and their grain size is phenocrystic (up to 0.2mm).

Detailed mineralogy

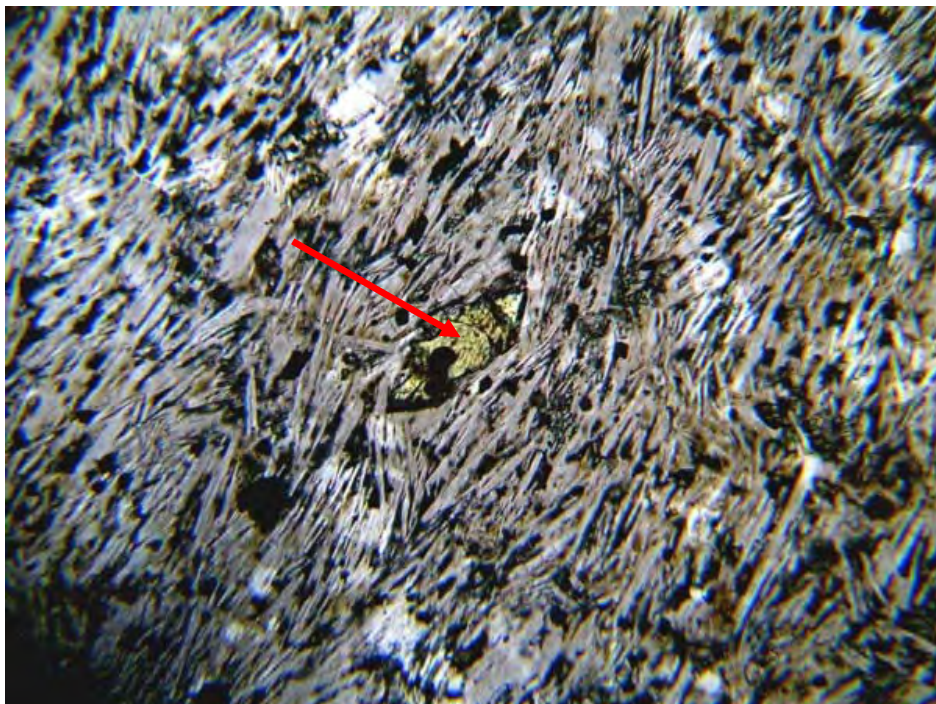
Mineral	%	Grain size(mm)	Comments
Anorthoclase	85	0.15-0.6	Slender prisms of anorthoclase have trachytic texture. Parallel alignment of the stacked, more or less equidimensional grains is common. Some grains are slightly bent, and wrap-around the olivine phenocrysts. In a small domain, they are partly replaced by very fine-grained carbonate.
Sanidine	5	Minute-0.3	Square and rectangular-shaped sanidine occurs as small phenocrysts interstitial to the plagioclase. Most sanidine are clear, and do not contain inclusions, but they often have a dark, Fe-rich rim.
Aegirine-augite	7	<0.05-0.16	Aggregates of very fine-grained, granular clinopyroxene are interstitial to the anorthoclase. They commonly occur as fine-grained aggregates.
Olivine	trace	Av. 0.15	Only a few small olivine phenocrysts were identified. One of the olivine is completely replaced by Fe-hydroxide, but retained the olivine shape.

Magnetite	3	0.02-0.2	Fine-grained, anhedral titanomagnetite is interstitial to the feldspars, and also to the fine-grained matrix clinopyroxene. A few larger, subhedral magnetite occur as 'phenocrysts' interstitial to the feldspars.
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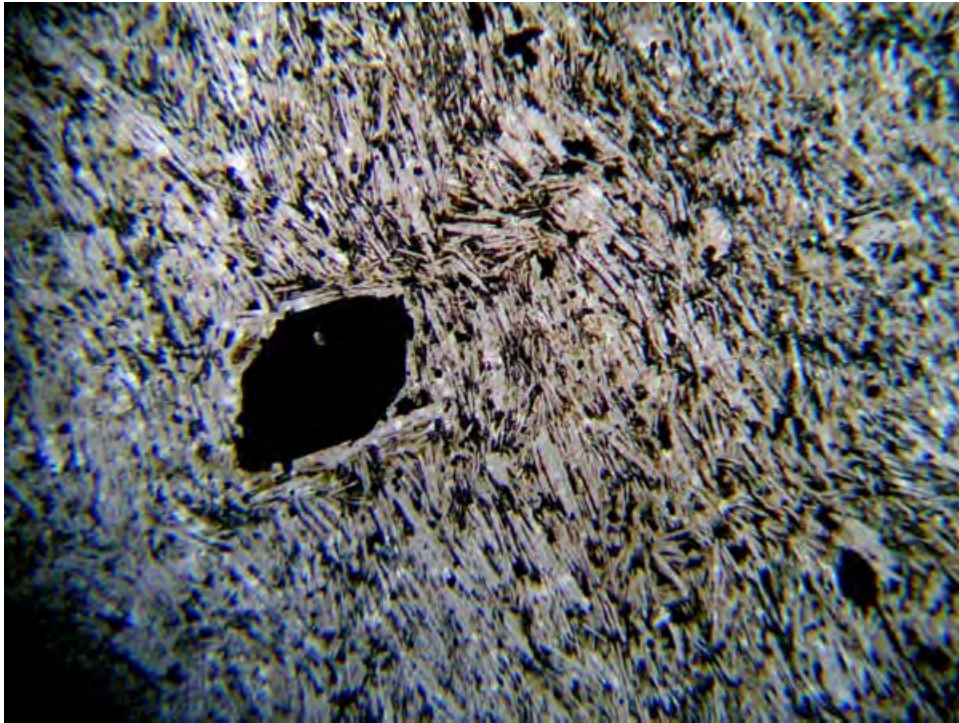
Accessory minerals: carbonate, apatite, rutile (or brookite).



Olivine phenocryst in fine-grained anorthoclase matrix is rimmed by dark Fe-hydroxide. X-axis of photo: 3.0mm. XN.



Small olivine phenocryst (arrow) in anorthoclase matrix. X-axis of photo: 1.5mm. Ppl.



Olivine phenocryst is replaced by Fe-hydroxide (black). X-axis of photo: 3.0mm. Ppl.

Sample Number: 5-27-1

Rock Type: Greywacke

Petrographic Description:

A coarse-grained clast-supported, poorly sorted sediment. The mineralogy is comparable to sample 5-26-5A, but it is more coarse-grained, and less uniform in grain size. Clasts of quartz, plagioclase, orthoclase and lithic fragments derived from volcanic rocks, sediments, and from chert, make up the polished thin section. The clasts are mostly angular and range in size between microcrystalline to 3 mm. The most coarse-grained clasts are quartz, orthoclase, and fragments of cherty sediments. The cement between the various clasts and fragments contain black, carbonaceous material, and the individual clasts are variably sericitized. A few small fragments of fine-grained biotite are kink-banded. Small, contorted sericite veinlets are interstitial to the clast and lithic fragments, and post-dated, or were contemporaneous with cementation.

Only a few minute grains of magnetite were identified in the rock, and sulfides are absent.

Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	24	Microcrystalline-3.0	Angular, strained quartz clasts have a wide range in grain size. Most have sharp, angular or embayed grain boundaries. Quartz also occurs as partly recrystallized clasts, and as microcrystalline aggregates in a chert clast.
Plagioclase	10	0.3-1.8	Angular plagioclase clasts range in composition between albite and oligoclase. A few clasts of fragmented chessboard albite is also interstitial to the other clasts. The plagioclase are generally unaltered, and some are intergrown with quartz.
Orthoclase	8	0.5-2.5	Large clasts of orthoclase are cloudy and weakly sericitized. The angular clasts have sharp to embayed grain boundaries, and some are rimmed and some are cross-cut by sericite veinlets.
Sericite / illite	3		Most of the lithic fragments are variably sericitized. Sericite (or illite) veinlets are interstitial to the cementing matrix, and

form a partial rim around some of the clasts and lithic fragments.

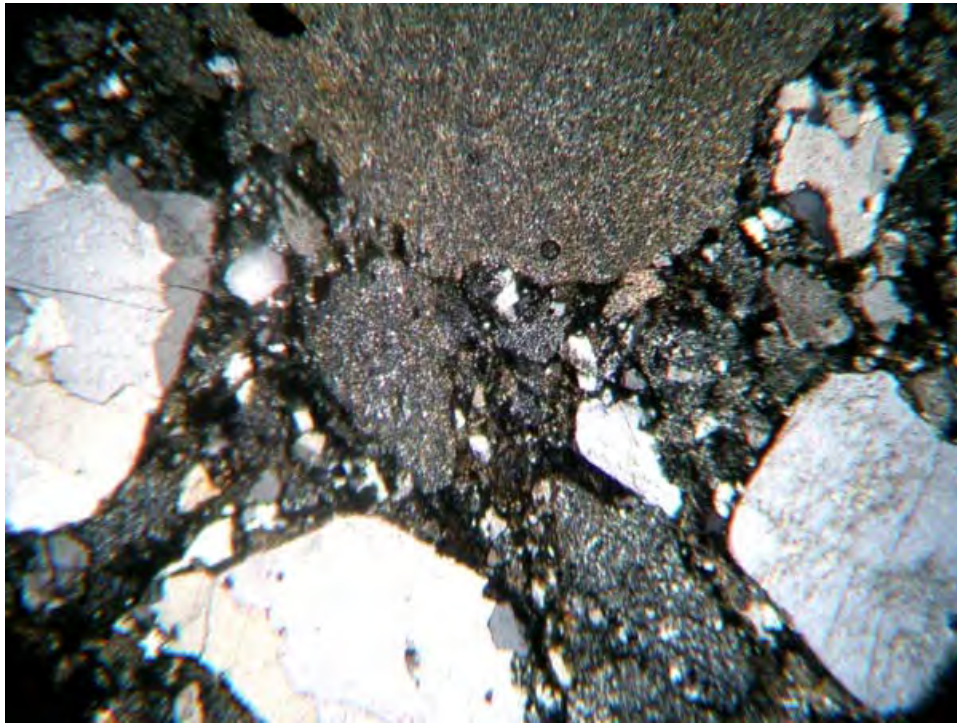
Lithic
fragments

55

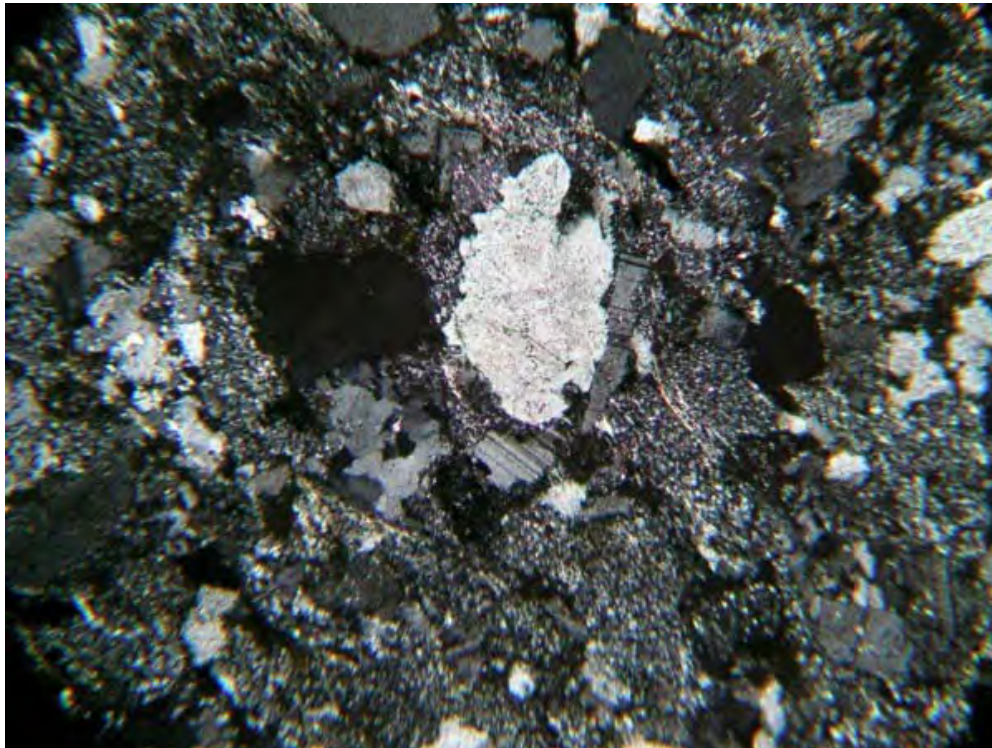
Up to 3.0

Fine-grained lithic fragments, derived from fine-grained sediments make up a significant part of the rock. They consist predominantly of fine-grained to microcrystalline quartz, and a few fragments were derived from fine-grained volcanic rocks.

Accessory minerals: graphite, chlorite, carbonate, apatite, magnetite, zircon



Greywacke / conglomerate. X-axis of photo: 3.0mm. XN.



More fine-grained domain in above sediment. X-axis of photo: 3.0mm. XN.

Sample Number: 5-27-3

Rock Type: Trachyandesite

Petrographic Description:

The rock is a weakly porphyritic fine-grained trachyandesite. The mineralogy and texture are comparable to the other volcanic rocks. It consists of slender prisms of anorthoclase, small, square grains of interstitial sanidine, phenocrysts of olivine, and interstitial, fragmented, pleochroic aegirine-augite. The rock has a slightly higher concentration of olivine (fayalite) phenocrysts, and several are rimmed by an overgrowth of poorly defined aggregates of anhedral olivine. The rock is partly oxidized and much of the interstitial fine-grained clinopyroxene and the olivine phenocrysts are rimmed by amorphous Fe-hydroxide.

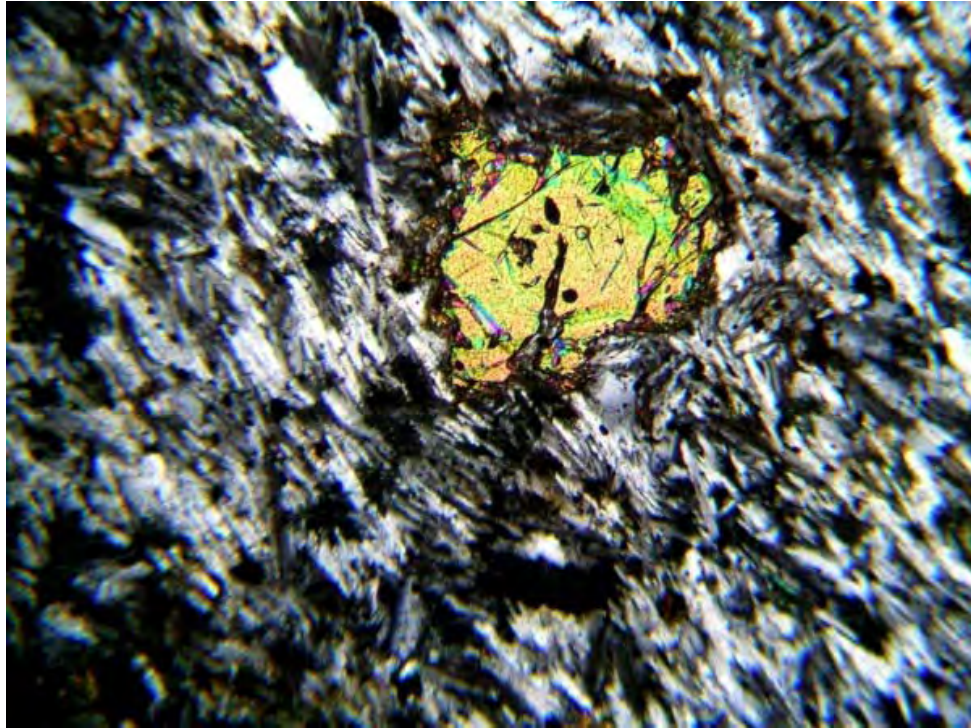
Fine-grained titanomagnetite is relatively abundant, and several of the olivine phenocrysts contain inclusions of subrounded magnetite.

Detailed mineralogy

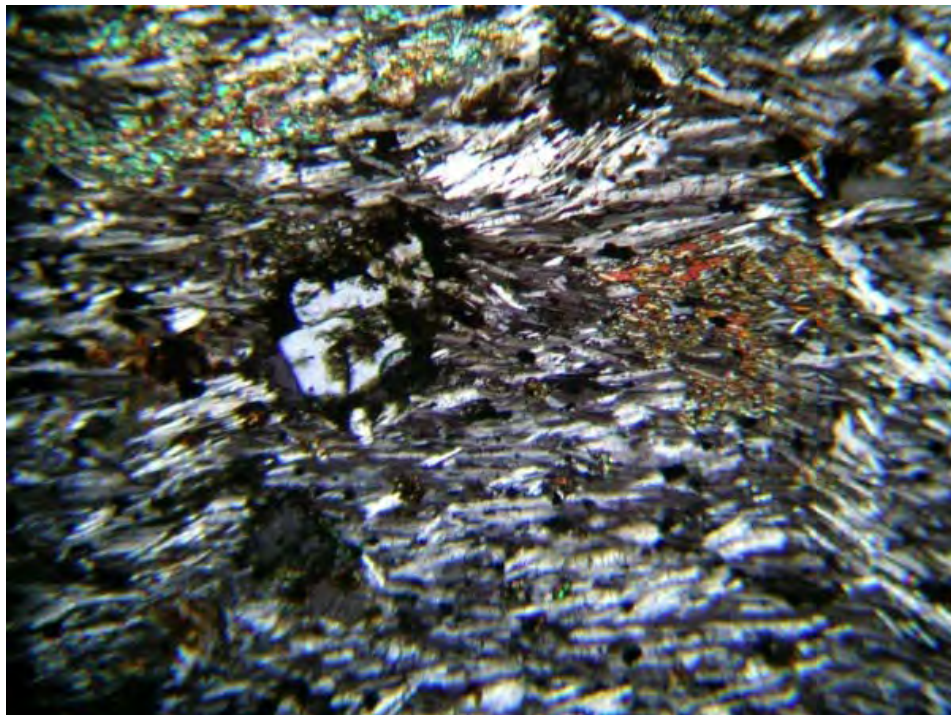
Mineral	%	Grain size(mm)	Comments
Anorthoclase	70	Av. 0.3	Slender prisms of anorthoclase are aligned parallel, they are stacked, and show evidence of flow-banding. Some wrap-around the anhedral olivine phenocrysts, and are slightly bent. The twin lamellae are poorly defined.
Sanidine	6	<0.05-0.2	Small, rectangular grains of sanidine are interstitial to the anorthoclase. Some are phenocrysts, but most occur as small grains between anorthoclase aggregates.
Olivine	6	<0.05-0.5	Several phenocrysts of olivine occur in the thin section. The phenocrysts often have ragged, poorly defined grain boundaries, and are overgrown by fine-grained aggregates of fine-grained olivine. Some are rimmed by a wide Fe-hydroxide rim. Most contain an abundance of long rutile needles,
Aegirine-augite	8	Variable up to 0.5	Pleochroic green, fragmented aegirine-augite are interstitial to the feldspars, and have similar, elongate shape as the feldspars. They are slightly poikilitic.

Magnetite	3	<0.05-0.3	Fine-grained, slightly subrounded titanomagnetite are disseminated through the thin section. Several magnetite grains occur as inclusions in the clinopyroxene.
Fe-hydroxide	7		Amorphous, poorly crystalline Fe-hydroxide forms a rim on the mafic phenocrysts, it is interstitial to the feldspars, and partly replace some of the mafic phenocrysts.

Accessory minerals: apatite, rutile



Olivine phenocryst in fine-grained anorthoclase matrix. X-axis of photo: 1.5mm. XN.



Cubic sanidine phenocryst (white) and fine-grained interstitial aegirine-augite (red & blue) in anorthoclase matrix. X-axis of photo: 3.0mm. XN.

Sample Number: 5-27-5 (1)

Rock Type: Trachyandesite

Petrographic Description:

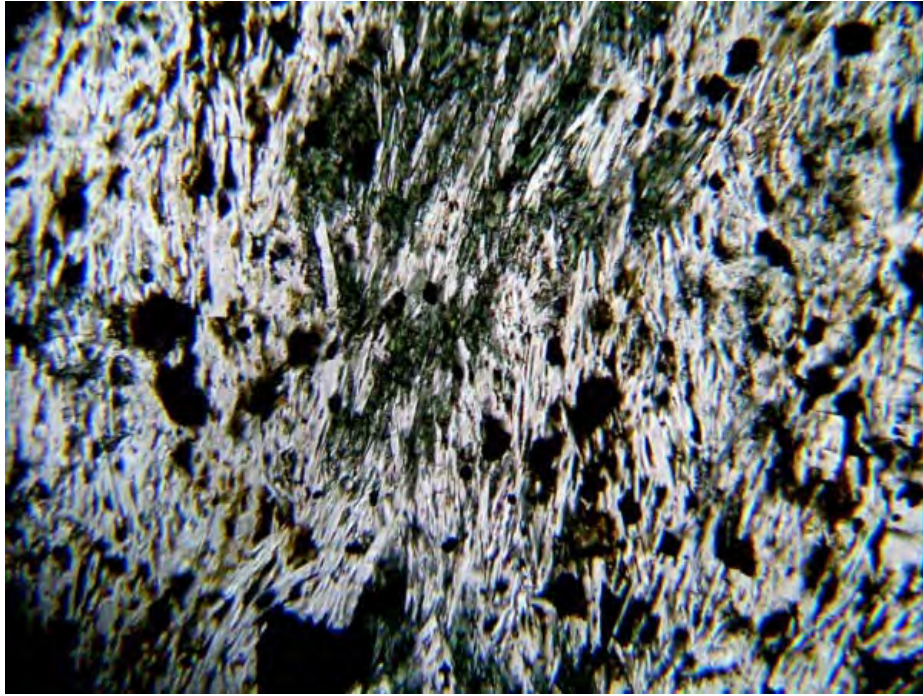
The volcanic rocks is a fine-grained, aphanitic trachyandesite that contains a relative abundance of pleochroic green aegirine-augite, which are interstitial to the matrix anorthoclase. The texture and mineralogy of the rock is comparable to the previous samples, but it contains less phenocrysts. Phenocryst-shaped, completely oxidized (opaque) grains, ca. 0.3-0.4mm diameter are believed to have been originally olivine that were replaced by Fe-hydroxide. The slender anorthoclase prisms are aligned parallel, they are stacked, and have trachytic texture. The rock is partly oxidized, and interstitial, granular clinopyroxene are rimmed by a wide rim of Fe-hydroxide.

Fine-grained, blocky magnetite are disseminated through the matrix.

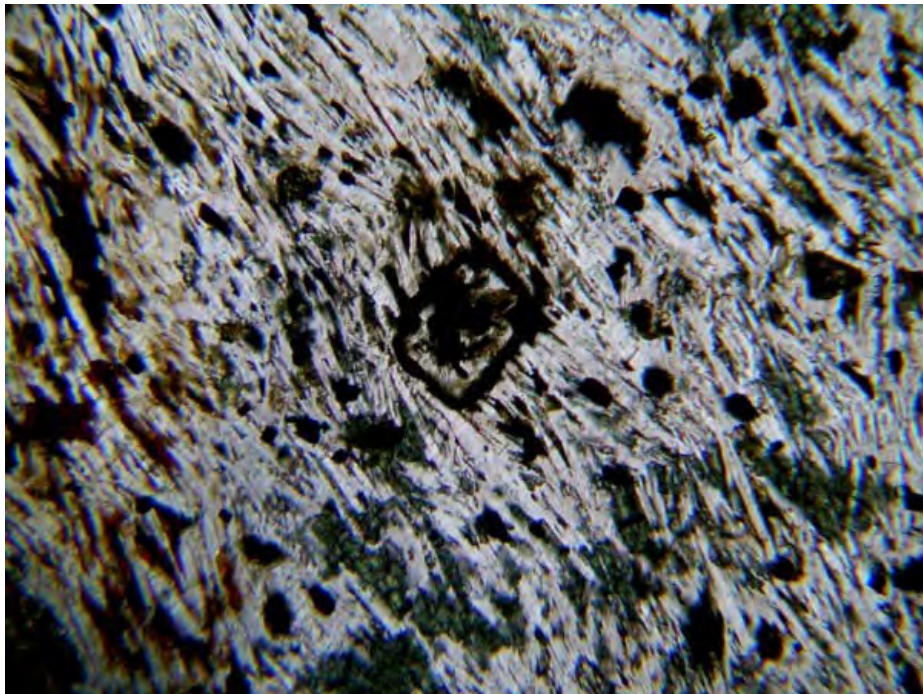
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Anorthoclase	80	Av. 0.2	Slender anorthoclase phenocrysts are aligned parallel, and the repeatedly stacked parallel rows appear as crenulation cleavage. As in the previous volcanic rocks, the twin lamellae of the feldspars are poorly defined.
Aegirine-augite	15	0.1-0.3	Fragmented, elongate grains of slightly poikilitic aegirine-augite are interstitial to the anorthoclase. As in the previous samples, they are pleochroic green, and contain a few inclusions of magnetite.
Olivine	3	<0.3	Very fine-grained olivine are interstitial to the anorthoclase and the aegirine-augite. They are rimmed by Fe-hydroxide, and have ragged and sutured grain (suggesting disequilibrium).
Magnetite	2	0.05-0.1	Fine-grained, subhedral and blocky titanomagnetite are disseminated through the thin section.

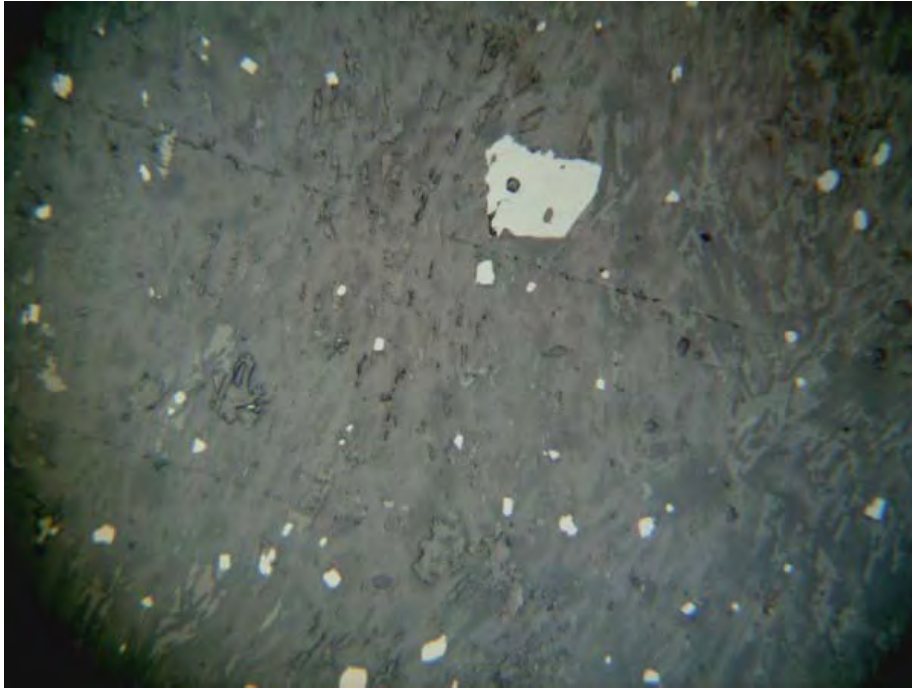
Accessory minerals: Fe-hydroxide, apatite, rutile



Fine-grained aegirine-augite (dk. grey green) is interstitial to the anorthoclase matrix.
X-axis of photo: 3.0mm. Ppl.



Rectangular sanidine in center of anorthoclase matrix with interstitial aegirine-augite. X-axis of photo: 1.5mm. Ppl.



Large and small magnetite is disseminated through the anorthoclase matrix. X-axis of photo: 1.5mm. Refl. Light.

Sample Number: 5-27-5(2)

Rock Type: Trachyandesite

Petrographic Description:

A fine-grained volcanic rock with trachytic texture. The slender anorthoclase prisms are aligned parallel, and the stacked arrangement of these parallel 'bands' define the crenulation cleavage on the scale of the thin section. Although the rock originally contained a fair number of small olivine phenocrysts, most of these phenocrysts were partly or completely replaced by amorphous Fe-hydroxide. The most common (small) phenocrysts are sanidine and nepheline. Fragmented and slightly granulated, fine-grained pleochroic green aegirine-augite is interstitial to the feldspars, and parallel the orientation of most anorthoclase grains.

The rock contains a relative abundance of fine-grained subhedral to anhedral magnetite. Magnetite of phenocrystic size also occurs as subhedral grains associated with some of the oxidized olivine.

Oxidation of the rock is quite pervasive, as most silicate phenocrysts were replaced by amorphous Fe-hydroxide and fine-grained, globular hydroxide is disseminated through the rock.

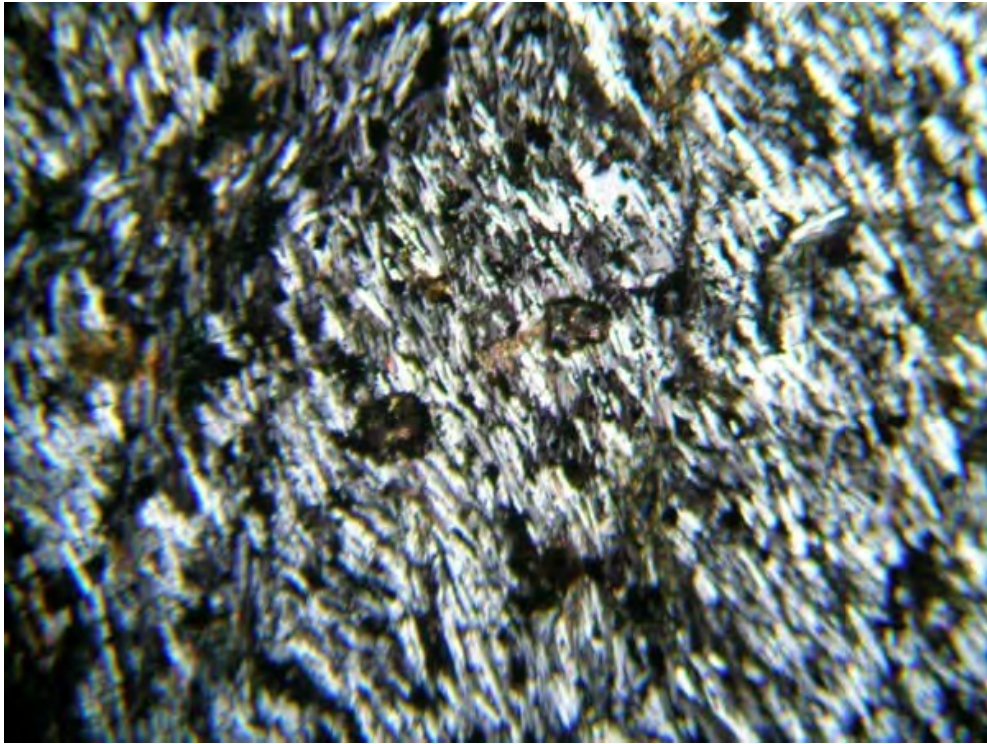
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Anorthoclase	75	0.1.5-0.3	Slender prisms of anorthoclase are stacked, and they are aligned parallel, forming a crenulation cleavage in the thin section. In some domains, they occur in radiating aggregates, and contain narrow prisms of interstitial aegirine-augite fragments. Some anorthoclase are partly oxidized, bent, and wrap around the small oxidized clinopyroxene phenocrysts.
Sanidine	5	<0.1-0.2	Small grains of rectangular, untwinned sanidine are interstitial to the anorthoclase matrix. A few of the larger grains have simple twinning, and some are rimmed and partly replaced by amorphous Fe-hydroxide.
Olivine	2	Av. 0.3	Most olivine phenocrysts are completely replaced by goethite or amorphous Fe-hydroxide. Fine-grained, granular and partly altered (by Fe-hydroxide) olivine are

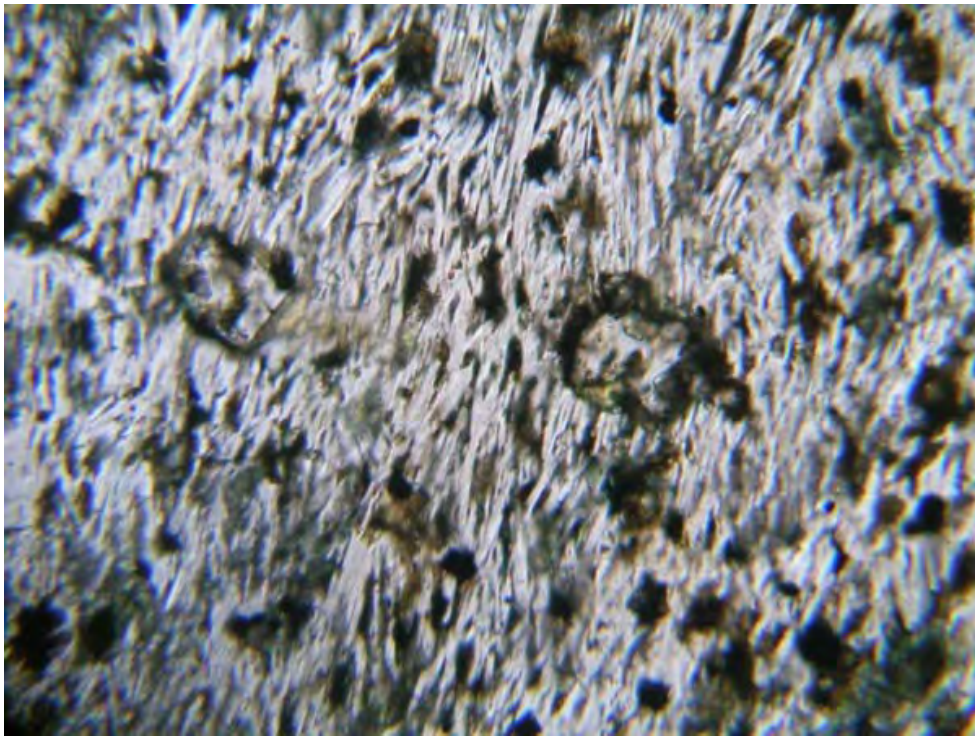
interstitial to the feldspars, and are part of the matrix.

Aegirine-augite	5	Variable up to 0.3	Fine-grained, pleochroic green aegirine-augite parallel the orientation of the plagioclase, and they are interstitial to the slender prisms of the anorthoclase.
Magnetite	3	<0.03-0.2	Fine-grained, subhedral / anhedral titanomagnetite is interstitial to the plagioclase, and occur as small inclusions in some of the clinopyroxene. A few larger grains of magnetite are phenocrystic.
Fe-hydroxide	10		Much of the Fe-hydroxide is poorly crystalline, and it partly replaces the olivine and the sanidine phenocrysts.

Accessory minerals: apatite, rutile



Anorthoclase-rich matrix of trachyandesite. X-axis of photo: 3.0mm. XN.



Sanidine and nepheline phenocrysts (semi-rectangular) in anorthoclase matrix. X-axis of photo: 1.5mm. Ppl.

Sample Number: 5-27-5A

Rock Type: Trachyandesite

Petrographic Description:

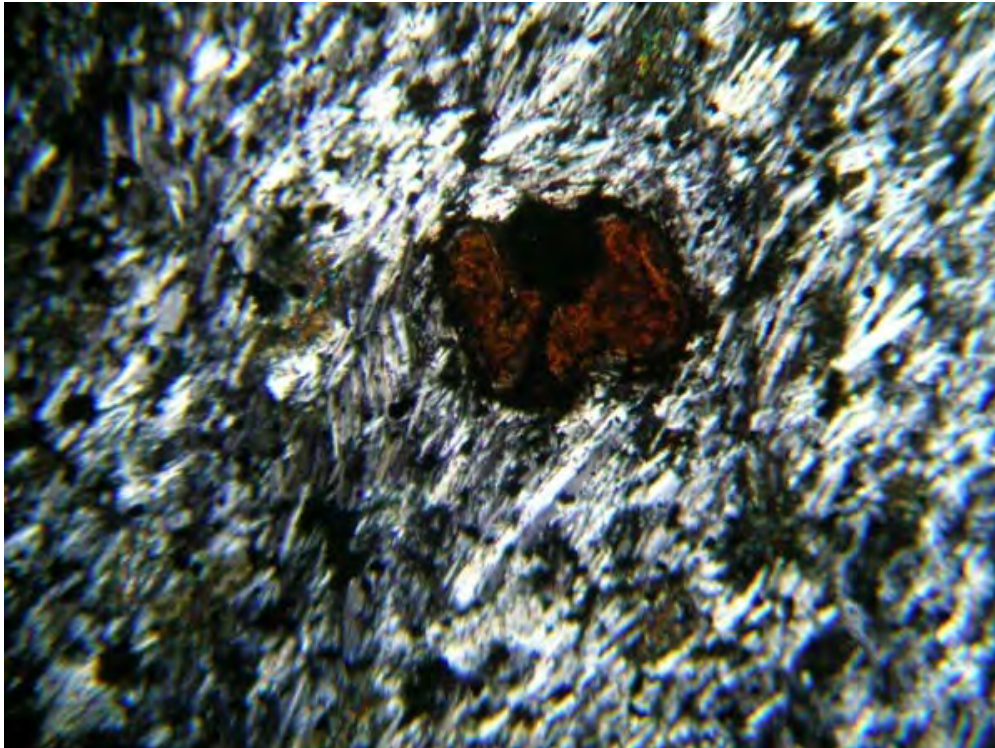
An oxidized aphanitic volcanic rocks with comparable mineralogy and texture to the other trachyandesites. Aegirine-augite is relatively abundant, and the few olivine phenocrysts are almost completely oxidized. Anorthoclase occurs as slender, stacked prisms, having parallel orientation, and less commonly, radiating. The orientation of anorthoclase define the direction of the flow. Twinning in the feldspars is poorly defined. A few small, untwinned, clear, rectangular sanidine phenocrysts are interstitial to the anorthoclase. A few oxidized phenocrysts occur in the thin section. As suggested from the shape of the phenocrysts, they were probably originally olivine. Pleochroic green aegirine-augite is interstitial to the feldspars. The fragmented, discontinuous grains have more or less the same orientation as the feldspars.

Fine-grained titanomagnetite is disseminated through the thin section. Most grains are anhedral to subhedral, and a few of the larger grains are phenocrystic.

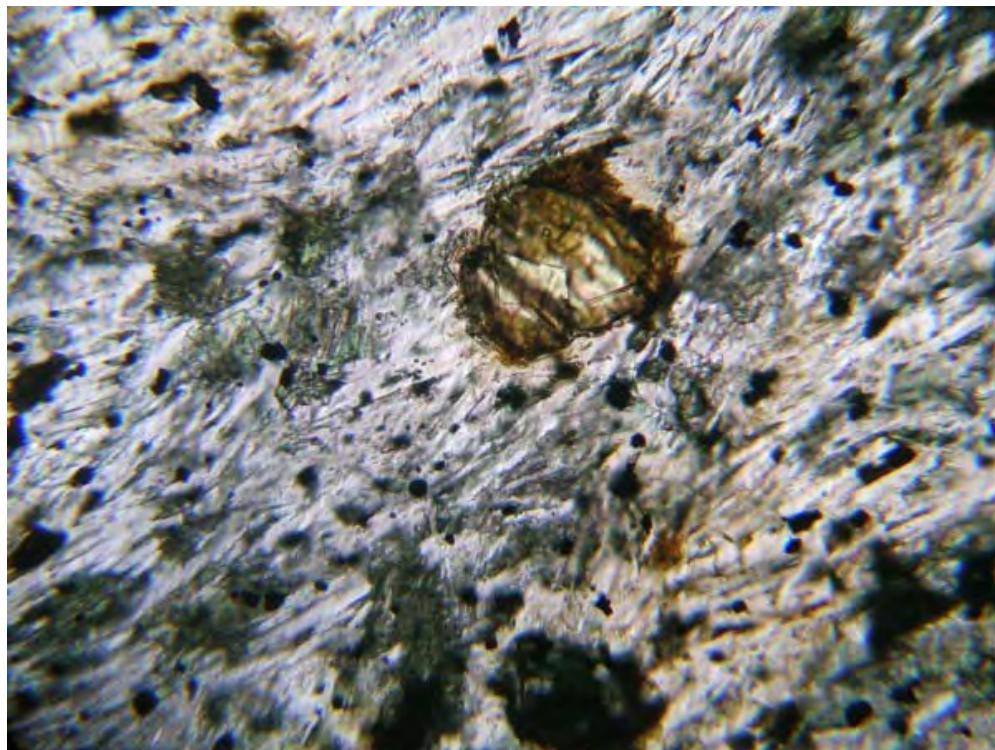
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Anorthoclase	82	0.1-0.3	Slender prisms of anorthoclase make up most of the volcanic rock. Trachytic texture is characteristic, and the orientation of the grains defines the flow direction.
Aegirine-augite	10	<0.1-0.3	Fine-grained, pleochroic green aegirine-augite is relatively abundant. The slightly prismatic grains are interstitial to the feldspars, and their orientation more or less parallel the feldspars. Some grains are fragmented and form fine-grained aggregates interstitial to the feldspars.
Magnetite	3	<0.05-0.2	Fine-grained titanomagnetite are interstitial to the feldspars. Some are included in the olivine, and some are phenocrystic.
Fe-hydroxide (amorphous)	5		Amorphous globules of Fe-hydroxide is disseminated through the thin section. They are interstitial to the feldspars, and partly replace the interstitial clinopyroxene.

Accessory minerals: apatite, carbonate



Oxidized (dark brown) olivine in anorthoclase matrix. X-axis of photo: 3.0mm. XN.



Olivine phenocryst is partly replaced by brown Fe-hydroxide.
X-axis of photo: 1.5mm. Ppl.

Sample Number: 5-29-4

Rock Type: Feldspar porphyry

Petrographic Description:

A pervasively altered coarse-grained feldspar porphyry. The rock consists of plagioclase, sericite, carbonate, altered titanomagnetite, minor chlorite and quartz. The plagioclase phenocrysts are pervasively sericitized, and partly replaced by fine-grained carbonate and some, by dark, amorphous clays. The matrix of the rock is completely altered to sericite and carbonate-rich domains. The original presence of minor mafic minerals is suggested by a few chlorite-rich domains that have the shape of amphibole (?) phenocrysts. Fine-grained quartz occurs only as part of the matrix and some are intergrown with aggregates of carbonate, suggesting secondary origin.

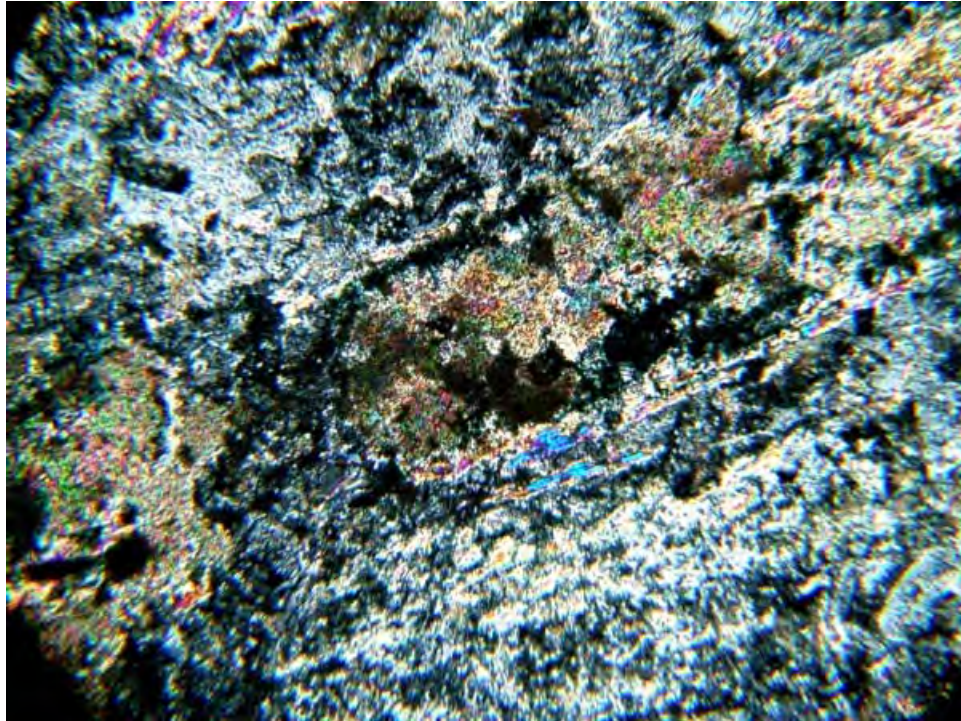
Leucoxene-altered titanomagnetite occur as subhedral / euhedral, relatively large grains disseminated through the rock. A few small grains of anhedral are included in the altered magnetite and in chlorite or carbonate-rich domains.

Detailed mineralogy

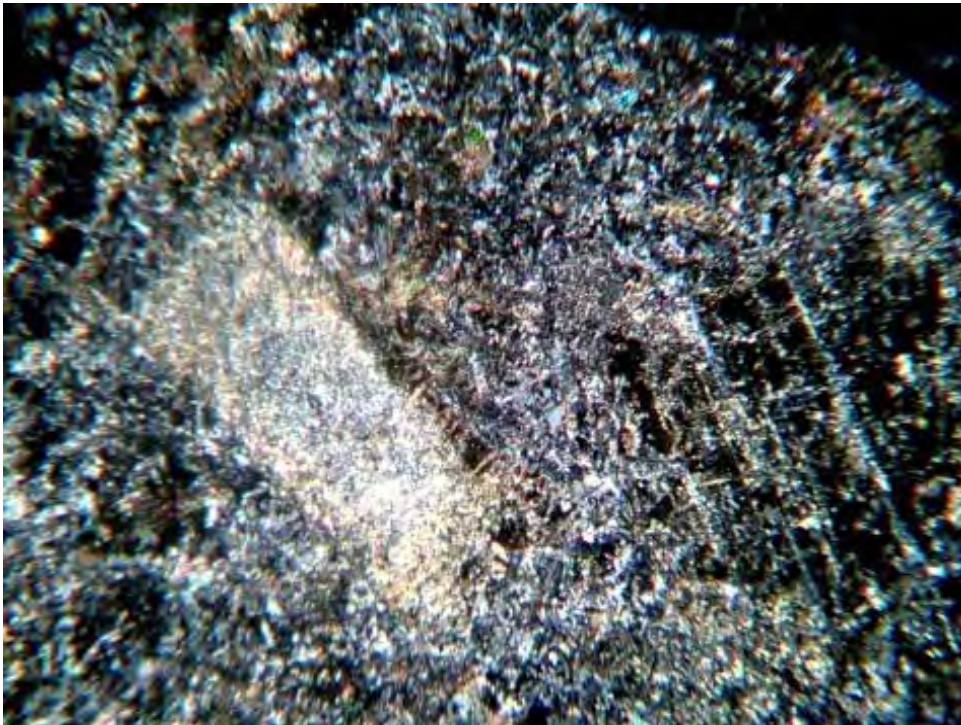
Mineral	%	Grain size(mm)	Comments
Plagioclase	35	1.0-4.0	Euhedral / subhedral, lath-shaped plagioclase is the most abundant mineral in the rock. As the twin lamellae were destroyed during alteration, the original composition cannot be estimated. The center of some phenocrysts are replaced by dark, amorphous clays and partly by sericite and fine-grained carbonate. There is some evidence of original zoning. The fine-grained, interstitial plagioclase are partly sericitized and partly carbonatized.
Sericite	25		Sericite is the most abundant replacement in the rock. It is abundant in the feldspars, and is mixed with fine-grained carbonate in the matrix and the plagioclase phenocrysts
Carbonate	20	Variable <0.5-1.5	Anhedral carbonate occurs as replacement after the matrix feldspars and the phenocrysts. Some pre-dated the sericite, and some occur as a late rim on the feldspars. In the matrix, they also form small domains where they re intergrown with secondary quartz.

Chlorite	5		Faintly pleochroic green chlorite appears to be replacement after mafic phenocrysts of unknown mineralogy. Chlorite also occurs as replacement in the more fine-grained matrix, where it is intercalated with sericite and carbonate.
Magnetite (leucoxene)	5	0.08-1.0	Subhedral titanomagnetite in the rock are all replaced by leucoxene. The dark, turbid grains have relict exsolution lamellae, suggesting lamellar intergrowth of Ti and Fe-rich domains.
Amorphous clays	10		Dark brown (Fe-stained?) amorphous clays partly replace the center of some of the plagioclase phenocrysts.

Accessory minerals: quartz, pyrite, apatite, zircon



Sericite/illite (light color) and carbonate (multi-color) altered feldspar porphyry. X-axis of photo: 3.0mm. XN.



Sericite/illite altered plagioclase phenocryst in feldspar porphyry. X-axis of photo: 3.0mm. XN.

Sample Number: 5-29-9(1)

Rock Type: Greywacke

Petrographic Description:

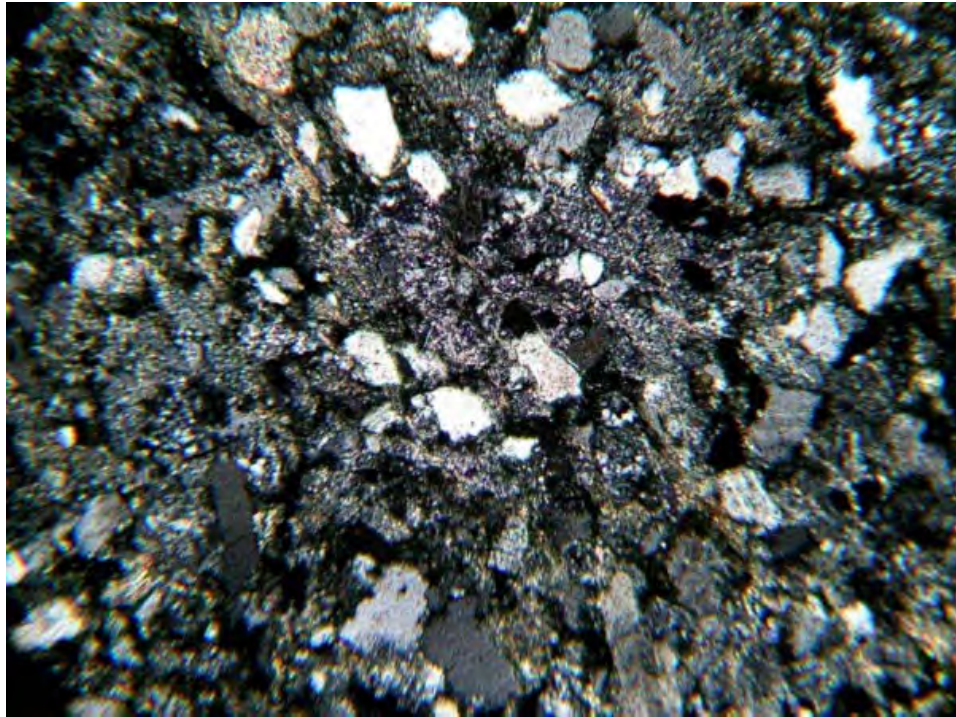
A relatively well sorted sediment. The mineralogy and texture of the rock is comparable to sample 5-26-5A, but it is slightly more fine-grained. The rock is clast-supported, and consists predominantly of quartz, plagioclase, orthoclase and sericite. All grains are angular, and many have sharp terminations, suggesting that they were not transported far from their origin. Some of the quartz have embayed and sutured grain boundaries, and the latter suggests disequilibrium. The K-feldspars are turbid orthoclase, and the plagioclase are mostly oligoclase. The two feldspars are variably sericitized and small, sericite-rich domains outline the shape of an earlier, lath-shaped mica. Microcrystalline quartz and sericite makes up the matrix, which represent replacement after some feldspar and quartz.

Detrital, dark brown rutile is disseminated through the thin section. The small, anhedral grains are interstitial to dark brown, clays between quartz and feldspars.

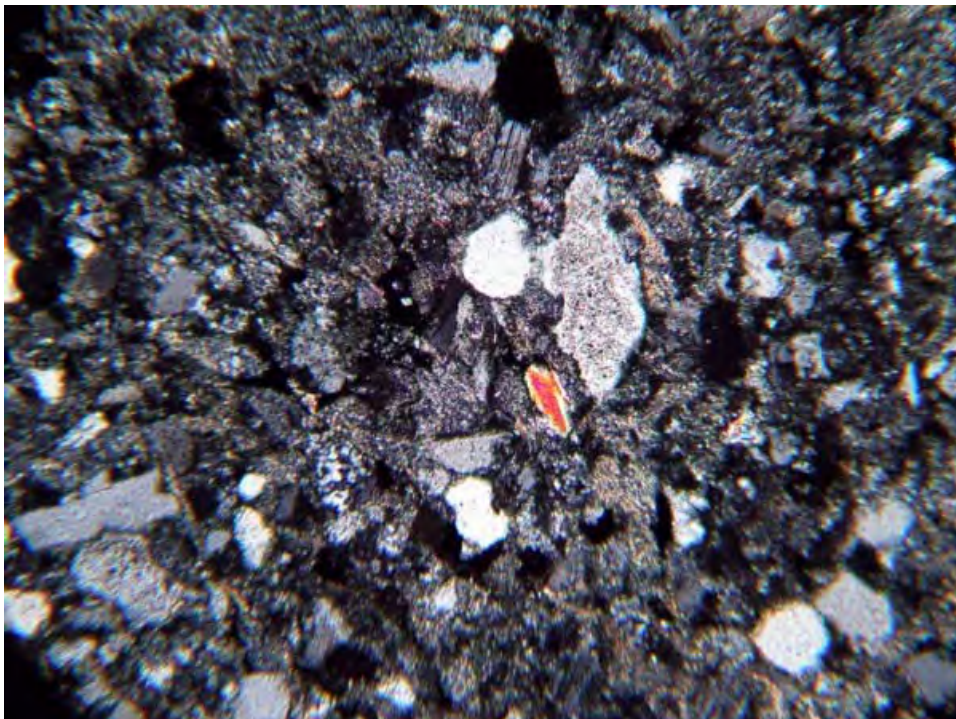
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	50	<0.1-0.3	Angular, variably strained quartz clasts make up part of the rock. Quartz also occurs as microcrystalline chert that act as cement between clasts.
Plagioclase	20	<0.1-0.3	Small, angular fragments of plagioclase clasts are variably sericitized, and some are partly recrystallized to fine-grained aggregates. They have sharp and embayed grain boundaries.
K-feldspar	25	0.1-0.2	Turbid, cloudy orthoclase clasts are interstitial to the quartz and feldspars. As the other clasts they often have sharp termination and ragged grain boundaries that suggest disequilibrium.
Sericite	5		Sericite is relatively abundant in the rock. The fine-grained mineral is disseminated in the matrix, and partly replace some of the feldspars. A few long grains of muscovite are interstitial to the feldspars.

Accessory minerals: chlorite, apatite, pyrite



Fine-grained greywacke. X-axis of photo: 3.00mm. XN.



Fine-grained greywacke. X-axis of photo: 3.0mm. XN.