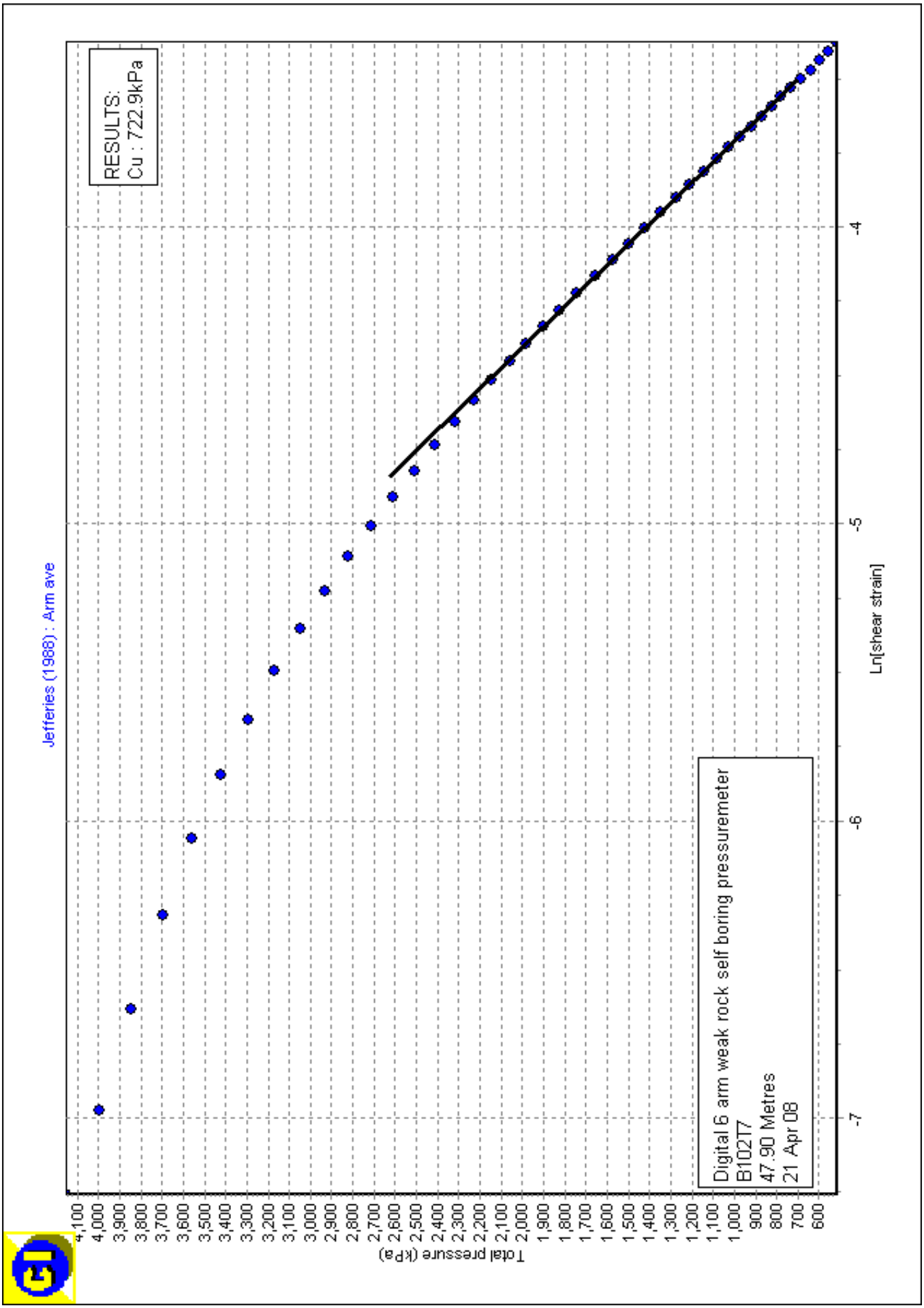
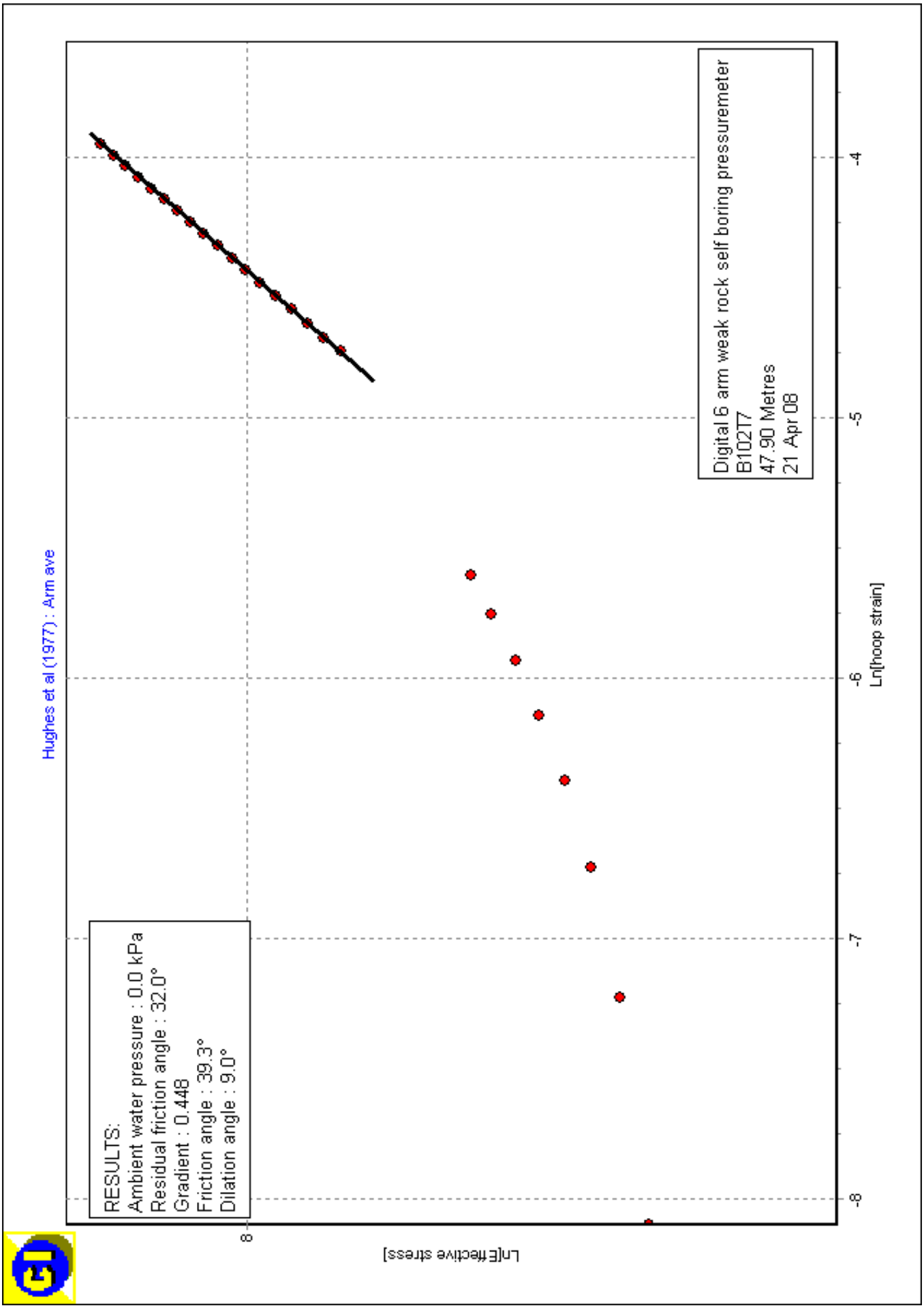
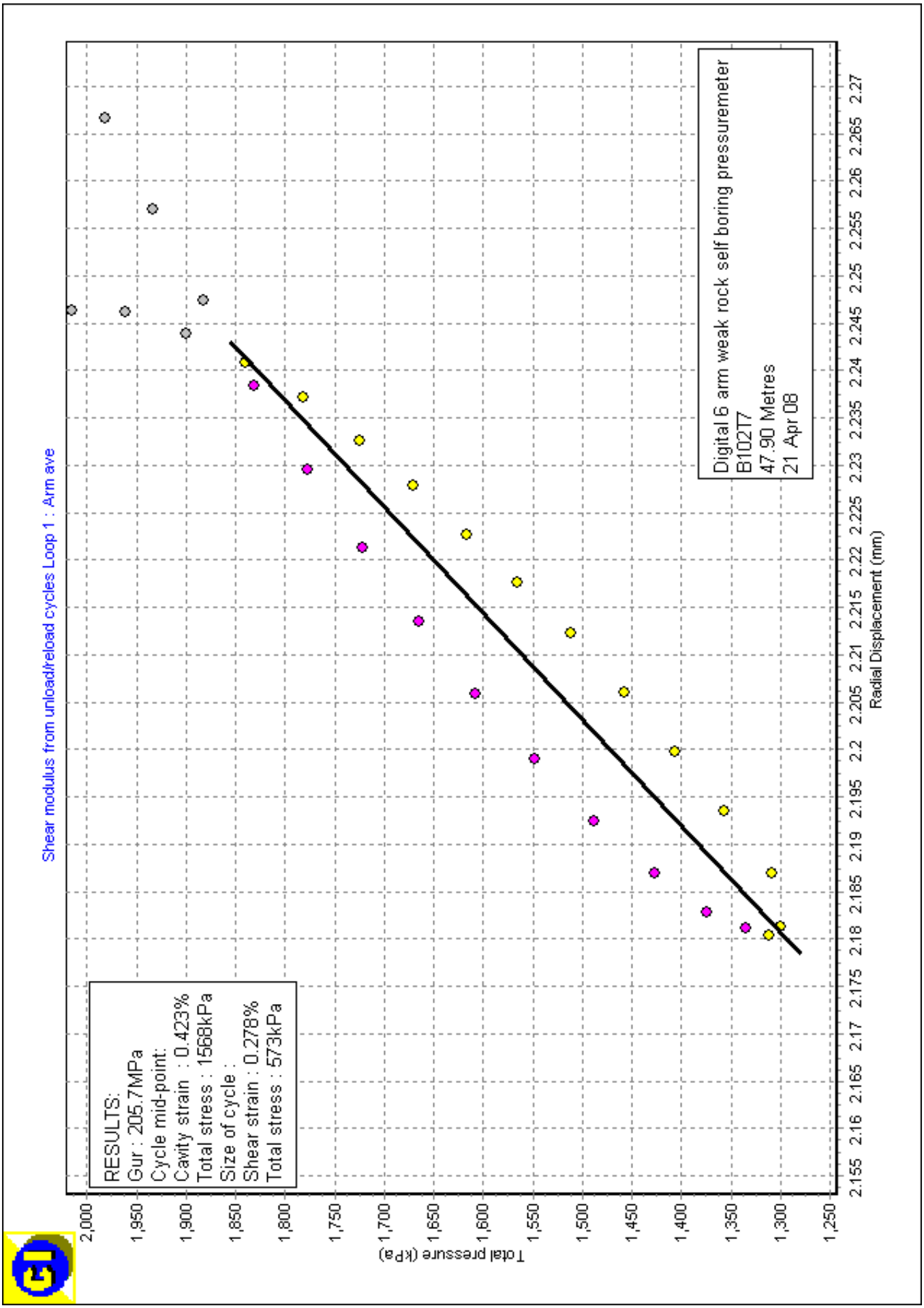
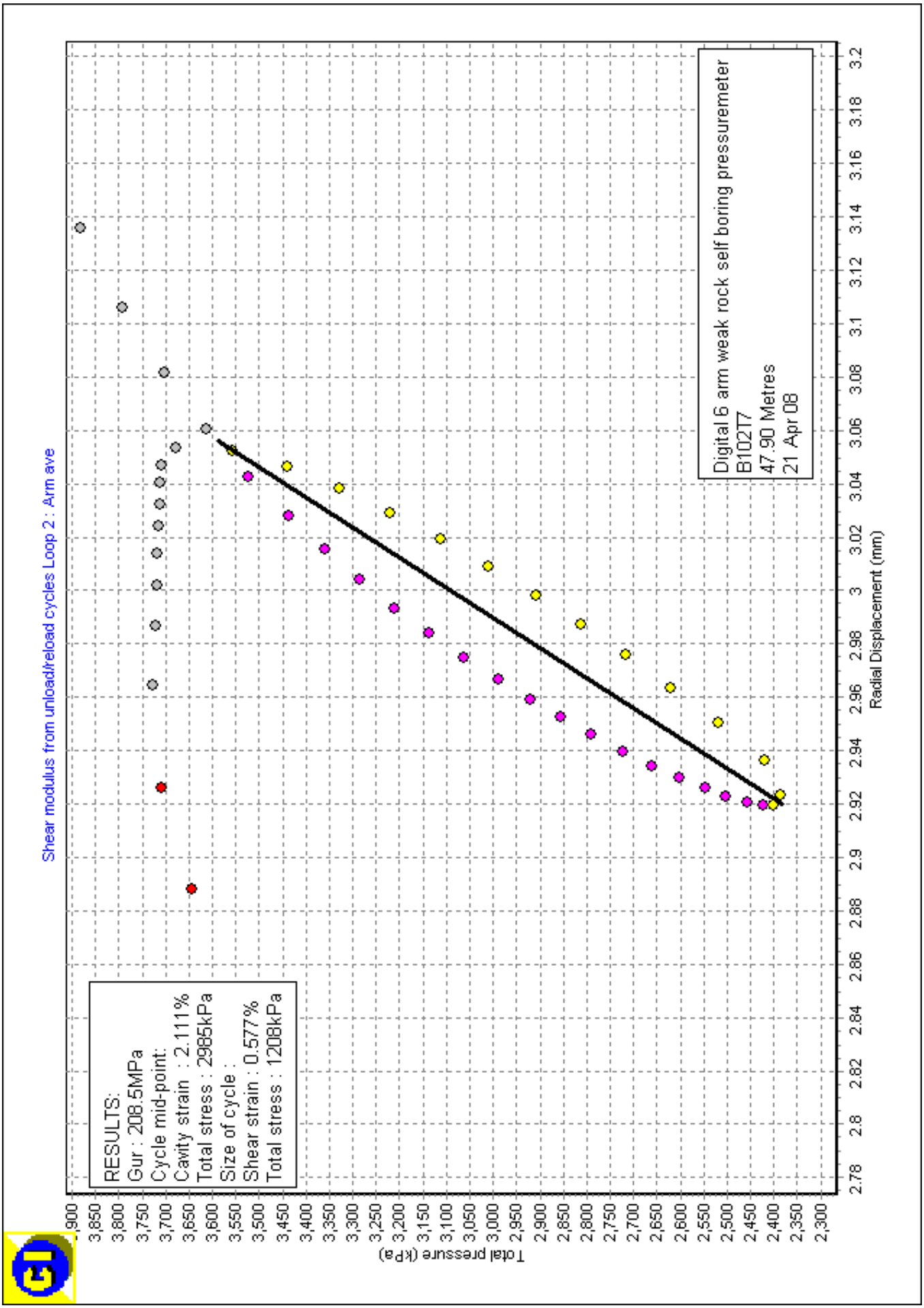
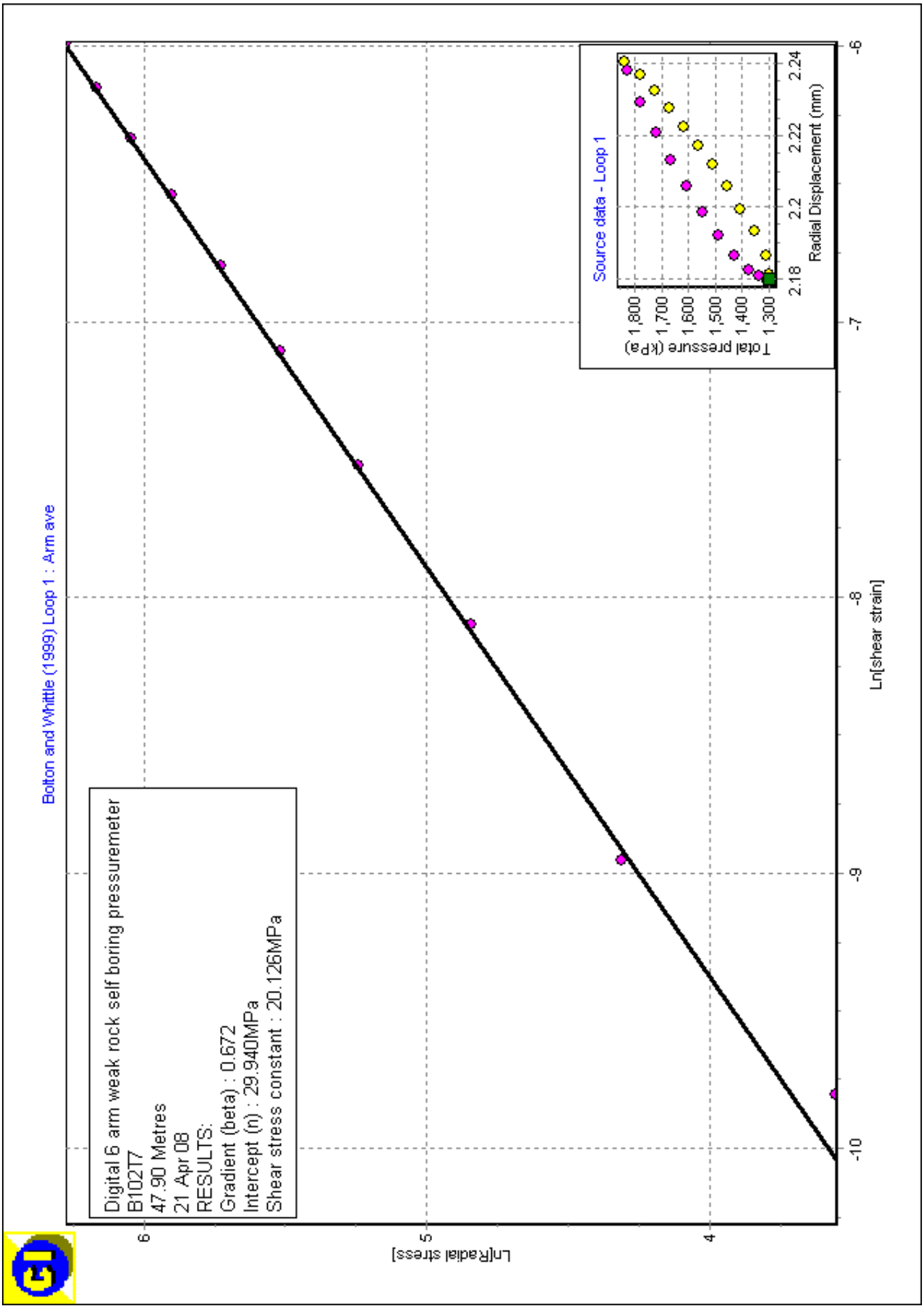
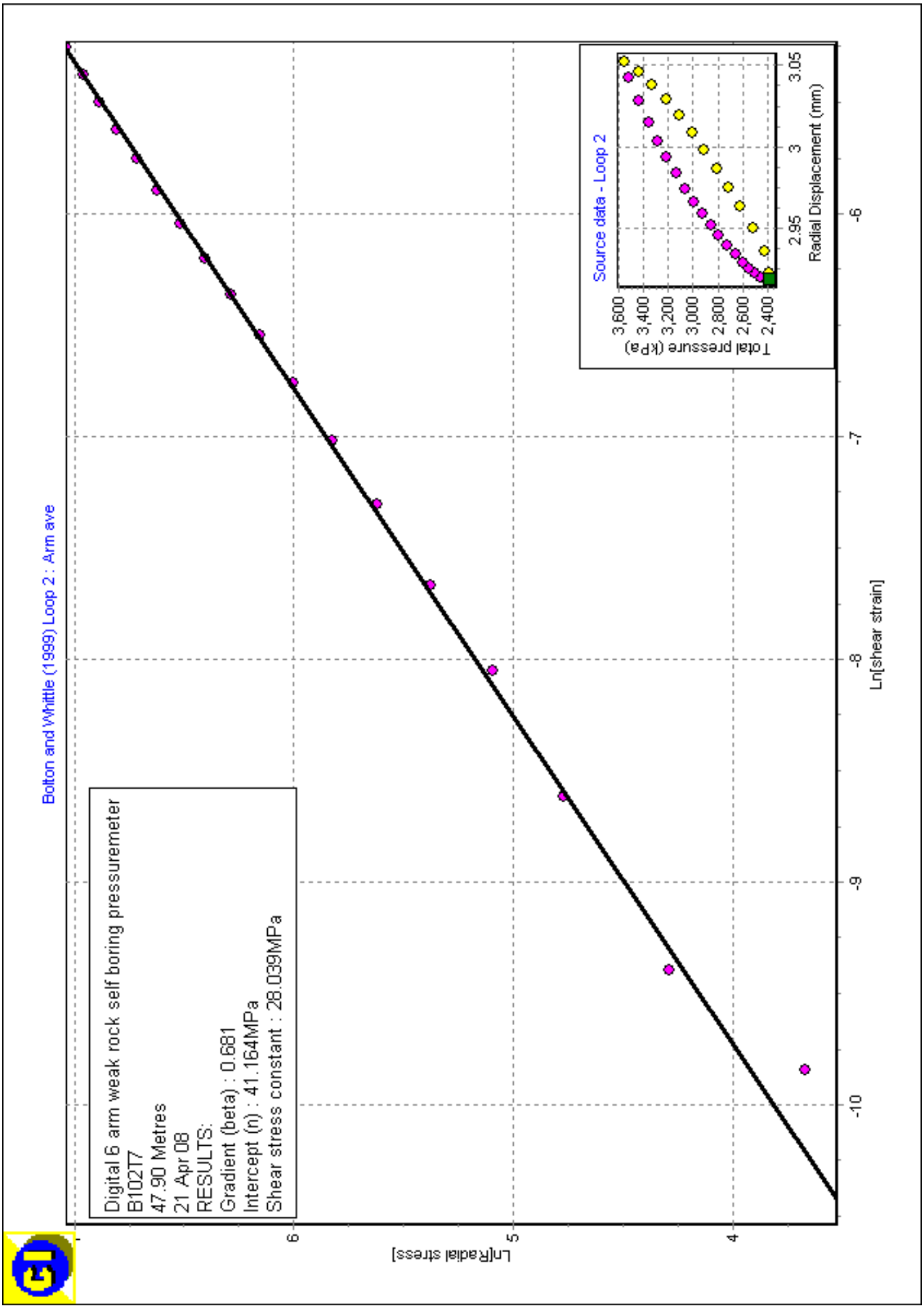

RESULTS:
Cu : 722.9kPa
Jefferies (1988) : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T7
47.90 Metres
21 Apr 08
Total pressure (kPa)
Ln[shear strain]

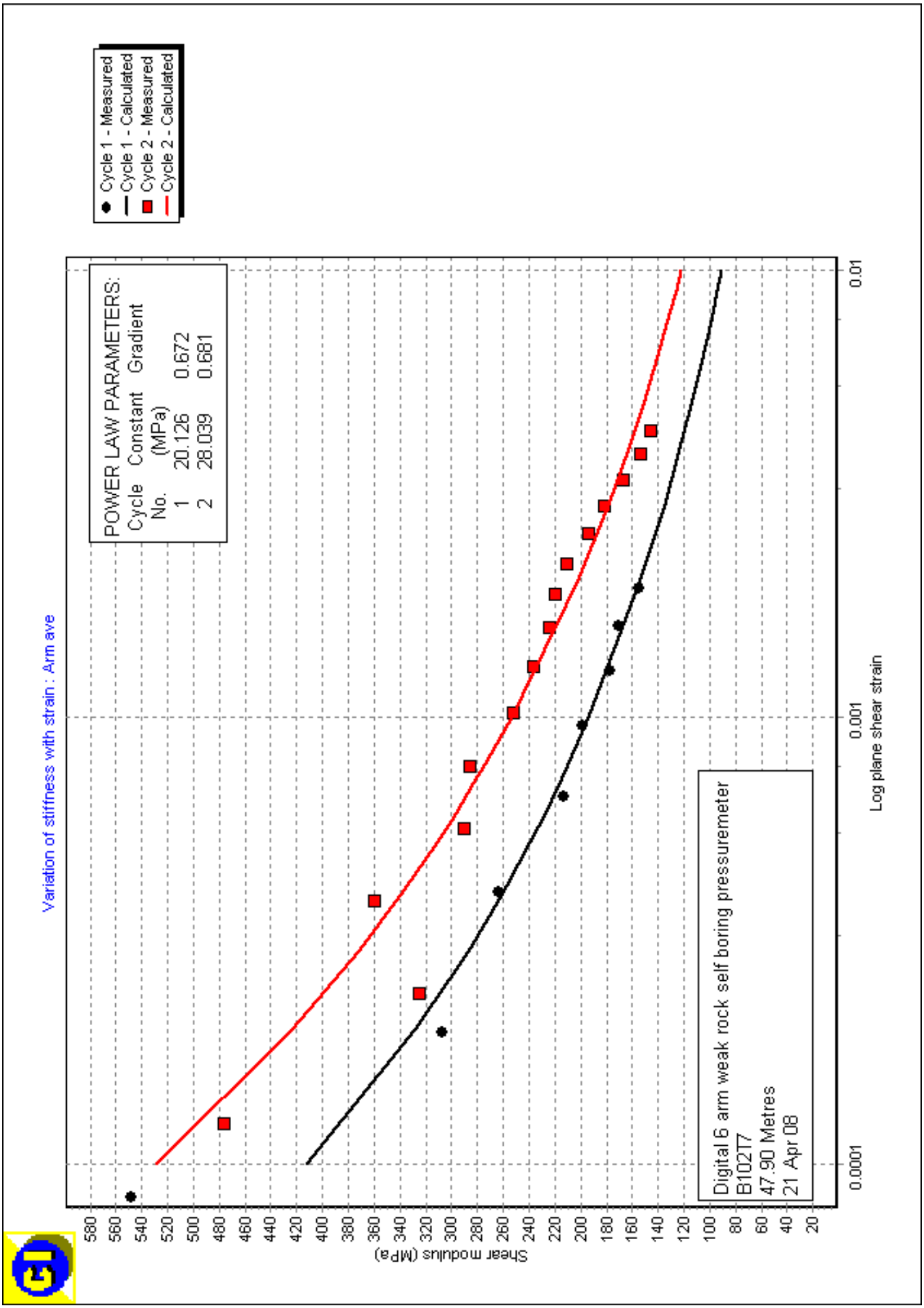

Hughes et al (1977) : Arm ave
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 32.0°
Gradient : 0.448
Friction angle : 39.3°
Dilation angle : 9.0°
Digital 6 arm weak rock self boring pressuremeter
B1027
47.90 Metres
21 Apr 08
Ln[Effective stress]
Ln[hoop strain]
8
-4
-5
-6
-7
-8

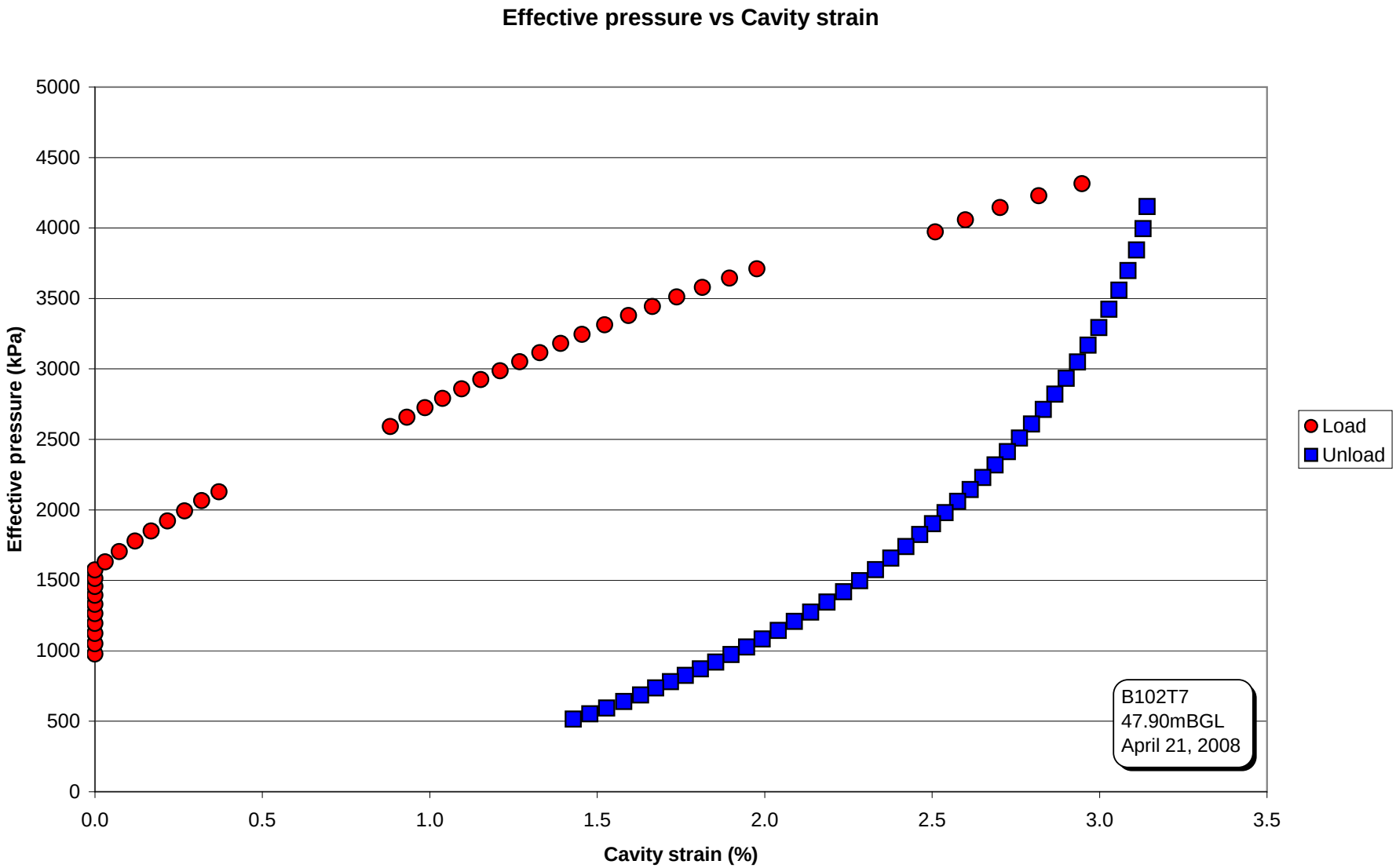

Shear modulus from unload/reload cycles Loop 1 : Arm ave
RESULTS:
Gur : 205.7MPa
Cycle mid-point:
Cavity strain : 0.423%
Total stress : 1568kPa
Size of cycle :
Shear strain : 0.278%
Total stress : 573kPa
Digital 6 arm weak rock self boring pressuremeter
B102T7
47.90 Metres
21 Apr 08
Total pressure (kPa)
Radial Displacement (mm)


Shear modulus from unload/reload cycles Loop 2 : Arm ave
RESULTS:
Gur : 208.5MPa
Cycle mid-point:
Cavity strain : 2.111%
Total stress : 2985kPa
Size of cycle :
Shear strain : 0.577%
Total stress : 1208kPa
Digital 6 arm weak rock self boring pressuremeter
B1027
47.90 Metres
21 Apr 08
Total pressure (kPa)
Radial Displacement (mm)

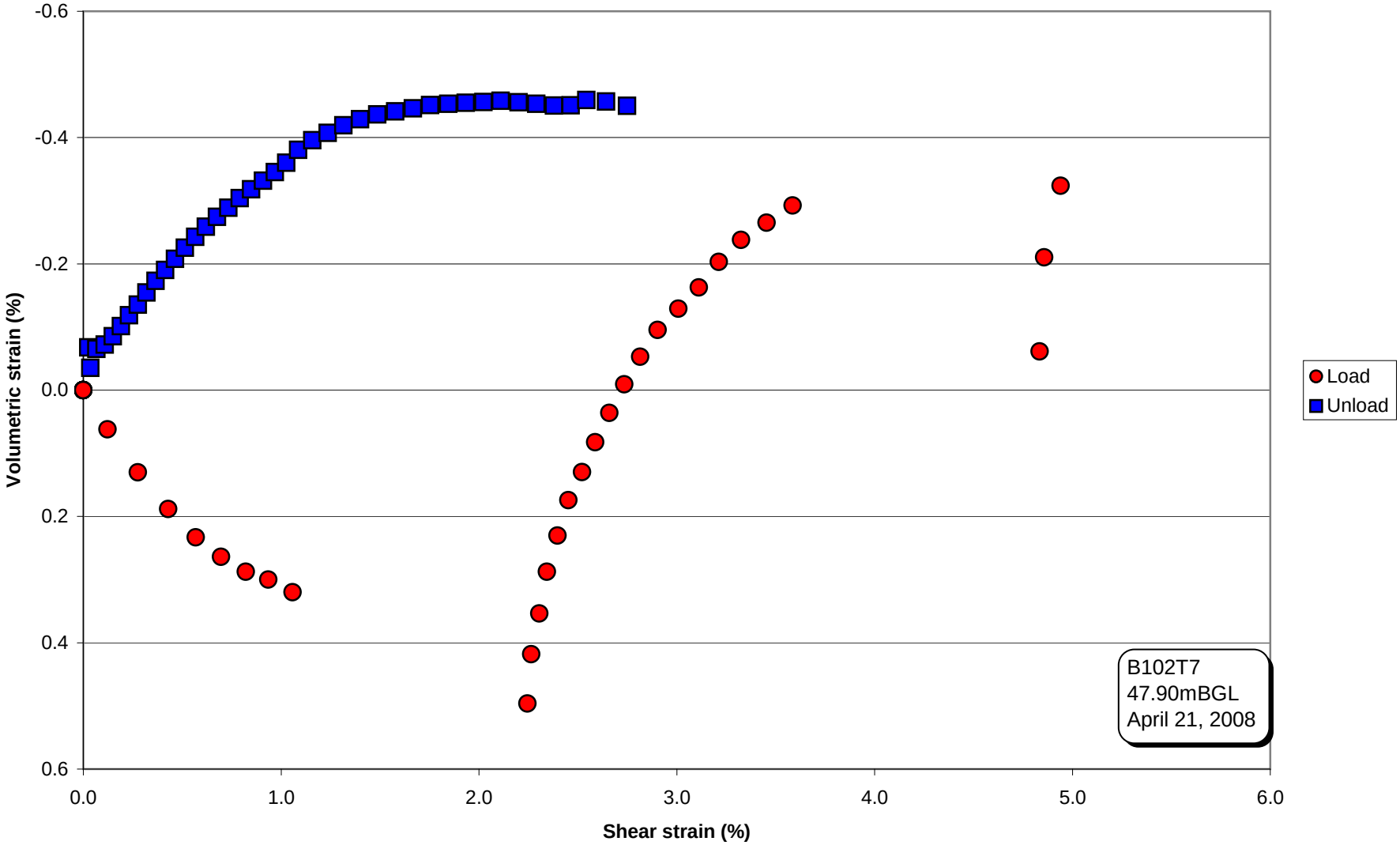

Bolton and Whittle (1999) Loop 1 : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T7
47.90 Metres
21 Apr 08
RESULTS:
Gradient (beta) : 0.672
Intercept (n) : 29.940MPa
Shear stress constant : 20.126MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)

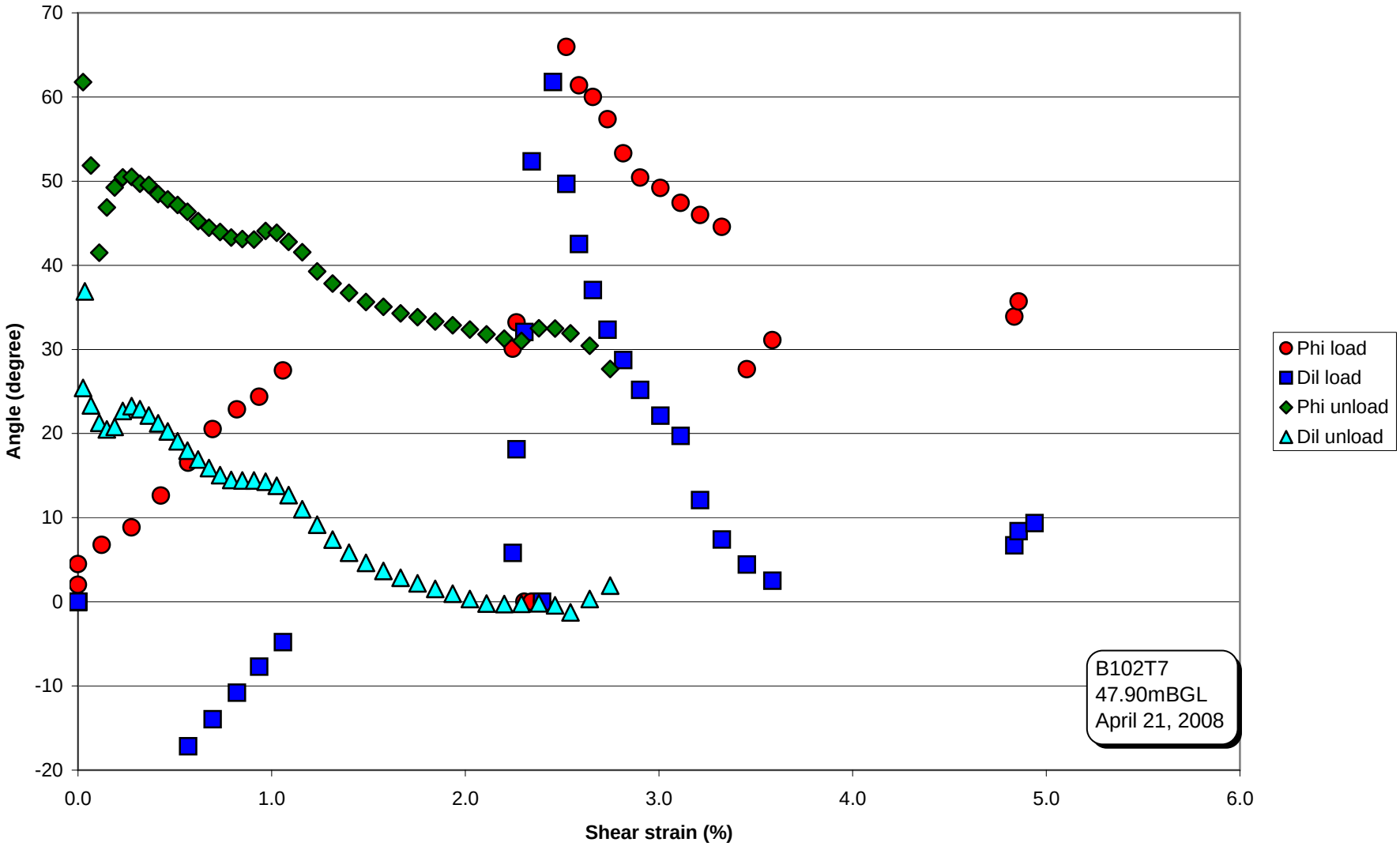

Bolton and Whittle (1999) Loop 2 : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T7
47.90 Metres
21 Apr 08
RESULTS:
Gradient (beta) : 0.681
Intercept (n) : 41.164MPa
Shear stress constant : 28.039MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 2
Total pressure (kPa)
Radial Displacement (mm)


Cycle 1 - Measured
Cycle 1 - Calculated
Cycle 2 - Measured
Cycle 2 - Calculated
POWER LAW PARAMETERS:
Cycle No.
Constant (MPa)
Gradient
1 20.126 0.672
2 28.039 0.681
Variation of stiffness with strain : Arm ave
Shear modulus (MPa)
Log plane shear strain
0.0001
0.001
0.01
Digital 6 arm weak rock self boring pressuremeter
B102T7
47.90 Metres
21 Apr 08

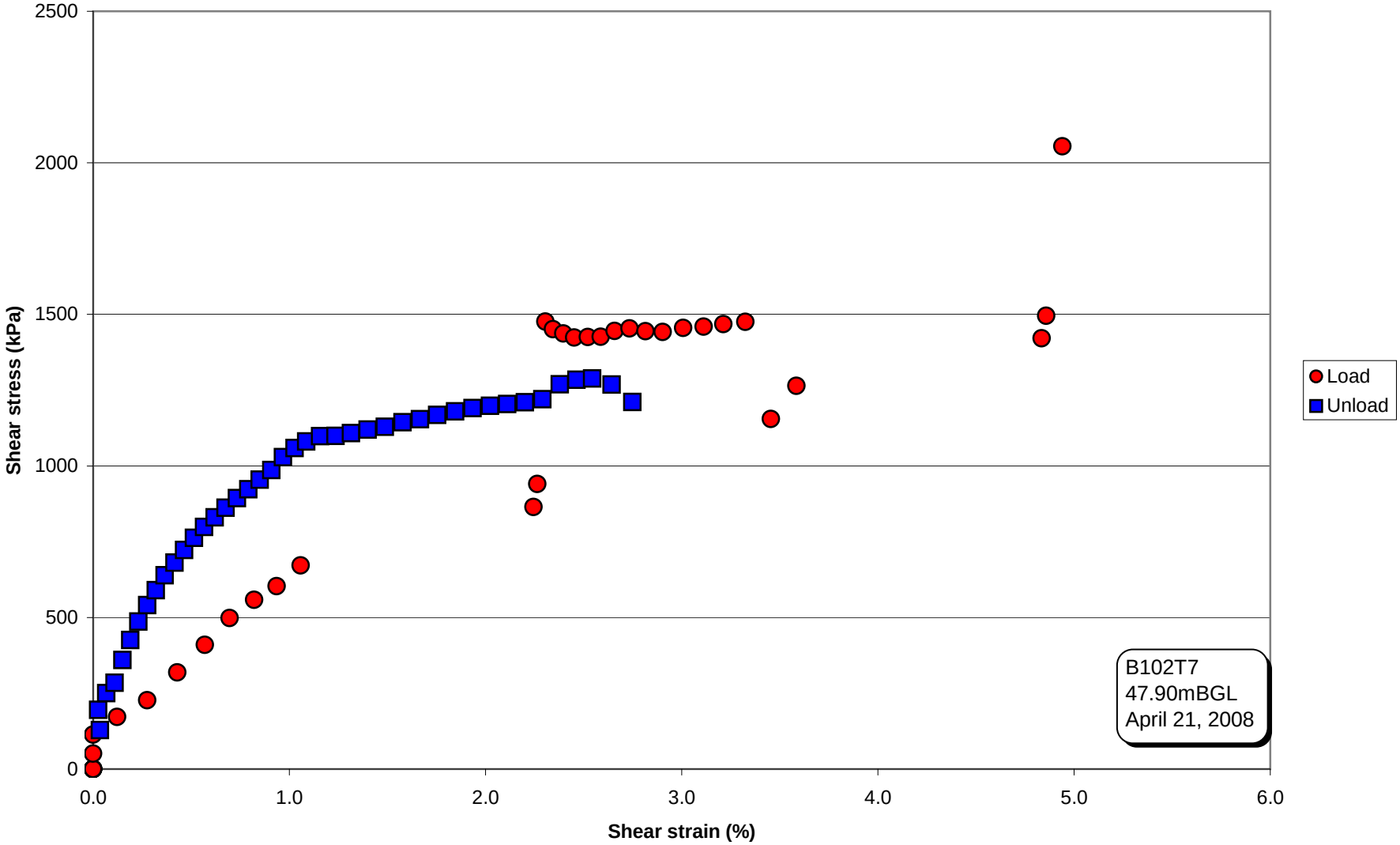

Effective pressure vs Cavity strain
Effective pressure (kPa)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Cavity strain (%)
Load
Unload
B102T7
47.90mBGL
April 21, 2008

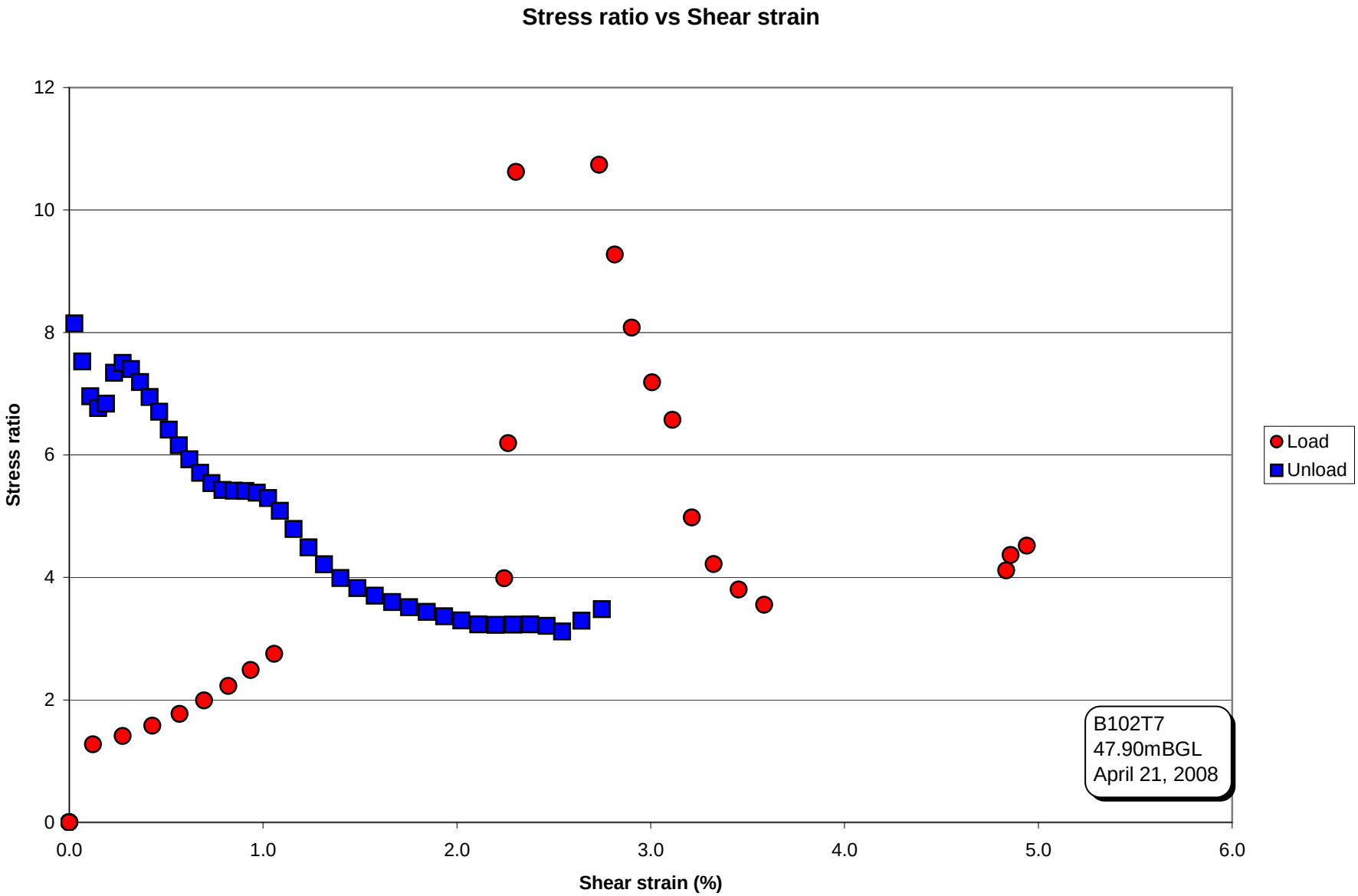
Volumetric strain vs Shear strain

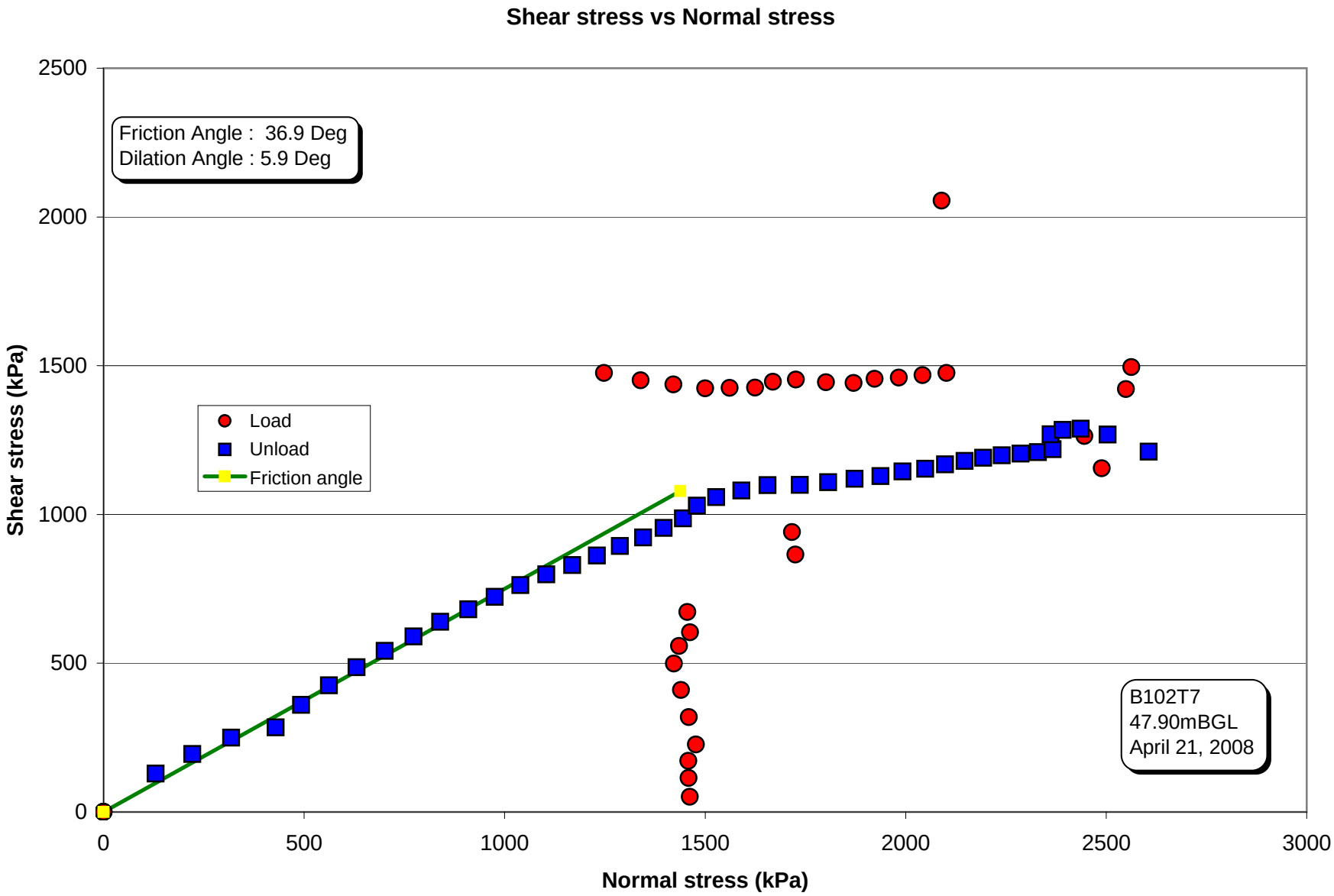



Angles of friction and dilation vs Shear strain
Angle (degree)
70
60
50
40
30
20
10
0
-10
-20
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Shear strain (%)
Phi load
Dil load
Phi unload
Dil unload
B102T7
47.90mBGL
April 21, 2008

Shear stress vs Shear strain




Stress ratio vs Shear strain
Stress ratio
Shear strain (%)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Load
Unload
B102T7
47.90mBGL
April 21, 2008


Shear stress vs Normal stress
Friction Angle : 36.9 Deg
Dilation Angle : 5.9 Deg
Load
Unload
Friction angle
B102T7
47.90mBGL
April 21, 2008
Shear stress (kPa)
Normal stress (kPa)
0
500
1000
1500
2000
2500
3000

6 ARM SELF BORING PRESSUREMETER **TEST RECORD SHEET**

Site	Date	Day	Borehole	Test	Depth to Test Centre (below ground level)
DENMARK PLACE	21/4/08	MON	B102	7	17.9m.

Weather:- Material:- THANETS? SANDY, SILTY, Band/ GRAVEL

Water table	Drilling Start	Drilling End	Distance	Drill Rate	Ram Pressure
?	15:07	15:56	0.9m	1m/50mins	160 BARS

Ground level :- Orientation:-

Water Press.	Inst.OD	Shoe OD	Cutter Type	Cutter position	Probe Reference
	88.1	89.1	TR-R	3mm	"MOLLY"

Drilling Remarks:- V. difficult.

Strain Rate	Press. Rate	Cycle Time	Gas Bottle	Battery	PPC Type	Max Pressure Cap.
— MANUAL —		65sec	300BARS	13.0V	TEXAS	10MPa.

Arm 1	Arm 2	Arm 3	Arm 4	Arm 5	Arm 6	PPC A	PPC B	TPC	Date:-
-107	84	-70	35	-84	132	-1033	-923	-2445	Ground Level Zeros
									Pre-drilling Zeros
									Post-drilling Zeros
-108	79	-73	39	-76	118	-901	-801	-2441	Pre-test Zeros
									Ground Level Zeros

Test starts:- 16:00

Line	Notes
546	Horiz 2.1MPa.
551	Loop 1 G = 21.3MPa.
609	Horiz 3.7MPa.
618	Loop 2. G = 20.6MPa.
660	Unload

Test ends:- 16:20. Max Press:- 4314 kPa.

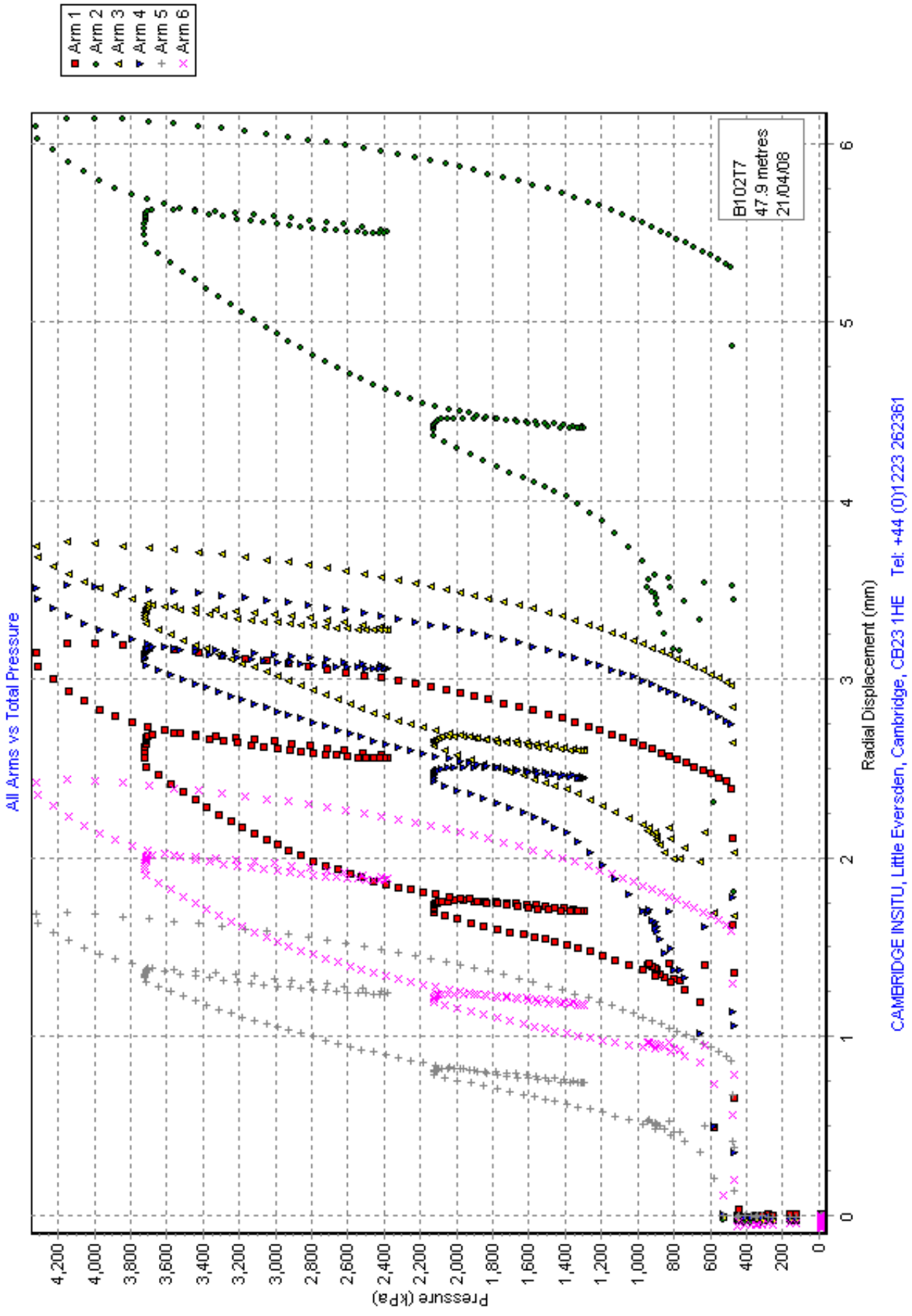
Calibrated Data details:

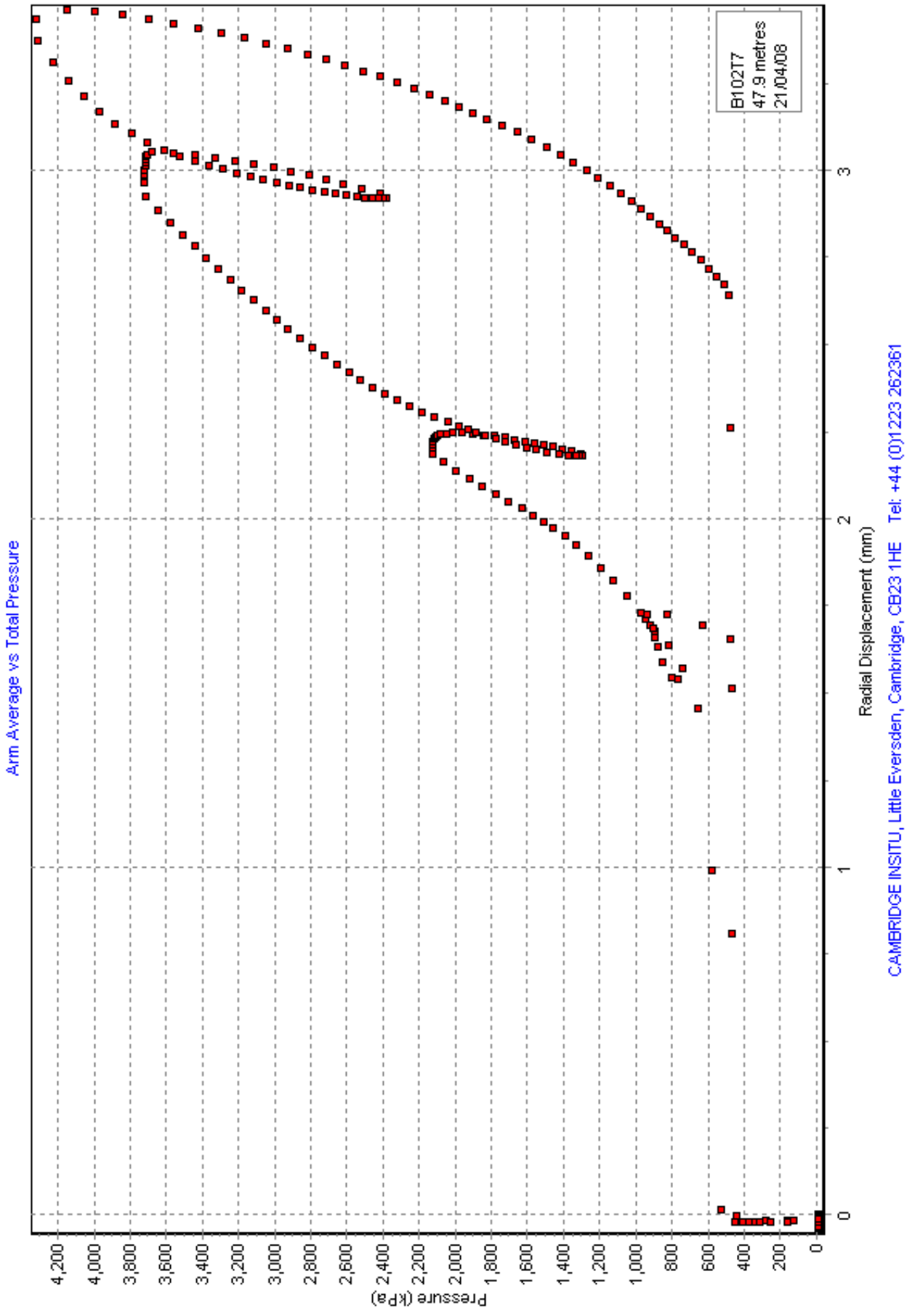
Mem. Correction.	Mem. Compression.	Strain Cals.	Pressure Cals.
W0130T1	W0130T2	10/4/08	11/4/08

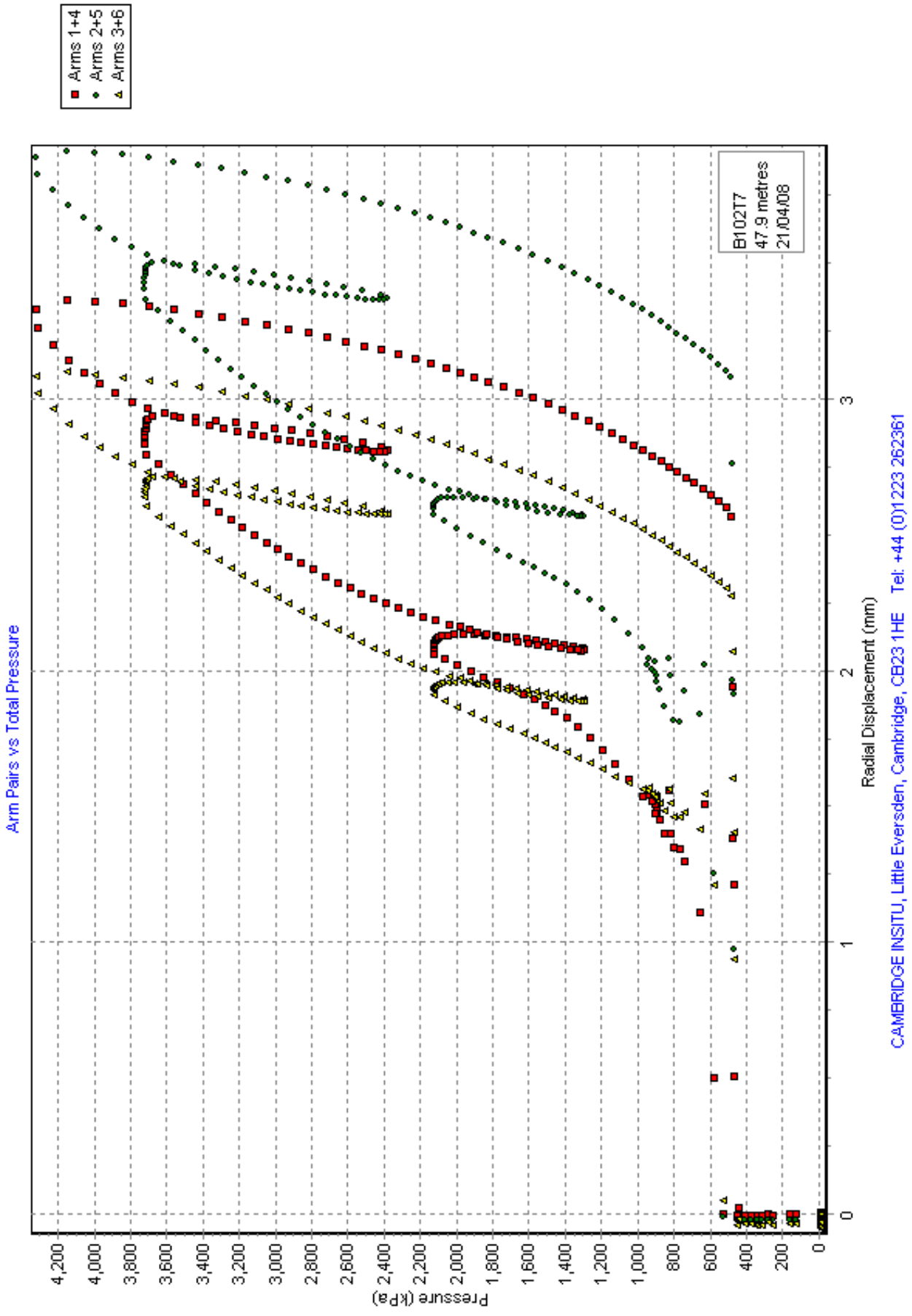
TEST REMARKS: MATERIAL PROBABLY UPPER D.STURRIDGE TEST. SHOE EDGE & CUTTER SEVERELY DAMAGED BY GRAVEL. Apparently no pump. Start of test a bit messy — completed stopped working.

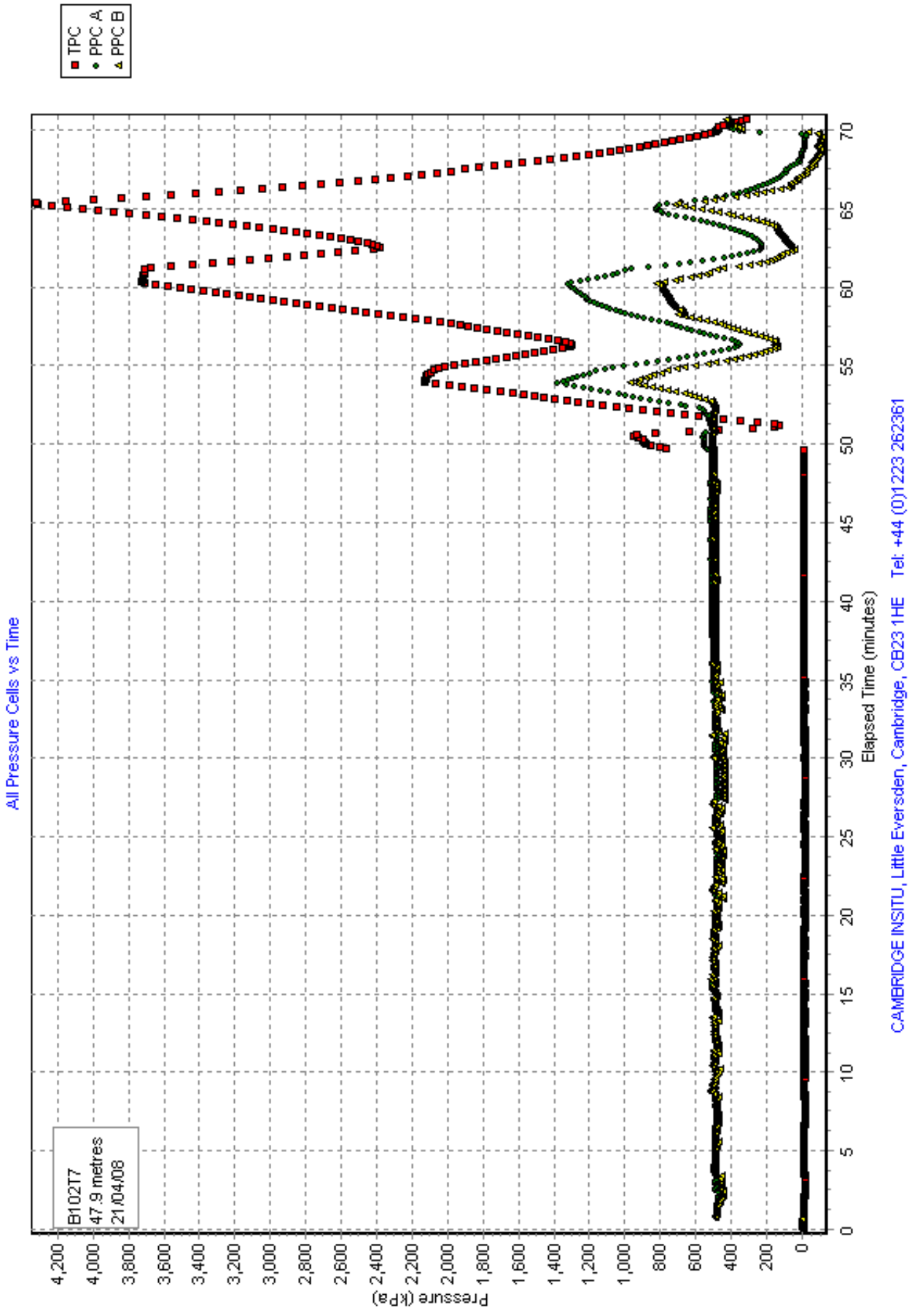
Driller: DAN

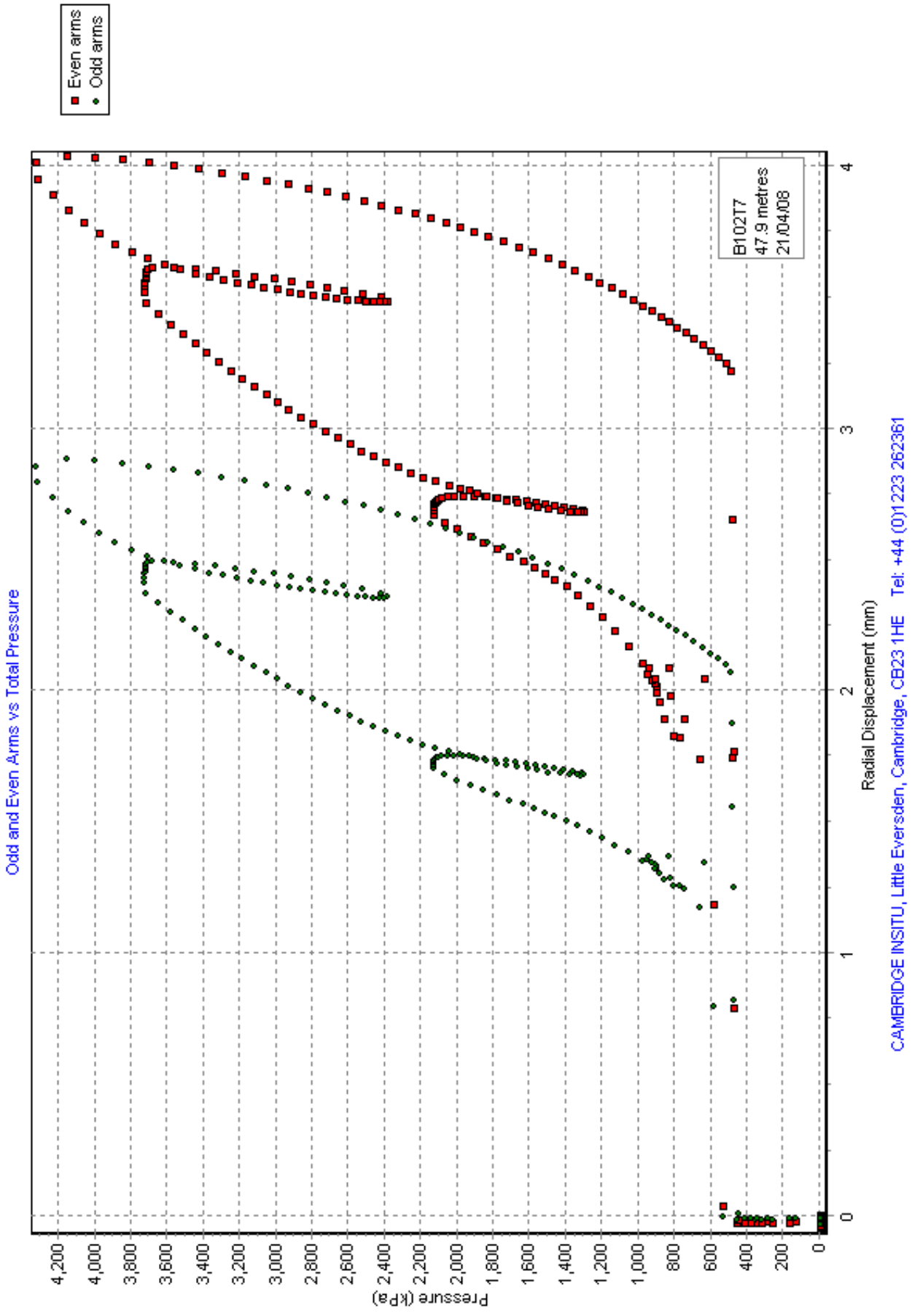
Tester: RWO


Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
B102T7
47.9 metres
21/04/08
All Arms vs Total Pressure
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
B10277
47.9 metres
21/04/08
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arms 1+4
Arms 2+5
Arms 3+6
Arm Pairs vs Total Pressure
Pressure (kPa)
Radial Displacement (mm)
B1027T
47.9 metres
21/04/08
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


TPC
PPC A
PPC B
All Pressure Cells vs Time
B102T7
47.9 metres
21/04/08
Pressure (kPa)
Elapsed Time (minutes)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Even arms
Odd arms
Odd and Even Arms vs Total Pressure
B102T7
47.9 metres
21/04/08
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

B102T8 - SUMMARY OF RESULTS
[File made with WinSitu Version 1.20.1.1]

[DETAILS OF TEST]

Project	:	36237
Site	:	Denmark Place
Borehole	:	BH102
Test name	:	B102T8
Test date	:	22 Apr 08
Test depth	:	50.00 Metres
Water table	:	5.6 Metres
Ambient PWP	:	0.0 kPa
Material	:	Thanet Sand
Probe	:	Digital 6 arm weak rock self boring pressuremeter
Diameter	:	88.1 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out

Analysed by RWW on 5 Jun 08

Remarks: Drilled in quickly, but some gravel in hole so test is disturbed. Some PWP response in p

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=2.100"
Po from Marsland & Randolph (kPa)	:	"Arm ave=1089.2"
Best estimate of Po (kPa)	:	"Arm ave=1089.0"

[UNDRAINED STRENGTH PARAMETERS]

Jefferies 1988 - Cu (kPa)	:	"Arm ave=960.7"
Undrained yield stress (kPa)	:	"Arm ave=4309.1"

[DRAINED ANALYSIS OF SANDS - HUGHES et al 1977]

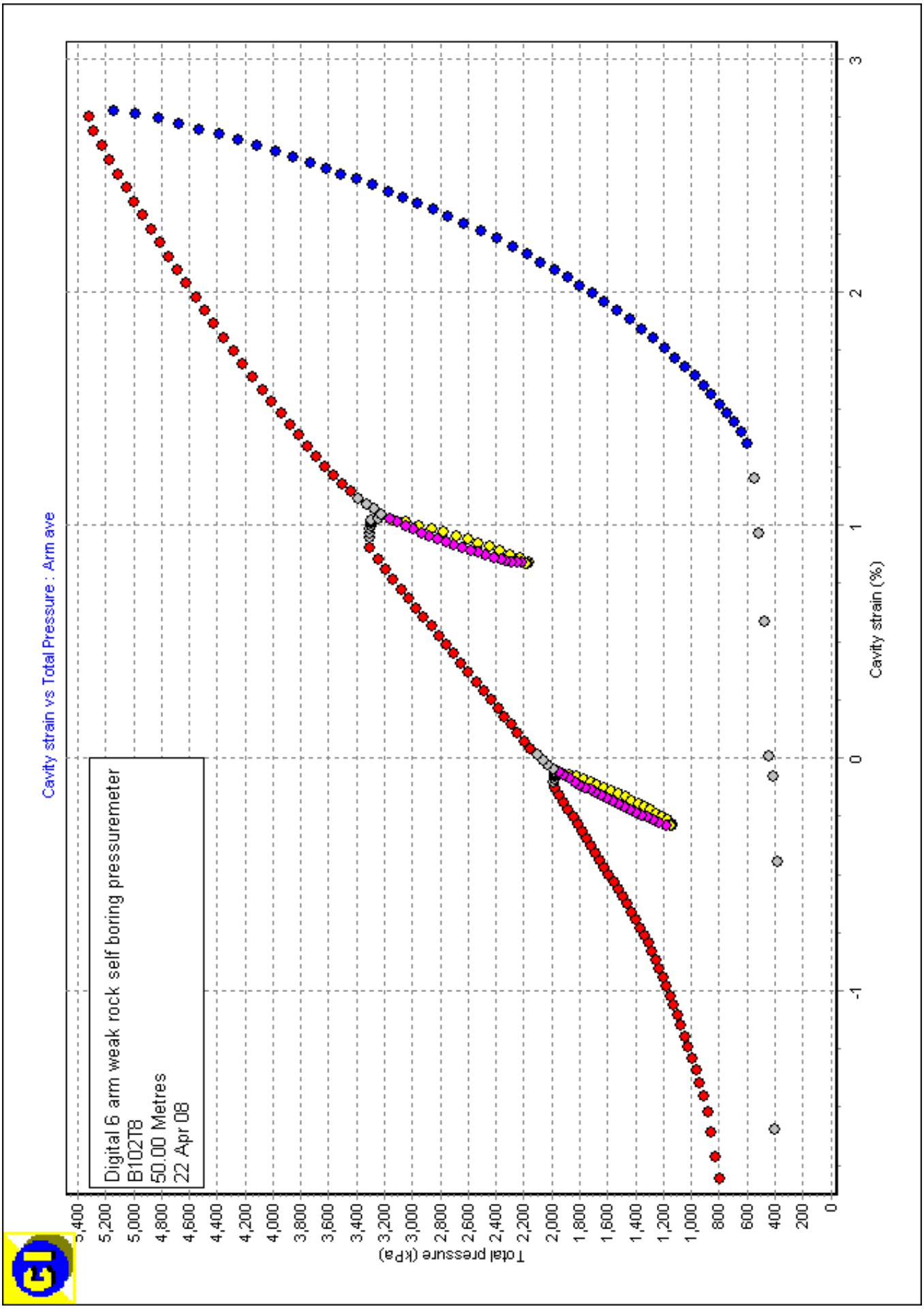
Constant volume friction angle (°)	:	32.0
Angle of internal friction (°)	:	"Arm ave=42.3"
Dilation angle (°)	:	"Arm ave=12.9"
Gradient of log-log plot	:	"Arm ave=0.492"

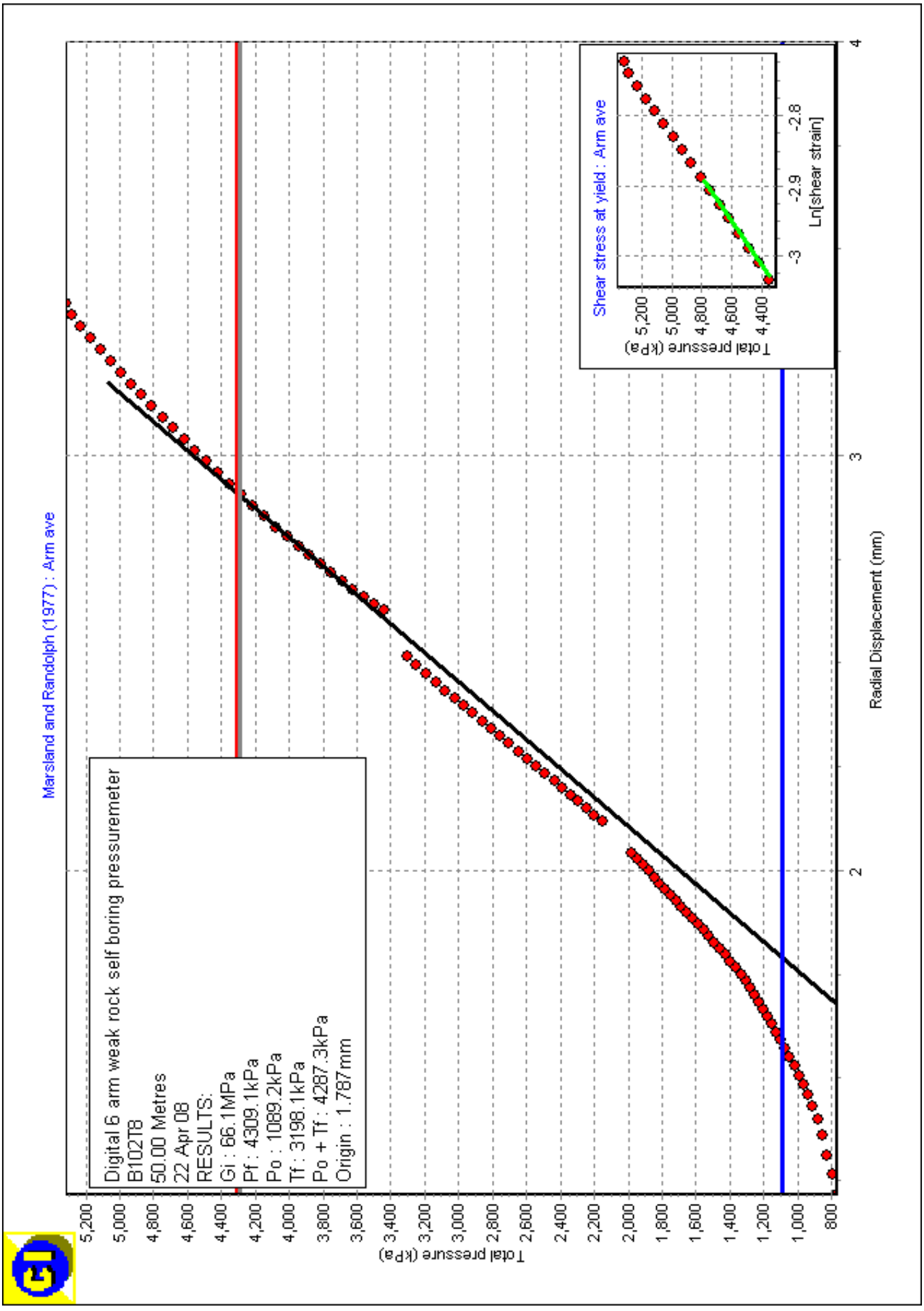
[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=66.1"

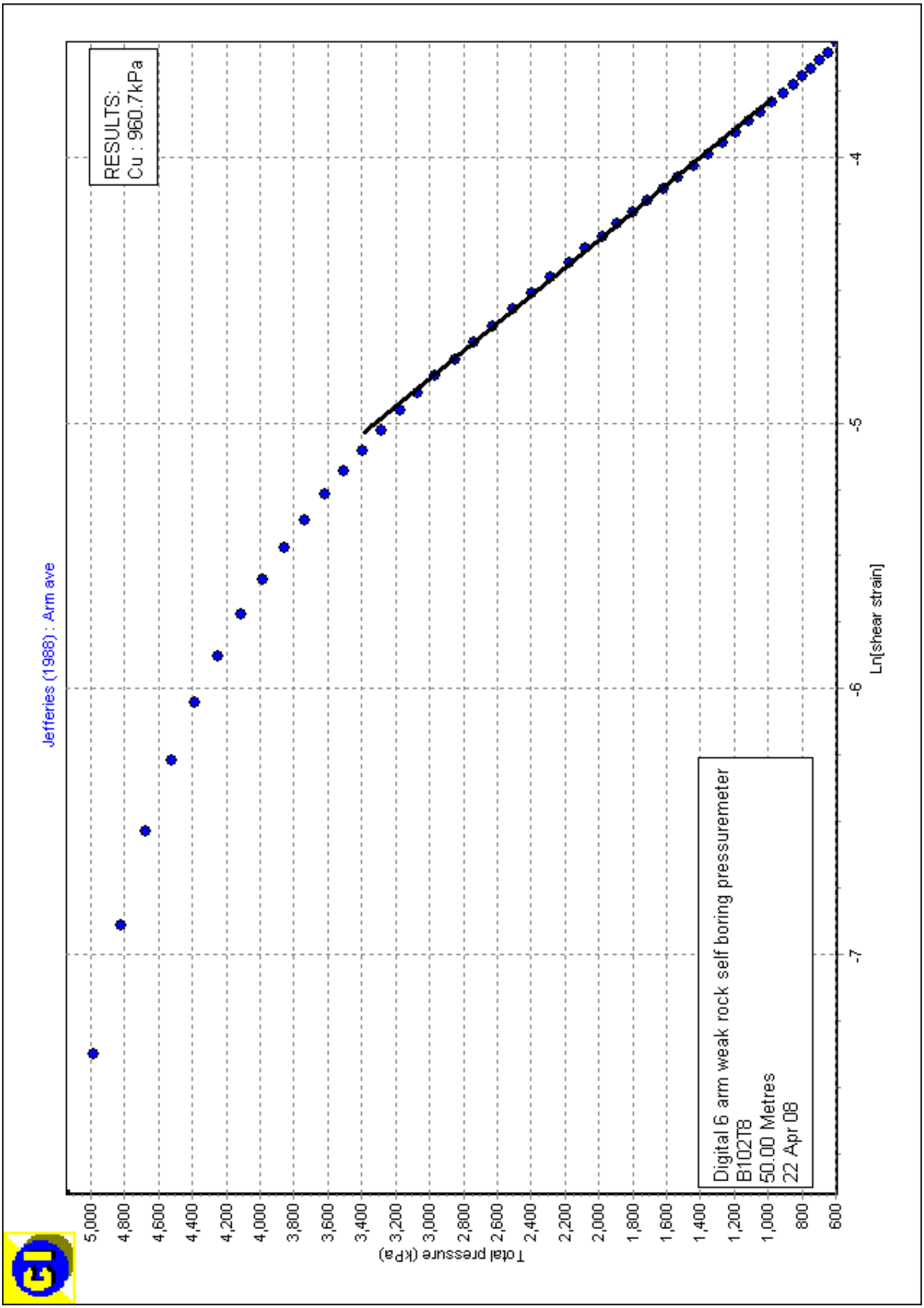
Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	175.1	-0.170	1541	0.490	860
Arm ave	2	255.8	0.934	2653	0.402	1030

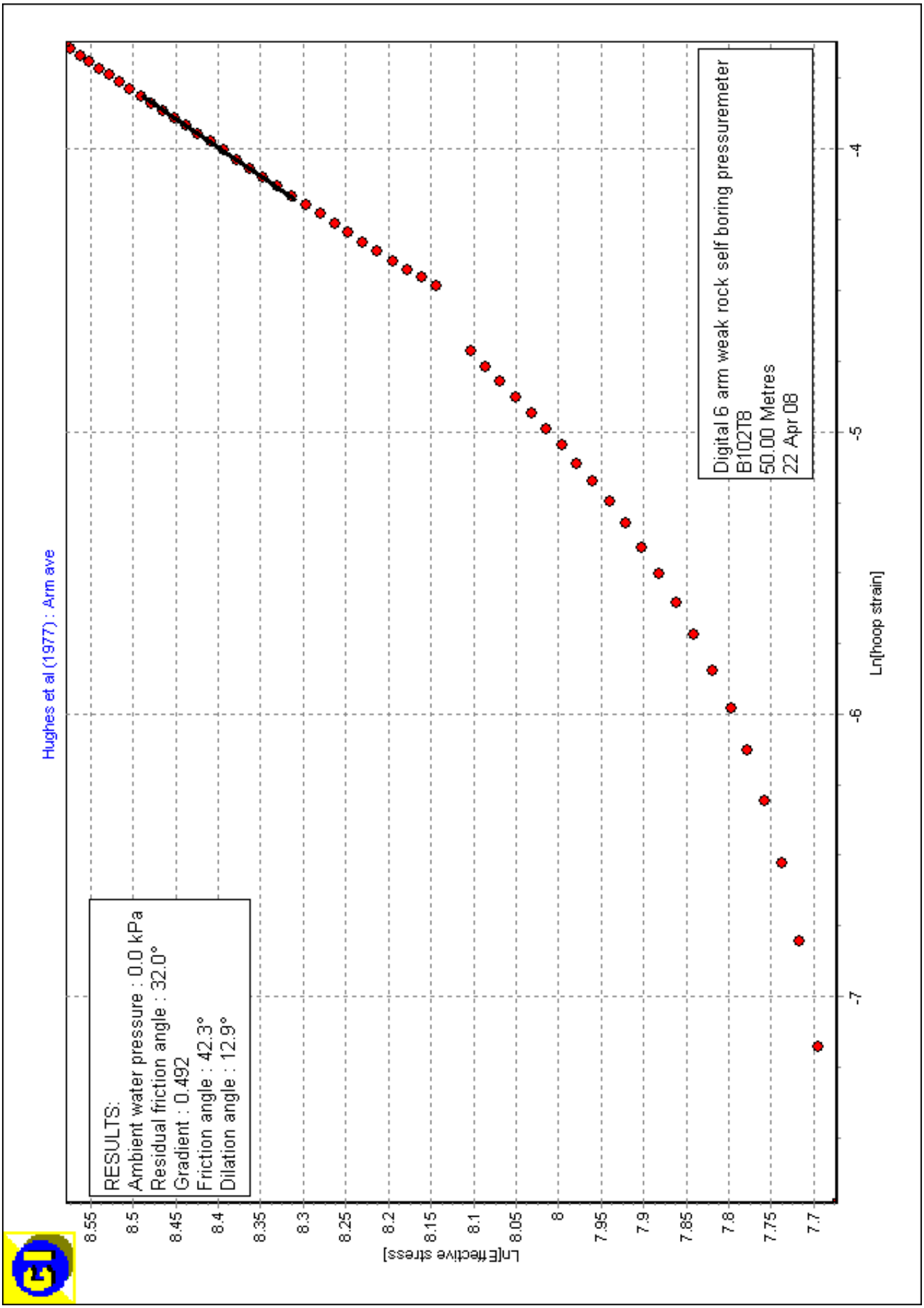
[NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

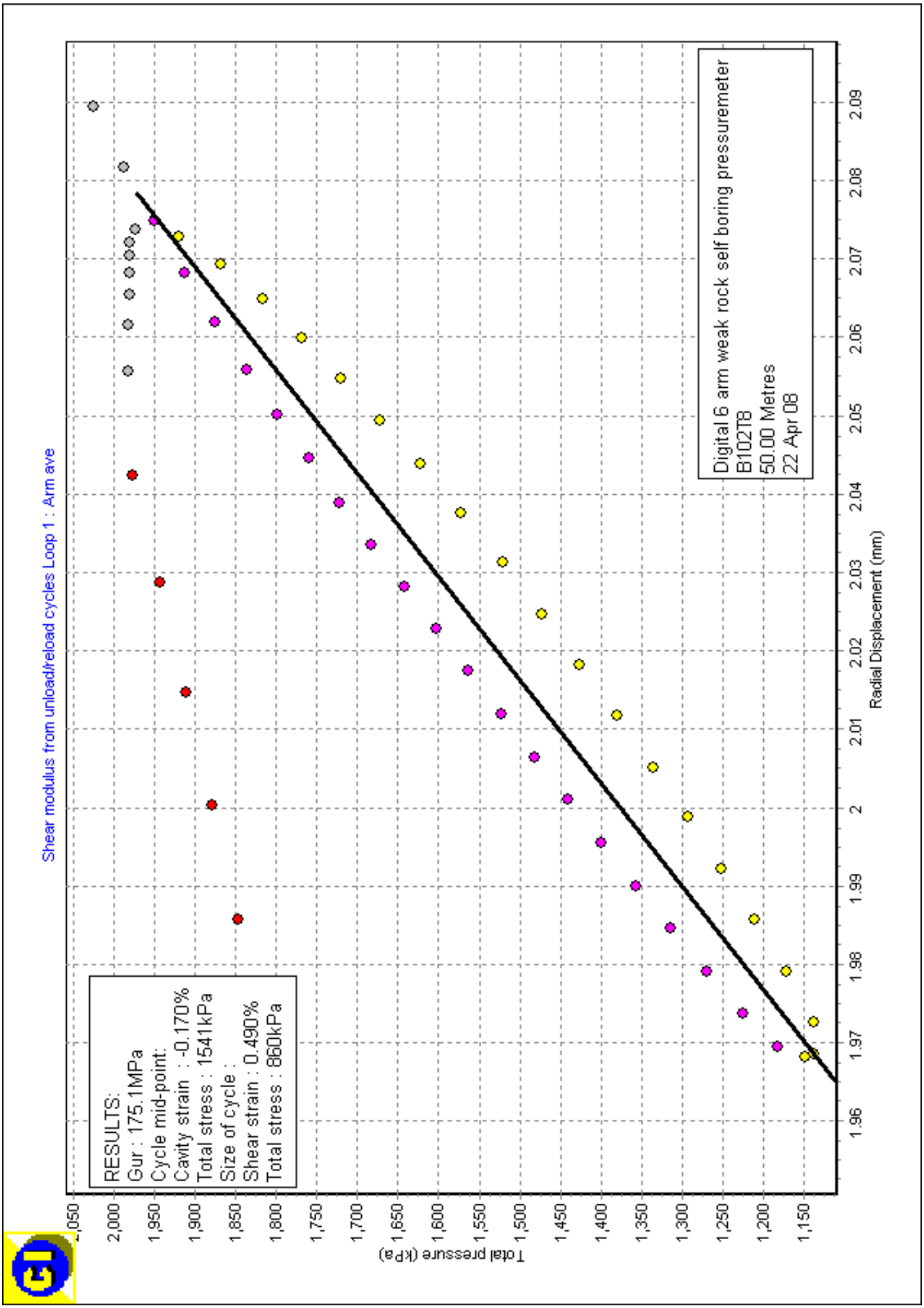
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	86.836	75.547	0.870
Arm ave	2	59.452	43.718	0.735

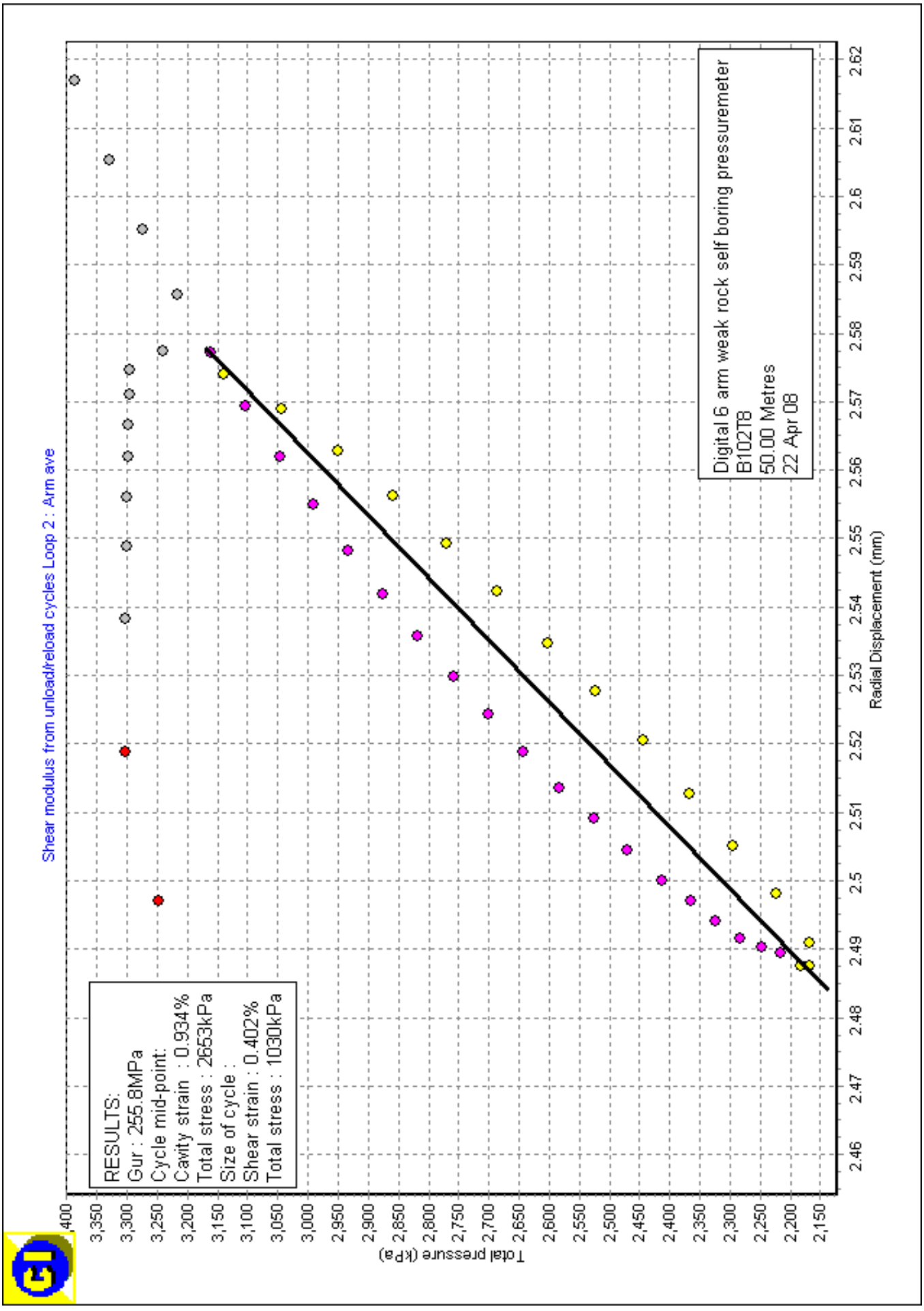

Cavity strain vs Total Pressure : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
Total pressure (kPa)
Cavity strain (%)

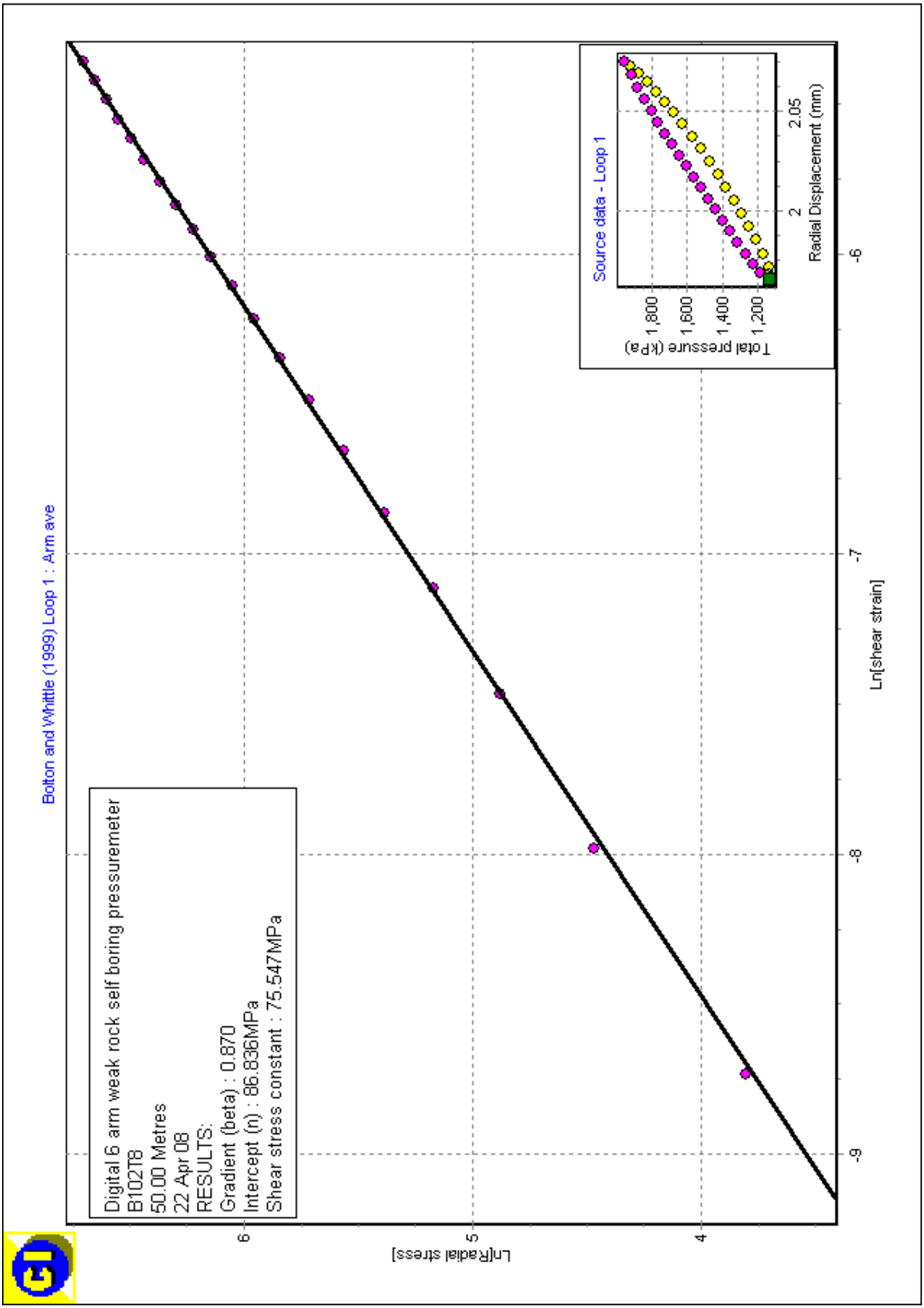

Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
RESULTS:
Gi : 66.1MPa
Pf : 4309.1kPa
Po : 1089.2kPa
Tf : 3198.1kPa
Po + Tf : 4287.3kPa
Origin : 1.787mm
Marsland and Randolph (1977) : Arm ave
Total pressure (kPa)
Radial Displacement (mm)
Shear stress at yield : Arm ave
Total pressure (kPa)
Ln[shear strain]

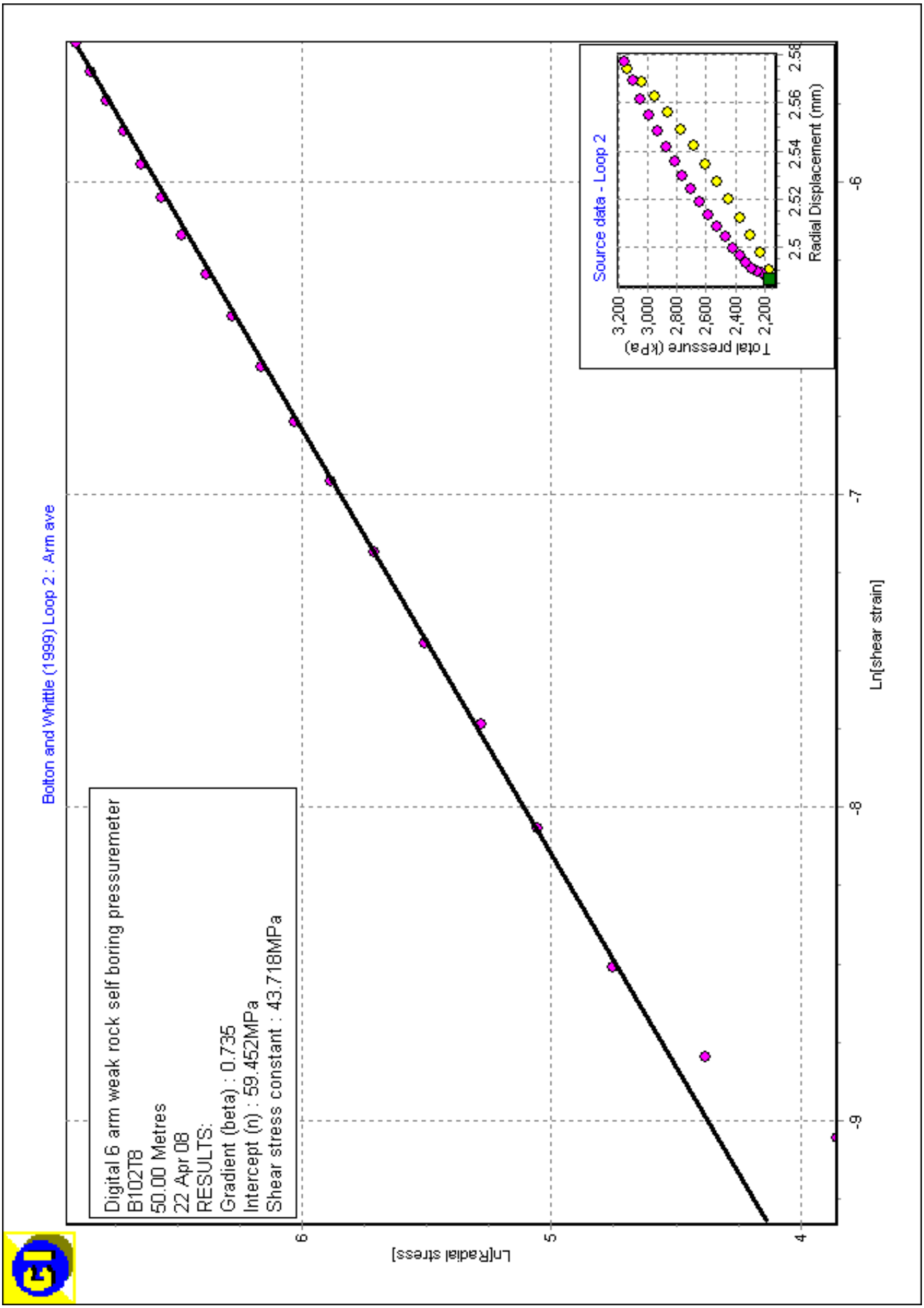

RESULTS:
Cu : 960.7kPa
Jefferies (1988) : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
Total pressure (kPa)
Ln[shear strain]
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
-4
-5
-6
-7

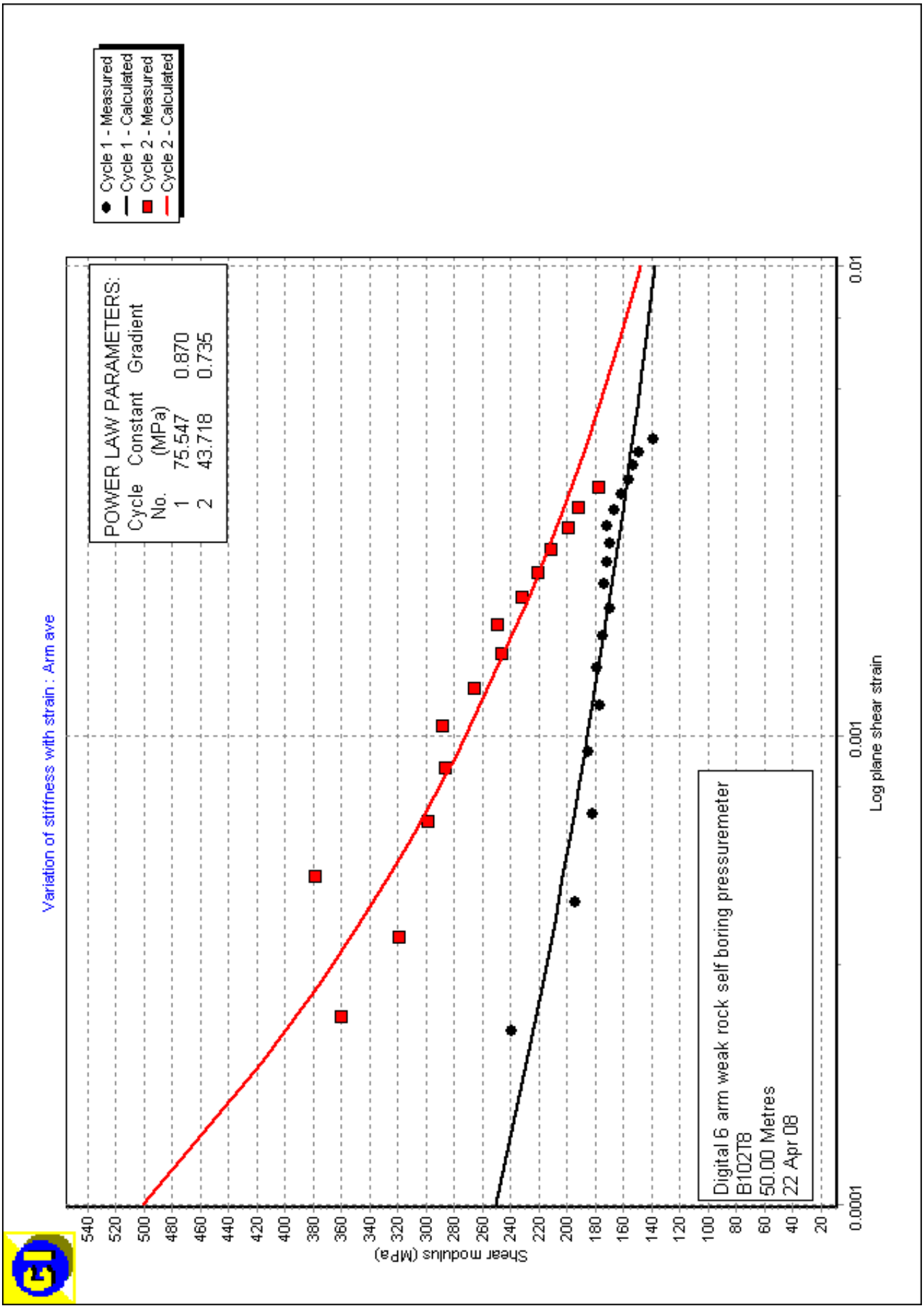

Hughes et al (1977) : Arm ave
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 32.0°
Gradient : 0.492
Friction angle : 42.3°
Dilation angle : 12.9°
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
Ln[Effective stress]
Ln[hoop strain]
8.55
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
7.9
7.85
7.8
7.75
7.7
-4
-5
-6
-7

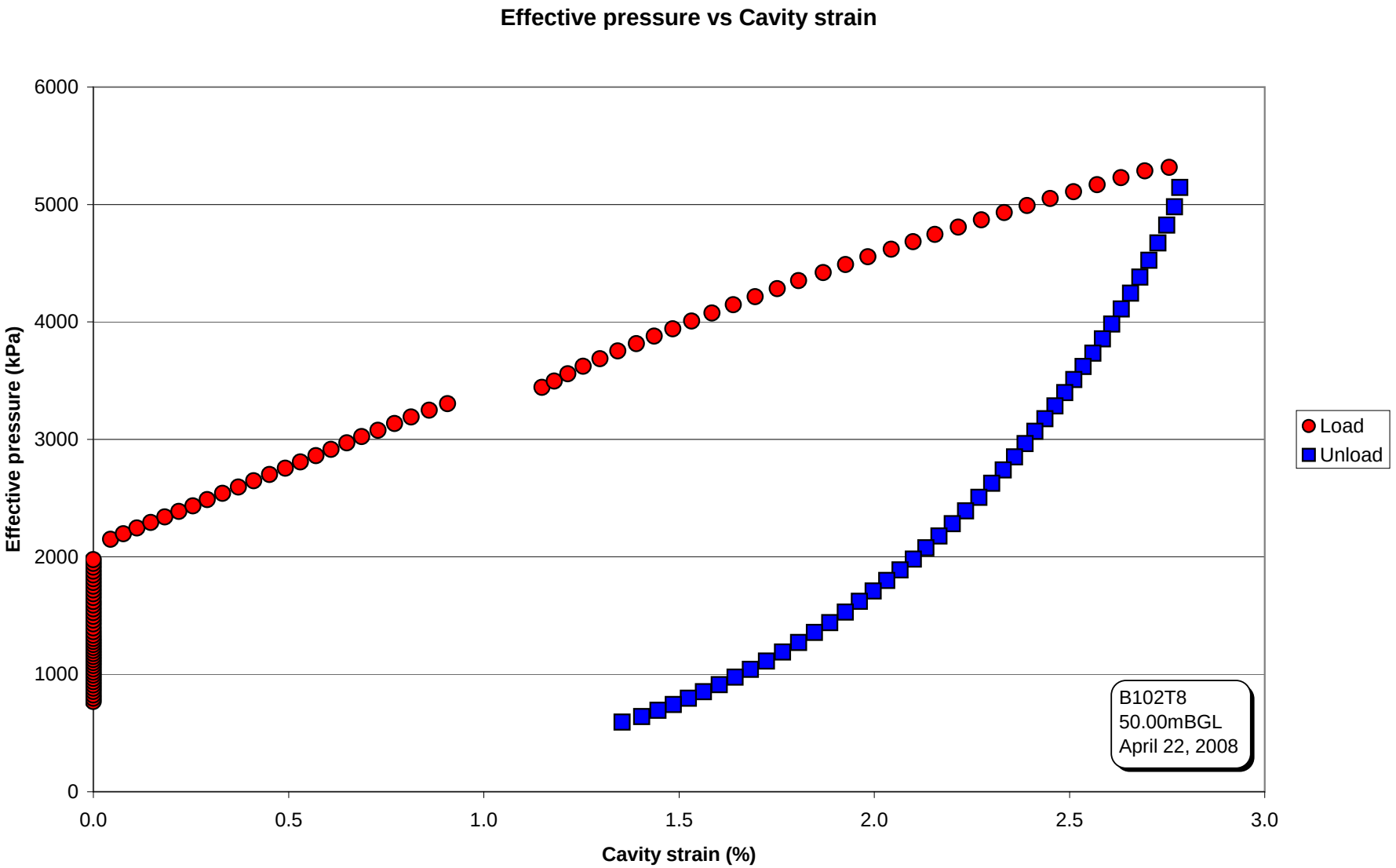

Shear modulus from unload/reload cycles Loop 1 : Arm ave
RESULTS:
Gur : 175.1MPa
Cycle mid-point:
Cavity strain : -0.170%
Total stress : 1541kPa
Size of cycle :
Shear strain : 0.490%
Total stress : 860kPa
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
Total pressure (kPa)
Radial Displacement (mm)


Shear modulus from unload/reload cycles Loop 2 : Arm ave
RESULTS:
Gur : 255.8MPa
Cycle mid-point:
Cavity strain : 0.934%
Total stress : 2653kPa
Size of cycle :
Shear strain : 0.402%
Total stress : 1030kPa
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
Total pressure (kPa)
Radial Displacement (mm)

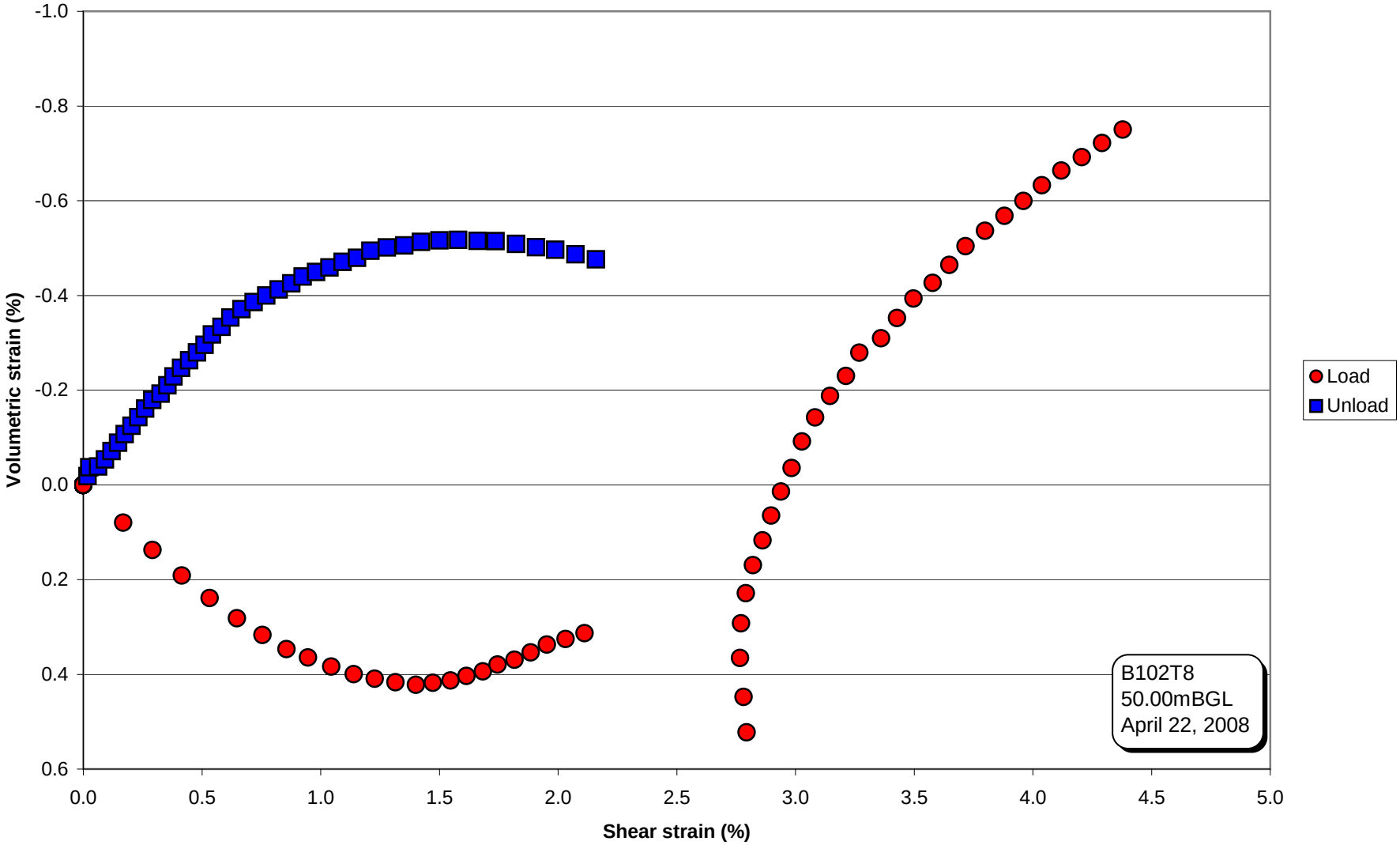

Bolton and Whittle (1999) Loop 1 : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
RESULTS:
Gradient (beta) : 0.870
Intercept (n) : 86.836MPa
Shear stress constant : 75.547MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)


Bolton and Whittle (1999) Loop 2 : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08
RESULTS:
Gradient (beta) : 0.735
Intercept (n) : 59.452MPa
Shear stress constant : 43.718MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 2
Total pressure (kPa)
Radial Displacement (mm)

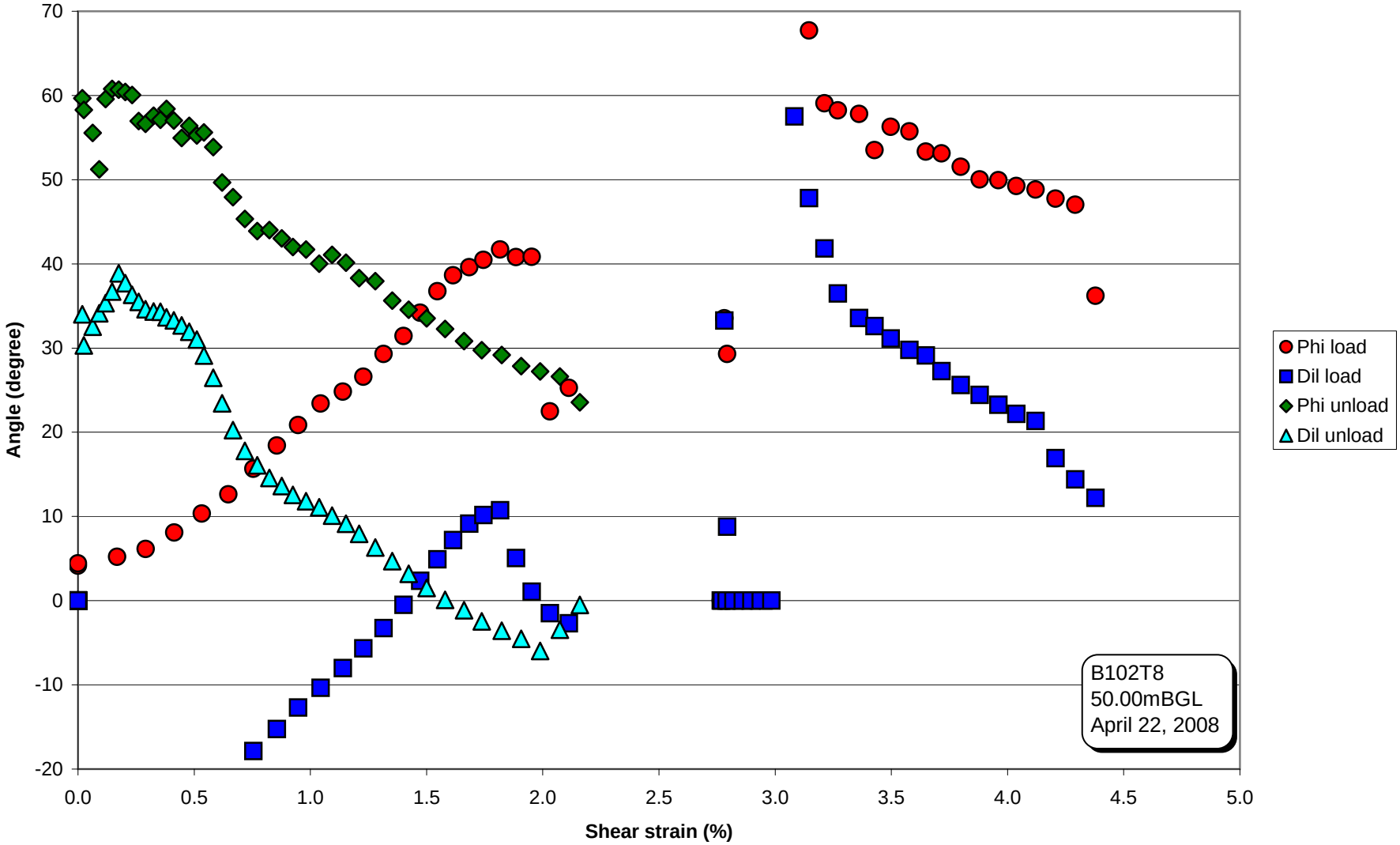

Cycle 1 - Measured
Cycle 1 - Calculated
Cycle 2 - Measured
Cycle 2 - Calculated
POWER LAW PARAMETERS:
Cycle No. Constant (MPa) Gradient
1 75.547 0.870
2 43.718 0.735
Variation of stiffness with strain : Arm ave
Shear modulus (MPa)
Log plane shear strain
Digital 6 arm weak rock self boring pressuremeter
B102T8
50.00 Metres
22 Apr 08


Effective pressure vs Cavity strain
Effective pressure (kPa)
6000
5000
4000
3000
2000
1000
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Cavity strain (%)
Load
Unload
B102T8
50.00mBGL
April 22, 2008

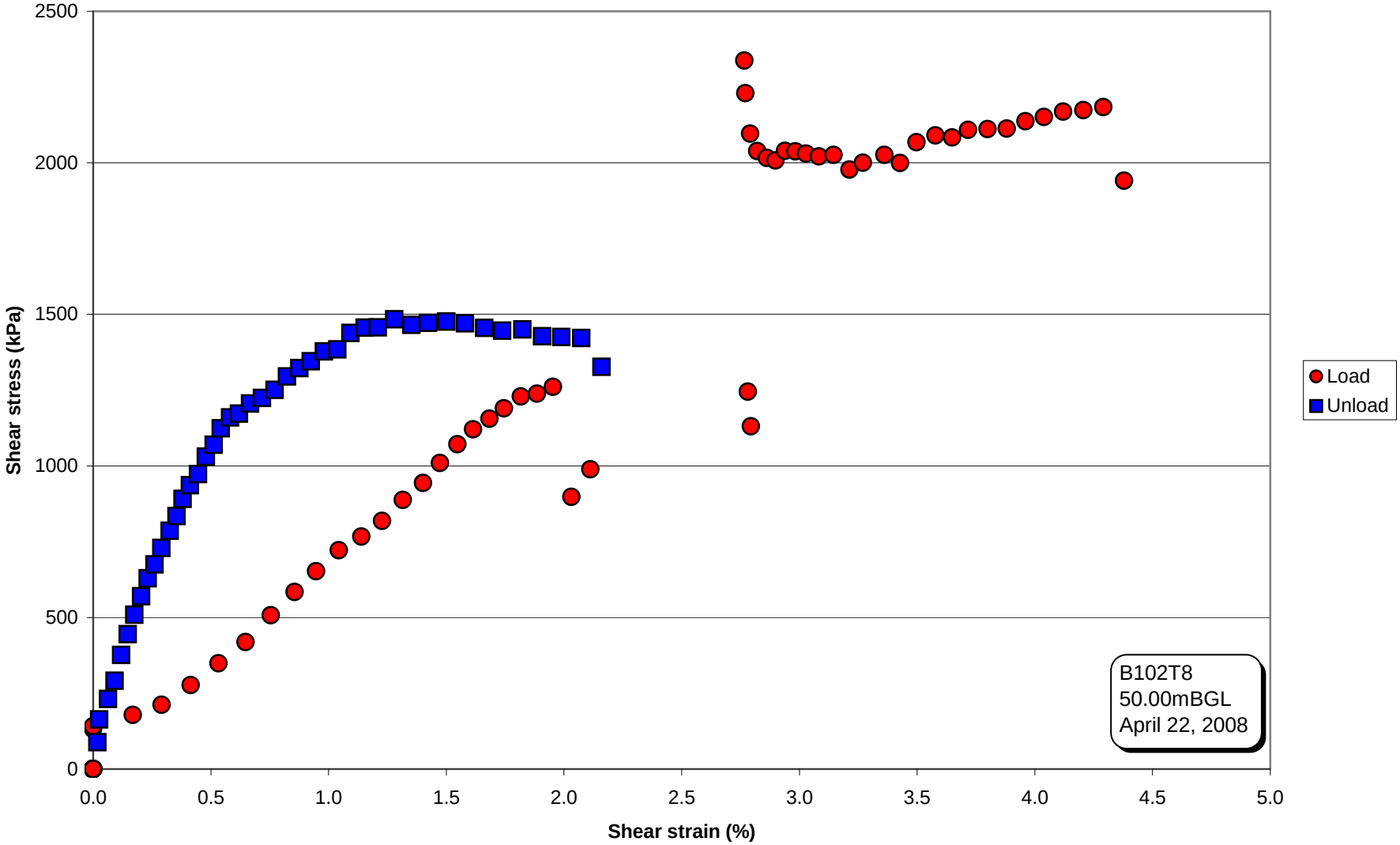
Volumetric strain vs Shear strain

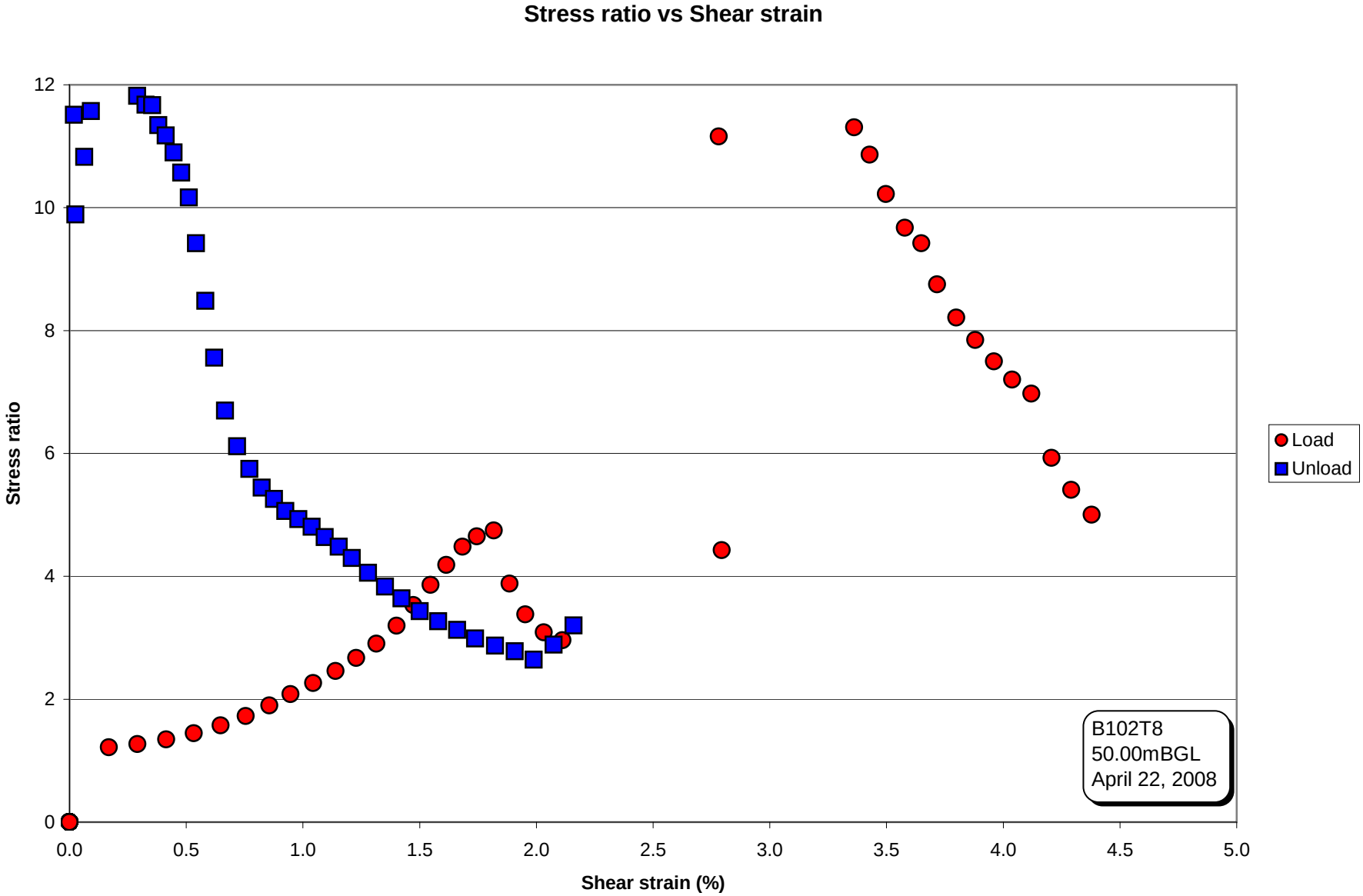


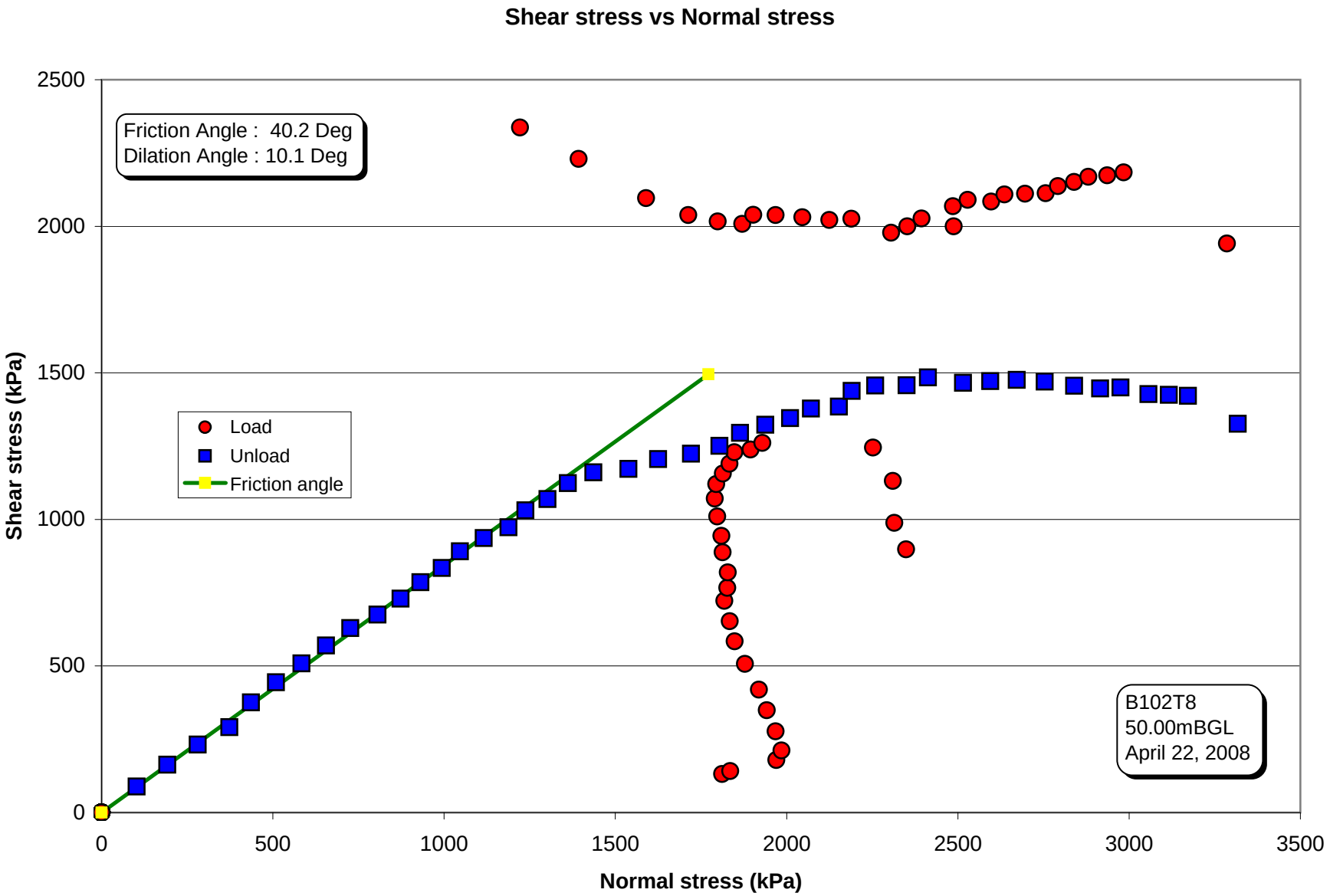
Angles of friction and dilation vs Shear strain



Shear stress vs Shear strain




Stress ratio vs Shear strain
Stress ratio
Shear strain (%)
0
2
4
6
8
10
12
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Load
Unload
B102T8
50.00mBGL
April 22, 2008


Shear stress vs Normal stress
Friction Angle : 40.2 Deg
Dilation Angle : 10.1 Deg
Load
Unload
Friction angle
B102T8
50.00mBGL
April 22, 2008
Shear stress (kPa)
Normal stress (kPa)
0
500
1000
1500
2000
2500
3000
3500

6 ARM SELF BORING PRESSUREMETER **TEST RECORD SHEET**

Site	Date	Day	Borehole	Test	Depth to Test Centre (below ground level)
DENMARK PLACE	22/4/08	TUES	B102	8	2 50m.

Weather:-	Material:-
OVERCAST.	THANET SAND.

Water table	Drilling Start	Drilling End	Distance	Drill Rate	Ram Pressure
?	15:30	15:37	1m.	1m/7m.in.	150 BARS.

Ground level :-	Orientation:-
NK.	NR.

Water Press.	Inst.OD	Shoe OD	Cutter Type	Cutter position	Probe Reference
180	88.1	89.1	73 RR	3mm	'Mary'

Drilling Remarks:-

Strain Rate	Press. Rate	Cycle Time	Gas Bottle	Battery	PPC Type	Max Pressure Cap.
— MANUAL —		6 SEC	250 BAR.	12.9	TRIAX	10MP.

Arm 1	Arm 2	Arm 3	Arm 4	Arm 5	Arm 6	PPC A	PPC B	TPC	Date:-
-105	82	-64	+34	-80	133	-1035	-931	-2445	Ground Level Zeros
									Pre-drilling Zeros
									Post-drilling Zeros
-116	76	-71	41	-86	117	-908	-817	-2447	Pre-test Zeros
									Ground Level Zeros

Test starts:- 15:38.

Line	Notes
147	Held 2MP.
153	Loop 1 q = 186MP.
221	Held 3.3MP.
228	Loop 2. q = 291 MP.
298	unload
	Test ends:- 16:06. Max Press:- 535 kPa

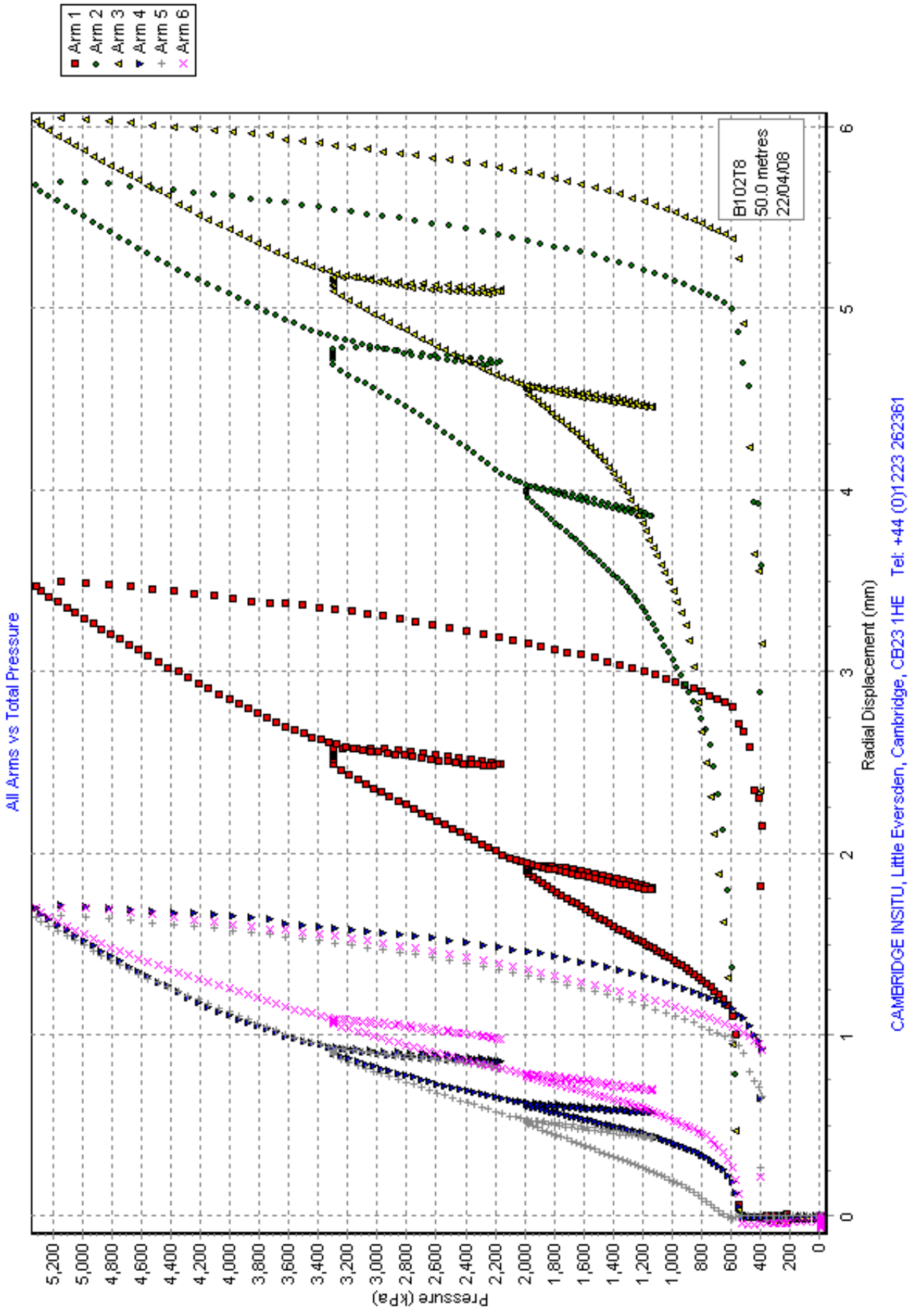
Calibrated Data details:

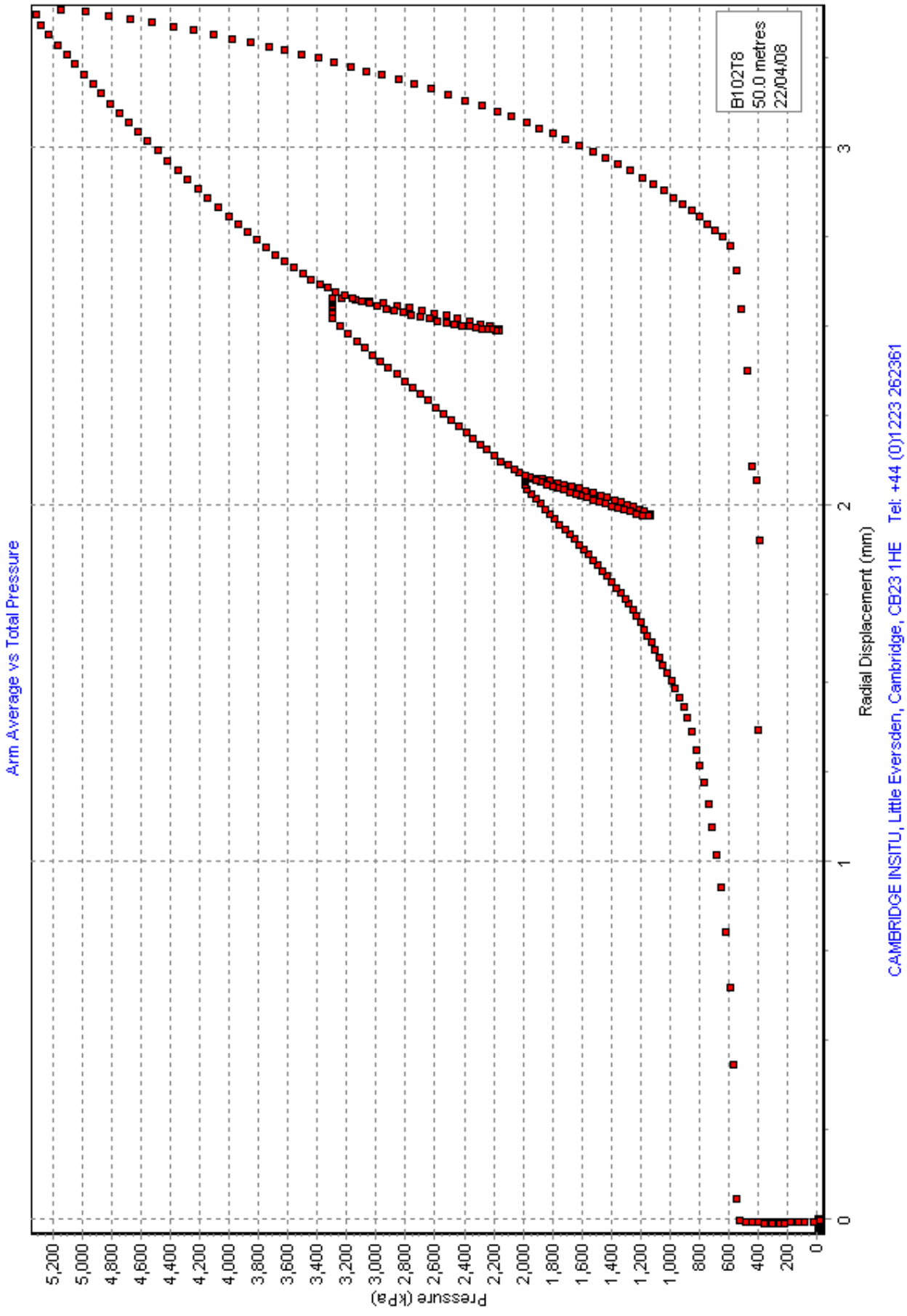
Mem. Correction.	Mem. Compression.	Strain Cals.	Pressure Cals.
WOLSOTT	WOLSOTT2	10/4/08	11/4/08

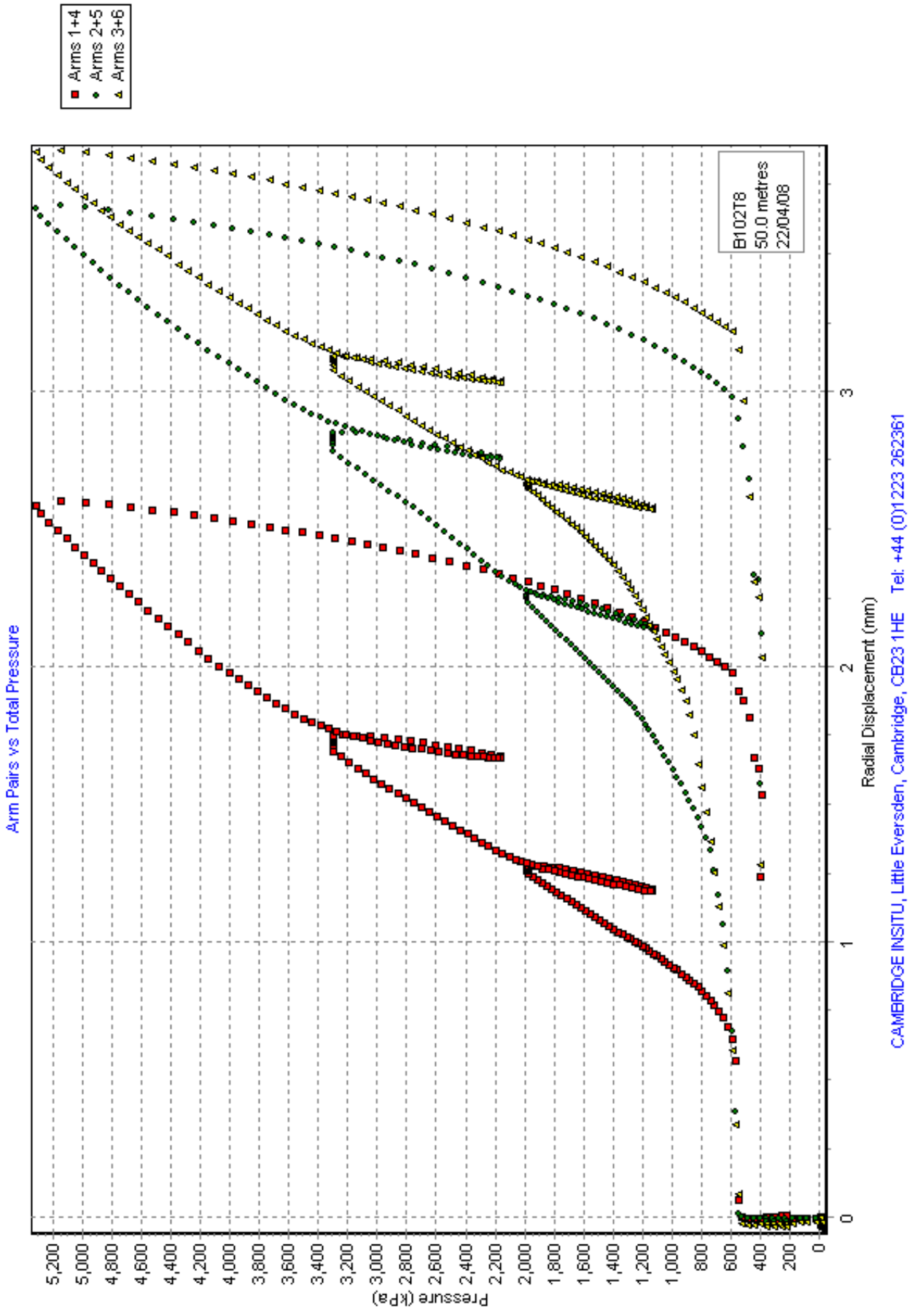
TEST REMARKS: Drilled in very quickly, but some gravel in hole - from above? Hence significant disturbance at start, & run out of expansion capability. NOTE PWP RESPONSE in PLASTIC PHASE.

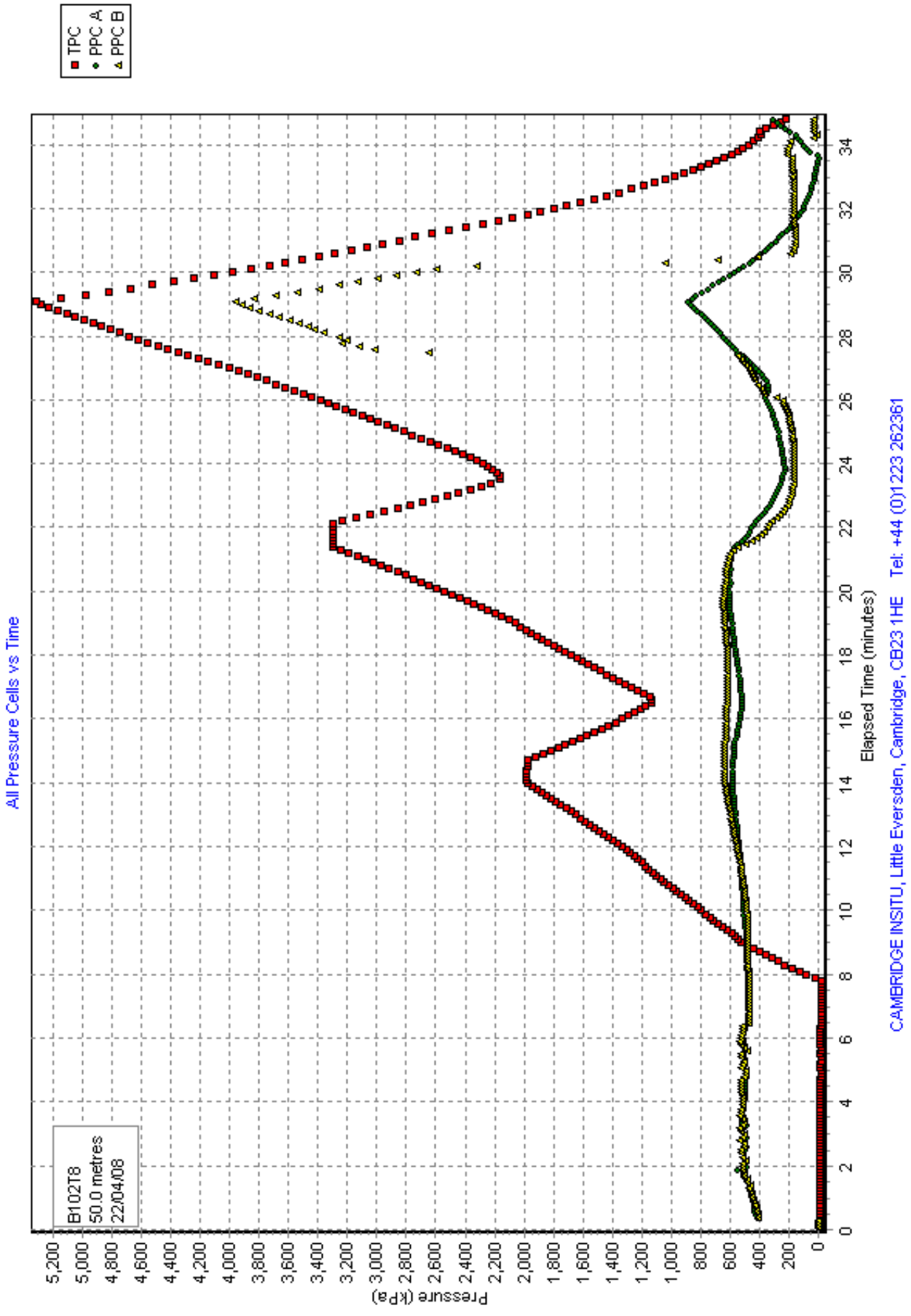
Driller: DAN

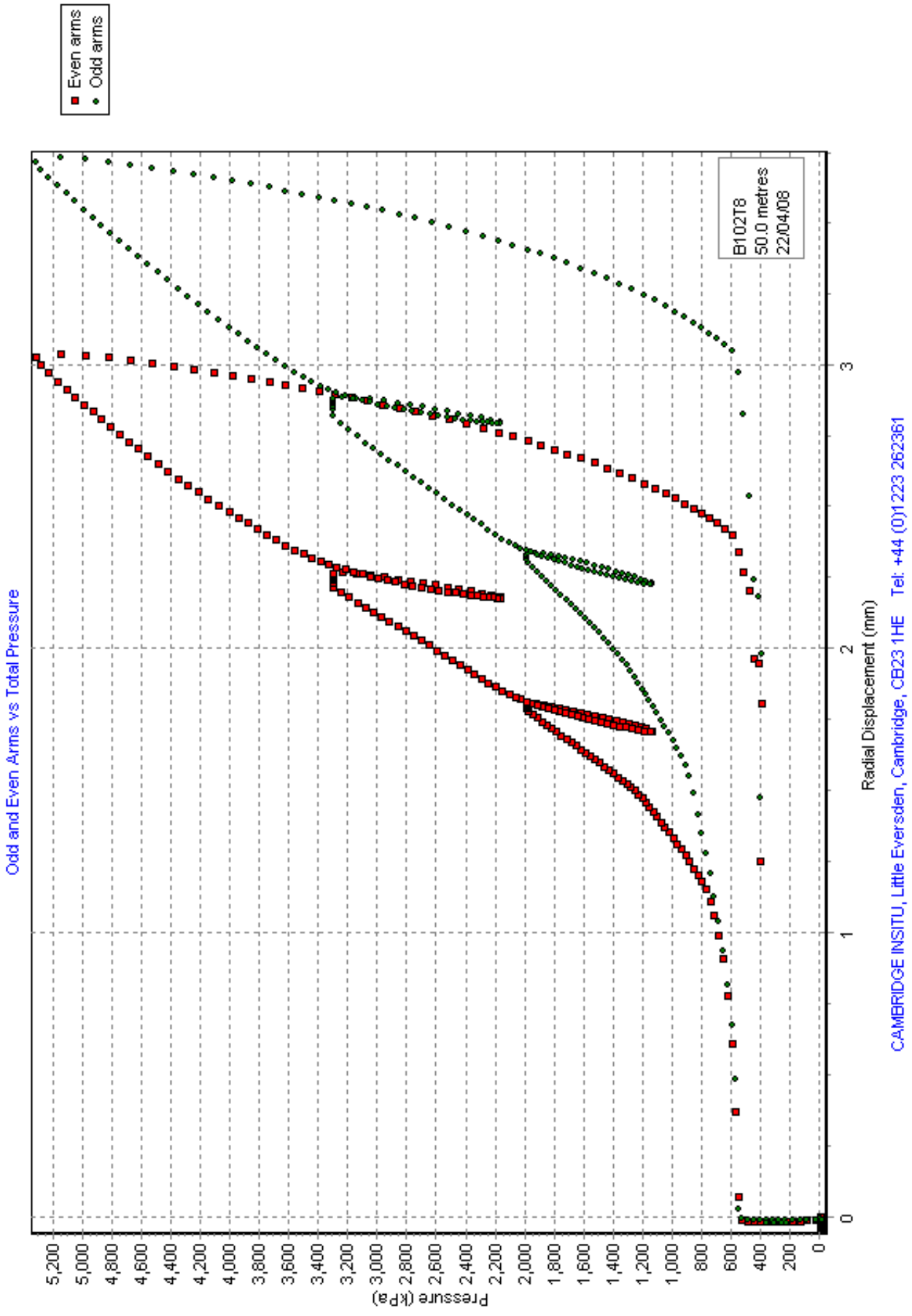
Tester: RD


Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
B102T8
50.0 metres
22/04/08
All Arms vs Total Pressure
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
Pressure (kPa)
Radial Displacement (mm)
B102T8
50.0 metres
22/04/08
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arms 1+4
Arms 2+5
Arms 3+6
B102T8
50.0 metres
22/04/08
Arm Pairs vs Total Pressure
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


TPC
PPC A
PPC B
All Pressure Cells vs Time
B102T8
50.0 metres
22/04/08
Pressure (kPa)
Elapsed Time (minutes)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Even arms
Odd arms
Odd and Even Arms vs Total Pressure
B102T8
50.0 metres
22/04/08
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

B102T9 - SUMMARY OF RESULTS
[File made with WinSitu Version 1.20.1.1]

[DETAILS OF TEST]
Project : 36237
Site : Denmark Place
Borehole : BH102
Test name : B102T9
Test date : 22 Apr 08
Test depth : 51.00 Metres
Water table : 5.6 Metres
Ambient PWP : 0.0 kPa
Material : Thanet Sand
Probe : Digital 6 arm weak rock self boring pressuremeter
Diameter : 88.1 mm
Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out

Analysed by RWW on 5 Jun 08

Remarks: Nice test

[RESULTS FOR CAVITY REFERENCE PRESSURE]
Strain Origin (mm) : "Arm ave=0.674"
Po from Marsland & Randolph (kPa) : "Arm ave=1434.3"
Best estimate of Po (kPa) : "Arm ave=1434.0"

[UNDRAINED STRENGTH PARAMETERS]
Jefferies 1988 - Cu (kPa) : "Arm ave=1518.6"
Undrained yield stress (kPa) : "Arm ave=3023.8"

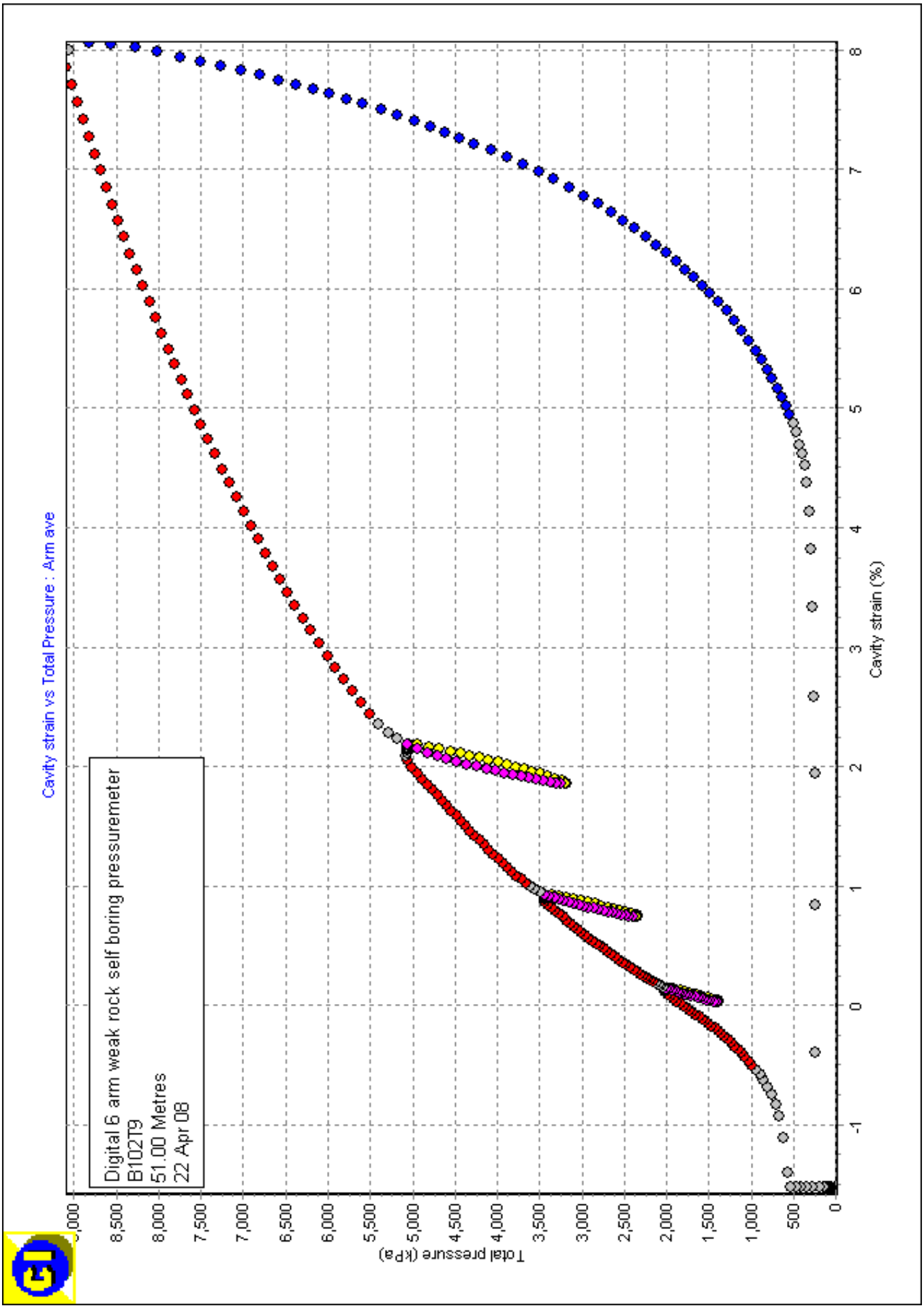
[DRAINED ANALYSIS OF SANDS - HUGHES et al 1977]
Constant volume friction angle (°) : 32.0
Angle of internal friction (°) : "Arm ave=38.2"
Dilation angle (°) : "Arm ave=7.6"
Gradient of log-log plot : "Arm ave=0.432"

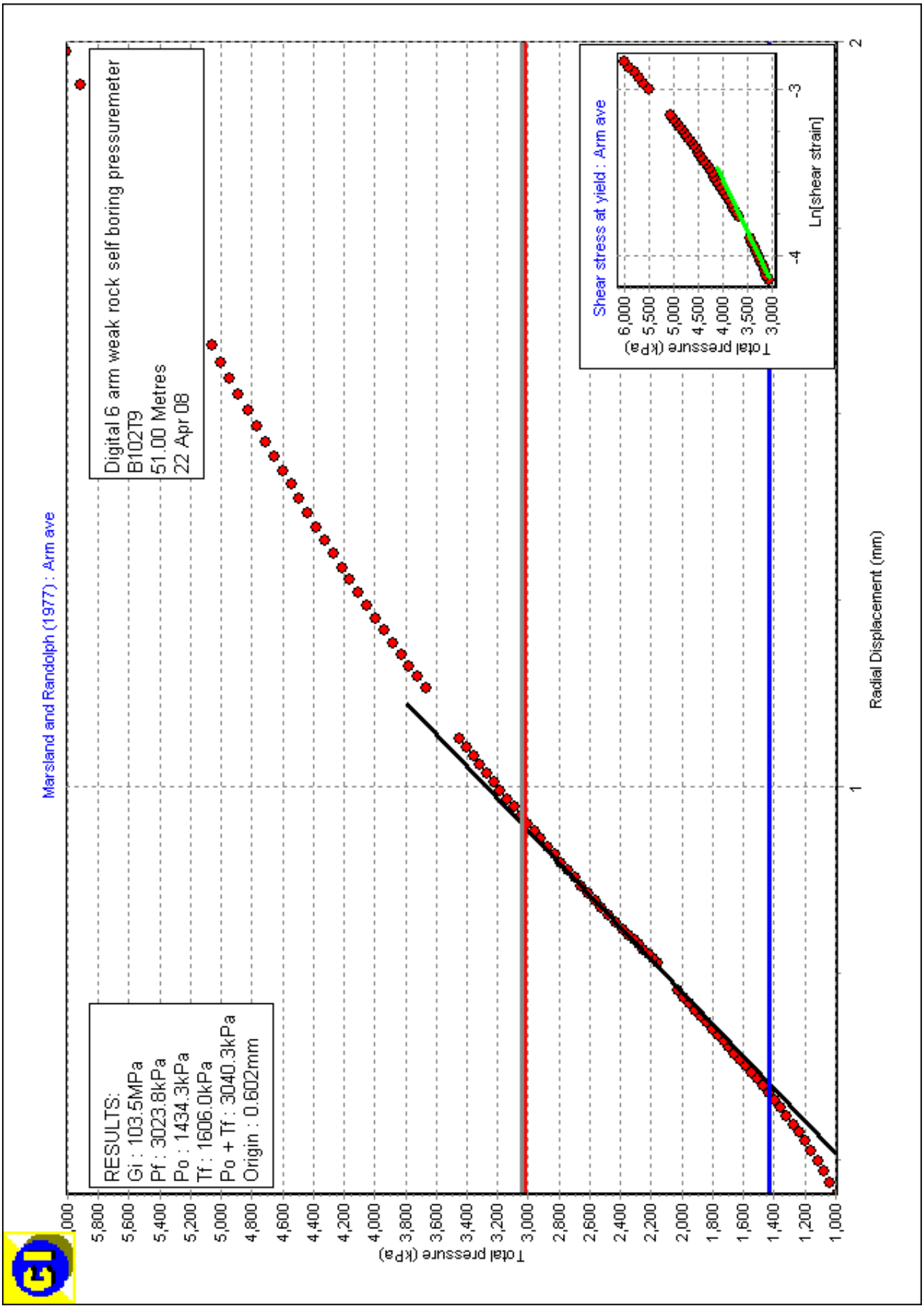
[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=103.5"

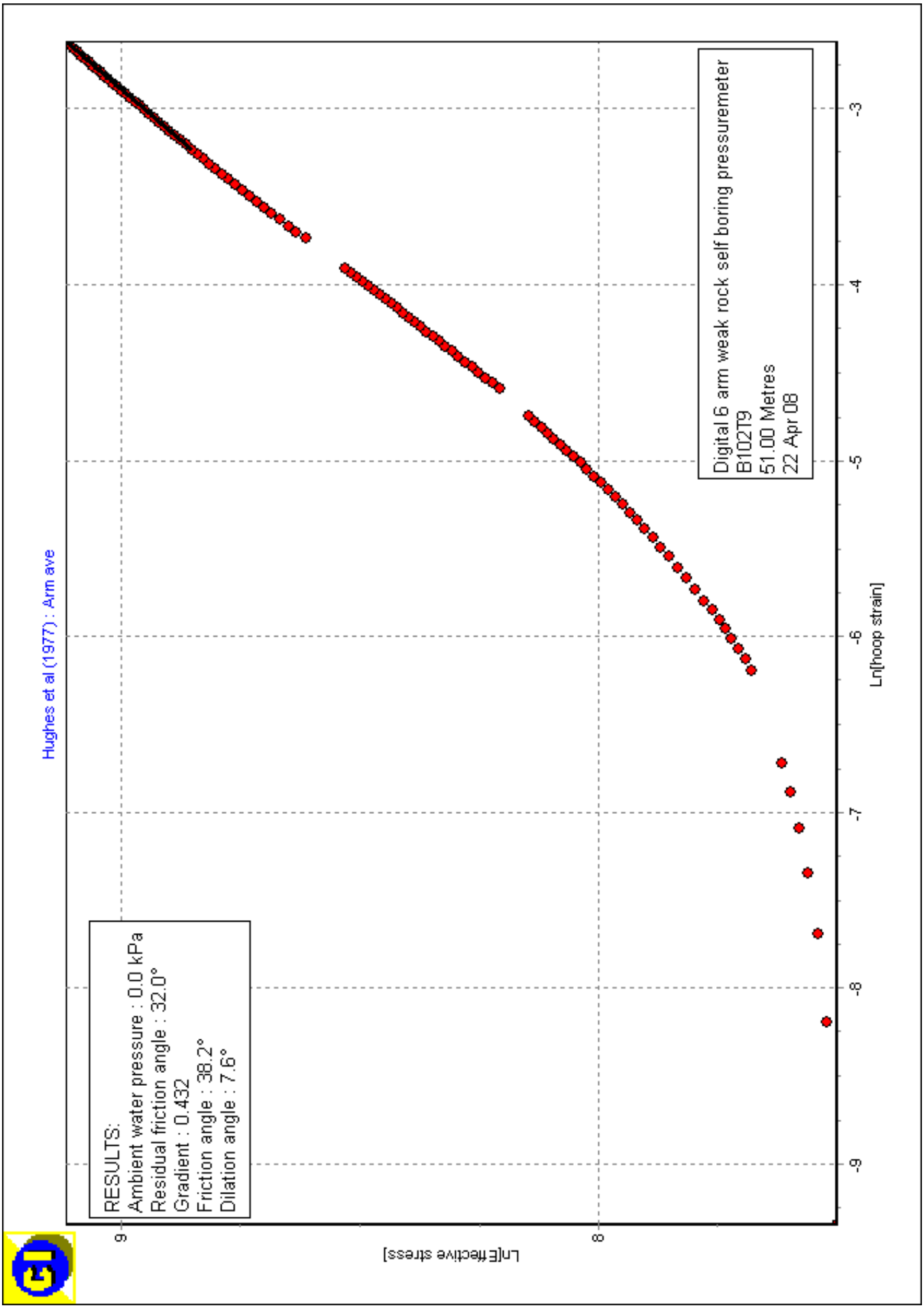
Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	268.4	0.095	1679	0.225	604
Arm ave	2	286.8	0.846	2893	0.402	1156
Arm ave	3	285.8	2.029	4116	0.687	1971

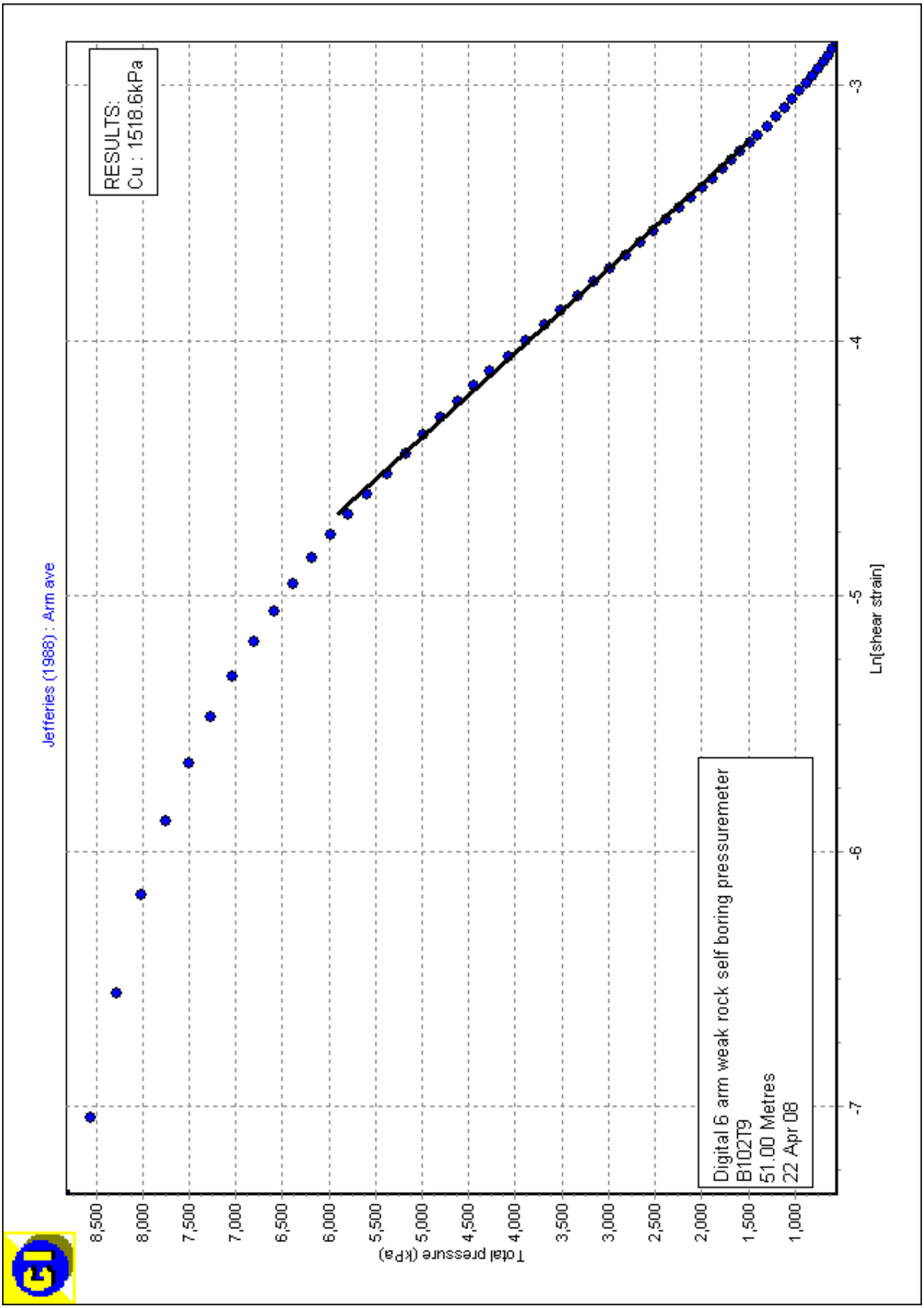
[NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

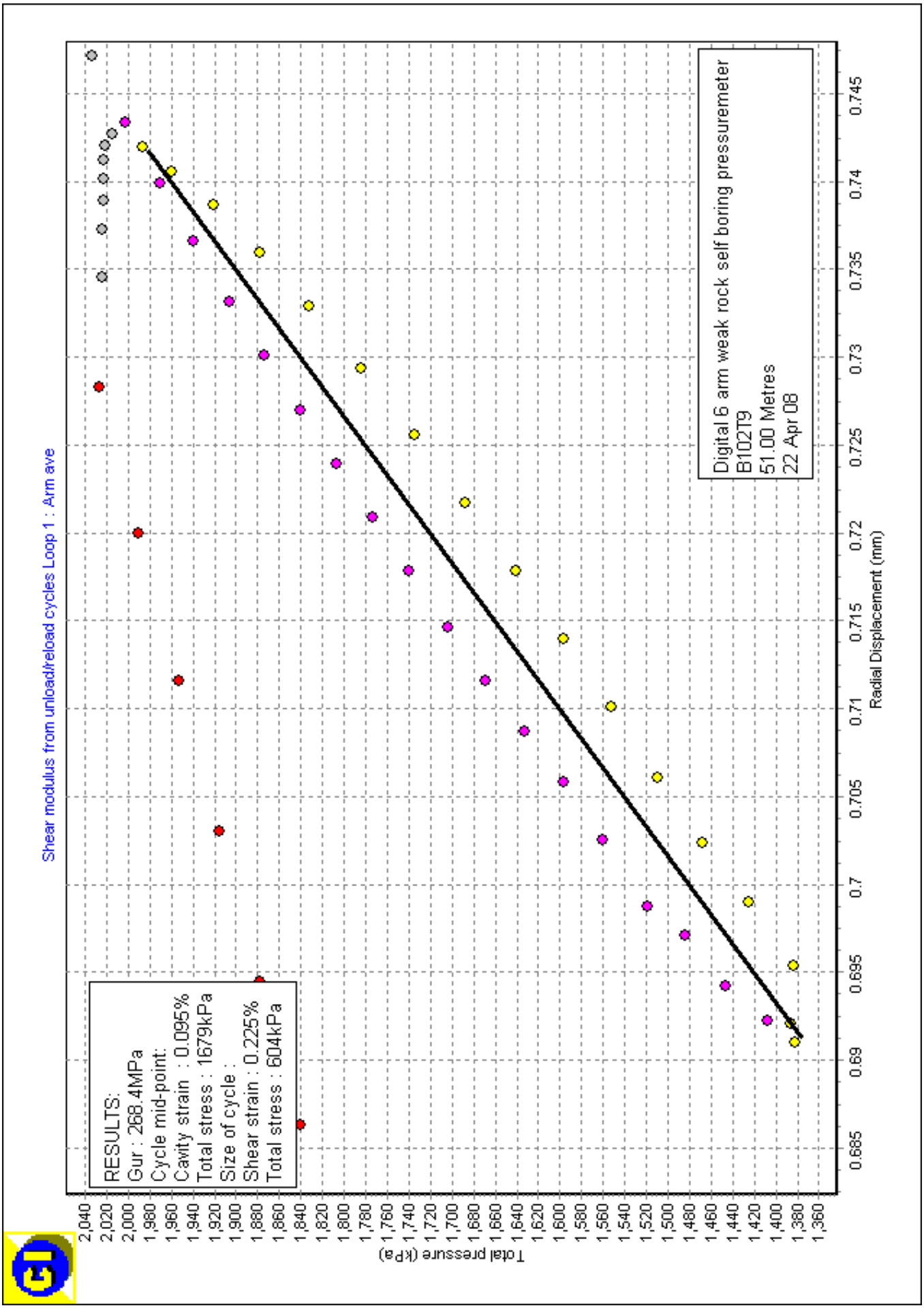
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	109.189	92.847	0.850
Arm ave	2	118.310	98.467	0.832
Arm ave	3	117.864	95.277	0.808

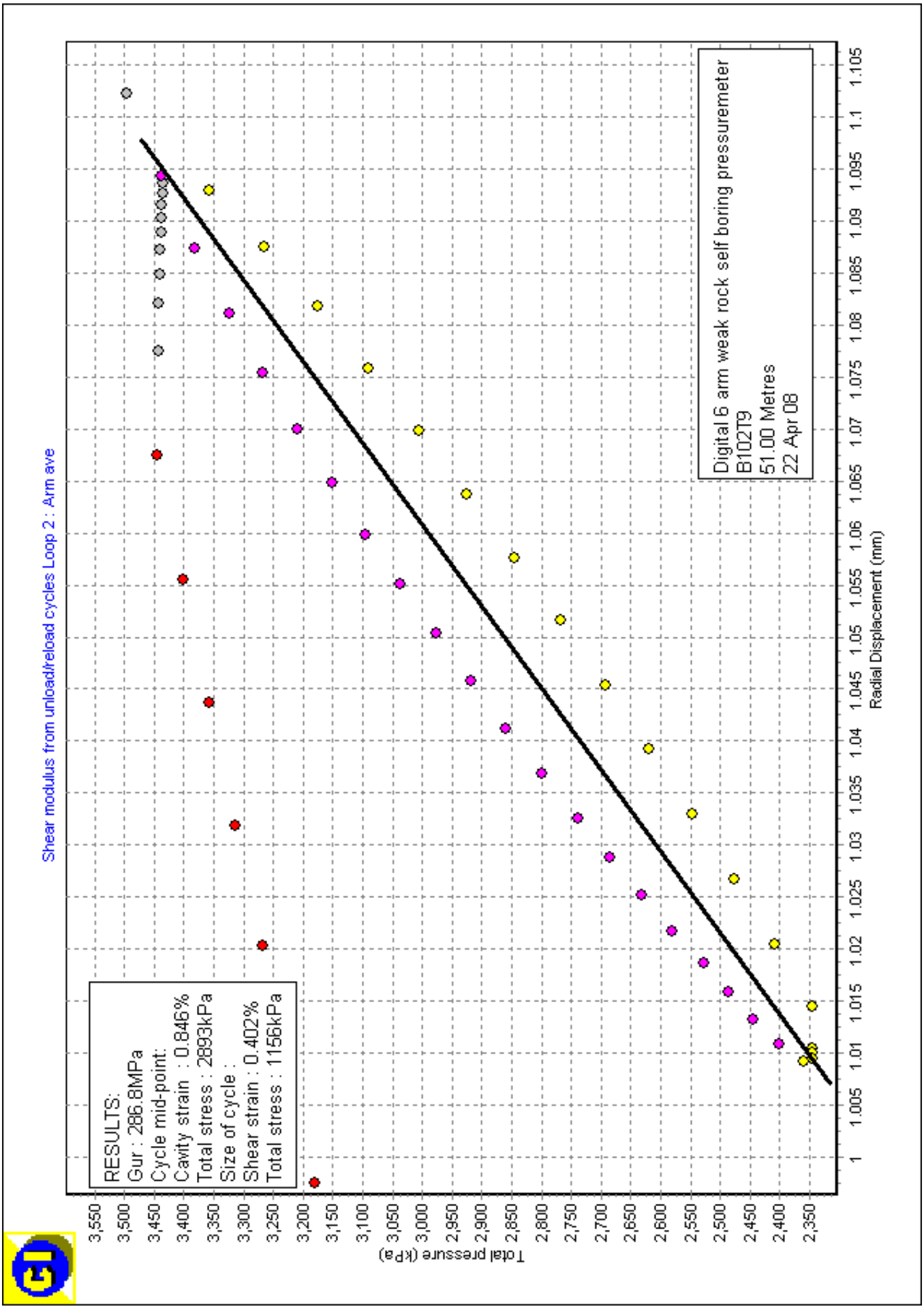

Cavity strain vs Total Pressure : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B1027T9
51.00 Metres
22 Apr 08
Total pressure (kPa)
Cavity strain (%)

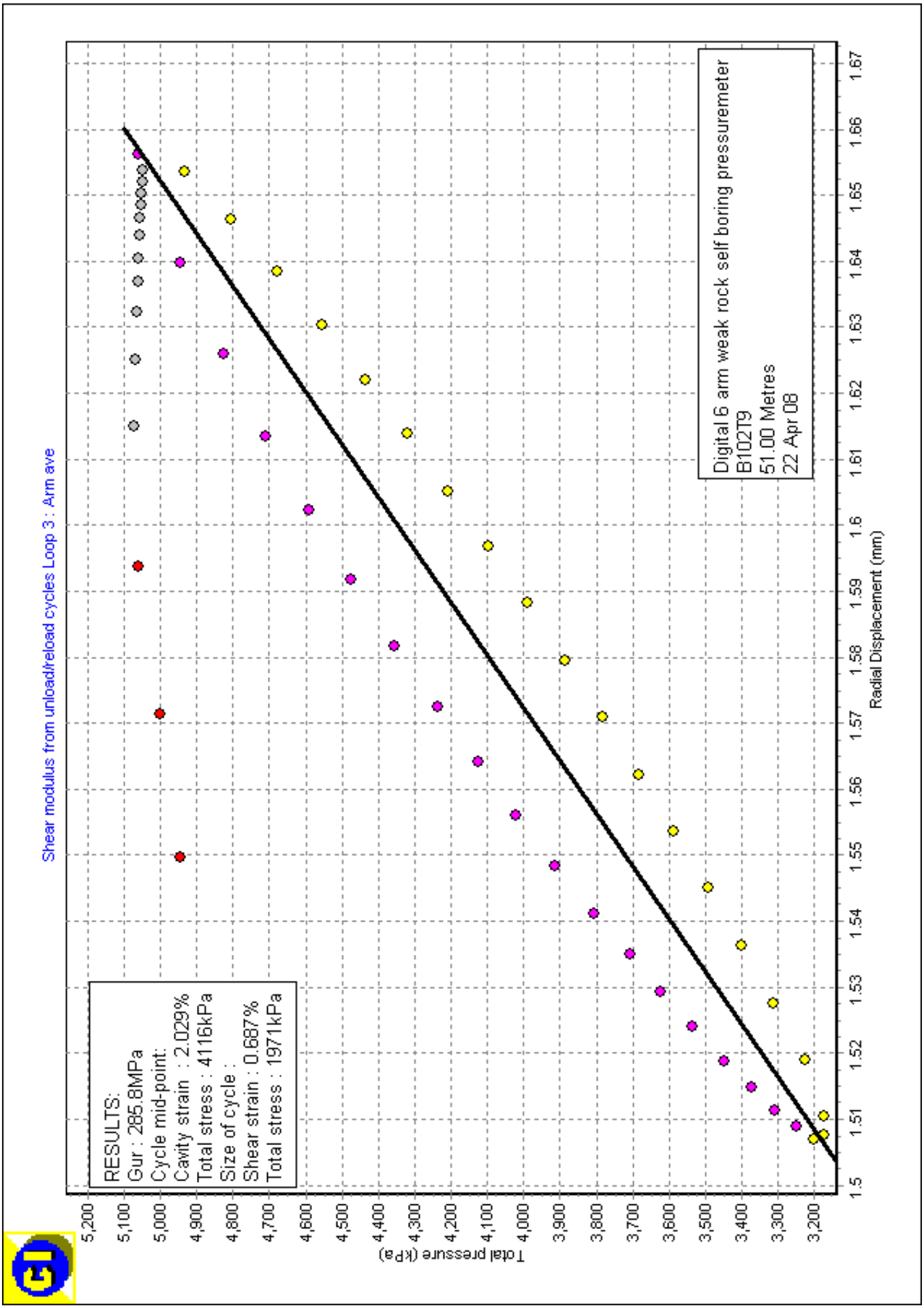

Digital 6 arm weak rock self boring pressuremeter
B102T9
51.00 Metres
22 Apr 08
RESULTS:
Gi : 103.5MPa
Pf : 3023.8kPa
Po : 1434.3kPa
Tf : 1606.0kPa
Po + Tf : 3040.3kPa
Origin : 0.602mm
Marsland and Randolph (1977) : Arm ave
Total pressure (kPa)
Radial Displacement (mm)
Shear stress at yield : Arm ave
Total pressure (kPa)
Ln[shear strain]

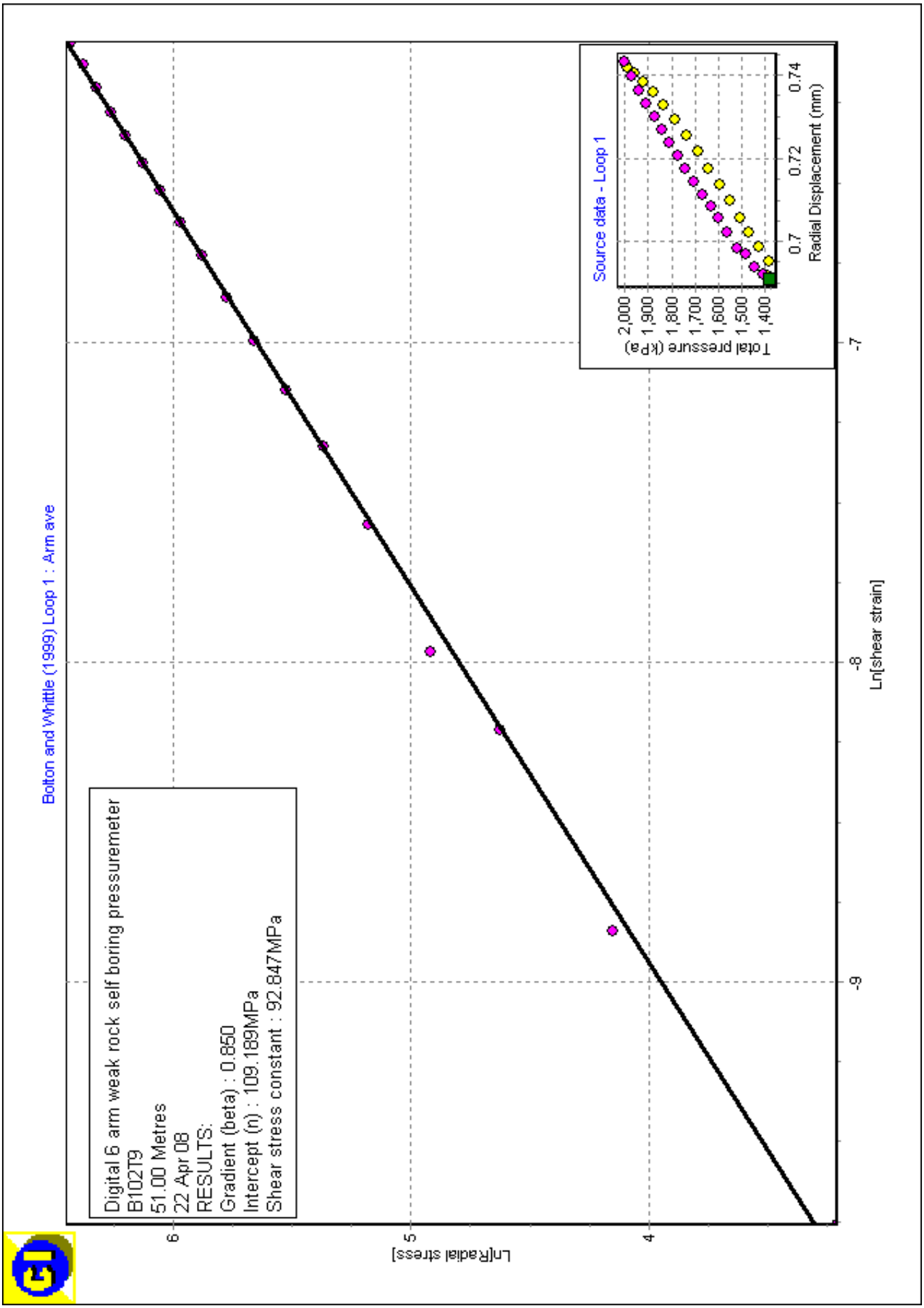

Hughes et al (1977) : Arm ave
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 32.0°
Gradient : 0.432
Friction angle : 38.2°
Dilation angle : 7.6°
Digital 6 arm weak rock self boring pressuremeter
B1027T9
51.00 Metres
22 Apr 08
Ln[Effective stress]
Ln[hoop strain]
9
8
6
-3
-4
-5
-6
-7
-8
-9


RESULTS:
Cu : 1518.6kPa
Jefferies (1988) : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T9
51.00 Metres
22 Apr 08
Total pressure (kPa)
Ln[shear strain]
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
-3
-4
-5
-6
-7


Shear modulus from unload/reload cycles Loop 1 : Arm ave
RESULTS:
Gur : 268.4MPa
Cycle mid-point:
Cavity strain : 0.095%
Total stress : 1679kPa
Size of cycle :
Shear strain : 0.225%
Total stress : 604kPa
Digital 6 arm weak rock self boring pressuremeter
B102T9
51.00 Metres
22 Apr 08
Total pressure (kPa)
Radial Displacement (mm)


Shear modulus from unload/reload cycles Loop 2 : Arm ave
RESULTS:
Gur : 286.8MPa
Cycle mid-point:
Cavity strain : 0.846%
Total stress : 2893kPa
Size of cycle :
Shear strain : 0.402%
Total stress : 1156kPa
Digital 6 arm weak rock self boring pressuremeter
B102T9
51.00 Metres
22 Apr 08
Total pressure (kPa)
Radial Displacement (mm)


Shear modulus from unload/reload cycles Loop 3 : Arm ave
RESULTS:
Gur : 285.8MPa
Cycle mid-point:
Cavity strain : 2.029%
Total stress : 4116kPa
Size of cycle :
Shear strain : 0.687%
Total stress : 1971kPa
Digital 6 arm weak rock self boring pressuremeter
B102T9
51.00 Metres
22 Apr 08
Total pressure (kPa)
Radial Displacement (mm)


Bolton and Whittle (1999) Loop 1 : Arm ave
Digital 6 arm weak rock self boring pressuremeter
B102T9
51.00 Metres
22 Apr 08
RESULTS:
Gradient (beta) : 0.850
Intercept (n) : 109.189MPa
Shear stress constant : 92.847MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)