Strain Gauges in Caves

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Abstract

Since Lloyd Robinson began work on the Augusta Jewel Cave in Western Australia in the 1960's, he and members of Illawarra Speleological Society have placed rock movement strain gauges in numerous caves around Australia. It is only recently that the data has been given to ISS and a summary of the locations and readings are provided.

The strain gauge is a gauge for measuring the movement of rocks in cave. The movement may be due to earthquake or movement of the cave rocks over time. There are two metal welding rods or glass rods placed in adjacent rocks to measure the gap between the rods. Measurements taken over time show either a movement apart or getting closer or no movement.

The gauges are measured with automotive feeler gauges used to measure the gap of the spark plug points used in petrol vehicles. It is best if they are measured using the same set of gauges to maintain accuracy but this may not be able to be undertaken in the future.

Introduction

Since Lloyd Robinson began work on the Augusta Jewel Cave in Western Australia in the 1960s', he and members of Illawarra Speleological Society have placed rock movement strain gauges in numerous caves around Australia. It is only recently that the data has been given to ISS and a summary of the locations and readings are given below.

What is a strain gauge?

The strain gauge is a gauge for measuring the movement of rocks in cave. The movement maybe due to earthquake or movement of the cave rocks over time. There are two metal welding rods or glass rods placed in adjacent rocks to measure the gap between the rods. Measurements taken over time show either a movement apart or getting closer or no movement.

How are they measured?

The gauges are measured with automotive feeler gauges used to measure the gap of the spark plug points used in Petrol vehicles. It is best if they are measured using the same set of gauges to maintain accuracy but this may not be able to be undertaken in the future.

Caves with Strain Gauges

Augusta Jewel Cave

After Lloyd's contract finished in June 1960 he installed 3 stations in AJC for his own interest. Later communications with Peter Bell from Western Australia suggests that Bell made a few more readings of the gauges.

Table 1 Club Straw Platform rock pile is a glass gauge in line

Date Measured	Imperial	Metric
June 1960	0.051"	1.2954mm
Mid 1968	0.054"	1.3716mm
5/02/1970	0.055"	1.3970mm
18/12/1975	0.057"	1.4478mm

Date Measured	Imperial	Metric
May 1979		1.5303mm
12/05/1986	0.0635"	1.6129mm
11/11/1988	0.066"	1.6764mm
10/01/1991	0.070"	1.7780mm
sept 1991		1.6510mm
Dec 1991		1.5621mm
Feb 1992		1.6129mm
March 1992		1.6129mm

Table 2 Playford's Cut Through. This cut through is a glass type gauge in a right hand crack in wall at cut though set in line with a nil gap to start with.

Date Measured	Measurement
June 1960	nil
Mid 1968	nil
5/02/1970	nil
18/12/1975	nil
May 1979	nil
12/05/1986	0.01
11/11/1988	nil
10/01/1991	nil
sept 1991	nil
Dec 1991	nil
Feb 1992	nil
March 1992	nil

Easter Cave

In Easter Cave there are 4 gauges and number 4 is a glass type gauge.

Table 3 Easter Cave Strain Gauges with Peter Henley (?)

Strain Gauge	Date Measured	Measurement
no 1	25-1-1968	0.020"
	24-8-1968	0.015"
	29-5-1979	0.02"
	13-5-1986	0.02"
	10-11-1988	0.020"
	6-5-1995	0.0195"
no2	25-1-1968	0.0215"
	24-8-1968	0.022"
	16-12-1975	0.021"
	29-5-1979	0.021"
	13-5-1986	
	10-11-1988	0.022"
no3	25-1-1968	0.020"
	24-8-1968	0.016"
	16-12-1975	
	29-5-1979	0.02"
	13-5-1986	
	10-11-1988	
	6-5-1995	0.018"
no4	25-1-1968	0.000"
	24-8-1968	0.000"
	16-12-1975	0.000"
	29-5-1979	glass has bow
	13-5-1986	firmly together

Strain Gauge	Date Measured	Measurement
	10-11-1988	no gap
	6-5-1995	intact under pressure

Table 4 White Canopy Station is a floor crack near a white canopy in bye with glass and is flat in line with a Nil gap **initially**

Date Measured	Imperial	Metric
June 1960	nil	
Mid 1968	nil	
5/02/1970	nil	
18/12/1975	nil	
May 1979	0.0015"	0.0381mm
12/05/1986	0.003"	0.0762mm
11/11/1988	0.002"	0.0508mm
10/01/1991	0.002"	0.0508mm
sept 1991	0.0025”	
Dec 1991		0.0635mm
Feb 1992		0.0635mm
March 1992		0.0635mm

Tuglow Main Cave

Table 5 Tuglow Main Cave. Large Bridge type slippery slopey rock approximately centre of the two gauges.

Strain Gauge	Measurement Date	Measurement (Imperial)
top gauge	3/12/1977	
	22/04/1978	0.017"

	14/03/1982	0.016"
bottom gauge	3/12/1977	0.065"
	22/04/1978	0.067"
	14/03/1982	0.0695"

Wyanbene Cave

These were installed by Lloyd Robinson on 18th November 1978 and numbered 1,2 and 3. No 1 is between "loose" roof and large boulder on the downstream side of the "Lavatory Pan" No2 is in a large crack on lower side of rockpile chamber and No3 is between roof and large "chock" boulder, half way up rockpile chamber. These are near the entrance to the Gunbarrel Aven area of the main passage.

Table 6 Wyanbene Cave Strain Gauges

Strain Gauge	Date Measured	Measurement
no 1	18-11-1978	0.031"
	10-11-1979	0.029"
	20/12/1981	0.033"
	6-2-1982	0.033"
	20-2-1983	0.033"
	18-9-1983	0.034"
	13-1-1996	0.028"
	22-9-2007	0.0275"
no 2	10-011-1979	rod + 0.0015" tight
	20-12-1981	spacer + 0.0015"
		rod length = 5.2575"
no 3	10-11-1979	rod length = 2.3855"

Jenolan Caves - J46

The strain gauge was installed by Lloyd Robinson, Kevin Hanrahan, David Dicker and possibly Chris Edwards. Normally we installed the gauges in an inconspicuous spot, but the location in J46 was ideal for measuring movement. As far as I know, it was never subsequently checked, ISS was heavily involved in the Kimberley at the time, so our energies were directed elsewhere.

Cliefden Main Cave

Location is on Right hand side of track immediately before entering the main chamber. There is a crack and the top part of the gauge is cemented in a hole drilled in the roof and the bottom part is cemented in a hole drilled through the moving slab.

Table 7 Cliefden Main Cave

Date Measured	Measurement
12-8-1978	0.029"
15-4-2006	0.0295"

Figure 1 Gerrard Collins and David Dicker measuring the gap in the Cliefden Main Cave gauge

Kimberley region Gauges

Table 8 Kimberley Strain Gauges

Cave	Gauge Type	Date Measured	Measurement	Notes
Network Cave	influx gauge	12/06/1991	3.763m	with steel tape measure
		14/06/1992	3.763m	but closed 0.5mm 11 days later!
		6-7-1993	3.763m	

		8-6-1995	3.763m	
Cathederal Cave **Mimbi**		19-6-1991	2.620m	twist in tape
		14-6-1992	2.621m	
		1-7-1993	2.621m	
		8-6-1995	2.621m	
Cave Springs	top gauge	12-6-1980	0.020"	
		7-6-1991	0.019"	

Napier Range

There are photos of these gauge locations but no other data.

Bibliography

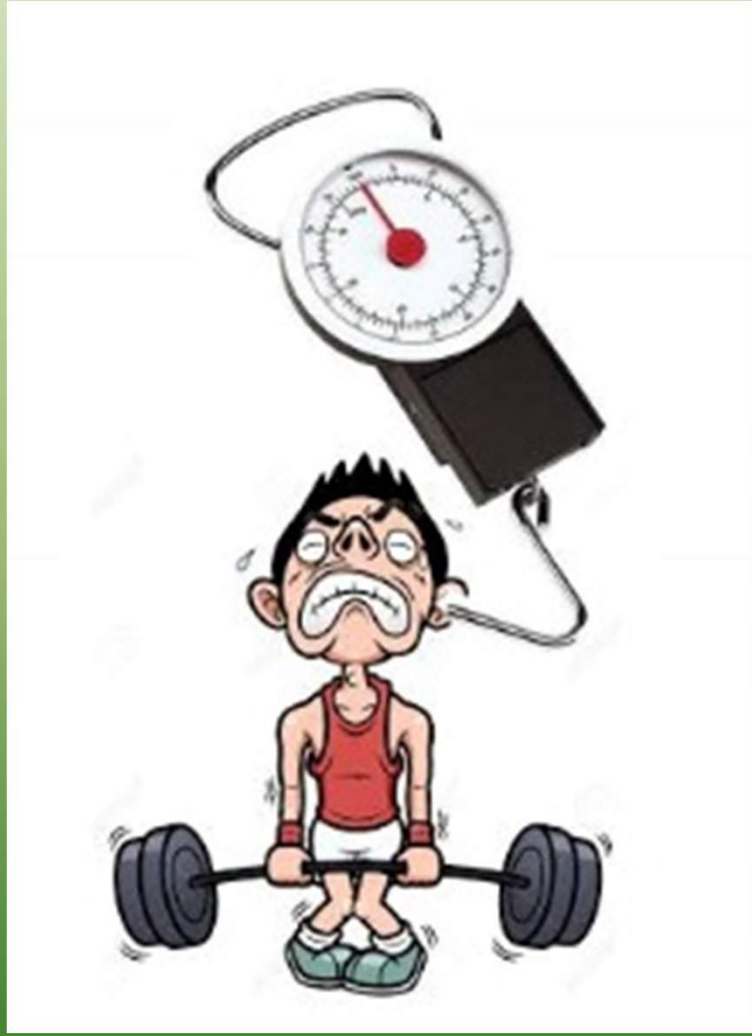
Lloyd Robinson various personal notes and letters

ISS trip reports

Illawarra Speleological Society Inc. Newsletter June 2006 Page 6

The slides for this presentation are provided in Appendix B.

Appendix B - Strain Gauges in Caves

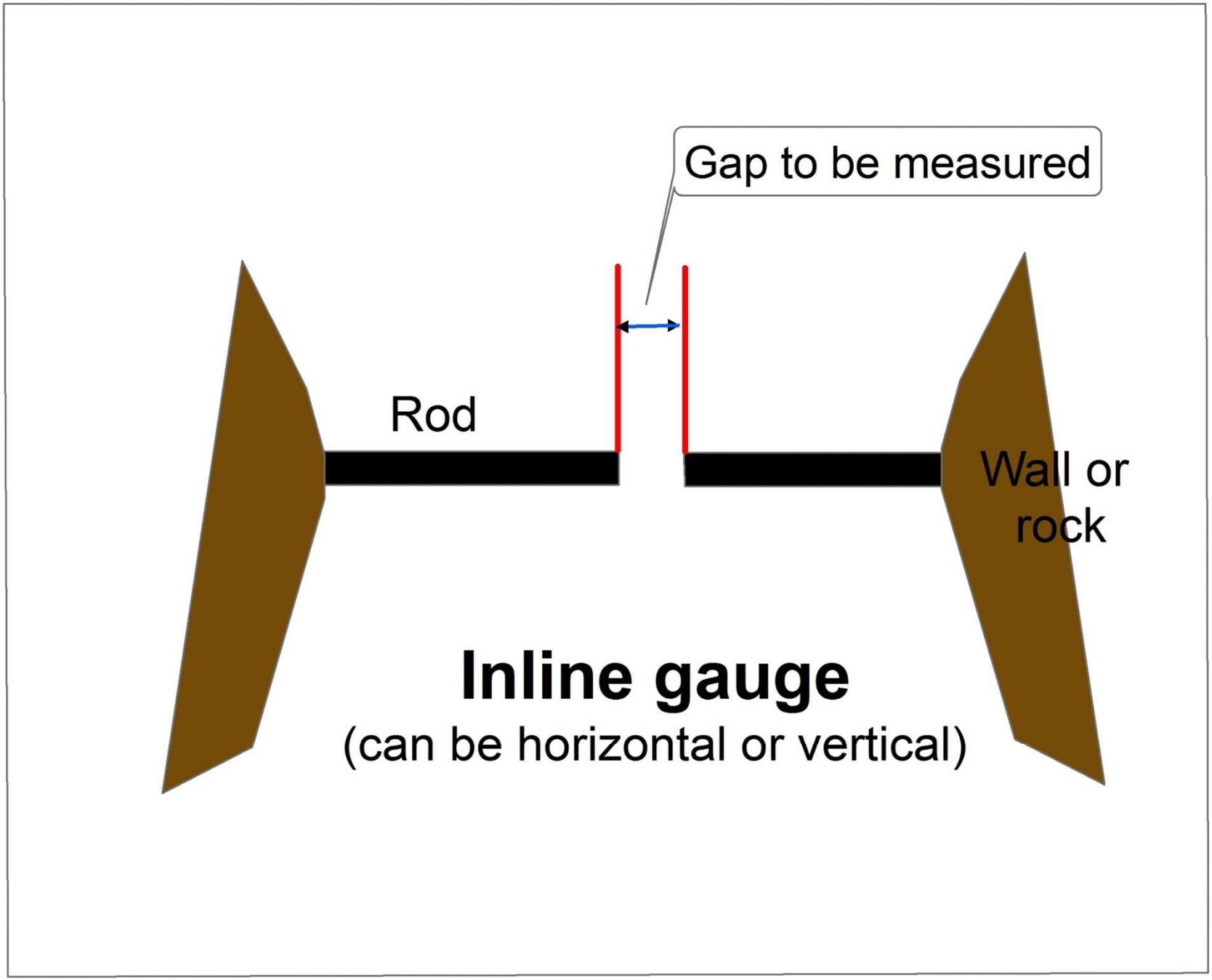


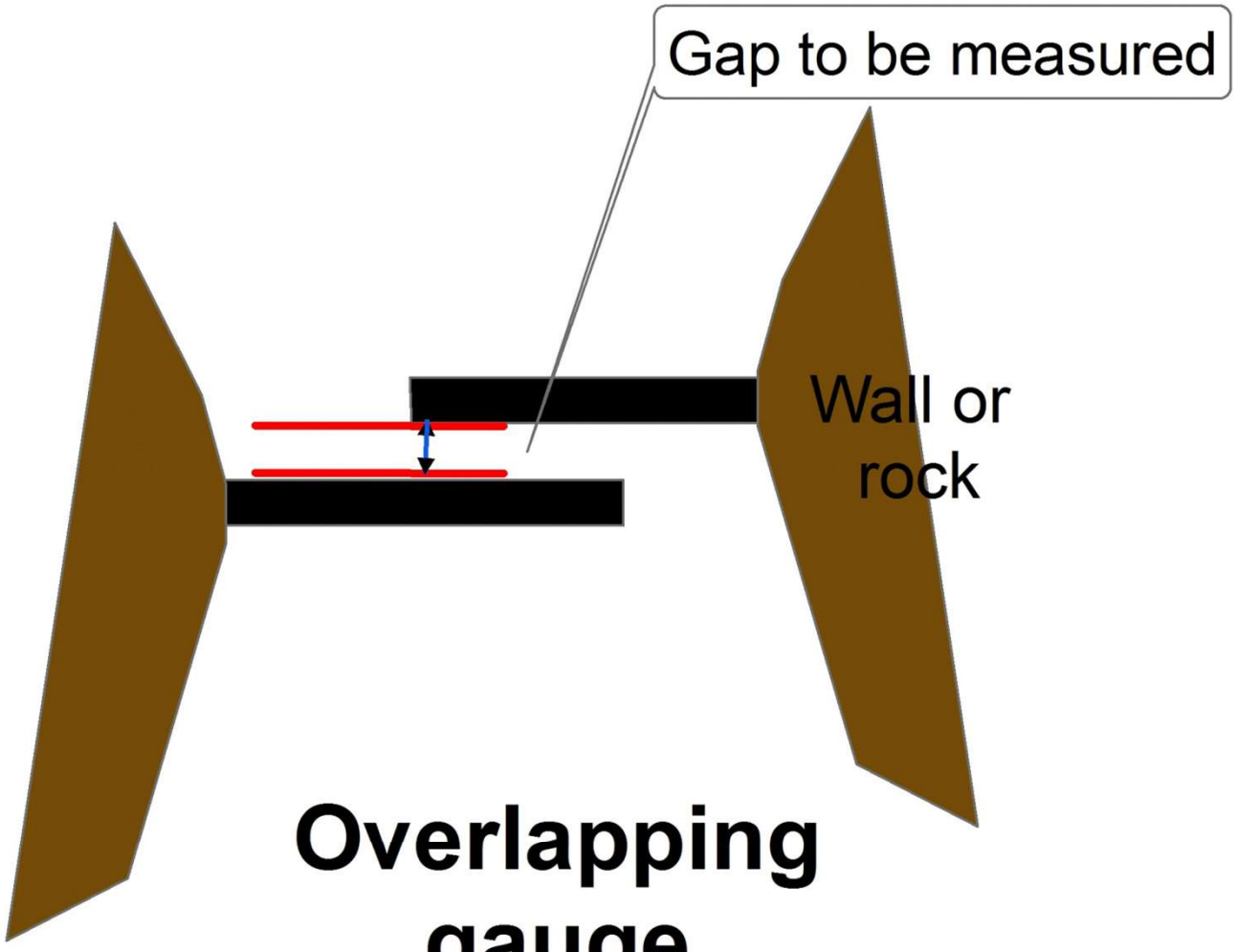
Strain Gauges

By Bob Kershaw
Illawarra Speleological Society Inc

Ningaloo Underground
30th ASF Conference
Exmouth, Western Australia
21-26 June 2015

Location of ISS strain gauges in Australia


Gap to be measured
Rod
Wall or rock
Inline gauge
(can be horizontal or vertical)

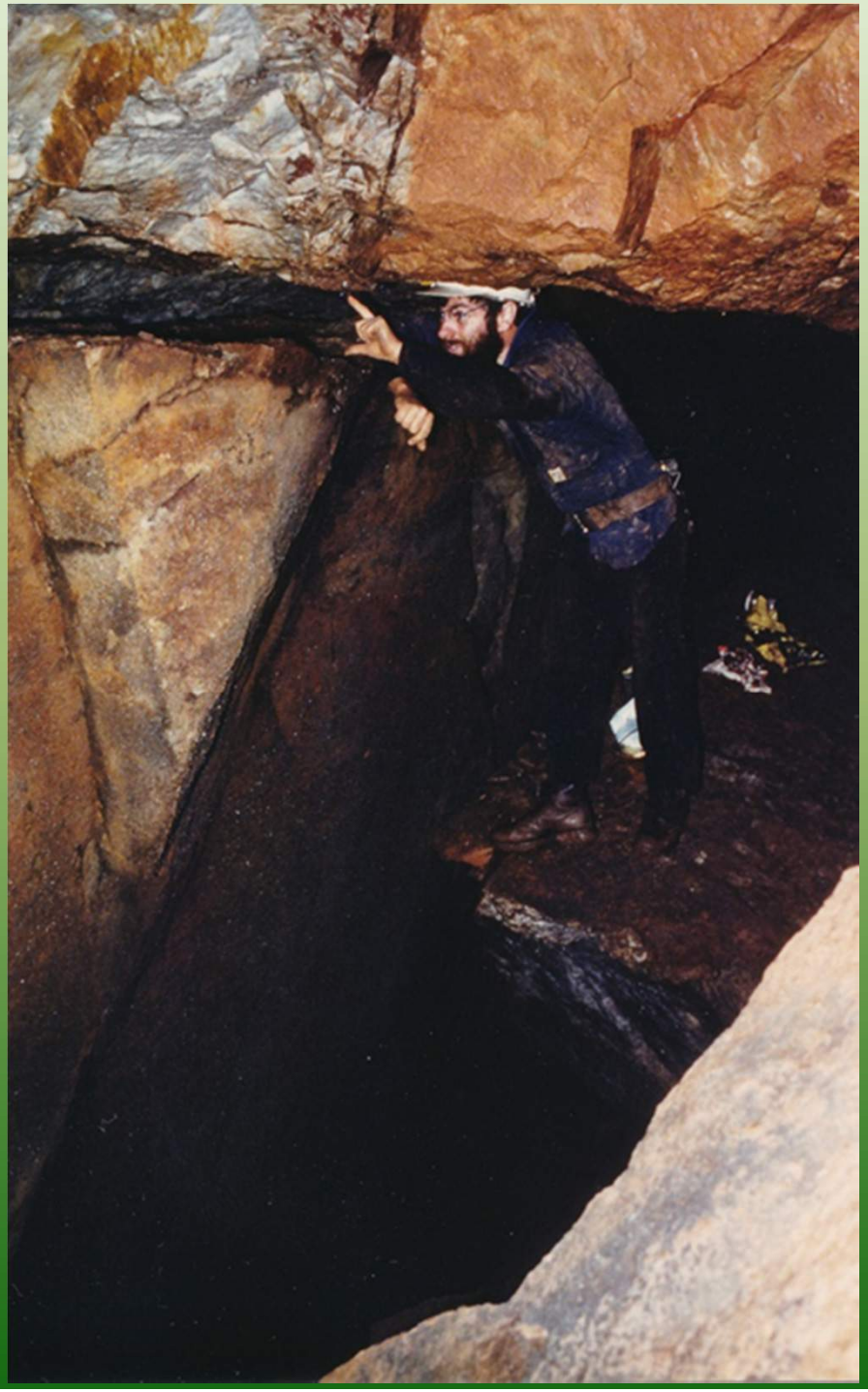


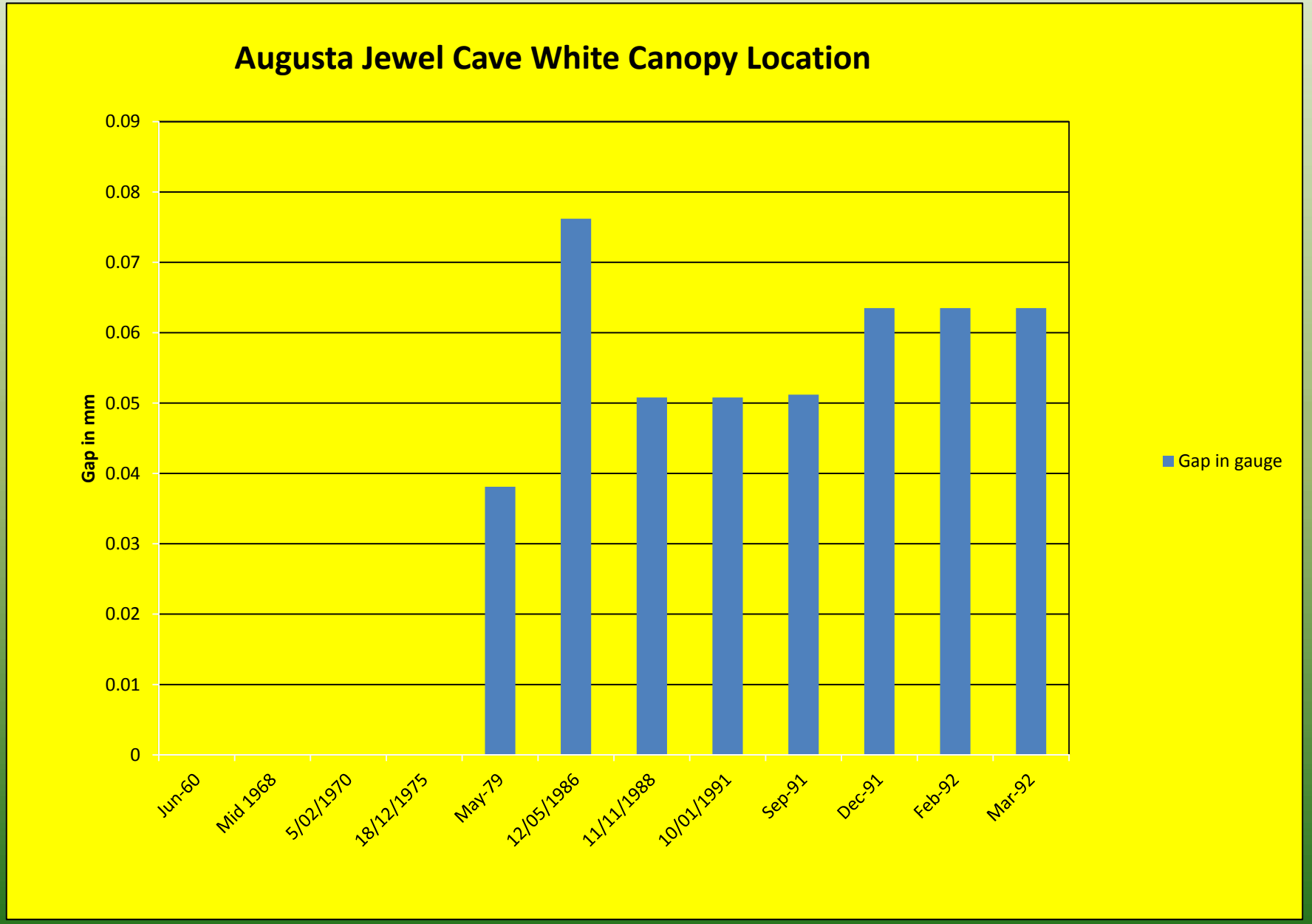
Overlapping gauge

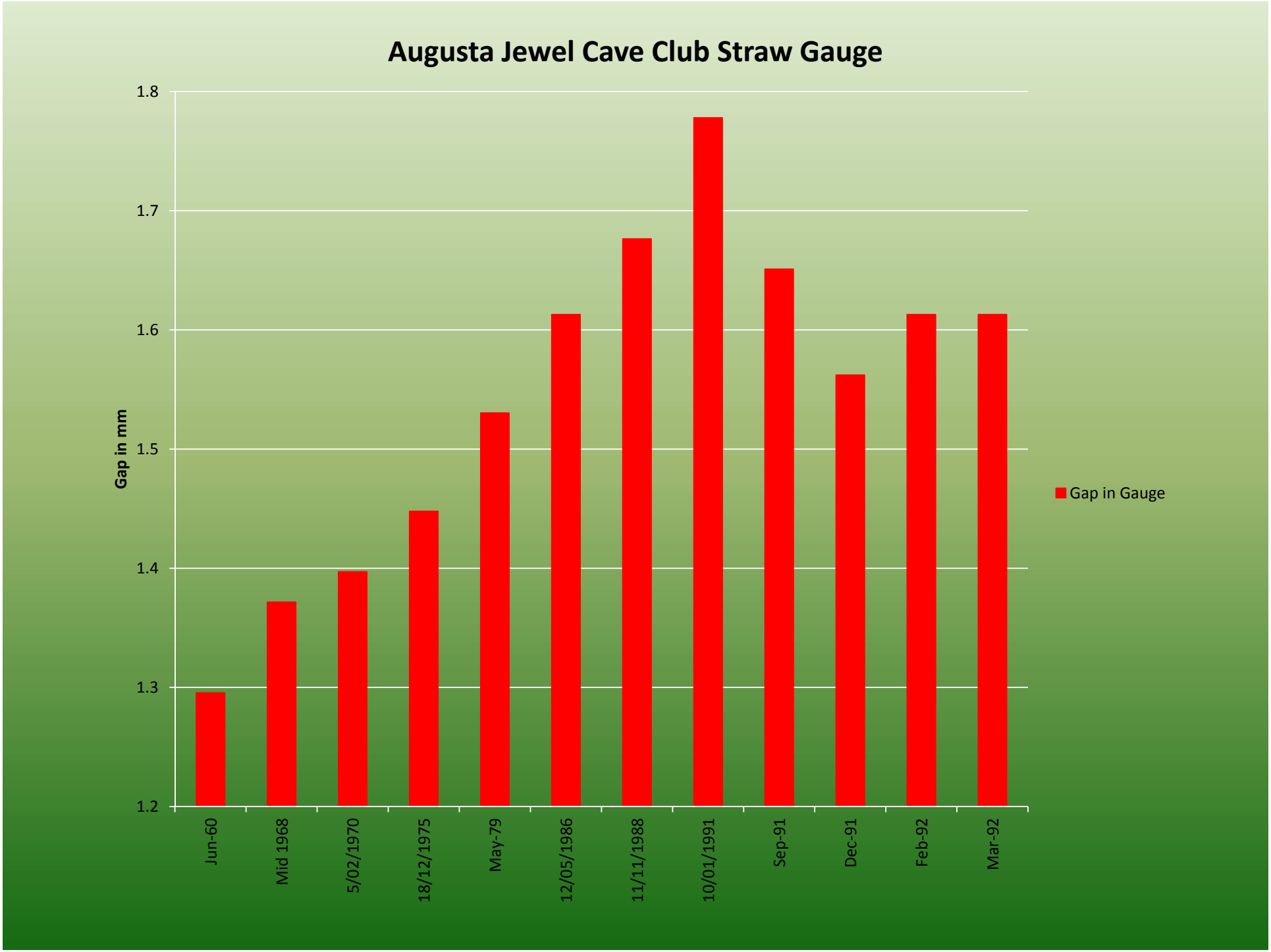

J46

Playfords Cut
Augusta Jewel Cave


012
010
008
004
THICKNESS GAUGE




Augusta Jewel Cave White Canopy Location
Gap in mm
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jun-60
Mid 1968
5/02/1970
18/12/1975
May-79
12/05/1986
11/11/1988
10/01/1991
Sep-91
Dec-91
Feb-92
Mar-92
Gap in gauge


Augusta Jewel Cave Club Straw Gauge
Gap in mm
1.8
1.7
1.6
1.5
1.4
1.3
1.2
Jun-60
Mid 1968
5/02/1970
18/12/1975
May-79
12/05/1986
11/11/1988
10/01/1991
Sep-91
Dec-91
Feb-92
Mar-92
Gap in Gauge

Conclusions

- **The data shows that there has been no movement in the rocks in the eastern States although the no1 gauge in Wyanbene has fluctuated.**
- **The north of Western Australia is stable.**
- **The fluctuations in the Augusta Jewel Cave are interesting but since the** *Augusta Margaret River Tourism Association* **do not want their data published, we cannot tell it there is any cyclic movements of rocks in the cave.**
- **Why is there is movement in the rocks in the SW of WA?**
- **Maybe it is the younger calcarenite rocks that move**
- **But since the last readings were taken many years ago we cannot really draw noteworthy conclusions.**
- **And I don't have the data on Yanchep to comment!**