ANDYSEZ 27
TWO DISCUSSIONS ON SPELEOTHEMS

- Andy Spate

Whilst on the Leeuwin-Naturalist Ridge for the 1998 Guides Gabfest I was seized by a number of ideas for ANDYSEZs - these thoughts were overtaken by ideas emmanating from others, Now read on ...

FURTHER REMARKS ON HELICTITES WITH JACQUI SKINNER

I was shown a remarkable series of CT scan images of a small helictite from Tantanoola Cave. These images were obtained by Jacquie Skinner who has graciously allowed me to reproduce some of them here. We will discuss the images shortly.

CT (Computerised Tomography) is a process of obtaining images of objects, usually of humans, by using X-rays and sophisticated computers to successively slice the object "virtually". These slices are then combined to give a 3D image. The pathology (i.e. the internal structure and functions of the body part or object being analysed) of the object are then interpreted by examining both the images of each "slice" and sometimes of the recombined 3D image.

Interpretation of such images is much like the techniques utilised in sophisticated geophysics - expensive machinery is used to produce lots of images which are then made clear by the use of coloured pencils and colouring-in at Post-Graduate Tertiary level - although medical interpretation seems a little better than this in my experience.

The various CT scans that I have had on a range of bits of my anatomy seem to be a little more real than interpretations of refraction seismographs of known caves and certainly better than early attempts at using ground-penetrating radar to find the North Glory Cave at Yarrangobilly to ground truth investigations of the "cathedral sized" cave in the collapsed Snowy Mountains Highway.

Many that know me will admit to my impressive dimensions but all (I hope) of these would not believe that a cave which would only allow me to get in as far as my waist could possibly be described as "cathedral-sized".

The images below, of a small helictite know as LB'sD (Plates 1 to 4), show remarkably clearly the central canal common to many forms of helictites (see ANDYSEZ 18). Plate 1 is a photograph of the helictite; Plates 2, 3 and 4 are long sections clearly showing the central canal.

Plate 1 can be oriented with Plates 2 and 3. Not reproduced here are cross sections which again show the canal clearly. The LB'sD• shown here is typical of many helictites - simple in form but complex in explanation.

SPELEOTHEM GROWTH RATES WITH PHIL SLATER

A further interesting observation was made by Phil Slater who generously brought this to my attention. On or about 17 March 1,373 BC, the large straw in Jewel Cave began growing. This remarkably accurate date (3,371; presumably +/- 0.5 years; Watts Holdings Pty Ltd, 1998) was obtained by means that did not seem to be related to such universal constants as one cubic inch (or centimetre) per thousand years. The straw, measured at 5.9 metres (19.5 feet; should this be an estimated 20 feet?) is said to be the longest straw stalactite in any tourist cave in the world. However, later in the week I was told that in the first 20 years since the cave was discovered the straw had grown by 35 mm. Doing all the multiplication and other complex maths does give the age quoted above - as at the time of measurement. The cave was discovered in 1957 so when did the twenty years begin or end? How were the measurements made. How should the calculations be carried out?

The estimate now allow Slater and myself to recommend that, in future, Australasian cave guides answer that oft-asked question about growth rates in the following fashion:

- straws grow at the following rates:

  ⇒ 1.75022 +/- 0.00003 mm per year

  or if you prefer

  ⇒ 0.5713 +/- 0.0001 years per mm (208.52 days per mm)

We do not believe that the source data allow a greater degree of precision than we have quoted above. It should be noted that secular variations in effective and absolute precipitation, vegetative condition above the cave, changes in fire regime, palaeoclimatic conditions and the phases of the moon influence such growth rates. There may be periodicity related to Milankcovitch cycles which reflect wobbles in the Earth's orbit around the Sun and other Solar System eccentricities. There is a good discussion in Hill and Forti (1986) on the ages of speleothems.

However, evidence on growth rates is also available from the nearby Lake Cave. Two straw stalactites a few tens on centimetres apart on the same joint were marked with candle or similar smoke 48 years ago. Measurements made in March (with a probable error of +/- 3 mm - and a near disaster!) indicated 23 and 39 mm growth in this time. Being charitable we will give the Jewel cave measurement +/- 3 mm observational errors and similarly for my measurements in Lake Cave. We will also assume,

in the absence of any other information that the Jewel Cave straw was accurately measured at 5.900 metres at the start of the period (i.e. it is now 5.935 metres in length). Robyn McBeath and Peter Bell also measured these latter straws. Using all these data we will calculate some growth rates as shown in the table below.

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	mm/100 yrs	yrs/ mm	age of straw
Jewel Cave Straw (5.938 m)			
38 mm in 20 years (+ 3 mm)	190	1.90	3,124 years
35 mm in 20 years ("observed")#	175	1.75	3,391 years
32 mm in 20 years (- 3 mm)	160	1.60	3,709 years

figure quoted by guides. Note if the age calculation is based on 5.900 m the three figures are 3,105; 3,371 and 3,688 years respectively. The figure in Watts Holdings Pty Ltd (1998 - 3,371 years) is the age calculated using growth data obtained since the straw was measured but using that rate applied to the length at the start of the measurement period. So with a +/- 3 mm measurement error and some uncertainty about how to do the calculation we have a spread of ages of some 600 plus years - nearly 20% of the age of the straw!

Lake Cave Straw A (0.423 m)			
26 mm in 38 years (+ 3 mm)	68.5	0.68	622 years
23 mm in 38 years*	60.5	0.61	693 years
20 mm in 38 years (- 3 mm)	52.6	0.53	798 years

* My observation using a 50 mm scale engraved on a "Leatherman Micra"! The plus/minus 3 mm is my estimation of the maximum error of my observation. But note Robyn McBeath's observation is greater than my observation plus 3mm. Her observation is probably more accurate than mine.

27 mm in 38 years (Mc Beath)	71.1	0.71	596 years

Lake Cave Straw B (0.542 m)			
42 mm in 38 years (+ 3 mm)	110.5	1.11	488 years
39 mm in 38 years*	102.5	1.03	526 years
36 mm in 38 years (- 3 mm)	94.5	0.95	571 years

* my observation using a 50 mm scale engraved on a "Leatherman Micra"! The plus/minus 3 mm is my estimation of the maximum error of my observation. But note Robyn McBeath's observation is greater than my observation plus 3mm. Her observation is probably more accurate than mine.

43 mm in 38 years (McBeath)	113	1.13	480 years

But the overall lengths of both Straw A and Straw B are also just estimates so the calculated ages are just illustrative.

OK, I have just had some fun with the Western Australians. I have also shown how much observational errors (Lake Cave) and a lack of information about earlier observations (Jewel Cave) can affect the result of apparently sensible observations. But this is a serious issue - we are asked all the time how old things are; how fast (or slow) speleothems form; how old the caves are and so on. These are questions proffered by our clients all the time and we owe them sensible answers - however difficult these might be.

I am told I am currently being quoted as saying that the average age of speleothems at Jenolan is 30,000 years. I sincerely hope that I have been misunderstood or misquoted or misrepresented. Giving a figure for the average age of <u>all</u> Jenolan spelothems is as easy as giving a sensible value for the average size of <u>all</u> straws, of stalactites, of stalagmites, of flowstone masses, of shawls and so on lumped together. An average age for the spelothems in any one cave - even the simplest - is statistical nonsense! Even giving the age for a single speleothem is very suspect because of the major variations in climate and other environmental variables once a little time is allowed to elapse.

Sadler et al. (1988, page 299) state that "the run of well below average rainfall in the region since about 1950 is consistent with such suggestions, [that there has been rainfall decline in south west Western Australia] but is statistically inconclusive." There is a considerable evidence that there has been a marked lowering of watertables in the south west as is all to evident in Jewel Cave. Just why this is so is open to question. If there has been a

real decline in rainfall this has been over the same time frame as the observations on the straws in Jewel and Lake Cave and thus we should be seeing a decline in speleothem growth rate in parallel. But how representative of the whole life of the straws is the last forty years? Even if rainfall has declined is it still falling with the same intensity? The same distribution throughout the year? Are other climatic parameters varying? What are the consequences of all this on the vegetation which, as you all know as a result of reading ANDYSEZs, has far reaching effects on the water reaching the cave and powering up the speleothems?

We will explore some of these issues in a future ANDYSEZ.

P.S. Please note that all of the ages and growth rates apply only to the three straws. Do not repeat not reproduce any of these figures as gospel but read all the qualifications.

REFERENCES

Hill CA and Forti P 1986 *Cave Minerals of the World*, Nat. Speleol. Soc, Huntsville, Alabama

Sadler BS, Mauger GW and Stokes RA 1988 The water resource implications of a drying climate in south-west Western Australia, pp 296-311 in Pearman GI (ed) *Greenhouse: Planning for Environmental Change*, CSIRO, Melbourne

Watts Holdings Pty Ltd 1988 *Watts What in Augusta Area, Western Australia*, 1998 Edition, 12 pp