ANDYSEZ 28

LABOURING THE POINT ABOUT SPELEOTHEM GROWTH RATES

- Andy Spate

First of all, apologies to Jacqui Skinner for the way the photos of the computerised tomography of the helictites turned out in the last ANDYSEZ. What you were supposed to see - and didn't - was the central canal running through the helictites. I am having some complex jiggery-pokery carried out on the images and hope to bring these to your attention in a future issue of the Journal. The Editor willing, that is (my copy was late in and six unshaven Sicilians appeared on my doorstep this morning wearing Dennis Rebbechi tee shirts and carrying violin cases).

Anyway, as the title suggests I am going to push the speleothem growth rate barrow again. Robyn will be pleased to know that I am going to talk about stals from "over east". First let's look a stalagmite from Jersey Cave, Yarrangobilly, kindly dated for me by Dr John Stone - then of the School of Earth Sciences at the Australian National University. The dating was by the uranium series method (for a good introduction see Chapter 6 of Dave Gillieson's recently published *Caves: Processes, Development and Management*. I imagine that everyone has bought a copy by now. If not, why not?). The following table sets out the pertinent details of this approximately 33 cm high stalagmite.

Age (years) BP	Error term (years)	Age interval (years)	Growth interval (mm)	Growth rate (mm/100 years)	Growth rate (years/mm)
38,800	+/- 2,500				
		3,800	70	1.84	54.4
35,000	+/- 2,200				
		4,020	15	0.37	268.0
3,980	+/- 320				
		1,140	210	18.42	5.4
2,840	+/- 240				
		2,840	25	0.88	113.6
Present	na				

Lots of things to note here:

- the average growth rate over the whole period has been about 120 years to produce one millimetre (or 0.83 millimetres per 100 years).
- the growth rate has varied between 5.4 and 268 years to produce one millimetre of calcite - a factor of about fifty times.
- even in the last four millennia years the growth rate has varied by a factor of over 20.
- in glacial times (when conventional wisdom has it that there would have been less water available to dissolve limestone and redeposit calcite in caves) the rate was about twice that of the last 3,000 years.
- I have ignored the error terms (note how they are relatively the same proportion of the date - and thus closer to today they are more precise. This is common in all dating methodologies - the older the sample the more imprecise the date is).
- if one takes the oldest date and add its error term the average growth rate for the whole period becomes 129.1 years per millimetre compared to 121.3 if one uses the primary date. This is equivalent to about a 6.5 % change in the growth rate over the life of the stal – again indicating that we must be aware of what we are measuring and what errors might mean if we are going to produce generalizations.

Well you all know that I keep harping on about variability and things turning on and off - this stalagmite demonstrates this extremely well. But just what is producing these switches is much harder to tell.

Hopefully the picture is clear enough for you to see the clearly obvious differences in the fabric of the stalagmite between the material older than about 35,000 years BP (BP = Before Present which is conventionally taken to be 1950 AD) and that younger than about 4,000 years BP. The older material is much more macro-crystalline and we are looking at a low growth rate as one would expect in colder times. But why should it be so slow in the last 3,000 years? I have no idea! There seems to be little difference in the fabric of the stal between the 4,000 and 3,000 dates and in the younger than 3,000 material. I am open to suggestions. More detailed dating within the hiatus between the 35,000 and 4,000 year old dates would clearly reveal the end of the last glaciation at about 18,000 years BP unless other factors are influencing the rate of growth of this speleothem.

Now for the second bit. Last time I had a go at Western Australian show caves and a minor, but much more serious swipe at Jenolan. Let's go a bit more world-wide this time around.

A most prestigious scientific journal (*The Canberra Times*, 10 May 1998 - no source) had the following story (in total):

> EXPENSIVE WONDER
>
> BEIJING: A 19.2 m-long <u>stalagmite</u> [emphasis mine] that has been growing in a cave for 200,000 years in China's central Hunan province has been insured for $A18.8 million to reflect its tourism value.

Lots of wonderful thoughts are generated by this. Who is the insurer? Who did the valuation? And how? Can I get on this gravy train?

Let's look at this more closely. We will accept the age as 200,000 years - no more, no less. Obviously, under the circumstances, the length will be precisely known - what insurance company is going to insure something which is not described precisely? The foundation for valuation we can't know but we will accept it as a basis for further discussion. Some elementary calculations lead us to the following conclusions:

Speleothem growth rate: 9.60 mm/100 years or 10.42 years/mm

Capital ($A) accumulation rate: 0.0010 mm/$ or 979.17 $/mm

Annual capital ($A) accumulation rate: 0.0106 years/$ or 94.00 $/year

Make what you will of these figures. Note that the growth rate falls within the Yarrangobilly stalagmite's range. However, based on an average age of 30,000 years for <u>all</u> Jenolan speleothems and the single Hunan stalagmite (200,000 years; insured value $A18.8 million) the Jenolan speleothem assemblage can only be valued at $A2.82 million - 15% of Hunan. Or perhaps there is a logical inconsistency here? Perhaps we should use Yap Island stone money for such a calculation?

Because we know Australian straw growth rates so well (ANDYSEZ 27) we can now proceed to valuing our caves properly. All we have to determine is the stalagmite/straw growth rate ratio (S_{tm}/S^{tw}). This GUT (Grand Unifying Theory) approach will clearly satisfy everyone! It will allow us to ignore minor issues like:

- climatic change in a vast range of influencing parameters
- changes in vegetation due to climatic change
- lithology
- surface to cave thickness
- soil depth
- degree of jointing
- variation in primary and secondary porosity
- variation in primary and secondary permeability
- lots of things I haven't thought of
- f...-up factors.

It would appear that our best available estimates of S_{tm}/S^{tw} in the eastern hemisphere are derived from data from Augusta-Margaret River on one hand and Hunan on the other. There appears to be little difficulty in taking the S_{tm}/S^{tw} ratio "over east" to Jenoleum. Thus taking a stalagmite growth rate for Hunan as 9.60 mm/100 years and dividing it by an average figure for Augusta-Margaret River of 122.67 we get a S_{tm}/S^{tw} ratio of 11.7 (dimensionless). Thus we have proved that the growth rates for straws is about ten times that of stalagmites. We all know that things that are young and grow quickly are not as valuable as venerable old bits and pieces like the Yunan stalagmite and Celery Reckons and Andysez. If we agree on our factor of about ten we can value the Augusta Margaret River straws at about one-tenth of Yunan - lets say about $A2 million.

I am not sure what to do with my dimensionless value (the stalagmite/straw growth rate ratio - S_{tm}/S^{tw}) but I am sure it will be useful in the years to come. Please read the caution at the end of ANDYSEZ 27. And something completely different next time....