GSA Data Repository Item # 7623

Title of article Stable isotope geochemistry, geothermometry, and geochronology of speleothems from West Virginia

Author(s) Peter Thompson et al.

see GSA Bulletin v. 87, p. 1730 - 1738

Contents 5 p.

GSA Depository # 76-23

TABLE 1. DESCRIPTION OF SAMPLES STUDIED

Name	Description of Site	Description of Sample
A. Samples deposited in O-isotopic equilibrium with drip-waters		
GV 2	Grapevine Cave. Precise location unknown; apparently deposited on sloping sediment bank (specimen was removed from cave during earlier trail clearing operations).	Flowstone varies from layer to layer from porous, opaque to massive translucent. Prominent layering in shades of pale yellow to dark grey or reddish grey, some solution pitting evident between layers; some layers contain occluded detritus.
NB 4	Butterscotch Room, Norman Cave. Wide (7 m), high (5 m), dry room enlarged by collapse of bedrock floor into lower chamber. Stalagmite from 2 m above floor of room, on sloping bank.	Thick, columnar stalagmite (one of three adjacent stalagmites; top broken). Creamy white, opaque, banded with dark brown layers due to occluded detritus. Locally very porous. Analysis based partly on core drilled out of broken-off stump.
NB 10	Half-way Room, Norman-Bone. Room formed by collapse, 6 m wide by 3 m high, decorated with many stalagmites growing on breakdown.	Stalagmite, non-porous, coarsely crystalline, translucent to opaque creamy white. Small amount of detritus on surface. Well-defined layering. Irregular outer surface due to deposition after collapse.
NB 11	Near roof of canyon passage. Lightly mud-covered bedrock substrate. Dry. Single deposit at this site.	Small, cone-shaped stalagmite. Very pure, white, opaque calcite with very little occluded detritus. One prominent growth layer.
B. Samples for which age data only are given		
NB 1	Half-way Room, Norman Bone; room formed by collapse; substrate is breakdown; one of many stalagmites.	Stalagmite, non-porous, pure white opaque calcite. Detritus on surface only. Some re-solution cavities on surface.
NB 2	Low, wide passage near present stream level, Norman Bone. Breakdown substrate; moist; slight air movement.	Non-porous, coarsely crystalline, pure, white calcite. Clean, wet surface; very little occluded debris.
NB 3	Narrow, high, fossil exit passage from Bone. Bedrock substrate on ledge 3 m above passage floor. Very dry cave; slight air movement.	Non-porous, coarsely crystalline, creamy white, opaque calcite. Eroded surface coated with detritus, but little detritus occluded; one prominent depositional break. Broken
NB 12	Fossil exit passage from Bone; alcove at side of main passage. Very dry; slight air movement; grown on bedrock.	Small (50 cm) stalagmite. Coarse grained, non-porous, translucent, light brown calcite; little occluded detritus. One marked depositional hiatus. Smooth, irregular surface, some solution cavities.

Thompson & others 2

TABLE 2. ANALYSIS OF A STANDARD GRANITE AND A SPELEOTHEM

Sample	U p.p.m.	$\frac{^{234}U}{^{238}U}$	$\frac{^{230}Th}{^{234}U}$	$\frac{^{230}Th}{^{232}Th}$
Granite reference sample supplied by J.N. Rosholt. U = 23.36 ± 0.19 p.p.m.				
G 3	20.5	1.01 ± 0.02	1.03 ± 0.035	--
G 4	23.0	1.02 ± 0.01	0.98 ± 0.04	--
Speleothem from N.W.T., Canada: replicate analyses.				
N 1	4.9	1.02 ± 0.02	1.04 ± 0.02	93
N 2	4.8	1.02 ± 0.02	1.06 ± 0.02	123
N 3	5.1	1.01 ± 0.02	1.04 ± 0.02	114

TABLE 3. $^{230}Th/^{234}U$ AGES OF SPELEOTHEMS FROM NORMAN-BONE AND GRAPEVINE CAVES

Speleothem	Sample Number	Average height above base (cm)	Age (Ka)
NB 1	1	90	6 ± 0.6
	2	73	69 ± 4.4
	3	58	78 ± 2.4
	4	52.5	82 ± 3.5
	5	46	93 ± 6.9
	6	28	118 ± 1.0
	7	20	129 ±11.2
	8	9.5	134 ± 1.5
	9	1.9	137 ± 7.8
NB 2	1	top(1)	2.5 ± 1.0
	2		4.5 ± 1.0
	3		5.5 ± 0.5
	4	base(1)	3.0 ± 0.3
NB 3		top and base 300	
NB 4-C	5	see	60.4 ± 6.4
	4	figure	53 ± 5.7
	3	3	102 ±25.2
	2		n.d.
	1		n.d.
NB 10	1	(2)	105 ± 4
	1A	(2)	130 ± 8
	2	89	163 ± 6.8
	3	48	173 ± 6.9
	4	29	183 ± 9.7
	5	24	203 ±11.4
	6	6.5	195 ±10.4
NB 11	1	10.0	2 ± 0.1
	2	8.5	2.1 ± 0.1
	3	1.0	3.5 ± 0.1
NB 12	from top to base		300
GV 2	1	17.0	60.4 ± 2.9
	2	15.5	81.2 ± 6.6
	3	14.0	70.0 ± 3.6
	4	12.0	69.0 ± 2.8
	5	10.0	85.9 ± 3.0
	6	8.4	79.5 ± 2.1
	7	6.3	97.2 ± 2.5
	8	4.5	104.5 ± 2.7
	9	1.2	159 ± 6.9

Notes:

1. Layers were stripped off by acid dissolution; heights of successive layers above base could not be accurately estimated. Total height of stalagmite was 17 cm.
   For complete analytical details see Thompson, Ford and Schwarcz, 1975.

2. Sometime between 163 and 135 Ka, NB10 toppled over; subsequently a new stalagmite grew on the side of NB 10, attaining a height of 12 cm. NB 10-1 is taken from the top of this later growth and NB 10-1A from the base.

Thompson, Ford, et al

TABLE 4. ISOTOPIC COMPOSITION OF MODERN SPELEOTHEMS AND ASSOCIATED SEEPAGE WATERS AND CALCULATED TEMPERATURES, NORMAN-BONE CAVE

Sample	$\delta^{18}O$ (PDB)	$\delta^{13}C$ (PDB)	$\delta^{18}O_w$ (SMOW) (1)	Calc. Temp. (2) (^oC)
Stalactite, NC 3	-7.87	-8.59	-9.08	10.7
Stalagmite, NC 3	-7.80	-8.14		10.4
Stalactite, NC 1	-8.11	-8.51	-9.49	10.0
Stalagmite, NC 2	-8.09	-8.34	-8.83	12.4
Stalagmite, NB 11 (3)	-7.70	-8.35	--	--
Stalactite, LW 1	-7.73	-9.24	-9.19	9.7
Average & Std. Dev.	-7.88 ± 0.18		-9.15	10.6 ± 0.9

(1) July - August drip-waters.

(2) Using the equation of O'Neil et al. (1969), modified as indicated in text.

(3) The Th^{230}/U^{234} age of this sample is 2000 ± 100 years.

TABLE 5. CALCULATED TEMPERATURES OF DEPOSITION FROM FLUID INCLUSION DATA

Sample	δD_i observed	$\delta^{18}O_i$ calculated	$\delta^{18}O_{CaCO_3}$	T°C*	Age
A. Modern Speleothems					
NC 4	-59.7	-8.71	-6.20	5.4	
NC 5	-64.2	-9.27	-6.97	6.2	
NC 6	-59.4	-8.67	-7.37	10.3	
NB 7	-60.1	-8.76	-8.37	14.1	
Average	-60.8	-8.85	-7.22		
Average Modern Summer Drip-water		-9.15			
B. Fossil Speleothems					
GV 2-F1	-62.5	-9.06	-5.66	2.0)	60,400 ± 2900
GV 2-F2	-62.1	-9.01	-5.13	0.2)	
GV 2-F3)	-51.2	-7.65	-4.78	4.0	70,200 ± 3600
	-61.9	-8.99	-4.42	2.0	
GV 2-F4	-52.2	-7.78	-6.86	11.9	97,000 ± 3000
GV 2-F5	-56.6	-8.33	-6.91	9.8	104,500 ± 2700
GV 2-F6	-58.3	-8.54	-4.81	0.8	
GV 2-F7	-54.5	-8.06	-6.94	11.0)	159,000 ± 6900
GV 2-F8	-64.8	-9.35	-4.96	-1.6	
NB 10-1F) (9a)	-65.7	-9.46	-6.93	5.35)	173,000 ± 5000
") (9b)	-64.2	-9.27	-7.03	6.5)	
NB 10-2F)	-52.4	-7.80	-7.13	12.9)	--
")	-55.3	-8.16	-7.07	11.1)	
NB 10-3F)	-60.5	-8.81	-7.71	11.1)	183,000 ± 9700
")	-62.5	-9.06	-7.52	9.3)	
NB 10-4F)	-66.1	-9.51	-7.19	7.6)	--
")	-71.0	-10.10	-7.14	3.7)	
NB 10-5F)	-70.0	-10.00	-6.74	2.5	
")	-61.7	-8.96	-6.99	7.6	
mean =	-60.7				

Analyses joined by tie bars) are duplicates.

*Calculated using the equation of O'Neil et al. (1969), modified as indicated in text.