Supplementary Material Table S1. Instrumental setups of excimer LA and quadrupole (Q)-ICP-MS used for elemental imaging of calcite samples

Excimer laser	Analyte G2 (Photon Machines)
Laser source	193 nm/5 ns ATLEX-I-LR (ATL Lasertechnik GmbH)
Sample cell	HelEx 2-volume cell
Signal smoother	not apply
Pulse width	<5 ns
Pulse energy	6 mJ
Beam size	80 x 80 µm square
Repetition rate	10 Hz
Scan speed	100 µm/s
Laser fluence	~4.6 J/cm^2 on sample surface
ICP-MS	Agilent 7700x (Agilent Technologies)
RF-power	1600 W
RF-matching	1.8 V
Sample gas (Ar)	0.85 L/min
Laser carrier gas (He)	1.2 L/min
Data reduction	Time resolved analysis (TRA)
Detection mode	Pulse counting and analog counting mode
Monitored isotopes	^{7}Li, ^{9}Be, ^{11}B, ^{23}Na, ^{24}Mg, ^{27}Al, ^{34}S, ^{39}K, ^{43}Ca, ^{45}Sc, ^{52}Cr, ^{55}Mn, ^{57}Fe, ^{59}Co, ^{60}Ni, ^{63}Cu, ^{66}Zn, ^{85}Rb, ^{87}Sr, ^{88}Sr, ^{89}Y, ^{118}Sn, ^{127}I, ^{137}Ba, ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, ^{238}U
Integration time	0.01 s for all mass peaks
Total integration time per reading	0.346 s
Number of lines	100 lines
Formation rate of ^{232}Th^{16}O	<0.5%
Interval of each line	30 s
Gas blank	Gas blank counts were obtained for 10 seconds before and after each line analysis
Data processing software	iQuant2+ Developed by Dr. Toshihiro Suzuki, Tokyo Institute of Technology

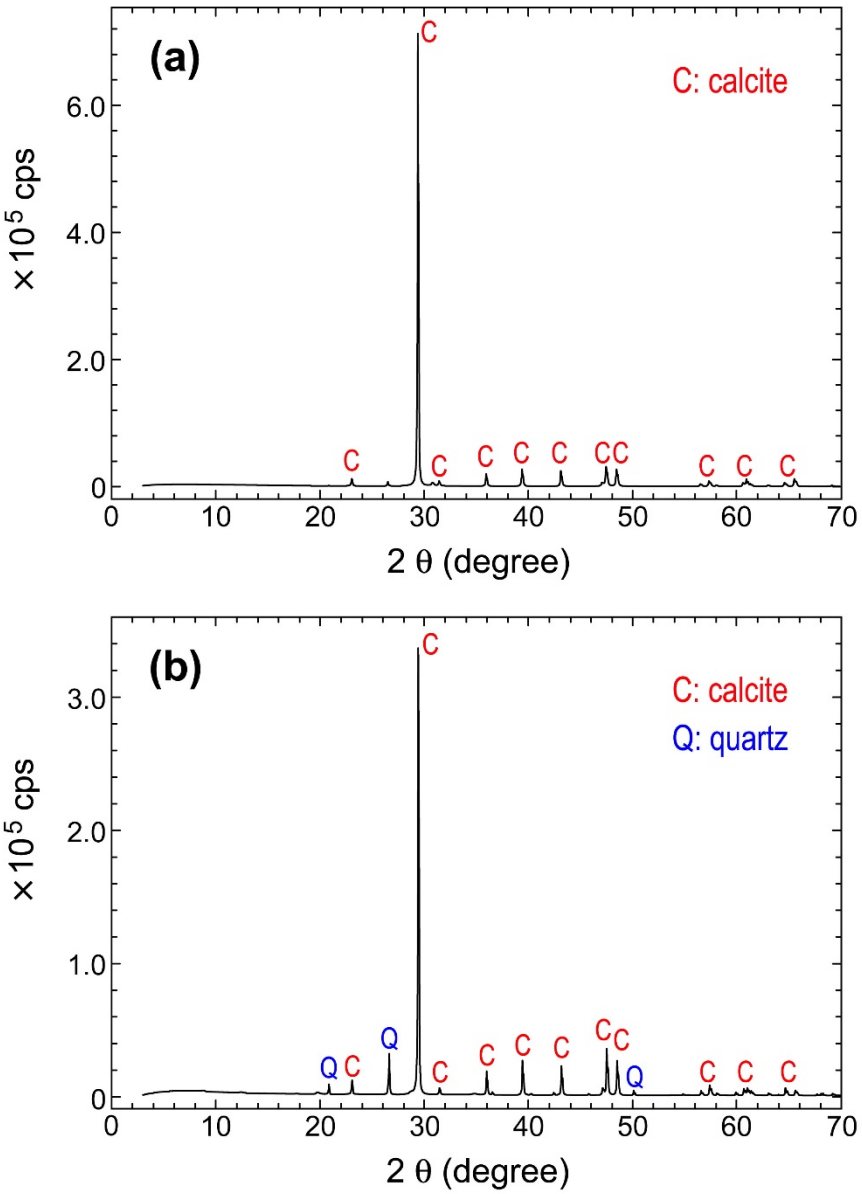
Supplementary Material Table S2. Analytical results of the WC-1 and *Pentremites* calcite samples

WC-1

Spot	$^{207}Pb/^{235}U$	1SD	$^{206}Pb/^{238}U$	1SD	Error correlation	$^{207}Pb/^{206}Pb$	1SD
15 spots analysis							
1	0.5008	0.0690	0.04138	0.00214	0.375	0.08777	0.01121
2	0.5551	0.0711	0.04180	0.00151	0.281	0.09630	0.01184
3	0.6893	0.0729	0.04397	0.00253	0.544	0.11370	0.01009
4	0.6256	0.0648	0.04319	0.00218	0.487	0.10505	0.00951
5	0.5630	0.0765	0.04312	0.00173	0.296	0.09469	0.01230
6	0.6203	0.1050	0.04328	0.00210	0.286	0.10393	0.01685
7	0.6425	0.0909	0.04458	0.00172	0.273	0.10452	0.01423
8	0.6260	0.1186	0.04528	0.00267	0.312	0.10027	0.01805
9	0.8555	0.0819	0.04672	0.00269	0.603	0.13279	0.01014
10	0.8057	0.0840	0.04551	0.00231	0.488	0.12838	0.01168
11	0.8158	0.0863	0.04652	0.00300	0.608	0.12717	0.01068
12	0.8170	0.0651	0.04765	0.00224	0.590	0.12436	0.00799
13	0.7394	0.0911	0.04390	0.00290	0.536	0.12217	0.01270
14	0.8083	0.0773	0.04585	0.00226	0.516	0.12786	0.01047
15	0.8091	0.0825	0.04676	0.00177	0.371	0.12549	0.01189
3 spots analysis in the same session of Pentremites sample							
1	0.8281	0.2287	0.04682	0.00289	0.223	0.08778	0.01121
2	0.8555	0.0819	0.04672	0.00269	0.603	0.13279	0.01014
3	0.8091	0.0825	0.04676	0.00177	0.371	0.12549	0.01189

Pentremites

Spot	$^{207}Pb/^{235}U$	1SD	$^{206}Pb/^{238}U$	1SD	Error correlation	$^{207}Pb/^{206}Pb$	1SD
1	1.540	0.341	0.06568	0.00532	0.366	0.17004	0.03505
2	0.8827	0.0430	0.05903	0.00184	0.640	0.10844	0.00405
3	1.604	0.235	0.06521	0.00298	0.312	0.17836	0.02480
4	1.479	0.250	0.06354	0.00274	0.255	0.16883	0.02760
5	1.077	0.089	0.06077	0.00251	0.496	0.12849	0.00927
6	0.9802	0.0908	0.05956	0.00093	0.169	0.11936	0.01090
7	1.376	0.209	0.06551	0.00328	0.330	0.15230	0.02181
8	0.8505	0.0581	0.05726	0.00092	0.235	0.10772	0.00715
9	0.7971	0.0488	0.06065	0.00261	0.702	0.09531	0.00416
10	0.7523	0.0923	0.05944	0.00235	0.323	0.09178	0.01065
11	0.8883	0.1473	0.05947	0.00167	0.169	0.10833	0.01770
12	0.6961	0.0359	0.05649	0.00119	0.408	0.08937	0.00421
13	0.7553	0.0609	0.05597	0.00171	0.379	0.09787	0.00731
14	0.7685	0.0632	0.05633	0.00089	0.193	0.09894	0.00798
15	0.8779	0.0925	0.05762	0.00096	0.158	0.11050	0.01470



Supplementary Material Fig. S1. *X-ray diffractometry patterns of calyx and infilling parts of the Pentremites sample. (a) Calyx part consists solely of calcite. (b) Infilling part contains a few or several percent of quartz crystals in calcite matrix.*