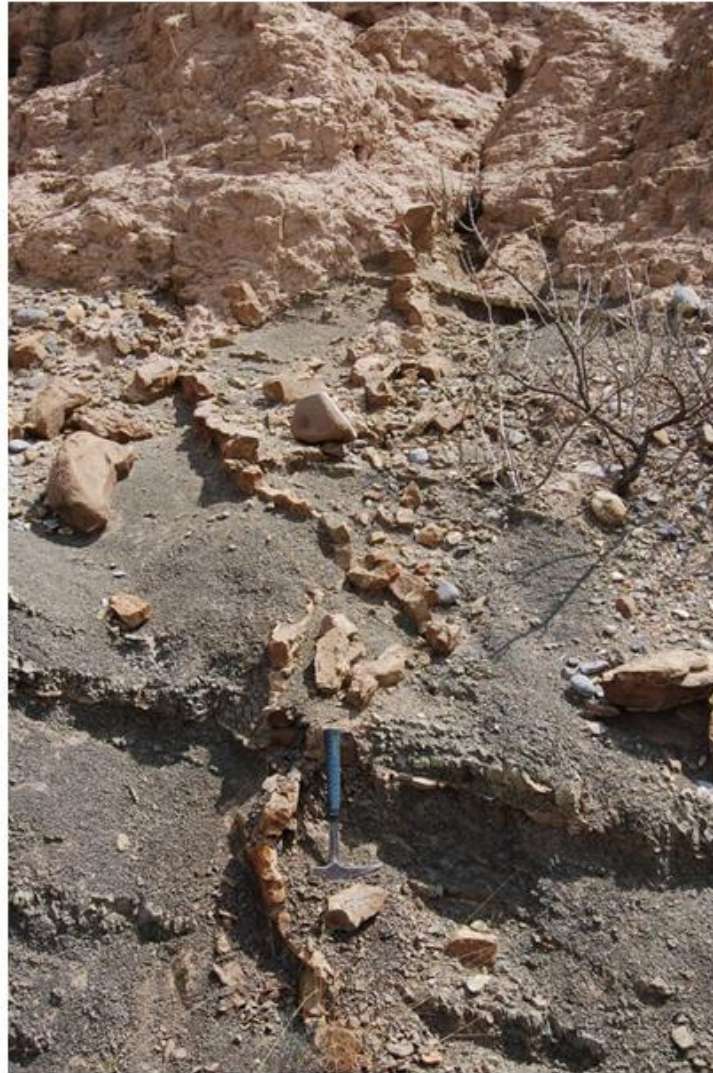


1 **SUPPLEMENTARY MATERIAL**

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5 **Fig. S1.** An example of an early sandy sedimentary dike which has been deformed during  
6 compaction.

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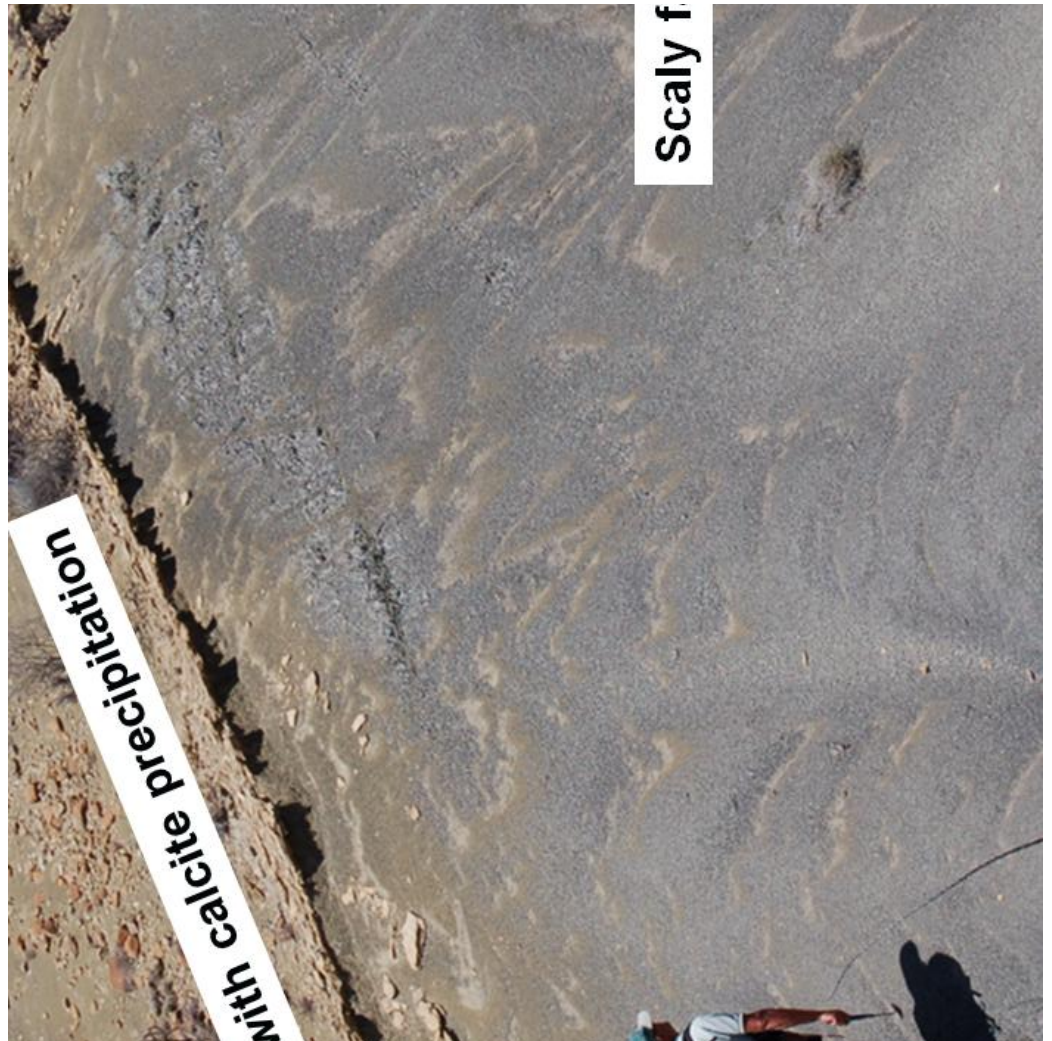
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10 **Fig. S2.** Detailed example of a boudinated sandstone element isolated within scaly shale.  
11 Such feature shows evidence of the ductile behavior of shale (same location as the outcrops of  
12 Fig. 11).



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**Fig. S3.** Example of scaly shale body showing disorganized stratification (50 m west of the outcrops of Fig. 12).

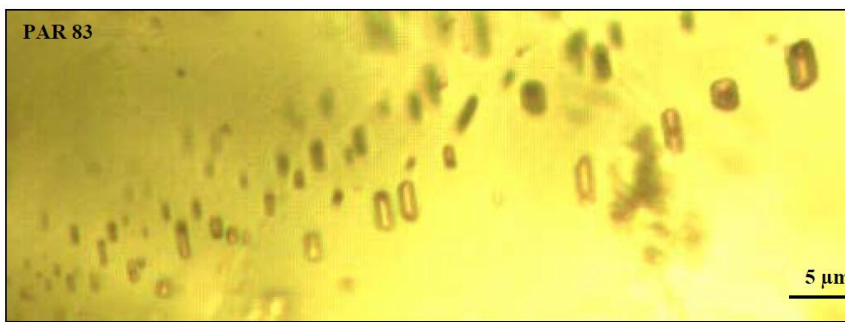


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**Fig. S4.** Example of a thrust plane across scaly shale (same location as outcrops of Fig. 12).



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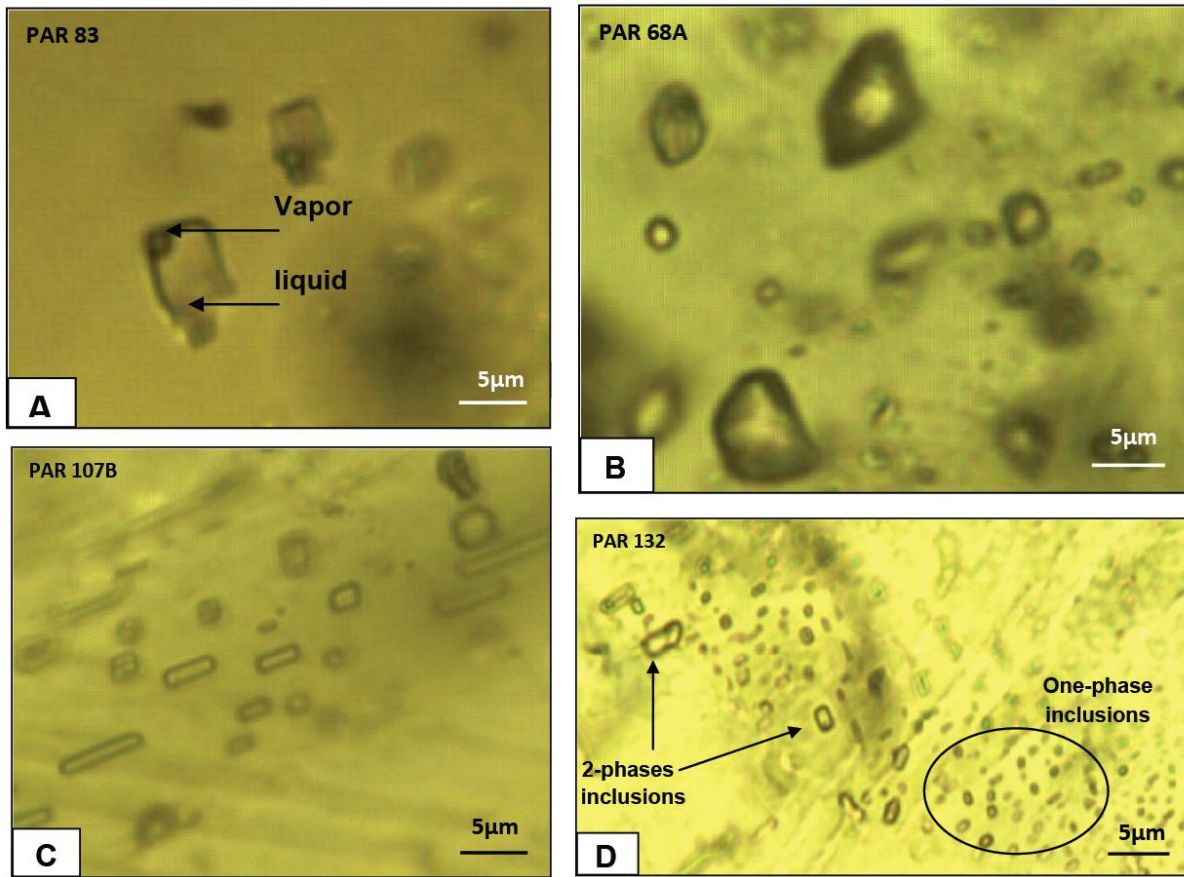
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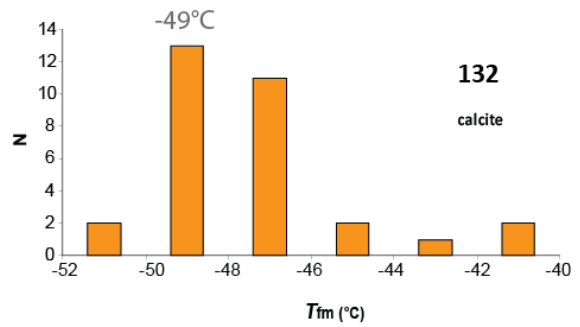
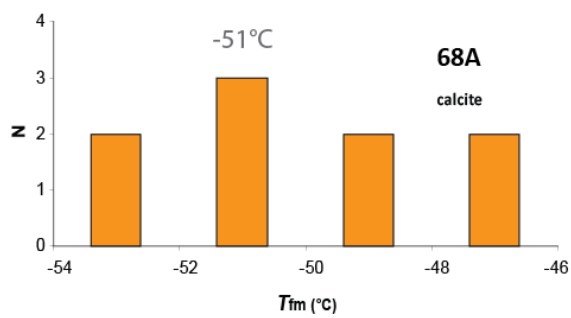
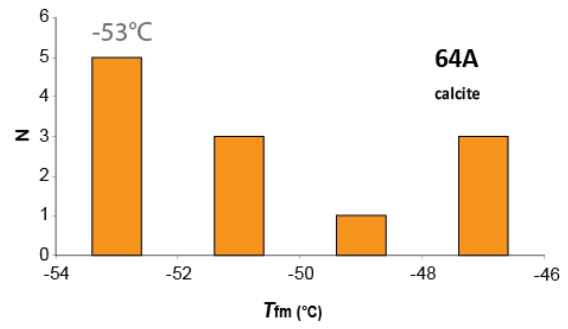
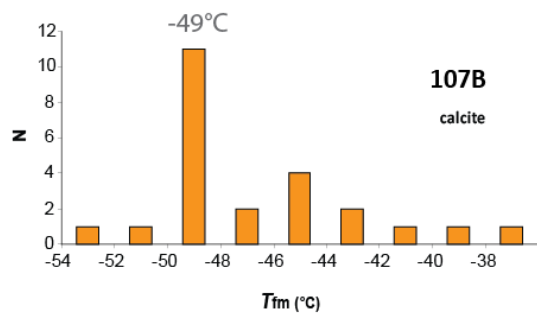
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**Fig. S5. A.** Primary two-phase fluid inclusion in calcite (sample 107B). Fluids which are present in primary inclusions are those present during the mineral crystallization and they allow revealing the conditions of crystallization of the mineral. **B.** Secondary fluid inclusion in a fracture scar where fluids were able to flow after the crystallization of the mineral (sample 83).



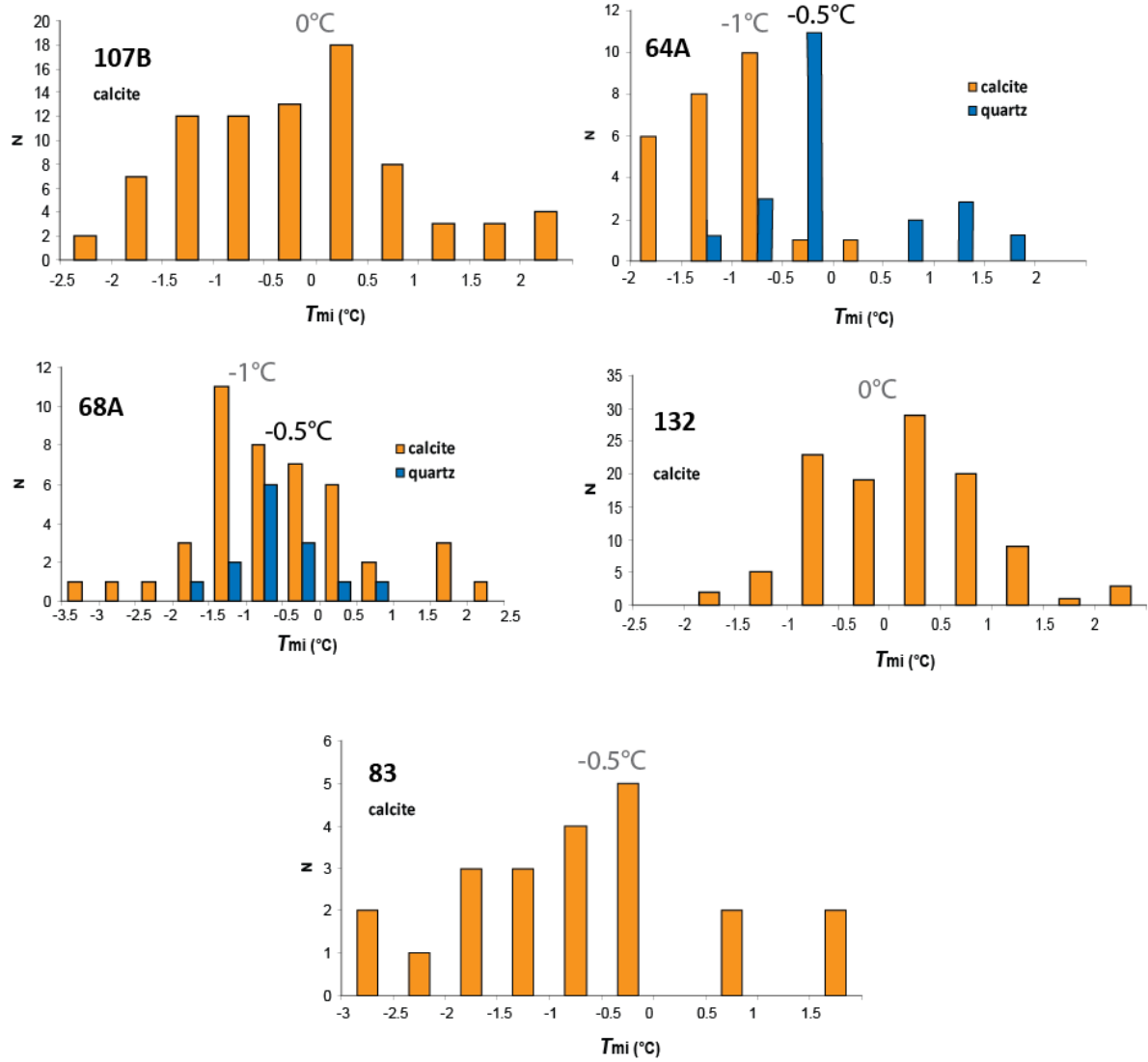
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**Fig. S6.** The different types of fluids inclusions: **A.** Type 1: Two-phase primary fluid inclusions; **B.** Type 2: primary gaseous fluid inclusions. **C.** Type 3: rectangular late primary aqueous fluid inclusions; **D.** Type 4: Aligned secondary fluid inclusions, the larger ones are two-phase, the smaller are one-phase



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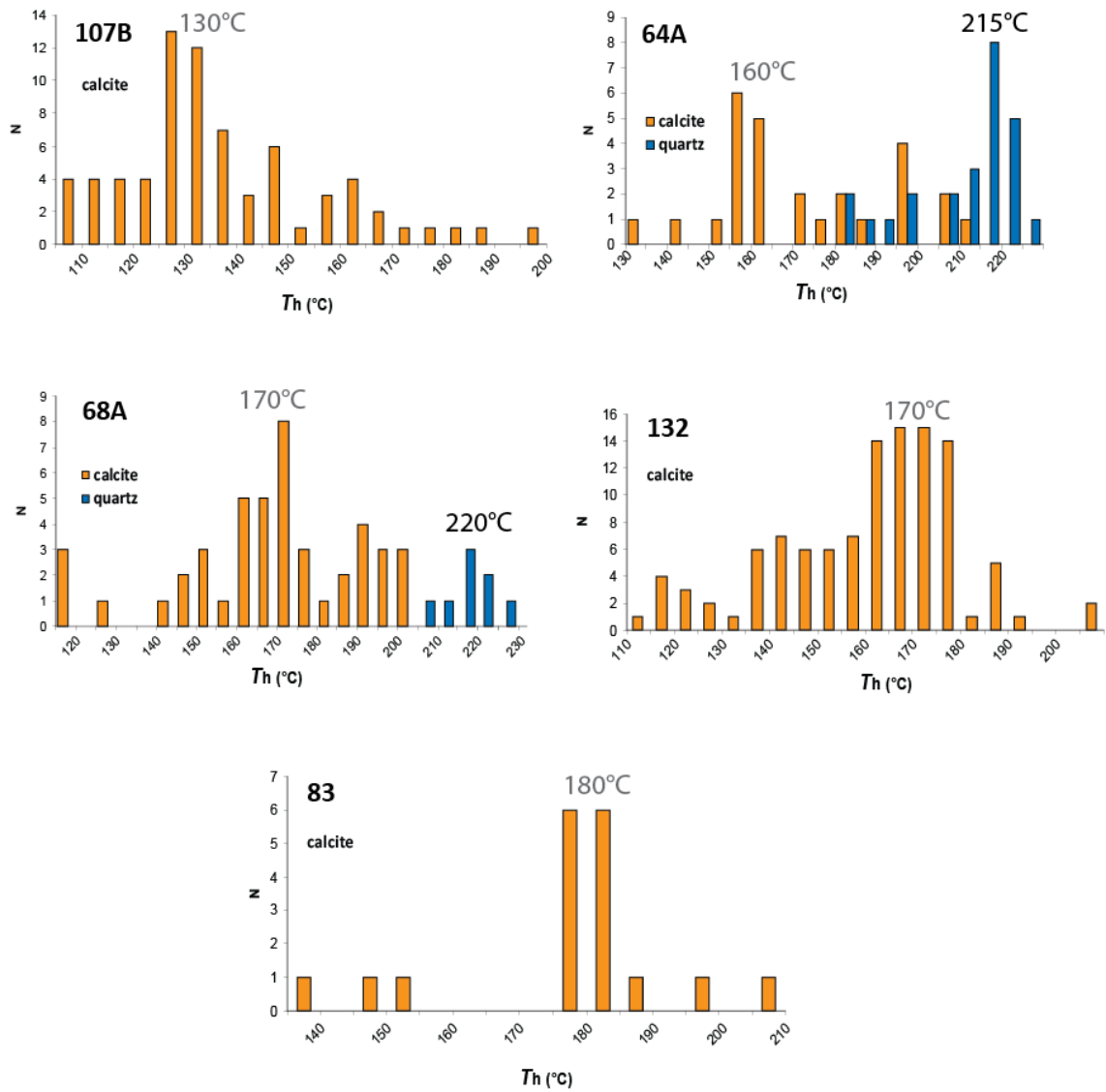
**Fig. S7.** Histogram of first melting temperatures (T<sub>fm</sub>) measured in aqueous fluid inclusions in calcite minerals of different samples.



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**Fig. S8.** Histograms of final melting temperatures ( $T_{mi}$ ) measured in aqueous fluid inclusions in calcite and quartz minerals of different samples.

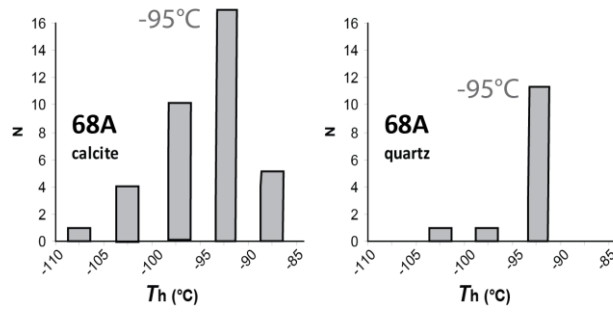




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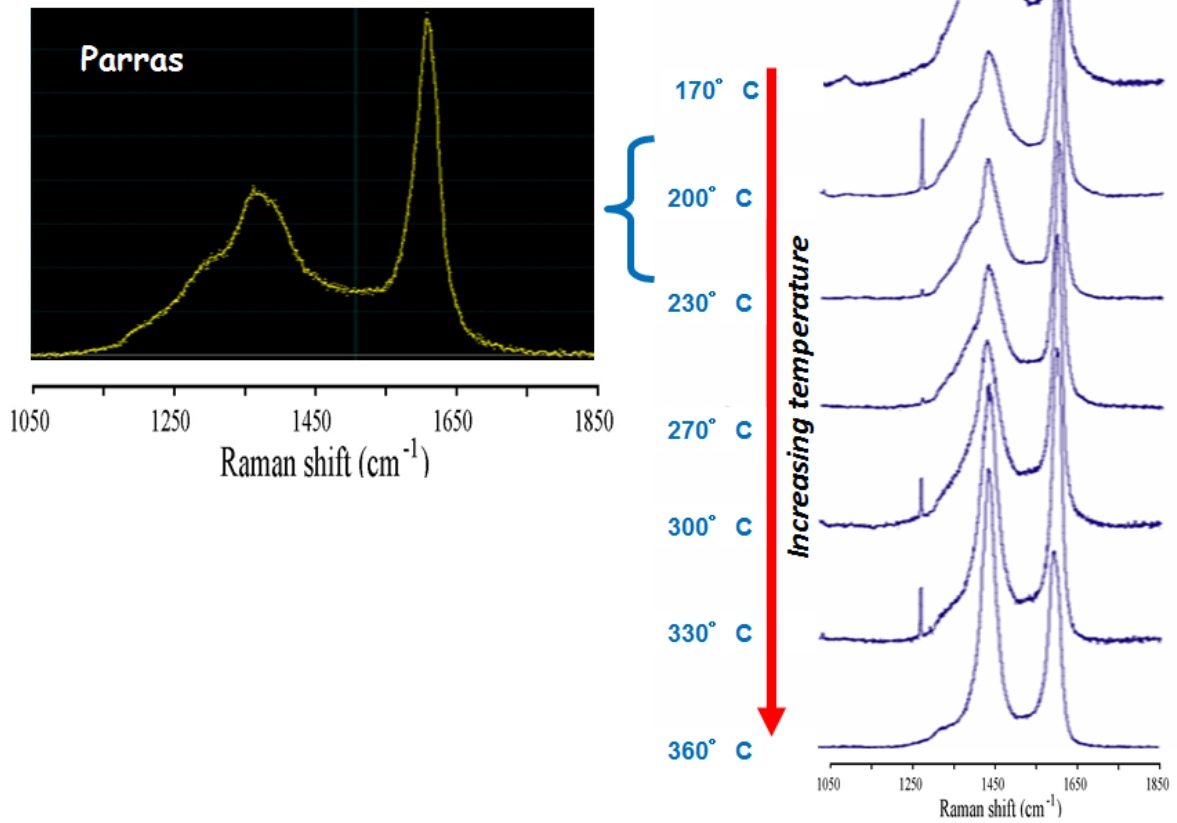
**Fig. S9.** Histograms of homogenization temperatures (THz) measured in aqueous fluid inclusions in calcite and quartz minerals of different samples.

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**Fig. S10.** Histograms of homogenization temperatures ( $T_h$ ) measured in gaseous fluid inclusions in calcite and quartz minerals of sample 68A.



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**Fig. S11.** Left: An example of thermometric measurement by Raman spectrometry (RSCM). The temperature in the decollement zone is estimated to be in the range  $200 \pm 20^\circ\text{C}$ . Right: Reference Raman spectrums are from Lahfid (2008) and Lahfid et al. (2010).

Table S1 - Isotopic compositions of calcite minerals					$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	$\delta^{18}\text{O}$	
					Mean	Std.Dev.	Mean	Std.Dev.	
Sample N°	Mineralogy	Type	Structural location		permil V-PDB		permil V-PDB		
1	107B-1	calcite	Vein	Above décollement	107B 1	-4.66	0.01	-9.96	0.03
2	11 (1)	calcite	Vein	Above décollement	11 1	-4.02	0.00	-9.53	0.01
3	120A-1	calcite	Vein	Décollement zone	120A 1	-6.27	0.01	-7.14	0.02
4	120A-2	calcite	Vein	Décollement zone	120A 2	-2.90	0.01	-9.93	0.02
5	122-1	calcite	Cataclasite	Décollement zone	122 1	-3.47	0.01	-6.24	0.01
6	122-1	calcite	Cataclasite	Décollement zone	122 1	-5.22	0.01	-6.28	0.02
7	122-2	calcite	Cataclasite	Décollement zone	122 2	-4.93	0.01	-6.07	0.03
8	122-3	calcite	Cataclasite	Décollement zone	122 3	-5.80	0.01	-6.37	0.01
9	124-1	calcite	Cataclasite	Décollement zone	124 1	-6.47	0.01	-5.76	0.02
10	128B-1	calcite	Vein	Below décollement	128B 1	-1.32	0.01	-9.72	0.02
11	132-1	calcite	Vein	Below décollement	132 1	-1.78	0.01	-9.73	0.02
12	13B-1	calcite	Calcite tube	Above décollement	13B 1	-3.85	0.01	-9.77	0.02
13	14A-1	calcite	Calcite tube	Above décollement	14A 1	-3.84	0.01	-10.12	0.02
14	14A-2	calcite	Vein	Above décollement	14A 2	-6.21	0.01	-8.03	0.01
15	18B-1	calcite	Vein	Above décollement	18B 1	-4.05	0.01	-10.18	0.01
16	25 (1)	calcite	Vein	Above décollement	25 1	-4.32	0.01	-9.53	0.02
17	29B-1	calcite	Vein	Above décollement	29B 1	-4.12	0.01	-9.68	0.01
18	2B-1	calcite	Vein	Above décollement	2B 1	-4.15	0.02	-9.66	0.01
19	2B-2	calcite	Vein	Above décollement	2B 2	-4.40	0.01	-8.25	0.01
20	2B-3	calcite	Vein	Above décollement	2B 3	-4.03	0.01	-8.97	0.02
21	42A-1	calcite	Vein	Décollement zone	42A 1	-4.35	0.01	-9.23	0.01
22	42A-1	calcite	Vein	Décollement zone	42A 1	-4.62	0.01	-9.56	0.02
23	42A-2	calcite	Vein	Décollement zone	42A 2	-4.42	0.01	-9.65	0.01
24	42A-3	calcite	Vein	Décollement zone	42A 3	-3.95	0.01	-9.86	0.01
25	42B-1	calcite	Cataclasite	Décollement zone	42B 1	-6.85	0.01	-6.27	0.02
26	42B-2	calcite	Cataclasite	Décollement zone	42B 2	-6.69	0.01	-6.45	0.03
27	59A-1	calcite	Vein	Décollement zone	59A 1	-5.22	0.01	-10.15	0.01
28	59A-2	calcite	Vein	Décollement zone	59A 2	-5.32	0.02	-9.49	0.01
29	60B-1	calcite	Calcite tube	Above décollement	60B 1	-3.47	0.00	-9.02	0.01
31	61B-2	calcite	Vein	Above décollement	61B 2	-5.44	0.01	-6.89	0.01
32	61B-3	calcite	Vein	Above décollement	61B 3	-5.36	0.01	-9.65	0.02
33	62-1	calcite	Vein	Above décollement	62 1	-5.86	0.01	-9.85	0.01
34	64A-1	calcite	Vein	Above décollement	64A 1a	-3.86	0.00	-9.46	0.02
35	64A-1	calcite	Vein	Above décollement	64A 1b	-5.35	0.01	-9.75	0.01
36	64A-2	calcite	Vein	Above décollement	64A 2	-5.40	0.01	-10.18	0.01
37	64A-3	calcite	Vein	Above décollement	64A 3	-4.25	0.02	-9.36	0.01
38	64A-4	calcite	Vein	Above décollement	64A 4	-3.82	0.02	-9.71	0.02
39	64A-5	calcite	Vein	Above décollement	64A 5	-3.41	0.01	-9.72	0.01
40	65A-1	calcite	Vein	Above décollement	65A 1	-5.85	0.01	-6.49	0.01
41	65B-1	calcite	Vein	Above décollement	65B 1	-5.43	0.01	-8.25	0.01
42	67-1	calcite	Vein	Above décollement	67 1	-10.83	0.02	-5.94	0.01
43	67-2	calcite	Vein	Above décollement	67 2	-10.06	0.02	-6.18	0.02
44	67-3	calcite	Vein	Above décollement	67 3	-4.52	0.01	-9.14	0.01
45	68B-1	calcite	Vein	Above décollement	68B 1a	-5.20	0.02	-10.29	0.02
46	68B-1	calcite	Vein	Above décollement	68B 1b	-5.13	0.01	-10.28	0.01
47	68B-1	calcite	Vein	Above décollement	68B 1	-5.02	0.01	-9.72	0.02
48	68C-1	calcite	Vein	Above décollement	68c 1	-6.48	0.02	-5.93	0.01
49	68C-1	calcite	Vein	Above décollement	68c 1	-6.36	0.02	-6.56	0.02
50	68D-1	calcite	Vein	Above décollement	68D 1	-9.97	0.02	-6.25	0.02
51	7C-1	calcite	Vein	Above décollement	7c 1	-4.36	0.00	-9.75	0.01
52	83-2	calcite	Cretaceous carbonate	Below décollement	83 2	0.44	0.01	-9.70	0.01
53	83A-1	calcite	Cretaceous carbonate	Below décollement	83A 1	0.46	0.01	-9.74	0.01
54	75-A	calcite	Vein	Above décollement	75A 1	-4.65	0.01	-9.58	0.02
55	89B-1	calcite	Vein	Above décollement	89B 1	-4.32	0.01	-10.34	0.02
56	89B-2	calcite	Vein	Above décollement	89B 2	-4.47	0.01	-9.86	0.01
57	89B-3	calcite	Vein	Above décollement	89B 3	-4.56	0.01	-10.19	0.01
58	89B-4	calcite	Vein	Above décollement	89B 4	-4.56	0.01	-9.94	0.01
59	8A-1	calcite	Vein	Above décollement	8A 1	-5.27	0.01	-10.57	0.01
60	8B-1	calcite	Vein	Above décollement	8B 1	-4.74	0.01	-9.54	0.01

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**Supplementary material. Table S<sub>I</sub>.** Isotopic compositions of carbonate cement in veins (values in ‰).

**Table S2 - Rock-Eval analyses**

Sample	Formation	S1	S2	Tmax °C	RC %Wt	TOC %Wt
		mg HC/g rock	mg HC/g rock			
99A	Las Encinas	0	0.01		0.25	0.26
P-GPS27	Cerro Grande	0	0.03	460	0.19	0.22
103A	Las Imagenes	0	0		0.08	0.08
GPS6	Canon Del Tule	0	0		0.11	0.12
P-ESP5	Canon Del Tule	0.01	0.01	483	0.12	0.14
P-ESP1	Canon Del Tule	0	0		0.09	0.09
P-ESP2	Canon Del Tule	0	0.01	495	0.19	0.2
105C	Canon Del Tule	0	0		0.1	0.11
135	Cerro Huertas	0	0		0.01	0.01
50	Cerro Huertas	0	0		0.05	0.05
140	Cerro Del Pueblo	0	0		0.23	0.23
P-GPS15	Cerro Del Pueblo	0	0		0.26	0.26
P-GPS20	Cerro Del Pueblo	0	0		0.14	0.14
P-GPS42	Cerro Del Pueblo	0.01	0		0.21	0.22
P-GPS10	Parras Shale	0	0		0.37	0.38
P-GPS11	Parras Shale	0	0		0.34	0.35
P-GPS11B	Parras Shale	0	0		0.34	0.35
P-GPS13	Parras Shale	0	0		0.29	0.3
P-GPS14	Parras Shale	0	0		0.18	0.19
P-GPS47	Parras Shale	0	0		0.19	0.2
P-GPS48	Parras Shale	0.01	0		0.22	0.23
P-GPS49	Parras Shale	0	0		0.38	0.38
P-GPS50	Parras Shale	0.01	0		0.21	0.21
P-GPS21	Parras Shale	0	0		0.29	0.3
P-GPS21B	Parras Shale	0	0		0.17	0.18
P-GPS22	Parras Shale	0	0		0.21	0.22
P-GPS24	Parras Shale	0	0		0.16	0.16
2	Parras Shale	0	0		0.16	0.17
1A	Parras Shale	0	0.01		0.25	0.26
4B	Parras Shale	0	0.02		0.28	0.28
7D	Parras Shale	0	0		0.34	0.34
15B	Parras Shale	0	0.01		0.39	0.4
15A	Parras Shale	0	0.01		0.14	0.15
18D	Parras Shale	0	0		0.17	0.18
22	Parras Shale	0	0		0.11	0.12
24	Parras Shale	0	0.01		0.24	0.25
28	Parras Shale	0	0.01		0.32	0.33
30	Parras Shale	0	0.01		0.3	0.31
31	Parras Shale	0	0		0.23	0.23
36B	Parras Shale	0	0		0.22	0.23
45	Parras Shale	0	0		0.29	0.3
47	Parras Shale	0	0		0.23	0.24
49	Parras Shale	0	0		0.25	0.26
56	Parras Shale	0	0		0.13	0.13
60C	Parras Shale	0	0		0.22	0.22
62B	Parras Shale	0	0.01		0.15	0.16
62A	Parras Shale	0	0		0.17	0.18
63	Parras Shale	0	0		0.27	0.27
66	Parras Shale	0	0		0.24	0.25
70	Parras Shale	0	0		0.17	0.18
72	Parras Shale	0	0		0.14	0.15
72B	Parras Shale	0	0		0.2	0.2
79	Parras Shale	0	0		0.27	0.27
81B	Parras Shale	0	0.01		0.34	0.35
85	Parras Shale	0.01	0		0.23	0.24
88	Parras Shale	0	0		0.19	0.2
89	Parras Shale	0	0		0.18	0.19
98A	Parras Shale	0	0.01		0.09	0.1
106	Parras Shale	0	0		0.21	0.23
109	Parras Shale	0	0		0.16	0.18
111	Parras Shale	0	0.01		0.33	0.34
114	Parras Shale	0	0		0.35	0.36
115	Parras Shale	0	0		0.31	0.32
116	Parras Shale	0	0.01		0.32	0.33
117	Parras Shale	0	0		0.18	0.19
120B	Parras Shale	0	0		0.36	0.37
121	Parras Shale	0	0		0.3	0.3
126	Parras Shale	0	0		0.14	0.15
130	Parras Shale	0	0		0.38	0.39
131B	Parras Shale	0	0		0.42	0.43
133B	Parras Shale	0	0		0.06	0.06
134B	Parras Shale	0	0		0.03	0.03

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**Supplementary material. Table S<sub>II</sub>.** Rock-Eval 6 analyses (RC: residual carbon; TOC: total organic content).