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Synthetic Fluid Inclusions. XVII.[1] PVTX Properties of High Salinity H_2O-NaCl Solutions (>30 wt % NaCl): Application to Fluid Inclusions that Homogenize by Halite Disappearance from Porphyry Copper and Other Hydrothermal Ore Deposits

S. P. Becker, A. Fall, and R. J. Bodnar

APPENDIX

The following table summarizes published studies from 1970 to 2007 that have reported microthermometry data for fluid inclusions that homogenize by halite disappearance ("Type C" inclusions, Fig. 1 from the main text). The first column refers to the literature sources that are listed immediately below the table. The second column lists the geologic environment and/or deposit type that most closely matches the description given by the authors of the paper. The following abbreviations are used when appropriate: PCD = porphyry copper deposit; IOCG = iron oxide copper-gold; MVT = Mississippi Valley type; BX = breccia; PGE = platinum group element; REE = rare earth element; SEDEX = SEDimentary EXhalitive; FI = fluid inclusions. The third and fourth columns list ranges in $Th_{L\text{-}V}$ and Tm_{halite} (°C), respectively. The fifth column lists the range of salinities reported, in equivalent weight percent NaCl. The sixth column lists pressures (in megapascals) reported in the publication that were determined from type C inclusions, and the seventh column lists depths (in kilometers) estimated by the authors of the original publication based on pressures reported in column 6.

In general, recent publications are more abundant and report data on type C inclusions in greater detail. Older publications often provide insufficient detail to identify inclusions that homogenize by halite disappearance, and generally require closer inspection to retrieve the relevant data. The higher quality of more recent data is likely due to advances in instrumentation, including the introduction of the USGS gas-flow stage in 1979 (Werre et al., 1979), and related improvements in fluid inclusion microthermometric methods and data analysis. Data in the table are listed chronologically, starting with the most recent publications on top.

This table is not intended to be a comprehensive list of all published data for inclusions that homogenize by halite disappearance. Rather it represents a list that may be a useful starting point for future researchers who encounter type C fluid inclusions in their studies and wish to review the available literature. Only publications in which the investigators clearly describe inclusions that homogenize by halite disappearance or show $Th_{L\text{-}V}$ versus Tm_{halite} and/or salinity versus homogenization temperature plots in which it is obvious that some inclusions homogenized by halite disappearance are included. Many additional publications were reviewed that described inclusions that could have been type C inclusions. However, these were not included because insufficient detail was provided to be certain that the inclusions did homogenize by halite disappearance. The manner in which microthermometric data were presented ranged from tables listing data for individual inclusions to statements of the ranges of $Th_{L\text{-}V}$ and Tm_{halite}, to graphs showing $Th_{L\text{-}V}$ versus Tm_{halite} and/or salinity versus homogenization temperature, to ambiguous histograms that do not necessarily indicate $Th_{L\text{-}V} < Tm_{halite}$, but with accompanying text indicating that type C inclusions were observed. In those cases in which ambiguity occurs, data were not included in the table and missing data are marked with a "—" symbol. Question marks are used in cases where ranges of data given the description in the text are questionable. Tilde (~) characters precede values that could only be approximated through visual inspection of graphical presentations of data.

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Summary of Reported Data in Selected Publications

Reference	Geologic environment	Th_{L-V} (°C)	Tm_{halite} (°C)	Salinity (wt %)	Pressure (MPa)	Depth (km)
1	IOCG	109-266	198-447	32-56	~20-250	—
2	MVT	141-300	up to +100	—	—	—
3	Alkaline massif	250-315	264-325	35.5-39.8	—	—
4	Vein	150-370	240-380	31-44	40-90	—
5	PCD	~200-500	~275-575	36.9-65.8	>90	—
6	Orogenic Au	161-307	198-396	31.8-46.2	—	—
7	Veins	145-220	270-300	36-38	50-300	—
8	PCD/epithermal	~200-420	—	~36-46	—	—
9	Intrusion Au	125-360	150-480	30-57	130	—
10	IOCG	80-200	100-500	26-65	—	—
11	PCD	291-400	421-520	49.4-60.1	~45-50	—
12	PCD	~250-~500	321-510	33-61	—	—
13	PCD	~190-~350	~210-~425	~30-50	60-225	—
14	Massive sulfide	—	~180?	30	—	—
15	Lode Au	96-322	91-386	~29-~44	93-256	—
16	PCD	124-449	215-530	33-64	50-200	~2
17	PCD	267-389	310-397	38.9-47.3	60	—
18	PGE	117-325	145-315	29.5-39.3	110-150	—
19	PCD	~200-~600	~220-~560	33-69	—	—
20	Unconformity U	68-188	~140-~180	—	70	4-5
21	PCD	165-600	340->600	56±5 (avg±1σ)	—	—
22	BX Pipe	217-385	251-411	35-49	50-170	—
23	PCD	—	320-350	~40	—	—
24	Unconformity U	109-261	136->409	29.1->43.3	—	—
25	PCD	~160-~500	~200-~550	29.4-55.1	80-350	5-10
26	Intrusion Au	265-365	275-390	36-46	—	—
27	Skarn	206-530	200->600	up to 63	—	—
28	PCD	~100-~400	200-580	~32-~66	143-247	5.3-9
29	Vein/Skarn	206-259	—	46.1-54.0	>300	—
30	PCD	54-530	150-600	26-90	340	13.6
31	PCD	101-228	140-373	29-44	—	—
32	PCD	86-475	127-520	28.8-62	30-750	—
33	BX pipe	213-257	250-503	34.6-56.7	>100	—
34	PCD	175-289	222-412	~40	—	—
35	Lode Au	90-140	182-204	~29-~38	250?	—
36	Lode Au	172-226	332-343	—	—	—
37	PCD	—	up to 600?	up to 74?	—	—
38	Veins	108-278	158-322	30-37	~100-~170	>4
39	Skarn	220-400	238-438	34-53	60-95	—
40	PCD	~200-~480	~275-~600	~35-~70	113-280	—
41	PCD	—	—	31-35	—	—
42	IOCG	—	168-270	31-36	60-150	—
43	PCD	171-456	175-467	28.5-55.4	>50	—
44	Greenstone Au	86-147	126-326	28.7-40.2	335-525	—
45	Greenstone Au	75-149	165-320	25.0-26.5	100-700?	—
46	PCD	—	~220-~360	~40-~55	—	—
47	Lode Sn	~230-~460	~295-~520	~37-~63	50-200	—
48	PCD	<522	~522	~63	—	—
49	PCD	~200-~500	262-520	30-~62	—	—
50	PCD	~110-~340	~230-~570	~33-~70	100-600	—
51	PCD	—	343-468	41.7-56.3	—	—
52	PCD/epithermal	—	—	—	—	—
53	PGE	65-263	~140-509	~24-61	110-160	4-6
54	Oceanic crust	—	255-418	32-47	—	—
55	REE/vein	—	340->600	52-83	225	—
56	PCD	176-~525	~400-~600	~44-~82	—	—
57	Vein Au	150-300	180-320	—	—	—
58	IOCG	—	137->430?	29-68?	—	—
59	Intrusion Au	122.5-181.5	217-289	30-37	130	4-6
60	Skarn	—	264-287	31-36	—	—
61	IOCG/REE	~225-~275	—	~33-~42	—	—
62	PCD	—	380-550	45-60	~60-280	up to 10
63	IOCG	83-132	209-495	33-50	250	—
64	Veins	—	151-323	30-39.5	—	—
65	Skarn/PCD	237-340	355-400	42-56	17-50	—
66	Epithermal	~270-~425	~325-~480	~40-~51	—	—
67	Epithermal	—	640	79.7	400	—
68	PGE	~87-~275	~100-~370	up to 49.4	~20-~230	—
69	Lode Au	—	~125-~400	~27-~50	—	—

APPENDIX *(Cont.)*

Reference	Geologic environment	Th_{L-V} (°C)	Tm_{halite} (°C)	Salinity (wt %)	Pressure (MPa)	Depth (km)
70	Shear zone/vein	170-200	<200	~30	—	—
71	SEDEX	up to 270	up to 386	~30-~45	110	—
72	Massive sulfide	100-193	385-510	—	—	—
73	Vein/PCD	~60-~170	130-240	36-48	—	—
74	PCD	215-451	~250-~490	~35-~54	80	—
75	Greisen	160-325	215-390	32.7-38.9	—	—
76	Lode/vein Au	100-125	128-138	28.9-29.2	—	—
77	IOCG/REE	100-489?	100-489?	34.7-59.8	—	—
78	Lode/vein Au	~75-~175	~115-~210	—	—	—
79	IOCG	178-405	192-430	35-68	several tens	1.2-1.7
80	Lode-vein	90-300	100-550	37-68	100	—
81	Vein	—	159-311	35.6-39.6	—	—
82	PGE	130-200	280-300	29-37	200	—
83	Skarn	—	320-485?	38-65	—	—
84	Ophiolite	~110-~260	~115-~300	~27-40	—	—
85	PCD	234-392	308-491	39-59	140	5
86	PCD	309.6-315.8	>500	>65	—	—
87	Granite intrusion	—	300-550	40-80	40-140	—
88	Manto/PCD	—	~115-~300?	~27-~36	—	—
89	PCD	130-270	250-485	~32-~65	—	—
90	Granite Sn/W	151-197	208-256	31.7-34.8	180	—
91	Unconformity U	100-140	170-240	31-34	—	—
92	PCD	200-560	460-650	up to ~80	—	—
93	Metamorphic	80-190?	170-250	>26?	—	—
94	Lode Au	81-138	169	28-30	—	—
95	Granite REE	~100->600	~100->600?	35-80	225	—
96	PCD	160-310	230-340	30-60	~300	—
97	PCD	~60-~380	~225-~475	~33-~57	80-140	—
98	Emeralds	180-190	260-340	38	106-112	—
99	Synthetic FI	136.8-328.7	305.0-326.3	40	18-429	—
100	PCD/epithermal	~100-~500	170-518	30.5-62.2	~50-~400	—
101	Vein	135-236	215-277	~34	~10-~70	—
102	PGE	—	260-420	35	—	—
103	Skarn	—	200-550	35->80	—	—
104	IOCG	157-166	198-245	31-34	—	—
105	Stratiform Cu	200-215	298-329	~38-~40	—	—
106	PCD	239-392	328-491	38-60	—	—
107	PCD	~125-~250	~200-~510	~31-~61	~65	—
108	Granite	180-225	—	40-60	—	—
109	Granite	70-150	220-430	32-48	>100	—
110	PCD	—	240-320	30.5-38.8	>28	—
111	BX Pipe	260-380	280-520	40-50	—	—
112	Veins	150	320	37-38	—	—
113	PCD	~50-~300	146-490	30-58	50-100	—
114	Ophiolite	300-400	400-500	46-56	~50	~5
115	Disseminated Au	179-224	215-347	32-42	—	—
116	PCD/shale-hosted	~155-~290	~165-~380	~32-~53	100-200	—
117	Unconformity U	66-150	114->220	up to 60	—	—
118	PCD	—	210-430	33-48	—	—
119	Talc/metamorphic	~110	150-300	36-42	—	—
120	PCD	—	160-600	32-71	~100	—
121	PCD	—	320->600	33->80	<50	—
122	Metamorphic	—	90-140	23-35	—	—
123	Granite/REE	89-329	147-428	29.6-48.7	—	—
124	Greisen	~100-~400	~200->600	~26-~65	—	—
125	Stratiform Cu	110-375	246-413	45-54	<120	—
126	Geothermal	—	150->330	—	—	—
127	Vein/PCD	259	317-403	55-65	>13	—
128	PCD	~235-~380	~260-~490	~32-~60	—	—
129	PCD	210-456	260-420	34-47	—	—
130	Vein	65-410	120-490	—	—	—
131	PCD	—	~400->580	—	—	—
132	Vein/BX	—	~250-~500	>40	—	—
133	PCD/BX pipe	—	320-480	~36-~50	—	—
134	PCD	205-290	280-330	~35-40	—	—
135	PCD	—	260-520	35-55	—	—
136	BX pipe	—	~200-~400	~33-~47	17-126	—
137	Skarn	400	460	—	—	—
138	Stratiform Cu	160-220	270-320	~35	—	—

APPENDIX *(Cont.)*

Reference	Geologic environment	Th_{L-V} (°C)	Tm_{halite} (°C)	Salinity (wt %)	Pressure (MPa)	Depth (km)
139	PCD/skarn	325.6-399.0	341.0-401.6	37.5-52.2	30	—
140	Greenstone Au	~42-~190	~120-~300	—	—	—
141PCD	~340-~500	~300-~580	~50	—	—	
142	Granite	—	~340-~500	~38-~64	>50	1.8-2.2
143	PCD	—	~210-370	33-45	—	—
144	PCD	~350-400	~380-540	—	—	—
145	Skarn	~300-~570	~330-~580	40-60	—	—
146	PCD	—	~150-~575	~30-~77	40-80	2
147	PCD	—	300-700	32-65	30	0.3
148	PCD	~150-~420	~210-~450	—	—	—
149	PCD	—	200-500	~30-~53	110	—
150	PCD/Skarn	~180-~540	up to 540?	~32-~64	<200	—
151	PCD	~265-~395	~275-~500	50-70?	—	—
152	Manto	150-400	~260-~700	32-60	30-270	—
153	The Halite trend	—	—	—	—	—
154	PCD	—	~275-~475	31-60	5.5-250	8
155	PCD	—	320-600?	63-75	—	—
156	PCD	—	250-450	36-61	—	—
157	PCD	—	—	—	60-200	—
158	PCD	—	300-500	33-45	—	—
159	BX Pipe	—	up to 350	>30	—	—
160	Veins	37-120	97-225	—	—	—
161	Intrusion Sn/W	~240-~470	~300-~600	28-47	—	—

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