UNITED STATES DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Homogenization Temperatures and Salinities of Fluid Inclusions from the Viburnum Trend, Southeast Missouri, and the Northern Arkansas Zinc District

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Open-File Report 87-675

1987

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ABSTRACT

Measurements have been made on fluid inclusions from mines and drill core within and adjacent to the Viburnum Trend and Northern Arkansas Zinc Mississippi Valley-type districts. Hydrothermal dolomite is the primary host mineral for the inclusions examined, but measurements have also been made on inclusions in sphalerite and calcite.

Measurements of homogenization temperature (Th) and final melting temperature of ice (Tm) for 306 fluid inclusions are tabulated and briefly discussed.

Results of this study give information on temperature and salinity of the ore fluids beyond the boundaries of the mining districts and provide insight into the regional distribution of the hot, saline brines trapped in the inclusions.

INTRODUCTION

Over a period of approximately five years, fluid inclusion data have been gathered for Mississippi Valley-type lead-zinc deposits of the mid-continent region of the U.S. The data presented here are for the Viburnum Trend region of southeast Missouri, the Northern Arkansas Zinc district, and from drill core located near these two districts (Fig. 1).

Most of the measurements have been made on inclusions hosted by hydrothermal, vug-lining, saddle dolomite, also commonly referred to as dolomite cement. Measurements have also been made on inclusions in sphalerite and calcite.

The Viburnum Trend fluid inclusion work presented here was undertaken to determine whether the district was a thermal anomaly with respect to country rock, and whether trends in temperature and salinity could be defined with respect to time, i.e. throughout the paragenesis. This report presents a tabulation of results of recent fluid inclusion work for the Viburnum Trend and Northern Arkansas Zinc district, so that the reader may use the data for purposes such as interpretation of fluid temperatures during brine migration, and regional fluid flow paths.

PREVIOUS WORK

Published fluid inclusion data are quite scarce for the Viburnum Trend and Northern Arkansas districts. In the first fluid inclusion study of the Viburnum Trend, Roedder (1977) examined inclusions in sphalerite from mines and drill core. He found final melting temperatures of ice predominantly between -20° and -28°C indicating very high salinities, and homogenization temperatures primarily between 94° and 120°C. Hagni (1983) also examined fluid inclusions in sphalerite. Measurements he made on inclusions in zoned sphalerite crystals may show a trend of declining temperature with time followed by a stage of warmer fluid. These studies and additional data presented here indicate that the sphalerite formed during distinct stages crystal growth from fluids ranging in temperature approximately from 122°C for the oldest, to 78°C for the youngest. Calcite is predominantly a late stage mineral with moderate to low temperature and salinity inclusions (Roedder, 1977). However measurements presented here for inclusions with higher temperatures and salinities, similar to those of the ore minerals, suggests that the precipitation of early calcite was associated with main stages of mineralization.

A study of the Northern Arkansas district by Leach and others (1975) examined fluid inclusions hosted by sphalerite, quartz, calcite, and dolomite. Inclusions in calcite were low temperature (≤50°C) and low salinity (≤4 wt.% NaCl equiv.). The homogenization temperature distribution for sphalerite showed two modes, at approximately 95°C and 115°C, while salinities were high, close to 23 wt.% NaCl equivalent. Three inclusions in dolomite homogenized at 121°, 123°, and 128°C. Inclusions in quartz homogenized between 110° and 130°C with moderate to high salinities (18 to 23 wt.% NaCl equiv.). In addition, Long and others (1986) reported homogenization temperature distributions for sphalerite with modes at approximately 120°C, and ice final melting temperatures generally between -22 and -24°C for this district. Inclusions in quartz homogenized primarily between 110° and 140°C, and had high salinities, indicated by ice final melting temperatures of approximately -21°C.

GEOLOGIC SETTING

Most of the measurements presented in this study were made on samples from the Viburnum Trend district of southeast Missouri. The Viburnum Trend district is located in southeast Missouri near the western margin of the St. Francois Mountains. Early Paleozoic carbonates and sandstones pinch out against topographic highs in the Precambrian felsic basement. Basement is exposed in the St. Francois Mountains, and has been a positive feature since Precambrian time. Mineralization in the Viburnum Trend is semi-continuous with mineralization in the historic Old Lead Belt district (Fig. 2). The region is structurally relatively undisturbed, except for a limited number of northwest-southeast trending normal faults. There are several small diatremes and buried cryptoexplosive features to the south of the district, however they are not spatially associated with mineralization.

Ore is hosted predominantly by the Bonneterre Dolomite, the lowest in a sequence of Upper Cambrian carbonates. Most of the mineralization occurs near the reef/back reef transition of an algal stromatolite build-up developed in the shallow water around the Precambrian basement high. West of the Viburnum Trend the Bonneterre grades sharply into limestone which contains no mineralization. Immediately above the Bonneterre is the Davis Formation which is shale dominated in the vicinity of the Viburnum Trend. Beneath the Bonneterre is the Lamotte Sandstone which lies directly on Precambrian crystalline basement. Both the Lamotte Sandstone and the Bonneterre Dolomite are considered to have been aquifers for the mineralizing fluid. A special issue of Economic Geology (v. 72, no. 3, 1977) devoted to the Viburnum Trend contains papers which discuss the geology of the district in greater detail than presented here. In addition, Gerdemann and Meyers (1972), and Heyl (1983) provide valuable discussion of factors related to ore genesis.

SAMPLE LOCATION AND DESCRIPTION

Sparry, hydrothermal gangue dolomite was collected from six mines in the Viburnum Trend and from five drill holes (Fig. 2). From north to south the mines sampled were No. 29, No. 35, Magmont, Buick, Fletcher, and Sweetwater. Samples were also taken from a series of drill holes numbered, from east to west, 12EE, 10EE, 1EE, 8EE and HM1. This series transects the narrow, north-south trending Viburnum Trend district between the No. 29 and No. 35 mines. The fluid inclusion samples were selected from each of the major facies known locally as 'white rock', 'brown rock', and 'gray rock'. Within the Bonneterre Dolomite, these facies correspond roughly to back reef, reef, and fore-reef facies, respectively, with diagenetic overprints of dolomitization and recrystallization by the mineralizing fluid. Drill hole sample locations span a vertical interval of approximately 700 ft., and extend laterally over a distance of approximately 10 miles. The westernmost drill hole, HM1, is in limestone, and lies approximately 6 1/2 miles west of the district. The easternmost drill hole, 12EE, intersects predominantly the 'white rock' facies of the Bonneterre, and lies approximately 3 1/2 miles east of the district.

Previous studies have examined fluid inclusions in sphalerite, and the predominantly late-stage calcite, however the sparry gangue dolomite has not previously been examined in the Viburnum Trend. As this district is primarily a lead district, sphalerite crystals coarse enough to host useable fluid inclusions are somewhat rare. As noted by Roedder (1977) and confirmed by the authors, sphalerite grains are rarer still in core drilled within or adjacent to the district. In some respects therefore, the abundant hydrothermal gangue dolomite is ideal for a study of spatial and temporal variations in fluid temperature and salinity.

The dolomite which hosts fluid inclusions used in this study is a saddle or baroque dolomite whose crystal faces show visible curvature in handsample. The dolomite is generally gray to white or pink in the Viburnum Trend, strong pink in the Northern Arkansas district, and occurs as coarse grained (1 to 8 mm), pore-filling and vug-lining crystals. In the Viburnum Trend, this vug-lining dolomite has been shown petrographically to span main stages in mineralization. A few measurements were also made on Viburnum 'host rock' dolomite which has been recrystallized to varying degrees by the mineralizing fluid (Frank and Lohmann, 1986). The vug-lining dolomite occurs throughout the Viburnum Trend although it is present in greatest abundance in the southernmost mines, Sweetwater and Fletcher, and is scarce in the northernmost mine sampled, No. 29. Similar vug-lining dolomite was also present in drill core examined from outside of the Vibrunum Trend proper.

The remainder of the data for dolomite hosted inclusions is from the coarse grained, vug lining and fracture filling, pink dolomite from the Ben Hogan Quarry in the Northern Arkansas Zinc district, and from drill hole 98 northwest of the district (Fig. 1). The Northern Arkansas district consists of flat-lying Paleozoic carbonates and sandstones. The Ordovician Everton and Mississippian St. Joe and Boone Formations host mineralization (McKnight, 1935). Mineralization occurs both as stratabound replacement deposits, and as breccia cements in solution collapse horizons (McKnight, 1935).

Drill hole 98 (Fig. 1) is located within approximately 75 miles to the northwest of the Northern Arkansas Zinc district. The depths from which fluid inclusions samples were taken, 1175 and 1320 feet, lie within the Cambrian Eminence Dolomite. This formation is extremely vuggy and porous in the facies examined. Vugs are typically lined with hydrothermal dolomite, very similar in color and grain size to the hydrothermal dolomite from the Viburnum Trend.

These hydrothermal dolomites typically displayed 'cloudy' cores consisting of extremely dense populations of inclusions (primarily fluid inclusions with some inclusions of solid material). Outside of the cloudy cores, the remainder of the crystals were often <u>relatively</u> inclusion-free, with an infrequent growth band defined by densely grouped inclusions. Fluid inclusions considered to be primary were generally associated with either the cloudy core or with an outer growth band. Measurements were made more difficult by the small size of the inclusions, commonly less than 10 microns in length, and strong double refraction which is minimized, but usually not eliminated using polarized light. Due to the rarity of useable fluid inclusions in this dolomite, a decision was made to make measurements on all suitable inclusions, even those of ambiguous origin. Only inclusions which had clearly undergone "necking-down" (Roedder, 1984) were avoided. Generally, a good estimate of primary versus secondary origin could be made based on comparison with temperatures and salinities of known primary and secondary inclusions.

In addition to the dolomite, measurements were made on three post main-stage sphalerite samples from the Viburnum Trend, 81-14, 81-6, and 81-4, collected by Allen Heyl, and described as follows. Sample 81-14 is orange-brown sphalerite perched on top of deeply etched and corroded main-stage octahedral galena. 81-6a is late yellow sphalerite which occurs on top of post main-stage, shiny, cubic galena. The late 'rosin' sphalerite, 81-4, occurred on top of etched octahedral galena, and is described as the youngest of the three samples.

Several measurements were also made on pore-filling calcite from drill hole HM1 west of the Viburnum Trend, and from drill hole 12EE east of the district.

RESULTS AND DISCUSSION

Primary vs. secondary origin could not be determined for inclusions from the Ben Hogan Quarry in the Northern Arkansas district. The inclusions measured occurred within irregular, cloudy (i.e. high fluid inclusion density) zones in coarse, pink, vug-filling, saddle dolomite crystals. Although one may suspect that many or most of these inclusions were primary, this determination cannot be made with certainty unless an inclusion is associated with a growth feature, such as an obvious growth band within the crystal. While they were grouped in the category of inclusions of ambiguous origin, they were not obvious secondaries. Four of the inclusions from the drill hole 98 in southwest Missouri (Fig. 1) were however identified as primaries.

Homgenization temperatures for Ben Hogan Quarry range from 108° to 142°C, although most of the values lie between 118° and 138°C (Fig. 3a). Homogenization temperatures for drill hole 98 range from 118° to 163°C with most of the values between 157° and 163°C (Fig. 3a). Scatter in both data sets may be a result of necking down which is a particularly common phenomenon in carbonate-hosted inclusions. In general, these temperatures are significantly hotter than the median values for the Viburnum Trend, Tri-State, or the Central Missouri Barite district (Leach and Rowan, 1986).

No salinity measurements were made on primary inclusions from either Ben Hogan Quarry or drill hole 98. The ice final melting temperature, Tm, was predominantly between -22.2° and -23.1°C for inclusions of unknown origin from both localities, with two values from Ben Hogan Quarry close to -17°C (Fig. 3b). These two lower salinity inclusions may have been secondary, although there is no petrographic evidence for their origin. The close agreement in salinity for samples from drill hole 98 and Ben Hogan Quarry (as well as Viburnum, discussed below) implies regional migration of high salinity fluids.

The remaining data are for mines in the Viburnum Trend district, and drill core in the vicinity. A valid comparison of measurements on inclusions hosted by pore-filling dolomite within and outside of the Viburnum Trend district, assumes that the dolomites were formed approximately contemporaneously, and from fluids with a common origin. A cathodoluminescent (CL) microstratigraphy defined by Voss and Hagni (1985) for the vug-lining, hydrothermal dolomites throughout the Vibrunum Trend has served as a valuable indicator of relative timing. The CL micro-stratigraphy consists of four distinctive zones each containing sub-bands. The oldest (zone 1) and the youngest (zone 4) have been shown petrographically to bracket the main stages of galena mineralization in the Vibrunum Trend. We interpret the presence of this CL microstratigraphy in the mines as well as in all of the drill core examined to indicate that these samples formed as part of a single hydrologic system (Rowan, 1986).

Calcite from drill hole HM1 in the limestone facies west of the district (see description of sample localities above) was found to have high salinity inclusions with Tm ranging from -20.5° to -22.0°C (Fig. 4b). Homogenization temperatures for these inclusions range between 94° and 121°C, with most of the values between 94° and 98°C (Fig. 4a). Slightly lower than average temperatures for the Viburnum region might be attributed to a decreased water to rock ratio in the relatively impermeable limestone facies, resulting in a slight cooling of the fluid. Inclusions in calcite from drill hole 12EE to the east of Viburnum homogenized at 112°C, yet had, with one exception, relatively low salinities (-4°<Tm<-7°C). This calcite appears to have formed from a fluid distinct from the high salinity fluid trapped in most of the ore and gangue minerals.

Three sphalerite samples, 81-14, 81-6a, and 81-4, from the Viburnum Trend were analyzed (Fig. 5a and 5b). For the oldest sphalerite, 81-14, homogenization temperatures range between 83° and 124.5°C with a median value of approximately 93°C. During most of the measurements of final ice melting temperature, liquid and solid were present in the system, but vapor was not. All values of Tm in Table 1 followed by "ms" represent metastable melting point equilibria, equivalent to an upper bound on the true melting temperature of the ice. Equilibrium melting temperatures of -3.6°C were determined in the presence of vapor for sample 81-14. In sample 81-6a, homogenization temperatures range between 101° and 113° with a median value of 108°C. Salinities range between -10.2° and -21.5°C. Finally, in sample 81-4 temperatures range from 68° to 85°C with a median of approximately 78°C. Salinities are low, but metastable. Based on comparison with the equilibrium melting temperatures in sample 81-14, the author would speculate that the true melting temperatures in 81-4 are not below -5°C (see Fig. 5b).

Most of these inclusions were secondary, with a few of unknown origin; only sample 81-4 contained primary inclusions. It is important to note that the timing of the secondary inclusions cannot be constrained; they may have formed contemporaneously with growth of their host crystal, or may have formed much later. Temperatures and salinities that are generally significantly lower than for the gangue dolomite and earlier sphalerite (see Roedder, 1977), suggest that the young sphalerite in sample 81-4 formed from a distinct (or possibly evolved), post-main stage fluid.

Analyses of inclusions in hydrothermal gangue dolomite from the Viburnum Trend comprise the bulk of the data. Homogenization temperatures for primary (and "probable" primaries) in this dolomite range from 92° to 162°C, although most of the values lie between 106° and 130°C (Fig. 6a). The mode of this population is approximately 115°C. The histograms in Figs. 6a and 6b include values from all five drill cores and four of the mines. (When primary vs. secondary origin was not known, the measurements were not plotted.) Salinities for the primaries and for the probable primaries were predominantly high. Most of the final melting temperatures fall between -21° and -23°C, although there is a smalller group near -19°C, and three inclusions with melting temperatures between -14° and -18°C. These inclusions may represent crystal growth from a pulse of lower salinity fluid. However, based on the observation that moderate salinities are typical of secondaries, one might suspect that they may also be secondary inclusions misidentified as primaries.

The 'host-rock' dolomite has been recrystallized to varying degrees by the mineralizing fluid. Host rock contains inclusions varying from high salinity ($T_m \approx -22°C$), typical of the vug-filling dolomite (dolomite cement), to low salinity ($T_m > -10°C$). The origin of most of these inclusions is ambiguous.

CONCLUSIONS

Comparison of final melting temperatures measured for dolomite hosted inclusions in the Viburnum Trend with dolomite and sphalerite hosted inclusions from the Northern Arkansas district shows a rather striking similarity. In both districts, as well as in drill core from outside of the districts, final melting temperatures are predominantly between -22° and -24°C, corresponding to NaCl equivalent salinities greater than halite saturation. Thus the fluids have high total salinity, and with significant calcium component. The presence regionally of high salinity fluids is consistent with a model in which fluids with a common origin are responsible for mineralization of several Mississippi Valley-type districts including the Northern Arkansas Zinc district and the Viburnum Trend (see Leach and Rowan, 1986, for discussion).

On a regional scale, homogenization temperatures in dolomite and sphalerite are generally higher to the south, in the Northern Arkansas Zinc district, than in the Viburnum Trend. This also is consistent with a model in which mineralization in both the Northern Arkansas and Viburnum Trend districts resulted from northward migration of a slowly cooling fluid of basinal origin.

ACKNOWLEDGEMENTS

I would like to thank first the mine geologists who made it possible to collect samples underground: Paul Gerdemann, formerly with St. Joe Minerals Corp., Mark Taylor, Bob Dunn, and Jim Kulas, of the Doe Run Company, Peter Sweeney, and Laura Nadelhoffer, formerly with Cominco Inc. I also thank Ralph Erickson and Allen Heyl at the U.S. Geological Survey in Denver for their help in obtaining samples. The staff at the Department of Natural Resources in Rolla, Missouri, particularly Jim Palmer, was extremely helpful in obtaining drill core for this study. I would also like to acknowledge Joe Hedal who made many of the fluid inclusion measurements prior to 1983. Numerous discussions with David Leach, Ralph Erickson, Allen Heyl, and John Viets have been of great value. Finally, reviews by Scott Rose and David Leach were very helpful.

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APPENDIX

Table 1. lists the fluid inclusion data collected over a period of approximately five years. Abbreviations and an explanation of the information in each column are given below.

State. Samples were collected from localities in two states, Missouri and Arkansas. Two-letter (postal) abbreviations are used for each state.

Mine or Core No. This column gives the name of the mine or the number of the drill core from which the sample was collected. Figs. 1 and 2 show the locality of each drill core or mine where samples were collected.

Host Mineral indicates the mineral which hosts the fluid inclusion on which measurements were made.

Date indicates the date on which the measurement was made.

-(Tm) This column gives the absolute value of (i.e. reports as a positive number) the ice final melting temperature in the inclusion. Precision is conservatively estimated to be ± 0.5 °C.

Th Homogenization temperature. Precision is conservatively estimated to be ± 1.0 °C.

P/S This column indicates primary (p) vs. secondary (s) origin for a given inclusion. In the numerous cases where origin was ambiguous, this column was left blank. Inclusions considered likely, although not definitely of primary or secondary origin, are indicated by p? and s? respectively. It should be noted that in these samples certainty as to primary vs. secondary origin rarely approached 100%.

Sample For drill core samples, the value in this column gives the depth or depth interval (in feet) of the sample. For samples collected from mines, a sample number is given.

Init. gives the initials of the person who made the fluid inclusion measurement. LR = Lanier Rowan, JH = Joe Hedal, and DL = David Leach.

Comments provides additional information, if avialable, on the sample or the inclusion. For dolomite, the cathodoluminescent zone (see text for discussion) hosting the inclusions, if known, is indicated by "zone 1", "zone 2" etc. Necking-down is indicated by the comment "necked" (see Roedder, 1984, for discusion). "Clear" indicates that the inclusion was in a portion of the sample relatively free of inclusions; "clear rim" indicates that the inclusion was in the clear outer margin of the dolomite crystal. "Cloudy core" refers to the inclusion rich core of the dolomite crystal. Commonly the margin between the cloudy core and clear outer rim, or between and a cloudy and clear zone, is quite sharp. Many of the inclusions analyzed occurred at these margins. "Pink" and "white" dolomite refer to the color of the crystal in handsample. "Host rock" indicates that the inclusion was not located in a vug-lining dolomite crystal. Host rock was recrystallized to varying degrees. Where recrystallization was very obvious, it is noted. "Brown rock" is an alteration facies defined in host rock and discussed in the text.

The following abbreviations have been used in the **Comments** column:

CC	cloudy core
CR	clear rim
CC/CR	margin of the cloudy core, adjacent to the clear rim
dolo	dolomite
fi	fluid inclusion
rxllized	recrystallized
sec.	secondary
sphal.	sphalerite

Table 1. Fluid Inclusion Analyses

#	State	District	Mine or Core No.	Host Mineral	Date	-(Tm) (C)	Th (C)	P/S	Sample	Init	Comments
1	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-8-84		131.5			LR	
2	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		129.0			LR	
3	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		108.0			LR	
4	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	23.0				LR	
5	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	22.9				LR	
6	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	22.9				LR	
7	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		130.0			LR	
8	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		119.5			LR	
9	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	22.7				LR	
10	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		142.0			LR	
11	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		124.0			LR	
12	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		138.0			LR	
13	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	22.2				LR	
14	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		125.0			LR	
15	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	22.6				LR	
16	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84		136.5			LR	
17	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	23.1				LR	
18	AR	N.Ark.Zn	Ben Hogan	Dolo.	5-9-84	22.9				LR	
19	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	23.1				LR	
20	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	22.9				LR	
21	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	22.5				LR	
22	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	22.8				LR	
23	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	23.1				LR	
24	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	17.4				LR	
25	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	17.0				LR	
26	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	16.5				LR	
27	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	23.1				LR	
28	AR	N.Ark.Zn	Ben Hogan	Dolo.	6-25-84	22.8				LR	
29	MO	SW	98	Dolo.	6-26-84		128.0	p	1320	LR	
30	MO	SW	98	Dolo.	6-26-84		118.0	p	1320	LR	
31	MO	SW	98	Dolo.	9-21-83	22.3	159.0		1175	LR	
32	MO	SW	98	Dolo.	9-21-83		157.0		1175	LR	
33	MO	SW	98	Dolo.	9-21-83		163.0		1175	LR	
34	MO	SW	98	Dolo.	9-21-83	23.0			1175	LR	
35	MO	SW	98	Dolo.	9-21-83		160.0	p	1175	LR	
36	MO	SW	98	Dolo.	9-21-83		161.5	p	1175	LR	
37	MO	Viburnum	12EE	Dolo.	11-17-82	22.0	130.2		480-490	JH	
38	MO	Viburnum	12EE	Dolo.	11-9-82	19.2			480-490	JH	
39	MO	Viburnum	12EE	Dolo.	8-10-82		117.3		550-560	JH	
40	MO	Viburnum	12EE	Dolo.	8-10-82		98.6		550-560	JH	
41	MO	Viburnum	12EE	Dolo.	8-24-82		102.0		490-500	JH	
42	MO	Viburnum	12EE	Dolo.	8-24-82		111.0		490-500	JH	
43	MO	Viburnum	12EE	Dolo.	8-24-82		107.5		490-500	JH	
44	MO	Viburnum	12EE	Dolo.	8-30-82		130.0		480-490	JH	
45	MO	Viburnum	12EE	Dolo.	8-30-82		93.1	p?	480-490	JH	
46	MO	Viburnum	12EE	Dolo.	8-9-82		154.5		550-560	JH	prob.necked; CR
47	MO	Viburnum	12EE	Dolo.	8-9-82		125.8		550-560	JH	
48	MO	Viburnum	12EE	Calcite	3-17-83		112.0		416	LR	

#	State	District	Mine or Core No.	Host Mineral	Date	-(Tm) (C)	Th (C)	P/S	Sample	Init	Comments
49	MO	Viburnum	12EE	Calcite	3-17-83	5.0			416	LR	
50	MO	Viburnum	12EE	Calcite	3-17-83	6.9			416	LR	
51	MO	Viburnum	12EE	Calcite	3-17-83	4.7			416	LR	
52	MO	Viburnum	12EE	Calcite	3-17-83	5.0	112.0		416	LR	
53	MO	Viburnum	12EE	Calcite	3-17-83	4.1	112.0		416	LR	
54	MO	Viburnum	12EE	Calcite	3-17-83	22.7			508-509	LR	
55	MO	Viburnum	12EE	Calcite	3-17-83	4.5			416	LR	
56	MO	Viburnum	10EE	Dolo.	10-13-82	22.0	119.2	p?	430-440	JH	
57	MO	Viburnum	10EE	Dolo.	8-19-82		110.4		350-360	JH	
58	MO	Viburnum	10EE	Dolo.	8-19-82		105.5	p?	430-440	JH	
59	MO	Viburnum	10EE	Dolo.	8-19-82		120.6	p?	430-440	JH	
60	MO	Viburnum	10EE	Dolo.	8-25-82		107.3	p?	430-440	JH	
61	MO	Viburnum	10EE	Dolo.	8-25-82		118.3	p?	430-440	JH	
62	MO	Viburnum	10EE	Dolo.	8-26-82		123.0	p?	430-440	JH	
63	MO	Viburnum	10EE	Dolo.	8-2-82		66.9		520-530	JH	necked(?),clear dolo
64	MO	Viburnum	10EE	Dolo.	8-2-82		95.7	s	520-530	JH	
65	MO	Viburnum	1EE	Dolo.	11-24-82	20.25	99.2		880-890	JH	
66	MO	Viburnum	1EE	Dolo.	11-3-82	18.0		p	720-730	JH	CR
67	MO	Viburnum	1EE	Dolo.	2-83		180.0		760-770	JH	leaked?
68	MO	Viburnum	1EE	Dolo.	2-83		110.0	p	880-890	JH	
69	MO	Viburnum	1EE	Dolo.	3-15-83		155.3	p?	880-890	DL	isolated fi, CR
70	MO	Viburnum	1EE	Dolo.	3-15-83		156.7	p?	880-890	DL	isolated fi, CR
71	MO	Viburnum	1EE	Dolo.	3-15-83		155.3	p?	880-890	DL	isolated fi, CR
72	MO	Viburnum	1EE	Dolo.	4-15-82		120.0		900-910	LR	pink dolo
73	MO	Viburnum	1EE	Dolo.	4-15-83		110.0		900-910	LR	pink dolo
74	MO	Viburnum	1EE	Dolo.	4-15-83	22.5	112.0		850-860	LR	pink dolo
75	MO	Viburnum	1EE	Dolo.	4-15-83		123.0		850-860	LR	pink dolo
76	MO	Viburnum	1EE	Dolo.	4-15-83		126.0		900-910	LR	pink dolo
77	MO	Viburnum	1EE	Dolo.	4-15-83		105.0		900-910	LR	pink dolo
78	MO	Viburnum	1EE	Dolo.	4-15-83		113.0	p	850-860	LR	pink dolo
79	MO	Viburnum	1EE	Dolo.	4-15-83	22.6	120.0	p?	850-860	LR	pink dolo
80	MO	Viburnum	1EE	Dolo.	7-29-82		119.3		760-770	JH	
81	MO	Viburnum	1EE	Dolo.	7-29-82		113.5	p	760-770	JH	
82	MO	Viburnum	1EE	Dolo.	7-29-82		116.5	p?	720-730	JH	CR
83	MO	Viburnum	1EE	Dolo.	8-31-82		110.8	p	760-770	JH	
84	MO	Viburnum	1EE	Dolo.	9-1-82		92.0		720-730	JH	
85	MO	Viburnum	1EE	Dolo.	9-1-82		111.0	p?	720-730	JH	
86	MO	Viburnum	1EE	Dolo.	9-2-82		96.8	p?	640-650	JH	
87	MO	Viburnum	8EE	Dolo.	11-18-82	24.5	101.9		750-760	JH	
88	MO	Viburnum	8EE	Dolo.	11-23-82	21.1			750-760	LR	
89	MO	Viburnum	8EE	Dolo.	11-9-82	22.1			780-790	JH	
90	MO	Viburnum	8EE	Dolo.	11-9-82	16.75			780-790	JH	
91	MO	Viburnum	8EE	Dolo.	1-7-85	10.5	122.1		630-640	LR	host rock
92	MO	Viburnum	8EE	Dolo.	1-7-85		111.0		630-640	LR	host rock
93	MO	Viburnum	8EE	Dolo.	1-7-85		96.5		630-640	LR	host rock
94	MO	Viburnum	8EE	Dolo.	1-7-85	25.9			630-640	LR	zone 2 or 3
95	MO	Viburnum	8EE	Dolo.	1-7-85	9.1			630-640	LR	host rock
96	MO	Viburnum	8EE	Dolo.	1-7-85		114.0		630-640	LR	zone 2 or 3
97	MO	Viburnum	8EE	Dolo.	1-7-85	10.5			630-640	LR	host rock
98	MO	Viburnum	8EE	Dolo.	1-7-85		130.0		630-640	LR	zone 2 or 3
99	MO	Viburnum	8EE	Dolo.	1-7-85	26.6			630-640	LR	zone 2 or 3

#	State	District	Mine or Core No.	Host Mineral	Date	-(Tm) (C)	Th (C)	P/S	Sample	Init	Comments
100	MO	Viburnum	8EE	Dolo.	2-12-85	2.4			630-640	LR	host rock (clear rim)
101	MO	Viburnum	8EE	Dolo.	2-12-85		101.0		630-640	LR	host rock
102	MO	Viburnum	8EE	Dolo.	2-12-85	22.1	123.0		630-640	LR	host rock, rxlized
103	MO	Viburnum	8EE	Dolo.	2-12-85		102.0		630-640	LR	host rock, rxlized
104	MO	Viburnum	8EE	Dolo.	2-12-85	7.9			630-640	LR	host rock, CR
105	MO	Viburnum	8EE	Dolo.	2-12-85		140.0		630-640	LR	host rock, CR
106	MO	Viburnum	8EE	Dolo.	2-17-82		122.0		630-640	LR	brown rock, (host rock)
107	MO	Viburnum	8EE	Dolo.	2-17-82	19.6	126.0	p	630-640	LR	brown rock, (host rock)
108	MO	Viburnum	8EE	Dolo.	2-17-83		63.6		630-640	LR	brown rock, (host rock)
109	MO	Viburnum	8EE	Dolo.	3-1-85		125.8		630-640	LR	host rock, rxlized
110	MO	Viburnum	8EE	Dolo.	3-1-85		144.2		630-640	LR	host rock, rxlized
111	MO	Viburnum	8EE	Dolo.	3-1-85		142.8		630-640	LR	host rock, rxlized
112	MO	Viburnum	8EE	Dolo.	3-1-85		107.0		630-640	LR	host rock, rxlized
113	MO	Viburnum	8EE	Dolo.	3-7-85	20.0			630-640	LR	host rock
114	MO	Viburnum	8EE	Dolo.	3-7-85	2.5			630-640	LR	host rock
115	MO	Viburnum	8EE	Dolo.	3-7-85	16.4	105.0	p	630-640	LR	zone 4
116	MO	Viburnum	8EE	Dolo.	7-26-82		96.5		780-790	JH	
117	MO	Viburnum	8EE	Dolo.	7-26-82		104.9		790-800	JH	
118	MO	Viburnum	8EE	Dolo.	7-27-82		122.0		790-800	JH	
119	MO	Viburnum	8EE	Dolo.	7-27-82		109.0	p?	790-800	JH	
120	MO	Viburnum	8EE	Dolo.	7-27-82		117.0	p?	790-800	JH	
121	MO	Viburnum	8EE	Dolo.	pre-2/83		108.0		780-790	LR	
122	MO	Viburnum	8EE	Dolo.	pre-2/83		128.5		790-800	LR	necked(?)
123	MO	Viburnum	HM-1	Calcite	3-8-83	20.5			910-920	LR	
124	MO	Viburnum	HM-1	Calcite	3-8-83	21.4	97.8		910-920	LR	
125	MO	Viburnum	HM-1	Calcite	3-8-83		118.0		910-920	LR	
126	MO	Viburnum	HM-1	Calcite	3-8-83	21.8			910-920	LR	
127	MO	Viburnum	HM-1	Calcite	3-8-83	21.4	94.5		910-920	LR	
128	MO	Viburnum	HM-1	Calcite	3-8-83		95.0		910-920	LR	
129	MO	Viburnum	HM-1	Calcite	3-8-83	22.0	121.0		910-920	LR	
130	MO	Viburnum	HM-1	Calcite	3-8-83	21.4	94.1	p	910-920	LR	
131	MO	Viburnum	HM-1	Dolo.	11-3-82	21.9			880-890	JH	
132	MO	Viburnum	HM-1	Dolo.	3-8-83		112.0		910-920	LR	
133	MO	Viburnum	HM-1	Dolo.	8-17-82		103.6		880-890	JH	
134	MO	Viburnum	HM-1	Dolo.	8-17-82		103.8	p?	880-890	JH	
135	MO	Viburnum	HM-1	Dolo.	8-17-82		122.0	p?	880-890	JH	
136	MO	Viburnum	HM-1	Dolo.	8-17-82		108.5	p?	880-890	JH	
137	MO	Viburnum	HM-1	Dolo.	8-23-82		105.2		1150-1160	JH	
138	MO	Viburnum	HM-1	Dolo.	8-23-82		118.5		1150-1160	JH	
139	MO	Viburnum	HM-1	Dolo.	8-23-82		125.7	p?	1150-1160	JH	
140	MO	Viburnum	HM-1	Dolo.	9-21-82	9.5			880-890	JH	
141	MO	Viburnum	29	Dolo.	8-24-83	24.6	100.0		200	LR	CC, white
142	MO	Viburnum	29	Dolo.	8-24-83		105.0		200	LR	CC/CR, white
143	MO	Viburnum	29	Dolo.	8-24-83	19.7			200	LR	CC
144	MO	Viburnum	29	Dolo.	8-29-83		117.2			LR	CC
145	MO	Viburnum	29	Dolo.	8-29-83	2.0				LR	margin of cloudy zone
146	MO	Viburnum	29	Dolo.	8-29-83	0.6				LR	CC
147	MO	Viburnum	29	Dolo.	8-29-83	1.2				LR	cloudy growth band
148	MO	Viburnum	29	Dolo.	9-7-83	0.1			100	LR	
149	MO	Viburnum	29	Dolo.	9-7-83	0.2			100	LR	
150	MO	Viburnum	29	Dolo.	9-7-83	0.1			100	LR	

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151	MO	Viburnum	29	Sphal.	9-8-83		67.5		400	LR	dark brown sphal.
152	MO	Viburnum	29	Sphal.	9-8-83	22.4	104.5			LR	dark brown sphal.
153	MO	Viburnum	35	Dolo.	8-26-85	22.5		p		LR	zone 4
154	MO	Viburnum	35	Dolo.	8-26-85	22.3		p		LR	zone 4
155	MO	Viburnum	35	Dolo.	8-26-85	22.1		p		LR	zone 4
156	MO	Viburnum	35	Dolo.	8-26-85	22.5		p		LR	zone 4
157	MO	Viburnum	35	Dolo.	8-26-85	22.5		p		LR	zone 4
158	MO	Viburnum	35	Dolo.	8-26-85	15.0		s		LR	zone 4;large, flat sec.
159	MO	Viburnum	35	Dolo.	8-26-85	15.4		s		LR	zone 4;large, flat sec.
160	MO	Viburnum	35	Dolo.	8-26-85	15.4		s		LR	zone 4;large, flat sec.
161	MO	Viburnum	35	Dolo.	8-26-85	14.9		s		LR	zone 4;large, flat sec.
162	MO	Viburnum	35	Dolo.	8-26-85	10.6		s		LR	zone 4;large, flat sec.
163	MO	Viburnum	35	Dolo.	8-26-85	15.6		s		LR	zone 4;large, flat sec.
164	MO	Viburnum	35	Dolo.	8-26-85	22.5		s		LR	zone 4;large, flat sec.
165	MO	Viburnum	35	Dolo.	8-26-85	15.5		s		LR	zone 3; large,flat sec.
166	MO	Viburnum	Magmont	Dolo.	10-26-82	20.4				JH	
167	MO	Viburnum	Magmont	Dolo.	8-3-82		119.0	p?	1A	JH	
168	MO	Viburnum	Magmont	Dolo.	8-3-82		138.9	p?	1A	JH	necked?
169	MO	Viburnum	Magmont	Dolo.	9-19-83	20.5			M500	LR	pink dolo
170	MO	Viburnum	Magmont	Dolo.	9-19-83	20.0			M500	LR	pink dolo, CC/CR
171	MO	Viburnum	Magmont	Dolo.	9-19-83		87.5		M500	LR	pink dolo, CC
172	MO	Viburnum	Magmont	Dolo.	9-19-83	20.5			M500	LR	pink dolo
173	MO	Viburnum	Magmont	Dolo.	9-19-83		96.0	p	M500	LR	pink dolo, CC
174	MO	Viburnum	Magmont	Dolo.	9-19-83		112.0	p	M500	LR	pink dolo, CR
175	MO	Viburnum	Magmont	Dolo.	9-19-83		94.5	p	M500	LR	pink dolo, CC
176	MO	Viburnum	Magmont	Dolo.	9-20-83		119.0		M500	LR	pink dolo
177	MO	Viburnum	Magmont	Dolo.	9-20-83		115.5	p	M500	LR	pink dolo
178	MO	Viburnum	Magmont	Dolo.	9-20-83		115.0	p	M500	LR	pink dolo
179	MO	Viburnum	Buick	Dolo.	5-3-84		115.0	P	3	LR	zone 1
180	MO	Viburnum	Buick	Dolo.	5-3-84		122.0	P	3	LR	zone 1
181	MO	Viburnum	Buick	Dolo.	5-3-84		123.5	P	3	LR	zone 1
182	MO	Viburnum	Buick	Dolo.	5-3-84		115.0	P	3	LR	zone 1
183	MO	Viburnum	Buick	Dolo.	5-3-84		116.0	P	3	LR	zone 1
184	MO	Viburnum	Buick	Dolo.	5-3-84		123.5	P	3	LR	zone 1
185	MO	Viburnum	Buick	Dolo.	8-16-83		137.5			LR	CR, zones 2-4
186	MO	Viburnum	Buick	Dolo.	8-16-83	22.0	108.0	p		LR	CR, zones 2-4
187	MO	Viburnum	Buick	Dolo.	8-16-83	21.8		p		LR	CR, zones 2-4
188	MO	Viburnum	Buick	Dolo.	8-16-83	21.9		p		LR	CR, zones 2-4
189	MO	Viburnum	Buick	Dolo.	8-16-83	21.8	112.8	p		LR	CR, zones 2-4
190	MO	Viburnum	Buick	Dolo.	8-17-83		99.3			LR	CR, zones 2-4
191	MO	Viburnum	Buick	Dolo.	8-17-83	22.6	128.5			LR	CC
192	MO	Viburnum	Buick	Dolo.	8-17-83	22.6				LR	CR, zones 2-4
193	MO	Viburnum	Buick	Dolo.	8-17-83	22.5	152.0			LR	CC
194	MO	Viburnum	Buick	Dolo.	8-18-83		123.5			LR	CR
195	MO	Viburnum	Buick	Dolo.	8-18-83	22.0	144.5			LR	CC
196	MO	Viburnum	Buick	Dolo.	8-18-83	23.0	151.6	p?		LR	CR, zones 2-4
197	MO	Viburnum	Buick	Dolo.	8-18-83	22.5		p?		LR	CC/CR
198	MO	Viburnum	Buick	Dolo.	8-18-83	23.0	118.0	p?		LR	CR, zones 2-4
199	MO	Viburnum	Buick	Dolo.	8-5-83		124.5			LR	White dolo
200	MO	Viburnum	Buick	Dolo.	8-5-83	22.0	111.0			LR	
201	MO	Viburnum	Buick	Dolo.	8-5-83	23.2	129.3			LR	

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202	MO	Viburnum	Buick	Dolo.	8-6-83		112.0			LR	CC
203	MO	Viburnum	Buick	Dolo.	8-6-83		109.5			LR	CC
204	MO	Viburnum	Fletcher	Dolo.			97.5		6A(1)	JH	necked?
205	MO	Viburnum	Fletcher	Dolo.	10-21-82	21.0				JH	
206	MO	Viburnum	Fletcher	Dolo.	10-21-82	21.3		p?		JH	
207	MO	Viburnum	Fletcher	Dolo.	10-4-82		132.2			JH	
208	MO	Viburnum	Fletcher	Dolo.	10-4-82		118.0			JH	
209	MO	Viburnum	Fletcher	Dolo.	10-4-82		135.1			JH	
210	MO	Viburnum	Fletcher	Dolo.	10-4-82		120.0			JH	
211	MO	Viburnum	Fletcher	Dolo.	10-4-82	22.3	135.3	p		JH	
212	MO	Viburnum	Fletcher	Dolo.	10-7-82	19.75		p		JH	
213	MO	Viburnum	Fletcher	Dolo.	7-19-82		120.0		1A	JH	
214	MO	Viburnum	Fletcher	Dolo.	7-19-82		136.5		1A	JH	
215	MO	Viburnum	Fletcher	Dolo.	8-4-82		109.7		6A(1)	JH	probably necked
216	MO	Viburnum	Fletcher	Dolo.	8-4-82		125.0	p		JH	
217	MO	Viburnum	Fletcher	Dolo.	8-4-82		127.3	p?	6A(1)	JH	
218	MO	Viburnum	Fletcher	Dolo.	8-5-82		138.8		6A(2)	JH	probably necked
219	MO	Viburnum	Fletcher	Dolo.	8-5-82		126.0	p		JH	
220	MO	Viburnum	Fletcher	Dolo.	8-5-82		115.0	p		JH	
221	MO	Viburnum	Fletcher	Dolo.	pre-2/83		123.5	p	6A(1)	JH	
222	MO	Viburnum	Sweetwater	Dolo.			114.0			LR	
223	MO	Viburnum	Sweetwater	Dolo.			110.0			LR	
224	MO	Viburnum	Sweetwater	Dolo.			114.0			LR	
225	MO	Viburnum	Sweetwater	Dolo.	4-29-83		114.0	p		LR	white dolo, clear band
226	MO	Viburnum	Sweetwater	Dolo.	4-29-83		110.0	p		LR	white dolo, clear band
227	MO	Viburnum	Sweetwater	Dolo.	4-29-83		114.0	p		LR	white dolo, clear band
228	MO	Viburnum	Sweetwater	Dolo.	6-11-85	17.4	127.0		81-4	LR	CC/CR
229	MO	Viburnum	Sweetwater	Dolo.	6-11-85	19.0ms	125.0		81-4	LR	margin of CC
230	MO	Viburnum	Sweetwater	Dolo.	6-11-85	20.1			81-4	LR	
231	MO	Viburnum	Sweetwater	Dolo.	6-11-85	19.7	125.0		81-4	LR	CC
232	MO	Viburnum	Sweetwater	Dolo.	6-11-85	17.5			81-4	LR	CR
233	MO	Viburnum	Sweetwater	Dolo.	6-11-85	20.0	117.5		81-4	LR	CR
234	MO	Viburnum	Sweetwater	Dolo.	6-11-85	20.5			81-4	LR	CR
235	MO	Viburnum	Sweetwater	Dolo.	6-11-85	20.0	138.4		81-4	LR	
236	MO	Viburnum	Sweetwater	Dolo.	7-24-85	19.3	132.0		81-6	LR	zone 3 (?)
237	MO	Viburnum	Sweetwater	Dolo.	7-24-85	15.7	119.5		81-6	LR	zone 3 (?)
238	MO	Viburnum	Sweetwater	Dolo.	7-24-85	14.7	112.5		81-6	LR	zone 3 (?)
239	MO	Viburnum	Sweetwater	Dolo.	7-24-85		127.0		81-6	LR	zone 3 (?)
240	MO	Viburnum	Sweetwater	Dolo.	7-24-85	21.8			81-6	LR	zone 3 (?)
241	MO	Viburnum	Sweetwater	Dolo.	7-26-84		140.0			LR	
242	MO	Viburnum	Sweetwater	Dolo.	8-28-84		97.0			LR	
243	MO	Viburnum	Sweetwater	Dolo.	8-85		117.9		81-4	LR	zone 3
244	MO	Viburnum	Sweetwater	Dolo.	8-85	21.3	125.5		81-4	LR	zone 3
245	MO	Viburnum	Sweetwater	Dolo.	8-85	20.0	120.2		81-4	LR	zone 3
246	MO	Viburnum	Sweetwater	Dolo.	8-85	19.7			81-4	LR	zone 3
247	MO	Viburnum	Sweetwater	Dolo.	8-85	20.2			81-4	LR	zone 3
248	MO	Viburnum	Sweetwater	Dolo.	8-85	17.0	120.5		81-4	LR	zone 3
249	MO	Viburnum	Sweetwater	Dolo.	9-12-83	19.7	130.0			LR	
250	MO	Viburnum	Sweetwater	Dolo.	9-12-83	19.7	122.0	p		LR	CC, white dolo
251	MO	Viburnum	Sweetwater	Dolo.	9-12-83		128.5	p		LR	CC, white dolo
252	MO	Viburnum	Sweetwater	Dolo.	9-12-83		150.0	p		LR	CC, white dolo

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253	MO	Viburnum	Sweetwater	Dolo.	9-12-83		128.5	p		LR	zone 3
254	MO	Viburnum	Sweetwater	Dolo.	9-12-83	19.7	128.0	p		LR	CC, white dolo
255	MO	Viburnum	Sweetwater	Dolo.	9-12-83		128.0	p		LR	CC, white dolo
256	MO	Viburnum	Sweetwater	Dolo.	9-12-83	14.4	116.0	p		LR	CC, white dolo
257	MO	Viburnum	Sweetwater	Dolo.	9-12-83	19.7	106.3	p		LR	zone 3
258	MO	Viburnum	Sweetwater	Dolo.	9-12-83		137.0	p		LR	CC, white dolo
259	MO	Viburnum	Sweetwater	Sphal.	7-23-85	19.0	101.3	s	81-6a	LR	late yellow sphal.
260	MO	Viburnum	Sweetwater	Sphal.	7-23-85		103.5	s	81-6a	LR	late yellow sphal.
261	MO	Viburnum	Sweetwater	Sphal.	7-23-85	10.2	109.0	s	81-6a	LR	late yellow sphal.
262	MO	Viburnum	Sweetwater	Sphal.	7-23-85	19.0	107.3	s	81-6a	LR	late yellow sphal.
263	MO	Viburnum	Sweetwater	Sphal.	7-23-85	16.3	113.0	s	81-6a	LR	late yellow sphal.
264	MO	Viburnum	Sweetwater	Sphal.	7-23-85	16.3		s	81-6a	LR	late yellow sphal.
265	MO	Viburnum	Sweetwater	Sphal.	7-23-85	18.0			81-6a	LR	late yellow sphal.
266	MO	Viburnum	Sweetwater	Sphal.	7-23-85	21.5			81-6a	LR	early dark sphal.
267	MO	Viburnum	Sweetwater	Sphal.	7-23-85	18.0	110.9		81-6a	LR	late yellow sphal.
268	MO	Viburnum	Sweetwater	Sphal.	6-10-85	0.7ms			81-4	LR	late 'rosin' sphal.
269	MO	Viburnum	Sweetwater	Sphal.	6-10-85		84.6		81-4	LR	late 'rosin' sphal.
270	MO	Viburnum	Sweetwater	Sphal.	6-10-85		81.5		81-4	LR	late 'rosin' sphal.
271	MO	Viburnum	Sweetwater	Sphal.	6-10-85	1.2ms			81-4	LR	late 'rosin' sphal.
272	MO	Viburnum	Sweetwater	Sphal.	6-10-85		82.5		81-4	LR	late 'rosin' sphal.
273	MO	Viburnum	Sweetwater	Sphal.	6-10-85		83.0		81-4	LR	late 'rosin' sphal.
274	MO	Viburnum	Sweetwater	Sphal.	6-10-85		80.6		81-4	LR	late 'rosin' sphal.
275	MO	Viburnum	Sweetwater	Sphal.	6-10-85	0.1ms	84.6		81-4	LR	late 'rosin' sphal.
276	MO	Viburnum	Sweetwater	Sphal.	5-21-85	1.5ms	79.8	p	81-4	LR	late 'rosin' sphal.
277	MO	Viburnum	Sweetwater	Sphal.	5-21-85	1.5ms	71.0	p	81-4	LR	late 'rosin' sphal.
278	MO	Viburnum	Sweetwater	Sphal.	5-21-85	1.5ms	75.9	p	81-4	LR	late 'rosin' sphal.
279	MO	Viburnum	Sweetwater	Sphal.	5-21-85		70.0	p	81-4	LR	late 'rosin' sphal.
280	MO	Viburnum	Sweetwater	Sphal.	5-21-85	0.2ms	68.3	p	81-4	LR	late 'rosin' sphal.
281	MO	Viburnum	Sweetwater	Sphal.	5-21-85		75.7	p	81-4	LR	late 'rosin' sphal.
282	MO	Viburnum	Sweetwater	Sphal.	5-22-85	0.2ms		s	81-14	LR	post-octahedral galena
283	MO	Viburnum	Sweetwater	Sphal.	5-22-85	3.4ms		s	81-14	LR	post-octahedral galena
284	MO	Viburnum	Sweetwater	Sphal.	5-22-85		97.0	s	81-14	LR	post-octahedral galena
285	MO	Viburnum	Sweetwater	Sphal.	5-22-85	3.5ms		s	81-14	LR	post-octahedral galena
286	MO	Viburnum	Sweetwater	Sphal.	5-22-85	2.7ms		s	81-14	LR	post-octahedral galena
287	MO	Viburnum	Sweetwater	Sphal.	5-22-85	0.5ms		s	81-14	LR	post-octahedral galena
288	MO	Viburnum	Sweetwater	Sphal.	5-22-85	6.2ms		s	81-14	LR	post-octahedral galena
289	MO	Viburnum	Sweetwater	Sphal.	5-22-85	2.1ms		s	81-14	LR	post-octahedral galena
290	MO	Viburnum	Sweetwater	Sphal.	5-22-85	1.5ms		s	81-14	LR	post-octahedral galena
291	MO	Viburnum	Sweetwater	Sphal.	5-22-85	3.6		s	81-14	LR	post-octahedral galena
292	MO	Viburnum	Sweetwater	Sphal.	5-21-85		95.5	s	81-14	LR	post-octahedral galena
293	MO	Viburnum	Sweetwater	Sphal.	5-21-85	0.0ms	90.5	s	81-14	LR	post-octahedral galena
294	MO	Viburnum	Sweetwater	Sphal.	5-21-85		93.0	s	81-14	LR	post-octahedral galena
295	MO	Viburnum	Sweetwater	Sphal.	5-21-85		99.5	s	81-14	LR	post-octahedral galena
296	MO	Viburnum	Sweetwater	Sphal.	5-21-85	3.4		s	81-14	LR	post-octahedral galena
297	MO	Viburnum	Sweetwater	Sphal.	5-21-85		87.0	s	81-14	LR	post-octahedral galena
298	MO	Viburnum	Sweetwater	Sphal.	5-21-85		93.0	s	81-14	LR	post-octahedral galena
299	MO	Viburnum	Sweetwater	Sphal.	5-21-85	2.3		s	81-14	LR	post-octahedral galena
300	MO	Viburnum	Sweetwater	Sphal.	5-21-85	0.2ms	83.0		81-14	LR	post-octahedral galena
301	MO	Viburnum	Sweetwater	Sphal.	5-21-85		87.0		81-14	LR	post-octahedral galena
302	MO	Viburnum	Sweetwater	Sphal.	5-17-85	1.5ms	101.5	s	81-14	LR	post-octahedral galena
303	MO	Viburnum	Sweetwater	Sphal.	5-17-85		124.5	s	81-14	LR	post-octahedral galena

#	State	District	Mine or Core No.	Host Mineral	Date	-(Tm) (C)	Th (C)	P/S	Sample	Init	Comments
304	MO	Viburnum	Sweetwater	Sphal.	5-17-85	3.0ms	113.5	s	81-14	LR	post-octahedral galena
305	MO	Viburnum	Sweetwater	Sphal.	5-17-85	3.6		s	81-14	LR	post-octahedral galena
306	MO	Viburnum	Sweetwater	Sphal.	5-17-85	2.9ms	94.7	s	81-14	LR	post-octahedral galena

FIGURE CAPTIONS

Figure 1. Locations of the Viburnum Trend, the Ben Hogan quarry in the Northern Arkansas Zinc district, and drill hole 98. Other Mississippi Valley-type districts in the study area, Tri-State, and Central Missouri are shown for reference.

Figure 2. Locations of sample sites in the Viburnum Trend region. Samples were obtained from each of the five drill holes (HM1, 8EE, 1EE, 10EE, and 12EE) and each of the six mines (No. 29, No. 35, Magmont, Buick, Fletcher, and Sweetwater) shown on the map.

Figure 3. Fluid inclusion data for hydrothermal dolomite from the Northern Arkansas Zinc district (Ben Hogan quarry), and drill hole 98 in southwest Missouri. a) Homogenization temperatures, Th. b) Salinities: final melting temperature, Tm, and wt. % NaCl equivalent.

Figure 4. Fluid inclusion data for calcite from two drill holes in the Viburnum Trend region. a) Homogenization temperatures, Th. b) Salinities: final melting temperature, Tm, and wt. % NaCl equivalent.

Figure 5. Fluid inclusion data for Viburnum Trend sphalerite. a) Homogenization temperatures, Th. b) Salinities: final melting temperature, Tm, and wt. % NaCl equivalent.

Figure 6. Fluid inclusion data for Viburnum Trend hydrothermal dolomite. a) Homogenization temperatures, Th. b) Salinities: final melting temperature, Tm, and wt. % NaCl equivalent.

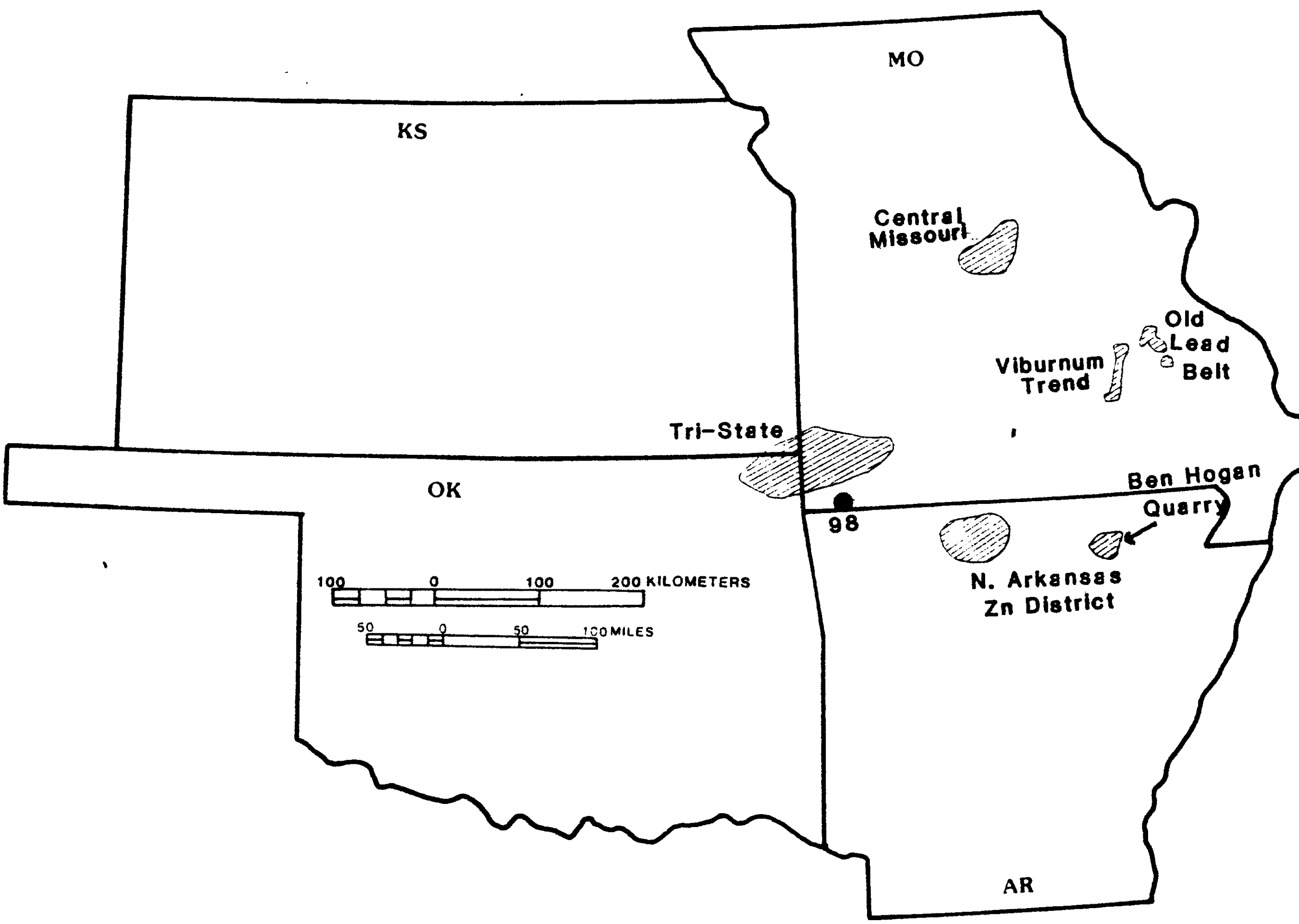
MO
KS
Central Missouri
Old Lead Belt
Viburnum Trend
Tri-State
OK
Ben Hogan Quarry
98
N. Arkansas Zn District
100 0 100 200 KILOMETERS
50 0 50 100 MILES
AR

Figure 1.

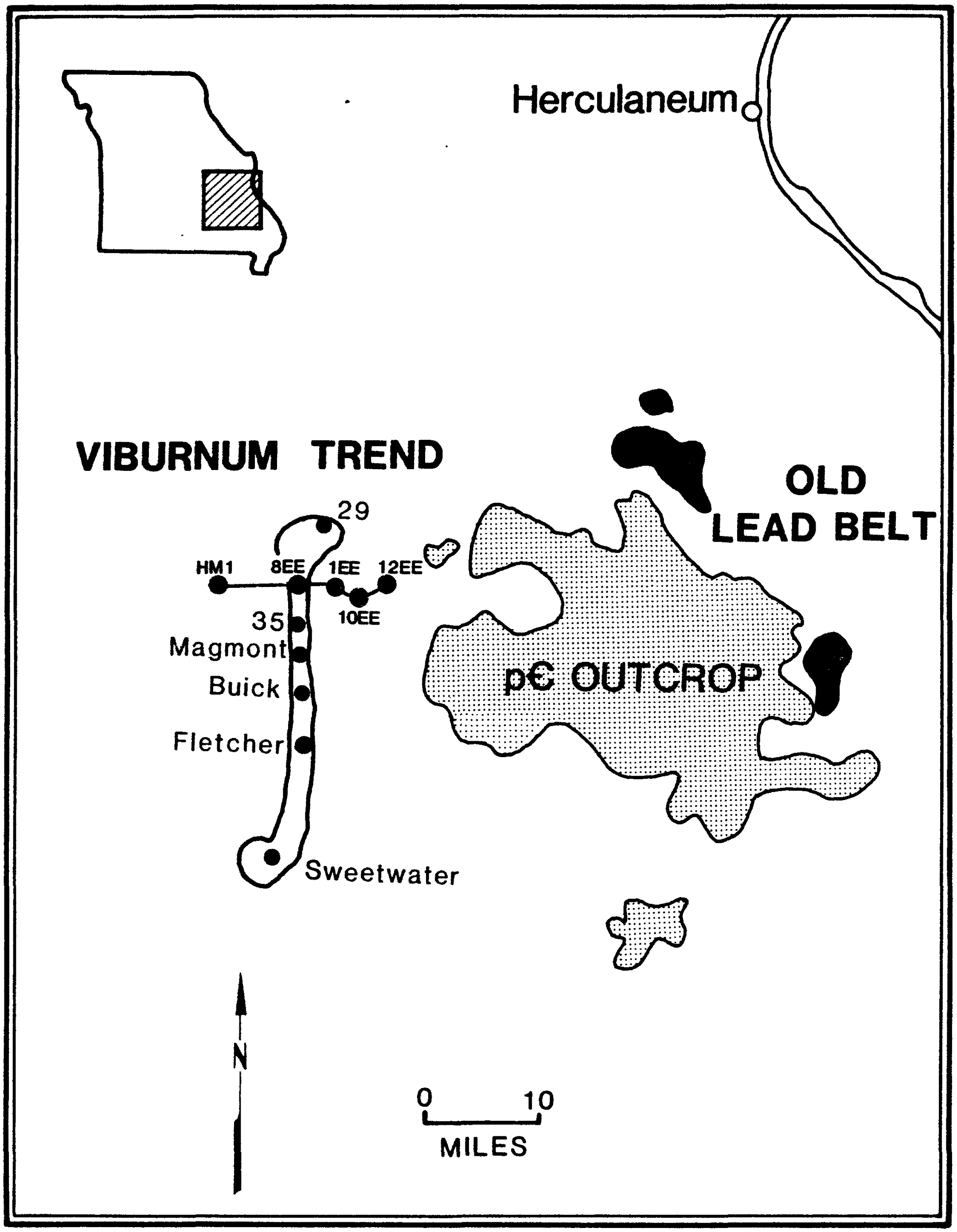
Herculaneum
VIBURNUM TREND
OLD
LEAD BELT
29
HM1
8EE
1EE
12EE
10EE
35
Magmont
Buick
Fletcher
Sweetwater
p€ OUTCROP
N
0
10
MILES

Figure 2.

Figure 3a. N. Ark. Dolomite

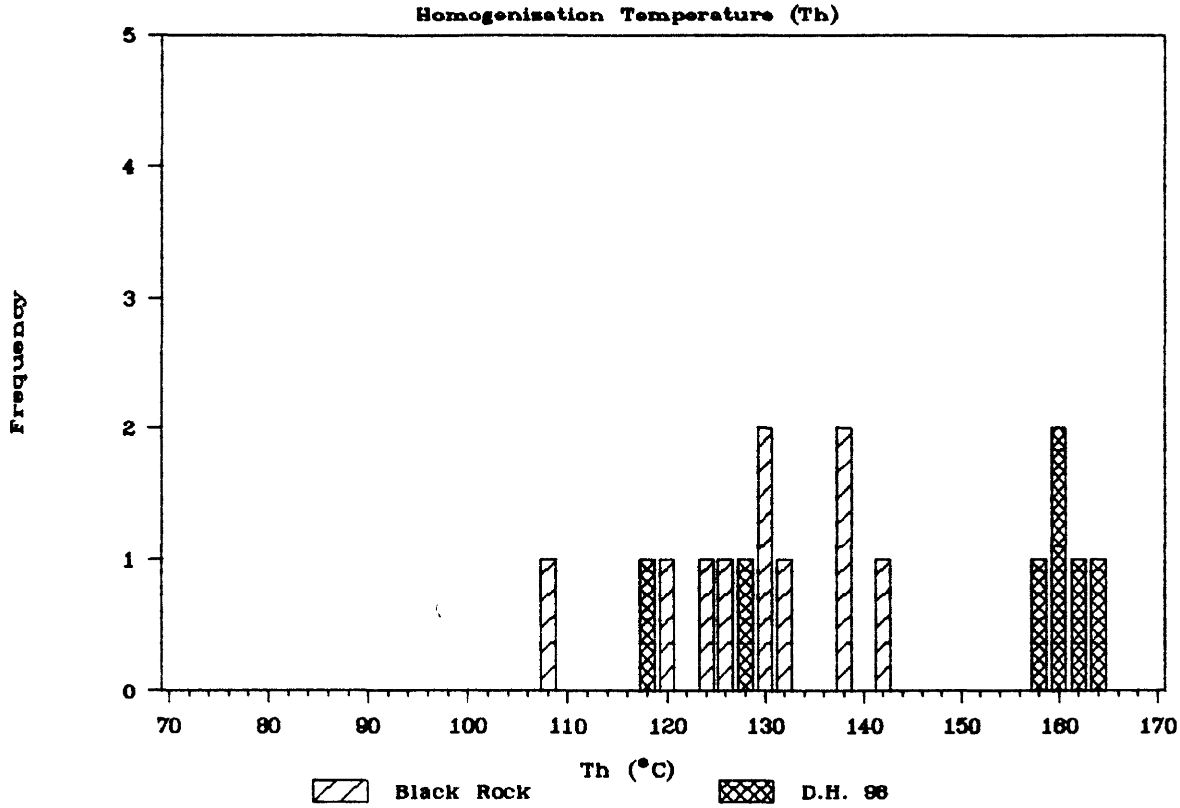

Figure 3b. N. Ark. Dolomite

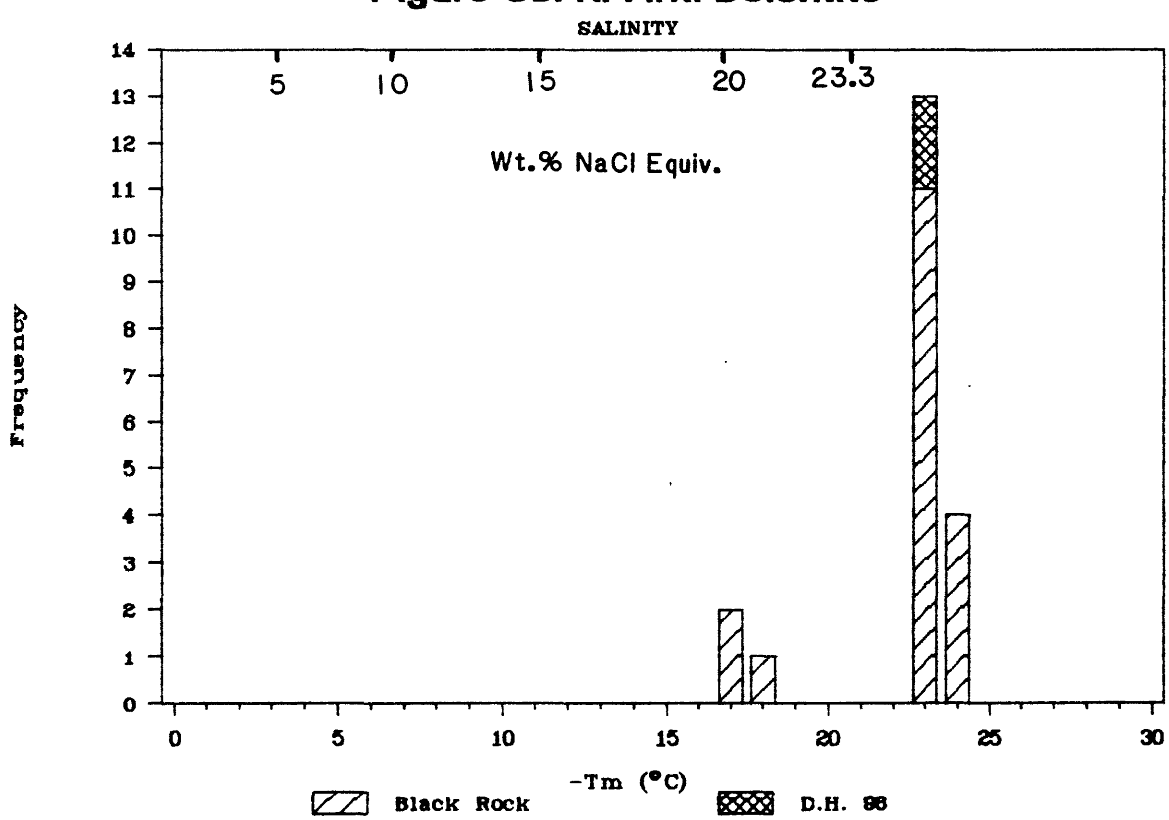

Figure 4a. Viburnum Trend Calcite

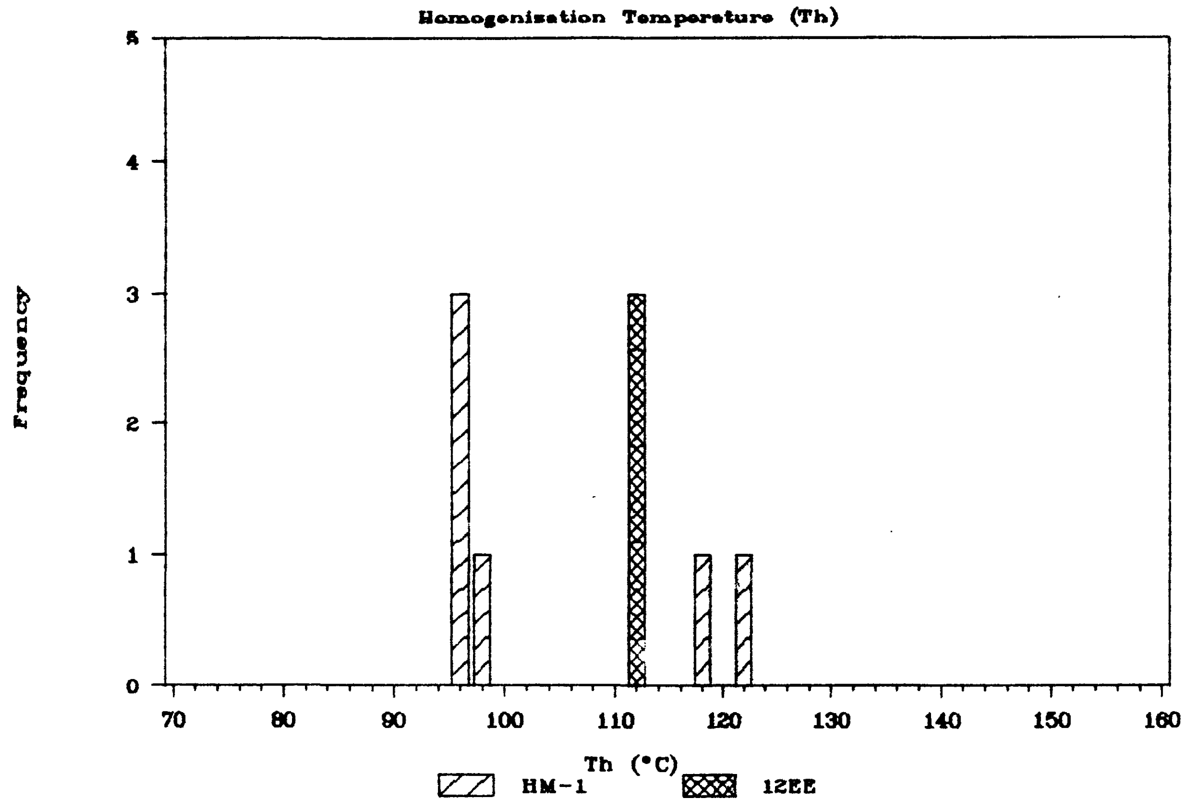

Figure 4b. Viburnum Trend Calcite

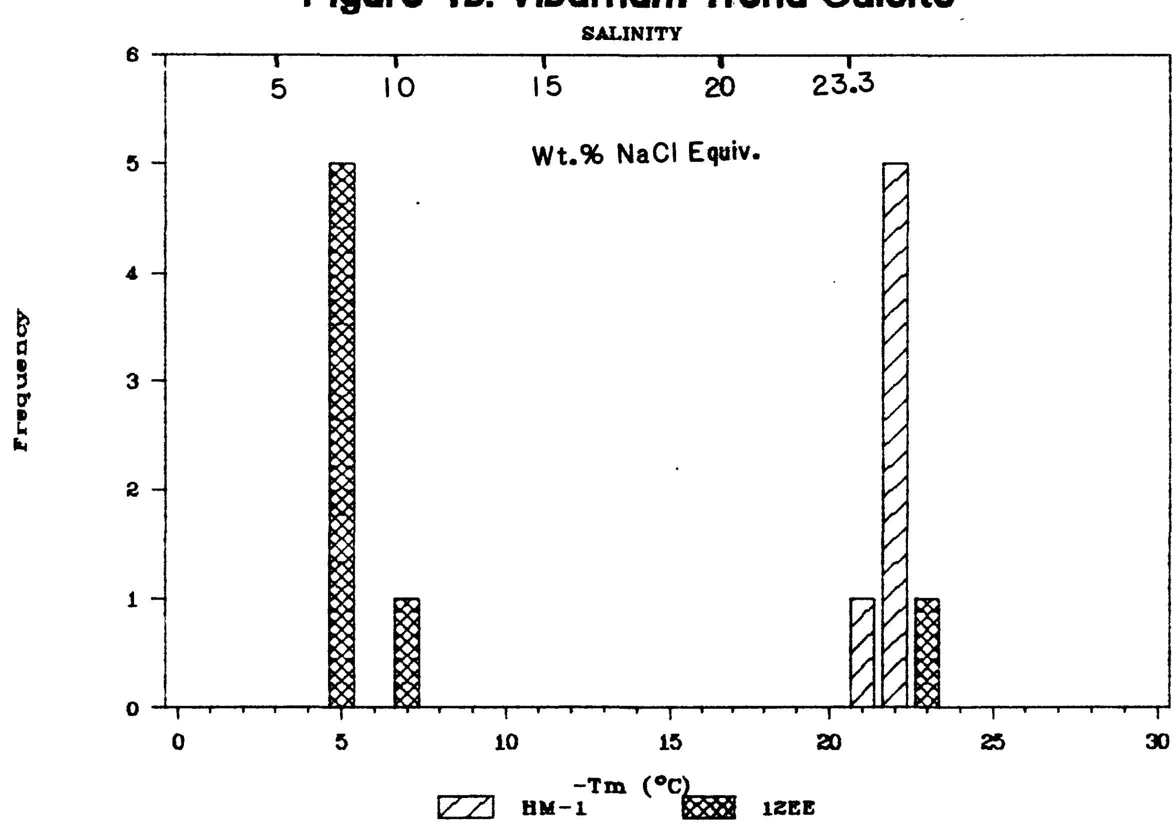

Figure 5a. Viburnum Trend Sphalerite

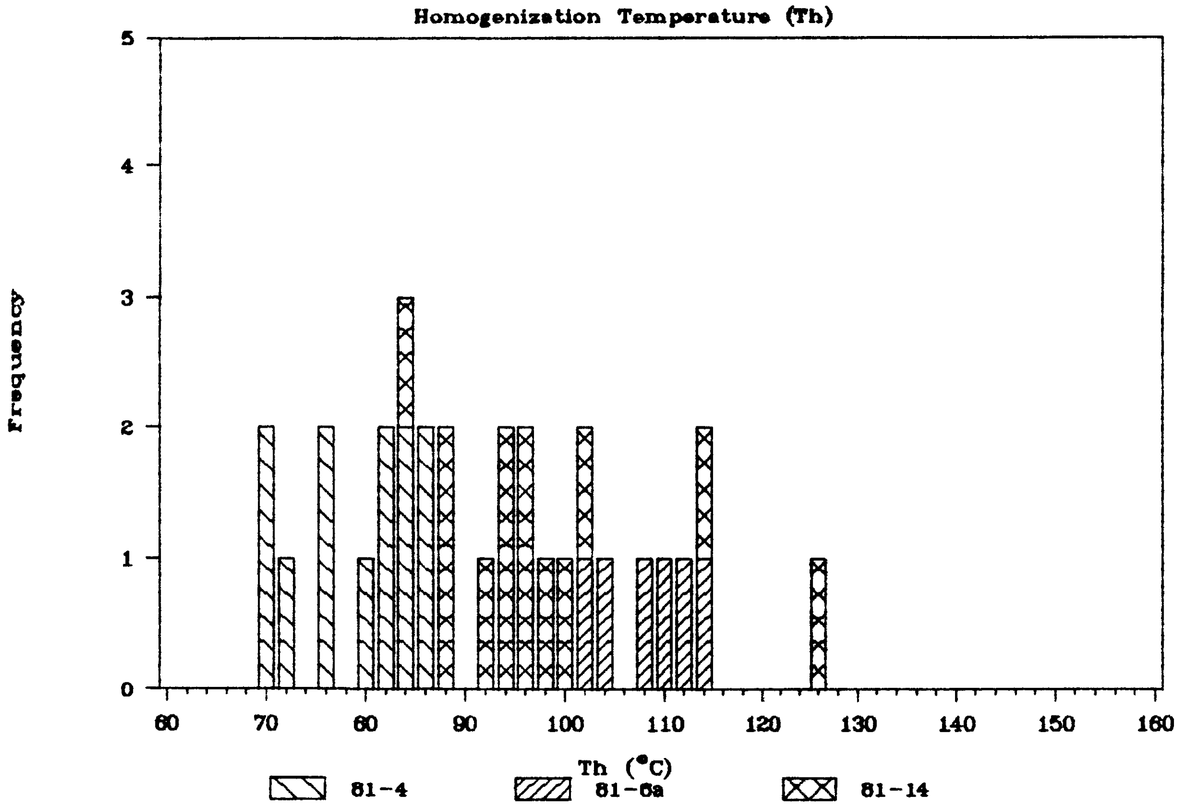

Figure 5b. Viburnum Trend Sphalerite

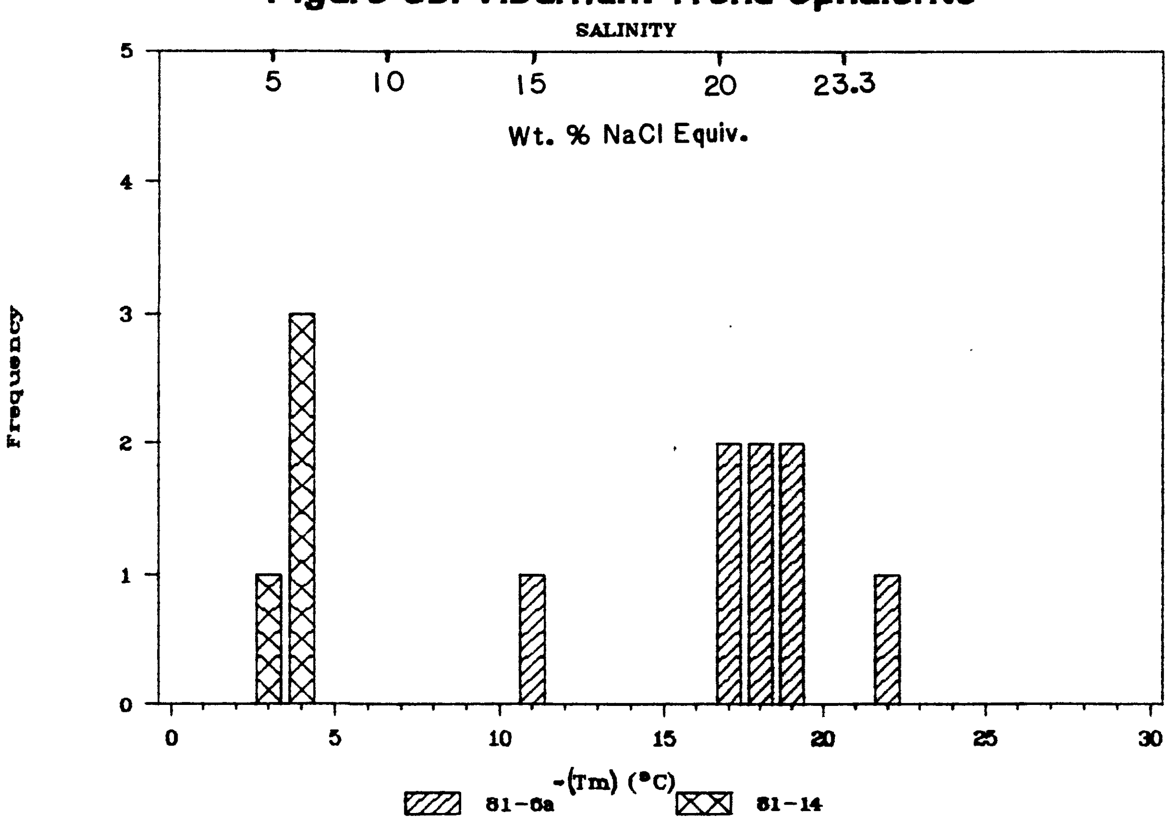

Figure 6a. Viburnum Trend Dolomite

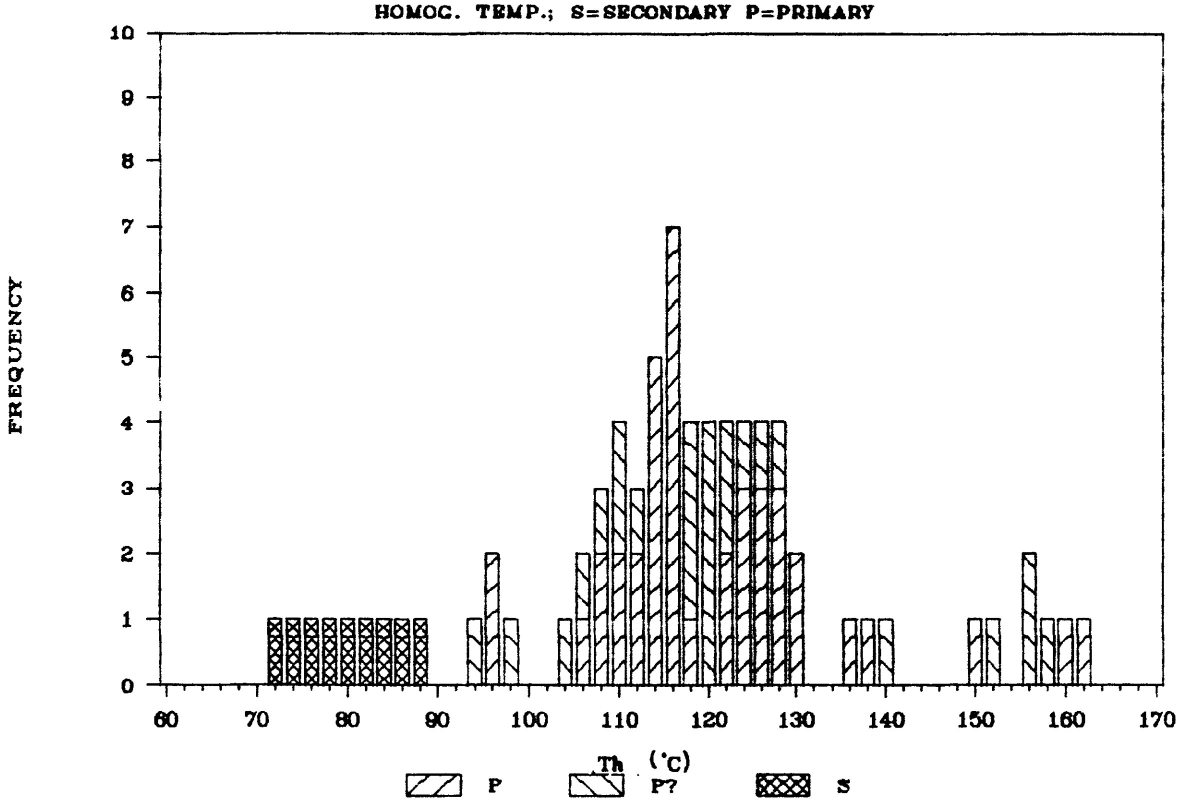

Figure 6b. Viburnum Trend Dolomite