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OBSIDIAN DATES II

A COMPENDIUM OF THE OBSIDIAN HYDRATION DETERMINATIONS MADE AT THE UCLA OBSIDIAN HYDRATION LABORATORY

Editors Clement W. Meighan
P.I. Vanderhoeven

MONOGRAPH VI
Institute of Archaeology, University of California
Los Angeles

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Edited by:

Clement W. Meighan

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INTRODUCTION

This is the second compendium of the obsidian hydration measurements to be issued by the UCLA laboratory; it reports readings obtained since our previous volume. A principal reason for making these data available is to allow for comparative study and analysis by other workers. Until now, no individual worker with obsidian hydration has had a broad number of measurements from many sites and many obsidian sources available. This has forced each writer to base his conclusions on limited samples from limited areas. As with tree-ring dates, radiocarbon determinations, or other dating methods it is important that there be a corpus of original data available for analysis. This compendium is part of our continuing effort to build up the amount of hydration data available. All of the readings reported here were done at the UCLA Obsidian Hydration Laboratory and the slides for all these specimens are on file and available for reanalysis by other scholars.

While numerous writers have reported obsidian determinations for individual site reports and in brief articles dealing with specific obsidian samples, the amount of "compendium" information is exceedingly limited. Such reporting includes only four previous items with extensive lists: Friedman and Smith, 1960; Clark, 1964; Dixon, 1969; Meighan, Findlow and De Atley, 1974. Our present list of readings includes 1614 determinations. Of the roughly 6000 published hydration readings in the items cited, more than two-thirds have been published by our laboratory. There are, of course, many additional readings which are unpublished. There are still huge areas of the world for which no obsidian hydration data have been collected. One goal of the UCLA laboratory is to obtain base-line data from areas for which no hydration readings are available. Once sufficient data can be collected, we move to our second goal which is establishing a rate of hydration for given areas and sources, so that obsidian hydration readings can be directly applied to chronological problems. We are working to establish well-founded empirical rates of utility to archaeologists in their dating studies.

In some parts of the world, notably California, the west and central Mexican area, and parts of the Southwest, useable rates have been developed by the personnel of the UCLA laboratory. In other areas, such as Central America and the Philippines, we are just beginning to accumulate readings based on controlled field collections. Hence, in our present compendium we have some lists of hydration readings which can merely be presented without much in the way of conclusions, as initial data. Other lists, and fortunately an increasing number, represent integrated projects which have specific chronological problems to resolve. Obviously, as the data base improves we will be able to concentrate more and more time on problem oriented studies aimed at determining new rates and at drawing conclusions based on obsidian chronology.

Obsidian hydration studies, like other chronological methods, have been found to be not so simple as first thought, and to use the method for dating purposes it is necessary to control a number of variables. No doubt still more variables will be found to introduce errors into the method, and part of our research is aimed at discovering those factors which affect the obsidian hydration process and its reliability as a dating tool. However, our laboratory does not currently have the equipment to do detailed chemical-physical studies, and the major contributions in this area will be made not by archaeologists but by scientists in other fields. Meanwhile, as an archaeological laboratory, we are concentrating on the empirical evidence that can be provided by field archaeology. Our main objective is to provide a chronological tool that can be used in archaeological studies, and fortunately this can be done empirically without necessarily knowing or understanding all of the variables affecting obsidian hydration. This is because archaeologists generally control considerable knowledge about their site chronology, and numerous checks exist, primarily through C-14 but also through internal stratigraphy and other sources of archaeological sequencing. Through these checks it is generally apparent when obsidian hydration is not yielding acceptable age estimates, showing us where more study is needed to unravel the method.

Most of the readings reported in the present compendium were done by Victoria C. Bennett as laboratory technician. She also did the preparation of the date lists. The final preparation of all the comments and papers was done by Petra Vanderhoeven, the laboratory technician who prepared the final edited version for reproduction. We are indebted to the colleagues who provided us with specimens for study and who prepared written comments (and in some cases brief articles) to accompany the hydration lists and evaluate their significance.

The Editors:

Clement W. Meighan
P. I. Vanderhoeven

How to Use this Volume

The compendium is divided into two main sections, the date lists with associated comments by the submitters, and a section of short papers provided by various scholars which give more background to the site/sites and a further evaluation of what the hydration values indicate.

The readings are grouped in sections covering large geographical areas such as California or the North American West. Within each of these sections the samples from the individual archaeological collections are arranged in alphabetical order by the county in which they are located.

Most of the entries in the compendium are self-explanatory. A few abbreviations are used as follows:

Micron Value:

NHV................ No Hydration Visible. This does not necessarily mean absence of hydration. However, problems of weathering in the ground and problems in preparation of the thin sections sometimes make it impossible to detect the hydration band on individual specimens. When this is the case a second slide is prepared.

2.3/3.2 .... Two hydration bands were viewed on the same specimen.

2.25................ Some micron values are given to the hundreth of a micron. This merely represents the arithmetic averages of several readings on the same hydration band.

DATE LISTS

CALIFORNIA

SITE: ALA-307

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4818	1-122880	3.9	F-5 150"	Early Horizon
4819	1-122881a	3.8	" "	"
4820	1-122881b	4.1	" "	"
4821	1-122882	3.7	" "	"
3148	1-123421	4.3	H-4 202"	"

Comments:

The obsidian artifacts were collected during the excavation of the West Berkeley site (ALA-307), conducted by W. J. Wallace and D. Lathrap, University of California, Berkeley.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 4818-4821, OHL No. 3148, selected from the collections of the Lowie Museum, University of California, Berkeley, are associated with radiocarbon dates, M-123, M-127m and their source characterizations by neutron activation analyses, INAA 1659-1662, INAA 756, respectively. The results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

Other hydration measurements, not included in the above study, were submitted by the excavator to resolve certain temporal problems encountered during excavation and analysis.

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the Alameda Province Central California cultural sequence presented by Ragir (1972).

Jonathon E. Ericson

SITE: ALA-309

SUBMITTED BY: Jonathon E. Ericson DATE: August, 1973
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3123	1-25999	3.4/12.9	Tr. 1 26' 4"	Ear. Mid. Horizon
3124	1-26004	3.4	2 25' 10" Bur. 380	"
3125	1-26007	4.7	3 27' 7"	Ear./Mid. Horizon Transition

Comments:

The obsidian artifacts were collected during the excavation of the Emeryville site (ALA-309), conducted in 1924-1926 by W.E. Schenck, University of California, Berkeley.

The artifacts, OHL No. 3123-3125, were selected from the collections of the Lowie Museum, University of California, Berkeley, and their source characterizations determined by neutron activation analyses, INAA 763-765, respectively. Results of these analyses and the source specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The cultural phase of the artifacts correlated with the Berkeley pattern, Alameda district Central California cultural sequence presented by J.A. Bennyhoff (personal communication).

Jonathon E. Ericson

SITE: CAL-99

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4822	1-139113	2.4	Pit 3 14"	Tamarack
4823	1-139118	2.7	" 21"	"
4824	1-139121	1.7	" 14"	"
4825	1-139122	2.5	" 16"	"
4826	1-139114	2.3	" 30"	"
4827	1-139115	2.6	" 24"	"
4828	1-139116	2.2	" 29"	"
4829	1-139117	2.7	" 24"	"
4830	1-139119	2.3	" "	"
4831	1-139120	3.1	" 22"	"
4832	1-139162	2.6	" 24"	"

Comments:

The obsidian artifacts were collected during the excavation of the Winslow Cave site (Cal-99), conducted in 1952 by C.W. Meighan and M.A. Bennyhoff, University of California, Berkeley (Gonsalves, 1955).

The above hydration measurements form the partial data base for deriving the source specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 4822-4825, OHL No. 4826-4832, selected from the collections of the Lowie Museum, University of California, Berkeley, are associated with radiocarbon dates, UCLA-1952A, UCLA 1952B, and their source characterizations by neutron activation analyses, INAA 1663-1666, INAA 1667-1673, respectively. Results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

Other hydration measurements, not included in the above study, were submitted by the Lowie Museum to resolve certain temporal problems encountered during excavation and analysis.

The assignment of cultural phase of the artifacts was accomplished by utilizing the associated radiocarbon dates correlated with the Yosemite sub-region Sierra Nevada cultural sequence presented by Elsasser (1960) adopted from Bennyhoff (1958).

Jonathon E. Ericson

SITE: CCO-30

SUBMITTED BY: Jonathon E. Ericson DATE: October, 1973
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
3706	1	1.8	I-28	18"-24"	Phase 1, Late Horizon
3707	2	2.6	"	"	"
3708	3	2.0/4.4	"	"	"
3709	4	1.8	"	"	"
3710	5	2.8	"	"	"
3711	6	2.2/4.6	"	"	"
3712	7	2.6/4.3	"	"	"
3713	8	2.7	"	"	"
3714	9	2.6	"	"	"
3715	10	2.7	"	"	"
3716	11	2.2	"	"	"
3717	12	3.4	"	"	"
3718	1	2.6	"	36"-42"	"
3719	2	2.3	"	"	"
3720	3	2.3	"	"	"
3721	4	1.7	"	"	"
3722	5	2.1	"	"	"
3723	6	2.6	"	"	"
3724	7	1.9	"	"	"
3725	8	1.7	"	"	"
3726	9	2.3	"	"	"
3727	10	2.6	"	"	"
3728	11	2.5	"	"	"
3729	12	2.1	"	"	"
3730	1	2.2	Q-40	18"-24"	Phase 2, Late Horizon
3731	2	2.5	"	"	"
3732	3	3.3	"	"	"
3733	4	2.2	"	"	"
3734	5	2.3	"	"	"
3735	6	2.6	"	"	"

SITE: CCO-30

SUBMITTED BY: Jonathon E. Ericson DATE: October, 1973
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
3736	7	2.3	Q-40	18"-24"	Phase 2, Late Horizon
3737	8	2.5	"	"	"
3738	9	1.8	"	"	"
3739	10	2.3	"	"	"
3740	11	2.1	"	"	"
3741	12	2.6	"	"	"
3742	1	2.3	"	36"-42"	Phase 1, Late Horizon
3743	2	2.2	"	"	"
3744	3	2.0	"	"	"
3745	4	2.0	"	"	"
3746	5	3.0	"	"	"
3747	6	2.6	"	"	"
3748	7	2.1	"	"	"
3749	8	2.1	"	"	"
3750	9	4.8	"	"	"
3751	10	2.8	"	"	"
3752	11	2.1	"	"	"
3753	12	2.3	"	"	"

Comments:

The obsidian artifacts were collected during the excavation of the La Serena site (CCO-30) conducted in 1962 by David Fredrickson, California State College, Sonoma (cf. Fredrickson, 1969).

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 3706-3717, OHL No. 3730-3741, OHL No. 3742-3753, selected from the collection of the Department of Anthropology, C.S.C. Sonoma, are associated with radiocarbon dates, UCLA 1793A, UCLA 1793B, UCLA 1793C, and their source characterizations by neutron activation analyses, INAA 869-880, INAA 881-892, INAA 893-904, INAA 905-916, respectively. The results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the Central California cultural sequence presented by Beardsley 1948; 1954; Lillard et al., 1939.

Jonathon E. Ericson

SITE: CCO-138 Hotchkiss Site

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4833	1-226486	2.7	1 G-S5, 44"-50"	Late Phase I/Late Hor.
4834	1-163947-1	2.5	1 G-S5, 50"	(Hollister Facies)
4835	1-163947-2	2.3	"	(Hotchkiss Culture)
4836	1-163947-3	2.9	"	"
4837	1-163947-4	2.2	"	"
4838	1-163947-5	1.8	"	"
4839	1-163947-6	3.7	"	"
4840	1-163947-7	2.8	"	"
4841	1-163947-8	2.0/4.1	"	"
4842	1-163947-9	3.0	"	"
4843	1-163947-10	2.4	"	"
4844	1-163947-11	2.6	"	"
4845	1-163947-12	2.0	"	"
4846	1-163947-13	2.2	"	"
4847	1-163947-14	1.7	"	"
4848	1-163947-15	NHV	"	"
4849	1-163947-16	1.8	"	"
4850	1-163947-17	2.0	"	"
4851	1-163947-18	3.4	"	"
4852	1-163947-19	1.9	"	"
4853	1-163947-20	1.8	"	"
4854	1-163947-21	3.1	"	"
4855	1-163947-22	NHV	"	"
4856	1-163947-23	2.3	"	"
4857	1-163947-24	1.8	"	"
4858	1-163947-25	2.8	"	"
4859	1-163947-26	1.7	"	"
4860	1-163947-27	2.6	"	"
4861	1-163947-28	2.4	"	"
4862	1-163947-29	2.7	"	"
4863	1-163947-30	1.9	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Hotchkiss site, conducted in the 1968 to 1970 excavation by J. A. Bennyhoff and members of Anthropology class 195, University of California, Berkeley.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 4833-4863, selected from the collections of the Lowie Museum, University of California, Berkeley, are associated with radiocarbon date, UCLA-1953, and their source characterizations by neutron activation analyses, INAA 1674-1704. These analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing the associated radiocarbon dates correlated with the Delta Province of the Central California cultural sequence presented by Ragir (1972).

Jonathon E. Ericson

SITE: CCO-308 Stone Valley Site (Mono County)

SUBMITTED BY: Jonathon E. Ericson DATE: September, 1974
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4050	M5	2.7	12"-18" M1	Phase I, Late Horizon
4051	waste 1	1.8	" "	" "
4052	M25	3.0	24"-30" "	Early " "
4053	waste 3	2.1	" "	"
4054	waste 5	3.4	36"-42" "	"
4055	M48	2.8	48"-54" "	Middle Horizon/Late Hor.
4056	waste 6	2.2	" "	"
4057	M55	4.3	54"-60" "	"
4058	waste 7	2.2	" "	"
4059	waste 8	No sample	66"-72" "	"
4060	waste 9	3.8/4.6	72"-78" "	"
4061	#71	4.4	78"-84" "	"
4062	waste 10	3.8	" "	"
4063	waste 11	2.0	84"-90" "	"
4064	waste 2	4.8	18"-24" "	Phase I, Late Horizon
4065	M75	4.1	90"-96" M2	Middle Horizon
4066	waste 14	4.9	102"-108" "	"
4067	None	4.6	" "	"
4068	waste 16	4.6	114"-120" "	"
4069	M119	4.1	120"-126" "	"
4070	A	chert	126"-132" "	"
4071	B	NHV	" "	"
4072	waste 17	7.5	" "	"
4073	M138	4.8	132"-138" "	"
4074	None	3.4	" "	"
4075	waste 18	5.9	144"-150" "	"
4076	waste 19	2.6	162"-168" M3	Ear. Mid. Hor./L.E.H.
4077	waste 20	5.5	168"-174" "	"
4078	waste 21	6.0	174"-180" "	"
4079	waste 22	5.2	180"-186" "	"

SITE: CCO-308 Stone Valley Site (Mono County)

SUBMITTED BY: Jonathon E. Ericson DATE: July, 1973
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3097	waste 4	3.3	30"-36" M1	Early Phase I, Late Hor.
3098	M32	3.7	" "	"
3099	M33	2.6	" "	"
3100	M41c	5.0	42"-48" "	Mid. Hor./Late Hor. (trans)
3101	M41d	2.7	" "	"
3102	M42	2.6	" "	"
3103	None	chert	90"-96" "	"
3104	waste 12	3.7	" "	"
3105	M81	5.9	96"-102" M2	Middle Horizon
3106	waste 13	2.5	" "	"
3107	waste 1	chert	" "	"
3108	waste 2	NHV	" "	"
3109	waste 3	5.2	" "	"
3110	waste 15	4.1	108"-114" M2	Ear. Mid. Hor./L.E.H.
3111	M106	5.5	" "	"
3112	None	chert	" "	"
3113	M152	4.4	150"-156" M2	"
3114	None	chert	" "	"
3115	waste 24	6.3/9.3	192"-198" M3	"
3116	M171	4.2	" "	"
3117	#83	NHV	160" Hor. Loc. 545E	"
3118	#84	4.2	"	"
3119	#82	5.0	"	"
3120	#145	4.1	168" 545 + 25E	"
3121	#143	3.3	"	"
3122	#144	4.3	"	"

SITE: CCO-308 Stone Valley Site (Mono County)

SUBMITTED BY: Jonathon E. Ericson DATE: September, 1974

Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4080	waste 23	chert	186-192" M3	Ear. Mid. Hor./L.E.H.
4081	waste 25	2.3	72-78" vandalized burial	unknown
4082	B27-9	3.7	53-60" Burial 27/29	"
4083	B27-7	2.7	" "	"
4084	None	4.1	No location	"
4085	#35	3.9	"	"
4086	#26	3.9	"	"
4087	#29	NHV	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Stone Valley site (CCO-308), conducted in 1962 by David Fredrickson, Department of Anthropology, California State College, Sonoma.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 3097-3099, OHL No. 3100-3102, selected from the collections of the Department of Anthropology, California State College, Sonoma, are associated with radiocarbon dates, UCLA-1792A from M-1, 30-36", UCLA-1792B from M-1, 42-48", and their source characterizations by neutron activation analyses, INAA 730-732 and INAA 733-735 respectively. These analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

Obsidian hydration measurements, not included in the above study, were submitted by J.E. Ericson to resolve certain temporal problems for trade analysis. Specifically, radiocarbon sequence dating was performed on samples UCLA-1786A, B, C; 1792 C, E, F, (Ericson, 1978) which are relatively associated with hydration measurements, above.

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the Central cultural sequence presented by Fredrickson, n.d.

Jonathon E. Ericson

SITE: CCO-311

SUBMITTED BY: Dave A. Fredrickson
Dept. of Anthropology
Calif. State College, Sonoma

DATE: September, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4088	#311-1	2.3	Associated, Burial C	Late to Middle Middle Horizon

Comments:

Single sample analyzed to ascertain temporal placement of 4-CCO-311, within 250 yards of CCO-308. Artifacts place the site (Fredrickson, personal communication) relative to CCO-308, or, late to middle Middle Horizon of Central California (Fredrickson, 1969).

Jonathon E. Ericson

SITE: ELd-44

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4909	1-197564	3.3	Tr. A, Sq. 2 12"-24"	unknown

Comments:

The obsidian artifact was collected during the excavation of the ELd-44 site, conducted in 1956 by F.A. Riddell, Archaeological Survey, University of California, Berkeley.

The above obsidian hydration measurement forms the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact group, OHL No. 4909, selected from the collections of the Lowie Musuem, University of California, Berkeley, is associated with radiocarbon date, UCLA - 1958, and source characterization by neutron activation analysis, INAA - 1751. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California and elsewhere (Ericson, 1978).

Jonathon E. Ericson

SITE: INY-2 (INYO COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4904	1-202489	2.6	5-LI, 0"-6"	Cottonwood
4905	1-202689-1	1.8	" "	"
4906	1-202689-2	1.9	" "	"
4907	1-202689-3	NHV	" "	"
4908	1-202689-4	NHV	" "	"

Comments:

The obsidian artifacts were collected during the excavation of the Cottonwood site (INY-2), conducted in 1950-1951 by Mr. and Mrs. H. Riddell, Jr. (Riddell, 1951).

The above hydration measurements form the partial data base for deriving the source specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact group, OHL No. 4904-4908, selected from the collections of the Lowie Museum, University of California, Berkeley, is associated with radiocarbon date UCLA-1957, and source characterizations by neutron activation analyses, INAA 1746-1750. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the Owens Valley cultural sequence presented by Lanning (1963).

Jonathon E. Ericson

SITE: INY-222 (INYO COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4890	1-130480-1	11.8	C-8, 11"-12"	See discussion by: Meighan, this volume.
4891	1-130480-2	NHV	" "	
4892	1-130480-3	12.9	" "	
4893	1-130480-4	7.2	" "	
4894	1-130480-5	12.6	" "	
4895	1-130480-6	11.7	" "	
4896	1-130480-7	12.0	" "	
4897	1-130480-8	11.6	" "	
4898	1-130480-9	7.5	" "	
4899	1-130480-10	13.3	" "	

Comments:

The obsidian artifacts were collected during the excavation of the Coville Rockshelter site (INY-222), conducted in 1951 by C. W. Meighan, M. A. Bennyhoff et al., University of California, Berkeley (Meighan, 1953).

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson (1975). The artifact group, OHL No. 4890-4899, selected from the collections of the Lowie Museum, University of California, Berkeley, are associated with radiocarbon date, UCLA-1955, and source characterizations by neutron activation analyses, INAA 1734-1741, respectively. A complete report of the results of these analyses and the source specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing the associated radiocarbon date correlated with the Death Valley cultural sequence presented by Hunt (1960).

Jonathon E. Ericson

SITE: INY-372

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4770	1-188101	7.2	Rose Springs	60"-64"	Middle Rose Spr.
4771	1-188102	10.6	"	"	"
4772	1-188103	9.8	"	"	"
4773	1-188104	6.3	"	"	"
4774	1-188105	6.9	"	"	"
4775	1-188106	7.6	"	"	"
4776	1-188107	8.7	"	"	"
4777	1-188108	7.1	"	"	"
4778	1-188109	8.4	"	"	"
4779	1-188160		"	72"-84"	Early Rose Spring
4780	1-188161	5.9	"	"	"
4781	1-188162	7.5	"	"	"
4782	1-188166	16.5	"	"	"
4783	1-188167	8.1	"	"	"
4784	1-188168	7.8	"	"	"
4785	1-188169	8.2	"	"	"
4786	1-188170	NHV	"	"	"
4787	1-188171	9.4	"	"	"
4788	1-188172	8.1	"	"	"
4789	1-188173	6.2	"	"	"
4790	1-188174	7.7	"	"	"
4791	1-188176	8.8	"	"	"
4792	1-144791a	8.4	D-3	84"-90"	Little Lake
4793	1-144791b	8.4	"	"	"
4794	1-144785a	11.4	"	96"-102"	"
4795	1-144785b	8.0	"	"	"
4796	1-144785c	8.2	"	"	"
4797	1-144785d	8.0	"	"	"
4798	1-144785e	8.3	"	"	"
4799	1-144785f	7.9	"	"	"

SITE: INY-372 (INYO COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4800	1-144785g	8.4	D-3	96"-102"	Little Lake
4801	1-144785h	8.5	"	"	"
4802	1-144785i	7.9	"	"	"
4803	1-144785j	8.2	"	"	"
4804	1-144790a	8.4	"	102"-108"	"
4805	1-144790b	8.6	"	"	"
4806	1-144790c	8.1	"	"	"
4807	1-144790d	7.5	"	"	"
4808	1-144790e	8.2	"	"	"
4809	1-144793a	8.1	D-1	90"-102"	"
4810	1-144793b	7.9	"	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Rose Spring site (INY-372), conducted in 1956 by R.A. Riddell and in 1961 by J.T. Davis, both from the University of California, Berkeley.

The above hydration measurements form the partial data base for deriving the source-specfic obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 4770-4778, OHL No. 4779-4791, OHL No. 4792-4793, OHL No. 4794-4803, selected from the collections of the Lowie Museum, University of California, Berkeley, are associated with radiocarbon dates, UCLA-1903A, UCLA-1093B, UCLA-1093C, UCLA-1093D, and their source characterizations by neutron activation analyses, INAA 1611-1619, INAA 1620-1632, INAA 1633-1634, INAA 1635-1644, respectively. Results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the Owen's Valley cultural sequence presented by Lanning (1963); and confirmed by radiocarbon dating, Clewlow et al., (1970).

Jonathon E. Ericson

SITE: LAK-153,

SUBMITTED BY: Jonathon E. Ericson DATE: January, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE			CULTURAL PHASE
4220	1	6.2	Unit	S12/E16	20-30 cm	Houx Pattern
4221	2	4.8		"	"	"
4222	3	6.0		"	"	"
4223	4	2.7		"	"	"
4224	5	4.8		"	"	"
4225	6	4.8		"	"	"
4226	1	4.7		"	60-70 cm	Borax Lake Patt.
4227	2	3.7		"	"	"
4228	3	NHV		"	"	"
4229	4	6.0		"	"	"
4230	5	NHV		"	"	"
4290	6	6.6		"	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Cold Springs Canyon "Tlotli" site (LAK-153), conducted in 1973 by R. L. Orlins, University of California, Davis.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 4220 to 4225, OHL No. 4226 to 4230, are associated with radiocarbon dates, UCLA - 1912 A, UCLA - 1913B, respectively, and their source characterizations by X-ray fluorescence analyses. These analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates do not correlate with the North Coast Ranges cultural sequence presented by Fredrickson, n.d.

Jonathon E. Ericson

SITE: LAK- 380 Mostin Site

SUBMITTED BY: Jonathon E. Ericson DATE: November, 1973; February, 1974
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3754	M1	6.4	Burial 4	Post Pattern Paleo Indian Period
3755	M2	5.7/12.4	"	"
3756	M3	6.2	"	"
3757	M4	4.6	"	"
3758	M5	4.6	"	"
3759	M6	6.8	"	"
3760	M7	4.6	"	"
4089	1	4.0	Burial 1	"
4090	2	3.8	"	"
4091	3	3.6	"	"
4092	4	NHV	"	"
4093	5	3.8	"	"
4094	6	4.3	"	"
4095	7	5.0	"	"
4096	1	3.8/4.7	Burial 9	"
4097	2	4.9	"	"
4098	3	4.1	"	"
4099	4	5.2	"	"
4100	5	7.4/16.0	"	"
4101	6	4.3	"	"
4102	7	3.6	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Mostin site, formerly numbered SDA-66, conducted in 1973 by R. King and G. Berg, Department of Anthropology, California State College, Sonoma (King and Berg, 1973).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates, correlated with the North Coast Ranges cultural sequence presented by Fredrickson, n.d.

Jonathon E. Ericson

Comments: (continued)

Assignment of a specific "cultural phase" to the Mostin assemblage is best left undetermined at this time. The materials excavated to date are not indicative of a Post Pattern affiliation as the Post Pattern (itself provisional) has been described by Fredrickson (1973:210-214, Doctoral Dissertation). Fredrickson (1973:210) defined the Post Pattern as a designation for those oldest materials present in Meighan and Haynes (1970) obsidian hydration seriation of the Borax Lake Site artifacts. These materials consisted primarily of fluted Clovis type points and crescents, and exhibited hydration readings of approximately 8-10 microns. To date, no fluted Clovis type points or crescents have been reported from the Mostin excavations. Further, the obsidian hydration readings reported for Mostin Site Borax Lake obsidian (Ericson and Berger, 1974) are smaller than the 8-10 micron readings obtained by Meighan and Haynes (providing that the fluted points and crescents from Borax Lake were made of Borax Lake obsidian). This is not to suggest that the Mostin Site is not of Paleo-Indian age, or that it cannot exhibit antiquity similar to that assumed for Post Pattern. It does indicate that the Mostin assemblage is not representative of Post Pattern as the latter has been defined in the literature.

In addition, the obsidian hydration rates which can be calculated from the obsidian hydration or radiocarbon association in Burial 4 (Ericson and Berger, 1974) appear to be at some divergence with other reported rate values, including that reported by Findlow, DeAtley and Ericson, this volume (890 $\pm$ 178 years per micron). Ericson and Berger report five obsidian hydration readings on Borax Lake obsidian of 5.7 to 12.4 microns in association with a radiocarbon date of 10,260 $\pm$ 340 years B.P. Four of these five values lie between 5.7 and 6.8 microns inclusive. (The 5.7 micron and 12.4 micron readings both occur on the same specimen). These result in rates of approximately 1800 to 1509 years per micron while the single 12.4 micron reading suggests a rate of approximately 827 years per micron. Findlow (personal communication) has a revised rate for Borax Lake of 1236 years per micron. The 4.6 micron readings from Mt. Konocti obsidian suggest a rate of approximately 2230 years per micron.

Causes for some of the above variability may include questionable and insufficient obsidian hydration-radiocarbon associations, a non-lineal hydration rate, intrasource hydration variability, ambiguous source determinations, and differing environmental conditions.

Thomas S. Kaufman

SITE: MALIBU, LAN-264 (Los Angeles, California)

SUBMITTED BY: C.W. Meighan DATE: December, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3869	573-1153	5.0	Pit A21 65"-71" T10a	Canalino
3870	573-969	4.1	A34 48"-54" T-9	"
3871	573-1545	3.7	A34 72"-78" T10f	"
3872	573-862a	4.4	A28 59"-66"	"
3873	573-862b	4.6	A28 59"-66"	"
3874	573-862c	4.3	A28 59"-66"	"
3875	573-862d	4.8	A28 59"-66"	"
3876	573-898b	3.8	A29 57"-63"	"
3877	573-1216	4.9	A26 63"-69"	"
3878	573-980	5.1	A34 54"-60" T10c	"
3879	573-858	4.6	A28 59"-66"	"
3880	573-982	5.7	A34 54"-60" T10c	"
3881	573-1152	3.4	A21 65"-71" T10a	"
3882	573-1377	4.6	A20 80"-86" T10c	"
3883	573-1634a	5.4	A22 72"-78" T10b	"
3884	573-1634b	4.3	A22 72"-78" T10b	"
3885	573-1634c	4.9	A22 72"-78" T10b	"
3886	573-1634d	6.0	A22 72"-78" T10b	"
3887	573-1198a	5.7	A26 63"-69"	"
3888	573-1198b	NHV	A26 63"-69"	"
3889	573-1198c	5.5	A26 63"-69"	"
3890	573-1198d	2.8	A26 63"-69"	"
3891	573-1198e	4.9	A26 63"-69"	"
3892	573-1331	5.4	A22 72"	"
3893	573-1693	4.9	Burial 33	"
3894	573-1798	4.6	A20 31"	"
3895	573-1794	5.2/6.3	Burial 37	"
3896	573-2021	5.8	A23 80"-86" T10d	"
3897	573-2022	4.6	A23 80"-86" T10d	"
3898	573-2014	2.2	A23 82"-86"	"

SITE: MALIBU, LAN-264 (Los Angeles County, California)

SUBMITTED BY: C. W. Meighan DATE: December, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3839	573-1062	5.5	Pit A-18 75"-84" T10c	Canalino
3840	573-923	4.9	A-28 72"-78" T10c	"
3841	573-1613	too small	A-21 78"-84" T10c	"
3842	573-1082	5.9	A-18 84"-90" T10d	"
3843	Burial 35	5.4	Burial 35	"
3844	573-1354a	5.7	A-19 84"-90" T10d	"
3845	573-1354b	5.4	A-19 84"-90" T10d	"
3846	573-1115a	6.3	A-20 67"-73" T10a	"
3847	573-1115b	4.9	A20 67"-73" T10a	"
3848	573-1115c	5.3	A20 67"-73" T10a	"
3849	573-1421a	4.9	A23 68"-72" T10a	"
3850	573-1421b	4.6	A23 68"-72" T10a	"
3851	573-1370	3.9	A20 80"-86" T10c	"
3852	573-1129	5.0	A21 65"-71" T10a	"
3853	573-1649	5.1	A23 72"-78" T10b	"
3854	573-1664	4.9	A23 78"-84" T10c	"
3855	573-1445	4.3	A24 72"-78" T10c	"
3856	573-1480a	NHV	A25 62"-68" T10a	"
3857	573-1480b	5.4	A25 62"-68" T10a	"
3858	573-1296	5.4	A34 72"-78" T10c	"
3859	573-868	4.2	A28 66"-72"	"
3860	573-1313	5.1	A30 54"-60" T10a	"
3861	Bur. 45	5.2	Burial 45	"
3862	573-1567	4.3	A34 78"-84" T10g	"
3863	Bur. 37a	4.9	Burial 37a	"
3864	Bur. 37b	NHV	Burial 37b	"
3865	573-898a	4.6	A29 57"-63"	"
3866	573-857	5.5	A28 59"-66"	"
3867	573-1314	5.2	A30 54"-60" T10a	"
3868	573-1568	6.0	A34 78"-84" T10g	"

SITE: MALIBU, LAN-264 (Los Angeles County, California)

SUBMITTED BY: C. W. Meighan DATE: December, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE				CULTURAL PHASE
3899	573-1826	5.4	Pit	A20	86"-92"	T10d	Canalino
3900	573-1991a	5.7		A22	78"-84"	T10c	"
3901	573-1991b	4.7		A22	78"-84"	T10c	"
3902	S-1	5.0		7-72	0"-6"		"
3903	S-2	5.8		4	12"-18"		"
3904	S-3	5.4		5	42"-48"		"
3905	S-4	4.9		3-72	24"-30"		"
3906	S-5	4.4		3	6"-12"		"
3907	S-5b	4.7		3	6"-12"		"
3908	S-6	6.2		1	12"-18"		"
3909	S-8	5.0		2-72	18"-24"		"
3910	572-2301	6.0		Feature 35, Historic Cemetery			
3911	572-3372	5.0		8-71	18"-24"		
3912	572-3389	4.6		4			
3913	572-1324	2.8		11	6"-12"		
3914	572-651	4.1		8	18"-24"		
3915	S-7	non-obsid.		1-72	18"-24"		
3916	S-9	3.2		J-15	12"-18"		
3980	573-2310a	3.9/4.9		A30	62"-68"		
3981	573-2310b	5.0		A30	62"-68"		
4111	573-270	5.4		A-9	64"-68"	T-9	

Comments: See article by Meighan, this volume

SITE: LAn-369; LAn-361; LAn-364 (LOS ANGELES COUNTY, CALIFORNIA)

SUBMITTED BY: Chester King DATE: January, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE			CULTURAL PHASE
3917	1	6.0	LAn-361	Bulldozed		Middle Period
3918	2	8.9	"	"		(750AD-1000A
3919	3	10.3	"	"		"
3920	4	6.2	"	"		"
3921	5	too small	"	"		"
3922	6	6.9	"	"		"
3923	7	too small	"	"		"
3924	8	9.0	"	"		"
3925	9	4.3	"	"		"
3926	10	12.5	"	"		"
3927	11	6.0	"	"		"
3928	None	7.4	LAn-369	N10/W3	24"-30"	L
3929	"	5.3	"	N6/E2	6"-12"	
3930	"	9.5	"	"	36"-42"	
3931	"	4.7	LAn-364	outside area		
3932	"	5.8	"	Ar-4-1230		
3933	"	7.0	"	Ar-4-1579		
3934	#1	5.4	"	Ar-4-1656		
3935	#2	2.3	"	"		
3936	None	4.8	"	Ar-4-1684		
3937	"	3.1	"	110 S	12"-18"	
3938	#1	2.5	"	114 S	0"-6"	
3939	#2	11.9	"	"	"	
3940	#1	7.5	"	"	12"-18"	
3941	#2	5.7	"	"	"	
3942	#1	5.4	"	114 U	12"-18"	
3943	#2	5.0	"	"	"	
3944	None	8.7	"	116 S	0"-6"	
3945	"	10.2	LAn-365	N9/E22	12"-18"	
3946	"	7.5	"	"	24"-30"	

SITE: LAn-582; LAn-371; LAn-362 (LOS ANGELES COUNTY, CALIFORNIA)

SUBMITTED BY: Chester King DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
3958	#1	6.9	LAn-582	Vs 17-59	Protohistoric
3959	#2	12.6	"	"	"
3960	None	3.8	LAn-371	S1/E4	Late Period
3961	"	5.5	"	S2/E5	"
3962	#1	7.8	"	S2/W2	"
3963	#2	8.3	"	"	"
3964	None	unclear	"	S7/E2	"
3965	"	10.5	"	N1/E3	"
3966	"	unclear	"	N2/E5	"
3967	"	13.0	"	N3/E6	"
3968	"	3.2	"	N5/W1	"
3969	"	10.8	"	N8/E5	"
3970	#1	2.0	LAn-362	202 G	Late Period
3971	#2	1.3	"	"	
3972	#3	1.9	"	"	
3973	None	7.7	"	203 G 18"-24"	
3974	"	1.8	"	" 24"-30"	
3975	#1	1.6	"	204 F 0"-12"	
3976	#2	1.7	"	" "	
3977	None	7.9	"	" 23"-30"	
3978	#1	2.7	"	" "	
3979	#2	1.7	"	" "	

Comments:

The research on the sites was part of an extensive environmental impact study within the environs of the proposed Vasquez Rocks County Park, administered by the Los Angeles County, Department of Parks and Recreation. The project, which employed general surveying, random surface collecting, and excavating techniques, was conducted in 1973-1974 by Chester D. King and the personnel of the California State University, Northridge, Archaeological Research Center. It was the second recent archaeological project within the territory of the Alliklik (Tataviam), whose results are reported in manuscript form by Chester D. King (King, n.d.).

Obsidian artifacts were submitted to J.E. Ericson for chemical characterization by neutron activation analysis as follows: LAn-361 (INAA 1071-1084), LAn-369 (INAA 1068-1070), LAn-364, (INAA 1071-1084), LAn-365 (INAA 1085-1086), LAn-582 (INAA 1172-1173), LAn-371 (INAA 1174-1183), LAn-362 (INAA 1184-1193). All of the obsidian originated from the Coso source, except for sample OHL 3917, which was from Casa Diablo, and sample OHL 3978, from Mono Glass Mountain.

The chronology of the sites was determined by bead seriation in conjunction with the hydration measurements of the obsidian derived from the Coso source (King, n.d., table 1 and 2).

Finally, it is noteworthy to mention that the findings of this project support a growing body of evidence of the diminishing of the Middle Period (circa 750 A.D. -1000 B.C.) obsidian trade systems during the Late Period in Southern California.

> "At Elderberry Canyon (LAn-324), Century Ranch (LAn-227, 229), Tujunga (LAn-167), as well as a number of sites on the Santa Barbara Coast, obsidian was more frequently used in the Middle Period than in the Late Period" (King, n.d. pg. 35).

Although Grimes Canyon fused shale, located near Moorpark, California, seems to replace obsidian during the Late Period (Ericson, n.d.-2), it remains to be resolved whether the "observed diminishing effect" is a function of the lack of response of existing exchange systems to supply a larger (consumer) population with obsidian or a function of archaeological sampling and increased status differentiation, i.e. the quantity of obsidian remains constant from the Middle to Late Periods, but its use changes from a scarce utilitarian matérial to a luxury, high status material in the Late Period or a function of an actual collapse or disruption of the northeast-southwest exchange systems, due to population movements in the eastern Shoshonean region.

Jonathon E. Ericson

SITE: MAD-179

SUBMITTED BY: Jonathon E. Ericson DATE:

Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4414	1	7.0	H.P. #15	120-140 cm	Mariposa
4415	2	6.5	"	"	"
4416	3	7.6	"	"	"
4417	4	6.4	"	"	"
4418	5	4.7	"	"	"
4419	6	8.9	"	"	"
4420	7	4.4	"	"	"
4421	8	7.3	"	"	"
4422	9	4.4	"	"	"
4423	10	7.5	"	"	"
4424	11	NHV	"	"	"
4425	12	6.2	"	"	"
4426	13	7.0	"	"	"
4427	14	6.5	"	"	"
4428	1	6.6	"	140-160 cm	Tamarack
4429	2	6.2/2.8	"	"	"
4430	3	6.5	"	"	"
4431	4	6.6	"	"	"
4432	5	6.2	"	"	"
4433	6	6.3	"	"	"
4434	7	6.5	"	"	"
4435	8	NHV	"	"	"
4436	9	6.0	"	"	"
4437	10	6.5	"	"	"
4438	11	5.8	"	"	"

Comments:

The obsidian artifacts were collected during the excavation of the 4-MAD-179 site, conducted in 1971 by E. Gary Stickel, and members of the Dept. of Anthropology, California State University, Long Beach.

The above hydration measurements form the partial data base for deriving the source specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 4414-4427, OHL No. 4428-4438, selected from the collections of the Department of Anthropology, California State University, Long Beach, are associated with

Comments: (continued)

radiocarbon dates, UCLA-1920A, UCLA-1920B, and their source characterizations by neutron activation analyses, INAA 1562-1575, INAA 1576-1586, respectively. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing the associated radiocarbon dates correlated with the Yosemite subregion of the Sierra Nevada cultural sequence presented by Elsasser (1960) adopted from Bennyhoff (1958).

Jonathon E. Ericson

SITE: Mrp-105 (MARIPOSA COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE: July, 1973
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
3075	335-1709	4.3	Pit 22c	18"-24"	Late Tamarack-Early
3076	335-1710	3.4	"	"	Mariposa
3077	335-1712	9.2	"	"	"
3078	335-1714	4.6	"	"	"
3079	335-1715	NHV	"	"	"
3080	335-1713	8.6	"	"	"
3081	335-1716	4.6	"	"	"
3082	335-1717	14.4/5.4	"	"	"
3083	335-1718	4.2	"	"	"
3084	335-1720	5.0	"	"	"
3085	335-1721	7.1/4.3	"	"	"
3086	335-1722	6.3	"	"	"
3087	335-1723	3.4	"	"	"
3088	335-1751	4.1	"	36"-42"	Early Tamarack
3089	335-1752	4.7	"	"	"
3090	335-1753	3.4	"	"	"
3091	335-1754	5.2	"	"	"
3092	335-1756	10.0	"	"	"
3093	335-1758	3.7	"	"	"
3094	335-1759	6.9	"	"	"
3095	335-1766	3.3	"	48"-54"	Crane Flat
3096	335-1768	NHV	"	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Crane Flat site (Mrp-105), conducted in 1962 by R. Fitzwater, Department of Anthropology, UCLA.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 3075-3987, 3088-3094, and 3095-3096, selected from the collections of the UCLA Museum of Anthropology, are associated with radiocarbon dates, UCLA 276, UCLA 277, UCLA 278, and their source characterizations by neutron activation analyses, INAA 676-687, INAA 688-694, and INAA 695-696, respectively. Results of the analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

Comments (Continued):

The assignment of cultural phase of the artifacts was accomplished by utilizing the associated radiocarbon dates correlated with the Yosemite Subregion, Sierra Nevada cultural sequence presented by Elsasser (1960), adapted after Bennyhoff (1958).

Jonathon E. Ericson

SITE: Bodie Hills Obsidian Quarry #612 Mono County

SUBMITTED BY: Jonathon Ericson, Clay Singer DATE: March, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4393	567-B1-2	2.7	Transect 8	surface	
4394	567-B4-1	NHV	"	"	
4395	567-B7-2	5.3	"	"	
4396	567-B10-1	less than 1.0	"	"	
4397	567-B13-2	2.7	"	"	
4398	567-B16-1	2.5	"	"	
4399	567-B19-4	5.2	"	"	
4400	567-B22-1	3.6	"	"	
4401	567-B25-3	3.4	"	"	
4402	567-B0-1	6.0	"	"	
4629	567-B2-1	6.3	Tran. 8-T	surface	
4630	567-B3-1	5.2	"	"	
4631	567-B5-1	NHV	"	"	
4632	567-B6-2	2.5	"	"	
4633	567-B8-2	8.9	"	"	
4634	567-B1-1	3.2	"	"	
4635	567-B12-1	4.9	"	"	
4636	567-B14-1	3.4	"	"	
4637	567-B15-1	4.8	"	"	
4638	567-B17-3	4.8	"	"	
4639	567-B18-2	4.2	"	"	
4640	567-B20-3	4.4	"	"	
4641	567-B21-4	5.5	"	"	
4642	567-B23-2	4.7	"	"	
4643	567-B24-2	4.3	"	"	
4644	567-E1-1	3.9	Tran. P-9	"	
4645	567-E2-1	NHV	"	"	
4646	567-E3-2	3.2	"	"	
4647	567-E4-2	6.2	"	"	
4648	567-E5-1	5.9	"	"	

SITE: Bodie Hills Obsidian Quarry #612 Mono County

SUBMITTED BY: Jonathon Ericson, Clay Singer DATE: January, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE			CULTURAL PHASE
4649	567-E7-1	8.9	Tran.	P-9	surface	
4650	567-E8-2	5.8		"	"	
4651	567-E9-1	3.9		"	"	
4652	567-E10-2	3.7		"	"	
4653	567-E11-3	2.0		"	"	
4654	567-E13-1	8.5		"	"	
4655	567-E14-2	4.9		"	"	
4656	567-E15-2	NHV		"	"	
4657	567-E16-1	NHV		"	"	
4658	567-E17-1	2.3		"	"	
4659	567-E18-1	7.0		"	"	
4660	567-E19-2	3.3		"	"	
4661	567-E19.5-3	4.9		"	"	
4662	567-E20-2	4.8		"	"	
4663	567-E21-3	5.0		"	"	
4664	567-F0-6	8.6	Tran.	11-12	"	
4665	567-F1-4	5.9		"	"	
4666	567-F4-5	4.3		"	"	
4667	567-F5-3	5.4		"	"	
4668	567-F6-7	NHV		"	"	
4669	567-F7-1	5.5		"	"	
4670	567-F8-5	6.2		"	"	
4671	567-F9-2	5.8		"	"	
4672	567-F10-2	NHV		"	"	
4673	567-F11-1	3.1		"	"	
4674	567-F12-3	4.3		"	"	
4675	567-F13-5	7.3		"	"	
4676	567-F14-5	7.3		"	"	
4677	567-F15-5	7.4		"	"	
4678	567-F19-5	1.6		"	"	

SITE: Bodie Hills Obsidian Quarry #612 Mono County

SUBMITTED BY: Jonathon Ericson, Clay Singer DATE: January, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4679	567-F20-4	NHV	Tran. 11-12	surface	
4680	567-F21-2	1.7	"	"	
4681	567-F22-4	4.1	"	"	
4682	567-G1-1	NHV	Tran. 10-4	"	
4683	567-G2-1	3.9	"	"	
4684	567-G3-5	6.4	"	"	
4685	567-G4-1	7.0	"	"	
4686	567-G5-2	6.6	"	"	
4687	567-G6-1	4.6	"	"	
4688	567-G7-2	8.6	"	"	
4689	567-H0-1	4.8	Tran. 13-14	"	
4690	567-H1-4	8.2/6.0	"	"	
4691	567-H2-4	4.6	"	"	
4692	567-H3-6	4.3	"	"	
4693	567-H4-2	8.0	"	"	
4694	567-H5-1	3.7	"	"	
4695	567-H6-2	17.1	"	"	
4696	567-H7-4	7.4	"	"	
4697	567-I1-5	NHV	Tran. 4-11	"	
4698	567-I2-5	NHV	"	"	
4699	567-I3-2	6.3	"	"	
4700	567-I5-6	NHV	"	"	
4701	567-I6-3	4.7	"	"	
4702	567-I7-2	NHV	"	"	
4703	567-J1-8	3.7	Tran. 14-15	"	
4704	567-J2-5	3.8	"	"	
4705	567-J3-12	3.4	"	"	
4706	567-K0-7	5.2	'Original Site'		
4707	567-K1-15	2.1	"	"	
4708	567-L1-5	3.8	Ridge Survey		

SITE: Bodie Hills Obsidian Quarry #612 Mono County

SUBMITTED BY: Jonathon Ericson, Clay Singer DATE: January, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4709	567-L2-10	4.4	Ridge Survey	
4710	567-L3-27	3.7/7.7	"	
4711	567-L4-8	5.9	"	
4762	567-F13-1	4.0	Tran. 11-2 surface	
4763	567-L1-1	2.5	Ridge Survey	
4764	567-L4-4	9.2	"	
4765	567-L4-2	3.0	"	
4766	567-L2-19	2.5	"	

SITE: Snow Creek #5 Mono County 722

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975

Dept. of Anthropology

U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4864	1705	4.7	Pit 4, Feature 2, 20-40 cm	Cottonwood
4865	1706	2.8	"	"
4866	1707	NHV	"	"
4867	1708	3.4	"	"
4868	1709	3.7	"	"
4869	1710	5.0	"	"
4870	1711	5.1	"	"
4871	1712	4.6	"	"
4872	1713	1.9	"	"
4873	1714	4.6	"	"
4874	1715	4.9	"	"
4875	1716	3.9	"	"
4876	1717	8.8/1.9	"	"
4877	1718	3.6	"	"
4878	1719	4.9	"	"
4879	1720	6.0	"	"
4880	1721	5.6	"	"
4881	1722	8.8	"	"
4882	1723	2.2	"	"
4883	1724	2.8	"	"
4884	1725	5.7	"	"
4885	1726	3.4	"	"
4886	1727	2.8	"	"
4887	1728	5.0	"	"
4888	1729	5.2	"	"
4889	1730	4.7	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Snow Creek #5 site, conducted in 1974 by N. Nelson Leonard, University of California, Riverside.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact group, OHL No. 4864-4889, selected from the collections of the Archaeological Research Unit, Drylands Research Institute, Riverside, are associated with radiocarbon date, UCLA-1954 and source characterizations by neutron activation analyses, INAA 1705-1730 respectively. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon date correlated with the Owens Valley cultural sequence presented by Lanning (1963).

Jonathon E. Ericson

SITE: RIV-463 (RIVERSIDE COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE: September, 1973
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
3157	d1	2.2	Area 2	30-40 cm	Marana/Desert Mohave
3158	d2	2.7	"	"	"
3159	d3	2.0	"	"	"
3160	d4	3.3	"	"	"
3161	d5	3.0	"	"	"
3162	d6	3.9	"	"	"
3163	d7	2.7	"	"	"
3164	g1	3.6	"	60-70 cm	Haiwee/Amargosa II
3165	g2	2.6	"	"	"
3166	g3	2.1	"	"	"
3167	g4	2.9	"	"	"
3168	g5	1.6	"	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Peppertree site. (RIV-463), conducted in 1971 by Phillip J. Wilke, and T. F. King, Department of Anthropology, University of California, Riverside (O'Connell et al, n.d.).

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, (1975). The artifact groups, OHL No. 3157-3163, OHL No. 3164-3168, selected from the collections of the California Department of Parks and Recreation, are associated with radiocarbon dates, UCLA 1816, UCLA 1815, and their source characterizations by neutron activation analyses, INAA 626-632, INAA 645-649, respectively. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing the associated radiocarbon dates correlated with the Marana and Haiwee phases of the South Great Basin cultural sequence presented by Bettinger and Taylor (1974), or the Desert Mohave and Amargosa II phases of the Mohave Desert cultural sequence presented by Wallace (1962).

Jonathon E. Ericson

SITE: SBCM-128 (SAN BERNARDINO COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE: August, 1973
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE			CULTURAL PHASE
3342	128-008a	4.4	N4/E4	Sq C	30-40 cm	Newberry/Amargosa1
3343	128-008b	5.0	"	"	"	"
3344	128-008c	4.1	"	"	"	"
3345	128-009a	4.3	"	D	"	"
3346	128-009b	4.7	"	"	"	"
3347	128-009c	4.7	"	"	"	"
3348	128-056	4.4	N6/WS	A	"	"
3349	128-0014	4.8	"	C	"	"
3761	152	2.5	N6/W8	B	10-20 cm	
3762	154	4.4	"	A	20-30 cm	
3763	156	4.4	"	"	60-70 cm	
3764	157	2.5	N6/W6	"	10-20 cm	
3765	166	4.1	N4/E4	"	"	
3766	167	4.4	"	"	20-30 cm	
3767	168	NHV	"	C	10-20 cm	
3768	169	4.1	"	B	30-40 cm	
3769	170	4.1	"	"	60-70 cm	

Comments:

The artifacts were collected during the excavation of the Ridge site (SBCM-128), conducted in 1973 by Chris White, Department of Anthropology, UCLA.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact groups, OHL No. 3342-3347, OHL No. 3348-3349, selected from the collections of the San Bernadino County Museum, are associated with radiocarbon dates, UCLA 1789A, UCLA 1789B, and their source characterizations by neutron activation analyses, INAA 787-792, INAA 793-794, respectively. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

Other hydration measurements, OHL No. 3761-3768, INAA 801-809 (non-sequential), not included in the above study, were submittedy by the excavator to resolve certain temporal problems encountered during excavation and analysis.

The assignment of cultural phase of the artifacts was accomplished by utilizing comments

Comments: (continued)

of the excavator and the associated radiocarbon dates correlated with the Newberry, South Great Basin cultural sequence presented by Bettinger and Taylor (1974), or with the Amargosa I, Mohave Desert cultural sequence presented by Wallace (1962).

Jonathon E. Ericson

SITE: SCI-17 (Little Harbor) (SANTA CATALINA ISLAND, CALIFORNIA)

SUBMITTED BY: Dave Morrill
Dept. of Anthropology
UCLA

DATE:

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4219	UCLA 417-1004	NHV	Pit #5 0-10cm Natural level I	

Comments:

Sample consists of a single flake unearthed during the summer, 1973 Little Harbor excavation, conducted by the UCLA Archaeological Survey. This piece was the only obsidian recovered from the site. The lack of hydration is attributed to chipping during excavation, or to post-excavation processing.

Obsidian does not occur on Catalina Island so the fragment must be imported from the mainland.

C.W. Meighan

SITE: Collard Site (SISKIYOU COUNTY, CALIFORNIA)

SUBMITTED BY: Joe Chartkoff DATE: April, 1974
Department of Anthropology
Michigan State University

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4231	KR-866	4.9	Pit S8/W20	Level 7	Late Horizon?
4232	KR-842	2.8	"	2	"
4233	KR-473	3.0	S31/W24	5	"
4234	KR-756	3.0	"	2	"
4235	KR-744	3.3	"	8	"
4236	KR-803	4.2	"	4	"
4237	KR-841	NHV	"	8	"

Comments:

The Collard Site is a stratified site on the Klamath River, three miles east of Happy Camp in western Siskiyou County. It is a habitation site located on a bluff about thirty feet above river level. These samples come from two pits. S31/W24 is in the middle of the site. S8/W20 is on the north side. Each is a 5'x5', dug in six inch levels.

At the Collard Site, there are milling stones which suggest that the site could have an early base. No organic samples for radiocarbon dating were recovered, probably due to the unfavorable soil conditions.

Joe Chartkoff

SITE: SOL-2

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4811	1-80106	NHV	Trench 1 Unit 3 30"	Emergent Period
4812	1-80107	NHV	" " "	"
4813	1-80108	2.6	" " "	"

Comments:

The obsidian artifacts were collected during the excavation of the Peterson site (SOL-2) conducted in 1948 by R. F. Heizer and members of Archaeological Field Method Class 195, University of California, Berkeley.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact group, OHL No. 4811 4813, selected from the collections of the Lowie Museum, University of California, Berkeley, is associated with radiocarbon date UCLA-1950, and source characterizations by neutron activation analyses, INAA 1652-1654, respectively. A complete report of the results of these analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the North Coast Range cultural sequence presented by Fredrickson, n.d.

Jonathon E. Ericson

SITE: Cardoza nos. 2, 4, and 8, Tolay Valley, (SONOMA COUNTY, CALIFORNIA)

SUBMITTED BY: George E. Phebus DATE: December, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4380	455,587 (1)	NHV	Cardoza #8	Middle Horizon?
4381	455,587 (2)	1.2	"	"
4382	455,587 (3)	less than 1.0	"	"
4383	455,587 (4)	2.7	"	"
4384	455,587 (5)	NHV	"	"
4385	455,587 (6)	1.1	"	"
4386	455,598 (1)	NHV	Cardoza #4	"
4387	455,598 (2)	less than 1.0	"	"
4388	455,598 (3)	NHV	"	"
4389	455,598 (4)	5.7	"	"
4390	455,598 (5)	2.6	"	"
4391	455,598 (6)	NHV	"	"
4392	451,590 3-7	2.0	Cardoza #2	Late Horizon, Phase I
4393	451,590 3-14	2.0	"	"
4394	451,621 3-39	1.8	"	"

Comments:

Samples 4380 - 4391 were collected from the surface of two sites, both believed to date from the Middle Horizon at the latest. One site, Cardoza #8, may be related to the Early Horizon.

Conversation with Paul Aiello (UCLA) and several scholars from the National Bureau of Standards suggest that due to submersion (annually) for many decades, the hydration layers have been greatly altered. Sample 4389 is believed to fall within the expected range based on comparison of the cultural materials recovered.

Samples 4392 - 4394 were excavated and are consistent with the age range for Late Horizon, Phase I.

George E. Phebus

SITE: Son-518 (SONOMA COUNTY, CALIFORNIA)

SUBMITTED BY: Jonathon E. Ericson DATE:
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4103	#2	2.5	Feature #1, floor, Circ. house pit	Protohistoric/ Houx Pattern
4104	003	2.6	"	"
4105	004	2.1	"	"
4106	005	2.5	"	"
4107	006	2.1	"	"
4108	73-9-628	2.3	"	"
4109	73-9-629	1.5	"	"
4110	73-9-631	2.5	"	"

Comments:

The obsidian artifacts were collected during the excavation of the Son-518 site (formerly SDA-30), conducted in 1973 by Ward Upson, Santa Rosa, under contract to the Sonoma County Water Agency.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California, discussed by Ericson, 1975. The artifact group, OHL 4103-4110, selected from the collections of the Department of Anthropology, California State University, Sonoma, is associated with radiocarbon date, UCLA-1794C, and source characterizations by neutron activation analyses, INAA 810-817, respectively. These analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the North Coast Ranges cultural sequence presented by Fredrickson, n.d.

Jonathon E. Ericson

SITE: BAJA CALIFORNIA

SUBMITTED BY: C. W. Meighan DATE: June, 1975

Dept. of Anthropology

UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4734	BC-1	4.5	Central Baja	
4735	BC-2	4.5	"	
4736	BC-3	2.9	"	
4737	BC-4	2.5	"	
4738	BC-5	3.9	"	
4739	BC-6	2.6	"	
4947	10	2.8	Rincon Grande	
4948	429-24	4.7	Las Pintas	
4949	430-8	3.0	Velicatá	
4950	431-17	chert	Tinaja De Refugio	
4951	431-88	4.0	"	
4952	431-88b	2.6	"	
4953	431-92	3.4	"	
4954	431-36	3.1	"	
4955	431-34	2.4	"	
4956	431-91	NHV	"	
4957	431-16	3.3	"	
4958	431-16b	3.0	"	
4959	431-35	2.1	"	

Comments:

These specimens are associated with a series of rock art sites in Central Baja California. They represent development of a data base for future use in dating the rock art locations. Source and hydration rates have not yet been determined. The obsidian is locally available in the area of the sites.

C.W. Meighan

NORTH AMERICAN WEST

SITE: Chevelon (ARIZONA)

SUBMITTED BY: Frank Findlow, Suzanne DeAtley DATE: April, 1975

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4238	None	3.0	CR-12	surface	
4239	"	2.7	CR-6	"	
4240	"	2.5	CR-17	"	
4241	"	2.5	CR-3	"	
4242	"	2.1	CR-19	"	
4243	"	2.8	CR-2	"	
4244	"	2.3	CR-10	"	
4245	"	2.6	CR-1	"	
4246	"	2.5	CR-7	"	
4247	"	2.3	CS-9	"	
4248	"	2.1	CS-15	"	
4249	"	2.6	CS-112	"	
4250	"	2.6	CS-218	"	
4251	"	3.4	CS-327	"	
4252	"	3.4	CS-312	"	
4253	"	2.8	CS-120	"	
4254	"	2.5	CS-65	"	
4255	"	2.1	CS-128	"	
4256	"	3.1/3.3	CS-128	"	
4257	"	2.3	CS-120	"	
4258	"	5.0	CS-179	"	
4259	"	2.2	CS-45E	"	
4260	"	2.3	CS-76A	"	
4261	"	2.5	CS-128	"	
4262	"	2.3	CS-120	"	
4263	"	6.4	CS-303	"	
4264	"	1.7	CS-65	"	
4265	"	2.2	CS-72	"	
4266	"	2.5	CS-120	"	
4267	"	1.5	CS-172	"	

SITE: Chevelor (ARIZONA)

SUBMITTED BY: Frank Findlow, Suzanne DeAtley DATE: April, 1975

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4268	None	2.1	CS-128 surface	
4269	"	2.3	CS-218 "	
4270	"	2.3	CS-45D "	
4271	"	2.6	CS-45 "	
4272	"	2.3	CS-66 "	
4273	"	1.8	CS-66 "	
4274	"	2.3	CS-45 "	
4275	"	2.1	CS-45 "	
4276	"	2.0	CS-89 "	
4277	"	2.1	CS-89 "	
4278	"	2.2	CS-89 "	
4279	"	3.3	CS-201 "	
4280	"	2.5	CS-66 "	
4281	"	2.0	CS-84 "	
4282	"	1.8	CS-89 "	
4283	"	1.4	CS-76 "	
4284	"	1.8	CS-195 "	
4285	"	2.0	CS-45 "	
4286	"	2.2	CR-14 "	
4287	"	2.0	CS-66 "	
4288	"	2.6	CS-45 "	
4289	"	1.8	CS-45 "	

SITE: N:16:51 N:16:31 (CENTRAL ARIZONA)

SUBMITTED BY: George J. Gumerman
Dept. of Anthropology
Southern Illinois University

DATE: September, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4165	A-1	2.7	N:16:51 Rm 5 Sect A 99cm	Pueblo 3
4166	B-1	NHV	2 " Fill	"
4167	C-1	3.1	II Unit II "	"
4168	D-1	2.3	" Sect II "	"
4169	D-2	2.8	" " "	"
4170	D-3	2.8	" " "	"
4171	E-1	2.5	5 A "	"
4172	F-1	1.8	N:16:31 I I	"
4173	F-2	2.3	" "	"
4174	F-3	2.0	" "	
4175	F-4	2.3	" "	"
4176	F-5	2.7	" "	"
4177	F-6	2.5	" "	"
4178	F-7	2.8	" "	"
4179	F-8	3.0	" "	"
4180	F-9	3.2	" "	"
4181	F-10	2.5	" "	"
4182	F-11	NHV	" "	"
4183	F-12	2.2	" "	"
4184	F-13	1.7	" "	"
4185	F-14	2.5	" "	"
4186	F-15	2.6	" "	"
4187	F-16	2.1	" "	"
4188	F-17	1.7	" "	"
4189	F-18	2.1	" "	"
4190	F-19	2.1	" "	"
4191	F-20	2.3	" "	"
4192	F-21	2.3	" "	"
4193	F-22	2.0	" "	"
4194	F-23	2.3	" "	"

SITE: N:16:31; N:16:46; N:16:80; T:4:54 (CENTRAL ARIZONA)

SUBMITTED BY: George J. Gumerman DATE: September, 1974
Dept. of Anthropology
Southern Illinois University

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4195	F-24	2.5	N:16:31 Rm I Sect I	Pueblo 3
4196	F-25	chert	" " "	"
4197	F-26	2.2	" " "	"
4198	F-27	2.6	" " "	"
4199	F-28	2.7	" " "	"
4200	F-29	2.6	" " "	"
4201	F-30	2.7	" " "	"
4202	F-31	2.1	" " "	"
4203	G-1	2.3	" I I Fill	"
4204	G-2	NHV	" " " "	"
4205	G-3	2.3	" " " "	"
4206	G-4	2.0	" " " "	"
4207	G-5	2.5	" " " "	"
4208	G-6	2.5	" " " "	"
4209	H-1	2.5	N:16:46 Unit I Fill	"
4210	H-2	2.0	" " "	"
4211	I-1	2.5	N:16:80 Surface	"
4212	I-2	2.1	" "	"
4213	I-3	2.6	" "	"
4214	J-1	3.4	T:4:54 Surface	"

Comments:

In general, it is our impression that the obsidian hydration dates correspond quite well to our expected dates. At Ariz. N:16:31 the dominant pottery types were of the Jeddito Series, the Awatovi Series and Salt Red; all of these pottery types have been dated from tree-ring association between 1275 and 1450 A D. It is our impression that the obsidian hydration rate dates fall within the expected range although slightly later than anticipated. This might be due, however, to the peripheral nature of our sites, especially since the ceramic types have probably been traded from some distance.

Ariz. N:15:51 have dominant pottery types which include Tusayan Black-on-white, Kayenta Black-on-white, and Tuzigoot White-on-red. All these pottery types have been dated by tree-ring associations at between 1200 and 1300 A. D. It is our impression that they fall within the expected range and they do not show the lateness that we expected from the Ariz. N:16 :31 site. In short, we expected Ariz. N:16:51 to be earlier than Ariz. N:16:31 and this was borne out by your obsidian hydration results.

At Ariz. P:4:54 the dominant pottery type is Sacaton Red-on-buff. This pottery type dates approximately between 1000 and 1100 A. D. It is our feeling that the obsidian hydration date is very early, although this sample was taken from a site in close association with an agricultural system which may have been in use for some time. In addition, it is a single sample and this of course makes it suspect. We are not overly concerned about this particular sample.

At Ariz. N:16:80 the dominant pottery type is Gila Polychrome which has been dated by associated tree-ring samples between 1200 and 1350 A.D. Therefore, the majority of the obsidian hydration dates are right on the money.

George J. Gumerman

SITE: NEV-15, North San Juan Site

SUBMITTED BY: Jonathon E. Ericson DATE: June, 1975

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4814	1-173134 1	4.4	16-SW-20 12"-24"	Martis
4815	1-173134 2	2.3	" "	"
4816	1-173134 3	4.1	" "	"
4817	1-173199	3.5	22-SE-20 "	Kings Beach

Comments:

The obsidian artifacts were collected during the excavation of the North San Juan site, conducted in 1954 by members of Anthropology Class, S197, University of California, Berkeley.

The above hydration measurements form the partial data base for deriving the source-specific obsidian hydration rates for California discussed by Ericson, 1975. The artifact group, OHL No. 4814-4816, selected from the collections of the Lowie Museum, University of California Berkeley, is associated with radiocarbon dates, UCLA-1951A, UCLA-B, and source characterizations by neutron activation analyses, INAA 1655-1657, and INAA 1658. These analyses and the source-specific obsidian hydration rates for California are reported elsewhere (Ericson, 1978).

The assignment of cultural phase of the artifacts was accomplished by utilizing comments of the excavator and the associated radiocarbon dates correlated with the Northern Sierra sub-region Sierra Nevada cultural sequence presented by Elsasser (1960) and adapted from Bennyhoff (1958).

Jonathon E. Ericson

SITE: HIGH ROCK LAKE/HOG RANCH MT. (Humboldt and Washo Cos., Nevada)

SUBMITTED BY: Roberta L. McGonagle
Dept. Of Anthropology
Stephen F. Austin State Univ.

DATE: February, 1974
(Samples collected 1972)

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3183	1	9.6	26 Hu 212 (surface)	
3184	6	5.3	" "	
3185	10	5.0	" "	
3186	11	8.5	" "	
3187	27	6.6	" "	
3188	No #	7.7	" "	
3189	2	1.1	26 Hu 213 (surface)	
3190	12	5.0	26 Hu 214 (surface)	
3191	14	3.0	" "	
3192	15	3.7	" "	
3193	16	4.4	" "	
3194	22	3.9	" "	
3195	37	6.0	" "	
3196	39	3.7	" "	
3197	40	5.7	" "	
3198	49	3.6	" "	
3199	51	7.3	" "	
3200	54	4.1	" "	
3201	56	2.3	" "	
3202	3	10.3	26 Hu 215 (surface)	
3203	4	6.3	" "	
3204	1	5.8	26 Wa 1520 (surface)	
3205	2	7.1	" "	
3206	5	7.0	" "	
3207	6	9.5	" "	
3208	10	8.2	" "	
3209	13	5.8	" "	
3210	14	6.3	" "	
3211	15	5.5	" "	
3212	16	10.2	" "	

SITE: HIGH ROCK LAKE/HOG RANCH MT.

SUBMITTED BY: Roberta L. McGonagle DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3213	17	3.4	26 Wa 1520 (surface)	
3214	1	2.7	26 Wa 1521(surface)	
3215	6	5.0	" "	
3216	12	9.0	" "	
3217	21	5.2	" "	
3218	27	4.3	" "	
3219	30	3.6	" "	
3220	31	2.8	" "	
3221	3	9.1	26 Wa 1522 (surface)	
3222	5	5.0	" "	
3223	3	5.3	26 Wa 1525 (surface)	
3224	4	4.2	" "	
3225	6	4.1	26 Wa 1526 (surface)	
3226	7	4.2	" "	
3227	8	4.6	" "	
3228	1	3.8	26 Wa 1527 (surface)	
3229	2	3.3	" "	
3230	1	3.9	26 Wa 1528 (surface)	
3231	5	5.0	" "	
3232	6	2.5	" "	
3233	9	2.6	" "	
3234	21	3.8	" "	
3235	26	2.3	" "	
3236	2	3.6	26 Wa 1529 (surface)	
3237	3	3.3	" "	
3238	12	3.4	" "	
3239	13	7.5	" "	
3240	3	5.5	26 Wa 1530 (surface)	
3241	5	4.3	" "	
3242	8	4.4	" "	

SITE: HIGH ROCK LAKE/HOG RANCH MT.

SUBMITTED BY: Roberta L. McGonagle DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3243	13	5.0	26 Wa 1530 (surface)	
3244	3	7.4	26 Wa 1531 (surface)	
3245	5	4.3	" "	
3246	14	4.1	" "	
3247	18	3.9	" "	
3248	1	6.8	26 Wa 1532 (surface)	
3249	2	6.5	" "	
3250	4	4.9	" "	
3251	5	3.6	" "	
3252	18	6.5	" "	
3253	1	4.2	26 Wa 1533 (surface)	
3254	2	5.2	" "	
3255	25	6.3	" "	
3256	26	4.4	" "	
3257	28	4.8	" "	
3258	36	5.3	" "	
3259	71	6.6	" "	
3260	76	4.3	" "	
3261	88	4.8	" "	
3262	89	6.4	" "	
3263	1	7.7	26 Wa 1534 (surface)	
3264	2	5.0	" "	
3265	3	5.0	" "	
3266	4	4.3	" "	
3267	5	5.0	" "	
3268	17	5.9	" "	
3269	1	5.7	26 Wa 1535 (surface)	
3270	2	7.3	" "	
3271	3	5.0	" "	
3272	4	5.5	" "	

SITE: HIGH ROCK LAKE/HOG RANCH MT.

SUBMITTED BY: Roberta L. McGonagle DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3273	5	5.0	26 Wa 1535 (surface)	
3274	6	6.4	" "	
3275	7	6.6	" "	
3276	8	4.3	" "	
3277	9	7.0	" "	
3278	10	4.3	" "	
3279	11	4.8	" "	
3280	1	5.7	26 Wa 1536 (surface)	
3281	2	5.8	" "	
3282	4	4.3	" "	
3283	5	3.7	" "	
3284	3	4.2	Acc.# Mu 2672	
3285	5	3.6	" "	
3286	36	8.6	" "	
3287	38	6.7	" "	
3288	44	5.3	" "	
3289	45	2.8	"	
3290	46	3.1	" "	
3291	84			
3292	85	3.2	" "	
3293	113	6.2	" "	
3294	116	5.3	" "	
3295	152	4.9	" "	
3296	154	2.8	" "	
3297	184	4.7	" "	
3298	185	7.4	" "	
3299	194	5.8	" "	
3300	202	6.5	" "	
3301	204	4.9	" "	
3302	208	4.6	" "	

SITE: HIGH ROCK LAKE/HOG RANCH MT.

SUBMITTED BY: Roberta L. McGonagle DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3303	214	6.6	Acc.# Mu2672	
3304	241	11.4	" "	
3305	251	1.3	" "	
3306	271	3.7	" "	
3307	277	3.7	" "	
3308	278	4.7	" "	
3309	279	4.3	" "	
3310	290	9.0	" "	
3311	294	9.2	" "	
3312	312	7.6	" "	
3313	320	3.9	" "	
3314	363	3.6	" "	
3315	375	6.2	" "	
3316	376	6.9	" "	
3317	377	6.3	" "	
3318	4	4.9	" "	
3319	10	6.6	" "	
3320	20	5.0	" "	
3321	23	4.2	" "	
3322	26	5.7	" "	
3323	31	2.0	" "	
3324	107	5.3	" "	
3325	112	4.2	" "	
3326	166	4.7	" "	
3327	176	5.8	" "	
3328	178	5.3	" "	
3329	183	6.4	" "	
3330	192	3.2	" "	
3331	234	5.0	" "	
3332	236	7.1	" "	

SITE: HIGH ROCK LAKE/HOG RANCH MT.

SUBMITTED BY: Roberta L. McGonagle DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3333	243	4.1	Acc.# Mu2672	
3334	249	4.3	" "	
3335	255	4.7	" "	
3336	263	5.0	" "	
3337	282	6.1	" "	
3338	288	5.1	" "	
3339	292	5.1	" "	
3340	389	2.5	" "	

Comments:

This rather large sample consists of surface collected obsidian obtained during the 1972 University of Missouri Northwest Nevada Survey Project conducted by Roberta Lee McGonagle.

This obsidian has been used to extend and supplement the existing chronological sequence for the region around High Rock Lake based on projectile point types.

Roberta L. McGonagle

SITE: Hidalgo Survey, NEW MEXICO

SUBMITTED BY: Frank Findlow, Suzanne DeAtley DATE: August, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4990	4	3.7	HS 1	
4991	5	3.3	"	
4992	1	5.0	32-B	
4993	1	NHV	HS 1	
4994	2	4.2	"	
5077	1	6.0	HS 1g	
5078	2	3.2	"	
5079	3	4.2	"	
5080	4	5.2	"	
5081	5	3.3	"	
5082	1	3.7	HS 9g	
5083	2	3.0	"	
5084	3	2.7	"	
5085	4	1.9	"	
5086	5	3.0	"	
5087	1	3.9	HS 11g	
5088	2	NHV	"	
5089	3	3.2	"	
5090	4	3.9	"	
5091	5	NHV	"	
5092	1	NHV	HS 15g	
5093	2	3.5	"	
5094	3	3.1	"	
5095	4	3.4	"	
5096	5	4.1	"	
5097	1	2.4	HS 100	

SITE: Hidalgo Survey, NEW MEXICO

SUBMITTED BY: Frank Findlow, Suzanne DeAtley DATE: August, 1975

Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4960	1	2.9	HS 10B	
4961	2	2.9	"	
4962	3	2.9	"	
4963	4	NHV	"	
4964	5	3.0	"	
4965	1	3.2	HS 32	
4966	2	2.9	"	
4967	3	3.2	"	
4968	4	2.2	"	
4969	5	3.1	"	
4970	6	2.2	"	
4971	7	3.0	"	
4972	1	5.4	HS 10	
4973	2	2.9	"	
4974	3	2.6	"	
4975	4	4.4	"	
4976	5	2.7	"	
4977	1	2.4	HS 9	
4978	2	2.1	"	
4979	3	3.1	"	
4980	4	3.3	"	
4981	5	2.2	"	
4982	6	2.3	"	
4983	7	2.9	"	
4984	8	1.8	"	
4985	9	2.5	"	
4986	10	NHV	"	
4987	1	2.9	HS 1	
4988	2	3.2	"	
4989	3	3.2	"	

Comments:

The region under study is in the southwesternmost corner of New Mexico and is comprised of the Upper Animas and San Luis Valleys, an area of roughly 500 square miles. A project was designed to determine a source-specific rate for the Antelope Wells obsidian source, which is located within the southeastern boundary of the survey area. Material for C^{14} dates in association with archaeological obsidian was collected. Presently, only one well-associated C^{14} date is available, but additional dates are forthcoming. The particular sites reported on below were chosen for the initial stage of the rate study because ceramic evidence suggests that they represent discrete occupations between 0 A.D. and 1450 A.D. Of course, the "ceramic dates" listed below may be subject to considerable error, but in the past they have provided fairly accurate temporal estimates. Accordingly, they should be regarded as tentative dates, subject to revision as the C^{14} dates become available.

1) HS 1 · a medium sized pueblo, occupies the crown of a small hill in Cloverdale Valley. While wall footings for between 20 to 30 rooms can still be traced, the size of the sherd scatter suggests that the site may have been considerably larger. The ceramic date for the site is 1100 to 1200 A.D.

2) HS 9 -(Pendleton Ruin) is a large pueblo of over 100 rooms, situated at the mouth of the Cloverdale Creek. Ceramic materials suggest a date of 1400 to 1450 A.D.

3) HS 10-is located in the mid-Cloverdale Valley area beside Cloverdale Creek. It is composed of roughly 50 to 75 rooms, arranged in two distinct room blocks Immediately adjacent to this site is a large lithic scatter covering several thousand square meters. The ceramic date for the site is 1250 to 1300 A.D.

4) HS 11-has no date estimate. It is a large surface scatter 50 meters west of HS 10. No structures are visible.

5) HS 15-is the largest site recorded during the 1975 survey. Although no structures are visible, the surface ceramic scatter covers an area of 200 by 200 meters. One hundred percent of the ceramics from the site are a local variant of Alma Plain and the suggested date is 0 to 600 A.D.

6) HS 32-is another very large site presently covering an area of 80 by 100 meters. The site has been badly damaged, but it appears to have been a multi-story pueblo of around 300 rooms. A C^{14} date on roofing material gave a date of 1250 $\pm$ 25 A.D. (UCLA - 1948 A).

7) HS100-is a small rock shelter in Double Adobe Canyon. The site is quite small, but it contained roughly 18 cm. of deposit. A corncob from the lowest level gave a C^{14} date of 500 $\pm$ 50 A.D. (UCLA 1948 D). Unfortunately, the single obsidian flake was not associated with the corncob, but came from the surface with late prehistoric and historic Apache artifacts.

If the tentative ceramic dates are accepted as approximately correct, and after removing the extreme hydration values for each site, the following represents the association between the mean hydration value and date.

Site	Mean Hydration	Dates A. D.
HS 15	3.67	0 to 600
HS 11	3.66	---
HS 1	3.46	1100 to 1200
HS 10	3.04	1200 to 1275
HS 32	3.08	1225 to 1275
HS 9	2.55	1400

Currently there are neither enough absolutely dated points nor hydration readings to draw sound conclusions about a possible hydration rate for the Antelope Wells source. However, obsidian from 47 additional sites and organic material for C^{14} dates are currently being processed, and a rate is being determined.

Frank J. Findlow
Suzanne P. De Atley

SITE: LA 12077, LA 676, LA 12110, Mimbres Valley, NEW MEXICO

SUBMITTED BY: Steven LeBlanc
Institute of Archaeology
UCLA

DATE: December, 1975

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
4910		NHV	LA 12077	8-1-2	
4911		2.6	"	8-3-2/a	
4912		2.3	"	8-3-2/b	
4913		3.1	"	8-3-2/c	
4914		5.3	"	8-3-2/d	
4915		3.5	"	8-2-2/a	
4916		2.9	"	8-2-2/b	
4917		2.5	"	8-4-5/a	
4918		2.4	"	8-4-5/b	
4919		2.8	"	8-4-5/c	
4920		3.0	"	8-4-5/d	
4921		3.4	"	8-4-5/e	
4922		2.3	"	8-2-3/a	
4923		NHV	"	8-2-3/b	
4924		3.0	"	8-1-3/a	
4925		2.5	"	8-1-3/b	
4926		3.0	"	8-3-4	
4927		3.1	LA 676	325-1-2	
4928		3.2/5.8	"	325-1-1/a	
4929		2.9	"	325-1-1/b	
4930		2.7	"	325-3-3	
4931		2.6	"	325-3-2	
4932		2.9	"	325-2-2	
4933		NHV	LA 12110	8-1-7	

Comments:

The samples were collected during the 1974 Mimbres Valley excavations, under the direction of Dr. Steven LeBlanc. The sites consisted of multi-roomed pueblos, with multiple living floors. The samples submitted were selected as a pilot project to test the usefulness of obsidian dating in this context.

Chemical characterization analyses have not been performed on this obsidian, but due to the limited number of easily accessible sources in the area, and their visual distinctiveness, the obsidian can be grouped.

Comments (Continued):

All pieces in the sample, except one, are believed to be from the Mule Creek source, which weathers out as cobbles in strata near the sites. The exception is No. 4933, which is from the Red Hill source.

These preliminary hydration measurements are encouraging, and a larger sample is currently being processed.

Steven A. LeBlanc

MEXICO

SITE: Capacha, Colima

SUBMITTED BY: Isabel Kelly DATE:

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4441	7970a	7.0	surface	
4442	7970b	7.9	"	
4443	7970c	6.4	"	
4444	8188a	Not measurable	"	
4445	8188b	8.5	"	
4446	8188c	Not measurable	"	

Comments:

Additional Capacha readings along with their interpretation and comments on surface West Mexican readings are given in the previous compendium (Meighan, Findlow, and De Atley 1974).

This list represents additional Capacha specimens not previously analyzed. There is a radiocarbon date for Capacha materials of about 1500 B.C., making this a very important early culture in West Mexico. Further discussion of the dating and associated ceramics is in Greengo and Meighan (1976).

Using the revised West Mexican rate proposed by Findlow and Bennett (this volume), these readings indicate ages between 486 B.C. and 111 A.D. Other pieces in presumed Capacha association yield ages as old as 1032 B.C. however. None of the obsidian dates are as old as the 1500 B.C. radiocarbon date. The more recent hydration dates associated with Capacha are very likely specimens from later cultures, since hydration readings to eight microns or so are associated with late Preclassic sites like Morett (Meighan 1972) which has a broad suite of radiocarbon dates indicating ages about the beginning of the Christian era. The Capacha culture should date at least 500 to 1000 B.C. and hydration readings should be on the order of nine to ten microns for this culture. It is predicted that this will prove to be the pattern when sufficient controlled field and dating evidence is available.

C.W. Meighan

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence
Dept. of Anthropology
Univ. of Western Ontario DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3351	T1-a	2.8	1:E:N6E3	
3352	T1-b	3.1	"	
3353	T1-c	3.1	"	
3354	T1-d	2.7	"	
3355	T1-e	4.1	"	
3356	T1-f	2.8	"	
3357	T1-g	3.0	"	
3358	T1-h	4.9	"	
3359	T1-i	NHV	"	
3360	T1-j	4.2	"	
3361	T1-k	3.4	"	
3362	T1-l	3.8	"	
3363	T1-m	4.4	"	
3364	T1-n	4.4	"	
3365	T2-a	2.3	1:E:N6E3	
3366	T2-b	2.0	"	
3367	T2-c	2.0	"	
3368	T2-d	NHV	"	
3369	T2-e	2.5	"	
3370	T2-f	2.1	"	
3371	T2-g	2.6	"	
3372	T2-h	2.1	"	
3373	T2-i	2.2	"	
3374	T2-j	2.7	"	
3375	T2-k	2.1	"	
3376	T2-l	1.8	"	
3377	T2-m	1.5	"	
3378	T2-n	2.5	"	
3379	T2-o	NHV	"	
3380	T2-p	3.2	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3381	T2-q	2.8	1:E:N6E3	
3382	T2-r	1.7	"	
3383	T2-s	2.7	"	
3384	T2-t	3.0	"	
3385	T2-u	2.8	"	
3386	T3-b	3.6	6:SW:N1W3	
3387	T3-c	2.6	"	
3388	T3-d	4.4	"	
3389	T3-e	3.3	"	
3390	T3-f	3.2	"	
3391	T4-a	1.7	"	
3392	T5-a	1.5	6:SE:N1W3	
3393	T5-b	1.1	"	
3394	T5-d	1.4	"	
3395	T5-e	1.1	"	
3396	T5-f	1.0	"	
3397	T6-a	NHV	6:NE:N1W3	
3398	T6-b	2.2	"	
3399	T6-c	2.0	"	
3400	T7-a	3.3	"	
3401	T7-b	3.6	"	
3402	T8-a	NHV	"	
3403	T8-b	1.0	"	
3404	T8-c	4.3	"	
3405	T8-d	NHV	"	
3406	T8-g	2.3	"	
3407	T9-a	1.8	9:NW:N1W3	
3408	T9-b	1.2	"	
3409	T9-c	0.9	"	
3410	T9-d	NHV	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3411	T9-e	1.5	9:NW:N1W3	
3412	T9-f	1.2	"	
3413	T9-g	1.2	"	
3414	T10-1	2.1	16:N4W3	
3415	T10-2	2.3	"	
3416	T10-3	4.6	"	
3417	T10-4	2.6	"	
3418	T10-5	2.7	"	
3419	T10-6	3.2	"	
3420	T10-7	2.0	"	
3421	T10-8	2.1	"	
3422	T10-10	3.1	"	
3423	T10-11	3.7	"	
3424	T11-1	3.4	"	
3426	T11-2	2.8	"	
3427	T12-a	3.6	"	
3428	T12-b	3.7	"	
3429	T12-c	3.6	"	
3430	T12-d	4.4	"	
3431	T13-a	2.5	15:N4W3	
3432	T13-b	2.7	"	
3433	T13-c	4.9	"	
3434	T13-d	2.6	"	
3435	T13-e	3.3	"	
3436	T13-f	2.5	"	
3437	T13-g	2.8	"	
3438	T13-h	3.4	"	
3439	T13-i	3.0	"	
3440	T13-j	2.2	"	
3441	T13-k	2.8	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3442	T13-l	2.1	15:N4W3	Postclassic ?
3443	T13-m	2.7	"	"
3444	T13-n	2.1	"	"
3445	T13-o	3.0	"	"
3446	T14-a	3.7	37:N1W2	
3447	T14-b	3.9	"	
3448	T14-c	2.8	"	
3449	T14-d	3.9	"	
3450	T14-e	3.6	"	
3451	T14-f	3.8	"	
3452	T15-a	4.3	46:NNE:N1W2	
3453	T15-b	3.8	"	
3454	T15-c	2.0	"	
3455	T15-d	4.2	"	
3456	T15-e	4.2	"	
3457	T15-f	3.4	"	
3458	T15-g	4.2	"	
3459	T15-h	3.8	"	
3460	T15-i	4.2	"	
3461	T15-j	3.9	"	
3462	T15-k	4.7	"	
3463	T15-l	4.2	"	
3464	T16-a	4.6	49:N1W2	
3465	T16-b	4.1	"	
3466	T16-c	3.8	"	
3467	T16-d	4.4	"	
3468	T16-e	3.8	"	
3469	T16-f	3.3	"	
3470	T16-g	1.4	"	
3471	T17-a	3.9	12:N1W1	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3472	T17-b	3.9	12:N1W1	
3473	T17-c	4.6	"	
3474	T18-a	2.8	2:N6W1	
3475	T18-b	2.8	"	
3476	T19	2.3	"	
3477	T20	NHV	"	
3478	T21-a	3.7	"	
3479	T21-c	1.9	"	
3480	T21-d	2.8	"	
3481	T22-a	3.1	5:E:N6W1	
3482	T22-c	3.7	"	
3483	T23	2.3	"	
3484	T24-a	2.5	"	
3485	T24-b	1.0	"	
3486	T25-a	3.6	14:N6W1	
3487	T25-b	2.6	"	
3488	T25-c	3.7	"	
3489	T25-a	3.7	13:N1E4	
3490	T26-b	3.8	"	
3491	T26-c	4.7	"	
3492	T26-d	3.3	"	
3493	T26-e	3.8	"	
3494	T26-f	3.7	"	
3495	T26-g	4.2	"	
3496	T26-h	4.2	"	
3497	T26-i	4.9	"	
3498	T26-j	3.4	"	
3499	T26-k	3.1	"	
3500	T27	2.6	14:S1E6	
3501	T28-a	2.6	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3502	T28-b	3.2	14:S1E6	
3503	T28-c	2.2	"	
3504	T28-d	2.7	"	
3505	T28-e	3.1	"	
3506	T28-f	3.1	"	
3507	T28-g	3.1	"	
3508	T29-a	2.5	7:N5W1	
3509	T29-b	2.7	"	
3510	T29-c	2.8	"	
3511	T29-d	2.8	"	
3512	T29-e	3.3	"	
3513	T30-a	4.6	17:A:S3E1	
3514	T30-c	3.6	"	
3515	T30-e	3.9	"	
3516	T30-f	4.6	"	
3517	T30-g	3.8	"	
3518	T30-h	3.7	"	
3519	T30-i	4.6	"	
3520	T30-j	4.2	"	
3521	T30-k	3.1	"	
3522	T30-l	4.2	"	
3523	T30-m	4.4	"	
3524	T30-n	4.4	"	
3525	T30-o	4.9	"	
3526	T30-p	4.1	"	
3527	T30-q	4.8	"	
3528	T30-r	3.9	"	
3529	T30-s	3.9	"	
3530	T30-t	4.8	"	
3531	T31-a	4.2	4:N1E6	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3532	T31-b	3.6	4:N1E6	
3533	T31-c	3.9	"	
3534	T31-d	4.4	"	
3535	T31-e	4.1	"	
3536	T31-f	4.4	"	
3537	T31-g	3.9	"	
3538	T31-h	4.1	"	
3539	T31-i	3.9	"	
3540	T31-j	4.3	"	
3541	T31-k	4.2	"	
3542	T31-l	3.4	"	
3543	T32-a	4.1	17:N1E7	
3544	T32-b	3.6	"	
3545	T32-c	4.1	"	
3546	T32-d	3.2	"	
3547	T32-e	3.9	"	
3548	T32-f	3.4	"	
3549	T32-g	3.8	"	
3550	T32-h	3.6	"	
3551	T32-i	4.5	"	
3552	T32-j	3.4	"	
3553	T33-a	2.7	"	
3554	T33-b	2.0	"	
3555	T33-c	1.4	"	
3556	T34-a	3.1	2:C:N1E8	
3557	T34-b	2.7	"	
3558	T34-c	NHV	"	
3559	T35-a	3.1	"	
3560	T35-b	3.2	"	
3561	T35-c	3.0	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3562	T35-d	2.7	2:C:N1E8	
3563	T35-e	3.6	"	
3564	T35-f	3.3	"	
3565	T35-g	3.4	"	
3566	T36-a	3.2	11:N1E7	
3567	T36-b	3.3	"	
3568	T36-c	2.2	"	
3569	T36-d	3.1	"	
3570	T36-e	2.7	"	
3571	T36-f	3.0	"	
3572	T36-g	2.2	"	
3573	T36-h	2.7	"	
3574	T36-i	3.2	"	
3575	T36-j	3.0	"	
3576	T37-a	2.6	5:N1E7	
3577	T37-b	2.6	"	
3578	T37-c	2.3	"	
3579	T37-d	3.4	"	
3580	T37-e	2.5	"	
3581	T37-f	3.4	"	
3582	T37-g	2.6	"	
3583	T38-a	2.4	7:N2E6	
3584	T38-f	2.5	"	
3585	T38-g	2.3	"	
3586	T38-h	3.2	"	
3587	T38-i	2.0	"	
3588	T38-k	2.3	"	
3589	T38-l	2.2	"	
3590	T38-m	2.8	"	
3591	T38-o	2.5	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3592	T39-a	4.9	26:N2E2	
3593	T39-b	3.6	"	
3594	T39-c	NHV	"	
3595	T39-d	3.6	"	
3596	T39-e	3.0	"	
3597	T39-f	3.0	"	
3598	T39-g	3.2	"	
3599	T39-h	3.3	"	
3600	T39-i	3.9	"	
3601	T39-j	4.7	"	
3602	T40-a	3.9	"	
3603	T40-b	4.4	"	
3604	T40-c	4.7	"	
3605	T40-d	3.7	"	
3606	T40-e	3.8	"	
3607	T41-a	4.0	13:N2W5	Preclassic?
3608	T41-c	5.2	"	"
3609	T41-d	NHV	"	"
3610	T41-e	1.8	"	"
3611	T41-f	NHV	"	"
3612	T41-g	NHV	"	"
3613	T41-h	2.2	"	"
3614	T42-a	3.7	1:C:N7W8 [w10s8-5]	Late Preclassic
3615	T42-b	3.3	" "	"
3616	T42-c	3.8	" "	"
3617	T42-d	3.8	" "	"
3618	T42-e	3.4	" "	"
3619	T42-f	NHV	" "	"
3620	T43-a	5.3	" [w6s6-3]	"
3621	T43-c	4.4	" "	"

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3622	T44-a	3.4	1:C:N7W8 [w1511-3]	
3623	T44-b	2.2	" "	
3624	T45	4.1	1:C:N7WS [w6s10-11]	
3625	T46	3.3	" [w7s9-EB10]	
3626	T47	NHV	1:C:N7W8 [w8s5-4]	
3627	T48	4.3	1:C:N7WS [w7w8-7]	
3628	T49	3.6	1:C:N7W8 [w7s8-6]	Late Preclassic
3629	T50	3.2	6:G:N5W1-TE5	"
3630	T51-a	3.8	" "	"
3631	T51-b	3.3	" "	"
3632	T51-c	2.8	" "	"
3633	T51-d	3.6	" "	"
3634	T51-e	3.1	" "	"
3635	T51-f	4.9	" "	"
3636	T51-i	3.4	" "	"
3637	T51-j	3.9	" "	"
3638	T51-k	3.0	" "	"
3639	T51-l	3.4	" "	"
3640	T51-m	3.9	" "	"
3641	T52-a	3.2	" "	Tlamimilolpa
3642	T52-b	2.8	" "	"
3643	T52-c	3.8	" "	"
3644	T52-d	2.9	" "	"
3645	T52-e	3.0	" "	"
3646	T52-f	2.8	" "	"
3647	T52-g	3.2	" "	"
3648	T52-h	3.3	" "	"
3649	T52-i	3.1	" "	"
3650	T52-j	2.8	" "	"
3651	T52-k	2.5	" "	"

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3652	T53-a	NHV	33:N2E2-TE13	
3653	T53-b	2.9	" "	
3654	T53-c	3.4	" "	
3655	T53-d	3.8	" "	
3656	T53-e	3.4	" "	
3657	T53-f	3.7	" "	
3658	T53-g	NHV	" "	
3659	T53-h	2.8	" "	
3660	T53-i	3.9	" "	
3661	T53-j	2.7	" "	
3662	T54-a	3.4	" "	
3663	T54-b	3.9	" "	
3664	T54-c	3.4	" "	
3665	T54-d	1.2	" "	
3666	T54-e	3.4	" "	
3667	T54-f	3.6	" "	
3668	T54-g	3.6	" "	
3669	T54-h	2.8	" "	
3670	T54-i	3.6	" "	
3671	T54-j	2.6	" "	
3672	T55-a	2.8	" "	
3673	T55-b	2.7	" "	Late Xolalpon/Metepac
3674	T55-c	2.6	" "	"
3675	T55-d	2.4	" "	"
3676	T55-e	2.5	" "	"
3677	T55-f	2.5	" "	"
3678	T55-g	3.0	" "	"
3679	T55-h	3.0	" "	"
3680	T55-i	3.1	" "	"
3681	T56-a	2.2	" "	"

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: September, 1973

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3682	T56-b	1.8	33:N2E2-TE13	Late Xolalopon/Met.
3683	T56-c	3.3	" "	"
3684	T56-d	2.7	" "	"
3685	T56-e	2.5	" "	"
3686	T56-f	2.6	" "	"
3687	T56-g	NHV	" "	"
3688	T56-h	3.4	" "	"
3689	T56-i	2.3	" "	"
3690	T56-j	3.0	" "	
3691	T57-a	2.7	L8:S3E7	
3692	T57-b	2.7	"	
3693	T58-a	4.1	"	Postclassic
3694	T58-b	2.3	"	"
3695	T58-c	1.7	"	"
3696	T59	3.2	9:SW:N1W3	"
3697	T60-a	1.8	9:N4W3	"
3698	T60-b	1.8	"	
3699	T61-a	2.1	L4:N:N3E2	Postclassic ?
3700	T61-b	1.8	"	"
3701	T61-c	2.5	"	"
3702	T61-d	2.7	"	"
3703	T61-e	2.7	"	"
3704	T61-f	2.2	"	"
3705	T61-g	1.8	"	"
4112	T62-2	4.1	38:N2:E6	
4113	T62-3	3.2	"	
4114	T62-4	4.1	"	
4115	T62-5	NHV	"	
4116	T62-6	4.1	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: April, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4117	T62-7	4.2	38:N2:E6	
4118	T63-1	4.3	37:N2E5	
4119	T63-2	4.2	"	
4120	T63-3	3.8	"	
4121	T64-1	3.2	"	
4122	T64-2	2.7	"	
4123	T64-3	2.2	"	
4124	T64-4	3.3	"	
4125	T64-5	2.5	"	
4126	T64-6	3.1	"	
4127	T64-7	2.7	"	
4128	T64-8	2.5	"	
4129	T64-9	3.2	"	
4130	T64-10	3.2	"	
4131	T64-11	2.5	"	
4132	T64-12	2.7	"	
4133	T64-13	2.3	"	
4134	T64-14	3.2	"	
4135	T64-15	2.2	"	
4136	T65-1	3.0	"	
4137	T65-2	3.3	"	
4138	T65-3	3.0	"	
4139	T65-4	2.5	"	
4140	T65-5	3.1	"	
4141	T65-6	2.5	"	
4142	T65-7	2.7	"	
4143	T65-8	3.1	"	
4144	T65-9	2.7	"	
4145	T65-10	2.8	"	
4146	T65-11	2.6	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: April, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4147	T65-12	2.6	37:N2:E5	
4148	T65-13	2.5	"	
4149	T65-14	2.5	"	
4150	T65	4.3	"	
4291	T66-a	3.0	1:N8W2	Tzacualli
4292	T66-b	3.8	"	"
4293	T66-c	2.8	"	"
4294	T66-d	2.6	"	"
4295	T66-e	2.8	"	"
4296	T67		19:W:N7W1	"
4297	T68	4.1	"	"
4298	T69-a	4.3	"	"
4299	T69-b	NHV	"	"
4300	T69-c	3.7	"	"
4301	T69-d	3.7	"	"
4302	T70-a	NHV	2:N1E7	
4303	T70-b	2.6	"	
4304	T70-c	2.8	"	
4305	T70-d	NHV	"	
4306	T70-e	3.3	"	
4307	T71	2.8	18:N4W3	
4308	T72	3.7	"	
4309	T73-a	4.4	"	
4310	T73-b	3.6	"	
4311	T73-c	3.0	"	
4312	T73-d	3.3	"	
4313	T73-e	2.8	"	
4314	T74	2.6	1:N2W5	Preclassic
4315	T75	3.6	15:N2W5	"
4316	T76	NHV	"	"

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: April, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4317	T77	NHV	6:SW:N1W3	
4318	T78	3.3	26:N2E2	
4319	T79	3.3	"	
4320	T80-a	3.4	"	
4321	T80-b	3.3	"	
4322	T80-c	NHV	"	
4323	T81-a	NHV	7:N1W3	
4324	T81-b	2.1	"	
4325	T81-c	3.1	"	
4326	T81-d	3.2	"	
4327	T81-e	3.1	"	
4328	T81-f	3.1	"	
4329	T82	3.3	"	
4330	T83	3.9	"	
4331	T84-a	2.0	6:NW:N1W3	
4332	T84-b	2.8	"	
4333	T84-c	NHV	"	
4334	T85-a	NHV	9:SW:N1W3	
4335	T85-b	NHV	"	
4336	T85-c	2.1	"	
4337	T85-d	NHV	"	
4338	T85-e	3.1	"	
4339	T85-f	1.6	"	
4340	T86-a	2.2	5:S:N1W3	
4341	T86-b	3.1	"	
4342	T86-c	1.6	"	
4343	T86-d	2.7	"	
4344	T87	3.4	"	
4345	T88	4.1	"	
4346	T89	3.7	"	

SITE: TEOTIHUACAN, MEXICO

SUBMITTED BY: Michael W. Spence DATE: April, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4347	T90	4.2	5:S:N1W3	
4348	T91	3.2	5:N:N1W3	
4349	T92	3.3	2:N1E8	
4350	T93	1.8	"	
4351	T94	2.8	4:N1E6	
4352	T95-a	3.7	"	
4353	T95-b	2.6	"	
4354	T95-c	3.2	"	
4355	T95-d	3.7	"	
4356	T95-e	3.0	"	
4357	T96-a	2.0	4:N4W3	
4358	T96-b	3.6	"	
4359	T97	3.1	"	
4360	T98-a	3.3	34:N4W3	
4361	T98-b	2.1	"	
4362	T99	3.4	"	
4363	T100	3.2	"	
4364	T101a	4.4	"	
4365	T101b	4.5	"	

Comments:

See article by Michael W. Spence, this volume

SITE: ZACATECAS, DURANGO, JALISCO MEXICO

SUBMITTED BY: Michael W. Spence DATE:

Dept. of Anthropology
Univ. of Western Ontario

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4503	S61	3.0		
4506	S66	NHV	LCAJ2-6	Alta Vista
4507	S69-a	4.6	LCAJ1-15	Loma San Gabriel
4508	S69-b	4.3	"	"
4509	S69-c	5.4/3.6	"	"
4510	S69-d	4.9	"	"
4511	S71-1	2.2	LCAJ1-17	"
4512	S71-2	3.7/3.2	"	"
4513	S71-3	3.1	"	"
4514	S71-4	5.2	"	"
4515	S71-6	5.9	"	"
4516	S71-7	3.1	"	"
4517	S71-8	NHV	"	"
4518	S71-9	5.0	"	"
4519	S70-1	4.4	LCAJ1-16	"
4520	S70-2	4.3	"	"
4521	S70-3	3.7/1.9	"	"
4522	S70-4	5.0	"	"
4523	S70-5	2.7	"	"
4524	S70-6	4.2	"	"
4525	S70-7	3.4	"	"
4526	S70-8	3.7	"	"
4527	S70-9	3.8	"	"
4528	S70-10	2.0	"	"
4529	S70-11	3.9	"	"
4530	S72-1	3.5	LCQJ1-7	Los Chivas Compl.
4531	S72-3	4.3	"	"
4532	S72-4	3.6	"	"
4533	S72-5	4.6	"	"
4534	S74-1	4.6	LCQJ1-11	"

SITE: ZACATECAS, DURANGO, JALISCO; MEXICO

SUBMITTED BY: Michael W. Spence DATE:

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4535	S74-3	2.0	LCQJ1-11	Los Chivas Complex
4536	S74-4	4.2	"	"
4537	S74-5	4.6	"	"
4538	S75-1	2.3	LCQJ2-1	Adams Complex
4539	S75-2	3.7	"	"
4540	S75-3	4.7	"	"
4541	S75-4	1.8	"	"
4542	S75-5	8.2	"	"
4543	S75-6	3.8	"	"
4544	S75-7	3.8	"	"
4545	S76-1	3.4	"	"
4546	S76-2	3.3	"	"
4547	S76-3	4.4	"	"
4548	S76-4	2.2	"	"
4549	S76-5	NHV	"	"
4550	S76-6	NHV	"	"
4551	S76-7	3.2	"	"
4552	S76-8	3.0	"	"
4553	S77-1	3.0	LCQJ2-2	"
4554	S77-2	NHV	"	"
4555	S77-3	3.8	"	"
4556	S77-4	1.5	"	"
4557	S79-1	4.7	LCQJ2-4	"
4558	S79-2	6.3	"	"
4559	S79-3	4.8	"	"
4560	S79-4	4.1	"	"
4561	S80-1	4.4	LCQJ2-4	"
4562	S80-2	3.1	"	"
4563	S80-3	4.3	"	"
4564	S81-1	5.4	LCQJ2-7	"

SITE: ZACATECAS, DURANGO, JALISCO; MEXICO

SUBMITTED BY: Michael W. Spence DATE:

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4565	S81-2	NHV	LCQJ2-7	Adams Complex
4566	S81-3	4.2	"	"
4567	S81-4	5.2	"	"
4568	S81-5	2.7	"	"
4569	S81-6	3.9	"	"
4570	S81-7	2.3	"	"
4571	S81-8	2.2	"	"
4572	S81-9	5.0	"	"
4573	S82-1	4.8	LSAK1-1	Los Caracoles Complex
4574	S82-2	5.2	"	"
4575	S83-3	4.2	"	"
4576	S83-4	NHV	"	"
4577	S83-1	3.1	Etzatlan 1	Huistla/Etzatlan
4578	S83-2	2.4	"	"
4579	S83-3	2.3	"	"
4580	S83-4	2.9	"	"
4581	S83-5	2.3	"	"
4582	S84-1	2.3	Etzatlan 3	"
4583	S84-2	2.7	"	"
4584	S84-3	2.3	"	"
4585	S84-4	3.0	"	"
4586	S85-1	3.3	Etzatlan 6	"
4587	S85-2	2.5	"	"
4588	S85-3	2.8	"	"
4589	S85-4	3.3	"	"
4590	S85-5	4.8	"	"
4591	S85-6	2.6	"	"
4592	S85-7	2.7	"	"
4593	S85-8	NHV	"	"
4594	S86-1	4.8	LSAK1-1	Los Caracoles Comp.

SITE: ZACATECAS, DURANGO, JALISCO; MEXICO

SUBMITTED BY: Michael W. Spence DATE: April, 1975

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4595	S86-2	5.7	LSAK1-1	Los Caracoles Comp.
4596	S86-3	5.7	"	"
4597	S86-4	5.4	"	"
4598	S86-5	4.8	"	"
4599	S86-6	5.0	"	"
4600	S86-7	NHV	"	"
4601	S87-1	NHV	"	"
4602	S87-2	3.4	"	"

Comments: See article by Spence, this volume

GUATEMALA

SITE: ATIQUIPAQUE, GUATEMALA

SUBMITTED BY: L.H. Feldman (Gary Rex Walters) DATE: September, 1977

Museum of Anthropology
University of Missouri-Columbia

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
5452		1.4 / 2.1	A-1-2-1	
5453		1.6	A-1-2-2	
5454		3.0	A-1-9-1	
5455		2.6 / 2.6	A-1-9-2	
5456		1.6	B-2-2-1	
5457		1.5	B-3-3-1	
5458		1.6 / 2.2	F-1-4-1	
5459		1.7	F-1-1-1	
5460		1.4	T-3-3-1	
5461		1.4 / 1.8	T-3-3-2	

Comments: See article by Walters for comments and cultural phase assignment, this volume.

SITE: Ixtepeque Source, GUATEMALA

SUBMITTED BY: Raymond Sidrys DATE: April, 1975
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4609	I-1	4.0	Ixtepeque Quarry	
4610	I-5	2.5	"	
4611	I-10	2.2	"	
4612	I-11b	NHV	"	
4613	I-12	3.3	"	
4614	I-14	2.6	"	
4615	I-18	2.7	"	
4616	I-27	3.6	"	
4617	I-28	2.3	"	
4618	I-32	2.5	"	
4487	I-3	3.3	"	
4488	I-8	2.3	"	
4489	I-16	2.8	"	
4490	I-19	3.3	"	
4491	I-20	3.0	"	
4492	I-22	2.8	"	
4499	IxA	NHV	Ixtepeque Geologic Sample	
4500	IxB	NHV	"	
4501	IxC	4.2	"	
4502	IxD	NHV	"	

Comments:

The Ixtepeque quarry is also one of the major highland obsidian sources that was utilized by the lowland Maya. There is also some evidence that it was used later than the El Chayal source (Hammond 1972:1093). The 15 Ixtepeque artifacts, which were gathered from the surface, show a mean hydration rim for the La Joya artifacts. However no hydration rate has been proposed yet for the Ixtepeque magma.

Raymond Sidrys

SITE: La Joya Quarry at the El Chayal Source, GUATEMALA

SUBMITTED BY: Raymond Sidrys DATE: April, 1975
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4480	J-4	3.3	La Joya Quarry	
4481	J-9	NHV	"	
4482	JR-66	3.6	"	
4483	JD-C-40	3.6	"	
4484	J-Hi-3-11	4.7	"	
4485	JR-14	3.2	"	
4486	JAR-31	NHV	"	
4619	J-86	2.3	"	
4620	Jr-5	3.0	"	
4621	Jar-27	3.0	"	
4622	Jar-29	2.6	"	
4623	Jr-72	3.4	"	
4624	Jr-73	2.8	"	
4625	Jr-85	3.3	"	
4626	DC	3.0	"	
4627	DCL	3.2	"	

Comments:

The fourteen artifacts from the La Joya Quarry in the El Chayal source area were gathered from the surface. The El Chayal source area, which includes at least seven major outcrops located within a 110 square kilometer area, is believed to have been the predominant obsidian supply source utilized by the Maya lowlands, during at least the Preclassic and Classic periods. The La Joya quarry appears to be the largest quarry within the source area (Sidrys, Andresen, and Marcucci n.d.).

The fourteen La Joya hydration readings show a time range from 1174 B.C. to 1219 A.D. with a mean date of 500 A.D. if a rate of 7.03 microns squared per thousand years is used for the El Chayal magma (Michels 1973:56-65). This substantial time range supports our contention that the La Joya Quarry was the most heavily utilized outcrop within the El Chayal source area throughout the Preclassic and Classic periods. The El Chayal quarry proper (Coe and Flannery 1964;43-49) appears to have been used primarily during the Late Classic through the Late Postclassic (Michels 1975:105; Sheets 1975:98).

Raymond Sidrys

SITE: Yaxha, GUATEMALA

SUBMITTED BY: Raymond Sidrys DATE: April, 1975
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4493	22-4	NHV	West Maler House Mounds	Late Classic
4494	22-5	2.0	"	"
4495	22-6	2.0	"	"
4496	22-7	2.0	"	"
4497	22-2	2.0	"	"
4498	22-3	2.0	"	"

Comments:

Yaxha is an important Classic period Maya site. Excavations of several house mounds near the Maler Group in 1972 (Sidrys n.d.) yielded 212 obsidian artifacts. The six artifacts submitted for hydration analysis came from a Late Classic midden (600-900 A.D.) and were characterized by neutron activation analysis as being from the El Chayal source. Using Michel's rate of 7.03 microns squared per thousand years, all five readings show a date of 1402 A.D. The hydration dates appear to be at least 500 years too recent.

Raymond Sidrys

HONDURAS

AND

BELIZE

SITE: COPAN, HONDURAS

SUBMITTED BY: Gary Pahl DATE: April, 1975

Latin American Center
University of California, Los Angeles

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4439	None	3.4		Classic
4440	"	2.3		"

Comments:

Sample No. 4439 is a large obsidian biface found in the recent (1972) excavations in the necropolis area at the north end of the Copan airfield.

Sample No. 4440 is an obsidian blade found in association with Copador ware sherds, on the airfield surface.

Gary Pahl

SITE: EL POZITO, BELIZE

SUBMITTED BY: Raymond Sidrys DATE: October, 1975
Dept. of Anthropology
U C L A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE		CULTURAL PHASE
5098	1	NHV	Tomb 1	Struc A-1	
5099	2	3.8	"	"	
5100	3	4.1	"	"	
5101	4	3.6	"	"	

Comments:

The Pozito artifacts come from a Classic tomb that contained a mortuary cache of over 5000 obsidian pieces (M. Nievens and D. Pfeiffer, personal communication). This is the largest in the Maya lowlands. The source of the obsidian has not been determined, consequently the hydration readings cannot be applied to a known hydration rate. Should the artifacts prove to be from the El Chayal source, the four readings would average approximately 111 B.C., according to the rate established by Michels for that source (1975:56-65).

Raymond Sidrys

ECUADOR

SITE: San Jose ECUADOR

SUBMITTED BY: Jonathon E. Ericson DATE: April, 1974
Dept. of Anthropology
UCLA

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4151	SI 939	7.1/25.0		
4152	SI 940	7.4		
4153	SI 945	6.9		
4154	SI 941	7.4		
4155	SI 936	8.0		
4156	SI 937	5.2		
4157	SI 934	7.6		
4158	SI 946	7.0		
4159	SI 942	6.3		
4160	SI 938	8.0		
4161	SI 935	8.4		
4162	SI 945	8.1		
4163	SI 946	8.2		
4164	SI 948	6.9		

Comments:

The hydration analysis formed the basis of a pilot study initiated by Dr. Mayer-Oakes, Texas Tech University in 1972. The objective of the study was to demonstrate the separation of source-specific obsidian hydration rates (Cf. Ericson, 1975) for Ecuador. If demonstrated, then, the implication of proposed cross-dating of Jomon pottery with uncorrected Ecuadorian obsidian hydration dating results would require reexamination.

For these purposes the above obsidian artifacts from the San Jose site in Ecuador and three obsidian source groups were submitted to J.E. Ericson for neutron activation and X-ray fluorescence analyses by Dr. Mayer-Oakes. The artifacts (INAA 602-615) were chemically analyzed by both techniques and compared to the three obsidian sources, La Cueva (INAA 616-617), "yellow" obsidian source (INAA 651-652), and clear "purple" obsidian source (INAA 653-654). The results of these analyses are contained in a manuscript on file in the UCLA Obsidian Hydration Laboratory (Ericson, n.d.-1).

Jonathon E. Ericson

GREECE

SITE: ACHILLEION (Thessaly, Greece)

SUBMITTED BY: Marija Gimbutas (Carol Witte) DATE: January, 1974

Dept. of Slavic Languages, U.C.L.A

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE			CULTURAL PHASE
3991	AX-0-2	5.0	Sq C	Quad 4	Level 1	Phase IV c
3992	AX-0-3	5.5	A	1	2	"
3993	AX-0-15	5.0	A	1	3	"
3994	AX-0-17	5.5	A	3	5	IV b
3995	AX-0-19	4.8	A	1	7	IV a
3996	AX-0-21a	4.9	A	3	7	IV a
3997	AX-0-21b	5.0	A	3	7	IV a
3998	AX-0-8a	3.8	A	2	13	III b
3999	AX-0-8b	5.0	A	2	13	"
4000	AX-0-8c	4.3	A	2	13	"
4001	AX-0-12a	4.9	A	1	13	"
4002	AX-0-12b	5.0	A	1	13	"
4003	AX-0-1	6.7	outside excavation-surface			
4004	AX-0-4	chert	B	3	2	IV b
4005	AX-0-5	NHV	D	2	2	"
4006	AX-0- 6	5.3	D	2	2	"
4007	AX-0-7	6.0	C	2	2	"
4008	AX-0-9	4.7	B	4	2	"
4009	AX-0-10a	chert	C	2	2	"
4010	AX-0-10b	3.1	C	2	2	"
4011	AX-0-10c	4.4	C	2	2	"
4012	AX-0-11	5.4	B	3	4	"
4013	AX-0-13	4.3	C	4	4	"
4014	AX-0-14a	5.2	D	4	2	"
4015	AX-0-14b	5.0	D	4	2	"
4016	AX-0-16a	5.4	C	3	4	IV a
4017	AX-0-16b	5.2	C	3	4	"
4018	AX-0-18	3.1	B	1	6	"
4019	AX-0-20	4.2	C	2	6	"
4020	AX-0-22	chert	C	4	5	"

SITE: ACHILLEION (Thessaly, Greece)

SUBMITTED BY: Marija Gimbutas (Carol Witte) DATE: January, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE			CULTURAL PHASE
4021	AX-0-23	5.2	Sq B	Quad 2	Level 7	Phase III c
4022	AX-0-24	5.3	C	4	7	IV a
4023	AX-0-25	5.3	C	1	8	"
4024	AX-0-26	4.8	B	4	8	III c
4025	AX-0-27	4.9	D	1	12	III a2
4026	AX-0-28	4.9	D	4	11	III b
4027	AX-0-29	NHV	D	3	11	"
4028	AX-0-30	5.7	C	1	12	III c
4029	AX-0-31a	5.7	C	4	12	"
4030	AX-0-31b	4.7	C	4	12	"
4031	AX-0-32	4.4	D	4	15	III a2
4032	AX-0-33	4.4	Test Pit E-9		Level 1	
4033	AX-0-34	5.8	C	4	18	III a
4034	AX-0-35	4.8	D	4	21	II a
4035	AX-0-36a	4.6	D	2	6	IV a
4036	AX-0-36b	6.2	D	2	6	"
4037	AX-0-36c	5.2	D	2	6	"

Comments: See article by Witte, this volume

SITE: Franchthi Cave (GREECE)

SUBMITTED BY: T. W. Jacobsen DATE: May, 1975
Classical Archaeology
Indiana University

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4740	10	5.7	Trench F/A Unit 162s	Upper Mesolithic
4741	9	5.1	" 161s	"
4742	8	5.7	" 156s	"
4743	7	6.0	" 143s	Aceramic Neolithic
4744	6	5.5	" 146n	Early Neolithic
4745	5 (30307)	4.9	" 124s	Middle Neolithic
4746	4 (30008)	5.0	" 116s	Middle/Late
4747	3 (23920)	4.0	" 98s	Late Neolithic
4748	2 (30392)	4.5	" 85s	"
4749	1 (25793)	3.7	" 74s	Final Neolithic
4750		NHV	Halieis 085/345 Unit 8	
4751		4.1	" 055/345 18	
4752		3.0	" 085/345 7	
4753	#108	3.3	" Acropolis	

Comments:

All of the Haleis are from the lower town, from a mixed context but presumably from the fourth century abandonment or destruction.

Sample #108 (OHL 4753) is from the acropolis, from a disturbed context, but possible prehistoric. There is a radiocarbon date on shell from the site, which is very late prehistoric. There is a radiocarbon date on shell from the site, which is very late Neolithic: 5102 ± 72 B.P. (5568 half-life).

All of the Franchthi pieces are from Trench F/A, which is farthest back in the cave, behind Trench G/G-1. F/A produced the most carefully controlled, contiguous Neolithic strata, as well as Mesolithic and Paleolithic strata, and was water-sieved throughout the entire sequence. All the radiocarbon dates are the 5568 half-life, and are quoted as B.P.

F/A 162S	Slightly earlier than 9153 ± 97 (P2097)
F/A 161S	Same as 162S
F/A 156S	8708 ± 100 (P2106)
F/A 143S	7927 ± 101 (P2904)
F/A 146N	6940 ± 90 (P2093)
F/A 124S	6668 ± 74 (P1824)

Comments: (continued)

F/A 116S	6855 ± 190 (I6128)
F/A 98S	
F/A 85S	6172 ± 60
F/A 74S	5261 ± 64

Spectrographic, fission track, and neutron activation analyses by Dr. Colin Renfrew have revealed the source of the Franchthi obsidian to be Adhamas and Dhemenegaki on the Island of Melos (Jacobsen, 1973).

For additional comments, see next page.

Additional comment on dating:

While evidence is insufficient to establish a clear rate of hydration, there is a good pattern of conformity between hydration readings and other dating evidence. My interpretation of the results yields the following correlation:

Upper Mesolithic (3 readings, ave. 5.5 microns)=	8700-9100 years ago (ave. 8900 years)
Early Neolithic (1 reading, 5.5. microns)	Same as above ?
Middle Neolithic range 4.9-5.0, ave.5.0 microns	7900 years ?
Late Neolithic range 4.0-4.5., ave. 4.25 microns	6500 years (average)
Final Neolithic 3/7 microns	5200 years

This does not look like a linear rate but it is close to one and a tentative rate of 1500 years per micron would come pretty close to correct answers for this obsidian.

The hydration increases in accordance with the age assigned by the excavator (as it should), for 9 out of 10 readings - there is only one misfit with the 6.0 reading and even that one is well possible if we take into account the margin of uncertainty of the C-14 dates. The general pattern has more internal consistency than most obsidian samples, and it looks like a very promising area in which to develop a hydration rate for use in chronology of the region.

INDONESIA

SITE: Tianko Panjang Cave (INDONESIA)

SUBMITTED BY: Bennet Bronson DATE: May, 1975
Field Museum of Natural History
Chicago, Illinois

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
4767	TP C6 M1	4.0	Tianko Panjang Cave	
4768	TP C6 M2	2.7	"	
4769	C6 M1	4.1	"	

Comments:

This sample represents the initial attempt to apply obsidian dating to the Asian tropics. Source data is unavailable. Nos. 4767 and 4769 represent two measurements of the same sample. An extended sample from Tianko Panjang Cave is currently being analyzed.

Victoria Bennett

MISCELLANEOUS

SITE: TEKTITE SAMPLES

SUBMITTED BY: J. O'Keefe
NASA

DATE: February, 1974

OHL NO.	COLLECTOR'S SAMPLE NO.	HYDRATION	PROVENIENCE	CULTURAL PHASE
3770	5424	NHV	None	None
3771	5424	NHV	"	"
3772	5424	NHV	"	"
3773	6	NHV	"	"
3774	6	NHV	"	"

Comments:

The initial concentration of water in obsidian samples appears to be a variable of the hydration process (Kimberlin, n.d.; Berger and Ericson, 1974: Ericson, 1974: Ericson, 1975). This observation is particularly salient in the comparison of obsidian and tektite hydration processes (Berger and Ericson, 1974).

For these purposes, the tektite samples, submitted by J. O'Keefe, NASA, having an exposure time of 700,000 years by potassium argon and fission track dating, were measured to ascertain the extent of the hydration over this period, as part of a joint project with UCLA California Institute of Technology, and the U.S. Geological Survey.

The concentration gradient of the water within a tektite sample was measured by F^{19} nuclear reaction which showed a gentle-sloping diffusion profile, rather than the steep, reaction - diffusion profile characterizing obsidian layers (Lee et al., 1974).

Jonathon E. Ericson

SEPARATE PAPERS

Current Obsidian Hydration Studies in the American Southwest

Frank J. Findlow

During the period 1972 to 1975 the American southwest has increasingly become the focal point of projects initiated in the Obsidian Hydration Laboratory, UCLA. To a certain extent this focus on the southwest marks an abrupt shift in the traditional orientation of the laboratory. In large measure this change has been produced by the recognition that variations in the hydration characteristics of glasses are at least partially determined by variation on the chemical composition of different obsidian sources (Ericson, 1975). Consequently, our desire to increase our knowledge about the hydration characteristics of volcanic glasses has placed at a premium those geographical areas in which chemical source variability can be most readily controlled. Unfortunately, the centers of traditional interest in the UCLA Obsidian Hydration Laboratory, ie. California and west Mexico are both characterized by extremely complex geological regimes and numerous geographically closely associated sources. On the other hand the southern portions of the American southwest are noted for a relatively small number of geographically widely spaced obsidian sources. This factor together with a relatively heavy pattern of prehistoric utilization of obsidian makes the American southwest an ideal area in which to continue investigations concerned with improving obsidian hydration dating techniques.

Given the potential of Southwestern obsidian hydration studies a series of four projects were developed with the intention of isolating "source-specific" hydration rates for the Sitgreaves Peak - Government Mountain, Red Hill, Mule Creek and Antelope Wells source areas (see Map 1). (It should be noted that the Sitgreaves Peak - Government Mountain source is the only source in the San Francisco Volcanic Field to be extensively used prehistorically). In each analysis the procedures followed were the same and consisted of the following four steps:

1. Archaeological obsidian directly associated with absolute dates (tree-ring or C^{14}) were collected from archaeological sites surrounding the source area. In these four studies materials for the Sitgreaves Peak - Government Mountain study were obtained largely from the Chevelon Archaeological Research Project, for the Mule Creek project from Dr. Steven Le Blanc's Mimbres Archaeological Project, for the Antelope Wells project from the Hidalgo Survey Project directed by the author and Suzanne P. De Atley. The Red Hill project is still in the planning stage and no archaeological materials have been gathered as yet.

2. The source of the individual obsidian artifacts was determined through either a semi-quantitative x-ray fluorescence technique or macroscopic petrological means, the latter being used only in those cases where easy visual sourcing is possible.

3. Hydration determinations were obtained for all obsidian samples analyzed using standard petrological techniques.

4. The rate for the individual source areas was determined through the fitting of the observed hydration data to a series of possible linear and non-linear functions, using an IBM computer.

At the present time these analyses have been completed only for the Sitgreaves Peak-Government Mountain source though the analyses for the Mule Creek and Antelope Wells sources are nearing completion. It is hoped that by the end of 1978 an accurate obsidian hydration dating program will be available throughout much of the southern half of the American southwest.

Currently there are no plans to extend these hydration studies to cover the highly complex group of sources in the Jemez Mountains of northern New Mexico. However, if the studies in the southern portions of the American southwest should indicate that the variation in rate between source areas is less than the normal measurement error, then an attempt will be made to set up a generalized rate for all the source areas in the Jemez Mountains similar to Meighan's (1968) west Mexican rate.

A Note on the West Mexican Obsidian Hydration Rate

Frank J. Findlow
Victoria C. Bennett

Over the past several years one of the major aims of the Obsidian Hydration Laboratory has been to develop a standardized set of analytical procedures suitable for the isolation of "source-specific" obsidian hydration rates. In the course of this endeavor a series of source determination and rate establishing techniques have come into regular use (Findlow et al., 1975). While these precedures are still in a developmental stage the initial results have been generally satisfactory.

Because the generalized West Mexican obsidian hydration rate (Meighan et al., 1968) was established prior to the general standardization of laboratory procedures it was felt that a reanalysis of those data used to develop that rate might allow it to be further refined. We felt this would be true even though the West Mexican hydration rate is a generalized non-"source-specific" rate containing additional variability not found in "source-specific" ones. In general we considered that any increase in the predictive accuracy of the rate would more than justify the time involved in the reanalysis. Furthermore, the use of the new standardized techniques facilitates comparisons with the various source-specific hydration data available from throughout the Greater Southwest.

Specifically the original West Mexican obsidian data used in Meighan's (1968) development of the regional rate were fitted to a series of possible linear and non-linear models using Pearson's product moment correlation coefficientas a measure of relative efficiency (Findlow et al, 1975). Table 1 provides a listing of the models tested, the value of Pearson's 'r' and the relative proportion of the variance explained by each. As can be seen, the greatest proportion of the data variance is explained by a non-linear .75 power function. However, such a model did not explain a statistically greater proportion of the variance than either a square root or linear model For the most part, this lack of differentiation between these models can best be explained by the short time span involved and the increased variation found at any dated point due to the presence of obsidian samples from more than one chemically distinct source. It is, of course, inevitable that the acquistion of additional data points would allow us to determine which of these models comes closest to reflecting the true hydration characteristics of the obsidian involved. As Figure 1 clearly shows, when the three alternate models are projected into the past, the age estimates of each would differ radically. Indeed an examination of Table 2 clearly demonstrates just how radically the three rates would differ given a sufficiently long time period, and examination of the results obtained from both the square root and .75 power functions reveal a dating regime that would be far from the known archaeological reality with values greater than 15 microns being required for dates as recent as 2774 B.P. For this reason, West Mexican obsidian samples will continue to be analyzed using the simpler linear model producing a rate of:

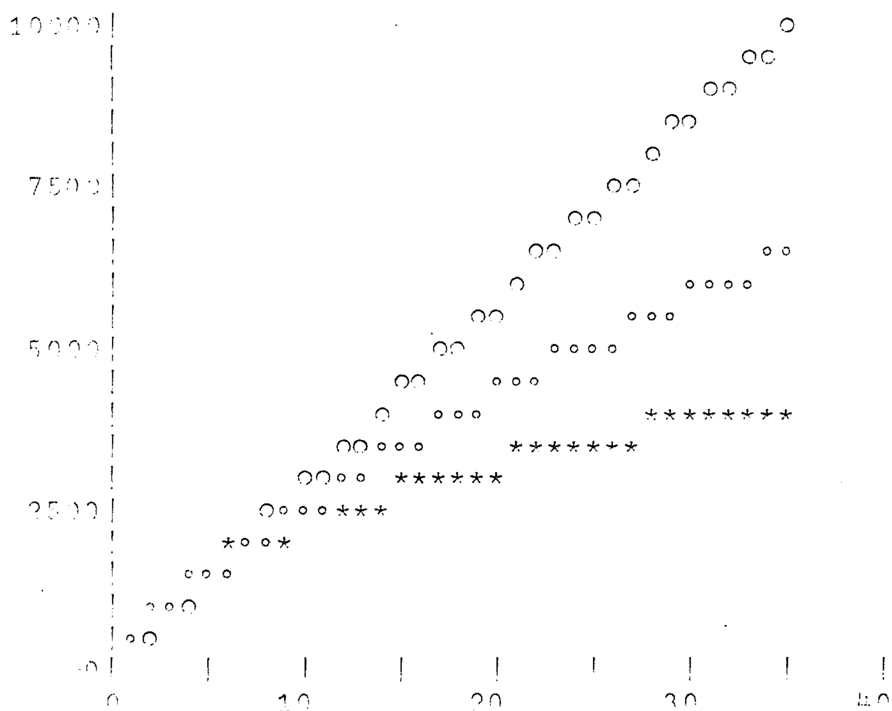
$$D = (285.74 \times x) + 10.94$$

where D is the date B.P. and x is the hydration value in microns. The deviation of the intercept from zero by the constant term of 10.94 is most probably the result of our lack of data points more recent than 1500 A.D.

As obsidian samples have been measured from West Mexico with micron values far in excess of the maximum reading of 8.8 microns used in this analysis, archaeologists may wish to compare the results given them using a general linear rate with the results obtained using either of the two non-linear models. For that reason, all three rates have been presented in Table 3. Again we want to reiterate that extreme caution must be used when samples older than roughly 3,000 years B.P. are involved.

In conclusion, this re-examination of the West Mexican obsidian hydration rate has reconfirmed the general acceptance of a simple linear rate over materials with ages less than 3,000 years. The re-examination did, however, result in a slight slowing of the original rate from 260 years per micron to 285 years per micron, a factor that will increase the ages of dated samples by 25 to 200 years, depending on their age.

FIGURE 1



where

o = a linear model.

∘ = a .75 power function.

⋆ = a square root function.

TABLE 1

Model	r	r^2
$x = x$	.982	.96
$x = x^{.1}$	.976	.95
$x = x^{.25}$	.979	.96
$x = x^{.4}$	.981	.96
$x = x$	.982	.96
$x = x^{.75}$	.983	.97
$x = x^{1.5}$	.974	.95
$x = x^{1.6}$	.972	.94
$x = x^{1.7}$	.969	.91
$x = x^{1.8}$	.966	.93
$x = x^{1.9}$	.963	.93
$x = x^{2}$	.96	.92
$x = x^{2.1}$	.956	.91
$x = x^{2.2}$	.952	.91
$x = x^{2.3}$	.948	.90
$x = x^{2.4}$	.944	.89
$x = x^{2.5}$	.94	.88
$x = x^{2.6}$	.935	.87
$x = x^{2.7}$	.931	.87
$x = x^{2.8}$	.926	.86
$x = x^{2.9}$	.921	.85
$x = x^{3}$	.915	.84
$x = x^{3.1}$	.91	.83
$x = x^{3.2}$	.905	.82
$x = x^{3.3}$	.899	.81
$x = x^{3.4}$	.893	.80
$x = x^{3.5}$	.888	.79
$x = x^2 - x$	.953	.91
$x = x^2 + x$	.965	.93

TABLE 2

	MODELS		
Microns	Linear	Square Root	.75 Power
1	296	712	453
2	582	1009	763
3	868	1237	1034
4	1153	1430	1283
5	1439	1599	1517
6	1725	1752	1740
7	2011	1893	1953
8	2296	2024	2159
9	2582	2147	2358
10	2868	2264	2552
11	3154	2374	2741
12	3439	2480	2925
13	3725	2582	3107
14	4011	2679	3285
15	4297	2774	3459
16	4582	2865	3631
17	4868	2953	3800
18	5154	3039	3966
19	5440	3122	4130
20	5725	3204	4292
21	6011	3283	4452
22	6297	3360	4610
23	6583	3436	4760
24	6868	3510	4921
25	7154	3582	5074
26	7440	3654	5226
27	7726	3723	5376
28	8011	3792	5524
29	8297	3859	5672
30	8583	3925	5818
31	8869	3990	5963
32	9154	4054	6106
33	9440	4117	6249
34	9726	4179	6390
35	10012	4240	6531

Each of the three right-hand columns represents the date BP for a micron value shown in the left-hand column.

TABLE 3

Model	Hydration Rate
$x = x$	$D = (285.74 \times x) + 10.94$
$x = \sqrt{x}$	$D = (717.63 \times \sqrt{x}) - 5.17$
$x = x^{.75}$	$D = (453.88 \times x^{.75}) + 0.06$

A Tentative Hydration Rate for the Obsidian from the Borax Lake Source, Lake County, California [1]

Frank J. Findlow
Suzanne P. De Atley
Jonathon E. Ericson

Abstract

A new hydration rate is presented for the Borax Lake obsidian source in northwest California. It is based on an analysis of hydration measurements from a series of independently dated obsidian artifacts from that source. Since obsidian from the Borax Lake source has been associated with Paleoindian technology at the Borax Lake Site, the development of the new hydration rate should provide archaeologists working on Paleoindian studies in the area with a reliable and inexpensive absolute dating technique.

Introduction

Although the use of hydration analysis as an archaeological dating technique has often been successful, there have been problems of reliability when the technique is applied in areas of complex volcanic geology. Research efforts to determine the cause of apparent anomalies have revealed that the chemical composition of obsidian (Ericson, 1972; 1974; 1976 and Ericson and Berger, 1971), initial intrinsic water concentration, (Berger and Ericson 1973), and the temperature at which it hydrates (Friedman and Smith, 1960; Friedman et al., 1963) are the critical variables affecting the rate of hydration. Further work by Morgenstein and Rosendahl (1976) has shown that the hydration rate within a single chemical variety of obsidian is consistent and can best be expressed by a linear model. The goal of this research and others like it carried out at the Obsidian Hydration Laboratory, U.C.L.A., is to develop usable hydration schemes for individual obsidian source areas by controlling for compositional characteristics of the particular source studied. In this particular analysis we are concerned with the establishment of a 'source-specific' hydration rate for the Borax Lake obsidian source in Lake County, California. Additionally, we apply the rate developed for this source to the Paleoindian Borax Lake Site.

Analysis

The establishment of a hydration rate for the Borax Lake source area was carried out using a group of obsidian waste flakes obtained by Dr. David Fredrickson during his excavation of Lak-261, a site closely adjacent to the Borax Lake source area. The obsidian sample con-

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1 Paper presented at the 1973 Society for American Archaeology, Annual Meeting, San Francisco.

sisted of 36 flakes associated with three well-dated and stratigraphically distinct proveniences within the midden of the site. Specifically, we used the following: a group of 15 samples associated with a C^{14} date of 675 ± 100 B. P., a group of 12 samples with a C^{14} determination of 2100 ± 150 B. P., and a group of 9 samples with a C^{14} date of 3600 ± 130 B. P.

While the Lak-261 site is closely associated with the Borax Lake source, the presence of other obsidian sources in the general area mandated a check on the source derivation of the samples in order to avoid errors produced through the compositional differences discussed above. This was accomplished through the use of a rapid scan semi-quantitative x-ray fluorescence technique similar to that described by Jack (1976) and Findlow et al. (1975). Basically, the technique involves the measurement of the relative proportions of Zr., Sr., and Rb. Samples are then assigned to source areas by comparing the values obtained for the individual samples with similar measurements taken on samples obtained directly from the source areas. In this case the source area characterizations were those published by Ericson et al. (1976) for 32 California source areas. Sample associations were measured using Mahalanobis' D^2 statistic. Based on this analysis, all of the 36 samples were clearly shown to have come from the Borax Lake obsidian source area. Following this source determination, hydration rind measurements were taken on each of the samples. Similar procedures are described in Clark (1961a; 1961b; 1964:141-217) and Michels (1973:201-215). For some of the smaller measurements, enlargement techniques like those described by Findlow and De Atley (1976:165-173) were used.

Based on the results of the hydration rind analysis, the following results were obtained: the group of samples associated with the 675 ± 100 B. P. date produced an average hydration value of 0.8 microns, the group with the date of 2100 ± 150 B. P. had an average hydration value of 2.7 microns, and the group associated with the 3690 ± 130 B. P. date gave an average value of 3.9 microns. As the number of data points are few, it was impossible to test the possibility that some non-linear function might best describe the hydration characteristics of the Borax Lake obsidian source area. For that reason the rate was approximated using a simple least squares fit. Given a zero intercept, this produced a linear rate of:

$$Y = 890X \pm 178 \text{ Years,}$$

where Y equals the date B. P. and X equals the hydration value of a particular sample. The error factor is due to the normal measurement error of .2 microns associated with standard hydration rind measurement error.

Given the extremely small number of data points, this rate must be viewed as tentative. Indeed, even the addition of a small number of additional data points would allow the rate to be refined considerably. Furthermore, concerning the dating of sites occupied during the past 1000 years, the error factor of plus or minus 178 years will prove to be a major handicap. However for sites older than 1000 years, the error factor will be of steadily decreasing importance.

Dating the Borax Lake Site

Since the excavation of the Borax Lake Site by Harrington (1948), its placement in California prehistory has concerned archaeologists (Meighan and Haynes, 1968; 1970a; 1970b). Dating the artifactual materials from the site has been problematic due to the mixed nature of the deposits and the lack of materials suitable for radiocarbon dating. Consequently, most efforts have centered on the use of geologic evidence and the application of obsidian hydration dating schemes. In the latter case it is not surprising that the results have been unreliable, because the various rates used were created without regard to the effect that chemical source variation has on the hydration characteristics of obsidian.

Since all but two of the artifacts from the Borax Lake Site have been shown to come from the Borax Lake obsidian source (R. F. Heizer, personal communication), the rate outlined in this paper should give reliable age estimates for the obsidian artifacts from that site. Table 1 shows the hydration values from Meighan and Haynes, reported in the previous compendium, and dates B. P. for the Borax Lake Site artifacts derived from the Borax Lake Site appears to have been occupied in an intermittent fashion over a period of roughly 8000 years. However, as Table 2 shows, specific artifact classes seem to have been used during much more restricted periods of time. Indeed, from this initial examination it appears that a number of kinds of artifact clusters were in use at the site at different times during the course of its occupation. Although fluted points appear at the Borax Lake Site, they were not included in Table 2 since they have not been definitely assigned to the Borax Lake source. Despite the fact that the data are sparse, it does appear that rather than representing a single occupation, the Borax Lake Site represents a long series of temporary occupations involving small populations practicing radically different activities.

Conclusions

Based on the associations between a series of well-dated obsidian samples from Lake County - 261, it was possible to propose a tentative hydration rate for obsidian from the Borax Lake obsidian source. While the number of data points available were quite small, the resultant rate of 890 $\pm$ 178 years per micron should provide quite acceptable results when applied to obsidian samples from the Borax Lake source.

The application of this rate to archaeological materials from the Borax Lake Site clearly shows that site to have been occupied between ca. 10000 and 1000 B. P. Furthermore, the results suggest that the site was occupied only intermittently by groups using quite distinctive technological regimes.

Table 1

Lab Number	Catalogue Number	Artifact Type	Hydration	Date B. P.
5	18-F-275	Wide Stem Point	5.0	4450
6	18-F-290	Wide Stem Point	7.3	6497
7	18-F-1156	Wide Stem Point	7.4	6586
8	18-F-1157	Wide Stem Point	7.1	6319
9	18-F-1236	Wide Stem Point	5.0	4450
10	18-F-1164	Wide Stem Point	2.6	2314
11	18-F-1221	One Shoulder Point	6.2	5518
12	18-F-2473	One Shoulder Point	9.2	8188
13	750-G-346	One Shoulder Point	4.3	3827
14	750-G-623	One Shoulder Point	11.1	9879
15	750-G-678	One Shoulder Point	NBS	---
16	18-F-2486	Crescent	9.8	8722
17	18-F-3755	Single Flake Blade	6.4	5696
18	18-F-4117	Single Flake Blade	5.3	4717
19	18-F-4322	Single Flake Blade	7.5	6675
20	18-F-5172	Single Flake Blade	4.8	4272
21	18-F-5280	Single Flake Blade	NBS	---
22	18-F-282	Stemmed Point	7.3	6497
23	750-G-700	Bi-Pointed Point	6.4	5697
24	786-G-3	Bi-Pointed Point	5.8	5162
25	786-G-2	Bi-Pointed Point	2.9	2581
26	750-G-1877	Concave Base Point	6.5	5785
27	750-G-222	Concave Base Point	3.8	3382
28	750-G-382	Concave Base Point	6.3	5607
29	750-G-508	Concave Base Point	6.6	5874
30	750-G-534	Concave Base Point	1.7	1513
31	18-F-1170A	Concave Base Point	3.8	3382
32	18-F-1170B	Concave Base Point	5.7	5073
33	18-F-1170C	Concave Base Point	5.9	5251
34	750-G-594A	Small Point	1.0	890
35	750-G-594B	Small Point	1.5	1335
36	18-F-4383	Small Point	1.6	1424
37	18-F-4397B	Small Point	1.6	1424
38	18-F-4382	Small Point	1.5	1335
39	18-F-4387	Small Point	2.2	1958
40	18-F-2824	Small Point	4.8	4272
41	830-G-121	Small Point	NBS	---
42	18-F-4389	Small Point	1.7	1513
126	BL-4	Scraper	8.0	7120
127	BL-5	Biface	9.4	8366
128	BL-6	Biface	NBS	---
129	BL-7	Biface	8.8	7832
130	BL-8	Biface	9.5	8455
131	BL-9	Biface	NBS	---
132	BL-10	Biface	7.6	6764
133	BL-11	Biface	8.1	7209
134	BL-12	Biface	NBS	---
135	BL-13	Biface	5.9	5251
138	BL-16	Biface	7.8	6942
139	BL-17	Biface	6.8	6052
136	BL-14	Flake	8.5	7565
137	BL-15	Endscraper	12.1	10769

Table 2

Artifact Type	Time Range	Average Date B.P.
Wide Stem Point	2314-6586 B.P.	5099
One Shoulder Point	3827-9879 B.P.	6853
Crescent	8722 B.P.	One reading
Single Flake Blade	4272-6675 B.P.	5340
Stemmed Point	6497 B.P.	One reading
Bi-Pointed Point	2581-5796 B.P.	4477
Concave Base Point	1513-5874 B.P.	4486
Small Point	890-4272 B.P.	1771
Scraper	7120 B.P.	One reading
Biface	5251-8455 B.P.	7111
Flake	7565 B.P.	One reading
End Scraper	10769 B.P.	One reading

Hydration Analysis of a Cultural Obsidian Background at Bodega Bay, California

Thomas S. Kaufman

Introduction

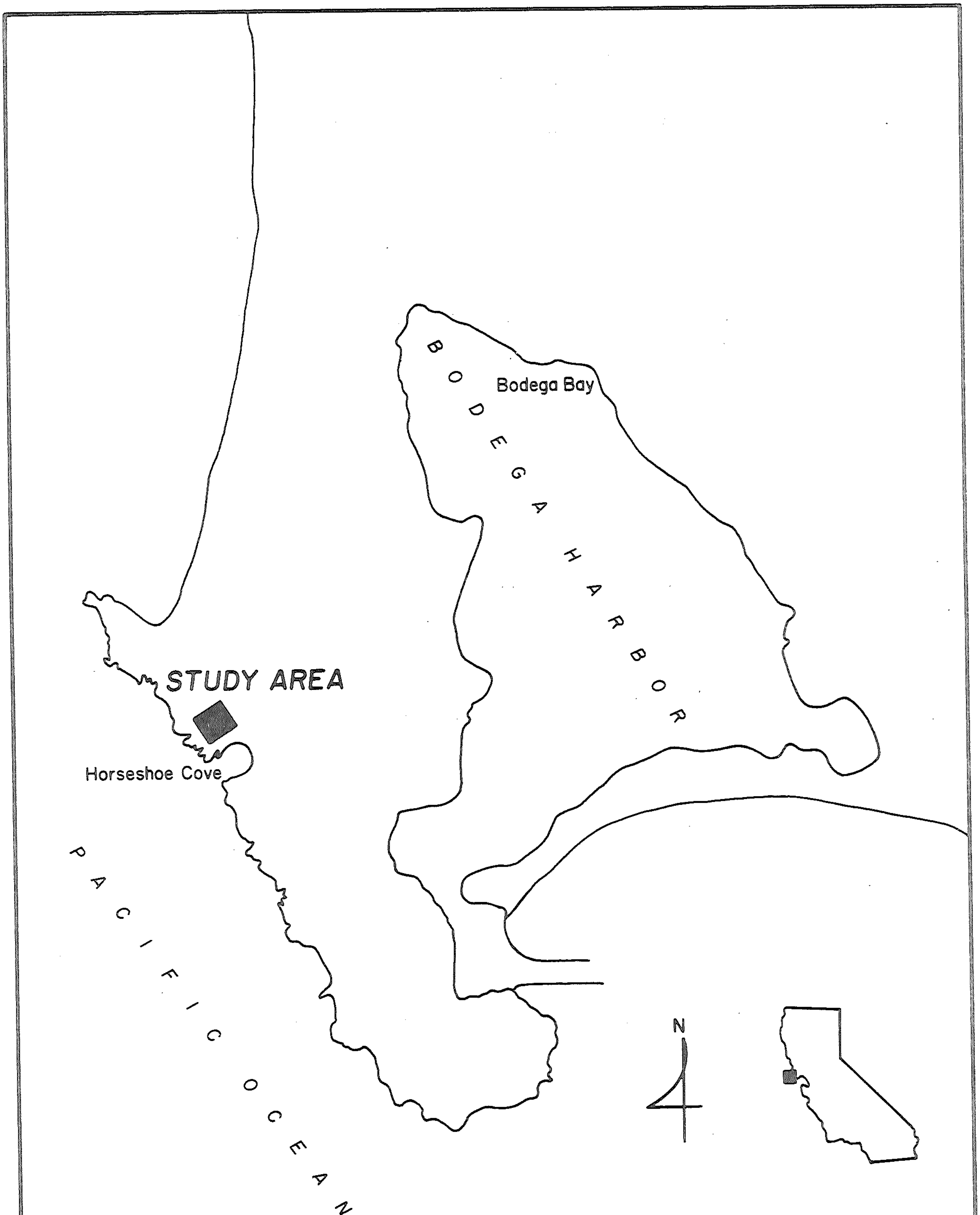
During summer 1974 archaeological investigations were conducted at Bodega Bay California (Fredrickson, 1974). The research was undertaken in conjunction with the environmental impact requirements for a proposed expansion of the University of California Bodega Marine Laboratory, located at Horseshoe Cove. The study area of approximately 22,000 square meters was situated immediately northwest of the laboratory facility. Thirty one-by-one meter units were excavated by 20cm arbitrary levels in a stabilized sand dune. All material (31 cubic meters) was screened with 1/4 inch control. The excavation yielded a total of 27 flakes of lithic debris (15 obsidian, 12 chert), a shale concave scraper, and two cobble fragments. These data appear in Table 1. Obsidian specimens are illustrated in Figure 1. Evidence of dietary debris was not found in the construction zone, although some shell (nearly 100% Mytilus sp.) was recovered from an excavation unit at the extreme northern corner of the study area.

Eighty percent of the obsidian assemblage consisted of small thin flakes of a type often associated with finishing or retouch activities. This material could represent a spillover from one of a number of nearby archaeological sites. However, the small number of specimens and their formal attributes suggests that the assemblage may better be classified as a cultural background scatter, or just background, of lithic material in an environment which was heavily utilized over a long period of time by indigenous populations. Analysis of this background data base has been largely neglected by archaeologists. It suggests that archaeological site distributions may often be better conceptualized as a continuum of differing material concentrations rather than as a series of discrete areas or points. Such distributions may best be represented graphically as a contour map, depicting the varying densities of cultural material throughout a region or study area.

Purpose

Obsidian hydration was utilized here for two purposes. The first of these involved the determination of hydration on individual specimens in order to define approximate temporal placement of and variability within the assemblage. These data would be indicative of long term versus short term utilization of the environment, and of differing intensities of utilization through time.

The second purpose was to obtain hydration readings from the two major surface



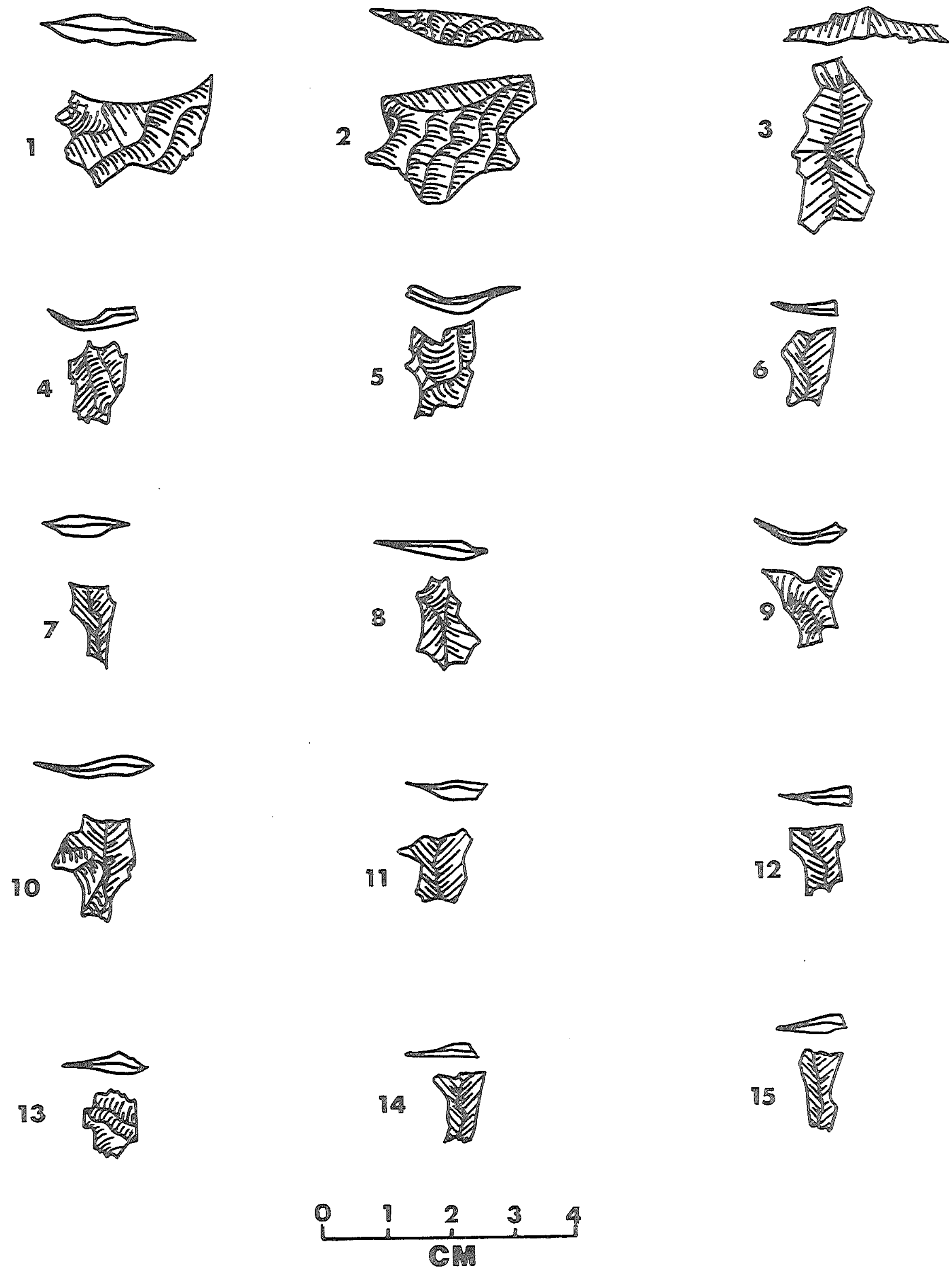
BODEGA BAY (Study area drawn actual size)

TABLE 1

NUMBER OF SPECIMENS BY DEPTH IN THE BODEGA DEPOSIT

DEPTH cm	VOLUME EXCAVATED m^2	OBSIDIAN	CHERT	COBBLE	CONCAVE SCRAPER	TOTAL
0-20	6.0	2	2	0	0	4
20-40	5.8	4	1	1	1	7
40-60	5.8	4	2	0	0	6
60-80	5.4	1	3	1	0	5
80-100	4.9	4	2	0	0	6
100-120	2.2	0	2	0	0	2
120-140	0.8	0	0	0	0	0
140-160	0.1	0	0	0	0	0
TOTAL	31.1	15	12	2	1	30

Fig. 1 BODEGA BAY OBSIDIAN SPECIMENS



old (dorsal) and new (ventril) of each specimen in the assemblage. Differences encountered between these surfaces could be indicative of an hiatus between manufacture and retouch or between various stages of manufacture and retouch during the service life or lives of an artifact. Measurement of the variation between old and new detach surface hydration values may provide a new interpretive tool for the analysis of obsidian assemblages. This might be manifest in the formulation and testing of predictive models regarding the frequency and magnitude of difference in multiple hydration values for different types of sites and environments (a quarry site versus a background scatter for example) at different times. Some important areas effecting these distributions include accessibility of material (distance from sources, topography, influence of exchange systems), the technological system utilized, the general adaptive strategy, etc.

It should be noted that the $\pm$ 0.2 micron measurement error presents a major limitation of this technique, this due to the resulting $\pm$ 0.28 micron (0.56 micron) measurement error for the difference of the two surfaces. The hydration rate for the specific obsidian source in a given significant observable difference in years. For fast to moderate California sources this would be on the order of 150-300 years, while figures on the order of 1000 years are suggested for the slowest sources known in the state. Such a technique would best be applied in warmer climates with the fastest hydrating obsidian sources.

Procedure

All specimens were prepared at the UCLA Obsidian Hydration Laboratory. Measurements were made on a Nikon petrographic microscope at 500 X magnification. All values reported are the average of five readings at a single location, and are reproducible within the $\pm$ 0.2 micron measurement error.

Of the 15 obsidian specimens a total of 12 or 80% exhibited a hydration band on at least one surface. Eight specimens or 53% of the total sample (66% of the specimens with hydration on both surfaces. The absence of hydration on the older surface of specimen 13 was probably the result of insufficient sample quantity (specimens 4-13 were virtually destroyed). The older surface of specimen 2 was heavily patinated and no reading could be obtained. Despite sufficient sample size no hydration band could be found on the new surface of specimen 3.

The Data

Specimen size, weight, and hydration are displayed in Table 2. Included are old surface, new surface, and mean hydration of both surfaces combined for each specimen. The number of specimens (means only) for a given hydration band size are graphed in Figure 3A.

Altogether the data consisted of some 20 hydration readings obtained from 12 obsidian specimens. The maximum reading was 7.9 $\pm$ 0.2 microns, the minimum was 1.7 $\pm$ 0.2 microns, and the range of hydration was 6.2 $\pm$ 0.2 microns. The data suggest most intensive occupation/utilization between 4.5 and 1.7 microns. The overall distribution of hydration values appears roughly bimodal with concentrations occurring in the 1.7 to 2.7 and 3.5 to 4.5 micron ranges. Mean values for these concentrations occur at approximately 2.4 and 4.2 microns respectively.

TABLE 2
DATA FOR BODEGA BAY OBSIDIAN SPECIMENS

SPECIMEN NO.	PROVENIENCE	WEIGHT gm.	LENGTH mm	WIDTH mm.	THICKNESS mm.	HYDRATION (microns)		
						OLD	NEW	MEAN
1	U-6 10-20	0.52	21.9	10.4	2.0	2.7	2.6	2.65
2	U-14 80-100	1.23	24.4	16.9	3.3	---	4.5	4.50
3	U-13 20-30	0.65	24.8	9.6	3.4	2.5	---	2.50
4	U-13 20-30	0.12	9.9	7.0	1.5	---	---	NHV**
5	U-5 80-90	0.21	13.6	9.7	2.3	5.5	3.8	4.65
6	U-7 20-30	0.12	8.5	5.0	0.9	2.6	2.5	2.55
7	U-11 80-90	0.14	9.3	6.9	1.8	3.5	3.8	3.65
8	U-13 40-60	0.14	12.1	6.5	1.2	---	---	NHV**
9	U-13 40-60	0.11	9.8	6.1	1.3	4.0	4.2	4.10
10	U-11 40-50	0.38	14.3	12.3	2.7	4.3	---	4.30
11	U-21 60-80	0.11	9.0	6.6	1.7	2.4	2.6	2.50
12	U-14-40-50	0.12	8.9	7.2	2.0	2.4	1.7	2.05
13	U-14 40-50	0.13	9.3	6.9	1.4	---	1.9	1.90
14	U-1 90-100	0.10	6.4	4.5	1.0	7.9	7.6	7.75
15	U-14 80-100	0.09	6.8	3.2	1.9	---	---	NHV**
MEAN		0.28	12.6	7.9	1.9	3.8	3.5	3.59
MAXIMUM		1.23	24.8	16.9	3.4	7.9	7.6	7.75
MINIMUM		0.09	6.4	3.2	0.9	2.4	1.7	1.90
RANGE		1.14	18.4	13.7	2.5	5.5	5.9	5.85

*Unit, depth in cm.

** No Hydration Visible

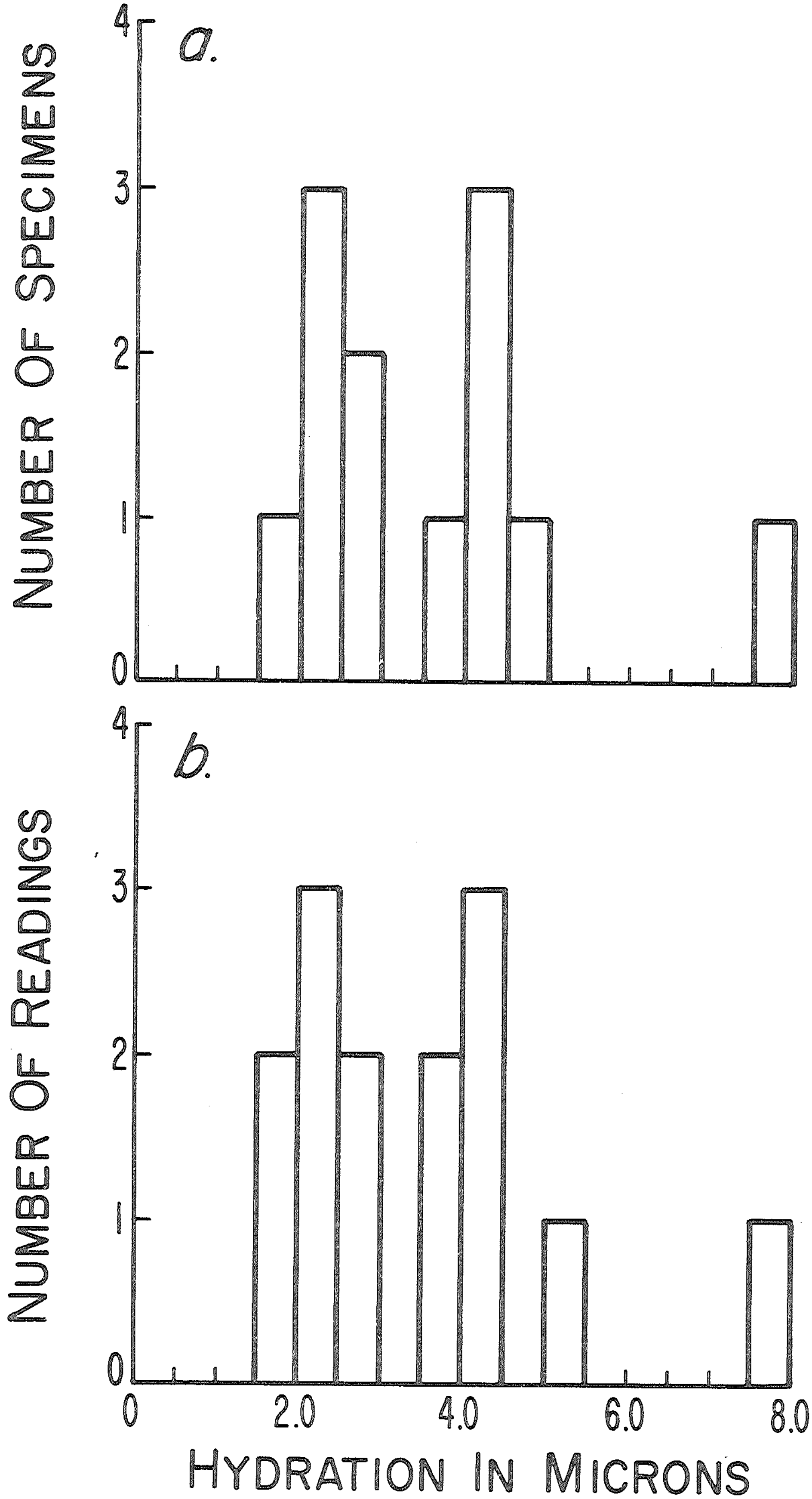

a.
b.
NUMBER OF SPECIMENS
NUMBER OF READINGS
0
1
2
3
4
0
2.0
4.0
6.0
8.0
HYDRATION IN MICRONS

Fig. 2

Vertical Distribution of Specimens

Samples of the 15 specimens have been preserved for neutron activation analysis, although this has not been accomplished at this writing. The absence of chemical characterization raises the question of whether the observed hydration variability is the product of age, the presence of multiple sources with different hydration rates, or of a single source with multiple rates. Here stratigraphic data can provide some insight. Figure 3 plots hydration in microns against depth in the Bodega deposit. A bimodal distribution of hydration values is suggested with modes at 2-3 and 4-5 microns. Greatest numbers of 2-3 micron specimens occur between 20 and 50 cm, with the greatest numbers of 4-5 micron specimens occurring between 50 and 100 cm. Thus there is some evidence for increased hydration with increased depth in the Bodega deposit. Although this does not rule out the possibility of multiple sources, it suggests that different sources are not singularly responsible for the range of hydration variability, and/or that sources with similar hydration rates are present. These hydration-depth data provide some evidence for consistent long term deposition in the study area. This is not incompatible with the background scatter concept as stated above.

Multiple Hydration Values

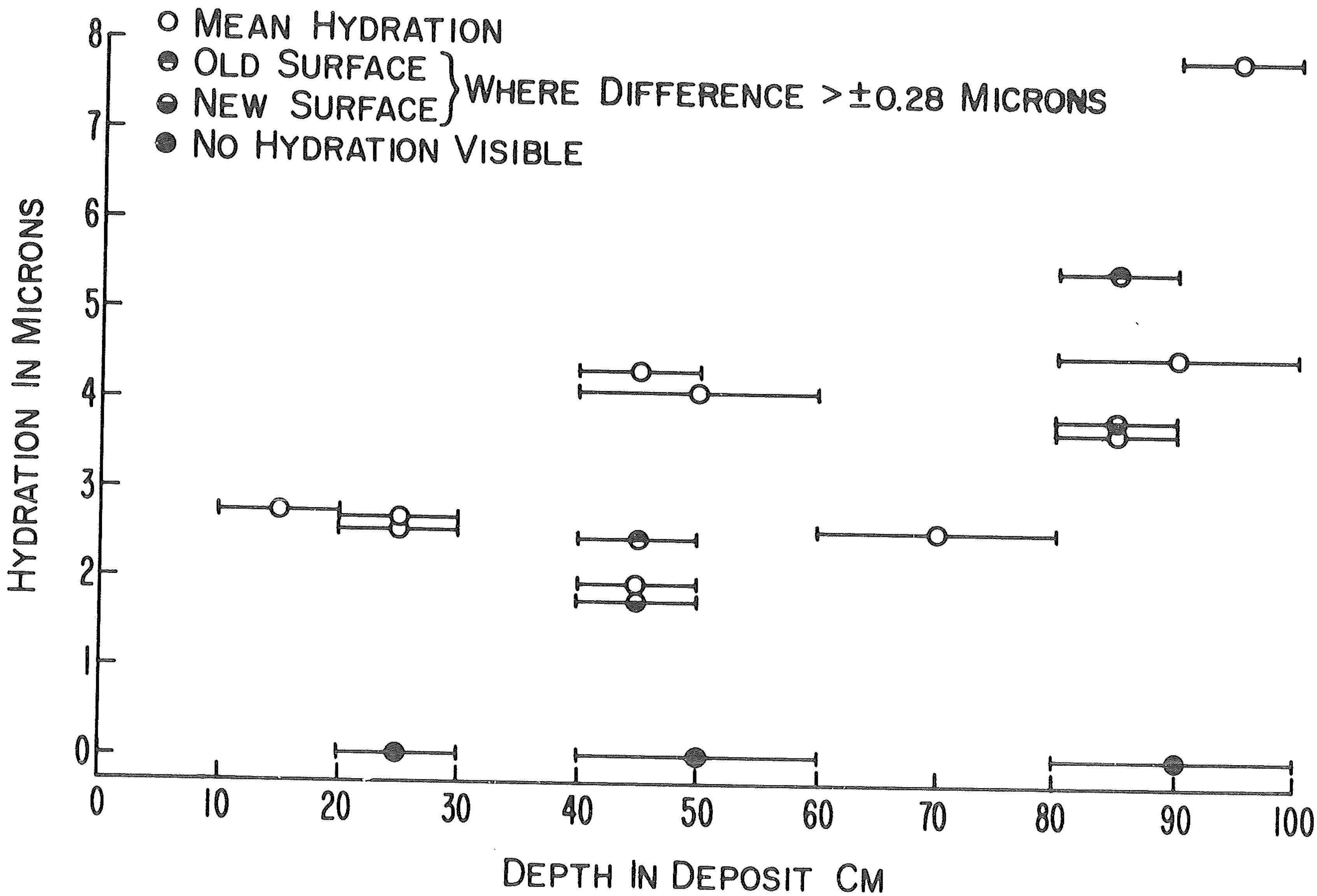
Of the eight specimens with hydration bands on both surfaces two exhibited variation in excess of the ± 0.28 micron measurement error. In both cases the larger hydration value was on the formally older surface. The largest difference occurred on specimen 5 with 1.7 microns. Specimen 12 displayed a difference of 0.7 microns. The distribution with multiple hydration readings included (2 values each for specimens 5 and 12) appears in Figure 2B. Additional work is necessary to determine the significance of these values.

Age Estimates

Without source characterization age projections based on this assemblage must be considered highly tentative. Of the local obsidian sources, material from Napa may be the most likely contributor. If this assemblage was derived from that provenience, then based on the lineal model presented in Ericson (1975:154) the 7.9 ± 0.2 micron specimen could date sometime between 3000 and 5600 years B. P. The 1.7 ± 0.2 micron reading should date to about 700 ± 300 years B. P. The mean at 2.4 microns suggests an age of between 900 and 1800 years B. P. The mean at 4.2 microns would date between approximately 1600 and 3200 years B. P. This large spread in years for a given hydration reading is due to uncertainties in the Napa obsidian hydration rate.

Comparison with Nearby Sites

Fredrickson (1974, 8-9) discusses six site excavations which have taken place at Bodega Bay. Of these, SON-293 had its most significant utilization during the Historic Period after the closing of San Rafael Mission in 1835 (Fredrickson, 1962). SON-294 is also supposed to be of historic affiliation. SON-299 was briefly reported by Porter and Watson (1933). Additional excavations revealed materials assignable to the McClure Facies of the Middle Horizon (Beardsley, 1954), the latter term now designated as the Berkeley Pattern (Fredrickson, 1973). Fredrickson (personal communication) places



Mean Hydration
Old Surface
New Surface
Where Difference > ±0.28 Microns
No Hydration Visible
Hydration in Microns
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
70
80
90
100
Depth in Deposit Cm

Fig. 3

the McClure Facies between approximately 1500 and 3000 years B. P. SON-324 (Fredrickson, 1962:56) was also tentatively assigned to the McClure Facies. SON-292 (Fredrickson, 1962) was found to be of Middle Horizon age, with some utilization during the Protohistoric Period. Excavations of the lower levels of SON-320 (King, 1966) revealed insufficient material to assign a temporal affiliation, although the upper levels have been assigned to the Late Horizon, now designated Augustine Pattern (Fredrickson, 1973) and historic material dated between 1875 and 1890 has also been found.

The above sites indicate occupation at Bodega Bay from the Middle Horizon until historic times. The tentative hydration ages suggest a similar range. The 1.7 to 2.7 micron readings are not inconsistent with the age for the upper levels of SON-320 and SON-292. The ages given for the 4.2 micron mean are consistent with the span of the McClure Facies reported for SON-299 and SON-324. The 7.9 ± 0.2 micron reading could suggest a faster hydrating source, or some occupation/utilization of that area earlier in, or possibly prior to, the Middle Horizon. Specimens without hydration bands, or with readings only from the older surface could date into the Historic Period.

Conclusion

Hydration values between 1.7 ± 0.2 and 7.9 ± 0.2 microns have been observed with most values between 1.7 ± 0.2 and 4.5 ± 0.2 microns. The hydration distribution appears to be roughly bimodal with concentrations in the 1.7 to 2.7 and 3.5 to 4.5 micron ranges. Lacking source characterization the hydration readings were compared with specimen depth in the Bodega deposit. Hydration bands were found to generally increase in size with increasing depth in deposit. This suggests that the variation in hydration readings may be a function of age, rather than the presence of different sources and/or internal variability within a single source. Age estimates based on the source at Napa California indicated that the specimens generally paralleled the ages of archaeological sites excavated at Bodega Bay. This and the hydration-depth data may provide some support for the background scatter concept. Differences in hydration between old and new detach surfaces of a single obsidian specimen have been observed, with the two significant values corresponding to their correct formal surfaces. Additional work is necessary before the validity of this technique can be ascertained.

Obsidian Hydration Analysis of 15 Specimens from the Borax Lake Obsidian Quarry, Lake County, California

Thomas S. Kaufman

Introduction

This paper reports the results of obsidian hydration analysis of 15 specimens from the Borax Lake Basin, Lake County, California. The assemblage was collected as part of an environmental analysis conducted in conjunction with proposed geothermal resource development within the Basin, and was submitted to Ecoview Environmental Consultants, Napa, California. Principle investigator was David A. Fredrickson, Sonoma State College. A total of 1,560 acres, nearly the entire Borax Lake Basin was surveyed (Fredrickson, 1976). The specimens utilized in this analysis derived from a concentration within the Borax Lake obsidian quarry (Lak-35), located within a quarter mile south of Lak-36, the Borax Lake Site, which proposed some of the oldest evidence for human activities on the west coast of North America (Harrington, 1948; Meighan and Haynes, 1970). All specimens utilized in this analysis were collected from the surface. Source characterization for the 15 specimens has not been accomplished to date and the possibility exists that material from other nearby sources may be present. For this analysis all specimens were assumed to have derived from the Borax Lake source.

The Assemblage

Of the 15 specimens submitted, 14 appear to be the result of cultural activities. Of these 14 specimens, 6 are artifacts, 7 are pieces of lithic debris, and one is utilized blade (see Figure 2). A more detailed description of the assemblage follows:

Projectile Points (3 specimens):
Specimen 52 is the basal section of a large concave base point. This specimen bears some resemblance to Clovis points from the Borax Lake site (Harrington, 1948, pl. XIII-XVI, Figs. 21-23). However, it may also be a more recent concave base point related to a later complex (Meighan and Haynes, 1970, 1220). Specimen 5 is a roughly-formed stemmed point with a small flute on one side at the base. This specimen increases in thickness towards the tip, which shows considerable attrition and is not unlike some Borax Lake Points (Harrington 1948, pl. XIX, Fig 32). Specimen 114 is a willow leaf point typical of the Central California Middle Complex.

Biface (2 specimens)
Both of these specimens (36, 38) are large, rough biface fragments. Neither show wear. They were probably broken during manufacture and are best classified as blanks or preforms.

Fig. 2-A BORAX LAKE OBSIDIAN QUARRY SPECIMENS

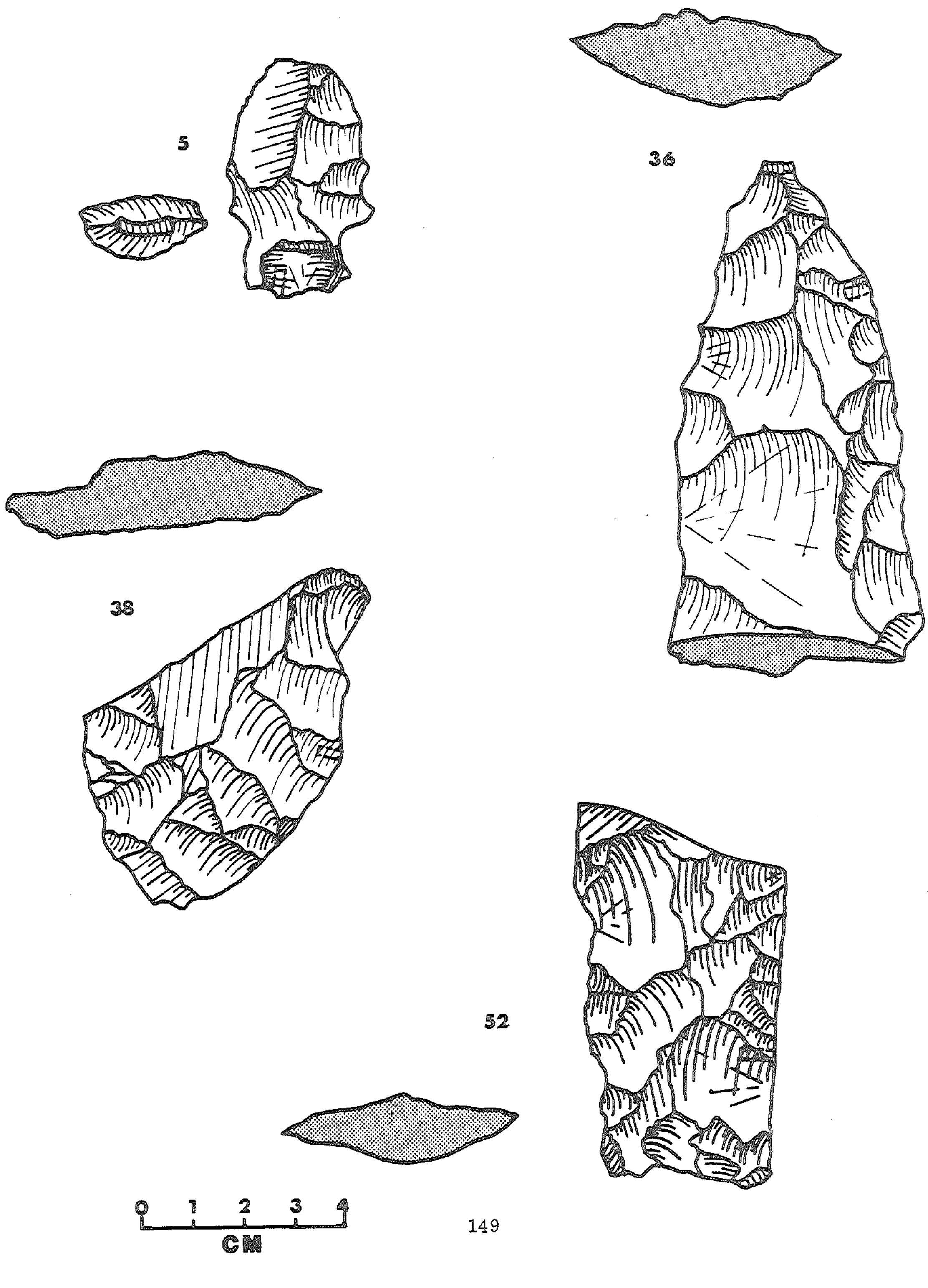


Fig. 2-B

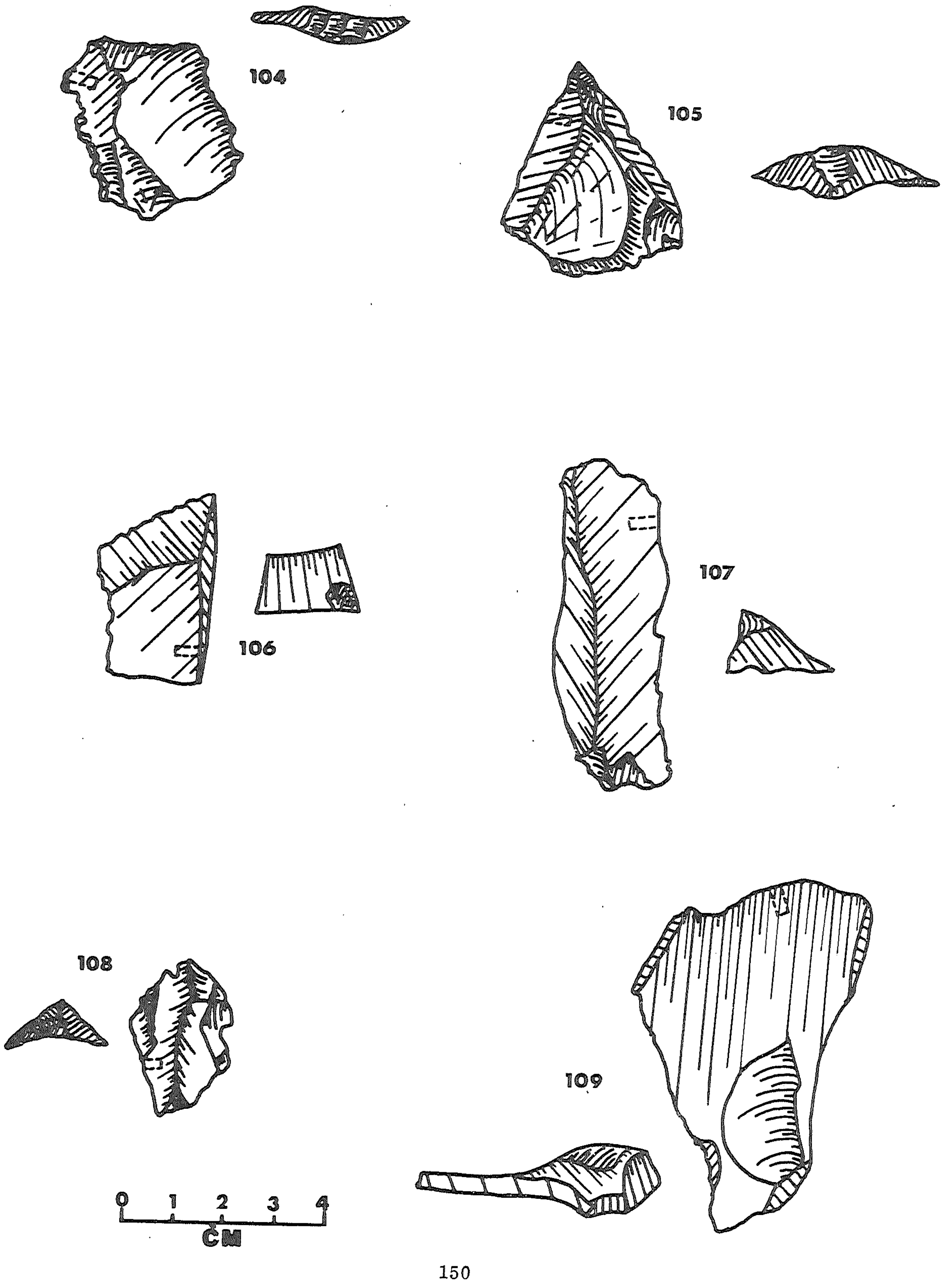
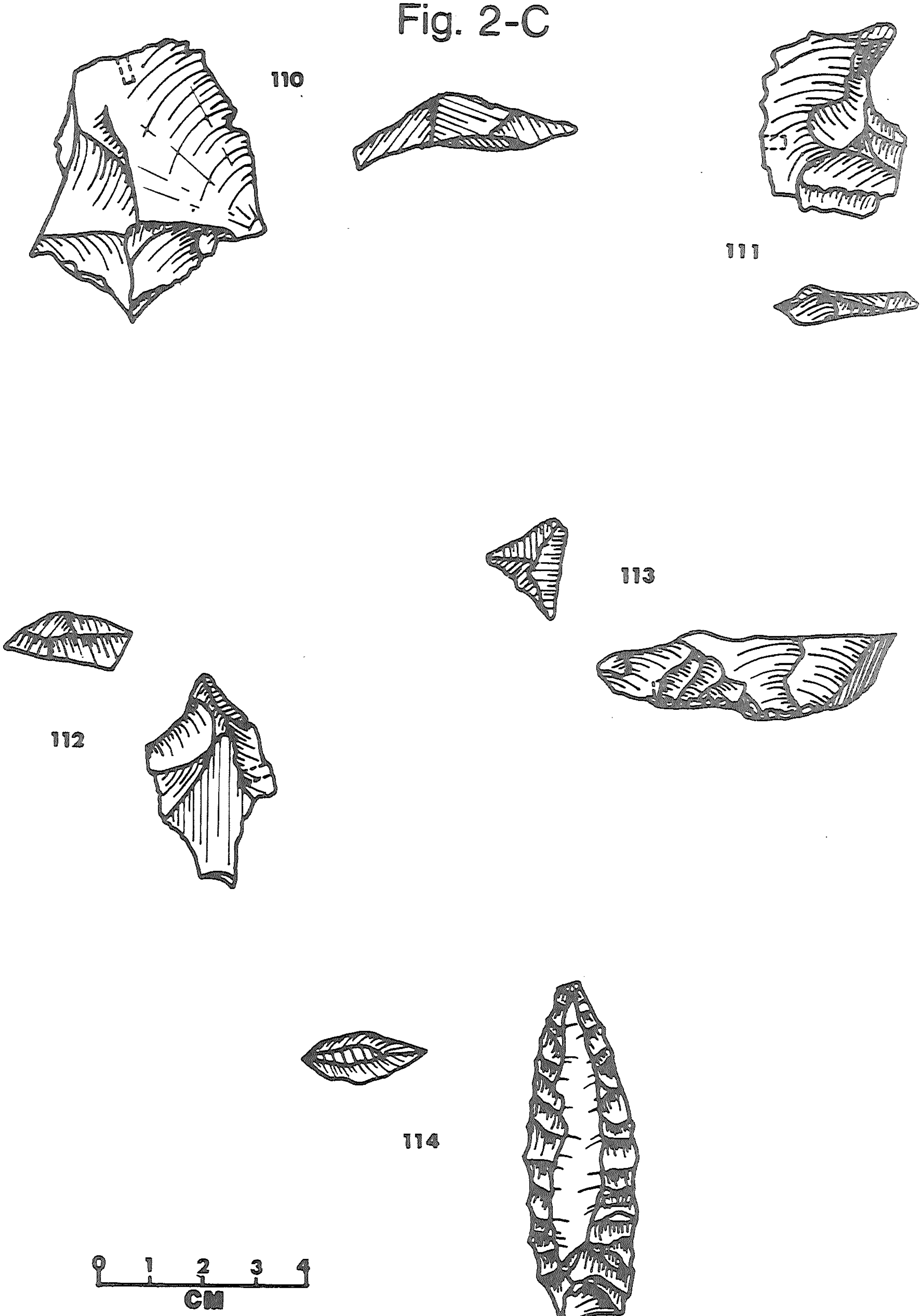


Fig. 2-C



Scraper (1 specimen):

The artifact (113) is a roughly triangular blade, not dissimilar to the keeled side scraper depicted in Harrington (1948, Fig. 37). Heavy attrition and some retouch can be seen along one edge.

Utilized Blade (1 specimen):

Specimen 104 is a thin blade with heavy attrition on one edge.

Debris (7 specimens):

Specimens 105, 107-110, 112 range from large to medium sized pieces of percussion detached debris. Some (105, 109, 110) exhibit light wear on one edge, suggesting use as temporary tools. Specimen 107 is similar to 113 above, but shows no detectable wear or retouch.

Unmodified Obsidian (1 specimen):

Specimen 106 is a roughly cubic shaped piece of obsidian unmodified over most of its surface. Its value has been omitted from the numerical data since it does not appear to be modified by man.

Although the sample is small, some tentative inferences can be made. The diversity of specimens indicate that a variety of activities occurred at CA-LAK-35. These included not only obsidian quarrying and artifact manufacture, but also the utilization of various artifacts and debris. This suggests that considerable living activity occurred at this locale.

Procedure and Results

All 15 specimens were prepared and measured at the UCLA Obsidian Hydration Laboratory. Thin sections were taken from surfaces that exhibited some form of modification (depicted by a dashed line in the illustrations). Hydration bands were read on an American Optical petrographic microscope at 537 magnification. Each hydration value was the mean obtained from five readings at the same location. All readings are reproducible to within $\pm$ 0.2 microns.

Hydration readings for the 15 specimens appear in Table 1. The number of readings versus hydration band size in microns for CA-LAK-35 and CA-LAK-36 are graphed in Figure 1. Hydration readings for 13 modified specimens in this analysis ranged from 2.7 $\pm$ 0.2 to 12.1 $\pm$ 0.2 microns (specimens 106 and 112 omitted). The surface of specimen 106 shows 19.1 microns. Six out of 13 specimens or 46% of the total sample were in the 10-11 micron range and 9 out of 13 specimens or 69% were in the 9.8-12.1 micron range. The data also suggest some later utilization in the 2.7 to 6.3 micron range. The range of hydration values was consistent with the hydration values of CA-LAK-36 (Meighan, Findlow and DeAtley 1974:17-19).

The hydration data hold some implications for understanding the formal assemblage. The large, concave-base point fragment (specimen 52) exhibited 10.5 microns, consistent with the Clovis point hydration measurements appearing in Meighan and Haynes (1970, Fig. 5). The stemmed point with the flute at the base (specimen 5) had a reading of 6.3 microns,

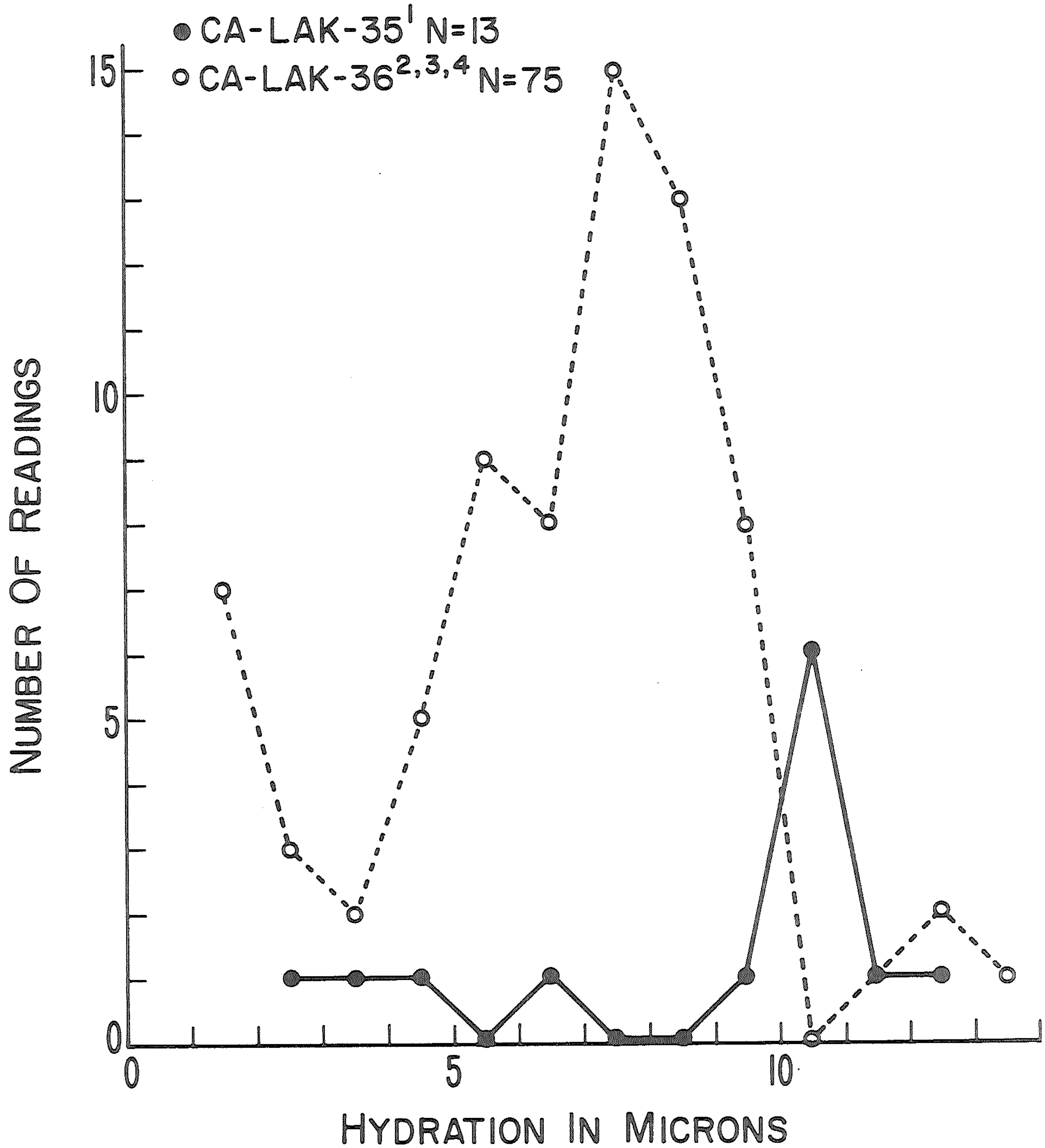


Fig. 1

1. Specimens 106 and 112 omitted
2. Meighan, Findlow, and DeAtley (1974, 17—19)
3. 1.0 micron reading omitted
4. Multiple hydration values included

this slightly less but not inconsistent with the stemmed point values appearing in Meighan and Haynes (1970 Fig 5). The leaf-shaped point exhibited a hydration band of 3.7 microns, consistent with its presumed age. The biface fragments had large values with 11.1 and 9.8 microns for specimens 36 and 38, respectively. The scraper (specimen 113) measured 10.9 microns. The utilized blade (specimen 104) has the largest value of any modified specimen with 12.1 microns. The obsidian debris exhibited readings from 2.7 to 10.6 microns . Specimen 112 presented a large diffuse hydrated area on the order of 10 microns, but was too amorphous to permit accurate measurement. It has been omitted from the numerical data.

Comparison with the Borax Lake Site

Overall, the range of data from CA LAK-35 is consistent with that reported by Meighan and Haynes (1970). The mean hydration value of 8.75 microns for CA-LAK 35 is about 2.2 microns larger than the mean for the CA-LAK-36 assemblage data appearing in Meighan, Findlow and De Atley (1974:17-19). However, the nine readings in the 9.8 to 12.1 micron range indicate an early occupation/utilization of greater intensity at CA LAK-35 than has been found at CA-LAK-36, suggesting that CA-LAK 35 might be of greater antiquity than CA-LAK-36. This observation must remain tentative due to the small sample size from CA-LAK-35 and the uncertain relationship of hydration readings obtained from surface and depositional environments.

Age Estimates

Both the Clark (1963-64) and the Friedman (1968) hydration rates as they apply to the Borax Lake hydration assemblage were summarized by Meighan and Haynes (1970). Findlow De Atley and Ericson, this volume, have suggested a rate of 890 ± 178 years per micron for Borax Lake obsidian. With an application of this rate the nine specimens between 9.8 and 12.1 microns would date between 8722 and 10,769 years B.P. The possible presence of the Mt. Konocti source with its slower rate (Ericson, personal communication) and possible deviations from a lineal rate (Ericson and Berger 1974:8-24) suggest some conservatism in using these age estimates.

Conclusion

Results of this study reaffirm the conclusions reached by Meighan and Haynes. The size distribution of hydration values delineate a period of maximum utilization represented by the 9.8-12.1 micron readings. These indicate an early occupation/utilization of greater intensity at CA-LAK-35 than has been found at CA-LAK-36. A later and more limited occupation/utilization was suggested by specimens in the 2.7 to 6.3 micron range. The formal assemblage of CA-LAK-35 indicated that living activities occurred there in addition to activities associated with obsidian quarrying and tool manufacture. Age estimates are uncertain, but data support a figure of between 9000 and 11,000 years B.P. Results indicate that surface collection of other sites and environments within the Borax Lake Basin will provide a more complete data base than has henceforth been available. Such new material may greatly increase our understanding of the nature of the Borax Lake site, and of early human occuaption in the North Coast Ranges.

TABLE 1

OBSIDIAN HYDRATION DATA FROM CA-LAK-35

Artifact No.	Description	Hydration in Microns
5	Stemmed Point	6.3
36	Biface Section	11.1
38	" "	9.8
52	Concave Base Point	10.5
104	Utilized Blade	12.1
105	Debris	10.5 (diffuse)
106	"	2.7
108	"	10.5
109	"	4.9
110	"	10.6
111	"	10.2
112	"	Large diffuse band-not measurable
113	Scraper	10.9
114	Leaf-shaped Point	3.7

Acknowledgments

I would like to thank Rainer Berger of UCLA and David A. Fredrickson of Sonoma State College for their assistance.

Obsidian Dating of the Coville Rockshelter (Iny-222)

Clement W. Meighan

The Coville Rockshelter is a small, mostly dry, cave site in the Panamint Mountains at an elevation of about 5000 feet. It was excavated in 1951 and the site report published a couple of years later (Meighan, 1953). The series of obsidian hydration determinations provides an opportunity to review and correct my earlier statements about the chronology of this site.

I estimated the occupation of the Coville Rockshelter to be between A.D. 1450 and 1750 (ibid, p. 189), that is, largely protohistoric and toward the end of what Hunt (1960) later called the Death Valley IV horizon. My original dating was much too late, as has been shown by considerable dating evidence accumulated since 1951 and further confirmed by the obsidian hydration readings presented in this volume. I was unable to make a good assessment of age for a number of reasons: absence of any relevant radiocarbon dates and no excavation reports for comparison (the closest excavated and published site at that time was Gypsum Cave, Nevada). More important, the site contained very few artifacts that might be used as time markers since most of the collection consists of basketry, cordage, and other items of styles that have been in use in the Great Basin for thousands of years. My estimate of age therefore rested on presence of pottery (two sherds that fit together forming a single vessel fragment) and an occurrence of two artifact types of "Amargosa" style: a corner-notched point and two incised slate tablets. The pottery was clearly proto-historic and the age of Amargosa at that time was believed to be linked to Basket-maker (A.D. 700 - 900) according to Rogers (1939). Since I was not convinced of Rogers' stylistic cross-dating, I did not think the Coville site went back even that far in time. However, as it turns out Rogers was wrong in his dating Amargosa but I was even further wrong and both of us dated it much too late. Later, Hunt (1960, p. 65) dated Amargosa (her Late Death Valley II) to about 2200 years ago, and Lanning (1963) put Amargosa and Late Death Valley II at 500 B.C. - A.D. 500, a dating which has since been confirmed by the radiocarbon dates of the Rose Spring Site (Iny-372). In addition, Ericson obtained a radiocarbon date for the Coville site itself (UCLA 1955, 1910 ± 60 years B.P.) which agrees with the above estimates.

The difficulties of dating dry sites in the Great Basin on purely stylistic grounds can be seen in comparing the total assemblage from the Coville Rockshelter with the sequence proposed by Hunt (1960). On stylistic grounds, one can argue that the Coville collection could match up with Death Valley II, III, or IV, or anywhere in the last 2500 years. On logical grounds, one might argue that all of these comparisons are correct and that the site was intermittently used over this long period of time. Here is where the obsidian dating evidence is very valuable, since it shows clearly that the bulk of the occupation was toward the early end of this time span. That there were occasional visits later is no doubt true, but the pottery can be discounted as a recent intrusion and not a time marker for the major occupation of the site.

On the early end of the time scale, the Coville site lacks the characteristic Pinto points of Little Lake, so Coville should be later in time than Lanning's "Little Lake" horizon

(Lanning 1963, Table 9), dated at over 1500 B. C. and supported by a radiocarbon date of 3580 years ago. At the end of the time scale, I now think that the Coville site had all, or nearly all, of its occupation prior to A. D. 1, based on the "Amargosa" items and the current dating of that horizon (ibid.). This revision makes the site over a thousand years older than I originally thought it to be, but the indicated time span--somewhere between 1500 B. C. and A.D. 1--is still too long to be very useful. A look at the obsidian dating evidence may help get a better fix on the chronology of the site.

The average hydration reading for the Coville site is 11.18 microns which is a very large amount of hydration; roughly equivalent to the average of over 10 microns for the Little Lake site (72 readings, Meighan et al. 1974, pp. 28-30). If we assume the Coville obsidian to be mostly from the Coso source and accept the rate estimate of 220 years per micron for that source (as discussed for the Malibu site in this volume), average age for the Coville obsidian would be 2420 years. This correlates with a typological similarity between the corner-notched point from Coville and similar specimens from the 60-72 inch level of Rose Springs site, which according to radiocarbon dates are 2240-2900 years old. Such an age puts the Coville occupation at about 500 B. C., or at the hinge between Lanning's Early Rose Spring and Amargosa (Lanning, 1963, p. 281). This appears to be the best estimate of age for the Coville occupation at the present time. Since there is an abundance of organic material from the site, it may be possible in the future to get additional C-14 dates on specimens from the site and see if C-14 dating is in agreement with the tentative obsidian hydration estimate. This estimate is somewhat older than the radiocarbon date from the Coville site, but it is noted that the 1910-year C-14 age is on charcoal from the upper levels of the site (6-12") and most of the obsidian is deeper and presumably somewhat older.

While this chronological reasoning is internally consistent, it does have a problem in explaining the hydration readings from the Little Lake site. The hydration evidence suggests that Little Lake is roughly contemporaneous with the Coville Rock Shelter, yet the Little Lake collection is dominated by Pinto points and there are none from Coville. This may be partly a sampling problem--the total lithic collection from Coville is very small, and Little Lake has none of the basketry or other dry materials to compare to Coville. On the other hand, there may be some unsuspected difficulties in interpreting the obsidian hydration results, making the age estimates given here subject to still further revision when we learn enough about obsidian hydration in the eastern California deserts.

Obsidian Dating of the Malibu Site

Clement W. Meighan

Malibu is a large coastal shell mound north of Los Angeles (site number LAn-264). It is a historic Chumash village from which the modern Malibu takes its name. It was occupied into the historic period when Indians from this community went to Ventura mission, with the terminal date of the site being about A.D. 1825. However, the midden is very deep in some places (over 5 meters), and the lower levels have been dated by C-14 at more than 3000 years ago.

Of concern here is the effort to apply obsidian dating to a short part of the total time span of the site. Obsidian is not common in southern California sites and there are only a few obsidian artifacts from Malibu. However, in the digging seasons of 1971-74, an intensive effort was made to secure obsidian chipping waste. All of the excavated midden was screened through 1/8 inch mesh and excavators were instructed to save all pieces of obsidian, however small. As a result a little more than 60 fragments were recovered, mostly in the form of very small flakes only a few millimeters in diameter.

Nearly all of these specimens were found in a cemetery area which has been dated by two radiocarbon tests (UCLA-1886 and 1863). These readings, corrected for tree-ring curve and other variables, should be interpreted as giving an age of ninth century A.D. For present purposes, an age of 1100 years (A.D. 850) is assumed to be the central date for the area excavated. In the list of hydration readings, all of the samples with a provenience in Trench A are from this context. Some additional hydration readings were also done (OHL Nos. 3902-3916), but these are from scattered locations in the site and from varying archaeological contexts; they are not used in the dating calculations discussed below.

A brief comment on the stratigraphy of the "A" samples is needed to understand the results. It will be observed that most of the recorded specimens are from a depth greater than 66 inches. However, this part of the site has been buried under about five feet of fill placed on top of the site when the coast highway was constructed. Therefore, a depth of 60 inches or so represents the actual surface of the site. In this part of the site, at the time of abandonment by the Indians there was about 30 inches of black sandy midden in the area of Trench A, on one edge of the site bordering on Malibu lagoon. There is considerable occupational debris in the form of shell and animal bones, but far less than is found elsewhere and it is clear that this portion of the site was a small sand dune used primarily as a cemetery. Details of the stratigraphy are considerably more complex than outlined here, but basically the excavated area is a fairly thin layer of sand with numerous graves in it.

Disturbance of the sandy layer comes from several sources, primarily the repeated digging of graves in the past. In addition, there was some use (and traffic) in the historic period as evidenced by the finding of a couple of glass trade beads and some recent metal objects. Finally, when this site was buried by highway fill, some scraping and churning of the top few inches was present from the highway equipment. Minor disturbance of the top few inches was also caused by the construction of water lines and brick walls associated with the modern period.

Stratigraphically, therefore, the whole midden area of Trench A can be treated as a single unit, and except for a few recent intrusions it appears to be of relatively short time span. Looking at the obsidian hydration readings, there are two very small ones (2.2 and 2.8 microns); these are not used in the age calculations and are considered from the recent occupation. The rest of the readings are quite consistent. There is a small shift in the direction of larger hydration bands for the deepest specimens (Average hydration for 54-66", 4.8; 66-72", 5.0; 72-84", 5.0; over 84", 5.6), but the average hydration for the area containing the graves is 5.0 microns, and the overall average for 60 readings is 5.055 microns.

If we can associate the average hydration reading with the average radiocarbon age of 1100 years, the indicated hydration rate would be 220 years per micron. Since there are many uncertainties connected with this correlation, it is obvious that this is a tentative rate subject to correction when better data are available. In the meantime this is the best data we have for southern California so it is important to explore the implications of this rate for the Malibu site and, as information accumulates, for other sites in the region.

Some sourcing studies were done on Malibu specimens by Jonathon Ericson (Table 1). These are very important at indicating the trade directions at Malibu, but they are equally important in assessing the hydration rate since there are two sources involved. Fortunately, from the limited evidence available, it does not appear that there is a big difference in the hydration rate for the two sources (Coso and Casa Diablo) since there is a general uniformity of hydration for the two classes of obsidian. Therefore, although source information is not available for all the obsidian from the site, we can operate on the assumption that the hydration rate is uniform and not subject to major errors of interpretation because of chemical variability of the obsidian.

My interpretation of the obsidian dating evidence from Malibu includes the following suggestions:

First, the Trench A cemetery was in use between A.D. 740 and A.D. 1000, about 260 years. This is based on my interpretation of the graphed obsidian readings suggesting that the cemetery associations should be those readings between 4.3 and 5.5 microns. The smaller hydration bands go with occupation of the area, but not in my opinion with the use of the cemetery. Similarly, the larger hydration bands are probably to be associated with pre-cemetery midden accumulation which is clearly evident in one end of the excavated area.

The pre-cemetery midden in Trench A (readings over 5.5 microns) would date A.D. 564-718. We know from other radiocarbon evidence that the overall site of Malibu is much older than this, but there is no archaeological evidence that would challenge the dating estimated for the Trench A area. These older hydration readings are not too important at indicating the age of the site, but they may prove to be very useful as markers for the beginning of obsidian trade to this site.

The most recent hydration (2.2 microns) suggests an age of 484 years or A. D. 1500 approximately. There is abundant evidence to show that not only the site as a whole, but this particular part of the site, had occupation at this time.

It is interesting to note that apparently very little obsidian reached the Malibu site after about 800 years ago--so little, in fact, that all of the more recent readings may well be due to re-use and re-manufacture of existing obsidian specimens. This suggests a change in trade relationships with the interior at about 800 years ago. It might also indicate a shift of preferred resources from obsidian to the fused shale commonly used in protohistoric Chumash sites (and available from adjacent Ventura county).

Unfortunately, the Malibu collection does not provide evidence for firm establishment of a hydration rate. We can make a correlation between a set of hydration readings and a set of radiocarbon dates, but since all of the data points appear to fall within a century or two (and maybe less), we wind up recognizing a particular point in time but do not have sufficient time span to elucidate a hydration curve. Therefore, at this time it is simply an assumption on my part that the rate is linear. The suggested interpretations are in conformity with the archaeological evidence, but demonstration of a different kind of hydration rate would clearly change my interpretaions of the site chronology. My suggestions raise some interesting questions to be challenged or confirmed by future evidence, and they show the value of obsidian hydration in contributing to a solution of chronology within a site.

TABLE 1. Sources of Malibu obsidian (determined by Jonathon Ericson).

OHL No.	HYDRATION	INAA No.	SOURCE	RADIOCARBON DATE
3844	5.7	1091	Casa Diablo	1185 B.P. ± 80
3845	5.4	1092	Coso	"
4111	5.4	1171	Casa Diablo	"
3843	5.4	1090	Casa Diablo	1245 B.P. ± 60
3855	4.3	1101	Coso	"
3896	5.8	1141	Coso	"
3897	4.6	1142	Coso	"
3898	2.2	1143	Coso	"
3839	5.5	1087	Casa Diablo	
3848	5.3	1095	"	
3853	5.1	1099	"	
3854	4.9	1100	"	
3842	5.9	1089	Coso	
3846	6.3	1093	"	
3847	4.9	1094	"	
3849	4.9	1096	"	
3850	4.6	1097	"	
3852	5.0	1098	"	

COMMENTS ON THE TEOTIHUACÁN OBSIDIAN HYDRATION MEASUREMENTS

Michael W. Spence

Dating of the extensive obsidian workshop areas collected by personnel of the Teotihuacán Mapping Project (directed by Rene Millon) offered a number of difficulties. Excavation of even an adequate sample of the roughly 500 workshop sites as a means of dating them was impossible. The long occupation of most Teotihuacán sites results in a mixture of the ceramics of several phases on the surface, so nothing but a very general date can be derived this way. Lithic typology is only of limited help too, since the major types seem to have persisted through much of Teotihuacán's history. Obsidian dating seemed to be the only possible way of obtaining a chronological framework for the obsidian industry, so a sample was submitted to the UCLA lab.

Two varieties of obsidian can be visually distinguished, a grey obsidian from the nearby Otumba area and a green variety from the Cerro de las Navajas area of Hidalgo. These source identifications have been generally supported by trace element analysis done by Robert Heizer and his associates at the University of California, Berkeley, and by Jane Pires-Ferreira and her colleagues at the University of Michigan. Michels (1971) has shown that the two varieties hydrate at different rates. The data presented in this report can be supplemented by other samples from elsewhere in the Valley of Mexico, but caution is required. Grey obsidians, visually indistinguishable from those of Otumba but in fact from different sources, do occur on sites beyond the Valley of Teotihuacán.

Several of the samples presented here provide the backbone for a hydration chronology. Nos. 3614-3628 are of grey obsidian from Tlachinolpan, a late Preclassic period site (particularly Patlachique and Tzacualli phases) in the Valley Teotihuacan. Nos. 4291-4301, also of grey obsidian, are from the large Tzacualli phase (1 A.D. -150 A.D.) workshop area at the north edge of the ancient city (Spence 1967: fig. 1, No. 1). On the whole, these readings and others from the Pyramid of the Sun and the Oztovhualco zone (Dixon 1969) suggest that 3.3 might mark the end of the Tzacualli phase.

Nos. 3641-3651, grey obsidian, are from Test Excavation 5, in an obsidian workshop in site 5:G:N5W1. The material was taken from a layer believed, on the basis of stratigraphy and ceramics, to date to a quite restricted point in the Tlamimilopla phase (200-450 A.D.). The sample mean and standard deviation are 2.8 ± .3. Nos. 3672-3690, also grey, are from Test Excavation 13, an obsidian workshop in site 33:N2E2. The workshop activity is believed to be Late Xolalpan or Metepec in time (ca. 550-750 A.D.). The mean is 2.7 ± .4. Finally, samples 3693-3698 are of grey obsidian blades believed, on the basis of their ground platforms, to be Postclassic.

Green obsidian samples of particular significance include 3629 - 3640 from Test Excavation 5 (3.5 ± .5) and 3652-3671 from Test Excavation 13 (3.4 ± .4). Nos. 3691-3692 are of Postclassic cores.

One problem of particular concern was the relationship between areas producing knives of the Pointed Base type and those producing the Straight Base type (Spence 1967 : 510-511, fig. 2a-g). It was at first believed that the Straight Base type was earlier, probably Miccaotli phase (150-200 A.D.), while the Pointed Base type was dominant in the Tlamimilolpa - Metepec span (200 - 750 A.D.). However, the complete lack of association of the two types on any sites suggested something sharper than a temporal shift, perhaps some sort of social distinction. Pointed Base workshop areas are represented by the Test Excavation 5 and 13 samples; by 3351-3364 (green) and 3365-3385 (grey) from site 1:E:N6E3 (Spence 1967:fig 1, no. 7); by 3500-3507 (grey) from site 14:S1E6 (Spence 1967 : fig. 1, no. 10); by 3592 - 3601, 4318 - 4322 (grey) and 3602 - 3606 (green) from 26:N2E2 (Spence 1967: fig. 1, no. 8); and by 3508 - 3512 (grey) from site 7:N5W1 (Spence 1967: fig. 1, no. 6). Straight base knife areas are represented by 3556-3582, 4302-4306, 4349-4350 (grey) from the Metepec Hacienda workshop area (Spence 1967: fig. 1, no. 3) and by 3583-3591 (grey) from site 7:N2E6 (Spence 1967: fig. 1, no. 4). The results indicate that the two kinds of area were indeed generally contemporaneous.

Several core-blade specialized areas were included in the analysis. Site 17: A:S3E1 (Spence 1967:fig. 1. no. 11) is represented by 3513-3530 (green), and site 13:N1E4 by 3489-3499 (green). Nos. 3446-3473 (green) are from a large core-blade area in square N1W2 (with one site in N1W1). Nos. 3476-3480, 3483-3488 (grey) and 3473-3475, 3481-3482 (green) are from the core-blade area in N6W1, the north part of the large workshop area associated with the Pyramid of the Moon (Spence 1967:fig. 1, no. 6). Nos. 3553-3555, 4351 (grey) and 3531-3552 (green) are from the core-blade area near to, and probably associated with, the Metepec Hacienda bifacial area (Spence 1967:fig. 1, no. 5). As nearly as can be determined with the different rates involved, these two areas were contemporaneous and so basically sub-specialized parts of one larger craft unit.

Samples 3607-3613 and 4314-4316 (grey) are from a possible Preclassic workshop area in square N2W5, and samples 3414-3445, 4307-4313 and 4352-4365 (grey) are from a large, long term workshop area in squares N4W2 and N4W3. Nos. 3699-3705 (grey) are from site L4:N:N3E2, a possible Postclassic workshop.

Samples 3386-3390, 3397-3401, 4317, 4329-4330, and 4344-4348 (grey) are bifacially worked items from a workshop area in square N1W3 Nos. 3391-3396, 3402-3413, 4323-4328, and 4331-4343 (grey) are nodule fragments from the same workshop area. It had been thought that the nodules were the raw material for the production of the bifacials there. However, most of the nodule fragments post-date the bifacial samples, suggesting that the nodules might be associated primarily with a distinct Postclassic set of activities.

Rates cannot yet be calculated with certainty. There are still some puzzling discrepancies in the results, for example the long span indicated for the Test Excavation 5 sample, which had been thought to represent a very restricted period perhaps a few years duration at most. Additional samples from Teotihuacán have been analyzed by Leonard Foote of Queens College, City University of New York. Although from the same areas and generally in agreement with these results, they are not included in this discussion for the sake of simplicity. Also, it is hoped that still further samples will be done. The final calculation of rates will require consideration of all the available Valley of Mexico data.

In the meantime, however, some tentative comments can be made. For grey obsidian, a linear rate of roughly $1\mu/550$ years gives acceptable results for the Teotihuacan data. The fit, however, seems less acceptable for Postclassic, Colonial and earlier Preclassic material, although not enough data are available on these periods to be sure. If an exponential rate is required, it might be on the order of $5.8\mu^2/1000$ years. The rate of $4.5\mu^2/1000$ years suggested by Michels (1971), and adopted from Friedman, does not fit with the Teotihuacan results. It would, for example, place the end of the Tzacualli phase (ca. 3.3μ) at 452 B.C. The $5.8\mu^2/$1000 years rate would place it at 97 A.D., the $1\mu/550$ years at 160 A.D.

For green obsidian, a linear rate of roughly $1\mu/400$ years may be correct. Here again, though, the fit with Postclassic, Colonial and earlier Preclassic readings is uncertain. On the other hand, the rate suggested by Michels (1971) of $11.45\mu^2/1000$ years is not accurate for Teotihuacan. By that rate the bulk of readings for Test Excavation 5 (3.9μ - 3.1μ) would date 640-1129 A.D., much too late. The $1\mu/400$ years rate give more acceptable dates, 415-735 A.D. If an exponential rate is preferable, one of about $8\mu^2/1000$ years might prove to be serviceable (although there are difficulties with this too).

In sum, hydration rates can only tentatively be proposed at this time. Those that have been suggested seem to fit the Teotihuacan data well enough, but must be tested against earlier and later samples from clearly defined proveniences (burials would be good). The exponential rates suggested by Michels do not work as well. Even treated as relative dates, however, the Teotihuacan results have been of invaluable assistance. It has been determined that the major Pointed Base knife and Straight Base knife workshop areas are contemporaneous, thus suggesting that their typological differences reflect social rather than temporal distance. The large N4W2-N4W3 workshop area is revealed to be largely Classic period, and the smaller Straight Base knife workshop in 7:N2E6 was probably a late offshoot of the nearly Metepec Hacienda area (Spence 1967:fig. 1, nos. 3-4). In addition, a number of other problems were solved and some new questions (for example, the N1W3 bifacial vs. nodule disparity) were raised. The hydration dating studies have, thus, been highly successful in Teotihuacan and hopefully will be expanded.

Comments on Zacatecas, Durango and Jalisco Obsidian Hydration Dates

Michael W. Spence

The hydration readings presented here expand upon an earlier set of readings from the area (Meighan et al. 1974:177-180; Spence 1974), completing the full sample. Most of the specimens reported here are of the Llano Grande variety of obsidian, although nos. 4577-4593 are of the Etzatlan variety (Spence 1971:22-24; 1974:181-182). Although these are visual identifications, the varieties are distinctive in appearance and my identifications seem to be generally supported by trace element analysis, conducted by Jane Pires-Ferreira and her colleagues at the University of Michigan. Unless noted otherwise, the samples discussed below are of the Llano Grande variety and their readings can thus be considered comparable. Site designations are based on the World Aeronautical Charts (Lake Chapala and Lake Santiaguillo sections), U.S.A.F. Aeronautical Chart and Information Service.

Only a few specimens in this set are from the Schroeder site of Durango, the bulk of readings from there having been reported previously (Meighan et al. 1974; Spence 1974; 181-182). Sample 4503, thought to be of the Calera phase, is 3.0 microns, seemingly too early for the Calera phase but satisfactory for the Las Joyas phase, which was represented in a minor way in that excavation unit. Sample 4602, of 3.4 microns, is from an Ayala phase unit, and seems correct (it is discussed more fully below). There are also a number of Schroeder site readings which have not yet been printed. These unreported readings are: 3.1, 3.7, 3.8, and 4.2 microns on specimens from excavation units primarily of the Ayala phase; 3.1, 3.0/3.8 microns on two specimens from primarily Las Joyas phase proveniences; 3.0, and 3.1 microns from a mixed Rio Tunal-Calera phase provenience; and 2.5 microns from a largely Calera phase provenience.

The present series includes only one sample from the Suchil Branch of the Chalchihuites Culture in Zacatecas. No. 4506 is from site LCAJ2-6, an Alta Vista phase site. Previously reported readings for Suchil Branch sites are nos. 1890, 1901 and 1906 from LCBJ1-13, another Alta Vista phase site, and 1908 from LCNJ1-2, a Canutillo phase site (Meighan et al. 1974). Not yet reported are readings of 3.9 microns from LCBJ1-2, 3.3 microns from LCAJ2-15 (a late Alta Vista - Calichal phase site), and 3.6 microns from LCBJ3-1 (an Alta Vista phase site).

Nos. 4573-4576 and 4594-4600 are all from the Laguna Medina site of Durango (LSAK1-1). This site is on the Los Caracoles complex, a preceramic complex with typological similarities to the San Pedro stage of the Cochise culture. It evolved into the ceramic Lona San Gabriel culture (Spence 1971:2-3, 19-20). Still other samples dated from this site, but not reported, gave readings of 3.4 microns and 4.3 microns. The bulk of the Laguna Medina readings fall in the 4.8 to 5.7 micron span. It had been thought possible that the scanty obsidian on the site represented a later intrusion, but the early readings indicate that it does indeed belong with the bulk of the site material.

Samples 4507-4510 are from LACJ1-15, represented also by earlier sample 1840

(Meighan et al. 1974:178) and an unreported reading of 4.1 microns. Samples 4511-4518 are from LCAJ1-17, also represented by earlier samples 1839, and 1851, while samples 4519-4529 are from LCAJ1-16 represented in earlier readings 1854 and 1857 (Meighan et al. 1974:178). These three sites are of the Loma San Gabriel culture. LCAJ1-15 use is from 3.6 microns to 5.4 microns, the bulk in the 4.1 to 4.9 micron range. For LCAJ1-17, the full range is 2.2 to 5.9 microns but the majority of readings are 3.1 to 3.7 microns. The LCAJ1-16 range is 1.9 to 5.3 microns, mostly 3.7 to 4.6 microns. All three sites thus seem to have occupation over a considerable period, LCAJ1-15 perhaps slightly antedating LCAJ1-16 but both largely preceding the Chalchihuites Culture occupation of the Schroeder site. The LCAJ1-17 occupation seems generally contemporaneous with the earlier part of the Chalchihuites occupation at Schroeder. The artifacts and ceramics do not contradict these datings. Other Loma San Gabriel culture readings, reported earlier (Meighan et al. 1974), are nos. 1835 and 1845 from LCAJ1-25 and 1858-1859 from LCAJ1-27.

Nos. 4530-4533 are from LCQJ1-7, a Las Chivas complex site in the Sierra Madre of Durango (Spence 1971:2-3, 20). Also from this site are previously reported samples 1616-1619, 1861 and 1863 (Meighan et al. 1974). Specimens 4534-4537 are from LCQJ1-11, another Las Chivas site, also represented by samples 1855-1856 (Meighan et al. 1974). Other readings from this general area are 1866, of 3.4 microns, from the LCQJ-27 site, believed to date to the El Camino complex (Meighan et al. 1974:178; Spence 1974:182), and an unreported reading of 3.7 microns for LCQJ1-25, a mixed Las Chivas - El Camino-Madronas site. The bulk of the Las Chivas complex readings fall between 3.5 and 4.6 microns, earlier than but overlapping with the Schroeder site sequence. The greatest clustering is in the 4.1 to 4.6 micron span, pre-Schroeder. The following El Camino complex is represented by the 3.4 micron reading, while the 3.7 micron reading for LCQJ1-25 probably represents the Las Chivas occupation there.

A number of sites have been assigned to the Adams complex, located to the east of the area of the Las Chivas, El Camino and Madronas complexes (Spence 1971:2-3, 20). Samples 4538-4552 are from LCQJ2-1, represented also by readings 1837 and 1847 (Meighan et al. 1974:178). Site LCQJ2-2 is represented by present samples 4553-4556, as well as by no. 1867 (Meighan et al. 1974:178). LCQJ2-4 is dated by nos. 4558-4563 of the present series and by 1838 and 1844 of the earlier group (Meighan et al. 1974:178), as well as by an unreported readings of 1.6 micron. LCQJ2-7 is represented here by nos. 4564-4572, and in the earlier series by 1843 and 1848 (Meighan et al. 1974:178). Another Adams complex site, LCQJ2-3, is not represented in the present readings but earlier gave the readings reported as nos. 1620-1622 (Meighan et al. 1974:178). Generally, the readings suggest long and roughly contemporaneous spans for the Adams complex sites, the bulk falling between 2.2 microns and 5.0 microns. The Adams complex would thus seem to temporally parallel the Loma San Gabriel culture and, in the earlier part of its sequence, the Las Chivas complex. It partially precedes but largely overlaps the Guadiana Branch of the Chalchihuites Culture, to judge by the obsidian hydration readings from the Schroeder site. The lithic and ceramic characteristics of the Adams complex support this dating.

On the basis of these readings, a rate of hydration can be defined with some confidence for the Llano Grande variety of obsidian, Sample 4602, of 3.4 microns, is from unit 6 of the 1958 excavations in Schroeder site structure 12. A radiocarbon date 660 A.D. ± 85 is associated with this unit. The unit ceramics are Ayala phase (550 A.D. - 700 A.D.), and include two late Ayala or early Las Joyas (700 A.D.-950 A.D.) sherds. Specifically, the ceramics are 9 Amaro Red-on-Cream, 1 Mercado Red-on-Cream, and 2 Refugio Red-on-Brown sherds. This, then, supports the radiocarbon date. If we equate 3.4 microns with 660 A. D. (dating from a 1975 base since the hydration measurement was done this year) a linear rate of about 1 micron per 385 years would result. This rate will be calculated from a compromise base of 1970 (the earlier series was actually done in 1968, the present one in 1975).

The bulk of the Schroeder site readings fall between 3.8 microns and 1.4 microns, which may be taken to represent the span of the Chalchihuites Culture occupation there. This span, translated into years would be 507-1350 A. D. (the terminal date is a bit uncertain). Specimens in the sequence assigned by ceramic associations to a particular phase may be quite variable in terms of hydration chronology. This difficulty was discussed for the earlier set (Spence 1974:181), where it was noted that the extensive Ayala - Las Joyas phase overlap was somewhat alleviated by dividing the presumably Las Joyas phase specimens into two groups, one of specimens from proveniences with 20% or more Ayala phase sherds included (the mean for these was 3.6 microns, or 584 A. D.) and one from proveniences with under 20% Ayala sherds (the mean was 2.8 microns, or 892 A. D.). These means, then, suggest that many of the samples in the former group are actually Ayala phase specimens included in the later Las Joyas phase proveniences.

The bulk of the Las Joyas phase specimens (including those from both groups noted above) fall at or after 3.3 microns, or 699 A. D. This agrees well with the estimated initial date for Las Joyas of 700 A. D. Many readings, however, go well beyond the estimated terminal date for the phase, indicating mixture with Rio Tunal (950-1150 A. D.) and even Calera (1150-1350 A. D.) phase specimens.

Most of the readings from primarily Calera phase proveniences fall in the 2.3 - 1.4 micron span, 1084 - 1431 A. D. Calera is thought to have started about 1150 A. D., generally congruent with a 2.2 micron reading, and so roughly in agreement with the hydration evidence.

In the Suchil Branch of the Chalchihuites Culture there are two dates in the range of 3.6 - 3.3 microns, or 584 - 699 A. D. This would be in the Calichal phase, which is believed to date about 500 - 650 A. D. and to overlap the Ayala phase of the Guadiana Chalchihuites. Other readings are generally later, with only one earlier reading of 3.9 microns. This suggests that some of the sparse Llano Grande variety obsidian entering the Suchil Branch did so during the Calichal phase, probably through trade with the Ayala phase occupants of the Schroeder site.

The preceramic Los Caracoles complex readings are as early as 5.7 microns, or 224 B. C. The extend up to 4.8 microns, or 122 A D., where there is a cluster of three readings, with a few later ones at 3.4 microns (661 A. D.), 4.2 microns (353 A. D.) and 4.3 microns (314 A. D.). The Los Caracoles complex may thus date primarily from ca. 224 B. C. to ca. 122 A. D.

The following Loma San Gabriel culture shows a long span, the bulk of readings in the 4.6 - 2.2 micron range (199 A. D. - 1123 A. D.), but scattered earlier and later readings occur. If the 4.6 microns readings (199 A. D.) are taken as the early limit for Lona San

Gabriel and the 4.8 readings (122 A.D.) as the late limit for the Los Caracoles complex, ceramics must have entered this area of Durango sometime between 125 A.D. and 200 A.D.

The Las Chivas complex dates largely between 4.6 microns and 3.5 microns, or 199 A.D. -662 A.D. (one reading of 5.0 microns must remain ambiguous until supported by others). This may indicate that ceramics appeared in this part of the Sierra Madre, with Las Chivas, at about 200 A.D., although the possibility of earlier but still undetected ceramic complexes cannot be ruled out. The later El Camino complex is represented by the one reading of 3.4 micron, or 661 A.D. However, it must be remembered that this area is somewhat higher than the Guadiana Valley, where the hydration measurements upon which the rate is defined were located. It may be that the greater cold here would slow the hydration rate somewhat, so the Las Chivas complex might date earlier than indicated.

The Adams complex, located further to the east and in a somewhat lower area, shows a long span, perhaps starting as early as 5.0 microns (45 A.D.), with some scattered readings still earlier, and extending up to 2.2 microns (1123 A.D.), with a few readings even later. Undoubtedly further research would produce temporal subdivisions within this long sequence.

Samples of the Etzatlan variety of obsidian, coming from a different source, may well have a different hydration rate and so cannot be compared directly with the readings obtained on the Llano Grande material specimens. Etzatlan variety samples presented here are all from parts of the Etzatlan site in Jalisco. Nos. 4577 - 4581 are from Etzatlan 1 (also designated locality W13), which is further represented by an unreported reading of 3.0 microns and earlier reported samples 1836, 1846 and 1862 (Meighan et al. 1974). Nos. 4582-4585 of the present series are from a different part of the Etzatlan site, Etzatlan 3 (W16), which is also represented by an unreported reading of 2.7 microns. Nos. 4586-4593 are from Etzatlan 6 (locality W20). The three areas sampled seem to be roughly contemporaneous in terms of hydration readings, falling in the 2.3 - 3.4 micron range. Locality W20 might be somewhat earlier than, although largely overlapping with, W13 and W16. Based on ceramics, the localities should date within the Huistla (800-1200 A.D.) and Etzatlan (1200 A.D. - Conquest) phases.

The site of Huistla is very near Etzatlan and so probably relied largely on the Etzatlan variety of obsidian, which seems to dominate Postclassic assemblages from this area. Thus the hydration measurements presented for Huistla (Meighan et al. 1974:150-151) should be generally comparable to those from the Etzatlan site. The range for the Huistla site (largely in the 2.8 - 3.6 micron span) is slightly earlier than that for the Etzatlan site (largely 2.3 - 3.4 microns) but this is to be expected since the Etzatlan site was a major center through the Etzatlan phase.

If the cluster of 2.8 microns readings from Huistla is taken as the terminal date for the Huistla phase, then a linear rate of about 1 micron per 275 years would be indicated. This is very near the rate of 1 micron per 260 years suggested by Meighan for West Mexico. Using this rate, and a base of 1968 A D. for calculations, the late cluster of 2.3 microns readings at Etzatlan would represent 1335 A D. The mean for Etzatlan (about 2.8 microns) is 1198 A.D., and the mean for Huistla (about 3.1 microns) is 1115 A.D. All of these dates seem acceptable.

Four blades of Etzatlan variety obsidian found at the Schroeder site have also been examined (Meighan et al. 1974:178). No. 1841, from a Las Joyas phase provenience, is 3.8 microns (923 A.D.). No. 1864, also Las Joyas, is 3.0 microns (1143 A.D.). An unreported sample from a mixed Las Joyas - Rio Tunal provenience is 3.3 microns (1060 A.D.), and an unreported Rio Tunal - Calera provenience blade is 3.1 microns (1115 A.D.). Translated into calendrical dates by the 1 per 275 years rate, all of these but no. 1864 are acceptable. This latter date may reflect an error of ceramic dating rather than of rate. Of particular interest is the fact that most of the blades seem to date within the Etzatlan site span. It is believed that most of them were imported from there by the occupants of the Schroeder site (Spence 1971:23-24). One other date on Etzatlan variety material is on a point fragment from the Carmelita 1 site of the Atoyac - Sayula valley of Jalisco (Spence 1971 24). The reading, on no. 1852, is 7.3 microns (Meighan et al. 1974:178). This translates to 39 B.C., somewhat earlier than anticipated for Carmelita 1, which may be Classic period.

In sum, a solid hydration rate can be established for the Llano Grande variety of obsidian and a tentative one for the Etzatlan variety. The resulting dates for Zacatecas and Durango are consistent with ceramic and lithic evidence, and permit the correlation of the Chalchihuites, Loma San Gabriel, and Sierra Madre sequences. We also obtain acceptable absolute dates for the appearance of ceramics in central Durango and for the important Las Chivas complex, difficult to date otherwise because of its lack of clear ties to well dated sites elsewhere. In Jalisco, the Etzatlan and Huistla sites can be correlated and, at least tentatively, given absolute dates. The imported blades of the Schroeder site can be related temporally to their source area in Jalisco, clarifying somewhat the trade contacts involved. Some of these accomplishments would have been virtually impossible without the use of obsidian hydration dating.

Comments on Hydration Readings from Atiquipaque, Guatemala

Gary Rex Walters

All of the samples examined came from excavations of stratified cultural deposits. The micron readings reinforce the reconstruction of the occupational sequence at the site. They were especially useful in determining the constructional sequence of the two fortified Post Classic ceremonial centers.

Two samples (A-1-9-1 and A-1-9-2) were associated with a structure dated by the ceramic assemblage to the Late Classic Period (A. D. 700-900). Both samples were from the 80-90 cm below surface level and represent the earliest cultural debris yet known from the site. The only previous micron reading available for Atiquipaque falls within this 2.6 - 3.0 range. Larry Feldman (1975, Papers on the Xinca) states: "Initial analysis of one blade (sz 4 A-1) has provided an obsidian hydration micron reading of 2.74 or, using linear rate, of 1258 ± 25 A. D. (Leonard Foote, personal communication)." The blade was recovered from mound fill and, when compared with our results, the 2.74 reading falls within the Late Classic range. It seems, then, that the linear rate Foote is using in his conversion produced a date which is much later than the actual manufacture of the artifact.

In the A excavation unit (in the western portion of the site) there is a sharp decrease in the number of artifacts between 40 and 60 cm. This is viewed as the transition zone between the Late Classic and the Postclassic. However, the tendency seems to be more of a change from Late Classic to Late Postclassic, although some Early Postclassic sherds are present. In the eastern portion of the site there seems to be a purely Early Postclassic component; this is represented in the micron readings as samples F-1-9-1 and F-1-4-1.

In contrast to the distinct break between A-1-9-1 and A-1-9-2 and the other sample there is a bit of overlap among certain of the latter. However, with all vertical distributions considered, the F to A-B-T transition is thought to represent a change from Early to Late Postclassic, a change from one fortified ceremonial center to another (see tables 1 and 2).

With regard to the tentative cultural history reconstruction based on the micron readings and associated cultural debris there may be a hiatus at the site between the Late Classic and Early Post Classic or that gap may merely not be represented in the sample. The Early and Late Postclassic interface may be subject to some fluctuation for it looks as though a Postclassic continuum is present at the site. The 1.4 reading probably reflects the period of time just prior to the conquest in 1524 and I would expect no micron readings from the site to be less than 1.3.

These 10 micron readings have done wonders in clarifying our interpretations of intrasite development; a more extensive analysis would certainly round this out even more. The site is stratified and provenience is known for all artifacts. The cultural history reconstruction has been based largely on ceramic types; this has been reinforced by the micron readings. The biggest drawback the site has is that no organic material was recovered for absolute dating methods and given the preservation quality of the soil, none can be expected.

As a possible complement to the Atiquipaque material, our 1977 excavations at Mi Cielo, near Iztapa, sampled three meters of stratified Classic Period deposits. Obsidian was present in virtually all of the 16 levels of the 3.20 meters of debris; thermoluminescence dates should be forthcoming on selected strata. These two sites seem to offer a stratified sequence from at least the beginning of the Classic Period to the conquest. Search for older stratified deposits will be one of the objectives of the 1978 field season.

MICRONS (MEANS)	UNIT & LEVEL		
1.0			
1.1			
1.2			
1.3			
1.4	T-3		
1.5	B-3		
1.6	A-2	B-2	T-3
1.7	A-2	F-1	
1.8			
1.9	F-4		
2.0			
2.1			
2.2			
2.3			
2.4			
2.5			
2.6	A-9		
2.7			
2.8			
2.9			
3.0	A-9		

TABLE 1

A Correlation of Micron Means and Unit and Level from Atiquipaque, Guatemala

	MICRONS		MICRONS	MICRONS	
	1.0		1.0	1.0	
	1.1		1.1	1.1	
	1.2		1.2	1.2	
	1.3		1.3	1.3	
Late Post Classic	1.4	A-2	1.4	1.4	T-3
Late Post Classic	1.5	A-2	1.5	1.5	T-3
Late Post Classic	1.6	A-2	1.6	1.6	T-3, F-4
Early Post Classic	1.7	A-2	1.7	1.7	T-3, F-4
Early Post Classic	1.8	A-2	1.8	1.8	T-3, F-4
Early Post Classic	1.9	A-2	1.9	1.9	F-4
Early Post Classic	2.0	A-2	2.0	2.0	F-4
Early Post Classic	2.1	A-2	2.1	2.1	F-4
Early Post Classic	2.2		2.2	2.2	F-4
	2.3		2.3	2.3	
?	2.4		2.4	2.4	
	2.5		2.5	2.5	
Late Classic	2.6	A-9	2.6	2.6	
Late Classic	2.7		2.7	2.7	
Late Classic	2.8		2.8	2.8	
Late Classic	2.9		2.9	2.9	
Late Classic	3.0		3.0	3.0	

Cultural History Tentatively Correlated with the Available Micron Readings from Atiquipaque, Guatemala.

Hydration in Microns: Two Bands (there distribution).

TABLE 2

Hydration Analysis on Obsidian Samples from the Gimbutas/ Theochares 1973 Excavations at Achilleion, Thessaly, Greece

Carol K. Witte

Abstract

The Achilleion obsidian is believed to have originated at the Melos source, although no chemical analysis of the pieces has been done (Witte, n.d.). The lack of chipping waste and cores at the site indicates that all obsidian reached the site as a result of trading activity.

The range of hydration readings is 3.1 to 6.7 microns. Five radiocarbon dates exist for the site. The calibrated dates are: 5700 B.C., 6000 B.C., 6100 B.C., 5800 B.C. to 6000 B.C. (Gimbutas, personal communication). These dates are, if the error factors are taken into consideration, essentially contemporaneous. The time span indicated does not warrant the attempt to associate specific obsidian measurements with specific C^{14} determinations in an effort to reveal the rate. Problems with correct level association due to the sloping nature of the site, and with disrupted stratigraphy are also present.

Achilleion is still, however, an extremely important site for rate studies of the area. The data, when taken as a whole, represent a firm point in time on the curve of hydration versus time.

The Sample

The sample consisted of a total of 47 obsidian pieces randomly collected from various levels of the site. As far as can be determined, this was the first analysis of Aegean obsidian for hydration dating purposes.

Nearly all specimens were opaque, predominantly gray-black in color, with some specimens showing a greenish tinge when held up to the light. This corresponds with the description of obsidian coming from the Island of Melos, as described by Renfrew, Cann and Dixon (1965, p. 231). All fracture conchoidally, and possess a 'pearly' luster, in contrast to the more usual smooth, black, shiny obsidian found elsewhere. The majority of the pieces appeared to be fine, elongated blade fragments, which were probably used as knives or razors. Many appeared to be unretouched, which would indicate, together with the relative lack of chipping waste (and especially cores of obsidian from which artifacts would be made) that these artifacts came to the site as a result of trading activity.

After an unsuccessful attempt to get any of the sample pieces characterized by neutron activation or spectroscopic analysis at UCLA, some of the pieces were sent to Renfrew by Ernestine Elster. His opinion of the source of the specimens, by observation, is that "they appear to have come from Melos."

The Site

Achilleion is a tell of 200 meters by 260 meters, composed solely of Neolithic material. It is one of several hundred neolithic mounds lying on the southeastern edge of the Karditsa Plain. Occupation began in mid-seventh millenium B. C. and continued for approximately 900 to 1000 years, paralleling Catal Huyuk VI-II, Hacilar Pottery Neolithic and Chalcolithic sequences in Anatolia, and the Pottery Neolithic of Jericho. Carbon dates range from 5650 to 6550 (True Age, B. C.). (For additional information, see Gimbutas 1974).

The Analysis

Of the 47 pieces prepared for microscopic analysis, 5 were found to lack hydration bands, and were labelled as non-obsidian composition. One came from the outside surface of the site, and yielded a hydration reading of 6.7, much higher than the other samples, and so was not included in the analysis results. One specimen came from the first level of a test pit, E-9, level 1, so its reading was not included as part of the main body of the sample. Of the 40 samples remaining, eleven came from the northwest Square A (26%), five came from the northeast Square B (12%), fourteen came from the northeast Square D (24%). All the squares were situated at the top of the mound and were five meter squares.

Wedge-like slices from each specimen were cut on the diamond-loaded blade saw, cemented to slides, then ground first on one side and then the other to take the sample down to 30 micron thickness without grinding away the edges in the process. Three sides of each slide sample were then examined under the 450 power microscope, and corrected to allow for about 1.23 micron optical calibration error. After approximately 100 hours of work, a set of readings was obtained which allowed the following graphs and attendant conclusions to be made.

The Results

The hydration band readings were then arranged in interval scale on a univariate graph (micron values being the variable), with the results as shown (see figure 1).

The graph indicates a unimodal distribution, with the clustering occurring about 5.1 microns. This was a strong indication that the obsidian came from a single source of supply, since a bimodal clustering would have indicated possible chemical differences in composition, which would have been the case if more than one source was used for the supply. In addition, this indicates a higher concentration of use at a particular time period.

Since there was not much of a spread in micron values, it also appears to indicate a rather slow rate of hydration for obsidian of this particular composition, and in this particular soil and climate.

A second graph of the total sample of hydration dated artifacts was made, in which the micron values were plotted on the vertical axis, as against the depth levels on the horizontal axis. A tendency was noted for the artifacts in the upper to mid-level of the site (down to about 1-1/2 meters) to have lower readings than would have normally been expected. Conversely, at the lower half of the site, there seemed to be a tendency for the readings to be younger than expected. This would tend to indicate a good deal of mixing and disturbance.

As a result of this, I decided to apply Michels' method to the graph to test for artifact reuse (AA 34, No. 1:15-22). In this method, the frequency distribution of artifact hydration-rim values is plotted against the deposition units from which the artifacts were recovered. Maximum thickness (maximum age) is located at the bottom of the left axis, and intervals of reduced thickness are expressed by the micron values progressing toward the top. The horizontal axis of the scatter diagram represents the deposition units. (The deepest units are located at the juncture of the two axes, and progressively shallower units are arranged toward the outer end) (see Figure 2).

Calculating the median hydration rim value for each deposition unit to express the central chronological tendency of each unit, I then drew the trend line, which expresses the overall chronological patterning of the site deposit. The sloping orientation is evidence of a tendency towards superposition in the deposit, even though there appears to be extensive mixing.

The median points were then entered and connected by a dotted line, so that the behavior of each deposition unit becomes observable with respect to the prevailing trend.

As Figure 2 illustrates, the median line fluctuates around the trend line. It is this fluctuation which offers some useful information, according to Michels (ibid., p. 16).

For example, the fluctuations which show segments above the trend line identify deposition units in which a proportional amount of the mixing is due to the intrusion of "younger" materials. Fluctuations below the trend line indicate deposition units in which a disproportional amount of the mixing is due to the intrusion of "older" refuse. Thus, in Figure 2, it would appear that there is a substantial bias in favor of artifact intrusion.

Actually, in the upper portions of the site, several Christian burials were found, which would explain some of the mixing. Also, there was evidence of ploughing down to about one-half meter depth. Below that, however, it is hard to explain. According to Michels, the features observable on such a scatter graph which would indicate the existence of a pattern of artifact reuse are (1) a positive slope of the trend line; (2) a pronounced dip of a segment of the median line below the trend line at some vertical sector; and (3) a horizontal sector of the scatter diagram located on or above the trend line which is largely or completely vacant. These phenomena do occur on Figure 2, and parallel the features shown by Michels in his Figure 11.

Actually, the area of reuse on the site seems to correspond to what would be the time of greatest population density, the Middle Neolithic Period (Gimbutas, op. cit., Table 3, p. 284).

We had one radiocarbon date at a level of Square D which also yielded three of the specimens used in this analysis. These three samples had rather close-reading hydration bands--5.0, 5.2, and 5.3 microns with an average value of 5.2 microns. This average reading of 5.2 microns can therefore be tentatively assigned the chronological date of 6930 $\pm$ 155 B.P. corrected to a True Age of about 5750 B.C. (Gimbutas, op. cit., Table 1, p. 282).

FIGURE 1 DISTRIBUTION OF MICRON VALUES (hydration band measurements) PER NUMBER OF SPECIMENS

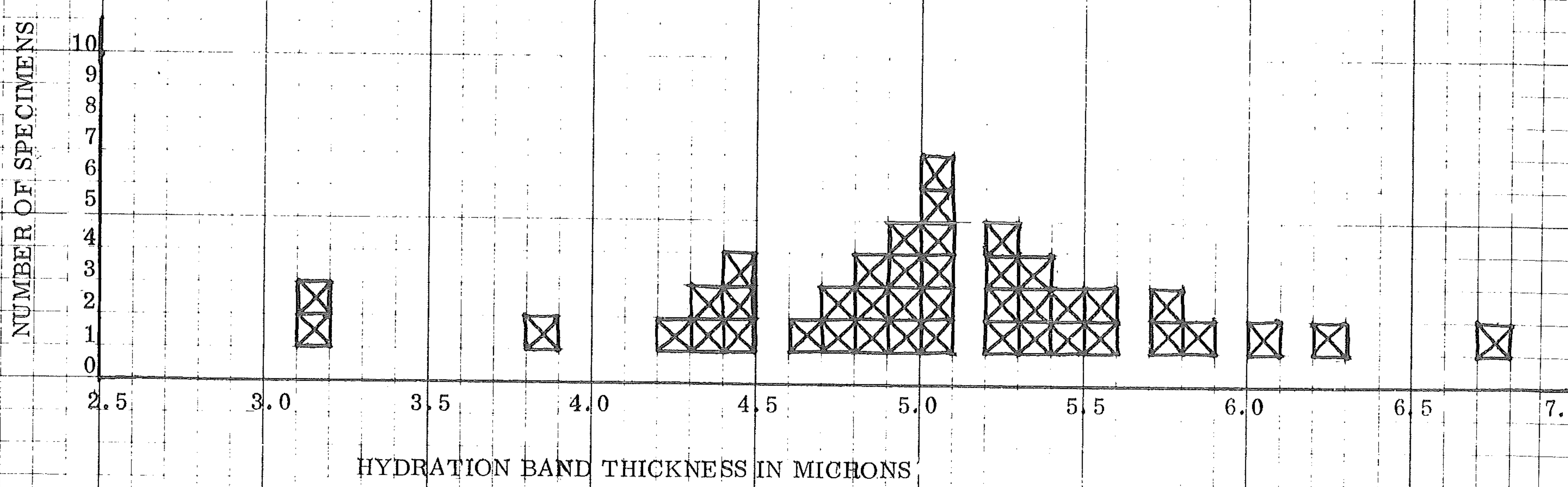
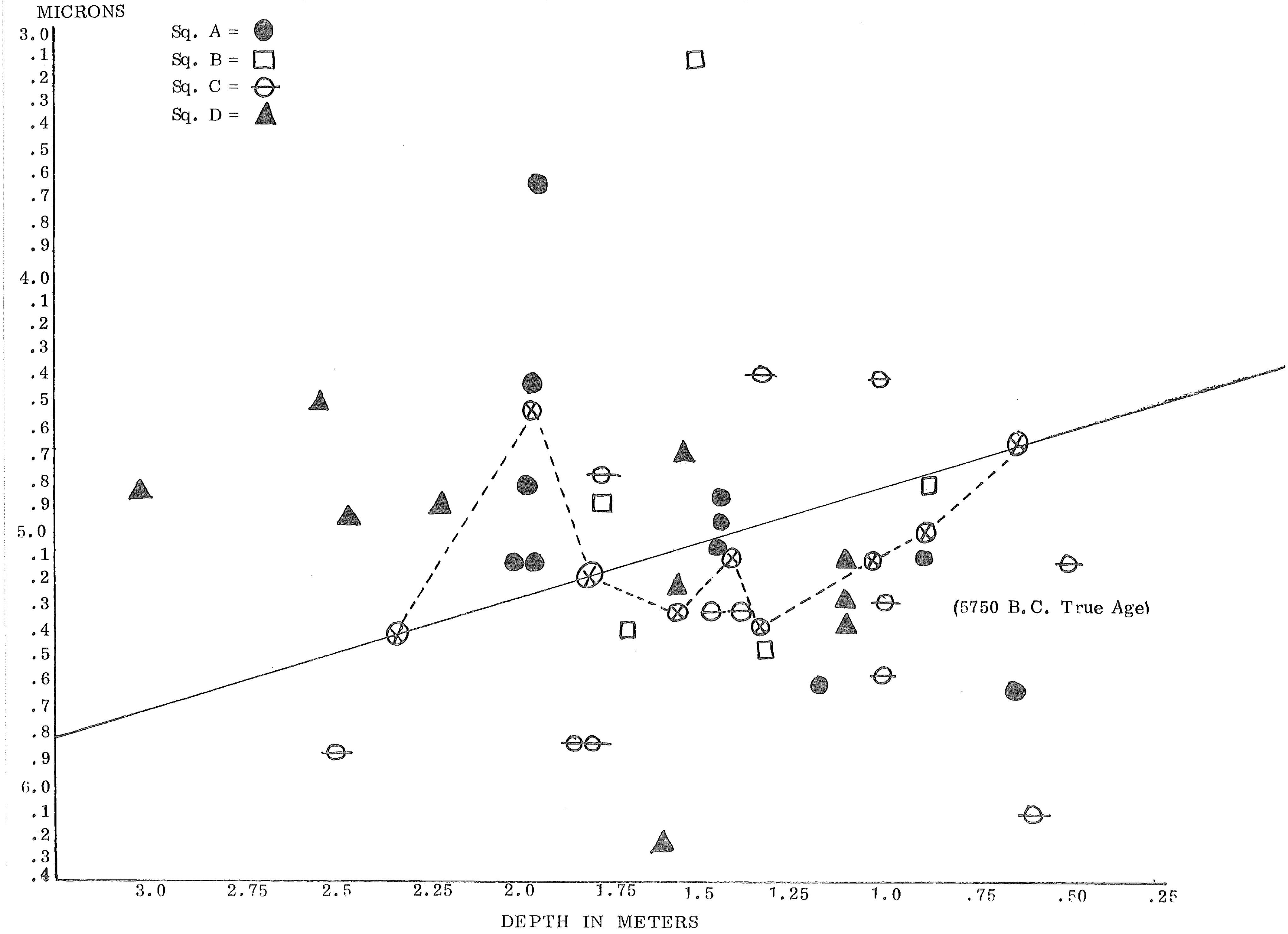


FIGURE 2 TOTAL SAMPLE OF DATED ARTIFACTS



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