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International Association for Obsidian Studies

Bulletin

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NEWS AND INFORMATION

NEWS AND NOTES

Have news or announcements to share? Send them to IAOS.Editor@gmail.com for inclusion in the next issue of the *IAOS Bulletin.*

CONSIDER PUBLISHING IN THE IAOS *BULLETIN*

The *Bulletin* is a twice-yearly publication that reaches a wide audience in the obsidian community. Please review your research notes and consider submitting an article, research update, news, or lab report for publication in the *IAOS Bulletin*. Articles and inquiries can be sent to IAOS.Editor@gmail.com Thank you for your help and support!

WINNERS OF THE SKINNER POSTER AWARD AT 2024 SAA

The Craig E. Skinner Poster Award highlights the best obsidian-focused poster presented at a major archaeological conference, as selected by the IAOS Awards Committee, comprised of members of the IAOS Executive Board. Winning posters present unique research, innovative application of methods, and creative analysis of obsidian materials. The winning poster's abstract can be found on page 4 of this issue of the *IAOS Bulletin.*

NOTES FROM THE PRESIDENT

Hello, IAOS members. As I am writing this column, I realise that a whole year has gone by since I last contributed to the Bulletin. I would really like to thank our wonderful Editor, Carolyn Dillian, for her retrospective in last issue's *Notes* column while I was on maternity leave. Last year was very busy and productive for the IAOS. The Association has welcomed its two youngest members as both me and past president Kyle Freund have welcomed our firstborns in late 2023 – welcome to the world little ones!

Before that, the much-anticipated International Obsidian Conference (IOC) took place in Engaru, Japan, between the 2nd-6th of July 2023 (below). It was a well-attended event with obsidian specialists from around the globe sharing their research on all topics 'obsidian'. The local organising committee did an amazing job welcoming the delegates to Engaru Town in Hokkaido, organising museum visits and excursions to the fantastic obsidian sources of the Shirataki Geopark (including sampling!!) and, last but not least, introducing mouthwatering dishes. The IAOS sponsored the Skinner Poster Award in the event, which was awarded to Mr. Matsumura, for his poster *Use of Obsidian Resources for Education and Tourism in Shiraraki GeoPark, Japan.* The next IOC will take place in Yerevan, Armenia in 2026 (see the flyer on the next page) after a successful bid during the Japan proceedings.

Several other IAOS initiatives took place during the year, including a sponsored table at the Great Basin Anthropological Association, new contacts for additional sponsorship opportunities both in the USA and Europe, and the 2024 Skinner Poster Award in the context of this year's Society for American Archaeology (SAA) Meeting. Nicholas Suarez, Claire Ebert, John Walden, Julie Hoggarth and Jaime Awe's poster titled *Interwoven Networks: Reconstructing Classic Maya Obsidian Economies in Western Belize* were this year's winners. The IAOS annual meeting also took place during the SAAs. We discussed several new items like updating our trifold handout, new sponsorship missions, updates on our website and possibly advertising for a social media/outreach person. If anyone has suggestions for future IAOS activities please let me know at: tmouts01@ucy.ac.cy.

Summer is here and I suspect many of you are travelling the world to conduct fieldwork. I won't be starting my field season until the start of the autumn when temperatures in Cyprus should be somewhat more humane. In the meantime, I hope everyone has a safe and productive summer and I look forward to finding out all about your exciting research in future conferences and/or our Bulletin!

Enjoy your summer!

Dora Moutsiou
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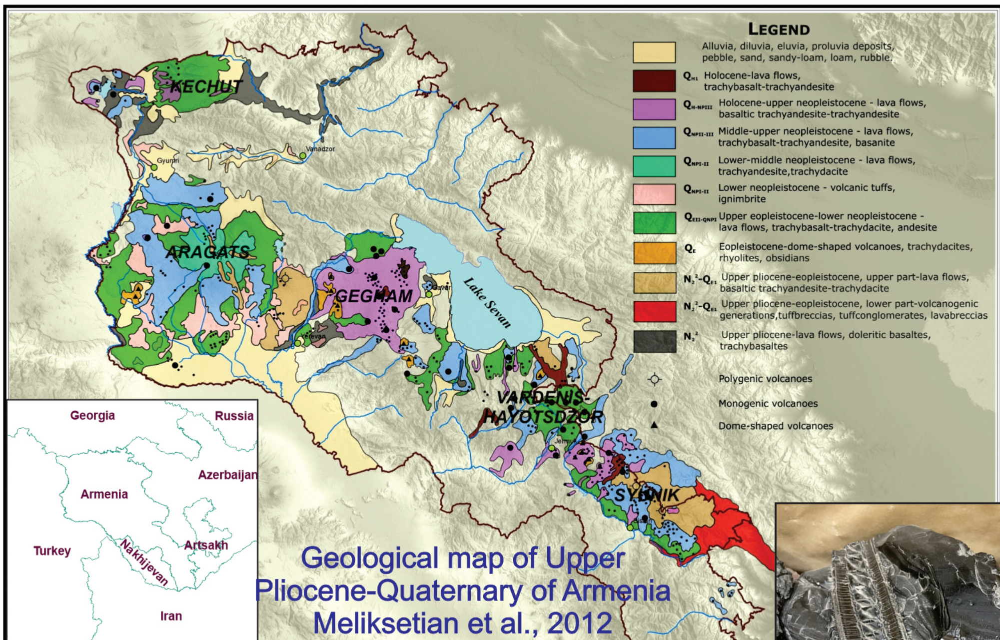
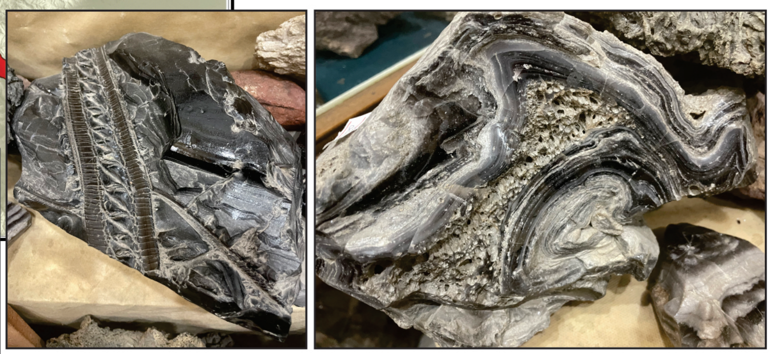
Special Scientist
Archaeological Research Unit
University of Cyprus

International Obsidian Conference 2026 (Armenia, Yerevan)

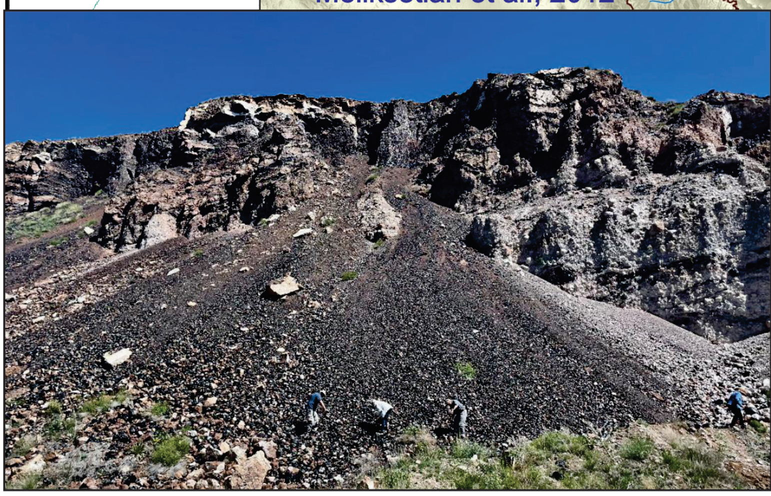


Geological map of Upper Pliocene-Quaternary of Armenia
Meliksetian et al., 2012

The Institute of Geological Sciences and Institute of Archaeology and Ethnography of the Armenian National Academy of Sciences announce the International Obsidian Conference to be held in Yerevan, 2026.



Obsidian exhibition at the Geological Museum



The Gutansar obsidian carrier

The Gutansar volcanic complex represents a bi-modal volcanic system: rhyolithic dome cut by basaltic-andesite cinde cone. It is one of most archaeological important obsidian sources in the South Caucasus.

Products of explosive eruptions of rhyolite pumice and perlite pyroclastics(left).
Obsidian cliff from Pokr Arteni volcano (right).

Conference excursion: We are going to visit Arteni obsidian volcano (1.5 Ma), Gutansar obsidian carrier, Barozh middle Paleolithic open air site.

1st Circular will be distributed in May 2025

Artifacts from the test trench at Middle Paleolithic site Barozh 12

Obsidian monument in Yerevan

Local Organization Committee,
Chairs:
Dr. Sci. Kh. Meliksetian (km@geology.am)
Dr. A. Bobokhyan (arsenbobokhyan@yahoo.com)
Dr. Sci. R. Badalyan (r.badalyan@yahoo.com)

Further information will be available on the website of the institute of Geological sciences https://geology.am/en/

2024 CRAIG E. SKINNER POSTER AWARD WINNER
SOCIETY FOR AMERICAN ARCHAEOLOGY, NEW ORLEANS, LOUISIANA, USA

Interwoven Networks: Obsidian Exchange and Overlapping Economies among the Ancient Maya of Western Belize

Suarez, Nicholas (University of Pittsburgh), Claire Ebert (University of Pittsburgh), John Walden (Harvard University), Julie Hoggarth (Baylor University) and Jaime Awe (Northern Arizona University)

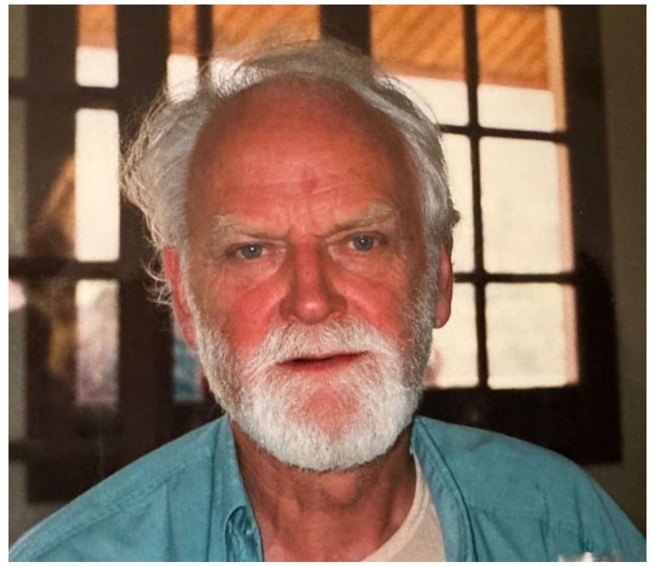
Abstract

Studies of ancient Maya commodities have focused on elite control of economic institutions, yet goods were mobilized at different levels of the social hierarchy to support the growth of broader economic institutions. Here we present the results of portable X-ray fluorescence (pXRF) analyses of over 4,000 obsidian artifacts from Preclassic to Terminal Classic period (ca. 900 BC–AD 900/1000) contexts from four sites across the Belize River Valley region of the Maya lowlands (Baking Pot, Cahal Pech, Lower Dover, Xunantunich) to reconstruct economic networks within and between communities. Geochemical sourcing data are integrated into formal network analyses to explore to what degree ancient Maya obsidian economies were centralized, the extent to which they overlapped, and how these trends transformed through time. Commoner households possessed more homogeneous assemblages with fewer sources, likely obtained through decentralized exchange relationships. In contrast, more diverse assemblages with more sources of obsidian from higher status contexts reflect the development of more formal economic institutions during the Classic period. This study has broad implications for understanding differences in distribution and consumption of commodities between apical elite, intermediate elite, and commoners, and the transformations of their relationships in the Maya world over the longue durée.

IN MEMORIAM: WAL AMBROSE (1933-2024)

Contributed by Robin Torrence

Wallace Raymond Ambrose, who passed away in Canberra, Australia on January 9, 2024, was a pioneer and outstanding innovator in obsidian hydration dating and characterisation and their application to archaeological research questions. Having discovered archaeology in 1955 while assisting an excavation on Great Mercury Island, New Zealand, Wal left art school to take up a position as photographer and cartographer in the Department of Anthropology at the University of Auckland. Shortly afterwards, while visiting Auckland on a Fulbright Scholarship, Roger Green introduced Wal to obsidian hydration dating and the potential of refractive index as a method for the characterisation of obsidian sources. In 1963 Jack Golson lured Ambrose to the Australian National University (ANU) where, until his death, Wal made stellar contributions to the study of materials conservation but especially to the nascent field of Pacific archaeology, together with pursuing art, photographic and building projects on the side. As an unintended consequence of his move between academic systems in different countries, Ambrose never obtained an undergraduate degree, but was eventually awarded the degree of Doctor of Letters by the ANU in 2006 based on his extensive published oeuvre which had received exceptionally high praise from all the examiners.



Wal Ambrose is unique among scholars researching past uses of obsidian due to his highly original, meticulous, and very wide-ranging theoretical and experimental research across multiple fields. His outstanding achievements have been widely recognised and, in 1997, were formally acknowledged by the IAOS 'Excellence in Obsidian Studies Award.' Jonathan Ericson's speech at the Society of American Archaeology Annual Meeting in Nashville, (published in the *IAOS Bulletin* no. 19: 4) well summarises the incomparable breadth and depth of Wal's substantial and original contributions to obsidian research in hydration dating, source characterisation, and inferential approaches for reconstructing ancient exchange systems. Ambrose's many other innovations in archaeological science, including his conservation studies involving freeze drying of wood and characterisation studies of pottery, are also showcased in a special issue of the journal *Archaeology in Oceania* (1997 volume 32, number 1) published in his honour. It is notable that several of the papers in the volume included Wal as a co-author because his contribution was absolutely essential to the reported research.

Ambrose's cutting-edge research continued long after the honours bestowed in 1997. Wal tackled difficult problems head on. He took up the challenge of improving the accuracy of obsidian hydration dating by obtaining detailed data necessary for better assessing the role of temperature and humidity.

He invented a thermal cell to gather precise measurements and embarked upon a 25 year-long low temperature hydration experiment to establish fundamental principles. Never one to be discouraged by difficult circumstances, he was particularly concerned with both understanding the mechanism for the dissolution of the hydration layer in environments with high temperature and humidity and discovering new ways to obtain meaningful measurements in these difficult conditions.

Wal was a very modest and kind person who was extremely generous in sharing ideas, techniques, and obsidian reference samples. Almost all researchers who characterise obsidian in the Pacific region have used a piece of Wal's AD2000 sample as a standard. He was often found in the tearoom in the Coombs Building at the Australian National University where he gently offered advice and mentoring in all aspects of archaeological science for numerous graduate students and early career researchers. As noted in the introduction to the *Archaeology in Oceania* volume in his honour, it is very telling that the words repeatedly used by his colleagues and students in their tributes to Wal were 'breadth, insight, originality, practical, precise, and helpful.' Through his publications and personal interactions with established and budding scholars, Wal has left obsidian studies with a substantial legacy. Hopefully, future research can satisfactorily address the important issues about temperature, humidity, and measurement in obsidian hydration studies that he raised, identify the missing obsidian sources he identified in archaeological assemblages from Manus, Papua New Guinea, and successfully take up his challenge to develop more appropriate methodology for inferring ancient exchange systems.

Acknowledgements: Thanks to Jim Allen, Christopher Stevenson and Peter Sheppard for information and helpful comments and to Jim Allen and Jill Allen for the photo.

IN MEMORIAM: ANA STEFFEN

Contributed by Carolyn Dillian

Anastasia Steffen, past-IAOS President, science advocate, and innovative obsidian researcher, passed away on February 16, 2024 after a battle with cancer. Dr. Steffen's work on the impacts of fire on archaeological resources, particularly its effects on obsidian, were foundational in our understanding and treatment of archaeological resources in fire-prone areas in the face of more intensive mega-fires resulting from climate change. Her work has changed the way we account for these impacts, and improved our efforts to interpret hydration data and protect archaeological sites from fire in these regions.

Dr. Steffen earned her B.A. in Anthropology and Archaeology from Washington University, and her M.A. and Ph.D. in Anthropology from the University of New Mexico, where she later served as an Adjunct Assistant Professor. Her dissertation "The Dome Fire Obsidian Study: Investigating the Interaction of Heat, Hydration, and Glass Geochemistry" investigated the impacts of this 16,000 acre mega-fire on cultural resources, emphasizing the ways in which fire alters obsidian artifacts. Work on fire impacts became her passion and she continued this research throughout her career.

Dr. Steffen was one of the first federal employees to work at the Valles Caldera National Preserve when it was established in 2000, first while employed by the U.S. Forest Service, and later, through the Valles Caldera Trust, and then with the National Park Service as Interdisciplinary Scientist/Communicator. In these roles, she worked extensively to shape the Valles Caldera National Preserve's management and interpretation of cultural resources. Her work helped preserve its archaeological legacy and she educated thousands of visitors to the Preserve through direct programming, training, and the creation of educational materials and media resources. Her enthusiasm for archaeology, history, and science shines through in all she created.

Ana was a frequent contributor to obsidian sessions at the annual Society for American Archaeology (SAA) meetings, and also served on the Climate Change Strategies Task Force, and the Committee on Climate Change Strategies and Archaeological Resources with the SAA. She also presented her work at numerous regional and specialized conferences both in the U.S. and abroad. She was always willing to answer questions and talk with session attendees about her research, and her pleasure in her work was readily apparent.

I first got to know Ana at the 2003 Melos Obsidian Conference (International Specialized Workshop: Recent Advances in Obsidian Dating and Characterization) held in Melos, Greece. We, and our fellow conference attendees, spent several days exploring the island and its obsidian quarries, and Ana and I quickly became friends – reconnecting for a drink or a meal each year at the SAA. I think I can speak for everyone, when I say that we will all miss her joy, her enthusiasm for the field, and her friendship.

To read more about Ana's lasting legacy with the Valles Caldera National Preserve, please visit https://www.nps.gov/articles/000/dr-ana-steffen-a-legacy-of-science-leadership.htm

Photos by Carolyn Dillian. Melos, Greece, 2003.

A SPECIATION MODEL FOR WATER IN OBSIDIAN

Alexander K. Rogers[a] and Christopher M. Stevenson[b]

[a] Maturango Museum, Ridgecrest, California, USA
[b] Virginia Commonwealth University, Richmond, Virginia, USA

Abstract
Water is embodied in obsidian in the process of magma formation at high temperatures and pressures, and a residual amount is trapped as the melt cools to form glass. Water exists as two species, hydroxyl (OH) and molecular water (H_2O_m), which have differing effects on obsidian hydration. We develop a simple speciation model based on the Langmuir equation and a data set of N= 184 data points representing obsidian sources of interest archaeologically. The resulting fit is OH = 2.093*[0.489*H_2O_t/(1 + 0.489*H_2O_t)], in which both OH and H_2O_t (= OH + H_2O_m) are in wt%. The R^2 for the fit = 0.9960, the rms residuals are 0.019 wt.%, and the range of validity is ≈0.05 wt% < H_2O_t < ≈2.5 wt%. A further equation allows predicting the wt.% OH in a specimen from absorbance measurements on the strong absorption band at 3570 cm^{-1}.

Introduction

Water is embodied in obsidian (rhyolitic glass) in the process of magma formation at high temperatures and pressures, and a residual amount I s trapped as the melt cools to form glass (Shelby 2005; Zhang 2008). Water exists as two species, hydroxyl (OH) and molecular water (H_2O_m), which have differing effects on obsidian hydration. This paper develops a simple speciation model based on the Langmuir equation and a data set of N= 184 data points representing obsidian sources of interest archaeologically. Data are from Newman et al. (1986: 1535, Table 6), Stevenson et al. (2019: 233, Table 1), and recent data on Bodie Hills obsidian from Mono County, eastern California (N = 114). The resulting model is useful in studies of the obsidian hydration process.

Obsidian Chemistry

The water in obsidian is originally trapped as molecular water (H_2O_m) during cooling of the magmatic melt. Hydroxyl (OH) is formed by a chemical reaction between molecular water and oxygen atoms bound to the glass matrix,

$$\text{Si–O–Si} + H_2O = \text{Si–OH} + \text{HO–Si} \qquad (1)$$

forming pairs of adjacent silanol (SiOH) groups (Doremus 1994: 198; 2002: 129; Ihinger at al. 1999). This process is known as speciation. The OH groups are immobile, so diffusion is by molecular water. Doremus (2002: 129ff.) further argued that the bonding in equation (1) is to non-bridging oxygen atoms, whose numbers are limited, in a process analogous to chemical adsorption on a surface.

Chemical adsorption on a surface can be described by the Langmuir equation of the form

$$y = C_1*C_2*x/(1 + C_2*x) \qquad (2)$$

where y is the number of reacted sites or species, x is the number of unreacted sites or species prior to the reaction, C_1 is a proportionality constant, and C_2 is the ratio of the forward and reverse reaction coefficients for equation (1) (Doremus 2001: 129).

For the present analysis, x is assumed to be proportional to the total water content ($H_2O_t = H_2O_m + OH$, all in wt %), y is proportional to OH wt%, and the constants C_1 and C_2 are determined empirically. Then equation (2) becomes

$$OH = C_1*C_2*H_2O_t/(1 + C_2*H_2O_t) \quad (3)$$

Equation (2) can be solved for H_2O_t, using OH as the independent variable to give

$$H_2O_t = (1/C_2)*[OH/(C_1 - OH)] \quad (4)$$

and molecular water content is then

$$H_2O_m = (1/C_2)*[OH/(C_1 - OH)] - OH \quad (5)$$

These simple algebraic equations can then be used in analysis of archaeological obsidians.

Data Sources

The first data source is Newman et al. (1986: 1535, Table 6); see Appendix A below. Plotting the data showed that one data point (labeled "NW Coulee LT") was clearly anomalous; it was excluded here by Chauvenet's criterion. Concentration of water species was computed by the Beer-Lambert law. The 4500 cm^{-1} absorption band responds to OH, and the 5200 cm^{-1} band responds to H_2O_m. The respective molar absorption (extinction) coefficients are 1.73 mol/(L*cm) and 1.61 mol/(L*cm) (Newman et al. 1986:1537, Table 7). The second data set was from Stevenson et al (2019). The data are shown in Appendix B below. The third part of the data set is a collection of recent measurements on obsidian from the Bodie Hills source in Mono County, eastern California, which are currently being analyzed. The data are presented in Appendix C.

Analysis

The method employed is to make a least-squares best fit to equation (3) using the combined data of Appendices A, B, and C. Here wt.% H_2O_t is the independent variable and wt.% OH is the dependent variable. The best fit was determined by the means of the model-fitting routine in PSIPlot©. The resulting values are C_1 = 2.093 wt.% and C_2 = 0.489 wt.%$^{-1}$, so the best-fit equation is

$$OH=2.093*[0.489*H_2O_t/(1 + 0.489*H_2O_t)] \quad (6)$$

The value of R^2 = 0.9960, so the fit is very good. The rms residuals are 0.019 wt.%. Figure 1 shows the fit graphically.

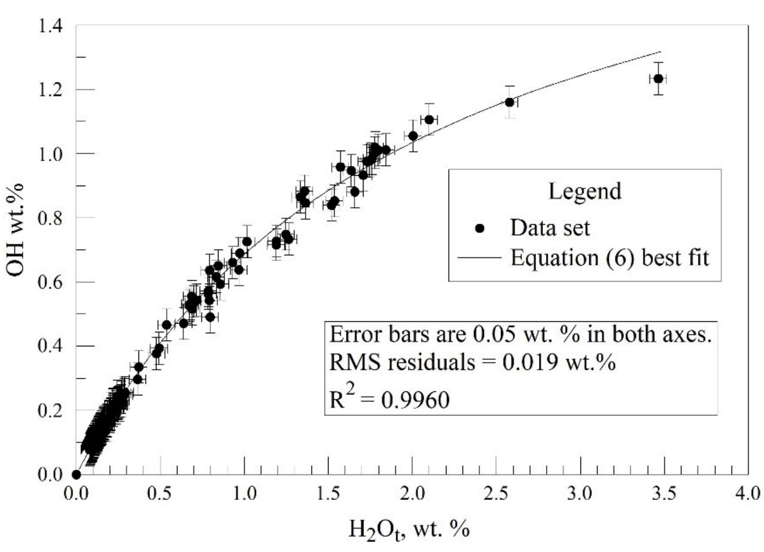


Figure 1. Speciation data and model for equation (6), showing fit. Error bars correspond to the 0.05 wt.% standard deviation of experimental accuracy in both variables. R^2 = 0.9960.

Equation (6) can be solved for H_2O_t to yield

H_2O_t = 2.045*[OH/(2.093 – OH)] (7)

where 2.045 = 1/0.489. Finally, wt% molecular water is simply

H_2O_m = 2.045*[OH/(2.093–OH)]–OH (8)

An important question is the behavior of equation (6) as OH → 0. At H_2O_t = 0, equation (6) gives OH = 0, as is should. Further, H_2O_m remains positive as OH → 0, which agrees with reality (negative concentrations are physically impossible). The root-mean-square (rms) residuals in OH to the best fit are 0.019 wt.%.

Application to 3570cm^{-1} Measurements

Water measurement by FTIR is based on the Beer-Lambert law

w_t = A*M/(d*t*e) (9)

where w_t is wt% H_2O_t, A is peak absorbance in the 3570 cm^{-1} band, M is 18.02 gm/mol, d is density in gm/cm^3, t is thickness in mm, and e is extinction coefficient in L/(mol*cm). However, since the 3570 cm^{-1} band responds to both OH and H_2O_m, with different extinction coefficients, the e value in equation (4) must be replaced by an effective coefficient which is the weighted average.

e_e = (e_o*w_o + e_m*w_m)/(w_o + w_m) (10)

where e_o is the extinction coefficient for OH (= 100 ± 2) and e_m is the coefficient for H_2O_m (=56 ± 4). Substituting equation (5) into equation (4), and recognizing that $w_t = w_o + w_m$,

A*M/(d*t) = e_o*w_o + e_m*w_m (11)

A solution for w_o can be developed by substituting equation (6) into equation (11). For convenience, define the variable X = A/(d*t) where d is in gm/cm^3 and t is in mm; w_o is then the solution of a quadratic equation such that

w_o = [b – sqrt(b^2 –4*a*c)]/(2*a) (12)

where

a = e_o – e_m = 44 ± 6

b = 2.093*(e_o–e_m)+2.045*e_m+X=206.61+18.02X

c = 2.093*X

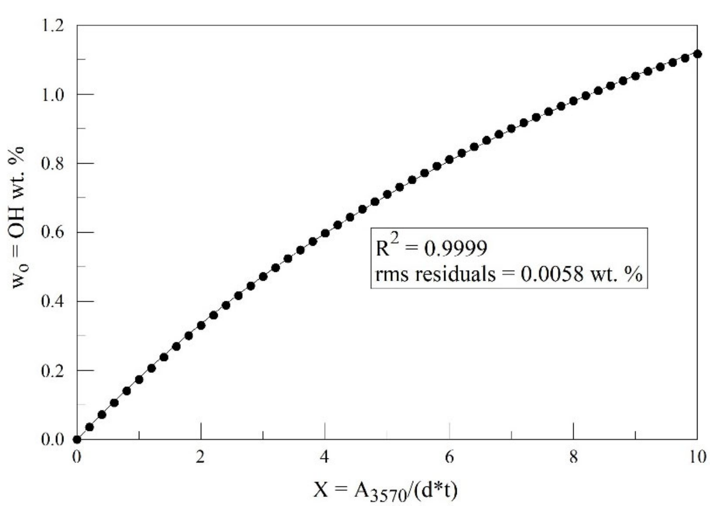


Figure 2. Speciation model and data set for equation (14), predicting OH content based on absorbance measurements at 3570 cm^{-1} and specimen physical properties.

Numerically this works out to

$$w_o=\{206.61+18.02*X-\mathrm{sqrt}(42668+808*X+324*X^2)\}/88 \qquad (13)$$

Plotting this equation shows that it again follows a Langmuir form, and an excellent fit ($R^2 = 0.9999$) to it is

$$w_o = 0.191*X/(1 + 0.07*X) \qquad (14)$$

The fit to the data set is shown in Figure 2.

Prediction Accuracy at 3570 cm^{-1}

Equation (14) predicts the wt.% OH, based on absorbance measurements at 3570 cm^{-1} and the specimen properties (thickness and density); prediction accuracy can be determined by comparing the OH computed by equation (14) with direct measurements of OH based on data taken at the 4500cm^{-1} band (Appendix D). Two data sets are available, that of Newman et al. (1986:1535, Table 5 and 1536 Table 6) and current Bodie Hills data. The Bodie Hills data are all from relatively dry obsidian (OH < 0.17 wt%), while the Newman data cover the range 0.08 wt% < OH < 1.24 wt%.

For the Newman data set (N = 31), the error standard deviation = 0.04 wt.%. The Bodie Hills data set (N = 45) is comprised of drier obsidians, whose OH values fall within a narrower range (0.08 < OH < 0.17 wt%). Here the error standard deviation is 0.004 wt.%. For the aggregate data set (N = 76), the rms error of the predicted OH content is ≈ 0.03 wt.%, so the fit is very good. Data are summarized in Table 1.

Conclusions

The Langmuir-based speciation models summarized here (equations 6 and 14) are based on a large data set, and yield accuracies on the order of 0.02 wt.%, which is comparable to the measurement limits of the FTIR method. Used with FTIR data, they provide a useful tool for analyzing water content data for obsidian.

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	Bodie Hills	Newman	Aggregate
Mean, wt% OH	-0.0020	-0.0097	-0.0051
St dev, wt% OH	0.0044	0.0451	0.0285
N	45	31	76

Table 1. Error statistics for Equation (14)

APPENDIX A

Absorbance data from Newman et al.(1986: 1535, Table 6)

Sample	Thickness, cm	Density (g/L)	A @ 4500	A @ 5200	wt %OH	wt %H20m	wt %H_2O_T
NRO (1b)	0.3730	2380	0.0660	0.0000	0.0774	0.0000	0.0774
Panum Dome (1b)	0.3610	2350	0.0940	0.0000	0.1154	0.0000	0.1154
DC-2 (1b)	0.4170	2360	0.1160	0.0000	0.1228	0.0000	0.1228
CIT-1 (1b)	0.1135	2350	0.0322	0.0000	0.1257	0.0000	0.1257
CIT-1 (2g)	0.3755	2360	0.1370	0.0000	0.1610	0.0000	0.1610
PAN-82-br (1b)	0.0540	2330	0.0250	0.0000	0.2070	0.0000	0.2070
N. Coulee (1b)	0.1235	2340	0.0667	0.0069	0.2404	0.0267	0.2671
DC-1 (1b)	0.2590	2350	0.1480	0.0110	0.2533	0.0202	0.2735
NW Coulee (1b)	0.1682	2340	0.0965	0.0122	0.2554	0.0347	0.2901
NW Coulee (LT)*	0.2222	2320	0.1395	0.2000	0.2819	0.4342	0.7161
BGM8-113(1a)	0.2610	2380	0.2000	0.0200	0.3354	0.0360	0.3714
MC-84-bb-5j (2a)	0.0834	2310	0.0863	0.0120	0.4666	0.0697	0.5363
MC-84-df (1a)	0.1290	2350	0.1530	0.0400	0.5257	0.1477	0.6734
MC-84-df (LT)	0.1449	2340	0.1730	0.0435	0.5315	0.1436	0.6751
NC5-V (2a)	0.2055	2380	0.2530	0.0700	0.5388	0.1602	0.6990
PAN-82-bt (1b)	0.0286	2340	0.0349	0.0148	0.5432	0.2475	0.7907
LGM-1a (1a)	0.1462	2360	0.1800	0.0530	0.5434	0.1719	0.7153
POB-82-45 (AF)	0.0954	2340	0.1190	0.0260	0.5553	0.1304	0.6856
MC-84-bb-4b-r (2a)	0.0832	2340	0.1070	0.0370	0.5725	0.2127	0.7852
KS (1a)	0.0288	2330	0.0397	0.0129	0.6162	0.2152	0.8314
MC-84-bb-5m (2a)	0.0260	2330	0.0370	0.0085	0.6362	0.1570	0.7932
MC-84-bb-4g (2a)	0.0965	2340	0.1410	0.0393	0.6504	0.1948	0.8452
POB-82-45 (A2)	0.0930	2340	0.1380	0.0525	0.6605	0.2700	0.9305
GM83-13 (1a)	0.0477	2360	0.0745	0.0285	0.6893	0.2834	0.9727
MC-84-t (1a)	0.0616	2330	0.1000	0.0370	0.7257	0.2885	1.0143
MC-84-bb-3d (2a)	0.0809	2320	0.1525	0.0868	0.8463	0.5176	1.3640
MC-84-bb-3b (1a)	0.1267	2300	0.2420	0.1220	0.8650	0.4686	1.3336
MC-84-bb-3e (2a)	0.0554	2320	0.1090	0.0545	0.8834	0.4746	1.3580
POB-82-2 (D2-3)	0.0565	2330	0.1180	0.0910	0.9337	0.7737	1.7073
POB-82-2 (F1-0)	0.0575	2330	0.1218	0.0825	0.9470	0.6892	1.6362
MC-84-bb-3c (1a)	0.1186	2310	0.2520	0.1500	0.9581	0.6128	1.5709
OBS-E (1a)	0.0465	2340	0.1020	0.0730	0.9764	0.7509	1.7273
POB-82-2 (C)	0.0558	2330	0.1220	0.0890	0.9774	0.7662	1.7436
POB-82-2 (F3-0)	0.0575	2330	0.1265	0.0925	0.9835	0.7728	1.7563
POB-82-2 (A0-2)	0.0645	2330	0.1420	0.1040	0.9842	0.7745	1.7587
POB-82-2 (F2-0)	0.0581	2330	0.1303	0.0935	1.0026	0.7731	1.7756
MC-84-bb-3b (LT)	0.1570	2310	0.3520	0.2550	1.0110	0.7870	1.7979
POB-82-2 (AF)	0.1122	2330	0.2540	0.1940	1.0120	0.8306	1.8426
POB-82-2 (B)	0.0544	2330	0.1240	0.0860	1.0190	0.7594	1.7784
PAN-82-bb-3c (3a)	0.1410	2310	0.3300	0.2760	1.0553	0.9484	2.0038
OBS-G (1a)	0.0342	2340	0.0850	0.0710	1.1063	0.9930	2.0993
MC-84-bb-4b-b	0.0324	2280	0.0823	0.0935	1.1605	1.4166	2.5771
OBS-L (1a)	0.0250	2330	0.0690	0.1160	1.2338	2.2289	3.4628
MC-84-bb-3a	0.1226	2280	0.3318	0.3665	1.2364	1.4675	2.7039

APPENDIX B

Absorbance data from Stevenson et al. (2019: 233, Table 1).

Sample	Thickness, cm	Density (g/L)	A @ 4500	A @ 5200	wt %OH	wt %H_20m	wt %H_2O_T
RHNM23D	0.0877	2304.9	0.1710	0.1400	0.8812	0.7752	1.6563
RHNM22D	0.074	2314.5	0.1380	0.1040	0.8393	0.6796	1.5189
RHNM22E	0.0913	2314.7	0.1730	0.1290	0.8527	0.6832	1.5359
RHNM26C	0.0864	2317.9	0.1440	0.0890	0.7490	0.4974	1.2464
RHNM 25C	0.0878	2319.6	0.1400	0.0860	0.7160	0.4726	1.1887
CVO707A	0.1005	2322.3	0.1330	0.0550	0.5936	0.2638	0.8573
CVO707C	0.0898	2323.3	0.1130	0.0410	0.5642	0.2200	0.7841
RHNM25B	0.0906	2324	0.1470	0.0870	0.7272	0.4625	1.1897
CVO707B	0.0968	2324.7	0.1380	0.0660	0.6388	0.3283	0.9670
RHCO07C	0.0955	2325.3	0.1100	0.0340	0.5160	0.1714	0.6873
RHCO2F	0.1036	2325.7	0.1090	0.0360	0.4712	0.1672	0.6384
RHNM25A	0.0933	2327.7	0.1530	0.1030	0.7338	0.5308	1.2647
RHCO3D	0.1055	2330.4	0.0890	0.0220	0.3771	0.1002	0.4772
RHCO1D	0.1026	2330.5	0.0560	0.0000	0.2439	0.0000	0.2439
TAK048D	0.1054	2331.6	0.0310	0.0000	0.1314	0.0000	0.1314
SUAZ09E	0.1081	2333.7	0.0530	0.0000	0.2188	0.0000	0.2188
SUAZ08D	0.1034	2333.9	0.0490	0.0050	0.2115	0.0232	0.2347
CVO713C	0.0863	2333.9	0.0950	0.0550	0.4913	0.3056	0.7969
TAK056H	0.1081	2335.5	0.0340	0.0000	0.1403	0.0000	0.1403
SUAZ08A	0.0994	2336.6	0.0460	0.0060	0.2063	0.0289	0.2352
SUAZ07C	0.1073	2336.7	0.0510	0.0080	0.2119	0.0357	0.2476
CPQ001A	0.1076	2338.9	0.0360	0.0000	0.1490	0.0000	0.1490
SUAZ09C	0.0984	2339.1	0.0480	0.0000	0.2172	0.0000	0.2172
BARD10D	0.0952	2340.2	0.0200	0.0000	0.0935	0.0000	0.0935
CPQ001B	0.1098	2340.7	0.0330	0.0000	0.1337	0.0000	0.1337
RHCO8D	0.0778	2347.5	0.0690	0.0160	0.3935	0.0981	0.4916
LAS CARGAS	0.0874	2352.7	0.0280	0.0000	0.1418	0.0000	0.1418
TWO09C	0.108	2354.9	0.0370	0.0060	0.1515	0.0264	0.1779
MAULE 42B	0.0812	2362.1	0.0180	0.0000	0.0978	0.0000	0.0978
MAULE 18	0.0995	2370.2	0.0180	0.0000	0.0795	0.0000	0.0795

APPENDIX C

Absorbance data for Bodie Hills, CA

Sample	**Thickness, cm**	**Density (g/L)**	**A @ 4500**	**A @ 5200**	**wt %OH**	**wt %H_20m**	**wt %H_2O_T**
Bodie Hills 1A	0.1459	2378	0.0439	0.0010	0.1318	0.0032	0.1350
Bodie Hills 1B	0.1385	2379	0.0344	0.0000	0.1088	0.0000	0.1106
Bodie Hills 1C	0.1208	2379	0.0420	0.0022	0.1523	0.0086	0.1608
Bodie Hills 1D	0.1063	2380	0.0252	0.0000	0.1037	0.0000	0.1055
Bodie Hills 1E	0.1648	2379	0.0416	0.0006	0.1105	0.0016	0.1121
Bodie Hills 1F	0.1507	2380	0.0380	0.0000	0.1103	0.0000	0.1122
Bodie Hills 1G	0.164	2381	0.0456	0.0013	0.1216	0.0037	0.1254
Bodie Hills 1H	0.1438	2380	0.0388	0.0008	0.1181	0.0026	0.1207
Bodie Hills 1I	0.1486	2380	0.0393	0.0010	0.1158	0.0032	0.1189
Bodie Hills 1J	0.1612	2381	0.0438	0.0011	0.1189	0.0032	0.1221
Bodie Hills 2D	0.1398	2380	0.0395	0.0000	0.1236	0.0000	0.1236
Bodie Hills 2G	0.1067	2384	0.0557	0.0066	0.2281	0.0290	0.2571
Bodie Hills 2H	0.1292	2381	0.0388	0.0000	0.1314	0.0000	0.1314
Bodie Hills 2I	0.0976	2382	0.0501	0.0052	0.2245	0.0250	0.2495
Bodie Hills 3B	0.1223	2381	0.0528	0.0042	0.1889	0.0161	0.2050
Bodie Hills 3D	0.1209	2381	0.0494	0.0033	0.1788	0.0128	0.1916
Bodie Hills 3H	0.1206	2379	0.0317	0.0000	0.1151	0.0000	0.1151
Bodie Hills 3I	0.1285	2383	0.0873	0.0183	0.2970	0.0669	0.3639
Bodie Hills 3J	0.1247	2384	0.0533	0.0045	0.1868	0.0169	0.2037
Bodie Hills 4A	0.1192	2382	0.0504	0.0034	0.1849	0.0134	0.1983
Bodie Hills 4C	0.1304	2381	0.0661	0.0069	0.2217	0.0249	0.2466
Bodie Hills 4D	0.1253	2381	0.0641	0.0063	0.2238	0.0236	0.2474
Bodie Hills 4E	0.1008	2380	0.0510	0.0049	0.2214	0.0229	0.2443
Bodie Hills 4F	0.1142	2384	0.0589	0.0066	0.2254	0.0271	0.2525
Bodie Hills 4G	0.1274	2384	0.0727	0.0097	0.2494	0.0358	0.2851
Bodie Hills 4H	0.1231	2357	0.0612	0.0057	0.2197	0.0220	0.2417
Bodie Hills 4I	0.1083	2383	0.0536	0.0088	0.2163	0.0382	0.2545
Bodie Hills 5A	0.151	2382	0.0544	0.0025	0.1575	0.0078	0.1653
Bodie Hills 5B	0.1303	2380	0.0670	0.0073	0.2250	0.0263	0.2514
Bodie Hills 5C	0.1476	2382	0.0487	0.0021	0.1443	0.0067	0.1510
Bodie Hills 5D	0.1571	2382	0.0497	0.0018	0.1384	0.0054	0.1437
Bodie Hills 5E	0.1403	2380	0.0495	0.0032	0.1544	0.0107	0.1651
Bodie Hills 5F	0.1632	2380	0.0622	0.0032	0.1668	0.0092	0.1761
Bodie Hills 5G	0.152	2380	0.0689	0.0050	0.1984	0.0155	0.2139
Bodie Hills 5H	0.1637	2380	0.0488	0.0000	0.1305	0.0000	0.1305
Bodie Hills 5I	0.113	2388	0.0432	0.0036	0.1668	0.0149	0.1817
Bodie Hills 5J	0.1066	2385	0.0495	0.0039	0.2028	0.0172	0.2199
Bodie Hills 6B	0.1075	2380	0.0322	0.0000	0.1311	0.0000	0.1311
Bodie Hills 6D	0.112	2379	0.0218	0.0000	0.0852	0.0000	0.0852
Bodie Hills 6E	0.125	2381	0.0374	0.0000	0.1309	0.0000	0.1309
Bodie Hills 6G	0.0798	2380	0.0302	0.0000	0.1656	0.0000	0.1656
Bodie Hills 6I	0.1679	2377	0.0354	0.0000	0.0924	0.0000	0.0924
Bodie Hills 6J	0.1355	2380	0.0292	0.0000	0.0943	0.0000	0.0943
Bodie Hills 7A	0.118	2379	0.0250	0.0000	0.0928	0.0000	0.0928
Bodie Hills 7B	0.0958	2377	0.0187	0.0000	0.0855	0.0000	0.0855
Bodie Hills 7C	0.0924	2378	0.0201	0.0000	0.0953	0.0000	0.0953
Bodie Hills 7G	0.0917	2379	0.0334	0.0000	0.1594	0.0000	0.1594
Bodie Hills 7H	0.171	2378	0.0323	0.0000	0.0827	0.0000	0.0827
Bodie Hills 7I	0.1682	2381	0.0429	0.0000	0.1116	0.0000	0.1116

Sample	Thickness, cm	Density (g/L)	A @ 4500	A @ 5200	wt %OH	wt %H_20m	wt %H_2O_T
Bodie Hills 7J	0.1794	2380	0.0340	0.0000	0.0830	0.0000	0.0830
Bodie Hills 8B	0.0598	2383	0.0127	0.0000	0.0928	0.0000	0.0928
Bodie Hills 8C	0.0896	2383	0.0182	0.0000	0.0888	0.0000	0.0888
Bodie Hills 8D	0.0832	2380	0.0322	0.0019	0.1694	0.0107	0.1801
Bodie Hills 8E	0.0869	2381	0.0181	0.0000	0.0911	0.0000	0.0911
Bodie Hills 8F	0.0787	2379	0.0172	0.0000	0.0957	0.0000	0.0957
Bodie Hills 8G	0.0753	2382	0.0235	0.0000	0.1365	0.0000	0.1365
Bodie Hills 8I	0.1333	2383	0.0551	0.0045	0.1807	0.0159	0.1965
Bodie Hills 8J	0.048	2381	0.0145	0.0000	0.1322	0.0000	0.1322
Bodie Hills 9A	0.1173	2380	0.0331	0.0011	0.1235	0.0044	0.1279
Bodie Hills 9B	0.0737	2378	0.0164	0.0000	0.0975	0.0000	0.0975
Bodie Hills 9C	0.1278	2379	0.0274	0.0000	0.0939	0.0000	0.0939
Bodie Hills 9D	0.132	2382	0.0396	0.0000	0.1312	0.0000	0.1312
Bodie Hills 9E	0.1191	2379	0.0221	0.0000	0.0813	0.0000	0.0813
Bodie Hills 9F	0.1592	2379	0.0406	0.0000	0.1116	0.0000	0.1116
Bodie Hills 9G	0.163	2380	0.0318	0.0000	0.0854	0.0000	0.0854
Bodie Hills 9H	0.0968	2386	0.0196	0.0000	0.0884	0.0000	0.0884
Bodie Hills 9I	0.0829	2379	0.0253	0.0000	0.1336	0.0000	0.1336
Bodie Hills 9J	0.1473	2380	0.0573	0.0037	0.1703	0.0118	0.1821
Bodie Hills 10A	0.1059	2380	0.0268	0.0000	0.1108	0.0000	0.1108
Bodie Hills 10B	0.1503	2378	0.0350	0.0000	0.1020	0.0000	0.1020
Bodie Hills 10C	0.0808	2377	0.0241	0.0000	0.1307	0.0000	0.1307
Bodie Hills 10D	0.1559	2377	0.0412	0.0000	0.1158	0.0000	0.1158
Bodie Hills 10E	0.1667	2378	0.0341	0.0000	0.0896	0.0000	0.0896
Bodie Hills 10F	0.1767	2378	0.0367	0.0000	0.0910	0.0000	0.0910
Bodie Hills 10H	0.1595	2379	0.0351	0.0000	0.0964	0.0000	0.0964
Bodie Hills 10J	0.0927	2389	0.0213	0.0000	0.1002	0.0000	0.1002
Bodie Hills 11A	0.1858	2381	0.0378	0.0000	0.0890	0.0000	0.0890
Bodie Hills 11C	0.1615	2379	0.0333	0.0000	0.0903	0.0000	0.0903
Bodie Hills 11D	0.1643	2384	0.0327	0.0000	0.0870	0.0000	0.0870
Bodie Hills 11E	0.1313	2378	0.0275	0.0000	0.0917	0.0000	0.0917
Bodie Hills 11G	0.1206	2378	0.0323	0.0000	0.1173	0.0000	0.1173
Bodie Hills 11H	0.1399	2381	0.0278	0.0000	0.0869	0.0000	0.0869
Bodie Hills 11J	0.1811	2377	0.0489	0.0013	0.1183	0.0034	0.1217
Bodie Hills 12B	0.2086	2381	0.0503	0.0000	0.1055	0.0000	0.1055
Bodie Hills 12C	0.1998	2378	0.0727	0.0043	0.1594	0.0101	0.1695
Bodie Hills 12D	0.1034	2382	0.0337	0.0009	0.1425	0.0041	0.1466
Bodie Hills 12E	0.2107	2378	0.0501	0.0000	0.1041	0.0000	0.1041
Bodie Hills 12F	0.1412	2379	0.0294	0.0000	0.0912	0.0000	0.0912
Bodie Hills 12G	0.1758	2382	0.0347	0.0000	0.0863	0.0000	0.0863
Bodie Hills 12I	0.1607	2382	0.0331	0.0000	0.0901	0.0000	0.0901
Bodie Hills 12J	0.1666	2380	0.0598	0.0023	0.1571	0.0065	0.1636
Bodie Hills 13A	0.1274	2380	0.0412	0.0012	0.1416	0.0044	0.1460
Bodie Hills 13B	0.1313	2381	0.0457	0.0000	0.1522	0.0000	0.1522
Bodie Hills 13C	0.1369	2380	0.0294	0.0000	0.0940	0.0000	0.0940
Bodie Hills 13D	0.1437	2380	0.0336	0.0000	0.1023	0.0000	0.1023
Bodie Hills 13F	0.157	2381	0.0319	0.0000	0.0889	0.0000	0.0889
Bodie Hills 13J	0.153	2340	0.0311	0.0000	0.0905	0.0000	0.0905
Bodie Hills 14A	0.1457	2380	0.0300	0.0012	0.0901	0.0039	0.0940
Bodie Hills 14B	0.1017	2380	0.0206	0.0000	0.0886	0.0000	0.0886
Bodie Hills 14C	0.1487	2381	0.0702	0.0090	0.2066	0.0285	0.2350
Bodie Hills 14D	0.0871	2389	0.0235	0.0000	0.1177	0.0000	0.1177

Sample	**Thickness, cm**	**Density (g/L)**	**A @ 4500**	**A @ 5200**	**wt %OH**	**wt %H_20m**	**wt %H_2O_T**
Bodie Hills 14E	0.1489	2380	0.0295	0.0000	0.0867	0.0000	0.0867
Bodie Hills 14G	0.134	2380	0.0608	0.0060	0.1986	0.0211	0.2196
Bodie Hills 15A	0.1178	2381	0.0283	0.0000	0.1051	0.0000	0.1051
Bodie Hills 15D	0.121	2378	0.0572	0.0052	0.2070	0.0202	0.2273
Bodie Hills 15E	0.1274	2379	0.0248	0.0000	0.0852	0.0000	0.0852
Bodie Hills 15F	0.1299	2381	0.0253	0.0000	0.0852	0.0000	0.0852
Bodie Hills 15G	0.1103	2380	0.0580	0.0083	0.2301	0.0354	0.2655
Bodie Hills 15I	0.1395	2380	0.0486	0.0024	0.1525	0.0081	0.1606
Bodie Hills 16A	0.0601	2389	0.0177	0.0000	0.1284	0.0000	0.1284
Bodie Hills 16B	0.1201	2382	0.0406	0.0000	0.1479	0.0000	0.1479
Bodie Hills 16D	0.1162	2385	0.0399	0.0000	0.1500	0.0000	0.1500
Bodie Hills 16E	0.1542	2379	0.0505	0.0014	0.1434	0.0043	0.1477
Bodie Hills 16F	0.1235	2379	0.0249	0.0000	0.0883	0.0000	0.0883

APPENDIX D

Data for Accuracy Test for 3570 cm^{-1}

Sample	Thick-ness (mm)	Density (g/cm^3)	wt%OH by 4500 cm^{-1}	A @ 3570 cm^{-1}	X	OH by spec. model	Δ OH	Data Source
1A1	1.4590	2.3781	0.1318	nm				Bodie Hills
1A2	1.1650	2.3781		1.8377	0.6633	0.1211	-0.0107	Bodie Hills
1B	1.3850	2.3786	0.1088	1.7796	0.5402	0.0994	-0.0093	Bodie Hills
1F	1.5070	2.3802	0.1103	2.2136	0.6171	0.1130	0.0026	Bodie Hills
1H	1.4380	2.3801	0.1181	2.1286	0.6219	0.1138	-0.0043	Bodie Hills
6D	1.1200	2.3788	0.0852	1.1683	0.4385	0.0813	-0.0040	Bodie Hills
7B	0.9580	2.3769	0.0855	0.9754	0.4284	0.0794	-0.0061	Bodie Hills
7C	0.9240	2.3785	0.0953	1.0838	0.4932	0.0910	-0.0042	Bodie Hills
7G	0.9170	2.3795	0.1346	1.4103	0.6463	0.1181	-0.0165	Bodie Hills
8B	0.5980	2.3833	0.0928	0.7176	0.5035	0.0929	0.0001	Bodie Hills
8C	0.8960	2.3827	0.0888	1.0205	0.4780	0.0883	-0.0005	Bodie Hills
8D	0.8320	2.3804	0.1694	1.8636	0.9410	0.1686	-0.0007	Bodie Hills
8E	0.8690	2.3813	0.0911	0.9984	0.4825	0.0891	-0.0020	Bodie Hills
8F	0.7870	2.3791	0.0957	0.9262	0.4947	0.0913	-0.0044	Bodie Hills
8G	0.7530	2.3815	0.1365	1.2150	0.6775	0.1235	-0.0129	Bodie Hills
8J	0.4800	2.3806	0.1322	0.7973	0.6977	0.1271	-0.0051	Bodie Hills
9A	1.1730	2.3804	0.1235	1.9408	0.6951	0.1266	0.0031	Bodie Hills
9B	0.7370	2.3784	0.0975	0.9736	0.5554	0.1021	0.0047	Bodie Hills
9C	1.2780	2.3789	0.0939	1.5662	0.5151	0.0950	0.0011	Bodie Hills
9E	1.1910	2.3788	0.0813	1.1544	0.4075	0.0757	-0.0056	Bodie Hills
9H	0.9680	2.3858	0.0884	1.1554	0.5003	0.0923	0.0039	Bodie Hills
9I	0.8290	2.3793	0.1336	1.4860	0.7534	0.1367	0.0031	Bodie Hills
10A	1.0590	2.3796	0.1108	1.5508	0.6154	0.1127	0.0019	Bodie Hills
10B	1.5030	2.3776	0.1020	1.9585	0.5481	0.1008	-0.0012	Bodie Hills
10C	0.8080	2.3771	0.1307	1.3790	0.7180	0.1306	-0.0001	Bodie Hills
10E	1.6670	2.3785	0.0896	1.8882	0.4762	0.0880	-0.0016	Bodie Hills
10J	0.9270	2.3887	0.1002	1.1065	0.4997	0.0922	-0.0080	Bodie Hills
11C	1.6150	2.3788	0.0903	1.8300	0.4763	0.0880	-0.0022	Bodie Hills
11D	1.6430	2.3841	0.0870	1.8396	0.4696	0.0868	-0.0001	Bodie Hills
11E	1.3130	2.3781	0.0917	1.5376	0.4924	0.0909	-0.0008	Bodie Hills
11G	1.2060	2.3777	0.1173	1.8625	0.6495	0.1187	0.0013	Bodie Hills
11H	1.3990	2.3810	0.0869	1.5982	0.4798	0.0887	0.0017	Bodie Hills
12F	1.4120	2.3792	0.0912	1.5757	0.4690	0.0867	-0.0044	Bodie Hills
12G	1.7580	2.3823	0.0863	1.8900	0.4513	0.0836	-0.0027	Bodie Hills
13C	1.3690	2.3798	0.0940	1.6278	0.4996	0.0922	-0.0018	Bodie Hills
13D	1.4370	2.3796	0.1023	1.8324	0.5359	0.0987	-0.0037	Bodie Hills
13F	1.5700	2.3806	0.0889	1.8278	0.4890	0.0903	0.0014	Bodie Hills
14A	1.4570	2.3803	0.0901	1.6578	0.4780	0.0883	-0.0018	Bodie Hills
14B	1.0170	2.3802	0.0886	1.1380	0.4701	0.0869	-0.0017	Bodie Hills
14D	0.8710	2.3885	0.1177	1.3341	0.6413	0.1172	-0.0004	Bodie Hills
14E	1.4890	2.3801	0.0867	1.6820	0.4746	0.0877	0.0010	Bodie Hills
15A	1.1780	2.3807	0.1051	1.6354	0.5831	0.1070	0.0019	Bodie Hills
15E	1.2740	2.3794	0.0852	1.3981	0.4612	0.0853	0.0001	Bodie Hills
15F	1.2990	2.3807	0.0852	1.4860	0.4805	0.0888	0.0036	Bodie Hills
16A	0.6010	2.3893	0.1284	0.9819	0.6838	0.1246	-0.0038	Bodie Hills
16F	1.2350	2.3792	0.0883	1.3640	0.4642	0.0859	-0.0024	Bodie Hills
BGM8-113(1a)	0.2610	2380	0.0360	0.0135	0.0196	0.3293	-0.0061	Newman 1986

Sample	Thick-ness (mm)	Density (g/cm^3)	wt%OH by 4500 cm^{-1}	A @ 3570 cm^{-1}	X	OH by spec. model	Δ OH	Data Source
CIT-1 (1b)	0.1135	2350	0.0000	0.027	0.0074	0.1345	0.0088	Newman 1986
CIT-1 (2g)	0.3755	2360	0.0000	0.018	0.0080	0.1448	-0.0163	Newman 1986
DC-1 (1b)	0.2590	2350	0.0202	0.0149	0.0168	0.2879	0.0346	Newman 1986
DC-2 (1b)	0.4170	2360	0.0000	0.0211	0.0072	0.1314	0.0087	Newman 1986
GM83-13 (1a)	0.0477	2360	0.2834	0.0068	0.0511	0.7188	0.0295	Newman 1986
KS (1a)	0.0288	2330	0.2152	0.0072	0.0399	0.5962	-0.0201	Newman 1986
LGM-1a (1a)	0.1462	2360	0.1719	0.0066	0.0417	0.6169	0.0735	Newman 1986
MC-84-bb-3a	0.1226	2280	1.4675	0.00285	0.1139	1.2103	-0.0261	Newman 1986
MC-84-bb-3b (1a)	0.1267	2300	0.4686	0.0058	0.0630	0.8348	-0.0303	Newman 1986
MC-84-bb-3b (LT)	0.1570	2310	0.7870	0.005	0.0788	0.9699	-0.0411	Newman 1986
MC-84-bb-3c (1a)	0.1186	2310	0.6128	0.0062	0.0733	0.9254	-0.0327	Newman 1986
MC-84-bb-3d (2a)	0.0809	2320	0.5176	0.0063	0.0664	0.8655	0.0192	Newman 1986
MC-84-bb-3e (2a)	0.0554	2320	0.4746	0.0068	0.0621	0.8269	-0.0564	Newman 1986
MC-84-bb-4b-b	0.0324	2280	1.4166	0.0042	0.1117	1.1975	0.0371	Newman 1986
MC-84-bb-4b-r (2a)	0.0832	2340	0.2127	0.0111	0.0404	0.6018	0.0293	Newman 1986
MC-84-bb-4g (2a)	0.0965	2340	0.1948	0.0111	0.0416	0.6151	-0.0353	Newman 1986
MC-84-bb-5j (2a)	0.0834	2310	0.0697	0.0155	0.0290	0.4610	-0.0056	Newman 1986
MC-84-bb-5m (2a)	0.0260	2330	0.1570	0.0104	0.0371	0.5630	-0.0732	Newman 1986
MC-84-df (1a)	0.1290	2350	0.1477	0.0109	0.0301	0.4743	-0.0514	Newman 1986
MC-84-t (1a)	0.0616	2330	0.2885	0.0112	0.0364	0.5541	-0.1716	Newman 1986
N. Coulee (1b)	0.1235	2340	0.0267	0.0169	0.0131	0.2300	-0.0104	Newman 1986
NC5-V (2a)	0.2055	2380	0.1602	0.0081	0.0348	0.5339	-0.0049	Newman 1986
NRO (1b)	0.3730	2380	0.0000	0.015	0.0045	0.0830	0.0056	Newman 1986
NW Coulee (1b)	0.1682	2340	0.0347	0.0183	0.0145	0.2511	-0.0043	Newman 1986
OBS-E (1a)	0.0465	2340	0.7509	0.004	0.0823	0.9971	0.0207	Newman 1986
OBS-G (1a)	0.0342	2340	0.9930	0.0042	0.0987	1.1149	0.0085	Newman 1986
PAN-82-bb-3c (3a)	0.1410	2310	0.9484	0.0042	0.0866	1.0296	-0.0257	Newman 1986
PAN-82-bt (1b)	0.0286	2340	0.2475	0.0083	0.0402	0.5987	0.0556	Newman 1986
Panum Dome (1b)	0.3610	2350	0.0000	0.0178	0.0065	0.1180	0.0025	Newman 1986
POB-82-2 (C)	0.0558	2330	0.7662	0.0056	0.0774	0.9589	-0.0185	Newman 1986

ABOUT OUR WEB SITE

The IAOS maintains a website at http://www.deschutesmeridian.com/IAOS/ The site has some great resources available to the public, and our webmaster, Craig Skinner, continues to update the list of publications and must-have volumes.

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Other items on our website include:

- World obsidian source catalog
- Back issues of the *Bulletin.*
- An obsidian bibliography
- An obsidian laboratory directory
- Photos and maps of some source locations
- Links

Thanks to Craig Skinner for maintaining the website. Please check it out!

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Submissions of articles, short reports, abstracts, or announcements for inclusion in the *Bulletin* are always welcome. We accept submissions in MS Word. Tables should be submitted as Excel files and images as .jpg files. Please use the *American Antiquity* style guide for formatting references and bibliographies.

Submissions can also be emailed to the *Bulletin* at IAOS.Editor@gmail.com Please include the phrase "IAOS Bulletin" in the subject line. An acknowledgement email will be sent in reply, so if you do not hear from us, please email again and inquire.

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NOTE: The IAOS asks that all payments be made using the PayPal link on our website: http://www.deschutesmeridian.com/IAOS/membership.html

For more information about membership in the IAOS, contact our Secretary-Treasurer:

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ABOUT THE IAOS

The International Association for Obsidian Studies (IAOS) was formed in 1989 to provide a forum for obsidian researchers throughout the world. Major interest areas include: obsidian hydration dating, obsidian and materials characterization ("sourcing"), geoarchaeological obsidian studies, obsidian and lithic technology, and the prehistoric procurement and utilization of obsidian. In addition to disseminating information about advances in obsidian research to archaeologists and other interested parties, the IAOS was also established to:

1. Develop standards for analytic procedures and ensure inter-laboratory comparability.
2. Develop standards for recording and reporting obsidian hydration and characterization results
3. Provide technical support in the form of training and workshops for those wanting to develop their expertise in the field.
4. Provide a central source of information regarding the advances in obsidian studies and the analytic capabilities of various laboratories and institutions