Supporting Information

Kirch et al. 10.1073/pnas.1119009109

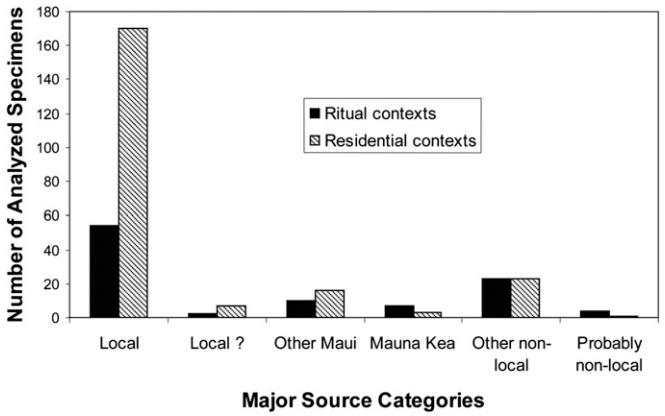

Fig. S1. Distribution of analyzed specimens grouped by major source categories in ritual (black) versus residential (hatched) contexts.

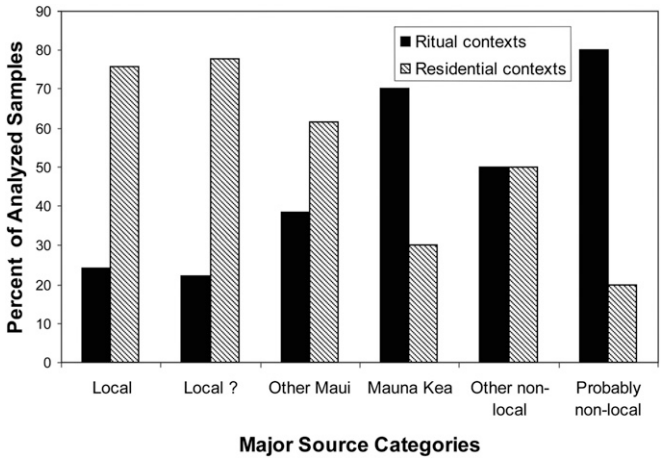

Fig. S2. Relative frequencies of main volcanic rock source categories by ritual (black) and residential (hatched) site categories.

Table S1. Archaeological features in Kahikinui district with lithic artifacts sampled for X-ray fluorescence (XRF) analysis

Feature no.	Feature type	Probable function	Excavated area, m^2	XRF samples analyzed, *n*
75	Square enclosure	Ritual/temple	2	2
76	Square enclosure	Ritual/temple	4	10
77	Enclosure	Ritual/temple	3	24
115	Irregular	Ritual/temple	4	4
117	Enclosure and terrace	Elite residential (priest's house)	12	35
263	Square enclosure	Residential	2	4
270	Rectangular enclosure	Residential	1	1
286	Rectangular enclosure	Residential	2	10
310	Rectangular enclosure	Residential	2	1
331	L-shaped shelter	Residential	3	1
366	Rectangular enclosure	Ritual/temple	1	1
380	C-shaped shelter	Residential	1	1
391	Rectangular enclosure	Residential	2	2
414	Irregular enclosure	Ritual/temple	Surface-collected	1
724	Rectangular enclosure	Residential	Surface-collected	1
725	Rectangular enclosure	Residential	12	30
726	Shelter	Residential	13	14
736	Lithic scatter	Residential	Surface-collected	1
742	Shelter	Residential	28	3
752	L-shaped shelter and terrace	Residential	26	62
755	Multiple terrace complex	Residential	27	7
1011	C-shaped shelter	Residential	9	1
1068	Square enclosure	Residential	1	2
1137	Rock shelter	Residential	2	14
1156	Rectangular enclosure	Ritual/temple	3	1
1164	Lithic scatter	Residential	Surface-collected	2
1217	Rectangular enclosure	Residential	1	2
1222	L-shaped shelter	Residential	1	1
1269	Rectangular enclosure	Residential	6	11
1285	Rock shelter	Residential	1	6
1304	Platform	Ritual/shrine	7	3
1307	Terrace complex	Ritual/shrine	2	20
1308	C-shaped shelter	Residential	1	2
1309	Rectangular enclosure	Residential	1	26
1310	Rectangular enclosure	Residential	2	11
M11	Rectangular enclosure	Residential	8	11
Total				**328**

Table S2. Average concentration values (in bold) and SDs for 17 defined geochemical groups (A–Q) compared with 26 analyses of the US Geological Survey standard basalt, Hawaiian Volcanic Observatory (BHVO-2)

	Group (*n*)																																	
	A (102)		B (60)		C (64)		D (25)		E (5)		F (6)		G (5)		H (10)		I (10)		J (2)		K (4)		L (11)		M (11)		N (2)		O (3)		P (2)		Q (3)		BHVO-2 (26)		
Element/ Oxide	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Av.	SD	Acc. value
Rb*	50	8	61	7	47	9	13	4	18	1	29	12	26	4	19	5	34	6	26	0	73	7	73	11	76	11	23	0	26	2	32	16	98	3	13	1	10
Sr*	1,084	144	1,116	83	959	106	340	46	543	13	785	79	815	33	434	62	557	24	486	20	1,332	44	1,077	62	828	56	416	7	653	37	419	3	1,773	177	383	8	389
Y*	39	3	40	3	36	3	48	30	24	2	33	6	41	4	41	7	40	3	44	1	42	1	48	7	49	6	201	84	31	2	60	6	48	3	27	1	26
Zr*	292	33	391	30	302	38	136	18	125	5	265	20	346	31	217	16	317	23	299	12	450	36	478	19	536	49	247	7	181	4	435	70	613	24	189	6	172
Nb*	58	9	68	6	57	7	10	2	24	3	46	10	27	2	13	2	36	3	21	0	85	4	87	8	90	11	17	0	26	2	30	7	115	7	18	1	18
Na_2O†	3	1	3	1	3	1	2	0	3	0	2	1	3	1	2	0	3	1	3	0	4	1	4	1	5	1	2	0	3	1	2	0	3	0	2	0	2
MgO†	3	1	2	1	3	2	5	2	5	2	3	1	4	1	4	1	4	1	3	1	2	0	1	0	1	1	3	0	3	2	3	2	0	0	7	0	7
Al_2O_3†	16	2	17	2	15	2	13	2	15	1	17	3	16	2	14	2	14	1	14	1	18	2	17	2	18	2	12	0	16	5	12	2	15	1	13	0	14
SiO_2†	42	5	45	6	39	7	43	8	43	5	33	6	40	7	43	4	45	3	49	5	48	3	49	6	52	7	44	0	48	3	50	1	39	5	49	1	50
K_2O†	1	0	2	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	2	0	2	0	2	0	1	0	1	0	1	0	2	0	1	0	1
CaO†	8	1	7	1	8	1	10	1	10	0	9	1	7	1	9	1	8	0	8	0	7	1	6	1	5	1	9	1	8	1	6	1	4	0	11	0	11
TiO_2†	4	0	3	0	3	0	2	0	2	0	3	0	4	0	3	0	4	0	3	0	3	0	2	0	2	0	3	0	3	0	3	0	2	0	3	0	3
V†	350	50	300	50	350	50	300	50	300	0	400	50	450	50	350	50	450	50	450	50	200	50	150	50	150	50	450	0	400	50	400	0	150	0	353	18	317
MnO†	1,700	200	2,000	300	1,600	100	1,600	100	1,400	0	1,500	200	1,300	100	1,500	100	1,600	100	1,700	100	2,400	200	3,000	400	3,200	600	1,500	200	1,400	200	1,600	100	3,600	100	1,500	100	1,666
Fe†,‡	11	2	10	2	12	2	8	2	10	1	14	1	11	2	10	2	11	1	12	0	9	0	9	1	8	2	10	1	11	4	12	0	5	1	9	0	9
Ni†	0	0	0	0	10	0	80	20	70	0	40	10	40	0	60	20	10	0	20	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	89	5	119
Cu†	20	0	20	10	50	20	90	20	20	10	80	60	30	10	110	40	40	20	30	10	10	10	10	10	10	10	100	20	30	20	50	20	20	0	119	8	127
Zn†	140	10	140	20	140	20	130	10	130	0	149	10	150	10	150	20	150	10	180	20	140	10	150	20	150	10	150	10	130	0	170	0	100	0	97	3	103

Acc. value, accepted value; Av., average.

*Reported concentrations and SDs for Rb, Sr, Y, Zr, and Nb are rounded to 1 ppm.

†Data for other elements are rounded to reflect varying degrees of analytical accuracy per Lundblad et al. (1): Na_2O, K_2O, TiO_2, and Fe are rounded to 0.1%; MgO, Al_2O_3, and SiO_2 are rounded to 1%; CaO is rounded to 1%; Ni, Cu, and Zn are rounded to 10 ppm; V is rounded to 50 ppm; and MnO is rounded to 100 ppm.

‡Total Fe is reported in a format following Shackley (2).

1. Lundblad SP, Mills PR, Drake-Raue A, Kikiloi SK (2010) Non-destructive EDXRF analyses of archaeological basalts. *X-Ray Fluorescence Spectrometry in Geoarchaeology*, ed Shackley MS (Springer, New York), pp 65–80.

2. Shackley MS (2005) Archaeological petrology and the archaeometry of lithic materials. *Archaeometry* 50:194–215.

Table S3. Distribution of analyzed lithic artifacts by archaeological feature and geochemical groups

Feature	Group																Outliers	No. of artifacts sampled	No. of groups
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		
75								1						1					2	2
76	3			3				1	2					1					10	5
77	7	4	3	4		1			4							1			24	7
115	1		1			1			1										4	4
117	7	13	2	3	4								6						35	6
263			4																4	1
270			1																1	1
286	2	1	3	1				1							2				10	6
310			1																1	1
331																		1	1	1
366	1																		1	1
380					1														1	1
391	2																		2	1
414																		1	1	1
724											1								1	1
725	6	3	15								1	4						1	30	6
726	5	2	4			1			1				1						14	6
736	1																		1	1
742	1		1	1															3	3
752	10	15	17	3		1	5	2			2		3		1	1	1	1	62	13
755	3	1	1	1														1	7	5
1011									1										1	1
1068	1											1							2	1
1137	7	2	3	1								1							14	5
1156			1																1	1
1164	1	1																	2	2
1217	2																		2	1
1222	1																		1	1
1269	4	3										2					2		11	4
1285	5	1																	6	3
1304	1	1		1															3	3
1307	7	1	1	3				2		2	1	3							20	8
1308				2															2	1
1309	10	8	3	1		2		1	1										26	7
1310	3	4	2					2											11	4
M11	9			1									1						11	3
Group totals	**101**	**60**	**63**	**25**	**5**	**6**	**5**	**10**	**10**	**2**	**4**	**11**	**11**	**2**	**3**	**2**	**3**	**5**	**328**	

Table S4. Analytical data for known Hawaiian high-silica adze sources

Oxide	O'ahu		Kaho'olawe	Lāna'i		West Moloka'i	
	Kailua	Waiahole	Pu'umoiwi	Kapohaku	Kaunolu	Ka'eo	Piko wmo112
n	1	4	4	10	6.00	2	1
SiO_2	54.35	53.91	53.42	52.18	52.35	51.23	52.99
TiO_2	2.20	2.17	3.02	2.14	2.11	3.06	2.44
Al_2O_3	14.30	14.11	14.19	14.32	14.21	13.96	13.93
FeO*	10.66	10.26	12.02	11.01	10.99	12.33	11.69
MnO	0.14	0.14	0.17	0.16	0.16	0.18	0.16
MgO	6.09	6.65	4.66	7.28	7.23	6.01	6.64
CaO	9.71	9.25	8.51	10.22	10.25	9.87	9.42
Na_2O	2.71	2.70	3.05	2.30	2.36	2.62	1.94
K_2O	0.36	0.73	0.87	0.44	0.52	0.65	0.48
P_2O_5	0.29	0.32	0.40	0.25	0.25	0.42	0.31
Sum	**100.81**	**100.25**	**100.31**	**100.30**	**100.43**	**100.32**	**100.00**

Data for O'ahu, Kaho'olawe, and Lāna'i sources are from Sinton and Sinoto (1).
*Total Fe is reported as FeO.

1. Sinton J, Sinoto Y (1997) *Prehistoric Long-Distance Interaction in Oceania: An Interdisciplinary Approach*, ed Weisler MI (New Zealand Archaeological Association, Auckland), pp 194–204.

Table S5. Wavelength-dispersive X-ray fluorescence (WD-XRF) analytical results for selected Kahikinui lithic artifacts

Oxide	77-S22-2-7	77-S22-2-21	77-S174-25[†]	115-J21-2-11	1011-L14-2B-1	76-F5-2-9	117-K17-1-9	76-F5-FE1-12	1309-TP2-2-20
SiO_2	49.03	49.01	49.09	48.97	48.79	47.71	54.29	52.40	51.70
TiO_2	3.99	3.88	3.93	3.88	3.78	3.71	2.02	2.11	3.02
Al_2O_3	13.76	13.75	13.76	13.57	13.65	13.36	14.32	14.10	13.28
FeO*	14.13	14.17	14.25	14.01	14.08	13.86	9.84	11.06	12.63
MnO	0.20	0.20	0.20	0.21	0.20	0.20	0.15	0.17	0.20
MgO	4.95	5.03	4.94	5.03	5.32	5.41	6.50	7.38	5.52
CaO	9.63	9.68	9.67	9.70	10.06	9.68	9.11	10.21	9.75
Na_2O	2.78	2.70	2.77	2.64	2.58	2.88	2.53	2.00	2.16
K_2O	1.15	1.03	1.07	1.19	1.04	1.18	0.49	0.53	0.64
P_2O_5	0.53	0.51	0.52	0.53	0.48	0.49	0.29	0.23	0.39
Sum	**100.14**	**99.96**	**100.21**	**99.73**	**99.98**	**98.48**	**99.54**	**100.19**	**99.28**
LOI	−0.59	−6.69	−0.06	−0.67	−0.83	−0.38	0.30	−0.05	0.02

All values are in wt %. LOI, loss on ignition at 900 °C.

*Total Fe is reported as FeO.

[†]Sample 77-S174-25 contains 25 ppm Sc, 432 ppm V, 12 ppm Cr, 53 ppm Co, 39 ppm Ni, 147 ppm Zn, 23 ppm Rb, 549 ppm Sr, 38 ppm Y, 293 ppm Zr, 34 ppm Nb, and 279 ppm Ba.

Dataset S1. Analytical database

Dataset S1