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Energy-Dispersive X-Ray Fluorescence (EDXRF) Analysis of Source Clays and Ceramics from Santa Rita B, Northern Peru

Author
Shackley, M. Steven

Publication Date
2007-11-14

BERKELEY ARCHAEOLOGICAL XRF LAB

Phoebe Hearst Museum of Anthropology
103 Kroeber Hall
University of California
Berkeley, CA 94720-3712

ENERGY-DISPERSIVE X-RAY FLUORESCENCE (EDXRF) ANALYSIS OF SOURCE CLAYS AND CERAMICS FROM SANTA RITA B, NORTHERN PERU

by

M. Steven Shackley, Ph.D.
Director

Report Prepared for
Pamela Shwartz
Department of Anthropology
Florida State University

14 November 2007

INTRODUCTION

This analysis reports the non-destructive EDXRF analysis of clay and ceramic samples from northern Peru. No attempt is made to relate the source data to the ceramic samples.

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

Spectrace/Thermo QuanX

The EDXRF trace element analyses were performed in the Geoarchaeological XRF Laboratory, University of California, Berkeley, using a Spectrace/Thermo™ *QuanX* energy dispersive x-ray fluorescence spectrometer. All samples were analyzed whole with no formal preparation. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). Or more essentially, these data through the analysis of international rock standards, allow for inter-instrument comparison with a predictable degree of certainty (Hampel 1984). The spectrometer is equipped with an air cooled Rh x-ray target with a 125 micron Be window, an x-ray generator that operates from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ reduction software. The x-ray tube is operated at 30 kV, 0.14 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Kα-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^{T}), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), and thorium (Th). Weight percent iron ($Fe_2O_3^{T}$) can be derived by multiplying ppm estimates by 1.4297(10-4). Trace element intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the US. Geological

Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Specific standards used for the best fit regression calibration include G-2 (basalt), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), all US Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994).

The data were translated directly into Excel™ for Windows software. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. An analysis of RGM-1 is included in Table 1. Further information on the laboratory instrumentation and source descriptions and data can be found at: http://www.swxrflab.net/ and Shackley (2005). Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight.

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Table 2. Elemental concentrations for the clay and archaeological ceramic samples. All measurements in parts per million (ppm).

Sample	Ti	Mn	Fe	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb	Th
PS-1	2594	123	8153	nd	11	54	18	89	153	4	106	1	6
PS-3	3049	104	29034	nd	9	22	15	52	31	12	135	8	21
PS-4	1862	132	19148	nd	9	24	14	237	97	13	127	0	6
PS-5	2215	298	7038	nd	22	52	16	111	67	3	67	3	6
PS-6	6863	154	8256	5	13	17	31	58	94	32	189	21	36
PS-7	7426	131	4111	nd	5	6	22	32	165	35	456	32	23
PS-8	6032	123	9635	nd	4	5	24	47	104	25	214	24	14
PS-9	4802	120	7171	nd	9	20	18	157	201	16	119	1	6
PS-10	2858	124	47943	20	32	32	17	59	32	8	87	6	28
PS-11	4426	208	57683	39	23	78	14	16	5	4	53	0	9
MINA FAROL-266	3477	104	3570	nd	nd	5	36	2	2	13	197	12	29
MINA FAROL-21	4536	104	4142	nd	12	34	20	2	154	15	147	12	22
J VICTORIA	2962	104	2402	nd	18	28	15	2	2128	3	148	9	6
SRB-93-9	5152	327	22884	29	56	173	24	93	243	32	211	15	17
SRB-616-49	5288	1879	50807	46	2341	180	17	81	300	27	294	11	21
CHOROBAL-1	6363	806	59371	39	114	129	22	113	352	25	245	10	24
SRB-629-57	3319	854	36327	11	39	142	21	71	248	18	112	8	6
SRB-609-21	5541	892	45904	26	24	95	17	43	407	10	179	6	6
CHOROBAL-2	5824	799	68890	51	45	95	15	53	190	21	156	9	15
SRB-625-55	3067	826	33086	29	62	145	17	69	208	22	112	5	10
SRB-929-81	4669	1457	54604	42	45	209	15	92	313	24	128	8	6
SRB-625-53	1516	782	4107	nd	22	67	8	9	389	3	21	7	6
SRB-17F-14M-8-1[2]	7542	1121	45822	29	25	135	25	64	463	19	234	16	14
-2	6118	1219	46928	26	1396	159	18	47	605	20	154	6	8

-3	6241	829	52441	21	48	105	22	51	379	12	167	13	6
-4	6162	1099	40624	27	27	118	19	57	447	18	181	14	24
-5	5661	617	46324	28	33	107	18	50	596	19	169	9	6
-6	5343	963	43961	18	26	104	21	54	331	31	186	15	6
-7	8390	770	56964	25	43	116	22	55	339	28	184	25	14
-8	7117	1177	52712	22	48	118	23	52	465	18	198	4	6
-9	7305	1699	127539	29	167	102	13	59	286	16	202	4	6
RGM-1 (standard)	1233	305	12808	nd	6	5	19	145	101	28	215	12	18
RGM-1 (standard)	1420	323	12857	nd	15	5	17	152	98	29	211	12	31

[1] nd = no data acquired for this sample, meaning that the data was lower than the error rate at six standard deviations.
[2] It was difficult to determine the unique numbers for these samples, and so were supplied.