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AN WHOLE SAMPLE ANALYSIS OF METALS IN A GROUP OF HOUSEHOLD OBJECTS AND TOYS

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Report Prepared for

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25 August 2006

INTRODUCTION

The following reports an analysis of a variety of household objects and toys mainly for lead. A total of 13 elements are reported here.

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

This assemblage was analyzed on a Spectrace/Thermo *QuanX* energy-dispersive x-ray spectrometer at the Archaeological XRF Laboratory, at the University of California, Berkeley. All samples were analyzed whole with little or no formal preparation, although some of the samples required breakage in order to fit in the sample chamber. 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).

The spectrometer is equipped with an electronically cooled Cu 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}), rubidium, cobalt (Co), zinc (Zn), gallium (Ga), (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb), lead (Pb), and Lα-line data for thorium (Th). 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 for elements of interest 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), GXR-1 (jasperoid), all US Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 obsidian standards from the Japan Geological Survey (Govindaraju 1994).

The data from both systems were translated directly into Excel™ for Windows software for manipulation and on into SPSS™ for Windows for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. An analysis of RGM-1, a USGS rhyolite standard, analyzed during each run is included in Table 1. Additionally, USGS Jasperoid GXR-1 was analyzed in one run to assess instrument precision. Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/. Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight (see also Figures 1 and 2).

The samples were irradiated at the requested location when available. A piece of tape with a black “X” is on each sample where irradiation occurred.

REFERENCES CITED

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Table 1. Elemental concentrations for the analyzed objects and USGS rock standards. All measurements in parts per million (ppm).

SAMPLE	Ti	Mn	Fe	Co	Zn	Ga	Rb	Sr	Y	Zr	Nb	Pb	Th
SHATTER FRAME	64122	197	23416	37	7459	23	2	30	0	43	16	23161	439
WHITE WINDOW FRAME	211025	122	2721	118	2717	6	2	343	0	27	113	4747	21
CERAMIC DOLL HEAD	1222	4502	11339	29984	2519	6	38	69	0	104	54	109759	1377
PEWTER BOWL	525	82	2456	0	5	6	2	4	0	9	0	776	19
PLASTIC DUCK (BEAK)	4353	1267	3312	20	127	35	2	23	0	9	9	10444	258
PEWTER PITCHER (LID)	1172	213	3071	0	84	6	2	12	0	9	14	6756	107
GARDEN CULTIVATOR	60906	3222	543603	0	1229010	2489	2	20	0	9	36	11032	264
POTATO RICER (HANDLE)	338327	3123	587869	0	1951	92	2	118	0	9	103	15783	347
SPINNING TOP	242577	4319	1875220	0	110	12	32	7	0	20	0	0	6
SMALL RED TEAPOT	1992	3003	3744	61	5	37	2	4	392	170	0	318453	342
SMALL VINEGAR CRUET	843	1659	4096	1587	822	57	181	70	44	84	26	17082	424
DUMP TRUCK	7936	13157	4902	0	1297360	1271	2	40	0	9	89	50635	1211
SMALL TRUCK	66876	8522	7135	0	1553610	884	2	51	0	9	63	34383	960
SALT SHAKER LID-1	1082	170	3891	25	5	6	2	74	135	79	202	428525	5324
JAPANESE WINE CUP	604	157	3821	0	405	22	144	66	35	84	11	523	47
MILK GLASS PEPPER SHAKER	849	120	2963	0	36	6	106	74	19	114	10	745	116
SALT SHAKER LID-2	2039	2601	3105	899	5	6	2	62	0	154	103	365275	2670
RUSSIAN DOLL	18643	126	6190	0	12470	50	4	12	4	9	3	190	22
RED WOOD APPLE	13307	88	2505	6	5	11	2	17	2	9	9	7	12
RED PYREX CASS.	7920	146	2981	11	26944	6	2	138	1	841	129	154635	3292
7-UP BOTTLE	763	275	3403	0	16	6	21	92	10	62	0	17	6
GARFIELD CUP	78001	164	3179	242	70	6	2	268	0	279	146	277579	3744
ICE CREAM SCOOP	978	2122	15923	0	11610	54	2	6	0	63	8	1063	15
TURTLE NECKLACE	535	284	3836	6	2870	6	2	29	0	180	28	236225	1084
Standards													
RGM1-S1	1455	356	13175	0	39	18	153	110	20	228	15	22	21
RGM1-S1	1559	294	12773	0	37	19	145	105	26	226	5	27	9
RGM1-S3	1488	263	12972	0	40	18	147	111	25	222	14	22	11
GXR-1	1687	1440	517265	0	688	6	2	267	0	34	16	776	629