Microanalysis of Thai amulet: Phra Luang Pho Thuad

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Abstract. Thai Amulets exist in many forms in Thailand and are made by many different traditions and ethnic groups. Many people in Thailand, Singapore, and Malaysia believe that amulets of Phra Luang Pho Thuad hold a great protective power granting safety in time of distress, especially saving the life of believer from fatal automobile accident. In this work, 16 samples of Phra Luang Pho Thuad amulets have been studied. The amulets are made from herbs and powder and created by Wat Chang Hai (Pattani). A scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS) has been used to characterize the elemental compositions and morphologies of amulets. It has been found that many elements are present as a major (C, O, Si, and Ca), minor (Mg, Al, S, K, and Fe) and trace elements (F, Na, P, Ti, Cu, Zn, and As). W, Au, Ag, and rare earths (La, Ce, and Nd) were detected in some samples. Quartz, orthoclase, and anhydrite are the base composition, while gold, silver, copper, magnetite, wolframite, and rare earths are the characteristic minerals. The difference in the compositions of amulets produced from different batches can be used as the reference to identify the batch of unknown-Phra Luang Pho Thuad amulets.

1. Introduction

An amulet, also known as a good luck charm, is an object believed to generate power of protection upon its possessor. The word "amulet" comes from a Latin word of amuletum which Pliny's Natural History describes as "an object that protects a person from trouble". Any item can function as an amulet. The items commonly used include gems, statues, coins, drawings, plant parts, animal parts, and written words. Amulets which are said to derive their extraordinary properties and powers from magic or those which impart luck are typically parts of folk religion or paganism. Amulets or sacred objects of major world religions including Christianity are believed to have no power of their own without being blessed by a clergyman. They will not also supposedly provide any supernatural benefit to the bearer who does not have an appropriate disposition. Talismans and charms may be different from amulets by having supreme magical powers other than protection. Amulet is sometimes confused with pendant, a small aesthetic object that hang from necklaces. Any pendant may be indeed an amulet that protects its holder from danger. With Buddhist and animist beliefs, Thai people also have a vast pantheon of amulets which are still popular and in common use by most people even in the present day. The belief in magic is impregnated into Thai culture and religious beliefs and folk superstitions. This belief is reflected by the fact that we always see the commonplace use of amulets and magical rituals in everyday life. Thai amulets exist in many forms in Thailand and are made by many different traditions and ethnic groups. The types of Thai amulets and their empowerment methods are different, depending on each grimier, temple, master monk, and ethnic group [1-2].

Many people in Thailand, Singapore, and Malaysia believe that amulets of Phra Luang Pho Thuad (also known as Luang Pu Thuat, Luang Pu Thuad, Luang Por Tuad, Luang Phu Tuad, and various other spellings) hold great protective power granting safety in time of distress, especially saving the life of believer from a fatal automobile accident. Phra Archan Tim Dharmataro, abbot of Wat Chang Hai, was the pioneer creator of Phra Luang Pho Thuad amulets.

The first batch was made from herbs and powder [3] in 2497 BE (1954 AC). Our previous works have been focused on examination of the morphology and composition of Phra Somdej Wat Rakhang (which is one of the most famous Thai amulets) using scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS) and proton-induced X-ray emission spectroscopy (PIXE) [4-5].

In this work, the morphology and elemental composition of Phra Luang Pho Thuad amulet (another one of the most famous Thai amulets) have been analyzed using SEM-EDS for the first time. The present work aims to use these results as a reference to identify the batch of unknown-Phra Luang Pho Thuad amulets.

2. Experimental

2.1. Samples

16 samples of Phra Luang Pho Thuad amulets with approximately 2 cm in base width and 3 cm in height were studied. They were collected from different molds in which possessed different patterns, textures, and colors. 5 of 16 samples are shown in figure 1.

Figure 1. Phra Luang Pho Thuad amulets produced from 5 different molds: (a) front and (b) back.

2.2. SEM-EDS

Only non-destructive preparation was allowed for these samples. The morphology and composition of samples were determined using a Horiba Emax X-act energy dispersive spectrometry (EDS) attached to a Hitachi S-4800 Field emission scanning electron microscopy (FE SEM). The system was operated in 5 kV accelerating voltage by an elapsed lifetime of 60 s. The elemental composition (wt%) was determined with different positions of analysis for each sample. The analysis was done on both front (3 positions: nose (F1); chest (F2); and lower base (F3)) and back (2 positions of B1 and B2) sides of each sample as shown in figure 2.

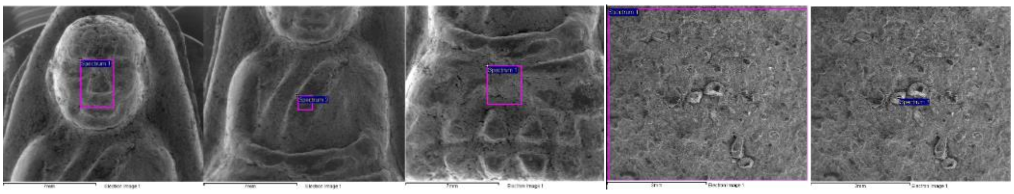
F1 F2 F3 B1 B2

Figure 2. The selected positions of analysis for Phra Luang Pho Thuad sample.

3. Result and discussion

The morphologies and elemental compositions of Phra Luang Pho Thuad amulets examined using SEM-EDS were shown in figure 2 and table 1, respectively. SEM micrographs show the surface with irregular plate-like granules, porous structure of cavities, cracks, and fine particles with a wide range of size distribution. The EDS results show that C, O, Mg, Al, Si, S, K, Ca, and Fe were the base composition of all samples. Si, Al, and Ca, which were the composition of minerals such as quartz (SiO_2), orthoclase ($KAlSi_3O_8$), and anhydrite ($CaSO_4$), were found in all samples. The other elements were present as impurities in raw materials of clay minerals and herb organics.

The amounts of these other elements were different in different molds and different batches of the same mold. As was present in samples PKC (1.02 wt%), PKN (0.32 wt%), PKS (0.79 wt%), PKT (0.20 wt%), PYA3 (0.19 wt%), and PYC1 (0.57 wt%). F was present in samples PKT (35.24 wt%) and PRY (1.03 wt%). Zn was found in sample PKL (0.19 wt%). Some samples possessed high content of Fe including KK2 (11.47 wt%), PKC (4.21 wt%), PKL (6.32 wt%), PKS (14.57 wt%), PYA1 (6.39 wt%), and PYC1 (4.24 wt%). Moreover, some characteristic elements were detected. Ag, La, Ce, and Nd were found in sample PRY. It is well known that La usually coexists with Ce and other rare earth elements including Nd. These elements were widely distributed in the Earth's crust, especially in a form of monazite that also present in southern Thailand. W was present in samples KK2 (28.40 wt%), PRY (22.11 wt%), and PYA1 (34.76 wt%). It was also found that W was the main composition of the wolframite found in southern Thailand, especially in Nakhon Si Thammarat. Au was detected in sample PKN2 (2.06 wt%). Cu was present in samples PKB, PKC, PKL, PKS, PKT, PRL, PYA3, and PYC1. Mn was detected in samples KK2, PKF, PKN2, PKT, PRL, PYA1, and PYC1. P was found in samples KK2, PKB, PKC, PKF, PKL, PKN, PRY, and PYC1. Na was present in samples KK2, PKC, PKF, PKL, PKN, PKN2, PKT, PYA1, PYC1, and PYC2. These elements may be added to the special molds. It was revealed that the difference in compositions of these minerals resulted in different kinds of stuff and colors which were in agreement with the historical resources.

Elemental composition in table 1 can be used to distinguish the amulets produced from different batches of the same mold, and those from different molds. The identification of amulets from 7 different batches of 3 molds are reported. For the samples (produced from different batches of the same mold) of PYA1, PYA2, and PYA3, the amounts of Mg, S, Ca, and Cu were significantly different and can be used for determination of batch difference. Large amounts of Ca, S, and Mg for PYA1, small amounts of Ca, S, and Mg for PYA2, and large amounts of Ca and S, and small amount of Mg with a presence of Cu for PYA3. For the samples (produced from different batches of the same mold) of PYC1 and PYC2, the amounts of Mn, Ca, and S were significantly different. Large amounts of Ca and S with a presence of Ti and Cu for PYC1, and small amounts of Ca and S with a presence of Mn for PYA2. For the samples (produced from different batches of the same mold) of PKN and PKN2, the amounts of Al, Si, S, Ca, Ti, Mn, and Au were significantly different. Large amounts of Ca and S, small amounts of Al and Si for PKN, and small amounts of Ca and S and large amounts of Al and Si with a presence of Au, Ti, and Mn for PKN2. Other 9 samples produced from other 9 different molds show different compositions. Some samples (PKC, PKF, and PRY) possessed the same amount of base composition with different content of characteristic elements. These 16 samples produced from 12 molds can be used as the reference for identification of batch and mold for an unknown-Phra Luang Pho Thuad amulet.

Table 1. Elemental composition of Phra Luang Pho Thuad amulets using SEM-EDS.

Sample/		Composition (wt%)									
Position		**C**	**O**	**Mg**	**Al**	**Si**	**S**	**K**	**Ca**	**Fe**	**Others**
KK2	F1	35.40	44.93	2.57	0.53	7.48	0.36	0.33	7.84	0.38	**P**=0.18
	F2	36.55	44.64	3.16	0.34	8.27	0.26	0.32	6.25	0.23	
	F3	31.47	45.50	1.08	0.64	3.75	0.52	0.62	15.43	0.48	**P**=0.50
	B1	23.19	32.96	0.61	N/A	N/A	N/A	0.21	N/A	11.47	**Mn**=0.38, **W**=28.40
	B2	29.85	48.25	2.05	0.42	5.50	0.32	0.45	10.36	1.03	**Na**=0.19, **Ti**=1.37, **Mn**=0.21
PKB	F1	44.29	37.29	0.11	0.36	5.66	0.20	0.44	10.16	0.25	**Cl**=0.08
	F2	43.38	35.40	0.31	1.69	8.87	0.22	0.63	8.95	0.45	**Cl**=0.16, **Mn**=0.07
	F3	32.58	46.35	0.30	0.92	5.38	0.27	0.34	13.64	0.22	
	B1	36.21	43.63	0.27	1.38	9.11	0.30	0.49	7.77	0.48	**P**=0.13, **Cl**=0.06, **Ti**=0.06, **Cu**=0.10
PKC	F1	38.08	42.07	0.37	0.72	3.14	0.23	0.56	13.93	0.22	**Na**=0.15, **P**=0.14, **Cu**=0.39,
	F2	43.76	41.22	0.61	0.54	2.87	0.24	0.46	9.82	0.16	**P**=0.20, **Cu**=0.10
	F3	34.29	48.04	0.24	0.64	2.36	0.11	0.53	13.34	0.16	**P**=0.28
	B1	31.00	47.06	0.23	0.32	1.25	0.93	0.46	17.51	1.24	
	B2	39.11	31.15	0.19	0.39	14.06	3.52	0.76	5.49	4.21	**Cl**=0.10, **As**=1.02
PKF	F1	31.62	46.25	0.46	0.51	3.23	0.19	0.59	16.63	0.24	**P**=0.19,
	F2	32.08	44.58	0.56	0.54	3.17	0.15	0.74	16.80	0.24	**P**=0.68, **Mn**=0.09
	F3	28.87	49.73	0.34	0.30	1.89	0.09	0.73	17.90	0.15	**Na**=0.18, **Mn**=0.27
	B1	27.04	47.92	0.28	0.48	2.67	0.13	0.68	20.32	0.21	**Na**=0.18
PKL	F1	29.51	46.10	0.47	0.43	2.94	1.75	0.95	17.11	0.19	**Na**=0.16, **Cu**=0.22, **Zn**=0.19
	F2	29.37	46.46	0.41	0.58	3.84	0.68	1.00	16.95	0.16	**Na**=0.17, **P**=0.12, **Cu**=0.16, **Zn**=0.10
	F3	25.80	51.22	0.16	0.23	1.60	1.20	0.86	18.66	0.09	**Na**=0.17
	B1	27.46	48.79	0.26	0.40	2.76	0.81	0.78	17.73	0.98	
	B2	49.31	25.47	0.29	0.51	4.78	7.22	0.73	5.04	6.32	**Na**=0.14, **P**=0.17
PKN	F1	34.94	42.01	0.55	0.56	3.58	0.19	0.82	16.63	0.23	**Na**=0.27, **P**=0.11, **Cl**=0.12
	F2	32.11	45.35	0.53	0.54	3.51	0.24	0.79	16.72	0.20	
	F3	25.06	51.41	0.44	0.40	2.68	0.09	0.74	19.02	0.16	
	B1	29.47	46.93	0.34	0.32	1.74	0.75	0.90	18.33	0.90	**As**=0.32
	B2	53.46	27.38	1.19	0.21	3.37	0.13	0.70	17.70	0.30	**Na**=0.31, **Cl**=0.24
PKN2	F1	45.72	36.72	1.39	1.95	9.93	0.14	0.46	2.13	0.43	**Na**=0.15, **Cl**=0.08, **Ti**=0.10, **Mn**=0.09, **Au**=0.71
	F2	44.43	35.99	1.12	3.51	11.26	N/A	0.56	2.45	0.47	**Na**=0.13, **Cl**=0.07, **Ti**=0.12, **Mn**=0.10, **Au**=0.78
	F3	37.15	44.02	0.76	2.62	10.52	0.10	0.58	3.14	0.49	**Na**=0.14, **Ti**=0.09, **Mn**=0.09, **Au**=0.29
	B1	38.05	40.40	0.80	3.09	11.71	N/A	0.62	2.44	0.52	**Na**=0.11, **Ti**=0.10, **Mn**=0.11, **Au**=2.06
	B2	29.11	39.78	0.28	7.97	17.85	N/A	3.51	0.25	0.45	**Na**=0.26, **Ti**=0.19, **Au**=0.34
PKS	F1	45.82	38.25	0.31	1.27	5.46	0.57	0.56	7.22	0.25	**Cu**=0.27
	F2	41.79	40.73	0.20	1.10	4.60	0.93	0.55	9.76	0.18	**Cl**=0.06, **Cu**=0.10
	F3	34.80	49.11	0.19	1.09	4.31	0.65	0.43	9.22	0.20	
	B1	37.17	43.62	0.19	0.75	3.42	1.74	0.63	10.96	1.41	**Cl**=0.12
	B2	42.53	25.08	N/A	N/A	0.83	14.46	0.41	1.33	14.57	**As**=0.79
PKT	F1	37.19	42.82	0.44	0.85	4.23	0.70	0.47	12.76	0.24	**Cl**=0.07, **Cu**=0.24
	F2	38.40	41.77	0.70	1.24	5.26	0.72	0.40	10.37	0.24	**Cl**=0.08, **Mn**=0.07, **Cu**=0.16
	F3	31.54	49.34	0.11	0.66	2.74	0.42	0.55	14.43	0.14	**Mn**=0.08
	B1	36.98	45.56	0.14	0.71	3.22	0.98	0.40	11.06	0.75	**As**=0.20
	B2	14.72	20.79	0.18	N/A	0.57	0.38	0.19	22.79	0.31	**Na**=0.21, **F**=35.24, **As**=0.21
PRL	F1	37.60	42.93	0.36	1.01	4.34	0.42	0.37	12.66	0.23	**Cl**=0.07
	F2	39.17	44.74	0.35	1.13	5.00	0.35	0.43	8.64	0.19	
	F3	36.97	48.72	0.34	0.62	3.00	0.26	0.27	9.64	0.11	**Mn**=0.07
	B1	42.58	44.05	0.51	0.64	3.47	0.27	0.45	7.45	0.28	**P**=0.12, **Cl**=0.09, **Cu**=0.09
PRY	F1	38.83	40.92	0.58	0.59	3.60	0.57	0.48	13.81	0.25	**P**=0.36
	F2	35.67	43.22	0.78	0.38	3.26	0.58	0.63	14.51	0.22	**P**=0.43, **Ti**=0.18
	F3	28.37	49.02	0.42	0.19	1.59	0.49	0.70	18.77	0.11	**P**=0.12, **Ti**=0.22
	B1	27.96	37.41	N/A	N/A	0.75	N/A	0.13	2.10	N/A	**F**=1.03, **P**= 6.92, **Ag**=0.46, **La**=6.65, **Ce**=14.25, **Nd**=4.40
	B2	25.25	35.63	0.29	N/A	N/A	0.32	0.66	14.76	0.17	**P**=0.61, **Ti**=0.24, **W**=22.11
PYA1	F1	38.82	41.09	1.01	1.77	9.93	0.17	0.48	5.87	0.42	**Na**=0.17, **P**=0.12, **Cl**=0.16
	F2	38.74	39.66	1.19	1.28	9.31	0.16	0.42	8.38	0.39	**Na**=0.22, **Cl**=0.23
	F3	31.08	47.43	2.16	0.86	8.97	0.14	0.30	8.44	0.29	**Na**=0.17, **Cl**=0.15
	B1	18.94	30.22	0.53	N/A	N/A	N/A	N/A	2.96	6.39	**W**=34.76
PYA2	F1	37.67	43.84	0.56	0.83	4.00	0.95	0.55	11.15	0.46	
	F2	34.99	44.84	0.52	1.07	4.68	0.84	0.61	11.89	0.39	
	F3	32.03	48.83	0.45	1.04	4.04	0.88	0.46	12.06	0.20	
	B1	37.04	47.35	0.28	1.03	3.61	0.37	0.54	9.29	0.41	**P**=0.08
PYA3	F1	34.17	46.85	0.19	0.54	2.47	0.28	0.44	15.09	0.16	
	F2	44.52	40.87	0.72	0.29	2.42	0.41	0.30	10.00	0.22	**Cu**=0.15
	F3	38.17	40.34	0.64	0.91	5.01	0.41	0.53	13.27	0.35	**Cl**=0.10, **Cu**=0.26
	B1	66.87	22.49	0.26	0.28	1.77	0.65	0.23	6.36	0.81	**As**=0.19, **Cu**=0.08
PYC1	F1	32.94	49.29	0.27	0.18	1.25	4.67	1.06	10.05	N/A	**Ti**=0.29
	F2	41.91	39.20	0.34	0.68	2.93	0.95	0.84	12.81	0.16	**Cu**=0.18
	F3	45.97	37.02	0.40	0.47	2.50	1.56	0.81	10.74	0.20	**Ti**=0.14, **Cu**=0.17
	B1	34.37	37.82	0.22	0.53	2.21	2.89	0.93	15.97	4.24	**Na**=0.12, **P**=0.13, **As**=0.57
PYC2	F1	37.41	45.38	0.25	1.04	4.67	N/A	0.69	10.02	0.15	**Mn**=0.38
	F2	39.01	43.80	0.20	1.32	5.24	0.39	0.46	8.89	0.45	**Mn**=0.23
	F3	35.22	51.38	0.18	0.48	2.02	N/A	0.51	9.90	0.12	**Mn**=0.18
	B1	33.46	48.36	0.12	0.60	2.40	0.15	0.72	13.59	0.22	**Na**=0.11, **Mn**=0.29

N/A denotes non-detectable or the content of < 0.01 wt%.

4. Conclusion

This non-destructive analytical technique of SEM-EDS was the essential technique for characterization of Phra Luang Pho Thuad amulets which provided information about the morphology and elemental composition. The results showed that the amulet matrices were heterogeneous. Thus, the difference in the contents of characteristic elements and main compositions of amulets produced from different batches can be used as the reference to identify the batch of unknown-Phra Luang Pho Thuad amulets.

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