

The Analysis of the Ancient Potsherd in New Stones Age in YeShi Mountain of Zhao Tong with X Ray Diffraction

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Abstract

X ray diffraction to crystal is the first and most convenient and important method for man to research the material microstructure. X ray diffraction has the character of no damaging sample, no pollution, and high measuring accuracy. Material phase structure, the measurements, direction and distribution of crystalline grain, stress and other information can be taken by the method. By means of X ray diffraction quantitative phase analysis, the test and research of potsherd in New Stone Age in Yeshe Mountain of Ludian County, Zhaotong City, Yunnan Province primarily ascertained its main composition, started and strengthened the research of unearthed cultural relics with science and technology in Zhaotong city, made the research of unearthed cultural relics turn to malty-subject study.

Keywords: X-ray, Diffraction, Spectrum, Zhaotong city, New stones age, Potsherd classified book number of China

Zhaotong has long been known as “the throat of the west of Shu and the key to the lock of south of Dian”. The culture of this old and magical place goes back to ancient time. In 1982, a piece of fossil of man's tooth was unearthed in Guoshan Cave of north suburb of Zhaotong City. It's determined as fossil of early intelligent man about 100 thousand years ago (called as Zhaotong man), which filled up the gap between ape-man phase and late intelligent man phase of Yunnan Province. The Yeshe Village to 4 km east of Ludian county covers area of about 1 km², the archaeology research institute of Yunnan province dug out earth pottery, sand taken pottery and polished pottery in area of 400 m². The colour of pottery included grey, black, brown and red. The shape of pottery included bottle, jar, cup, bowl, pot, basin and spinning wheel. There are many little flat-bottomed pots and bird-head like pots in unearthed pottery. Statistical number of bird head-like pots reach more than 70. The typical unearthed pottery included bottle which has ear, wide mouth, long neck, wide shoulder, oblique and long belly, small flat bottom, and was similar as big pot unearthed in Shanxingdui and black sheep head-like polished pot with two big ears. Stoneware includes crescent and rectangular stone knife, long bar-like stone axe. A lot of bird head-like pottery had been unearthed in Yeshe, Ludian. They are very like bird head-shaped pottery in Shanxing dui.

Because of special geographic position, many kinds of ancient cultural relics were unearthed, but the

multi-subject comprehensive test, analysis and research of them have not been started yet for lack of funds. The study will strengthen the research of unearthed cultural relics of our city, and make it turn to multi-subject research.

X-ray quantitative phase analysis means that first, measure accurately every diffraction intensity of mixture with technology of X-ray diffraction, and then get the content of every kind of composition of multi-phase matter. Its theoretical basis is that the diffraction intensity of matter is directly proportional to the volume or quality of matter taken in diffraction. Therefore, through the diffraction intensity, we can get the proportion of volume or quality of some phase taken in diffraction of mixture, and then we can ascertain the composition of the sample and the content of every phase of mixture.

1. Sample and experimental way

The tested sample was taken from the remains of Yeshi Mountain in Taoyuan, Ludian County, Zhaotong City, which is the important protected cultural relics remains of Yunnan Province. Unearthed earth pottery, sand taken pottery. Black potsherd of small flat-bottomed jar, as is shown in Fig. 1.

The sample tested this time was 1#Y, 2#Y, 3#G, 2#B, 3#B supplied by cultural relics management office of Ludian County (1#Y and 2#Y are yellow, 3#G is grey, 2#B and 3#B are black).

The testing instrument is the X-ray diffraction instrument made in science company, Japan (The advanced analysis and measurement center of Yunnan University) Type: D/max-3B, the maximum power: 3kW. The maximum voltage: 60 kV. The maximum current: 80 mA. The stability of voltage and current: $\pm 0.03\%$ the scanning model of angle-measuring instrument: continuous, step forward, or fixed angle: 2θ . The measuring scope of angle: $-3^{\circ}\sim 160^{\circ}$, the precision of angle-measuring instrument $\leq \pm 0.01^{\circ}$, the precision of reappearance $\leq \pm 0.01^{\circ}$

2. Experimental result and analysis

The experimental result is in Fig. 2~Fig.4. The experimental data is in Fig. 5~Fig. 9.

The analysis of experimental result: With the analysis software and PDF database of instrument, we find that the main composition of sample are quartz, little illite, Calcium zeolite, A mica. The quartz is the result of calcinations, other composition may come from soil or result from incomplete calcinations. We plan to conclude after comparing the data of potsherd of Shanxingdui with the relative data set after quantitative test and analysis.

References

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Figure 1. Sample Objects

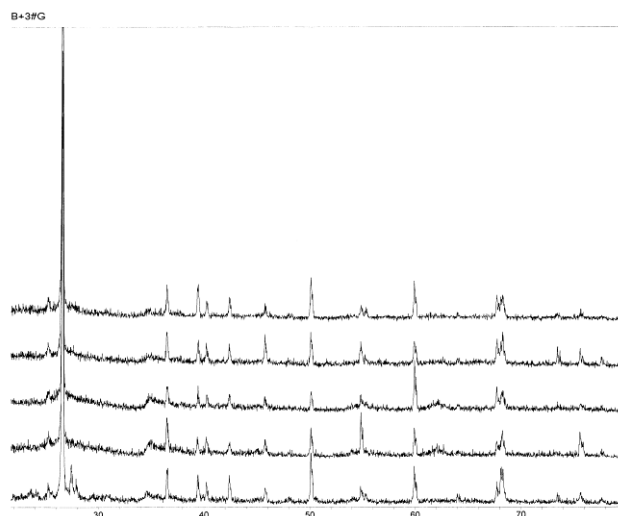


Figure 2. Experimental Result (A)

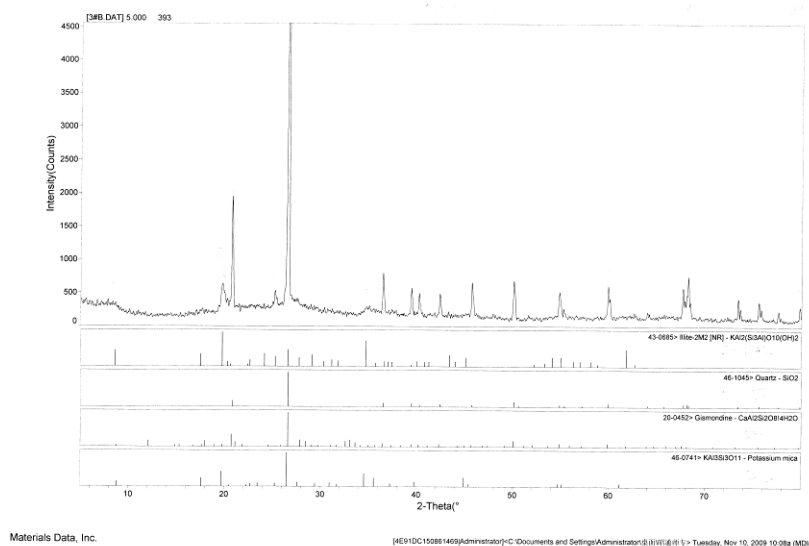


Figure 3. Experimental Result (B)

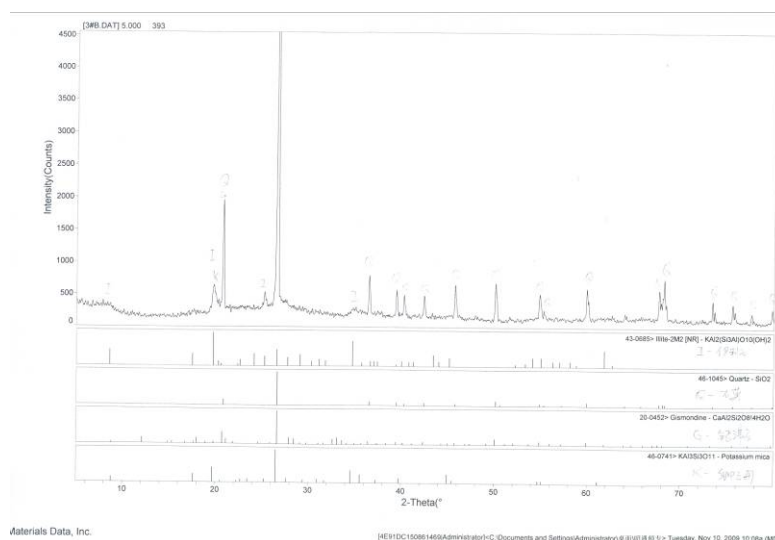


Figure 4. Experimental Result (C)

[3#B.DAT] 5.000 393										Peak Search Report
SCAN: 5.02/79.9999/0.02/1(sec), Cu, I(max)=9376, 11-03-09 11:53										
PEAK: 19-pts/Parabolic Filter, Threshold=5.0, Cutoff=1.0%, BG=3/1.0, Peak-Top=Centroid Fit										
NOTE: Intensity = Counts, 2T(0)=0.0(°), Wavelength to Compute d-Spacing = 1.54056A(Cu/K-alpha1)										
#	2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM		
1	11.021	8.0212	145	77	0.9	1620	1.9	0.358		
2	19.784	4.4839	255	377	4.2	8810	10.2	0.397		
3	20.272	4.3770	262	143	1.6	3634	4.2	0.432		
4	20.810	4.2650	292	1661	18.4	15771	18.2	0.161		
5	25.283	3.5196	294	234	2.6	2969	3.4	0.216		
6	26.611	3.3470	340	9036	100.0	86692	100.0	0.163		
7	34.739	2.5802	182	95	1.1	3984	4.6	0.713		
8	35.034	2.5591	197	104	1.2	3277	3.8	0.536		
9	36.522	2.4583	202	594	6.6	5594	6.5	0.160		
10	39.461	2.2817	197	376	4.2	2905	3.4	0.131		
11	40.285	2.2369	173	318	3.5	2907	3.4	0.155		
12	42.429	2.1286	141	341	3.8	3579	4.1	0.178		
13	45.791	1.9799	146	505	5.6	5972	6.9	0.201		
14	47.958	1.8954	107	76	0.8	2131	2.5	0.477		
15	50.122	1.8185	86	593	6.6	7601	8.8	0.218		
16	51.612	1.7694	90	75	0.8	1182	1.4	0.268		
17	54.867	1.6719	119	393	4.3	6361	7.3	0.275		
18	55.292	1.6600	125	137	1.5	1638	1.9	0.203		
19	59.946	1.5418	106	496	5.5	7419	8.6	0.254		
20	62.675	1.4811	110	71	0.8	1839	2.1	0.440		
21	64.028	1.4530	112	104	1.2	1285	1.5	0.210		
22	64.153	1.4505	105	85	0.9	1805	2.1	0.361		
23	67.742	1.3821	118	461	5.1	8452	9.7	0.312		
24	68.247	1.3731	127	623	6.9	11372	13.1	0.310		
25	73.457	1.2880	90	326	3.6	3251	3.8	0.170		
26	75.616	1.2565	88	277	3.1	2859	3.3	0.175		
27	77.631	1.2289	72	154	1.7	2107	2.4	0.233		
28	77.852	1.2259	69	62	0.7	1129	1.3	0.310		

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Figure 5. Experimental Datas (A)

[2#B.DAT] 5.000 541										Peak Search Report
SCAN: 5.02/79.9999/0.02/1(sec), Cu, I(max)=7981, 11-03-09 11:53										
PEAK: 23-pts/Parabolic Filter, Threshold=5.0, Cutoff=1.0%, BG=3/1.0, Peak-Top=Centroid Fit										
NOTE: Intensity = Counts, 2T(0)=0.0(°), Wavelength to Compute d-Spacing = 1.54056A(Cu/K-alpha1)										
#	2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM		
1	6.422	13.7512	598	147	1.9	4526	6.4	0.523		
2	13.221	6.6909	128	73	1.0	1908	2.7	0.444		
3	18.039	4.9133	200	97	1.3	1917	2.7	0.336		
4	19.799	4.4805	293	627	8.3	14197	20.0	0.385		
5	20.789	4.2692	358	1135	14.9	9824	13.8	0.147		
6	25.255	3.5235	329	235	3.1	3781	5.3	0.274		
7	26.617	3.3462	382	7599	100.0	71137	100.0	0.159		
8	34.766	2.5783	209	173	2.3	5823	8.2	0.572		
9	35.055	2.5577	214	215	2.8	7340	10.3	0.580		
10	36.528	2.4578	241	662	8.7	7765	10.9	0.199		
11	39.411	2.2844	164	291	3.8	2925	4.1	0.171		
12	40.272	2.2376	176	296	3.9	3416	4.8	0.196		
13	42.428	2.1287	145	207	2.7	3434	4.8	0.282		
14	45.782	1.9803	151	248	3.3	3374	4.7	0.231		
15	50.131	1.8182	103	568	7.5	7168	10.1	0.215		
16	54.906	1.6708	159	787	10.4	10056	14.1	0.217		
17	59.966	1.5413	126	546	7.2	6356	8.9	0.198		
18	62.036	1.4948	143	159	2.1	4331	6.1	0.463		
19	62.336	1.4883	157	81	1.1	1645	2.3	0.345		
20	67.766	1.3817	131	259	3.4	4833	6.8	0.317		
21	68.226	1.3735	125	460	6.1	9859	13.9	0.364		
22	73.323	1.2901	113	69	0.9	1549	2.2	0.382		
23	75.639	1.2562	103	461	6.1	8164	11.5	0.301		
24	77.690	1.2281	87	99	1.3	1841	2.6	0.316		

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Figure 6. Experimental Datas (B)

[2#Y.DAT] 5.000 549								Peak Search Report
SCAN: 5.02/79.9999/0.02/1(sec), Cu, I(max)=6259, 11-03-09 11:52								
PEAK: 25-pts/Parabolic Filter, Threshold=5.0, Cutoff=1.0%, BG=3/1.0, Peak-Top=Centroid Fit								
NOTE: Intensity = Counts, 2T(0)=0.0(*), Wavelength to Compute d-Spacing = 1.54056A(Cu/K-alpha1)								
#	2-Theta	d(A)	BG	Height	I%	Area	I% FWHM	
1	6.895	12.8092	664	170	2.9	5096	9.1	0.510
2	14.106	6.2734	119	80	1.4	1427	2.5	0.303
3	14.455	6.1225	123	72	1.2	666	1.2	0.157
4	18.121	4.8914	186	87	1.5	4422	7.9	0.864
5	19.827	4.4741	192	736	12.5	19996	35.5	0.462
6	20.810	4.2649	351	1417	24.1	11740	20.9	0.141
7	25.274	3.5209	311	181	3.1	3188	5.7	0.299
8	26.629	3.3448	388	5871	100.0	56306	100.0	0.163
9	30.242	2.9529	225	106	1.8	1127	2.0	0.181
10	34.883	2.5699	225	173	2.9	5109	9.1	0.502
11	35.380	2.5349	222	147	2.5	7954	14.1	0.920
12	36.558	2.4559	223	381	6.5	5223	9.3	0.233
13	37.837	2.3757	182	86	1.5	1620	2.9	0.320
14	39.466	2.2814	176	305	5.2	2920	5.2	0.163
15	40.304	2.2359	164	272	4.6	3615	6.4	0.226
16	42.446	2.1279	158	273	4.6	3972	7.1	0.247
17	45.776	1.9805	140	222	3.8	3731	6.6	0.286
18	50.147	1.8177	100	364	6.2	4148	7.4	0.194
19	53.958	1.6979	142	89	1.5	922	1.6	0.176
20	54.906	1.6708	146	217	3.7	5114	9.1	0.401
21	55.328	1.6591	151	103	1.8	2012	3.6	0.332
22	55.977	1.6414	134	74	1.3	756	1.3	0.174
23	59.984	1.5409	105	920	15.7	10770	19.1	0.199
24	61.700	1.5021	150	78	1.3	2517	4.5	0.549
25	62.192	1.4914	147	127	2.2	4191	7.4	0.561
26	64.068	1.4522	115	80	1.4	1413	2.5	0.300
27	67.753	1.3819	134	415	7.1	5643	10.0	0.231
28	68.274	1.3726	128	356	6.1	7963	14.1	0.380
29	73.462	1.2880	107	79	1.3	1567	2.8	0.337
30	75.678	1.2557	102	120	2.0	2565	4.6	0.363
31	77.644	1.2287	77	73	1.2	1582	2.8	0.368

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Figure 7. Experimental Datas (C)

[3#G.DAT] 5.000 400								Peak Search Report
SCAN: 5.02/79.9999/0.02/1(sec), Cu, I(max)=9887, 11-03-09 11:54								
PEAK: 21-pts/Parabolic Filter, Threshold=4.0, Cutoff=0.5%, BG=3/1.0, Peak-Top=Centroid Fit								
NOTE: Intensity = Counts, 2T(0)=0.0(*), Wavelength to Compute d-Spacing = 1.54056A(Cu/K-alpha1)								
#	2-Theta	d(A)	BG	Height	I%	Area	I% FWHM	
1	8.348	10.5825	242	74	0.8	1729	1.9	0.397
2	17.823	4.9725	155	63	0.7	2724	3.0	0.736
3	18.132	4.8883	161	64	0.7	3125	3.4	0.830
4	18.679	4.7464	177	80	0.8	844	0.9	0.179
5	19.822	4.4753	175	442	4.6	12129	13.3	0.466
6	20.834	4.2601	334	2167	22.7	18608	20.3	0.146
7	23.741	3.7446	263	91	1.0	2311	2.5	0.432
8	25.283	3.5196	293	244	2.6	3473	3.8	0.242
9	26.621	3.3457	329	9558	100.0	91520	100.0	0.163
10	28.572	3.1216	245	78	0.8	505	0.6	0.110
11	30.806	2.9000	194	86	0.9	2347	2.6	0.464
12	32.494	2.7532	151	62	0.6	719	0.8	0.197
13	33.147	2.7004	148	72	0.8	625	0.7	0.148
14	34.584	2.5915	184	85	0.9	3319	3.6	0.664
15	34.880	2.5701	200	111	1.2	2295	2.5	0.351
16	36.537	2.4573	201	556	5.8	6064	6.6	0.185
17	39.461	2.2817	152	648	6.8	7540	8.2	0.198
18	40.295	2.2363	154	302	3.2	3755	4.1	0.211
19	42.441	2.1281	147	380	4.0	4559	5.0	0.204
20	45.796	1.9797	140	209	2.2	2998	3.3	0.244
21	48.047	1.8920	105	76	0.8	1470	1.6	0.329
22	48.273	1.8837	99	57	0.6	1466	1.6	0.437
23	50.140	1.8179	103	847	8.9	10076	11.0	0.202
24	53.886	1.7000	119	56	0.6	1634	1.8	0.496
25	54.223	1.6902	125	56	0.6	1036	1.1	0.314
26	54.881	1.6715	127	232	2.4	3834	4.2	0.281
27	55.332	1.6590	121	172	1.8	3184	3.5	0.315
28	58.777	1.5697	105	55	0.6	619	0.7	0.191
29	59.966	1.5414	119	690	7.2	8731	9.5	0.215
30	64.042	1.4527	117	101	1.1	997	1.1	0.168
31	65.674	1.4205	119	66	0.7	929	1.0	0.239
32	67.747	1.3820	123	443	4.6	7653	8.4	0.294
33	68.259	1.3729	118	456	4.8	10755	11.8	0.401
34	70.106	1.3412	97	53	0.6	559	0.6	0.179
35	70.611	1.3328	92	56	0.6	890	1.0	0.270
36	71.581	1.3171	78	51	0.5	530	0.6	0.177
37	73.433	1.2884	93	106	1.1	2262	2.5	0.363
38	73.580	1.2862	94	71	0.7	1481	1.6	0.355
39	75.681	1.2556	87	160	1.7	3251	3.6	0.345
40	77.615	1.2291	75	71	0.7	1610	1.8	0.385
41	77.827	1.2263	73	52	0.5	1268	1.4	0.415
42	79.329	1.2068	59	49	0.5	572	0.6	0.198

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Figure 8. Experimental Datas (D)

[1#.DAT] 5.000 134										Peak Search Report
SCAN: 5.02/79.9999/0.02/1(sec), Cu, I(max)=9462, 11-03-09 11:51										
PEAK: 21-pts/Parabolic Filter, Threshold=5.0, Cutoff=1.0%, BG=3/1.0, Peak-Top=Centroid Fit										
NOTE: Intensity = Counts, 2T(0)=0.0(°), Wavelength to Compute d-Spacing = 1.54056A(Cu/K-alpha1)										
#	2-Theta	d(A)	BG	Height	I%	Area	I%	FWHM		
1	8.709	10.1450	184	136	1.5	3269	3.6	0.409		
2	14.653	6.0401	97	65	0.7	984	1.1	0.257		
3	17.618	5.0297	98	106	1.2	1927	2.1	0.309		
4	19.693	4.5043	136	422	4.6	7365	8.0	0.297		
5	20.822	4.2625	153	1911	20.8	19596	21.3	0.174		
6	23.542	3.7758	172	142	1.5	3963	4.3	0.474		
7	24.254	3.6666	170	129	1.4	1209	1.3	0.159		
8	25.262	3.5225	172	253	2.8	5020	5.5	0.337		
9	25.581	3.4794	184	134	1.5	3174	3.5	0.403		
10	26.612	3.3469	265	9197	100.0	91793	100.0	0.170		
11	27.449	3.2466	303	574	6.2	6184	6.7	0.183		
12	27.894	3.1959	150	333	3.6	7468	8.1	0.381		
13	29.502	3.0252	149	77	0.8	1239	1.3	0.274		
14	30.804	2.9003	141	89	1.0	2445	2.7	0.467		
15	34.588	2.5911	150	176	1.9	4263	4.6	0.412		
16	36.533	2.4575	145	647	7.0	7995	8.7	0.210		
17	39.456	2.2819	153	474	5.2	4653	5.1	0.167		
18	39.966	2.2540	125	99	1.1	2210	2.4	0.379		
19	40.285	2.2369	150	329	3.6	3372	3.7	0.174		
20	41.793	2.1596	117	71	0.8	1044	1.1	0.250		
21	42.444	2.1280	111	466	5.1	5701	6.2	0.208		
22	45.805	1.9793	94	294	3.2	4610	5.0	0.267		
23	47.795	1.9015	76	61	0.7	1201	1.3	0.335		
24	48.073	1.8911	79	82	0.9	1688	1.8	0.350		
25	50.137	1.8180	85	1011	11.0	12991	14.2	0.218		
26	50.538	1.8045	80	82	0.9	2536	2.8	0.526		
27	54.876	1.6716	116	272	3.0	3802	4.1	0.238		
28	55.319	1.6593	100	142	1.5	3294	3.6	0.394		
29	59.952	1.5417	85	629	6.8	9312	10.1	0.252		
30	63.999	1.4536	93	127	1.4	2142	2.3	0.287		
31	67.748	1.3820	99	331	3.6	6038	6.6	0.310		
32	68.130	1.3752	92	672	7.3	20965	22.8	0.530		
33	73.441	1.2883	70	165	1.8	2764	3.0	0.285		
34	75.634	1.2563	68	203	2.2	3746	4.1	0.314		
35	77.625	1.2290	52	90	1.0	1858	2.0	0.351		

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Figure 9. Experimental Datas (E)