Phase Identification Exercise

Identify the phase that produced each of these powder diffraction patterns using the phase identification table

Place your identification in the table to the right

ID #	Phase
1	
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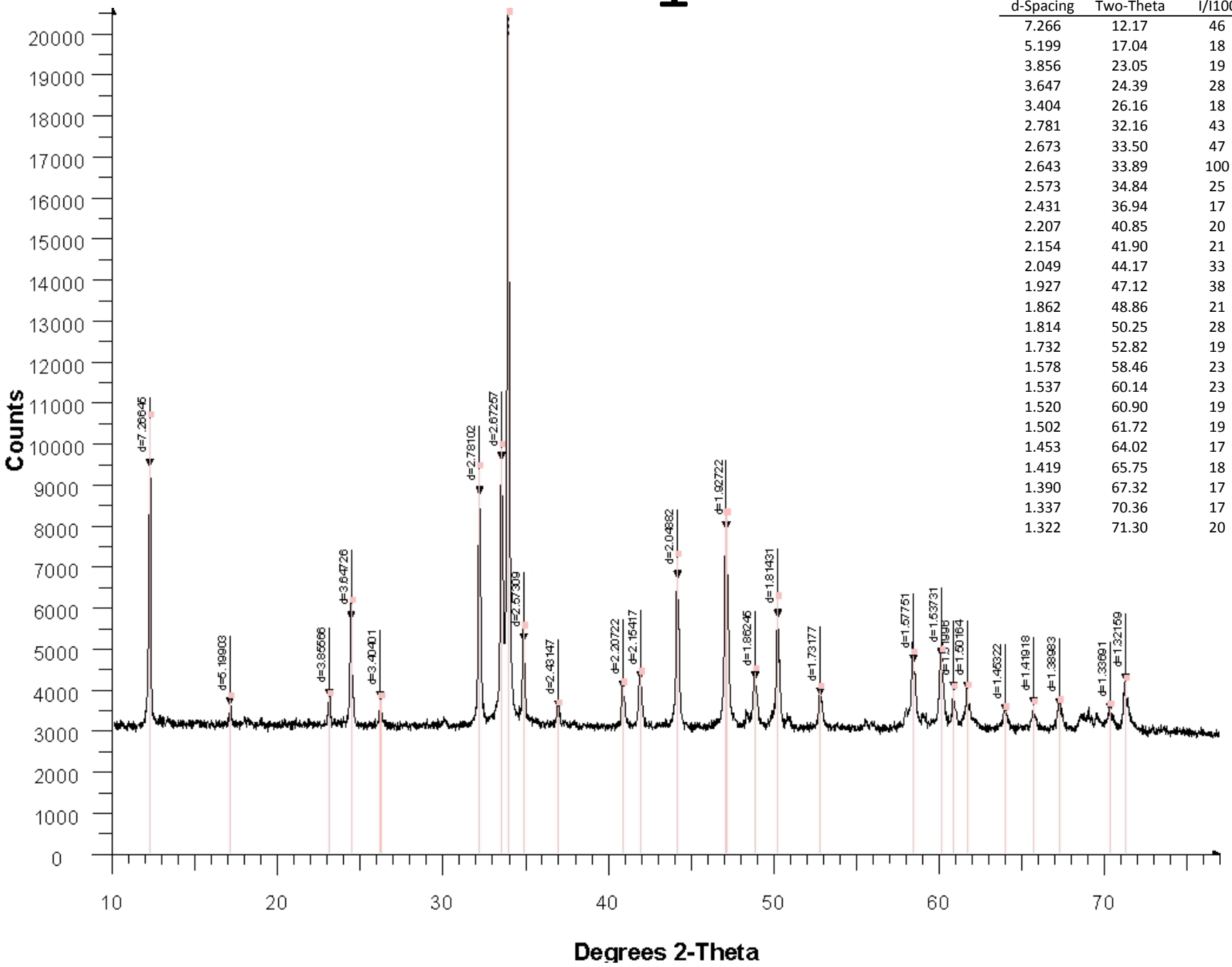
Key Lines for Cement Phase Identification using XRD

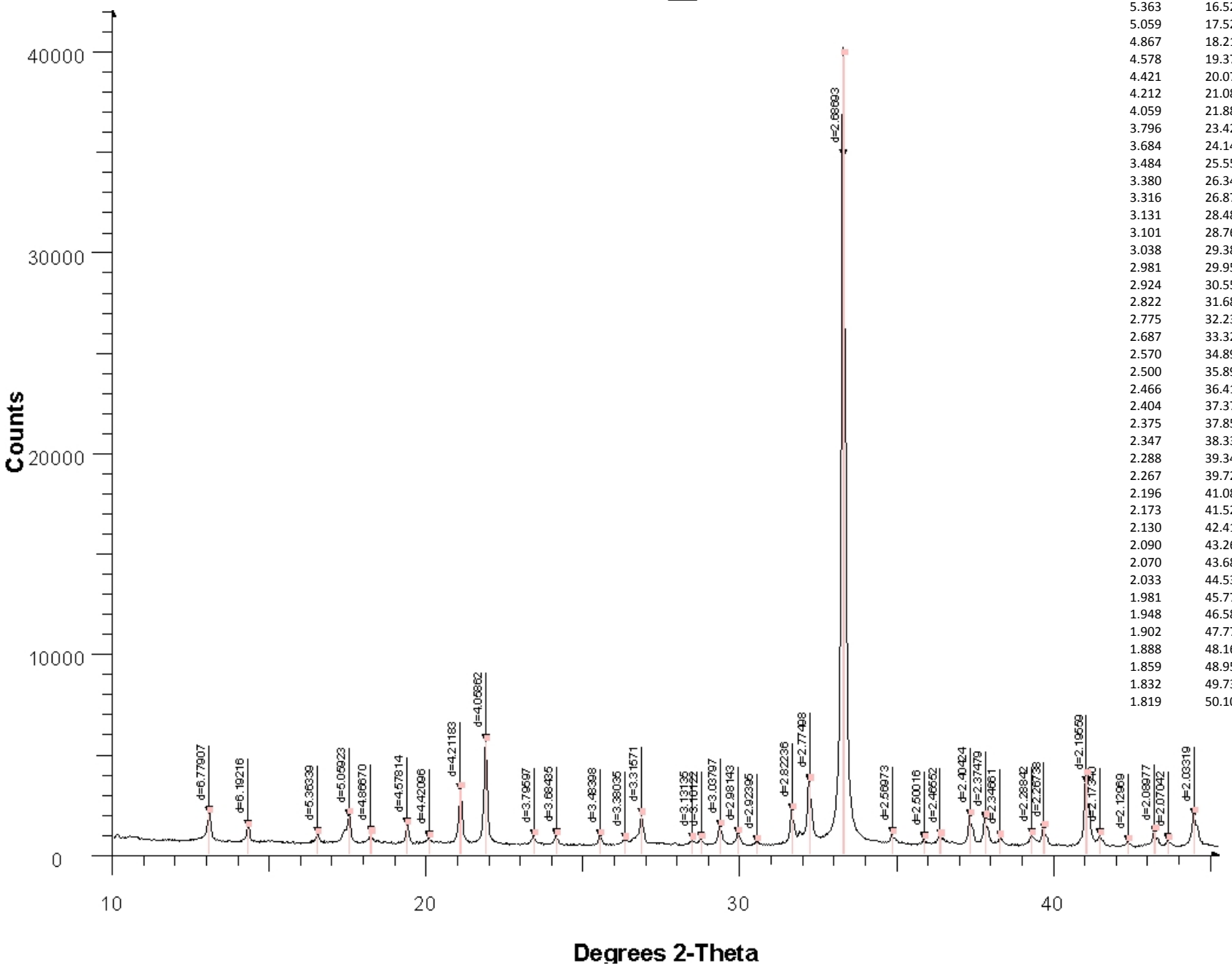
d-Spacing	Two-Theta	Phase
7.627	**11.593**	**gypsum (100)**
7.249	**12.200**	**C4AF (45)**
5.997	**14.759**	**bassanite (80)**
5.970	14.827	triclinic C3S (12)
5.953	14.869	triclinic C3S (12)
5.927	14.935	triclinic C3S (12)
5.927	14.935	mono. C3S (12)
5.610	15.784	γC2S (19)
5.107	17.350	C3Ao (10)
4.917	18.026	aphthitalite (10)
4.659	19.033	thenardite (71)
4.640	19.112	α´C2S (30)
4.316	20.561	γC2S (45)
4.284	**20.717**	**gypsum (100)**
4.253	20.869	langbeinite (30)
4.235	**20.959**	**C3Ac (6)**
4.222	21.024	langbeinite (25)
4.188	21.197	langbeinite (16)
4.175	**21.264**	**arcanite (28)**
4.158	**21.352**	**arcanite (23)**
4.091	21.706	aphthitalite (30)
4.079	**21.770**	**C3Ac (12)**
4.059	21.879	γ C2S (20)
3.900	22.783	αC2S (20)
3.886	22.866	triclinic C3S (10)
3.855	23.052	calcite (9)
3.838	23.156	thenardite (17)
3.817	23.285	γC2S (509)
3.810	23.328	α´C2S (30)
3.799	**23.397**	**gypsum (17)**
3.764	23.617	γC2S (119)
3.744	23.745	arcanite (18)
3.670	**24.231**	**aphthitalite (20)**
3.653	**24.346**	**C4AF (16)**
3.497	**25.450**	**anhydrite (100)**
3.468	**25.666**	**bassanite (40)**
3.462	25.711	langbeinite (12)
3.424	26.002	C3Ao (11)
3.385	26.307	arcanite (13)
3.379	26.354	γC2S (25)
3.370	26.426	α´C2S (30)
3.313	**26.889**	**langbeinite (95)**
3.271	**27.241**	**langbeinite (80)**
3.263	**27.309**	**langbeinite (80)**
3.225	**27.637**	**langbeinite (100)**
3.180	28.036	thenardite (52)
3.153	28.281	langbeinite (18)
3.114	28.643	langbeinite (18)
3.077	28.995	thenardite (55)
3.065	**29.111**	**gypsum (75)**
3.056	29.198	triclinic C3S (60)
3.045	29.306	bassanite (10)
3.038	29.375	M1 C3S (50)
3.036	29.400	calcite (100)
3.036	**29.395**	**mono C3S (40)**
3.034	**29.415**	**m1 C3S (50)**
3.025	**29.504**	**triclinic C3S (65)**
3.025	**29.504**	**mono C3S (75)**
3.011	29.645	γC2S (80)
3.002	**29.736**	**bassanite (80)**
3.000	**29.756**	**arcanite (77)**
2.985	**29.909**	**triclinic C3S (25)**
2.974	**30.022**	**triclinic C3S (18)**
2.972	30.043	M1 C3S (20)
2.968	30.084	mono C3S (12)
2.968	30.084	M1 C3S (20)
2.965	**30.115**	**triclinic C3S (20)**
2.961	**30.157**	**mono C3S (25)**
2.940	**30.378**	**aphthitalite (75)**
2.902	**30.785**	**arcanite (100)**
2.894	30.872	γC2S (25)
2.886	**30.960**	**arcanite (53)**
2.880	**31.026**	**langbeinite (18)**
2.876	**31.070**	**βC2S (21)**
2.872	31.115	gypsum (45)
2.870	31.137	α´C2S (30)
2.850	31.361	anhydrite (29)
2.843	31.440	calcite (2)
2.838	**31.497**	**aphthitalite (100)**
2.813	31.784	βC2S (22)
2.813	31.784	bassanite (100)
2.810	31.819	αC2S (80)
2.790	32.053	βC2S (97)
2.788	32.077	triclinic C3S (100)
2.788	32.077	gypsum (10)
2.786	32.101	langbeinite (45)
2.784	**32.124**	**C4AF (25)**
2.784	32.124	thenardite (100)
2.782	32.148	βC2S (100)
2.776	32.220	free lime (36)
2.775	32.231	M1 C3S (100)
2.775	32.231	langbeinite (50)
2.773	32.255	mono C3S (85)
2.767	32.327	triclinic C3S (70)
2.754	32.484	triclinic C3S (65)
2.750	32.533	γC2S (70)
2.750	32.533	langbeinite (45)
2.747	32.569	mono C3S (45)
2.747	32.569	M1 C3S (40)
2.745	32.593	βC2S (83)
2.743	32.618	M1 C3S (60)
2.743	32.618	langbeinite (45)
2.740	32.655	α´C2S (100)
2.737	32.691	mono C3S (75)
2.736	32.704	triclinic C3S (60)
2.717	32.939	βC2S (30)
2.714	**32.976**	**C3Ao (65)**
2.714	32.976	bassanite (10)
2.710	**33.026**	**αC2S (100)**
2.698	**33.178**	**C3Ac (100)**
2.692	**33.254**	**C3Ao (100)**
2.684	33.356	gypsum (35)
2.680	33.407	α´C2S (75)
2.673	33.497	C4AF (35)
2.647	33.836	thenardite (52)
2.644	**33.875**	**C4AF (100)**
2.618	34.222	triclinic C3S (60)
2.612	34.303	triclinic C3S (90)
2.610	**34.330**	**βC2S (42)**
2.607	34.371	M1 C3S (70)
2.605	34.398	M1 C3S (80)
2.603	34.425	mono C3S (100)
2.590	34.604	γC2S (14)
2.576	34.798	C4AF(17)
2.517	35.640	arcanite (13)
2.514	35.684	γC2S (25)
2.499	35.906	arcanite (15)
2.495	35.968	calcite (15)
2.494	35.980	gypsum (11)
2.458	36.526	triclinic C3S (12)
2.458	36.526	aphthitalite (10)
2.455	36.572	γC2S (17)
2.448	36.680	βC2S (12)
2.442	36.774	aphthitalite (16)
2.430	36.962	periclase (10)
2.422	37.088	arcanite (25)
2.409	37.296	βC2S (13)
2.405	**37.360**	**free lime (100)**
2.402	37.408	βC2S (18)
2.385	37.685	arcanite (13)
2.374	37.866	arcanite (17)
2.360	38.100	α´C2S (30)
2.339	38.455	triclinic C3S (15)
2.329	38.627	triclinic C3S (20)
2.329	38.627	thenardite (25)
2.329	38.627	aphthitalite (14)
2.328	38.644	anhydrite (20
2.325	38.696	γC2S (10)
2.323	38.725	M1 C3S (10)
2.319	38.800	M1 C3S (20)
2.315	38.870	triclinic C3S (25)
2.315	38.870	mono C3S (20)
2.285	39.408	calcite (20)
2.280	39.491	βC2S (22)
2.280	39.491	triclinic C3S (11)
2.270	39.672	α´C2S (10)
2.268	39.709	bassanite (10)
2.230	40.415	α´C2S (30)
2.220	40.605	αC2S (40)
2.218	40.643	gypsum (15)
2.209	40.816	anhydrite (20)
2.205	40.893	C3Ao (20)
2.205	40.893	arcanite (14)
2.203	40.932	C3Ac (10)
2.196	41.068	langbeinite (12)
2.195	41.088	triclinic C3S (75)
2.189	41.206	βC2S (51)
2.184	41.304	M1 C3S (40)
2.181	41.364	mono C3S (60)
2.180	41.383	α´C2S (30)
2.179	41.403	triclinic C3S (17)
2.179	41.403	M1 C3S (40)
2.171	41.563	triclinic C3S (11)
2.169	41.603	M1 C3S (10)
2.166	41.663	M1 C3S (10)
2.164	41.704	βC2S (13)
2.164	41.704	mono C3S (15)
2.163	41.724	triclinic C3S (11)
2.162	41.744	M1 C3S (10)
2.136	42.276	bassanite (20)
2.109	42.844	langbeinite (18)
2.105	**42.930**	**periclase (100)**
2.094	43.157	calcite (15)
2.093	43.188	langbeinite (20)
2.088	43.297	arcanite (25)
2.085	43.362	gypsum (25)
2.082	43.428	arcanite (25)
2.073	43.626	gypsum (15)
2.051	44.118	C4AF(35)
2.050	44.141	βC2S (14)
2.041	44.346	aphthitalite (45)
2.036	44.461	langbeinite (14)
2.026	44.692	βC2S (15)
2.024	44.738	γC2S (13)
2.020	44.832	α´C2S (30)
2.019	44.855	βC2S (15)
2.017	44.902	langbeinite (20)
2.009	45.091	langbeinite (14)
1.994	45.449	triclinic C3S (10)
1.982	45.740	M1 C3S (10)
1.981	45.764	βC2S (20)
1.973	45.960	mono C3S (10)
1.940	46.788	αc2s (60)
1.937	46.865	M1 C3S (10)
1.933	46.968	M1 C3S (10)
1.930	47.045	α´C2S (30)
1.930	47.045	mono C3S (13)
1.928	47.097	C4AF(35)

1

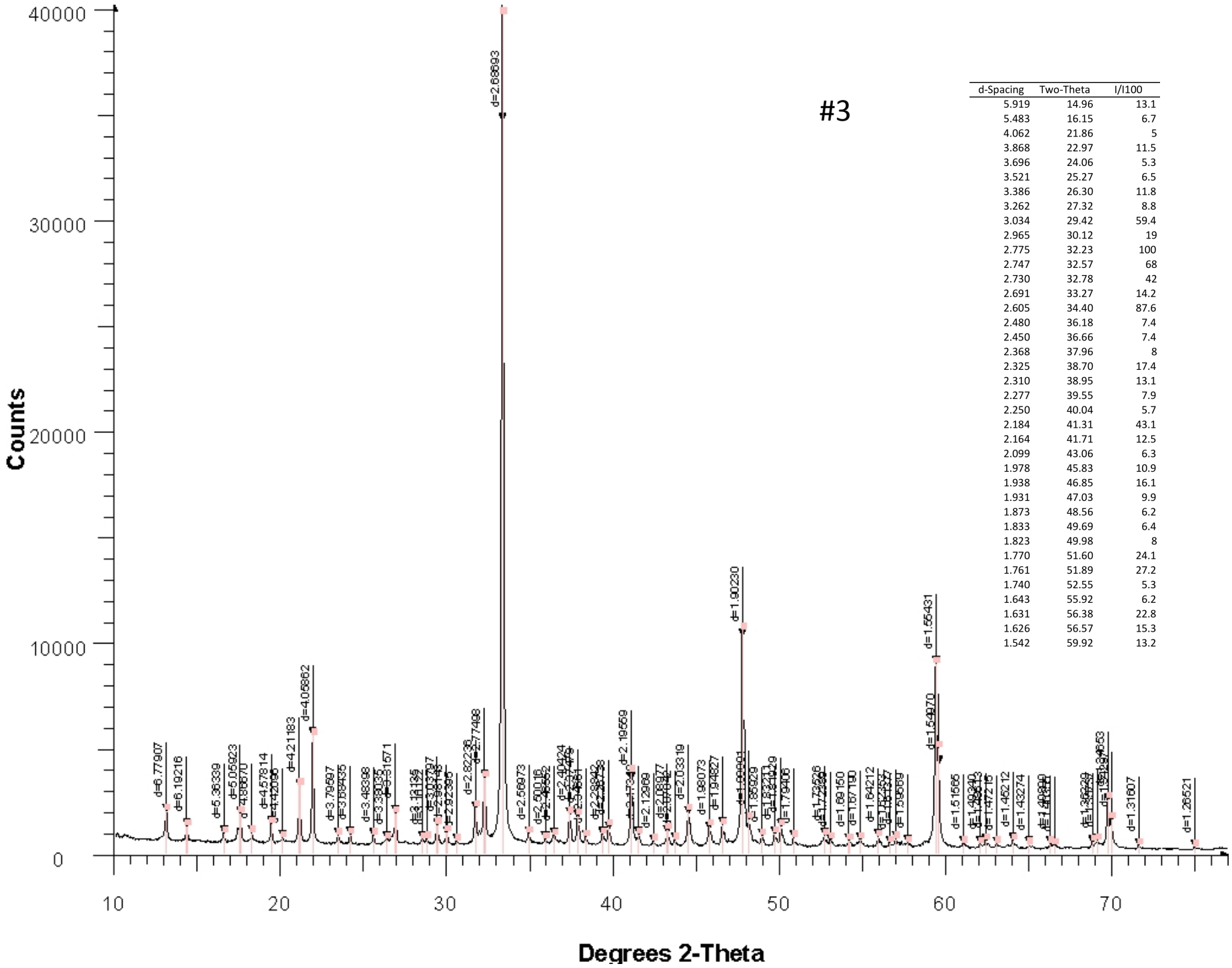


d-Spacing	Two-Theta	I/I100
7.266	12.17	46
5.199	17.04	18
3.856	23.05	19
3.647	24.39	28
3.404	26.16	18
2.781	32.16	43
2.673	33.50	47
2.643	33.89	100
2.573	34.84	25
2.431	36.94	17
2.207	40.85	20
2.154	41.90	21
2.049	44.17	33
1.927	47.12	38
1.862	48.86	21
1.814	50.25	28
1.732	52.82	19
1.578	58.46	23
1.537	60.14	23
1.520	60.90	19
1.502	61.72	19
1.453	64.02	17
1.419	65.75	18
1.390	67.32	17
1.337	70.36	17
1.322	71.30	20

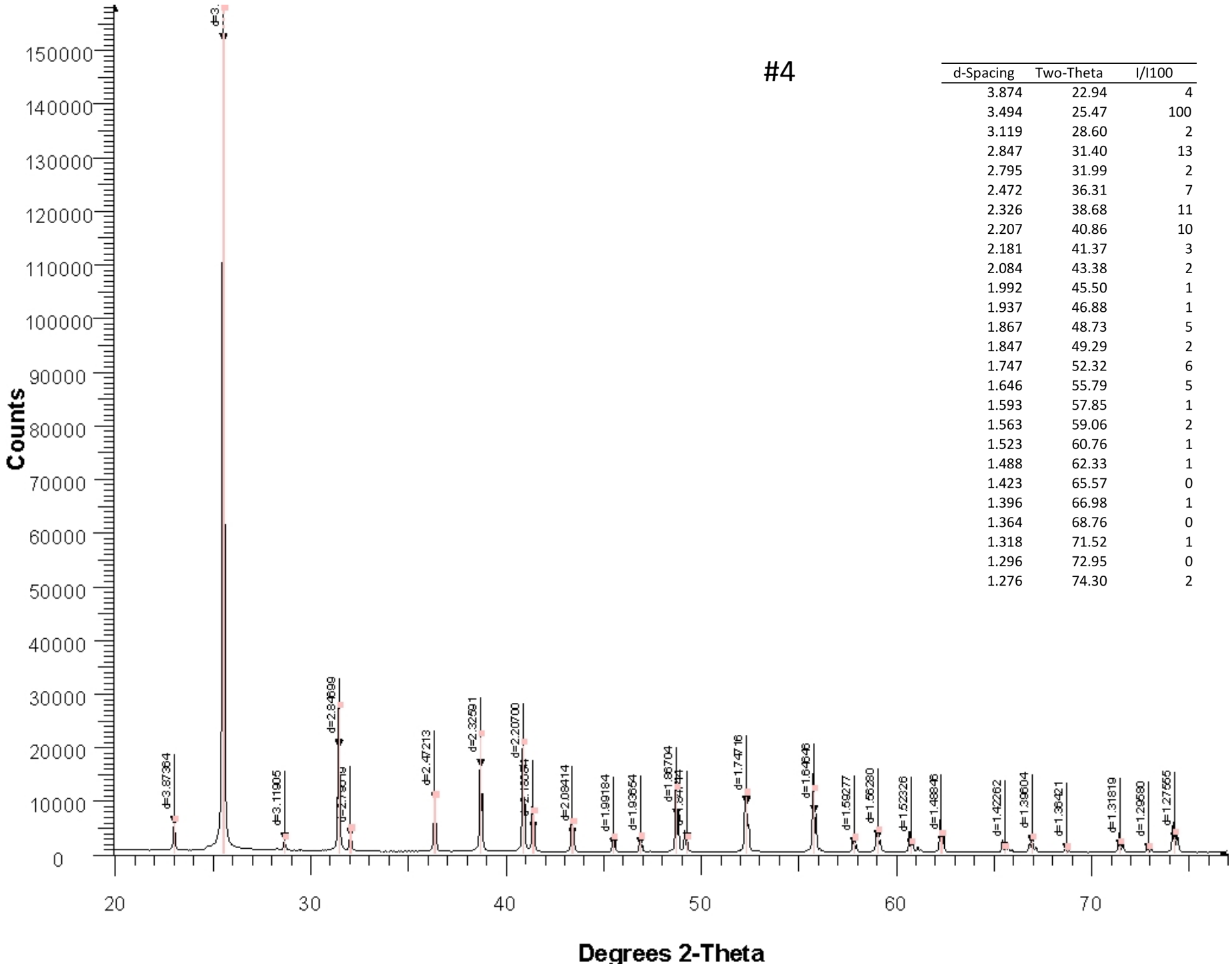
2



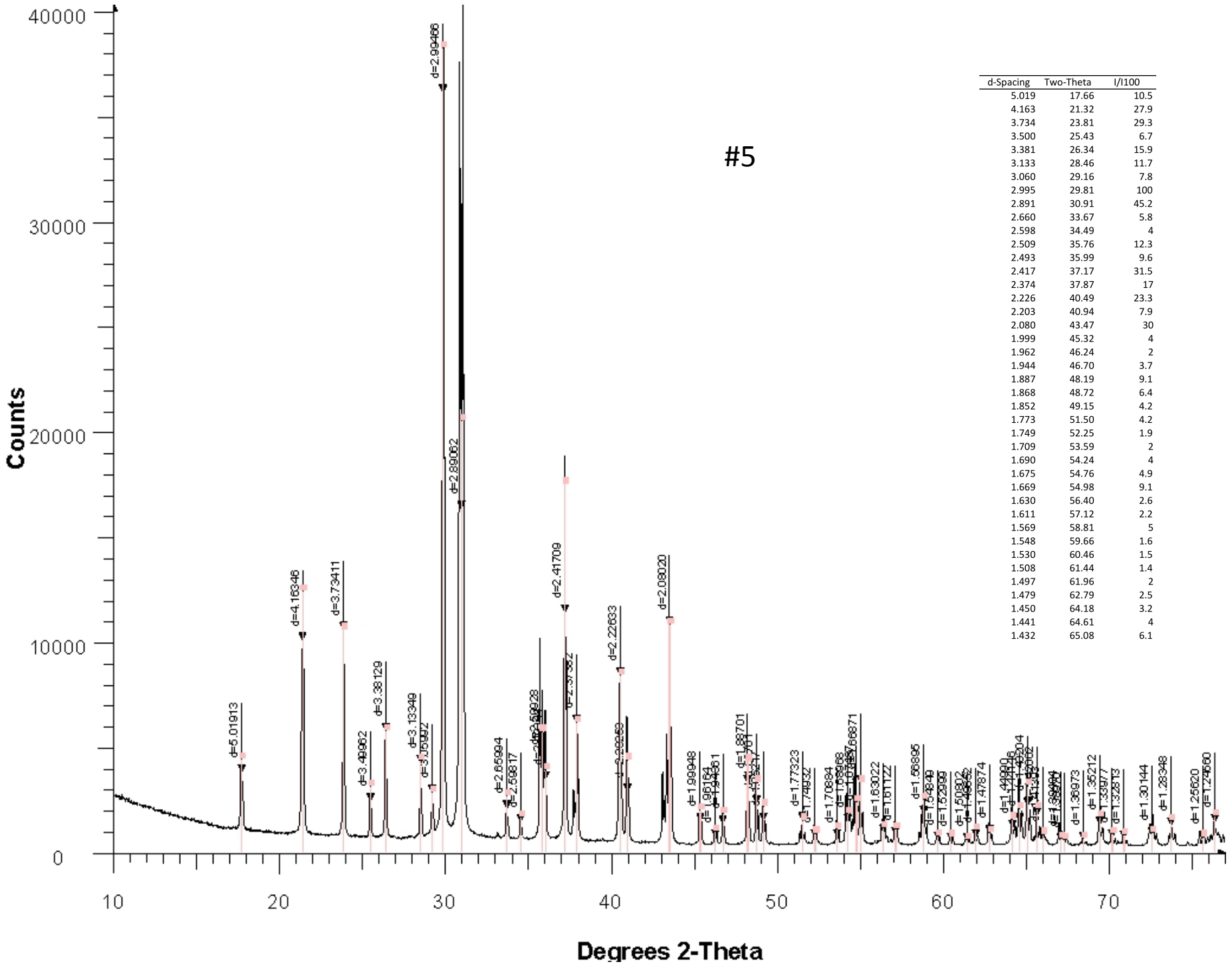
d-Spacing	Two-Theta	Rel I
6.779	13.05	6
6.192	14.29	4
5.363	16.52	3
5.059	17.52	5
4.867	18.21	3
4.578	19.37	4
4.421	20.07	2
4.212	21.08	9
4.059	21.88	16
3.796	23.42	3
3.684	24.14	3
3.484	25.55	2
3.380	26.34	2
3.316	26.87	6
3.131	28.48	2
3.101	28.76	2
3.038	29.38	4
2.981	29.95	3
2.924	30.55	2
2.822	31.68	6
2.775	32.23	10
2.687	33.32	100
2.570	34.89	3
2.500	35.89	2
2.466	36.41	3
2.404	37.37	5
2.375	37.85	5
2.347	38.33	2
2.288	39.34	3
2.267	39.72	3
2.196	41.08	10
2.173	41.52	3
2.130	42.41	2
2.090	43.26	3
2.070	43.68	2
2.033	44.53	6
1.981	45.77	3
1.948	46.58	4
1.902	47.77	30
1.888	48.16	5
1.859	48.95	2
1.832	49.73	3
1.819	50.10	4



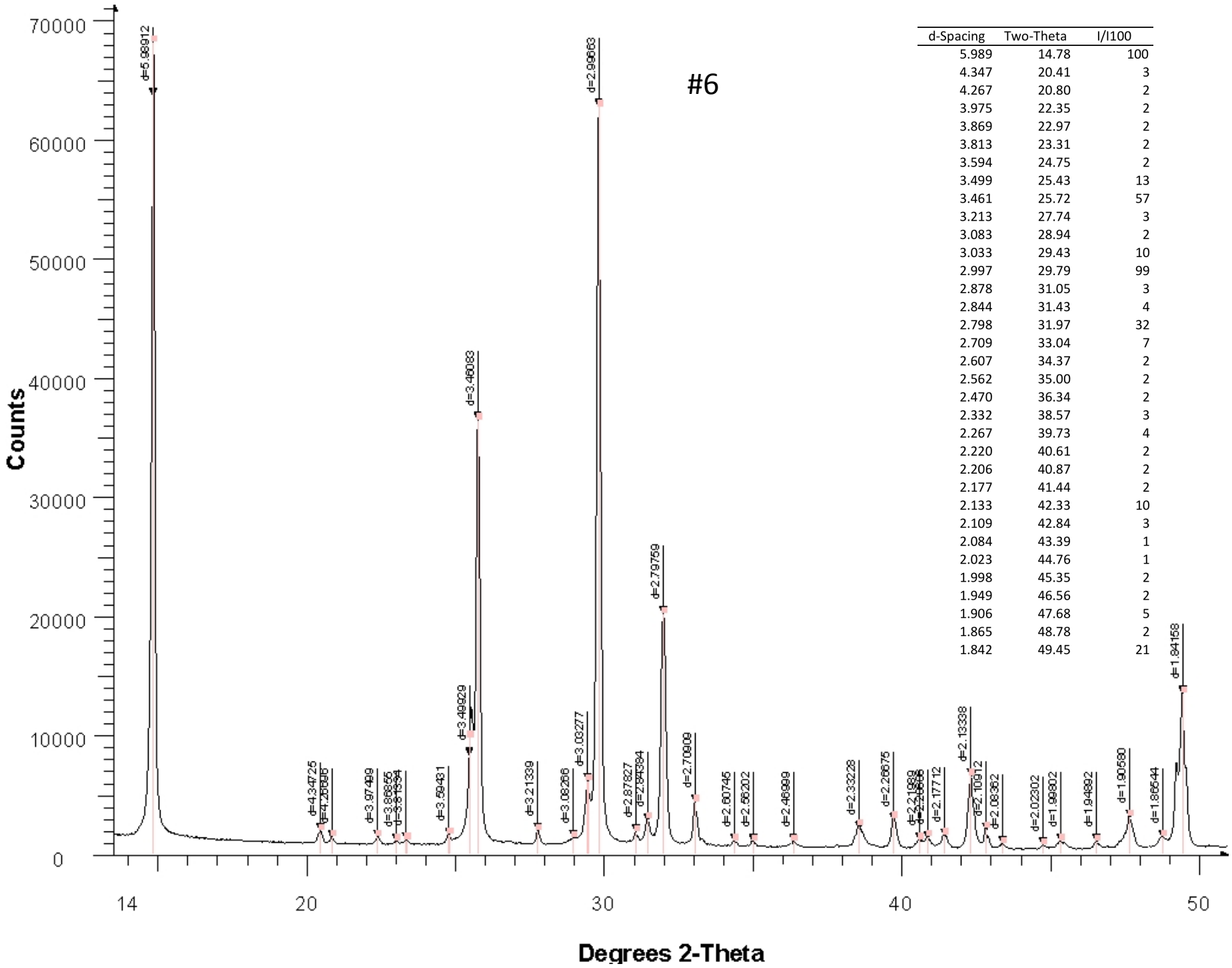
d-Spacing	Two-Theta	I/I100
5.919	14.96	13.1
5.483	16.15	6.7
4.062	21.86	5
3.868	22.97	11.5
3.696	24.06	5.3
3.521	25.27	6.5
3.386	26.30	11.8
3.262	27.32	8.8
3.034	29.42	59.4
2.965	30.12	19
2.775	32.23	100
2.747	32.57	68
2.730	32.78	42
2.691	33.27	14.2
2.605	34.40	87.6
2.480	36.18	7.4
2.450	36.66	7.4
2.368	37.96	8
2.325	38.70	17.4
2.310	38.95	13.1
2.277	39.55	7.9
2.250	40.04	5.7
2.184	41.31	43.1
2.164	41.71	12.5
2.099	43.06	6.3
1.978	45.83	10.9
1.938	46.85	16.1
1.931	47.03	9.9
1.873	48.56	6.2
1.833	49.69	6.4
1.823	49.98	8
1.770	51.60	24.1
1.761	51.89	27.2
1.740	52.55	5.3
1.643	55.92	6.2
1.631	56.38	22.8
1.626	56.57	15.3
1.542	59.92	13.2



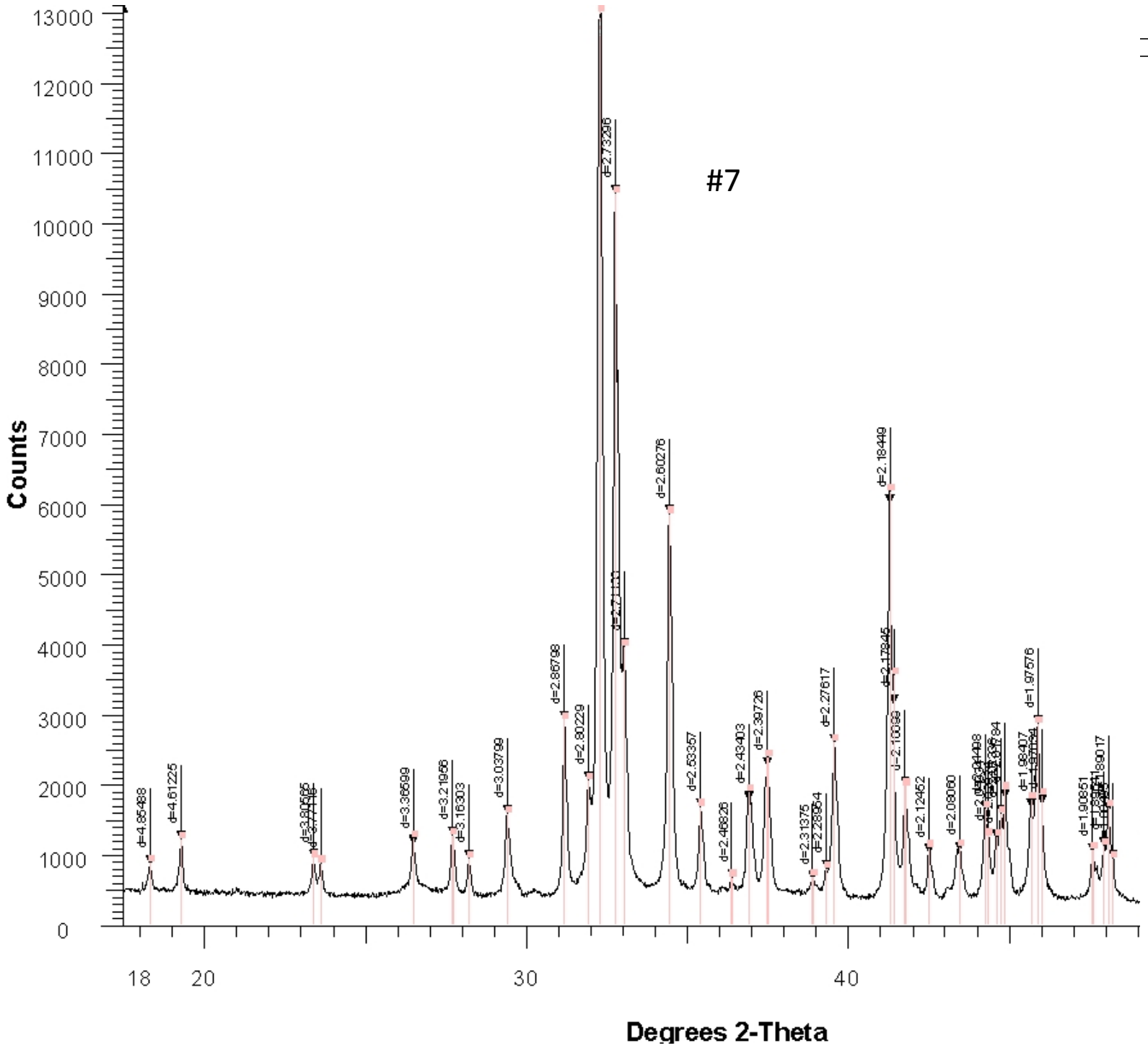
d-Spacing	Two-Theta	I/I100
3.874	22.94	4
3.494	25.47	100
3.119	28.60	2
2.847	31.40	13
2.795	31.99	2
2.472	36.31	7
2.326	38.68	11
2.207	40.86	10
2.181	41.37	3
2.084	43.38	2
1.992	45.50	1
1.937	46.88	1
1.867	48.73	5
1.847	49.29	2
1.747	52.32	6
1.646	55.79	5
1.593	57.85	1
1.563	59.06	2
1.523	60.76	1
1.488	62.33	1
1.423	65.57	0
1.396	66.98	1
1.364	68.76	0
1.318	71.52	1
1.296	72.95	0
1.276	74.30	2



d-Spacing	Two-Theta	I/I100
5.019	17.66	10.5
4.163	21.32	27.9
3.734	23.81	29.3
3.500	25.43	6.7
3.381	26.34	15.9
3.133	28.46	11.7
3.060	29.16	7.8
2.995	29.81	100
2.891	30.91	45.2
2.660	33.67	5.8
2.598	34.49	4
2.509	35.76	12.3
2.493	35.99	9.6
2.417	37.17	31.5
2.374	37.87	17
2.226	40.49	23.3
2.203	40.94	7.9
2.080	43.47	30
1.999	45.32	4
1.962	46.24	2
1.944	46.70	3.7
1.887	48.19	9.1
1.868	48.72	6.4
1.852	49.15	4.2
1.773	51.50	4.2
1.749	52.25	1.9
1.709	53.59	2
1.690	54.24	4
1.675	54.76	4.9
1.669	54.98	9.1
1.630	56.40	2.6
1.611	57.12	2.2
1.569	58.81	5
1.548	59.66	1.6
1.530	60.46	1.5
1.508	61.44	1.4
1.497	61.96	2
1.479	62.79	2.5
1.450	64.18	3.2
1.441	64.61	4
1.432	65.08	6.1



d-Spacing	Two-Theta	I/I100
5.989	14.78	100
4.347	20.41	3
4.267	20.80	2
3.975	22.35	2
3.869	22.97	2
3.813	23.31	2
3.594	24.75	2
3.499	25.43	13
3.461	25.72	57
3.213	27.74	3
3.083	28.94	2
3.033	29.43	10
2.997	29.79	99
2.878	31.05	3
2.844	31.43	4
2.798	31.97	32
2.709	33.04	7
2.607	34.37	2
2.562	35.00	2
2.470	36.34	2
2.332	38.57	3
2.267	39.73	4
2.220	40.61	2
2.206	40.87	2
2.177	41.44	2
2.133	42.33	10
2.109	42.84	3
2.084	43.39	1
2.023	44.76	1
1.998	45.35	2
1.949	46.56	2
1.906	47.68	5
1.865	48.78	2
1.842	49.45	21



d-Spacing	Two-Theta	I/I100
4.855	18.26	7
4.612	19.23	9
3.806	23.36	7
3.771	23.57	7
3.366	26.46	9
3.220	27.69	10
3.163	28.19	7
3.038	29.38	12
2.868	31.16	22
2.802	31.91	16
2.772	32.27	100
2.733	32.74	80
2.711	33.01	30
2.603	34.43	45
2.534	35.40	13
2.468	36.37	5
2.434	36.90	14
2.397	37.49	17
2.314	38.89	5
2.290	39.32	6
2.276	39.56	20
2.184	41.30	46
2.178	41.42	24
2.161	41.77	15
2.125	42.52	8
2.081	43.46	8
2.045	44.26	13
2.040	44.36	10
2.029	44.62	9
2.023	44.75	12
2.018	44.88	14
1.984	45.69	13
1.976	45.89	22
1.970	46.03	13
1.909	47.61	8
1.895	47.96	9
1.890	48.10	12
1.885	48.24	7
1.837	49.59	5
1.817	50.15	5
1.800	50.67	9
1.796	50.79	9
1.786	51.10	8
1.782	51.24	6
1.762	51.86	5
1.757	51.99	5
1.723	53.10	6
1.719	53.26	5
1.705	53.72	10
1.701	53.87	7
1.694	54.11	5
1.688	54.29	6
1.683	54.47	4
1.660	55.28	3

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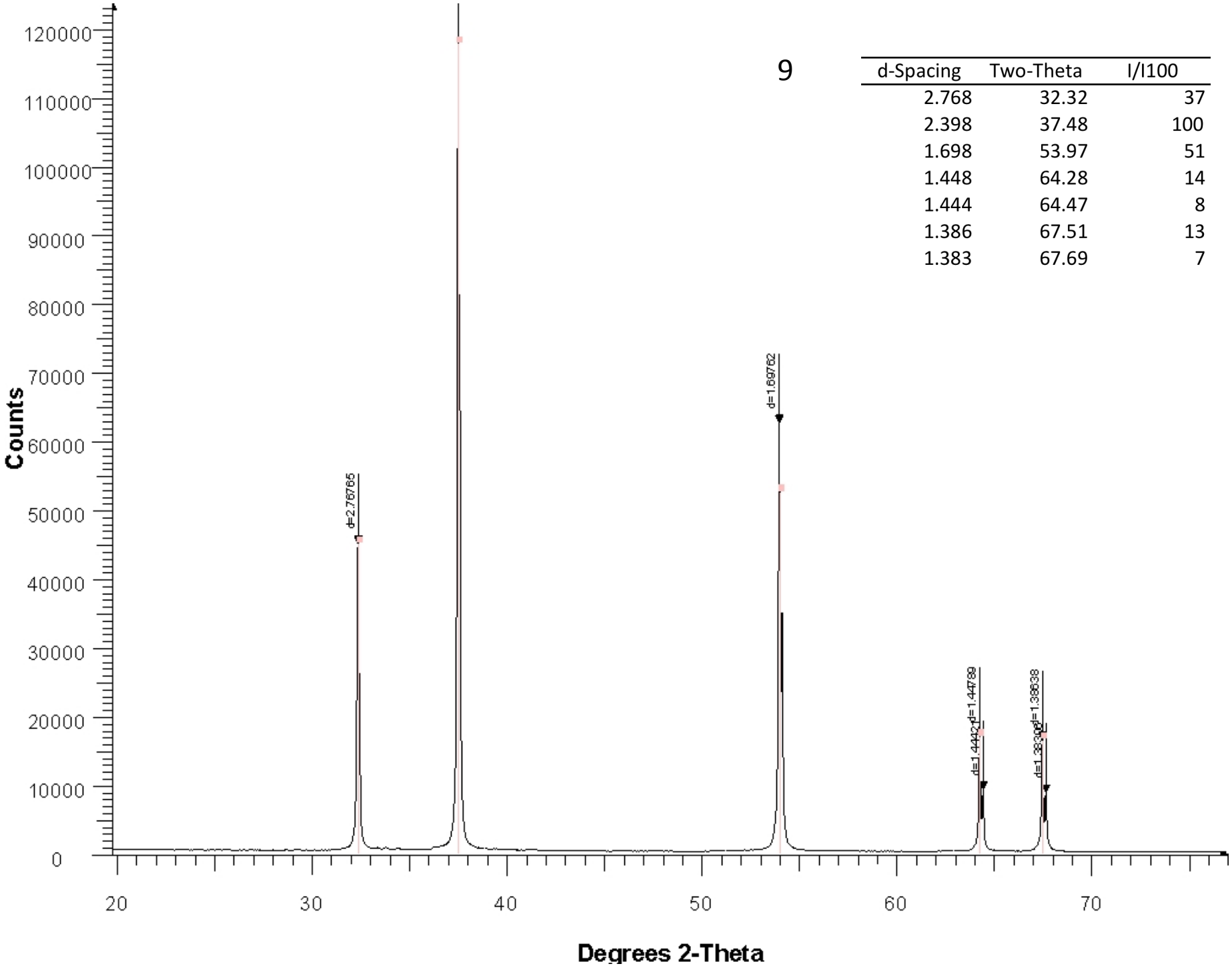

d-Spacing	Two-Theta	I/I100
2.768	32.32	37
2.398	37.48	100
1.698	53.97	51
1.448	64.28	14
1.444	64.47	8
1.386	67.51	13
1.383	67.69	7

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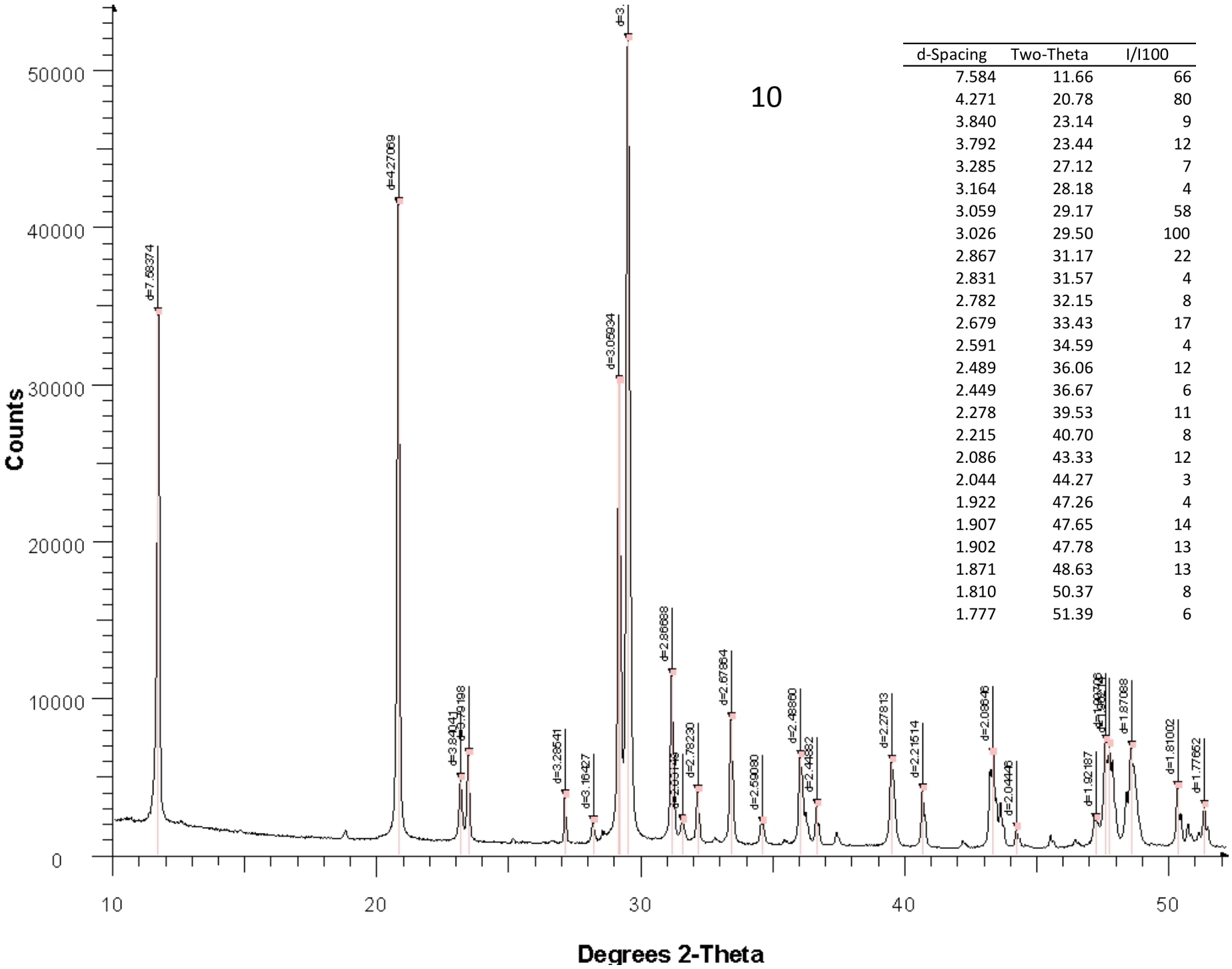
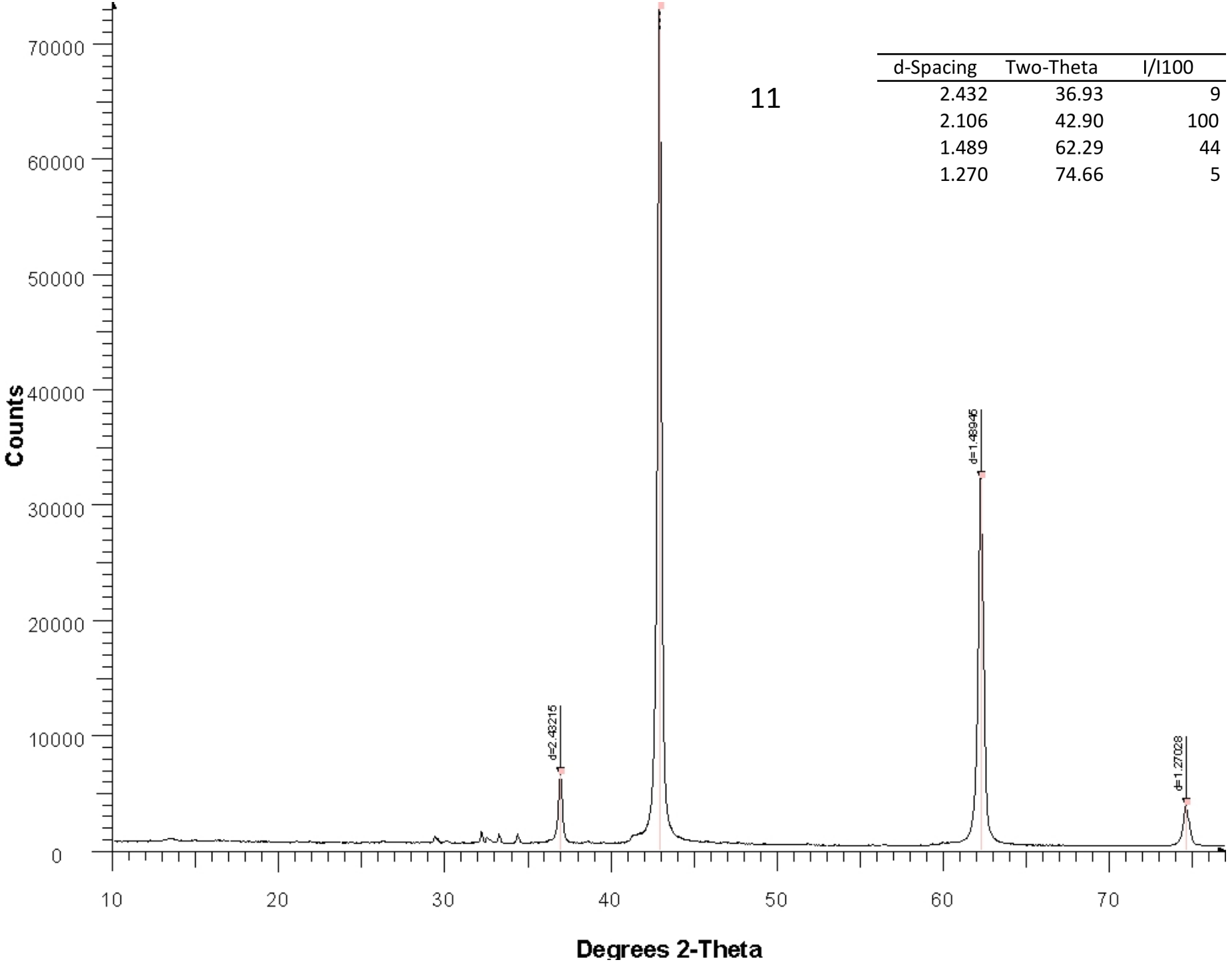
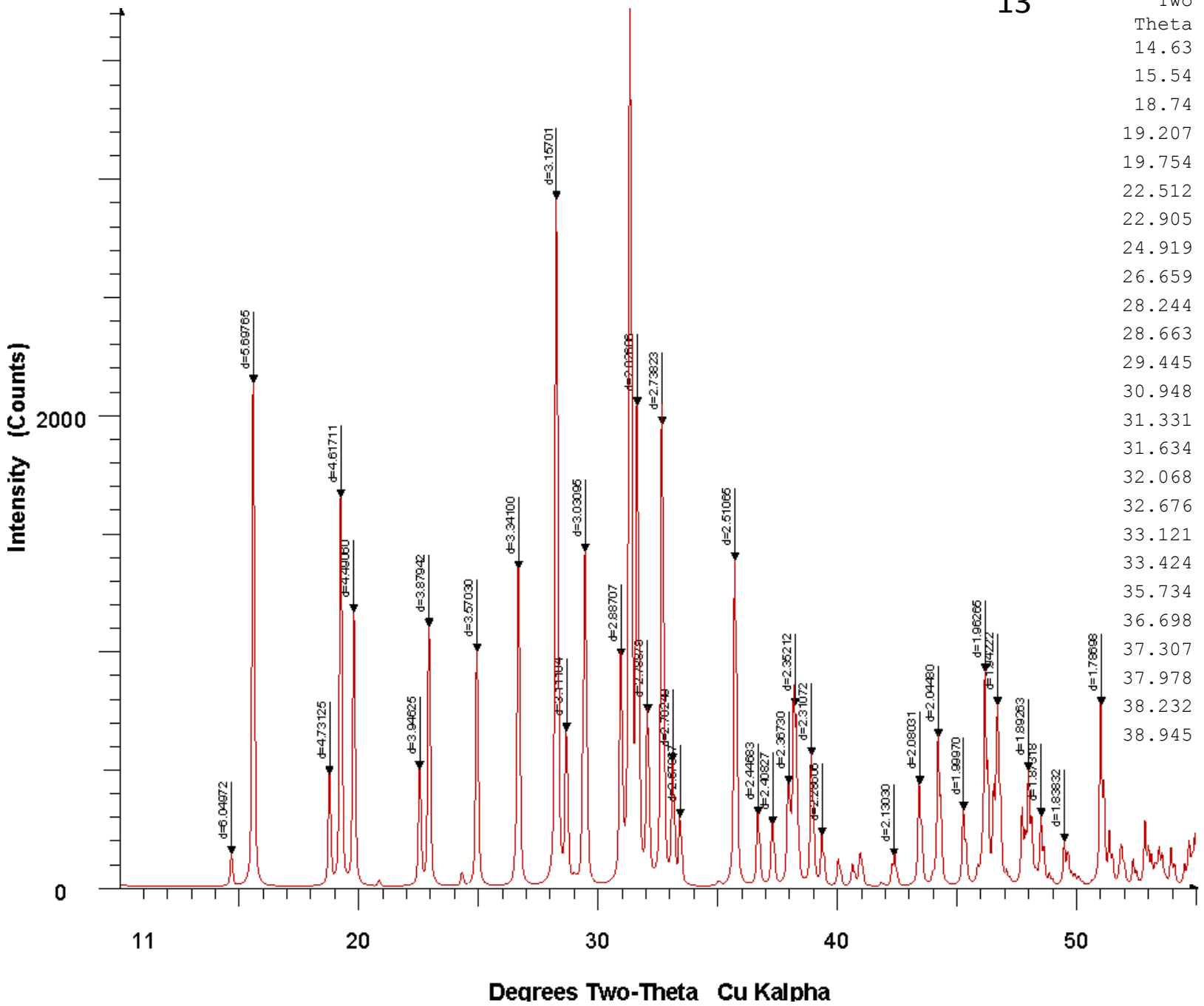


d-Spacing	Two-Theta	I/I100
7.584	11.66	66
4.271	20.78	80
3.840	23.14	9
3.792	23.44	12
3.285	27.12	7
3.164	28.18	4
3.059	29.17	58
3.026	29.50	100
2.867	31.17	22
2.831	31.57	4
2.782	32.15	8
2.679	33.43	17
2.591	34.59	4
2.489	36.06	12
2.449	36.67	6
2.278	39.53	11
2.215	40.70	8
2.086	43.33	12
2.044	44.27	3
1.922	47.26	4
1.907	47.65	14
1.902	47.78	13
1.871	48.63	13
1.810	50.37	8
1.777	51.39	6

11

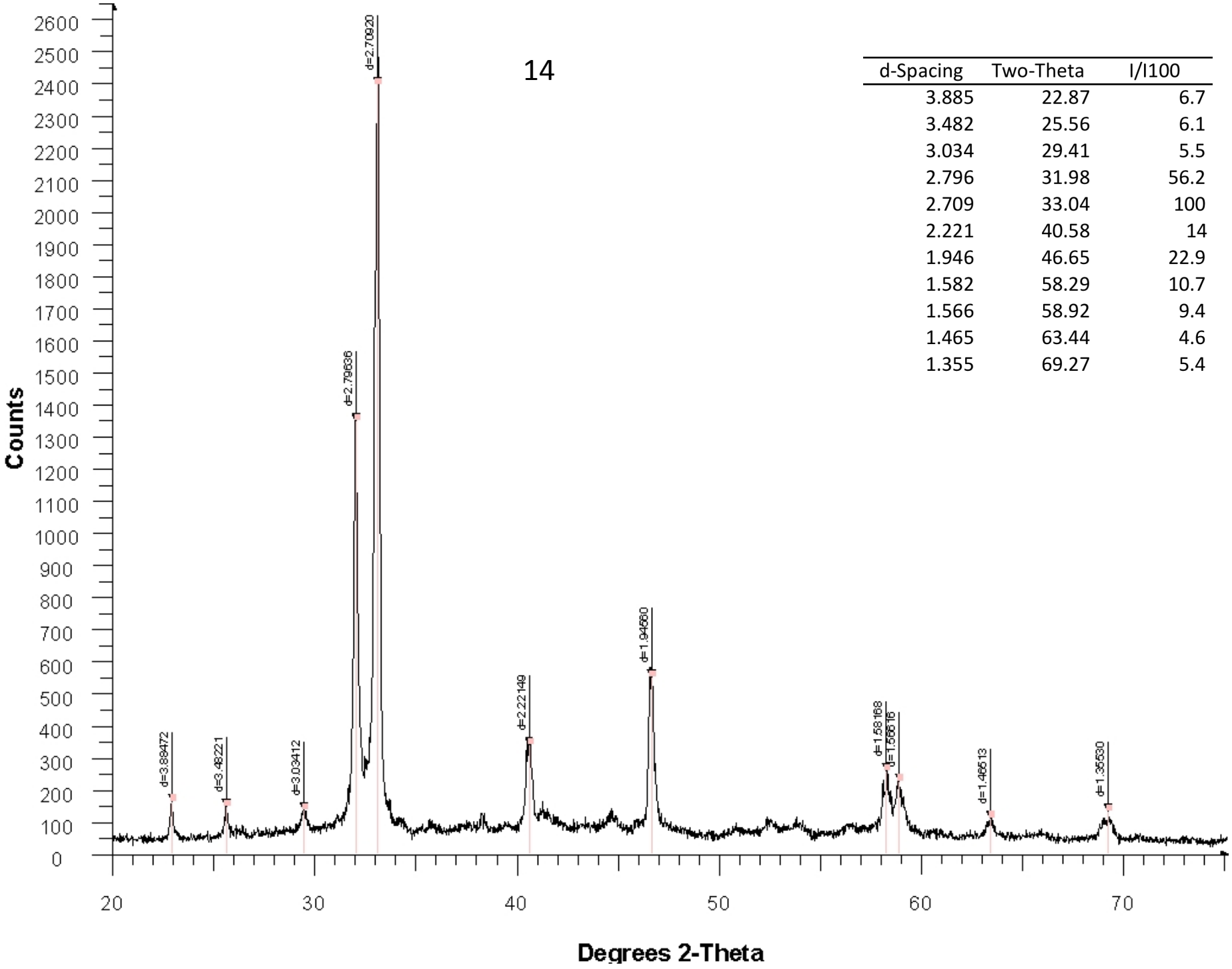
d-Spacing	Two-Theta	I/I100
2.432	36.93	9
2.106	42.90	100
1.489	62.29	44
1.270	74.66	5





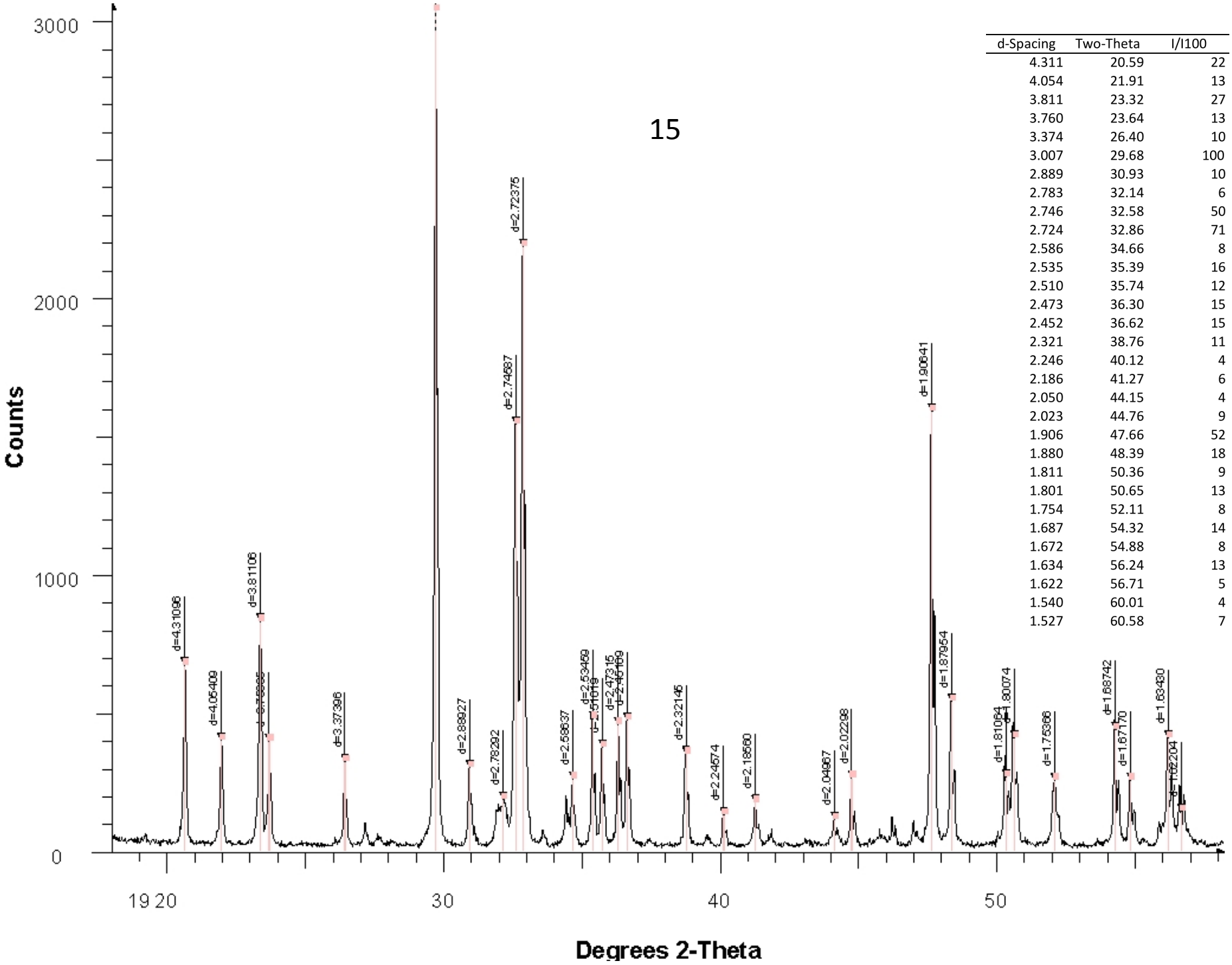
Two Theta	d-spacing	Rel I
14.63	6.050	4
15.54	5.698	57
18.74	4.731	13
19.207	4.617	44
19.754	4.491	31
22.512	3.946	13
22.905	3.879	30
24.919	3.570	27
26.659	3.341	36
28.244	3.157	78
28.663	3.112	18
29.445	3.031	38
30.948	2.887	26
31.331	2.853	100
31.634	2.826	55
32.068	2.789	20
32.676	2.738	53
33.121	2.702	14
33.424	2.679	8
35.734	2.511	37
36.698	2.447	8
37.307	2.408	7
37.978	2.367	12
38.232	2.352	21
38.945	2.311	15

14

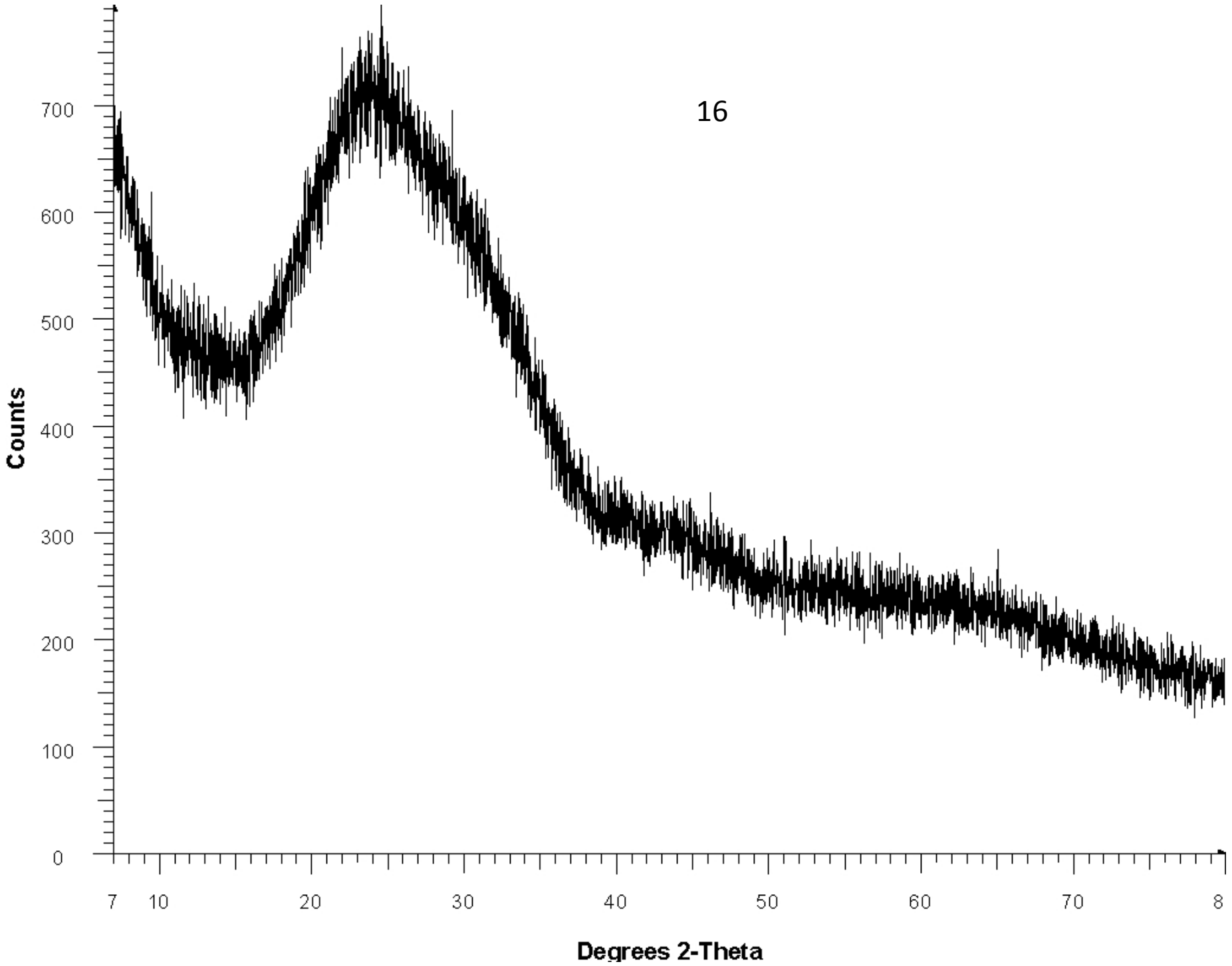


d-Spacing	Two-Theta	I/I100
3.885	22.87	6.7
3.482	25.56	6.1
3.034	29.41	5.5
2.796	31.98	56.2
2.709	33.04	100
2.221	40.58	14
1.946	46.65	22.9
1.582	58.29	10.7
1.566	58.92	9.4
1.465	63.44	4.6
1.355	69.27	5.4

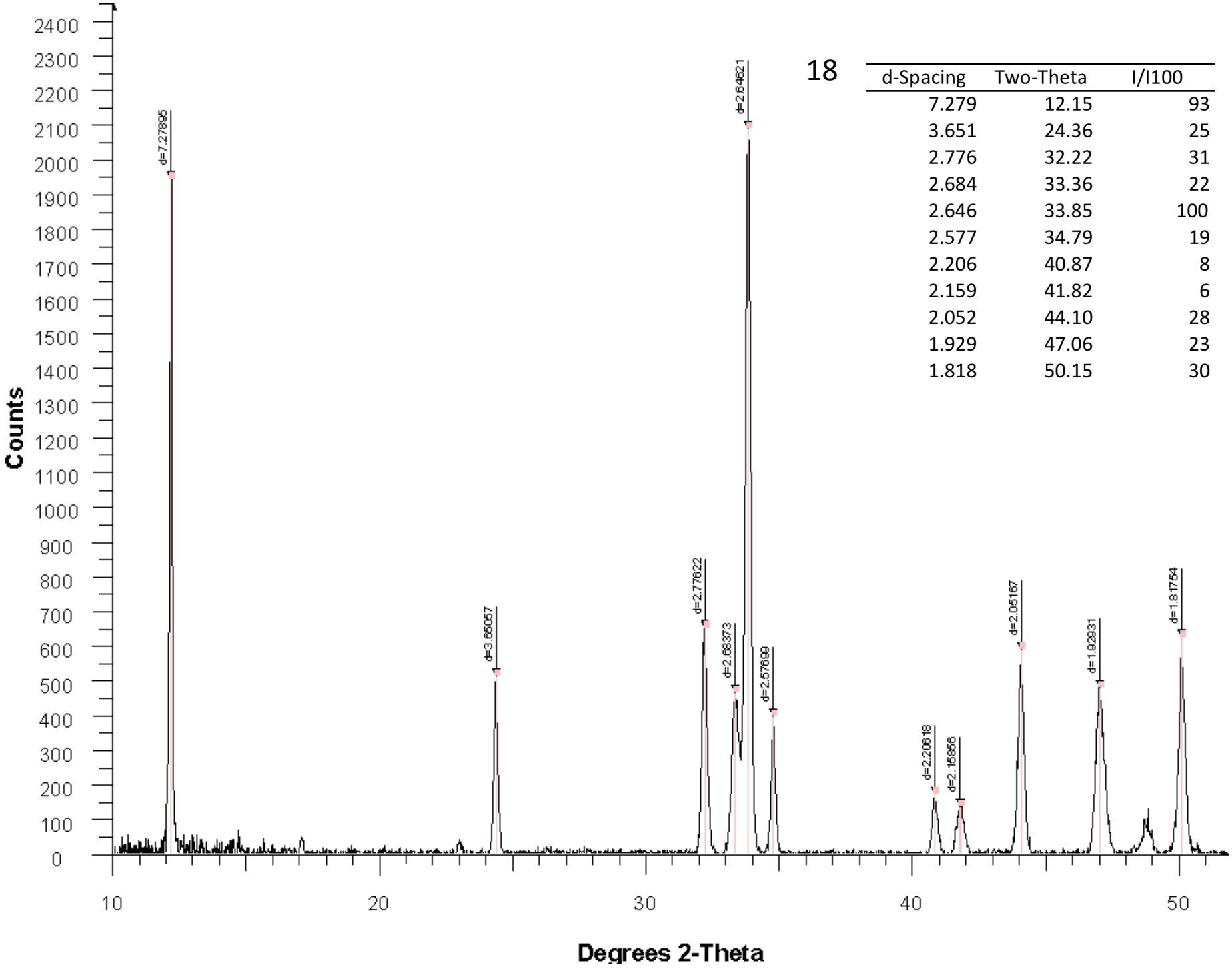
15



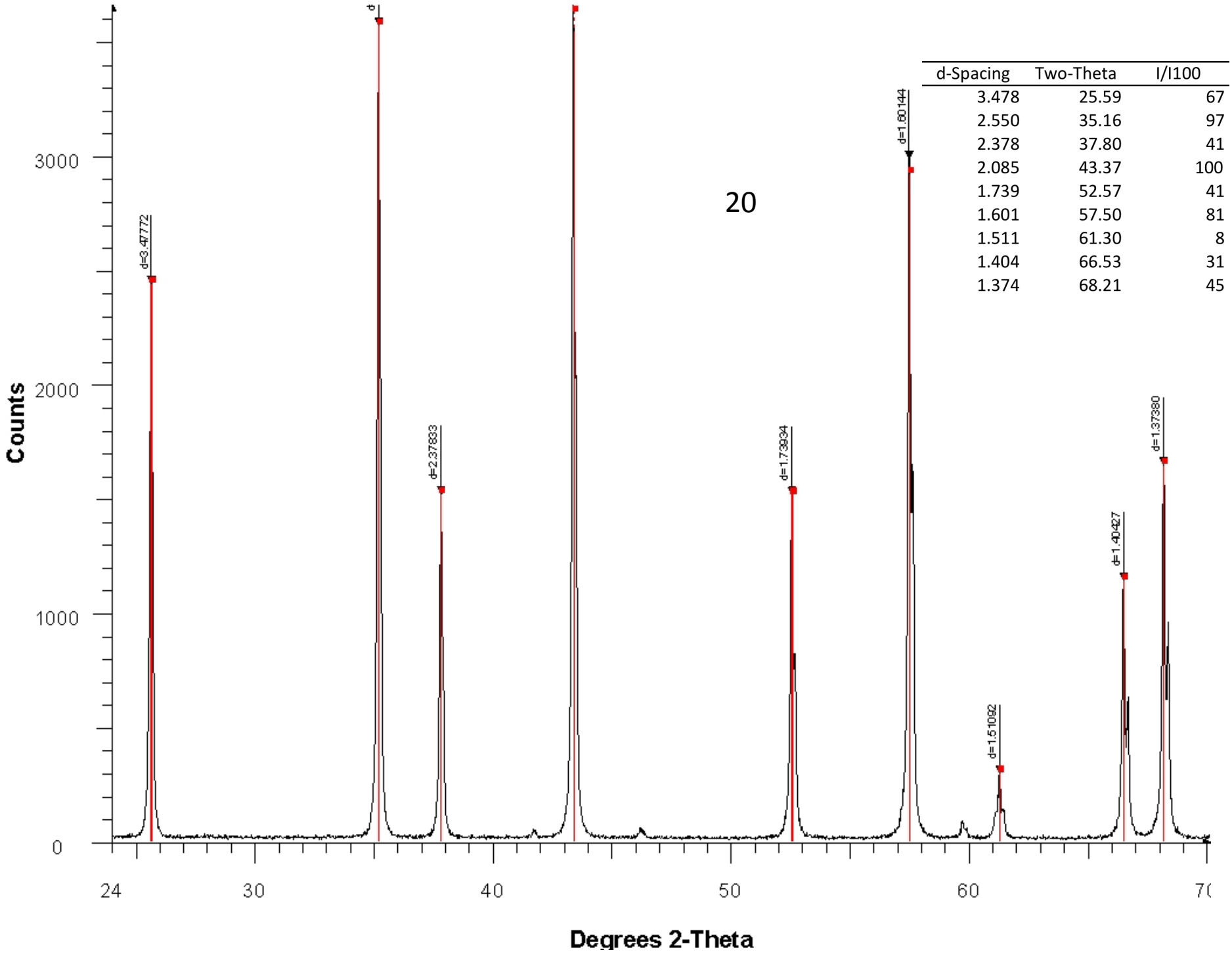
d-Spacing	Two-Theta	I/I100
4.311	20.59	22
4.054	21.91	13
3.811	23.32	27
3.760	23.64	13
3.374	26.40	10
3.007	29.68	100
2.889	30.93	10
2.783	32.14	6
2.746	32.58	50
2.724	32.86	71
2.586	34.66	8
2.535	35.39	16
2.510	35.74	12
2.473	36.30	15
2.452	36.62	15
2.321	38.76	11
2.246	40.12	4
2.186	41.27	6
2.050	44.15	4
2.023	44.76	9
1.906	47.66	52
1.880	48.39	18
1.811	50.36	9
1.801	50.65	13
1.754	52.11	8
1.687	54.32	14
1.672	54.88	8
1.634	56.24	13
1.622	56.71	5
1.540	60.01	4
1.527	60.58	7


16
Counts
700
600
500
400
300
200
100
0
7
10
20
30
40
50
60
70
8
Degrees 2-Theta

18



d-Spacing	Two-Theta	I/I100
7.279	12.15	93
3.651	24.36	25
2.776	32.22	31
2.684	33.36	22
2.646	33.85	100
2.577	34.79	19
2.206	40.87	8
2.159	41.82	6
2.052	44.10	28
1.929	47.06	23
1.818	50.15	30



d-Spacing	Two-Theta	I/I100
3.478	25.59	67
2.550	35.16	97
2.378	37.80	41
2.085	43.37	100
1.739	52.57	41
1.601	57.50	81
1.511	61.30	8
1.404	66.53	31
1.374	68.21	45

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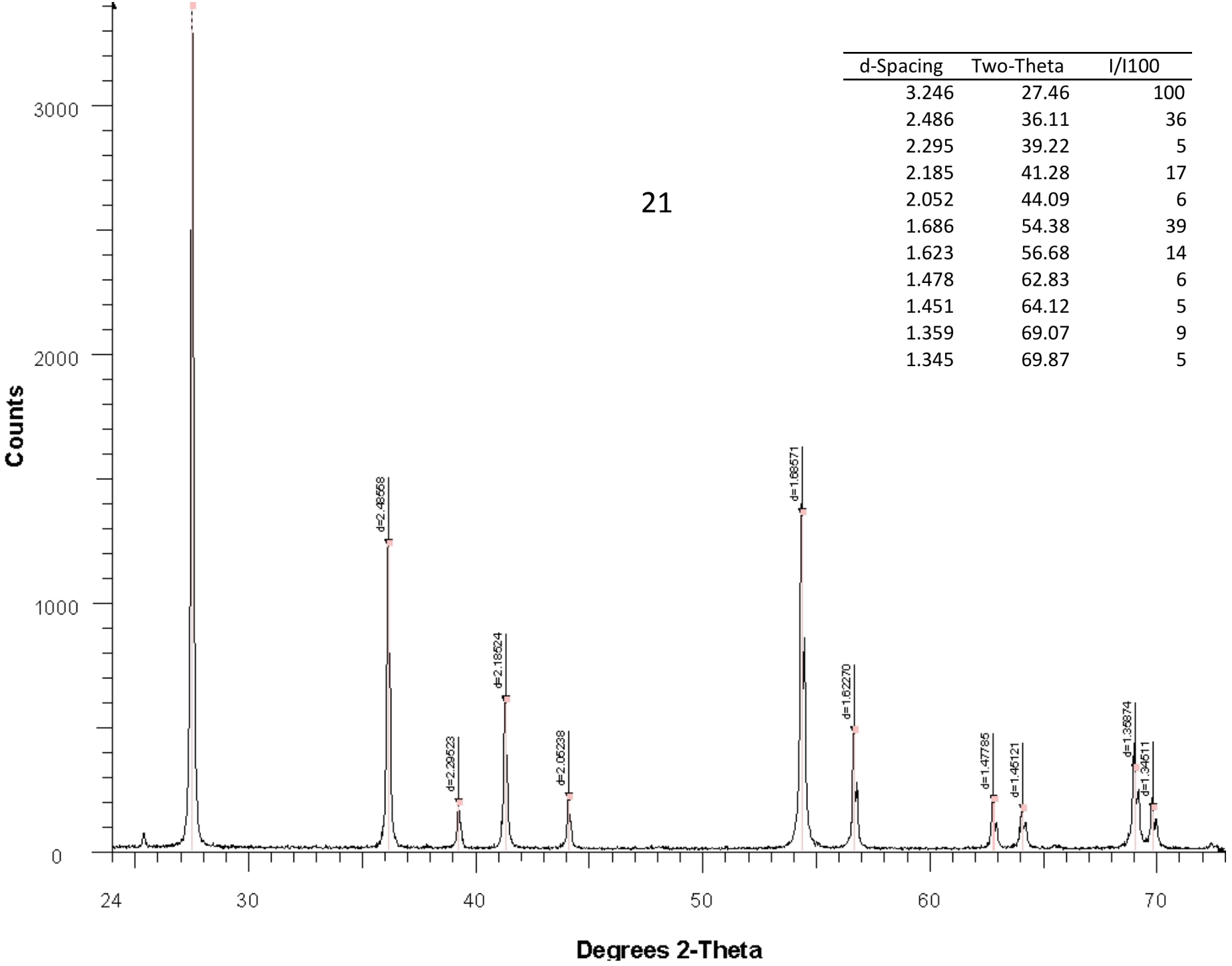
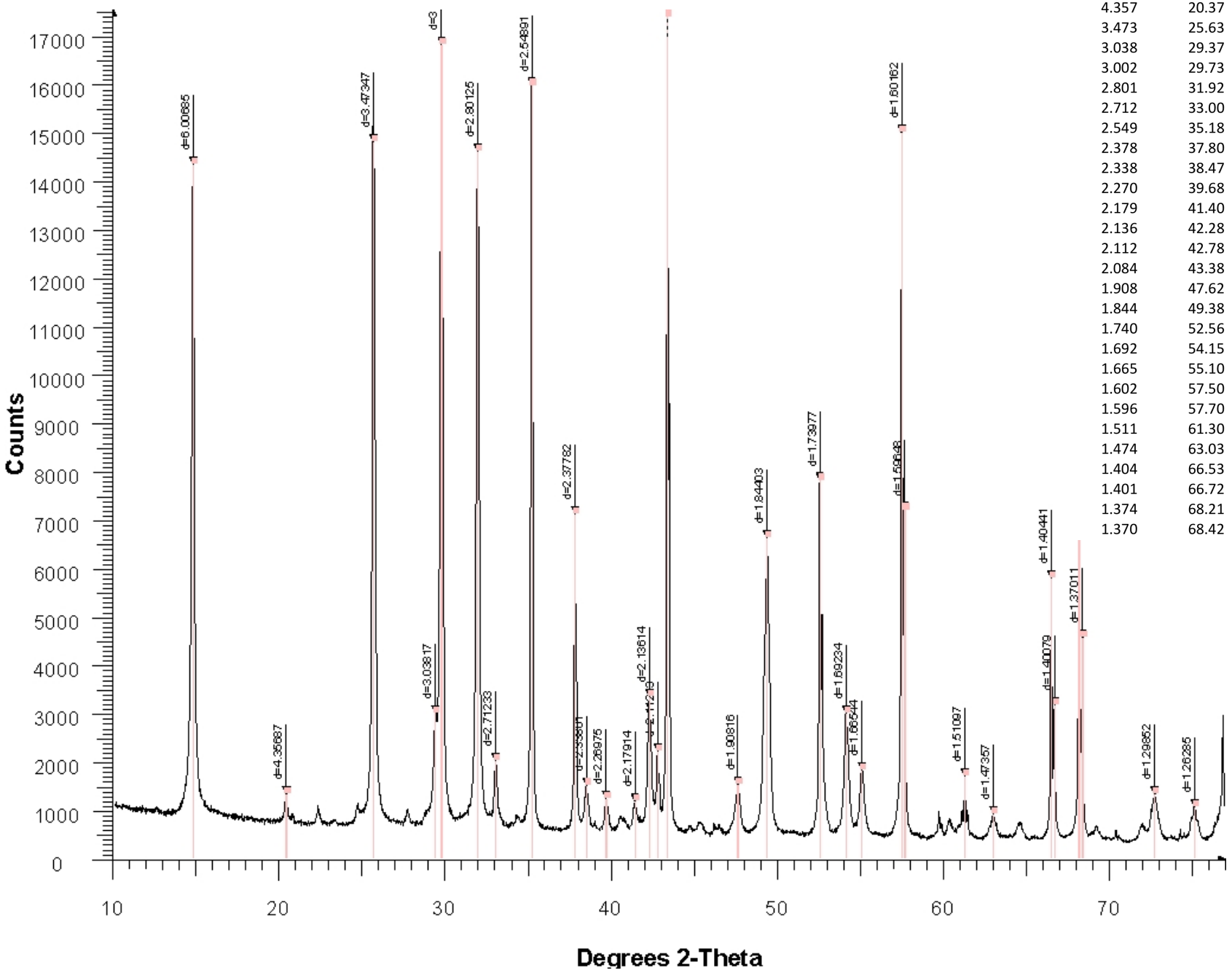
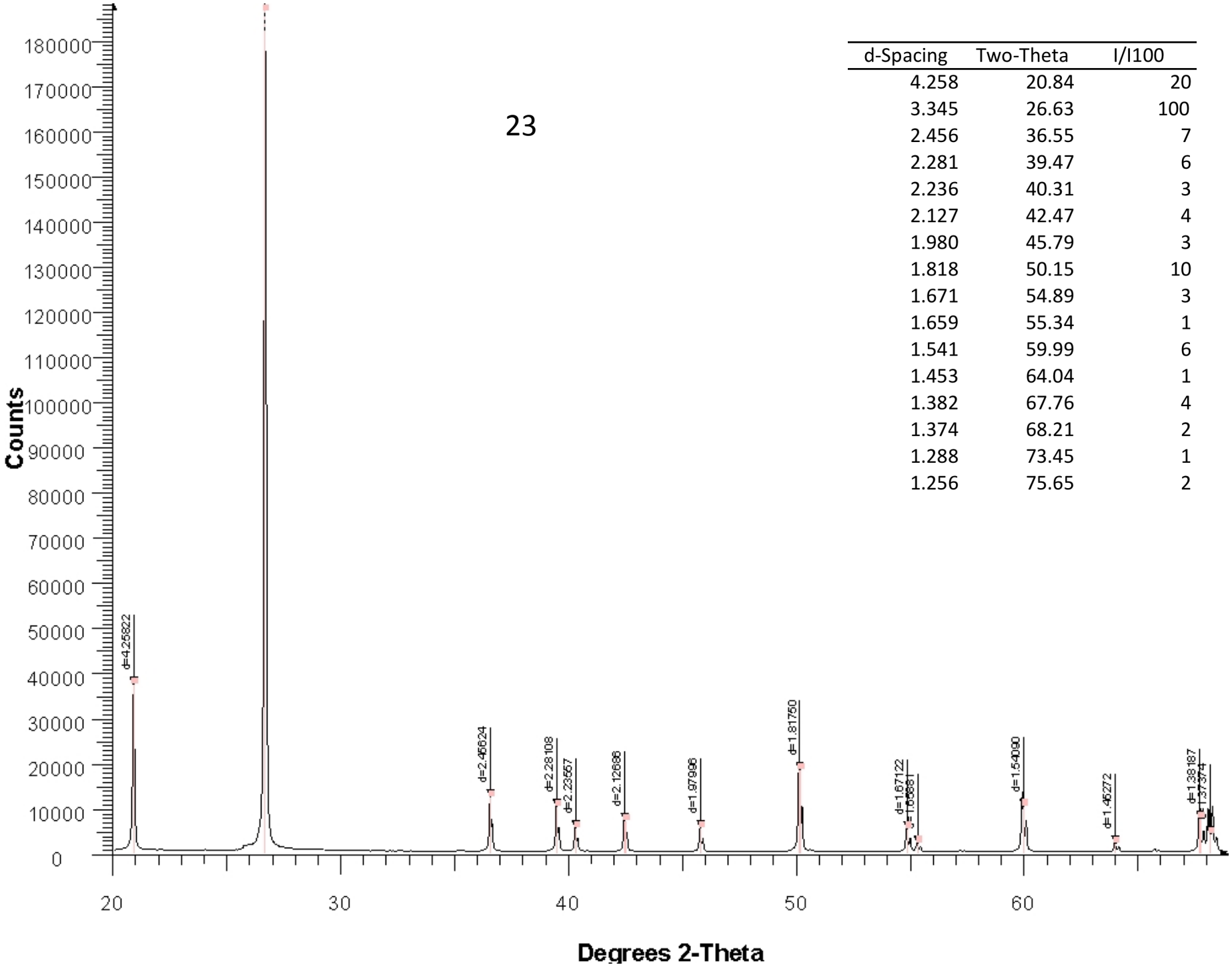
d-Spacing	Two-Theta	I/I100
3.246	27.46	100
2.486	36.11	36
2.295	39.22	5
2.185	41.28	17
2.052	44.09	6
1.686	54.38	39
1.623	56.68	14
1.478	62.83	6
1.451	64.12	5
1.359	69.07	9
1.345	69.87	5





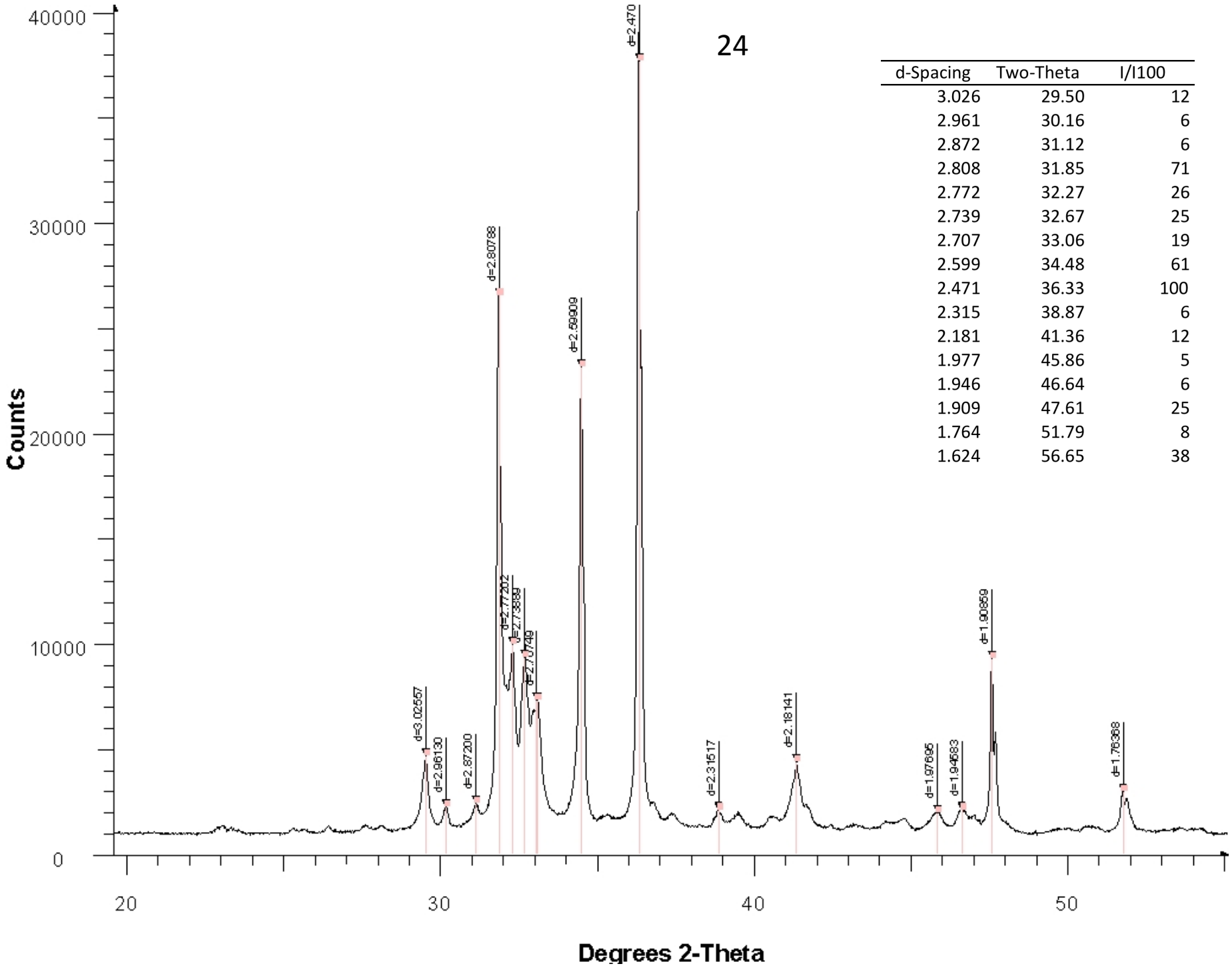
d-Spacing	Two-Theta	I/I100
6.007	14.74	82
4.357	20.37	8
3.473	25.63	85
3.038	29.37	17
3.002	29.73	96
2.801	31.92	83
2.712	33.00	12
2.549	35.18	91
2.378	37.80	41
2.338	38.47	9
2.270	39.68	7
2.179	41.40	7
2.136	42.28	19
2.112	42.78	13
2.084	43.38	100
1.908	47.62	9
1.844	49.38	38
1.740	52.56	45
1.692	54.15	17
1.665	55.10	10
1.602	57.50	86
1.596	57.70	41
1.511	61.30	10
1.474	63.03	5
1.404	66.53	33
1.401	66.72	18
1.374	68.21	49
1.370	68.42	26

23

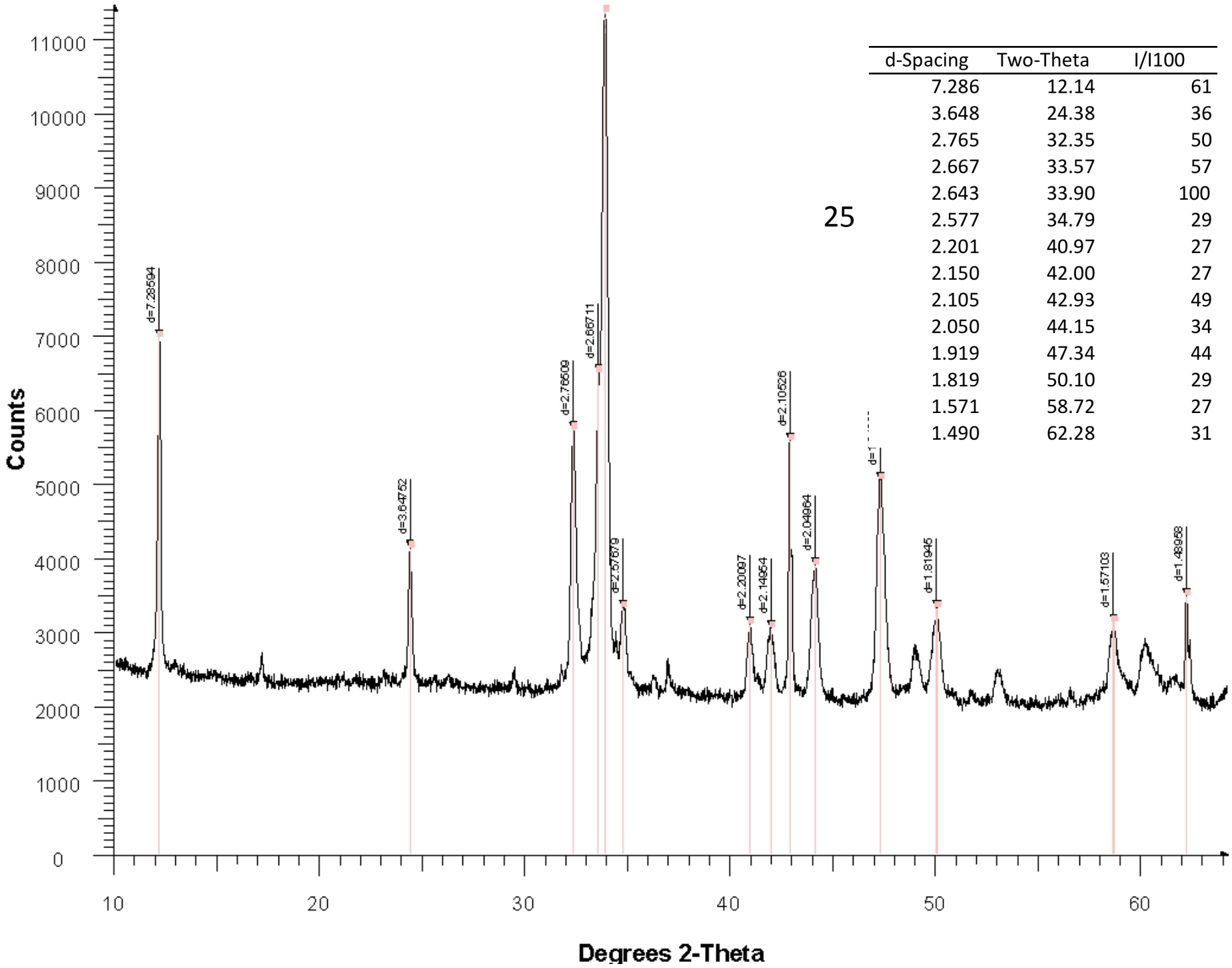


d-Spacing	Two-Theta	I/I100
4.258	20.84	20
3.345	26.63	100
2.456	36.55	7
2.281	39.47	6
2.236	40.31	3
2.127	42.47	4
1.980	45.79	3
1.818	50.15	10
1.671	54.89	3
1.659	55.34	1
1.541	59.99	6
1.453	64.04	1
1.382	67.76	4
1.374	68.21	2
1.288	73.45	1
1.256	75.65	2

24



d-Spacing	Two-Theta	I/I100
3.026	29.50	12
2.961	30.16	6
2.872	31.12	6
2.808	31.85	71
2.772	32.27	26
2.739	32.67	25
2.707	33.06	19
2.599	34.48	61
2.471	36.33	100
2.315	38.87	6
2.181	41.36	12
1.977	45.86	5
1.946	46.64	6
1.909	47.61	25
1.764	51.79	8
1.624	56.65	38



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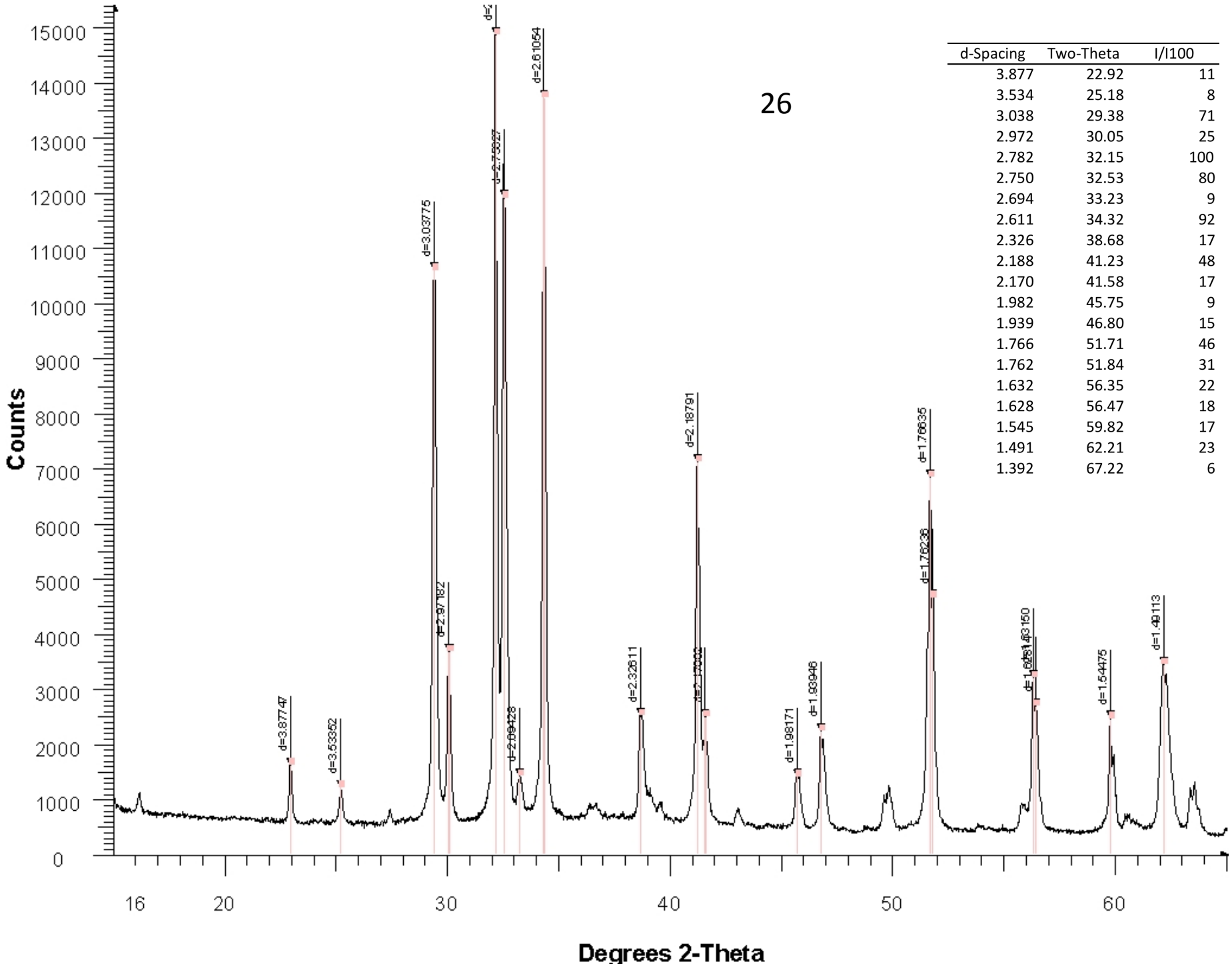
d-Spacing	Two-Theta	I/I100
7.286	12.14	61
3.648	24.38	36
2.765	32.35	50
2.667	33.57	57
2.643	33.90	100
2.577	34.79	29
2.201	40.97	27
2.150	42.00	27
2.105	42.93	49
2.050	44.15	34
1.919	47.34	44
1.819	50.10	29
1.571	58.72	27
1.490	62.28	31



d-Spacing	Two-Theta	I/I100
3.877	22.92	11
3.534	25.18	8
3.038	29.38	71
2.972	30.05	25
2.782	32.15	100
2.750	32.53	80
2.694	33.23	9
2.611	34.32	92
2.326	38.68	17
2.188	41.23	48
2.170	41.58	17
1.982	45.75	9
1.939	46.80	15
1.766	51.71	46
1.762	51.84	31
1.632	56.35	22
1.628	56.47	18
1.545	59.82	17
1.491	62.21	23
1.392	67.22	6