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Data Repository

Supplementary Material: X-Ray Diffraction Data

TABLE S1. Semi-quantitative mineralogical analysis using X-ray Diffraction[a]

Sample	Sand fraction		Silt fraction		Coarse clay fraction		Fine clay fraction		Carbonate, organic material, and procedural loss
	%	Mineralogy[b]	%	Mineralogy[b]	%	Mineralogy[b]	%	Mineralogy[b]	%
Pennsylvanian Johns Valley Formation									
ART-14	68.63	Q	27.13	C?,Q	0.15	C,I,Q	N.D.	N.D.[c]	4.09
Pennsylvanian Jackfork Formation									
ART-6	85.09	Q	12.37	C?,Q	1.02	S,C,I/S,I,Q	0.18	S,C,I/S,I,Q	1.34
ART-15	73.88	F,Q	21.06	F,Q	2.58	C,I,Q	0.12	C,I	2.35
Mississippian Stanley Formation									
ARM-1	46.60	C,I,F	38.69	C,I,F	10.69	C,I	1.20	C,I	2.81
ARM-5	36.66	C,I,F,Q	52.08	C,I,F,Q	9.15	C,I,Q	0.48	C,I,Q?	1.63
ART-2	80.26	C,I?,F,Q	15.64	C,I?,F,Q	1.66	C,I,Q	0.22	C?,I,Q	2.22
ART-5	69.51	I?F,Q	26.51	C,I,F,Q	2.42	C,I,Q	0.18	C,I	1.38
ART-18	67.68	C,I?,F,Q	26.54	C,I?,F,Q	3.09	C,I,Q	0.38	C,I,Q	2.31
Silurian-Ordovician, Undivided									
ARM-8	29.02	I?,Q	44.14	I?,Q	11.76	I,Q	3.63	I,Q	11.46
ART-19	80.58	I?,Q	12.86	C?,I?,Q	2.78	C?,I,Q	0.24	C,I,Q	3.53
Ordovician Bigfork Formation									
ART-12	83.29	Q	13.25	Q	0.76	C,I,Q	0.13	C,I,Q	2.57
Ordovician Womble Formation									
ARM-7	22.22	C,I,F,Q	59.19	C,I,F,Q	15.35	C,I	1.23	I,C	2.01
ART-3	82.43	Q	15.36	I?,Q	0.28	I,K,Q	N.D.[c]	N.D.[c]	1.93
Ordovician Blakely Formation									
ARM-6	26.37	C,I,Q	56.91	C,I,Q	12.72	C,I	1.01	C,I	3.00
Ordovician Crystal Mountain Formation									
ART-9	91.63	Q	6.97	Q	0.37	Q	N.D.[c]	N.D.[c]	1.03

[a] Sand and silt fractions are randomly oriented and side loaded into an aluminum holder. Both clay fractions are oriented and mineralogy determined from inspection of the diffractograms of each treatment type (i.e., ethylene glycol vapor solvation and heat treatments). Carbonate, organic material, and procedural loss determined by subtracting combined weight of the fractions from the initial sample weight prior to pretreatments.

[b]Minerals present denoted using the following abbreviations: C--chlorite, F--feldspars, I--illite, I/S--interlayered illite and smectite, K--kaolinite, and Q--quartz.

[c]N.D. =no data.

TABLE S2. CHLORITE 001 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Pennsylvanian Johns Valley Formation					
ART-14, coarse					
Air-dried	6.30	14.030	113.8	1224.5	0.472
Ethylene Glycol Vapor	6.45	13.704	106.1	1107.1	0.485
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Pennsylvanian Jackfork Formation					
ART-6, coarse[§]					
Air-dried	6.35	13.919	259.2	2414.1	0.420
Ethylene Glycol Vapor	6.35	13.919	343.4	4255.0	0.511
Heated 300˚C	6.45	13.704	75.4	725.1	0.433
Heated 550˚C	6.85[†]	12.904[†]	29.4[†]	472.6[†]	.788[†]
ART-6, fine[§]					
Air-dried	6.40	13.811	71.1	729.0	0.541
Ethylene Glycol Vapor	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Mississippian Stanley Formation					
ARM-1, coarse					
Air-dried	6.30	14.030	12.5	53.1	0.210
Ethylene Glycol Vapor	6.30	14.030	14.7	69.0	0.173
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	6.50	13.598	36.8	239.9	0.323
Mississippian Stanley Formation					
ARM-1, fine					
Air-dried	6.40	13.811	62.7	709.3	0.560
Ethylene Glycol Vapor	6.35	13.919	45.0	474.9	0.636
Heated 300˚C	6.45	13.704	31.8	357.5	0.595
Heated 550˚C	6.60[†]	13.393[†]	44.3[†]	711.4[†]	0.589[†]
ARM-5, coarse					
Air-dried	6.50	13.598	15.8	73.8	0.226
Ethylene Glycol Vapor	6.65	13.292	13.1	59.7	0.222
Heated 300˚C	6.90[†]	12.811[†]	17.2[†]	212.6[†]	0.828[†]
Heated 550˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
ARM-5, fine					
Air-dried	6.25	14.142	39.8	239.5	0.240
Ethylene Glycol Vapor	6.35	13.919	45.9	320.4	0.374
Heated 300˚C	6.35	13.919	35.8	282.8	0.516
Heated 550˚C	6.65	13.292	53.8	528.8	0.480
ART-2, coarse					
Air-dried	6.80[†]	12.999[†]	27.1[†]	346.5[†]	0.501[†]
Ethylene Glycol Vapor	6.65[†]	13.292[†]	22.2[†]	278.9[†]	0.498[†]
Heated 300˚C	7.25[†]	12.193[†]	22.3[†]	160.5[†]	0.168[†]
Heated 550˚C	7.65[†]	11.557[†]	64.1[†]	1138.7[†]	0.799[†]

Note: Samples without C_{001} data omitted.
*N.D. =no data.
[†]Broad peak measurement.
[§]Possible smectite interlayering, mainly with illite.

TABLE S3. CHLORITE 001 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Mississippian Stanley Formation					
ART-2, fine					
Air-dried	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Ethylene Glycol Vapor	6.25	14.142	19.3	270.2	0.161
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	7.65†	11.557†	63.6†	1125.5†	.963†
ART-5, coarse					
Air-dried	6.40†	13.811†	25.3†	519†	1.027†
Ethylene Glycol Vapor	6.65†	13.292†	25.3†	480.7†	1.101†
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	7.60†	11.633†	19.9†	124.1†	.241†
Ordovician Bigfork Formation					
ART-12, course					
Air-dried	6.35	13.919	18.5	72.0	0.220
Ethylene Glycol Vapor	6.35	13.919	26.9	85.1	0.111
Heated 300˚C	6.40	13.811	15.7	42.3	0.060
Heated 550˚C	6.50	13.598	38.4	217.6	0.289
Ordovician Blakely Formation					
ARM-6, coarse					
Air-dried	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Ethylene Glycol Vapor	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	6.45	13.704	53.0	271.4	0.203
Ordovician Blakely Formation					
ARM-6, fine					
Air-dried	6.95†	12.719†	273.5†	7473.0†	1.286†
Ethylene Glycol Vapor	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 300˚C	N.D.*	N.D.*	N.D.*	N.D.*	N.D.*
Heated 550˚C	6.70	13.193	83.7	626.8	0.471

Note: Samples without C_{001} data omitted.
*N.D. =no data.
†Broad peak measurement.
§Possible smectite interlayering, mainly with illite.

TABLE S4. ILLITE 001 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Pennsylvanian Johns Valley Formation					
ART-14, coarse					
Air-dried	8.95	9.8807	18.4	78.3	0.348
Ethylene Glycol Vapor	8.95*	9.8807*	14.3*	56.8*	0.317*
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Pennsylvanian Jackfork Formation					
ART-6, coarse§					
Air-dried	8.15*	10.8490*	528.8*	8955.8*	0.688*
Ethylene Glycol Vapor	8.85*	9.9922*	145.7*	1425.0*	0.433*
Heated 300˚C	8.85*	9.9922*	241.6*	5864.8*	1.128*
Heated 550˚C	9.20*	9.6128*	50.9*	812.9*	0.757*
ART-6, fine§					
Air-dried	8.05	10.9830	516.7	11196.2	0.818
Ethylene Glycol Vapor	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 300˚C	8.25*	10.717*	195.4*	4264.7*	0.992*
Heated 550˚C	9.50*	9.3099*	59.3*	694.1*	0.555*
ART-15, coarse					
Air-dried	8.90	9.9361	207.3	3769.3	0.656
Ethylene Glycol Vapor	8.95	9.8807	212.8	3445.8	0.624
Heated 300˚C	9.00*	9.8259*	52.4*	1075.1*	0.833*
Heated 550˚C	8.30*	10.6530*	76.6*	2410.9*	1.571*
Pennsylvanian Jackfork Formation					
ART-15, fine					
Air-dried	8.95*	9.8807*	55.2*	855.3*	0.748*
Ethylene Glycol Vapor	8.85	9.9922	49.1	849.1	0.562
Heated 300˚C	8.85*	9.9922*	67.9*	1105.9*	0.756*
Heated 550˚C	8.80*	10.049*	79.0*	2048.7*	1.308*
Mississippian Stanley Formation					
ARM-1, coarse					
Air-dried	8.90	9.9361	53.7	379.1	0.298
Ethylene Glycol Vapor	8.95	9.8807	49.7	353.6	0.274
Heated 300˚C	8.96	9.8751	36.6	205.9	0.241
Heated 550˚C	8.85	9.9922	65.6	364.4	0.244
ARM-1, fine					
Air-dried	8.85	9.9922	647.6	9230.5	0.624
Ethylene Glycol Vapor	8.90	9.9361	629.2	8836.2	0.613
Heated 300˚C	8.90	9.9361	705.8	9050.5	0.543
Heated 550˚C	8.90	9.9361	374.6	5054.8	0.549
ARM-5, coarse					
Air-dried	9.10	9.7182	192.7	1898.5	0.417
Ethylene Glycol Vapor	9.15	9.6652	197.9	2099.1	0.458
Heated 300˚C	9.25	9.5609	229.5	2109.8	0.389
Heated 550˚C	9.23	9.5868	61.4	719.7	0.522

Note: Samples without I_{001} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S5. ILLITE 001 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Mississippian Stanley Formation					
ARM-5, fine					
Air-dried	8.90	9.9361	628.9	7681.5	0.528
Ethylene Glycol Vapor	8.95	9.8807	586.6	7546.2	0.543
Heated 300˚C	8.95	9.8807	667.2	7437.1	0.468
Heated 550˚C	8.90	9.9361	348.2	3466.9	0.425
ART-2, coarse					
Air-dried	8.85	9.9922	319.2	3047.3	0.412
Ethylene Glycol Vapor	8.90	9.9361	311.7	3032.2	0.414
Heated 300˚C	8.90	9.9361	212.9	1647.9	0.306
Heated 550˚C	8.90	9.9361	99.3	948.9	0.361
ART-2, fine					
Air-dried	8.75	10.1060	35.6	395.9	0.517
Ethylene Glycol Vapor	8.80	10.0490	39.8	395.2	0.377
Heated 300˚C	8.85	9.9922	35.2	391.8	0.551
Heated 550˚C	8.85	9.9922	121.8	1475.0	0.532
ART-5, coarse					
Air-dried	8.95	9.8807	454.3	3207.0	0.291
Ethylene Glycol Vapor	8.95	9.8807	441.2	3236.3	0.301
Heated 300˚C	8.90	9.9361	97.4	763.4	0.338
Heated 550˚C	8.80	10.0490	60.7	423.6	0.310
Mississippian Stanley Formation					
ART-5, fine					
Air-dried	9.00	9.8259	54.3	475.2	0.507
Ethylene Glycol Vapor	9.00	9.8259	55.0	489.9	0.385
Heated 300˚C	9.00	9.8259	33.3	253.4	0.394
Heated 550˚C	8.85	9.9922	26.3	173.4	0.143
ART-18, coarse					
Air-dried	8.95	9.8807	162.5	2050.1	0.409
Ethylene Glycol Vapor	8.95	9.8807	162.3	2056.4	0.404
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-18, fine					
Air-dried	9.05	9.7718	36.9	412.0	0.500
Ethylene Glycol Vapor	9.05*	9.7718*	37.1*	530.8*	0.677*
Heated 300˚C	9.05*	9.7718*	17.9*	145.7*	0.173*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Silurian-Ordovician, Undivided					
ARM-8, coarse					
Air-dried	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ethylene Glycol Vapor	8.95	N.D.†	20.5	153.8	0.387
Heated 300˚C	8.90	9.9361	24.6	318.6	0.656
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†

Note: Samples without I_{001} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S6. ILLITE 001 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Silurian-Ordovician, Undivided					
ARM-8, fine					
Air-dried	8.90	9.9361	1245.2	21144.1	0.745
Ethylene Glycol Vapor	8.90	9.9361	1119.4	19089.4	0.727
Heated 300˚C	8.95	9.8807	1218.2	18401.0	0.650
Heated 550˚C	8.90	9.9361	1229.7	17802.7	0.625
ART-19, coarse					
Air-dried	8.90	9.9361	775.4	6977.6	0.360
Ethylene Glycol Vapor	8.90	9.9361	784.8	7167.5	0.363
Heated 300˚C	9.00	9.8259	47.5	390.1	0.311
Heated 550˚C	8.95	9.8807	39.4	230.5	0.089
ART-19,fine					
Air-dried	8.85	9.9922	219.4	2892.5	0.594
Ethylene Glycol Vapor	8.90	9.9361	219.0	3050.3	0.615
Heated 300˚C	8.80	10.0490	437.0	5184.2	0.506
Heated 550˚C	8.85	9.9922	195.2	2407.9	0.527
Ordovician Bigfork Formation					
ART-12, coarse					
Air-dried	8.85	9.9922	61.1	415.1	0.274
Ethylene Glycol Vapor	8.90	9.9361	68.8	487.3	0.311
Heated 300˚C	8.90*	9.9361*	35.0*	244.5*	0.330*
Heated 550˚C	8.85	9.9922	14.8	71.2	0.241
Ordovician Bigfork Formation					
ART-12, fine					
Air-dried	8.90*	9.9361*	56.9*	1151.5*	0.875*
Ethylene Glycol Vapor	8.95*	9.8807*	49.9*	848.6*	0.780*
Heated 300˚C	9.00*	9.8259*	27.8*	500.2*	0.706*
Heated 550˚C	8.85*	9.9922*	22.7*	402.3*	1.130*
Ordovician Womble Formation					
ARM-7, coarse					
Air-dried	8.85	9.9922	4344.6	39109.5	0.363
Ethylene Glycol Vapor	8.90	9.9361	3978.2	38284.2	0.388
Heated 300˚C	8.95	9.8807	1723.4	13309.1	0.297
Heated 550˚C	9.40	9.4087	336.2	3167.6	0.371
ARM-7, fine					
Air-dried	8.85	9.9922	629.9	7379.7	0.491
Ethylene Glycol Vapor	8.90	9.9361	628.9	7660.3	0.498
Heated 300˚C	8.85	9.9922	600.2	6811.3	0.486
Heated 550˚C	8.90	9.9361	161.9	1860.0	0.528
ART-3, coarse					
Air-dried	8.95	9.8807	288.5	2026.2	0.273
Ethylene Glycol Vapor	8.95	9.8807	284.1	2171.5	0.303
Heated 300˚C	8.95	9.8807	86.6	580.7	0.234
Heated 550˚C	9.05	9.7718	34.3	317.2	0.515

Note: Samples without I_{001} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S7. ILLITE 001 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Ordovician Blakely Formation					
ARM-6, coarse					
Air-dried	8.95	9.8807	478.2	3769.5	0.328
Ethylene Glycol Vapor	8.90	9.9361	459.1	3805.2	0.340
Heated 300˚C	8.95	9.8807	459.8	3833.7	0.332
Heated 550˚C	8.90	9.9361	252.8	2164.7	0.333
ARM-6, fine					
Air-dried	9.00	9.8259	1274.2	13740.7	0.417
Ethylene Glycol Vapor	9.05	9.7718	806.5	7860.0	0.398
Heated 300˚C	9.05	9.7718	1230.5	14869.9	0.432
Heated 550˚C	9.00	9.8259	1140.7	13494.3	0.443

Note: Samples without I_{001} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S8. CHLORITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Pennsylvanian Johns Valley Formation					
ART-14, coarse					
Air-dried	12.65	6.9978	773.7	8828.4	0.413
Ethylene Glycol Vapor	12.60	7.0255	793.9	8855.8	0.404
Heated 300˚C	12.55	7.0533	62.6	1005.4	0.598
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Pennsylvanian Jackfork Formation					
ART-6, coarse§					
Air-dried	12.60	7.0255	2332.6	19790.4	0.337
Ethylene Glycol Vapor	12.60	7.0255	2418.7	20459.0	0.336
Heated 300˚C	12.60	7.0255	1031.6	10743.0	0.420
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-6, fine§					
Air-dried	12.55	7.0533	405.7	3809.4	0.367
Ethylene Glycol Vapor	12.55	7.0533	361.7	3449.2	0.388
Heated 300˚C	12.70	6.9704	163.1	1935.0	0.512
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-15, coarse					
Air-dried	11.85*	7.4684*	307.1*	11633.7*	1.788*
Ethylene Glycol Vapor	12.20*	7.2549*	286.4*	10970.5*	1.843*
Heated 300˚C	12.10*	7.3146*	110.0*	3355.6*	1.161*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Pennsylvanian Jackfork Formation					
ART-15, fine					
Air-dried	11.90*	7.4371*	95.8*	3565.8*	1.570*
Ethylene Glycol Vapor	12.05*	7.3449*	91.7*	3042.0*	1.693*
Heated 300˚C	11.95*	7.4061*	115.2*	3656.1*	1.369*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Mississippian Stanley Formation					
ARM-1, coarse					
Air-dried	12.60	7.0255	40	174.7	0.202
Ethylene Glycol Vapor	12.60	7.0255	34.6	185.4	0.192
Heated 300˚C	12.65	6.9978	13.4?	83.9	0.226
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ARM-1, fine					
Air-dried	12.65	6.9978	307	3699.6	0.458
Ethylene Glycol Vapor	12.60	7.0255	294.8	3611.7	0.461
Heated 300˚C	12.70	6.9704	150.2	2095.6	0.517
Heated 550˚C	13.95*	6.3485*	50.8*	1160.3*	1.087*
ARM-5, coarse					
Air-dried	12.75	6.9432	125.2	1067.5	0.336
Ethylene Glycol Vapor	12.85	6.8893	135.8	1193.0	0.383
Heated 300˚C	12.90	6.8628	104.1	983.0	0.394
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†

Note: Samples without C_{002} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S9. CHLORITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Mississippian Stanley Formation					
ARM-5, fine					
Air-dried	12.65	6.9978	224.5	2009.6	0.330
Ethylene Glycol Vapor	12.60	7.0255	224.0	1894.9	0.316
Heated 300˚C	12.65	6.9978	134.6	1355.6	0.375
Heated 550˚C	13.45*	6.5833*	45.1*	918.6*	1.003*
ART-2, coarse					
Air-dried	12.10*	7.3146*	80.1*	3267.3*	1.780*
Ethylene Glycol Vapor	12.20*	7.2549*	84.7*	3273.4*	1.866*
Heated 300˚C	12.05*	7.3449*	59.7*	1913.6*	1.699*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-5, coarse					
Air-dried	12.20*	7.2549*	225.3*	5377.6*	0.880*
Ethylene Glycol Vapor	12.25*	7.2254*	235.4*	5518.1*	0.864*
Heated 300˚C	12.25*	7.2254*	79.6*	1828.6*	0.889*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-5, fine					
Air-dried	12.35*	7.1671*	66.1*	1834.0*	1.152*
Ethylene Glycol Vapor	12.40*	7.1383*	76.4*	1933.6*	1.027*
Heated 300˚C	12.35*	7.1671*	47.1*	994.7*	0.778*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Mississippian Stanley Formation					
ART-18, coarse					
Air-dried	12.20*	7.2549*	117.3*	3758.0*	1.526*
Ethylene Glycol Vapor	12.15*	7.2846*	119.4*	4167.8*	1.536*
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-18, fine					
Air-dried	12.05*	7.3449*	52.4*	1551.3*	1.389*
Ethylene Glycol Vapor	12.30*	7.1961*	51.5*	1674.4*	1.269*
Heated 300˚C	12.50*	7.0814*	21.9*	347.5*	0.427*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Silurian-Ordovician, Undivided					
ARM-8, fine					
Air-dried	13.80*	6.4171*	68.1*	1686.8*	1.402*
Ethylene Glycol Vapor	13.80*	6.4171*	54.7*	1168.1*	1.043*
Heated 300˚C	13.90*	6.3712*	71.9*	1512.5*	1.227*
Heated 550˚C	13.60*	6.5111*	103.3*	2750.5*	1.322*
ART-19, coarse					
Air-dried	12.00*	7.3754*	47.9*	945.2*	0.825*
Ethylene Glycol Vapor	12.25*	7.2257*	48.7*	1072.6*	1.128*
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†

Note: Samples without C_{002} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S10. CHLORITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Silurian-Ordovician, Undivided					
ART-19,fine					
Air-dried	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ethylene Glycol Vapor	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 300˚C	12.40*	7.1383*	34.2*	572.6*	0.882*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ordovician Bigfork Formation					
ART-12, coarse					
Air-dried	12.60	7.0255	74.4	623.8	0.318
Ethylene Glycol Vapor	12.60	7.0255	77.1	624.9	0.288
Heated 300˚C	12.5*	7.0814*	46.6*	418.9*	0.451*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-12, fine					
Air-dried	12.25*	7.2254*	77.4*	2179.4*	1.466*
Ethylene Glycol Vapor	12.15*	7.2846*	59.4*	1914.4*	1.735*
Heated 300˚C	12.40*	7.1383*	43.0*	1249.2*	1.377*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ordovician Womble Formation					
ARM-7, coarse					
Air-dried	12.55	7.0533	181.1	1553.0	0.302
Ethylene Glycol Vapor	12.60	7.0255	164.0	1517.2	0.318
Heated 300˚C	12.60	7.0255	92.8	622.5	0.254
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ordovician Womble Formation					
ARM-7, fine					
Air-dried	12.60	7.0255	31.8	227.1	0.259
Ethylene Glycol Vapor	12.55	7.0533	33.3	216.1	0.228
Heated 300˚C	12.60	7.0255	18.5	128.5	0.212
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-3, coarse					
Air-dried	12.3*	7.1961*	137.8*	3334.4*	0.888*
Ethylene Glycol Vapor	12.3*	7.1961*	149.2*	3765.3*	0.852*
Heated 300˚C	12.35*	7.1671*	85.3*	1521.7*	0.553*
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ordovician Blakely Formation					
ARM-6, coarse					
Air-dried	12.55	7.0533	66.8	491.1	0.327
Ethylene Glycol Vapor	12.55	7.0533	65.4	587.5	0.355
Heated 300˚C	12.50	7.0814	55.0	549.0	0.504
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ARM-6, fine					
Air-dried	12.65	6.9978	57.4	512.6	0.377
Ethylene Glycol Vapor	12.70	6.9704	38.2	290.6	0.421
Heated 300˚C	12.65	6.9978	31.5	213.7	0.319
Heated 550˚C	13.85*	6.3941*	74.5*	1593.9*	1.094*

Note: Samples without C_{002} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S11. ILLITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Pennsylvanian Johns Valley Formation					
ART-14, fine					
Air-dried	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ethylene Glycol Vapor	18.06*	4.9109*	19.6*	153.5*	0.458*
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Pennsylvanian Jackfork Formation					
ART-6, coarse§					
Air-dried	17.85	4.9692	72.7	707.2	0.505
Ethylene Glycol Vapor	17.95*	4.9431*	89.5*	1154.2*	0.894*
Heated 300˚C	17.85	4.9692	103.5	1513.9	0.727
Heated 550˚C	18.35*	4.835*	94*	1913.6*	1.094*
ART-6, fine§					
Air-dried	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ethylene Glycol Vapor	18.70*	4.7452*	207.2*	4298.0*	0.780*
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	18.60*	4.7705*	81.0*	3447.6*	0.769*
ART-15, coarse					
Air-dried	17.90*	4.9555*	45.3*	585.8*	0.632*
Ethylene Glycol Vapor	17.95*	4.9418*	43.8*	659.4*	0.712*
Heated 300˚C	17.97	4.9365	28.4	401.3	0.681
Heated 550˚C	17.80*	4.9822*	41.6*	739.0*	0.675*
Pennsylvanian Jackfork Formation					
ART-15, fine					
Air-dried	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ethylene Glycol Vapor	17.90	4.9555	62.9	911.3	0.637
Heated 300˚C	17.90*	4.9555*	51.5*	912.4*	1.105*
Heated 550˚C	17.50*	5.0678*	68.3*	1194.0*	0.904*
Mississippian Stanley Formation					
ARM-1, coarse					
Air-dried	18.10*	4.9012*	32.7*	767.0*	1.099*
Ethylene Glycol Vapor	18.05*	4.9146*	34.5*	721.2*	1.133*
Heated 300˚C	18.08	4.9079	52.4	633.8	0.55
Heated 550˚C	17.85*	4.9692*	50.0*	1203.9*	1.484*
ARM-1, fine					
Air-dried	17.75	4.9970	366.1	5656.5	0.641
Ethylene Glycol Vapor	17.80	4.9831	422.3	5940.3	0.589
Heated 300˚C	17.85	4.9692	445.8	6027.6	0.519
Heated 550˚C	17.80	4.9831	468.1	6207.8	0.528
ARM-5, coarse					
Air-dried	17.95	4.9418	174.7	2290.6	0.521
Ethylene Glycol Vapor	18.00	4.9282	192.5	2390.1	0.494
Heated 300˚C	18.05	4.9146	176.1	2480.5	0.491
Heated 550˚C	18.05	4.9146	145.2	2098.7	0.53

Note: Samples without I_{002}data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S12. ILLITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Mississippian Stanley Formation					
ARM-5, fine					
Air-dried	17.85	4.9692	370.0	4787.7	0.536
Ethylene Glycol Vapor	17.80	4.9831	385.8	4907.8	0.522
Heated 300˚C	17.85	4.9692	434.3	4949.4	0.470
Heated 550˚C	17.70	5.0110	472.6	5415.7	0.457
ART-2, coarse					
Air-dried	17.80	4.9831	155.5	1271.9	0.391
Ethylene Glycol Vapor	17.85	4.9692	148.2	1299.4	0.344
Heated 300˚C	17.85	4.9692	110.4	1105.3	0.322
Heated 550˚C	17.70	5.0110	115.6	1179.2	0.350
ART-2, fine					
Air-dried	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ethylene Glycol Vapor	17.78*	4.9900*	71.2*	1124.3*	.884*
Heated 300˚C	17.75	4.9970	73.4	962.9	0.750
Heated 550˚C	17.75	4.9970	120.6	1271.6	0.443
ART-5, coarse					
Air-dried	17.85	4.9692	234.5	1734.8	0.303
Ethylene Glycol Vapor	17.85	4.9692	240.8	1734.2	0.278
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	17.71	5.0092	129.7	1827.8	0.468
Mississippian Stanley Formation					
ART-5, fine					
Air-dried	17.90	4.9555	39.0	349.4	0.389
Ethylene Glycol Vapor	17.95	4.9418	35.3	356.8	0.402
Heated 300˚C	17.85	4.9692	56.8	621.5	0.388
Heated 550˚C	17.77*	4.9912*	49.3*	1381.6*	0.869*
ART-18, coarse					
Air-dried	17.85	4.9692	47.3	399.7	0.414
Ethylene Glycol Vapor	17.90	4.9555	60.3	456.8	0.485
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
ART-18, fine					
Air-dried	18.00	4.9282	27.0	418.8	0.702
Ethylene Glycol Vapor	18.10	4.9012	20.1	301.1	0.769
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	17.75*	4.996*	20.2*	213.6*	0.240*
Silurian-Ordovician, Undivided					
ARM-8, fine					
Air-dried	17.90	4.9555	687.9	13324.2	0.762
Ethylene Glycol Vapor	17.90	4.9555	711.9	12466.7	0.709
Heated 300˚C	17.95	4.9418	784.4	13325.8	0.654
Heated 550˚C	17.80	4.9831	1057.8	17501.7	0.636

Note: Samples without I_{002} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S13. ILLITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Silurian-Ordovician, Undivided					
ART-19, coarse					
Air-dried	17.80	4.9831	261.5	2265.8	0.383
Ethylene Glycol Vapor	17.80	4.9831	285.4	2313.1	0.343
Heated 300˚C	17.90*	4.9555*	60.9*	1875.6*	1.238*
Heated 550˚C	17.79*	4.9856*	61.4*	1459.2*	0.911
ART-19,fine					
Air-dried	17.85	4.9692	115.4	1272.2	0.502
Ethylene Glycol Vapor	17.80	4.9831	120.1	1353.7	0.530
Heated 300˚C	17.80	4.9831	257.5	3617.7	0.575
Heated 550˚C	17.80	4.9831	241.6	3494.7	0.554
Ordovician Bigfork Formation					
ART-12, coarse					
Air-dried	17.90	4.9555	38.6	267.8	0.321
Ethylene Glycol Vapor	17.90	4.9555	43.4	308.7	0.296
Heated 300˚C	17.95	4.9418	32.2	309.6	0.464
Heated 550˚C	17.70	5.0110	40.0	515.9	0.199
ART-12, fine					
Air-dried	17.95*	4.9418*	37.1*	543.1*	0.763*
Ethylene Glycol Vapor	17.90*	4.9555*	33.9*	716.6*	0.906*
Heated 300˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Heated 550˚C	N.D.†	N.D.†	N.D.†	N.D.†	N.D.†
Ordovician Womble Formation					
ARM-7, coarse					
Air-dried	17.80	4.9831	2626.8	25643.4	0.375
Ethylene Glycol Vapor	17.75	4.9970	2762.6	25505.6	0.347
Heated 300˚C	17.85	4.9692	1422.6	11894.0	0.313
Heated 550˚C	18.25	4.8612	738.4	6633.7	0.367
ARM-7, fine					
Air-dried	17.80	4.9831	365.8	4664.1	0.527
Ethylene Glycol Vapor	17.80	4.9831	416.4	4817.1	0.454
Heated 300˚C	17.75	4.9970	400.2	5325.0	0.472
Heated 550˚C	17.75	4.9970	322.4	4395.6	0.501
ART-3, coarse					
Air-dried	17.90	4.9555	154.4	973.1	0.280
Ethylene Glycol Vapor	17.90	4.9555	167.3	1095.4	0.281
Heated 300˚C	17.90	4.9555	64.7	717.6	0.349
Heated 550˚C	17.70*	5.0110*	61.3*	861.3*	0.576*
Ordovician Blakely Formation					
ARM-6, coarse					
Air-dried	17.90	4.9555	428.0	4051.1	0.357
Ethylene Glycol Vapor	17.90	4.9555	442.1	4045.6	0.349
Heated 300˚C	17.90	4.9555	445.3	3941.0	0.335
Heated 550˚C	17.75	7.9970	360.0	4042.4	0.378

Note: Samples without I_{002} data omitted.
*Broad peak measurement.
†N.D. = no data.
§Possible smectite interlayering, mainly with illite.

TABLE S14. ILLITE 002 PEAK VALUES AT AIR DRIED, ETHYLENE GLYCOL VAPOR SOLVATED, HEATED 300˚C, AND HEATED 550˚C

Sample, clay fraction	2Θ (degrees)	D-spacing (angstroms)	Peak max counts (counts/second)	Peak area (integrated counts)	FWHM (degrees)
Ordovician Blakely Formation					
ARM-6, fine					
Air-dried	17.95	4.9418	760.2	8199.5	0.440
Ethylene Glycol Vapor	18.00	4.9282	572.8	6427.3	0.413
Heated 300˚C	18.00	4.9282	772.1	8616.5	0.425
Heated 550˚C	17.80	4.9831	1038.4	11157.8	0.421

Note: Samples without I_{002} data omitted.
*Broad peak measurement.
[†]N.D. = no data.
[§]Possible smectite interlayering, mainly with illite.

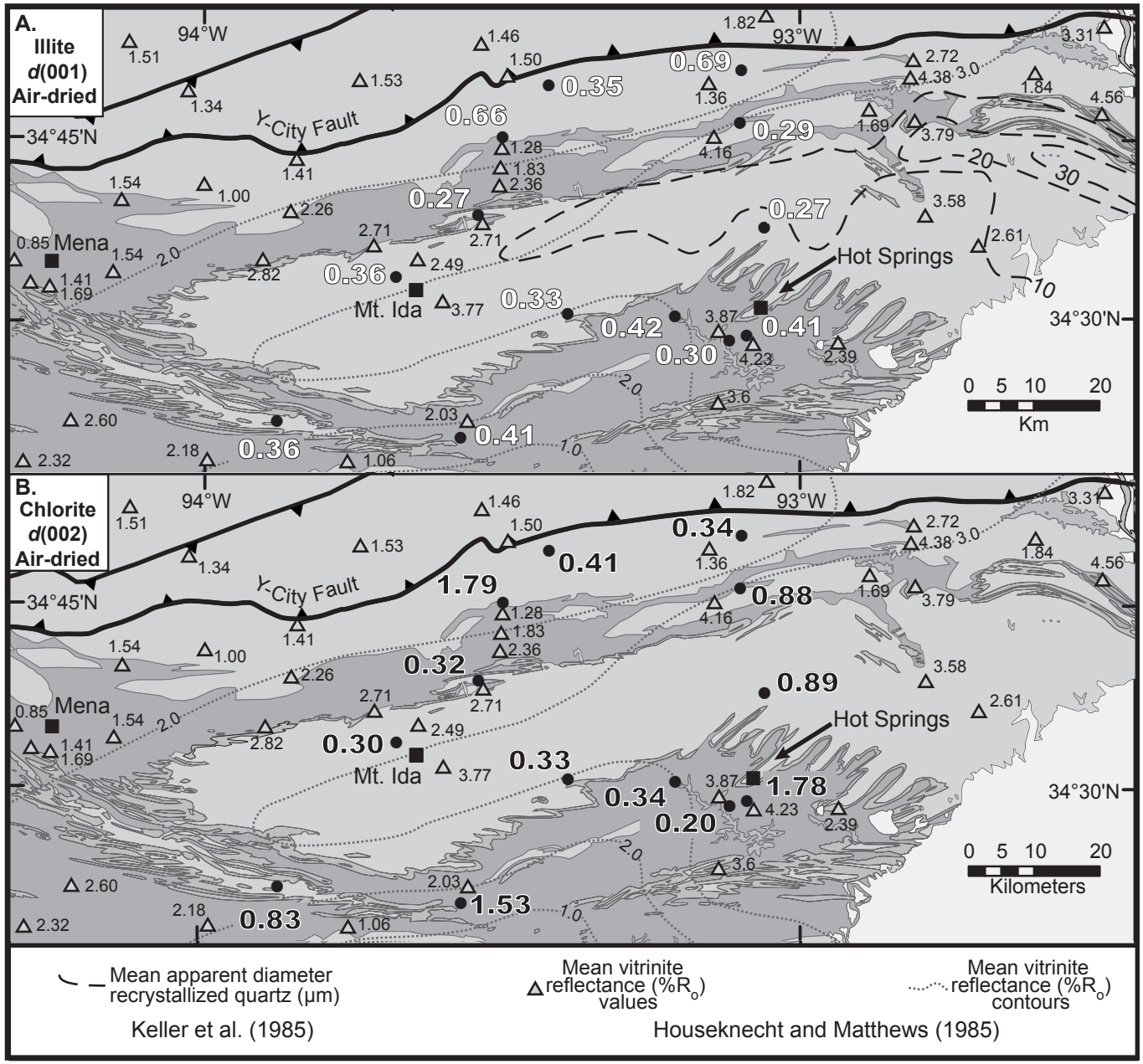

Figure S1. A. Crystallinity values for the air-dried coarse clay fraction of illite d(001). Crystallinity is given in FWHM °2Θ CuKα. Mean apparent diameter of recrystallized quartz are given by Keller et al. (1985). Mean vitrinite reflectance values and contours are given by Houseknecht and Matthews (1985). B. Crystallinity values for the air-dried coarse clay fraction of chlorite d(002). Crystallinity is given in FWHM °2Θ CuKα. Mean apparent diameter of recrystallized quartz are given by Keller et al. (1985). Mean vitrinite reflectance values and contours are given by Houseknecht and Matthews (1985).

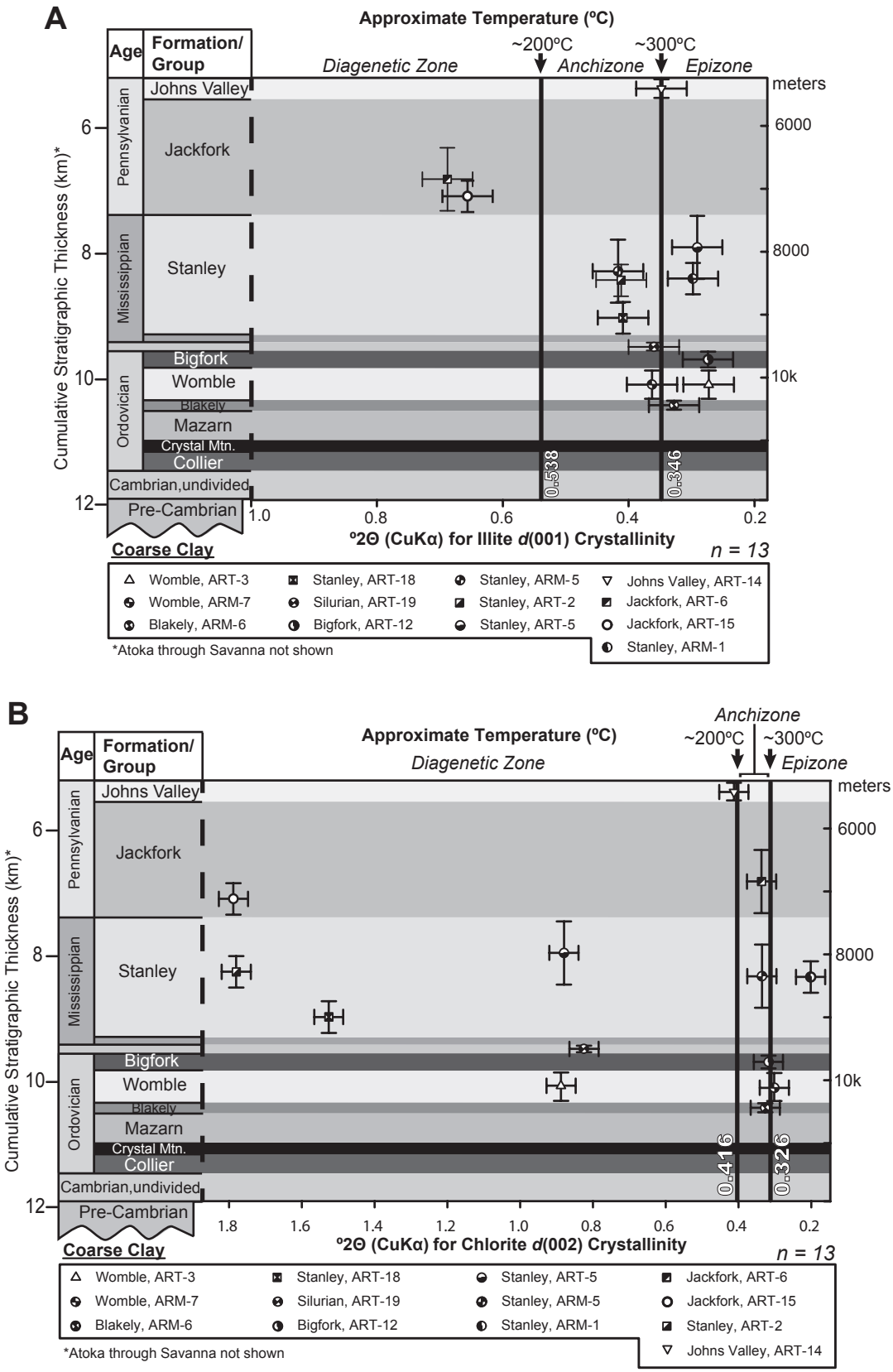

Figure S2. Coarse clay crystallinity of samples vs. the cumulative stratigraphic thickness for (A) illite and (B) chlorite. All samples K-saturated, air-dried and X-rayed at room temperature. Cumulative stratigraphic thickness is the thickness of sediments above a particular sample that would have existed assuming no erosion (values determined from Fig. 3).

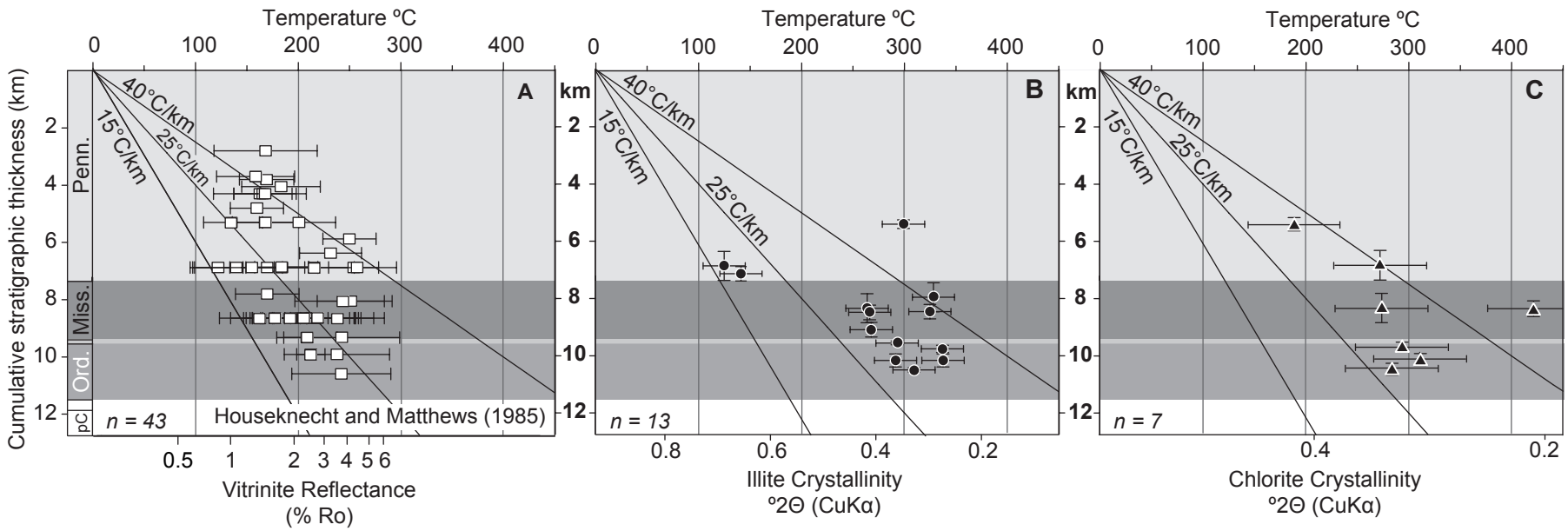

Figure S3. Comparison with different types of thermal maturation. A. Vitrinite reflectance. B. Illite crystallinity. C. Chlorite crystallinity. Plotted peak temperatures based on VR calculated using equation, Tpeak = (ln(VR) + 1.680/0.0124, for burial-related maturation (Barker and Pawlewicz, 1994). Filled symbols are coarse clay data. Not all crystallinity data are plotted because the FWHM exceed the X-axis at this scale, and see supplemental Figs.1 and 2 for plots of all data. See Fig. 3 for cumulative stratigraphic thickness. Both measures of thermal maturation measures increase toward exposed eastern Ouachita metamorphic core to reach lower greenschist transition.

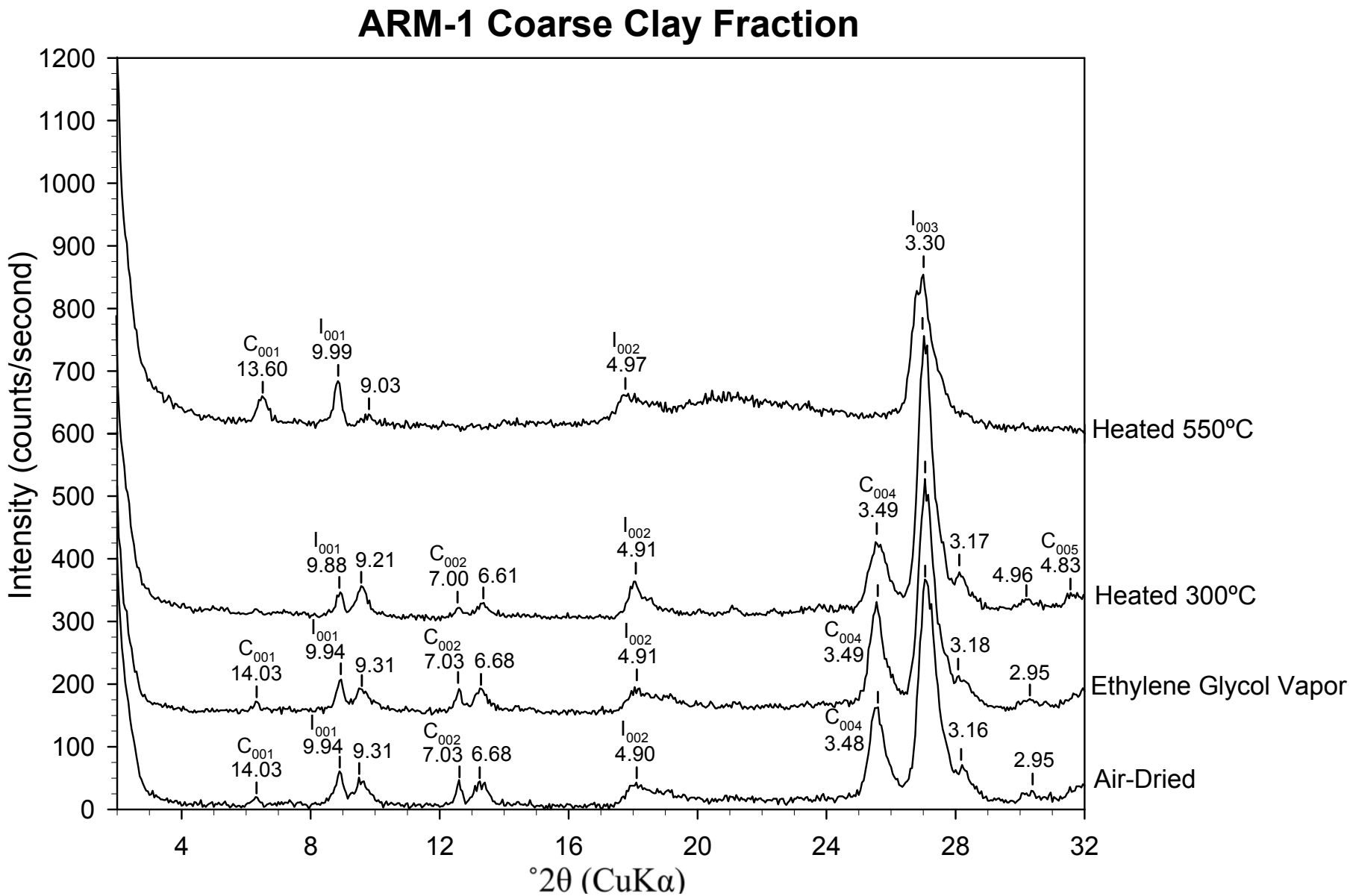

Figure S4. ARM-1 Coarse clay diffractogram with peak positions indicated.

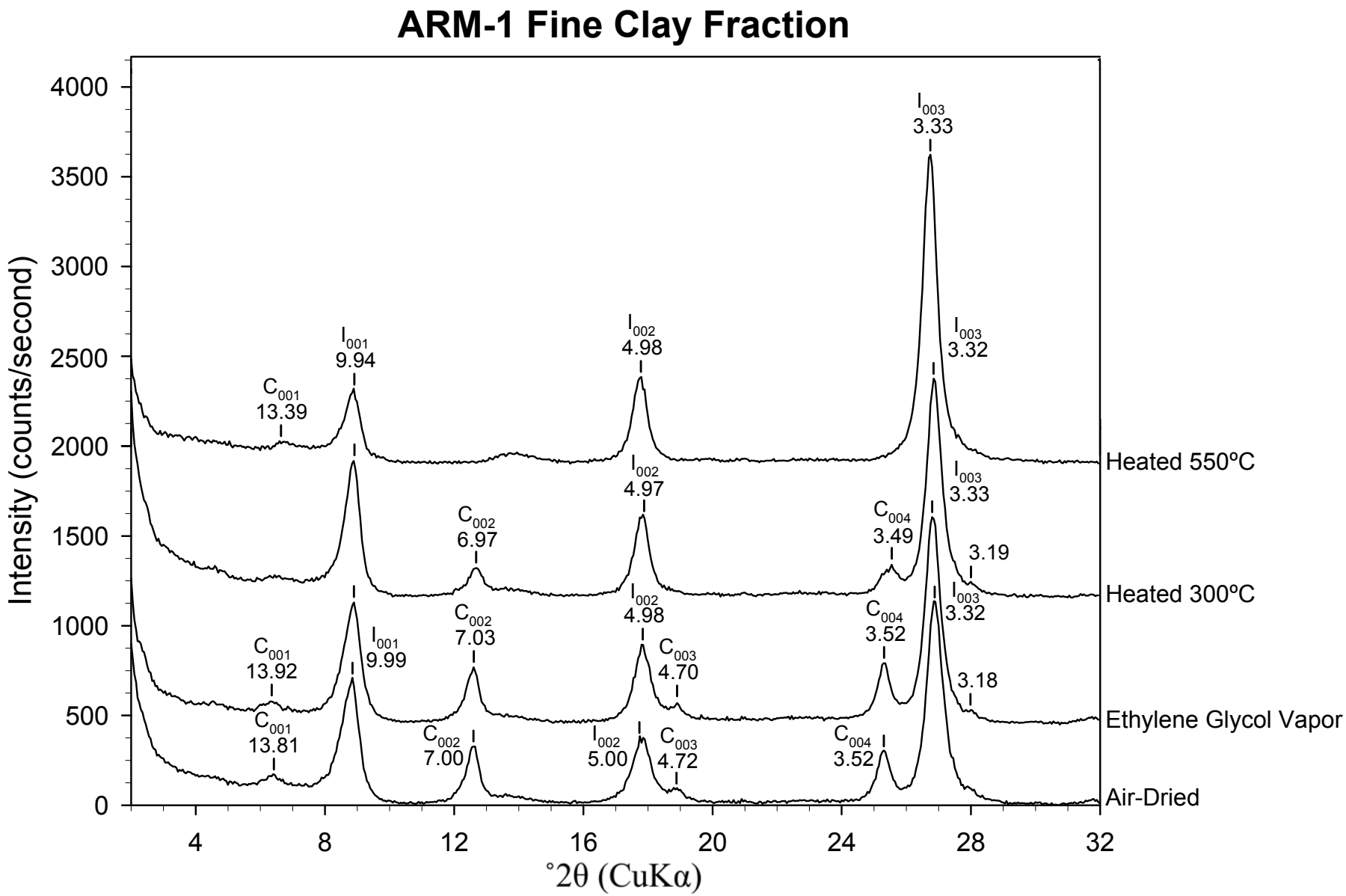

Figure S5. ARM-1 Fine clay diffractogram with peak positions indicated.

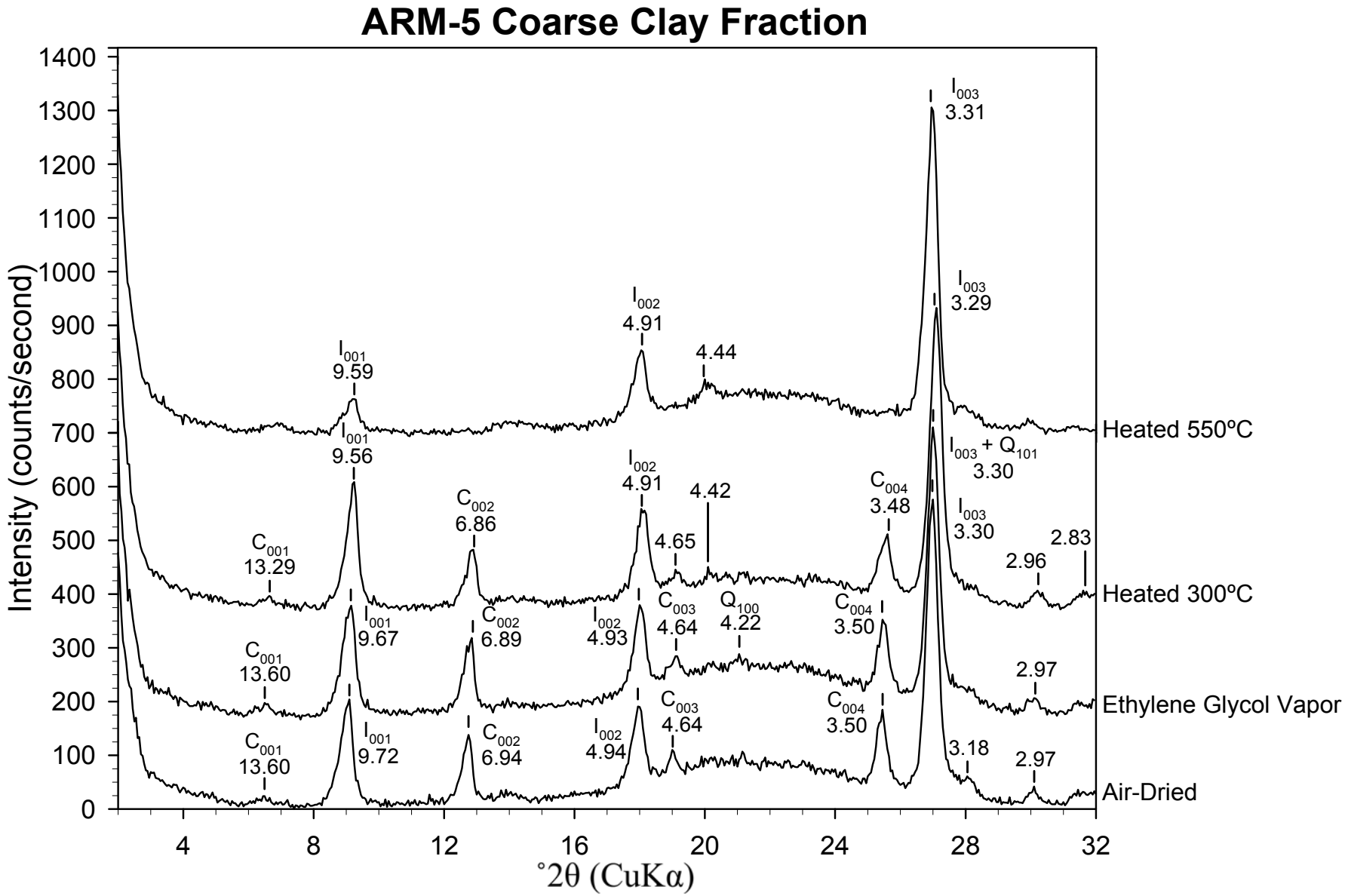

Figure S6. ARM-5 Coarse clay diffractogram with peak positions indicated.

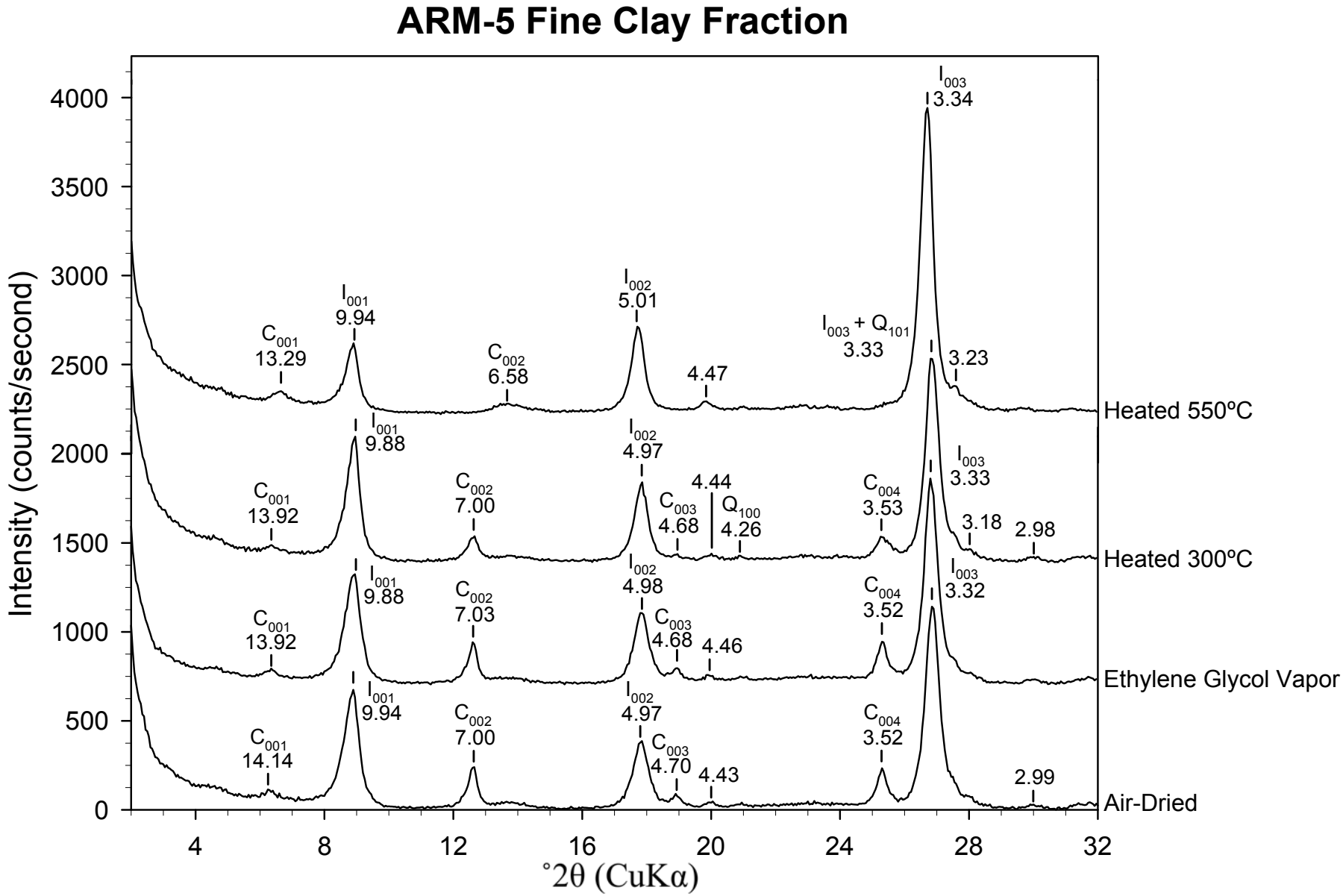

Figure S7. ARM-5 Fine clay diffractogram with peak positions indicated.

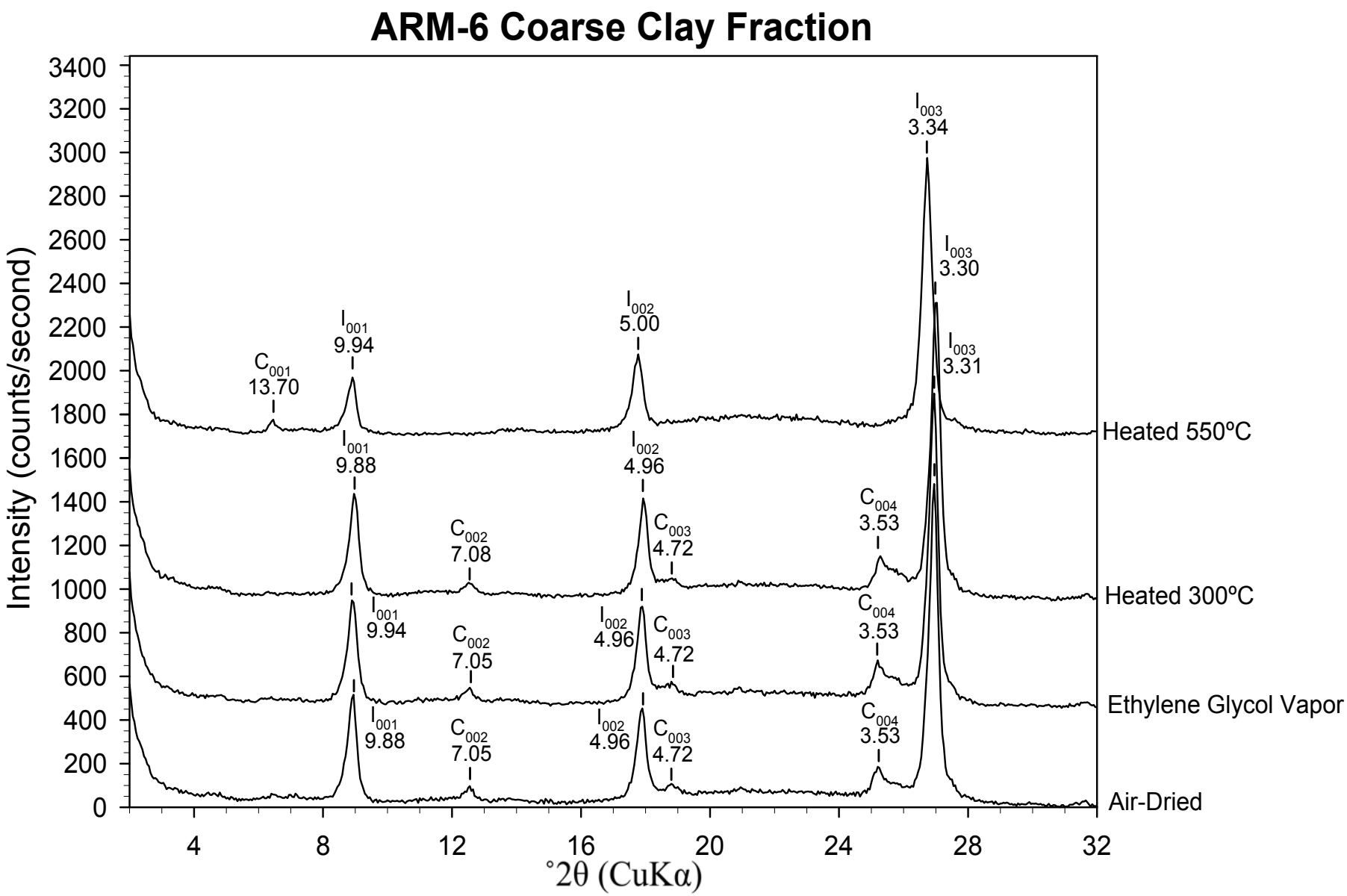

Figure S8. ARM-6 Coarse clay diffractogram with peak positions indicated.

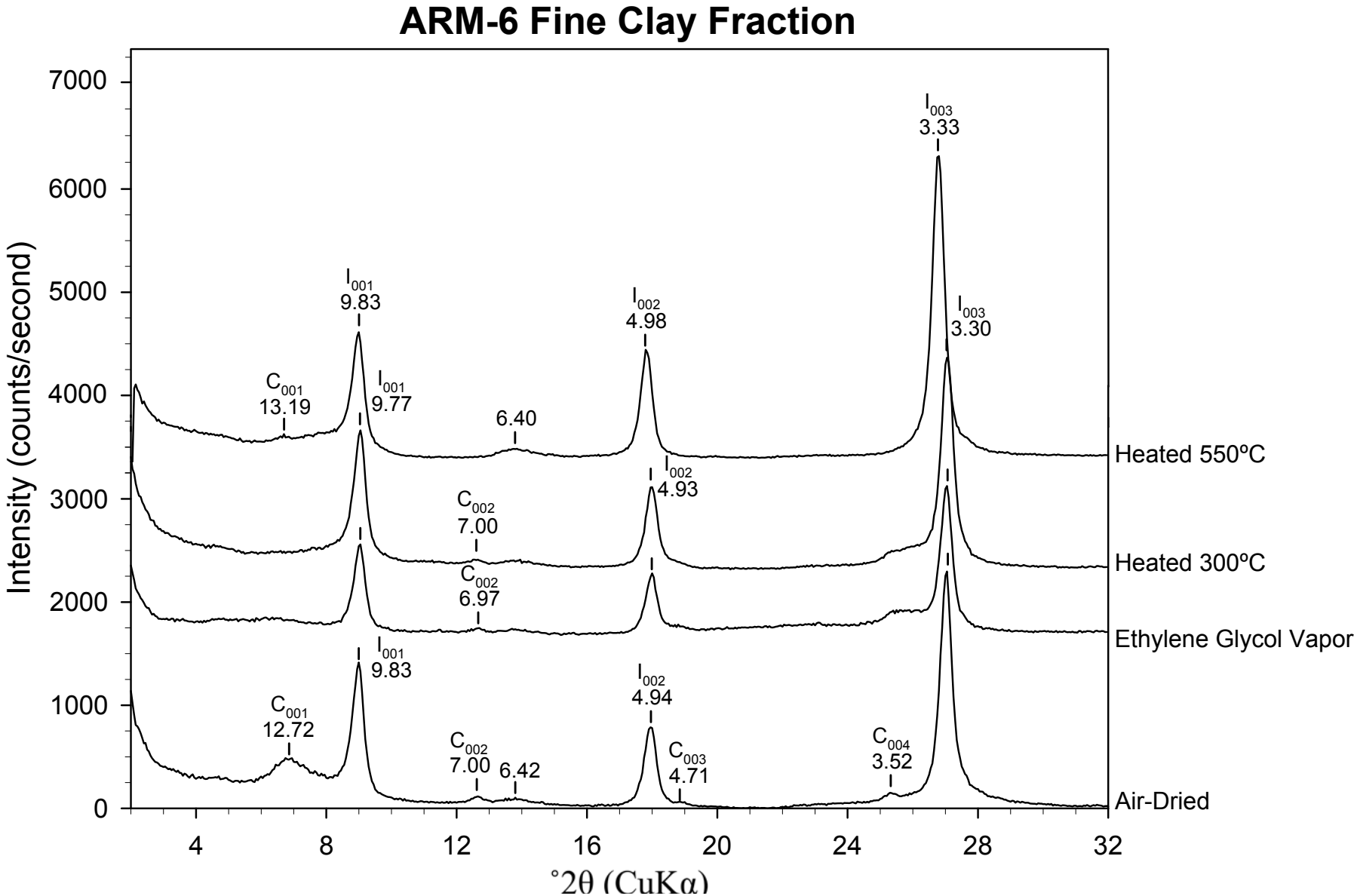

Figure S9. ARM-6 Fine clay diffractogram with peak positions indicated.

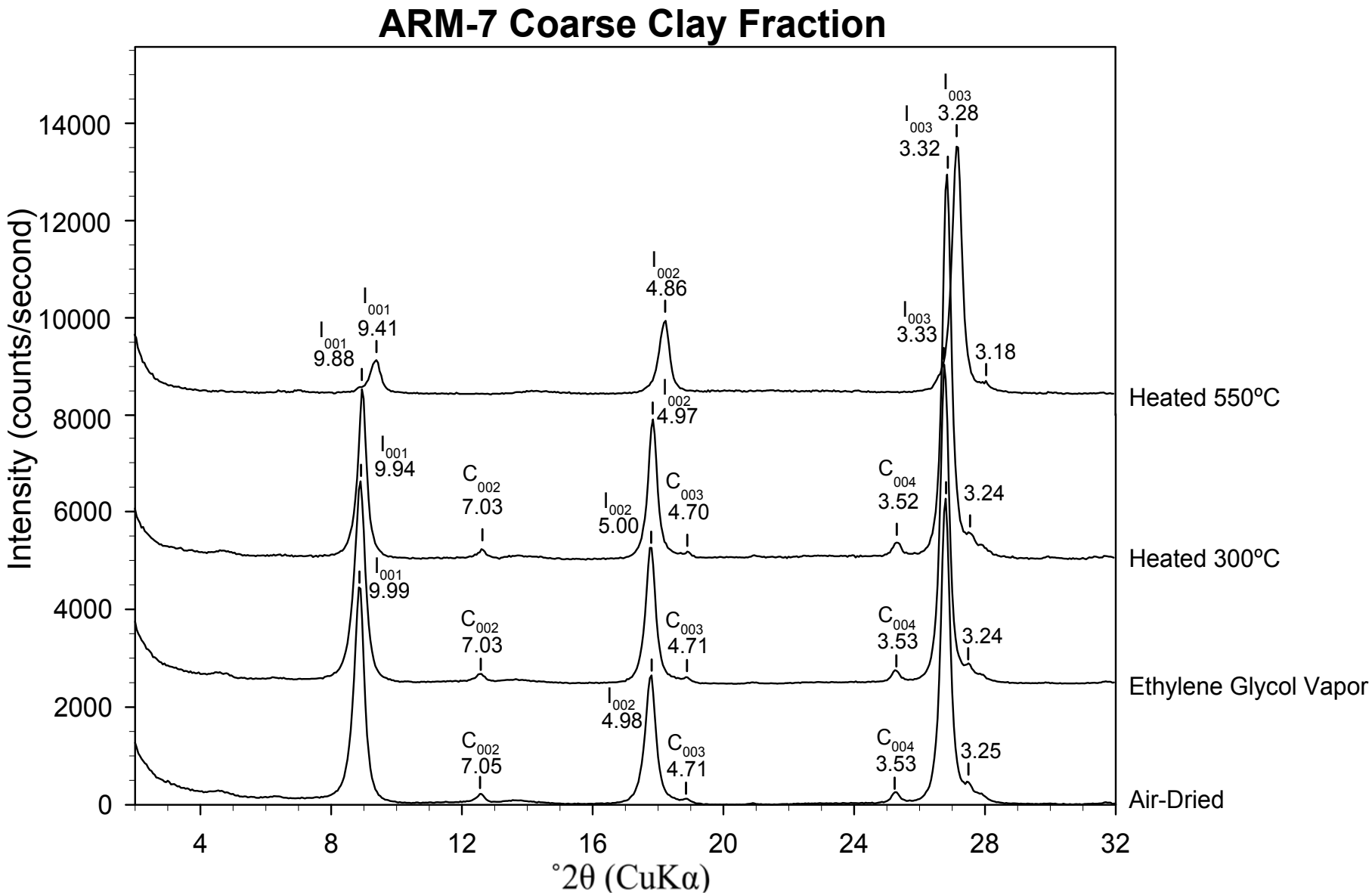

Figure S10. ARM-7 Coarse clay diffractogram with peak positions indicated.

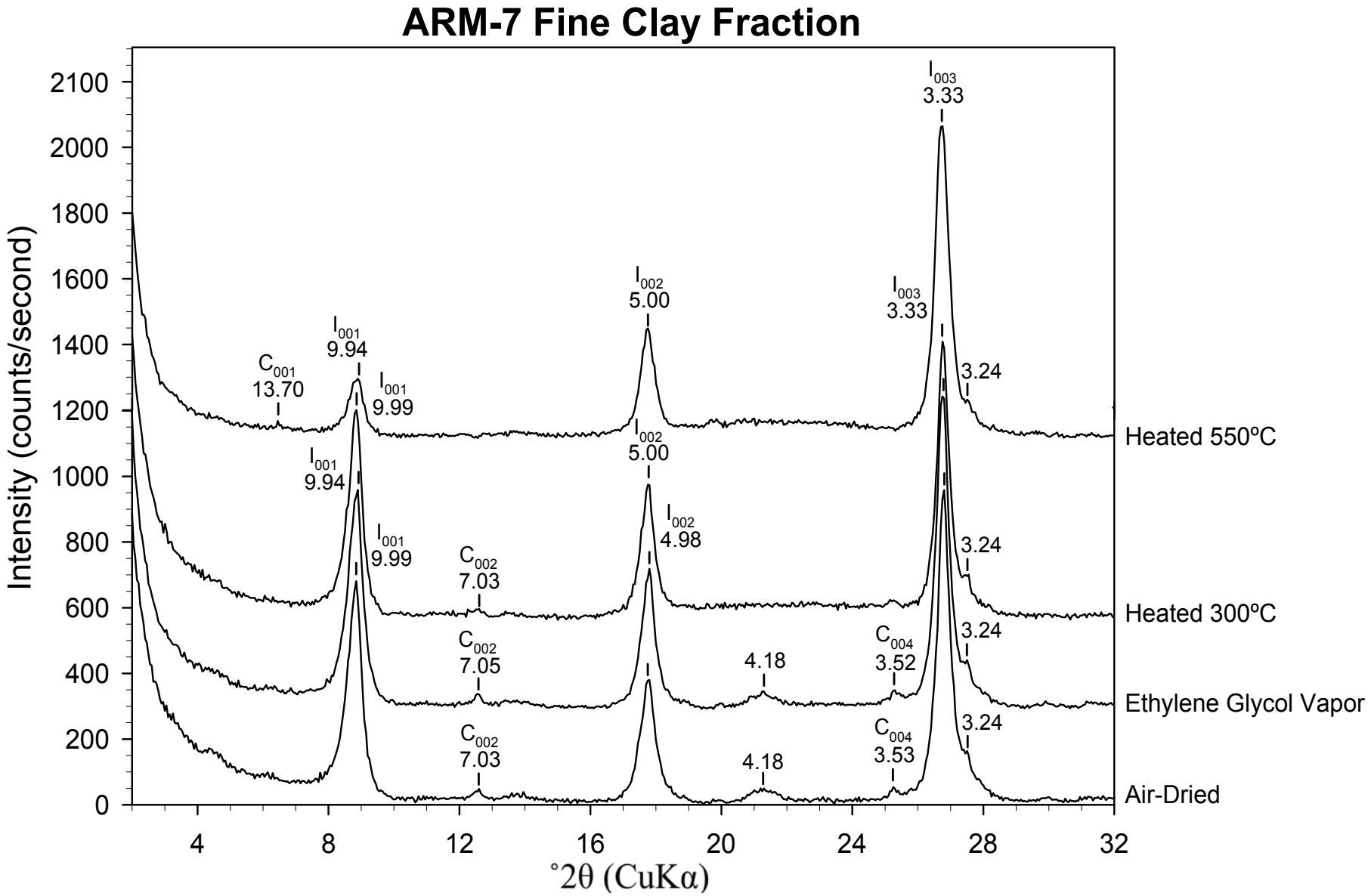

Figure S11. ARM-7 Fine clay diffractogram with peak positions indicated.

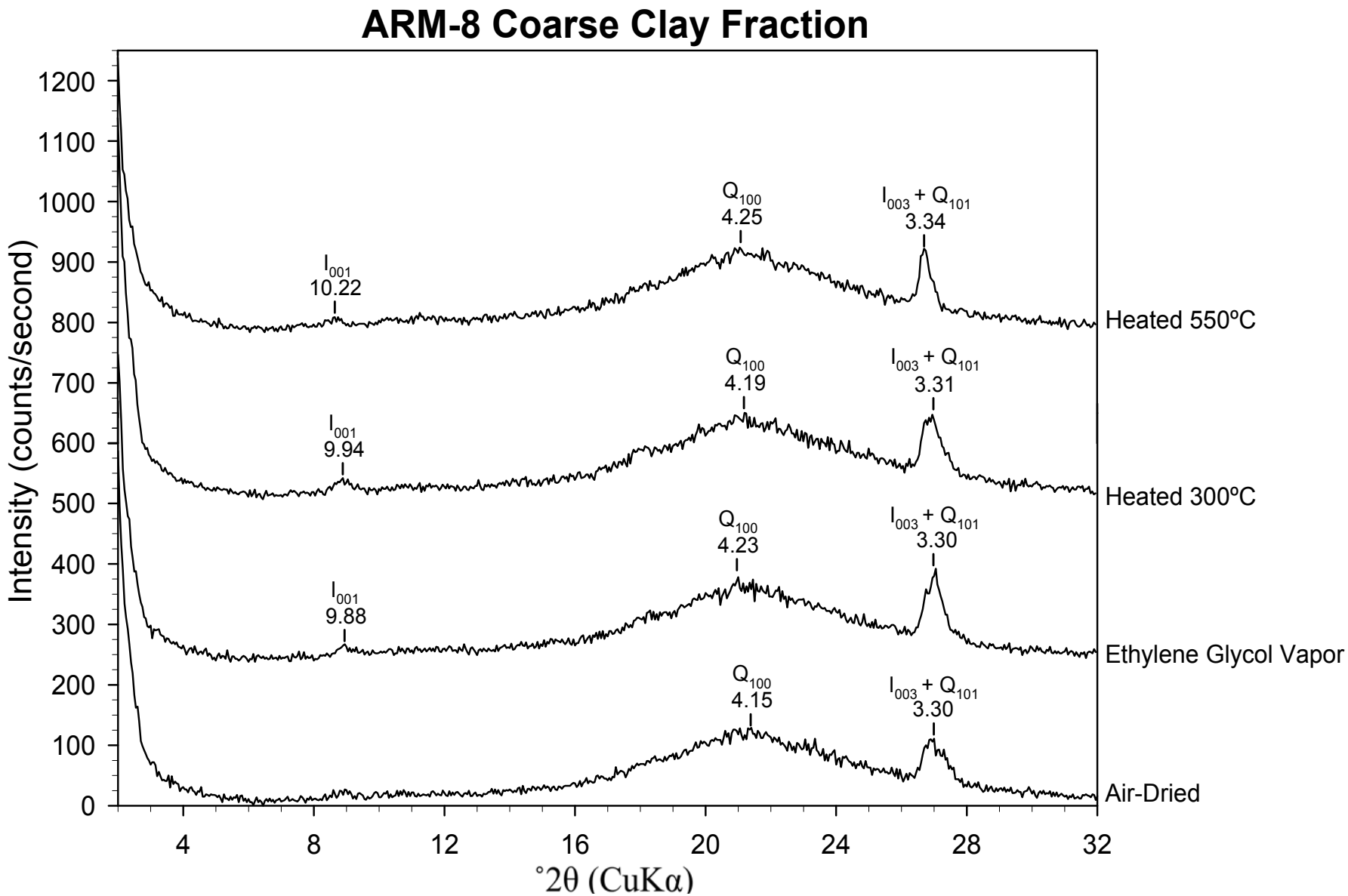

Figure S12. ARM-8 Coarse clay diffractogram with peak positions indicated.

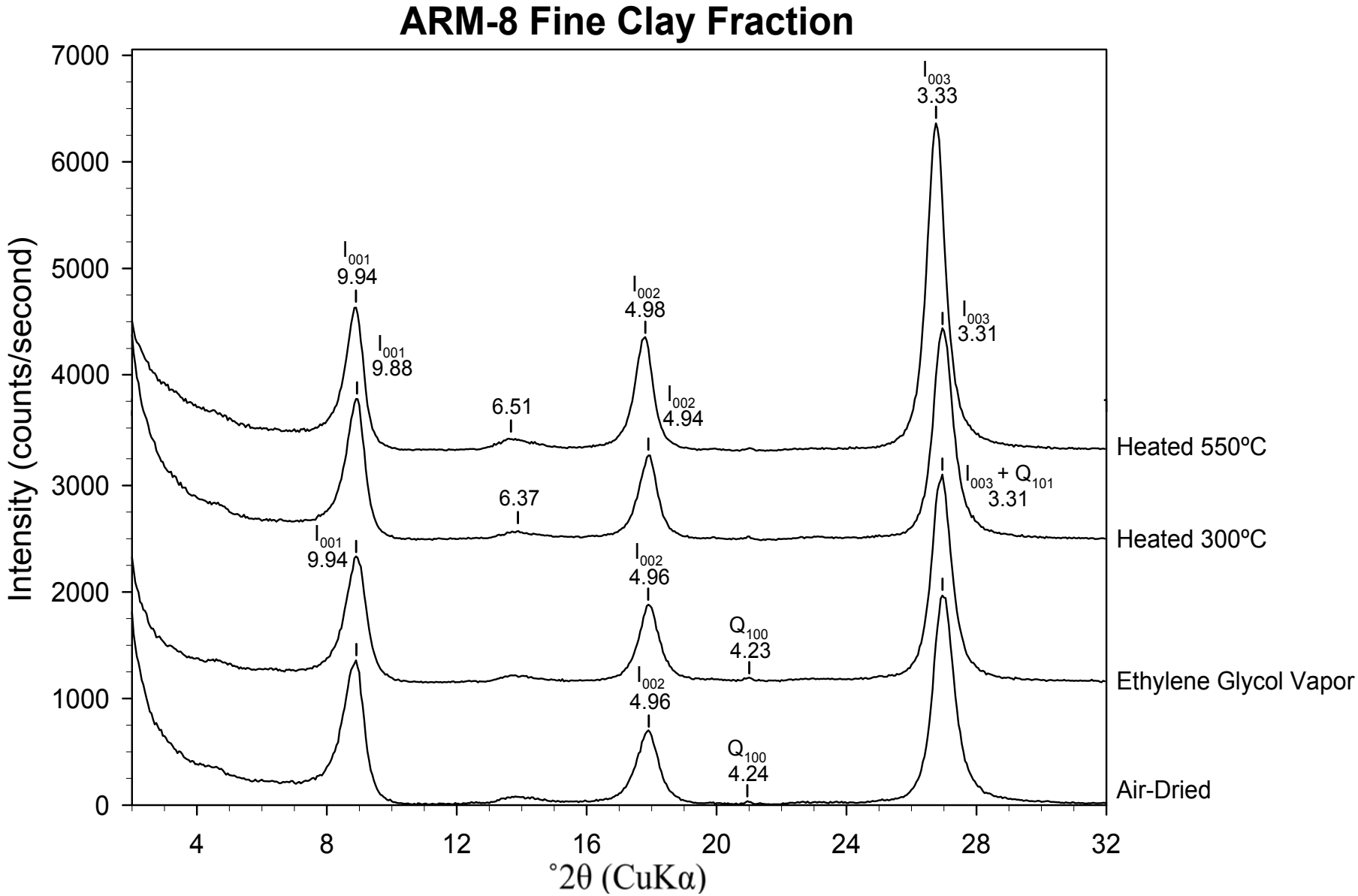

Figure S13. ARM-8 Fine clay diffractogram with peak positions indicated.

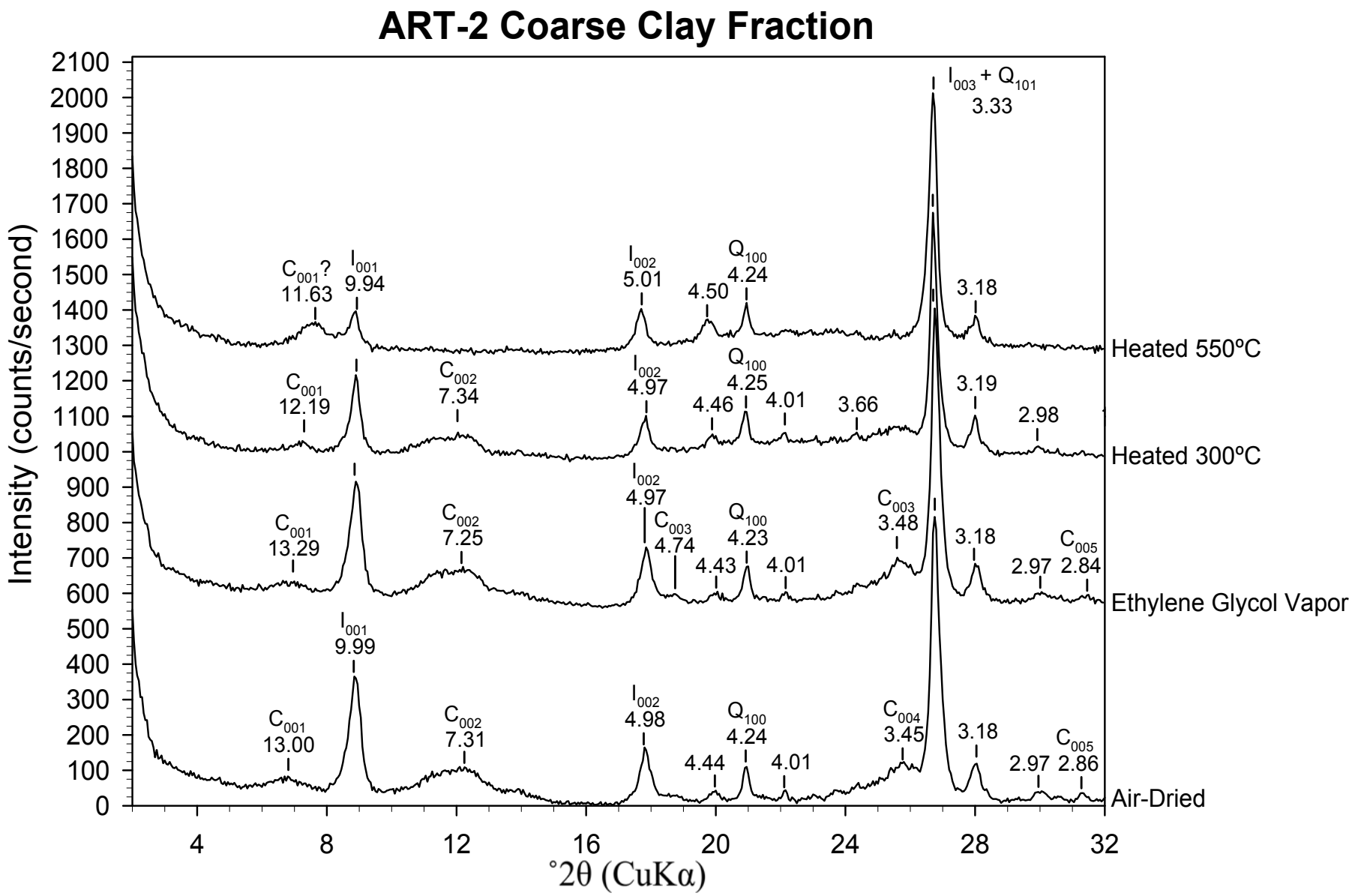

Figure S14. ART-2 Coarse clay diffractogram with peak positions indicated.

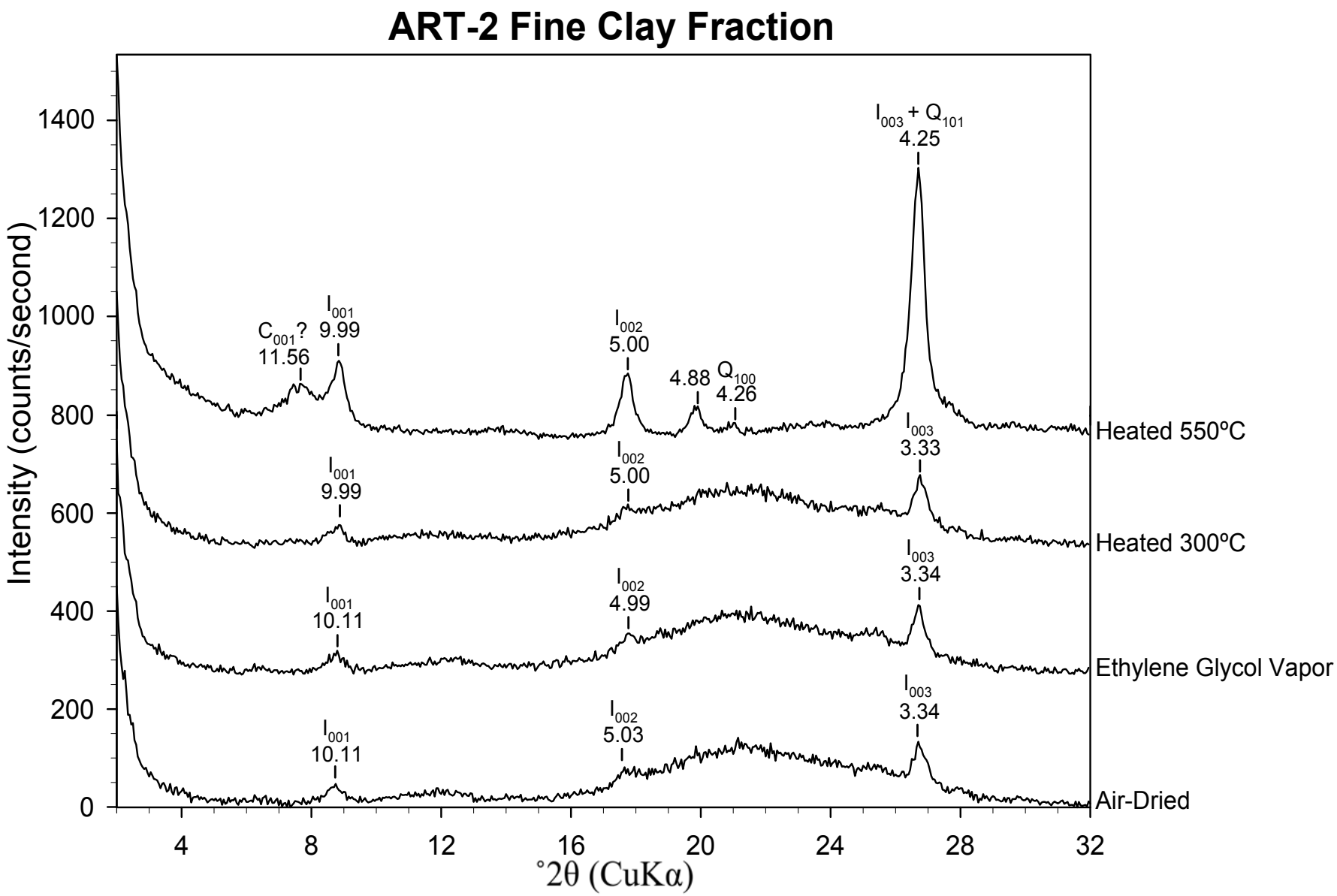

Figure S15. ART-2 Fine clay diffractogram with peak positions indicated.

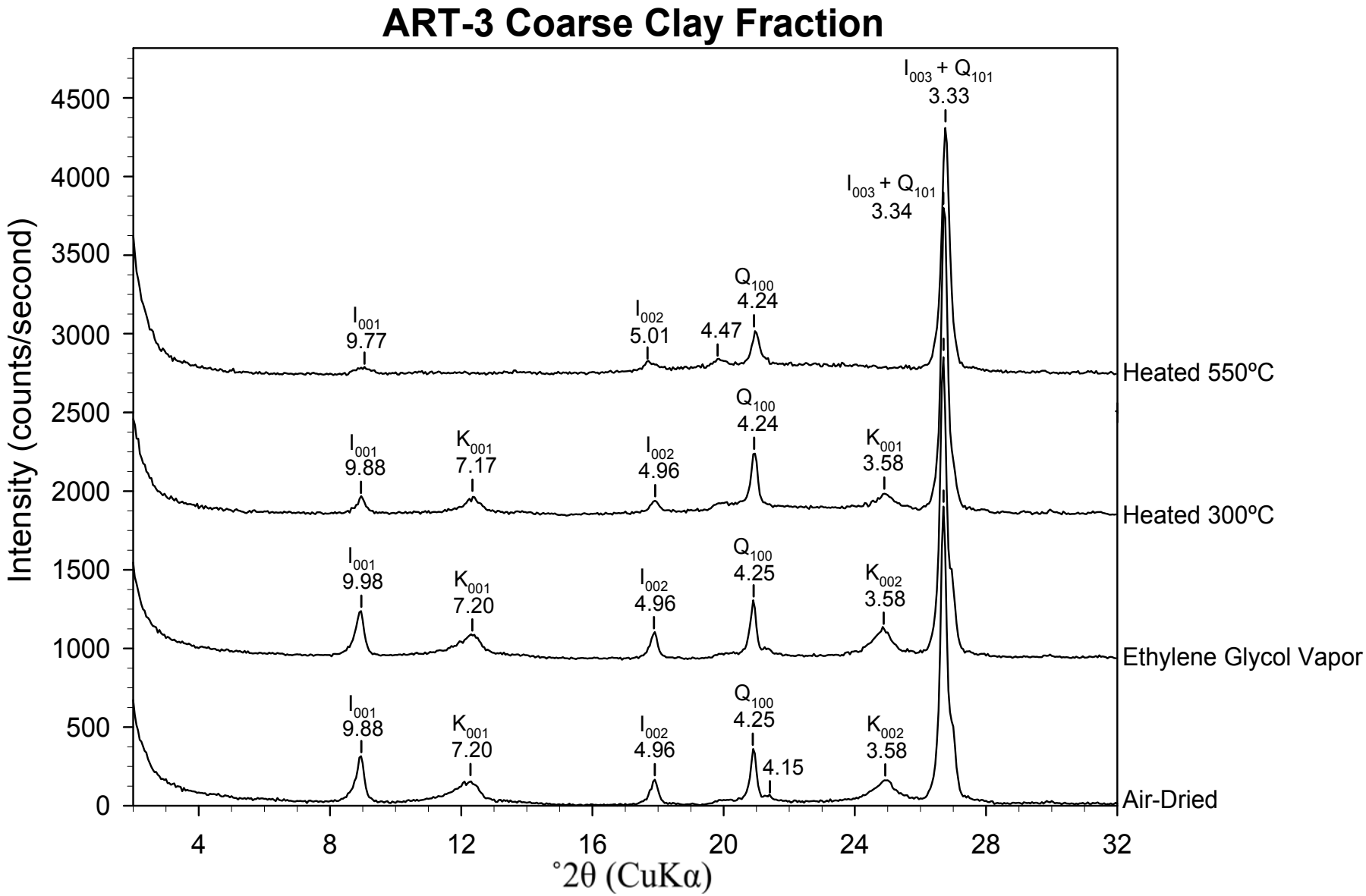

Figure S16. ART-3 Coarse clay diffractogram with peak positions indicated.

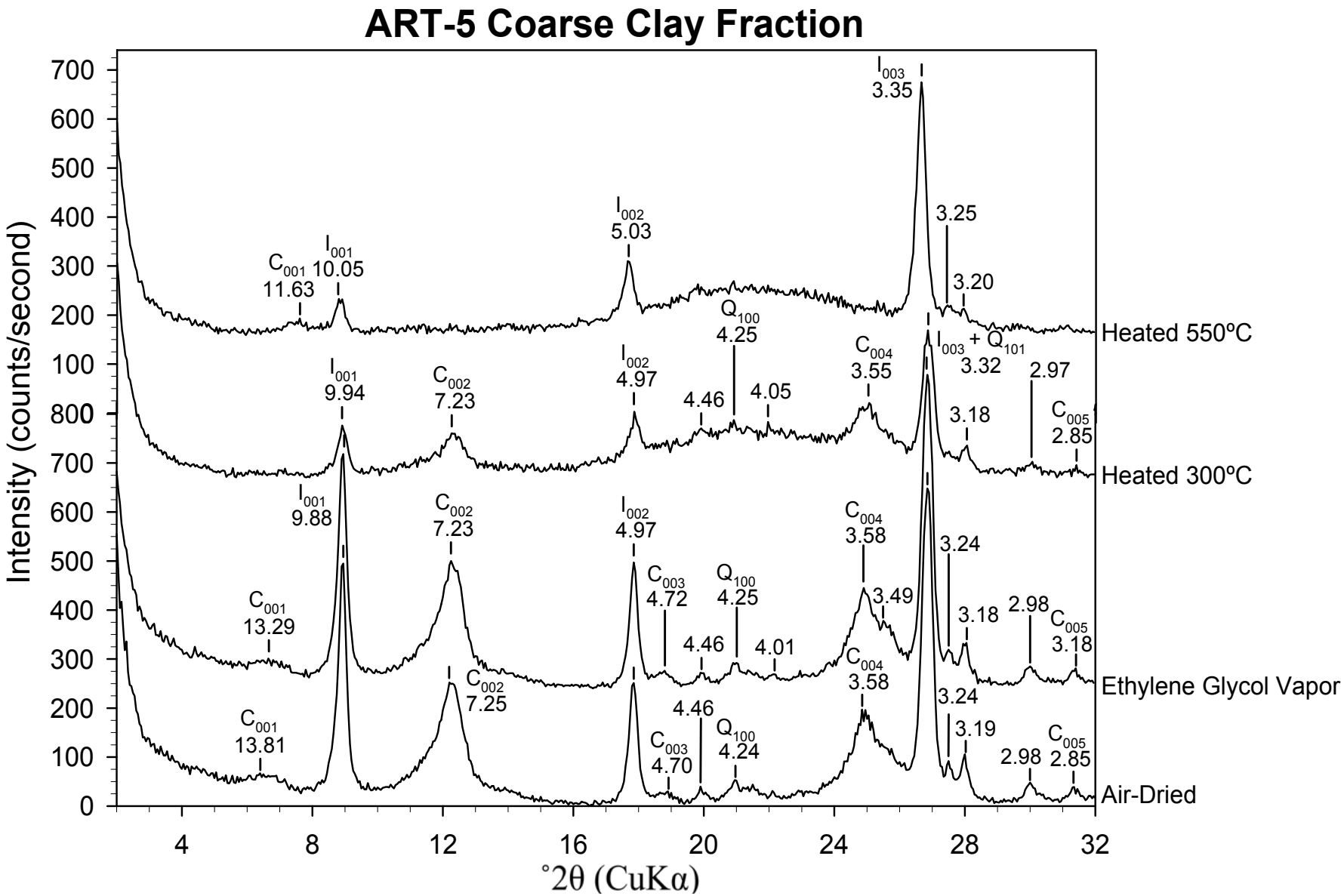

Figure S17. ART-5 Coarse clay diffractogram with peak positions indicated.

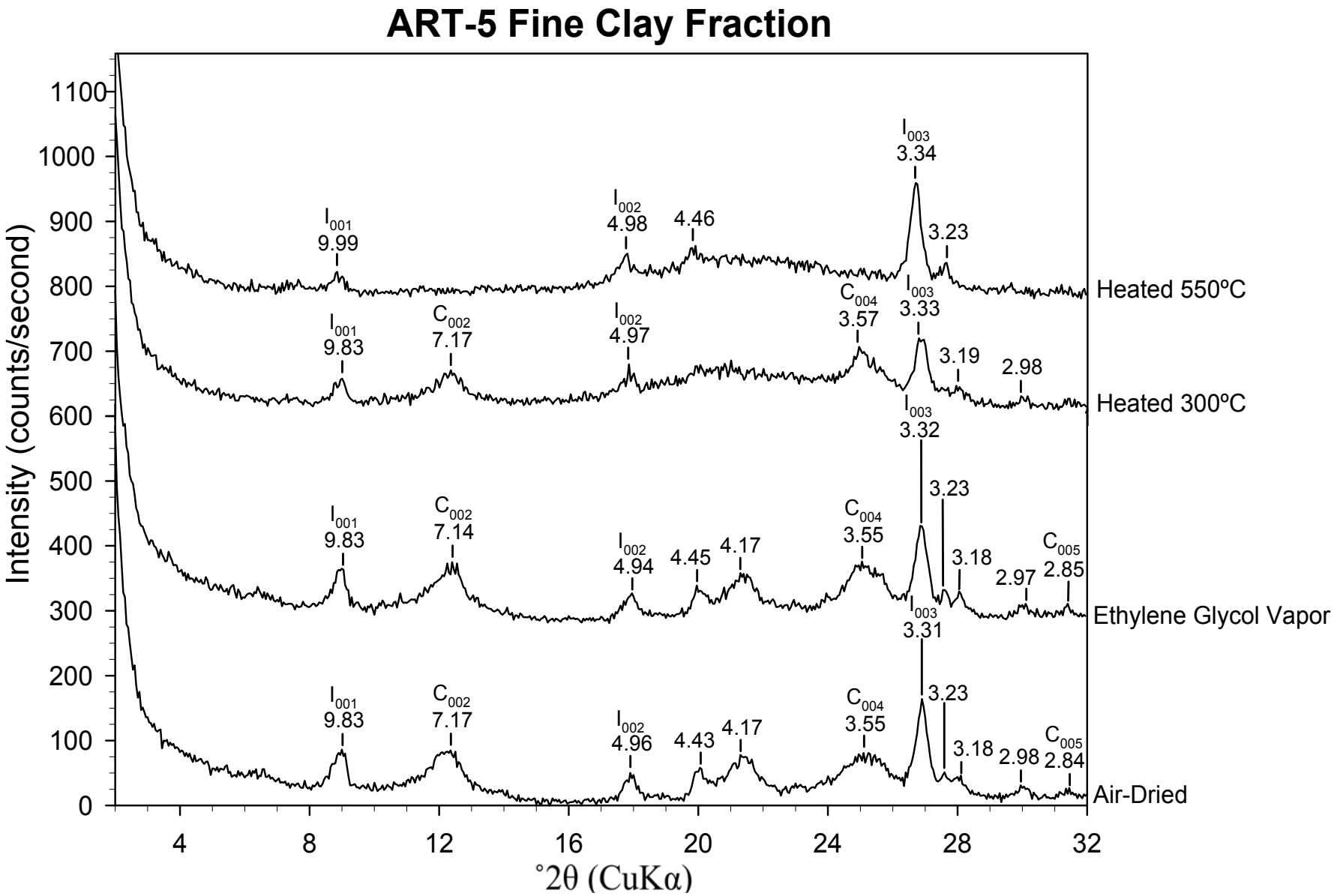

Figure S18. ART-5 Fine clay diffractogram with peak positions indicated.

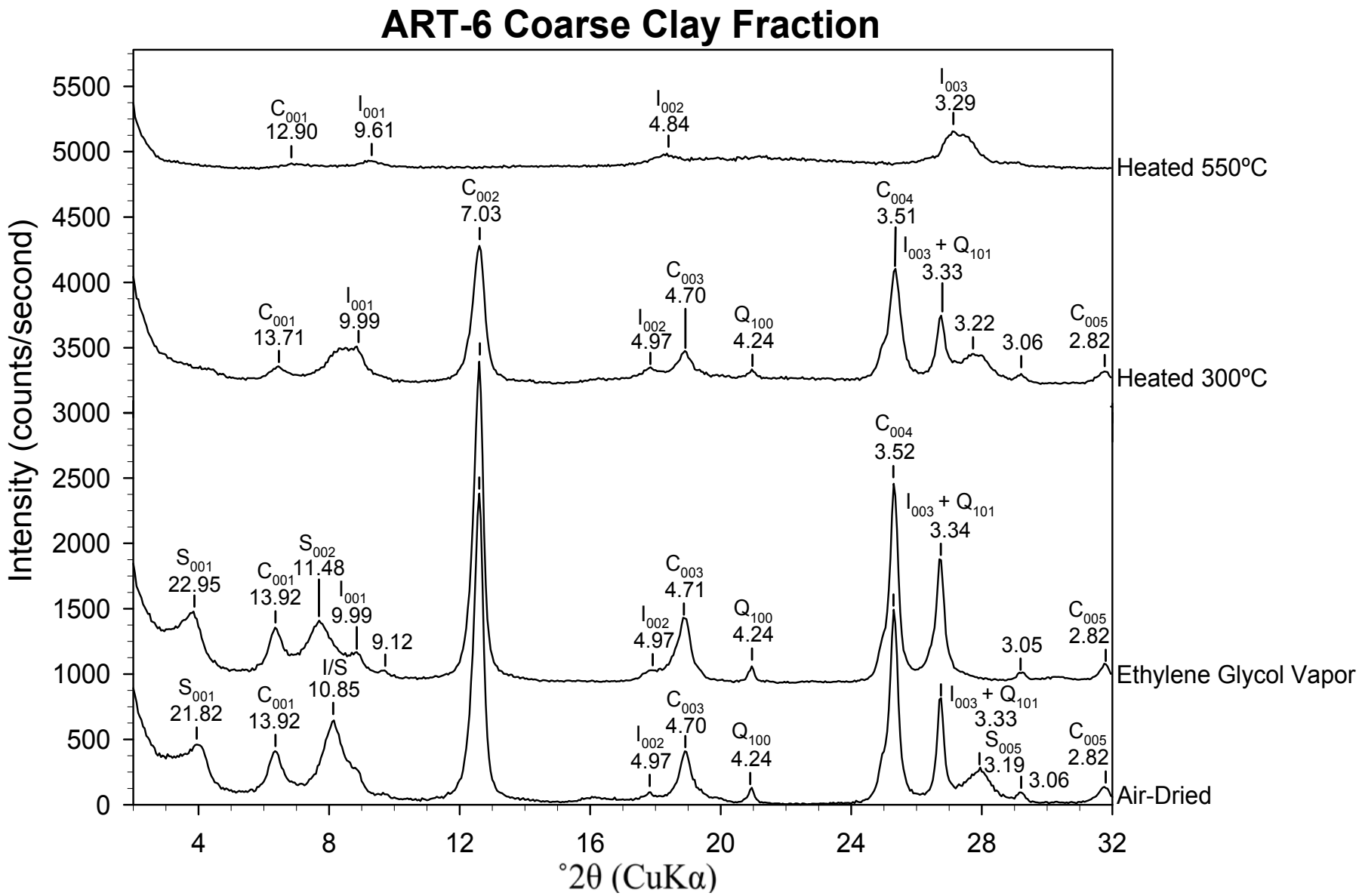

Figure S19. ART-6 Coarse clay diffractogram with peak positions indicated.

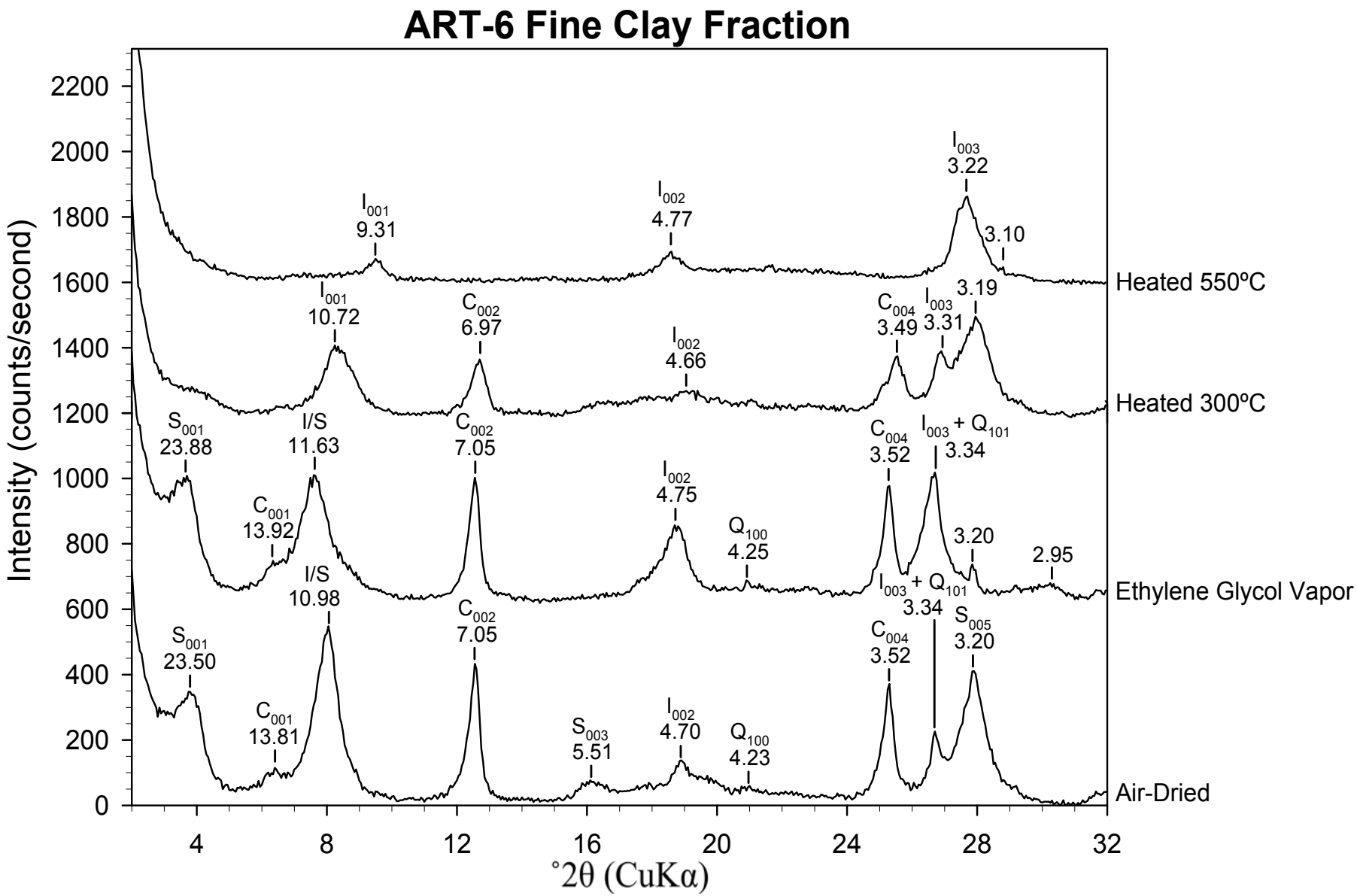

Figure S20. ART-6 Fine clay diffractogram with peak positions indicated.

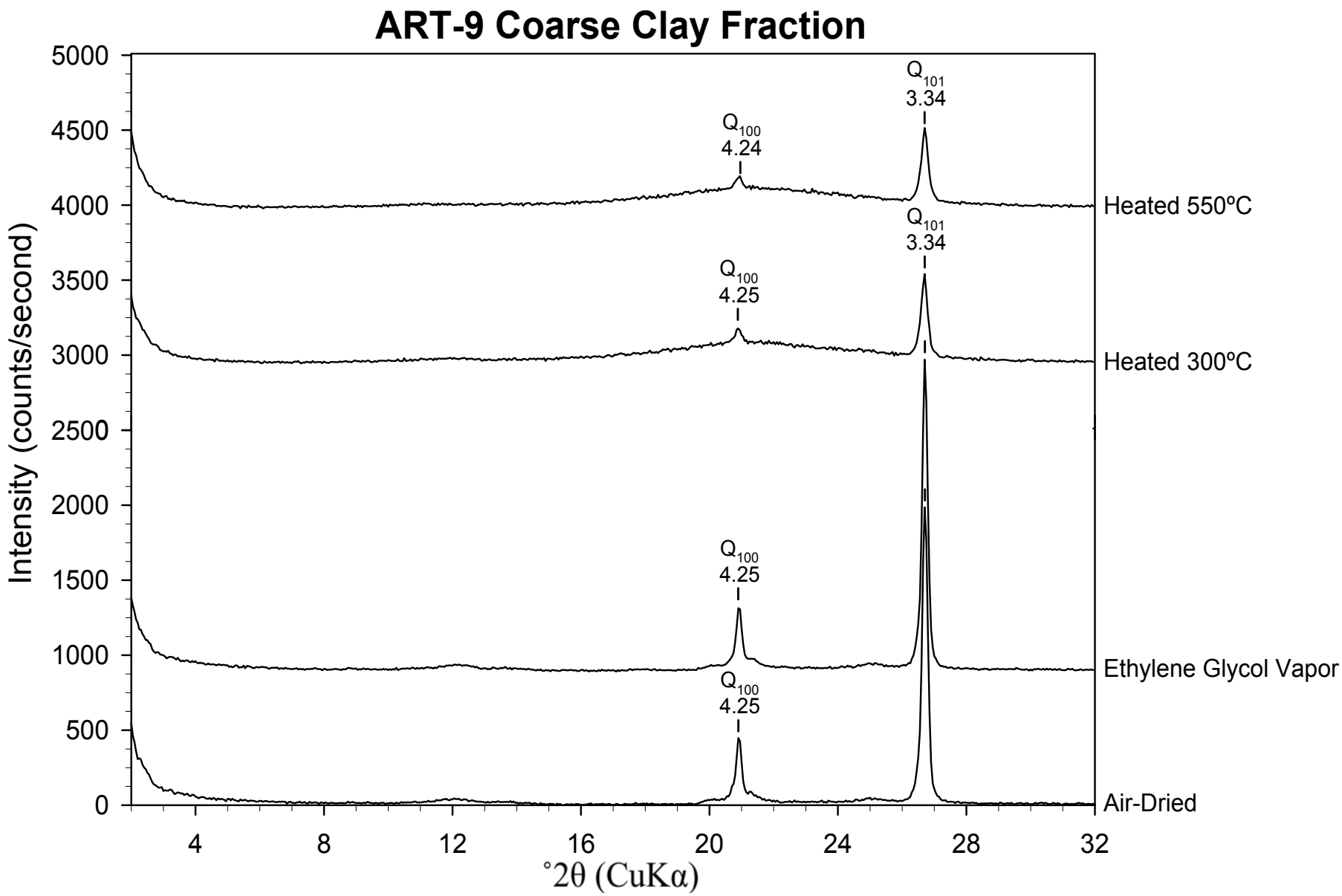

Figure S21. ART-9 Coarse clay diffractogram with peak positions indicated.

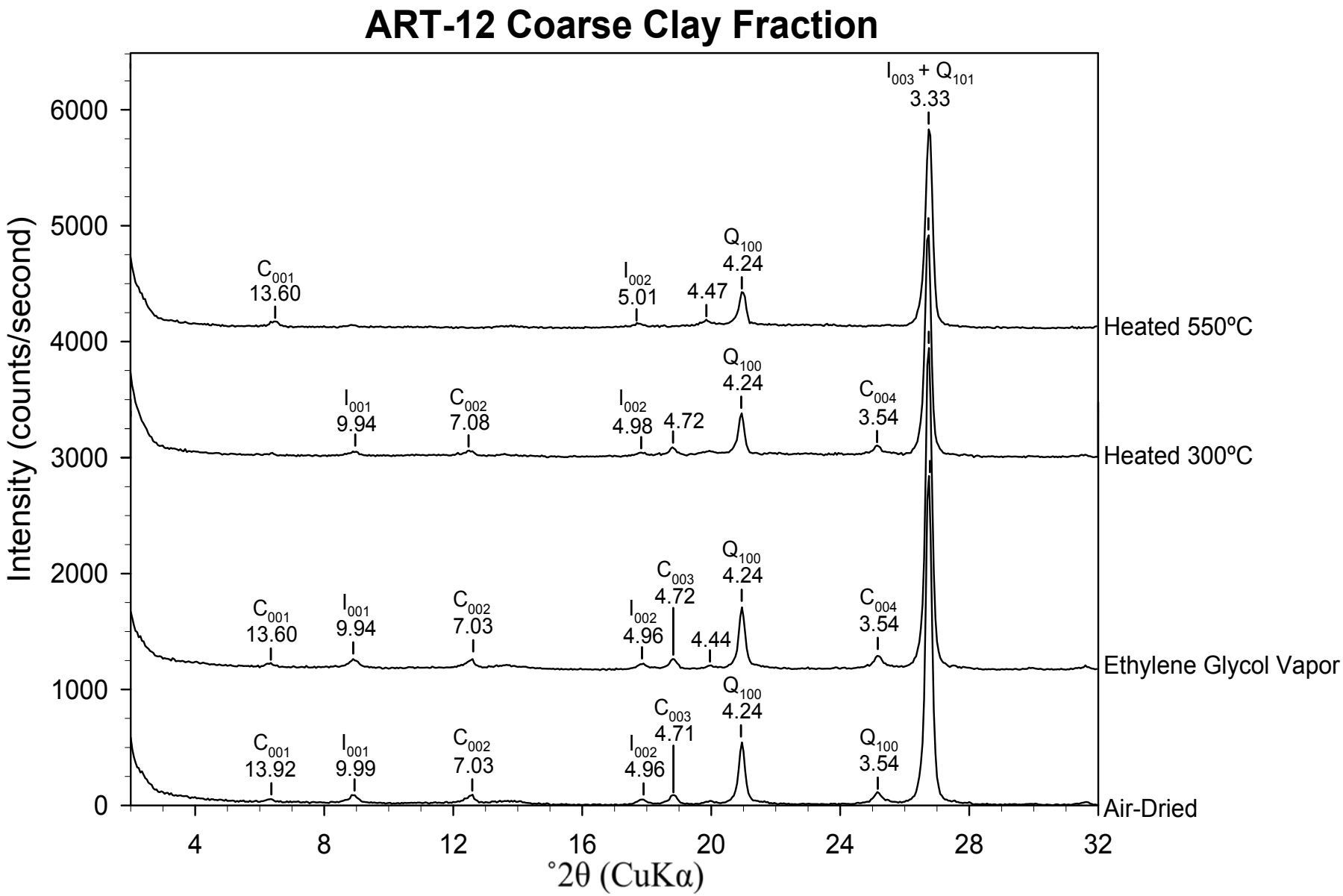

Figure S22. ART-12 Coarse clay diffractogram with peak positions indicated.

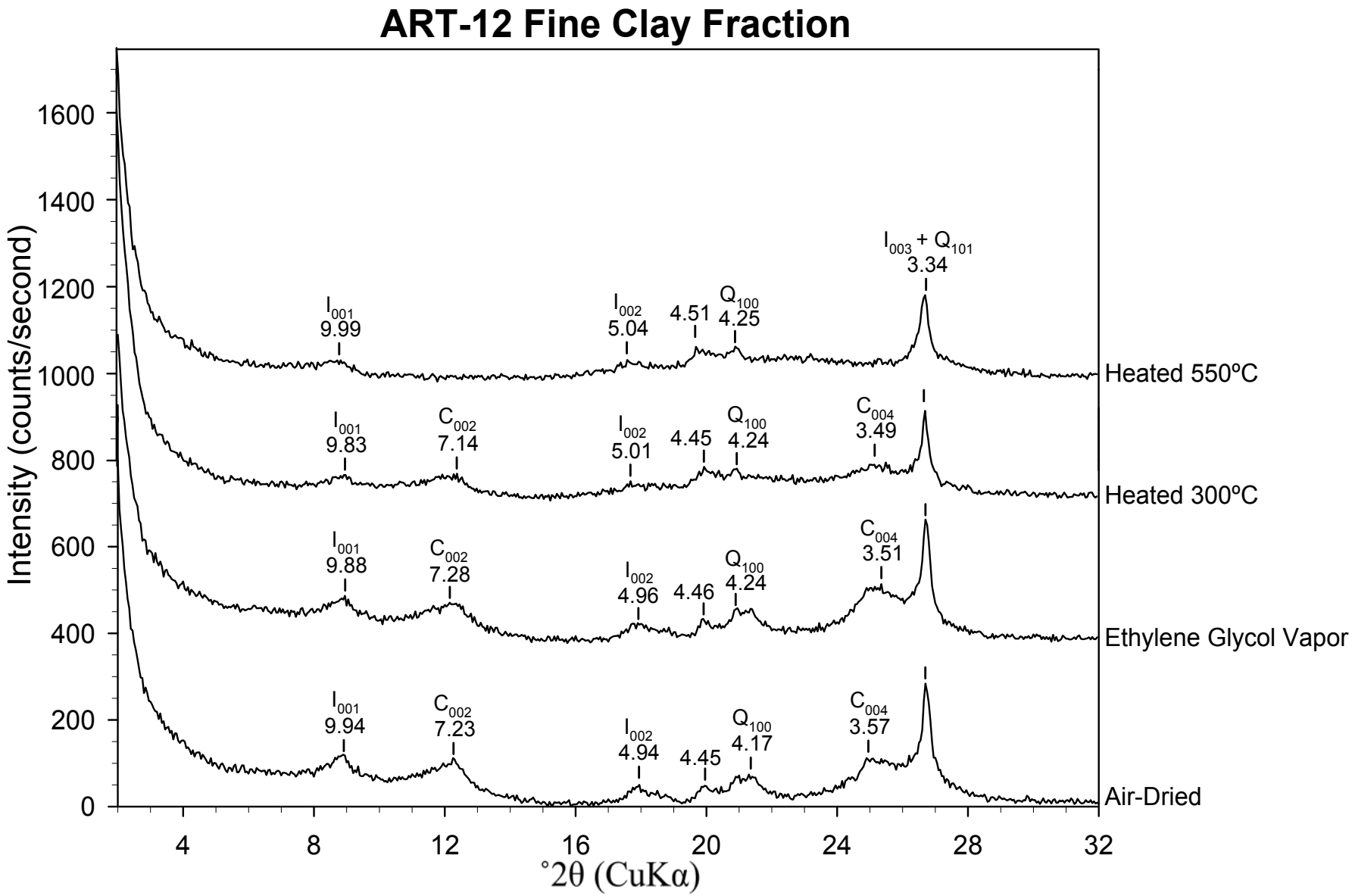

Figure S23. ART-12 Fine clay diffractogram with peak positions indicated.

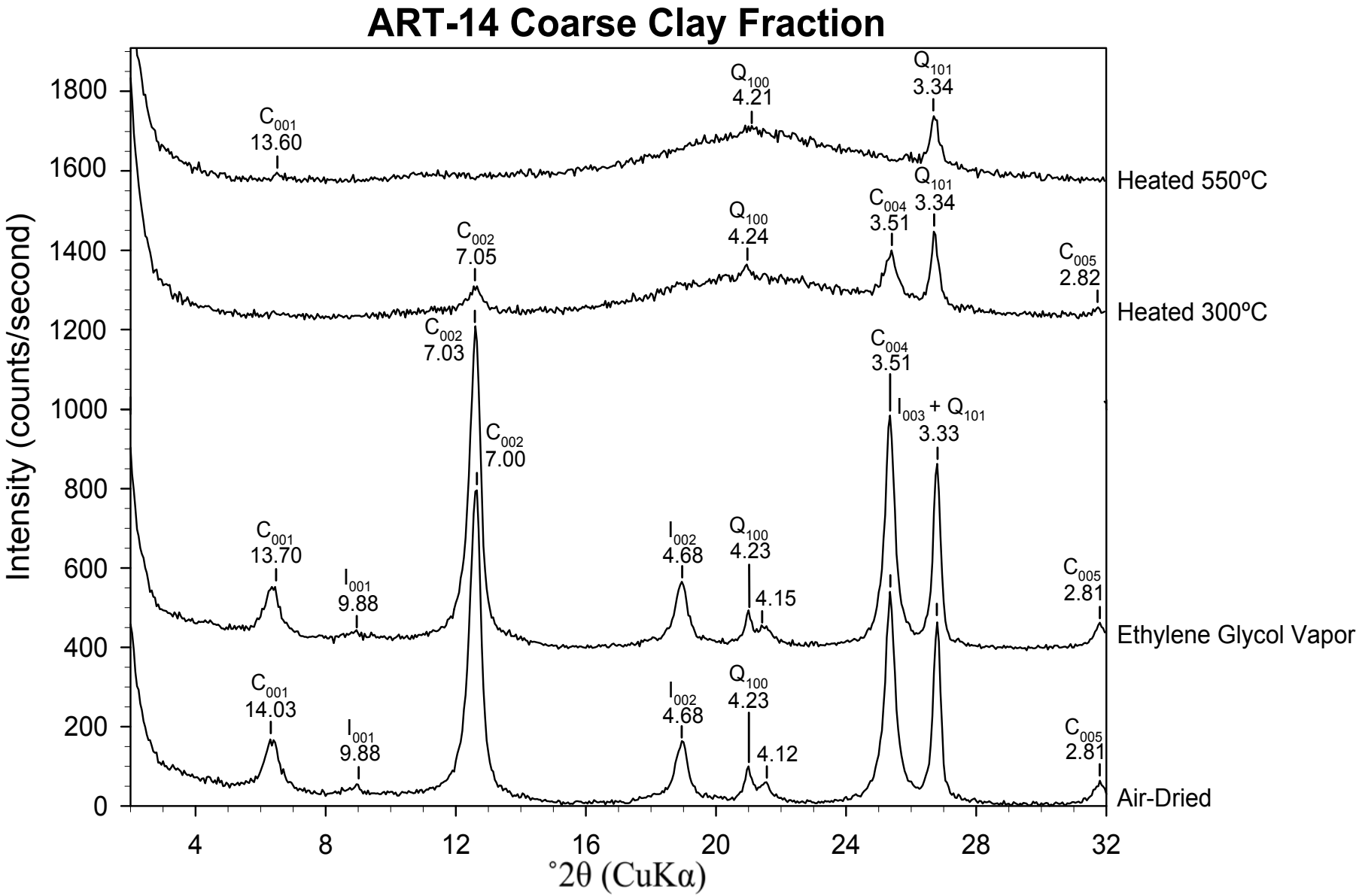

Figure S24. ART-14 Coarse clay diffractogram with peak positions indicated.

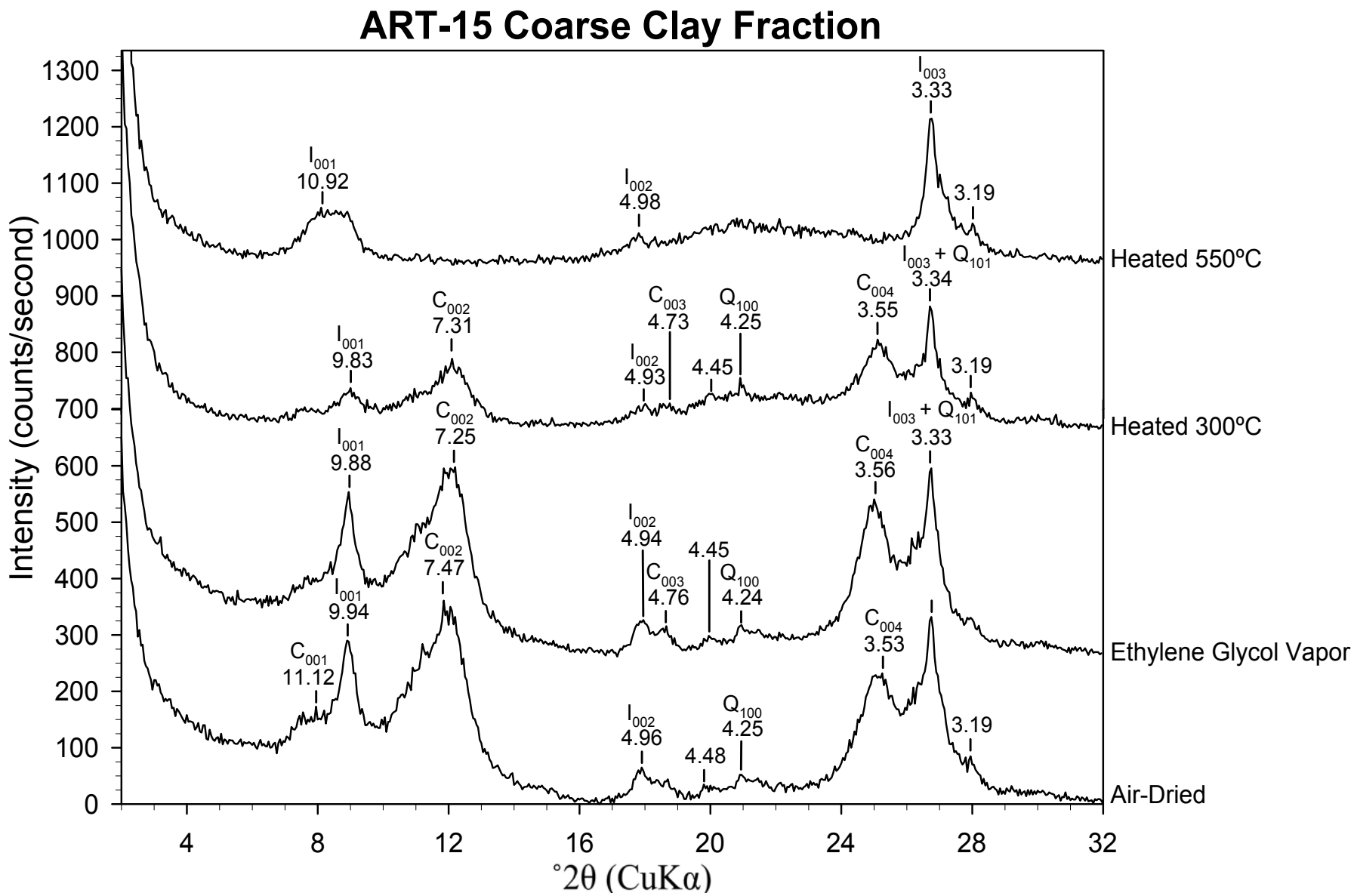

Figure S25. ART-15 Coarse clay diffractogram with peak positions indicated.

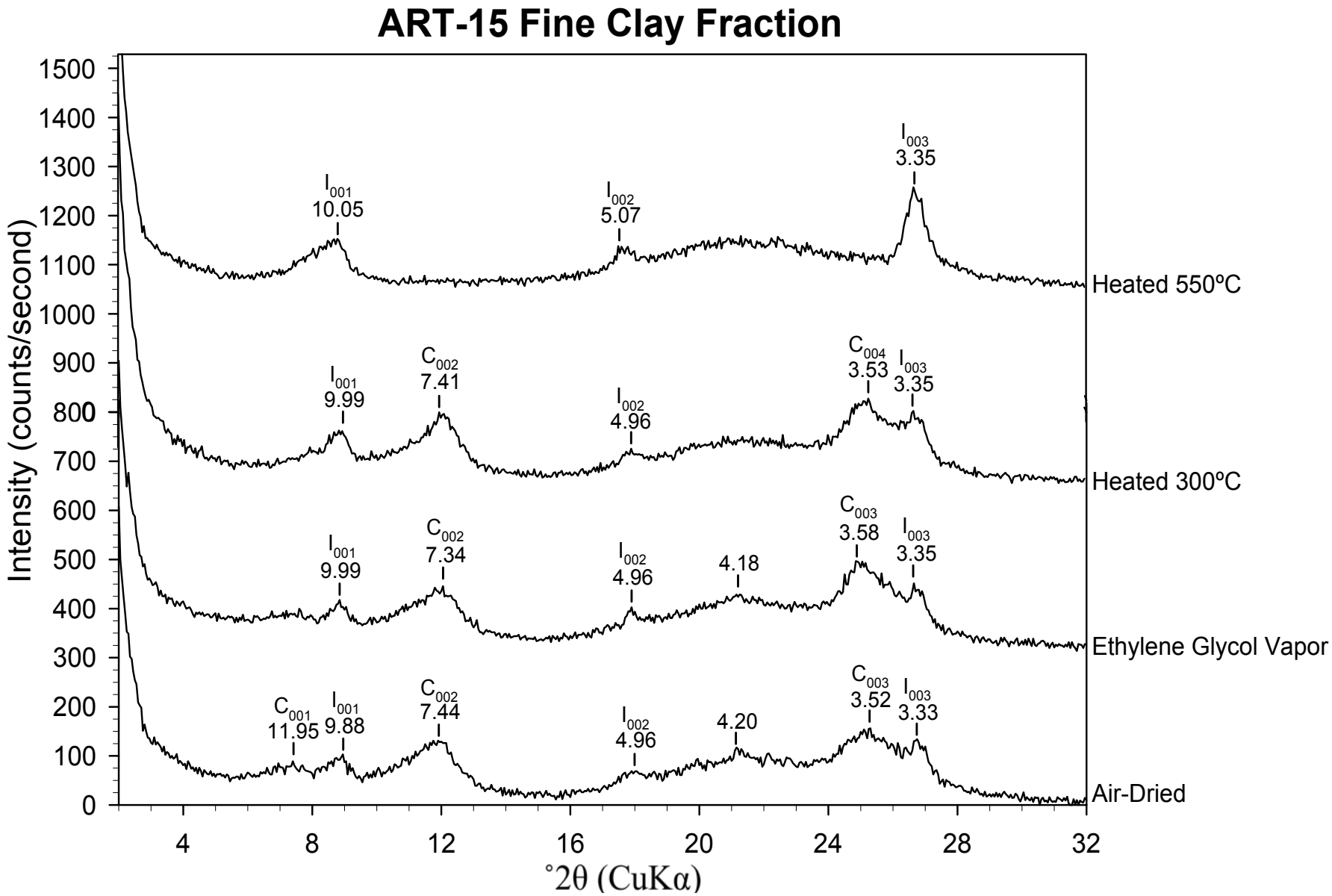

Figure S26. ART-15 Fine clay diffractogram with peak positions indicated.

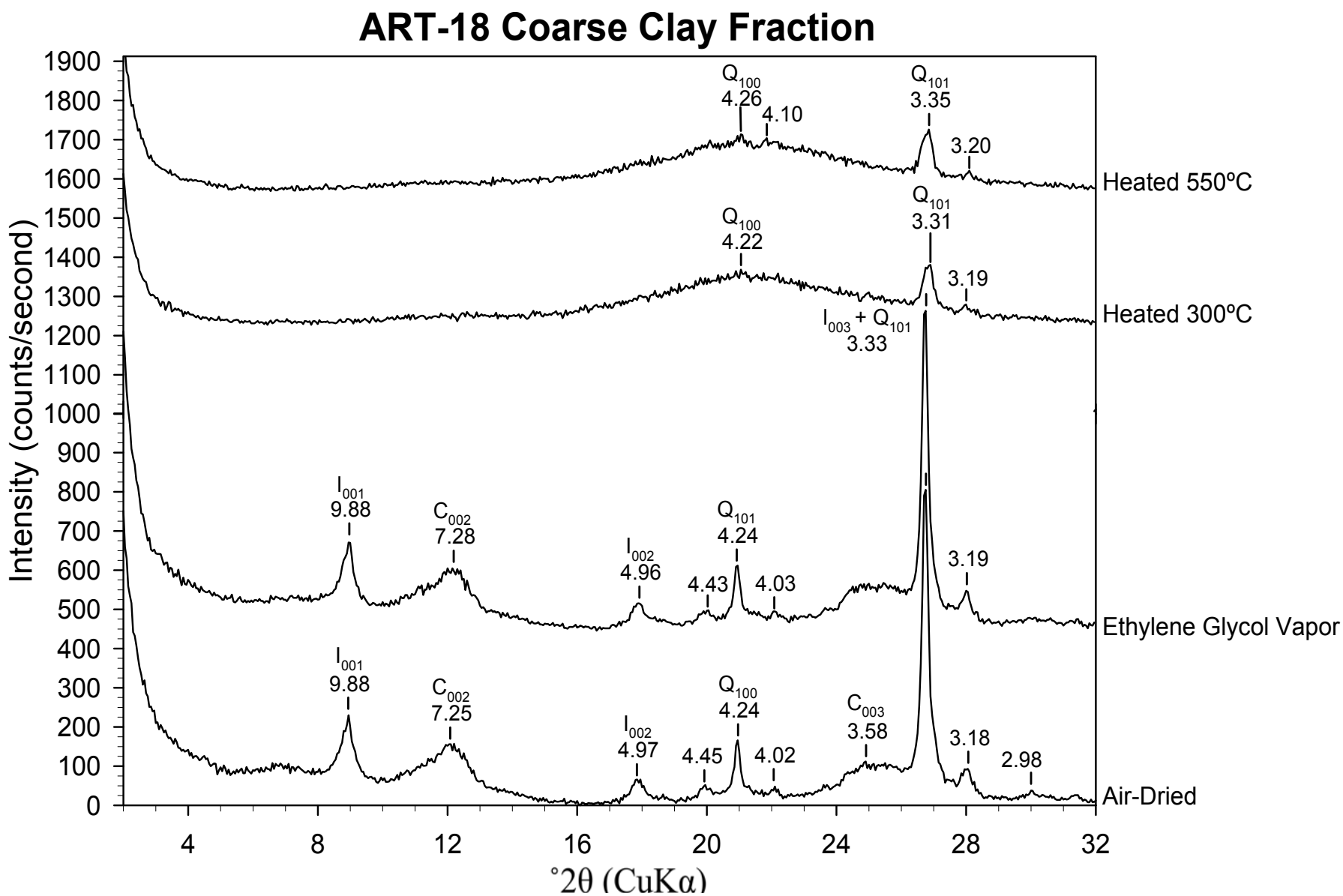

Figure S27. ART-18 Coarse clay diffractogram with peak positions indicated.

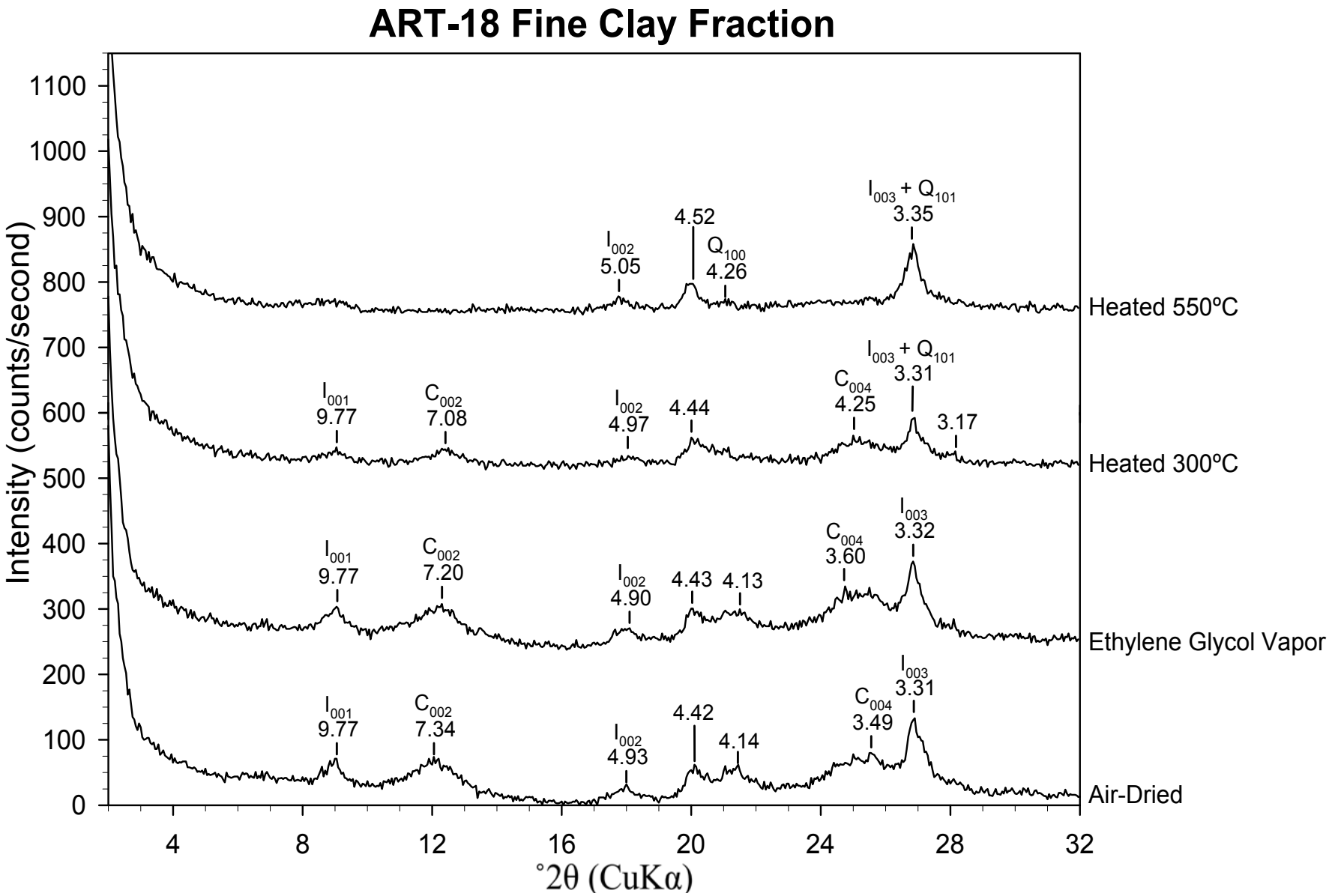

Figure S28. ART-18 Fine clay diffractogram with peak positions indicated.

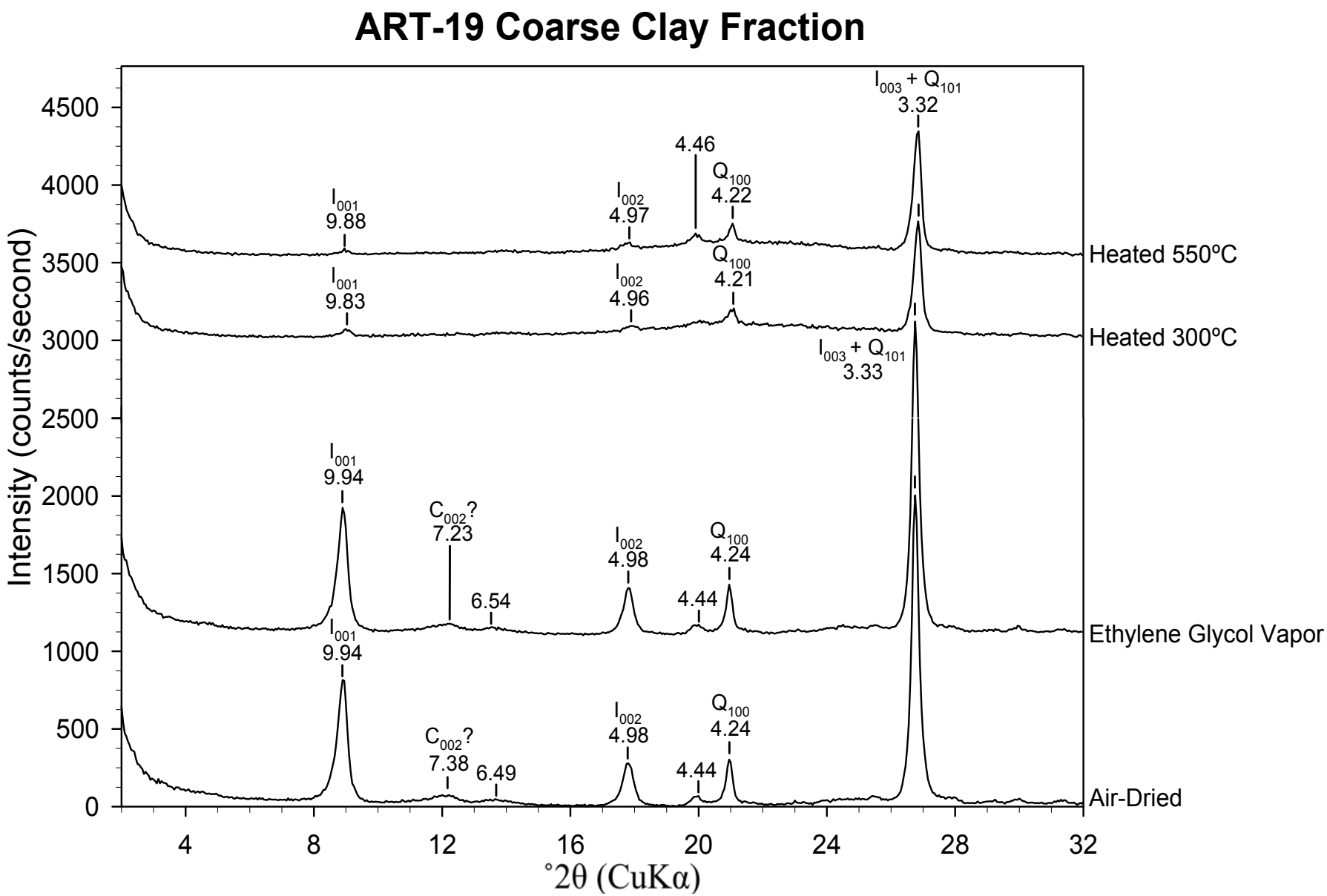

Figure S29. ART-19 Coarse clay diffractogram with peak positions indicated.

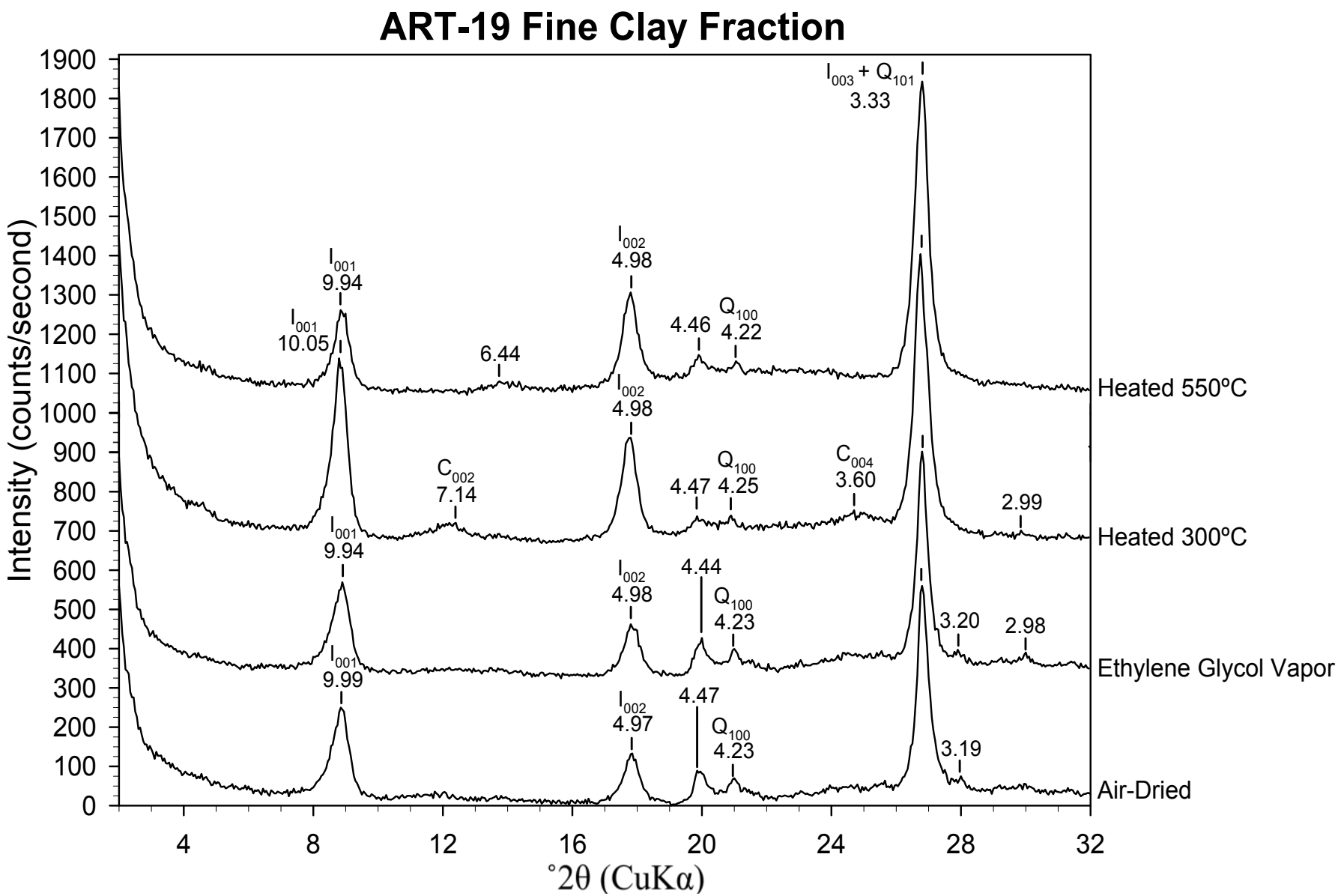

Figure S30. ART-19 Fine clay diffractogram with peak positions indicated.