Dear Mr

Enclosed are the x-ray diffraction (XRD) analytical results for two "Lava Rock" samples received earlier this month. The XRD "raw" data is enclosed, as requested. This report will be mailed and emailed to you. I apologize for the long turnaround time. We received the part to fix the XRD unit late yesterday. The signed acknowledgment of the "New Client Credit Application" will be mailed with this report.

A representative portion of each sample was ground to approximately -400 mesh in a steel swing mill, packed into a well-type plastic holder and then scanned with the diffractometer over the range, 3-61 2θ using Cu-Kα radiation. The results of these scans are summarized on the enclosed table labeled "Bulk XRD Results." Mineral concentrations were estimated using our XRF-determined elemental compositions and the relative peak areas on the XRD scans. The detection limit for an average mineral in these samples is ~1-3% and the analytical reproducibility is approximately equal to the square root of the amount. These samples appear to contain a minor concentration of "amorphous" (noncrystalline material). Amorphous material appears only as a broad elevation in the background of the XRD scan so its composition cannot be determined and the concentration should be considered an "educated guess" based on the difference between the total mineral concentration and 100%. "Unidentified" accounts for that portion of the scan which could not be identified and a "?" indicates doubt in both mineral identification and amount.

The samples were subjected to a size separation procedure based on Stokes' Law to concentrate the clay-size (-2μm) fractions for XRD analysis. A representative portion of each sample was blended with distilled water and 10 ml of 5% Calgon solution to disaggregate the sample without reducing grain size. The mixtures were brought up to volume in a 1000 ml graduated cylinder, allowed to settle for 19.5 hrs and then 20 ml of the material suspended above the 300 ml mark in the cylinder was drawn into a pre-weighed beaker. The material was dried at ~75 C and the weight of the clay-size material determined. The table labeled, "Clay Size Separation Results" lists the weight percent -2μm particles concentrated by this procedure. These figures should not be interpreted as the total weight percent of clay minerals in the sample but as the weight percent of -2μm material concentrated by this procedure.

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The remaining suspensions were siphoned off for XRD analysis of the clay-size fractions. A portion of each suspension was drawn onto a cellulose acetate filter and then the deposited material was rolled onto a glass disk forming an "oriented mount." The oriented mounts were scanned over the range, 2-62° 2θ using Cu-Kα radiation, treated with glycol and then re-scanned over the range, 2-22°. The table labeled, "XRD Results for -2μm Fractions" summarizes the results of these scans as approximate mineral weight percent concentrations. Estimates of mineral concentrations were made using the relative peak areas on the dry XRD scans and comparison to the scans of the bulk samples. The amorphous component of these samples cannot be distinguished from the glass (amorphous) substrate upon which the sample is thinly smeared so these concentrations should be considered **relative weight percent concentrations** of mineral (crystalline) components. Detection limits and reproducibility are similar to those for the bulk samples.

Thank you for the opportunity to be of service.

Sincerely,

		Approx. Wt %	
Mineral Name	**Chemical Formula**	**Red**	**Black**
Plagioclase feldspar	$(Na,Ca)Al(Si,Al)_3O_8$	56	57
Clinopyroxene	$Ca(Mg,Fe,Mn,Al,Ti)(Si,Al)_2O_6$	13	14
Olivine	$(Mg,Fe)_2SiO_4$	6	7
Hematite	Fe_2O_3	7	—
Magnetite	$(Fe,Mg,Zn,Cu,Ni)(Fe,Al,Cr)_2O_4$	<3?	6
K-feldspar	$KAlSi_3O_8$	<5	—
Apatite	$Ca_5(PO_4,CO_3)_3(OH,F,Cl)$	—	<1?
"Amorphous"	?	<15	<15
"Unidentified"	?	<5	<5

Initial _____

Date _____

Sample ID	Weight % -2μm Material Concentrated
Red	1.1
Black	1.0

Initial _____

Date _____

		Approx. Relative Wt %*	
Mineral Name	**Chemical Formula**	**Red**	**Black**
Plagioclase feldspar	$(Na,Ca)Al(Si,Al)_3O_8$	70	70
Clinopyroxene	$Ca(Mg,Fe,Mn,Al,Ti)(Si,Al)_2O_6$	15	23
Hematite	Fe_2O_3	7	—
Magnetite	$(Fe,Mg,Zn,Cu,Ni)(Fe,Al,Cr)_2O_4$	<3?	<3?
K-feldspar	$KAlSi_3O_8$	<3	—
Quartz	SiO_2	—	<3
"Unidentified"	?	<5	<5

*Please read cover letter.

Initial _____

Date _____

2-Theta - Scale

THE MINERAL LAB 29-Jun-2022 11:44

Raw XRD data for bulk sample

Counts
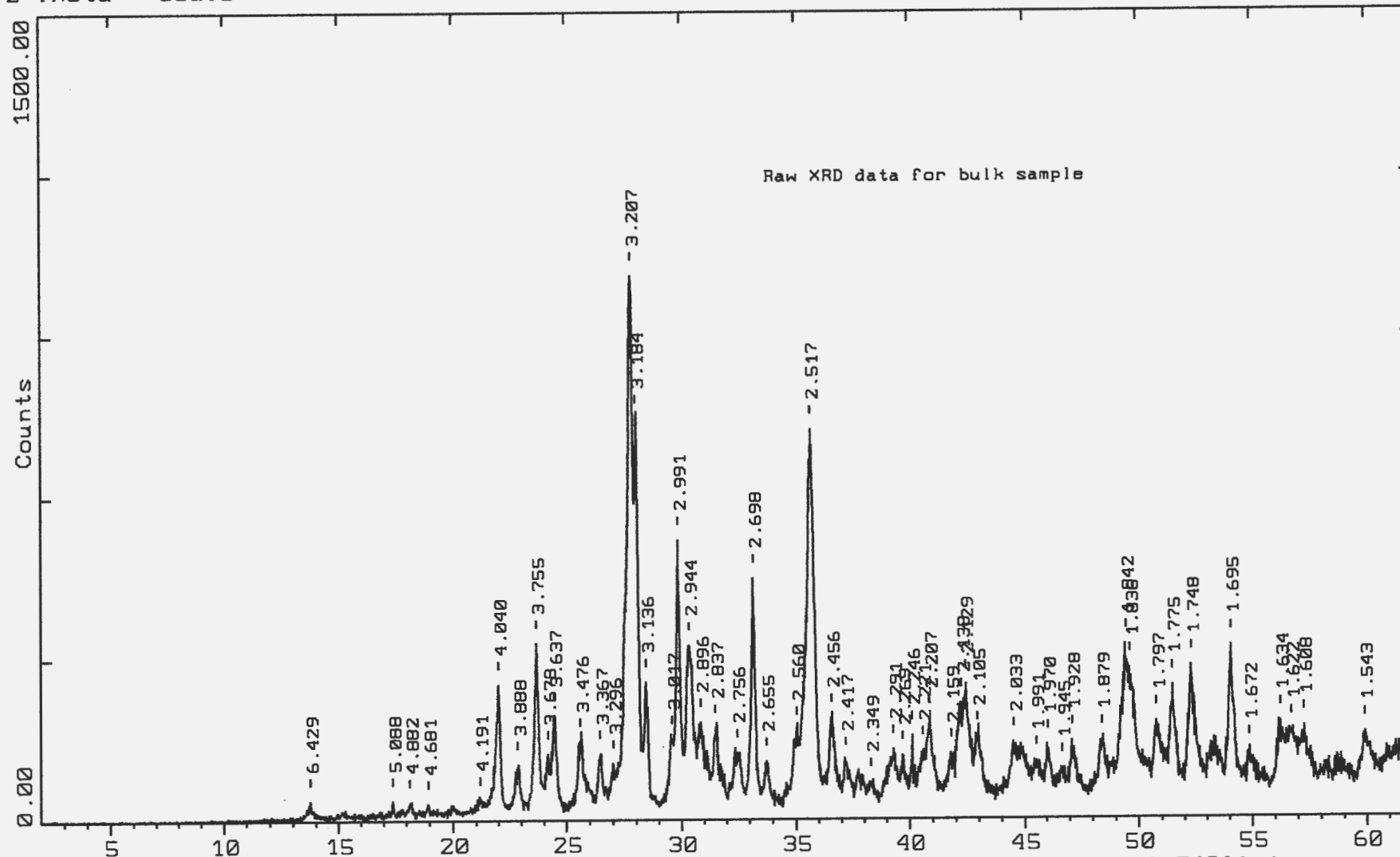
C:\SD5\DATA\2221511.RAW 2221511 RED LAVA ROCK (CT: 0.6s, SS:0.020dg, WL: 1.5406Ao)

2-Theta - Scale

THE MINERAL LAB 29-Jun-2022 11:45

Counts

1500.00

0.00

Raw XRD data for bulk sample

5.083
4.644
4.010
3.876
3.734
3.614
3.450
3.345
3.189
3.164
3.117
3.007
2.989
2.932
2.894
2.823
2.771
2.642
2.557
2.511
2.458
2.407
2.253
2.221
2.133
2.094
2.036
2.011
1.982
1.947
1.923
1.875
1.847
1.830
1.794
1.768
1.749
1.712
1.676
1.623
1.538
1.514

5   10   15   20   25   30   35   40   45   50   55   60

C:\§D5\DATA\2221512.RAW 2221512 BLACK LAVA ROCK (CT: 0.6s, SS:0.020dg, WL: 1.5406Ao)

2-Theta - Scale

THE MINERAL LAB 29-Jun-2022 11:45

Raw XRD data for clay-size

''C''=dry   ''G''=glycolated
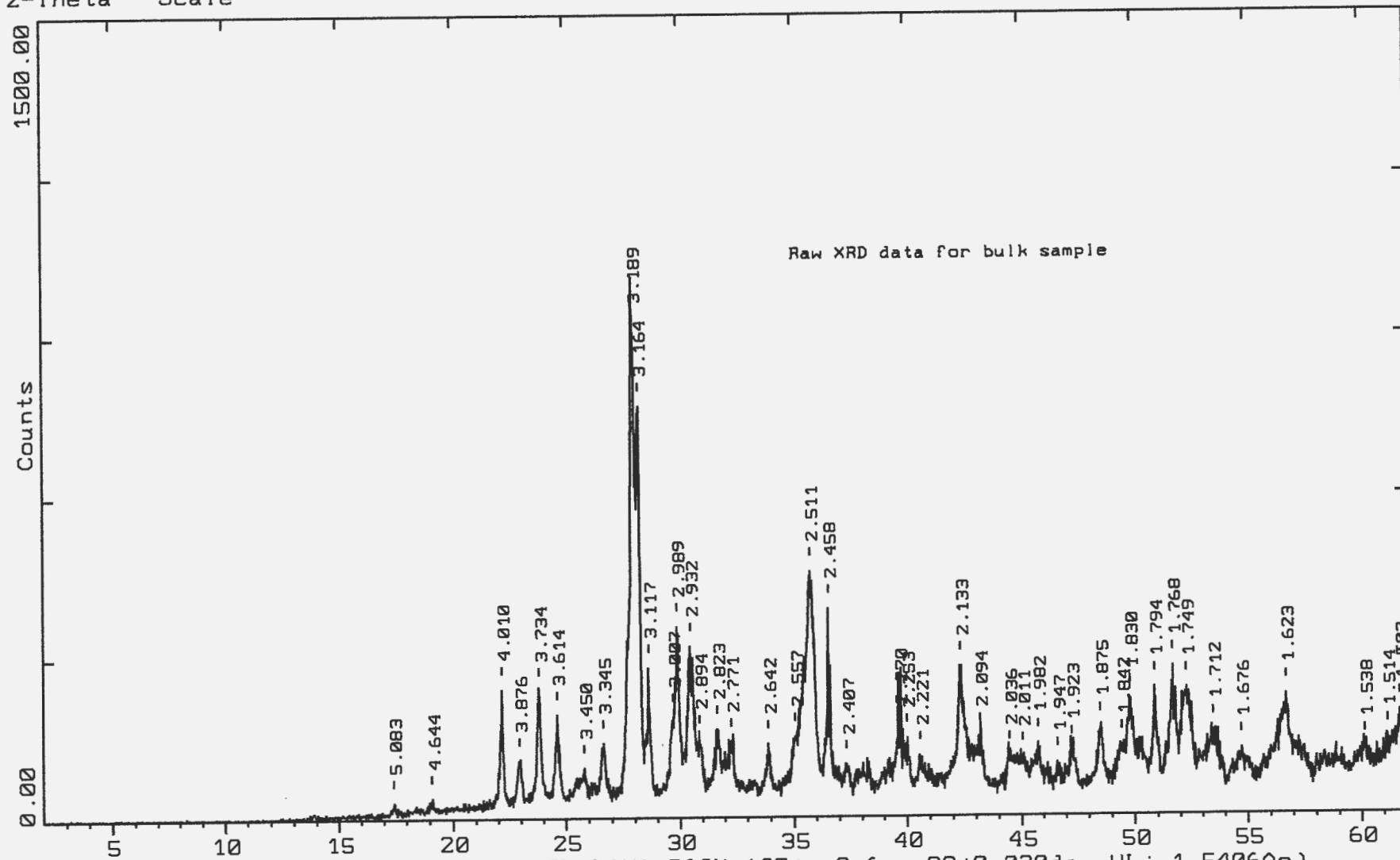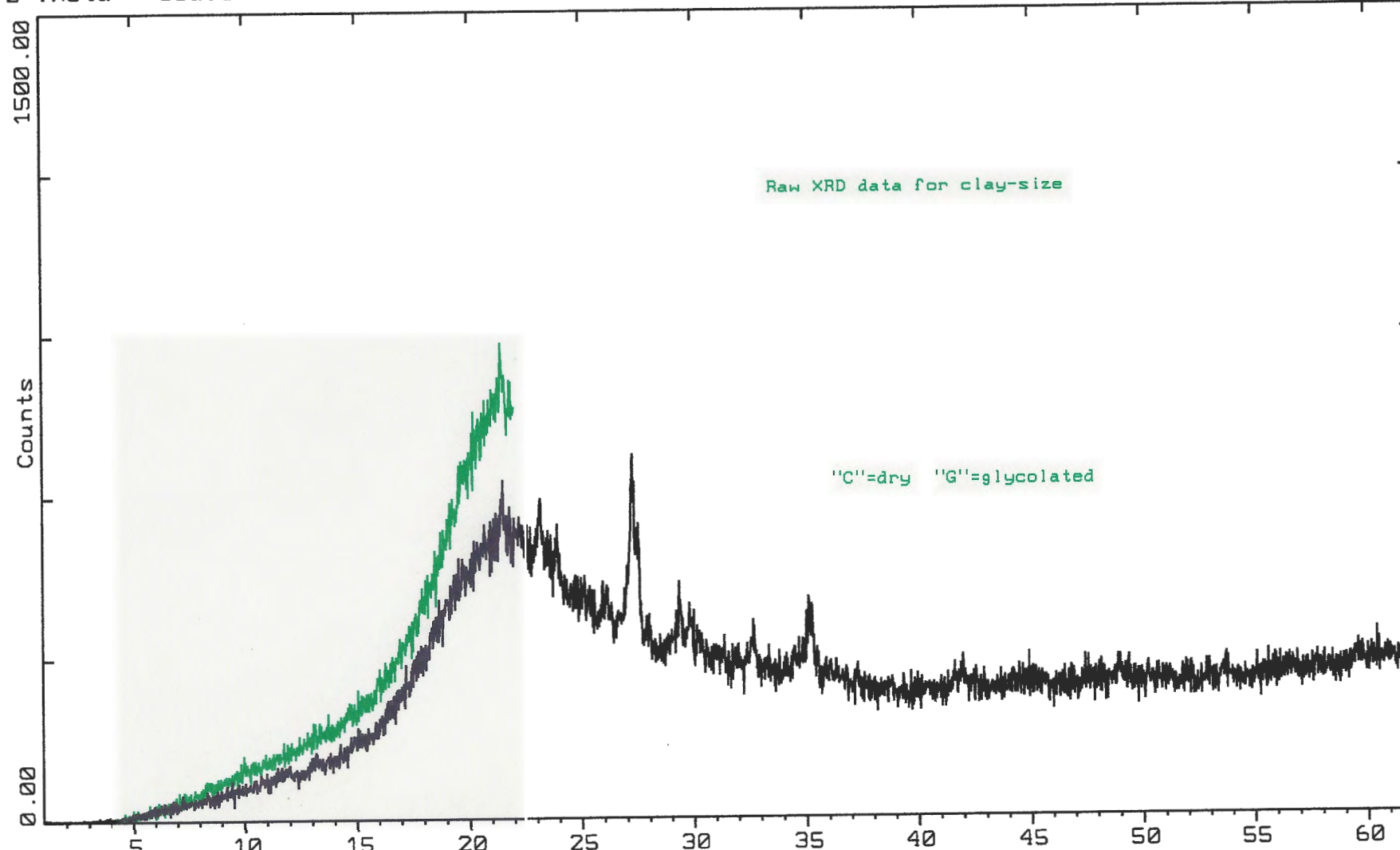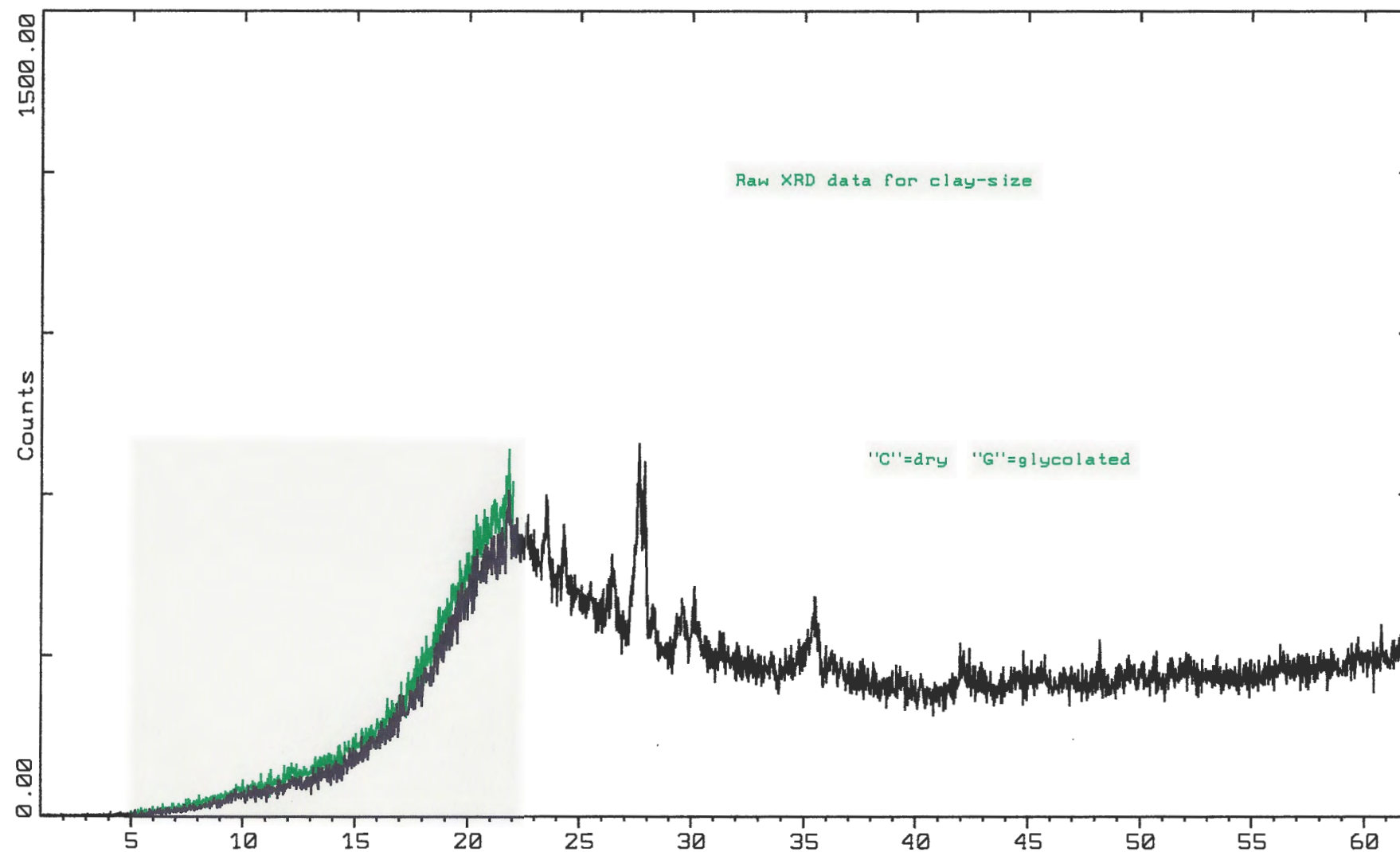
C:\5D5\DATA\2221511C.RAW 2221511C RED LAVA ROCK (CT: 1.0s, SS:0.020dg, WL: 1.5406Ao)
C:\5D5\DATA\2221511G.RAW 2221511G RED LAVA ROCK (CT: 1.0s, SS:0.020dg, WL: 1.5406Ao)

2-Theta - Scale

THE MINERAL LAB 29-Jun-2022 11:45

Raw XRD data for clay-size

''C''=dry   ''G''=glycolated

C:\5D5\DATA\2221512C.RAW 2221512C   BLACK LAVA ROCK (CT: 1.0s, SS:0.020dg, WL: 1.5406Ao)
C:\5D5\DATA\2221512G.RAW 2221512G   BLACK LAVA ROCK (CT   1.0s, SS:0.020dg, WL: 1.5406Ao)