

**Hyperspectral analysis at Angularli uranium deposit, Northern Territory.
BR Smith and P Sinclair, 2025.
Northern Territory Geological Survey, Record 2025-006.**

Appendix 2

XRD analyses: drillcore, Northern Territory. Mineralogical/Petrology Report:LJN2017-096.
RS Bottrill and RN Woolley, Mineral Resources Tasmania

NTGS Technical Note 2017-007

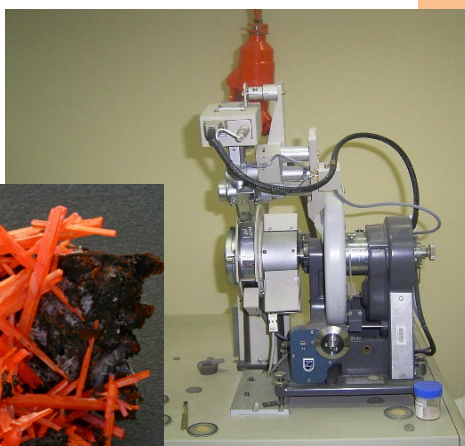
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Mineral Resources Tasmania

Mineralogical/Petrology Report

LJN2017-096

XRD ANALYSES: DRILLCORE, NORTHERN TERRITORY



An unpublished Mineral Resources
Tasmania Report for:

**Belinda Smith,
NTGS**

By: R S Bottrill and R N Woolley
Date: 26 September 2017

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SUMMARY

The XRD results generally confirm the presence of most of the minerals indicated by the Hylogger/IR methods; there are few significant misidentifications or misses in the Hylogger results. In a few cases, however, the Hylogger results seem to have misidentified some minerals, e.g. hornblende, feldspar; chlorite, kaolinite and some micas. Few major minerals were missed by the Hylogger excepting some minor quartz, biotite and feldspar in some cases. The Al-rich assemblages are suggestive of advanced argillic hydrothermal alteration. The “amphibolites” are variable in constitution and appear to include quartz-mica-chlorite schist, talc-chlorite schist (ultramafic?), quartz-mica-amphibole schist or mica-amphibole quartzite(?) as well as a true hornblende-plagioclase quartz amphibolite. The talc was validated as expected. The chlorite in 008 is probably Sudoite, a Mg-Al rich chlorite.

INTRODUCTION AND BACKGROUND

The Hylogger IR spectroscopic analyses of drillcore being conducted by various Geological Surveys in Australia routinely return analyses indicating various minerals that often cannot be readily confirmed in the hand specimens, and require XRD (X-ray diffraction) or other methods for confirmation.

The objective of this particular study is mostly to validate the presence or absence of various minerals, or their more specific identity, in samples from some drillholes in the Northern Territory, particularly the King River prospect, in the Darwin district.

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SAMPLES

The details of the five samples, submitted for XRD by Belinda Smith, Northern Territory Geological Survey (NTGS), are given in Table 1 below. The drill core samples were all from the King River area, NT.

Table 1: Sample details

| Client ID | TSG DDH, depth | Description | Hylogger mineralogy | Comment |
|------------|--------------------|-----------------------|---|--|
| CP17BRS004 | WRD0084/ 218.5 | Mamawaderre Sst | Check for presence of K-Feldspar. Possibly surface effect only (?) | Quartz, pyrophyllite, kaolinite. Possible white mica. Possible k-feldspar |
| CP17BRS005 | WRD0091/ 240.07 | Mamawaderre Sst | Check for presence of K-Feldspar. Possibly surface effect only (?) | Quartz, dickite, pyrophyllite. Possible white mica, goethite, k-feldspar |
| CP17BRS006 | WRD0091/ 310.05 | Cahill Fm amphibolite | Validate the talc | Hornblende, talc, chlorite. Possible minor feldspar or plagioclase (??) |
| CP17BRS007 | WRD0091/ 346.8 | Cahill Fm amphibolite | Logged as amphibolite (same as above) but mineralogically different to above (confirm) | Quartz, hornblende, chlorite, white mica |
| CP17BRS008 | WRD0097/ 86.05 | Mamawaderre Sst | Validate the chlorite; is it Mg-rich? Is it sudoite? What polytype is it? | Quartz, Mg chlorite, white mica |
| CP17BRS009 | WRD0097/ 204.58 | Mamawaderre Sst | K-Feldspar matched in system matches but turned off. Is it there or surface effect? Is chlorite present? | Quartz, pyrophyllite, kaolinite. Possible chlorite(?) Possible k-feldspar |
| CP17BRS010 | WRD0104/ 266.1 | Cahill Fm amphibolite | Logged as amphibolite (same as above) but mineralogically different to below and to samples 6 and 7 (confirm) | Quartz, muscovite, chlorite (possible biotite?) |
| CP17BRS011 | WRD0104/ 452.4 | Cahill Fm amphibolite | Logged as amphibolite (same as above) but mineralogically different to above (confirm) | Hornblende, quartz, garnet, quartz |
| CP17BRS012 | WRD0117/ 75.4 | Mamawaderre Sst | Confirm that there is chlorite (similar to sample CP17BRS008) | Quartz, muscovite, Mg chlorite (possible minor poorly crystalline kaolinite) |
| CP17BRS013 | WRD0117/ 106.66 | Mamawaderre Sst | Confirm that there is chlorite (although it might be less magnesian than other chlorite in sandstone samples??) | Quartz, FeMg chlorite, white mica |

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ANALYTICAL TECHNIQUES

The samples were all prepared, examined and analysed by XRD, and two by XRF, in the MRT laboratories, Rosny Park, Tasmania.

XRF

METHOD

The samples were analysed for major elements on a fused disk, in a Bruker ASX58 XRF, with proprietary Bruker software and a series of commercial standards. The results are shown in Appendix 2.

RESULTS

The results were reasonably consistent with the XRD analyses. CP17BRS008 shows moderate Al and Mg, low Fe contents, and high Mg/Fe and Al/Mg, which are more consistent with sudoite than Mg-chlorite.

CP17BRS011 was suspected to contain plagioclase, from the XRD analysis, and XRF confirmed a significant Na content plus some K which indicates this sample may contain some K feldspar as well as mica.

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XRD

METHOD

The samples were prepared, examined and analysed in the MRT laboratories, Rosny Park, Tasmania. They were run on an automated Philips X-Ray diffractometer system: PW 1729 generator, PW 1050 goniometer and PW 1710 microprocessor with nickel-filtered copper radiation at 35kV/25mA, a graphite monochromator (PW1752), sample spinner and a proportional detector (sealed gas filled PW1711). Our typical step-size is 0.02 degrees, and the standard scanning speed is 0.02 degrees/second. The PW1710 system is presently driven by the CSIRO XRD software: "VisualXRD", "PW1710 for Windows" and "XPLOT for Windows". Interpretation and quantification is largely manual, using a series of prepared standards of the more common minerals to enable some semi-quantitative analysis. Quartz, if present, is used as an internal standard; and if not present, is often added to the sample for a supplementary scan. Our semi-quantitative results are calculated using single-peak calibration factors derived from scans of known mixtures of minerals.

RESULTS

The XRD results are attached in Appendix 1 and are summarised in Table 2, with comparison to the Hylogger and other results. The results are discussed further below.

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Table 2: Summary of Main Results, discrepancies highlighted.

| Client ID | HyLogger Sample # | Client Comment | Hylogger mineralogy | Main XRD mineralogy | Summary Comments, possible rocktype |
|------------|--------------------|---|--|---|--|
| CP17BRS004 | WRD0084/ 218.5 | Check for presence of K-Feldspar. Possibly surface effect only (?) | Quartz, pyrophyllite, kaolinite. Possible white mica. Possible K-feldspar | Quartz (65%-80%), Pyrophyllite (10%-15%), Mica ^D (2%-5%), Kaolinite (2%-5%), Diaspore (<2%), Pyrite (<2%), | Very good No feldspar (argillic alteration) |
| CP17BRS005 | WRD0091/ 240.07 | Check for presence of K-Feldspar. Possibly surface effect only (?) | Quartz, dickite, pyrophyllite. Possible white mica, goethite, K-feldspar | Quartz (>80%), Dickite (10%-15%), Mica ^D (2%-5%), Pyrophyllite (<2%), | Very Good No feldspar (argillic alteration) |
| CP17BRS006 | WRD0091/ 310.05 | Validate the talc | Hornblende, talc, chlorite. Possible minor feldspar or plagioclase (??) | Chlorite (35%-50%), Talc (25%-35%), Quartz (10%-15%), Mica ^T (5%-10%), Calcite (2%-5%) | Fair No feldspar, or hornblende (talc-chlorite schist, not amphibolite) |
| CP17BRS007 | WRD0091/ 346.8 | Logged as amphibolite (same as above) but mineralogically different to above (confirm) | Quartz, hornblende, chlorite, white mica | Amphibole ³ (25%-35%), Quartz (25%-35%), Mica ^T (25%-35%), Chlorite (2%-5%) | Fair Biotite not white mica (quartz amphibolite, different to above) |
| CP17BRS008 | WRD0097/ 86.05 | Validate the chlorite; is it Mg-rich? Is it sudoite? What polytype is it? | Quartz, Mg chlorite, white mica | Quartz (>80%), Chlorite (5%-10%), Mica ^D (2%-5%), | Very good Probably sudoite (chloritic quartzite) |
| CP17BRS009 | WRD0097/ 204.58 | K-Feldspar matched in system matches but turned off. Is it there or surface effect? Is chlorite present? | Quartz, pyrophyllite, kaolinite. Possible chlorite(?) Possible K-feldspar | Quartz (>80%), Kaolinite (5%-10%), Mica ^D (<2%), Andalusite (<2%), Pyrophyllite (<2%), Diaspore (<2%), Bohmite (<2%) | Very good No feldspar or chlorite (argillic alteration) |
| CP17BRS010 | WRD0104/ 266.1 | Logged as amphibolite (same as above) but mineralogically different to below and to samples 6 and 7 (confirm) | Quartz, muscovite, chlorite (possible biotite?) | Quartz (50%-65%), Mica ^D (15%-25%), Chlorite (15%-25%), Calcite (2%-5%) | Very good some biotite possible (probably quartz-chlorite-mica schist not amphibolite, different to 006, 007) |
| CP17BRS011 | WRD0104/ 452.4 | Logged as amphibolite (same as above) but mineralogically different to above (confirm) | Hornblende, quartz, garnet | Amphibole ⁴ (65%-80%), Quartz (5%-10%), Plagioclase (5%-10%), Garnet (2%-5%), Chlorite (2%-5%), | Very good XRF also suggests Kf? (quartz-plag amphibolite, different to above) |
| CP17BRS012 | WRD0117/ 75.4 | Confirm that there is chlorite (similar to sample CP17BRS008) | Quartz, muscovite, Mg chlorite (possible minor poorly crystalline kaolinite) | Quartz (>80%), Mica ^D (5%-10%), Chlorite (2%-5%), | Good No kaolinite detected (mica quartzite) |
| CP17BRS013 | WRD0117/ 106.66 | Confirm that there is chlorite (although it might be less magnesian than other chlorite in sandstone samples??) | Quartz, FeMg chlorite, white mica | Quartz (>80%), Chlorite (5%-10%), Mica ^D (2%-5%), Talc (<2%) | Very good Talc presence suggests a Mg chlorite? (chloritic quartzite) |

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SUMMARY

The XRD results generally confirm the presence of most of the minerals indicated by the Hylogger/IR methods. There are few significant misidentifications or misses in the Hylogger results. The Hylogger results shown in Table 2 are classified here as:

Very good: all main minerals identified, no major misidentifications.

Good: Two or more main minerals identified, and no minerals detected incorrectly.

Fair: One main mineral confirmed, and/or only one incorrectly identified; some subordinates detected correctly.

Poor: Main phases not detected, some subordinates detected correctly.

Very poor: No phases detected correctly.

The results thus vary from (mostly) very good to fair, and overall the results are very good.

Notable XRD results and possible issues include that:

1. In one sample (006) hornblende was reported by Hylogger but XRD indicated no amphibole. The XRD suggests the amphiboles are mostly calcic (hornblende type), but some orthoamphiboles (eg Anthophyllite) may be present also.
2. The feldspars reported by the Hylogger in four samples could not be validated by XRD.
3. One sample (011) contained plagioclase and possibly K-feldspar, neither detected by the Hylogger.
4. White mica was indicated by Hylogger in 007 but XRD indicates mostly biotite (could be both?).
5. In one sample (010) biotite was suggested by Hylogger, but muscovitic mica was found by XRD.

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6. In one sample (009) chlorite was suggested by Hylogger, but not found by XRD.
7. In one sample (012) kaolinite was suggested by Hylogger, but not found by XRD.
8. The Hylogger mostly only missed some minor constituents (<2%) in these samples, except in 006 and 011.
9. The garnet is possibly a manganoan or calcic almandine.

DISCUSSION

The Al-rich assemblages are interesting, including some moderate to relatively high-temperature phases like andalusite, dickite and pyrophyllite. These assemblages, with pyrite, are suggestive of advanced argillic hydrothermal alteration. They are too siliceous to be sediments or palaeosols.

The “amphibolites” are variable in constitution and appear to include quartz-mica-chlorite schist, talc-chlorite schist (ultramafic?), quartz-mica-amphibole schist or mica-amphibole quartzite(?) as well as a true hornblende-plagioclase quartz amphibolite.

The talc was validated as expected.

The chlorite in 008 is probably Sudoite, a Mg-Al rich chlorite, from its chemistry. With the other chlorites, the relatively small amounts and admixtures make it difficult to determine the Mg/Fe/Al contents and any polytypes.

R.S. Bottrill

MINERALOGIST/PETROLOGIST

R.N. Woolley

TECHNICAL OFFICER

Mineral Resources Tasmania

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This and other data collected in MRT laboratories may enter the MRT databases but every attempt will be made to ensure it remains closed file and not be available externally, unless at your request.

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Appendix 1: Mineral Resources Tasmania Laboratory Report

Client: B. Smith, NTGS

Sample Source: Various (NT)

MRT Job Number: LJN2017/096

Analysis: Approximate Mineralogy

Method: X-Ray Diffraction

Results:

| ID | File Name | Depth (m) | Minerals Identified |
|------------|-----------|-----------|--|
| CP17BRS004 | WRD0084 | 218.50 | Quartz (65%-80%), Pyrophyllite (10%-15%), Mica ^D (2%-5%), Kaolinite (2%-5%), Diaspore (<2%), Pyrite (<2%), ? ¹ (<2%) |
| CP17BRS005 | WRD0091 | 240.07 | Quartz (>80%), Dickite (10%-15%), Mica ^D (2%-5%), Pyrophyllite (<2%), ? ² (<2%) |
| CP17BRS006 | WRD0091 | 310.05 | Chlorite (35%-50%), Talc (25%-35%), Quartz (10%-15%), Mica ^T (5%-10%), Calcite (2%-5%) |
| CP17BRS007 | WRD0091 | 346.80 | Amphibole ³ (25%-35%), Quartz (25%-35%), Mica ^T (25%-35%), Chlorite (2%-5%) |
| CP17BRS008 | WRD0097 | 86.05 | Quartz (>80%), Chlorite (5%-10%), Mica ^D (2%-5%), Rutile (<2%) |
| CP17BRS009 | WRD0097 | 204.58 | Quartz (>80%), Kaolinite (5%-10%), Mica ^D (<2%), Andalusite (<2%), Pyrophyllite (<2%), Diaspore (<2%), Bohmite (<2%) |
| CP17BRS010 | WRD0104 | 266.10 | Quartz (50%-65%), Mica ^D (15%-25%), Chlorite (15%-25%), Calcite (2%-5%) |
| CP17BRS011 | WRD0104 | 452.40 | Amphibole ⁴ (65%-80%), Quartz (5%-10%), Plagioclase (5%-10%), Garnet ⁵ (2%-5%), Chlorite (2%-5%), Mica (<2%) |
| CP17BRS012 | WRD0117 | 75.40 | Quartz (>80%), Mica ^D (5%-10%), Chlorite (2%-5%), Amphibole (<2%), ? ¹ (<2%) |
| CP17BRS013 | WRD0117 | 106.66 | Quartz (>80%), Chlorite (5%-10%), Mica ^D (2%-5%), Talc (<2%) |

Peak overlap (e.g. K-Feldspar and Clinopyroxene) may interfere with identification and quantitative calculations

Amorphous material (e.g. some hydrous iron oxides, organic matter) and minerals present in trace amounts may not be detected

^D Dioctahedral Mica

^T Trioctahedral Mica

¹ very small peak at 12.3Å; possible Stilpnomelane? Sepiolite? mixed-layer mineral?

² barely detectable peaks at 14.0Å and 4.7Å; possible trace of Chlorite?

³ probably two types of Amphibole present:

main mineral: 9.02Å, 8.37Å, [5.05Å, overlapped], 4.89Å, 4.76Å, 4.51Å, 4.20Å, 3.88Å, 3.27Å, 3.12Å, 2.940Å, 2.799Å, 2.731Å, 2.708Å, 2.595Å, etc; possible Ca-Mg Amphibole?

minor mineral: 8.23Å, 4.13Å, 3.24Å, 3.05Å, 2.75Å (other peaks may be overlapped); probable Orthoamphibole

⁴ main mineral: 9.01Å, 8.39Å, [5.08Å], 4.91Å, [4.75Å], 4.52Å, 4.21Å, 3.89Å, 3.28Å, 3.12Å, 2.945Å, 2.806Å, 2.743Å, 2.713Å, [2.598Å], etc; very similar to main Amphibole in CP17BRS007; XRF analysis suggests significant Fe content
small peak at 3.06Å; possible trace of second Amphibole?

⁵ peaks at 4.73Å, 4.08Å, 3.09Å, 2.895Å, 2.589Å, 2.466Å, 2.365Å, 2.271Å, 2.115Å, 2.047, 1.878, [1.672, overlapped], 1.607; close match to manganoan Almandine

Analyst: R.N. Woolley

Date: 4 October 2017

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Appendix 2: Mineral Resources Tasmania Laboratory Report

Client: B. Smith, NTGS

Sample Source: Various (NT)

MRT Job Number: LJN2017/096

Analysis: Whole Rock Chemistry

Methods: X-Ray Fluorescence

Results:

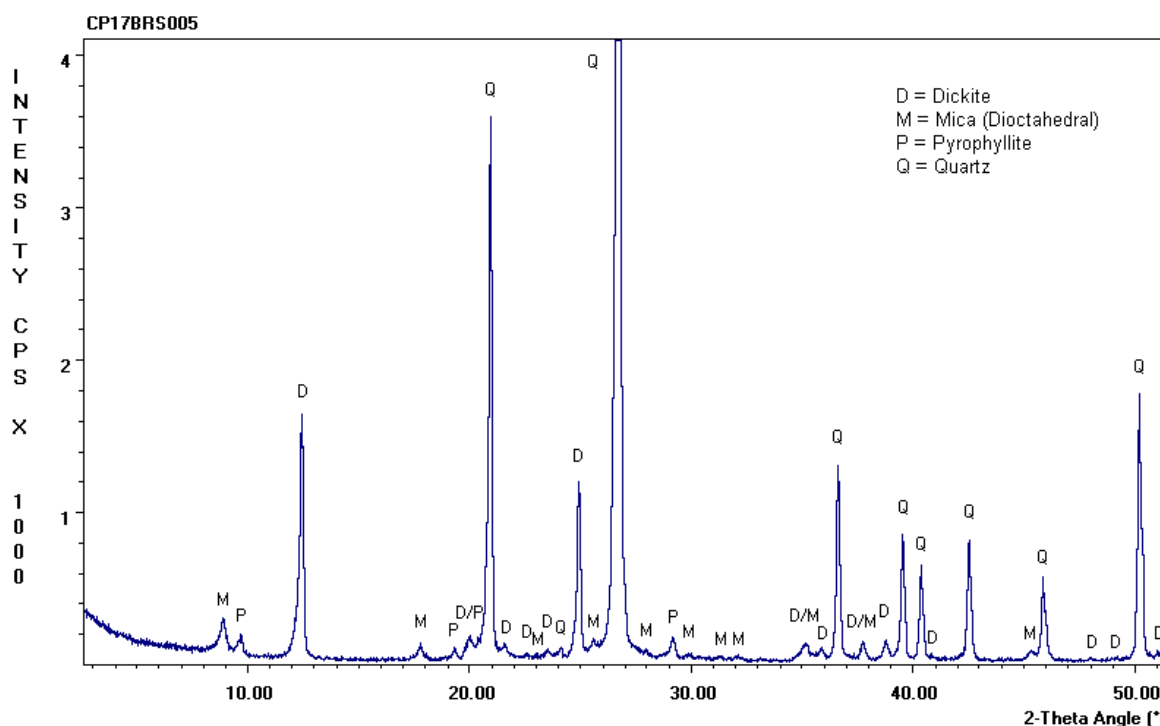
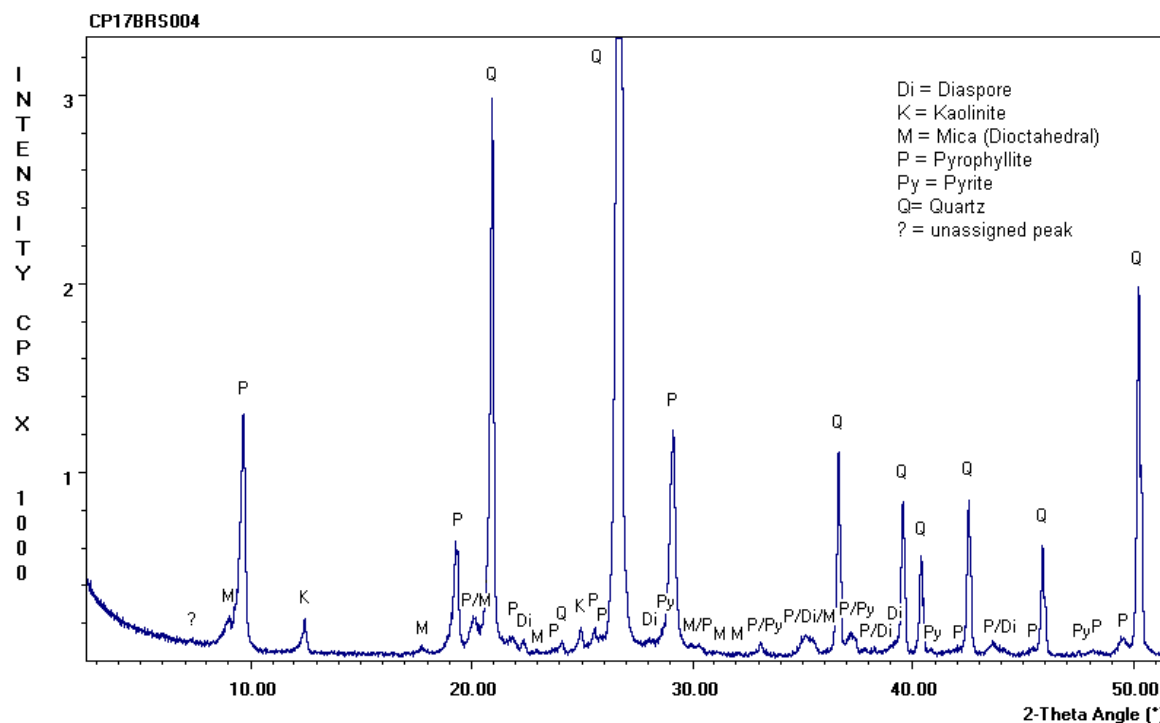
| <i>Sample</i> | CP17BRS008 | CP17BRS011 |
|--------------------------------|--------------|--------------|
| <i>Oxide</i> | <i>Wt. %</i> | <i>Wt. %</i> |
| SiO ₂ | 93.00 | 49.40 |
| TiO ₂ | 0.79 | 1.68 |
| Al ₂ O ₃ | 2.86 | 13.50 |
| Fe ₂ O ₃ | 0.30 | 16.00 |
| MnO | <0.01 | 0.24 |
| MgO | 1.24 | 6.64 |
| CaO | 0.08 | 8.58 |
| Na ₂ O | 0.02 | 1.89 |
| K ₂ O | 0.46 | 1.06 |
| P ₂ O ₅ | 0.03 | 0.21 |
| LOI | 0.83 | 0.52 |
| Total | 99.61 | 99.72 |

Analyst: R.N. Woolley

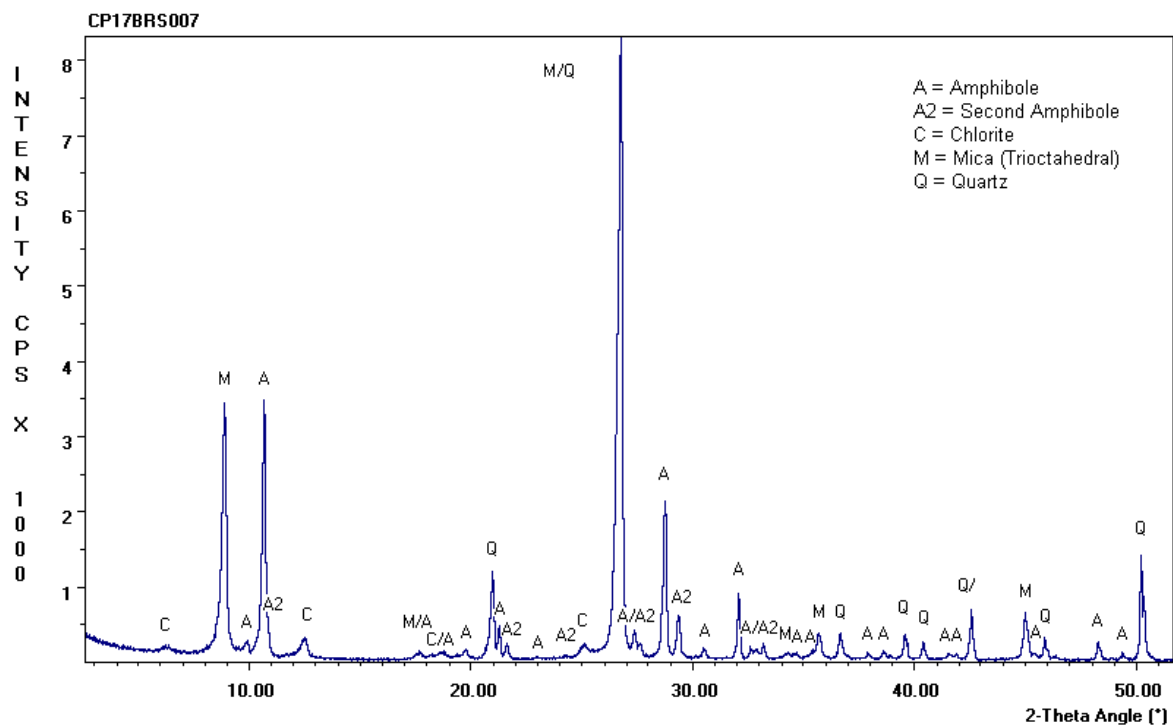
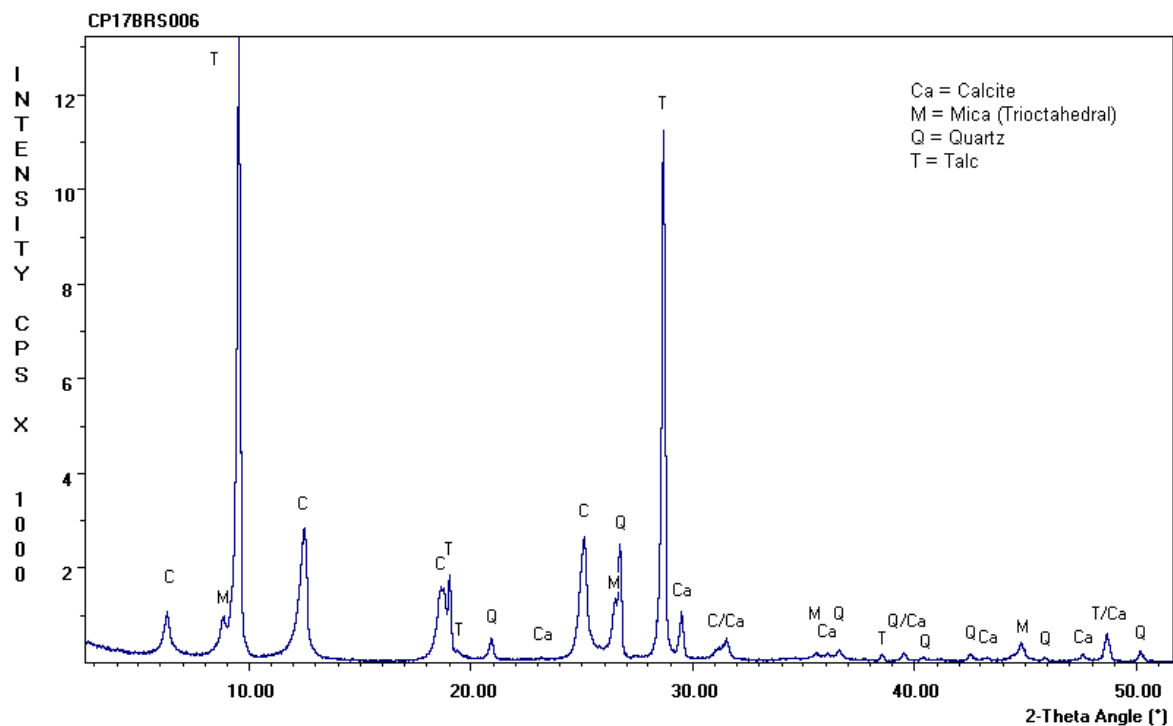
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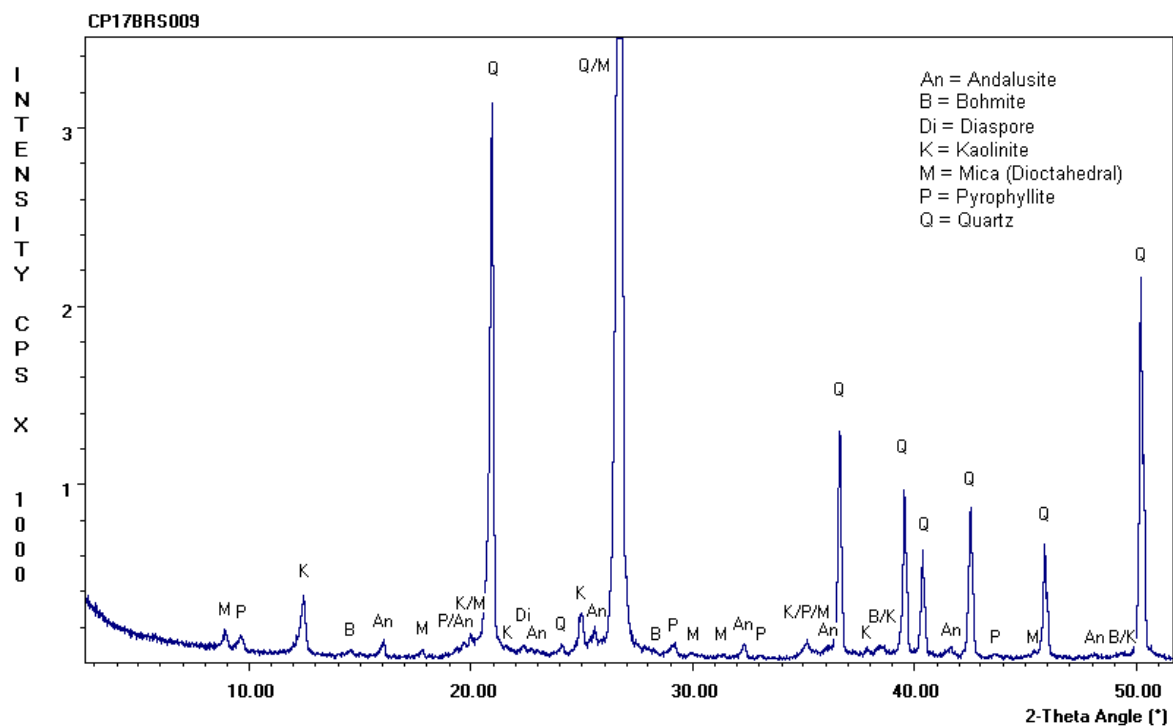
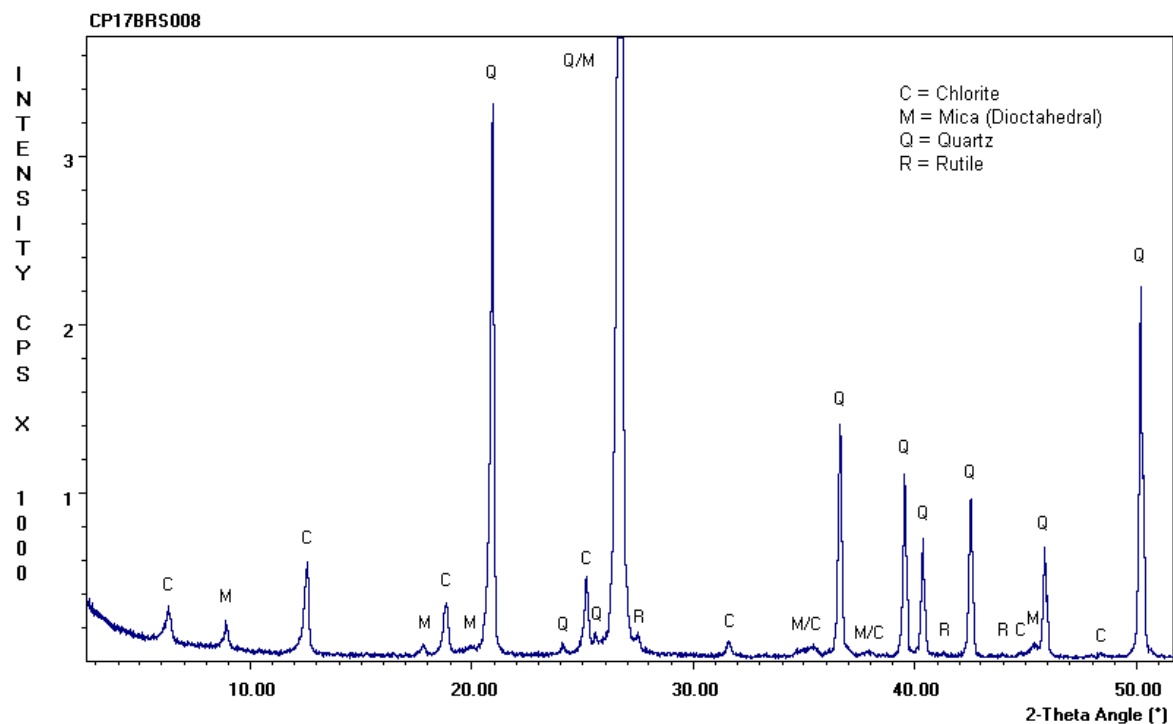
Appendix 3: XRD Traces



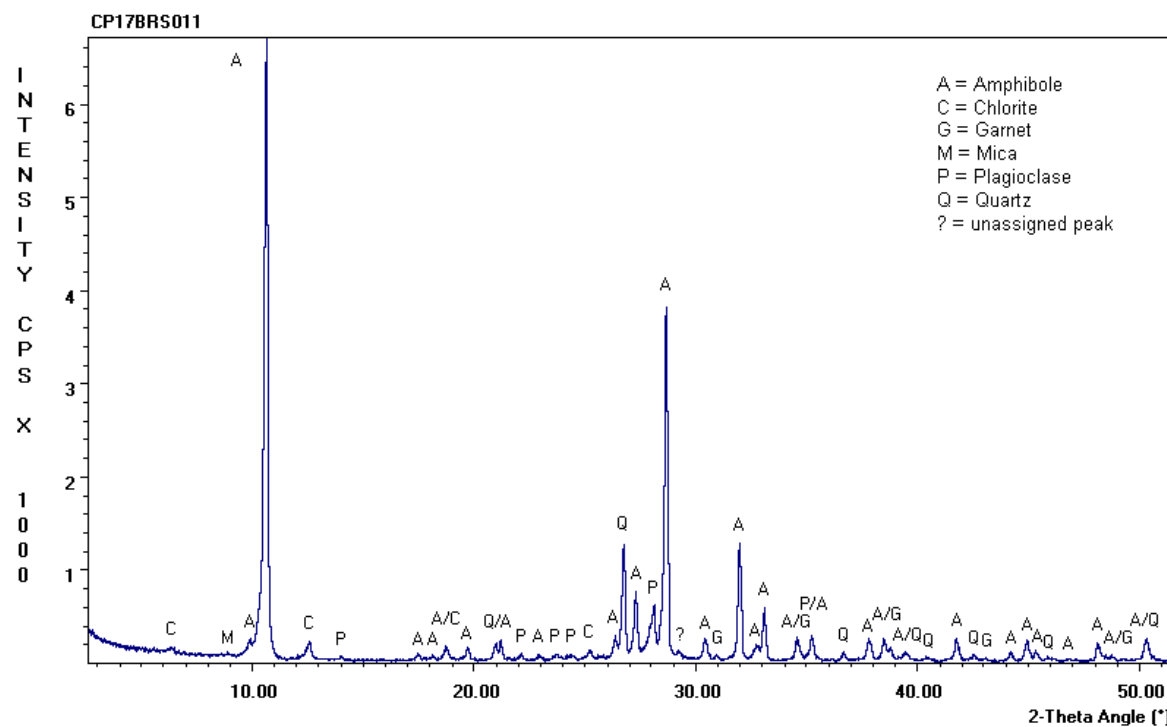
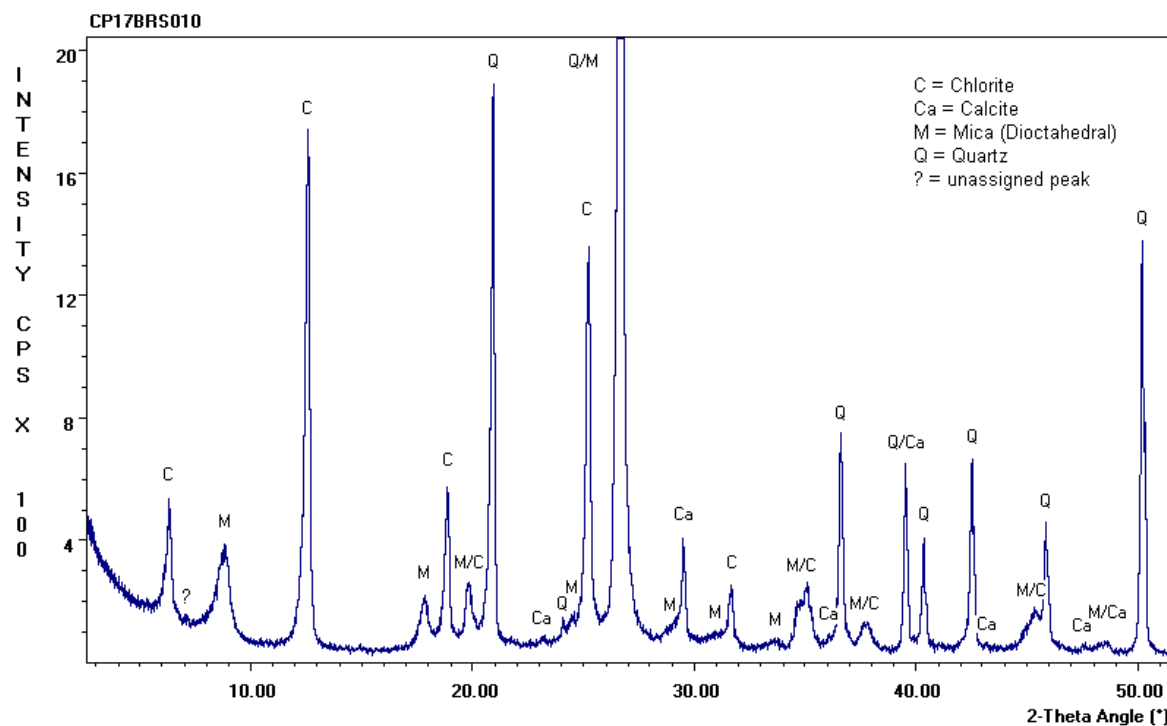
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