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**Report Number LSXXXX**

# Quantitative X-Ray Diffraction Analysis

**Introduction:**

Three (3) samples were submitted for quantitative phase analysis using X-ray diffraction (XRD).

**Sampling & Preparation:**

The samples were pulverised in a tool steel grinding head using a bench top ring mill then prepared as an unoriented powder mount of the total sample.

Clay separations were required for several samples. The -4 micron fraction of the sample was separated from the bulk sample and used to create oriented clay mounts. Clay mounts were run as untreated, glycolated and heat treated at 350 and 550°C to determine clay minerals present.

**Analytical Method:**

The XRD patterns were produced using a Bruker-AXS D8 XRD with copper radiation at 40 kV and 25 mA, over a range of 5 to 80o2, with a 0.02 degree step and 2 second per step count time.

Identification of phases present was carried out using Bruker DIFFRAC.EVA Search/Match software and the ICDD PDF-4+ database. The quantitative phase analysis was performed using SIROQUANTTM version 5 software including calculation of the Amorphous content.

**Results:**

The XRD scans are attached. Note that the intensity of the peaks in an XRD pattern depend upon the crystallinity as well as the concentration of the phase. The Siroquant quantitative phase analyses are given in the following table(s):

**SPL Ref:** **LSXXXX-01**
**Sample ID:** **Sample 1**

| **Phase** | **Weight%** |
|---|---|
| Quartz | 46 |
| Illite | 27 |
| Plagioclase feldspar (albite) | 15 |
| Kaolin | 5 |
| Mixed layer illite-smectite | 4 |
| Anatase | 2 |
| Vermiculite | 1 |

**SPL Ref:** **LSXXXX-02**
**Sample ID:** **Sample 2**

| **Phase** | **Weight%** |
|---|---|
| Quartz | 60 |
| Illite | 18 |
| Kaolin | 8 |
| Mixed layer illite-smectite | 7 |
| Hematite | 3 |
| Anatase | 3 |
| Vermiculite | 1 |

**SPL Ref:** **LSXXXX-03**
**Sample ID:** **Sample 3**

| **Phase** | **Weight%** |
|---|---|
| Quartz | 60 |
| Muscovite | 31 |
| Kaolin | 5 |
| Goethite | 4 |

Margin of error (absolute) in Siroquant analyses should be no greater than: +/- 2% for phases 50-95%, +/- 5% for phases 10-50% and +/- 10% for phases 3-10%. Phases of approximately 3% and less are approaching detection limit and normally no refinements are made to these phases. Actual accuracy is dependent on crystallinity of component phases, sample matrix, phase overlaps and sample preparation.

**Discussion:**

The results of the analysis are summarised in the tables and scans attached.

Quantification of the crystalline mineral phases was performed with the SIROQUANT™ software package. This software uses the full-profile Rietveld method of refining the profile of the calculated XRD pattern against the profile of the measured XRD pattern. The total calculated pattern is the sum of the calculated patterns of the individual phases.

Results are given as % of the total.

Corrections are incorporated in the process that allows for a more accurate description of the mineral's contribution to the measured pattern and to allow for variation due to atomic substitution, layer disordering, preferred orientation, and other factors that affect the acquisition of the XRD scan.

The limitations of qualitative XRD analysis are as follows:

1. There is a limit of detection of 1-2% on most crystalline phases.
2. Where there exist multiple phases, overlap of diffracted reflections can occur, thus rendering some ambiguity into the interpretation.
3. Some phases cannot be unambiguously identified as they are present in minor or trace amounts.

The limitations of quantitative XRD analysis by a full-profile Rietveld method are as follows:

1. The limitations for qualitative XRD analysis apply
2. The method as described is standardless: it relies solely on the published crystallographic data available for each phase. Some data may not exactly describe the phases present.

Potential limitations on the quantitative analysis can also include effects from varying crystallinity of each mineral, their preferred orientation in the sample preparation and their differing absorption of the X-rays.

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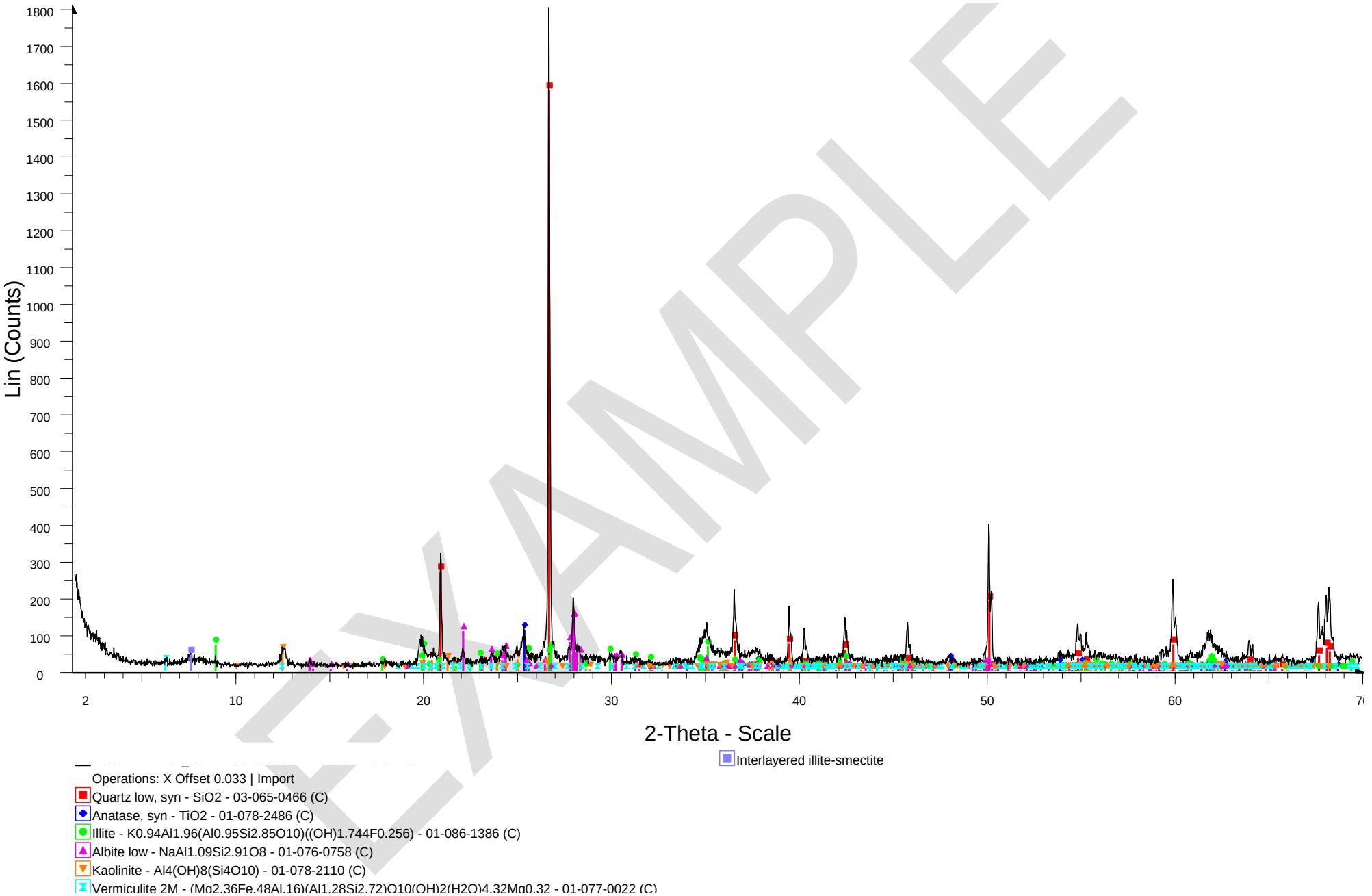
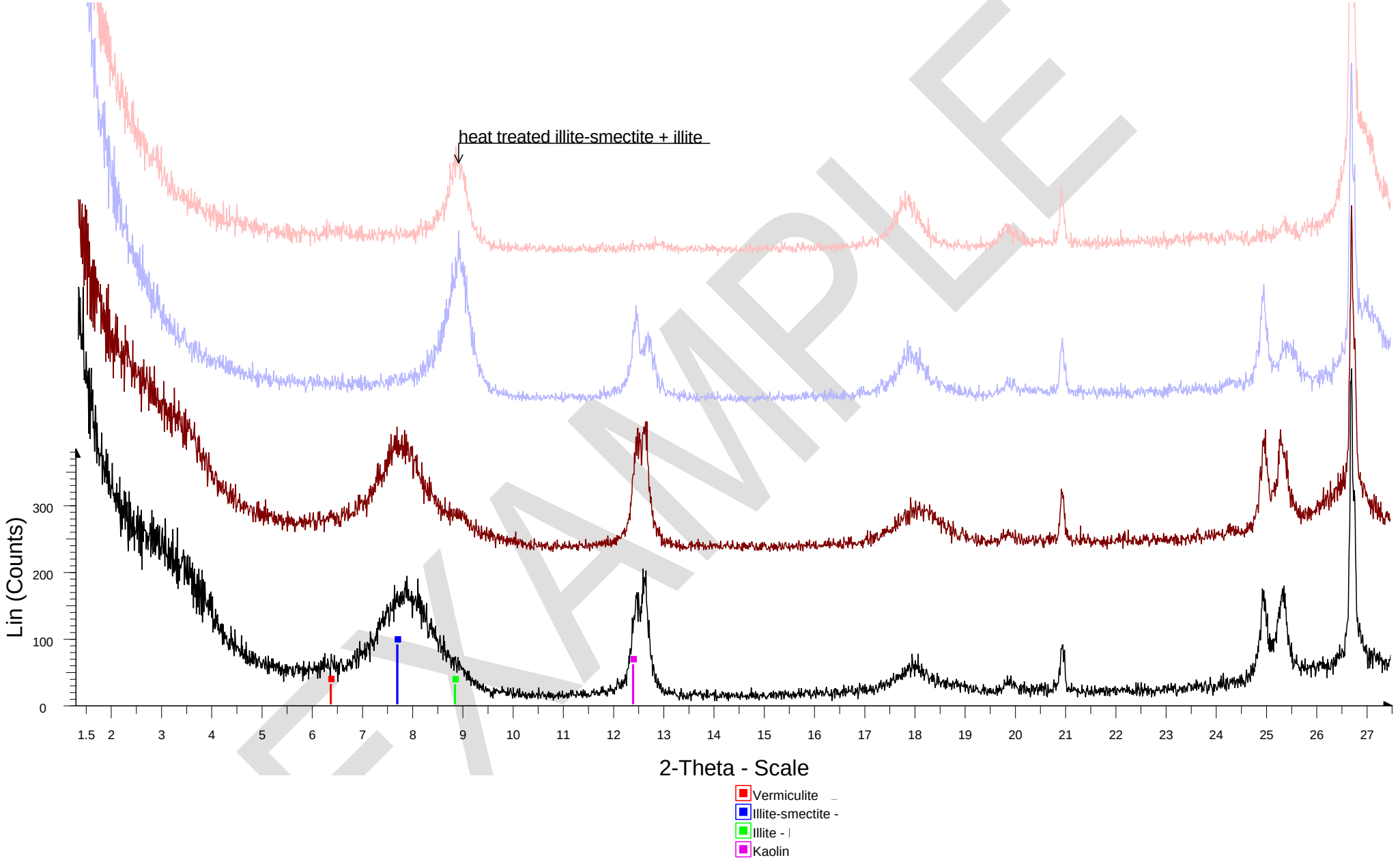
**Please note:** If samples are required to be returned or held for a long period of time please contact Sietronics Pty Ltd as soon as possible. All samples are discarded one (1) month after receipt at Sietronics Pty Ltd.

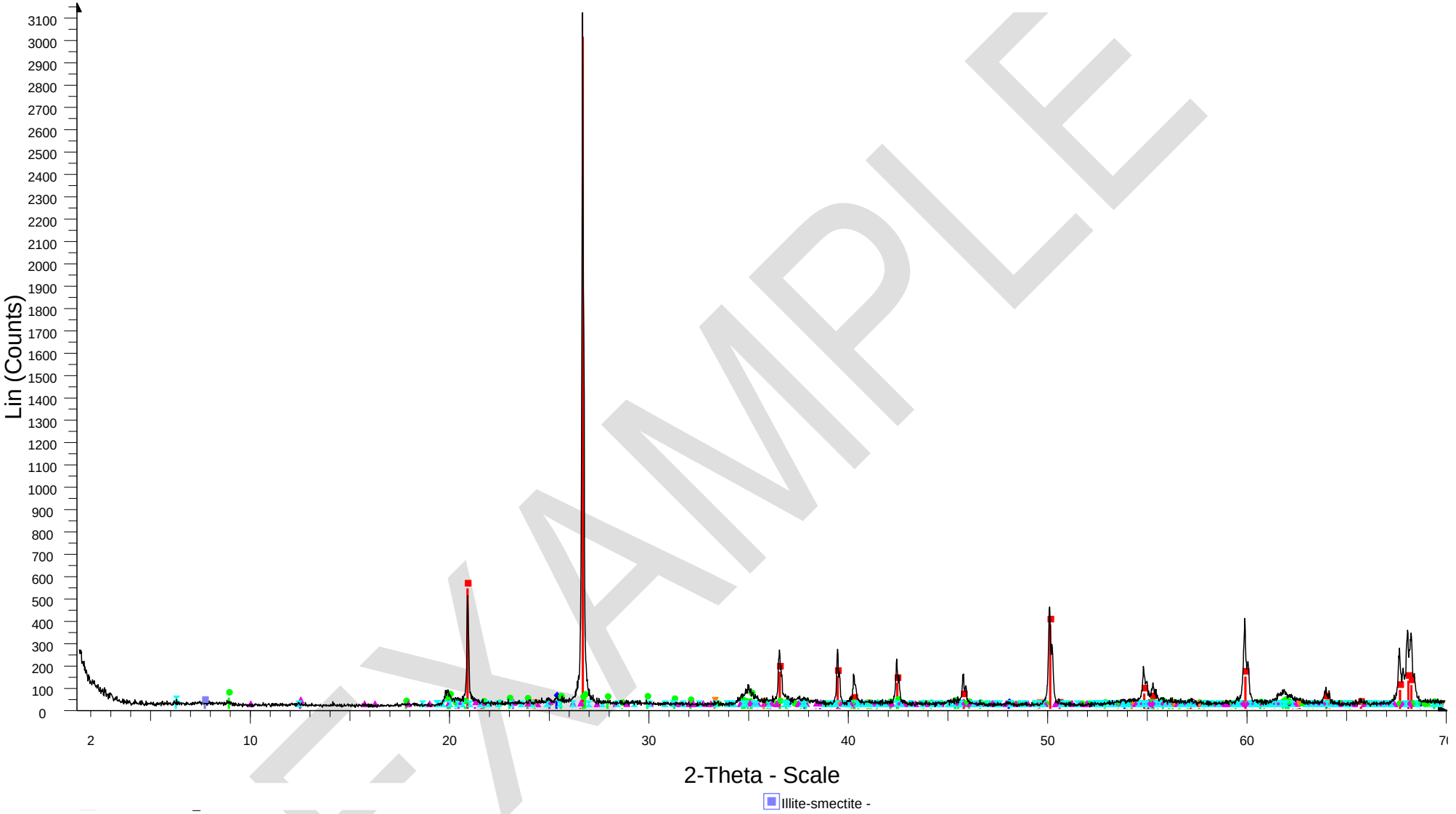
# SAMPLE 1



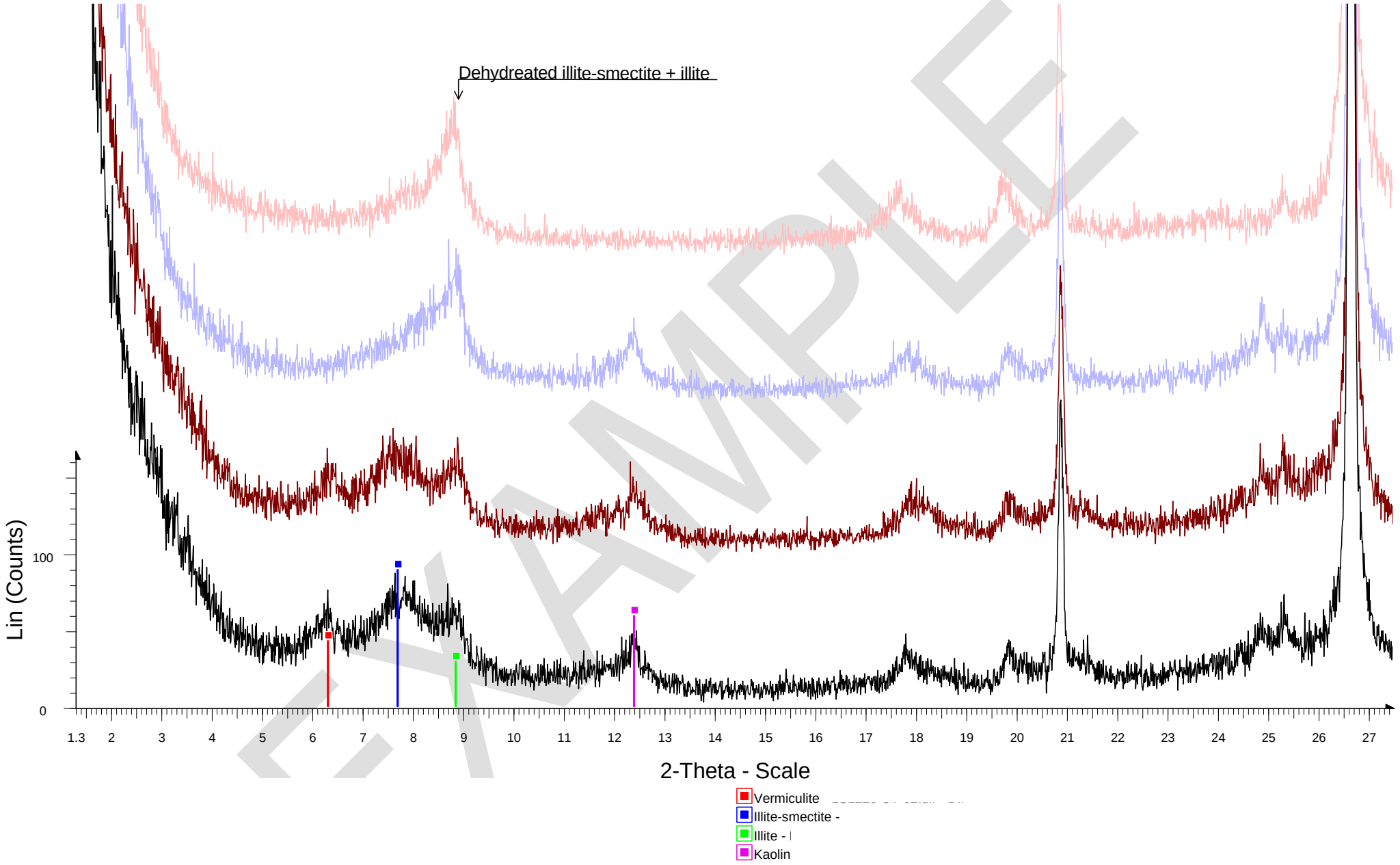
**SAMPLE 1** Clay Mount Overlay. Black= Untreated. Maroon= Glycolated. Purple= Heat Treated 350C. Pink= Heat Treated 550C.



# SAMPLE 2



**SAMPLE 2** : Clay Mount Overlay. Black= Untreated. Maroon= Glycolated. Purple=Heat Treated 330C. Pink= Heat Treated 550C.



# SAMPLE 3