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Clay mineral inventory in soils of Europe based on LUCAS survey soil samples

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Contents

Abstract

Clay minerals are a key factor in mineral soils as they are controlling physic, chemical and biological soil properties. The X-ray diffraction (XRD) analysis has been widely used to identify and quantify minerals in earth science The aim of this research is to describe the clay minerals in soils of Europe and United Kingdom by using soil samples from the Land Use/Cover Area Frame Survey (LUCAS) topsoil database sampled in 2015. A subset of 388 soil samples were selected from LUCAS 2015 topsoil survey. The clay fraction (<2 µm) was separated by sedimentation in distilled water. X-ray powder diffraction (XRPD) measurements have been carried out with a Siemens D5000 diffractometer with a graphite monochromator, using CuKα radiation at 40 kV and 40 mA. Clay mineralogy has been studied by measurement of basal spacing parameters on the clay fraction oriented in glass slides: 3 to 13 °2θ range 0.02 °2θ step size. The study involved the measurement of the 1. air-dried sample, 2. ethylene glycol solvated sample, 3. heat treatment at 110, 350 and 550 °C. Identification of clay minerals were based on the d-spacing value of their 00*l* (mainly 001) reflections after different diagnostic treatment. The semiquantitative composition of <2 µm fractions was estimated by using integrated areas of 00*l* reflections. Brief description of the clay mineralogy of all samples and semi quantitative mineral composition was performed at country level. The X-ray diffractograms after the different treatment (black = untreated, blue = ethylene glycol solvated, green = 110 °C, dark red = 350 °C, red = 550 °C) for each soil sample were analyzed. Majority clay minerals were compared to soils properties such as CEC, soil pH, soil organic carbon (SOC), and clay and sand content. Current descriptive analysis can be used to identify the most relevant clay minerals in soils of Europe. Monitoring over time can be used as soil health indicator to establish potential correlations between clay minerals and relevant threats as soil degradation, soil erosion, and soil pollution.

Acknowledgements

Authors

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1 Introduction

In accordance with Laurence Noel Warr (2022), 21.5 weight% (wt%) of the brittle crust is composed of clay minerals, with 12.9 wt% located in the upper continental crust and 8.6 wt% in the thinner oceanic crust down to average depths of 6.57 km. The most abundant clay mineral type in Earth's upper crustal environments is the 2:1 clay minerals with little or no expandability, commonly illite, which total 7.7 wt%. The remaining 13.8 wt% is distributed more equally between the 1:1 kaolin-serpentine minerals (5.7 wt%), the highly expandable 2:1 smectites (3.0 wt%), and the 2:1:1 chlorites (5.1 wt%). The continental soils and the underlying regolith represent only a small part of the clay mineral inventory (just 0.02 wt%), but they are important generating zones. The total amount of stored water (adsorbed and crystalline water) held is equivalent in volume to 22% of today's surface water with approximately half located in altered oceanic crust. The trapping and release of surface water in and from the clay mineral sink influenced both interior crustal processes and climate change throughout Earth's history. On a shorter time, scale, clay minerals aid climate stability by influencing atmospheric CO2 concentrations and the carbon cycle by means of coupled clay Mg and Ca exchange reactions affecting carbonates precipitation-dissolution equilibrium.

To date, several quantitative methods have been used for identification and quantification of clay minerals in soils (Xiao et al., 2023). The X-ray powder diffraction (XRPD) analysis, as one of the most powerful methods, has been widely used to identify and quantify minerals in earth science. XRD is based on the principle that X-rays are diffracted by the atoms in a crystal lattice, and the resulting diffraction pattern can be used to determine or confirm the crystal structure of the sample (Bragg’s law)

XRPD has many applications in soil analysis, including soil mineral qualification, soil mineral quantification, and soil evolution studies. Soil mineral qualification involves identifying the types of minerals present in a soil sample, while soil mineral quantification involves determining the relative amounts of each mineral present. XRPD can also be used to study soil evolution, by analyzing the changes in the mineralogy of a soil over time. This can provide valuable information about the environmental conditions that existed in the past and how they have changed over time. Overall, XRPD is a valuable tool for soil analysis, providing information about soil mineralogy that can be used to understand soil properties and environmental conditions.

The aim of this research is to assess the clay minerals in soils of Europe by using the Land Use/Cover Area Frame Survey (LUCAS) topsoil database. All figures and tables are generated in-house in the JRC.

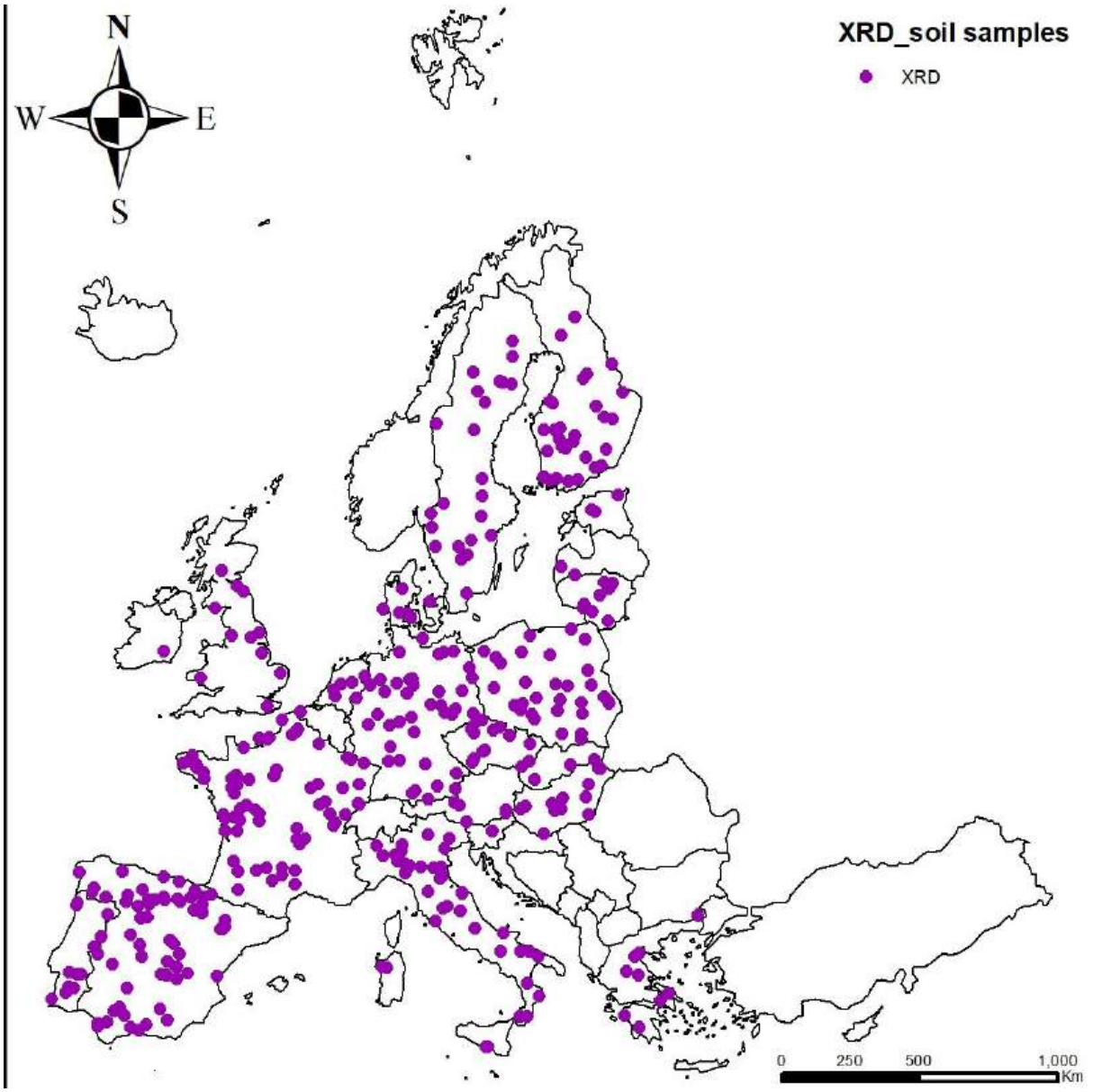
2 Samples withdrawn

Clay mineral study of 388 topsoil samples from LUCAS 2015 topsoil survey were carried out (see Figure 1). Separation of the clay fraction, and the identification and quantification of the clay minerals in the samples using X-ray powder diffraction were performed after different diagnostic treatments.

Soil samples LU17-00204_13 and LU17_00192_050 were removed as no X-ray diffractograms were available to be analyzed. Quantification of LU17_00208_13 soil sample was wrongly assigned to LU17_00204_13 soil sample (page 567). The LU17_00208_13 sample was also excluded for analysis in order to avoid potential misunderstanding.

Furthermore, 383 X-ray diffractograms were included into the analysis. Number of samples analysed by country were; Austria 60, Belgium 1, Czechia 13, Denmark 6, Estonia 3, Finland 30, France 66, Germany 39, Greece 9, Hungary 12, Ireland 1, Italy 38, Latvia 2, Lithuania 8, Netherland 5, Poland 30, Portugal 12, Poland 30, Portugal 12, Slovakia 4, Slovenia 1, Spain 60, and Sweden 23. Additionally, 14 samples from UK were also analysed.

Figure 1. Distribution of soil samples for clay mineralogy analysis



3 Methodology

3.1 Sample preparation and clay mineral separation

Samples preparation, XRD analysis and discussion of the results were carried out in the department of the mineralogy (Eötvös Loránd University) and following the methodologies reported (Zhou et al. 2018, Moore and Reynolds, 1997) The clay fraction (<2 µm) was separated by mechanical shaking dispersion and sedimentation in distilled water (Figure 2). Before the sedimentation small portion of all samples was checked for calcium carbonate using 20% acetic acid. If it was necessary, carbonates were removed by 10% acetic acid.

In some cases, gentle (10-30 sec) sonification, of distilled water suspension was used for the dispersion of the sample. In cases of problematic samples longer sonification (1-2 min) was used. If the repeated sonification adding several distilled water step washings was not enough to produce clay dispersion, we repeated it several times.

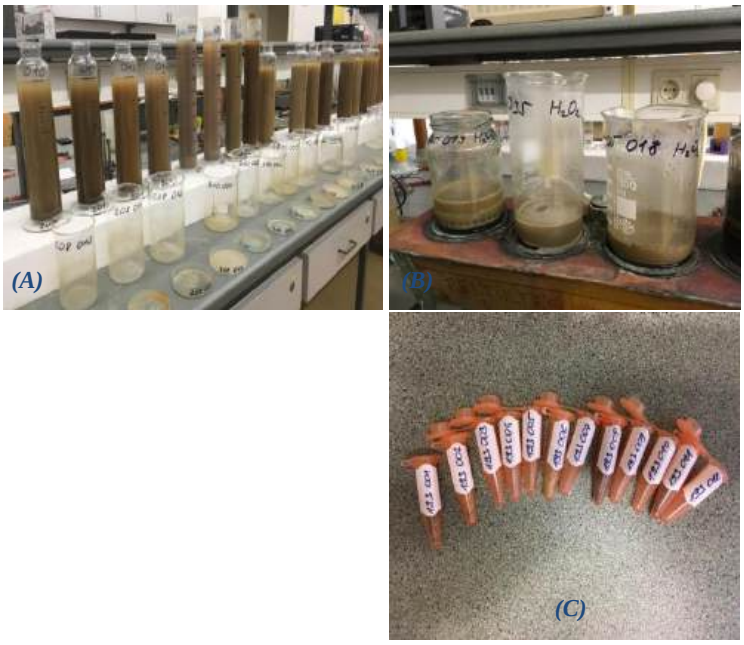
Prior to the separation of the clay fraction organic matter has been removed by 30% hydrogen peroxide in dark coloured samples, or in cases when clay yield was very weak. Peroxidation was carried out for several days (even one week) at 70-80 °C. It is to be noted that this treatment can cause changes in clay minerals, and in samples containing high amount of organic matter calcium oxalate in the form of weddellite precipitated, similarly to the observation of Robert and Beavers (1963).

No chemical dispersion was used if it was not necessary to avoid the saturation of the clays by sodium. However, sodium-tri-polyphosphate was used in some problematic samples as a chemical dispersant agent, but it did not help.

The collected clay fraction was dried on water bath (the suspension itself was of 40-50 °C), and a sufficient quantity (min. 100 mg) was put and stored in an Eppendorf tube.

Finally, oriented aggregates of the clay fraction were prepared by the glass-slide method for the XRPD studies. To ensure the comparability of the measurements and the proper thickness the same quantity of clay suspension has been put on a glass-slide (3.4 mg clay/cm^2). Figure 1 shows the steps of the sample preparation.

Figure 2. Details of Sedimentation of the clay fractions (A), Drying of the collected clay fraction on water bath (B) and, The dried collected clay fractions in Eppendorf tubes(C)



3.2 Analytical methods and clay mineral diagnostic treatments

X-ray powder diffraction (XRPD) measurements have been carried out with a Siemens D5000 diffractometer with a graphite monochromator, using CuKα radiation at 40 kV and 40 mA. Measurement parameters on the clay fraction glass slides: 3 to 13 °2θ range, 0.02 °2θ step size and 2 sec counting time for each step; 13 to 36°2θ range, 0.05 °2θ step size and 2 sec counting time. Measurement parameters on bulk soil samples: 3 to 65 °2θ range 0.05 °2θ step size and 2 sec counting time.

Clay mineralogical study involved the measurement of the 1. air-dried sample, 2. ethylene glycol solvated sample for the detection of the swelling clay minerals (ethylene glycol vapour at 60 °C overnight, 3. heat treatment at 110, 350 and 550 °C for 1 hour, the two later for chlorite–kaolinite differentiation, and for the detection of chlorite- or hydroxy interlayering in the swelling clay minerals.

3.3 Identification of the clay minerals

Identification of clay minerals is based on the d value of their 00*l* (mainly 001) reflections after different diagnostic treatment, as follow:

- **Illite (I)** was identified based on its 001 and 002 reflections at 10 and 5 Å, which did not change at all upon glycolation and heating.
- **Kaolinite (K)** was determined if there was a 7 (7.2) Å peak which disappeared upon 550 °C heating, and there was a peak before 25°2θ, at 3.57-3.58 Å, or there was a clearly distinguishable shoulder or splitting of this peak, thus differentiating kaolinite from chlorite when both minerals are present in the sample. Identification of kaolinite is uncertain when the clay fraction contains higher amount of vermiculite, because of the coinciding peaks at 3.58 Å.
- **Chlorite (C)** was determined if there was a 7 Å and 4.7 Å peak, and/or a peak appeared upon 550 °C heat treatment. A peak at 3.54 Å, serves to confirm its presence instead of kaolinite.
- **Smectite (S)** was identified based on its swelling to 17 Å upon ethylene glycol solvation, and on its collapse to 10 Å upon 350 and 550 °C heating. Distinction of the different mineral species within the smectite group would be possible only after additional treatments and XRD measurements.
- **Vermiculite (V)** was determined if there was a sharper peak around 14.3 Å, which does not shift upon glycolation, or showed just a small expansion, but it collapsed to 10 Å upon 350 and 550 °C heat treatment. It must be noted, however, that conventionally vermiculite identification requires additional treatments and XRD measurements by checking if it collapses under K-exchange at ambient T to 10 Å.
- **Sepiolite (Sep)** was identified based on its reflection around 12.8 Å, which peak remained at that position upon ethylene glycol solvation and 110 °C and disappeared at higher temperatures. These results should be confirmed as most authors are identifying sepiolite by using a reflection peak between 12.2 to 11.9 Å (Brindley and Brown, 1980; Sanchez del Rio et al. 2011)
- **Palygorskite (Plg)** was identified based on its reflection around 10.5 Å, which peak remained at that position upon ethylene glycol solvation and 110 °C and disappeared at higher temperatures.
- **Halloysite** was not determined in the samples, because of its uncertain identification as it expand from 7 to 10 Å under hydration. It is suggested when 7 Å peak assigned to kaolinite is unusually broad and relatively weak compared to the *hk*0 reflection and shows some sharpening upon heating. The uncertainty of its identification increases in the presence of kaolinite, kaolinite/smectite, or chlorite. Identification would be possible on the basis of the morphology seen by TEM, as far as halloysite nanotubes are evinced (Rachel et al., 2012). If there is a suggestion on halloysite we refer to that in the text.
- **Mixed-layer Illite/Smectite (I/S)** was identified based on a broad reflection between 10 and 14 Å, which became a “valley” upon glycolation, forming a very broad, diffuse reflection at higher d-spacing values than smectite. When it is present in higher amount, it can be also identified by its broad 002 reflection between 8.5–10 Å. Interstratification was characterised using Newmod II software.
- **Mixed-layer Kaolinite/Smectite (K/S)** was suggested when a diffuse, continuous reflection was observed on the low-angle side of the 7 Å, which changed, moved upon glycolation and heating. In cases the mixed-layer clay minerals were clear, showing clear, quite intensive reflections, their XRPD patterns were

compared to calculate mixed-layer mineral (MLM) patterns using Newmod II software, and the interstratification have been characterised by that.

- **Mixed-layer illite/vermiculite (I/V)** was identified from XRD patterns like mixed-layer illite/Smectite (I/S) from the untreated sample but without swelling. Reflection of 8.5 Å also suggests R1 or R0.5 ordered I/V (or ***mica/chlorite***); however, this peak may also denote amphibole.
- Peak appearing upon 550 °C at around 12 (11-13) Å was interpreted as the interstratification of a swelling mineral (smectite or vermiculite) with chlorite. In most cases it cannot be determined it is ***chlorite/smectite*** or ***chlorite/vermiculite***. It must be noted that hydroxy-interlayered vermiculite or smectite may behave similarly.
- Other **non-clay minerals** were identified by their strongest peaks which are denoted on the XRD patterns with their abbreviated mineral names.

3.4 Quantification of the mineral composition

The semiquantitative composition of <2 μm fractions was estimated by using integrated areas of 00/ reflections.

Peaks were identified as follows: the major quartz peak at 3,34 Å , the potassium feldspar peak at 3.24-3.25 Å , the plagioclase feldspar peak at 3,19 Å, the ~17 Å peak for smectite in the glycolated sample, the ~14 Å peak for vermiculite, the ~10 Å peak for mica (muscovite, biotite) and illite and ~7 Å peak for chlorite or kaolinite (if only one of them is included in the samples). Peak of kaolinite were used for calculation to resolve the superimposed ~ 7 Å peaks of chlorite and kaolinite, areas of 3.54-3.55 Å reflection of chlorite and 3.58-3.59 Å. Other small amount of silicate minerals and iron oxides are present in the soil <2 μm fractions, peak areas of 12.3 Å of sepiolite, 10.4 Å of palygorskite, 9,2 Å of talc, ~8.4 Å of amphibole (if MLM illite/vermiculite or MLM illite/chlorite is not present), 4.18 Å of goethite (if kaolinite is not present the sample, and the colour of the clay fraction allows it), 6,27 Å of lepidocrocite were applied for their quantification. Calcite, dolomite, gypsum, calcium oxalate (in the form of weddellite) were also observed but not quantitatively evaluated. The mineral composition is reported using a modified semiquantitative approach of Svensson et al. (2000). Correspondingly, the characteristic peak areas (mentioned above) were integrated using the following weight factors for each phase: smectite 1, vermiculite 1, illite 4, kaolinite 2, chlorite 2, quartz 1, feldspars 1, other silicates and iron oxides 1. The relative abundance of mineral components was estimated by dividing the weighted peak area with the integrated peak areas. We performed quantitative analysis on appropriate amounts of random powder clay samples using Rietveld refinement method and compared the quantitative and semiquantitative results, accordingly, estimated the applied weight factors.

The amount of mixed layer clay minerals was estimated as follows. Relative abundance of mixed layer illite/smectite or illite/vermiculite was evaluated as the difference between the total peak area of ~10 to ~14 Å and the peaks bellow 14 Å and 10 Å using a weight factor of 0.5. The amount of other mixed layer clay mineral was estimated by its behaviour and XRPD diffractogram after clay mineral diagnostic treatments (ethylene glycol solvation, heating) if mixed layer minerals present as a minor component besides the main non-mixed layer clay minerals. In the case, the clay fraction contains mostly mixed layer clay mineral, the relative abundance was determined by its characteristic peak. The weight factor was 1 for each mixed layer clay mineral except for mixed layer illite/swelling clay mineral (0.5).

The semiquantitative method used to determine the mineralogical composition is appropriate for comparison between samples analysed in the same way. As far as it perceives the dominant and minor components of the soil clay fraction, it is an applicable approach.

4 Results

4.1 Clay yield, calcite and 7.7 Å reflection problems

Some discrepancies were observed between effervescence test with 20% acetic acid and the measured carbonate contents and the mineralogical composition of the clay fractions, or that of the bulk soil. The critical samples (some 30) were tested again for carbonate by effervescence, and we found only three cases when we have done a mistake in the first test. Unfortunately, calcite from these samples was not removed (LU17 00189 003, LU17 00189 022, LU17 00189 026). However, the test was negative again in the other cases. For example, the clay fraction of 187 008 sample. In some such problematic cases we have done the XRD study of the bulk soil (BS) sample and quantified it using full profile Rietveld refinement. For 187 008 sample we obtained that it contains 15% smectite and similar amount of mica-illite. Contrarily, the clay fraction practically does not contain any clay minerals, but significant amount of calcite. Our suggestion is that this calcite was formed during the production of the clay fraction from lime which could be used for soil remediation, through portlandite, and its transformation to carbonate due to atmospheric CO_2. Another explication of the preservation of calcite is that it is covered by clay minerals and organic matter.

Surprisingly, many samples have a 7.7-7.6 Å peak on the XRD pattern of the clay fraction. In this report this reflection was assigned as gypsum for all samples. Gypsum can be of natural or artificial, anthropogenic origin. However, it must be noted that 7.7 Å reflection can belong also to calcium aluminate hydrate (CAH), which has been demonstrated to be formed from lime at moderately elevated temperature (Bell, 1996) or in the reaction of quick lime added to soil at ambient temperature (Robin et al., 2014). In this issue we cannot take sides as we do not know the past of the studied soils.

The presence of salt (halite) is also enigmatic. Normally, salt must be dissolved and easily removed by washing by distilled water from the sample. In many cases it was not successful. Calcite, gypsum, salt, and CAH, each provoke the aggregation of clay particles, and thus result a very weak clay yield.

Other group of samples which did not produce clay minerals in their clay fraction have been verified according to the XRPD study of the bulk soil samples to do not contain clay minerals, only quartz and primary silicates (feldspars, amphibole, mica).

4.2 Results from X-ray diffractograms

Brief description of the clay mineralogy of all samples and semi quantitative mineral composition are showed at country level. The X-ray diffractograms after the different treatment (black = untreated, blue = ethylene glycol solvated, green = 110 °C, dark red = 350 °C, red = 550 °C) for each soil sample were placed in Annex section. Additionally details of some reprentative clay fractions prepared on glass slides of the soil samples from each country are shown

4.2.1 Germany

Illite, chlorite and kaolinite are the main clay minerals present in soil samples from Germany. The precipitation of calcite in the clay fraction was produced during the separation of the clay fraction in samples with extremely low clay minerals content due presumably to the previous lime addition to the soil. Clay minerals hk0 reflections are present. Then, they are very disordered small crystal size particles.

Figure 3. Details of clay fractions prepared on glass slides of the soil samples from Germany

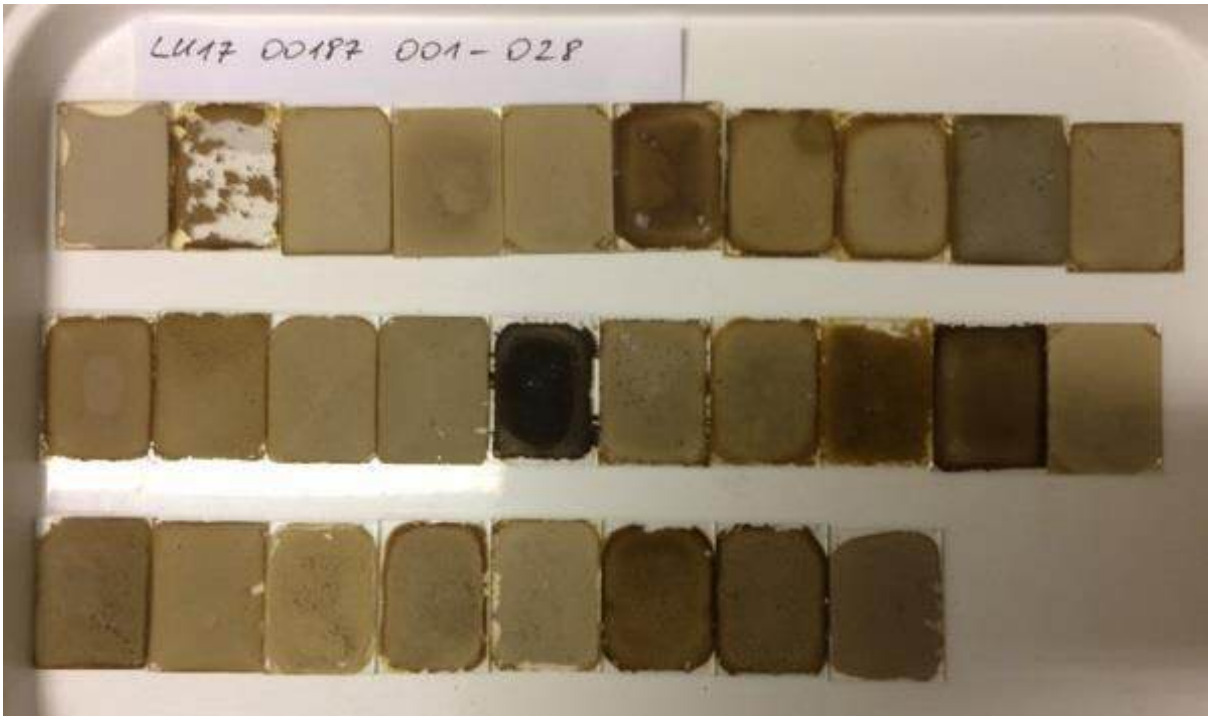


Table 1. Description of the clay mineralogy of the soil samples from Germany

ID	Description
DE1	Kaolinite is the dominating clay mineral (not a typical soil kaolinite, relatively well crystallized), with some illite. Minor amount of quartz and calcite as non-clay minerals.
DE2	Kaolinitic and illitic clay mineralogy with organic matter and quartz
DE3	Illitic and kaolinitic clay mineralogy with quartz, calcite, halite (!) and minor amount of gypsum and feldspars, and organic matter.
DE4	Illite, chlorite and mixed layer illite/smectite dominated clay mineralogy, maybe with some kaolinite, with quartz, calcite and minor gypsum as non-clays
DE5	Illite, chlorite and mixed layer illite/smectite dominated clay mineralogy, maybe with some kaolinite, with quartz, calcite and minor gypsum as non-clays.
DE6	Illite and kaolinite (and/or chlorite), with considerable quartz and calcite content, and some feldspars
DE7	Vermiculite, illite, chlorite and some kaolinite compose the clay fraction with quartz, and some feldspar, gypsum and halite. The vermiculite does not swell, it seems to be high charged and/or partly hydroxy-interlayered
DE8	The peculiarity of this sample is its high calcite content in the clay fraction. No effervescence with 10% HCl has been observed for this sample, and based on the soil chemical analysis it contains only 0.1% CaCO3. Practically there is no clay mineral 00l reflection on the pattern, however the hk0 reflection at 4.5 Å shows their presence. Clay minerals particles in this sample seems to be of very small crystal size, very badly crystallised. It contains high amount of quartz, and some anatase. However, based on the XRPD pattern of the bulk soil the sample contains 15-15% smectite and illite (mica), 60% quartz, 9% feldspar and does not contain calcite. This suggests that calcite precipitated during the clay fraction production. Its precursor could be lime, which strongest reflections are appeared on the X-ray pattern
DE9	Practically there is no clay mineral 00l reflection on the pattern, and even hk0 reflection at 4.5 Å is quite weak. According to the study of the bulk soil sample, actually it contains nothing besides

96% quartz and 4% feldspar. Therefore, calcite and salt should be again a by-product of the clay fraction production

DE10 Similar to the previous samples with newly formed calcite, gypsum, some quartz, and clay mineral is illite

DE11 Illite, chlorite and some MLM illite/vermiculite or illite/smectite are the clay minerals, with significant amount of calcite and some quartz as non-clay minerals

DE12 Vermiculitic clay mineralogy (non-expanding on EG, probably high layer charged), with illite, kaolinite and chlorite. Quartz, calcite, gypsum and halite as non-clay minerals

DE13 Illitic–chloritic clay mineralogy showing illite dominance and less chlorite. Significant amount of calcite, quartz, some gypsum and as non-clay minerals

DE14 Vermiculitic clay mineralogy (non-expanding on EG, probably high layer charged), with similar amount of chlorite and less illite. Significant amount of non-clay minerals: quartz, calcite, and halite. The bulk soil contains in fact only 86% quartz and 13% feldspars (both plagioclase and K-feldspar)

DE15 Organic matter rich sample, unfortunately there is no information about the clay minerals. Quartz, feldspars and halite are non-clay minerals present

DE16 Illite and chlorite are the clay minerals present in the sample, with significant amount of calcite (probably newly formed) and some quartz as non-clay minerals.

DE17 Illite and chlorite are the clay minerals present in the sample, with significant amount of calcite (probably newly formed) and quartz as non-clay minerals

DE18 Illitic–chloritic clay mineralogy, with significant amount of calcite (probably formed during the sample preparation) and quartz, and some halite and gypsum as non-clay minerals.

DE19 Chloritic clay mineralogy, with some MLM illite/vermiculite or illite/smectite. Significant amount of non-clay minerals in the clay fraction: quartz, calcite, halite and gypsum

DE20 Illite, mixed layer illite/smectite, chlorite and kaolinite are the clay minerals with quartz, calcite, some feldspar and gypsum.

DE21 Clay fraction rich in calcite and salt, and less quartz. There is no information about the clay minerals

DE22 Illite and kaolinite represent clay minerals in the sample. Significant amount of non-clay minerals in the clay fraction: quartz and calcite. Calcite is a by-product of the sample preparation, because the bulk soil does not contain it, only 83% quartz, 15% feldspar (plagioclase and K-feldspar too), 1% mica, and probably less than 1% lime.

DE23 No effervescence with 10% HCl has been observed for this sample, and based on the soil chemical analysis it contains 2% CaCO3. However, the clay fraction is dominated by calcite. Practically there is no clay mineral 00l reflection on the pattern, however the hk0 reflection at 4.5 Å shows their presence. Clay minerals in this sample seems to be very small crystal size, very badly crystallised. Itt contains high amount of quartz, and some anatase

DE24 Clay mineralogy dominated by kaolinite, with less illite, illite/smectite and minor amount a mixed layer chlorite/smectite or chlorite/vermiculite. Quartz and calcite are non-clay minerals

DE25 Kaolinite, illite, MLM illite/smectite, chlorite and MLM chlorite/smectite or chlorite/vermiculite are the present clay minerals, with calcite and quartz

DE26 Clay minerals showing hk0 reflection and weak basal reflections, with high amount of organic matter and quartz, and some gypsum. Kaolinitic, subordinately illitic

DE27 Illite dominated clay fraction with chlorite, quartz and some feldspar as non-clay minerals

DE28 Clay mineralogy characterised by illite, mixed layer illite/smectite or illite/vermiculite, chlorite and kaolinite also. Quartz and calcite are the non-clay minerals

DE29 Illite is the dominating clay minerals, with chlorite, mixed-layer illite/smectite or illite/vermiculite, and also with some mixed-layer chlorite/smectite. Quartz, some calcite and gypsum are present as non-clay minerals

DE30 Dominantly illite, with randomly interstratified illite/smectite containing 10-15% expanding component. Kaolinite is also present, with some quartz and gypsum

DE31	Vermiculite, illite, chlorite, kaolinite and mixed layer illite/vermiculite and some chlorite/vermiculite or HIV represent the clay mineralogy, with quartz
DE32	The dominant clay minerals are smectite and mixed layer illite/smectite showing R0 ordering approximately 50/50 illite and smectite. The clay fraction contains kaolinite and minor amount of illite, and some quartz
DE33	Clay minerals in the sample are kaolinite, illite, chlorite, and mixed layer illite smectite (R0, 60% smectite).
DE34	Illite, kaolinite, chlorite and mixed layer illite/smectite represent the clay minerals, with quartz, and minor amount of feldspar and calcite
DE35	Kaolinite, vermiculite, and less illite, and mixed-layer chlorite/vermiculite are the clay minerals in the sample, with quartz and gypsum
DE36	Chloritic, mixed-layer chlorite/vermiculitic clay mineralogy with less illite, with high amount of quartz and some gypsum and calcite
DE37	Dominantly illite and kaolinite, with some chlorite (maybe vermiculite). Non-clay minerals are quartz, feldspar, calcite and gypsum
DE38	Dominantly illitic clay mineralogy, with less kaolinite, chlorite and mixed-layer chlorite/vermiculite. Non-clay minerals are quartz, feldspar, calcite and gypsum
DE39	Vermiculite dominated clay mineralogy, with less chlorite and illite. According to the Na-citrate extraction test we have done complementary, a part of this vermiculite shows hydroxy interlayering, so it is partially a HIV (partial expansion upon glycolation after citrate treatment of the originally non-swelling 14 Å mineral). Quartz, feldspar and calcite with trace amount of gypsum are the non-clay minerals

Table 2. Semi-quantitative mineral composition of the clay fraction of the soil samples from Germany

ID	S	V	I	C	K	I/S	I/V	C/S	C/V	HIV	Qz	Fsp	Cal	Gp
DE1			13		81						6		+	+
DE2			29		22						49		-	+
DE3			31		13		2				48	5	+	+
DE4			56	10	4	6					23	1	+	+
DE5			44	8	9	5					32	2	+	+
DE6	7		19	10		2					63	6	+	-
DE7			25	9	9						47	2	+	+
DE8				12							88		+	-
DE9			10								85	5	+	-
DE10			10								90		+	+
DE11		14	21	35			19				25		+	+
DE12			16	8	9						47	5	+	+
DE13		15	33	13							49	5	+	+
DE14			11	17							52	4	+	+
DE15											99	1		
DE16			31	30							39		+	-
DE17			15	18							65	2		
DE18			20	12							66	2	+	+

DE19				20		5					58	17	+	+
DE20			29	10	10	15					34	2	+	+
DE21											100		+	+
DE22			30		13						57		+	-
DE23			57	14		1					26	3	+	-
DE24			29	2	37	5					25	2	+	-
DE25			40	9	19			6			23	3	+	-
DE26			22		25						53		-	+
DE27			34	4							60	3	+	-
DE28			53	3	10	6					26	2	+	-
DE29			65	3	4		2	2			22	1	+	+
DE30		6	69		8	5					17	1	+	+
DE31	11		32	6	12		9				34	2	+	+
DE32	5		18		20	29					20	1	+	-
DE33			37	6	24	8					20		-	+
DE34		9	27	7	17	7					40	3	+	+
DE35			15	7	12				5		46	7	+	+
DE36			7	18					5		70		+	+
DE37			44	7	17						30	2	+	+
DE38		21	47	2	11				3		34	2	+	+
DE39			14	33						15	14	1	+	+

4.2.2 Greece

Illite, smectite and expandable MLM, chlorite, and kaolinite are the main clay minerals present in soil samples form Grece. Quartz is the main non clay mineral and iron oxides are also present.

Figure 4. Details of clay fractions prepared on glass slides of the soil samples from Greece

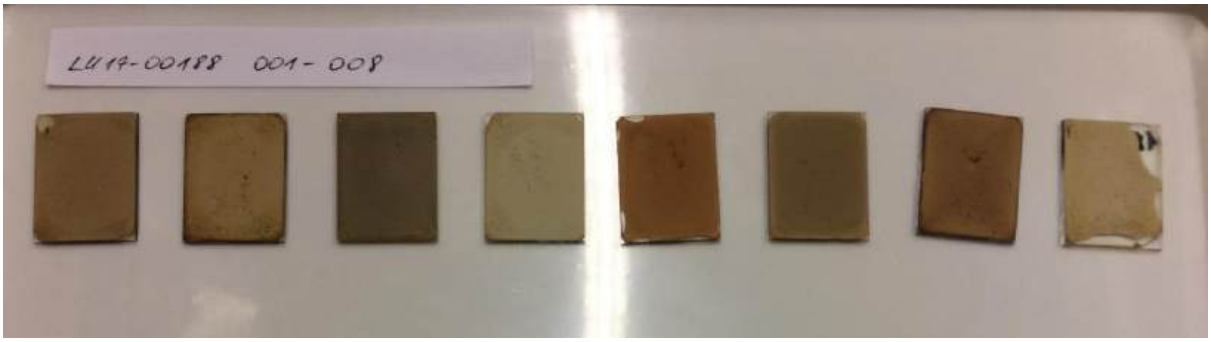


Table 3. Description of the clay mineralogy of the soil samples from Greece

ID	Description
GR1	The dominating clay minerals are illite, smectite, MLM illite/smectite, kaolinite with quartz, calcite and gypsum as non-clay minerals

GR2	Weak clay mineral 00l reflection with high amount of organic matter. Illite, kaolinite, chlorite compose the clay fraction with quartz and calcite
GR3	The dominating clay minerals are Na-smectite, chlorite, illite with halite and calcite as nonclay minerals
GR4	Illite, MLM illite/smectite and chlorite compose the clay minerals with calcite and quartz
GR5	Kaolinite, chlorite, illite and MLM illite/smectite clay mineralization with goethite, calcite and quartz
GR6	Kaolinite, chlorite, illite and MLM illite/smectite clay mineralization with goethite, calcite, and quartz
GR7	Weak clay mineral 00l reflection with high amount of organic matter. The dominating clay minerals are kaolinite and illite with calcite and quartz as non-clay minerals
GR8	The dominating clay minerals are kaolinite and illite with calcite, halite, and quartz as non-clay minerals
GR9	The dominating clay minerals are illite, kaolinite and chlorite with high amount of gypsum, halite, calcite, and quartz as non-clay

Table 4. Semi-quantitative mineral composition of the clay fraction of the soil samples from Greece

ID	S	I	C	K	I/S	Qz	Fsp	Gth	Cal	Gp
GR1	3	66		8	6	16			+	+
GR2		34	5	10		51			+	+
GR3	56	20	16			7	1		+	-
GR4		38	18		29	14			+	-
GR5		27	24	34	3	12			+	+
GR6		54	12	8	8	16		1	+	+
GR7		42		21		37			+	-
GR8		45		25		30			+	+
GR9		53	12	31			3		-	+

4.2.3 Spain

Illite predominate in Spanish soils clay minerals. Randomly ordered R=0 explandable illite/smectite MLM and kaolinite are abundant. Palygorskite is sometimes present. Non clay minerals are represented by calcite, gypsum, dolomite, and quartz. Sometimes the presence of dolomite is associated with gypsiferous soils. Oxyhydroxides as lepidocrocite and goethite are frequenting in the clay fraction.

Figure 5. Details of clay fractions prepared on glass slides of the soil samples from Spain

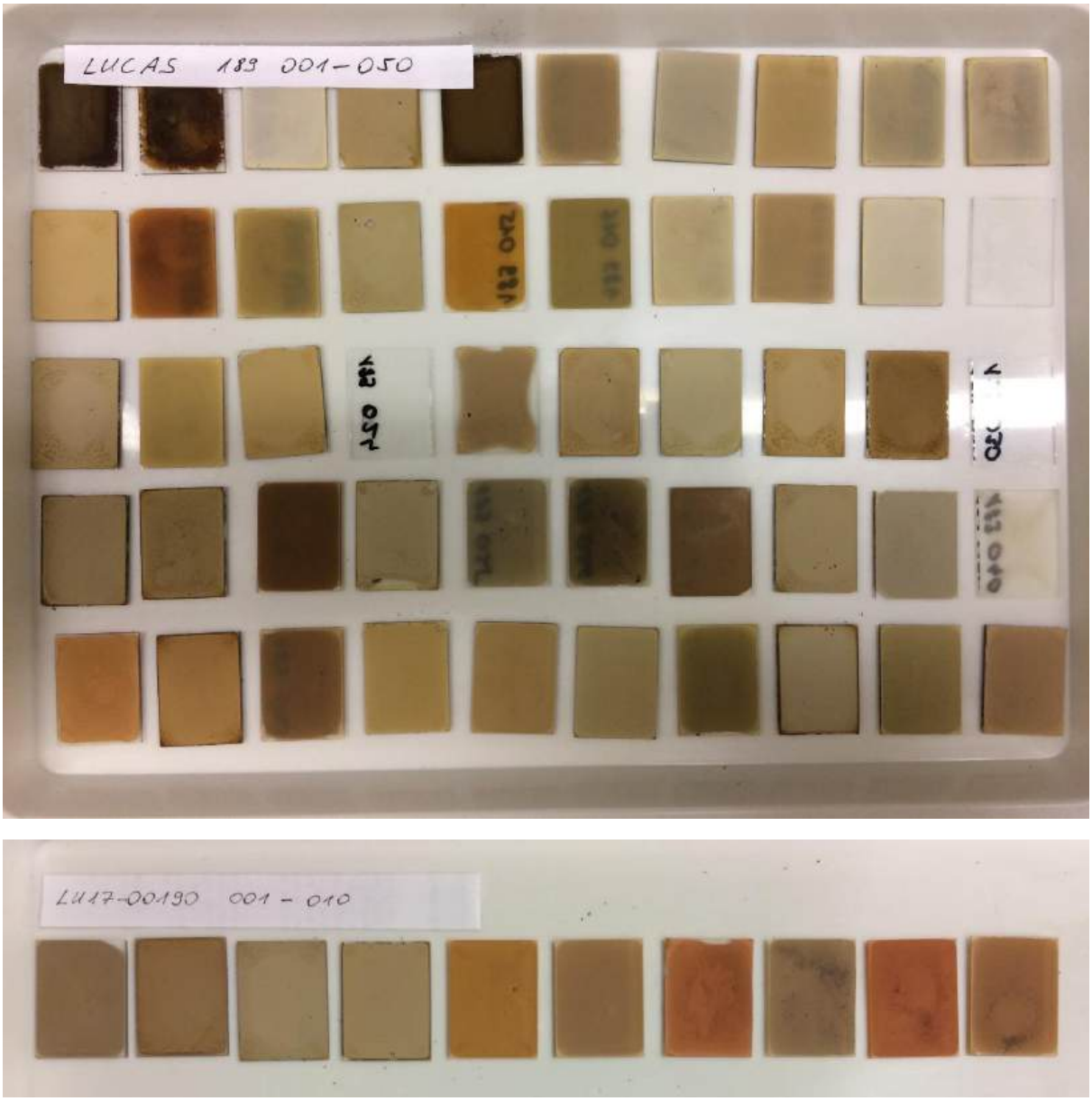


Table 5. Description of the clay mineralogy of the soil samples from Spain

ID	Description
ES1	Illite and mixed layer illite/vermiculite dominated clay mineralogy with some kaolinite, containing relatively high quantity quartz and gypsum
ES2	Chlorite and illite are the clay minerals in the sample, with some quartz and halite
ES3	Illite dominated clay mineralogy with mixed layer illite/smectite and some chlorite. High amount of calcite
ES4	Characteristic clay minerals in the sample are sepiolite and illite, with less vermiculite. The sample contains lepidocrocite
ES5	Goethite dominates the clay fraction, with lepidocrocite, calcite and quartz
ES6	Dominantly illitic clay mineralogy with less kaolinite, and trace chlorite, with some calcite
ES7	Predominant clay minerals are illite and less palygorskite, with less kaolinite and chlorite. Minor amount of non-clay minerals: quartz, feldspar, calcite

ES8 Dominantly illitic and kaolinitic clay mineralogy, but with significant chlorite content. Quartz and calcite as non-clays

ES9 Illite and mixed layer illite/smectite (R0, 65-70% illite component) dominated clay mineral composition, with some chlorite, containing significant amount of calcite

ES10 Illite and mixed layer illite/smectite (55-60% illite component) dominated clay mineral composition, with some chlorite, containing significant amount of calcite

ES11 Predominantly illitic and kaolinitic clay mineralogy, containing also vermiculite, and minor amount of mixed-layer chlorite/vermiculite, with quartz, goethite and trace feldspar, calcite

ES12 Kaolinite, chlorite/vermiculite, or HIV, illite, MLM illite/smectite and kaolinite are the clay minerals. According to its reddish colour it can contain hematite, and goethite

ES13 Kaolinite and MLM illite/smectite characterise the clay mineralogy, with discrete illite, and trace chlorite

ES14 Illite and kaolinite dominated clay mineralogy with some MLM illite/smectite and chlorite/smectite. Significant amount of calcite and trace gypsum

ES15 Illitic clay mineralogy, with kaolinite and some MLM illite/smectite (R0, 80% illite), and with minor amount of goethite

ES16 Characteristically expanding clay mineralogy with smectite and MLM illite/smectite (50% swelling component), but also with kaolinite and chlorite, and less discrete illite, and some quartz

ES17 Mixed layer illite/smectite (R0, 55-60% smectite) dominated clay fraction, with less kaolinite, and some discrete illite and chlorite. Significant amount of calcite, some quartz, and maybe anatase

ES18 Illitic and chloritic clay mineralogy, with calcite and some quartz

ES19 Characteristically MLM illite/smectite (60% swelling component) dominates the clay mineralogy, with some illite and kaolinite. The clay fraction contains higher amount of calcite and less gypsum

ES20 The clay fraction separation was difficult and provided only gypsum. XRD pattern of the bulk soil sample indicate the dominance of gypsum, with dolomite, quartz, plagioclase feldspar. Mica (muscovite) and chlorite represent phyllosilicates, suggesting some information about the clay mineralogy

ES21 Dominantly illitic clay mineral character, with minor amount of kaolinite (and/or chlorite). Presence of palygorskite is not evident, but it cannot be excluded. Non-clay minerals are quartz, calcite, gypsum, feldspars, and halite

ES22 Illite dominated clay mineralogy with kaolinite and chlorite. Non-clay minerals are calcite, quartz, K-feldspar and/or rutile

ES23 Dominantly illitic clay mineralogy, with kaolinite, chlorite, quartz, goethite, and calcite

ES24 Extremely poor clay fraction (although we used the same material quantity it is transparent). Illite and some chlorite, with higher amount of quartz and feldspars

ES25 Predominant clay mineral is illite, with less kaolinite, MLM illite/smectite, and trace MLM chlorite/smectite. Quartz and calcite are non-clay minerals

ES26 Illitic clay mineralogy with MLM illite/smectite and kaolinite. Significant amount of calcite, less quartz

ES27 Mixed-layer chlorite/vermiculite (about 50:50%) and illite dominated clay mineralogy, with some MLM illite/smectite. Feldspar, some quartz, and calcite are the non-clay minerals

ES28 Illite, MLM chlorite/smectite and kaolinite dominated clay mineralogy, with less chlorite and MLM illite/smectite. Non-clays are quartz and calcite

ES29 Kaolinitic and illitic clay mineralogy with calcite and quartz

ES30 Extremely poor clay fraction (although we used the same material quantity it is transparent). Illite and some chlorite, with higher amount of quartz, calcite, and halite

ES31 Illitic clay mineralogy and vermiculite, chlorite/vermiculite, with higher amount of quartz and calcite

ES32 Illite, kaolinite, and chlorite, with some MLM chlorite/vermiculite (or smectite), with quartz and calcite

ES33 Illite, MLM illite/smectite, chlorite and kaolinite represent clay minerals, with some quartz and calcite

ES34 Illitic clay mineralogy with some MLM illite/smectite and kaolinite, quartz

ES35 Swelling clay mineralogy with smectite and MLM illite/smectite (R0, 65-70% smectite) and discrete illite and kaolinite

ES36 Swelling clay mineralogy with smectite and MLM illite/smectite with 60% swelling component and discrete illite and some kaolinite.

ES37 Illite dominated clay mineralogy with MLM chlorite/vermiculite, and chlorite

ES38 Kaolinitic clay mineralogy with illite, some MLM illite/smectite and chlorite/vermiculite. Quartz and calcite as non-clay minerals

ES39 Predominant clay mineral is illite. Beside illite the sample contains pure smectite, chlorite and MLM chlorite/vermiculite and trace amount of calcite as non-clay mineral

ES40 The separation of the clay fraction was not successful, it contains only gypsum

ES41 Mixed layer illite/smectite (R0, 65-70% illite content), discrete illite and kaolinite are the clay minerals in the sample, with some calcite and quartz as non-clay minerals

ES42 Illitic and kaolinitic clay mineralogy with some MLM chlorite/vermiculite in the sample, with quartz, some goethite, feldspar and maybe anatase

ES43 Typical expanding clay dominated clay mineralogy with discrete smectite, MLM illite/smectite (R0, 70% swelling component) and discrete illite and kaolinite, without non-clay minerals

ES44 Predominating clay mineral is illite, with kaolinite and some MLM chlorite/vermiculite and MLM illite/smectite. The sample contains some calcite and quartz and probably goethite.

ES45 Clay mineralogy characterised by illite and chlorite, with some calcite

ES46 Predominating clay minerals are illite and MLM illite/smectite (R0, 65% illitic component), with less chlorite, and some MLM chlorite/vermiculite. The sample contains some calcite

ES47 Predominating clay mineral is MLM illite/smectite (R0, 65-70% illitic component), with illite, and some chlorite or MLM chlorite/smectite. The clay fraction contains quartz and some calcite

ES48 Illitic clay mineralogy with less chlorite and some MLM chlorite/smectite. The clay fraction contains calcite, quartz, and some feldspar

ES49 Predominating clay minerals are MLM illite/smectite (R0, 80% illitic component) and illite, with less chlorite and kaolinite. The clay fraction contains quartz and some calcite.

ES50 Smectitic and MLM illite/smectitic (R0, 70-80% swelling component) clay mineralogy with discrete illite and less chlorite

ES51 Illitic clay mineralogy with chlorite, and some illite-rich MLM illite/smectite, with trace amount of quartz

ES52 Illitic clay mineralogy with chlorite, and some illite-rich MLM illite/smectite, with trace amount of quartz and goethite

ES53 Kaolinite dominated clay mineralogy with significant amount of illite, and some MLM illite/smectite. Non-clay minerals present are quartz, calcite, feldspar

ES54 Expanding clay mineralogy with almost pure smectite probably with heterocationic interlayer composition (Na+ and divalent cations), some MLM illite/smectite and non-swelling high charged vermiculite. Discrete illite and kaolinite are also present, with some quartz

ES55 Predominating clay mineral is illite, with less kaolinite, MLM illite/smectite (R0, 70-75% illite content), and some chlorite, and probably trace amount of goethite as non-clay mineral

ES56 Smectite, MLM illite/smectite (60-65% illitic component), palygorskite and illite dominated clay mineralogy, with some, chlorite, and kaolinite

ES57 Illitic–kaolinitic clay mineralogy with some MLM illite/smectite (R0, 65-70% illitic component). Non-clay minerals are calcite, some quartz and hematite

ES58 Palygorskite and illite dominated clay mineralogy, with some MLM illite/smectite (50:50%), kaolinite and chlorite

ES59 Predominating clay minerals are MLM illite/smectite (60-65% illitic component), illite and kaolinite, and some palygorskite, containing some goethite

ES60 Smectite, illite, chlorite, kaolinite, and some MLM illite/smectite compose the clay fraction with some feldspar and quartz

Table 6. Semi-quantitative mineral composition of the clay fraction of the soil samples from Spain

ID	S	V	I	C	Sep	Plg	K	I/S	I/V	C/S	C/V	Qz	Fsp	Gth	Lp	Cal	Gp
ES1	0		44				3		25			27	2			-	+
ES2			37	47								16				-	-
ES3			62	8				17				9	4			+	+
ES4		4	56		6							29	2		3	-	-
ES5												21		79		+	-
ES6			80	3			5					11				+	-
ES7			72	4		5	7	1				10	1			+	-
ES8			66	7			15					12				+	-
ES9			80	6				5				8	1			+	-
ES10			58	12				16				10	4			+	-
ES11		5	46				24				3	21	1			+	-
ES12			43				30	10			7	9				-	-
ES13			31	1			43	13				11	1			+	-
ES14			43				22	5		2		27	2			+	+
ES15			55				18	11				17				-	-
ES16	10		10	8			34	30				8				-	-
ES17	16		20	5			16	20				22				+	+
ES18			74	16								10				+	-
ES19			27				12	50				11				+	+
ES20																-	+
ES21			80			1	5					13	1			+	+
ES22			73	4			8					14	2			+	-
ES23			70	4			6					18	1	1		+	+
ES24			45	4				4				29	17			-	+
ES25			58				16	7		4		14	1			+	-

ES26			68			12	6			13	2		+	+
ES27			49	2			2		29	17	1		-	-
ES28			45	2		25	2		9	16	1		+	-
ES29			40			32				25	3		+	-
ES30			43	18						29	10		+	-
ES31		8	50	10						29	3		+	-
ES32			38	13		21	7		3	17			+	-
ES33			57	6		15	10			11	1		+	-
ES34			71			8	6			14	2		+	-
ES35			30			18	44			7			-	-
ES36			19			6	68			7			+	-
ES37			67	20					10	3			+	-
ES38			22			63	2		6	5	2		+	-
ES39	2		78	2					6	12			+	-
ES40													-	+
ES41			62			17	11			8	1		+	-
ES42			50			18			5	26	1		+	+
ES43	2		38			14	29			6			-	-
ES44			76			9			3	11			+	-
ES45			74	13					2	10			+	-
ES46			61	12			13		2	13			+	-
ES47			37				38	5		20			-	-
ES48			60	10				1		28	2		+	-
ES49			55	4		10	14	3		15			+	-
ES50	13		42	14			19			13			-	-
ES51			62	10			15			13				
ES52			66	10			10			14			-	-
ES53			31			59	3			6	1		+	-
ES54	11	10	30			19	15			15	1		-	-
ES55			64	5		12	10			8	0		-	-
ES56			55	1	1	8	26			7	1		-	-
ES57			55		0	26	1			18	0		+	-
ES58			69	3	5	9	5			9	0		-	-
ES59			39		1	25	25			11			-	-
ES60	10		51	6		10	13			9	1		-	-

4.2.4 Finland

Typical grey dark colours characterize Finland clay mineral in soils. Vermiculite including HIV Al hydroxide intercalated are typical of Finland soils. MLM chloritic and ordered smectite minerals with illite are also present. Non clay minerals include amphibole indicative of a low degree of weathering. Quartz and feldspars are the main non clay minerals. Also, micas are present. Presence of vermiculite, halite and amorphous simultaneously could be explained when taking place extraordinarily strong leaching rate.

Figure 6. Details of clay fractions prepared on glass slides of the soil samples from Finland

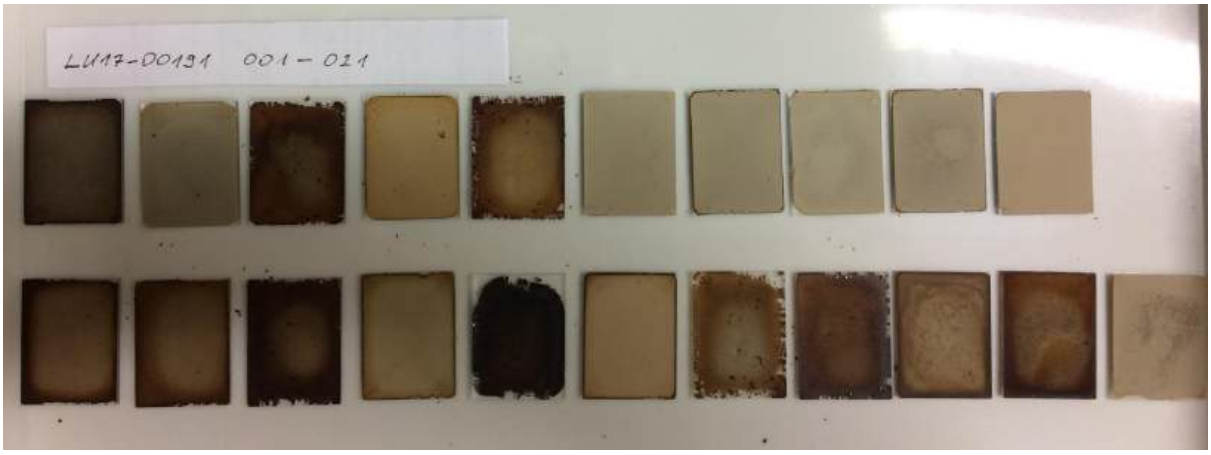


Table 7. Description of the clay mineralogy of the soil samples from Finland

ID	Description
FI1	The dominating clay minerals are HIV, Na-vermiculite, and small amount of illite, with quartz and halite
FI2	The dominating clay fraction are illite, chlorite, vermiculite, MLM illite/vermiculite (probably hydrobiotite) (ordered 50:50%) with quartz, calcite, and amphibole as non-clay minerals
FI3	Extremely poor clay fraction with small amount of chlorite and illite. Quartz as a non-clay. The bulk soil sample does not contain clay minerals, it is composed of 63% quartz, 33% feldspars and 2% amphibole
FI4	Illite, chlorite, vermiculite dominated clay fraction with quartz and calcite
FI5	Poor clay fraction with vermiculite and quartz, calcite. According to the analysis of the bulk soil it contains 60% quartz, 34% feldspars, 5% amphibole and 1% chlorite
FI6	Characteristic clay minerals in the sample are illite and chlorite with amphibole and quartz as non-clay
FI7	Characteristic clay minerals in the sample are illite and chlorite with amphibole, quartz, and feldspars as non-clay
FI8	Characteristic clay minerals in the sample are illite and chlorite with amphibole, quartz, feldspars, and some calcite as non-clay
FI9	The dominating clay minerals are illite, chlorite, MLM illite/vermiculite, and small amount of MLM illite/chlorite with quartz and feldspars
FI10	Characteristic clay minerals in the sample are illite, chlorite and MLM chlorite/vermiculite with amphibole and quartz as non-clay
FI11	Poor clay fraction with vermiculite and quartz
FI12	Extremely poor clay fraction with illite and vermiculite. Quartz as non-clay
FI13	Extremely poor clay fraction with very small amount chlorite with quartz and organic matter. According to the analysis of the bulk soil it contains 65% quartz, 32% feldspars, 2% amphibole and 1% mica

FI14	The dominating clay fraction are illite, chlorite and MLM chlorite/vermiculite with quartz, amphibole, and calcite
FI15	The dominating clay fraction are illite, vermiculite and MLM illite/vermiculite with quartz and organic matter
FI16	Illite, chlorite and MLM illite/vermiculite dominated clay fraction with quartz and amphibole
FI17	Extremely poor clay fraction with vermiculite and quartz
FI18	Poor clay fraction with illite and vermiculite. Quartz as non-clay
FI19	The dominating clay minerals are illite and MLM kaolinite/smectite with amphibole and quartz
FI20	The dominating clay minerals are illite, kaolinite and MLM illite/smectite with quartz
FI21	The dominating clay minerals are illite, kaolinite and MLM illite/vermiculite with quartz
FI22	Poor clay fraction with illite, vermiculite and MLM illite/chlorite/vermiculite with quartz and organic matter
FI23	The dominating clay fraction are illite, vermiculite and HIV with quartz, gypsum, and calcite
FI24	The dominating clay minerals are illite, HIV and MLM illite/vermiculite with amphibole and quartz
FI25	Chlorite, illite and MLM chlorite/vermiculite dominated clay fraction with quartz, amphibole, and talc.
FI26	The dominating clay minerals are illite, chlorite, MLM illite/chlorite and smectite with quartz
FI27	The dominating clay minerals are illite, chlorite, MLM illite/chlorite with quartz
FI28	Characteristic clay minerals in the sample are vermiculite and illite with gypsum and amphibole
FI29	Illite, vermiculite, HIV dominated clay fraction with gypsum, amphibole, and quartz
FI30	The sample did not yield clay fraction. According to the XRD analysis of the bulk soil it contains 79% quartz, 20% feldspars (plagioclase > K-feldspar) and 1% biotite

Table 8. Semi-quantitative mineral composition of the clay fraction of the soil samples from Portugal

ID	S	V	I	C	Tlc	K	I/S	I/V	I/C	I/C/V	C/S	C/V	HIV	K/S	Qz	Fsp	Amp	Cal	Gp
FI1		13	10		3								10		40	24		-	-
FI2		5	26	16				13							30	9	3	+	-
FI3			16	10											50	24		-	-
FI4		8	36	15											21	15	4	+	-
FI5		19													53	27		+	-
FI6			54	16				5							19	6	1	-	-
FI7			61	16											16	5	1	-	-
FI8			51	14											23	10	2	+	-
FI9			37	18				5	1						29	10		-	-
FI10			52	12							3				25	7	1	-	-
FI11		16													64	20		-	-
FI12		12	34												43	10		+	-
FI13				10											64	26		-	-
FI14			36	8								4			35	16	2	+	-
FI15		15	31					1							43	10		-	-
FI16			44	12			9								21	11	3	-	-

FI17		20											49	31		-	-
FI18		4	30										47	20		-	-
FI19			30									8	39	19	4	-	-
FI20			30			10	7						33	20		-	-
FI21			57	8				6					22	7		-	-
FI22		5	33							5			51	6		-	-
FI23		11	22								3		47	16		-	+
FI24			8					7			17		57	10	1	-	+
FI25			25	25	2						7		30	9	2	-	+
FI26	6		22	16					19				26	11		-	-
FI27			38	22					9				21	11		-	-
FI28		13	6										62	17	3	-	+
FI29		13	20								11		41	13	2	-	+
FI30																79	20

4.2.5 Hungary

Clay mineralogy in the Hungary soils is composed mainly of illite, chlorite and kaolinite. Expandable MLM components with all these layers are described. Quartz is the main non clay mineral with minor amounts of gypsum and calcite and less halite.

Figure 7. Details of clay fractions prepared on glass slides of the soil samples from Hungarian

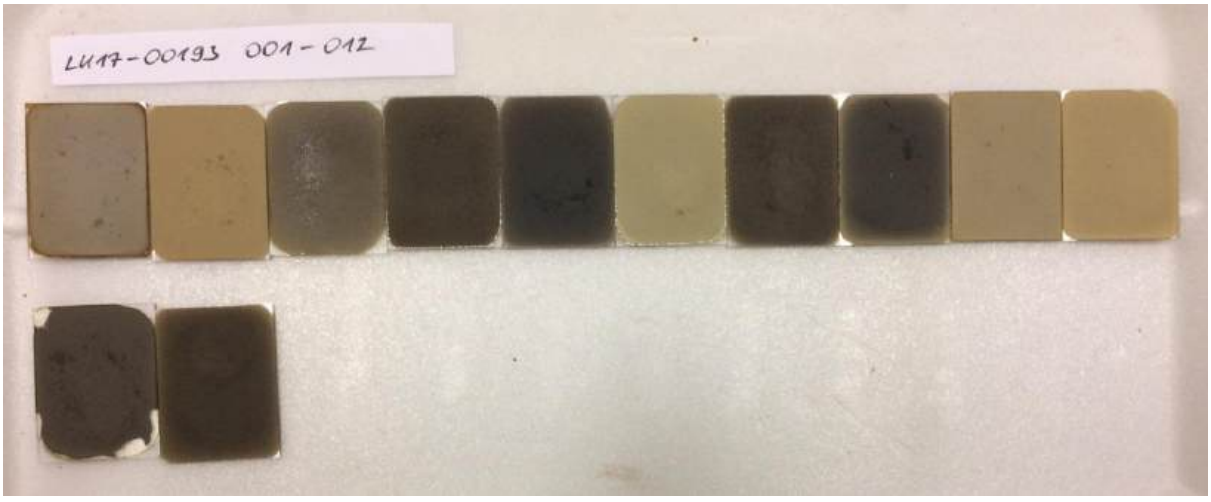


Table 9. Description of the clay mineralogy of the soil samples from Hungary

ID	Description
HU1	The dominating clay minerals are illite, kaolinite, chlorite, MLM illite/smectite, MLM chlorite/smectite, with quartz and gypsum as non-clay minerals
HU2	Illite, kaolinite, chlorite and MLM chlorite/smectite compose the clay fraction with quartz

HU3	Weak clay mineral 00l reflection with high amount of organic matter. The dominating clay minerals are MLM illite/vermiculite, illite, and kaolinite, with calcite and quartz as non-clay minerals
HU4	The dominating clay minerals are illite, kaolinite, chlorite and MLM illite/smectite with quartz, calcite, and halite
HU5	Clay minerals dominated by illite, chlorite, kaolinite and MLM illite/smectite (60% swelling component) with quartz
HU6	Illite is the dominating clay minerals with chlorite, MLM illite/smectite, MLM chlorite/smectite with quartz, gypsum, and halite as non-clay minerals
HU7	lllite, chlorite and MLM illite/smectite with gypsum, calcite, and quartz
HU8	The dominating clay minerals are MLM illite/smectite (R0, 70-75% swelling component), illite and kaolinite with quartz
HU9	The dominating clay minerals are illite and kaolinite, with small amount of MLM chlorite/smectite, MLM illite/smectite with quartz, calcite, and halite as non-clay minerals
HU10	Illite, kaolinite and MLM illite/smectite compose the clay fraction with quartz, calcite, gypsum, and halite
HU11	The dominating clay minerals are illite, kaolinite, MLM chlorite/smectite, MLM illite/smectite with quartz, gypsum, and calcite
HU12	Illite, kaolinite and MLM illite/smectite compose the clay fraction with quartz and calcite

Table 10. Semi-quantitative mineral composition of the clay fraction of the soil samples from Hungary

ID	I	C	K	I/S	I/V	C/S	Qz	Fsp	Cal	Gp
HU1	44	9	9	11		3	23	1	-	+
HU2	60	4	4	5		4	23		-	-
HU3					53		47		+	+
HU4	33	29		3			33	2	+	+
HU5	40	16	6	8			29	1	+	-
HU6	56	10		4		3	25	2	+	+
HU7	36	28		6			29	1	+	+
HU8	42		12	23			23		-	+
HU9	63		8	4		3	20	2	-	+
HU10	52	8	4	5			29	2	+	+
HU11	49		7	6		2	34	2	-	+
HU12	55	8	4	3			28	2	+	+

4.2.6 Italy

Smectitic soils and illite/smectite or vermiculite/smectite MLM clay mineral are frequent in the studied soils form Italy. Kaolinite is less represented, and chlorite is present many times in amounts smaller than expandable clay minerals. Quartz and calcite predominate in the non-clay minerals components sometimes with dolomite and gypsum. Lepidocrocite and goethite oxyhydroxides are sometimes present.

Figure 8. Details of clay fractions prepared on glass slides of the soil samples from Italy

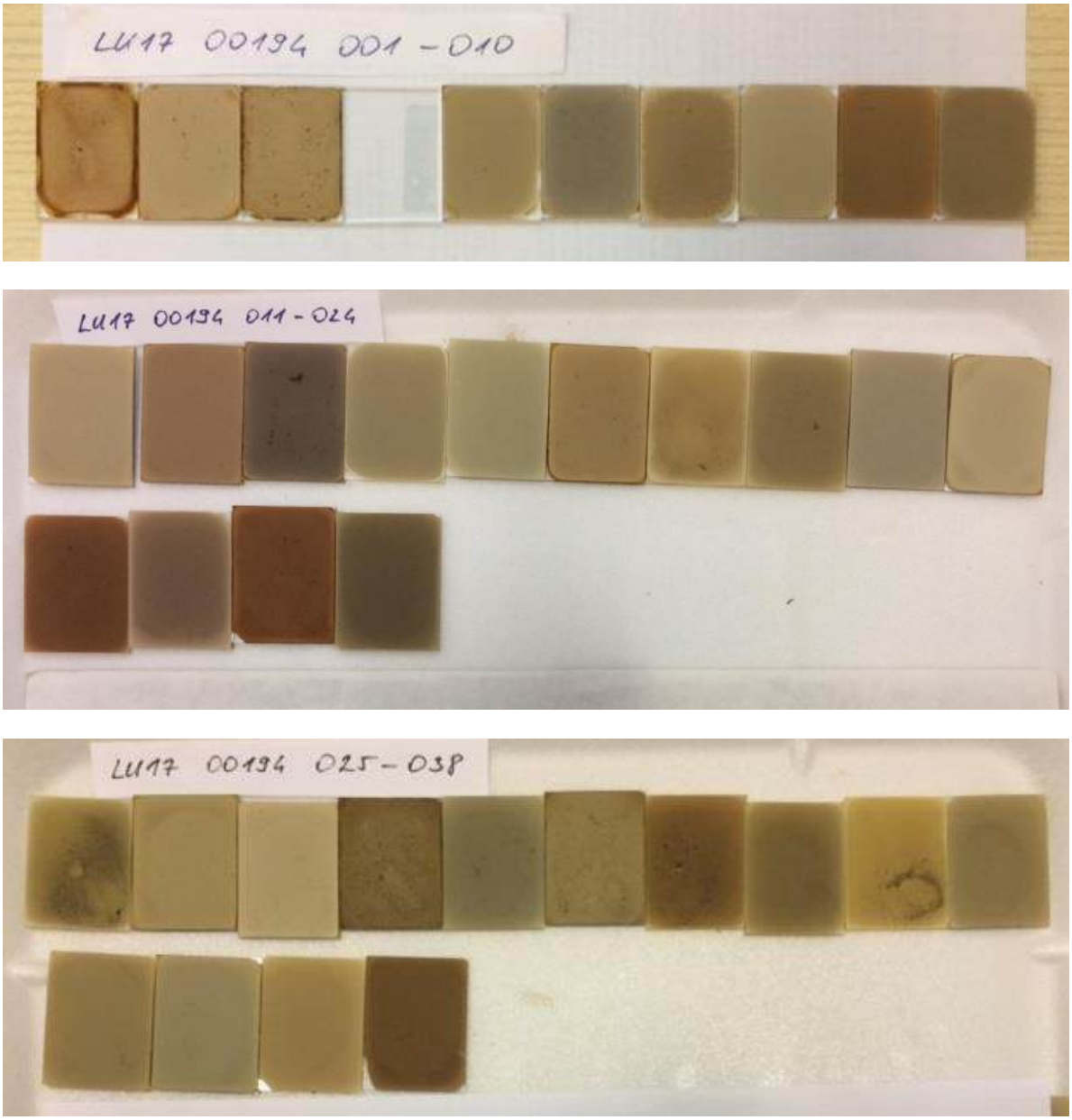


Table 11. Description of the clay mineralogy of the soil samples from Italy

ID	Description
IT1	The dominant clay mineral is illite, with less chlorite, MLM chlorite/vermiculite and some kaolinite. Non-clay minerals are quartz, feldspar, and some calcite
IT2	Illitic and chloritic clay mineralogy. The clay fraction contains gypsum and quartz
IT3	Illitic and chloritic-vermiculitic clay mineralogy, with MLM illite/vermiculite, MLM chlorite/vermiculite, discrete illite and chlorite. The clay fraction contains quartz and lepidocrocite
IT4	Chloritic-vermiculitic clay mineralogy, with illite, chlorite, some MLM illite/vermiculite, MLM chlorite/vermiculite, discrete illite and chlorite. The clay fraction contains quartz, calcite, feldspar, and gypsum

IT5 Clay mineralogy dominate by expanding clays: smectite, MLM illite/smectite (60% illitic component), MLM chlorite/smectite, illite and chlorite. The clay fraction contains quartz and some feldspar

IT6 Clay mineralogy dominate by expanding clays: smectite, MLM illite/smectite (60-65% illitic component), illite, MLM chlorite/smectite and chlorite. The clay fraction contains quartz and some feldspar

IT7 Clay mineralogy dominate by expanding clays: smectite, MLM illite/smectite (75-80% smectitic component), illite, MLM chlorite/smectite and some chlorite. The clay fraction contains some quartz

IT8 Clay mineralogy dominate by different interlayered partially expanding clays: MLM chlorite/smectite (50-50% each component) or chlorite/vermiculite, MLM kaolinite/smectite (75% kaolinite component), MLM illite/smectite (75-80% illitic component), and discrete illite. The clay fraction contains some quartz and calcite

IT9 Vermiculitic clay mineralogy predominated by vermiculite (non-expanding, high layer charged or hydroxy-interlayered (HIV)), MLM chlorite/vermiculite, some discrete illite and chlorite. The clay fraction contains some quartz

IT10 Illite, chlorite, MLM illite/smectite (R0, 60% illitic component), MLM chlorite/smectite or chlorite/vermiculite and kaolinite. The clay fraction contains some quartz

IT11 Illitic–chloritic clay mineralogy with discrete illite, chlorite, and less kaolinite. The clay fraction contains quartz, feldspar, and some calcite

IT12 Kaolinite, illite and MLM illite/smectite dominated clay mineralogy, with some chlorite, MLM chlorite/smectite. The clay fraction contains quartz, feldspar and some calcite and gypsum

IT13 Smectitic clay mineral character, with almost pure smectite, some MLM illite/smectite and MLM kaolinite/smectite, and minor amount of kaolinite and discrete illite. Cristobalite is a specific non-clay mineral, with feldspar

IT14 Smectitic clay mineral character, with almost pure smectite, some swelling component rich (80-90%) MLM illite/smectite, some discrete illite, and trace amount of kaolinite and. non-clay minerals do not occur.

IT15 Approximately same amount of kaolinite, illite, MLM illite/smectite (65% illitic component), chlorite, and some MLM chlorite/smectite represent the clay minerals. Non-clay minerals are some quartz and calcite

IT16 Kaolinitic – illitic clay mineralogy with some MLM chlorite/smectite (or chlorite/vermiculite), and with higher amount of quartz

IT17 Swelling clay mineral character, with almost pure smectite and smectite rich (80%) R0 MLM illite/smectite, and minor amount of kaolinite and discrete illite. Quartz and calcite are the nonclay minerals

IT18 Smectitic clay mineral character with MLM illite/smectite (50-60% swelling component), and some MLM kaolinite/smectite, kaolinite, chlorite and discrete illite. Quartz and calcite are the non-clay minerals

IT19 Illite and chlorite dominated clay mineralogy, with MLM illite/smectite (60-65% illite component), and less kaolinite, and MLM chlorite/smectite, and quartz

IT20 Illitic clay mineralogy with MLM chlorite/smectite or chlorite/vermiculite (R0.5, 65-70% chlorite component), and MLM illite/vermiculite (or smectite) (70% illite component). Non-clay minerals are quartz, feldspar, and calcite

IT21 Illitic–kaolinitic clay mineralogy with quartz, goethite, and calcite as non-clay minerals

IT22 Smectitic clay mineral character, with MLM illite/smectite (approximately 50:50%) and some almost pure smectite. It contains also significant amount of kaolinite and discrete illite, and quartz.

IT23 Illitic–kaolinitic clay mineralogy with quartz, goethite, and calcite as non-clay minerals

IT24	Kaolinite, MLM illite/smectite (50-55% illite content), and illite are the major clay minerals, with less chlorite. Quartz, gypsum, and calcite occur as non-clay minerals
IT25	Smectitic clay mineral character, with MLM illite/smectite (55-60% smectite component), and less kaolinite and trace amount of discrete illite, and probably palygorskite. Non-clay minerals in the sample are quartz and calcite
IT26	Illitic–chloritic clay mineralogy with some MLM illite/smectite, and less kaolinite. Quartz, calcite, feldspar, and gypsum as non-clay minerals
IT27	Clay mineralogy is composed of same amount of MLM illite/smectite (50-65% illitic component), discrete illite, chlorite and kaolinite and less kaolinite. Quartz, calcite, feldspar, gypsum, and halite as non-clay minerals
IT28	Weak phyllosilicate 00l reflections, only the presence of illite and kaolinite and/or chlorite is suggested. However, according to the more intensive 4.5 Å reflection they are clay minerals in the sample. It contains organic matter, significant amount of quartz, gypsum, and feldspar
IT29	Illitic–chloritic clay mineralogy containing also MLM illite/smectite (R0, 65-70% illitic component), and kaolinite, and quartz as non-clay mineral
IT30	Vermiculitic–chloritic clay mineralogy containing non swelling vermiculite (high charged or OH-interlayered), MLM chlorite/vermiculite or HIV, discrete chlorite, some illite, and less kaolinite. Non-clay minerals in the clay fraction are amphibole, quartz, and gypsum
IT31	Illitic clay mineralogy containing discrete illite, less illite-rich MLM illite/smectite, and some kaolinite
IT32	Smectitic clay mineral character, dominated by MLM illite/smectite (60% swelling component) and with some almost pure smectite, less kaolinite and discrete illite, and minor amount of MLM chlorite/smectite and chlorite. Non-clay minerals are quartz, calcite, and feldspar
IT33	Smectitic clay mineral character dominated by MLM illite/smectite (70-75% swelling component) and MLM chlorite/smectite (60% smectitic component). Discrete illite, kaolinite and some chlorites are also present. Trace of quartz as non-clay mineral
IT34	Smectitic clay mineral character dominated by MLM illite/smectite (70-75% swelling component) with some discrete illite and chlorite. Calcite, quartz, dolomite, and gypsum as nonclay minerals
IT35	Illitic–chloritic–kaolinitic clay mineralogy containing also MLM illite/smectite and some MLM chlorite/smectite/kaolinite. Calcite and quartz are present as non-clay minerals
IT36	Illite and chlorite dominated clay mineralogy with less smectite-rich MLM illite/smectite and some MLM chlorite/smectite and kaolinite. Calcite and quartz are present as non-clay minerals
IT37	The predominating clay minerals are illite and MLM illite/smectite (R0, 65-70% illite content), with some kaolinite. Calcite and quartz are present as non-clay minerals
IT38	Kaolinitic clay mineralogy with illite. Calcite, plagioclase, quartz, and goethite are present as non-clay minerals

Table 12. Semi-quantitative mineral composition of the clay fraction of the soil samples from Italy

ID	S	V	I	C	K	I/S	I/V	C/S	C/V	K/S	Qz	Crs	Fsp	Amp	Gth	Lp	Cal	Dol
IT1			56	11	6				2		22		3				+	-
IT2			34	31							34		1				-	-
IT3			31	15			7		5		41		1			4	-	-
IT4			33	41							23		3				+	-
IT5	5		39	23		10		3			19		1				-	-
IT6	5		39	24	5	10					16						-	-
IT7	42		19			18		7			13						-	-
IT8			43			6			34	3	13						+	-
IT9		29	9	19					28		15						-	-
IT10			28	15	17	19		7			14						-	-
IT11			38	22	12						25		3				+	-
IT12			42		24	13		6			13		1				+	+
IT13	65		6		4	16					2	6	7				-	+
IT14	61		14		2	23											-	-
IT15			27	12	20	25		4			13						+	-
IT16			27		27			13			34						-	-
IT17	44		9		11	18					18						+	-
IT18			31	12	12	21		7			17		1				+	-
IT19			30	23	17	14		4			12						+	-
IT20			51				15		18		16		1				+	-
IT21			46		32						14		2		6		+	-

IT22		15		24	28		8			25				-	-
IT23		50		30						16			4	+	-
IT24		32	8	30	16					14				+	-
IT25		16		40	30					15				+	-
IT26		59	19		4					17	2			+	-
IT27		44	8	18	10					17	3			+	-
IT28		24		21						47	8			-	-
IT29		28	19	22	13					17	2			+	-
IT30	16	7	40	2				20		14		2		-	-
IT31		77		13						10				+	-
IT32		28		16	25		13			17	1			+	-
IT33		29		14	20		17			20	1			-	-
IT34		30	14		29					26				+	+
IT35		42	8	12	15		2			20				+	-
IT36		50	14	9	6		3			17	1			+	-
IT37		50		5	10					35				+	-
IT38		19		55						9	13		5	+	-

4.2.7 Poland

Poland soils have grey to pale cream colours similarly to Finland, Germany, and Hungary. Vermiculite including HIV and illite/vermiculite are present together in major proportions with illite and less smectite/illite as secondary assemblages. Kaolinite is present elsewhere. Quartz dominates non clay minerals and calcite is in very small amounts.

Figure 9. Details of clay fractions prepared on glass slides of the soil samples from Poland

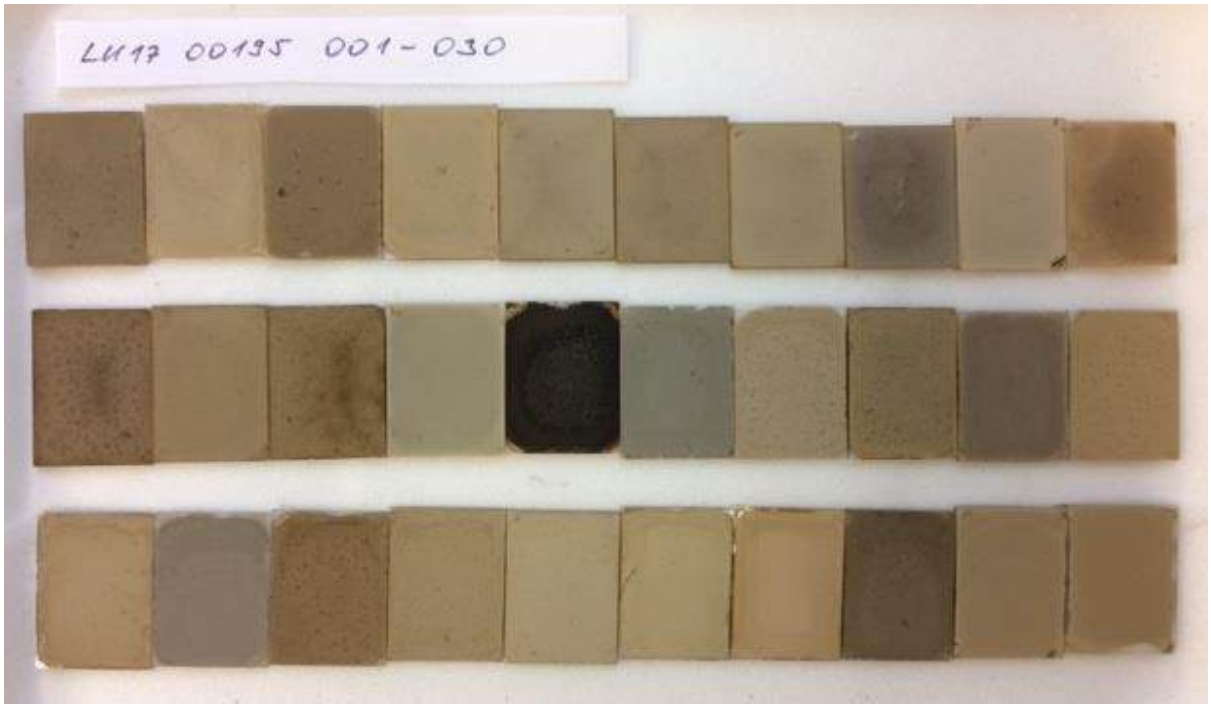


Table 13. Description of the clay mineralogy of the soil samples from Poland

ID	Description
PL1	Vermiculitic clay mineralogy, with minor amount of illite, MLM illite/vermiculite. Non-clay minerals are quartz, calcite, and gypsum
PL2	Clay mineralogy is composed of approximately same amount of vermiculite, illite, and kaolinite, and of gypsum, quartz, calcite, and K-feldspar and/or rutile as non-clay minerals
PL3	Vermiculite dominated clay mineral composition with some MLM chlorite/vermiculite or HIV. Non-clay minerals are calcite, and an unidentified crystalline phase showing reflections close to alunite-jarosite group
PL4	Illitic–kaolinitic clay mineralogy with some MLM illite/smectite (50:50%). Non-clay minerals are quartz and feldspar
PL5	Clay mineralogy is composed of approximately same amount of vermiculite with some MLM chlorite/vermiculite or HIV, illite, and kaolinite. Gypsum, quartz, calcite, feldspar, and halite are present as non-clay minerals
PL6	Vermiculitic clay mineralogy, with minor amount of illite, MLM chlorite/vermiculite and kaolinite. Non-clay minerals are quartz, calcite, K-feldspar, and gypsum

PL7 Clay mineralogy is composed of vermiculite with some MLM chlorite/vermiculite or HIV, MLM illite/vermiculite, illite, and kaolinite. Gypsum, quartz, calcite, feldspar are present as non-clay minerals

PL8 Illitic–kaolinitic clay mineralogy with some MLM illite/smectite (50:50%). Non-clay minerals are quartz, calcite, and gypsum

PL9 Illite and MLM illite/smectite (50-55% swelling component) dominated clay mineralogy with less kaolinite. Non-clay minerals are quartz, calcite and probably cristobalite.

PL10 Illite, MLM illite/smectite (R0, 60% swelling component) and kaolinite are the major clay minerals, with some vermiculite. Quartz, calcite, gypsum, and some feldspars are nonclay minerals

PL11 High amount of non-clay minerals (quartz, feldspars, less calcite) in the clay fraction, probably due to the presence of gypsum and salt. Vermiculite and kaolinite represent clay minerals

PL12 Vermiculitic clay mineralogy with MLM chlorite/vermiculite or OH-interstratification, kaolinite and illite. Non-clay minerals are quartz and gypsum

PL13 Vermiculitic clay mineralogy with some kaolinite and MLM illite/vermiculite. Non-clay minerals are quartz, gypsum, feldspars, and calcite

PL14 Mixed layer illite/smectite (50-55% swelling component) dominated clay fraction, with significant amount of discrete illite and kaolinite, and some quartz

PL15 In this organic matter rich sample dehydrated calcium oxalate (weddellite) precipitated during peroxidization. Presence of chlorite and illite is suggested by weak peaks.

PL16 Mixed layer illite/smectite (50-55% swelling component) dominated clay fraction, with discrete illite and kaolinite, and some quartz and precipitated weddellite

PL17 Vermiculitic clay mineralogy with MLM chlorite/vermiculite or OH-interstratification, kaolinite and illite. Non-clay minerals are quartz, feldspars, calcite, and gypsum

PL18 Clay mineralogy composed of MLM illite/smectite, illite and kaolinite, with quartz, feldspars, calcite, and halite as non-clay minerals

PL19 Clay mineralogy composed of MLM illite/smectite (60% swelling component), illite and kaolinite, with quartz

PL20 Vermiculitic clay mineralogy with some kaolinite and MLM illite/vermiculite. Non-clay minerals are quartz, gypsum, and feldspars

PL21 Clay mineralogy is composed of vermiculite with some MLM chlorite/vermiculite or HIV, MLM illite/vermiculite, illite, and kaolinite. Gypsum, quartz, calcite, feldspar are present as non-clay minerals

PL22 Vermiculite, MLM illite/vermiculite, illite and kaolinite compose the clay fraction, with quartz, feldspars, calcite, gypsum and precipitated weddellite

PL23 Vermiculitic clay mineralogy with some kaolinite and illite. Quartz and calcite are non-clay minerals present

PL24 Clay mineralogy is composed of vermiculite, MLM illite/vermiculite, illite, and some kaolinite, and of quartz and feldspars as non-clay minerals

PL25 Clay mineralogy is composed of vermiculite, MLM illite/vermiculite, illite, and some kaolinite, and of quartz, calcite, gypsum, and feldspars as non-clay minerals

PL26 Vermiculitic clay mineralogy with MLM illite/vermiculite, vermiculite probably with hydroxy interlayering, illite and some kaolinite. Quartz and feldspars as non-clay minerals

PL27 Vermiculitic clay mineralogy with MLM illite/vermiculite, MLM chlorite/vermiculite (or with hydroxy interlayering), illite and some kaolinite. Quartz and feldspars as non-clay minerals

PL28 Vermiculitic clay mineralogy with some kaolinite and illite, with significant amount of quartz, some gypsum, and feldspars

PL29 Illite dominated clay mineralogy containing also MLM illite/smectite (smectite-rich), kaolinite and some MLM chlorite/smectite (50:50%). Non-clay minerals are feldspars and quartz.

PL30 Illite dominated clay mineralogy containing also MLM illite/smectite, kaolinite and some MLM chlorite/smectite. Non-clay minerals are feldspars, quartz, calcite, and gypsum.

Table 14. Semi-quantitative mineral composition of the clay fraction of the soil samples from Poland

ID	S	V	I	C	K	I/S	I/V	C/V	Qz	Crs	Fsp	Cal	Gp	Wed
PL1		20	17						56		7	+	+	-
PL2		8	20		15				52		5	+	+	-
PL3		22							70		8	+	+	+
PL4			39		18	15			24		4	+	+	-
PL5		10	16		15			5	50		4	+	+	-
PL6		10	11		10			3	59		7	+	+	-
PL7		8	15		12		10	3	46		5	+	+	-
PL8			33		7	8			48		3	+	+	-
PL9			36		10	17			24	10	2	+	+	-
PL10		7	29		13	13			37		1	+	+	-
PL11		4			6				72		18	+	+	-
PL12		13	7		10			3	62		6	-	+	-
PL13		13	5		16				62		5	+	+	-
PL14			30		21	37			11		1	-	-	-
PL15		30							70			-	-	+
PL16					18	64			15		3	-	-	+
PL17		7	11		13			3	60		5	+	+	-
PL18			13		14	5			65		2	-	+	-
PL19			32	8	15	12			32		1	+	-	-
PL20		17	7		19		5		44		8	+	+	-
PL21		8	14		17		4	3	51		3	+	+	-
PL22		9	17		12		6		51		5	+	+	+
PL23		11	7		22				57		3	+	-	-
PL24		8	16	13	2		2		56		2	+	-	-
PL25		6	21	13	2		2		53		4	+	+	-
PL26		5	25	20	2		7	3	36		2	-	-	-
PL27		9	22	22	2		7	3	33		2	-	+	-
PL28		9	11		13				62		5	-	+	-

PL29	47	18	6		26	2	-	-	-
PL30	35	19	8		35	2	+	+	-

4.2.8 Lithuania

Lithuania soils are represented by grey and dark grey colours. Sometimes are rich in organic matter (weddellite has been identified). Clay minerals are dominated by vermiculitic components and chlorite MLM clay minerals. Quartz is the main companion mineral of clay minerals in these soils.

Figure 10. Details of clay fractions prepared on glass slides of the soil samples from Lithuania

Table 15. Description of the clay mineralogy of the soil samples from Lithuania

ID	Description
LT1	The dominating clay minerals are chlorite and vermiculite with high amount of calcite, quartz and halite
LT2	The dominating clay minerals are vermiculite, illite, chlorite and MLM chlorite/vermiculite with quartz, calcite as non-clay
LT3	Vermiculite, illite and MLM chlorite/vermiculite dominated clay fraction with quartz and calcite.
LT4	Characteristic clay minerals in the sample are vermiculite, illite and chlorite/vermiculite with calcite and quartz
LT5	Illite, HIV and MLM illite/vermiculite dominated clay minerals with quartz, calcite
LT6/1	The dominating clay minerals are HIV and illite with quartz, weddellite, calcite and organic matter.
LT7	Characteristic clay minerals in the sample are chlorite, illite and MLM chlorite/vermiculite with quartz, calcite and gypsum.
LT8	Characteristic clay minerals in the sample are chlorite, illite and MLM chlorite/illite with quartz, calcite

Table 16. Semi-quantitative mineral composition of the clay fraction of the soil samples from Lithuania

ID	V	I	C	I/V	C/V	Qz	Fsp	Cal	Gp	Wed
LT1	9		32			59		+	+	-
LT2	10	25	19		1	42	3	-	+	-

LT3	11	35			10	36	9	+	+	-
LT4	7	43			13	34	3	+	+	-
LT5	12	13	18	2	2	49	4	-	-	+
LT6/1		15			31	52	2	-	-	+
LT7		17	23		4	55	2	+	+	-
LT8		36	29		5	27	2	+	+	-

4.2.9 Slovenia

Just one soil is represented coming from Slovenia. There is no significant trend to be described.

Figure 11. Detail of clay fraction prepared on glass slides of the soil sample from Slovenia

Table 17. Description of the clay mineralogy of the soil samples from Slovenia

ID	Description
SI1	Illitic–chloritic–kaolinitic clay mineralogy with some MLM chlorite/vermiculite. Non-clay minerals are quartz, calcite, dolomite, and some feldspars

Table 18. Semi-quantitative mineral composition of the clay fraction of the soil samples from Slovenia

ID	V	I	C	K	I/V	C/V	Qz	Fsp	Cal	Dol	Gp
SI1		52	12	12		4	19	1	+	+	-

4.2.10 Estonia

Estonia soils have a marqued vermiculite clay component that seems to be characteristic of northern soils in Europe.

Figure 12. Details of clay fractions prepared on glass slides of the soil samples from Estonia

Table 19. Description of the clay mineralogy of the soil samples from Estonia

ID	Description
EE1	Clay mineralogy composed of illite, chlorite, vermiculite, and MLM chlorite/vermiculite, containing quartz, calcite, gypsum, and feldspars as non-clay minerals
EE2	Vermiculitic sample with MLM illite/vermiculite, MLM chlorite/vermiculite, less illite and chlorite, with quartz, calcite, and feldspars as non-clay minerals
EE3	Vermiculite dominated clay mineralogy with MLM chlorite/vermiculite or HIV, and some MLM illite/vermiculite. Non-clay minerals are quartz, calcite, and feldspars

Table 20. Semi-quantitative mineral composition of the clay fraction of the soil samples from Estonia

ID	V	I	C	K	I/V	C/V	Qz	Fsp	Cal	Dol	Gp
EE1	9	31	20			2	36	3	+		+
EE2	10	29	20		4	3	31	3	+		-
EE3	13	18	30			3	31	5	+		+

4.2.11 The Netherlands

Illite, chlorite and vermiculite dominate in the soils from the Netherlands. Their organic component is represented by the presence of weddellite, and quartz is the main clastic non clay mineral. Relatively soluble minerals are absent.

Figure 13. Details of clay fractions prepared on glass slides of the soil samples from The Netherlands

Table 21. Description of the clay mineralogy of the soil samples from The Netherlands

ID	Description
NL1	Illite and chlorite are the dominating clay minerals with some MLM illite/vermiculite. Minor amount of quartz and calcite as non-clay minerals
NL2	Illite, chlorite and MLM illite/vermiculite clay mineralogy with quartz and calcite
NL3	Illite and small amount of chlorite with quartz, calcite, and weddellite as non-clay minerals
NL4	The dominating clay minerals are illite and chlorite with quartz, calcite, and halite as non-clay minerals
NL5	Illite, chlorite and vermiculite compose the clay fraction with quartz, calcite, gypsum, and precipitated weddellite

Table 22. Semi-quantitative mineral composition of the clay fraction of the soil samples from The Netherlands

ID	V	I	C	I/S	Qz	Fsp	Fl	Gp	Wed

NL1		51	17	5	24	2	+	+	-
NL2		44	15	3	36	2	+	-	-
NL3		5	4	2	90		+	+	+
NL4		48	17		33	2	+	+	-
NL5	5	37	22		34	2	+	+	+

4.2.12 Denmark

Denmark soil clay minerals are diverse with predominant illite and chlorite. Also, vermiculite HIV is present in high amounts in one soil with important evidence of Al-hydroxide interlayering. Quartz dominates the soil mineralogy.

Figure 14. Details of clay fractions prepared on glass slides of the soil samples from Denmark

Table 23. Description of the clay mineralogy of the soil samples from Denmark

ID	Description
DK1	Illitic–chloritic clay mineralogy with some MLM illite/smectite or illite vermiculite. Non-clay minerals are quartz, calcite, and feldspars
DK2	Clay mineralogy is composed of illite, chlorite, less MLM illite/vermiculite and MLM chlorite/vermiculite. Non-clay minerals are quartz, calcite, gypsum, and feldspars
DK3	Illitic–chloritic clay mineralogy with quartz, calcite, gypsum, and feldspars as non-clay minerals
DK4	This sample did not produce clay fraction at all. According to the XRD pattern of the bulk soil sample it is composed almost entirely of quartz (90%), with 10% feldspars (plagioclase and K-feldspar), without any phyllosilicate
DK5	Vermiculitic clay mineralogy, with vermiculite showing hydroxy-interlayering or chlorite interstratification, and containing MLM illite/vermiculite (50:50%), and some illite and quartz and feldspars as non-clay minerals
DK6	Clay mineralogy is composed of illite, chlorite, some MLM illite/vermiculite and MLM chlorite/vermiculite. Non-clay minerals are quartz, calcite, gypsum, and feldspars

Table 24. Semi-quantitative mineral composition of the clay fraction of the soil samples from Denmark

ID	I	C	I/V	C/V	Qz	Fsp	Cal	Gp
DK1	29	15	4		46	5	+	-
DK2	20	18	1	2	53	5	+	+
DK3	20	17			55	8	+	+

DK4				100			
DK5	24	21	22	29	4	+	+
DK6	43	8	10	34	5	+	+

4.2.13 Latvia

Latvia, Ireland and Slovaquia soils are more or less similar to the grey colour soils presented previously. The small number of samples in these zones did not allow to consider the description of some characteristic features. Illite is the most abundant clay mineral in all these soils.

Figure 15. Details of clay fractions prepared on glass slides of the soil samples from Latvia

Table 25. Description of the clay mineralogy of the soil samples from Latvia

ID	Description
LV1	Illitic–chloritic clay mineralogy, chlorite showing some vermiculite interstratification, with quartz, feldspars, and calcite as non-clay minerals
LV2	Chloritic–illitic clay mineralogy, with quartz, feldspars, and calcite as non-clay minerals

Table 26. Semi-quantitative mineral composition of the clay fraction of the soil samples from Latvia

ID	I	C	C/V	Qz	Fsp	Cal	Gp
LV1	49	21	5	24	1	+	-
LV2	21	26		50	3	+	-

4.2.14 Ireland

Just one soil is represented coming from Irland. There is no significant trend to be described.

Figure 16. Detail of clay fraction prepared on glass slides of the soil sample from Ireland

Table 27. Description of the clay mineralogy of the soil samples from Ireland

ID	Description
IE1	Clay fraction dominated by non-clay minerals, quartz, and Mg-calcite. Clay minerals are poorly crystallised illite and kaolinite and/or chlorite

Table 28. Semi-quantitative mineral composition of the clay fraction of the soil samples from Ireland

ID	I	K	Qz	Fsp	Cal	Gp
IE1	22	16	62	0	+	+

4.2.15 Slovakia

Figure 17. Details of clay fractions prepared on glass slides of the soil samples from Slovakia

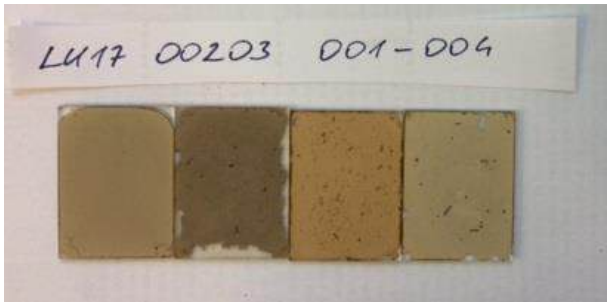


Table 29. Description of the clay mineralogy of the soil samples from Slovakia

ID	Description
SK1	Predominating clay mineral is illite, with less chlorite and MLM illite/smectite (R0, 60% illitic component). Quartz, calcite, and dolomite are present as non-clay minerals
SK2	Illitic and MLM illite/smectitic (R0, 70-75% swelling component) clay mineralogy with less kaolinite, and quartz, calcite, and feldspars as non-clay minerals
SK3	Illitic–kaolinitic clay mineralogy with calcite and quartz
SK4	Clay mineralogy is dominated by MLM illite/smectite (R0, 60% swelling component) and illite, with less chlorite and kaolinite. Non-clay minerals present are quartz, calcite, and feldspars

Table 30. Semi-quantitative mineral composition of the clay fraction of the soil samples from Slovakia

ID	I	C	K	I/S	Qz	Fsp	Cal	Gp
SK1	46	17		14	22	0	+	-
SK2	41		12	12	31	4	+	-
SK3	51		19		25	5	+	-
SK4	23	7	8	15	42	5	+	+

4.2.16 Portugal

Illite is the clay mineral dominant in Portugal soils and kaolinite/smectite is present in significant amounts, differentiated to the vermiculitic soils found more to the north of Europe. The rose colour of the slides evidence a small quantity of iron oxides to be present. Quartz is the main accessory mineral with feldspars present significantly.

Figure 18. Details of clay fractions prepared on glass slides of the soil samples from Portugal

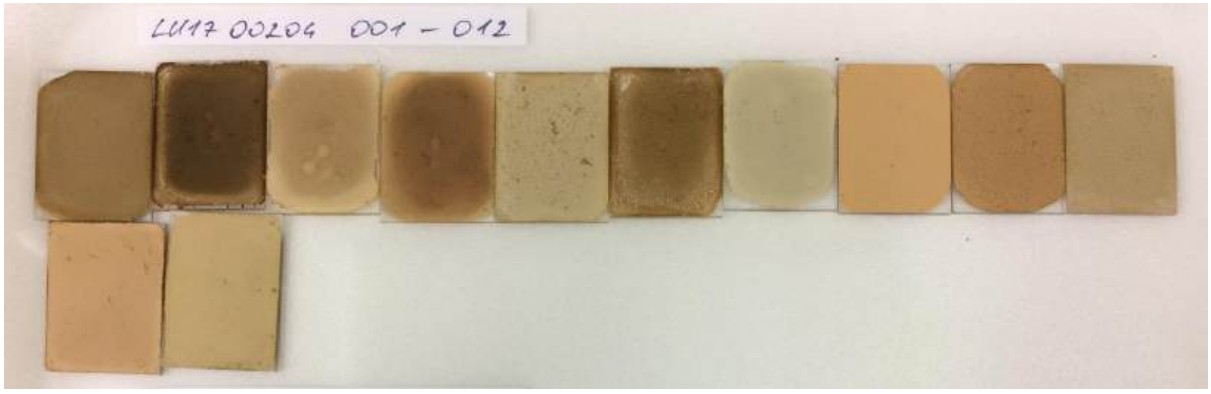


Table 31. Description of the clay mineralogy of the soil samples from Portugal

ID	Description
PT1	The dominant clay minerals are illite and vermiculite. Non-clay minerals are quartz, gypsum and some calcite and halite
PT2	Illitic and chloritic clay mineralogy. The clay fraction contains quartz and gypsum
PT3	The dominating clay minerals are smectite, MLM illite/smectite, discrete illite and MLM kaolinite/smectite. The non-clay minerals are quartz and calcite
PT4	Characteristic clay minerals in the sample are MLM kaolinite/smectite with quartz and calcite as non-clay minerals
PT5	Illite, MLM illite/smectite and MLM kaolinite/smectite dominated clay fraction with calcite and quartz
PT6	Very poor clay fraction with kaolinite. The non-clay minerals are quartz, calcite, and halite
PT7	Illite, MLM kaolinite/smectite and MLM illite/smectite dominated clay mineralogy, with calcite and quartz
PT8	The dominating clay minerals are discrete illite, kaolinite and MLM chlorite/vermiculite. The non-clay minerals are quartz, calcite, and halite
PT9	Illitic-kaolinitic clay mineralogy with quartz, calcite, and halite as non-clay minerals
PT10	The dominating clay minerals are discrete illite, smectite and some MLM kaolinite/smectite. The clay fraction contains quartz, calcite, and halite as non-clay minerals
PT11	Illite dominated clay mineralogy with kaolinite Quartz as non-clay mineral
PT12	The dominating clay minerals are illite, kaolinite, MLM chlorite/smectite and MLM illite/smectite. The non-clay minerals are quartz and calcite

Table 32. Semi-quantitative mineral composition of the clay fraction of the soil samples from Portugal

ID	S	V	I	C	Sep	K	I/S	C/V	K/S	Qz	Crs	Fsp	Cal	Gp
PT1		15	35							45		5	-	+
PT2			27	36	17					20			-	+
PT3	31		27				28		8	7			+	+
PT4									72	18		10	+	+
PT5			40				4		33	13		9	+	+
PT6									20	72		8	+	+
PT7			48				4		28	18		2	+	+
PT8			50			16		12		20		2	+	-
PT9			35			21				37		6	+	-
PT10			30			34			5	23		8	+	-
PT11			80			5				15			-	-
PT12			17			22	5		35	16		5	+	+

4.2.17 Sweden

Illite is always present with vermiculite and several MLM with chlorite and vermiculite components in the clay fraction of the Sweden soils. Smectite and kaolinite are not represented significantly. Feldspars are important no clay minerals in these soils in comparison with other countries. Anyway, quartz is the main mineral in the non-clay mineral fraction. Gypsum is detected elsevere and calcite is scarce. Gypsum is soluble and in the case of the XRD detection can have overlapping of peaks if there exist chlorite-like hydroxide interlayering. The presence of Gypsum in this humid regions soils must be confirmed.

Figure 19. Details of clay fractions prepared on glass slides of the soil samples from Sweden

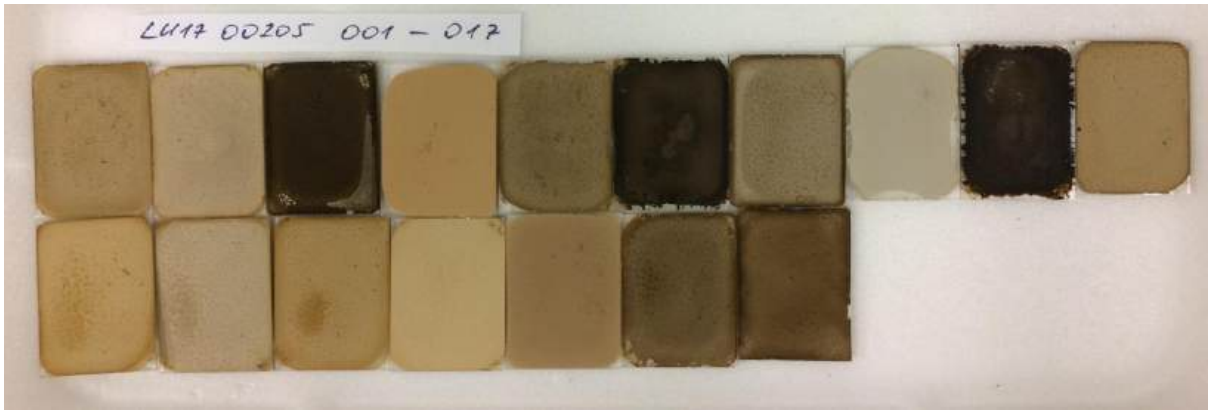


Table 33. Description of the clay mineralogy of the soil samples from Sweden

ID	Description
SE1	The dominating clay minerals is vermiculite, some HIV, illite and chlorite, with quartz, feldspars, gypsum, and calcite as non-clay minerals
SE2	Characteristic clay minerals in the sample is illite, associated with some chlorite and with quartz, calcite, gypsum, feldspars, and organic matter
SE3	Organic matter rich sample with very few clay minerals, dominated by non-clay minerals: higher amount of quartz, feldspars, and gypsum.
SE4	Vermiculite, MLM chlorite/vermiculite or HIV, and illite are the dominating clay minerals with gypsum, quartz, calcite and probably talc.
SE5	Vermiculite and chlorite are the dominating clay minerals with gypsum, quartz, and calcite as non-clay minerals
SE6	Vermiculite, illite and MLM illite/vermiculite clay mineralogy with quartz, calcite, and organic matter
SE7	The dominating clay minerals are illite and MLM illite/vermiculite with quartz, calcite, gypsum, amphibole, and organic matter
SE8	The characteristic clay minerals in the sample are illite, kaolinite and MLM illite/vermiculite with quartz
SE9	Extremely poor clay fraction. Some illite with gypsum, quartz, and organic matter
SE10	Illite and vermiculite dominated clay mineralogy, with MLM illite vermiculite. Gypsum and quartz. The vermiculite partially expanded after Na-citrate extraction suggesting hydroxy interlayered vermiculite (HIV).
SE11	The dominating clay minerals are chlorite, illite, MLM illite/vermiculite and some HIV with gypsum, quartz, feldspars, and halite
SE12	Vermiculite and MLM illite/vermiculite clay mineralogy with high amount of halite, quartz, and calcite
SE13	Vermiculitic clay mineralogy, with vermiculite, MLM illite/vermiculite, and illite, with quartz, calcite, feldspars, gypsum, and halite
SE14	The dominating clay minerals are illite, vermiculite, chlorite and less MLM illite/vermiculite or hydrobiotite, with amphibole, quartz, feldspars, and halite
SE15	The dominating clay minerals are illite and MLM illite/smectite, with less kaolinite or MLM kaolinite/smectite with quartz and calcite as non-clay
SE16	Extremely poor clay fraction. Some illite with gypsum and quartz
SE17	Extremely poor clay fraction. Some vermiculite with quartz
SE18	Vermiculite, illlite and chlorite dominated clay fraction. Quartz, halite, calcite, and gypsum as non-clay minerals
SE19	Illite and MLM illite/vermiculite dominated clay mineralogy, with less vermiculite, MLM and MLM chlorite/vermiculite with quartz, feldspars and weddellite
SE20	The dominating clay minerals are vermiculite, MLM illite/vermiculite with amphibole, feldspars, quartz, and halite
SE21	Illite dominated clay fraction with quartz and organic matter
SE22	The dominating clay fraction is MLM illite/smectite (50-60% swelling component) and/or MLM illite/vermiculite, illite, chlorite with quartz and gypsum
SE23	Vermiculite dominated clay fraction with quartz, feldspars, gypsum, calcite, and halite

Table 34. Semi-quantitative mineral composition of the clay fraction of the soil samples from Sweeden

ID	V	I	C	Tlc	K	I/S	I/V	I/C/V	C/V	HIV	HydroB	K/S	Qz	Fsp	Amp	Cal	Gp
SE1	20	9	7	5					1				49	8		+	+
SE2		51	6										35	7		+	+
SE3													79	21		-	+
SE4	23	22		3					10				37	6		+	+
SE5	48	0							17				26	8		+	+
SE6	33	30					5						22	10		-	-
SE7		24					3						60	12	1	-	+
SE8		44			11			4					33	8		+	+
SE9		30											56	14		+	+
SE10		27					15			25			30	4		+	+
SE11		23	23					4	8				38	4		-	+
SE12	25						7						50	18		+	+
SE13	13	15							10				47	15		+	+
SE14	7	28	14								4		26	18	3	-	+
SE15		24			7	18						8	39	4		+	+
SE16		10											70	20		-	+
SE17	14												59	27		-	-
SE18	18	22	5										47	8		+	+
SE19	7	33	4				13		4				32	7		-	-
SE20	10						4						46	40		+	+
SE21		100														-	-
SE22		13	4			30	16						33	4		-	+
SE23	36												44	20		-	+

4.2.18 United Kingdom

Illite and kaolinite dominate the clay mineralogy in the United Kingdom soils. There is a wide variety of mineralogical compositions including iron oxyhydroxides and typical ore minerals as barite and fluorite. Quartz is abundant in the non-clay minerals content. Sometimes there are very low amounts of clay in the analyzed samples.

Figure 20. Details of clay fractions prepared on glass slides of the soil samples from United Kingdom

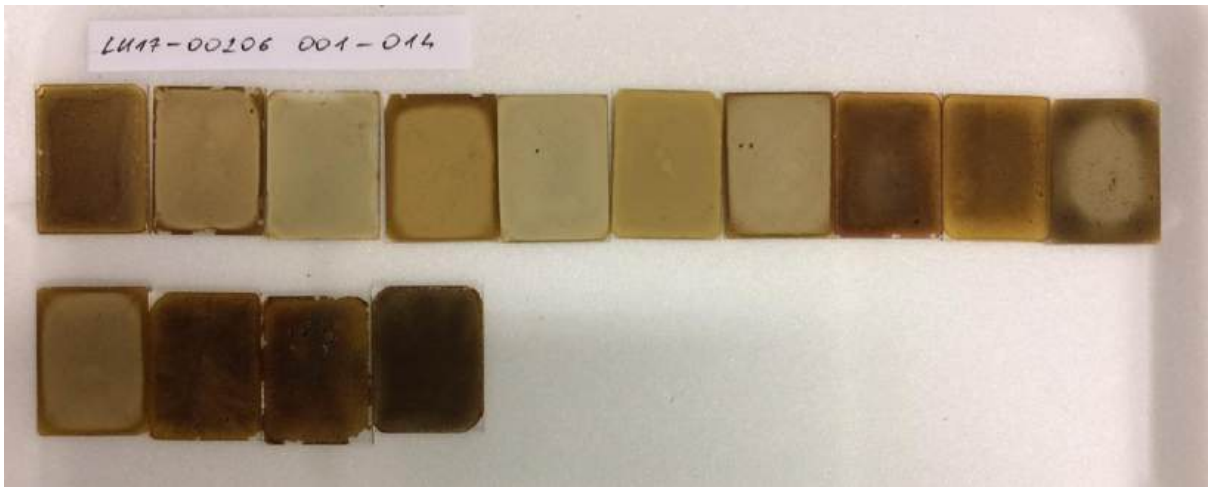


Table 35. Description of the clay mineralogy of the soil samples from United Kingdom

ID	Description
UK1	Quite weak clay mineralogy with kaolinite and maybe trace MLM (I/S or I/V). Significant amount of quartz, less calcite, gypsum, and halite as non-clay minerals
UK2	Predominating clay minerals are kaolinite and illite, with some MLM illite/vermiculite or illite/smectite, and trace of chlorite interstratification with vermiculite or smectite. Significant quartz content and some calcite.
UK3	Illite, kaolinite and MLM illite/smectite dominated clay mineralogy, with quartz and calcite as non-clay minerals
UK4	Clay fraction containing only some kaolinite as clay mineral. Significant amount of goethite and quartz, some gypsum, and feldspars
UK5	Kaolinite dominated clay mineralogy with some illite, MLM illite/vermiculite (appr. 50:50%), and MLM chlorite/vermiculite or HIV
UK6	Clay fraction dominated by non-clay minerals: calcite, quartz, goethite, and gypsum. Clay minerals are kaolinite and MLM illite/smectite containing the components in a various range
UK7	Weakly diffracting clay minerals: MLM chlorite/vermiculite or HIV, some chlorite and illite. Quartz and gypsum as non-clay mineral
UK8	Organic matter rich sample with very few clay minerals (illite and kaolinite) and significant amount of quartz. According to the XRPD pattern of the bulk soil, the sample contains 88% quartz, 7% feldspars (plagioclase and K-feldspar), 3% chlorite and 2% mica
UK9	High amount of non-clay minerals: quartz, calcite, gypsum, halite, and trace of feldspar. Clay minerals are kaolinite, illite and trace of MLM illite/smectite. Based on the XRPD analysis of the bulk soil, the sample contains 78% quartz, 12% feldspars (plagioclase and K-feldspar), 5% chlorite and 5% mica
UK10	Not a typical soil composition with predominating barite, fluorite, and quartz, with some kaolinite, illite and trace of MLM illite/smectite. According to the XRPD pattern of the bulk soil sample, it does not contain clay minerals, it is composed of 48% quartz, 16% barite, 23% fluorite, 6% feldspar, 5% chlorite and 2% mica
UK11	Weakly crystallised clay minerals illite, kaolinite and MLM illite/smectite. Non-clay minerals are quartz and calcite (Mg-calcite too). However, according to the XRD analysis of the bulk soil the sample does not contain calcite, it is composed of 90% quartz, 7% feldspar, 2% micaillite and less than 1% kaolinite

UK12	High amount of non-clay minerals: quartz, calcite, gypsum, halite, and feldspars. Clay minerals are chlorite and trace of illite
UK13	Chloritic–illitic clay mineralogy with quartz and feldspar as non-clay minerals
UK14	Vermiculitic clay mineralogy, vermiculite containing partial OH-interstratification, some MLM illite/vermiculite and discrete illite, with quartz as non-clay mineral

Table 36. Semi-quantitative mineral composition of the clay fraction of the soil samples from United Kingdom

ID	V	I	C	K	I/S	I/V	C/V	Qz	Fsp	Brt	Gth	Fl	Cal	Gp
UK1				43	14			43					+	+
UK2		26		29		2	5	36	2				+	-
UK3		32		31	18			18	2				+	-
UK4		4		18				53	10		15		+	+
UK5		15		42		10	10	22	1				+	+
UK6				19	15			54			12		+	+
UK7		34	25				10	27	5				+	+
UK8		6		6				88					-	-
UK9		25		25	15			32	3				+	+
UK10		17		17	5			47		13			-	+
UK11		32		24	5			39					+	+
UK12		21	10	16				41	13				+	+
UK13		34	54						12				-	-
UK14	20	23				10	6	41					-	+

4.2.19 Austria

Illite and chlorite are the most abundant clay minerals in the soils from Austria. There are few samples, so the representation of soil mineralogy is not significant. Quartz is the main non-clay mineral represented.

Figure 21. Details of clay fractions prepared on glass slides of the soil samples from Austria

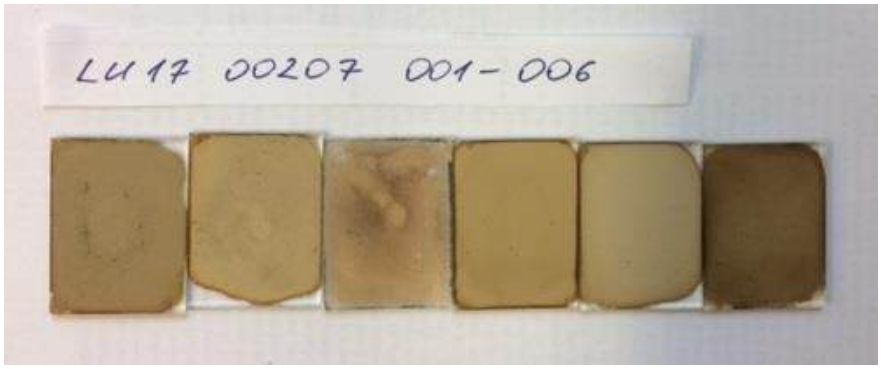


Table 37. Description of the clay mineralogy of the soil samples from Austria

ID	Description
AT1	Illitic–chloritic clay mineralogy with quartz, calcite, and feldspars as non-clay minerals
AT2	Illite, kaolinite, MLM illite/smectite and MLM chlorite/smectite compose the clay fraction with quartz
AT3	The dominating clay minerals are illite, less chlorite, and small amount of smectite with Mg-calcite, feldspar, quartz, and gypsum as non-clay minerals
AT4	Clay mineralogy dominated by smectite, illite, MLM illite/smectite, MLM chlorite/vermiculite, kaolinite and chlorite with quartz
AT5	The dominating clay minerals are illite and chlorite with quartz, calcite, and halite as non-clay fraction.
AT6	Chlorite and illite compose the clay fraction with gypsum, amphibole, and quartz as non-clay minerals.

Table 38. Semi-quantitative mineral composition of the clay fraction of the soil samples from Austria

ID	S	I	C	K	I/S	C/S	Qz	Fsp	Amp	Cal	Gp
AT1		39	26				33	2		+	+
AT2		39		19	14	8	19	1		+	+
AT3	3	36	15				40	5		+	+
AT4	7	34	15	14	8	3	18	1		-	-
AT5		62	22				14	2		+	-
AT6		42	28				20	6	4	+	+

4.2.20 Czechia

Clay minerals from the Czechia show the grey-dark grey aspect of oriented slides. Illite and its MLM dominated clay mineralogy, although Vermiculite components with HIV characteristics are frequent. This is typical of highly weathered horizons in humid regions. This is consistent also with quartz predominancy in the non-clay mineralogical part.

Figure 22. Details of clay fractions prepared on glass slides of the soil samples from Czechia

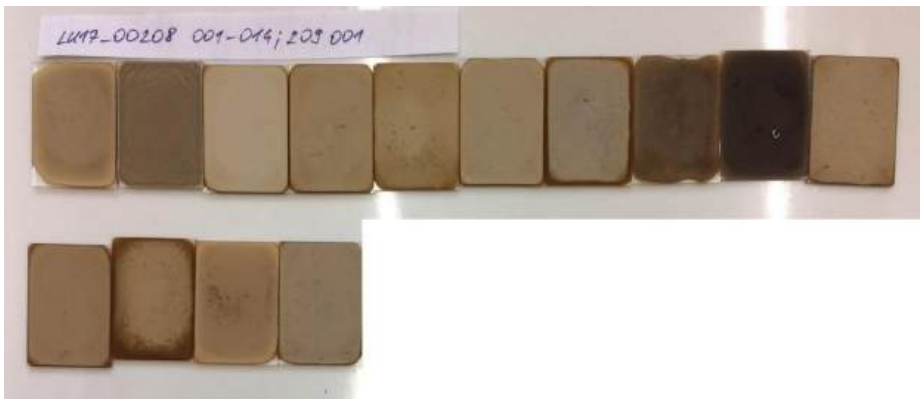


Table 39. Description of the clay mineralogy of the soil samples from Czechia

ID	Description
CZ1	Characteristic clay minerals in the sample are kaolinite, illite and MLM illite/smectite with quartz, feldspars, gypsum, and calcite as non-clay minerals.
CZ2	Predominant clay minerals are smectite and MLM illite/smectite (50-55% swelling component), with discrete illite and kaolinite. The clay fraction contains some quartz.
CZ3	Characteristic clay minerals in the sample are illite. chlorite and MLM chlorite/vermiculite or HIV. The non-clay minerals are quartz and gypsum.
CZ4	Illite, MLM chlorite/vermiculite, MLM illite/vermiculite or MLM illite/smectite dominated clay fraction. The clay fraction contains high amount of calcite and some quartz.
CZ5	The dominating clay minerals are illite, MLM illite/vermiculite, MLM chlorite/vermiculite, illite and MLM illite/chlorite/vermiculite. The clay fraction contains high amount of gypsum, calcite, feldspars, and quartz as non-clay minerals.
CZ6	Illitic and kaolinitic clay fraction with MLM illite/vermiculite and gypsum, calcite, and quartz as non-clay.
CZ7	Dominantly kaolinitic and illitic clay mineralogy, but with significant MLM illite/vermiculite content. The clay fraction contains quartz, calcite, and gypsum.
CZ8	Illite, kaolinite and MLM illite/vermiculite dominated clay mineralogy. The sample contains high amount of calcite, quartz, gypsum, and some halite.
CZ9	The dominating clay minerals are kaolinite, illite and MLM illite/smectite with quartz, calcite as non-clay minerals.
CZ10	Kaolinitic clay mineralogy with chlorite, illite, MLM illite/vermiculite and illite/HIV. The sample contains high amount of quartz as non-clay minerals.
CZ11	Kaolinite, smectite and illite/vermiculite dominated clay fraction with high amount of quartz.
CZ12	Characteristic clay minerals in the sample are vermiculite, HIV and illite with high amount of gypsum and quartz, calcite as non-clay.
CZ13	NO DATA. Removed from the analysis
CZ14	The dominating clay minerals are chlorite, illite, HIV and MLM illite/vermiculite with high amount of quartz and some feldspars and calcite.

Table 40. Semi-quantitative mineral composition of the clay fraction of the soil samples from Czechia

ID	S	V	I	C	K	I/S	I/V	I/C/V	C/V	Qz	Fsp	Cal	Gp
CZ13													
CZ1			22		20	12				44	3	+	+
CZ2	14		27		9	35				15		-	-
CZ3			48	17					15	19	1	-	+
CZ4			38				16		25	19	2	+	-
CZ5			35				10	+	21	30	4	+	+
CZ6			53		18	5				23	1	+	+
CZ7			27		40	3				27	3	+	+
CZ8			35		17	5				40	3	+	+

CZ9		40		28	14				18		+	-
CZ10		15	9	38		5	+		31	3	-	+
CZ11	11	13				5			66	5	-	-
CZ12	26	17						15	39	3	+	+
CZ13						NO Data						
CZ14	10	15	23			4			44	3	+	+

4.2.21 Belgium

There is just one sample from Belgium soils with a high expansive clay components. This type of clay is not very abundant generally in soil clay mineralogy of humid regions, and maybe is not very representative.

Figure 23. Detail of clay fraction prepared on glass slides of the soil sample from Belgium

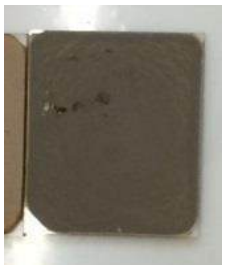


Table 41. Description of the clay mineralogy of the soil samples from Belgium

ID	Description
BE1	Typical expanding clay. Smectite dominated clay mineralogy, with MLM illite/smectite (R0, 75% swelling component), and with less illite, kaolinite and chlorite.

Table 42. Semi-quantitative mineral composition of the clay fraction of the soil samples from Belgium

ID	S	I	C	K	I/S	Qz	Cal	Gp
BE1	14	23	15	4	24	20	-	-

4.2.22 France

A wide variety of soils have been sampled from France. Cream or orange cream first two series in Figure 24 are rich in illite and kaolinite components with the presence of calcite and sometimes goethite. Calcite is detected but no quantified in many samples. The third series is more illite-smectite with higher OM contents. It is curious how in this grey samples vermiculite or HIV vermiculite is not present. Non clay minerals are represented by quartz, feldspars, and calcite, with minor gypsum o saline soil representation containing halite.

Figure 24. Details of clay fractions prepared on glass slides of the soil samples from France

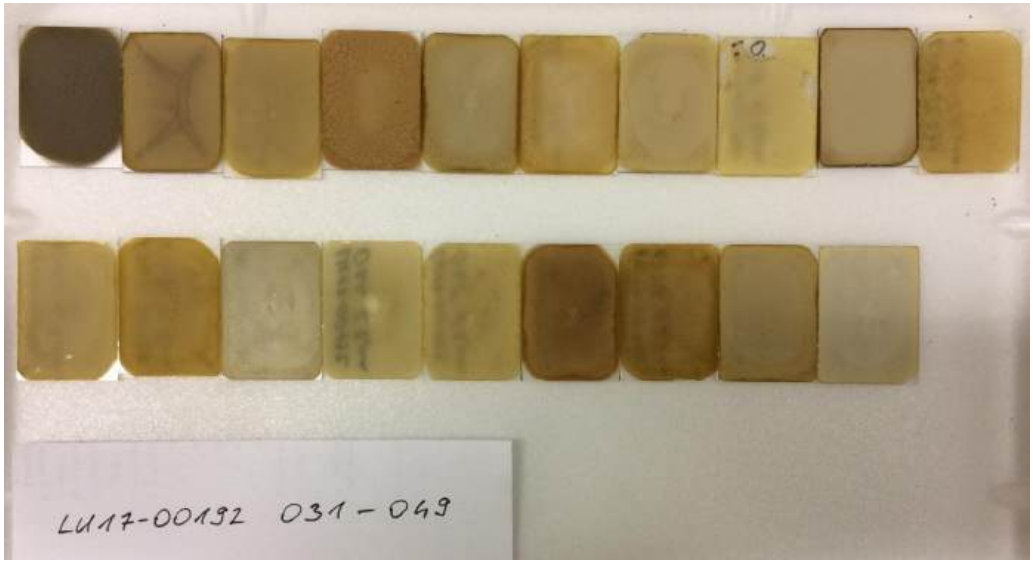


Table 43. Description of the clay mineralogy of the soil samples from France

ID	Description
FR1	Illite, kaolinite dominant clay, poorly crystallised. High amount of non-clay minerals: Quartz, calcite. Calcite seems to be covered by clay, organic matter (OM), iron oxides and thus has not shown reaction for acetic acid. This problem occurred in several samples
FR2	Very high amount of non-clay minerals (quartz, halite) and OM. The presence of halite despite of several washing is curious. This problem occurred in several samples
FR3	Illite, kaolinite dominant clay, poorly crystallised. High amount of non-clay minerals: Quartz
FR4	Illite, kaolinite dominant clay, poorly crystallised. High amount of non-clay minerals: Quartz, calcite
FR5	Dominantly illite/smectite mixed layer with less than 30% swelling component. High amount of covered calcite
FR6	Dominantly kaolinite
FR7	Illite, kaolinite dominant clay, poorly crystallised. High amount of non-clay minerals: Quartz, calcite
FR8	Illite, kaolinite dominant clay, poorly crystallised. High amount of non-clay minerals: Quartz, calcite
FR9	Two kinds of Illite/smectite, a smectite rich and illite rich phase, illite, kaolinite
FR10	Very high amount of non-clay minerals (Quartz, calcite) and OM. Should be repeated.
FR11	The partial heat stability (12 Å at 550 °C) of the 14 Å phase suggests chlorite/smectite (vermiculite) (Chl/Sm) mixed layer mineral. It could be hydroxy interlayered vermiculite (HIV), but the presence of calcite, gypsum, halite indicates higher pH, where HIV does not form
FR12	Kaolinite and illite with OM
FR13	Kaolinite and illite with gypsum, calcite, and halite
FR14	Kaolinite and illite with calcite
FR15	Kaolinite, illite and illite/smectite with 70% swelling component
FR16	Illite/smectite, high amount of OM
FR17	Dominantly illite, I/S with some smectite
FR18	Kaolinite and disordered I/S (30-50% Sm) with high amount of goethite
FR19	Kaolinite, illite, disordered I/S (50-70% Sm), with some chlorite, and C/S or HIV
FR20	Illite and kaolinite with high amount of OM and quartz, some calcite
FR21	Illite, I/S and vermiculite (slightly or non-swelling 14 Å, which collapse to 10 Å upon heating), some kaolinite
FR22	Relatively well crystallised pure illite and kaolinite
FR23	Illite, vermiculite, I/S, kaolinite and a 9.3 Å phase (probably zeolite, talc and/or kerolite).
FR24	Illite, kaolinite with some vermiculite. Calcite, feldspars
FR25	Vermiculite, kaolinite, illite
FR26	Dominantly illite and I/S (an illite rich and a smectitic), with some C/S
FR27	Illite and I/S (15-20% swelling component) and kaolinite with some goethite and calcite.
FR28	Dominantly kaolinite with some illite, I/S, goethite, calcite
FR29	Dominantly kaolinite with some illite, I/S, goethite, calcite, and gypsum
FR30	High amount of OM, with kaolinite, illite, I/S and smectite
FR31	Kaolinite, smectite (or vermiculite) with gypsum, halite, OM
FR32	Kaolinite, illite with gypsum, OM
FR33	Kaolinite, illite, I/S with gypsum, calcite, OM
FR34	Kaolinite, talc and/or kerolite with halite, calcite

FR35 OM, calcite rich with kaolinite, illite

FR36 OM, calcite rich

FR37 Dominantly illite, I/S, with kaolinite

FR38 Dominantly illite, I/S, with kaolinite

FR39 Dominantly illitic with chlorite, vermiculite, and kaolinite.

FR40 Talc, probably kerolite, illite with high amount of OM and probably halite, calcite

FR41 Kaolinite and/or kaolinite/smectite mixed layer, I/S, smectite, calcite

FR42 Vermiculite, I/S or I/V, kaolinite with some gypsum and calcite

FR43 I/S (40-60% smectite component), illite, with kaolinite and some chlorite. Gypsum and calcite

FR44 Dominantly I/S (15-20% swelling component) and illite

FR45 Illite, I/S and kaolinite. High amount of OM, calcite

FR46 Mixed layer illite/smectite, kaolinite and illite, with calcite and quartz as non-clay minerals

FR47 Small amount of clay minerals, high amount of OM, calcite, halite. Should be repeated.

FR48 Illite, kaolinite and smectite

FR49 Mixed layer illite/smectite (60-70% swelling component), illite, with some kaolinite. Calcite and quartz as non-clay minerals.

FR50 No Data

FR51 The dominating clay minerals are illite, kaolinite and MLM illite/smectite with calcite and quartz as non-clay minerals.

FR52 Predominant clay mineral is kaolinite, with less chlorite and illite. Quartz, gypsum, and calcite as non-clay minerals.

FR53 Kaolinite, chlorite, MLM illite/smectite, illite and MLM chlorite/smectite dominated clay fraction with quartz and some calcite.

FR54 The dominating clay minerals are kaolinite, MLM illite/smectite and illite with calcite and quartz as non-clay minerals.

FR55 Illitic –chloritic clay mineralogy with gypsum, quartz, and calcite.

FR56 The dominating clay minerals are chlorite, MLM chlorite/vermiculite, vermiculite, illite, kaolinite with quartz and calcite.

FR57 Illite, chlorite, MLM illite/vermiculite, vermiculite, MLM chlorite/vermiculite dominated clay fraction with quartz and feldspars.

FR58 Characteristic clay minerals in the sample are kaolinite, MLM illite/smectite, illite, chlorite with high amount calcite and quartz.

FR59 Characteristic clay minerals in the sample are kaolinite, MLM illite/smectite, illite, chlorite with calcite and quartz

FR60 The dominating clay minerals are illite, chlorite and kaolinite with gypsum and quartz.

FR61 The dominating clay minerals are kaolinite, illite, chlorite, MLM illite/vermiculite and MLM chlorite/vermiculite with quartz.

FR62 Kaolinite, chlorite, illite dominated clay mineralogy with some MLM illite/smectite, with gypsum and quartz.

FR63 Illitic clay mineralogy with some MLM illite/smectite, and kaolinite, with calcite and quartz.

FR64 Illite, kaolinite and chlorite dominated clay fraction, with less MLM mica/chlorite or MLM illite/vermiculite, but it can be also sepiolite, with calcite and quartz as non-clay minerals.

FR65 The dominating clay are kaolinite, illite, chlorite and vermiculite with quartz.

FR66 Illitic clay mineralogy with less kaolinite and chlorite, with quartz.

FR67 The dominating clay minerals are kaolinite, vermiculite and illite with gypsum, quartz, and calcite.

Table 44. Semi-quantitative mineral composition of the clay fraction of the soil samples from France

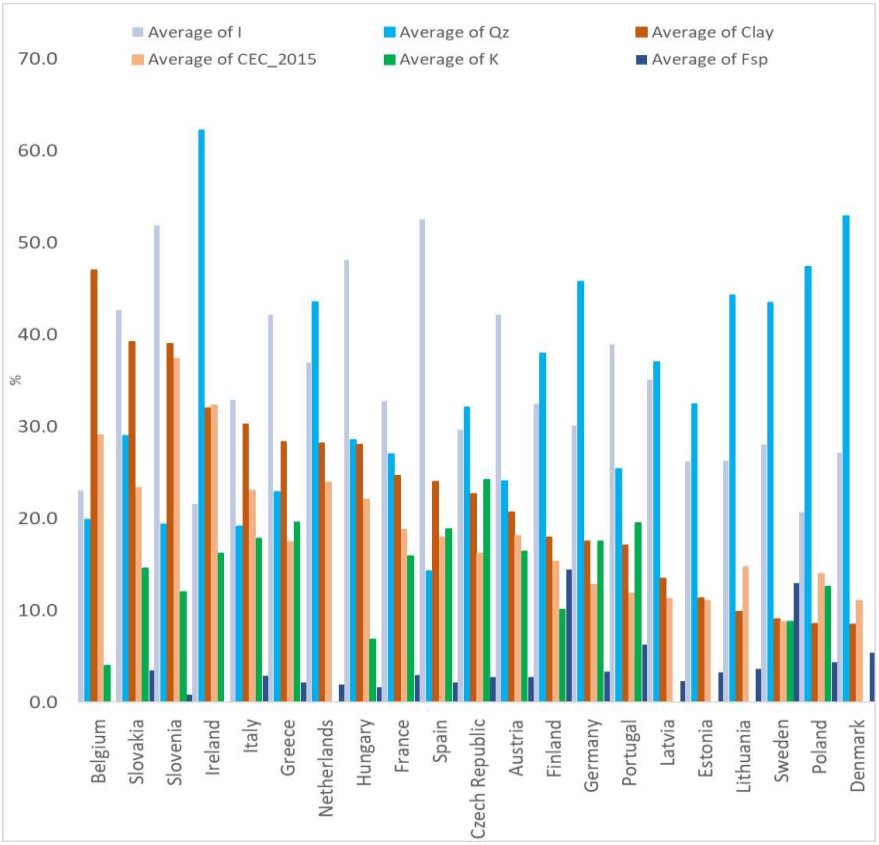
ID	S	V	I	C	Tlc + Sep	Plg	K	I/S	I/V	C/S	C/V	K/S	Qz	Crs	Fsp	Cal	Gp
FR1	0	0	25	0	0		7	5					57		6		
FR2	0	0	25	0	0		11	15					49		0		
FR3	0	0	13	0	0		6	10					68		3		
FR4	0	14	15	0	0		0	8					60		3		
FR5	0	0	29	0	0		11	35					25		0		
FR6	0	0	19	0	0		28	20					33		0		
FR7	0	0	36	12	0		0	22					27		3		
FR8	0	0	16	0	0		8	13					61		2		
FR9	9	0	32	4	0		9	29					15		2		
FR10	0	0	35	5	0		5	14					42		0		
FR11	21	21	16	0	0		0	11					25		7		
FR12	0	0	35	0	0		27	10					26		2		
FR13	0	0	16	0	0		8	16					55		5		
FR14	0	0	19	0	0		11	22					36		11		
FR15	0	0	30	0	0		13	29					26		3		
FR16	0	0	20	0	0		8	28					43		2		
FR17	6	0	32	2	0		6	24					27		3		
FR18	9	16	17	0	0		0	23					33		2		
FR19	7	3	29	3	0		8	35					14		1		
FR20	0	0	46	0	0		14	15					25		0		
FR21	3	20	25	0	0		13	29					15		0		
FR22	0	0	75	0	0		20	0					5		0		
FR23	5	15	20	0	6		15	14					27		2		
FR24	0	5	40	0	0		17	0					33		5		
FR25	2	25	17	0	0		15	7					46		3		
FR26	10	4	58	0	0		0	20					9		0		
FR27	0	0	52	0	0		16	21					11		0		
FR28	0	0	15	0	0		60	9					14		1		
FR29	0	0	28	0	0		50	10					10		1		
FR30	14	0	28	0	0		25	5					15		14		
FR31	18	0	11	0	0		7	0					59		5		
FR32	0	0	25	0	0		9	0					59		8		
FR33	0	0	15	0	0		11	41					29		4		
FR34	0	0	30	0	11		30	0					23		7		

FR35	0	0	32	0	0	16	0				49	2				
FR36	0	0	56	0	0	19	0				25	0				
FR37	0	0	46	0	0	10	12				33	0				
FR38	0	0	27	0	0	17	41				15	0				
FR39	0	10	47	6	0	6	10				18	3				
FR40	0	0	36	0	10	19	0				27	7				
FR41	11		31		0		21			18	14	4				
FR42	0	23	0	0	0	26	27				24	0				
FR43	0		35	2	0	8	45				8	0				
FR44	0		52	0	0	3	40				6	0				
FR45	0		34	0	0	12	30				24	0				
FR46	0		60	0	0	16	13				12	0				
FR47	0		36	0	0		0				44	20				
FR48	15		30	0	0	30	5				11	11				
FR49	16		29	0	0	9	37				5	4				
FR50							No data									
FR51			42	5		29	9				15		+	-		
FR52			28	6		19					43	4	+	+		
FR53			46	7		17	8		5		18		+	-		
FR54			43			31	13				13		+	+		
FR55			41	35							22	2	+	+		
FR56		8	25	9		17		7		3	29	2	-	+		
FR57		12	43	26				7		10		2	-	+		
FR58			39	5		35	21						+	+		
FR59			49	5		15	6				24	1	+	-		
FR60			68	9		5					17	1	-	+		
FR61			12	20		20		22		13	13		-	-		
FR62			37	20		23	3				17		-	+		
FR63			61			17	10				13		+	+		
FR64			34	12		26		10			16	1	+	+		
FR65		9	28	7		24		6			24	2	-	+		
FR66			45	14		23					17	1	+	+		
FR67		9	28			29					32	2	+	+		

5 General discussion

Countries with soil samples below 5 such as Belgium, Estonia, Ireland, Slovakia, Latvia, and Slovenia were not included into the discussion. Potential correlations between some relevant minerals detected by XRD analysis (illite, quartz, feldspars, and kaolinite) were compared to some soil properties such as clay and Cation Exchange Capacity (CEC) and they were split by country (see Figure 25). As already expected, and reported many times as CEC increases clay content increases. Soil properties such as CEC and clay content are inversely related to quartz content. Thus, countries such as Denmark, Poland, Sweden, Lithuania show a high content of quartz and a low content of clay and CEC lower than 15 cmolc/kg. In general terms no clear relations could be met between clay minerals such as illite and kaolinite and cation exchange capacity. Some authors already reported (Ma et al. 1999) that permanent negative charges due to isomorphous substitution of Al^{3+} for Si^{4+} are not largely affecting on cation exchange capacity and only pH-dependent substitutions on the edges and on the basal (OH) surfaces of the kaolinites are contributing on CEC. Typical low CEC rate around 10 cmolc/kg can be found in soils with kaolinite as the predominant clay mineral. In conversely way, a high net charge due to isomorphic substitutions is reported for Illite (around 2) and it should be expected that good correlations were found with CEC. This trend could be found but most of the time non-exchange potassium is place between illite layers and CEC is dropped, mainly in agricultural soils where potassium is usually added as mineral fertilizers. Other soil properties such as pH, gypsum and carbonates should be analysed as well.

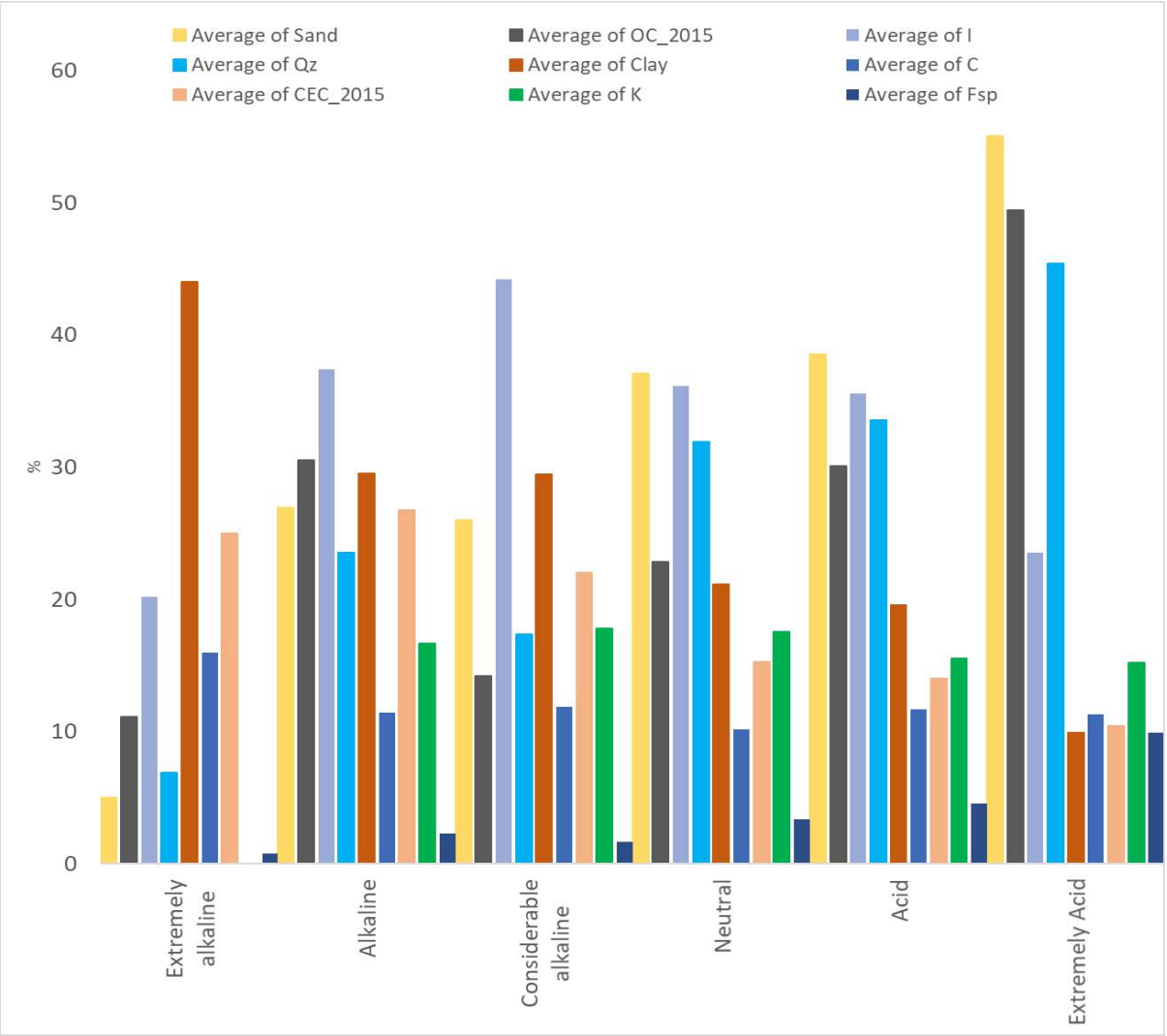
Figure 25. Distribution of some soil properties by country



Correlations between soil acidity and clay content is found (see figure 25). Additionally, as soil pH values decreases CEC also decreases. It is related to the content of sand and quartz that increase in acid soils.

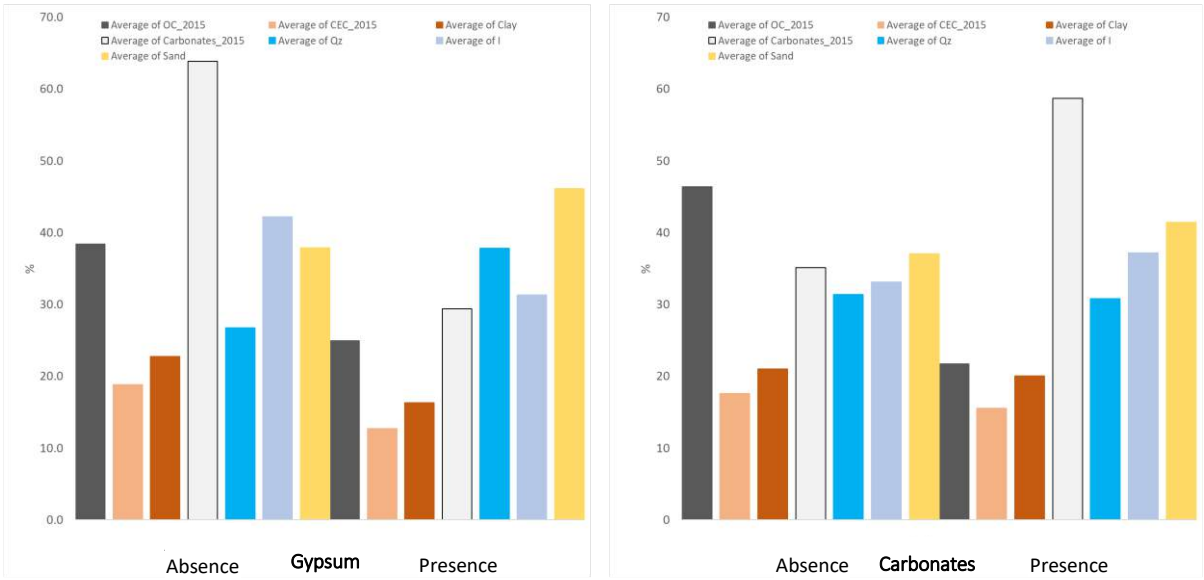
It is concluding that clay content is the main soil property affecting on CEC as extremely acid soils have the largest content of soil organic carbon (around 50%), but CEC is around 10 cmolc/Kg. On the other hand, extremely- and alkaline soils (with pH above 7.5) with clay content above 30% show a CEC higher than 25 cmolc/kg.

Figure 26. Distribution of soil properties and main clay minerals along pH interval. Soils with pH values ≤ 5.0 were labelled as extremely acid, with 5.0 ≤ pH ≤ 6.0 as Acid soils, with 6.0 ≤ pH ≤ 7.0 as neutral soils, with 7.0 ≤ pH ≤ 7.5 as Alkaline soils, with 7.5 ≤ pH ≤ 8.5 as Considerable alkaline soils, and with pH ≥ 8.5 as Extremely alkaline soils. Units of Soil organic carbon are in g/kg



Other clay minerals such as gypsum and carbonates were qualitatively analyzed (see figure 27). Soil with absence of gypsum show a higher content of carbonates (65%) than those with gypsum. This fact is relevant as gypsum is largely affecting of soil salinity and soils with high content of carbonates are expected to show low salinity. Nevertheless, in many cases compared to humid regions and in the presence of chlorite-like minerals, the presence of gypsum has to be confirmed. Other soil properties as soil organic carbon, clay content and CEC are higher in soils without gypsum. Soils with presence of carbonates show on average a percentage of carbonates around 6% and a content of organic carbon lower than those without carbonates as clay minerals

Figure 27. Distribution of soil properties and clay minerals by presence/absence of Gypsum (left) and Carbonates (right). Units of Soil organic carbon are in g/kg



Added interesting patterns were identified when 2:1 clay mineral such as smectites were analysed as well as the mixed-layer minerals such us I/S, I/V, C/S and C/V minerals (see figure 26). Similar trend between CEC and I/S content was detected along pH interval. Higher content of I/S mixed-layer minerals can be found in soils with pH values above 7.5. No clear correlations could be concluded between 2:1 clay minerals such as smectite and vermiculite and soil pH. It could be explained as they have a permanent negative layer charge regardless soil pH. Additionally, all soil samples corresponding to the topsoil layer (first 20 cm) and further information could be analysed whether subsoil samples were taken.

Matrix with Pearson correlation coefficients are shown in the table 45. Some preliminary findings can be discussed as significant correlation coefficients (R> 0.400) were found between clay minerals and soil attributes measured in LUCAS 2015 survey, but more data are needed to confirm them. As clay content increases those quartz (-0.490) and amphibole percentages decrease (-0.414). As silt content increases amphibole percentage (0.637) increases. As sand content increases quartz percentage (0.462) increase. As cation exchange capacity increases from 5 to 25 cmolc kg/1 amphibole percentage (-0.439) decrease from 4 to 0.5% as other clay minerals such as smectite and vermiculite as well as soil attritubes as SOC can be more related to more intense wheathering processes. Therefore amphibole presence could be indicating soils with low clay content and soils with low reactivity. As vermiculite percentage increases that C/V one (0.602) increases but amphibole percentage (-0.498) decreases as chlorite and vermiculite are wheathering products from amphibole. As illite precentage increases that quartz one (-0.555) decreases. As Plagioclase percentage increase that kaolinite one decreases (-0.583) as reported elsewhere (Yuan et al. 2019) but all these correlations can not be profusely discussed as a few data for analysis were available. As kaolinite percentage increase that C/S one (0.425) increases. As I/V percentage increases those C/V (0.664), amphibole (0.949), carbonates (0.551) and magnesium (0.434) ones increases. As C/V percentage increases total chromium (0.486) and nickel (0.542) contents increase. As quartz percentage increase both soil pH in water (-0.501) and soil pH in CaCl2 (-0.488) decreases. As feldspars percentage increases amphibole content (0.533) increases but both soil pH in water (-0.480) and soil pH in CaCl2 (-0.488) decrease. As amphibole

percentage increase iron content (0.424) increases. Preliminary findings confirm the close correlations between clay mineralogy and soil properties and therefore the relevance in considering clay mineralogy as part of the soil monitoring process. Anyway futher investigations should be conducted to confirm these preliminar correlations as additional data are available.

Table 45. Pearson correlation coefficients between clay minerals percentage and soil properties from LUCAS 2015 soil database.

	SOC	coarse	Clay	Silt	Sand	CEC	S	V	I	C	Tlc + Sep	Plg	K	I/S	I/V	C/S	C/V	Qz	Fsp	Amp	Lime	N	pHw	pHCaCl2	As	Cd	Co	Cr	Cu	Fe	Mg	Mn	Ni	P_y	Pb	Sb	V
coarse	0.000																																			
Clay	-0.041	0.080																																		
Silt	-0.055	-0.060	0.286																																	
Sand	0.060	-0.003	-0.742	-0.854																																
CEC	0.392	0.072	0.588	0.088	-0.379																															
S	-0.282	-0.059	0.174	-0.160	0.019	0.155																														
V	0.134	-0.077	-0.406	-0.295	0.376	-0.069	0.302																													
I	-0.041	0.042	0.224	0.141	-0.224	0.104	-0.338	-0.381																												
C	0.221	-0.031	-0.074	-0.092	0.111	-0.020	0.363	0.358	-0.099																											
Tlc + Sep	0.279	0.026	-0.098	0.181	-0.101	0.089	-0.085	-0.021	-0.007	-0.083																										
Plg	-0.169	0.147	-0.311	-0.548	0.480	-0.753			0.491	0.999																										
K	0.038	0.130	0.010	-0.090	0.062	0.007	-0.210	-0.134	-0.198	-0.090	0.183	-0.583																								
I/S	-0.021	0.025	0.339	0.025	-0.224	0.333	0.074	0.035	-0.344	-0.175	-0.262	-0.487	-0.152																							
I/V	-0.044	-0.033	0.001	-0.221	0.168	0.111		-0.044	-0.057	0.176			0.243																							
C/S	-0.252	0.398	-0.077	-0.126	0.155	-0.115	0.999		-0.309	-0.365			0.425	0.064																						
C/V	0.326	0.070	0.044	-0.120	0.060	0.161		0.602	-0.097	0.373			0.104	-0.252	0.664																					
Qz	0.199	-0.180	-0.490	-0.280	0.462	-0.241	-0.345	0.154	-0.555	0.000	-0.051	-0.532	-0.260	-0.279	-0.240	-0.123	-0.251																			
Fsp	0.146	0.028	-0.328	-0.191	0.302	-0.234	0.149	0.316	-0.312	0.093	0.167	0.607	0.023	-0.216	-0.174	-0.235	-0.041	0.385																		
Amp	-0.004	0.049	-0.414	0.637	-0.035	-0.439		-0.498	-0.168	0.103					0.949		-0.046	-0.145	0.533																	
Lime	-0.130	0.053	0.343	0.123	-0.270	0.203	0.281	-0.191	0.272	-0.062	-0.099	0.280	-0.007	0.208	0.551	-0.018	-0.129	-0.357	-0.172	-0.367																
N	0.891	-0.013	0.096	0.015	-0.063	0.565	-0.268	0.092	-0.022	0.204	0.246	-0.043	0.020	0.010	0.080	-0.215	0.272	0.130	-0.005	0.014	-0.090															
pHw	-0.307	0.031	0.503	0.184	-0.400	0.396	0.262	-0.430	0.349	-0.003	-0.065	0.388	0.073	0.251	0.298	-0.023	-0.085	-0.501	-0.480	-0.106	0.519	-0.161														
pHCaCl2	-0.311	0.019	0.517	0.211	-0.426	0.404	0.211	-0.434	0.333	-0.016	-0.093	0.346	0.069	0.259	0.283	-0.037	-0.100	-0.488	-0.488	-0.035	0.494	-0.139	0.992													
As	0.026	0.104	0.095	0.100	-0.122	0.083	-0.122	-0.159	0.008	-0.115	-0.088	-0.468	0.237	-0.061	-0.044	0.302	0.077	-0.147	-0.085	0.262	-0.031	0.098	0.004	0.020												
Cd	0.100	0.033	0.009	0.014	-0.015	0.111	-0.106	-0.025	-0.113	-0.018	-0.024	0.639	0.076	-0.074	0.098	-0.103	0.007	0.035	-0.007	-0.076	-0.046	0.143	0.015	0.022	0.204											
Co	-0.037	0.084	0.341	0.260	-0.367	0.202	0.282	-0.139	0.017	0.030	-0.130	-0.909	0.112	0.030	0.077	0.034	0.141	-0.251	0.019	0.234	-0.027	0.044	0.122	0.141	0.381	0.063										
Cr	0.006	-0.008	0.198	0.151	-0.215	0.131	0.019	-0.118	-0.002	-0.007	-0.037	-0.855	0.057	-0.016	0.146	-0.128	0.486	-0.138	-0.063	0.146	-0.027	0.057	0.083	0.092	0.053	0.022	0.366									
Cu	-0.007	0.024	0.291	0.159	-0.270	0.205	0.125	-0.106	0.070	0.172	-0.201	0.121	-0.016	-0.016	0.057	-0.011	0.264	-0.193	-0.109	0.227	0.085	0.061	0.209	0.222	0.158	0.085	0.351	0.193								
Fe	0.033	0.095	0.189	0.171	-0.223	0.176	0.185	-0.114	0.087	0.135	-0.060	-0.624	0.087	-0.024	0.061	0.297	0.120	-0.190	-0.013	0.424	0.004	0.112	0.084	0.099	0.204	0.573	0.221	0.087	0.140							
Mg	-0.062	0.089	0.298	0.143	-0.262	0.196	0.267	0.017	0.151	0.252	-0.170	0.087	-0.018	0.104	0.434	0.045	0.193	-0.297	-0.135	0.116	0.271	-0.021	0.362	0.363	-0.013	0.025	0.183	0.115	0.426	0.183						
Mn	0.012	0.096	0.084	0.083	-0.104	0.157	-0.025	-0.118	0.164	0.034	-0.221	-0.502	0.028	-0.081	0.155	-0.066	0.058	-0.129	-0.153	0.103	0.030	0.119	0.146	0.159	0.216	0.538	0.212	0.071	0.111	0.603	0.081					
Ni	0.004	0.013	0.258	0.109	-0.218	0.178	0.047	-0.140	0.056	0.044	-0.042	-0.385	0.029	-0.034	0.073	-0.186	0.542	-0.153	-0.157	0.146	-0.027	0.059	0.138	0.146	0.050	0.013	0.339	0.824	0.230	0.088	0.144	0.078				
P	0.028	-0.033	0.239	0.184	-0.260	0.144	-0.040	0.012	0.019	0.114	-0.170	0.066	0.044	-0.084	0.108	-0.018	0.096	-0.061	-0.053	0.056	0.026	0.158	0.144	0.164	0.130	0.205	0.261	0.112	0.286	0.280	0.296	0.248	0.117			
Pb	0.076	0.010	0.159	0.216	-0.238	0.109	-0.237	-0.132	-0.028	-0.060	-0.041	-0.797	0.128	-0.051	-0.009	0.061	-0.018	-0.025	-0.139	0.220	-0.089	0.167	0.014	0.043	0.421	0.348	0.305	0.100	0.270	0.213	0.068	0.279	0.062	0.267		
Sb	0.013	0.002	0.143	0.147	-0.181	0.090	-0.091	-0.127	0.047	0.037	-0.058	-0.799	0.120	-0.076	0.063	0.206	0.099	-0.098	-0.154	0.171	-0.003	0.069	0.067	0.076	0.243	0.366	0.202	0.280	0.294	0.187	0.103	0.181	0.270	0.154	0.310	
V	0.018	0.039	0.419	0.239	-0.395	0.299	0.168	-0.094	-0.084	-0.087	-0.010	-0.780	0.164	0.130	0.120	0.083	0.332	-0.187	0.007	0.098	-0.041	0.105	0.141	0.168	0.308	0.222	0.714	0.317	0.358	0.341	0.165	0.260	0.277	0.234	0.343	0.240
Zn	0.021	0.040	0.260	0.202	-0.283	0.150	-0.039	-0.141	-0.033	0.050	-0.002	-0.038	0.174	0.004	0.069	0.079	0.111	-0.159	-0.131	0.048	-0.037	0.135	0.101	0.127	0.382	0.481	0.523	0.194	0.400	0.367	0.267	0.411	0.194	0.442	0.649	0.291	0.495

6 Conclusions

From the point of view of clay mineralogy and general mineralogy:

A wide variety of soils have been analysed for clay mineralogy in UE and United Kingdom countries. As have been stated above, in general, clay content and the presence of permanent charged minerals conditioned, in this order, the CEC values of soils rather than pH or OM contents.

On a qualitative observation basis, central Europe (i.e. Germany, Czechia, Poland) and northern countries (i.e. Finland, Sweden, Latvia) have clay mineralogies more akin to have chlorite-like or vermiculitic compositions in addition to the persistent predominance of illite. These mineralogies are consistent with highly weathered, organic rich, topsoils form more cold and humid regions, very poor, on the other hand, in clay minerals, and in nutrients such as calcium, magnesium and, potassium

Kaolinite and smectite are more represented in mediterranean or southern UE countries and, in addition, iron oxyhydroxides are present and differentiate orange-brown colours of these regions.

Quartz is the main stable no clay mineral and feldspars or amphiboles appear in soil mineralogies from the well-known granitic shields of Scandinavian countries.

Presence and quantification of sparingly soluble (carbonates) or soluble minerals (gypsum and halite) is not always stablished with certainty or either quantified, it is necessary to revisite some samples to capture signal overlapping in order to obtain further interpretations on salinity issues. Knowledge of the existence of lime additions to analyzed soils will be important to solve some of the interpretations concerning calcite presence or not in representative soils.

Current descriptive analysis can be used to identify the most relevant clay minerals in soils of Europe. Monitoring over time can be used as soil health indicator to establish potential correlations between clay minerals and relevant threats as soil degradation, soil erosion, and soil pollution.

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List of abbreviations and definitions

Abreviations used in the text, XRD figures, and mineralogical composition tables (mainly after Whitney and Evans, 2010):

S	Smectite
V	Vermiculite
I	Illite
M	Mica
C	Chlorite
K	Kaolinite
Plg	Palygorskite
Sep	Sepiolite
Pg	Paragonite
Bt	Biotite
Tlc	Talc
MLM	mixed-layer clay mineral
I/S	MLM illite/smectite
I/V	MLM illite/vermiculite
I/C	MLM illite/chlorite
I/C/V	MLM illite/chlorite/vermiculite
C/S	MLM chlorite/smectite
K/S	MLM kaolinite/smectite
C/V	MLM chlorite/vermiculite
HIV	Hydroxy-interlayed vermiculite
Qz	Quartz
Crs	Cristobalite
Fsp	Feldspars
Kfs	K-feldspar
Amp	Amphibole
Zeo	Zeolite
Cal	Calcite
Dol	Dolomite
Gth	Goethite
Lep	Lepidocrocite
Hem	Hematite
Ant	Anatase
Rt	Rutile
Gp	Gypsum
Brt	Barite
Hl	Halite
Fl	Fluorite
Wed	Weddellite
Lim	Lime

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Annexes

Annex 1. Overall XRD characteristics

Table 46. Tables of the soil samples with their behaviour (carbonate effervescence, yield of clay on a scale of 0 to 3), and with the indication of the pre-treatments carried out.

ID	Country	Sample ID	Soil ID	Effervescence (0-3)	Removal of carbonates	Removal of OM H_2O_2	Yield of clay (0-3)
DE1	Germany	LU17_00187_001	26003	0			2
DE2	Germany	LU17_00187_002	26008	0			1
DE3	Germany	LU17_00187_003	26031	0			1
DE4	Germany	LU17_00187_004	26078	0.5			2
DE5	Germany	LU17_00187_005	26135	0			1
DE6	Germany	LU17_00187_006	26310	0			0.5
DE7	Germany	LU17_00187_007	26333	0			1
DE8	Germany	LU17_00187_008	26416	0			1
DE9	Germany	LU17_00187_009	26481	0			0
DE10	Germany	LU17_00187_010	26572	0			0
DE11	Germany	LU17_00187_011	26578	1			
DE12	Germany	LU17_00187_012	26800	0			
DE13	Germany	LU17_00187_013	26803	0			
DE14	Germany	LU17_00187_014	26889	0			0
DE15	Germany	LU17_00187_015	26900	0			0
DE16	Germany	LU17_00187_016	27047	0			
DE17	Germany	LU17_00187_017	27201	0			
DE18	Germany	LU17_00187_018	27211	0			0
DE19	Germany	LU17_00187_019	27243	0			0
DE20	Germany	LU17_00187_020	27361	0			
DE21	Germany	LU17_00187_021	27466	0			0
DE22	Germany	LU17_00187_022	27543	0			
DE23	Germany	LU17_00187_023	27565	0			
DE24	Germany	LU17_00187_024	27663	0			
DE25	Germany	LU17_00187_025	27724	0			
DE26	Germany	LU17_00187_026	27839	0			
DE27	Germany	LU17_00187_027	27942	0			
DE28	Germany	LU17_00187_028	28012	0			
DE29	Germany	LU17_00187_029	26256	0			2
DE30	Germany	LU17_00187_030	26257	0			3
DE31	Germany	LU17_00187_031	26364	0			2
DE32	Germany	LU17_00187_032	26504	0			3
DE33	Germany	LU17_00187_033	26716	0			2

DE34	Germany	LU17_00187_034	27101	0			1.5
DE35	Germany	LU17_00187_035	27430	0		x	0.5
DE36	Germany	LU17_00187_036	27525	0			2
DE37	Germany	LU17_00187_037	27953	0			1
DE38	Germany	LU17_00187_038	27988	0			1.5
DE39	Germany	LU17_00187_039	27480	0			2
GR1	Greece	LU17_00188_001	29318	0			2
GR2	Greece	LU17_00188_002	29360	0			1
GR3	Greece	LU17_00188_003	29379	0			3
GR4	Greece	LU17_00188_004	29387	0			2
GR5	Greece	LU17_00188_005	29388	0			2.5
GR6	Greece	LU17_00188_006	29452	0			2.5
GR7	Greece	LU17_00188_007	29482	0			2
GR8	Greece	LU17_00188_008	29702	0			1
GR9	Greece	LU17_00188_009	29164	0			1.5
ES1	Spain	LU17_00189_001	47001	1			1
ES2	Spain	LU17_00189_002	47102	0			1
ES3	Spain	LU17_00189_003	47324	0			2
ES4	Spain	LU17_00189_004	47113	0			2
ES5	Spain	LU17_00189_005	47119	0			2
ES6	Spain	LU17_00189_006	47138	0			2
ES7	Spain	LU17_00189_007	47168	0			
ES8	Spain	LU17_00189_008	47264	0			
ES9	Spain	LU17_00189_009	47386	2			
ES10	Spain	LU17_00189_010	47436	2			
ES11	Spain	LU17_00189_011	47471	0			
ES12	Spain	LU17_00189_012	47638	1			
ES13	Spain	LU17_00189_013	47665	0			2
ES14	Spain	LU17_00189_014	47674	0			1
ES15	Spain	LU17_00189_015	47755	1			
ES16	Spain	LU17_00189_016	47788	1			
ES17	Spain	LU17_00189_017	47812	2			2
ES18	Spain	LU17_00189_018	47937	2			
ES19	Spain	LU17_00189_019	48094	3			
ES20	Spain	LU17_00189_020	48103	2			0
ES21	Spain	LU17_00189_021	48145	0			2
ES22	Spain	LU17_00189_022	48189	0			
ES23	Spain	LU17_00189_023	48197	0			2

ES24	Spain	LU17_00189_024	48406	0			0.5
ES25	Spain	LU17_00189_025	48485	0			2.5
ES26	Spain	LU17_00189_026	48509	0			2
ES27	Spain	LU17_00189_027	48802	0			
ES28	Spain	LU17_00189_028	48806	0			2
ES29	Spain	LU17_00189_029	48868	0			2
ES30	Spain	LU17_00189_030	48888	0			0
ES31	Spain	LU17_00189_031	48921	0			
ES32	Spain	LU17_00189_032	48929	0			
ES33	Spain	LU17_00189_033	48995	4			
ES34	Spain	LU17_00189_034	49047	0			
ES35	Spain	LU17_00189_035	49120	3			
ES36	Spain	LU17_00189_036	49127	3			
ES37	Spain	LU17_00189_037	49144	3			
ES38	Spain	LU17_00189_038	49164	0			
ES39	Spain	LU17_00189_039	49262	4			
ES40	Spain	LU17_00189_040	49282	3			
ES41	Spain	LU17_00189_041	49515	2			
ES42	Spain	LU17_00189_042	49700	0			
ES43	Spain	LU17_00189_043	49899	1			
ES44	Spain	LU17_00189_044	50147	0			
ES45	Spain	LU17_00189_045	50265	2			
ES46	Spain	LU17_00189_046	50566	2			
ES47	Spain	LU17_00189_047	50592	0			
ES48	Spain	LU17_00189_048	50611	0			
ES49	Spain	LU17_00189_049	50736	3			
ES50	Spain	LU17_00189_050	50742	2			
ES51	Spain	LU17_00190_001	50753	3			
ES52	Spain	LU17_00190_002	50771	3			
ES53	Spain	LU17_00190_003	51043	0			
ES54	Spain	LU17_00190_004	51058	0			
ES55	Spain	LU17_00190_005	51136	3			
ES56	Spain	LU17_00190_006	51170	3			
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ES59	Spain	LU17_00190_009	51294	2			
ES60	Spain	LU17_00190_010	51434	3			
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FI3	Finland	LU17_00191_003	20238	0			0
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FI5	Finland	LU17_00191_005	20459	0			0
FI6	Finland	LU17_00191_006	20497	0			
FI7	Finland	LU17_00191_007	20503	0			
FI8	Finland	LU17_00191_008	20524	0			
FI9	Finland	LU17_00191_009	20559	0			
FI10	Finland	LU17_00191_010	20590	0			
FI11	Finland	LU17_00191_011	20617	0			
FI12	Finland	LU17_00191_012	20618	0			
FI13	Finland	LU17_00191_013	20649	0			
FI14	Finland	LU17_00191_014	20655	0			
FI15	Finland	LU17_00191_015	20759	0			0
FI16	Finland	LU17_00191_016	20815	0			
FI17	Finland	LU17_00191_017	20864	0			0
FI18	Finland	LU17_00191_018	20884	0			
FI19	Finland	LU17_00191_019	20938	0			
FI20	Finland	LU17_00191_020	21022	0			
FI21	Finland	LU17_00191_021	21127	0			
FI22	Finland	LU17_00191_022	20136	0		x	2
FI23	Finland	LU17_00191_023	20234	0		x	1
FI24	Finland	LU17_00191_024	20032	0		x	1.5
FI25	Finland	LU17_00191_025	20217	0			1
FI27	Finland	LU17_00191_026	20377	0			3
FI27	Finland	LU17_00191_027	20600	0			3
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FI29	Finland	LU17_00191_029	21098	0		x	2
FI30	Finland	LU17_00191_030	21192	0		x	0.5
HU1	Hungary	LU17_00193_001	30034	0			3
HU2	Hungary	LU17_00193_002	30040	0			3
HU3	Hungary	LU17_00193_003	30078	1			1.5
HU4	Hungary	LU17_00193_004	30110	1			2.5
HU5	Hungary	LU17_00193_005	30135	1			3
HU6	Hungary	LU17_00193_006	30233	0			2.5
HU7	Hungary	LU17_00193_007	30276	2			2.5
HU8	Hungary	LU17_00193_008	30282	0			3
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HU10	Hungary	LU17_00193_010	30373	0			2
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HU12	Hungary	LU17_00193_012	30461	0.5			1.5
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IT2	Italy	LU17_00194_002	32107	0			
IT3	Italy	LU17_00194_003	32117	0			
IT4	Italy	LU17_00194_004	32260	0			
IT5	Italy	LU17_00194_005	32295	2			
IT6	Italy	LU17_00194_006	32304	1.5			
IT7	Italy	LU17_00194_007	32340	2			
IT8	Italy	LU17_00194_008	32354	0			
IT9	Italy	LU17_00194_009	32362	0			
IT10	Italy	LU17_00194_010	32409	2			
IT11	Italy	LU17_00194_011	32542	0			
IT12	Italy	LU17_00194_012	32693	0			
IT13	Italy	LU17_00194_013	32863	0			
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IT15	Italy	LU17_00194_015	32938	2			3
IT16	Italy	LU17_00194_016	32940	0			
IT17	Italy	LU17_00194_017	33061	3			2.5
IT18	Italy	LU17_00194_018	33191	1			3
IT19	Italy	LU17_00194_019	33242	1.5			3
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IT22	Italy	LU17_00194_022	33481	2			
IT23	Italy	LU17_00194_023	33637	0			
IT24	Italy	LU17_00194_024	33795	3			
IT25	Italy	LU17_00194_025	33796	3			
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IT27	Italy	LU17_00194_027	34014	1			
IT28	Italy	LU17_00194_028	34034	0			
IT29	Italy	LU17_00194_029	34086	2			
IT30	Italy	LU17_00194_030	34207	0			
IT31	Italy	LU17_00194_031	34301	0			
IT32	Italy	LU17_00194_032	34326	2			
IT33	Italy	LU17_00194_033	32284	1			2.5
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IT35	Italy	LU17_00194_035	32373	0			3

IT36	Italy	LU17_00194_036	32392	0			2
IT37	Italy	LU17_00194_037	33305	0			3
IT38	Italy	LU17_00194_038	33454	0			2
PL1	Poland	LU17_00195_001	40028	0			
PL2	Poland	LU17_00195_002	40135	0			
PL3	Poland	LU17_00195_003	40228	0		x	
PL4	Poland	LU17_00195_004	40256	0			
PL5	Poland	LU17_00195_005	40313	0			
PL6	Poland	LU17_00195_006	40495	0			
PL7	Poland	LU17_00195_007	40703	0			
PL8	Poland	LU17_00195_008	40771	0			
PL9	Poland	LU17_00195_009	40786	0			
PL10	Poland	LU17_00195_010	40788	0			
PL11	Poland	LU17_00195_011	41148	0		x	
PL12	Poland	LU17_00195_012	41209	0			
PL13	Poland	LU17_00195_013	41275	0			
PL14	Poland	LU17_00195_014	41520	0		x	
PL15	Poland	LU17_00195_015	41543	0		x	
PL16	Poland	LU17_00195_016	41639	0		x	
PL17	Poland	LU17_00195_017	41771	0			
PL18	Poland	LU17_00195_018	40072	0			
PL19	Poland	LU17_00195_019	40148	0			
PL20	Poland	LU17_00195_020	40432	0		x	
PL21	Poland	LU17_00195_021	41045	0			2.5
PL22	Poland	LU17_00195_022	41099	0		x	0
PL23	Poland	LU17_00195_023	41187	0			1.5
PL24	Poland	LU17_00195_024	41332	0			2
PL25	Poland	LU17_00195_025	41340	0			2
PL26	Poland	LU17_00195_026	41426	0			3.5
PL27	Poland	LU17_00195_027	41437	0			3
PL28	Poland	LU17_00195_028	41633	0		x	2
PL29	Poland	LU17_00195_029	41673	0			3
PL30	Poland	LU17_00195_030	41767	0			3
LT1	Lithuania	LU17_00196_001	56004	0		x	1
LT2	Lithuania	LU17_00196_002	56025	0			1.5
LT3	Lithuania	LU17_00196_003	56050	0			2.5
LT4	Lithuania	LU17_00196_004	56067	0			1.5
LT5	Lithuania	LU17_00196_005	56203	0			1.5

LT6/1	Lithuania	LU17_00196_006_1_2	56217	0		x	
LT7	Lithuania	LU17_00196_007	56316	0			1
LT8	Lithuania	LU17_00196_008	56351	0			2
SI1	Slovenia	LU17_00197_001	46014	0			3
EE1	Estonia	LU17_00198_001	19120	0			2
EE2	Estonia	LU17_00198_002	19165	0			2
EE3	Estonia	LU17_00198_003	19169	0			2
NL1	Netherlands	LU17_00199_001	39151	1			2.5
NL2	Netherlands	LU17_00199_002	39194	0			2.5
NL3	Netherlands	LU17_00199_003	39055	0		x	1
NL4	Netherlands	LU17_00199_004	39086	0			0.5
NL5	Netherlands	LU17_00199_005	39153	0		x	1
DK1	Denmark	LU17_00200_001	18003				
DK2	Denmark	LU17_00200_002	18028				
DK3	Denmark	LU17_00200_003	18079				
DK4	Denmark	LU17_00200_004	18096			x	
DK5	Denmark	LU17_00200_005	18128			x	
DK6	Denmark	LU17_00200_006	18202				
LV1	Latvia	LU17_00201_001	35060				
LV2	Latvia	LU17_00201_002	35069				
IE1	Ireland	LU17_00202_001	31120				
SK1	Slovakia	LU17_00203_001	45009	0			
SK2	Slovakia	LU17_00203_002	45019	0			
SK3	Slovakia	LU17_00203_003	45207	0			
SK4	Slovakia	LU17_00203_004	45219	0			
PT1	Portugal	LU17_00204_001	42010	0			2
PT2	Portugal	LU17_00204_002	42027	0			0.5
PT3	Portugal	LU17_00204_003	42137	0			2
PT4	Portugal	LU17_00204_004	42141	0			3
PT5	Portugal	LU17_00204_005	42171	0			1
PT6	Portugal	LU17_00204_006	42178	0			1
PT7	Portugal	LU17_00204_007	42202	0			2
PT8	Portugal	LU17_00204_008	42315	0			2
PT9	Portugal	LU17_00204_009	42383	0			1

PT10	Portugal	LU17_00204_010	42412	0			1
PT11	Portugal	LU17_00204_011	42428	0			3
PT12	Portugal	LU17_00204_012	42431	0			2
SE1	Sweden	LU17_00205_001	60023	0			2
SE2	Sweden	LU17_00205_002	60434	0			2
SE3	Sweden	LU17_00205_003	60643	0			1
SE4	Sweden	LU17_00205_004	60856	0			1
SE5	Sweden	LU17_00205_005	60974	0			1
SE6	Sweden	LU17_00205_006	60975	0			2
SE7	Sweden	LU17_00205_007	61077	0			2
SE8	Sweden	LU17_00205_008	61411	0			3
SE9	Sweden	LU17_00205_009	61627	0			2
SE10	Sweden	LU17_00205_010	61695	0			2
SE11	Sweden	LU17_00205_011	61713	0			2
SE12	Sweden	LU17_00205_012	61786	0			1
SE13	Sweden	LU17_00205_013	61800	0			1
SE14	Sweden	LU17_00205_014	61854	0			3
SE15	Sweden	LU17_00205_015	62101	0			0.5
SE16	Sweden	LU17_00205_016	62227	0			0.5
SE17	Sweden	LU17_00205_017	62332	0			1
SE18	Sweden	LU17_00205_018	61374	0			0.5
SE19	Sweden	LU17_00205_019	60047	0		x	0.5
SE20	Sweden	LU17_00205_020	60543	0		x	1.5
SE21	Sweden	LU17_00205_021	60631	0		x	2
SE22	Sweden	LU17_00205_022	61297	0			2
SE23	Sweden	LU17_00205_023	61883	0			1
UK1	United Kingdom	LU17_00206_001	54074	0			1
UK2	United Kingdom	LU17_00206_002	54142	0			3
UK3	United Kingdom	LU17_00206_003	54162	0			3
UK4	United Kingdom	LU17_00206_004	54179	0			3
UK5	United Kingdom	LU17_00206_005	54180	0			3
UK6	United Kingdom	LU17_00206_006	54181	0.5			3
UK7	United Kingdom	LU17_00206_007	54215	0			2

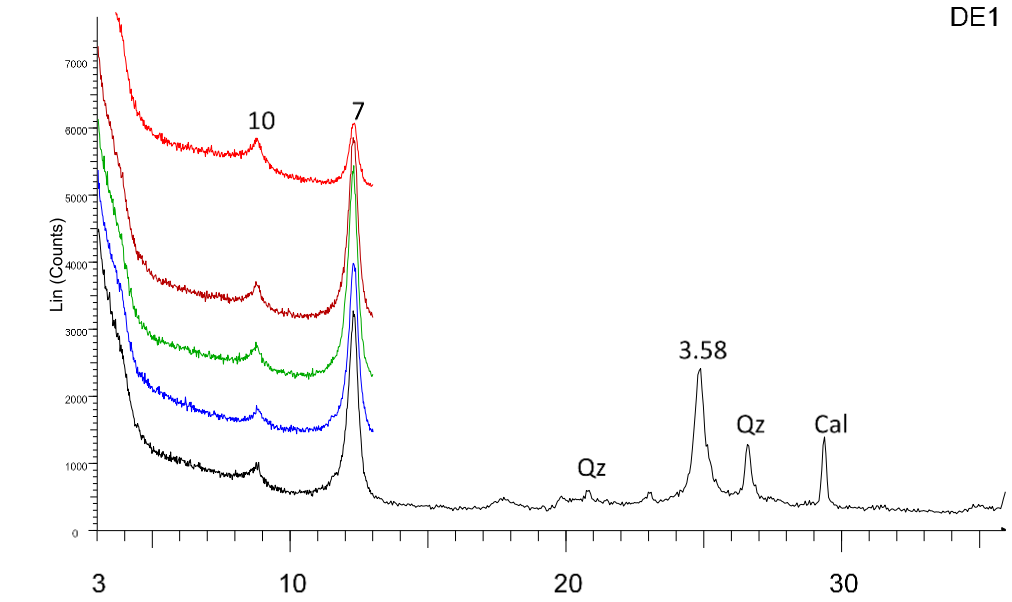
UK8	United Kingdom	LU17_00206_008	54263	0			1
UK9	United Kingdom	LU17_00206_009	54306	0			1.5
UK10	United Kingdom	LU17_00206_010	54318	0			1.5
UK11	United Kingdom	LU17_00206_011	54693	0			1.5
UK12	United Kingdom	LU17_00206_012	54747	0			1.5
UK13	United Kingdom	LU17_00206_013	54765	0			1.5
UK14	United Kingdom	LU17_00206_014	54943	0			0.5
AT1	Austria	LU17_00207_001	11176	0			
AT2	Austria	LU17_00207_002	11211	0			
AT3	Austria	LU17_00207_003	11307	0			
AT4	Austria	LU17_00207_004	11335	0			
AT5	Austria	LU17_00207_005	11413	0			
AT6	Austria	LU17_00207_006	11425	0			
CZ1	Czechia	LU17_00208_001	17029	0			1
CZ2	Czechia	LU17_00208_002	17123	1.5			3
CZ3	Czechia	LU17_00208_003	17165	0			3
CZ4	Czechia	LU17_00208_004	17228	0			2
CZ5	Czechia	LU17_00208_005	17230	0			2
CZ6	Czechia	LU17_00208_006	17231	0			1
CZ7	Czechia	LU17_00208_007	17262	0			1
CZ8	Czechia	LU17_00208_008	17283	0			1
CZ9	Czechia	LU17_00208_009	17285	0			1
CZ10	Czechia	LU17_00208_010	17296	0			1
CZ11	Czechia	LU17_00208_011	17307	0			2
CZ12	Czechia	LU17_00208_012	17389	0			2
CZ14	Czechia	LU17_00208_014	17431	0			1
BE1	Belgium	LU17_00209_001	12026	1			3
FR1	France	LU17_00192_001	22126	0			
FR2	France	LU17_00192_002	22132	0			
FR3	France	LU17_00192_003	22142	0			
FR4	France	LU17_00192_004	22159	0			
FR5	France	LU17_00192_005	22173	1			
FR6	France	LU17_00192_006	22201	0			
FR7	France	LU17_00192_007	22290	2			

FR8	France	LU17_00192_008	22295	0			
FR9	France	LU17_00192_009	22354	0			
FR10	France	LU17_00192_010	22374	2			
FR11	France	LU17_00192_011	22400	0			
FR12	France	LU17_00192_012	22461	0			
FR13	France	LU17_00192_013	22497	0			
FR14	France	LU17_00192_014	22503	0			
FR15	France	LU17_00192_015	22506	0			
FR16	France	LU17_00192_016	22675	0			
FR17	France	LU17_00192_017	22797	0			
FR18	France	LU17_00192_018	22843	0			
FR19	France	LU17_00192_019	22940	0			
FR20	France	LU17_00192_020	22950	0			
FR21	France	LU17_00192_021	23135	0			
FR22	France	LU17_00192_022	23217	0			
FR23	France	LU17_00192_023	23219	0			
FR24	France	LU17_00192_024	23223	0			
FR25	France	LU17_00192_025	23245	0			
FR26	France	LU17_00192_026	23257	0			
FR27	France	LU17_00192_027	23262	1			
FR28	France	LU17_00192_028	23453	0			
FR29	France	LU17_00192_029	23533	0			
FR30	France	LU17_00192_030	23693	0			
FR31	France	LU17_00192_031	23771	0			
FR32	France	LU17_00192_032	23811	0			
FR33	France	LU17_00192_033	23813	1			
FR34	France	LU17_00192_034	24038	0			
FR35	France	LU17_00192_035	24100	0			
FR36	France	LU17_00192_036	24191	0			
FR37	France	LU17_00192_037	24230	0			
FR38	France	LU17_00192_038	24236	0			
FR39	France	LU17_00192_039	24280	0			
FR40	France	LU17_00192_040	24284	0			
FR41	France	LU17_00192_041	24418	0			
FR42	France	LU17_00192_042	24432	0			
FR43	France	LU17_00192_043	24789	0			
FR44	France	LU17_00192_044	24792	0			
FR45	France	LU17_00192_045	24845	1			

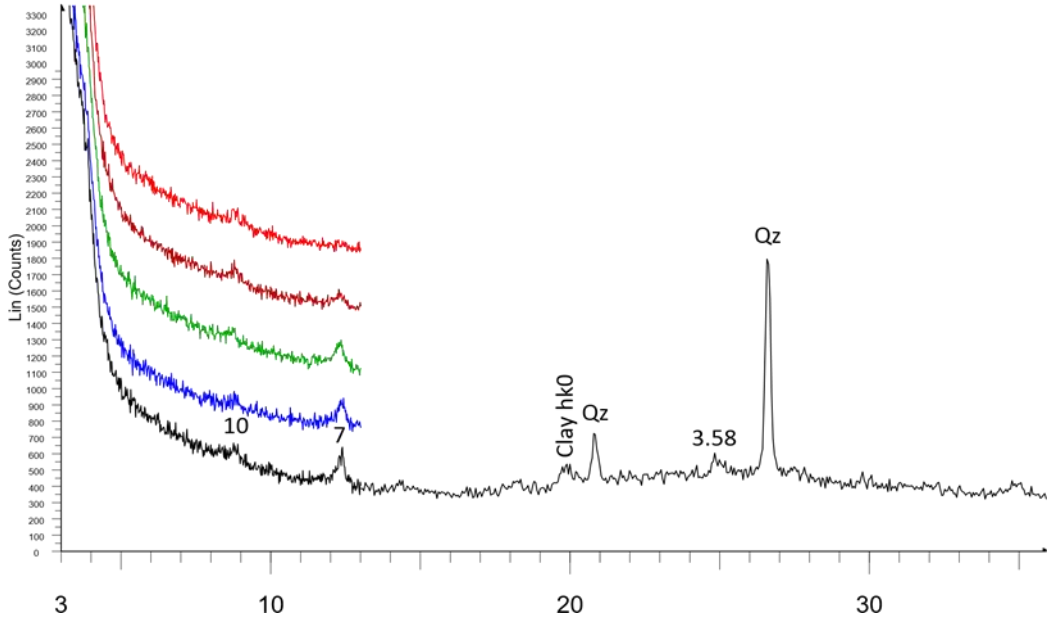
FR46	France	LU17_00192_046	24911	0			
FR47	France	LU17_00192_047	25162	0			
FR48	France	LU17_00192_048	25456	0			
FR49	France	LU17_00192_049	25546	2			
FR51	France	LU17_00210_001	22025	2			3
FR52	France	LU17_00210_002	22144	0			1.5
FR53	France	LU17_00210_003	22190	2			3
FR54	France	LU17_00210_004	22388	3			2
FR55	France	LU17_00210_005	22459	0			3
FR56	France	LU17_00210_006	22531	0			2
FR57	France	LU17_00210_007	22833	0			1
FR58	France	LU17_00210_008	22901	2			3
FR59	France	LU17_00210_009	24228	0			2
FR60	France	LU17_00210_010	24367	0			2
FR61	France	LU17_00210_011	24419	0			3
FR62	France	LU17_00210_012	24539	0			3
FR63	France	LU17_00210_013	24756	3			3
FR64	France	LU17_00210_014	24933	0			
FR65	France	LU17_00210_015	25302	0			
FR66	France	LU17_00210_016	25447	0			3
FR67	France	LU17_00210_017	25463	0			

Annex 2. RX Diffractograms from Germany

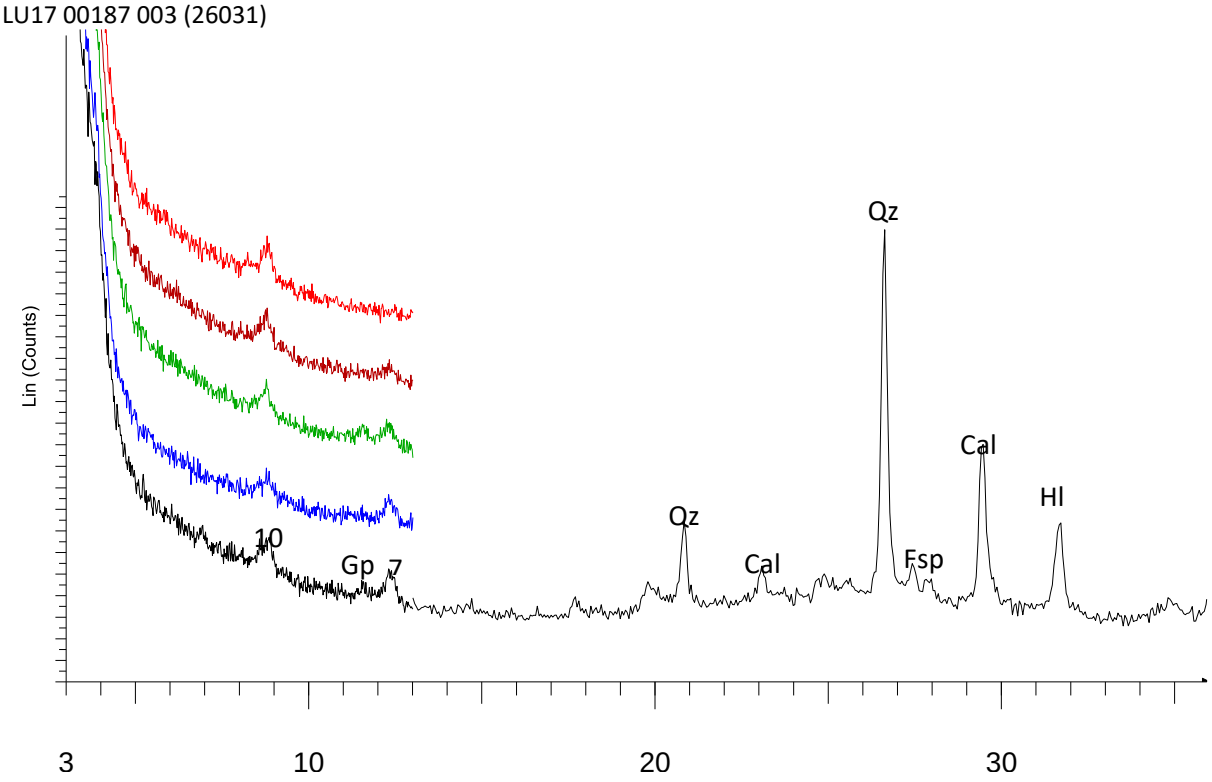
LU17 00187 001 (26003)



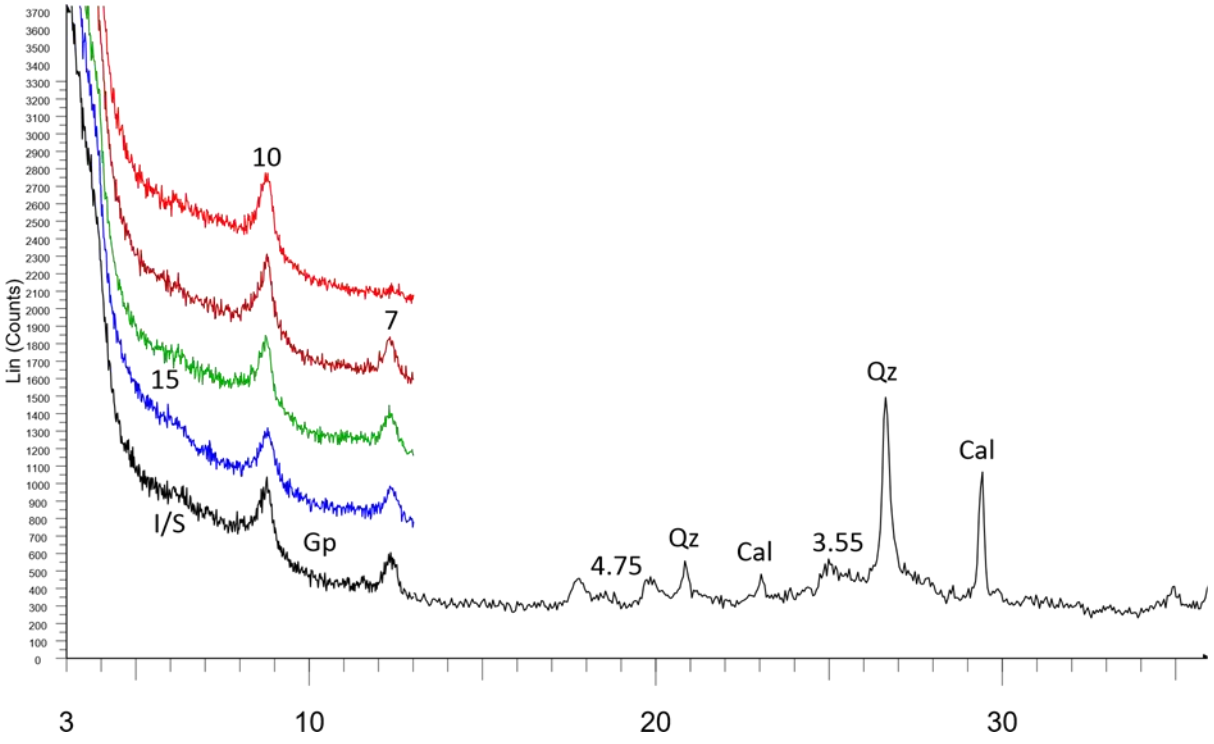
LU17 00187 002 (26008)



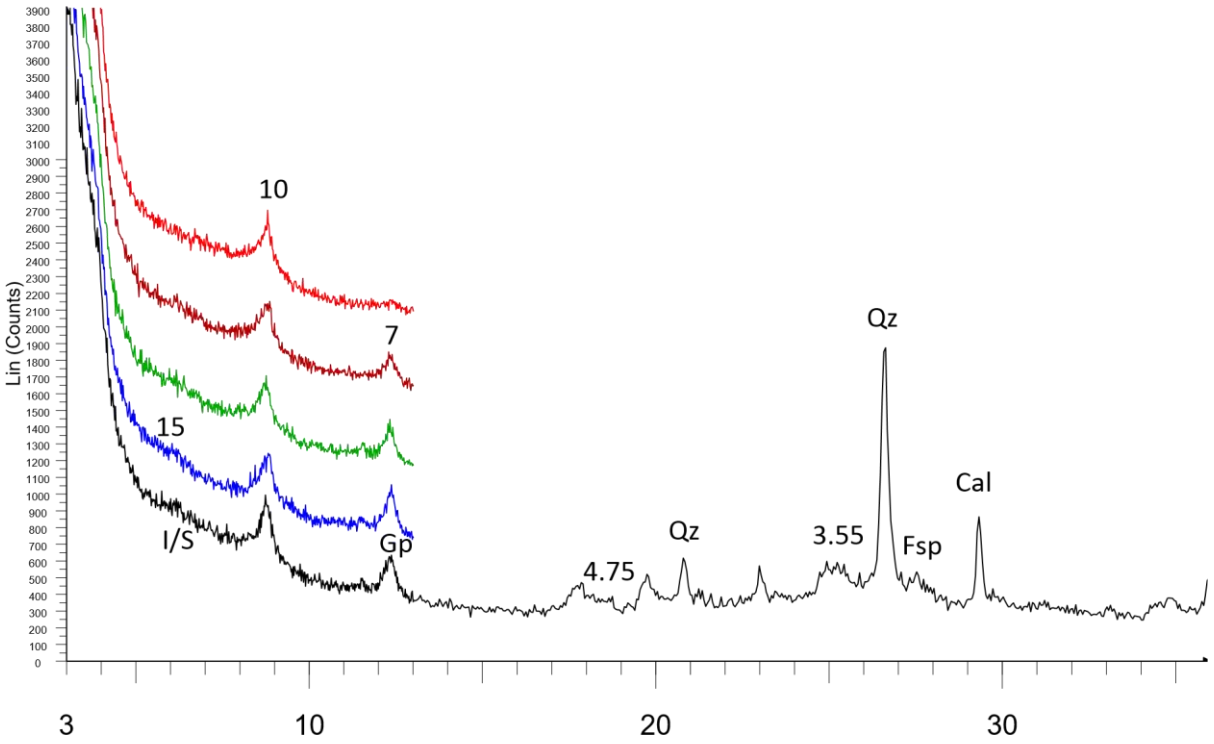
LU17 00187 003 (26031)



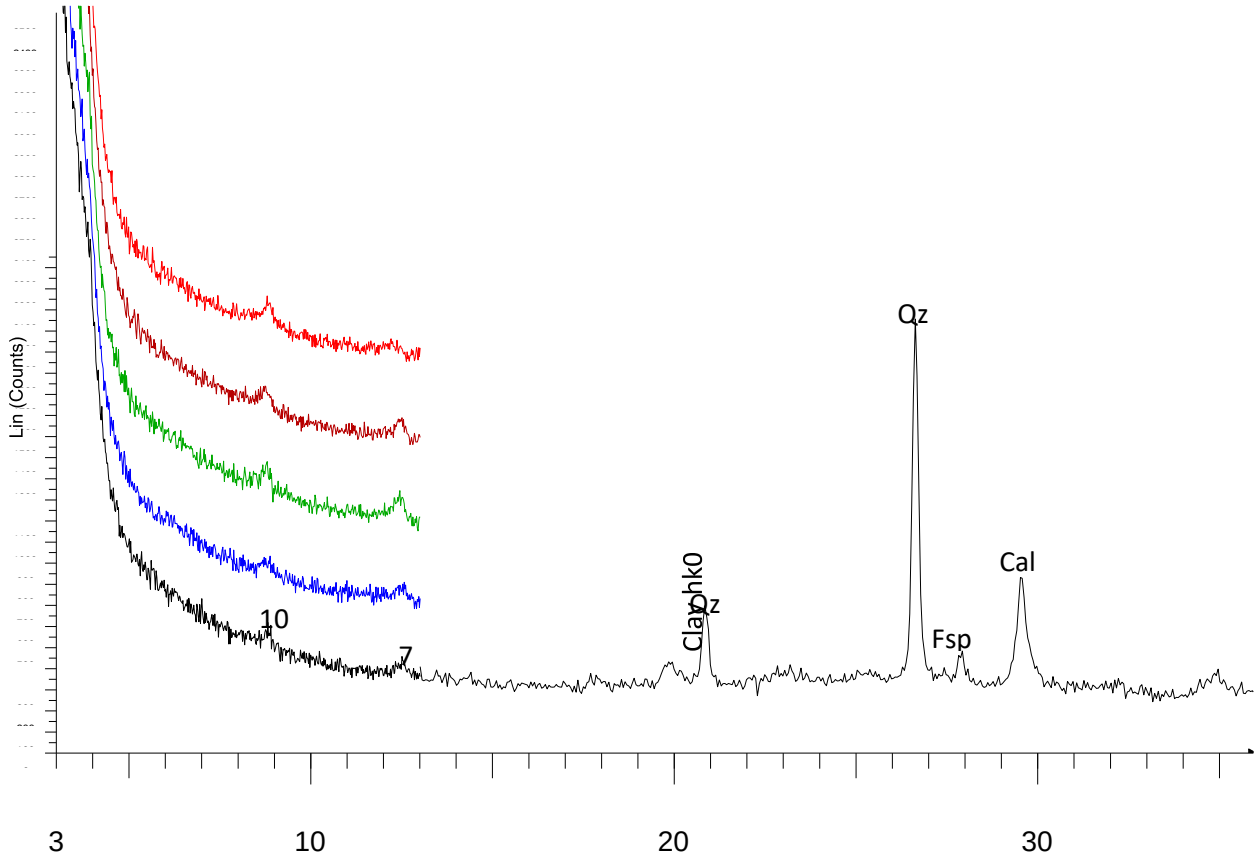
LU17 00187 004 (26078)



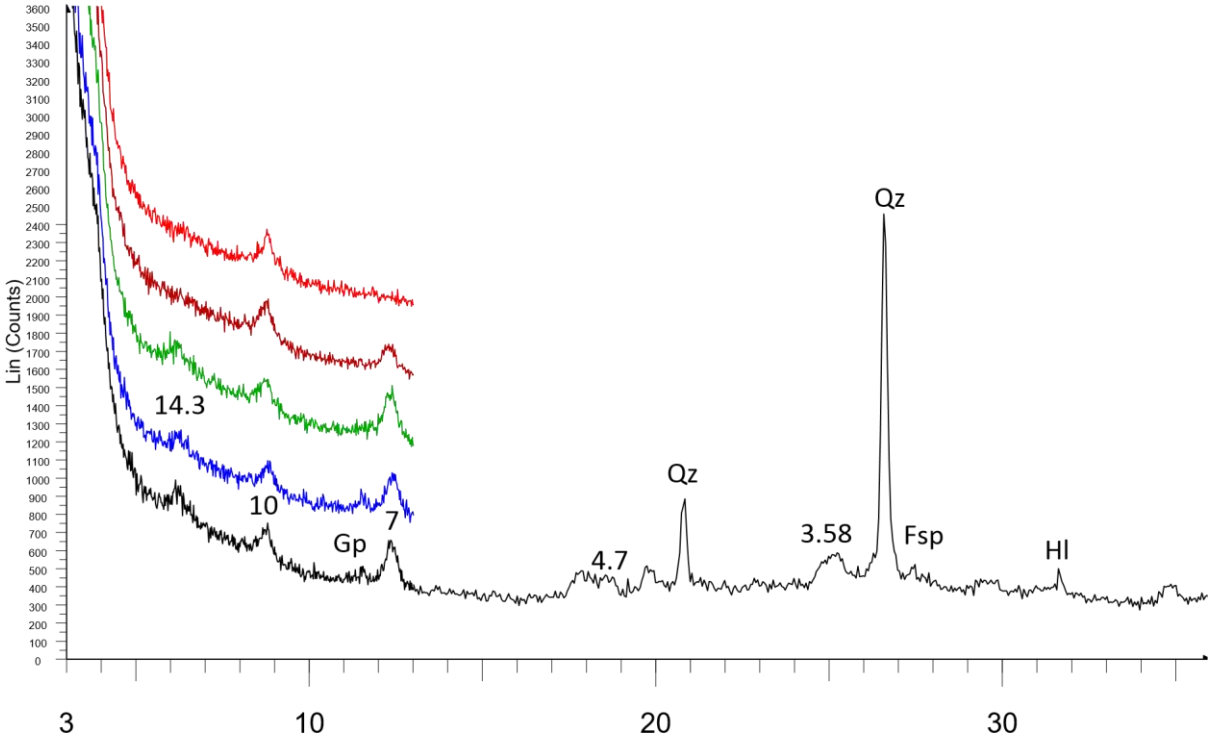
LU17 00187 005 (26135)



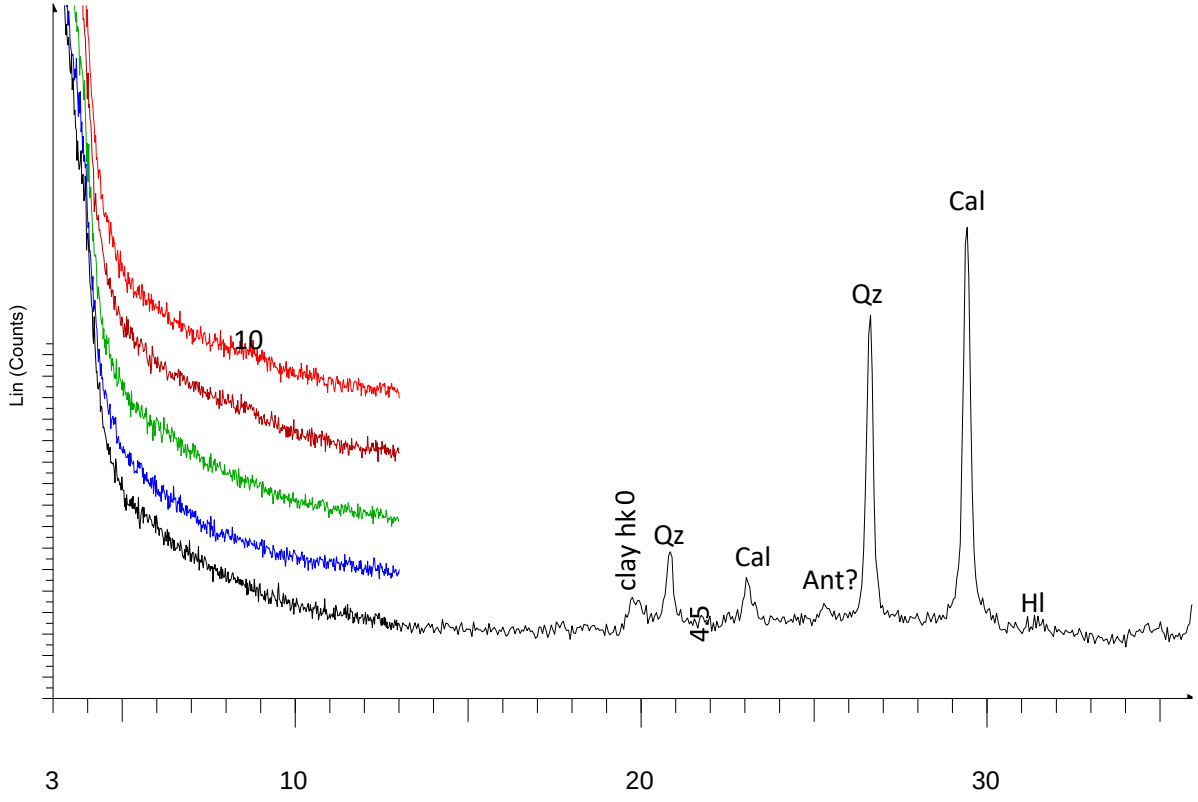
LU17 00187 006 (26310)



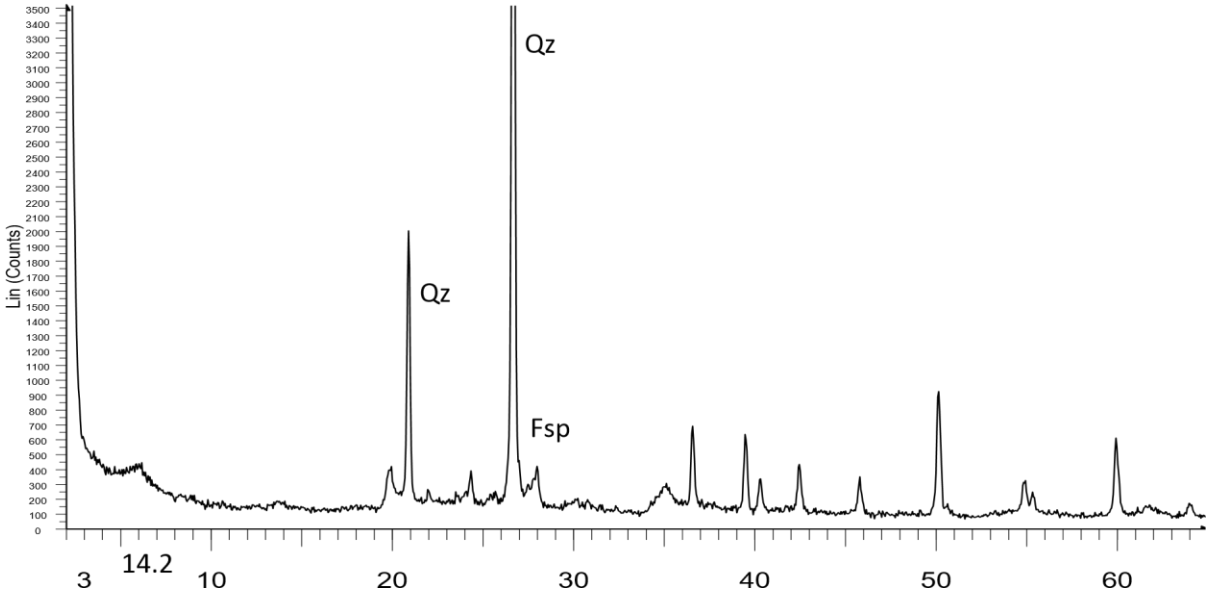
LU17 00187 007 (26333)



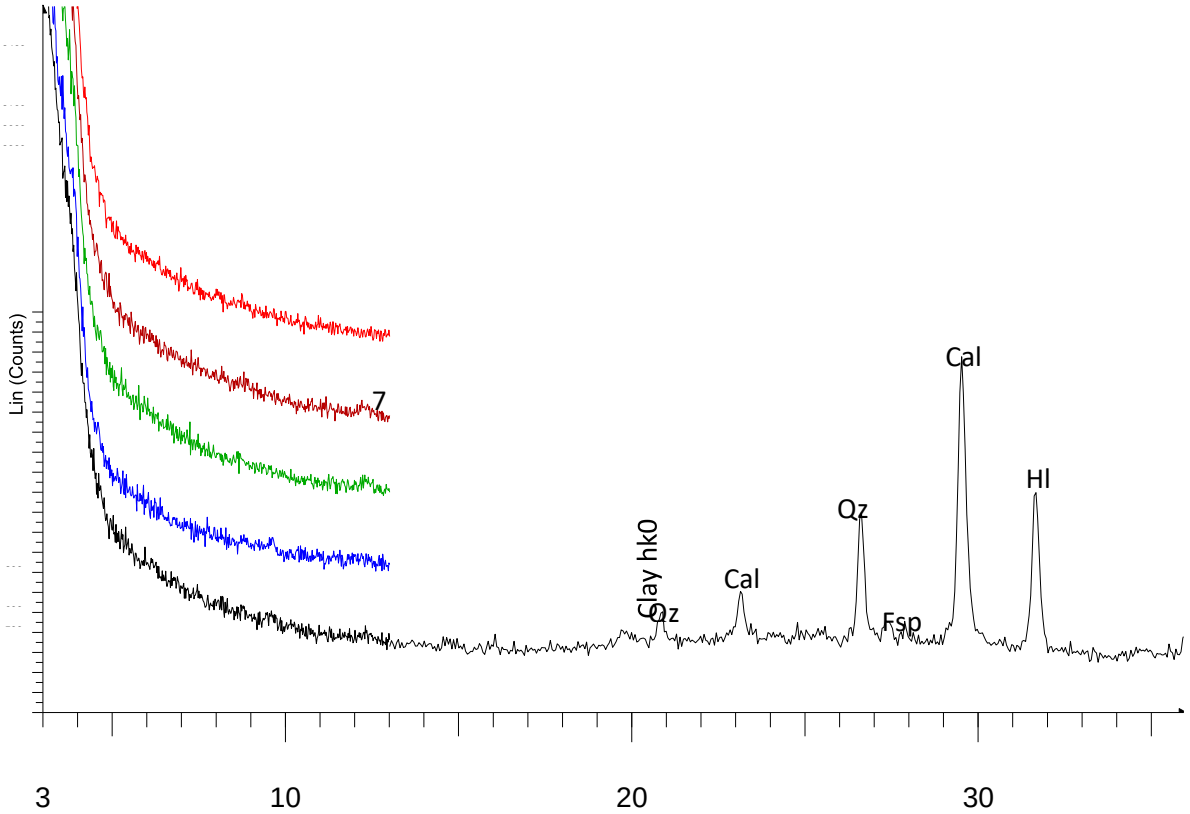
LU17 00187 008 (26416)



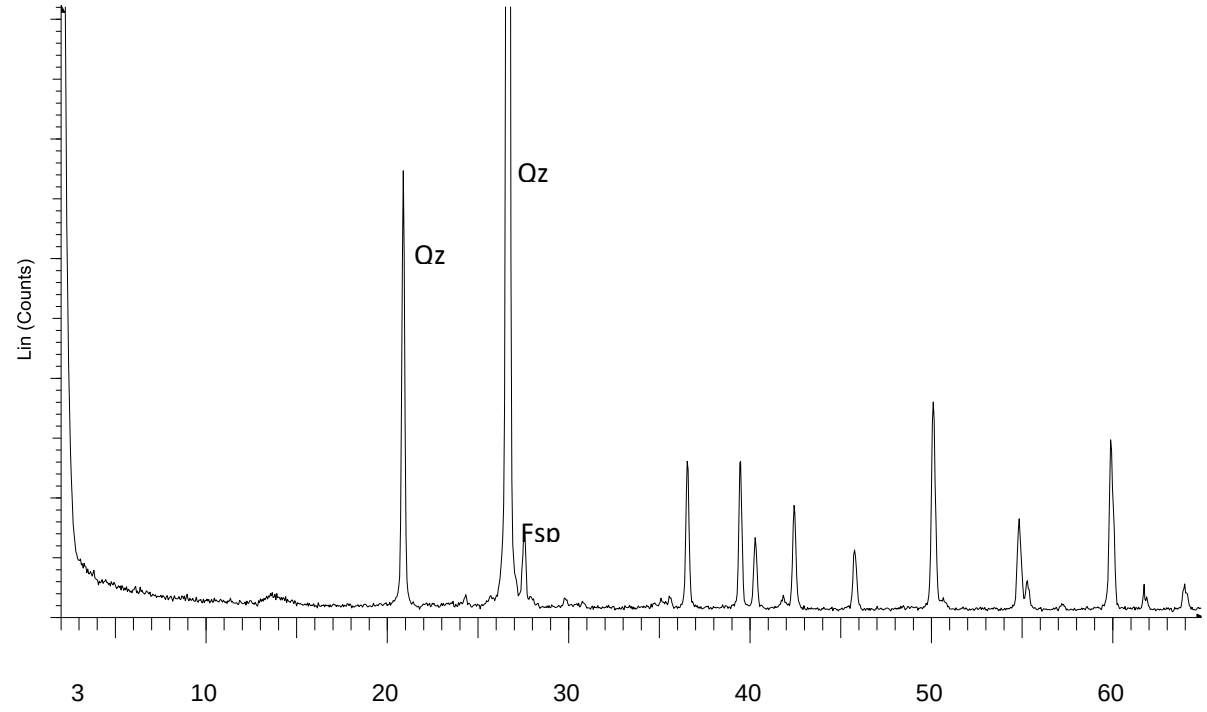
LU17 00187 008 (26416) bulk soil



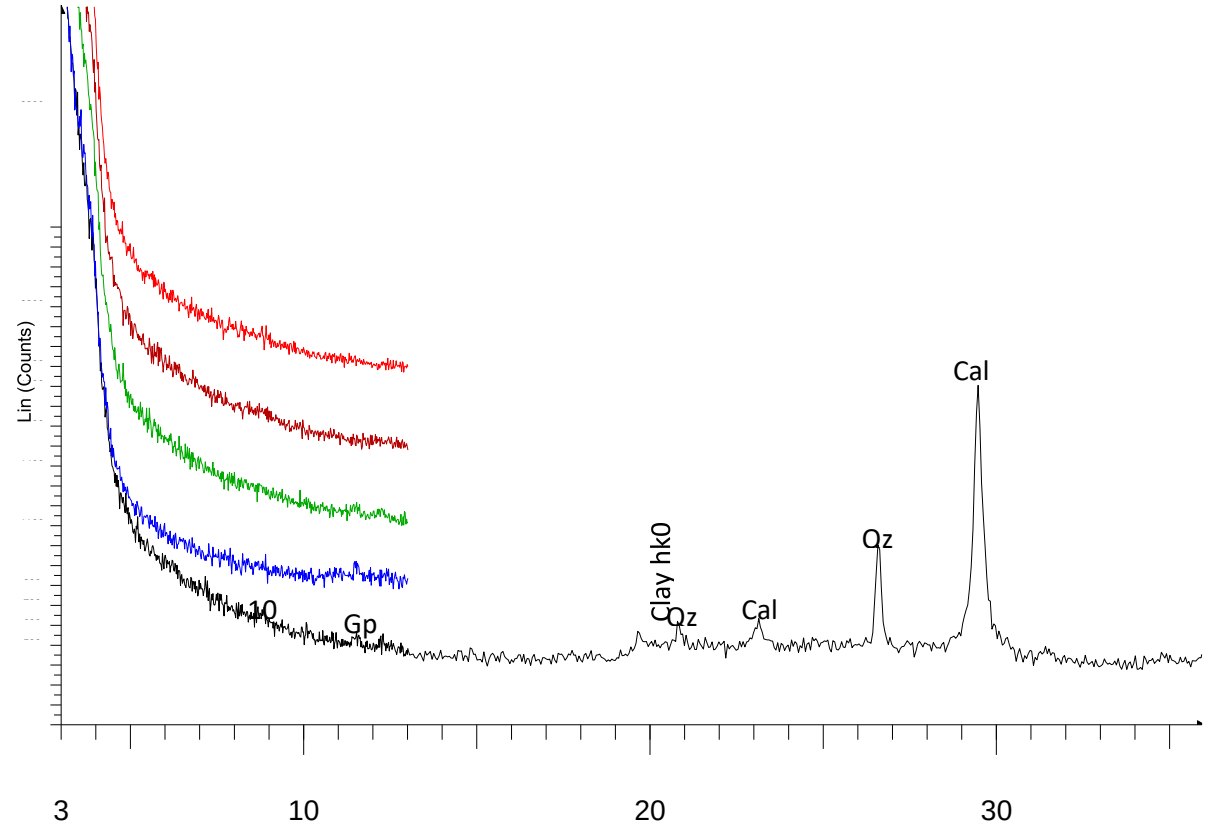
LU17 00187 009 (26481)



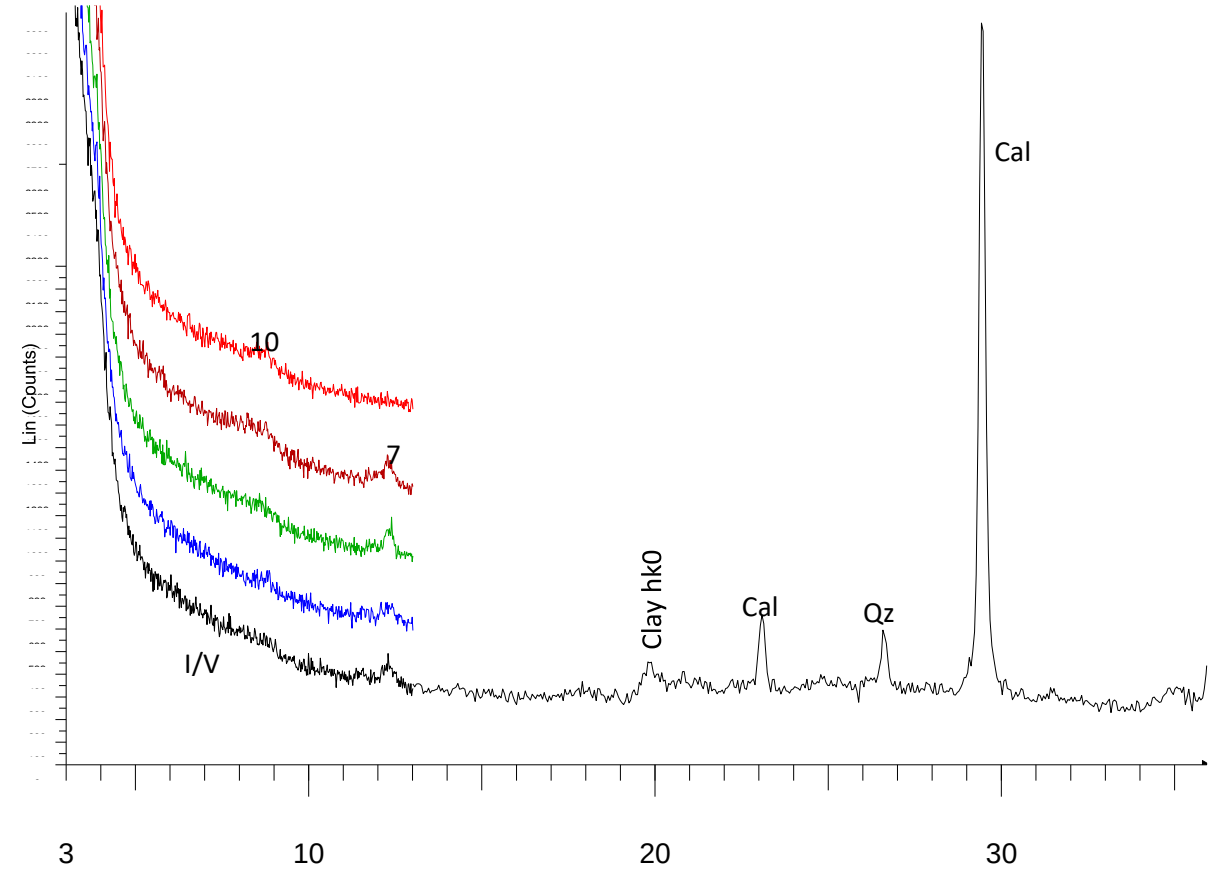
LU17 00187 009 (26481) bulk soil



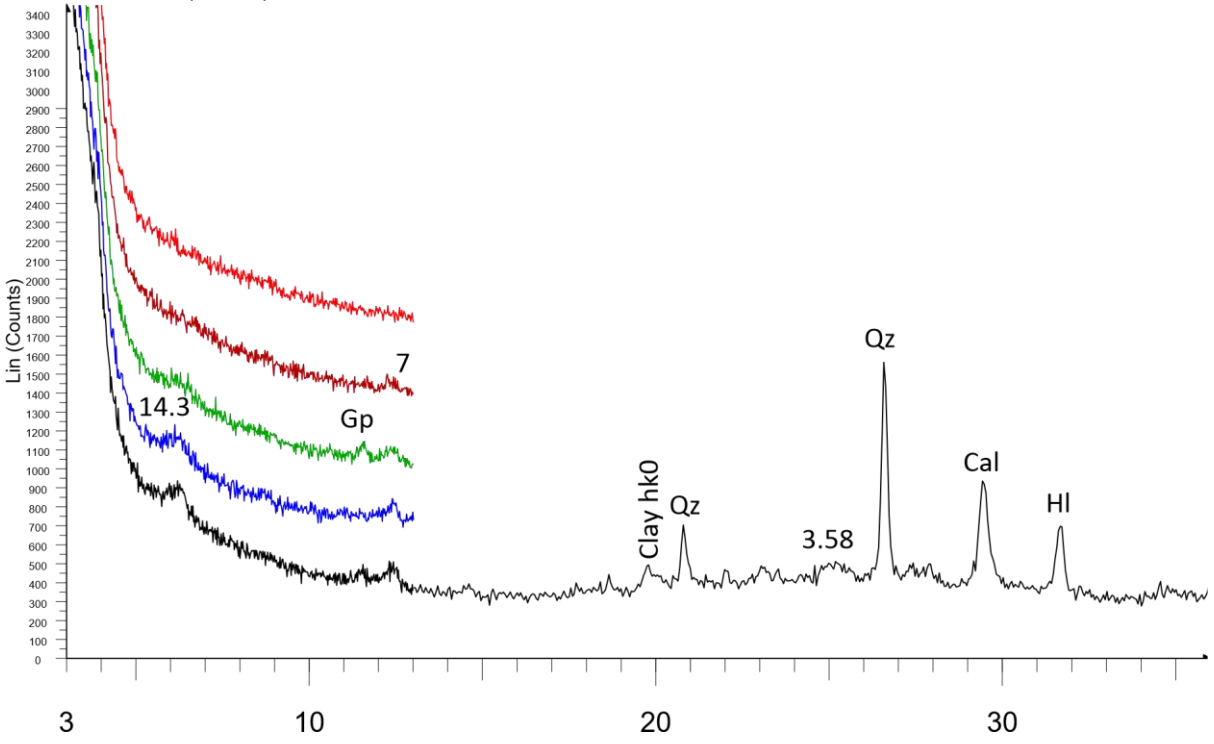
LU17 00187 010 (26572)



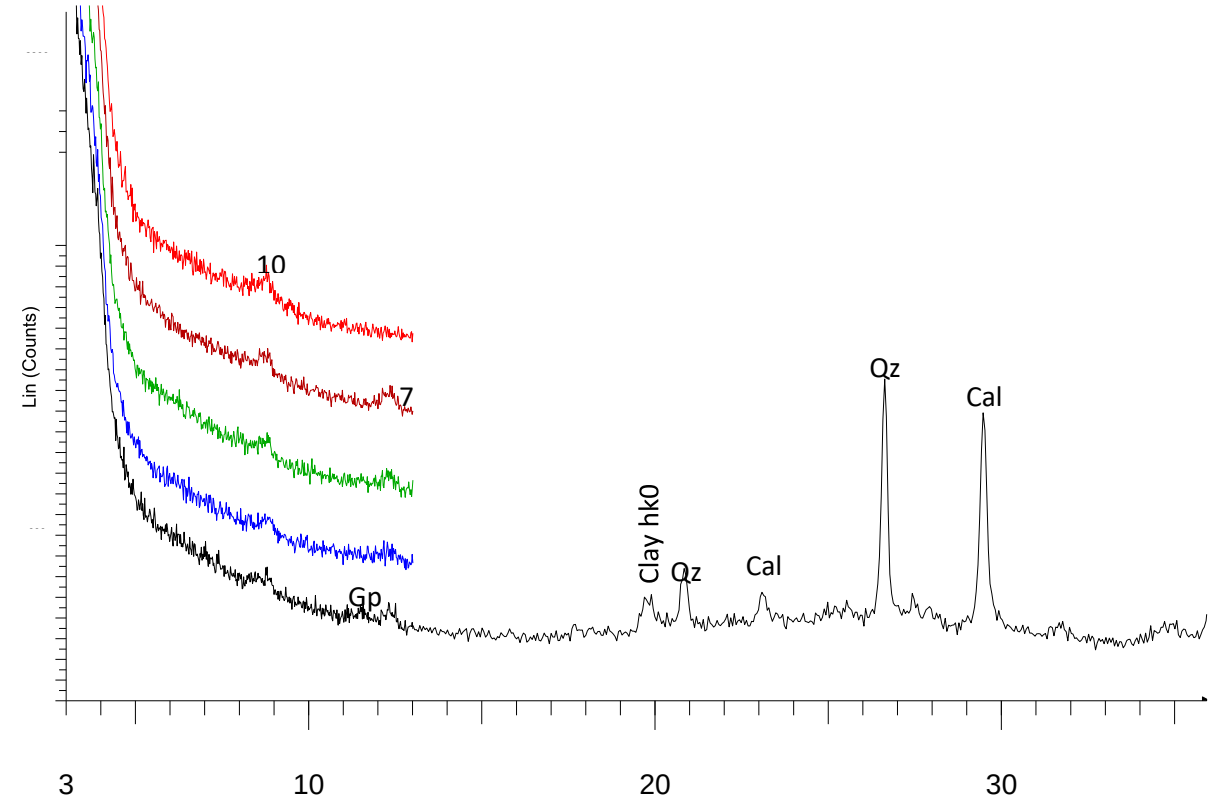
LU17 00187 011 (26578)



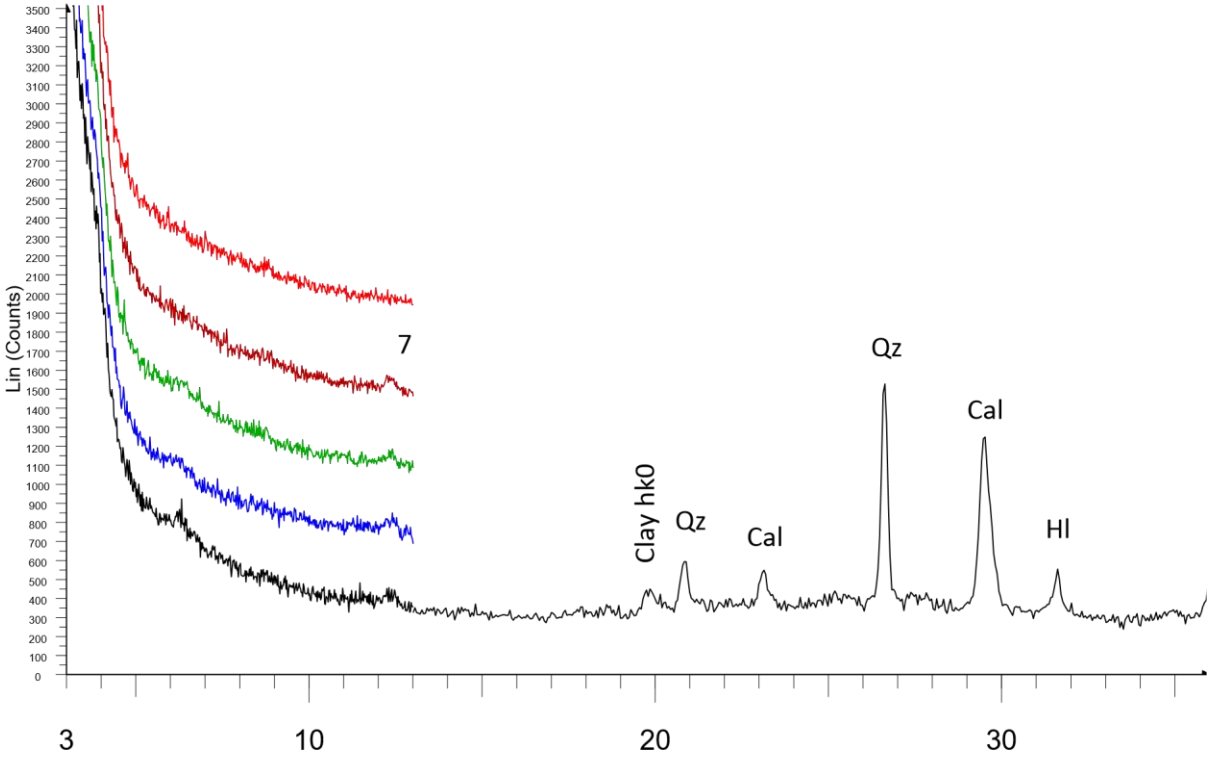
LU17 00187 012 (26800)



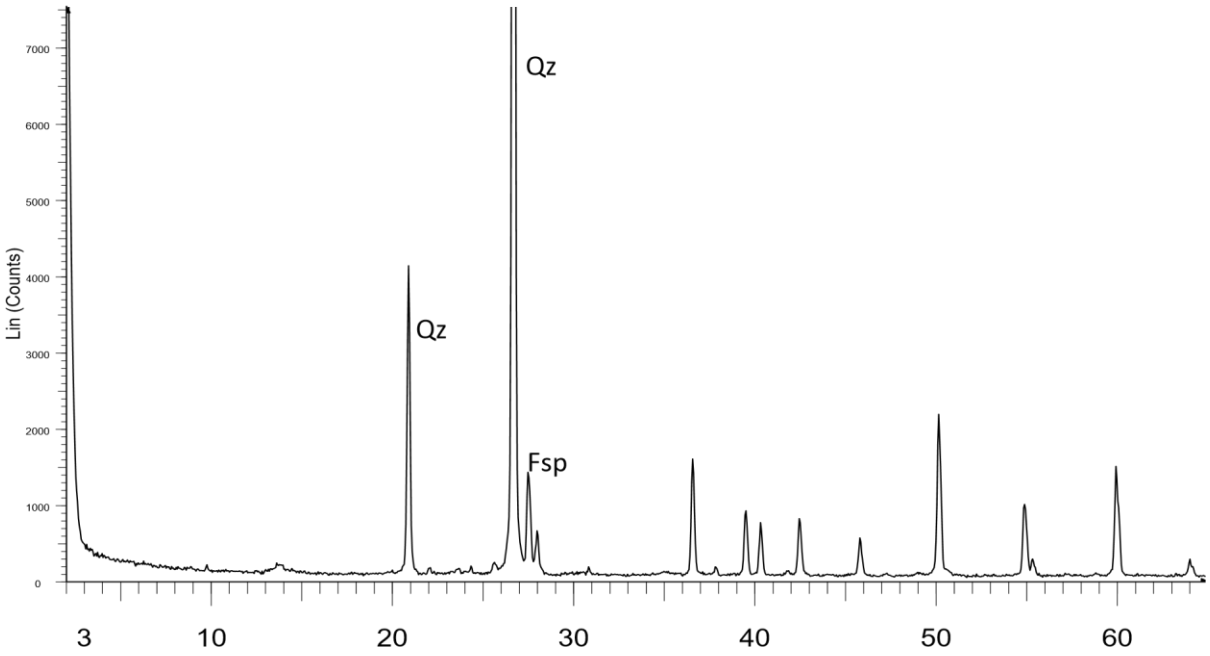
LU17 00187 013 (26803)



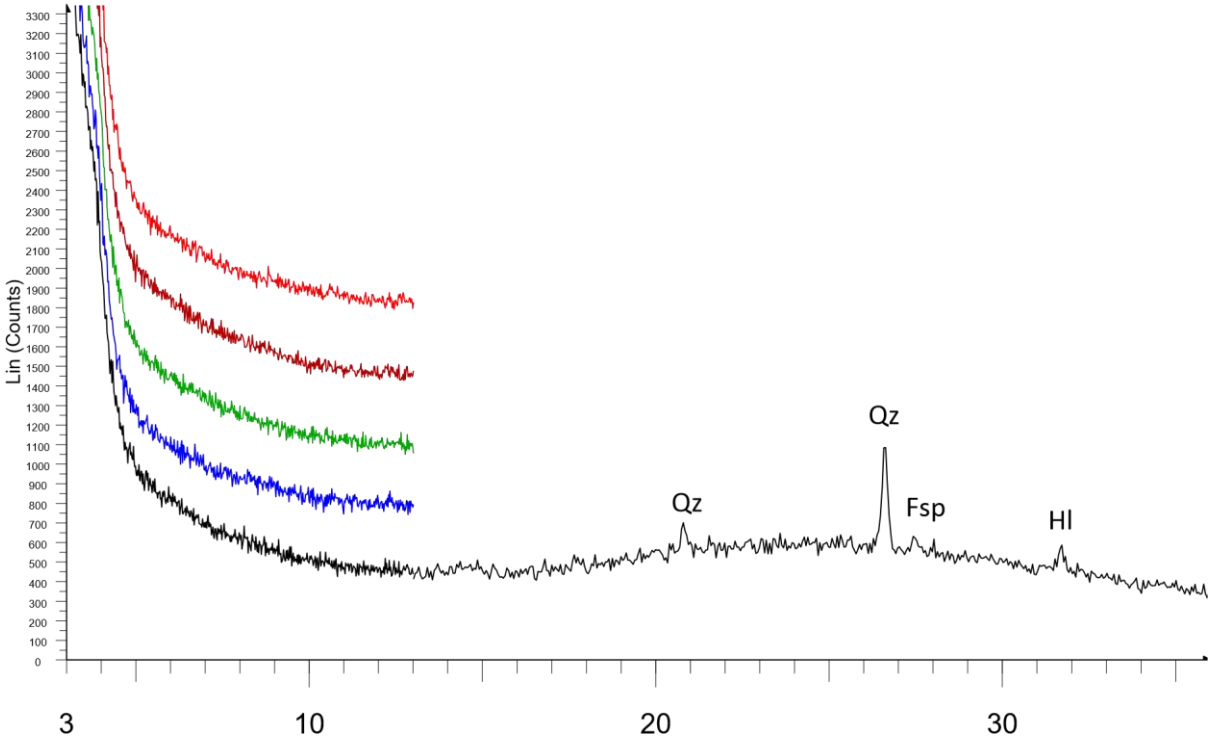
LU17 00187 014 (26889)



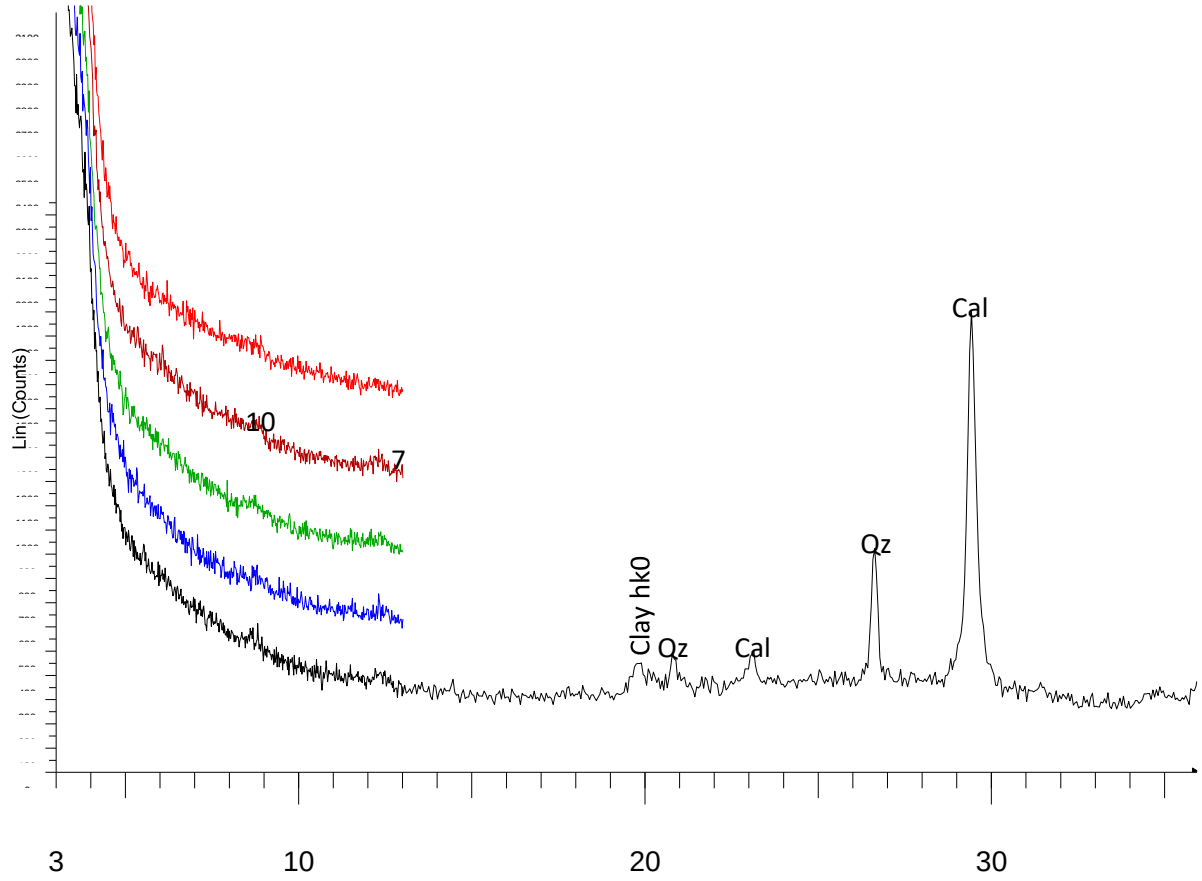
LU17 00187 014 (26889) bulk soil



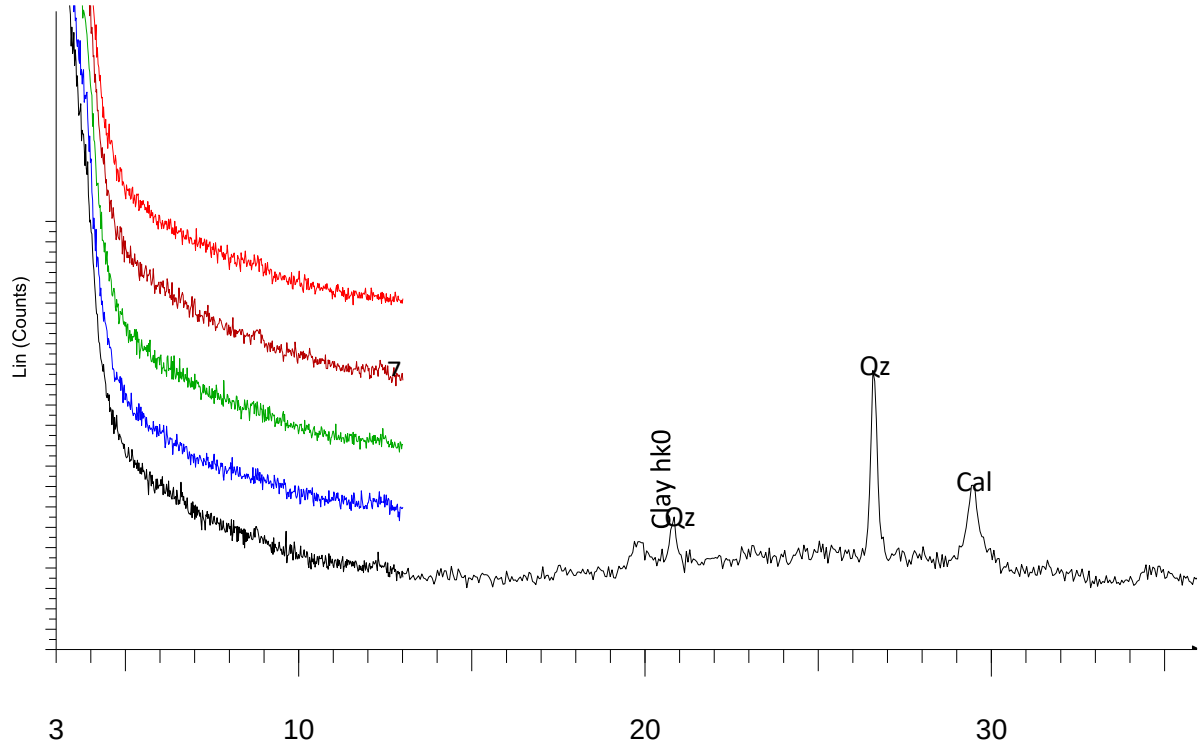
LU17 00187 015 (26900)



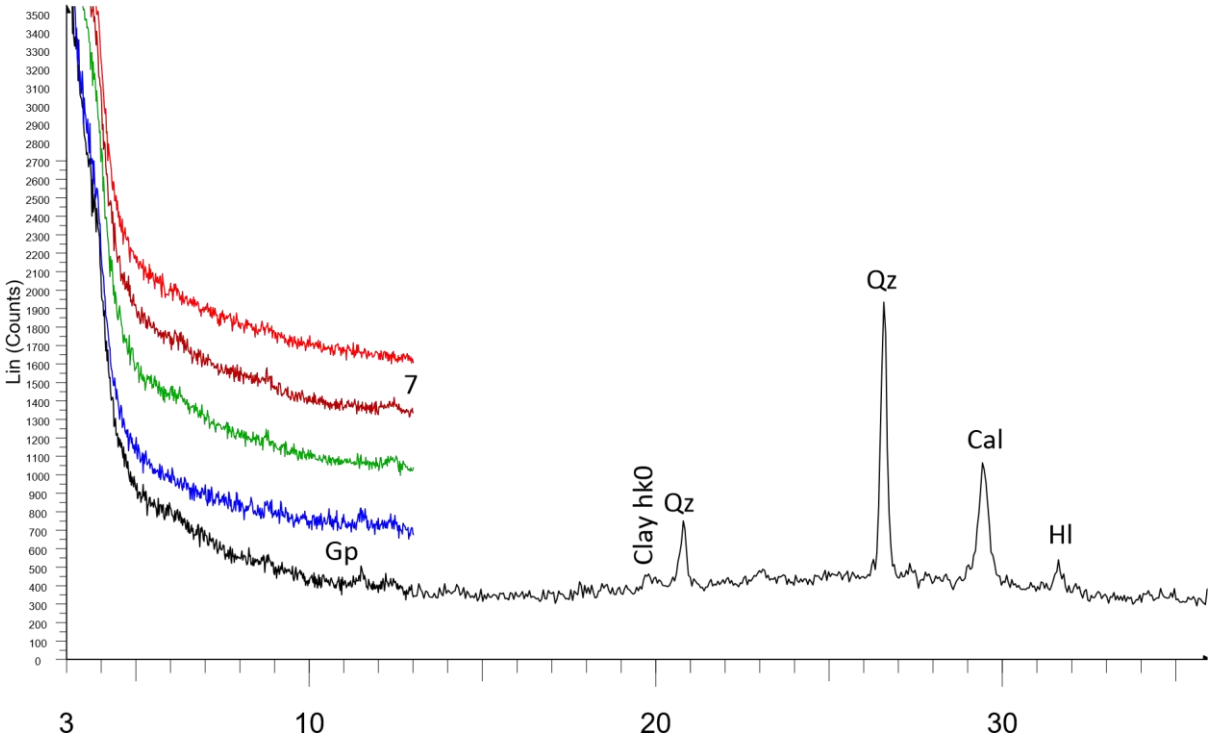
LU17 00187 016 (27047)



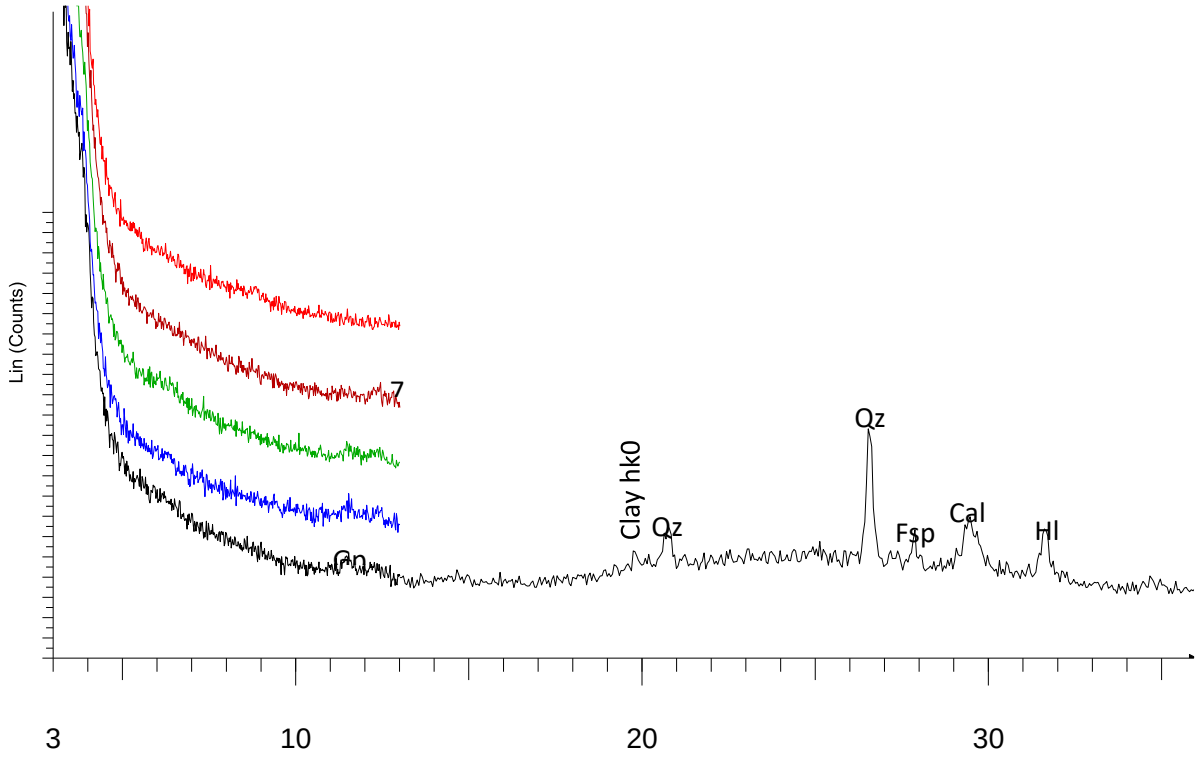
LU17 00187 017 (27201)



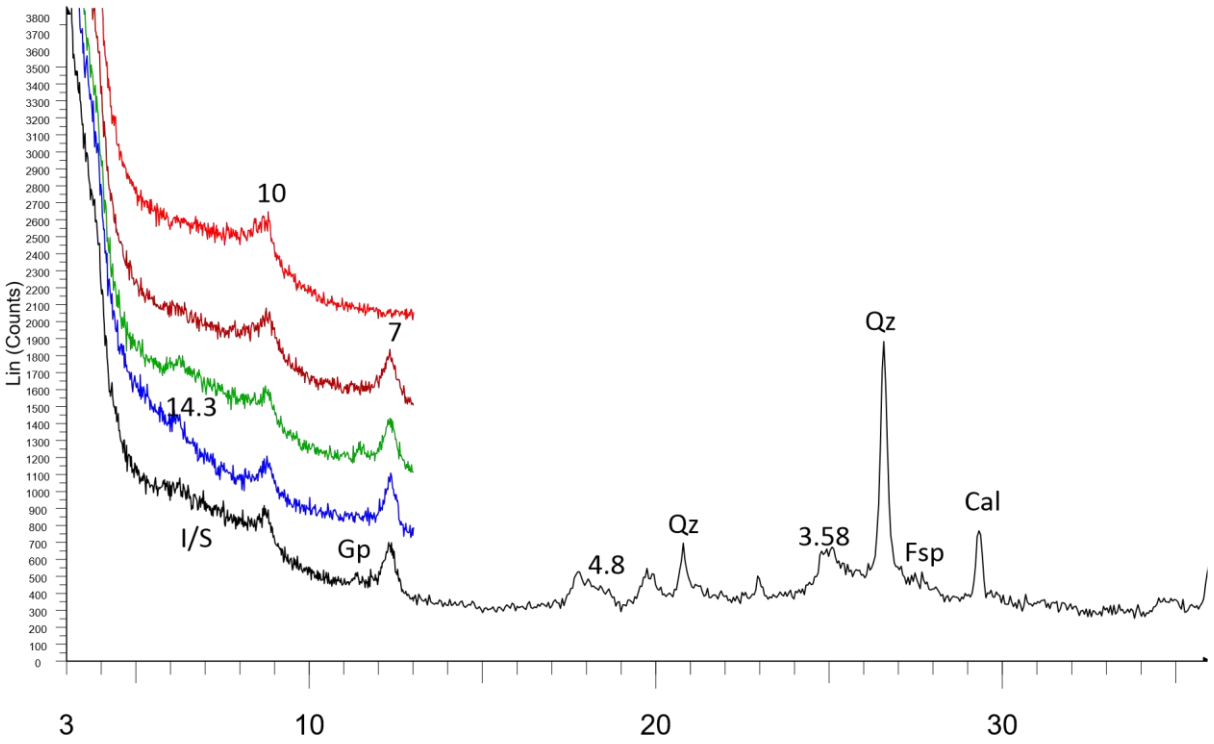
LU17 00187 018 (27211)



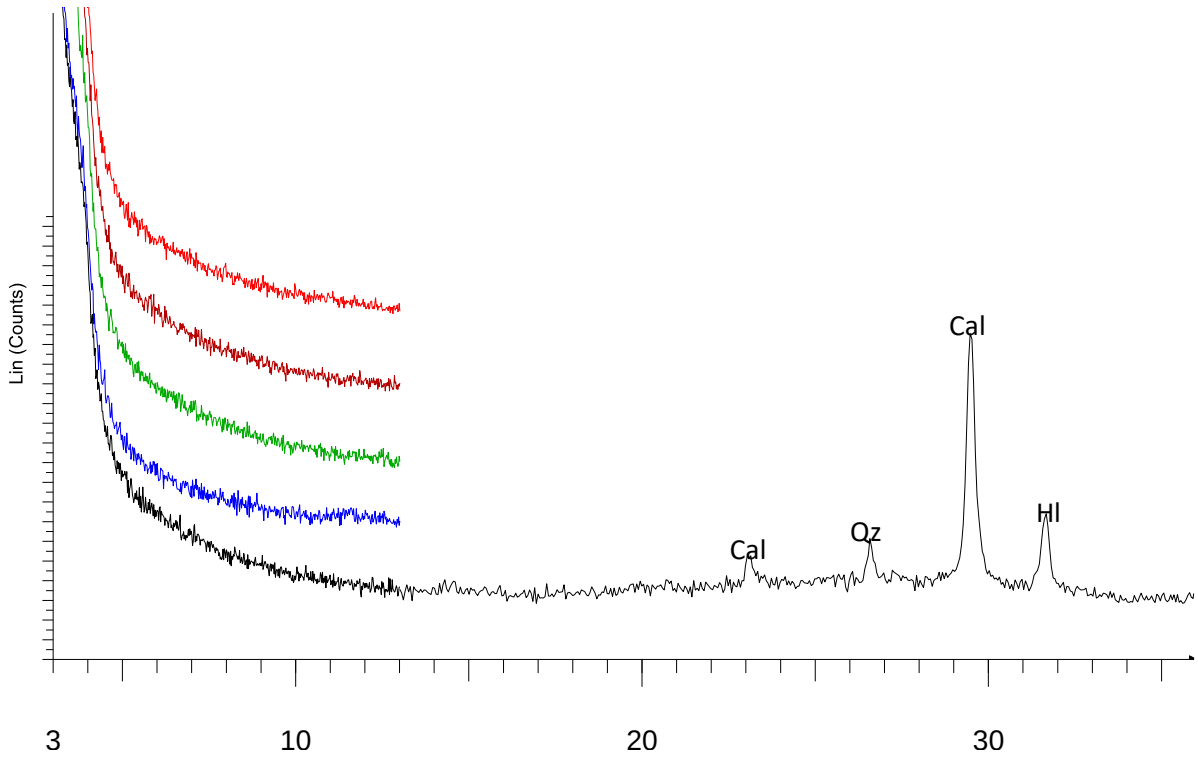
LU17 00187 019 (27243)



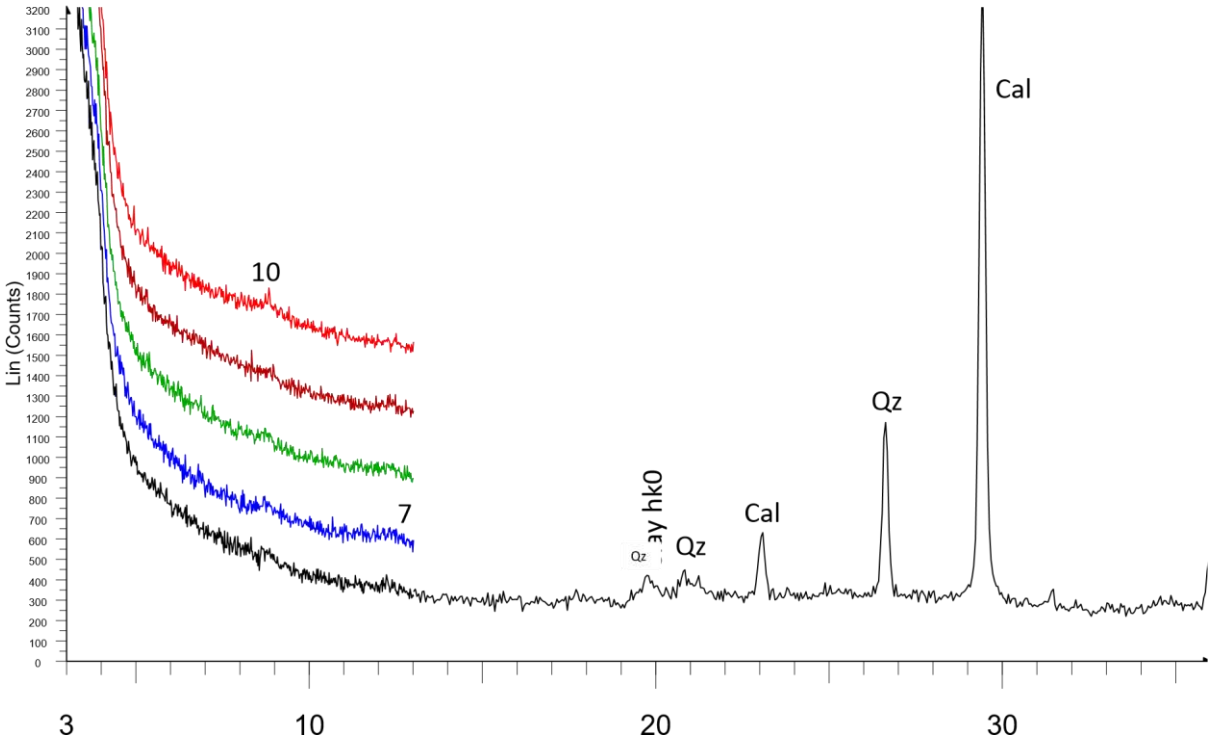
LU17 00187 020 (27361)



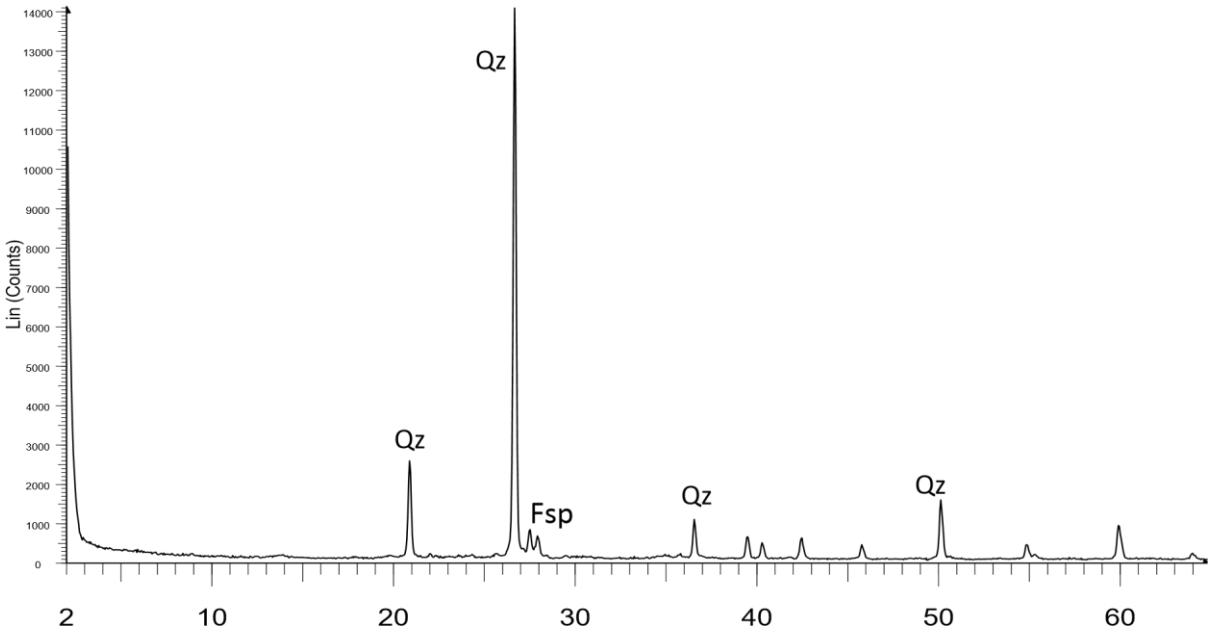
LU17 00187 021 (27466)



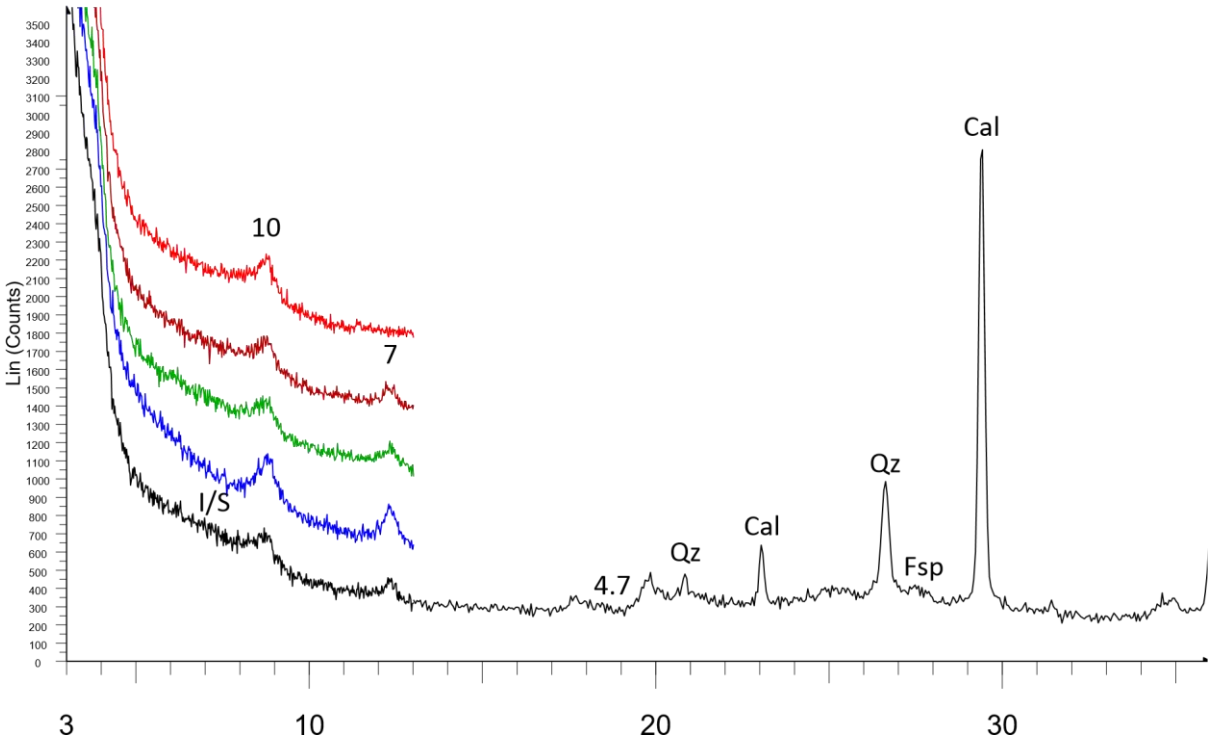
LU17 00187 022 (27543)



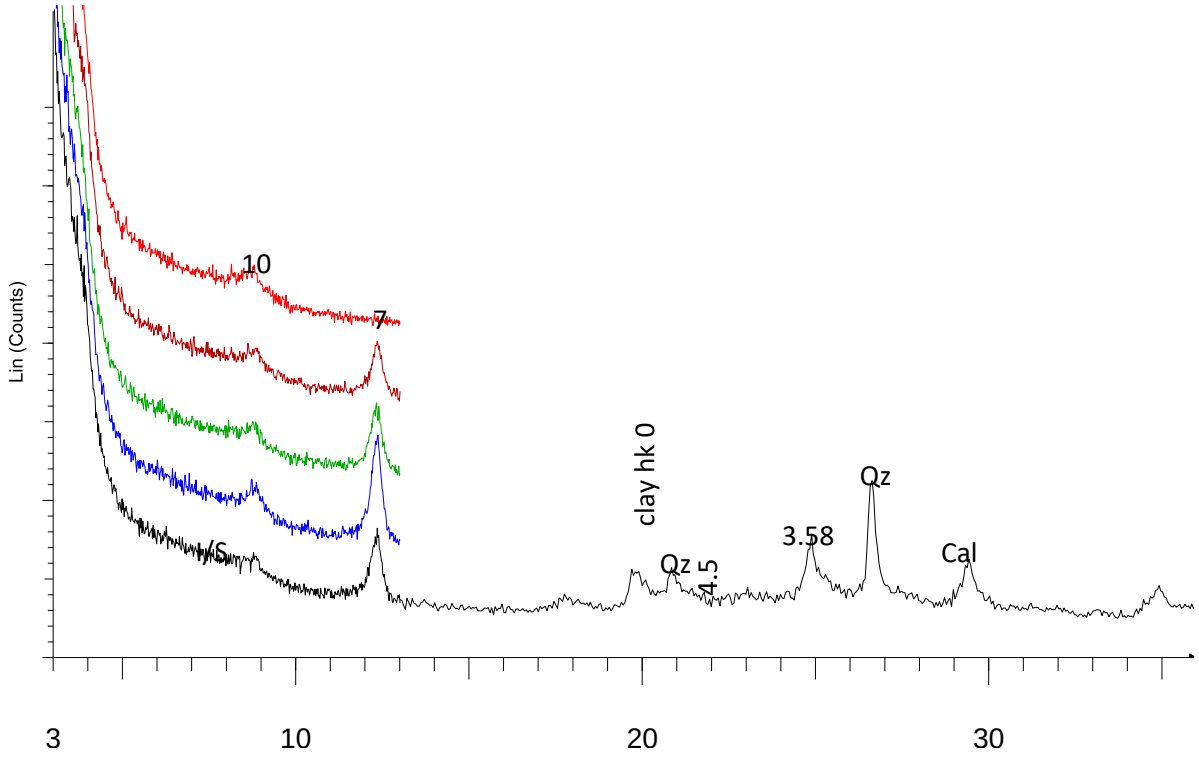
LU17 00187 022 (27543) bulk soil



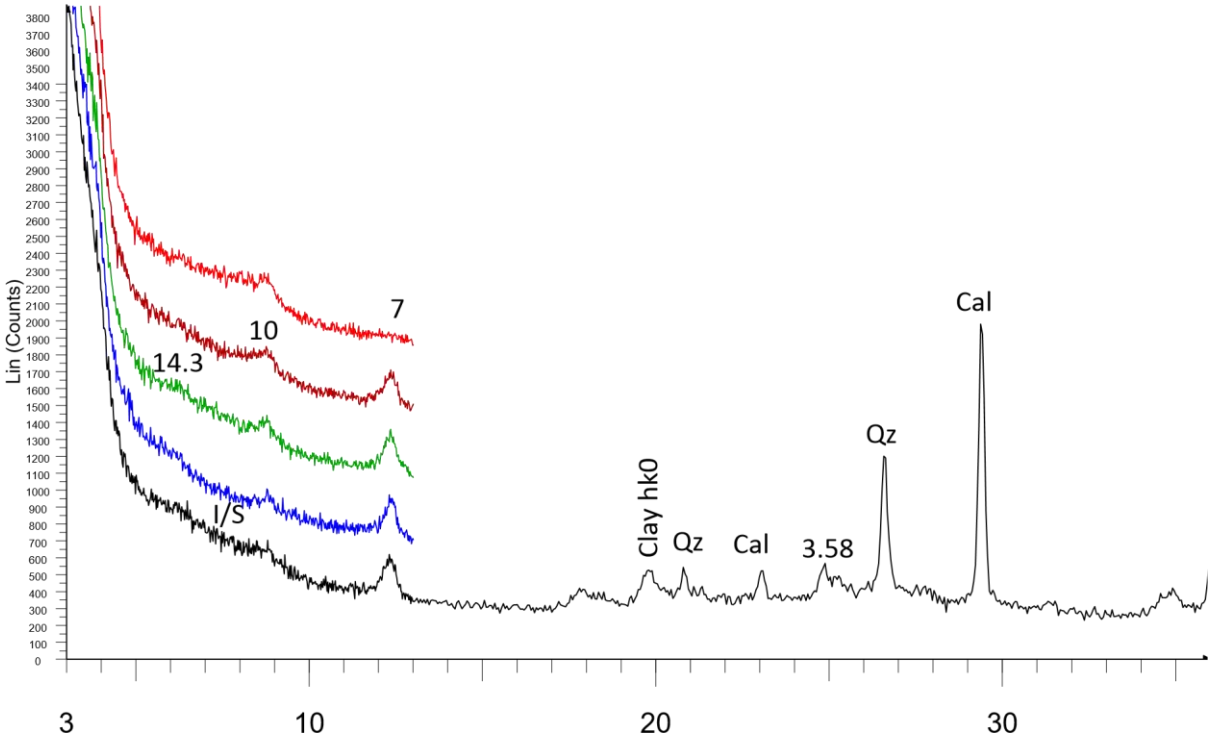
LU17 00187 023 (27565)



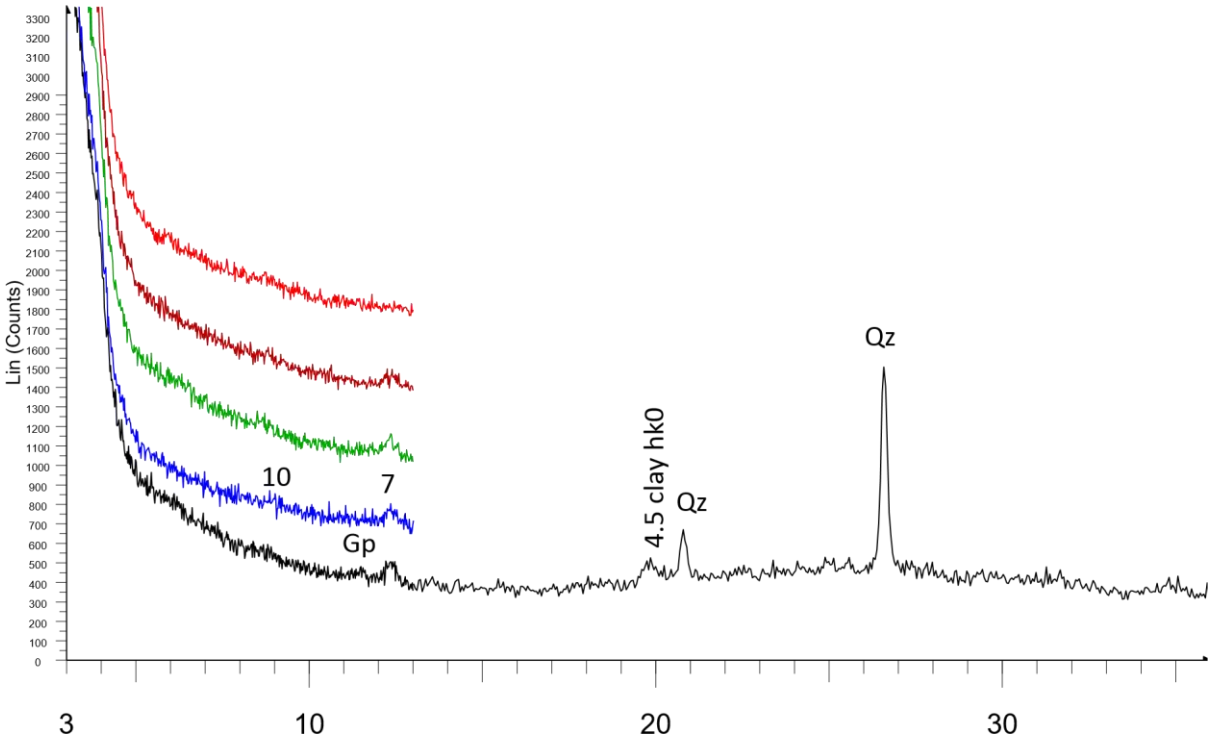
LU17 00187 024 (27663)



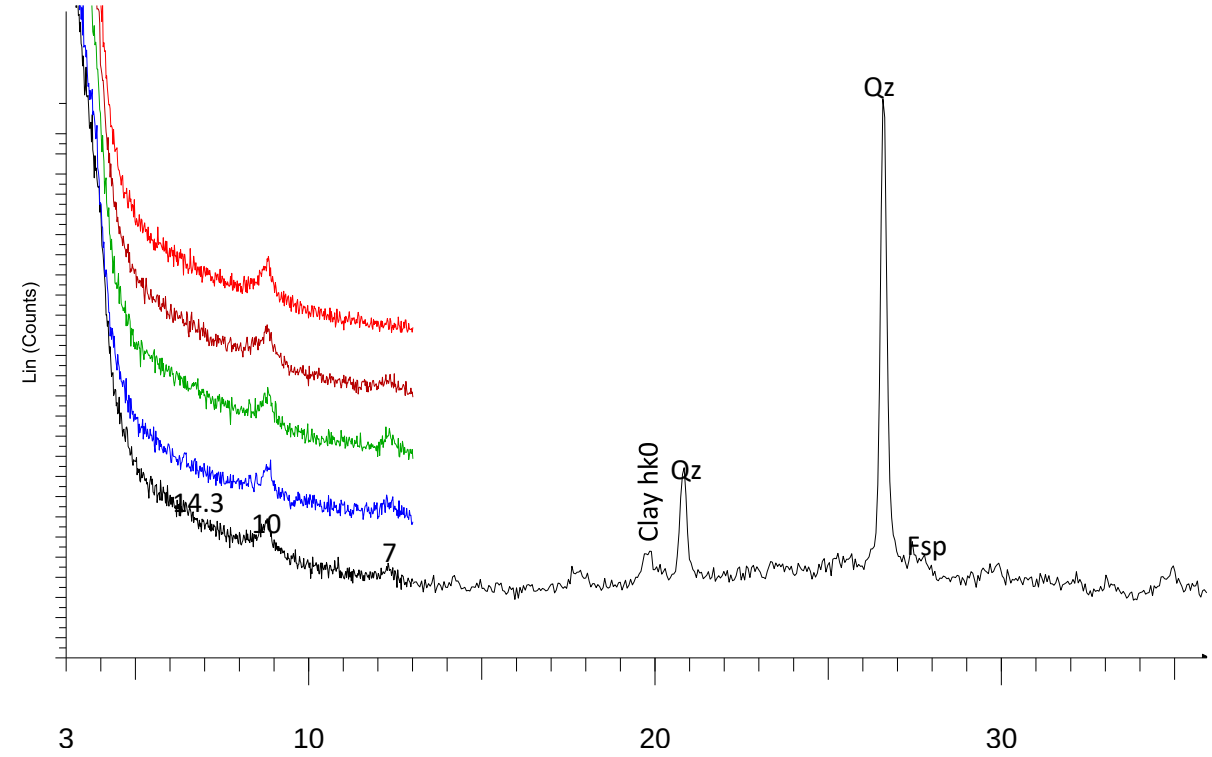
LU17 00187 025 (27724)



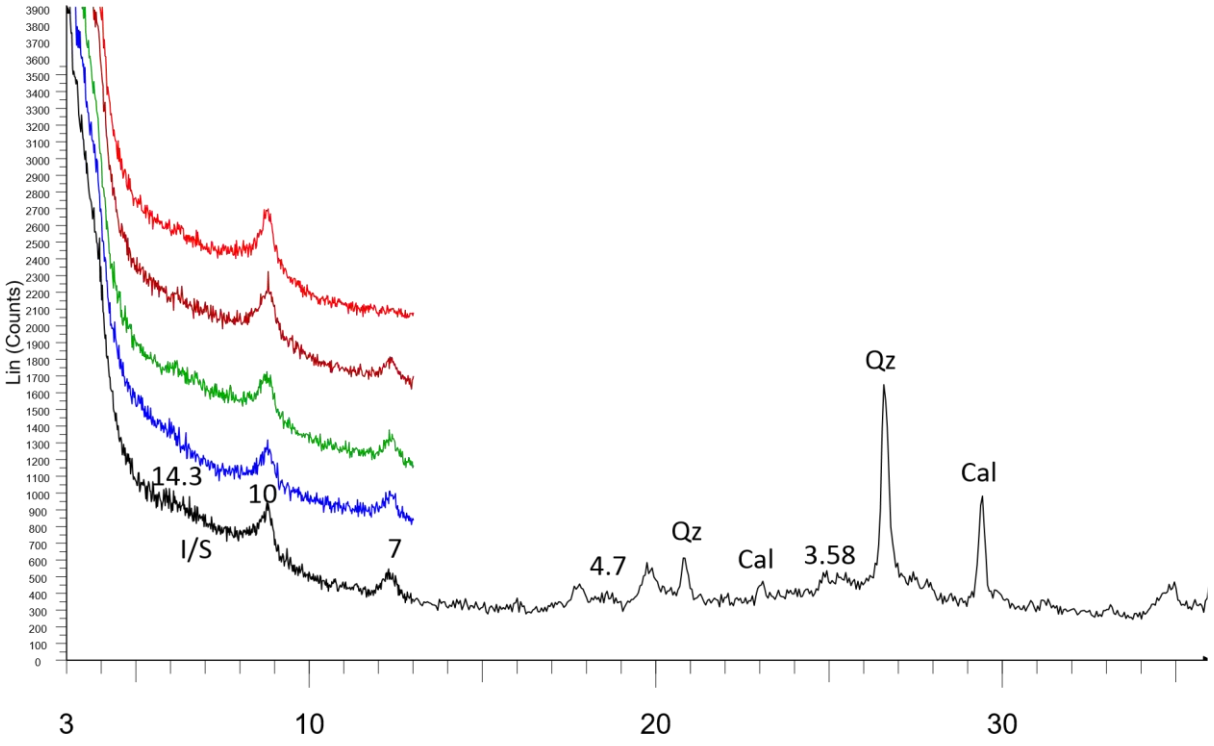
LU17 00187 026 (27839)



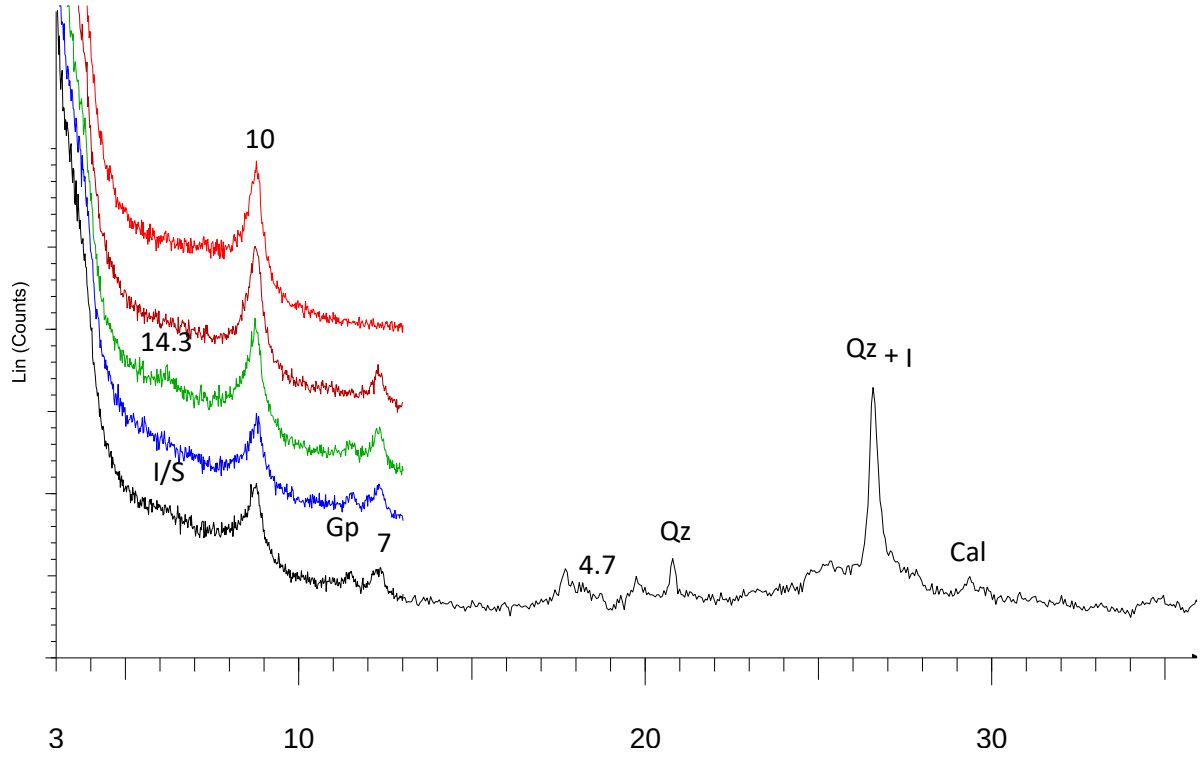
LU17 00187 027 (27942)



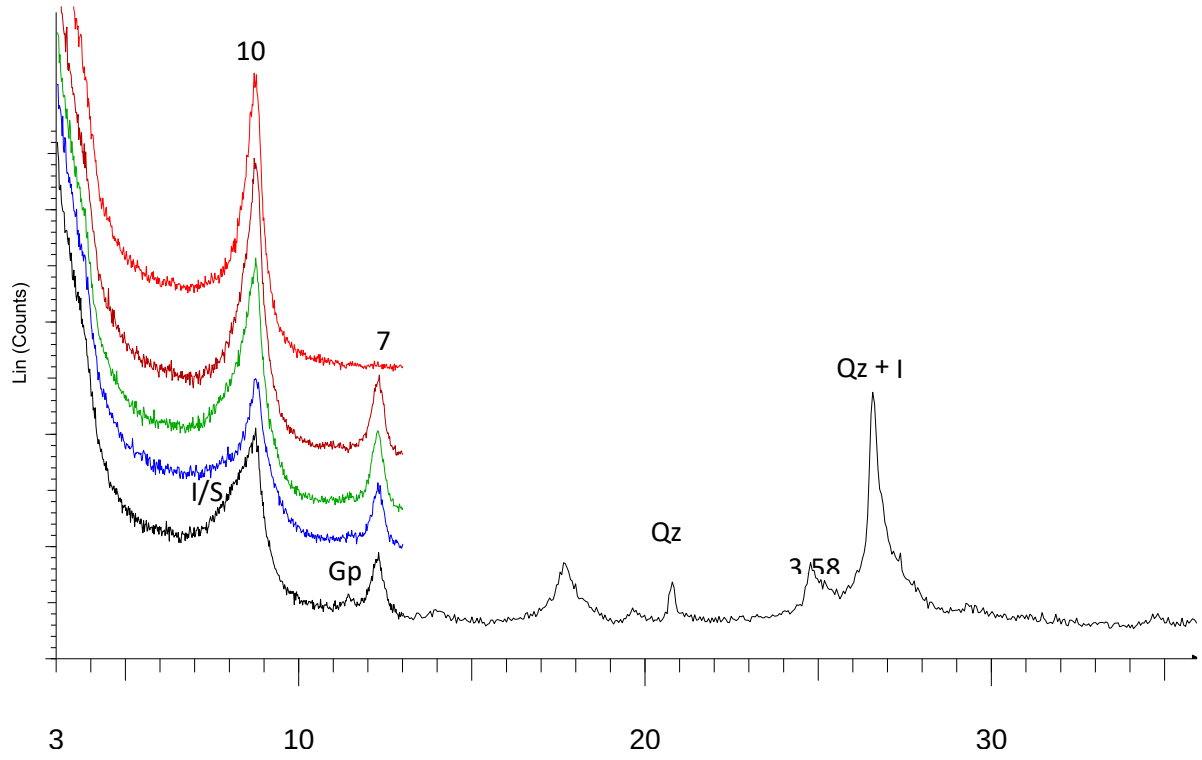
LU17 00187 028 (28012)



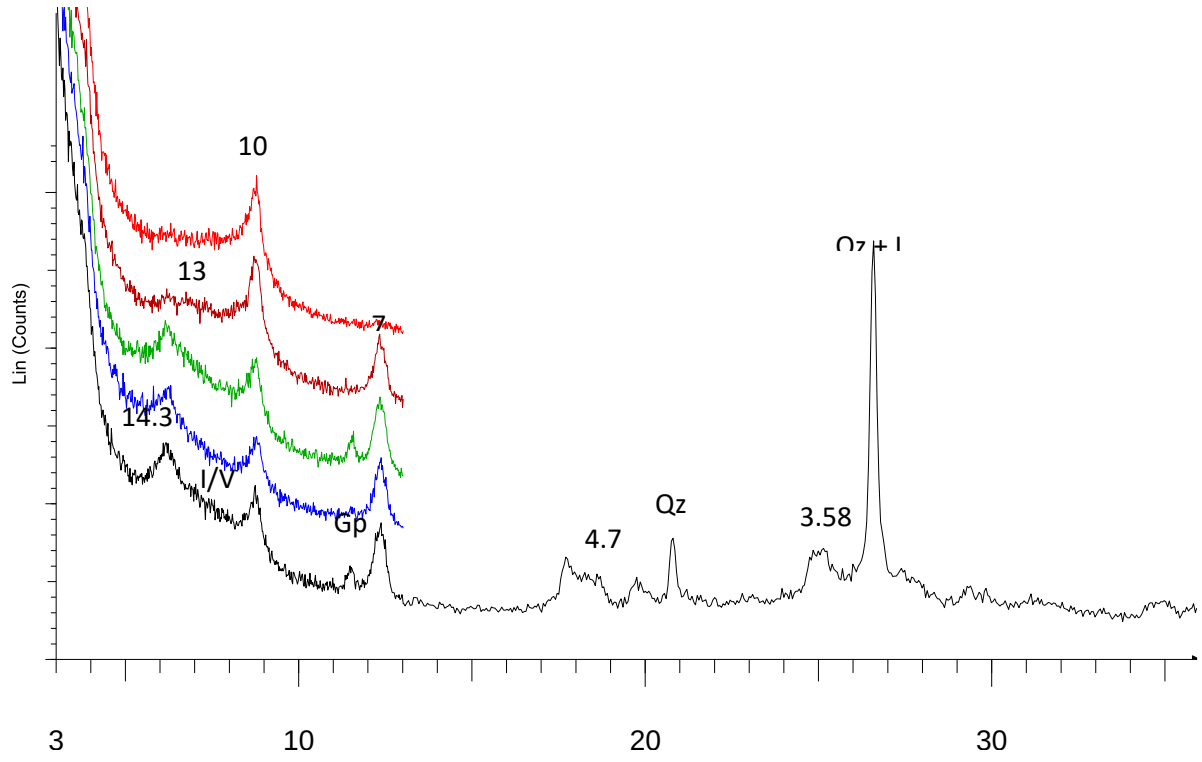
LU17 00187 029 (26256)



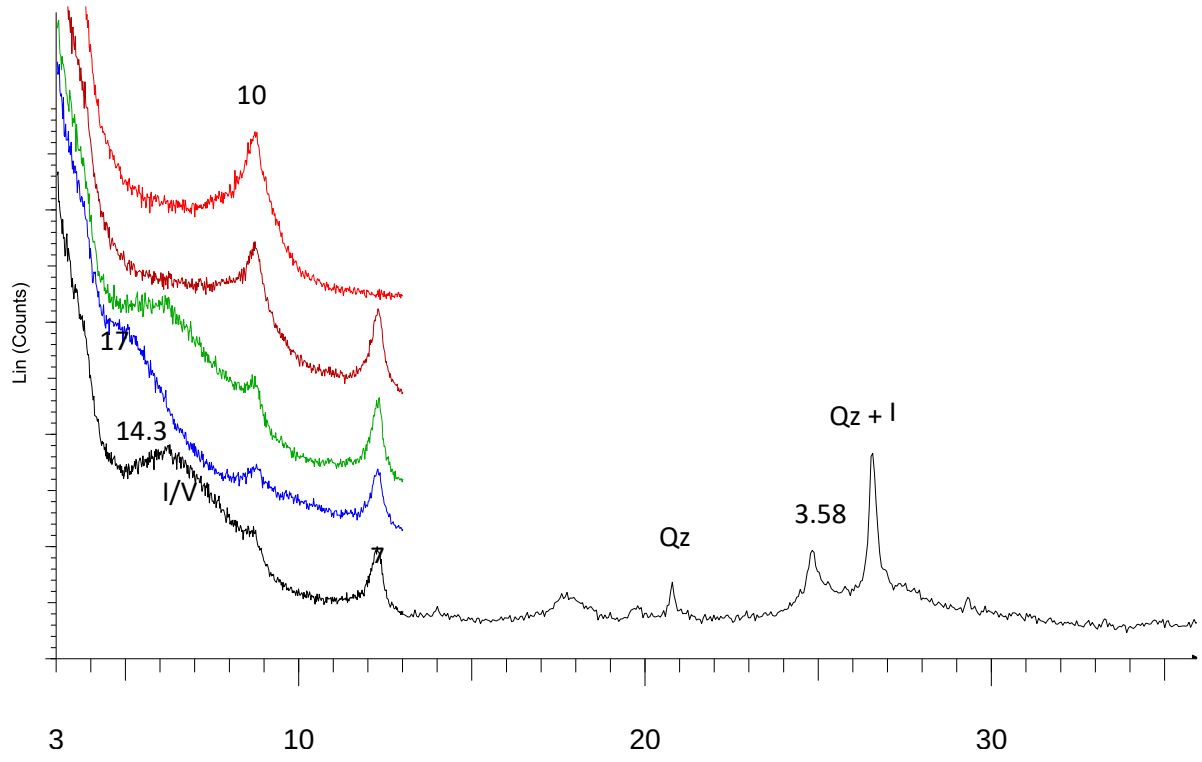
LU17 00187 030 (26257)



LU17 00187 031 (26364)



LU17 00187 032 (26504)



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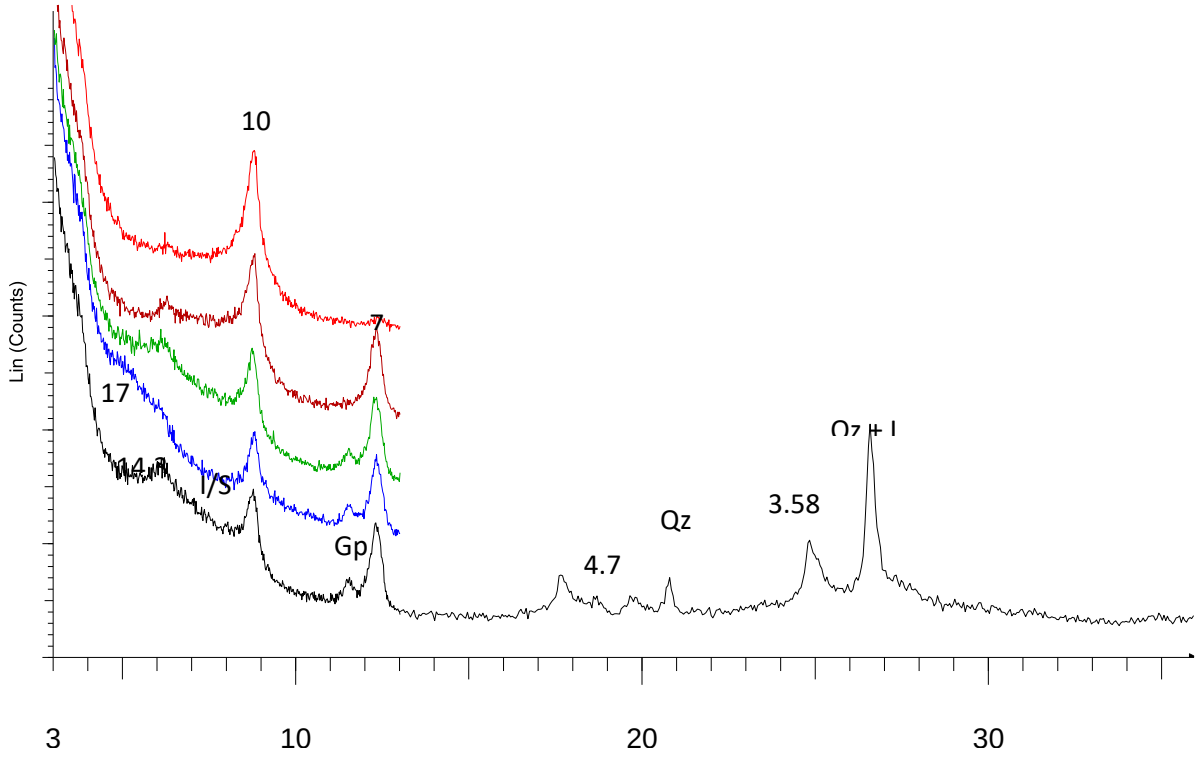
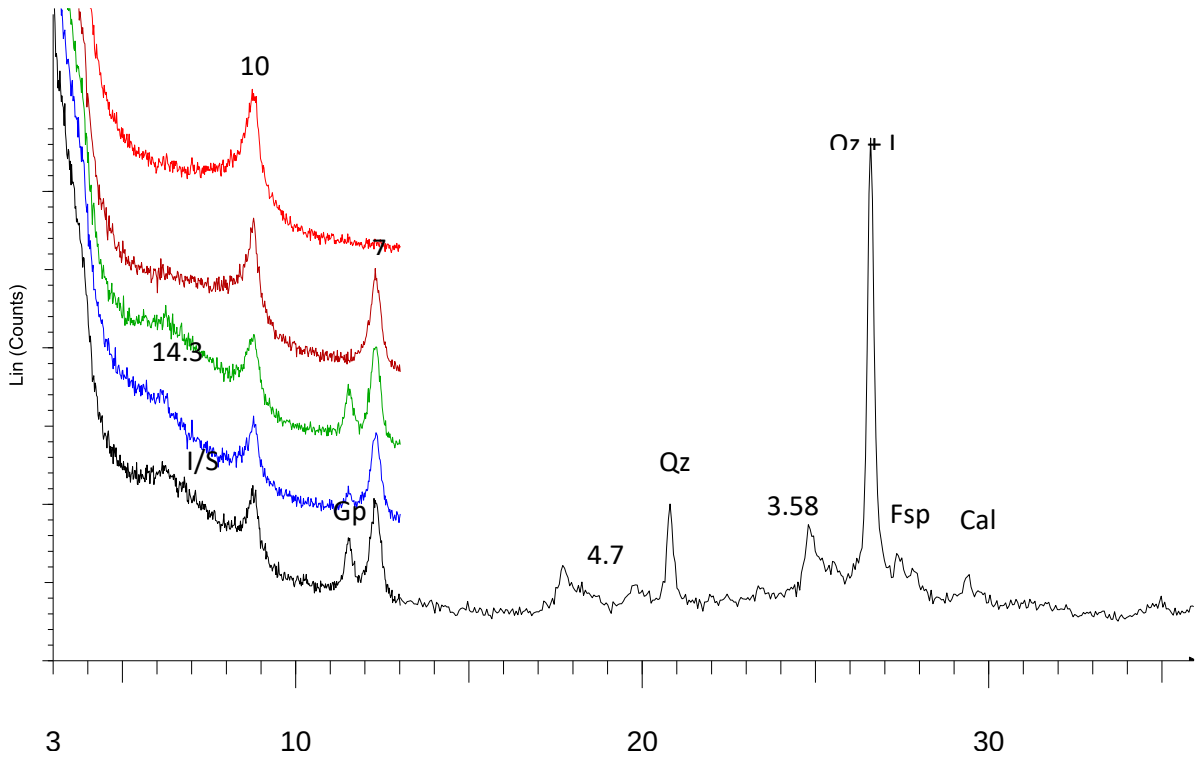
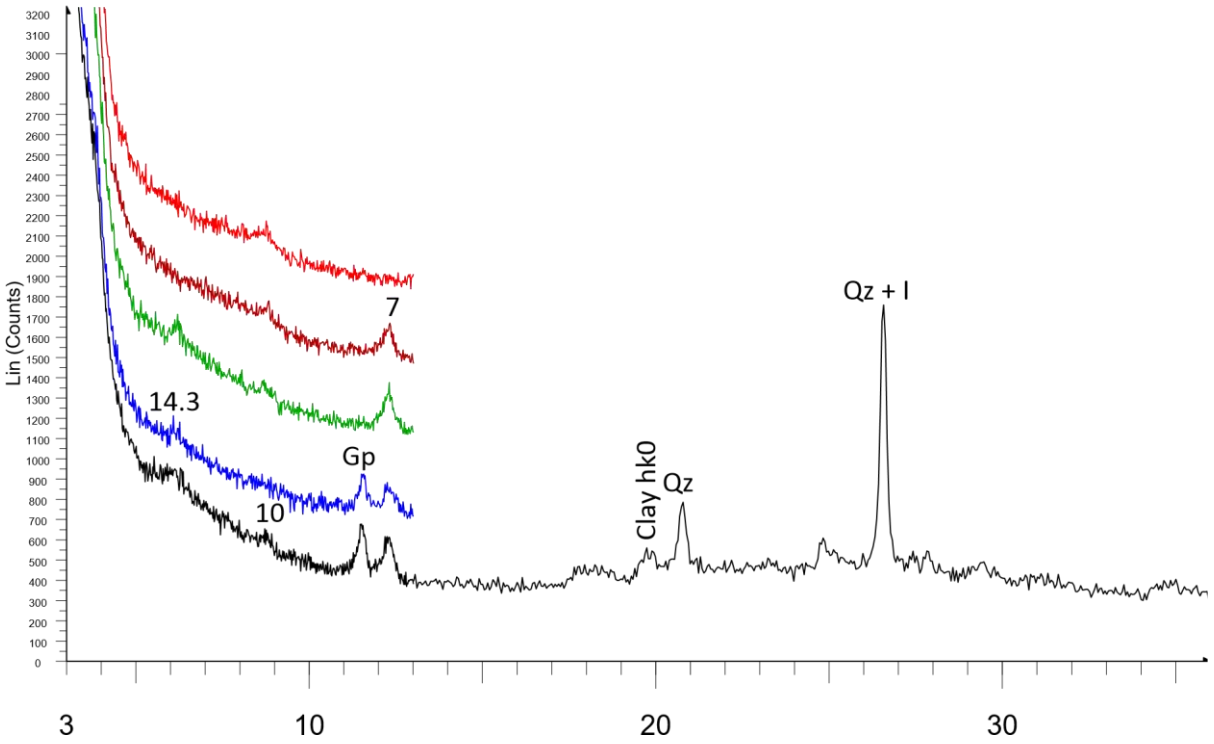


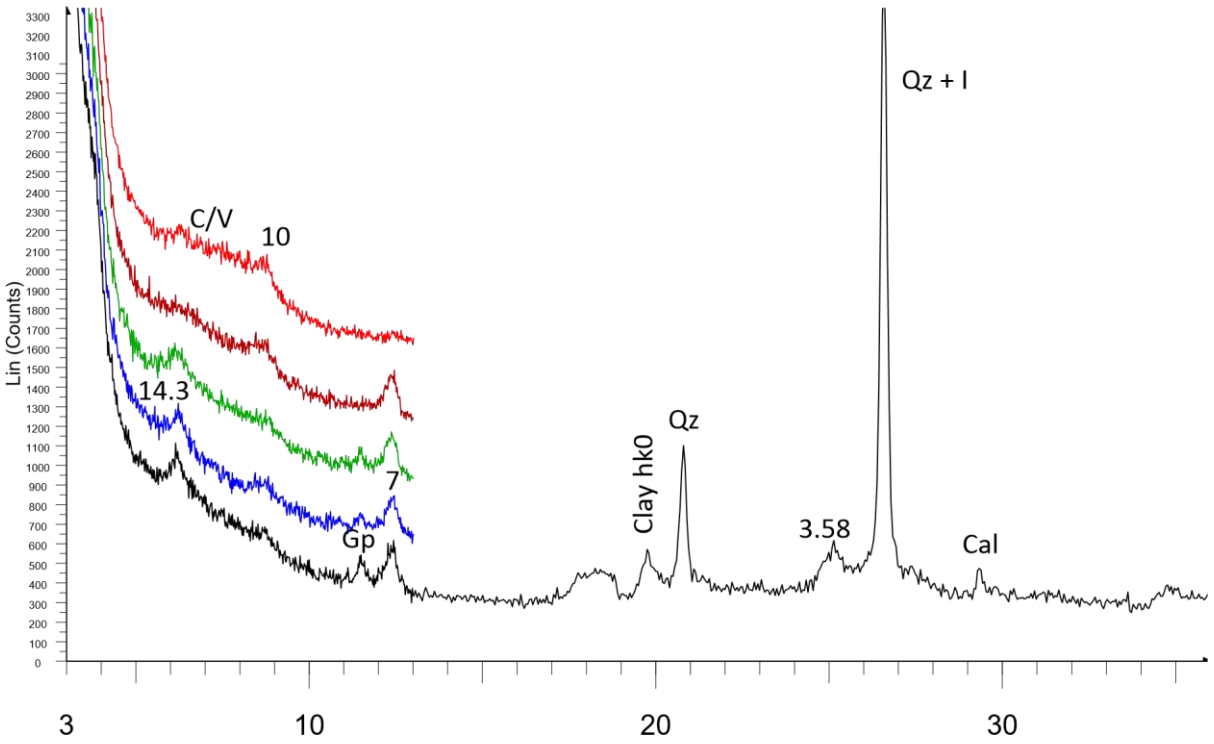
LU17 00187 034 (27101)



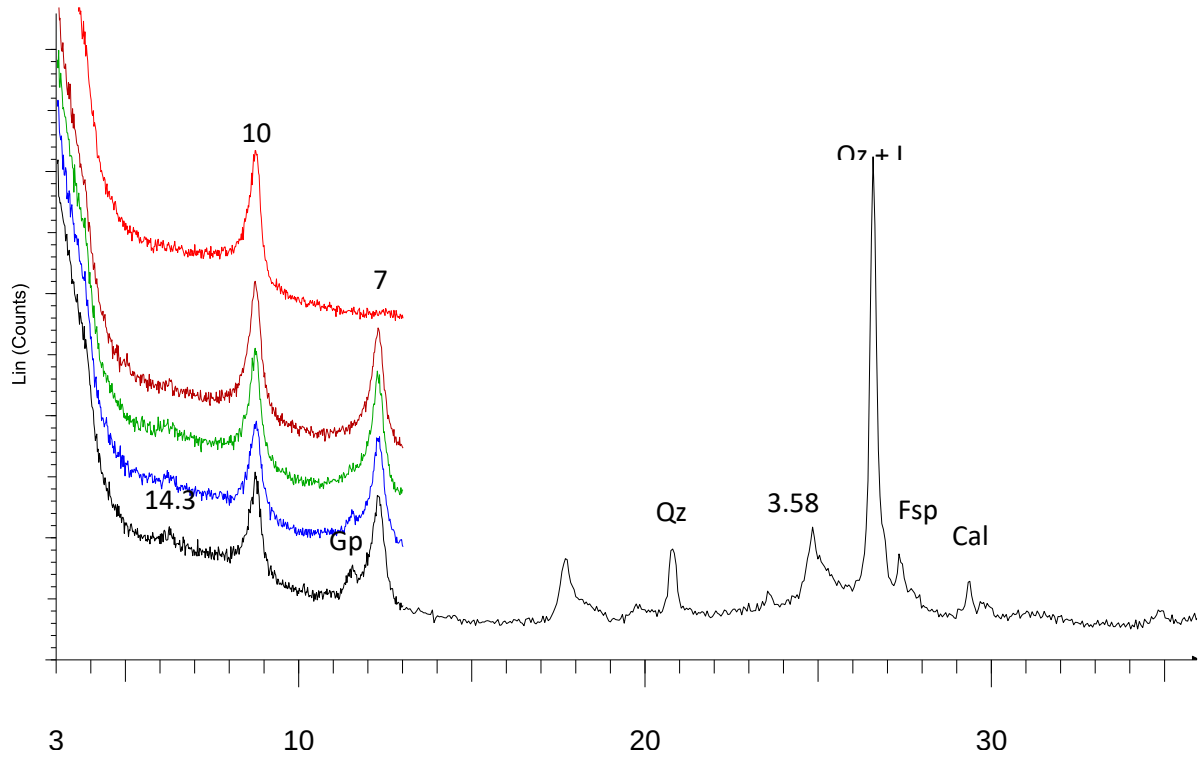
LU17 00187 035 (27430)



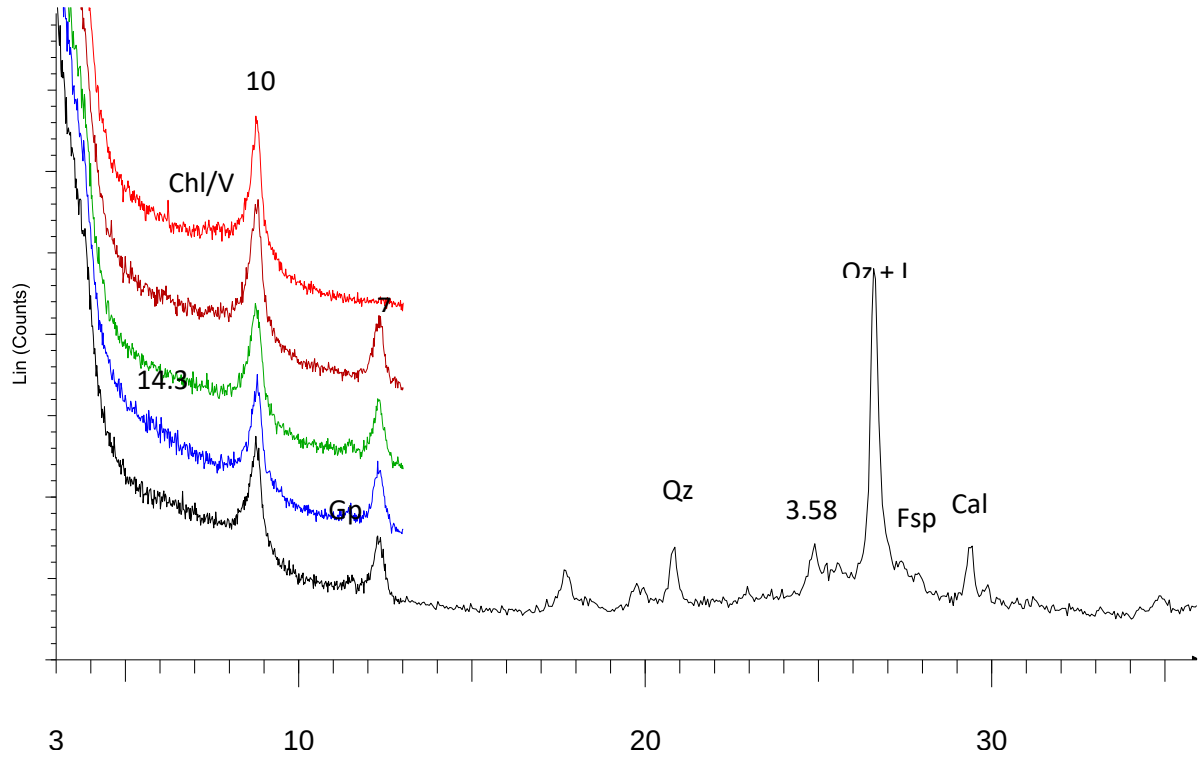
LU17 00187 036 (27525)



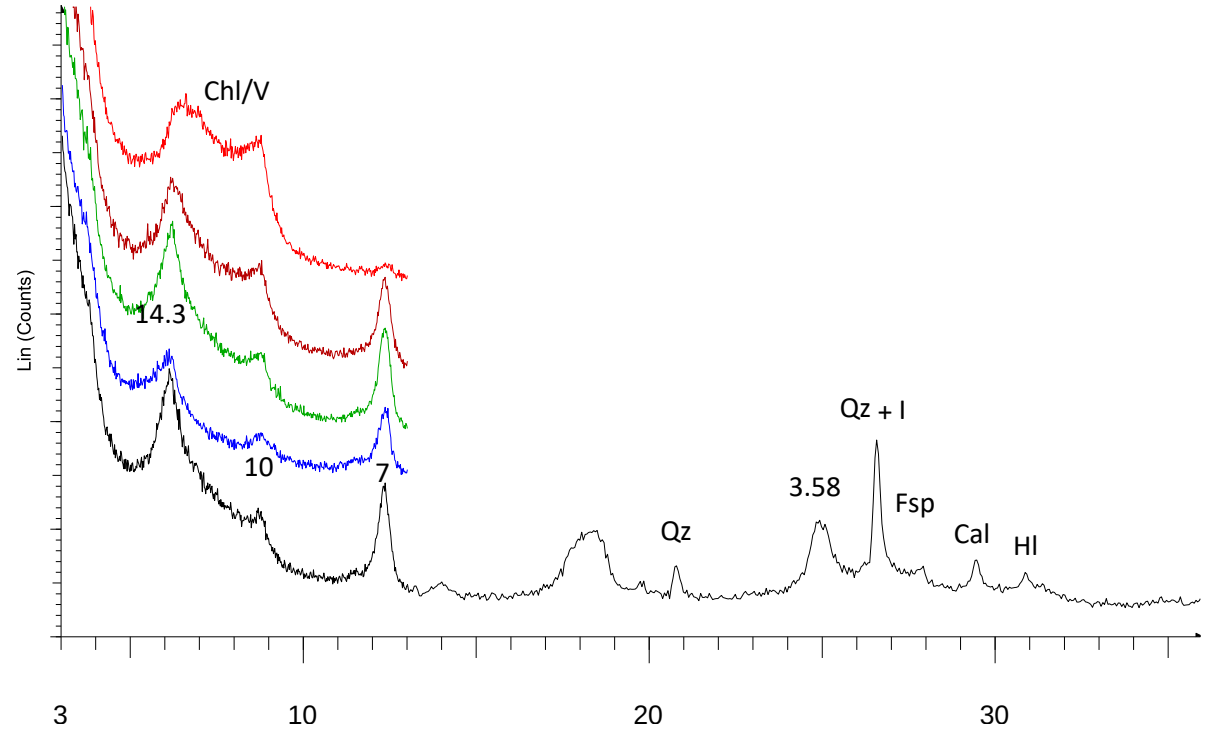
LU17 00187 037 (27953)



LU17 00187 038 (27988)



LU17 00187 039 (27480)



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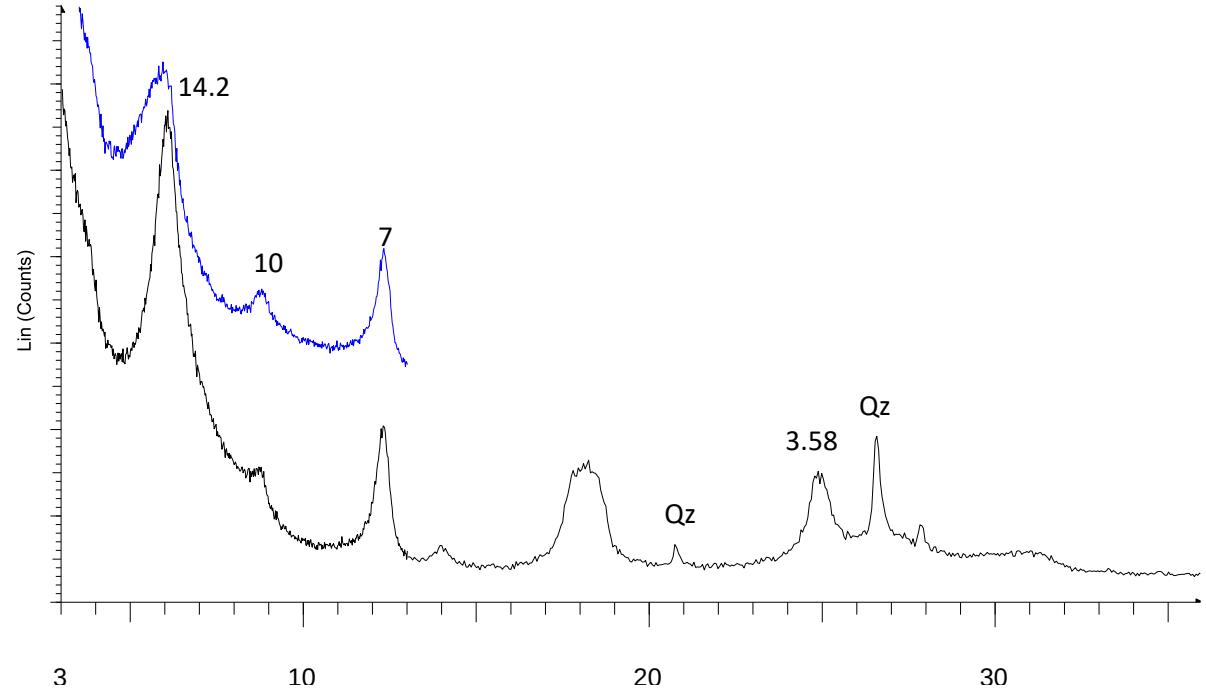
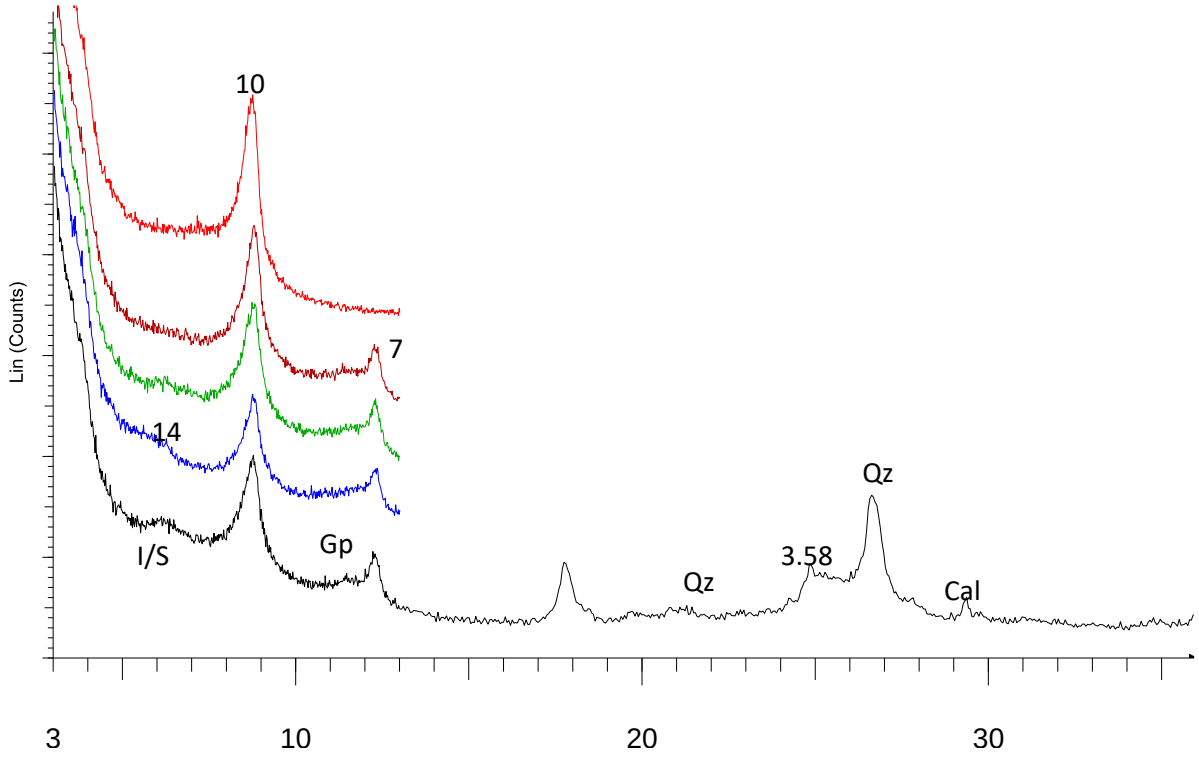
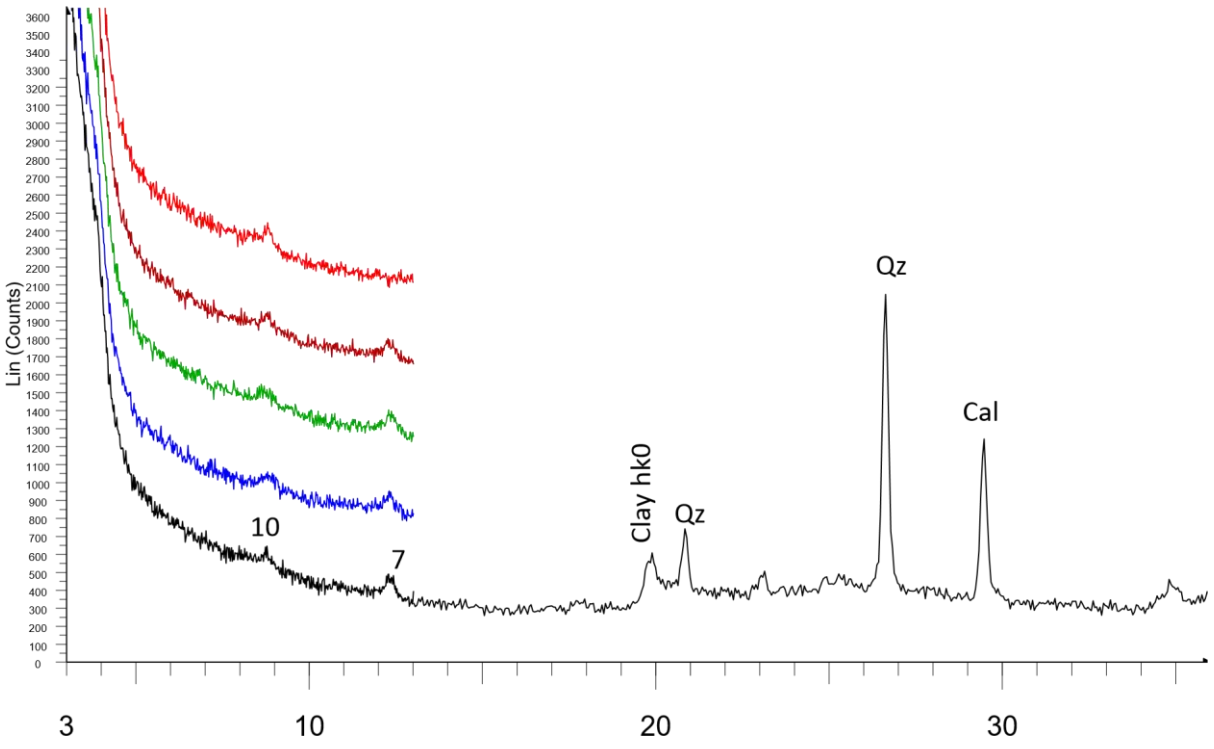


Annex 3. RX Diffractograms from Greece

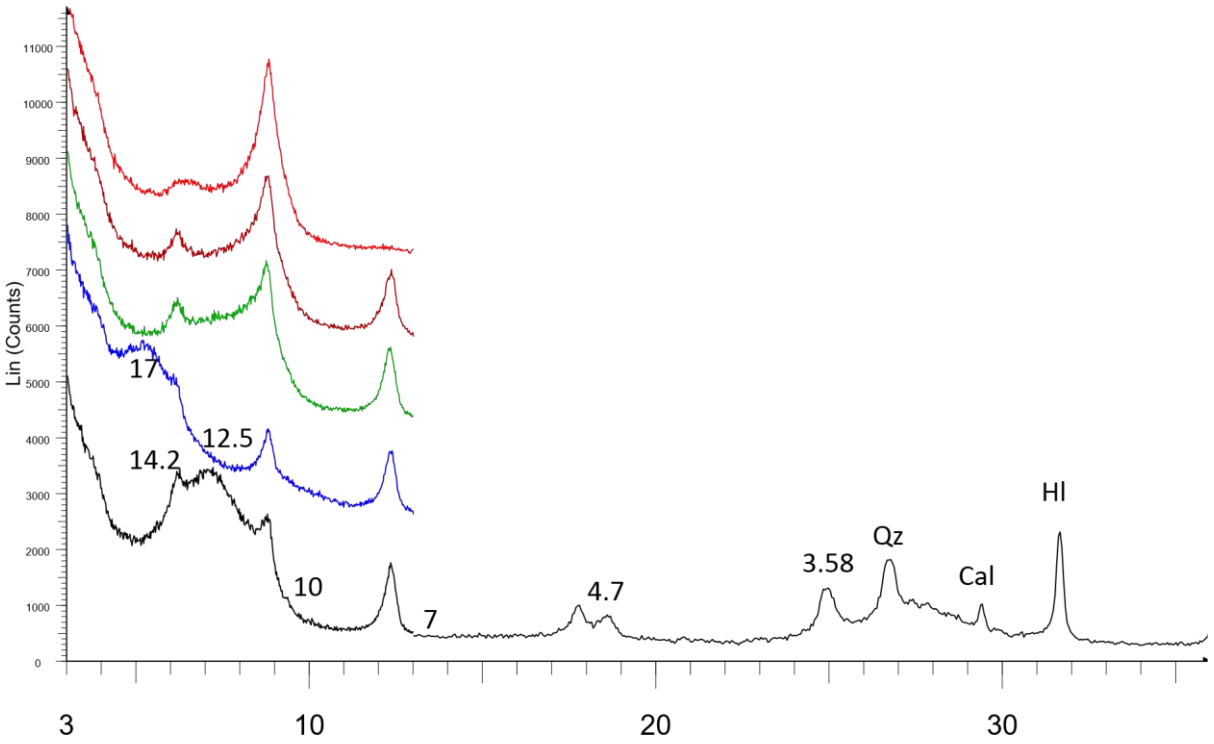
LU17 00188 001 (29318)



LU17 00188 002 (29360)



LU17 00188 003 (29379)



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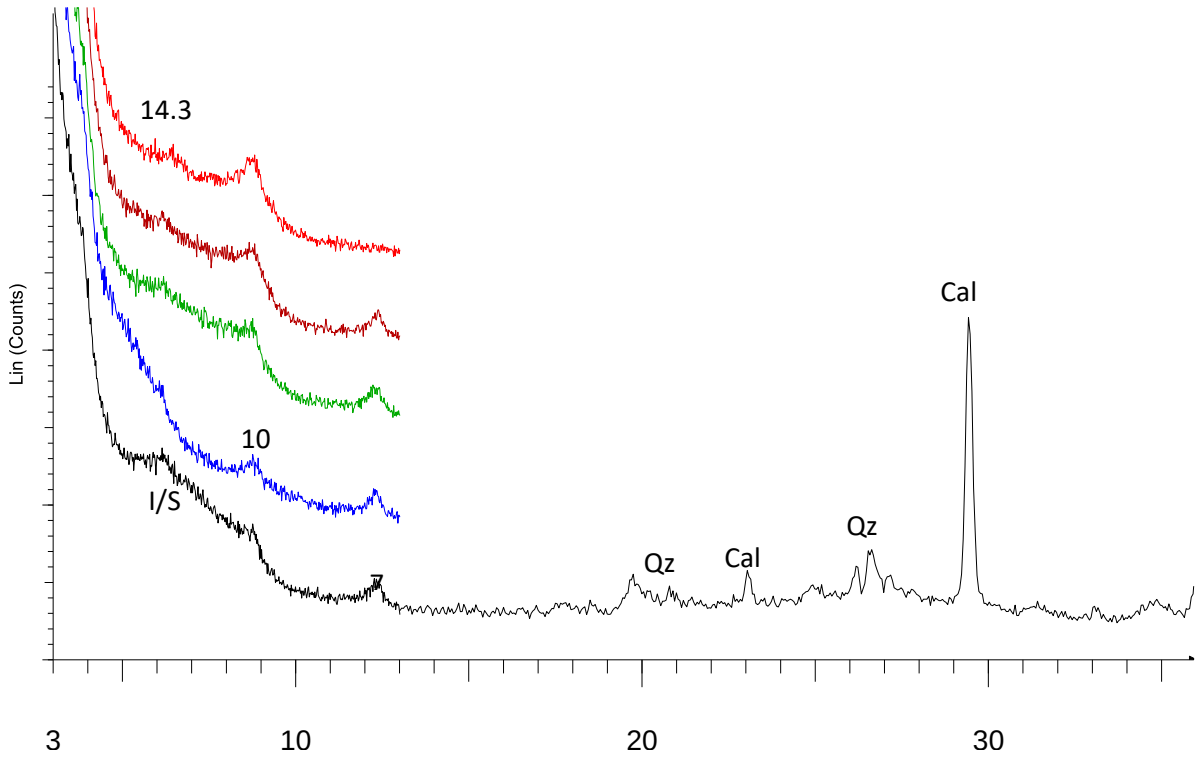
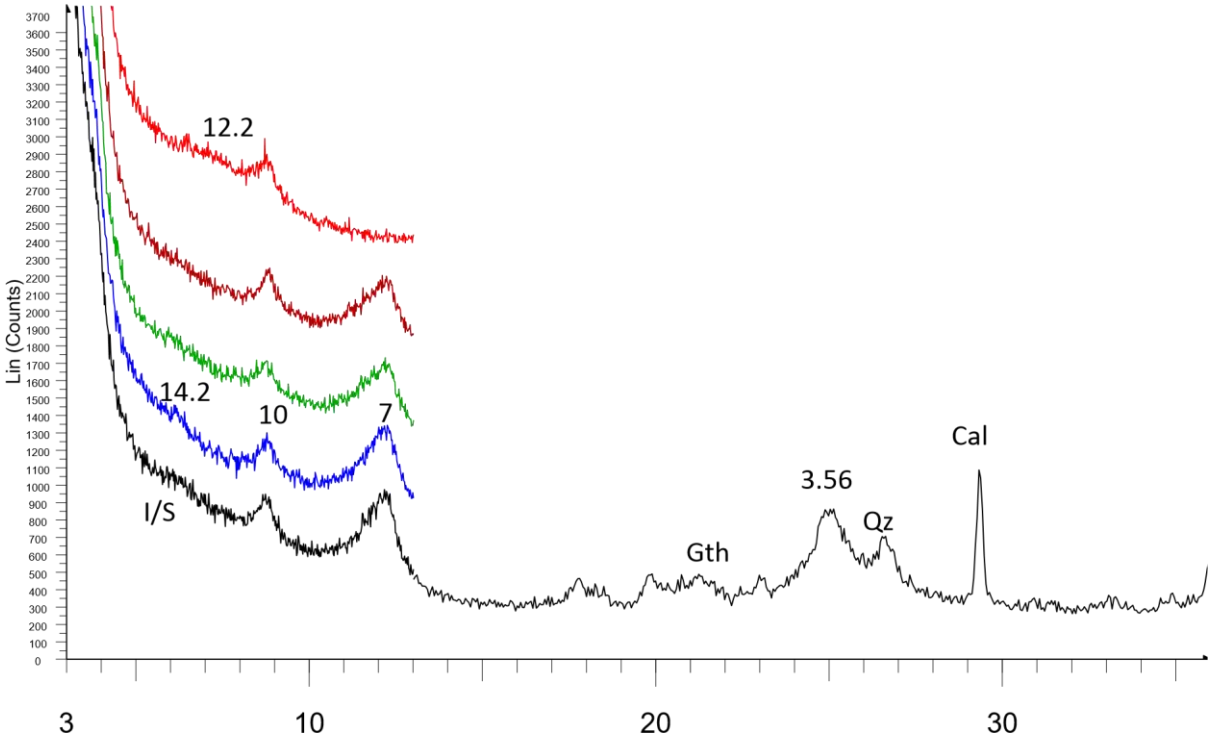


LU17 00188 005 (29388)



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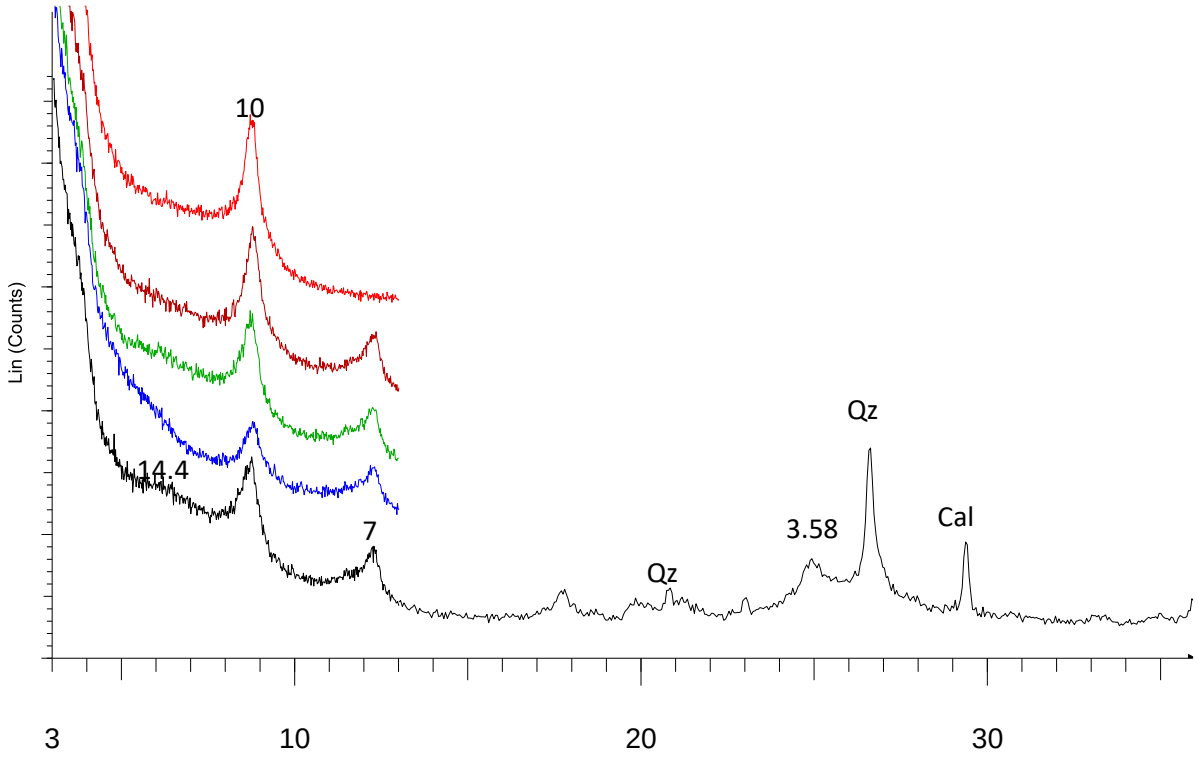
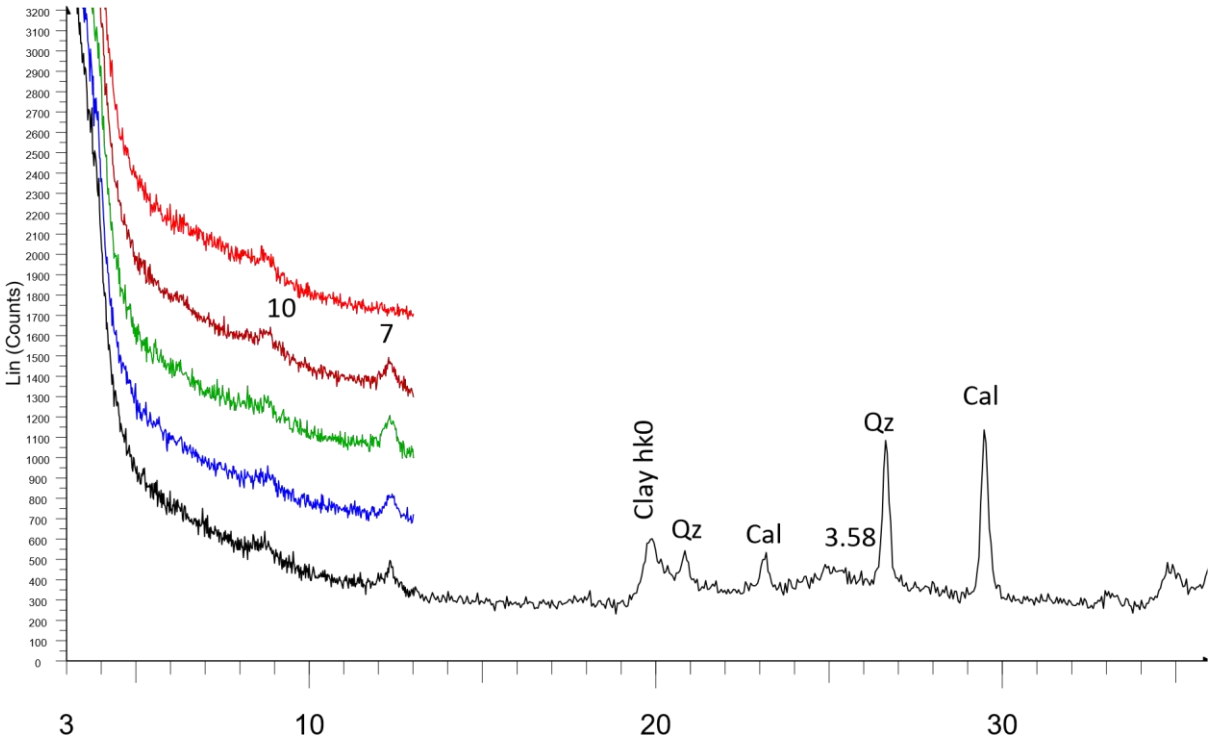
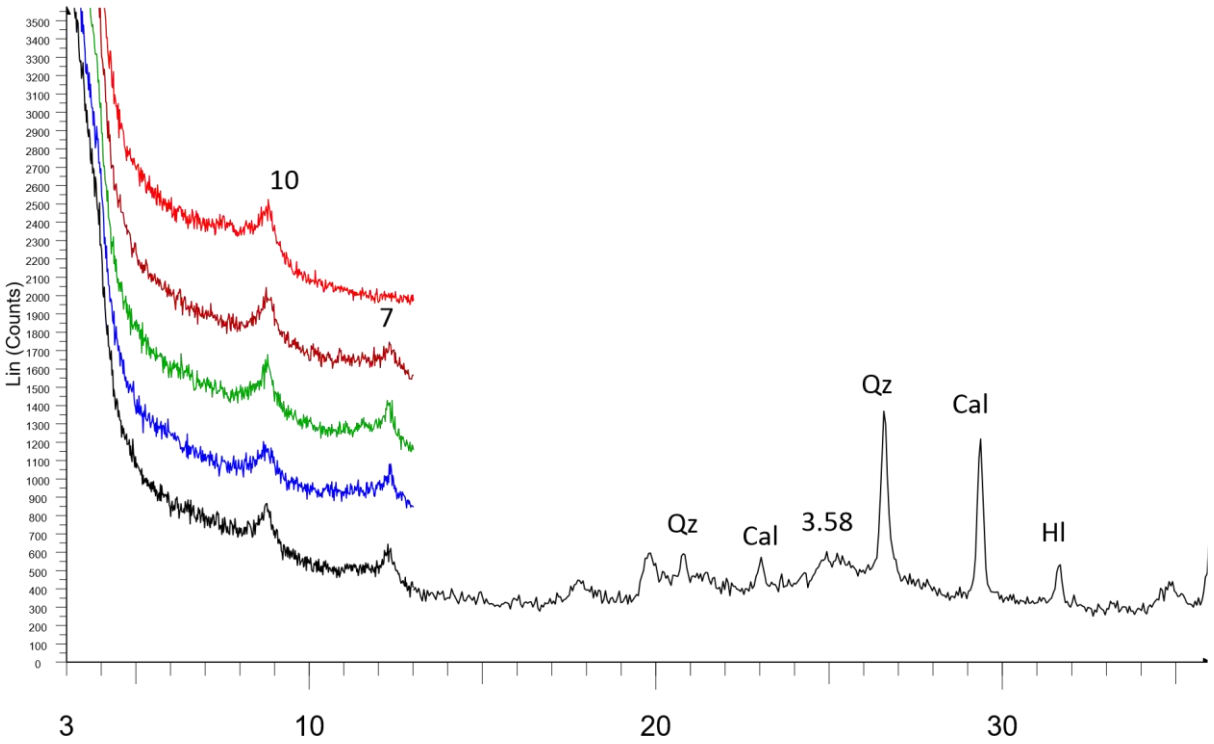


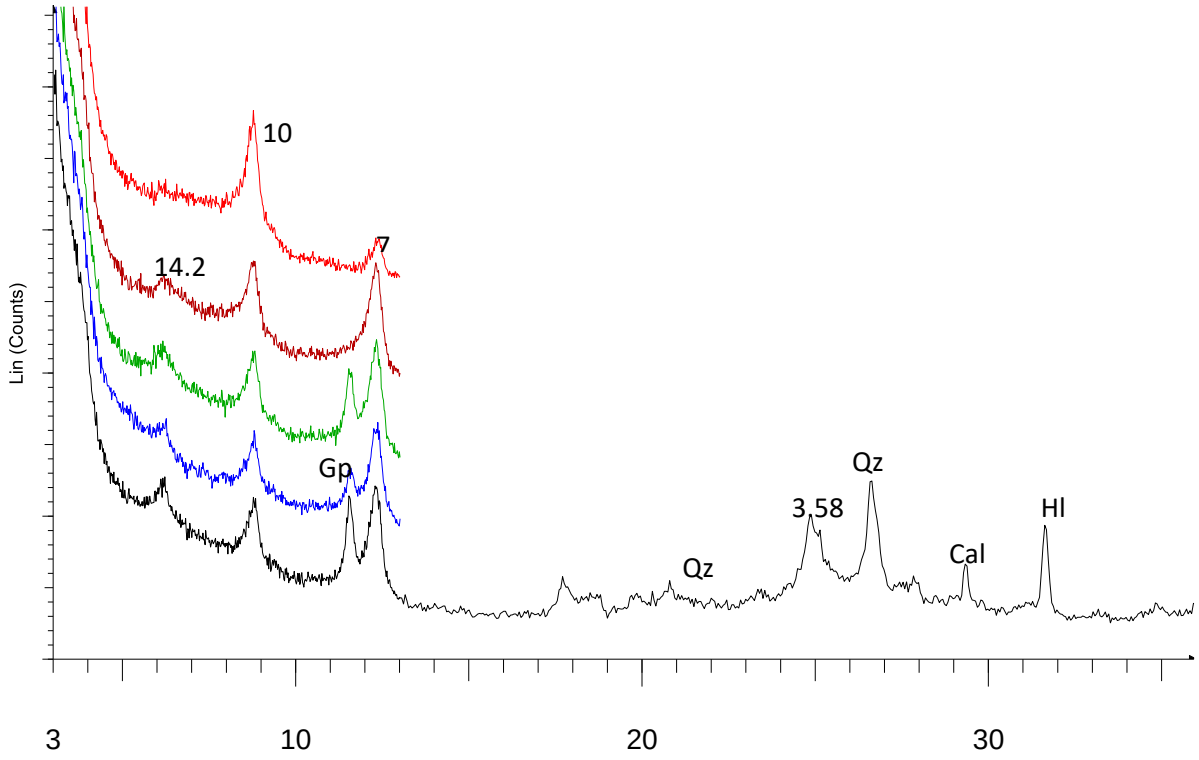
LU17 00188 007 (29482)



LU17 00188 008 (29702)

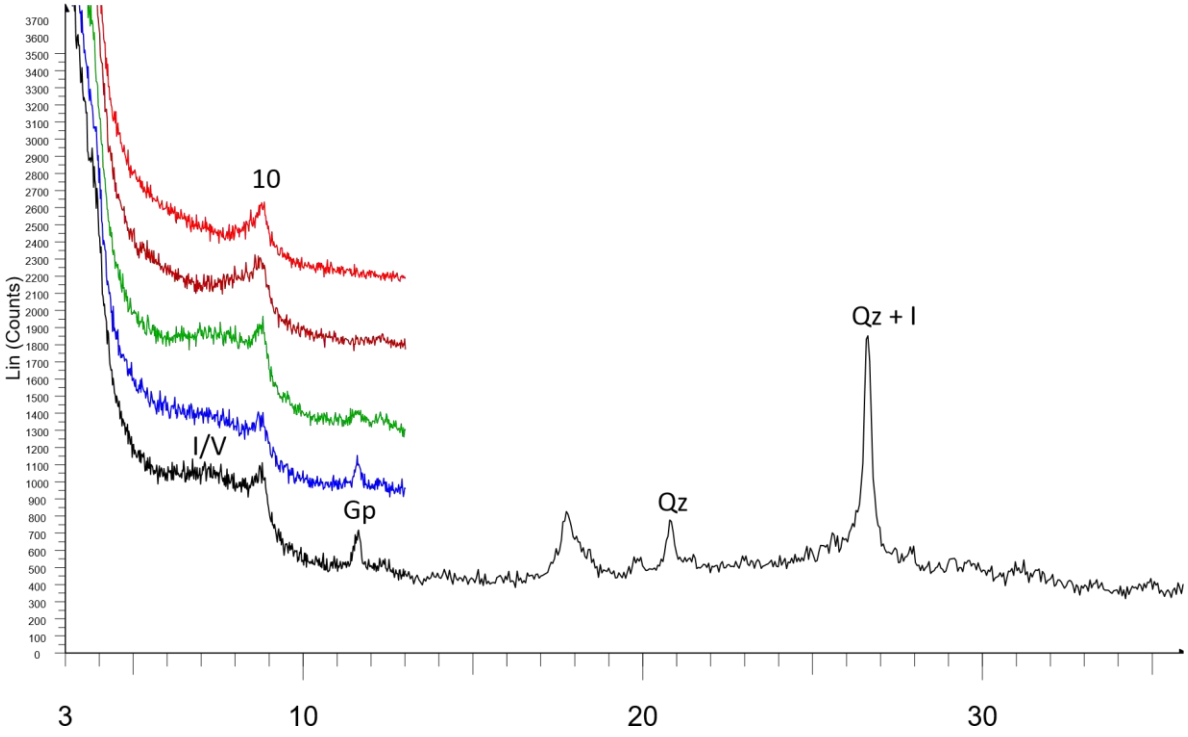


LU17 00188 009 (29164)



Annex 4 RX Diffractograms from Spain

LU17 00189 001 (47001)



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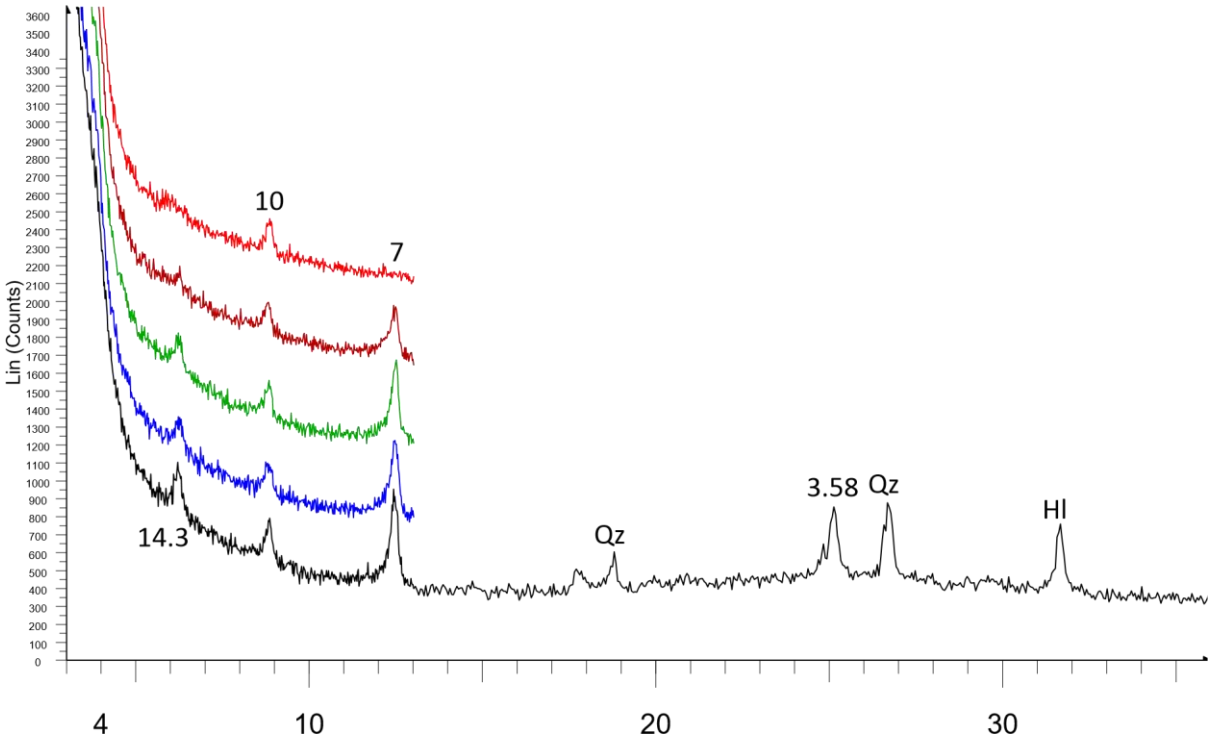
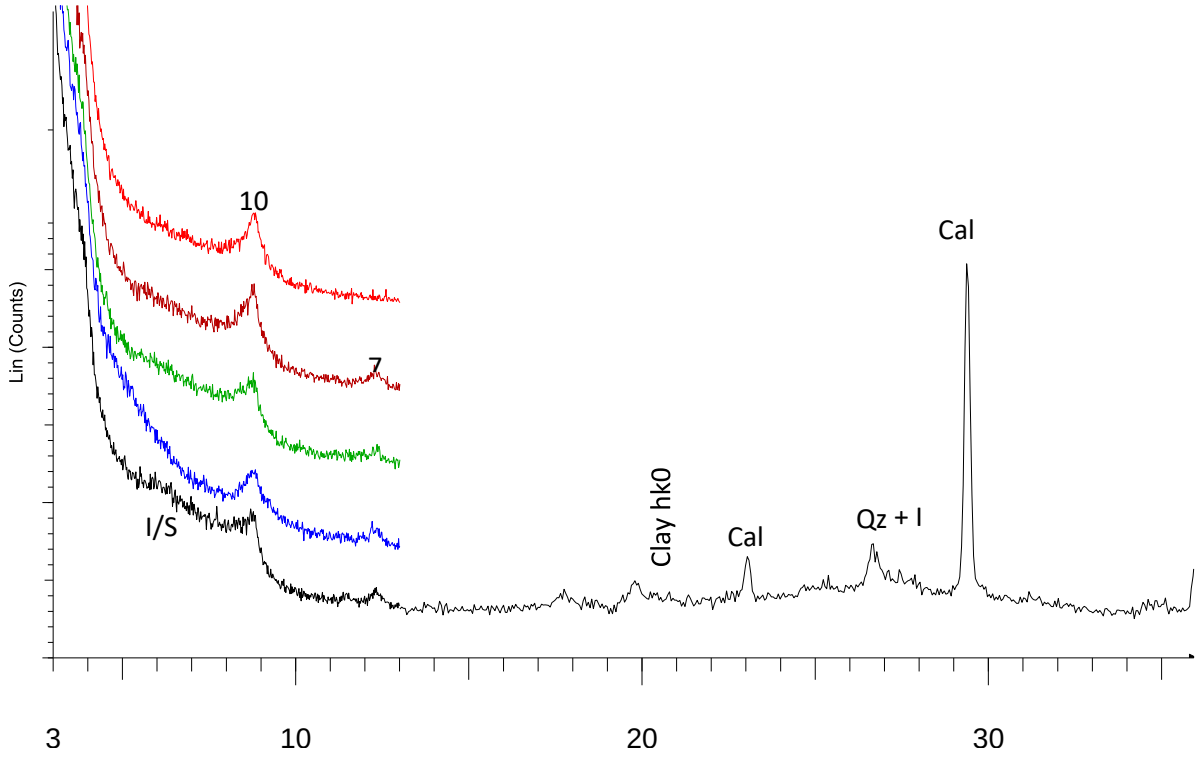
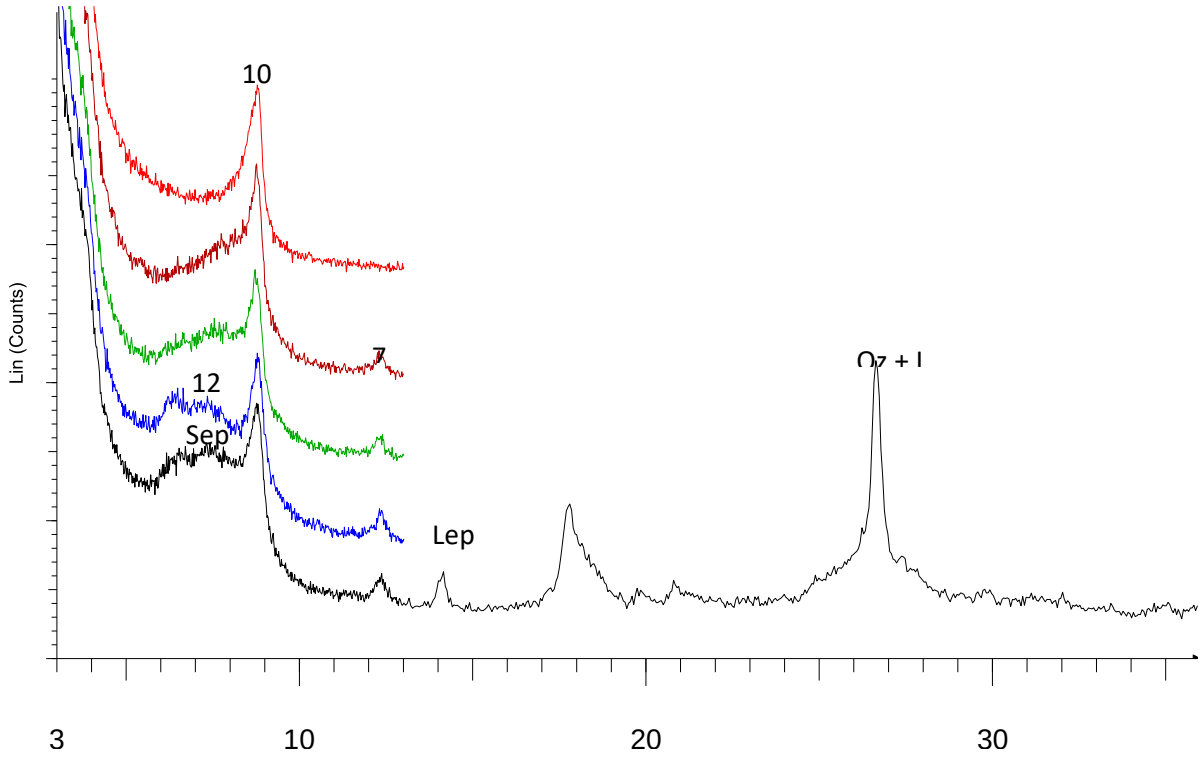


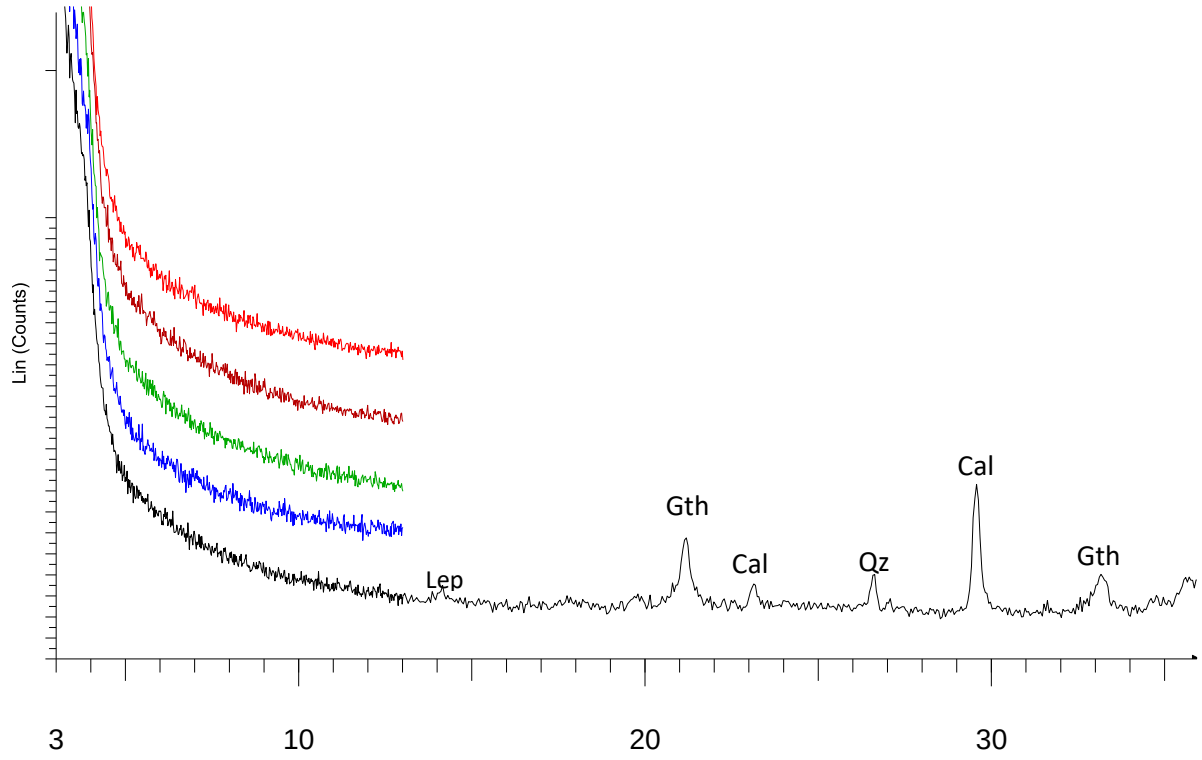
LU17 00189 003 (47324)



LU17 00189 004 (47113)



LU17 00189 005 (47119)



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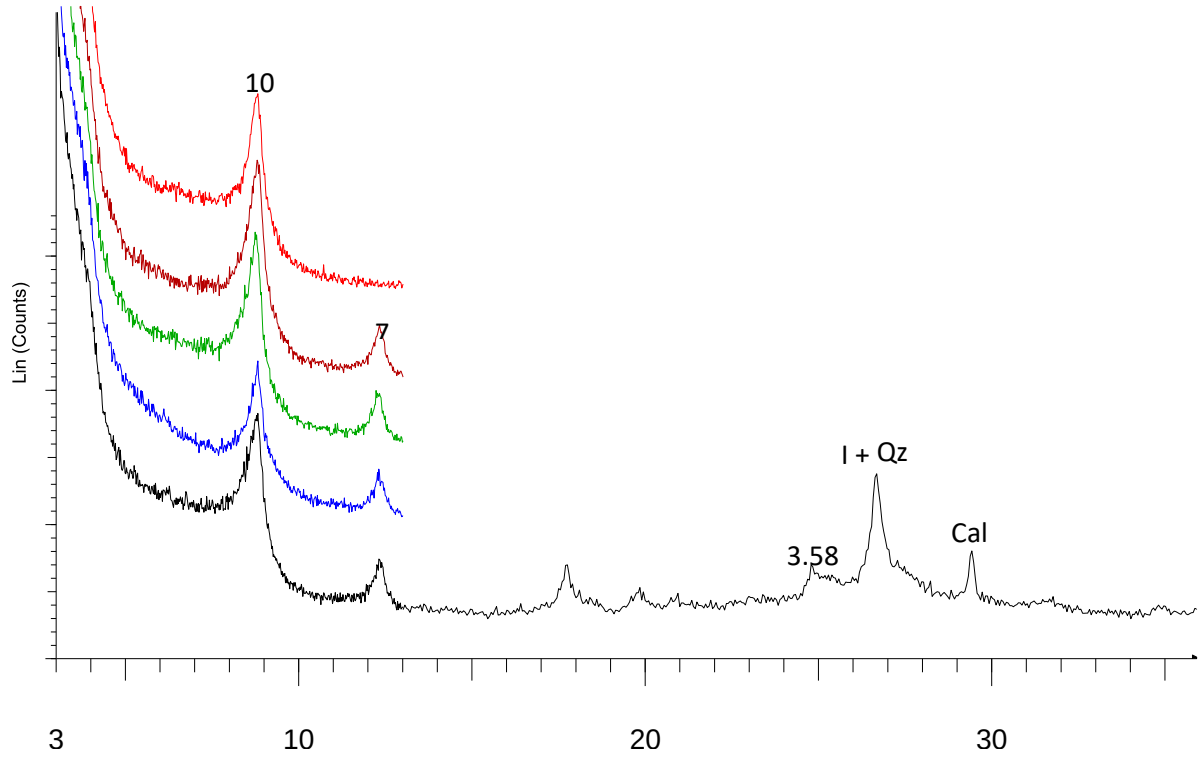
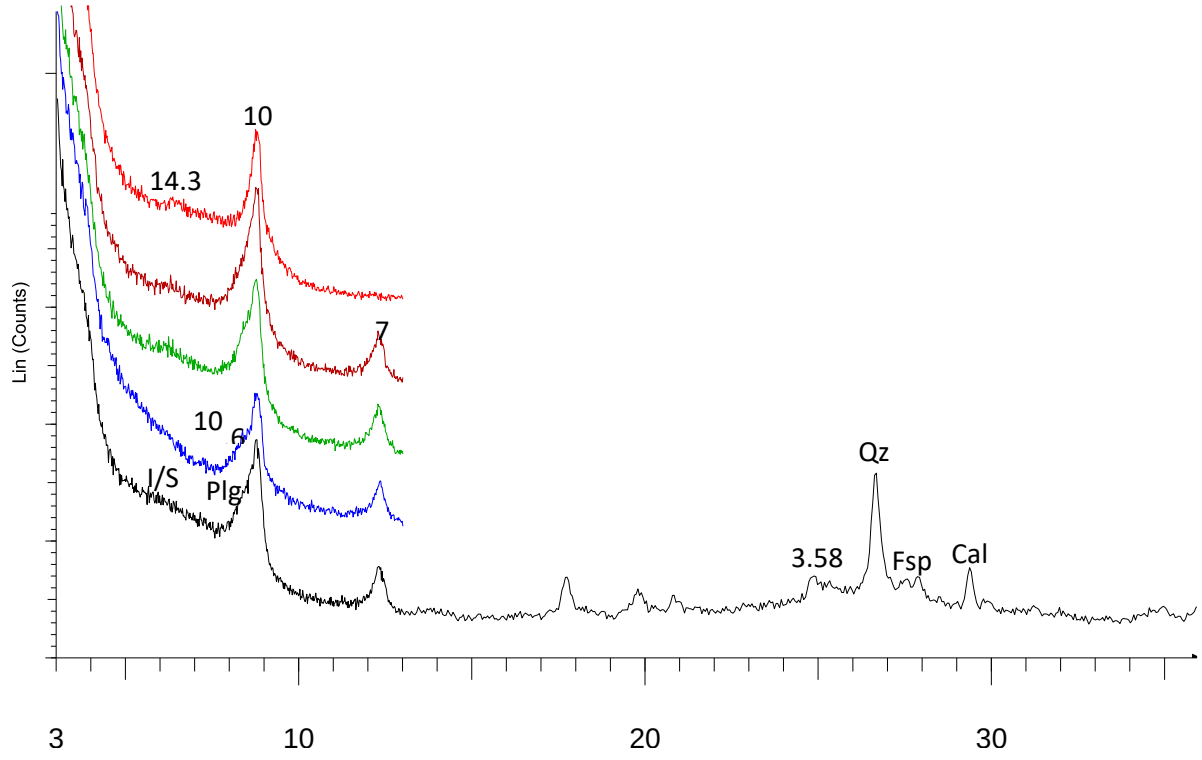


LU17 00189 007 (47168)



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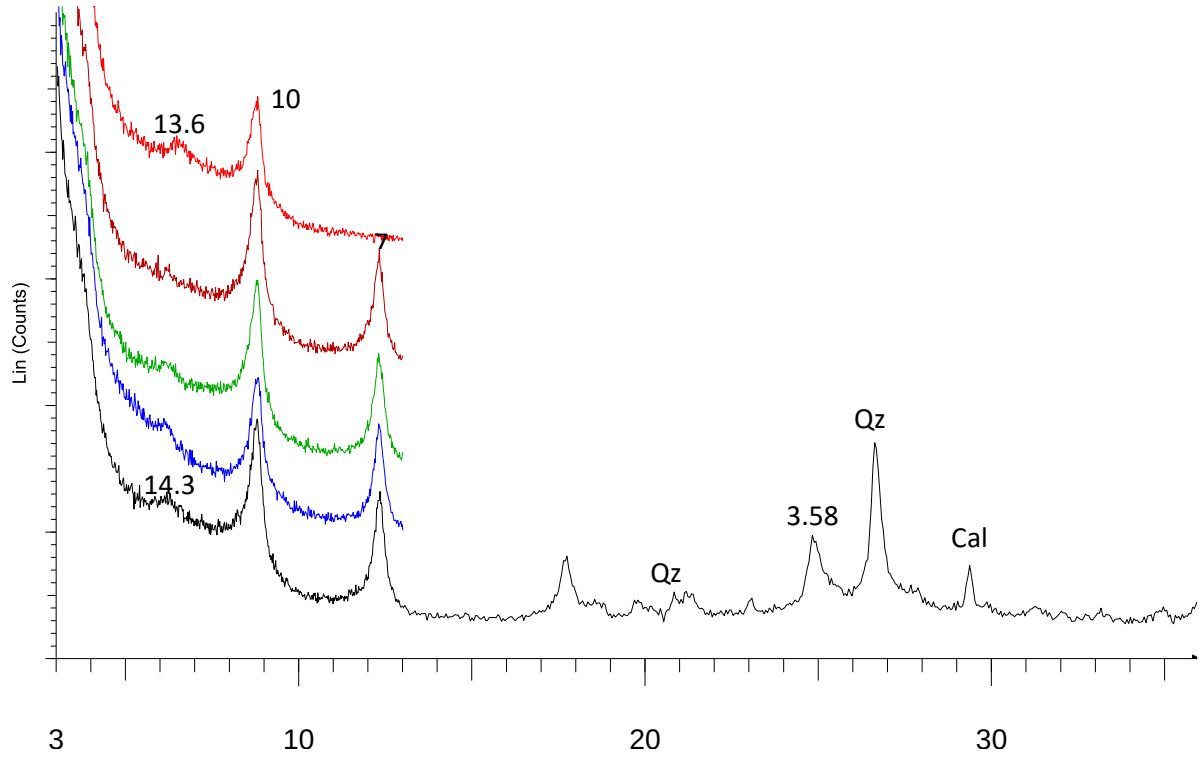
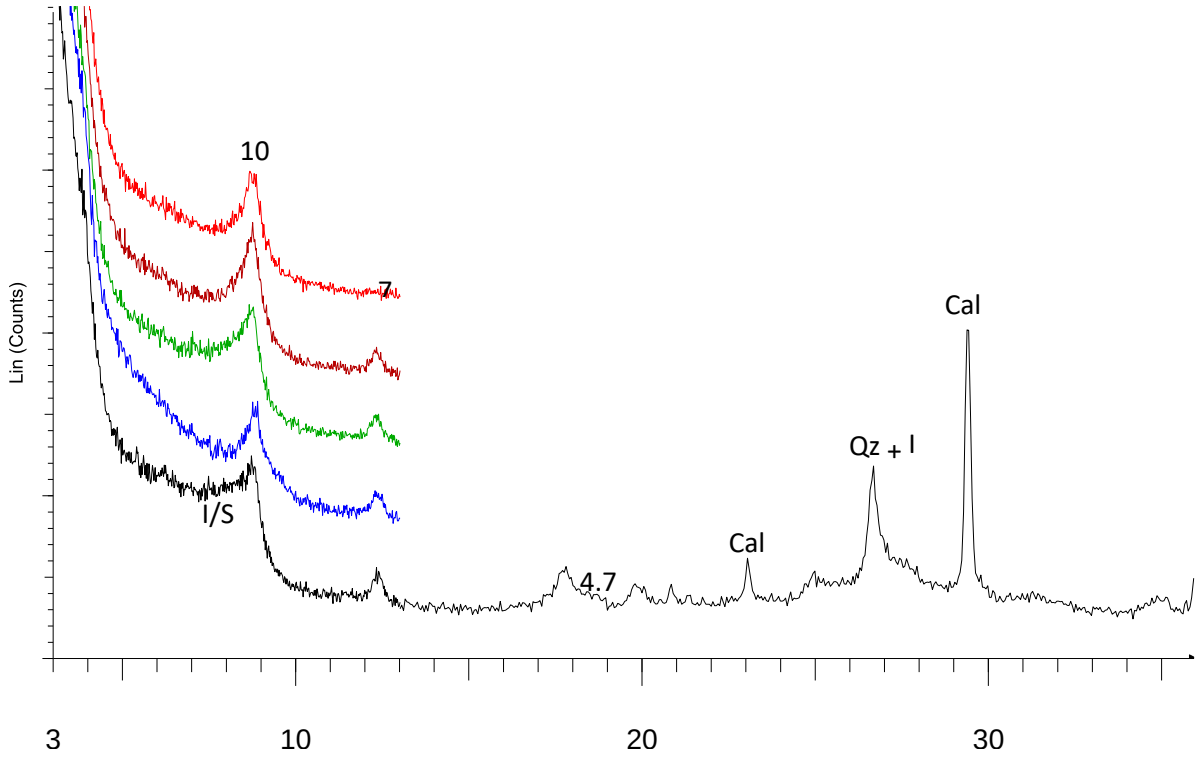
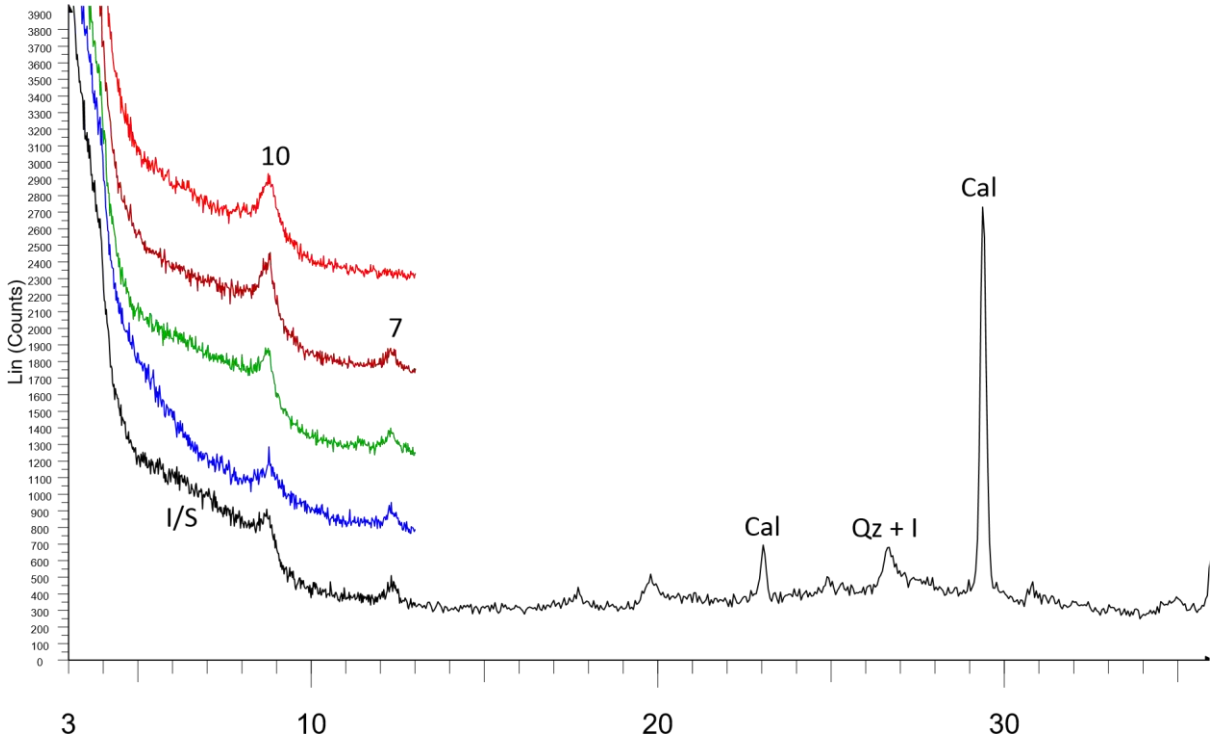


LU17 00189 009 (47386)



LU17 00189 010 (47436)



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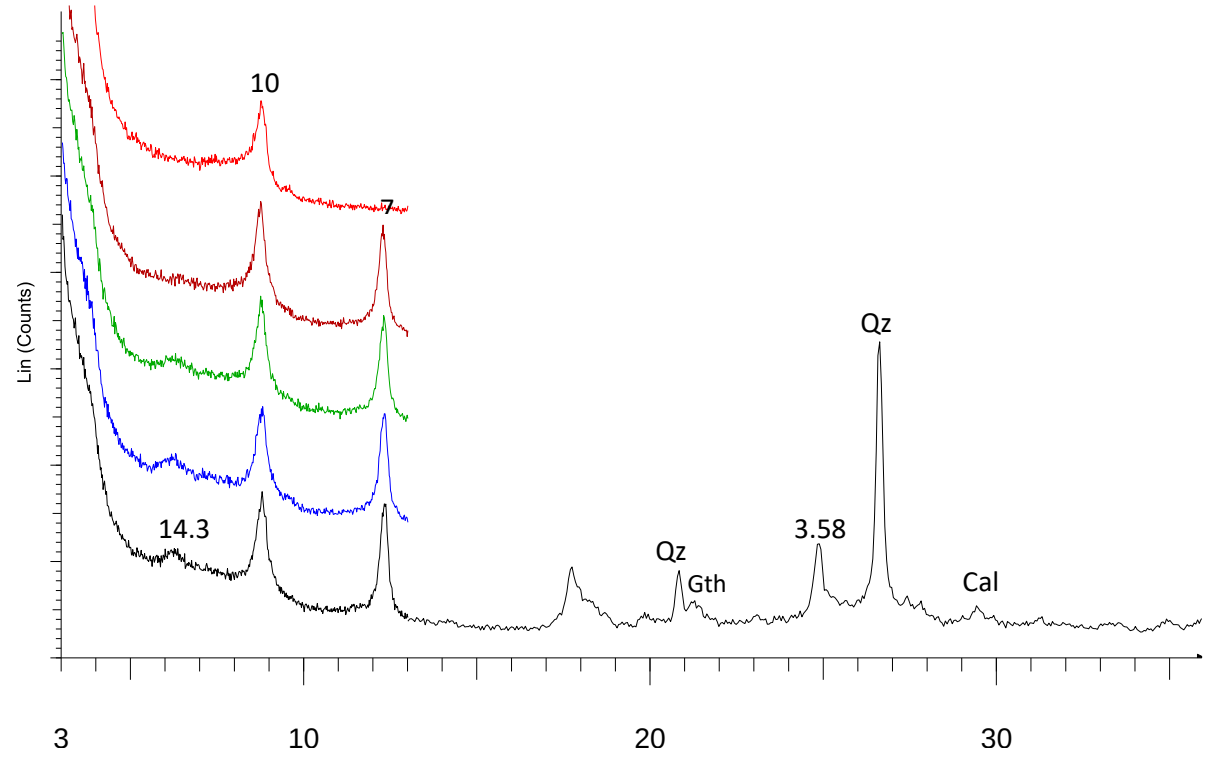

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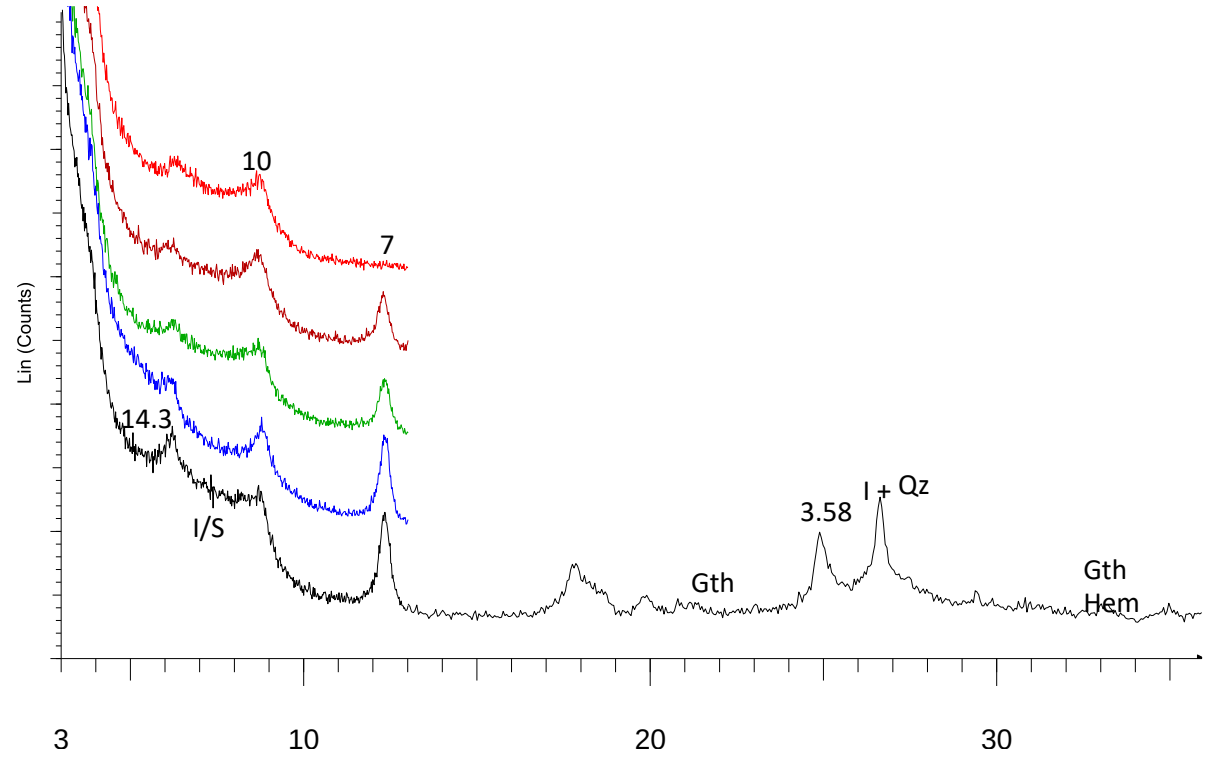

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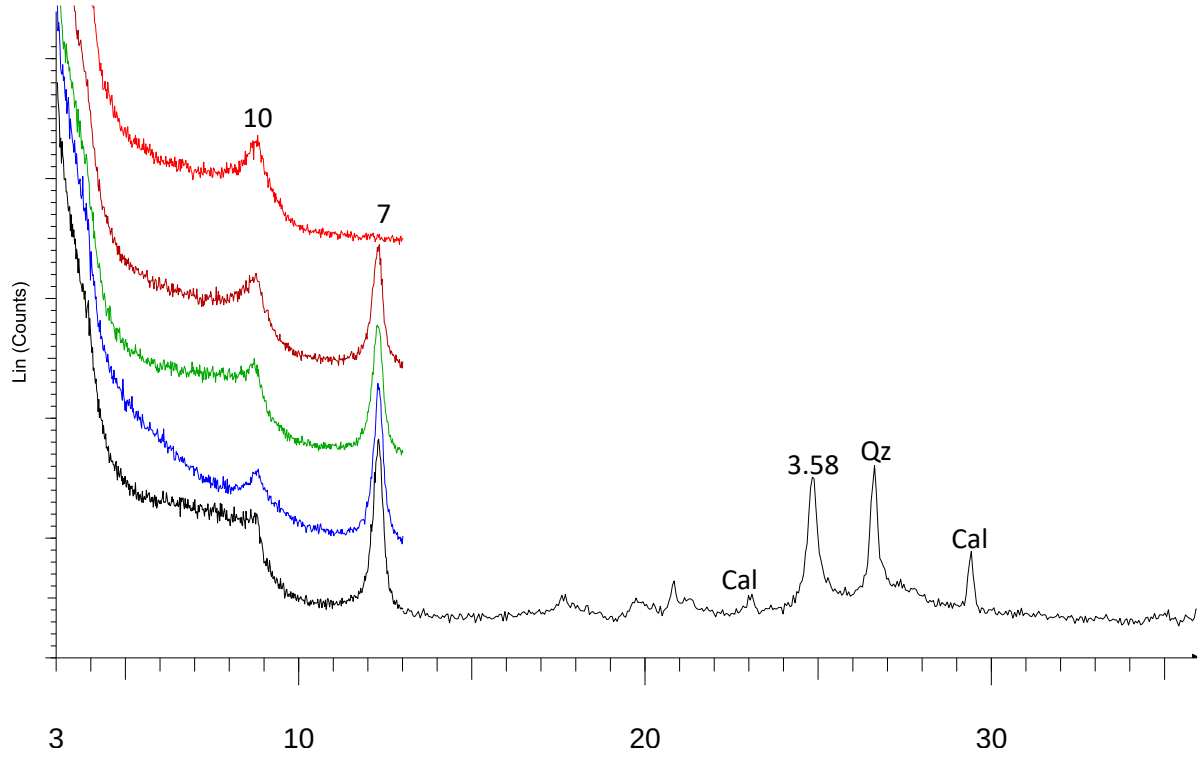

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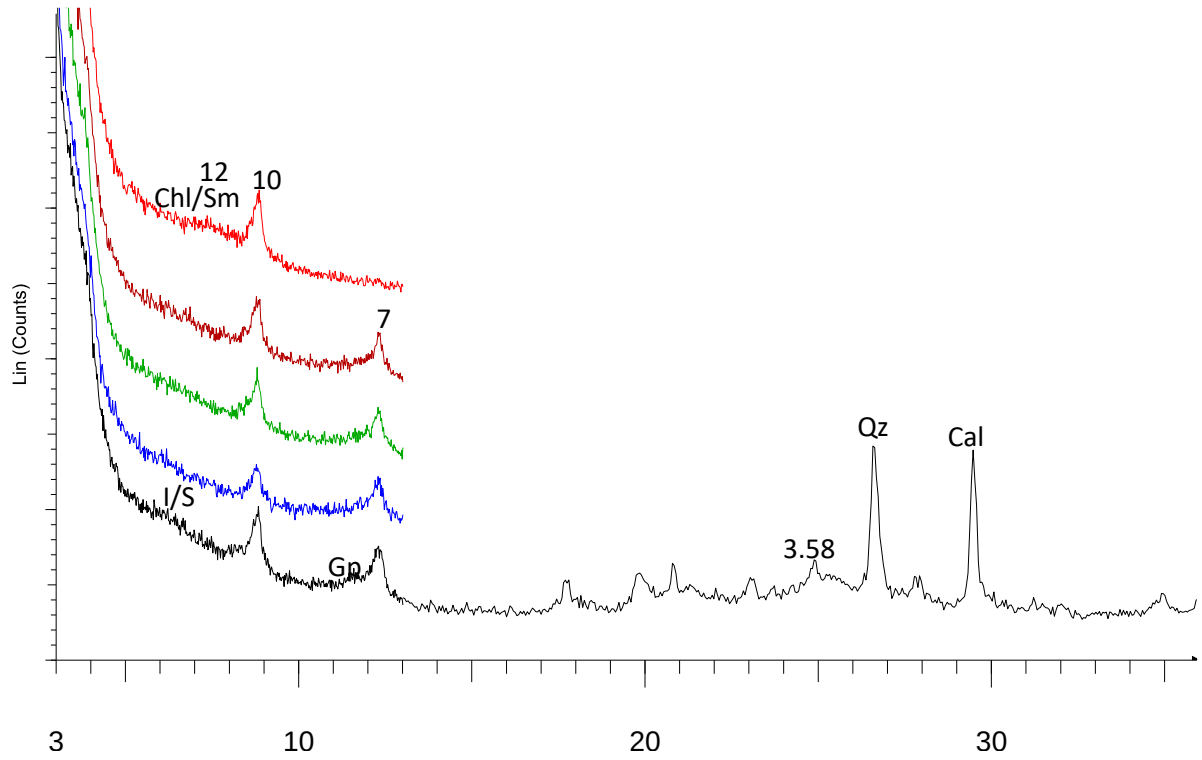

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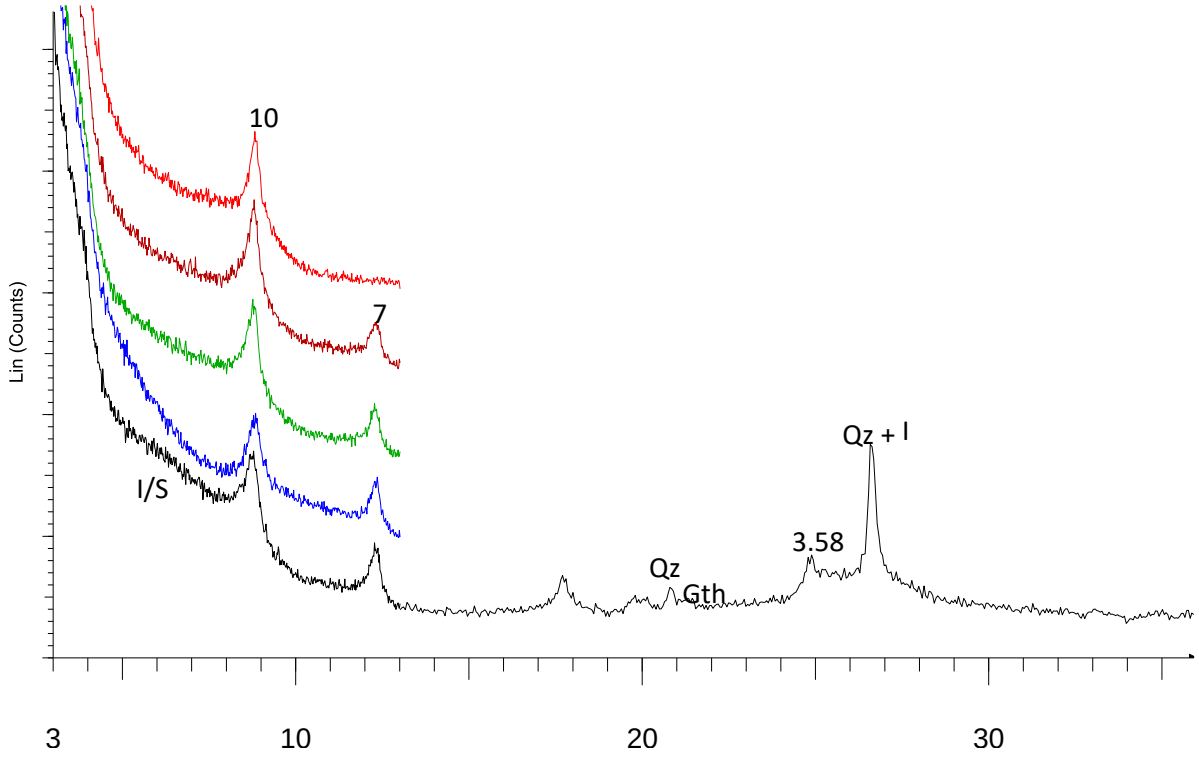

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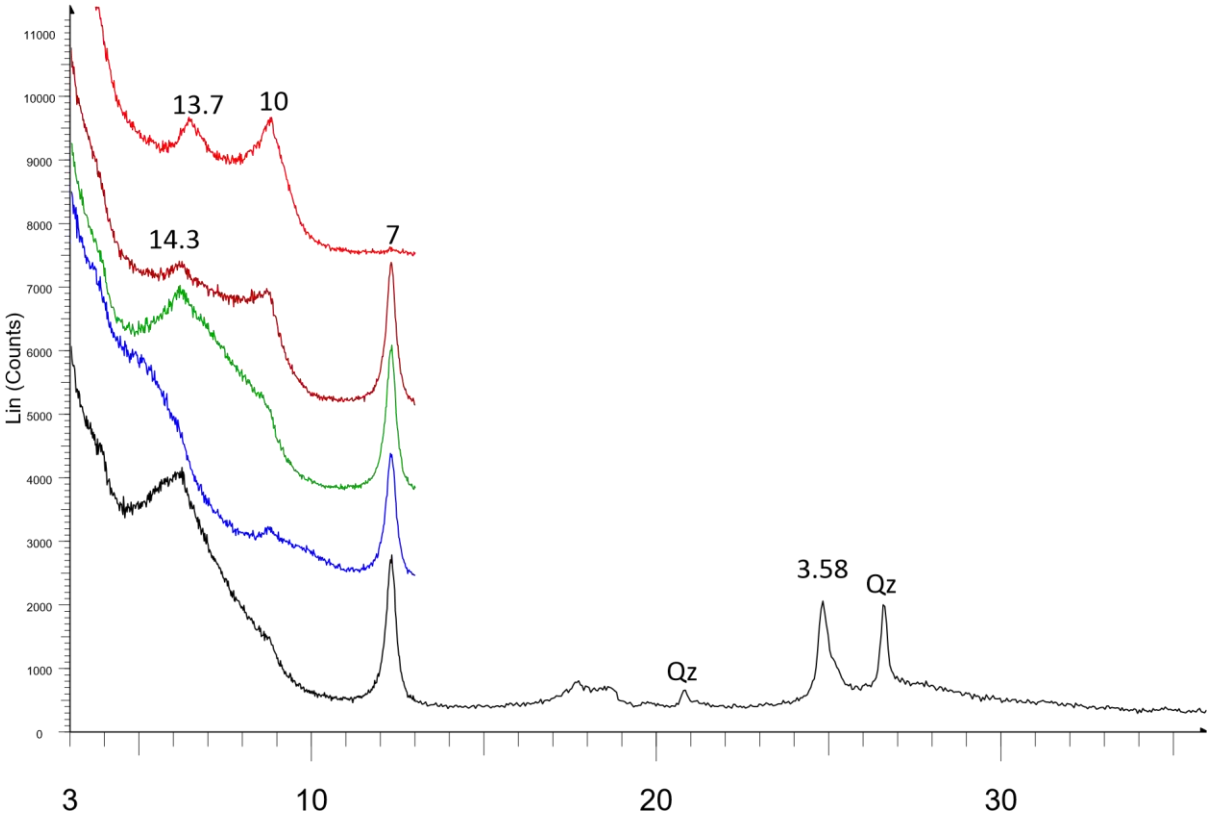

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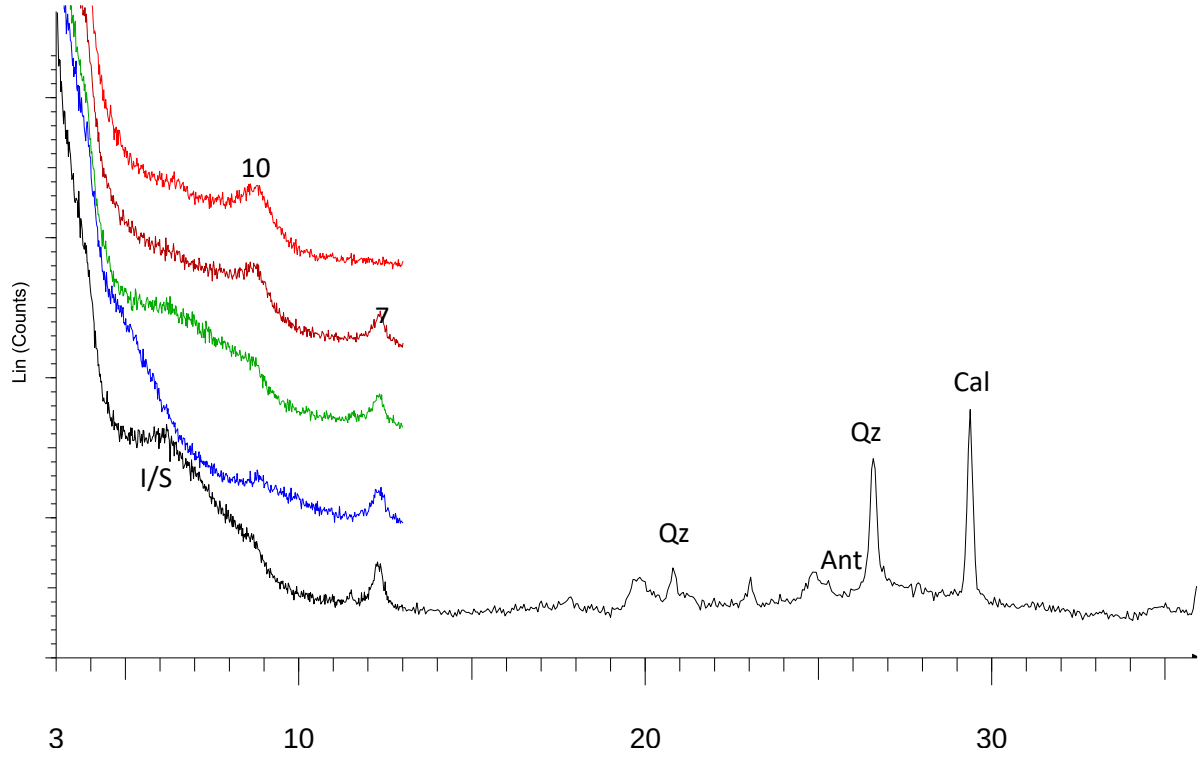

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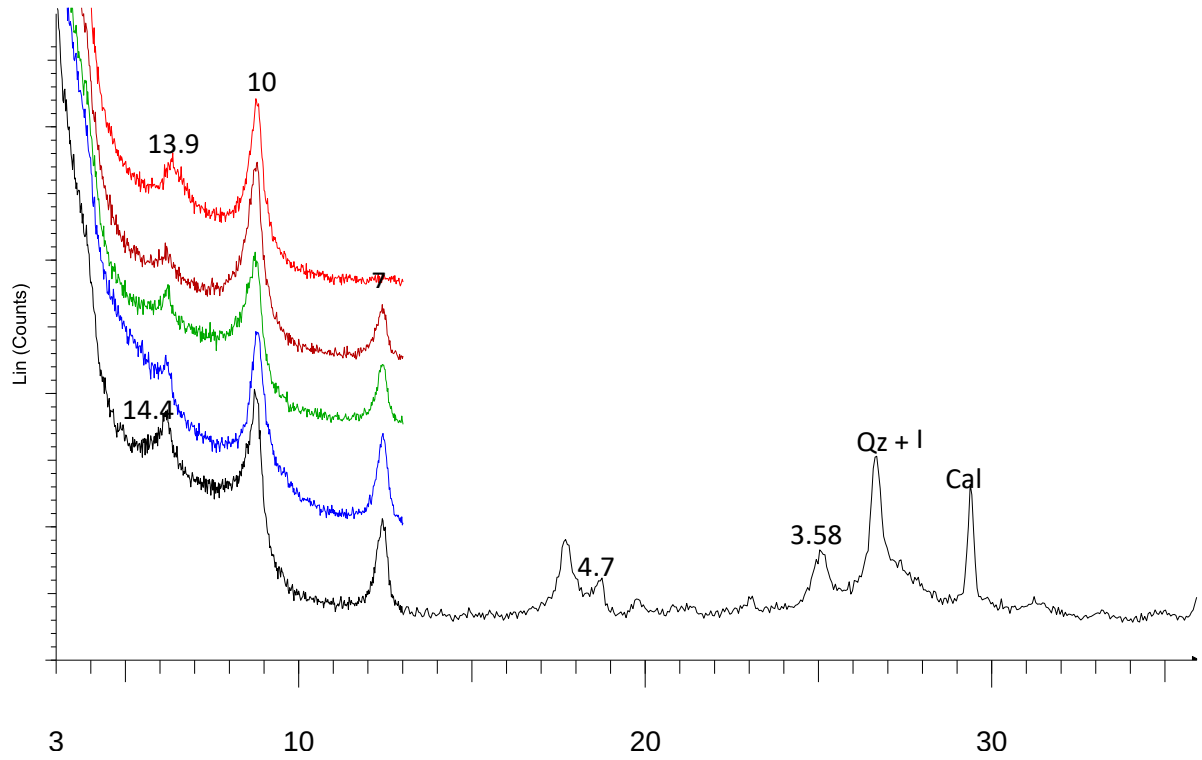

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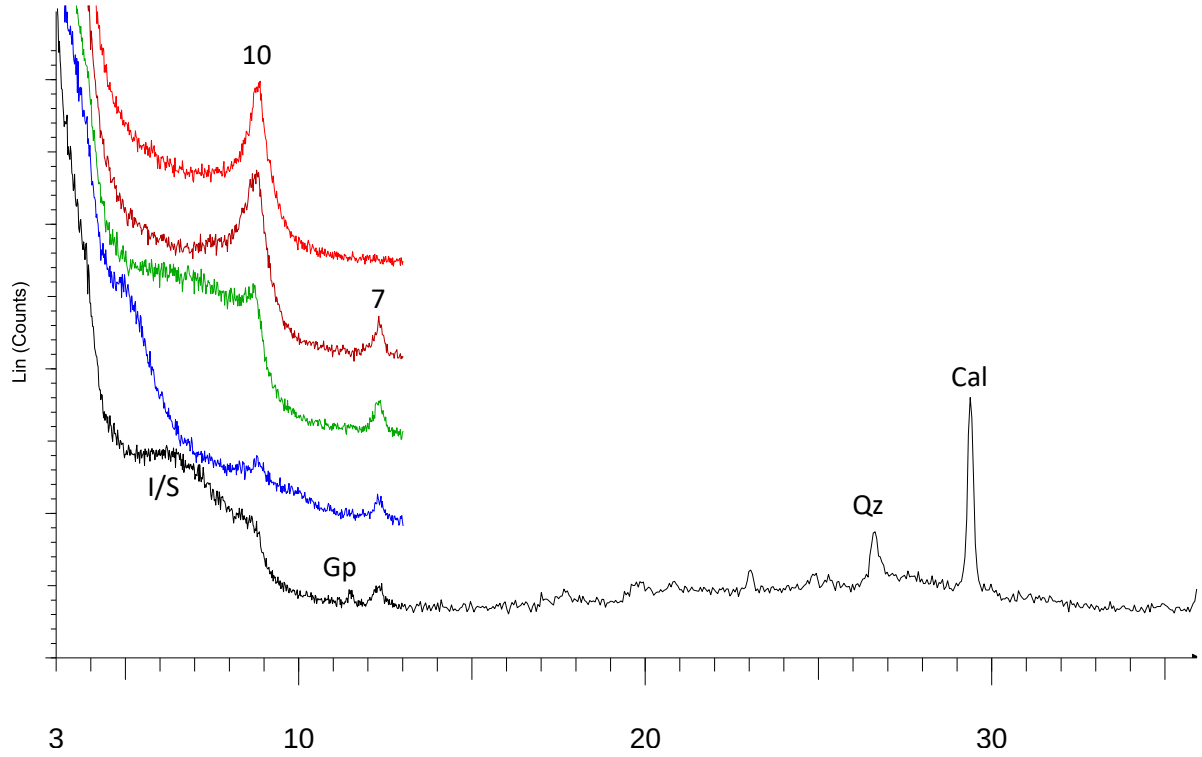

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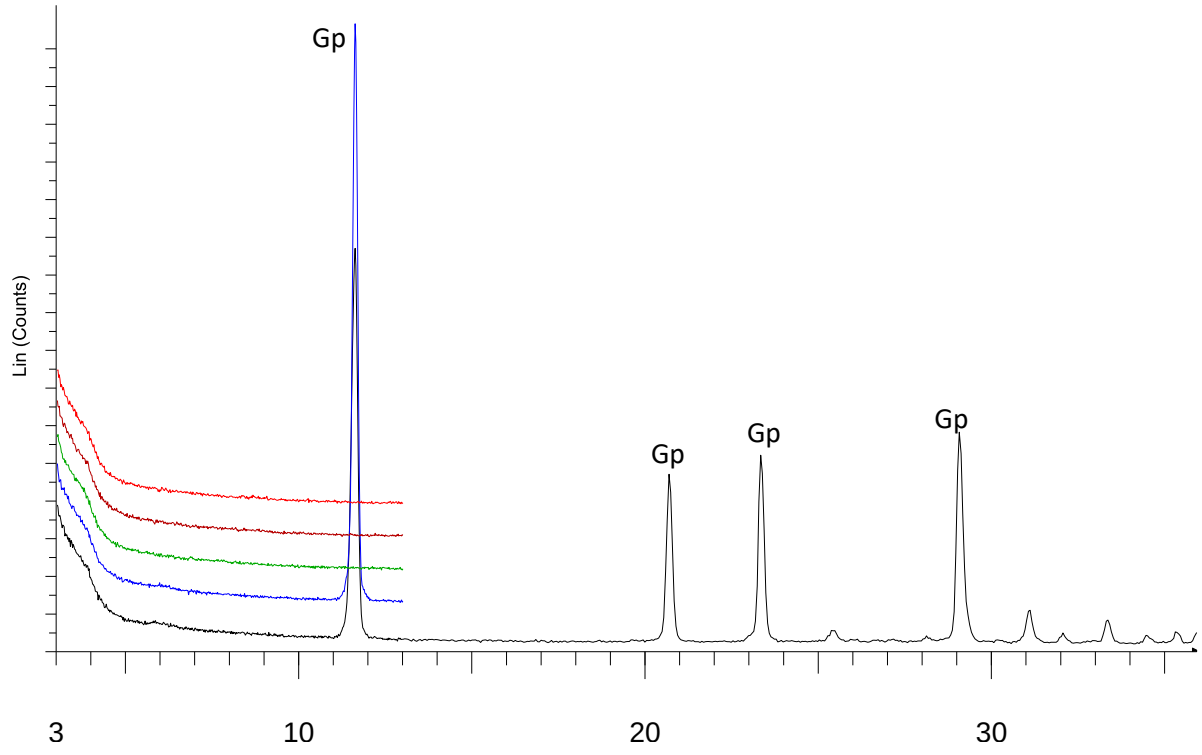

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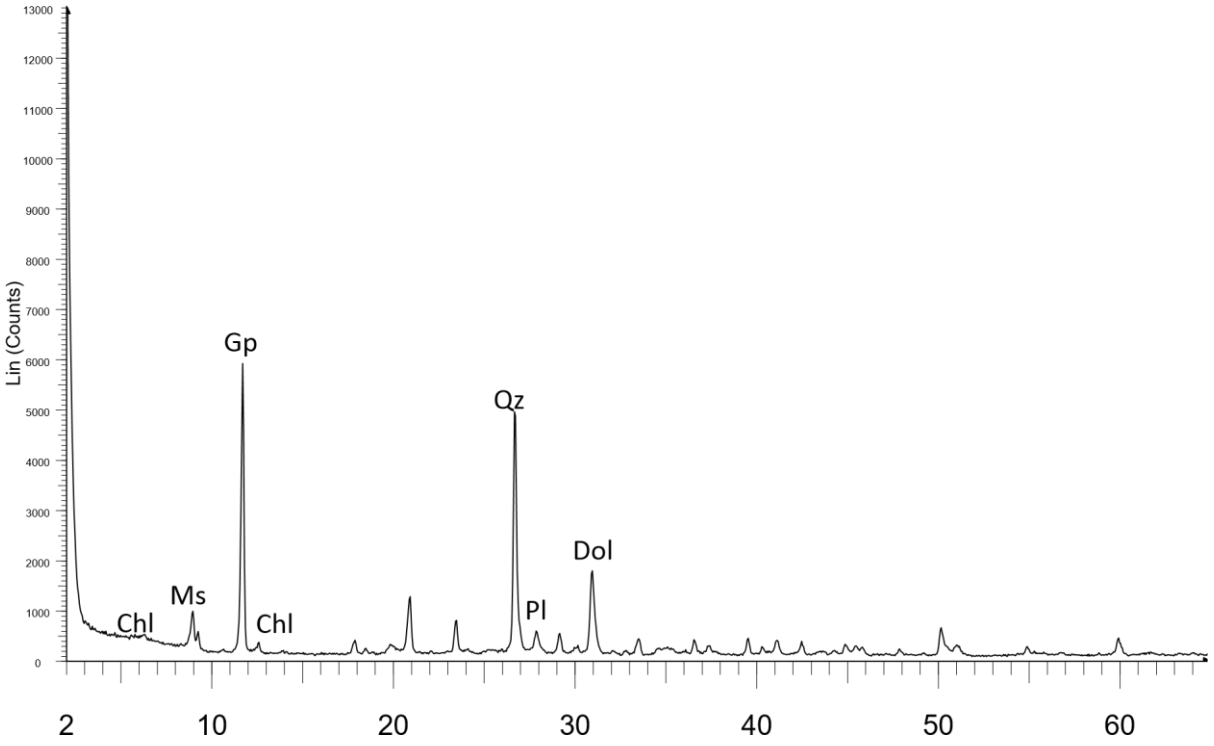

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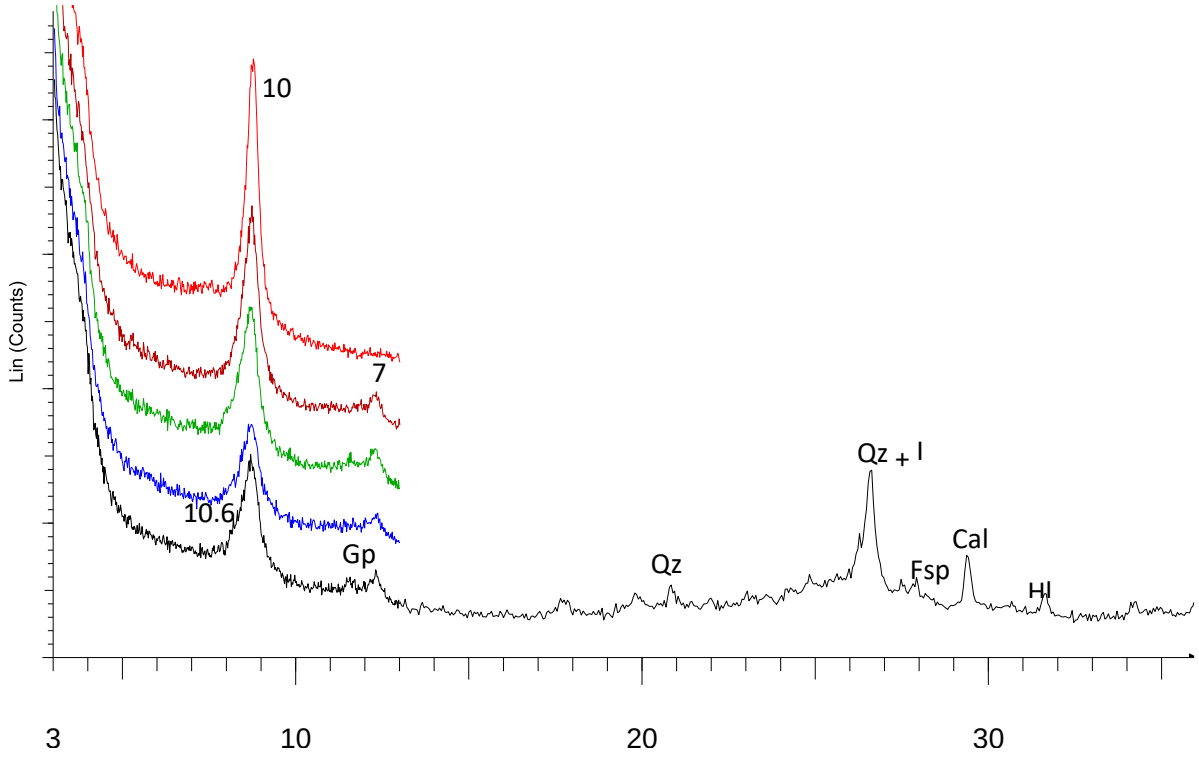

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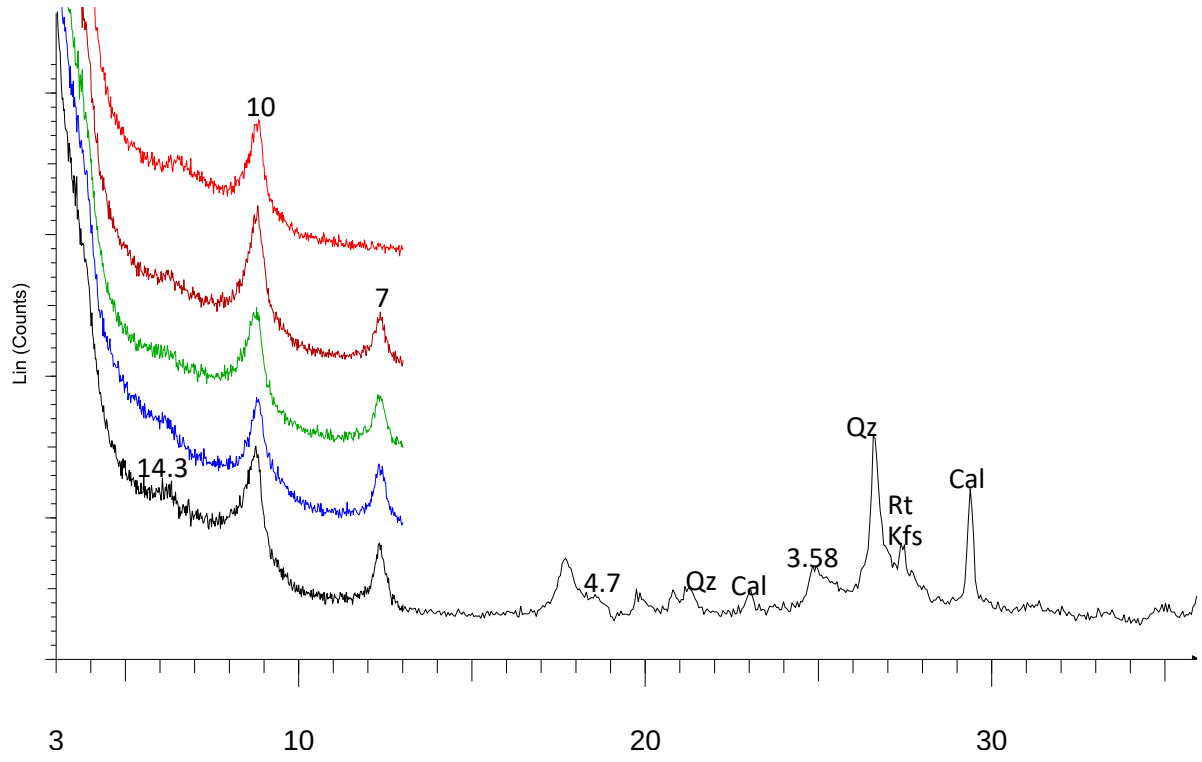

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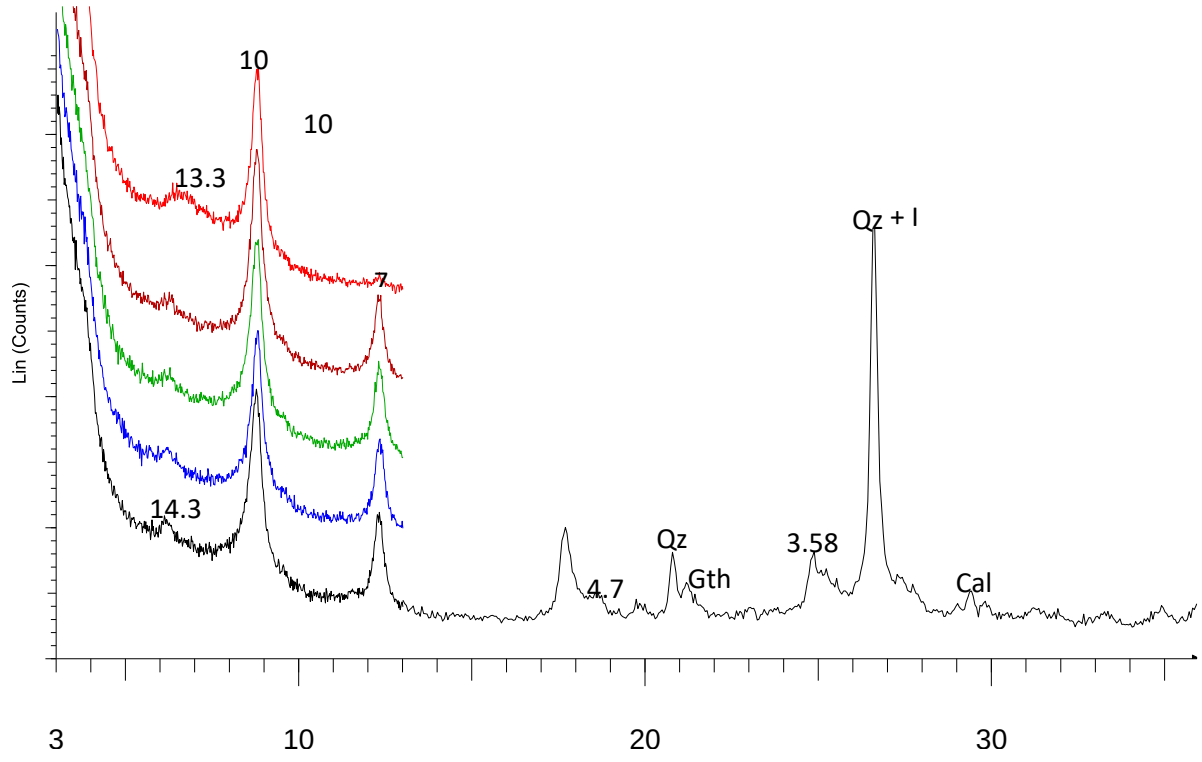

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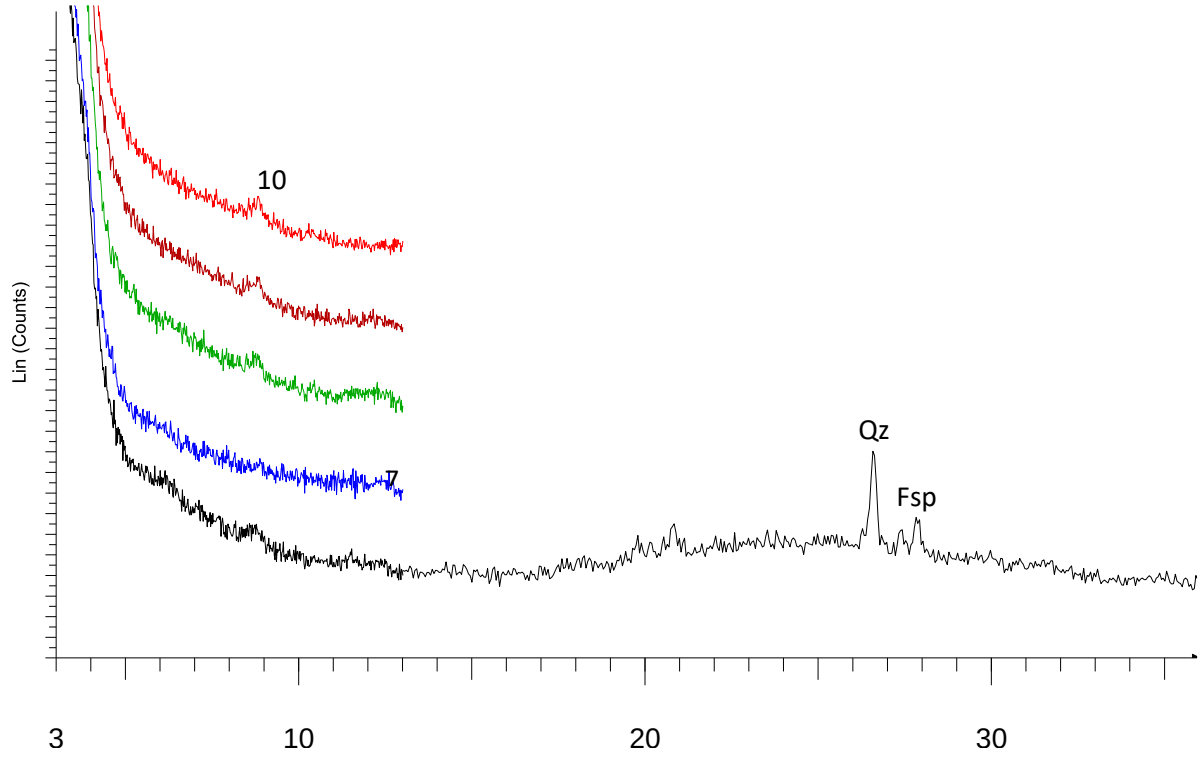

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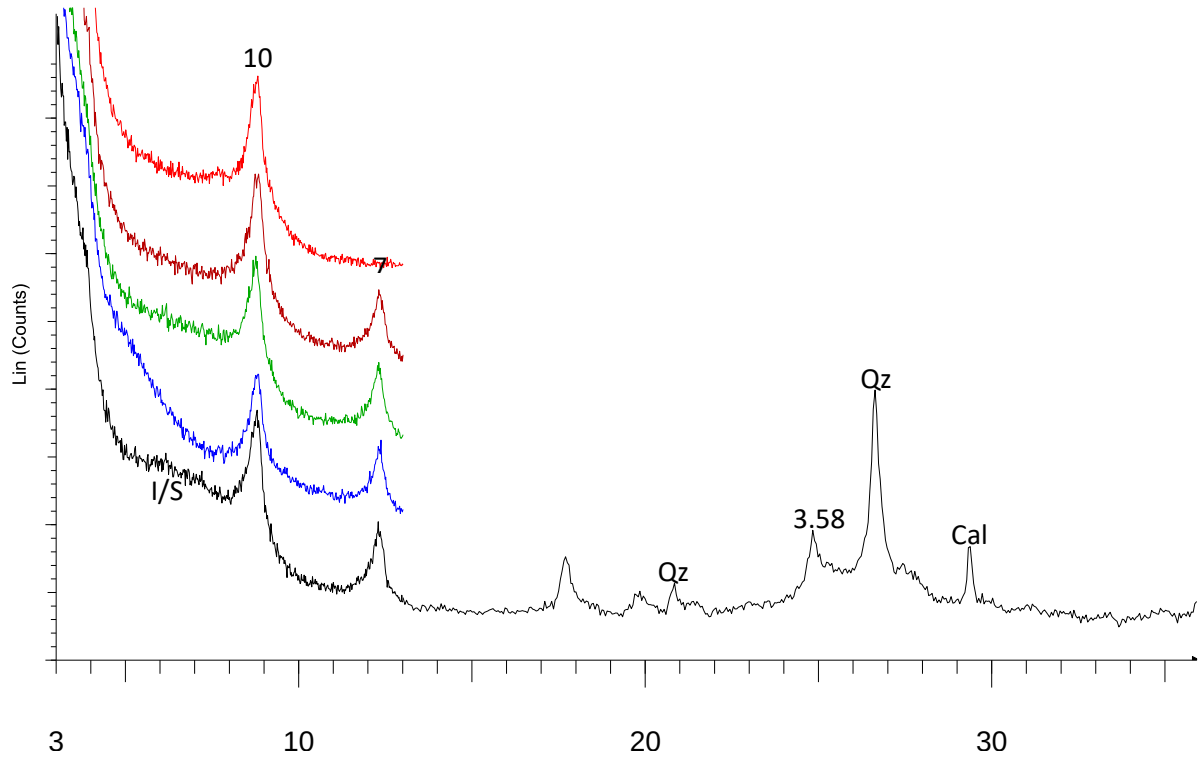

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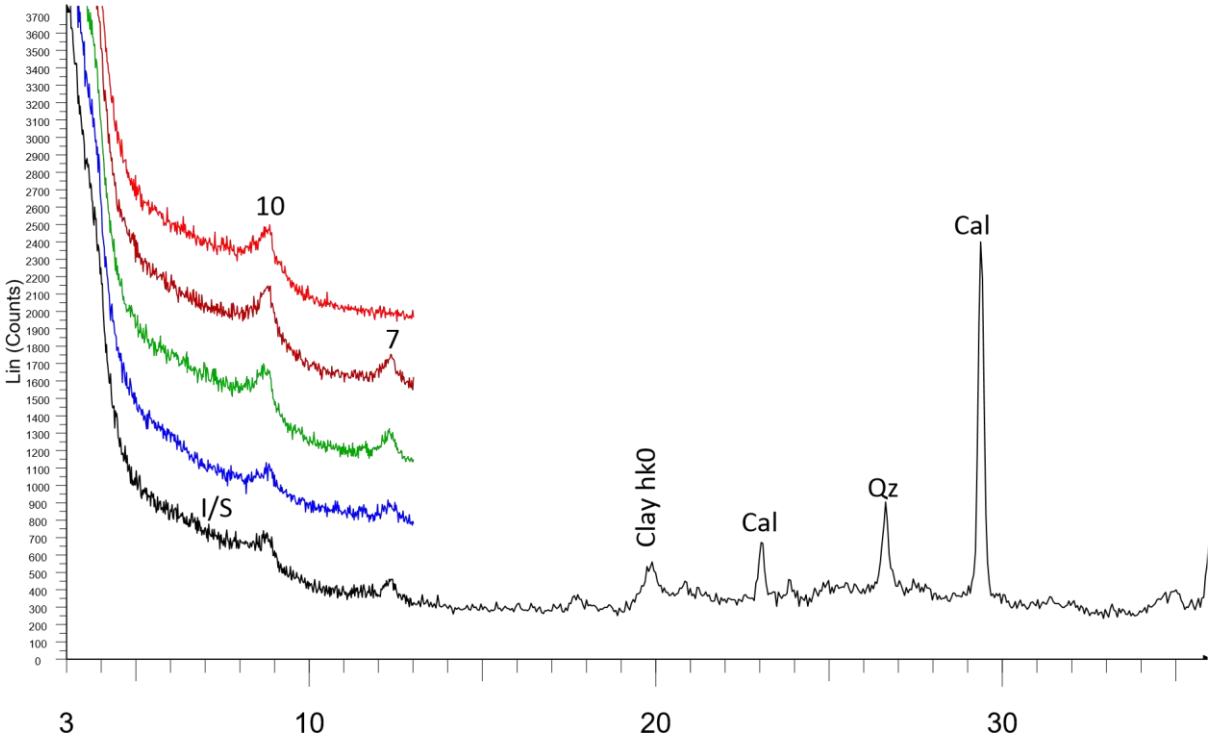

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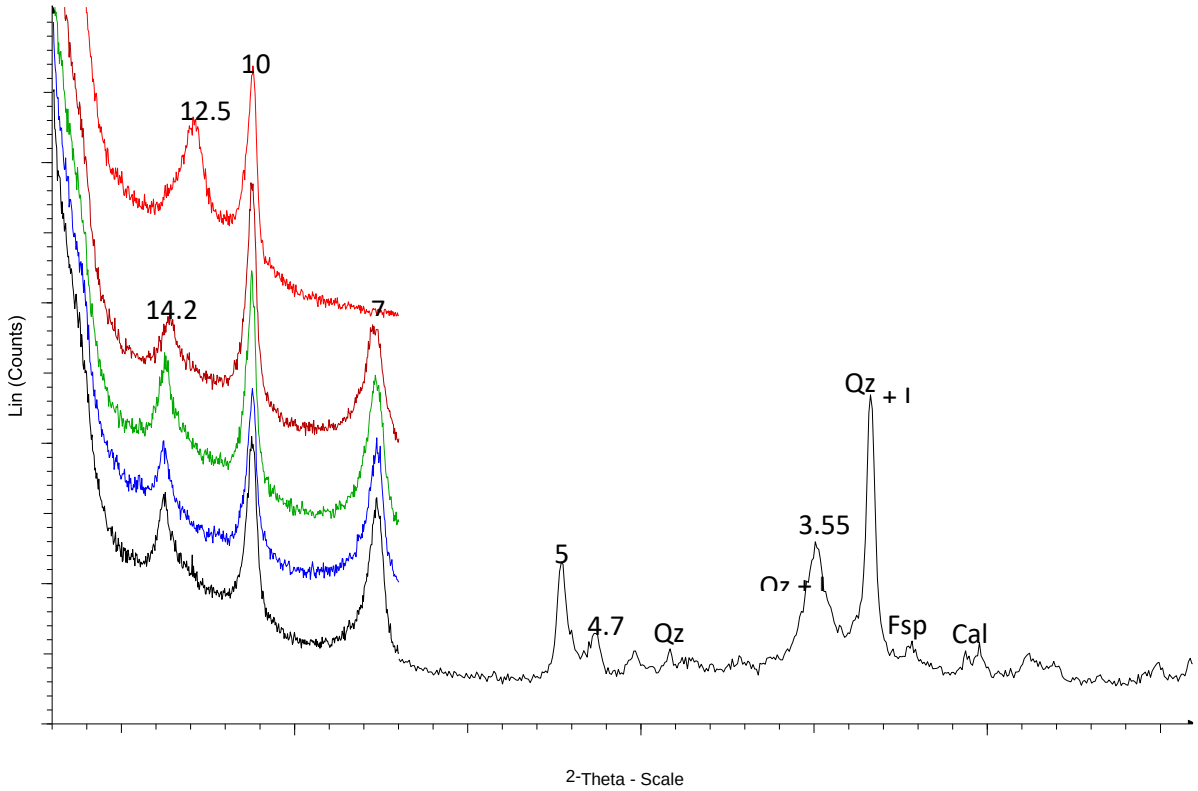

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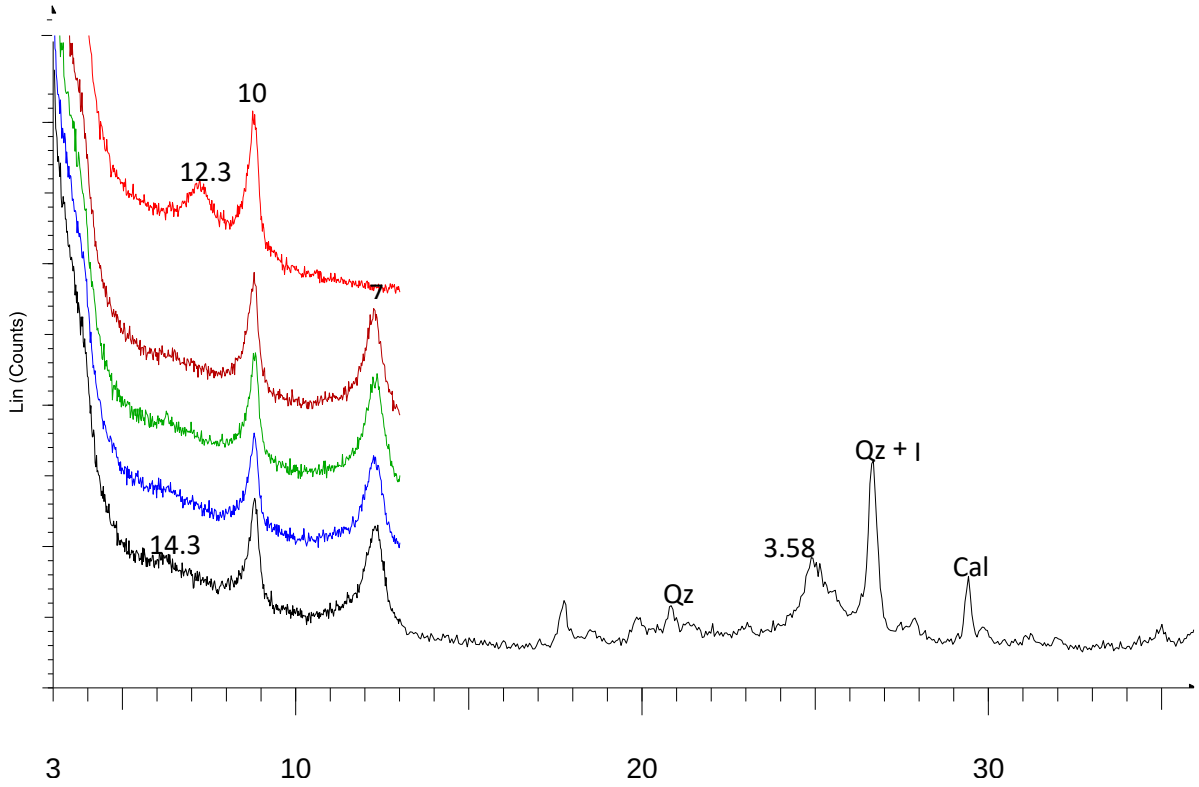

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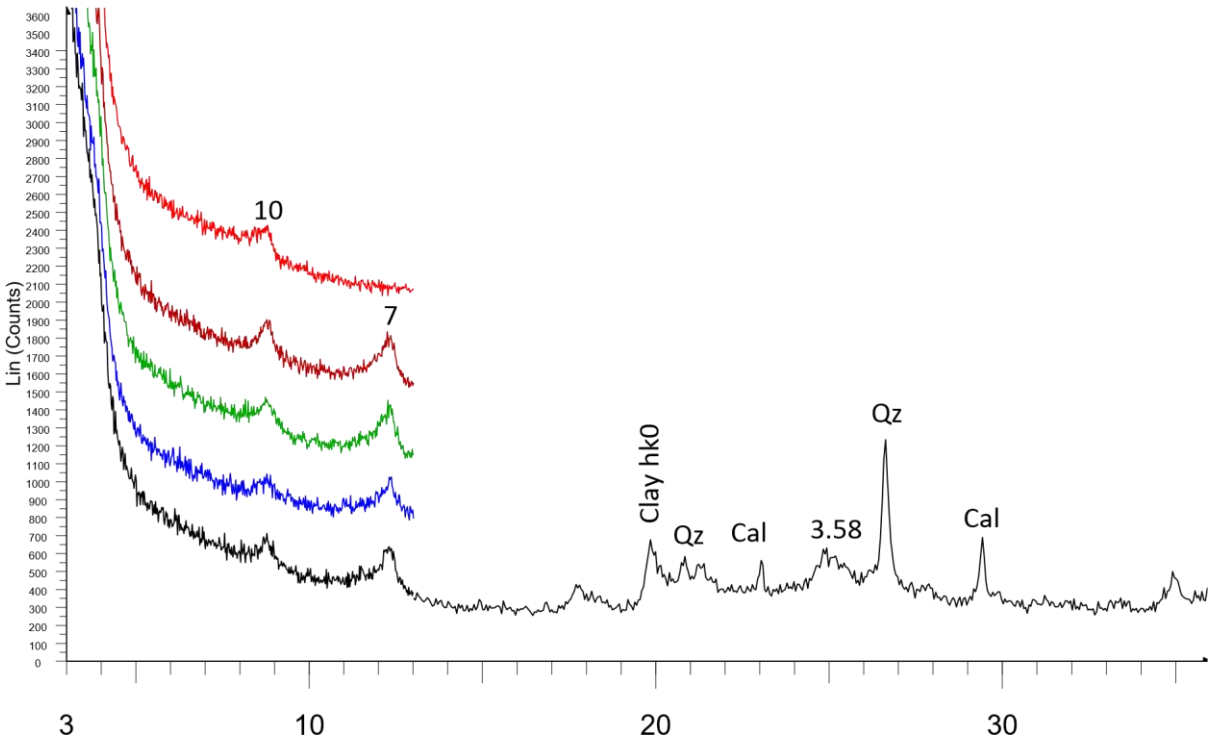

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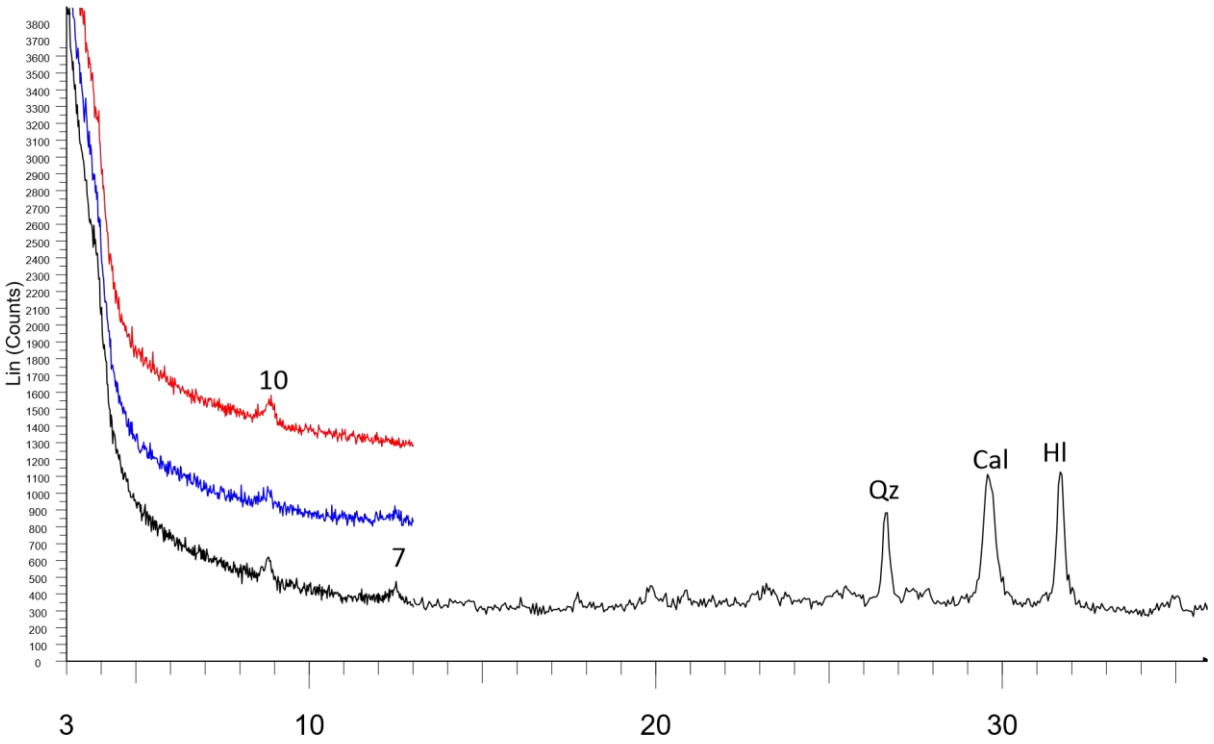

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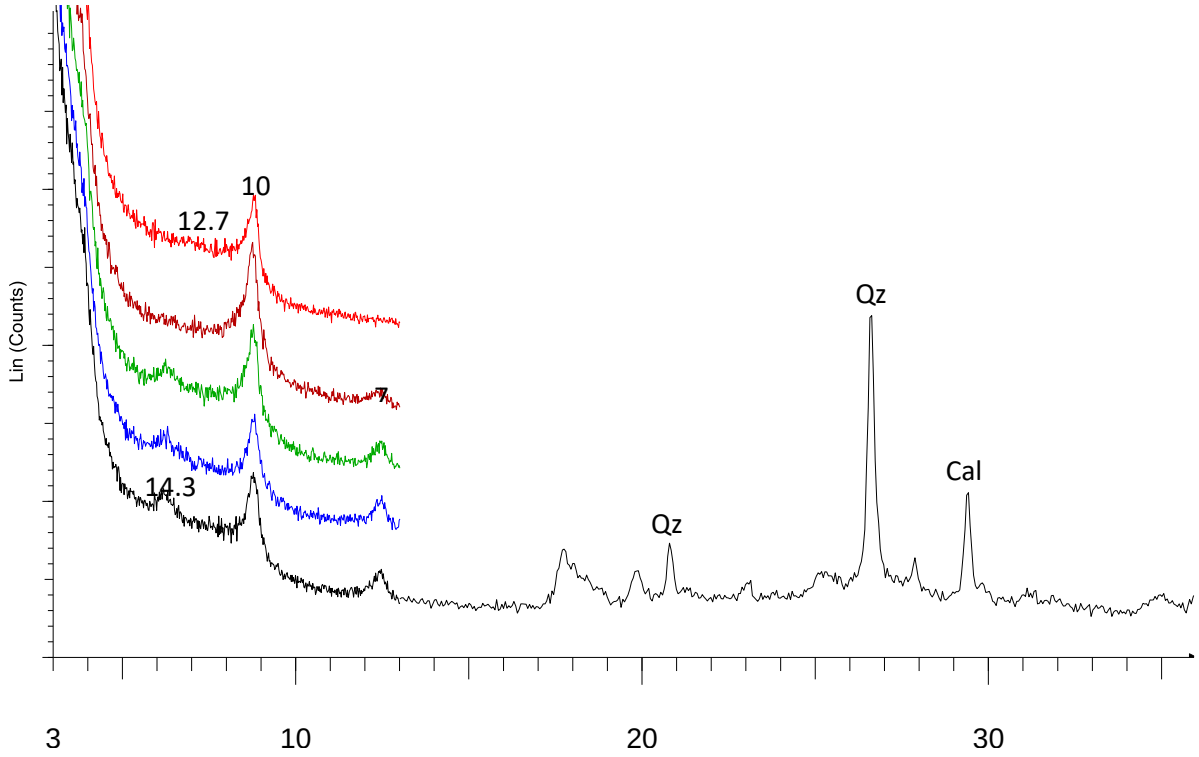

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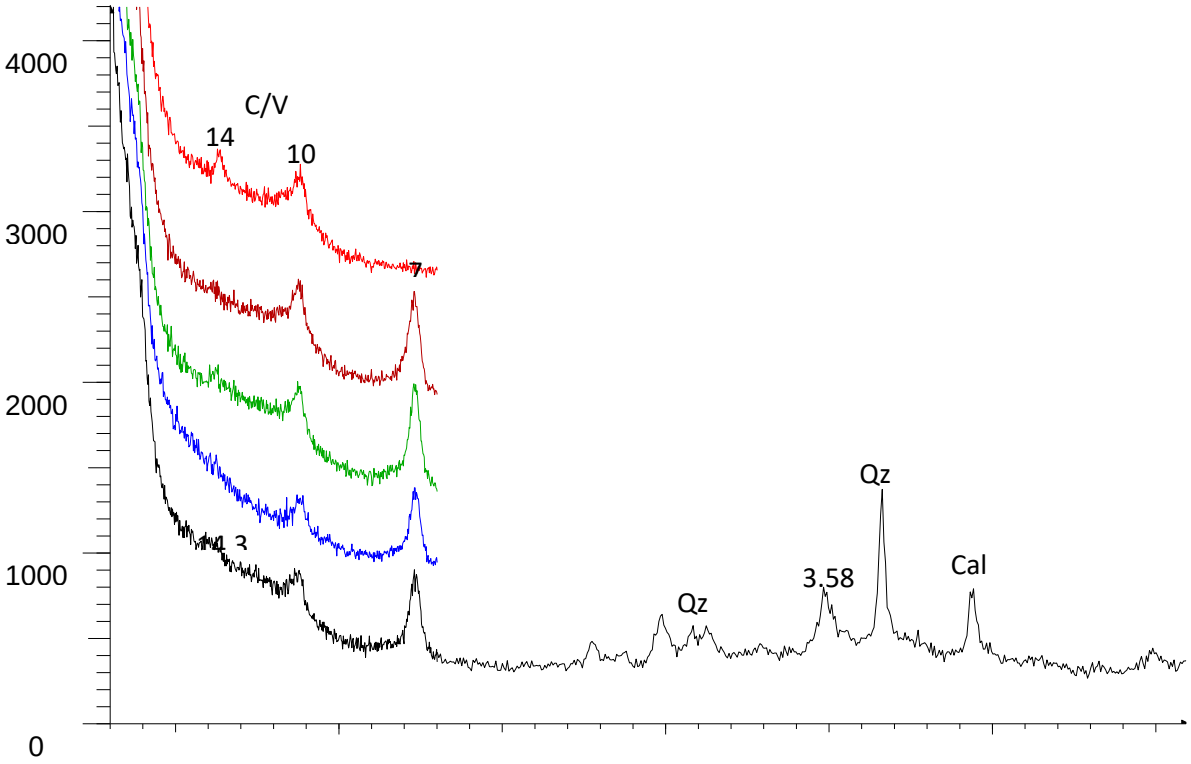

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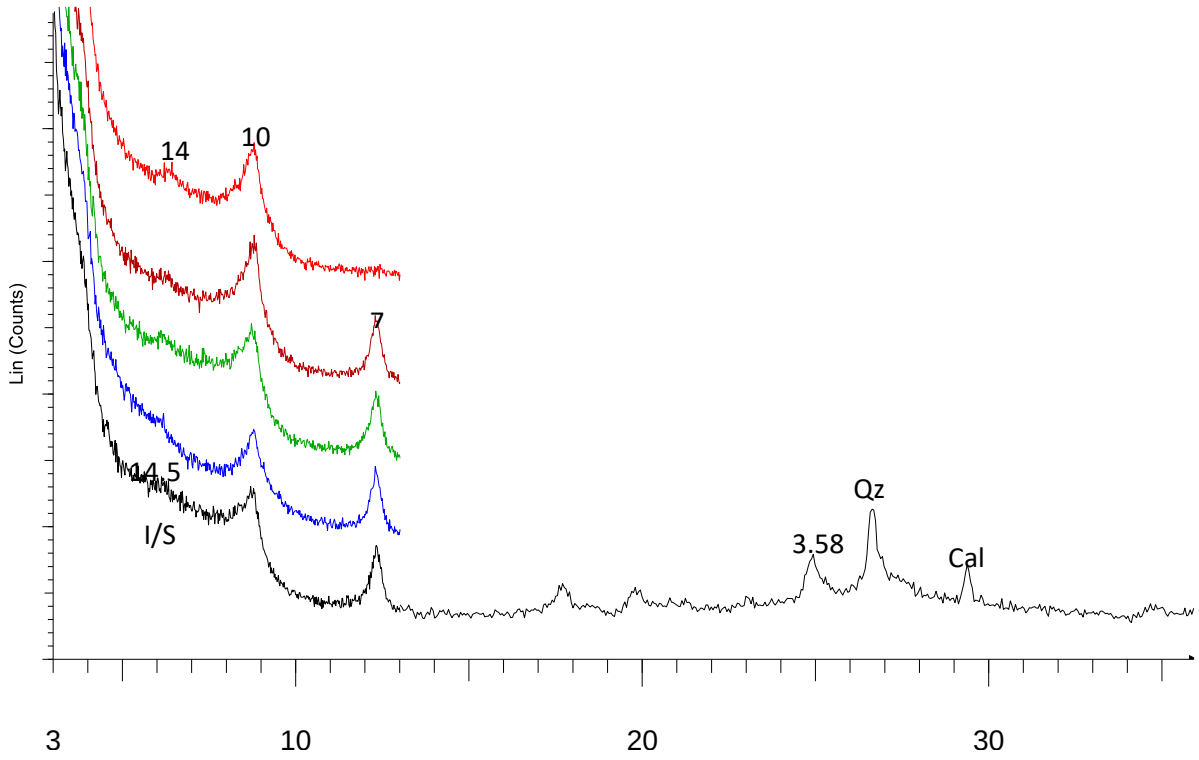

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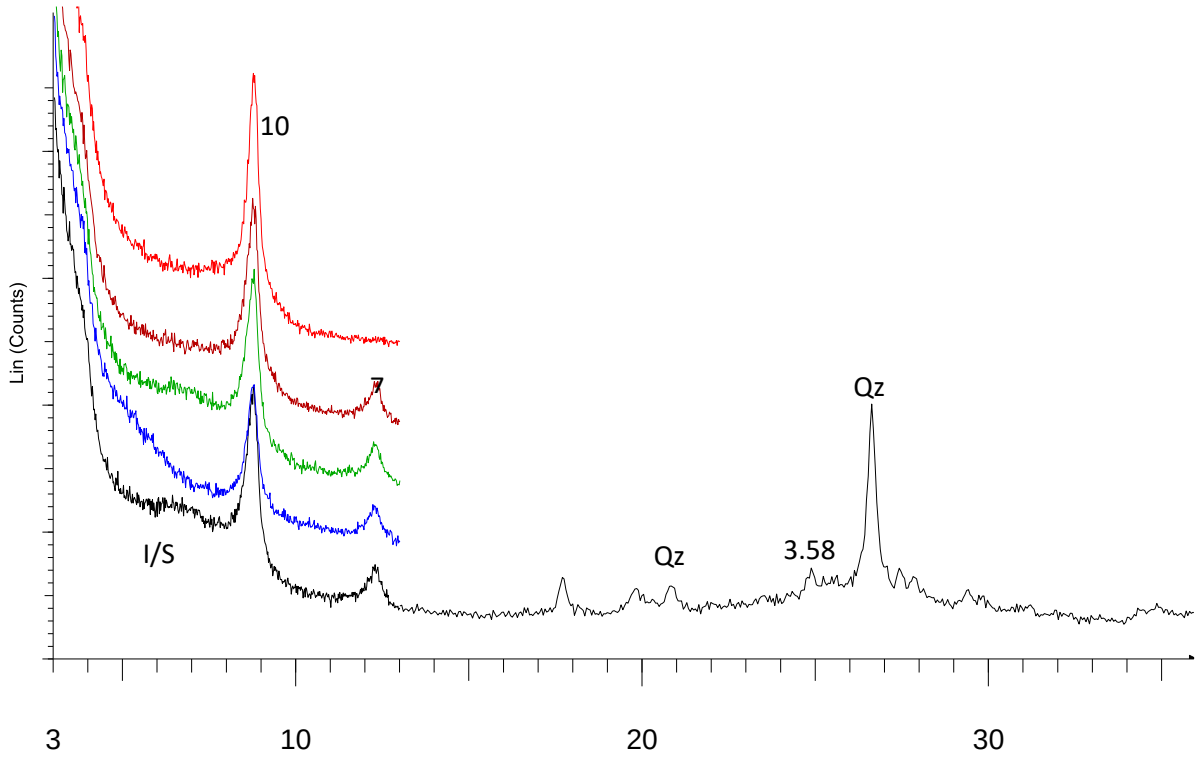
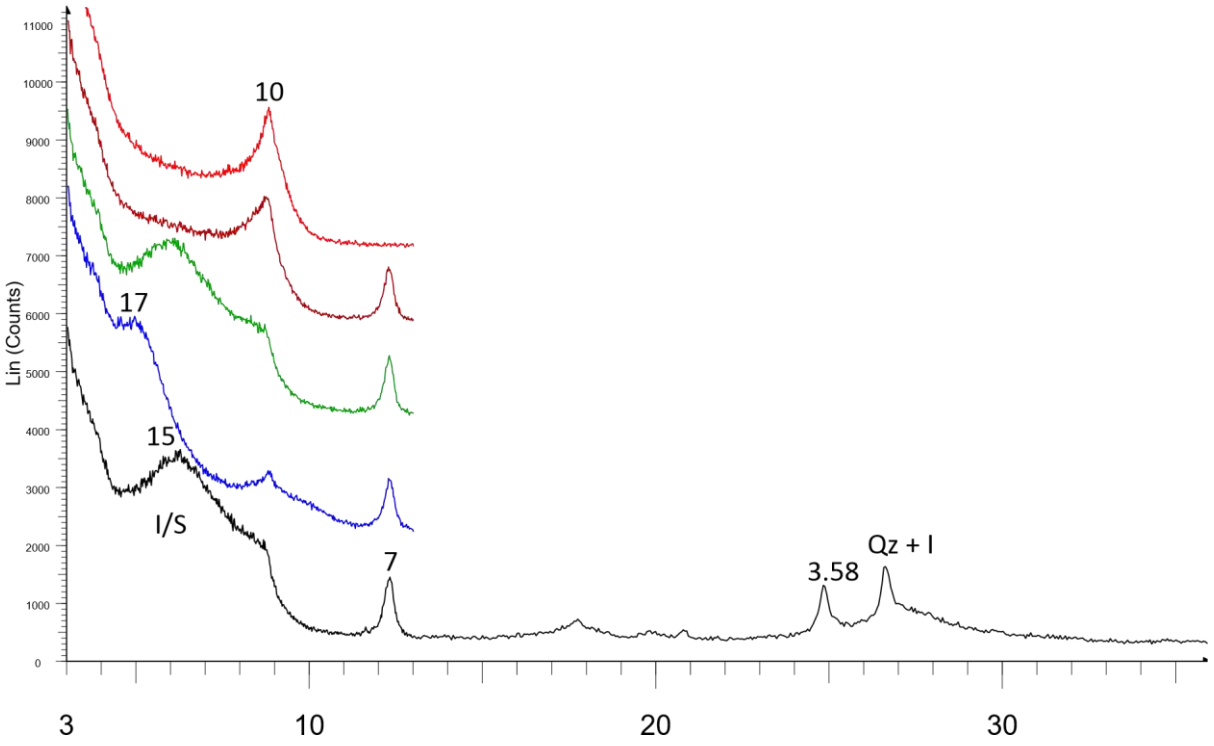


LU17 00189 035 (49120)



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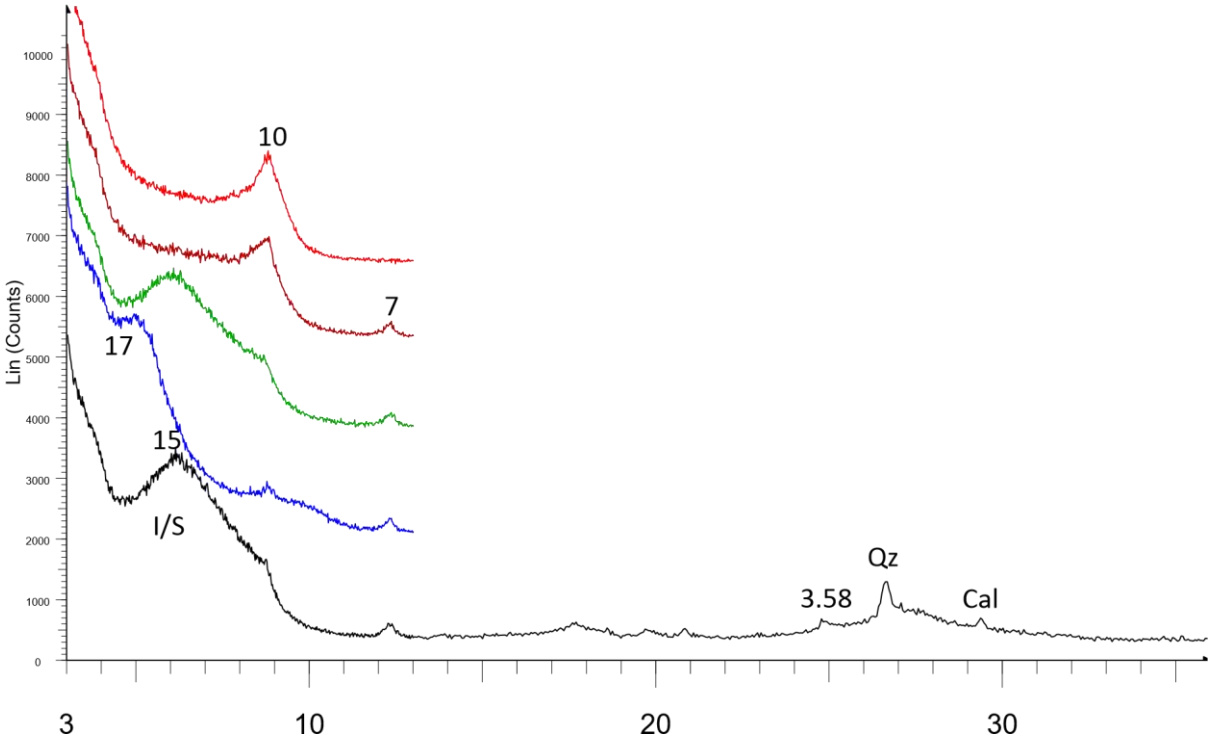

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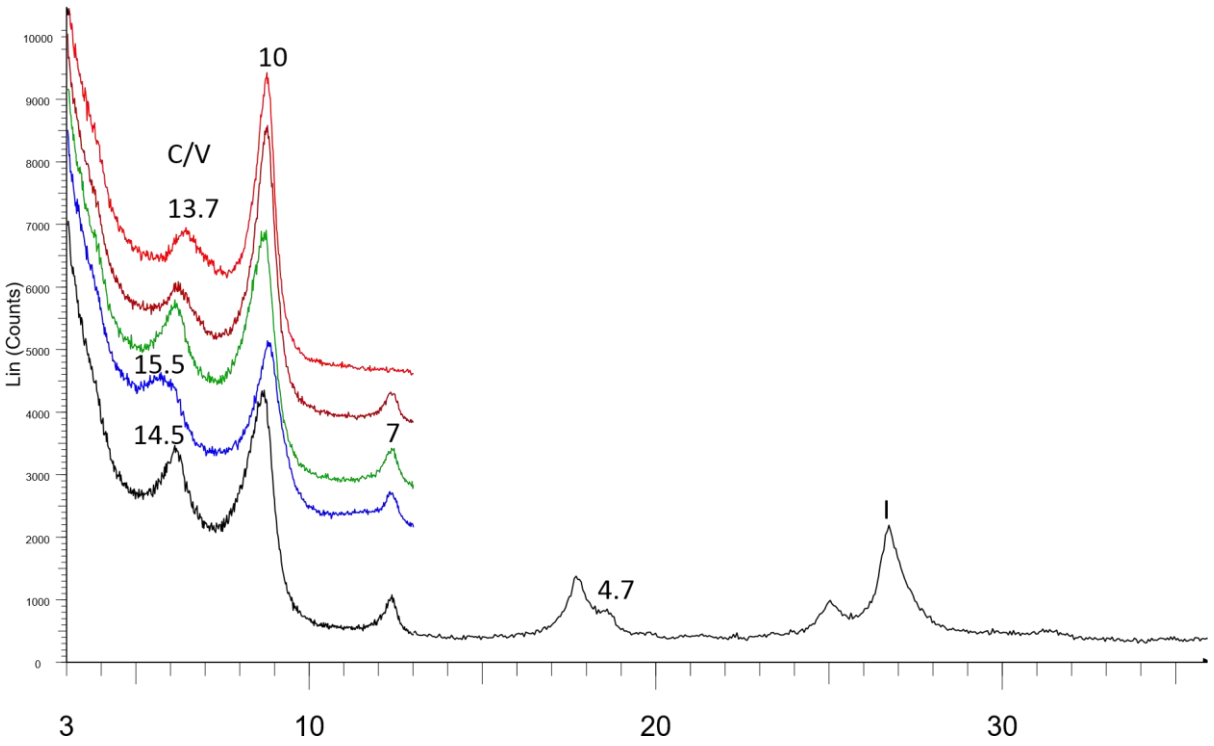
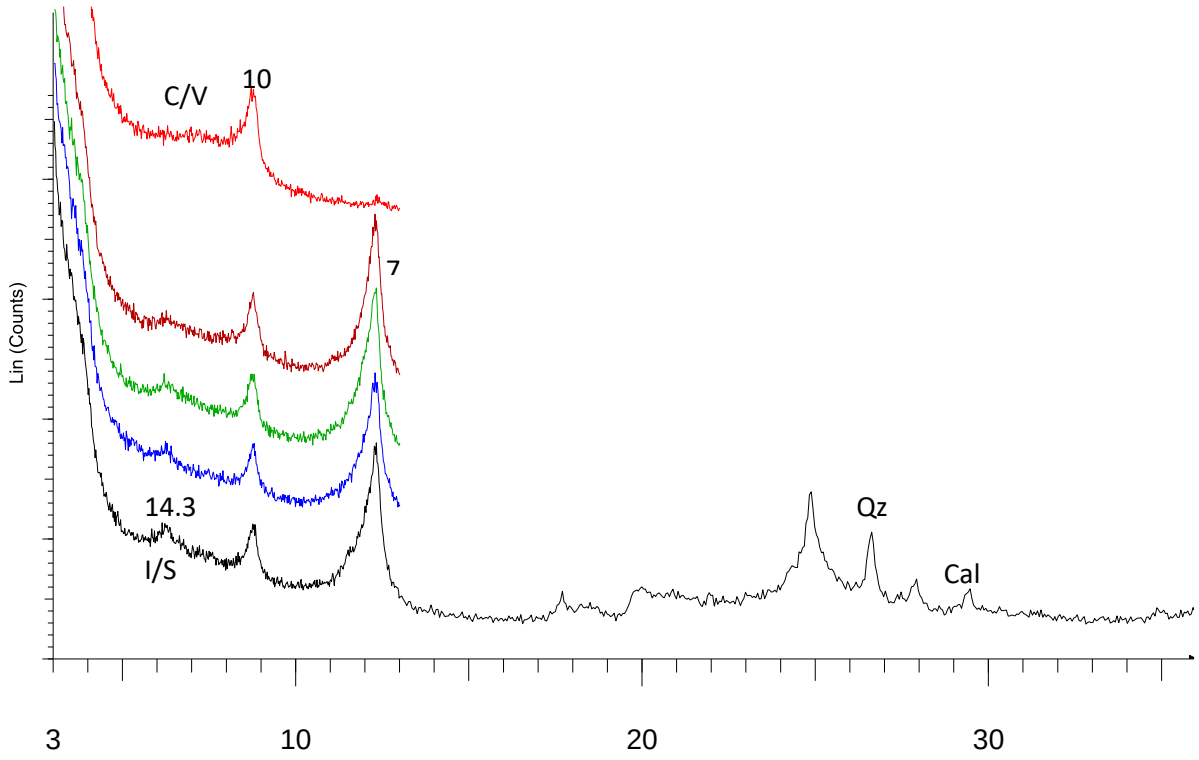
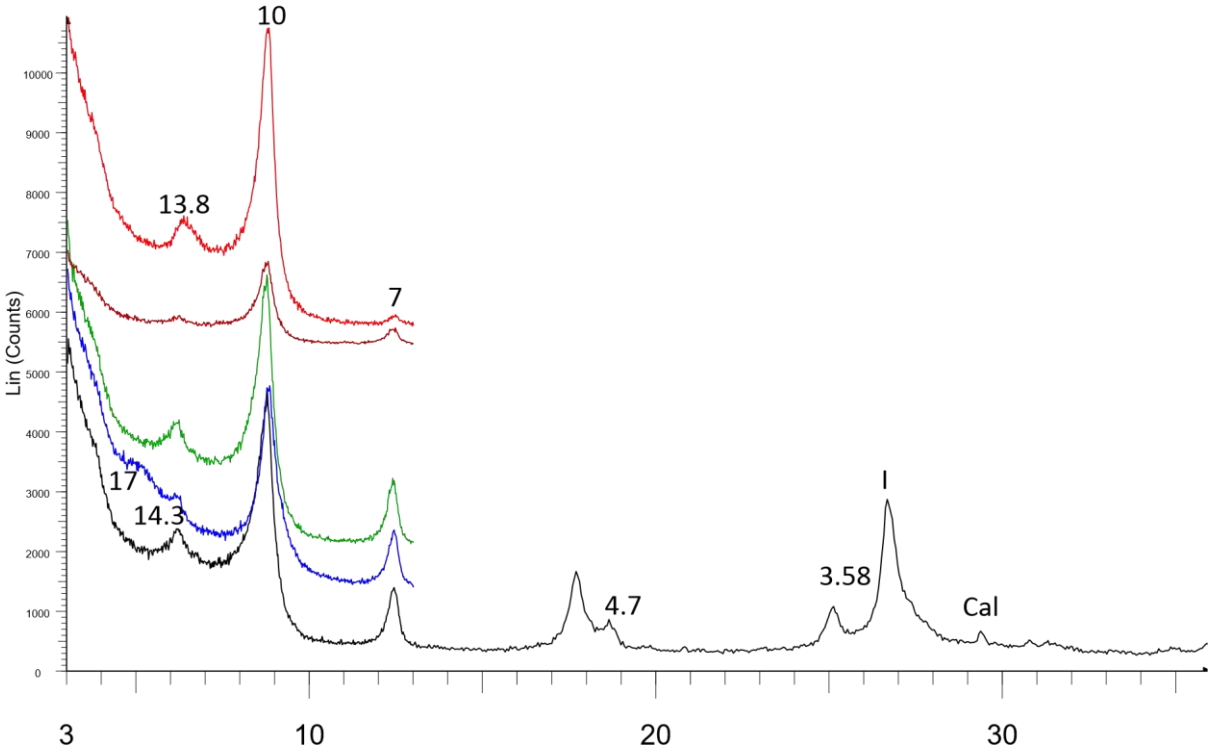


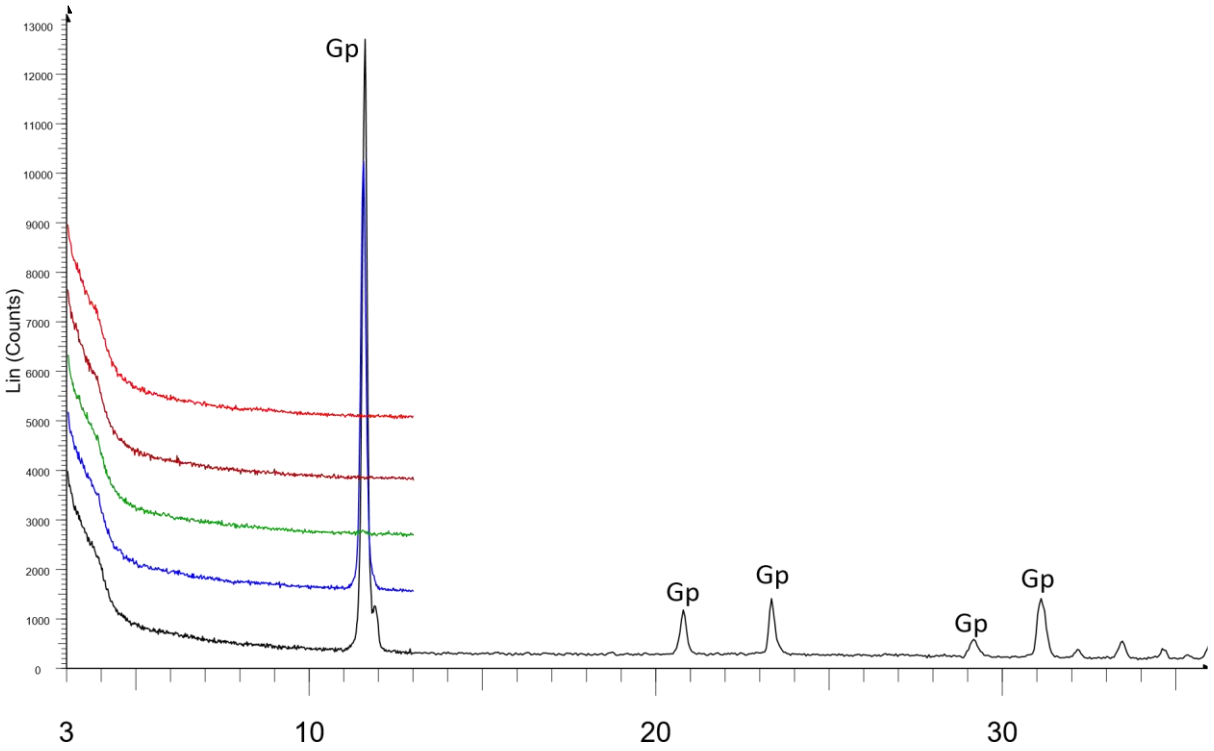
LU17 00189 038 (49164)



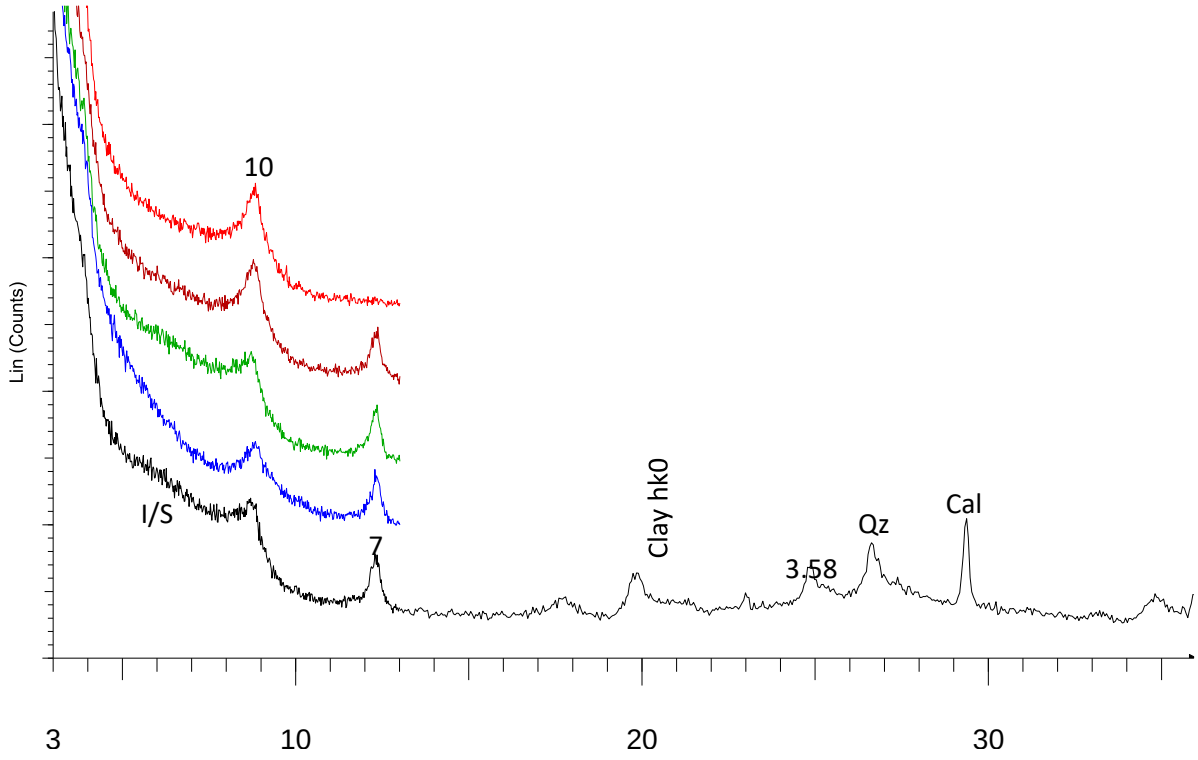
LU17 00189 039 (49262)



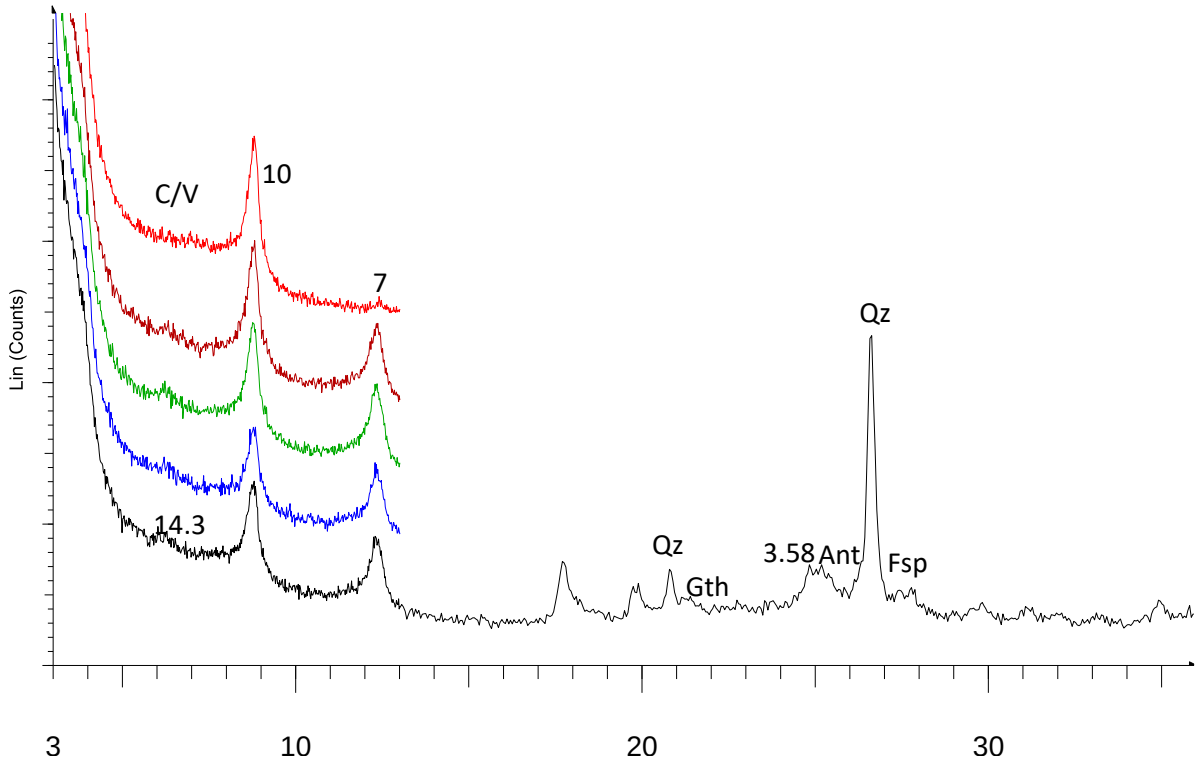
LU17 00189 040 (49282)



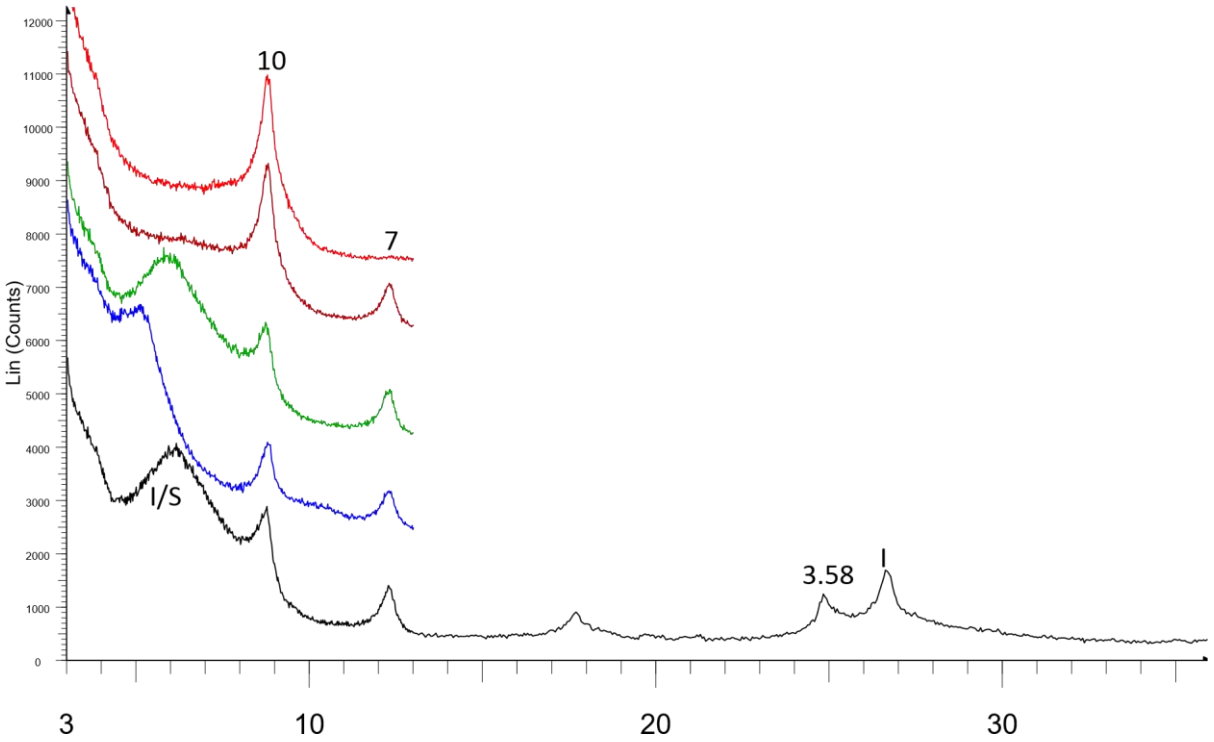
LU17 00189 041 (49515)



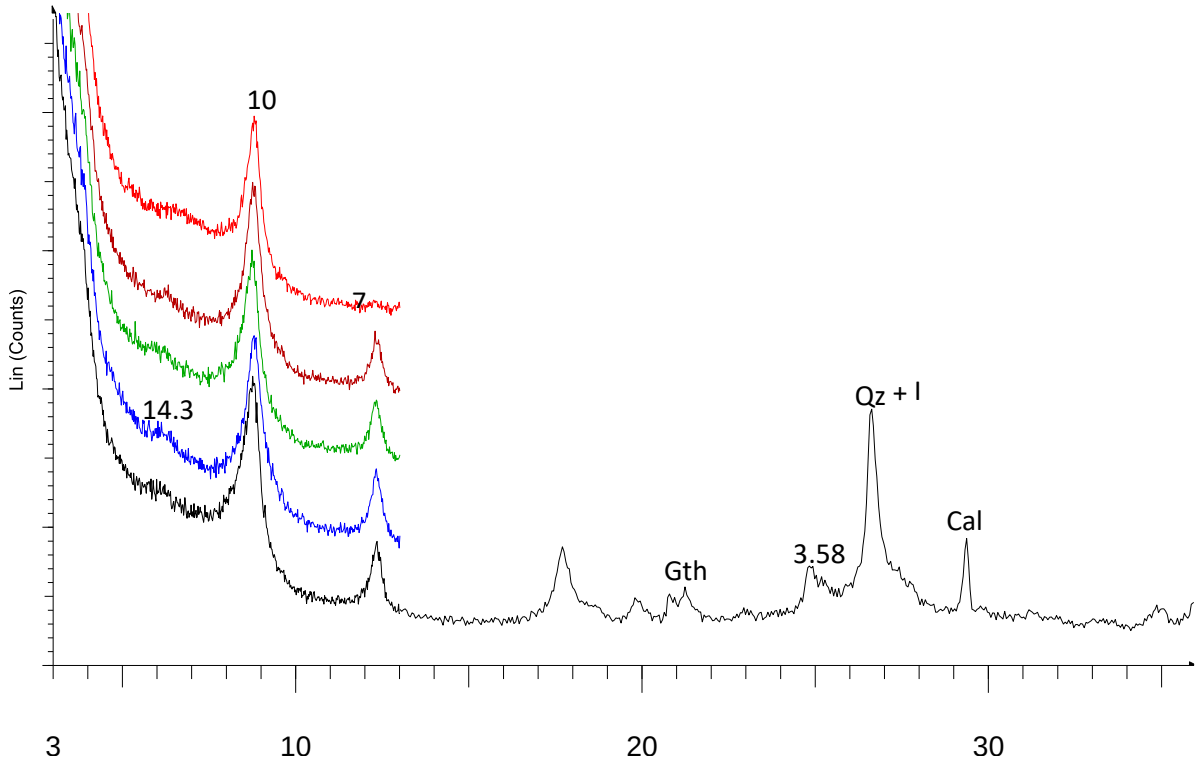
LU17 00189 042 (49700)



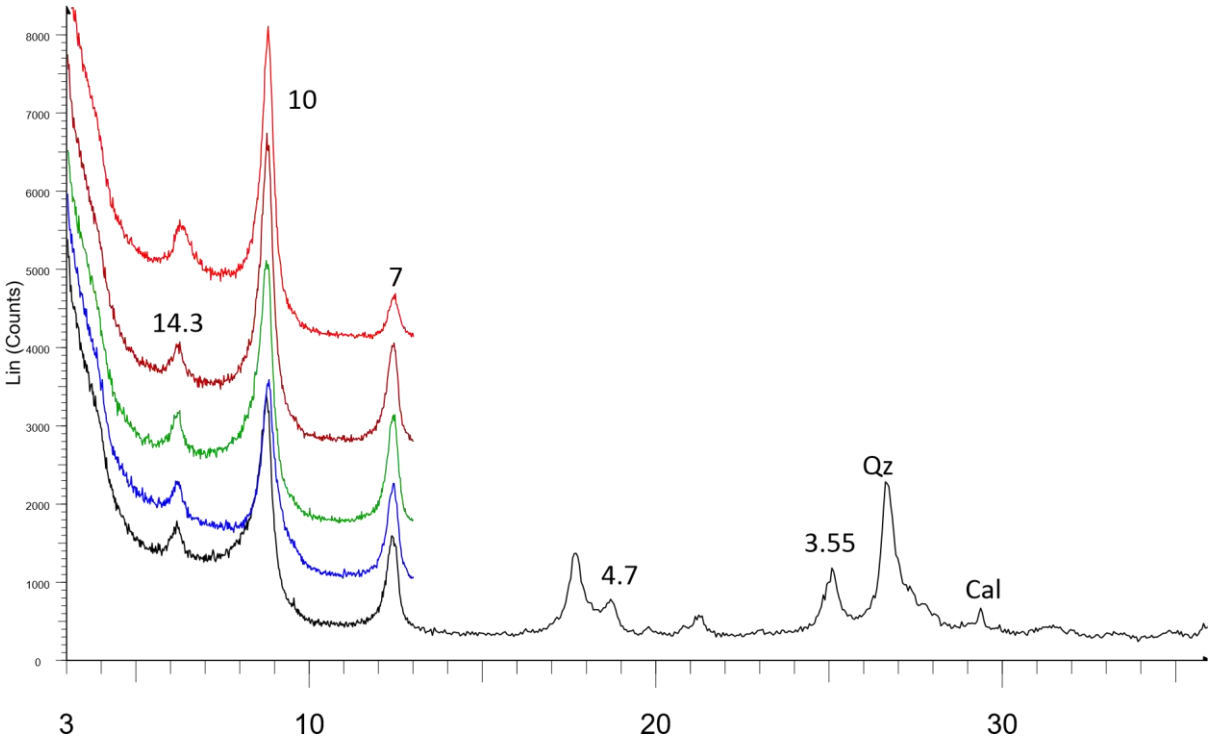
LU17 00189 043 (49899)



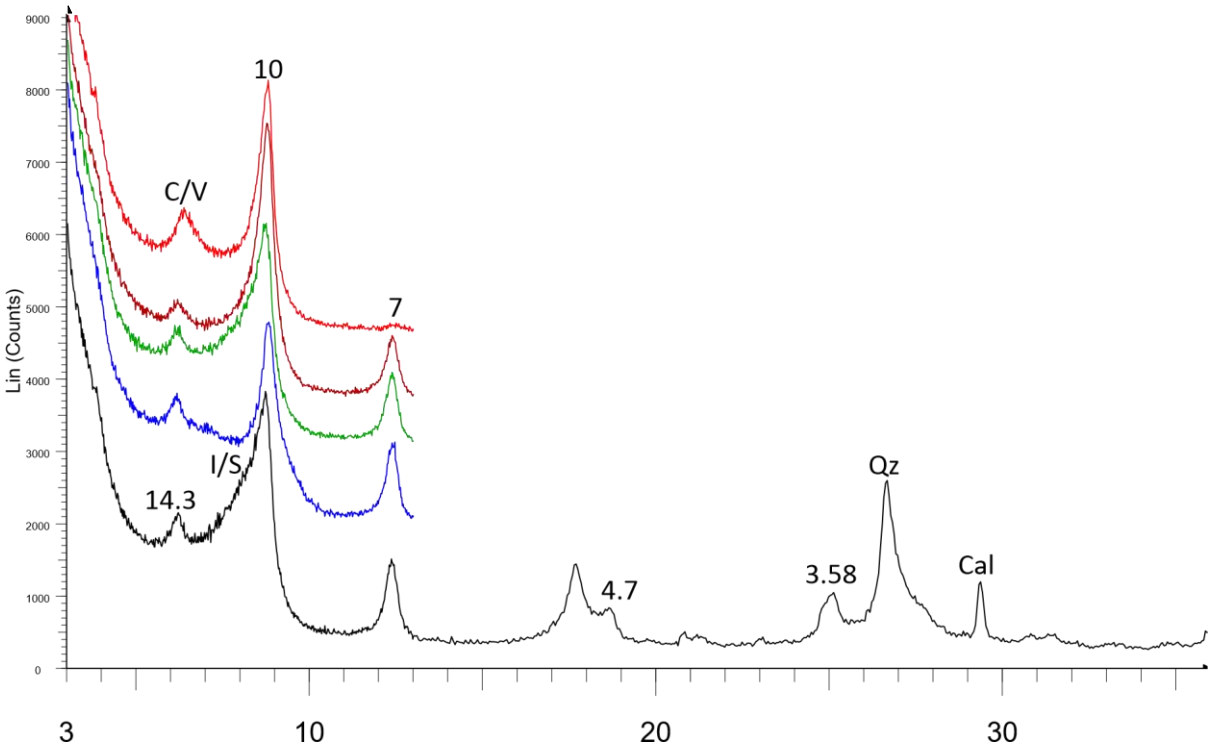
LU17 00189 044 (50147)



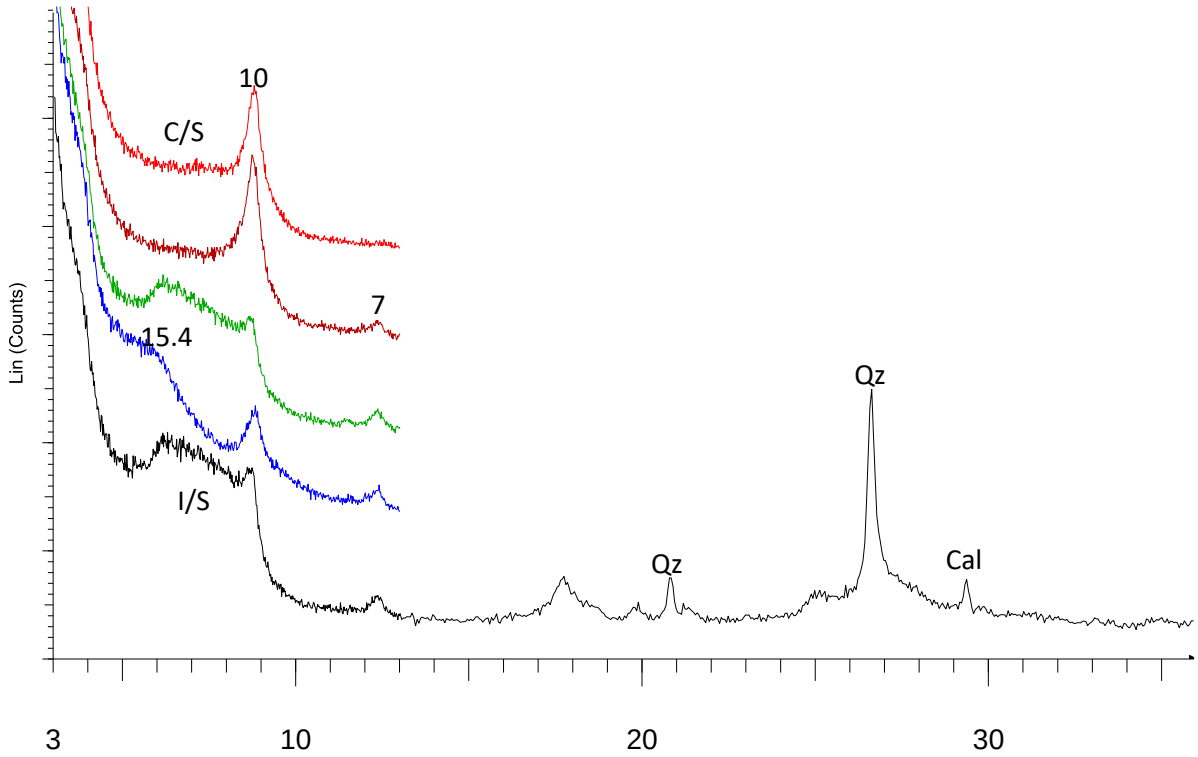
LU17 00189 045 (50265)



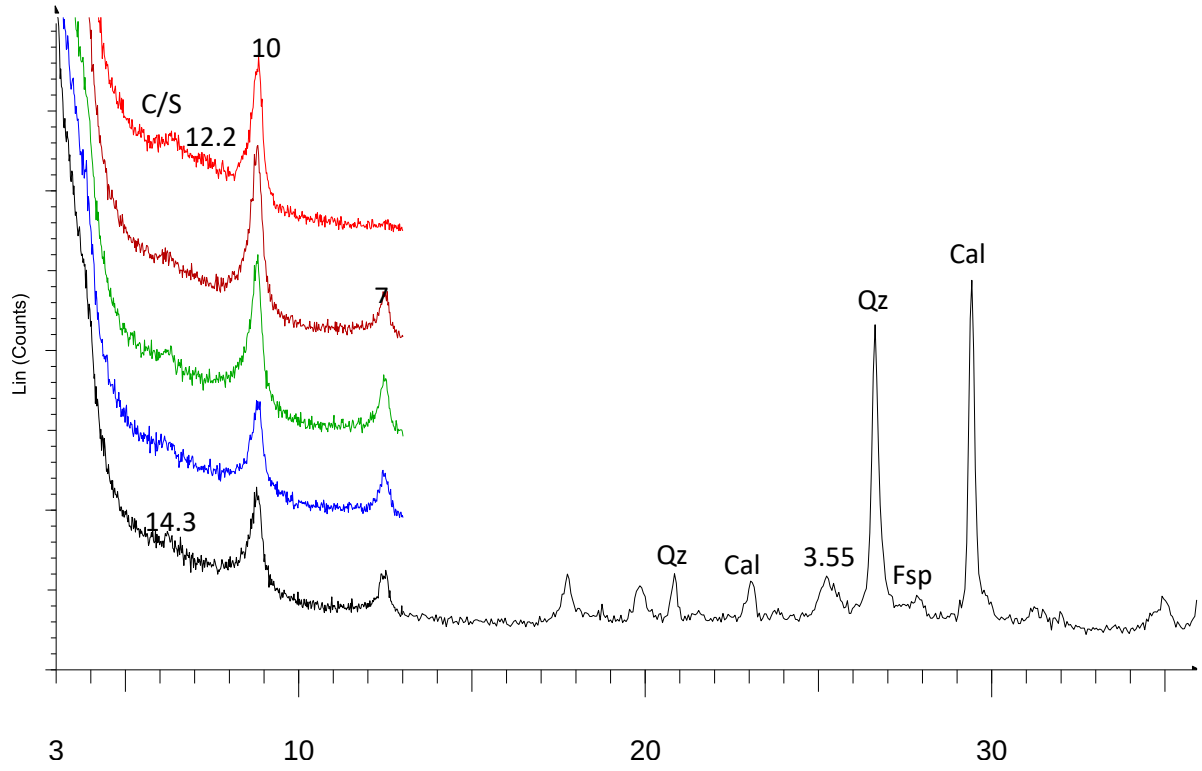
LU17 00189 046 (50566)



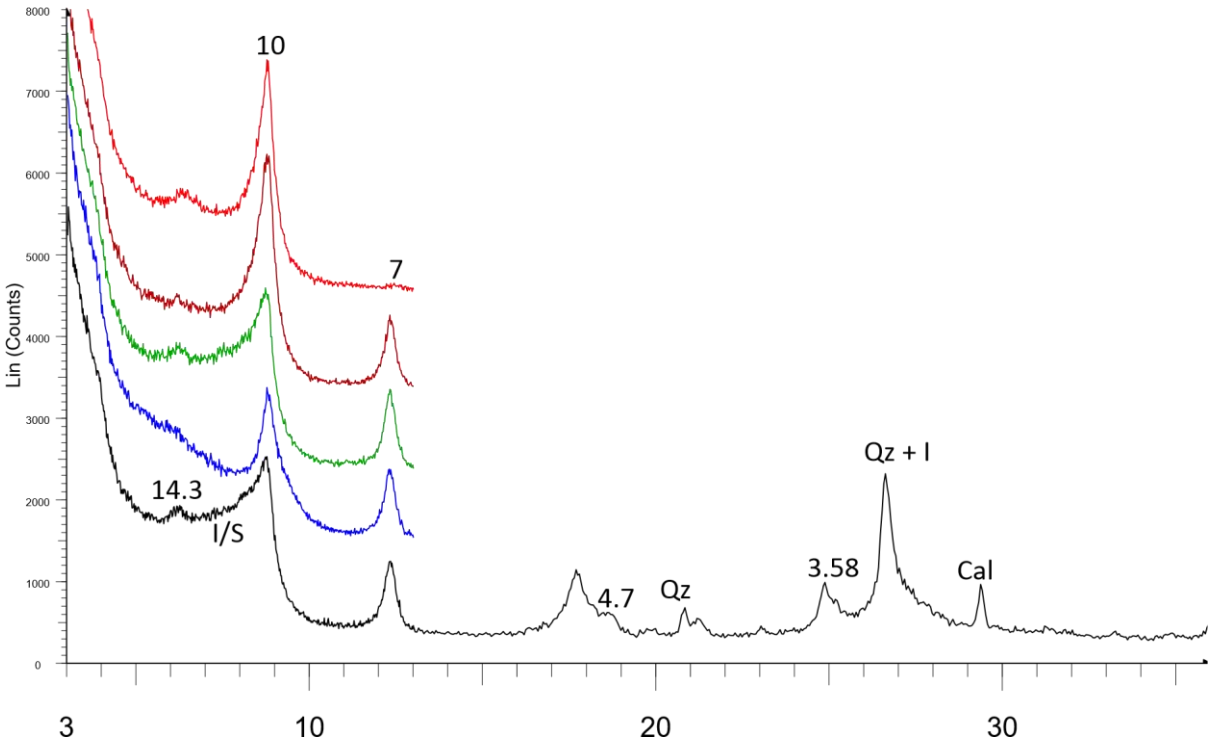
LU17 00189 047 (50592)



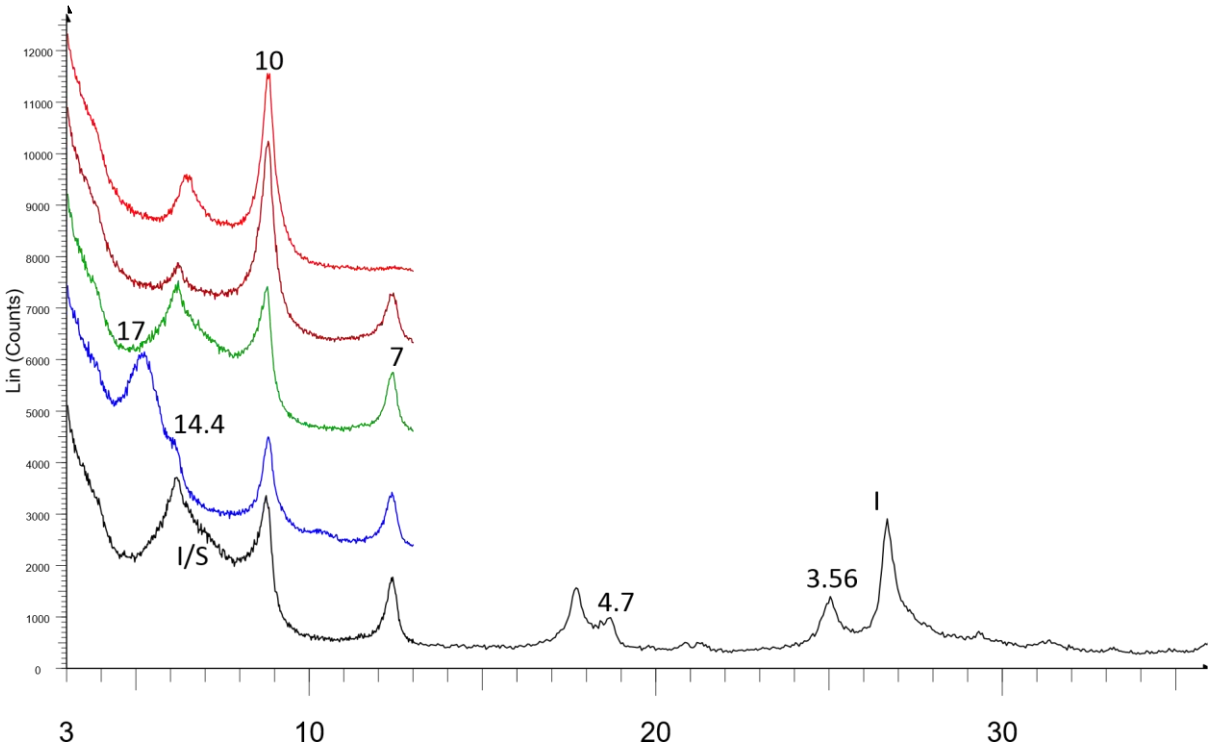
LU17 00189 048 (50611)



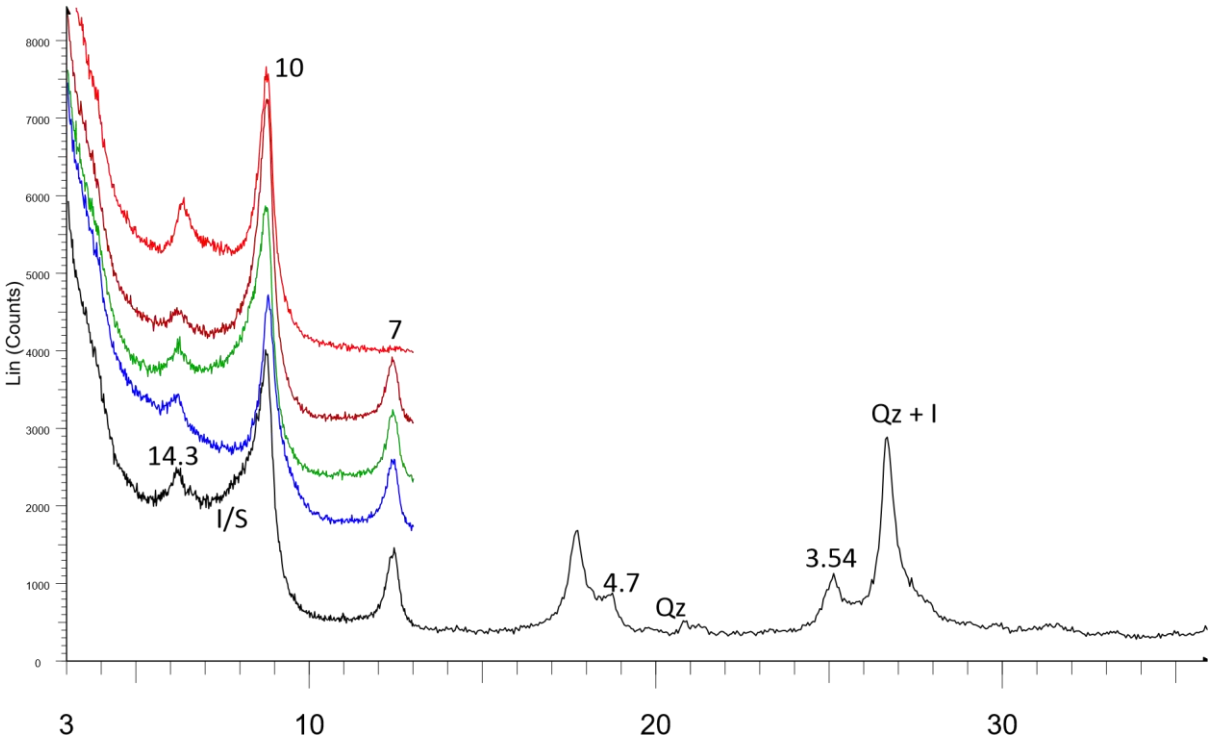
LU17 00189 049 (50736)



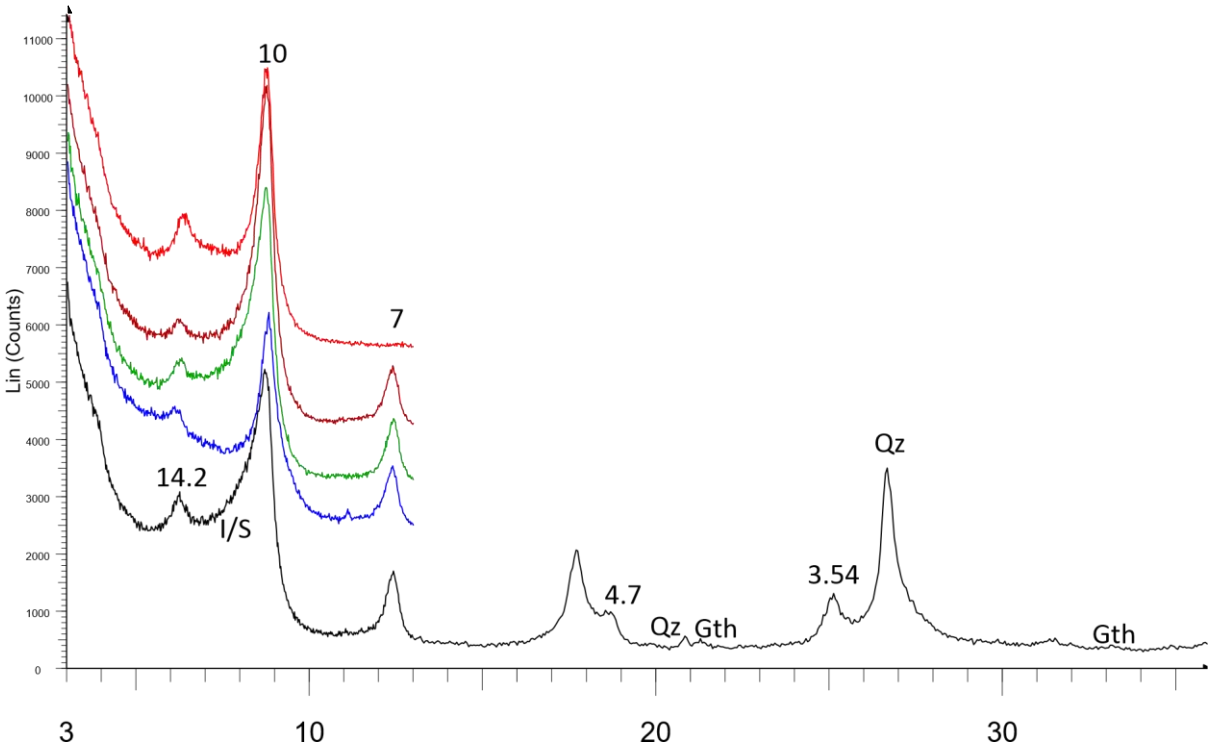
LU17 00189 050 (50742)



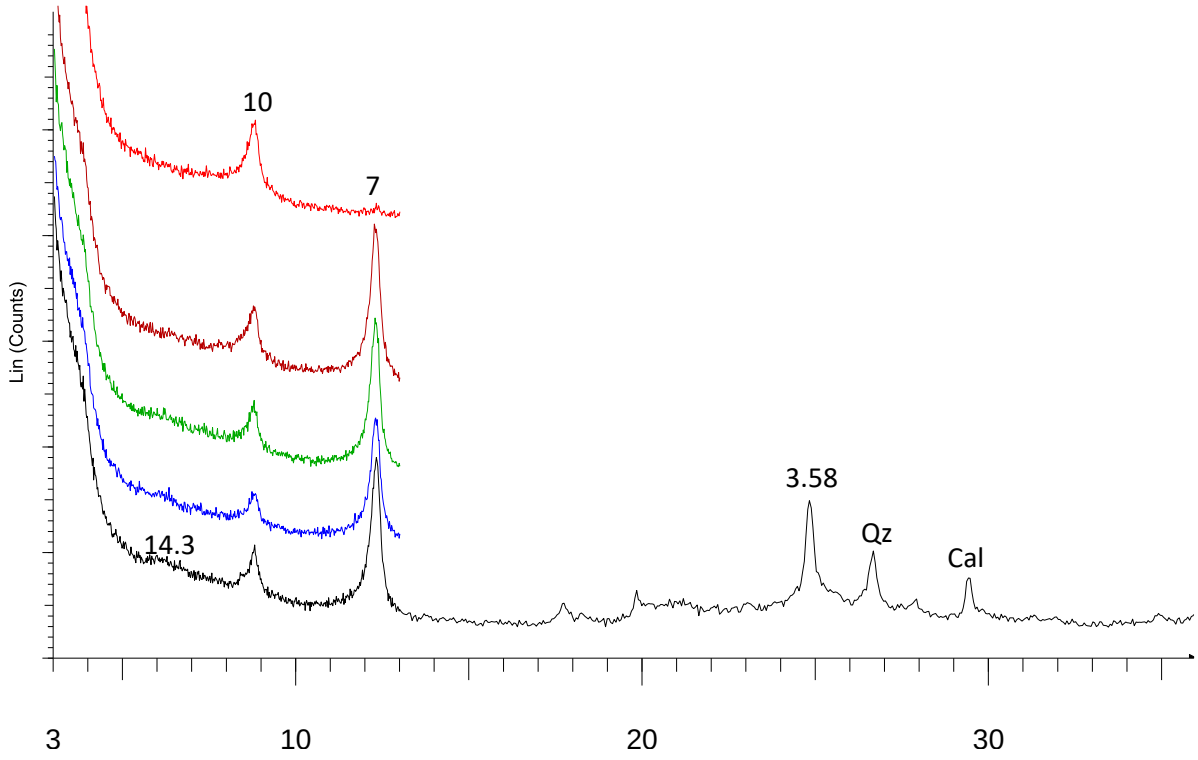
LU17 00190 001 (50753)



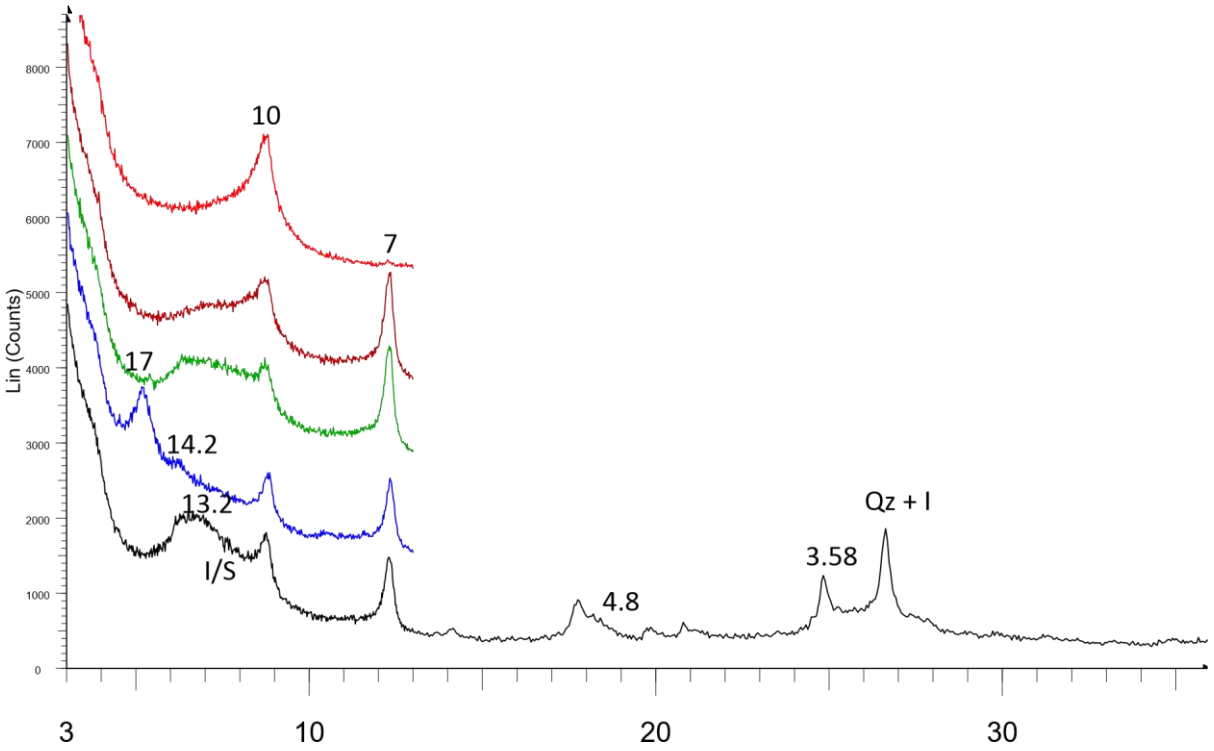
LU17 00190 002 (50771)



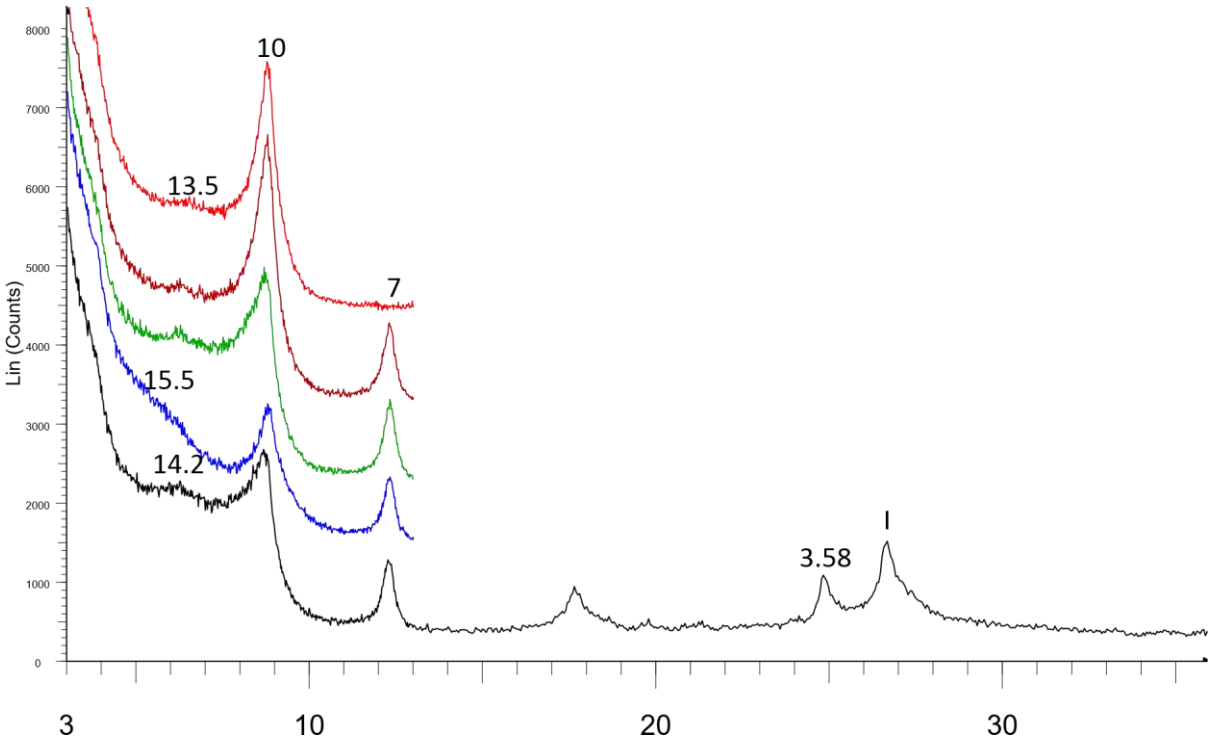
LU17 00190 003 (51043)



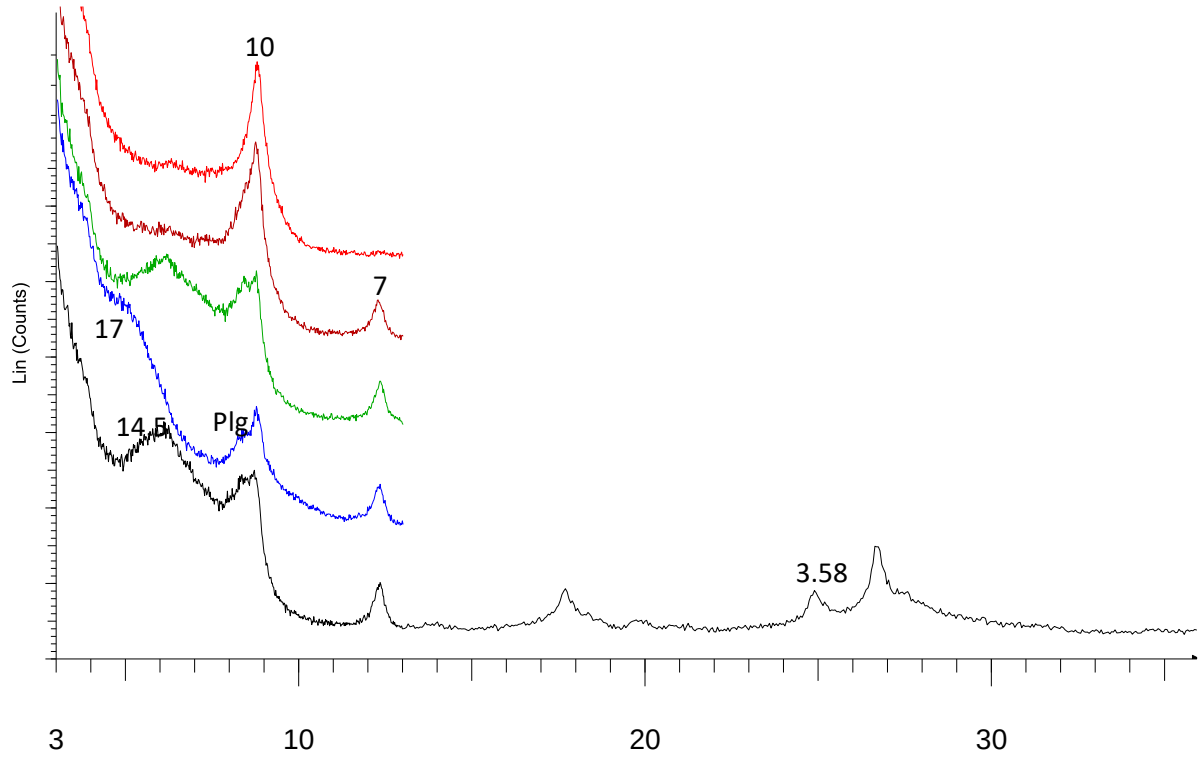
LU17 00190 004 (51058)



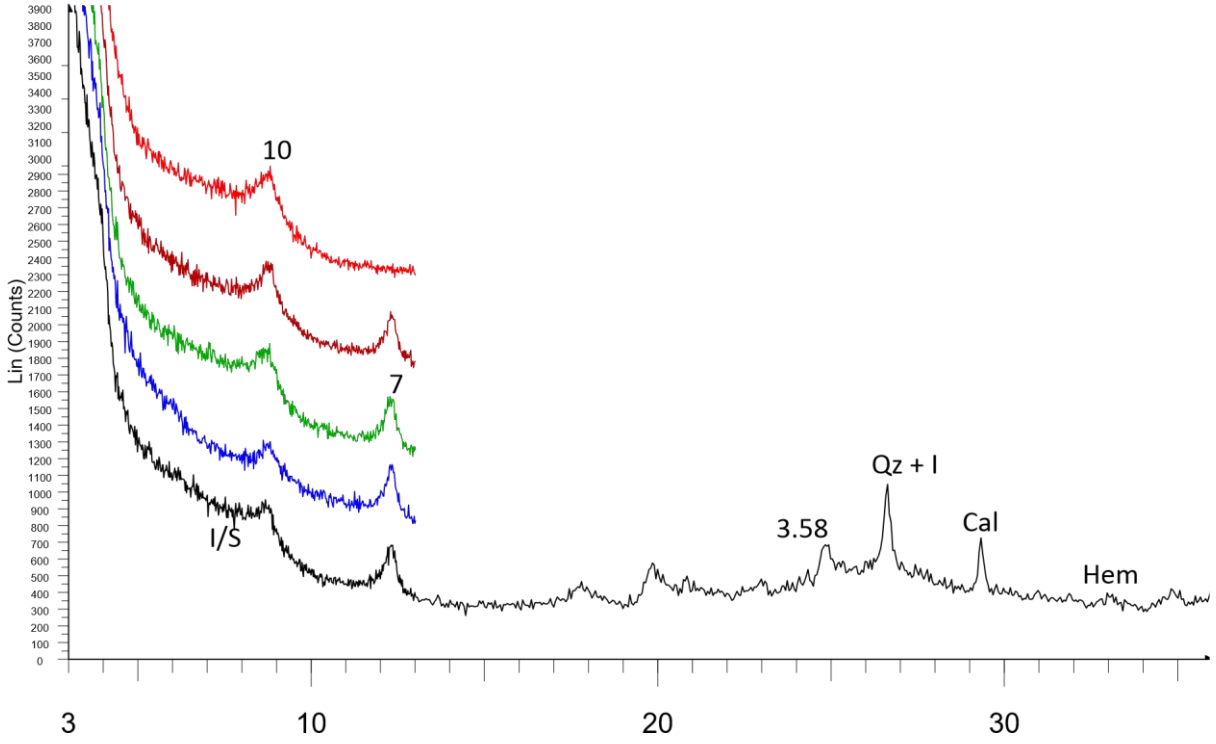
LU17 00190 005 (51136)



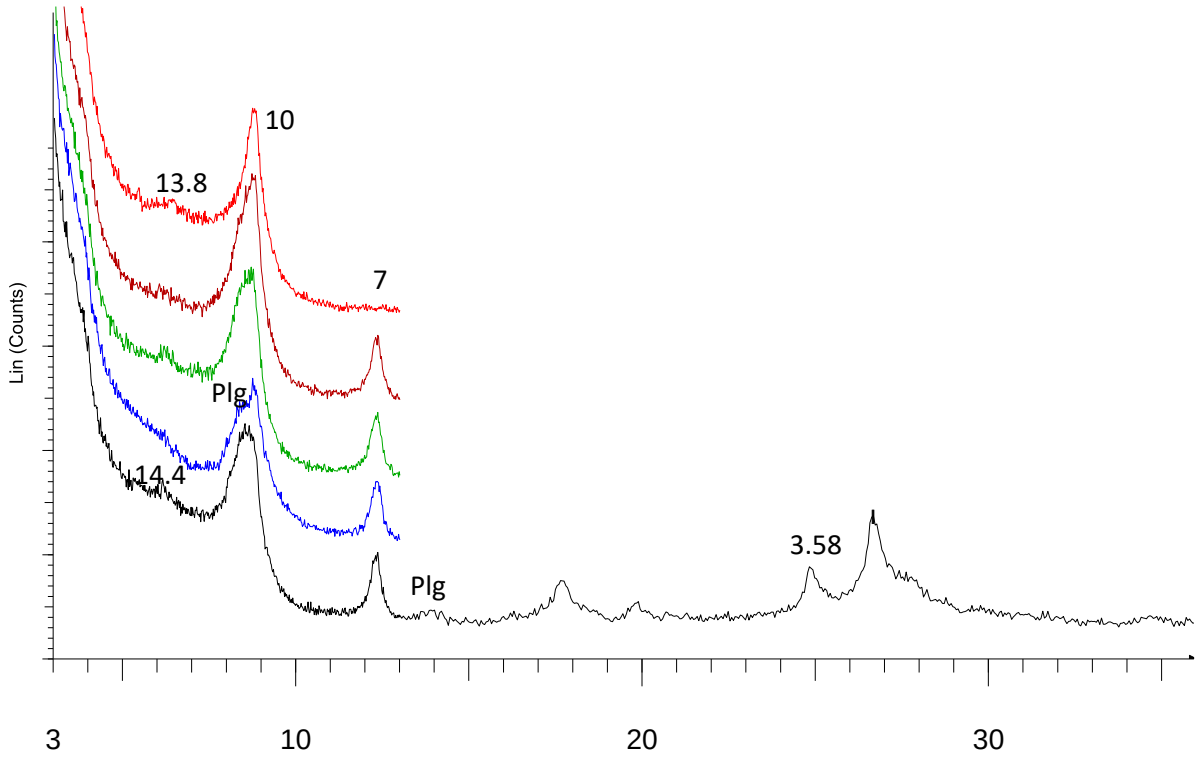
LU17 00190 006 (51170)



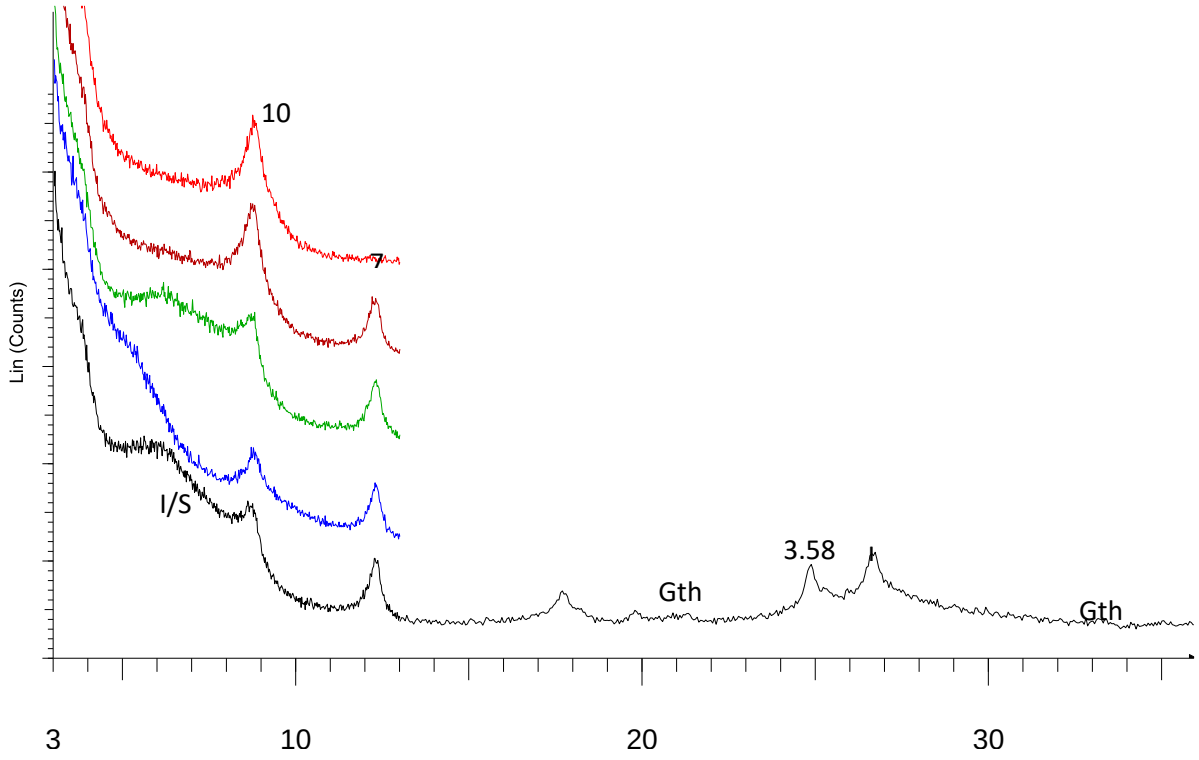
LU17 00190 007 (51273)



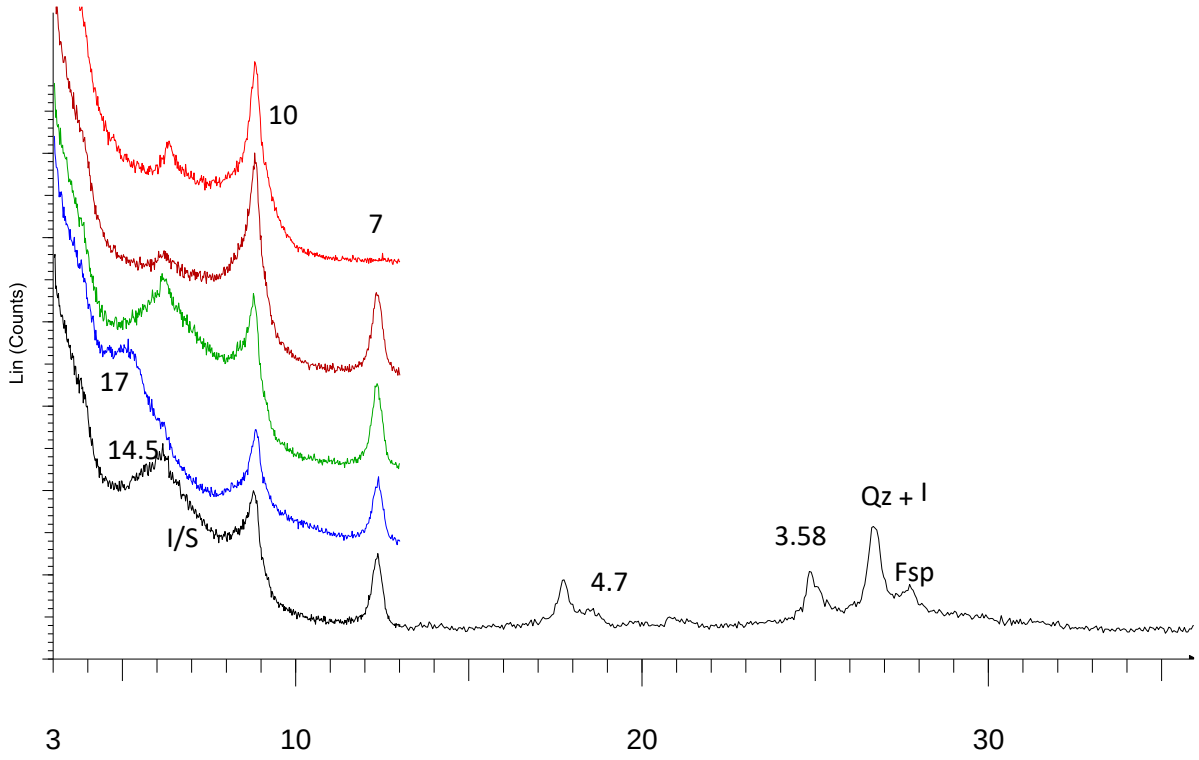
LU17 00190 008 (51278)



LU17 00190 009 (51294)

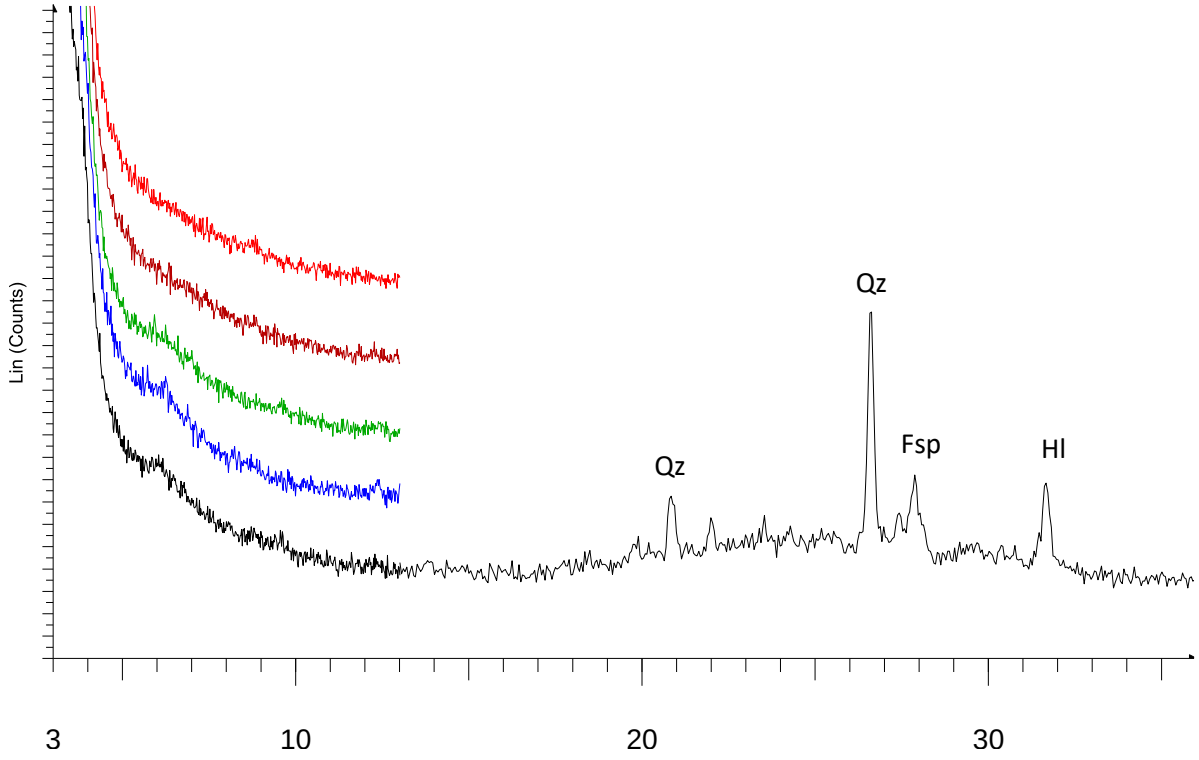


LU17 00190 010 (51434)

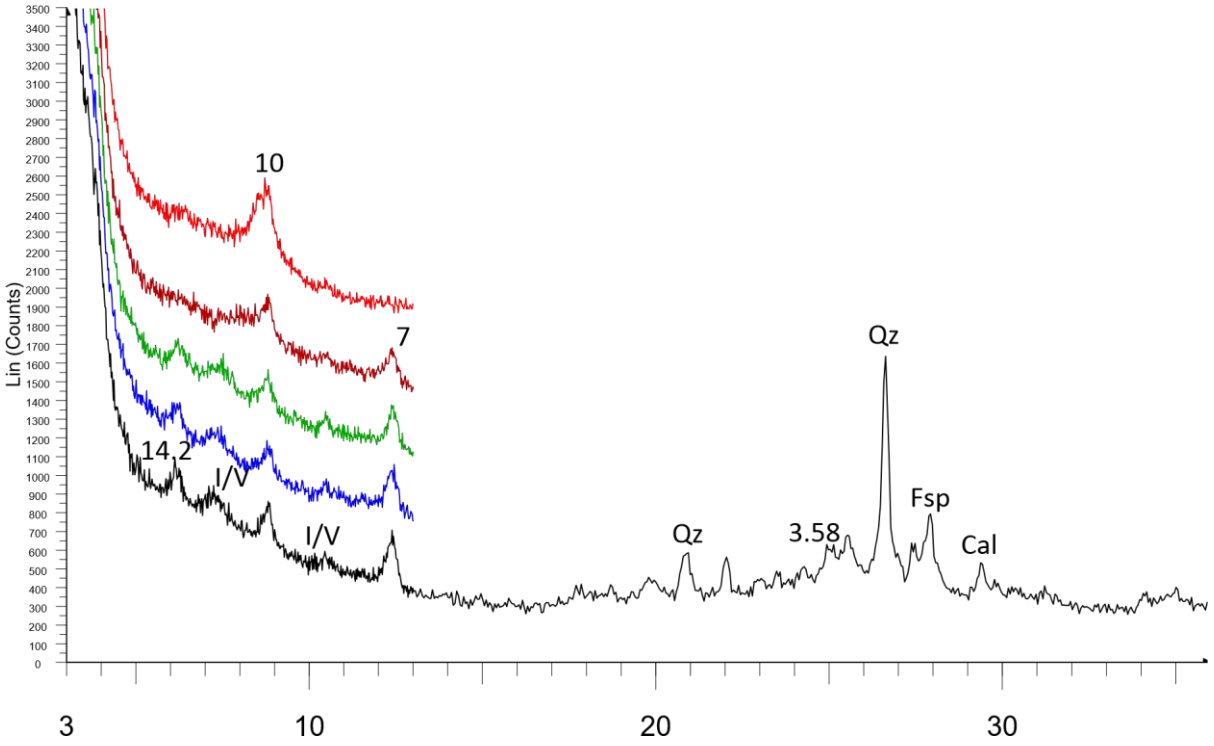


Annex 5. RX Diffractograms from Finland

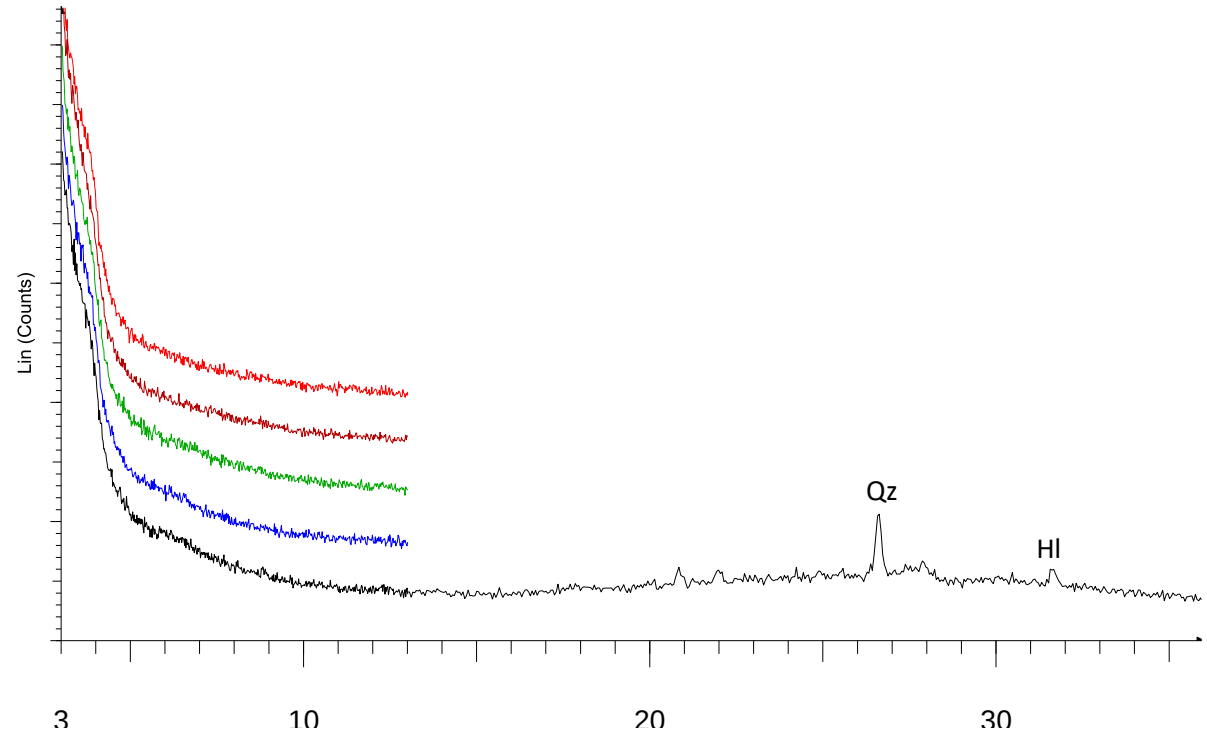
LU17 00191 001 (20089)



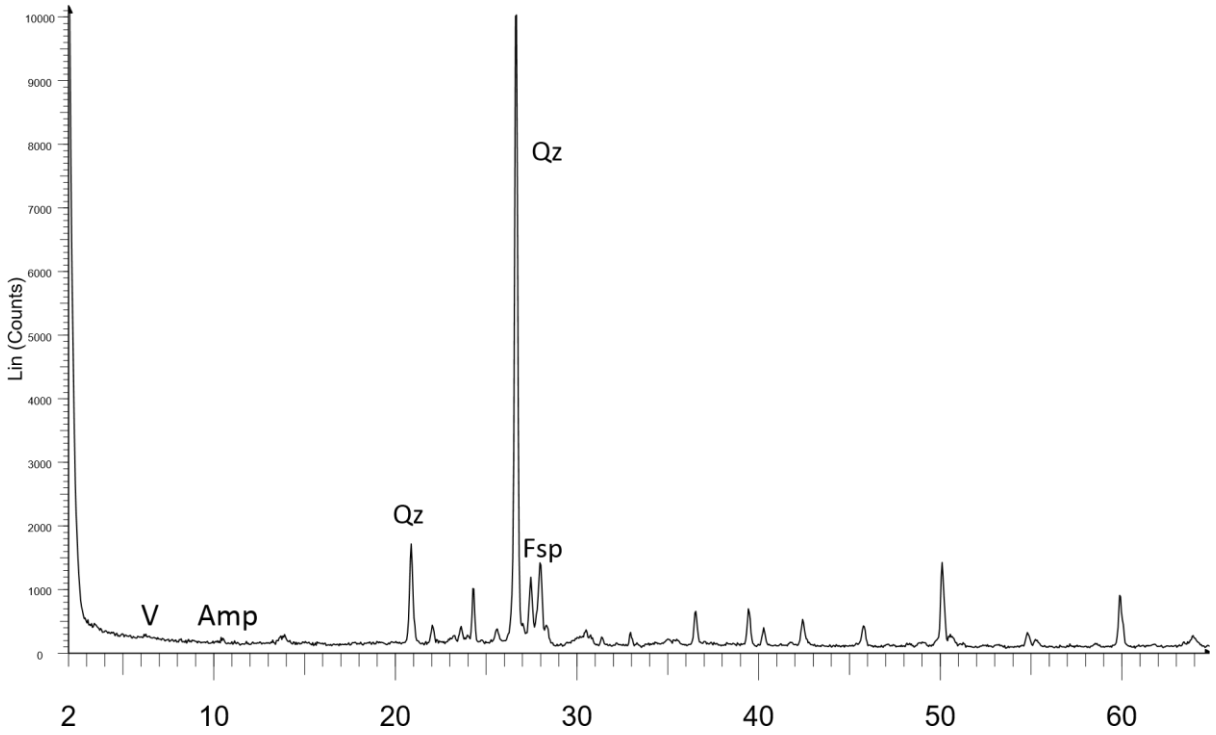
LU17 00191 002 (20114)



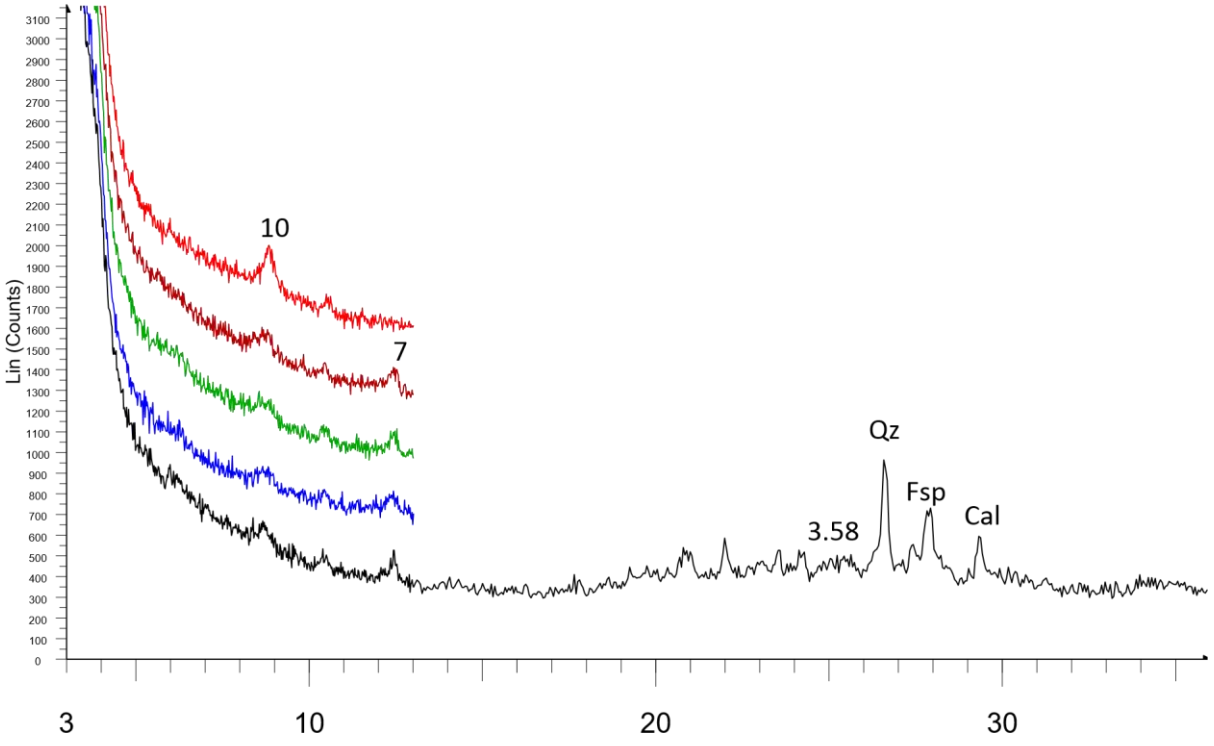
LU17 00191 003 (20238)



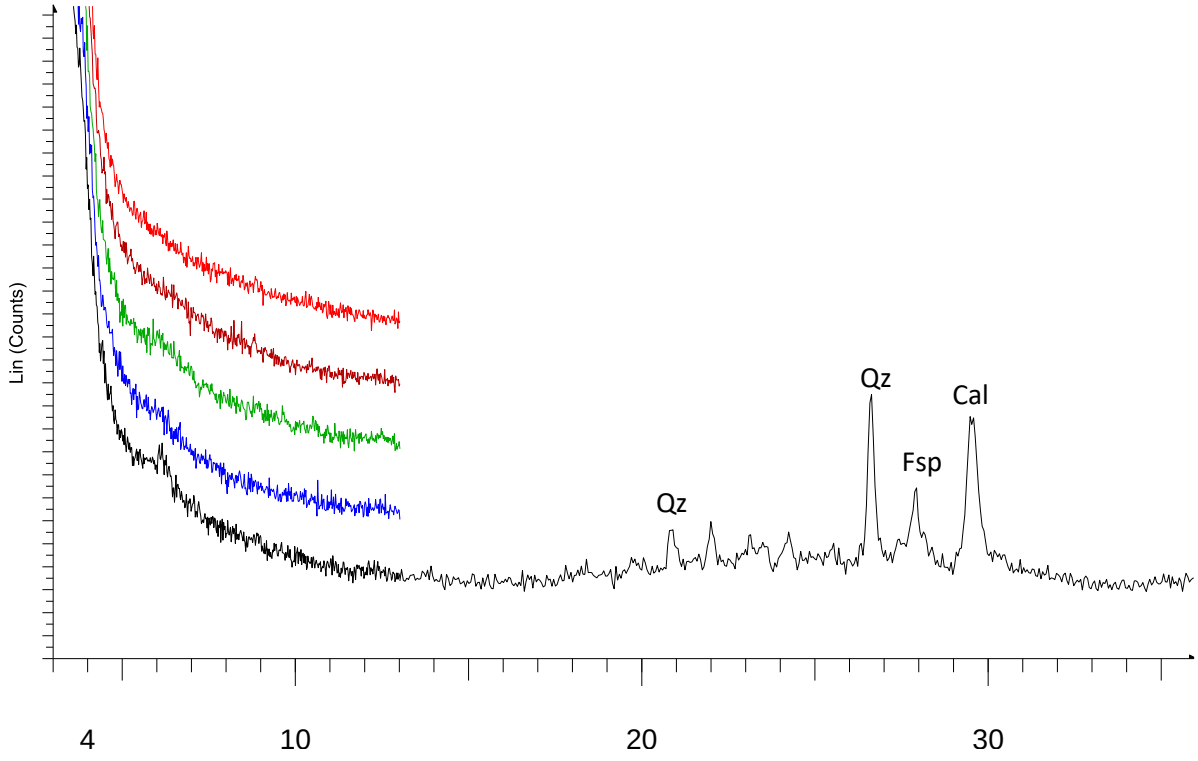
LU17 00191 003 (20238) bulk soil



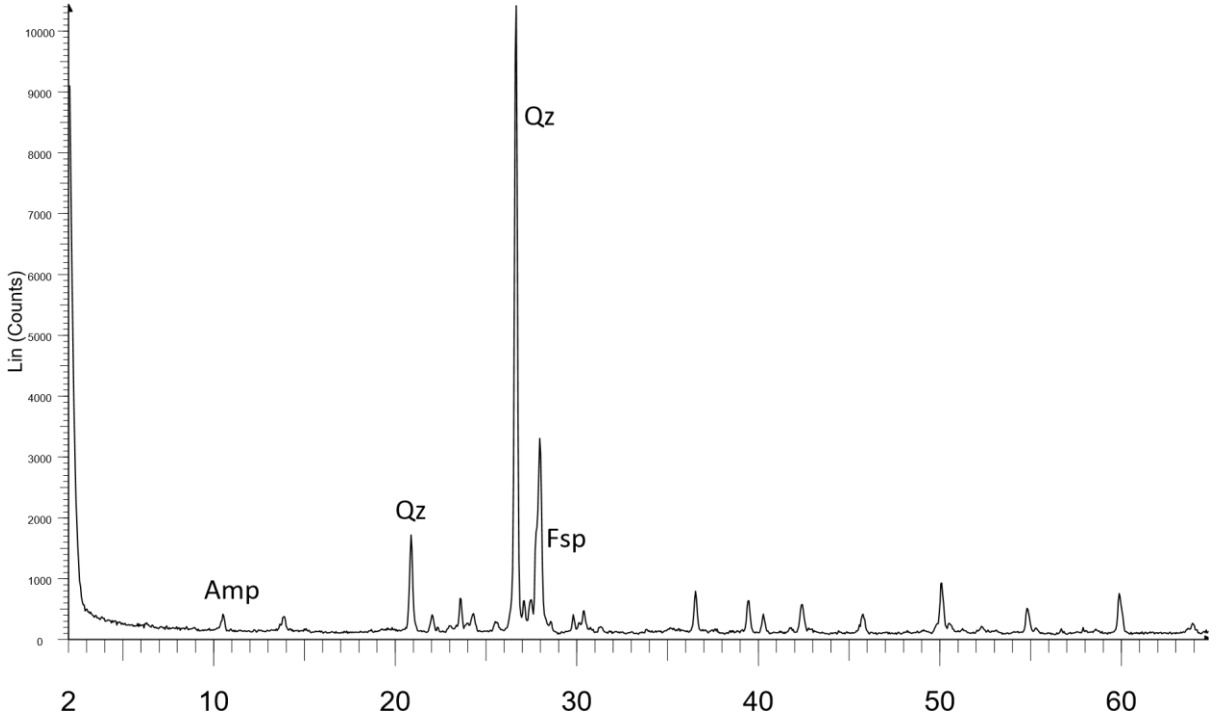
LU17 00191 004 (20303)



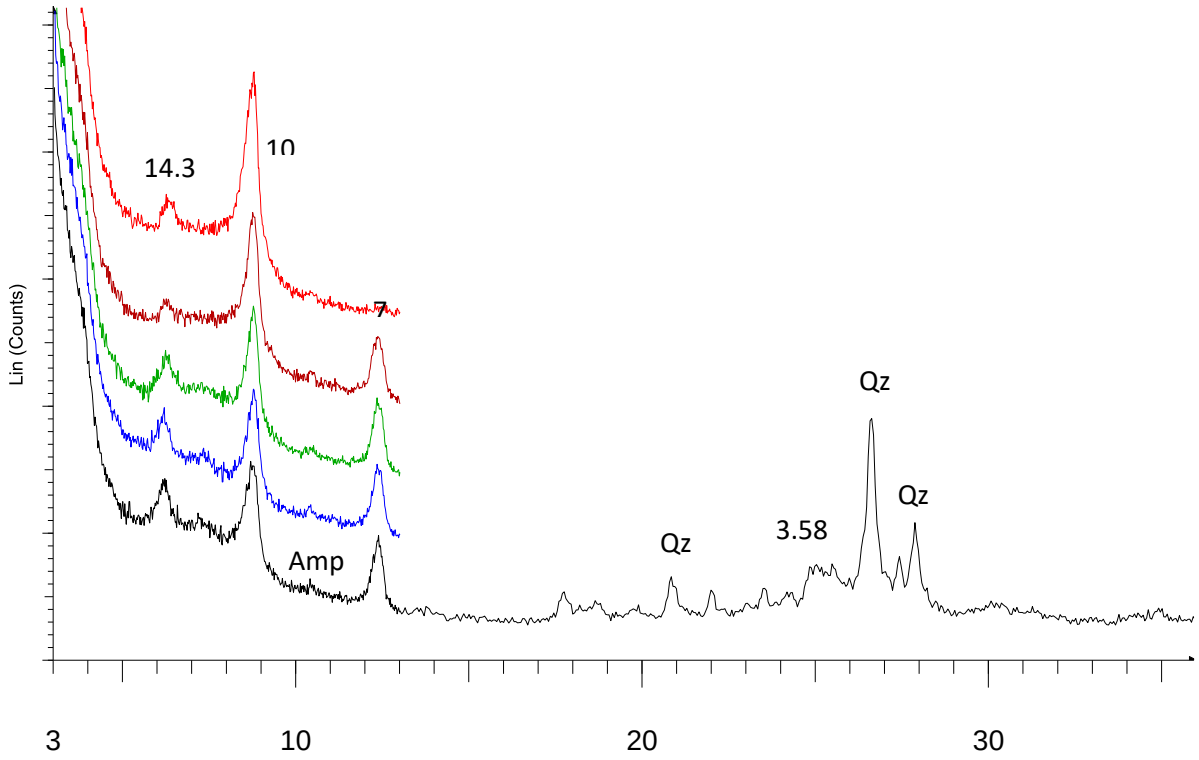
LU17 00191 005 (20459)



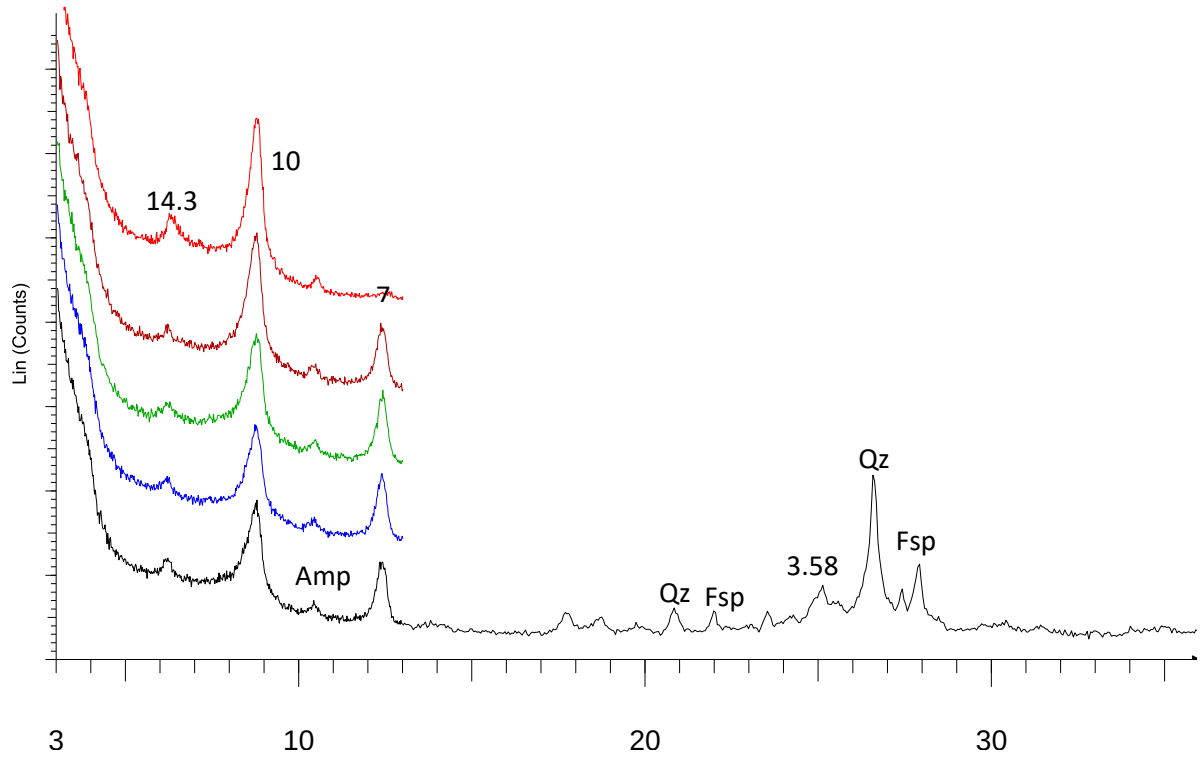
LU17 00191 005 (20459) bulk soil



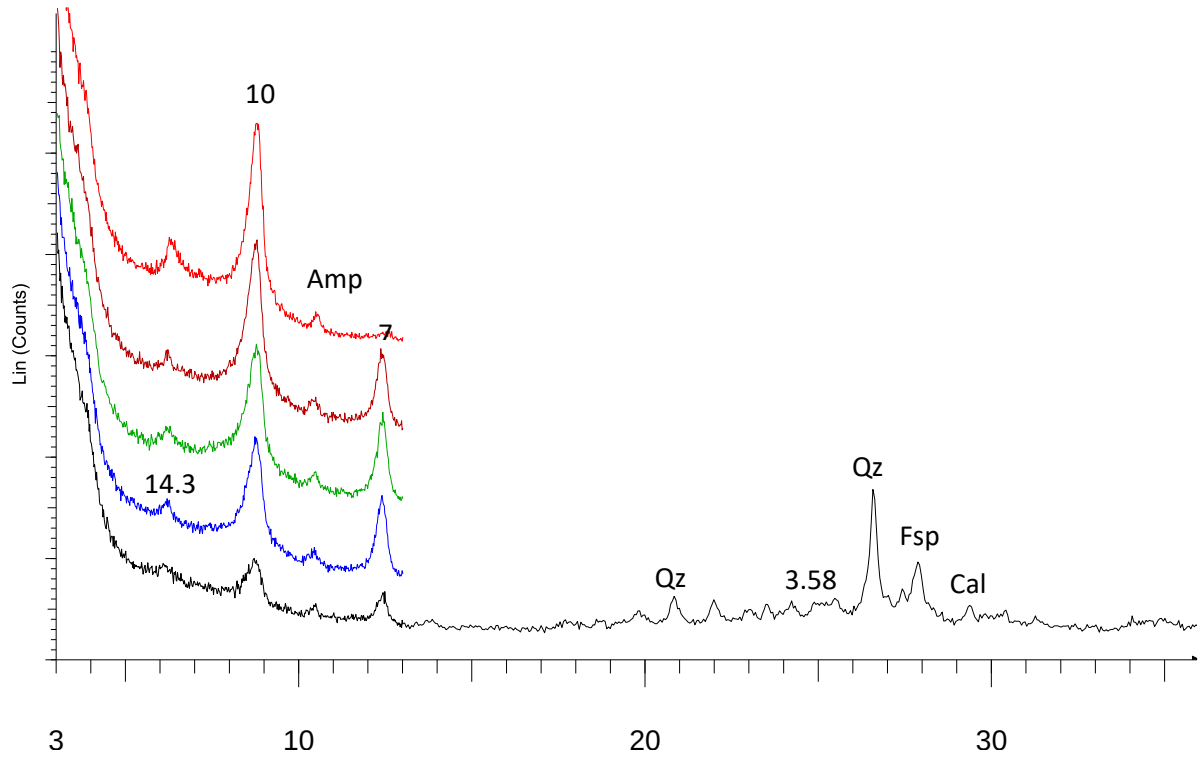
LU17 00191 006 (20497)



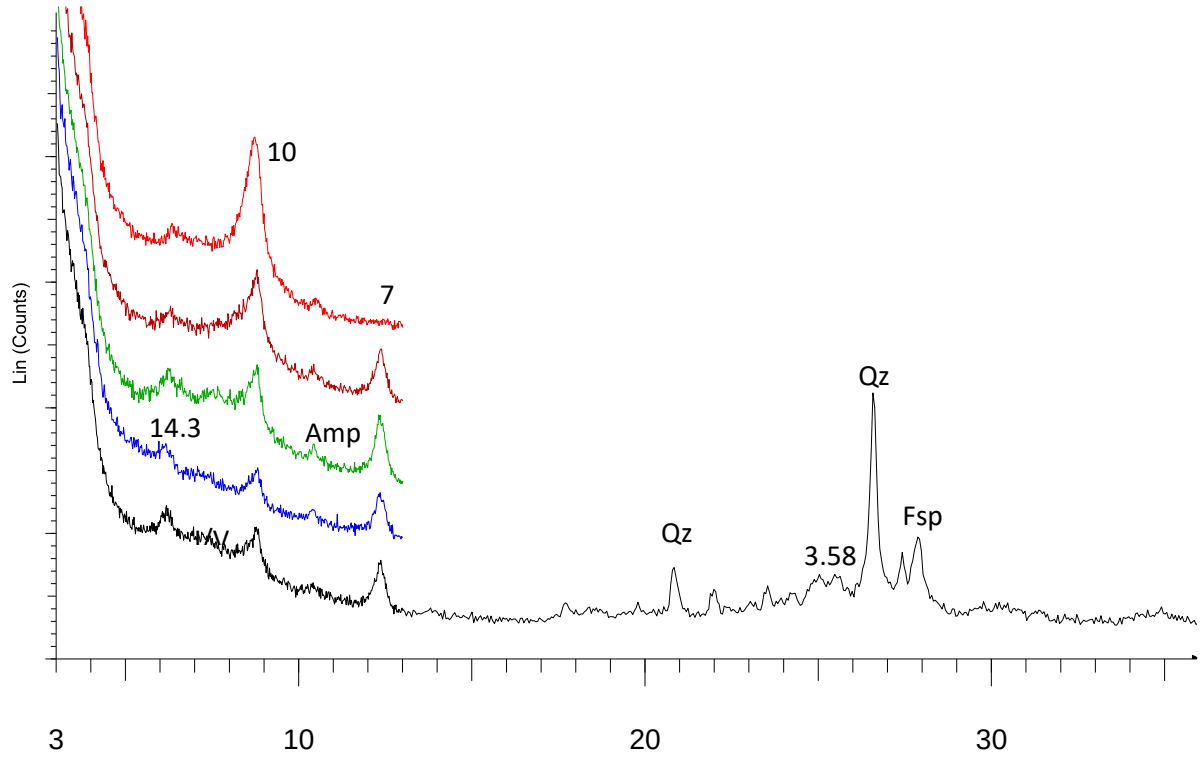
LU17 00191 007 (20503)



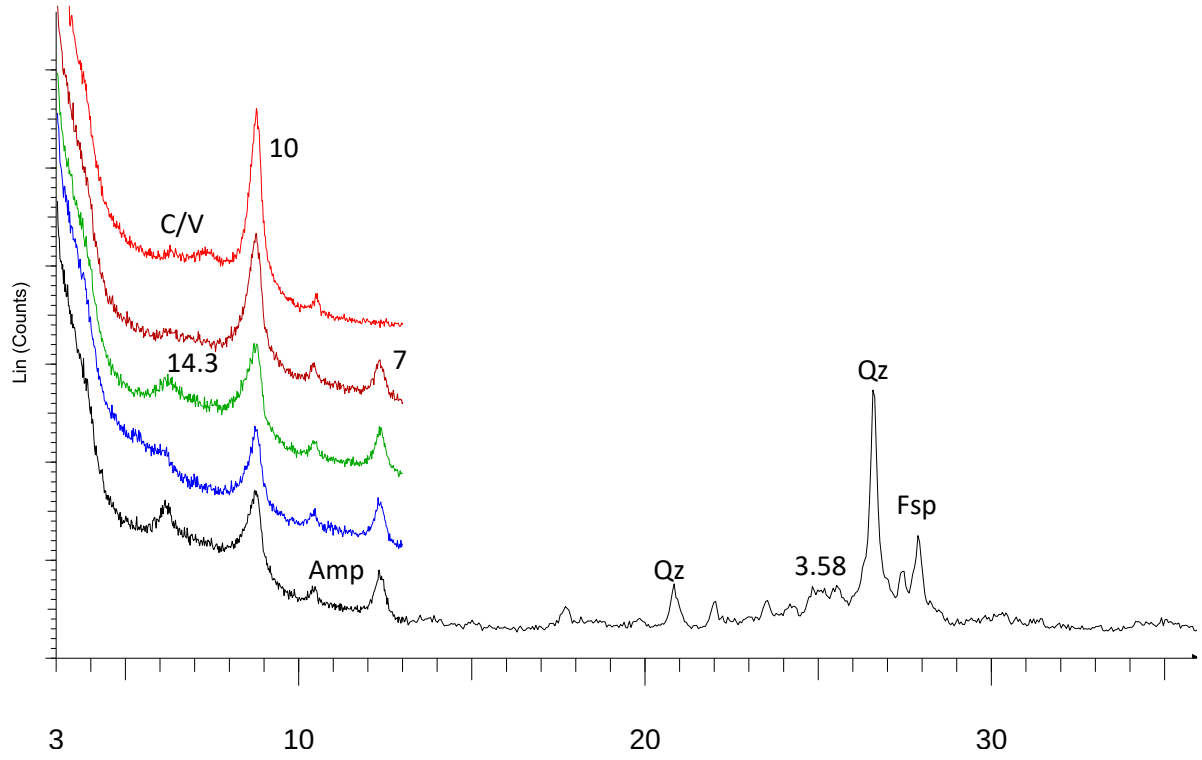
LU17 00191 008 (20524)



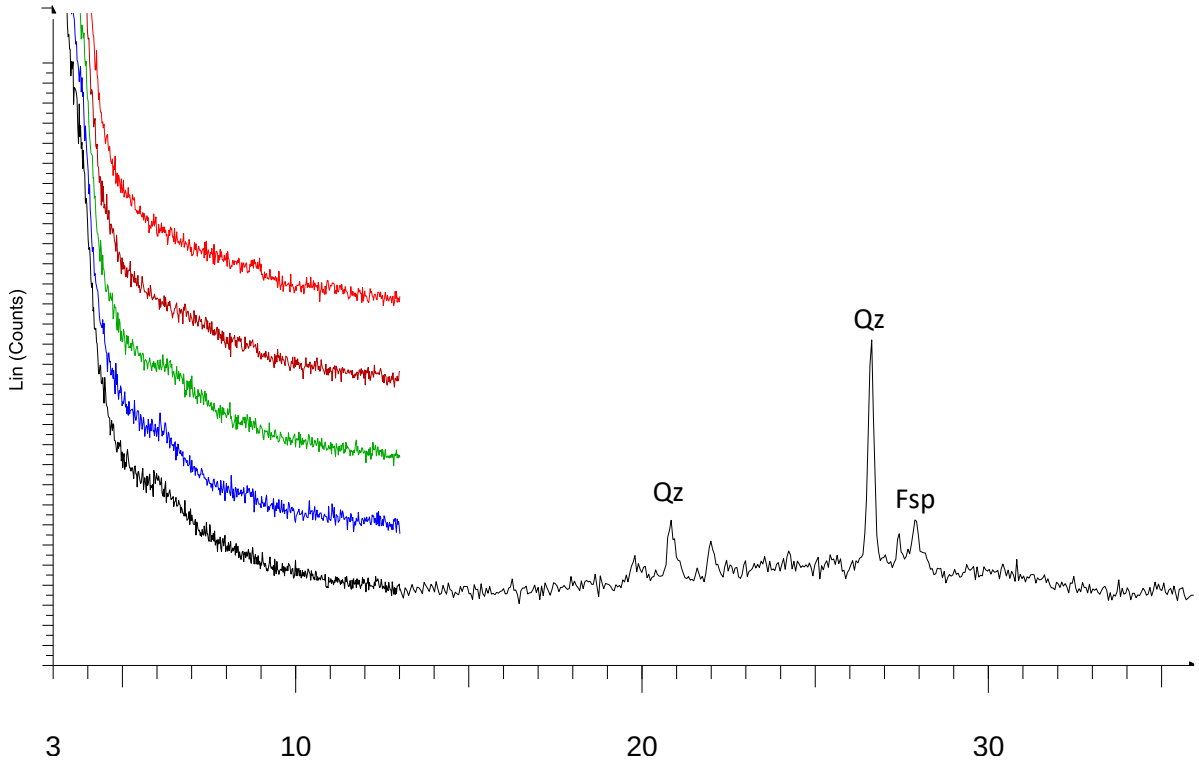
LU17 00191 009 (20559)



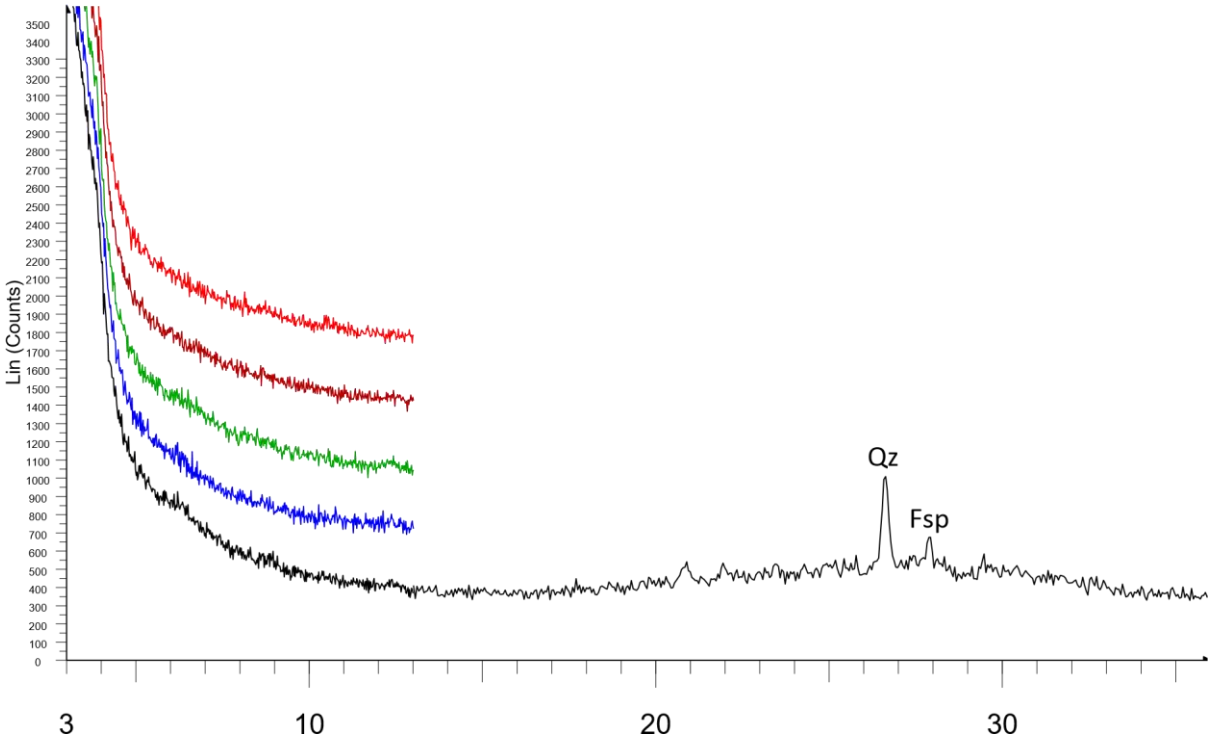
LU17 00191 010 (20590)



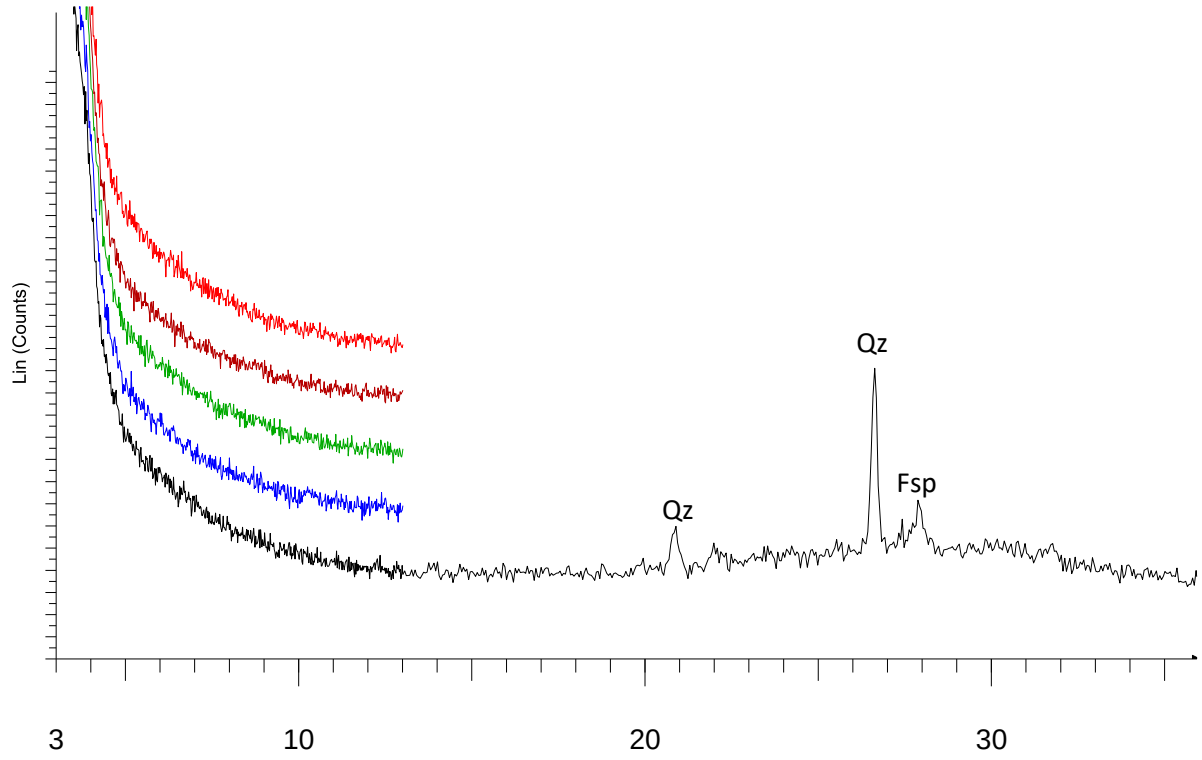
LU17 00191 011 (20617)



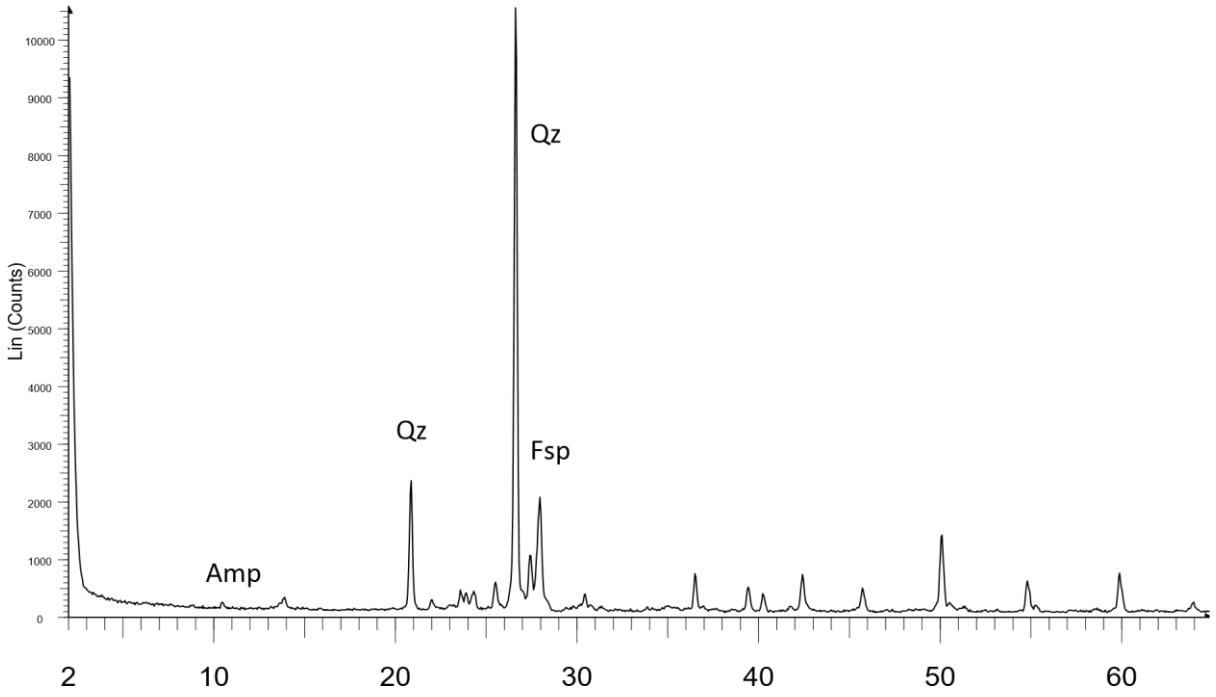
LU17 00191 012 (20618)



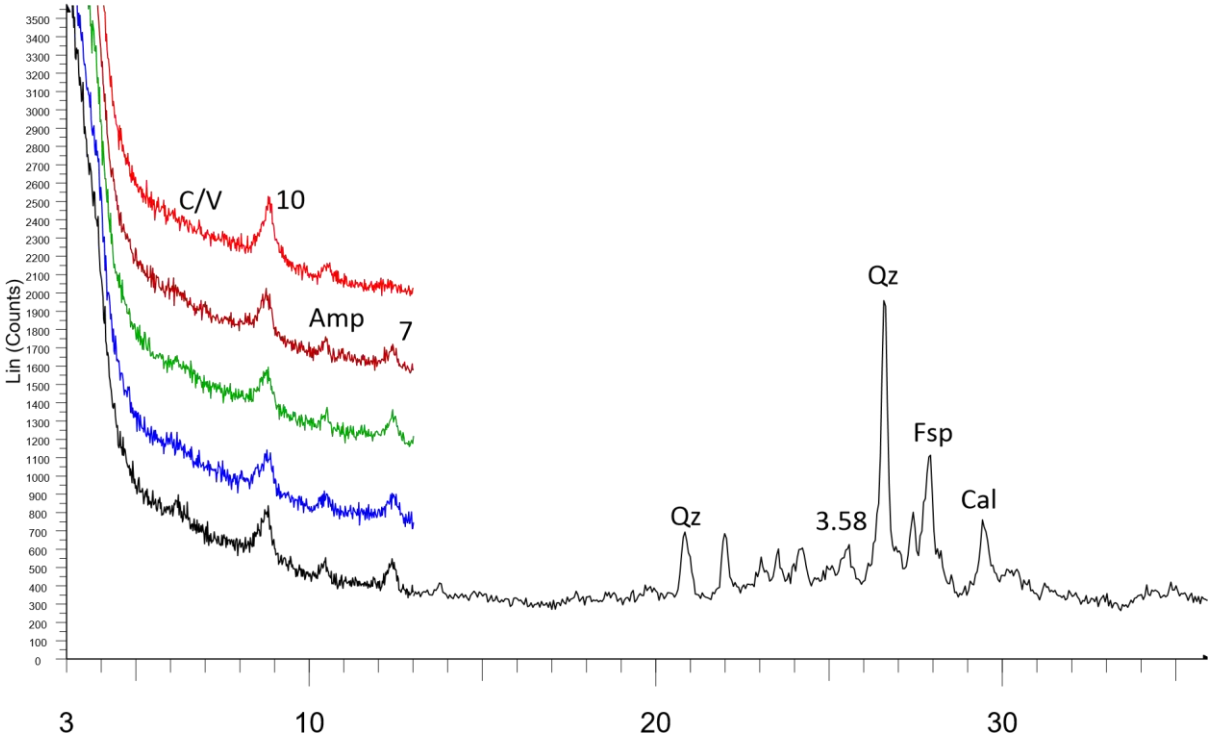
LU17 00191 013 (20649)



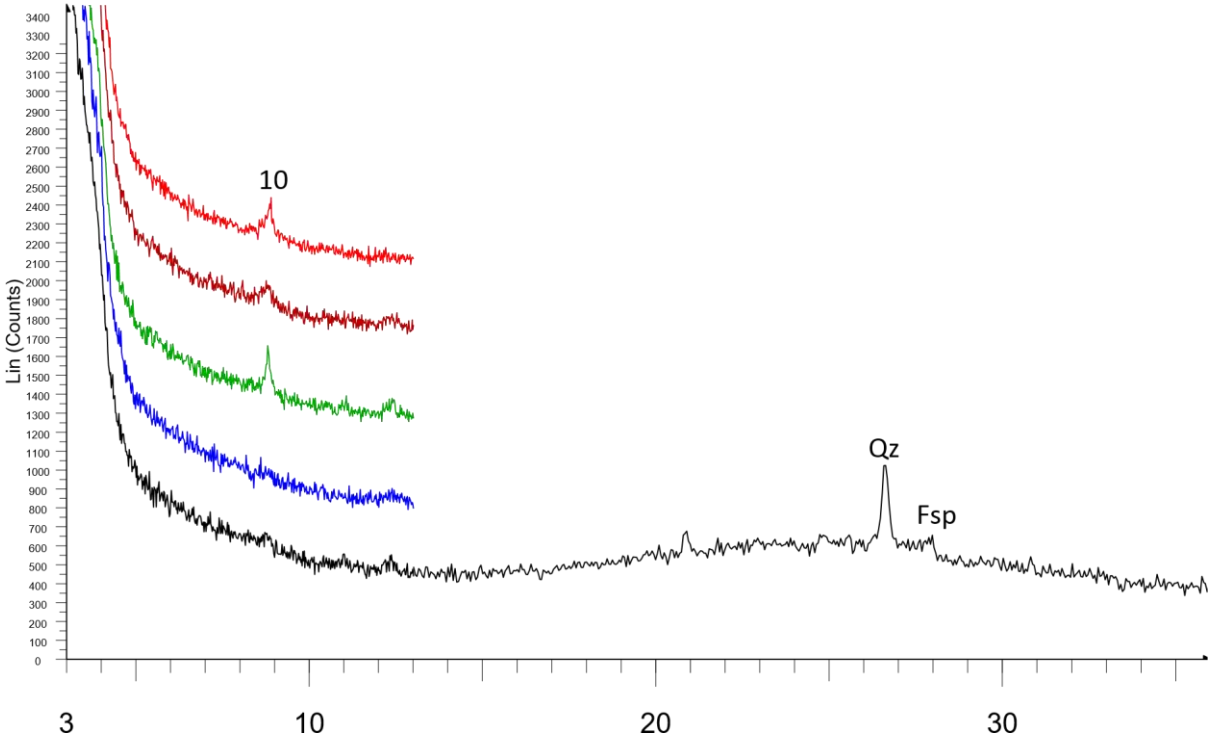
LU17 00191 013 (20649) bulk soil



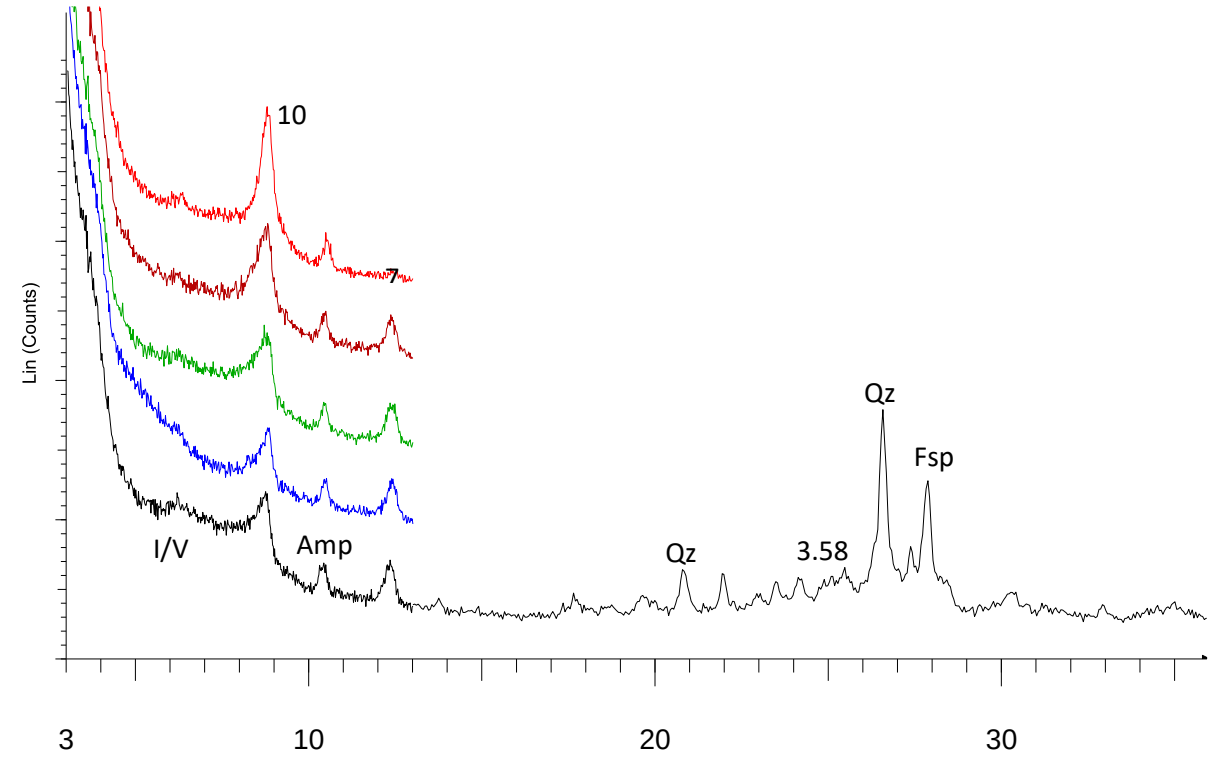
LU17 00191 014 (20655)



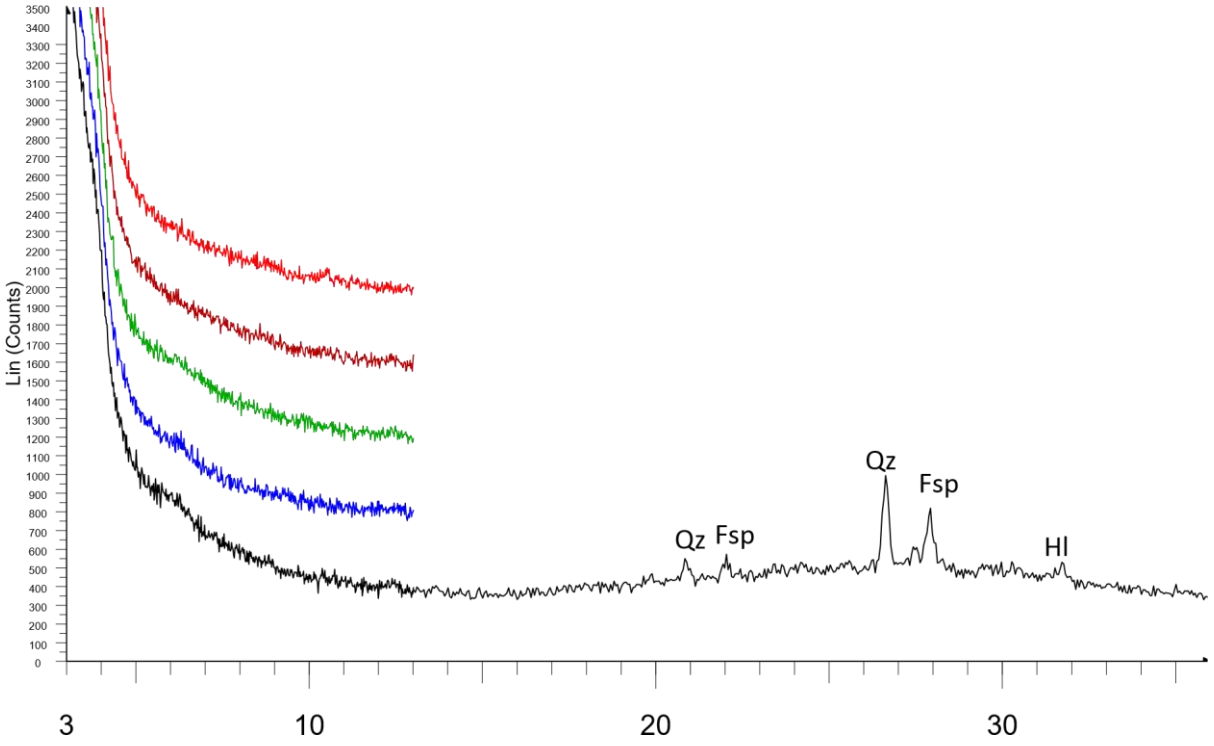
LU17 00191 015 (20759)



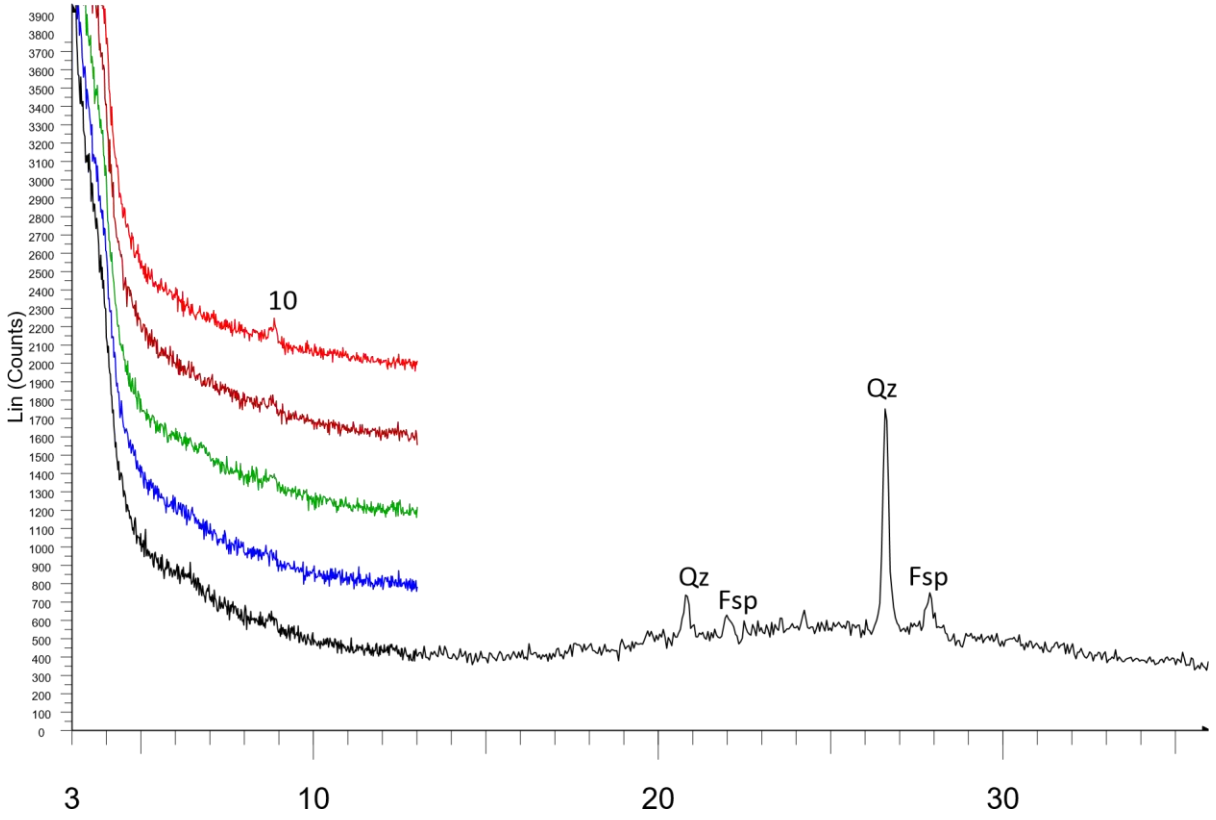
LU17 00191 016 (20815)



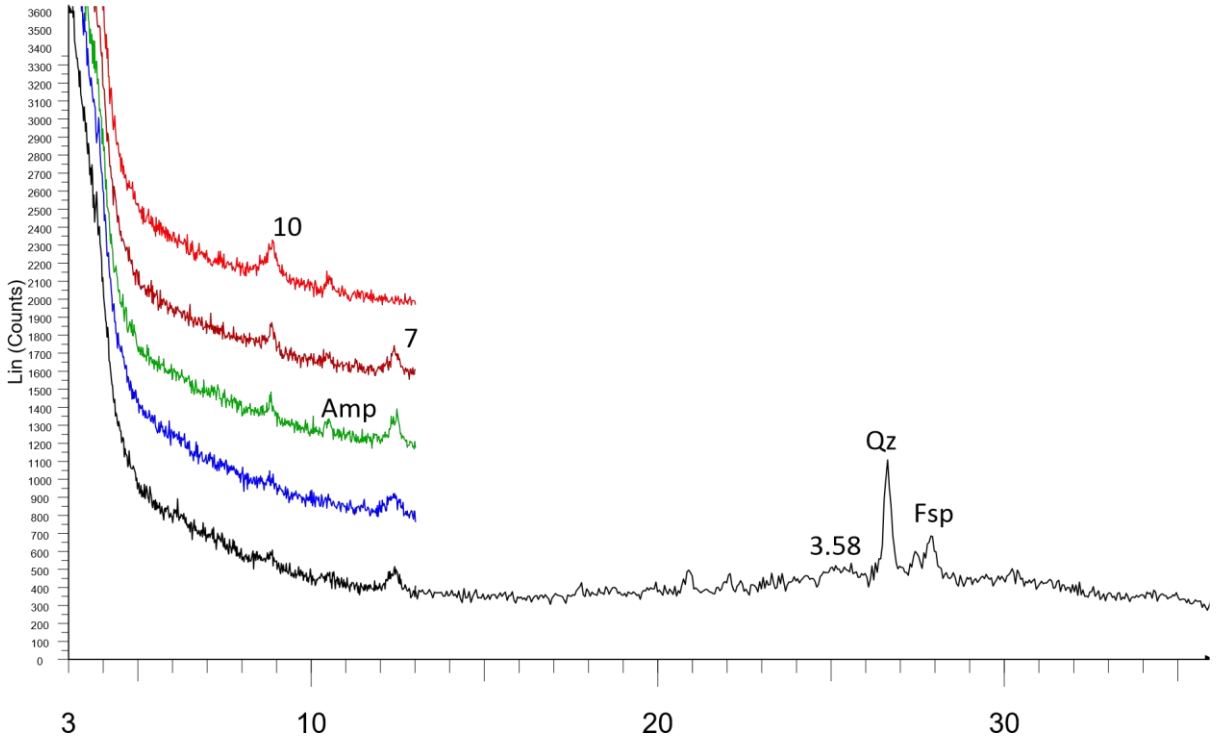
LU17 00191 017 (20864)



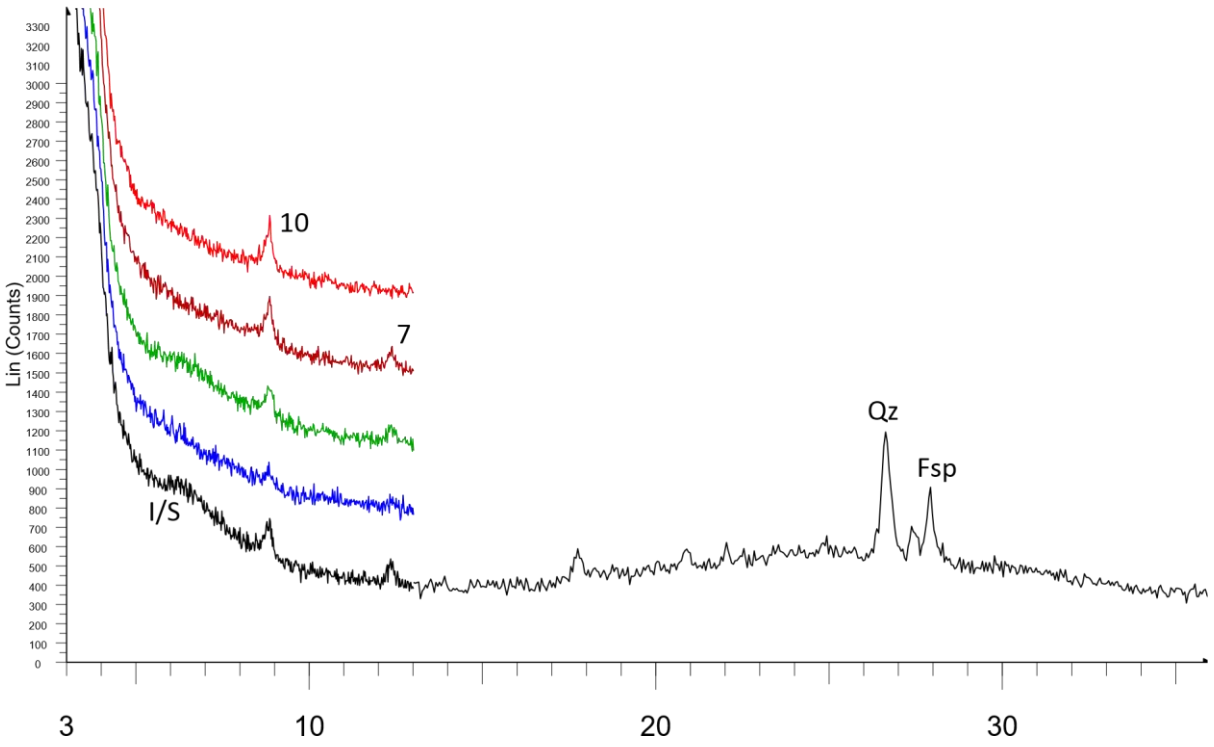
LU17 00191 018 (20884)



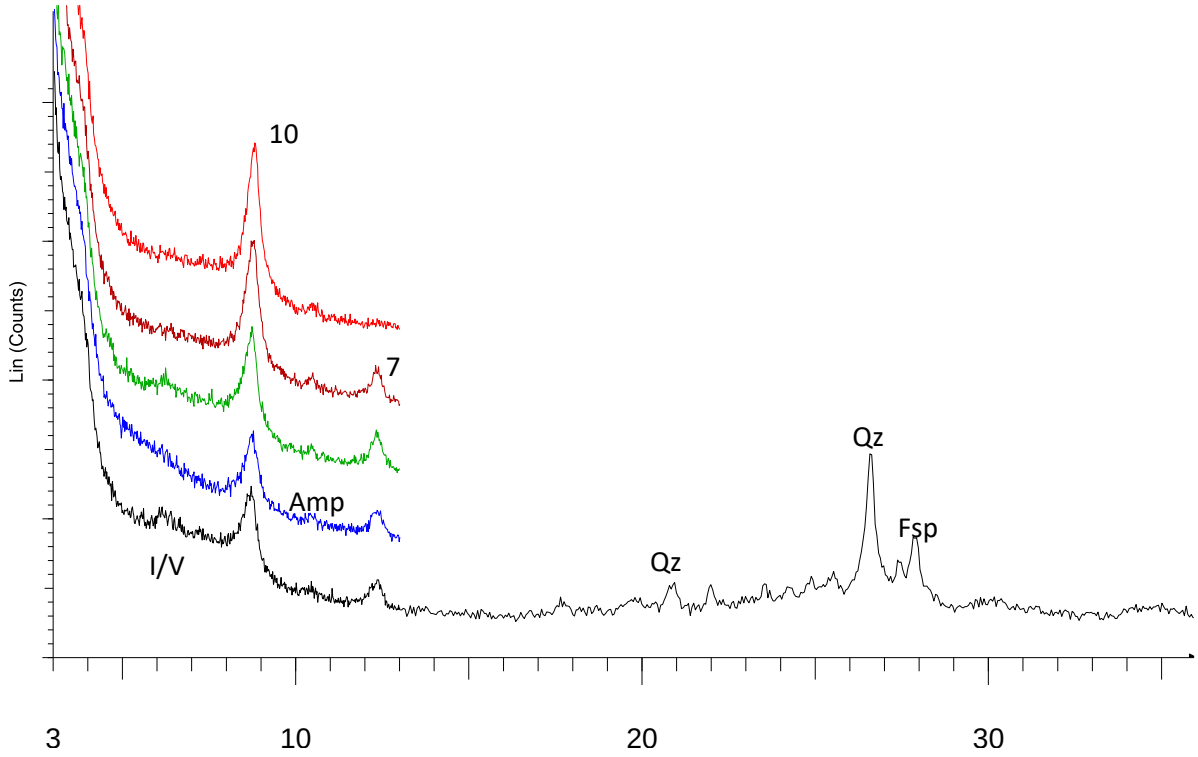
LU17 00191 019 (20938)



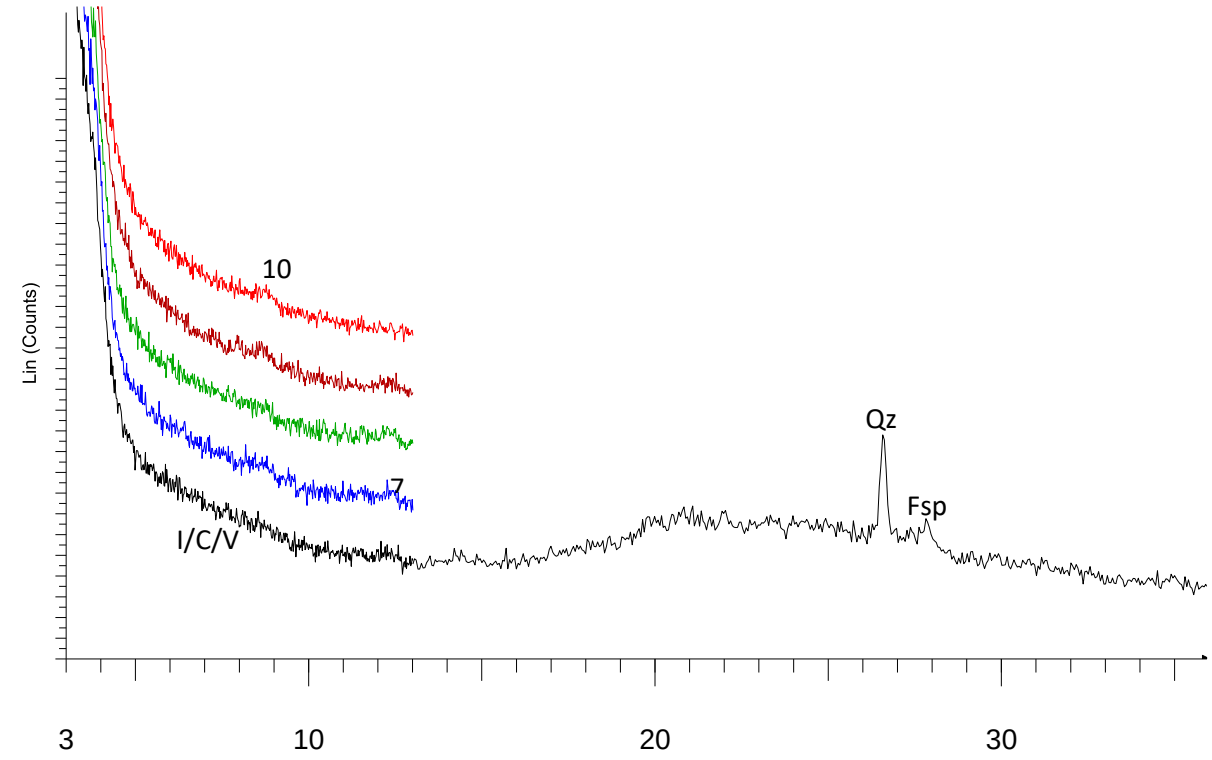
LU17 00191 020 (21022)



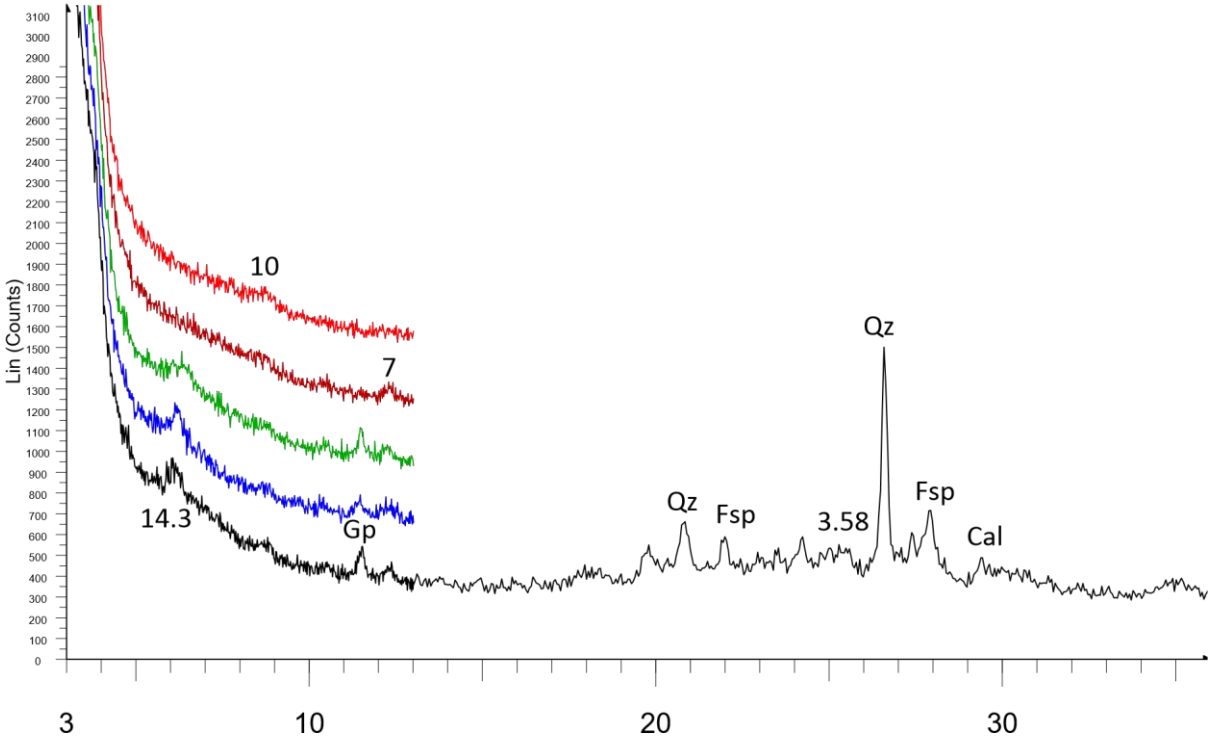
LU17 00191 021 (21127)



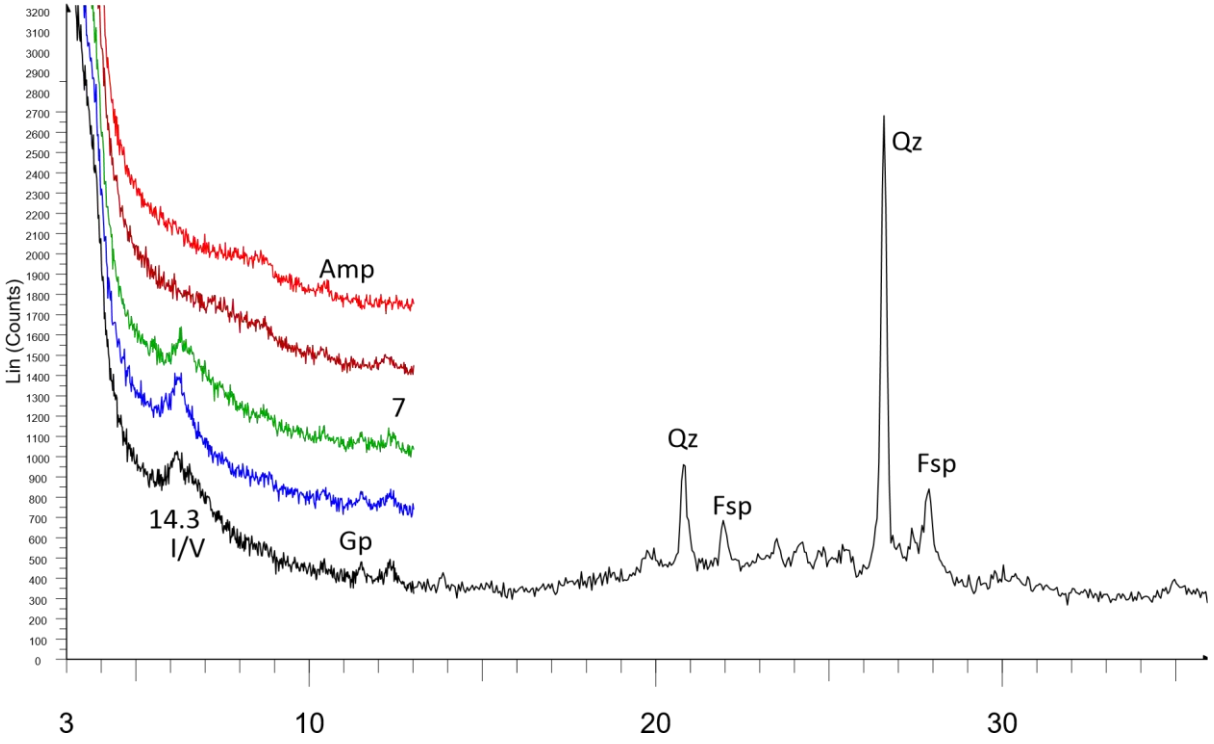
LU17 00191 022 (20136)



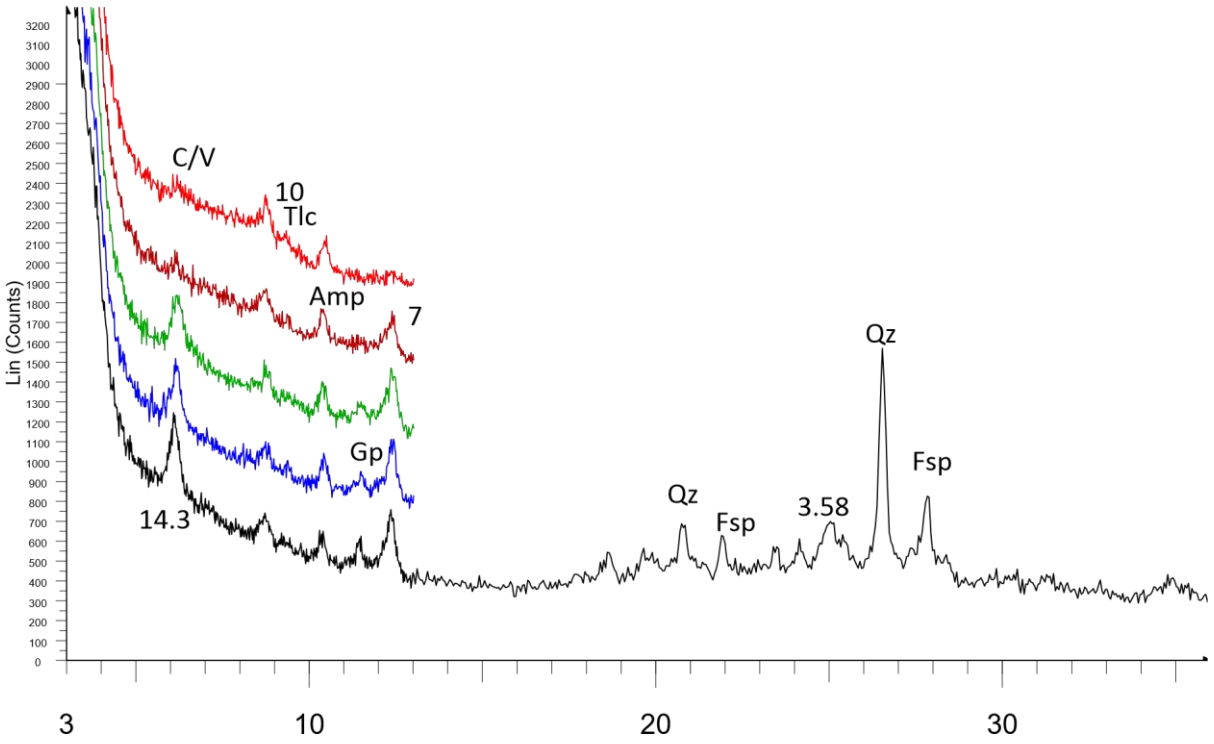
LU17 00191 023 (20234)



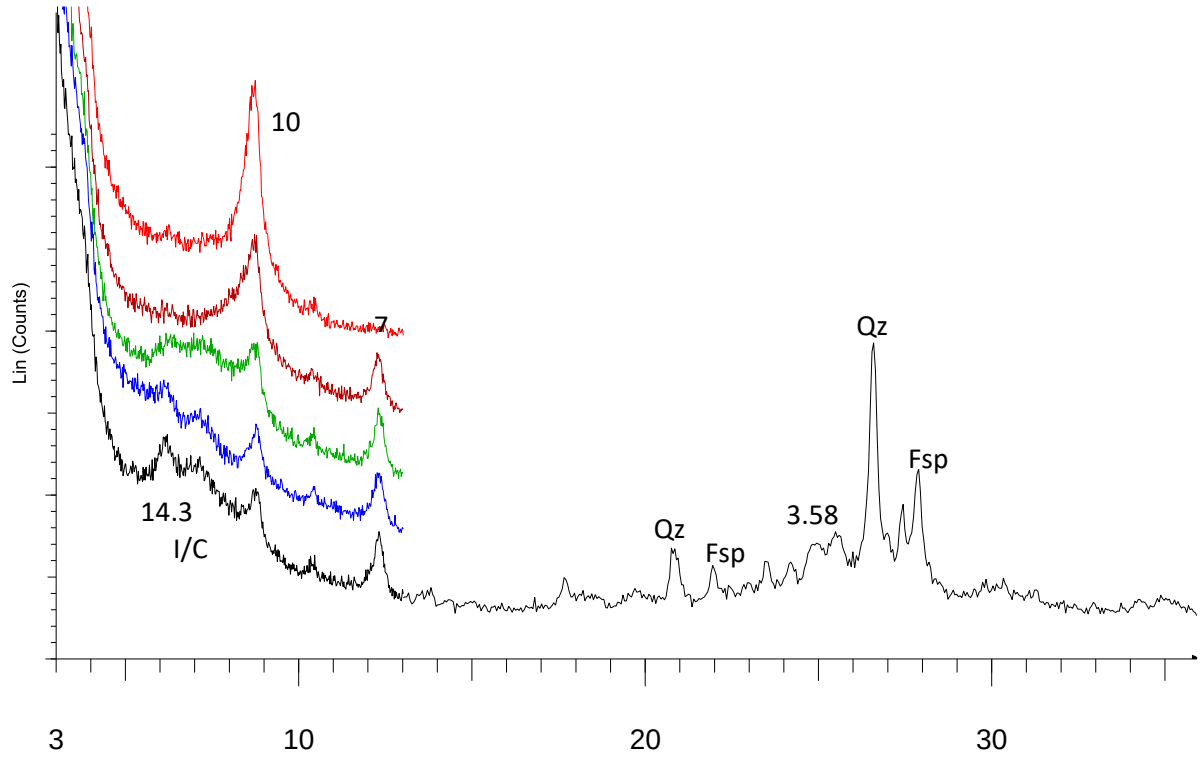
LU17 00191 024 (20032)



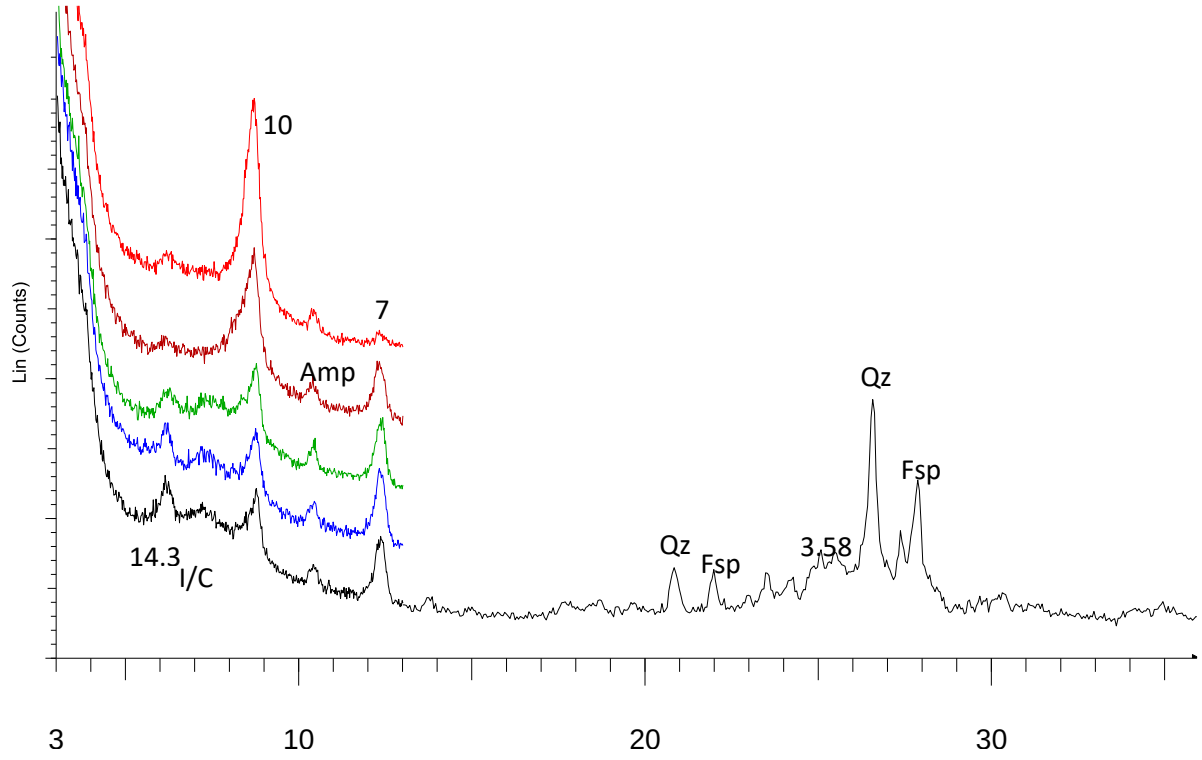
LU17 00191 025 (20217)



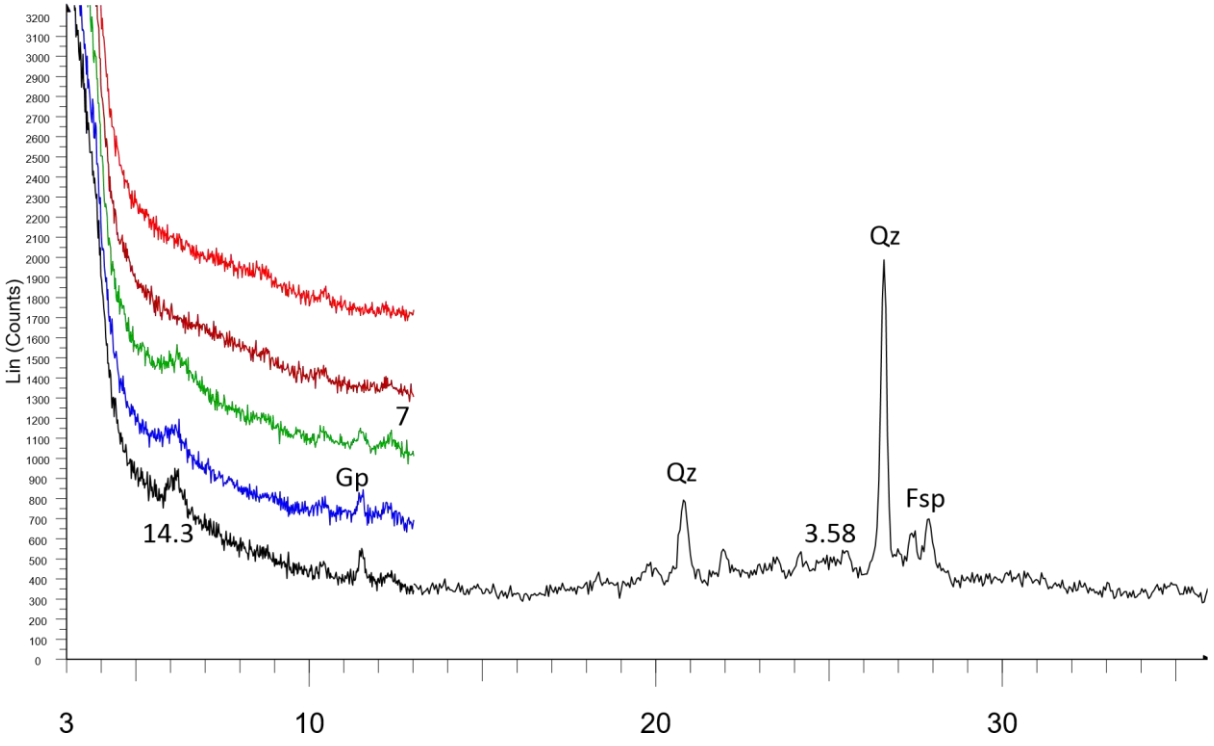
LU17 00191 026 (20377)



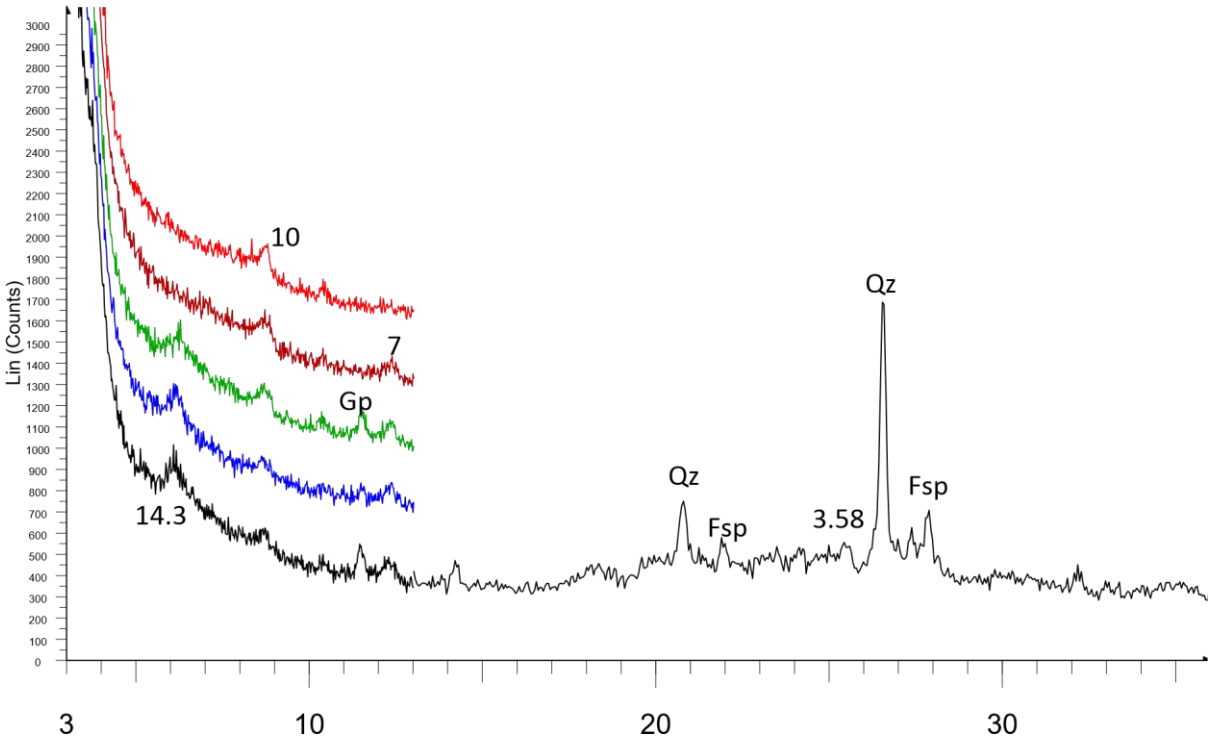
LU17 00191 027 (20600)



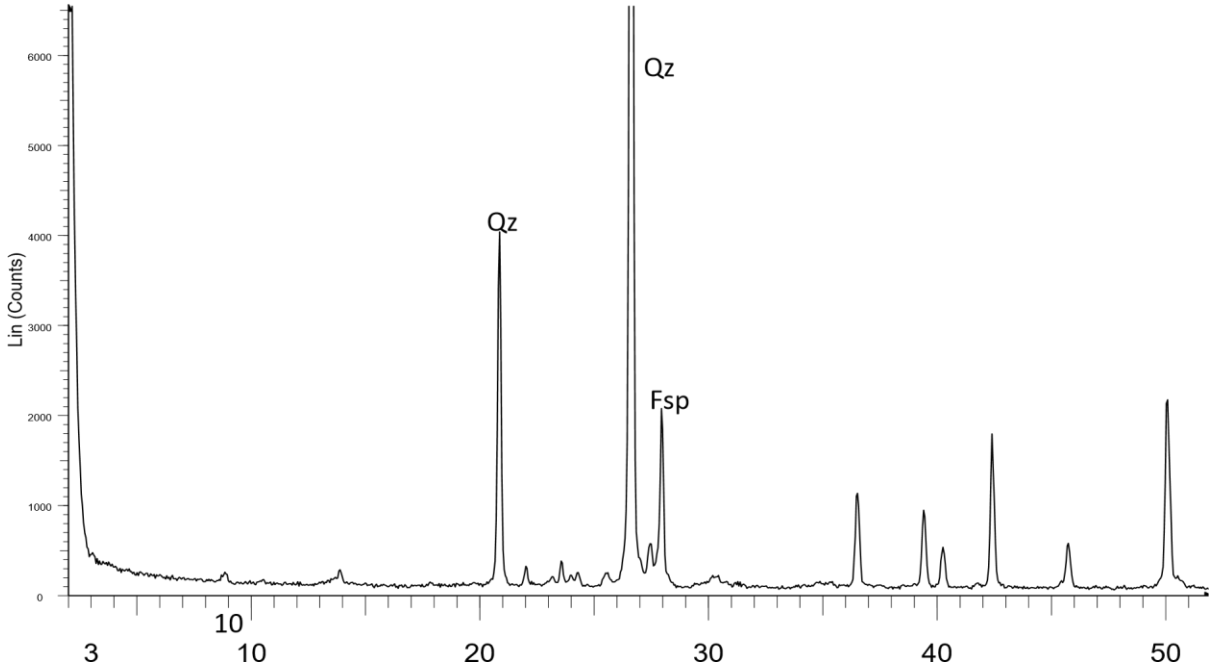
LU17 00191 028 (20798)



LU17 00191 029 (21098)

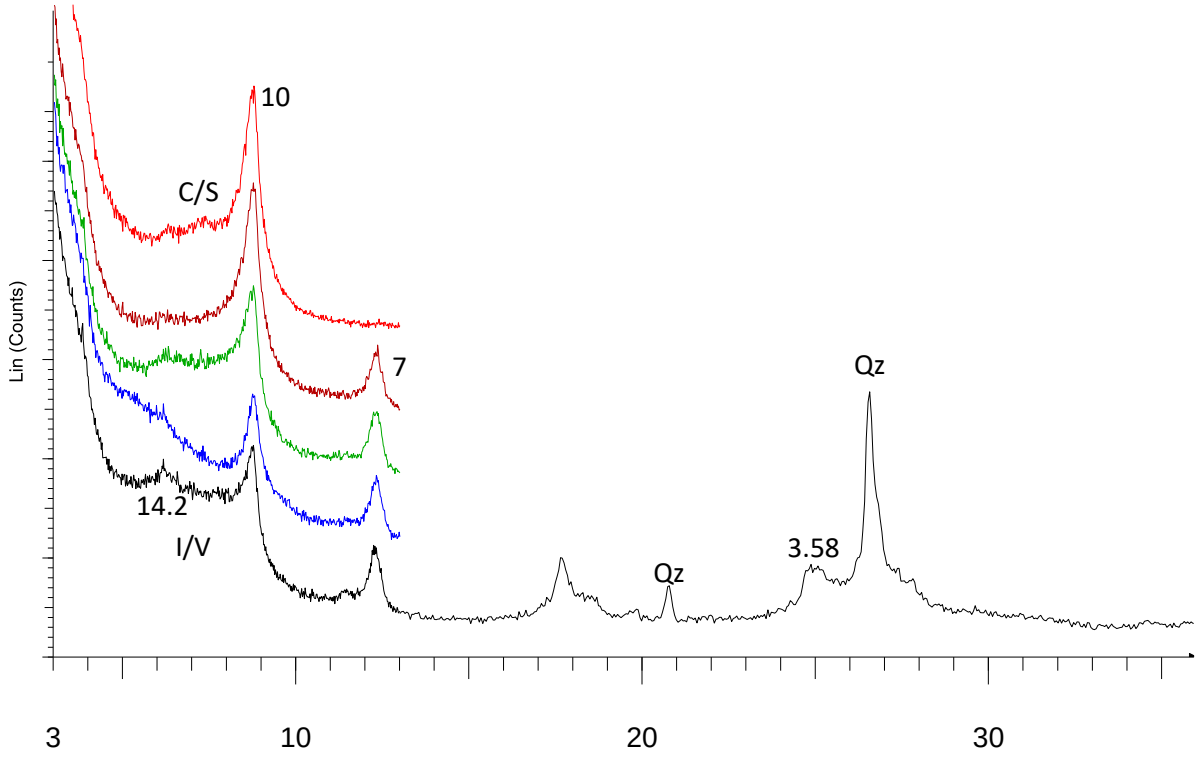


LU17 00191 030 (21192)

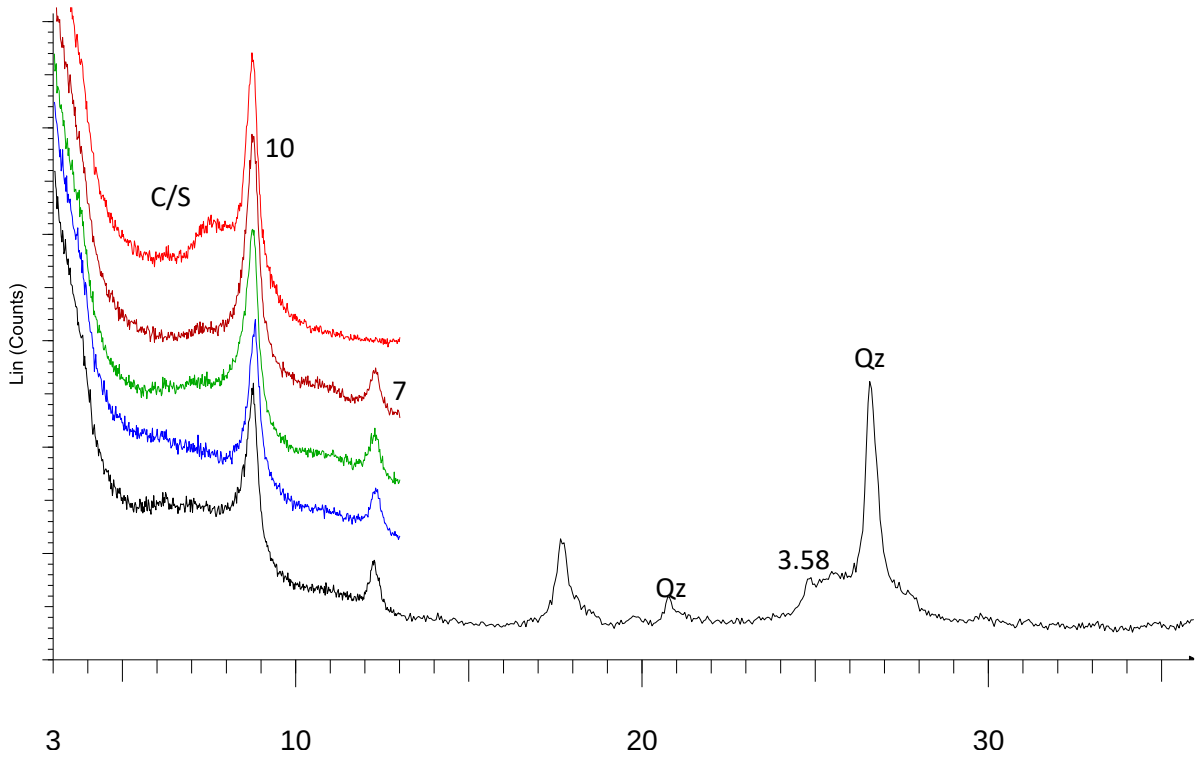


Annex 6. RX Diffractograms from Hungary

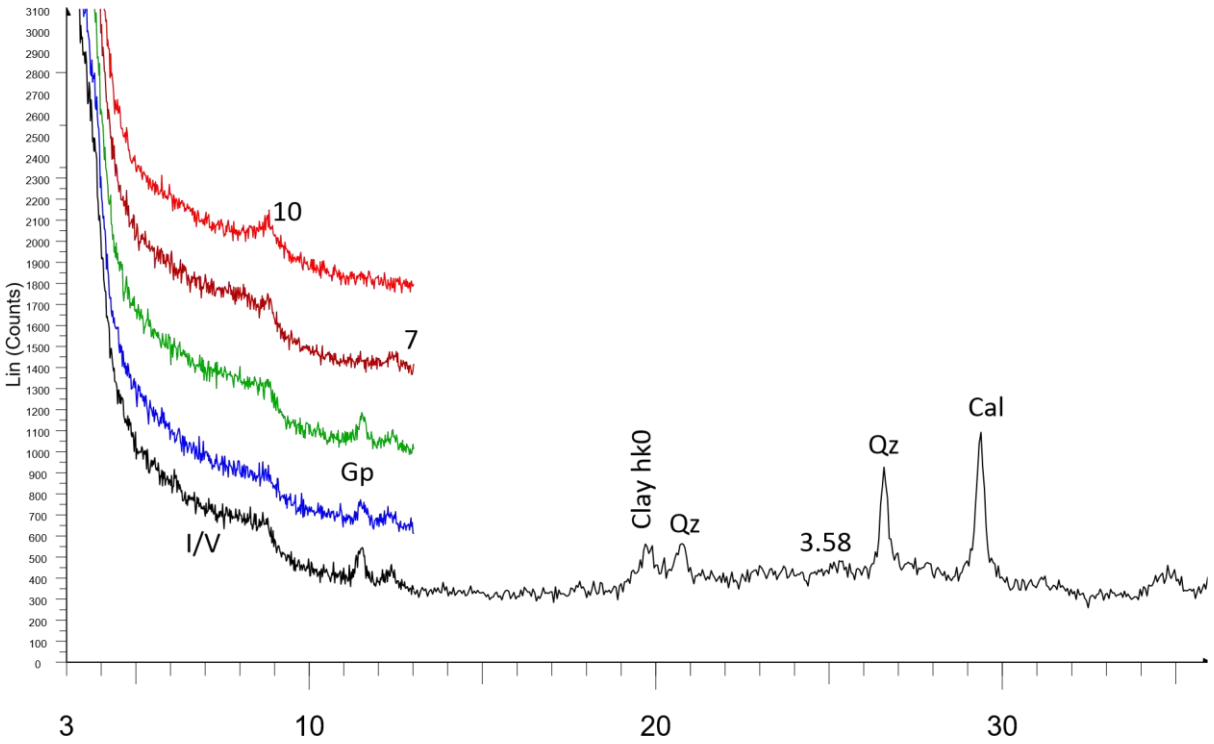
LU17 00193 001 (30034)



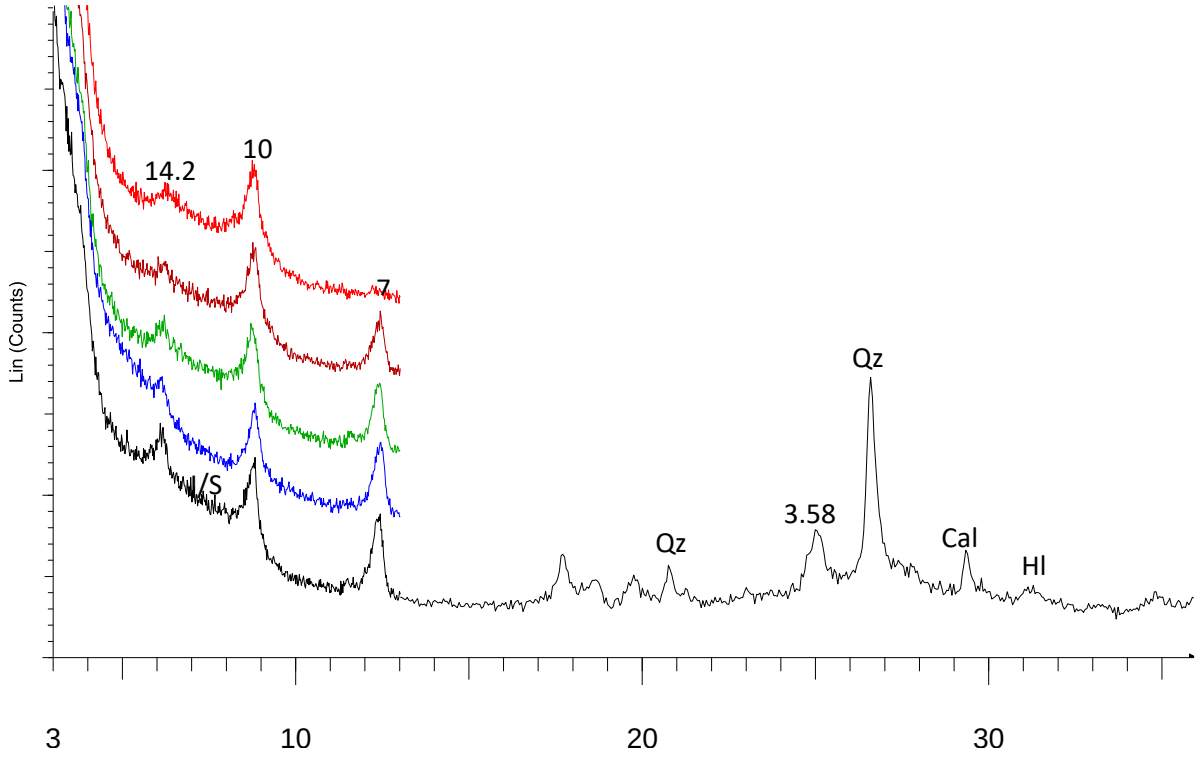
LU17 00 193 002 (30040)



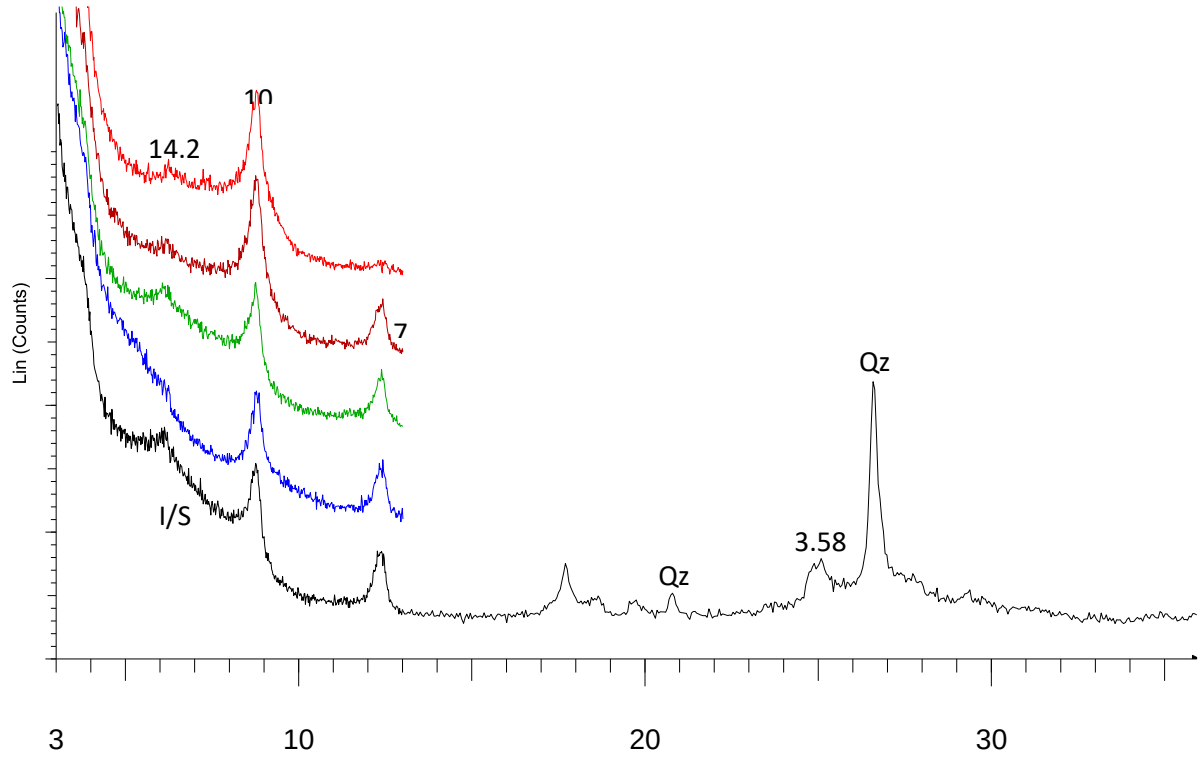
LU17 00193 003 (30078)



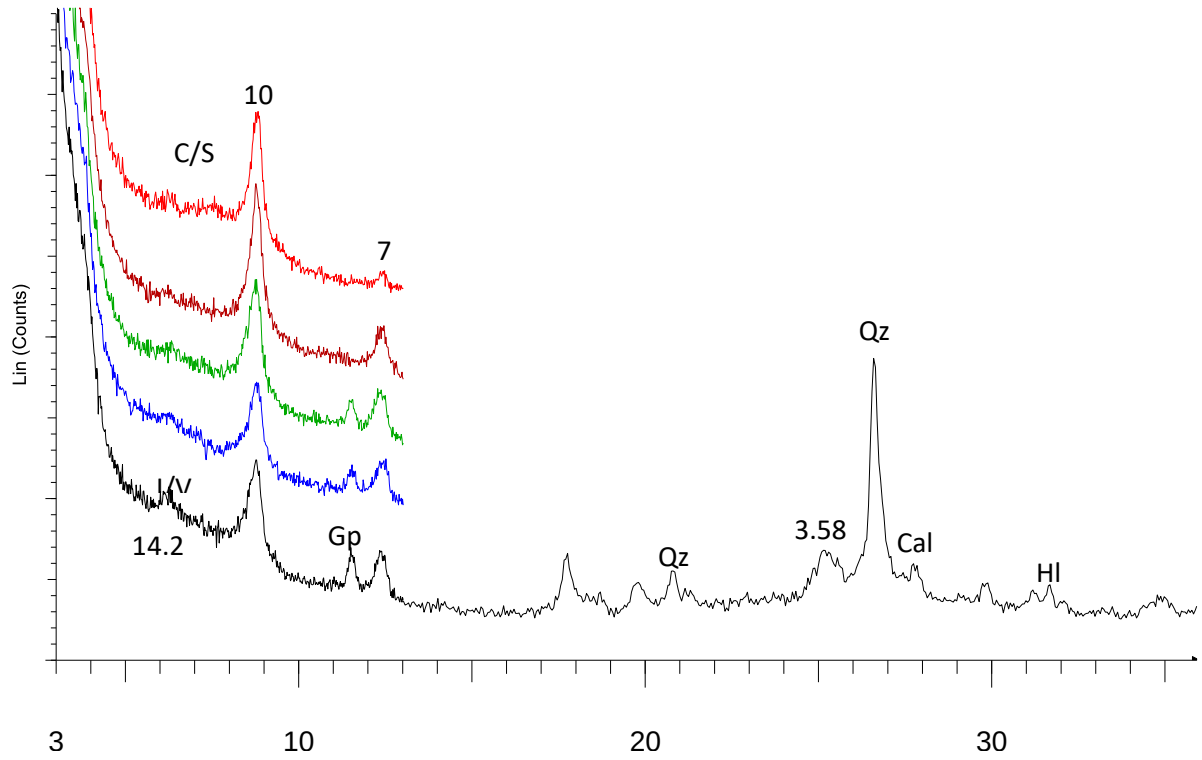
LU17 00193 004 (30110)



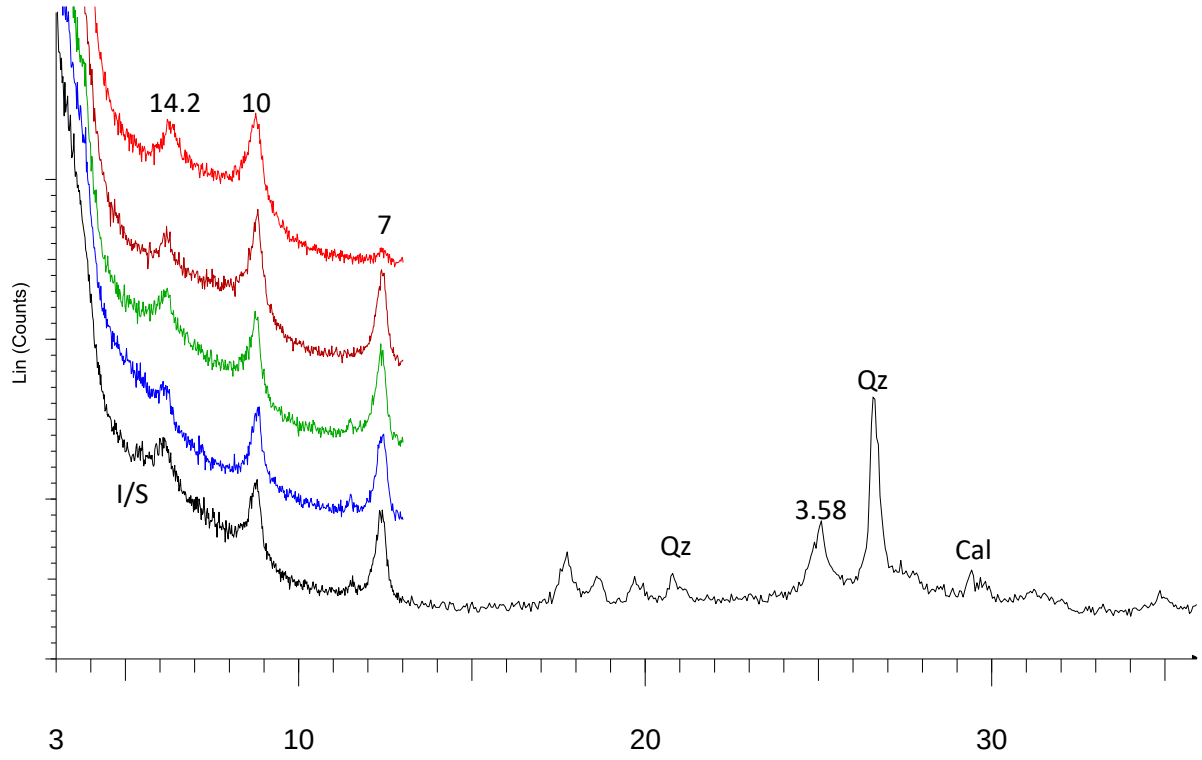
LU17 00193 005 (30135)



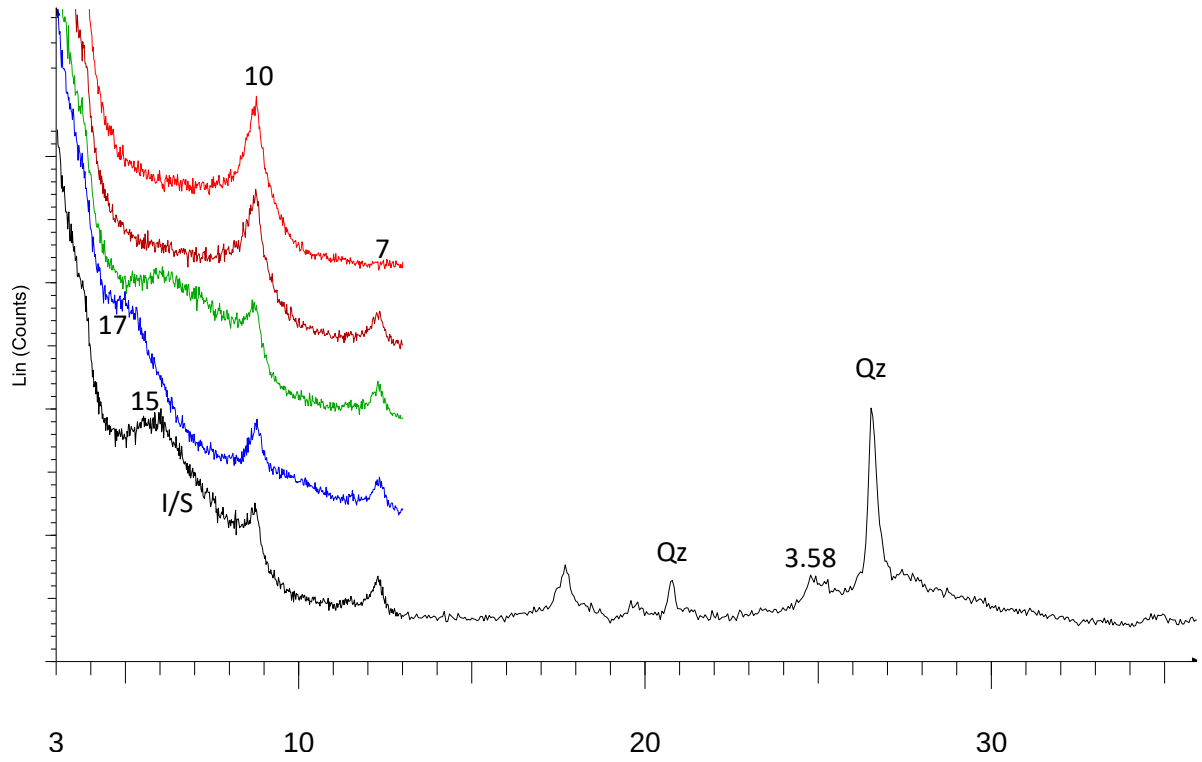
LU17 00193 006 (30233)



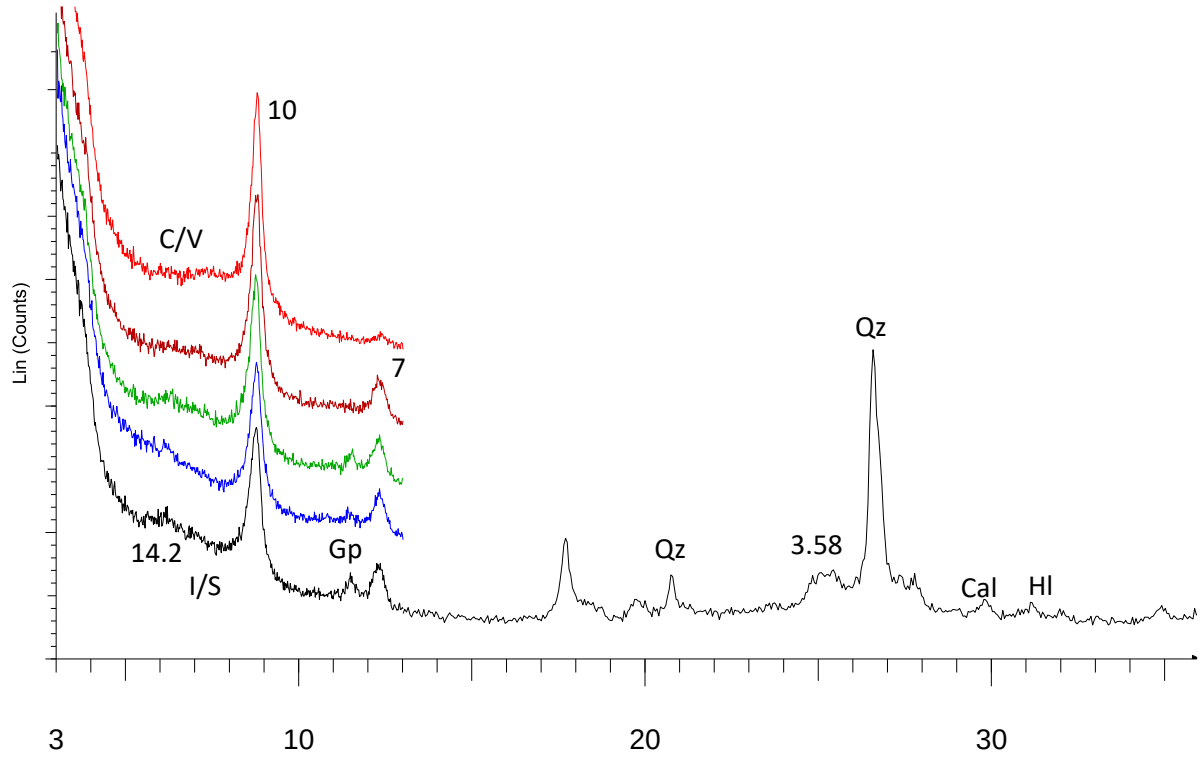
LU17 00193 007 (30276)



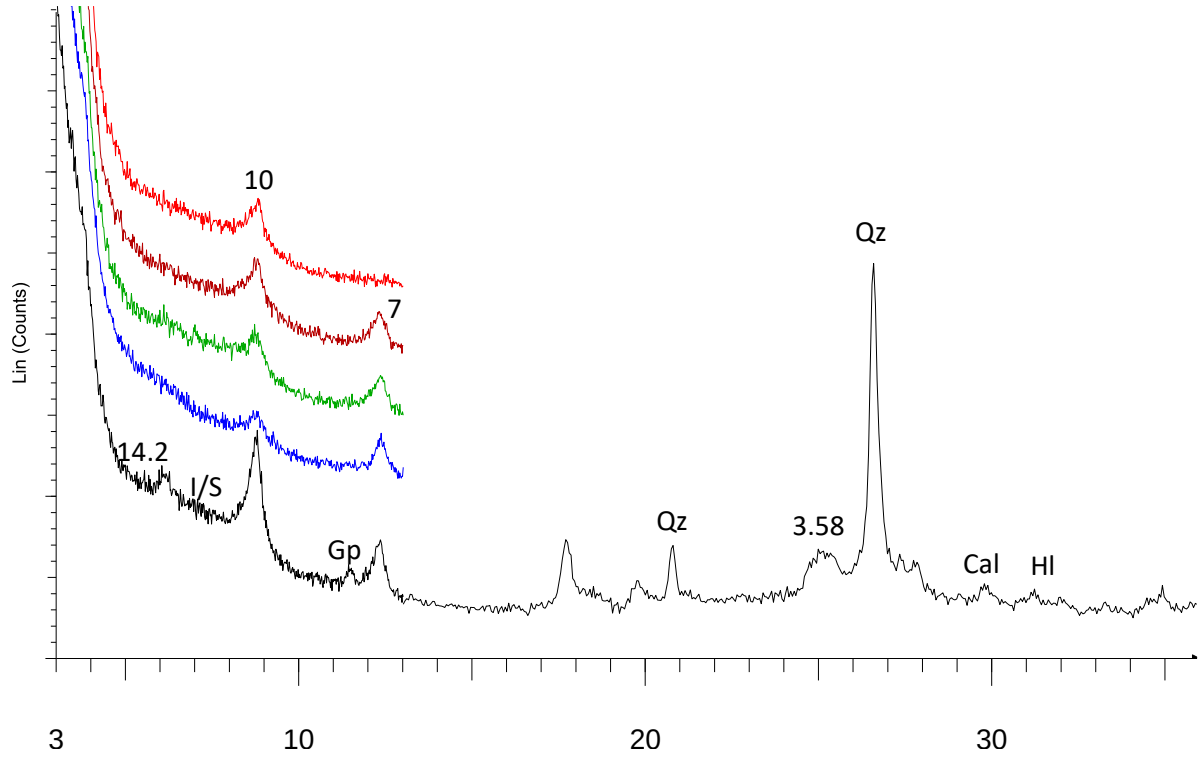
LU17 00193 008 (30282)



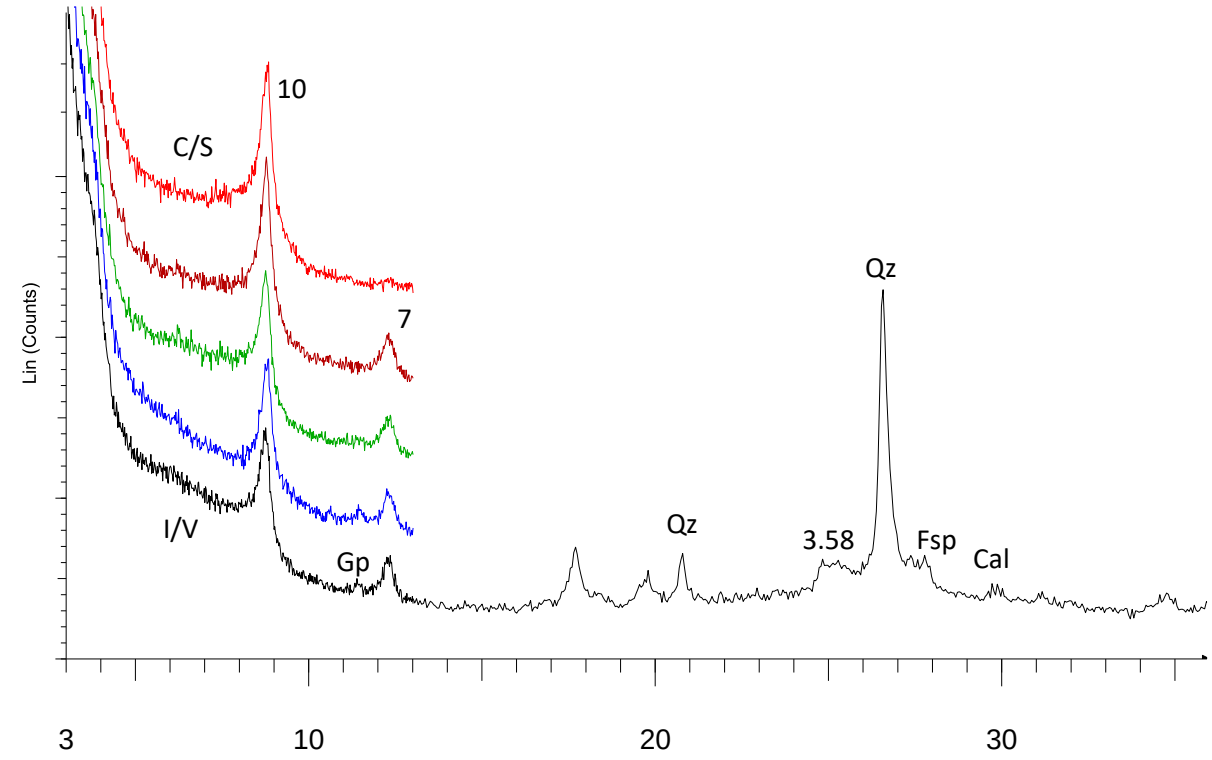
LU17 00193 009 (30326)



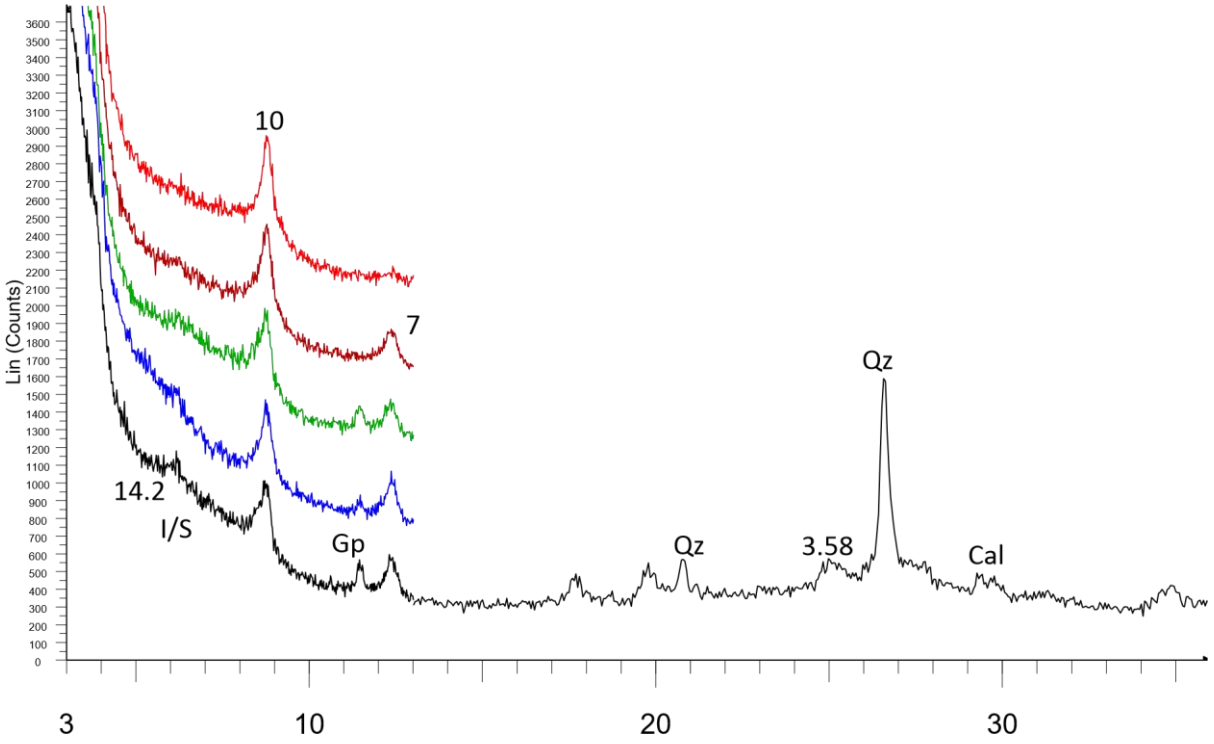
LU17 00193 010 (30373)



LU17 00193 011 (30416)

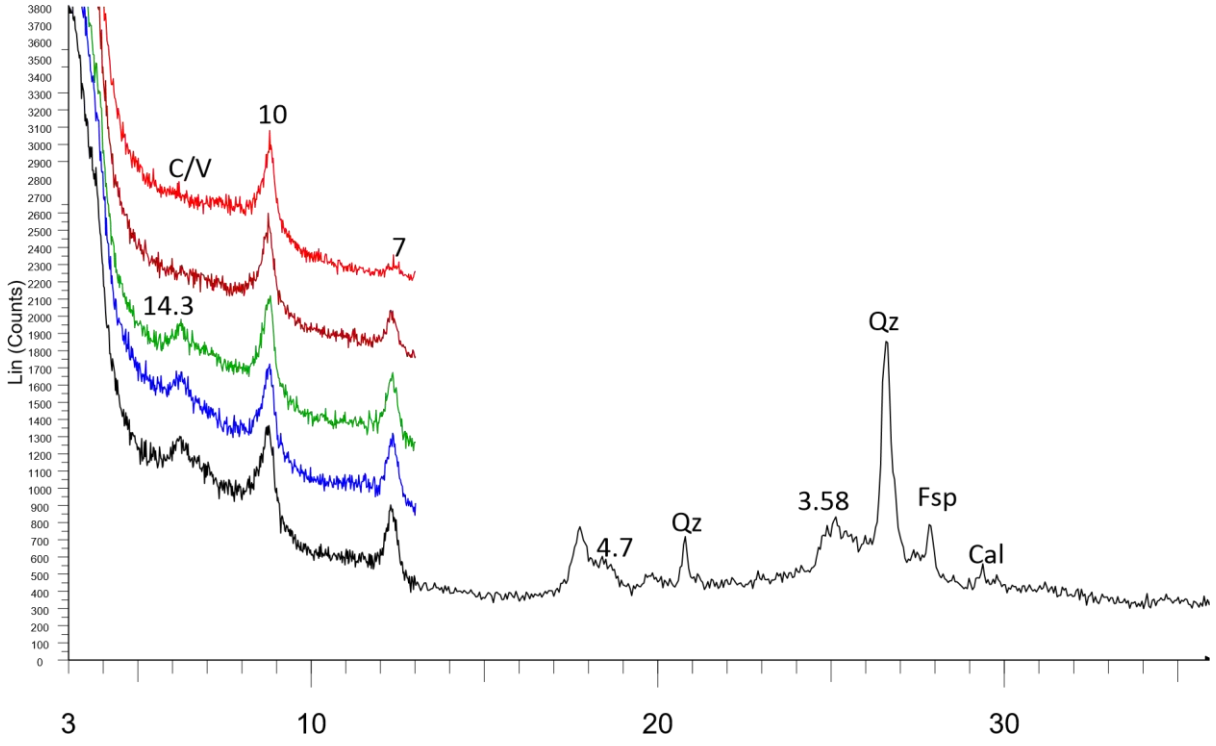


LU17 00193 012 (30461)

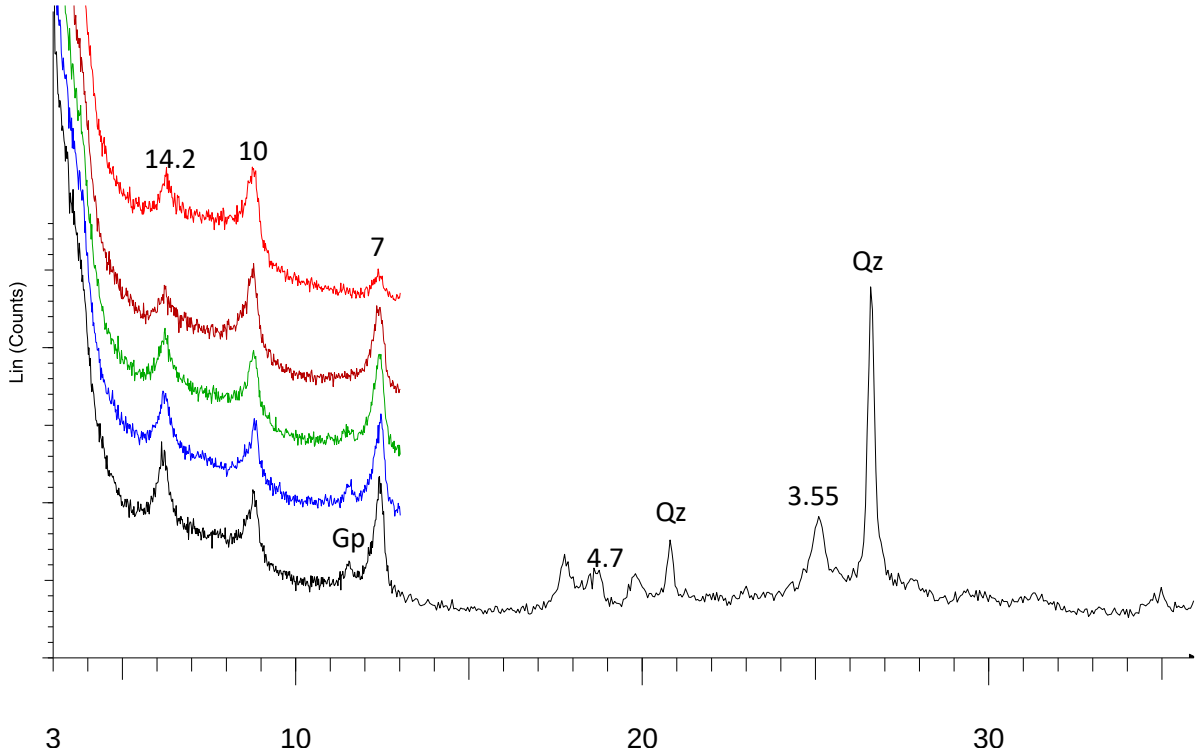


Annex 7. RX Diffractograms from Italy

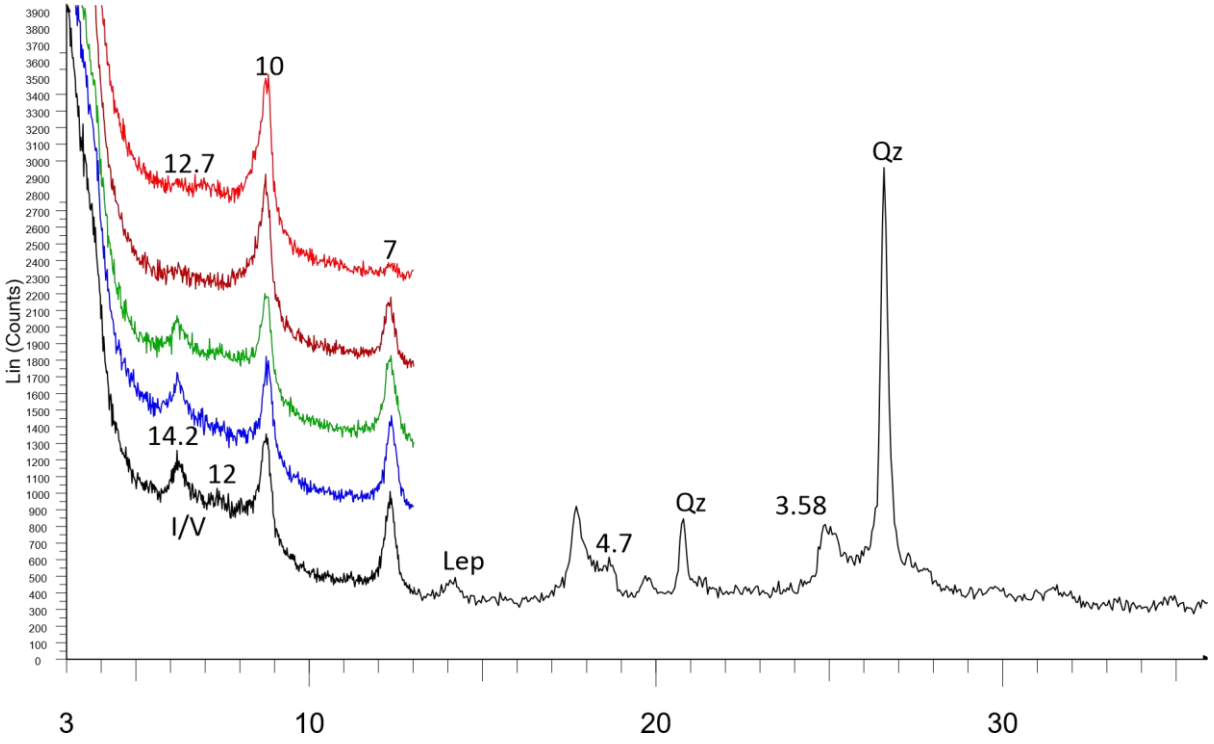
LU17 00194 001 (32100)



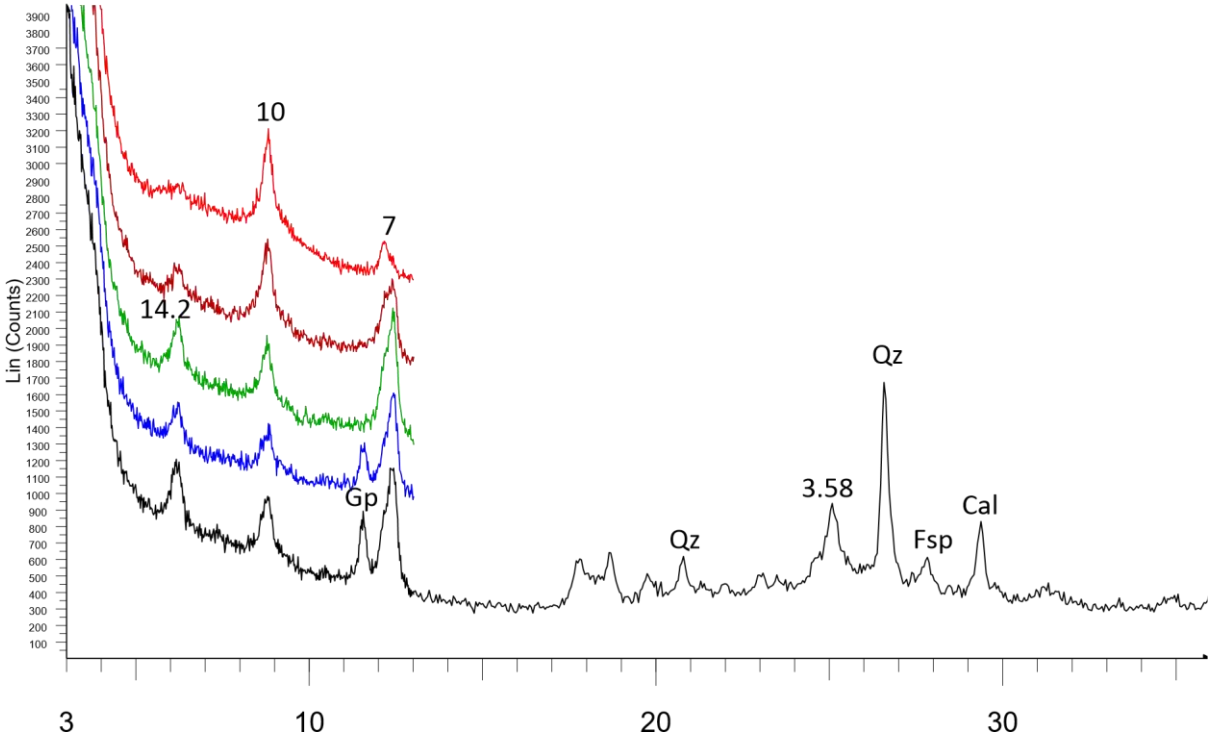
LU17 00194 002 (32107)



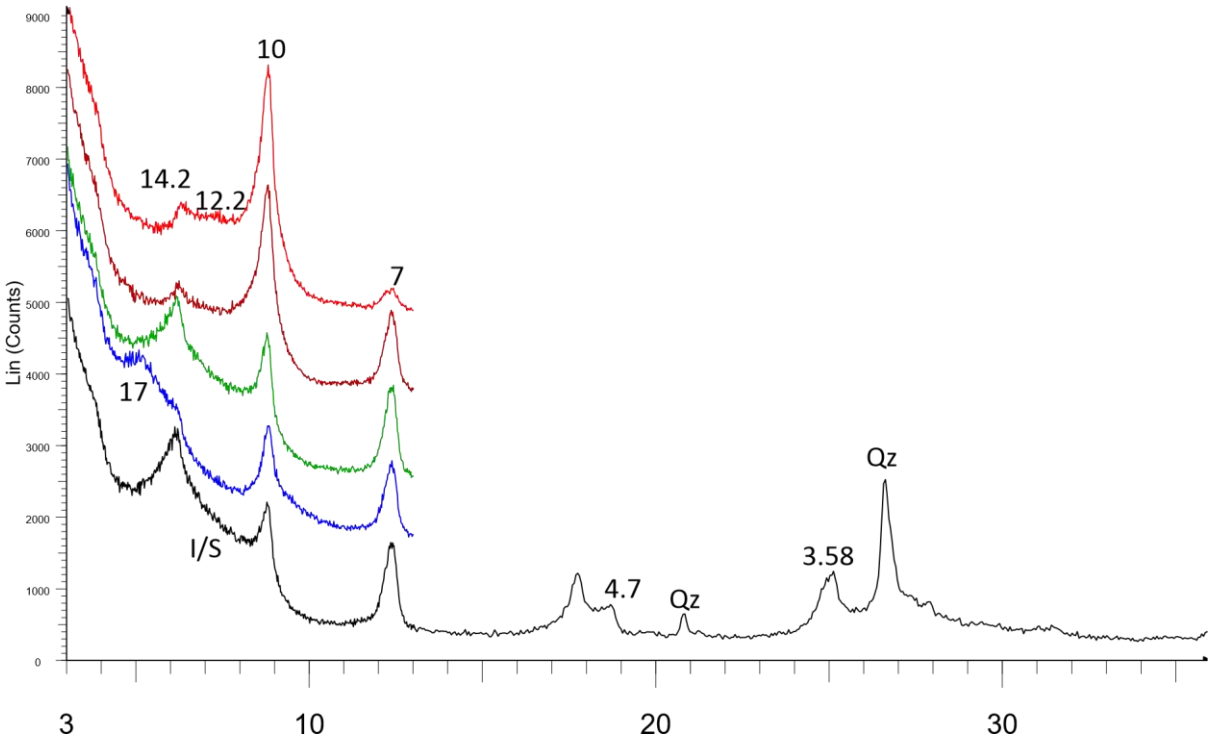
LU17 00194 003 (32117)



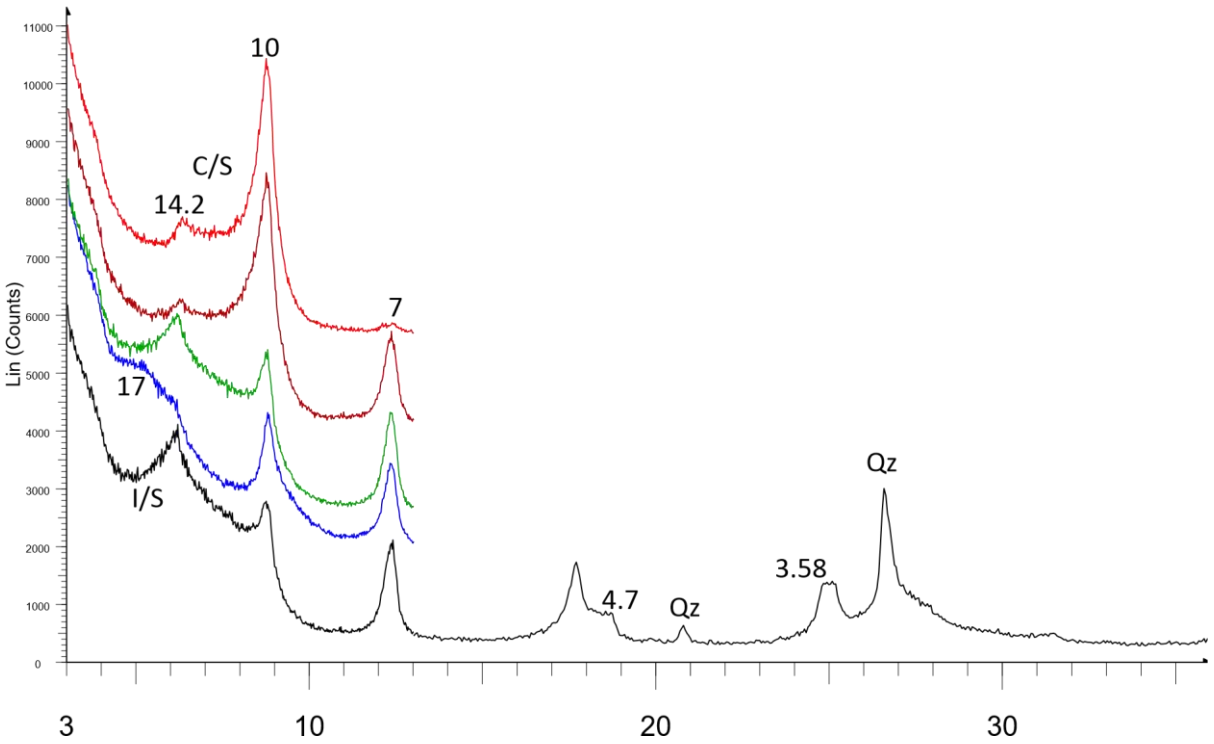
LU17 00194 004 (32260)



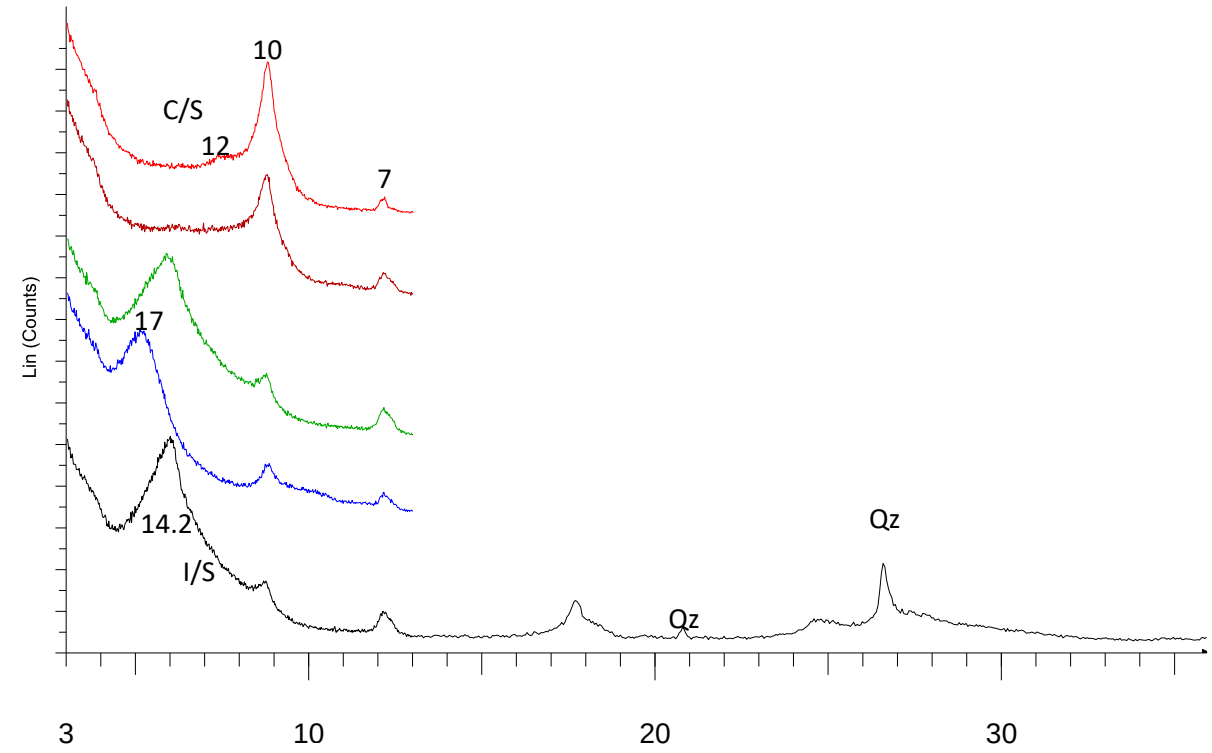
LU17 00194 005 (32295)



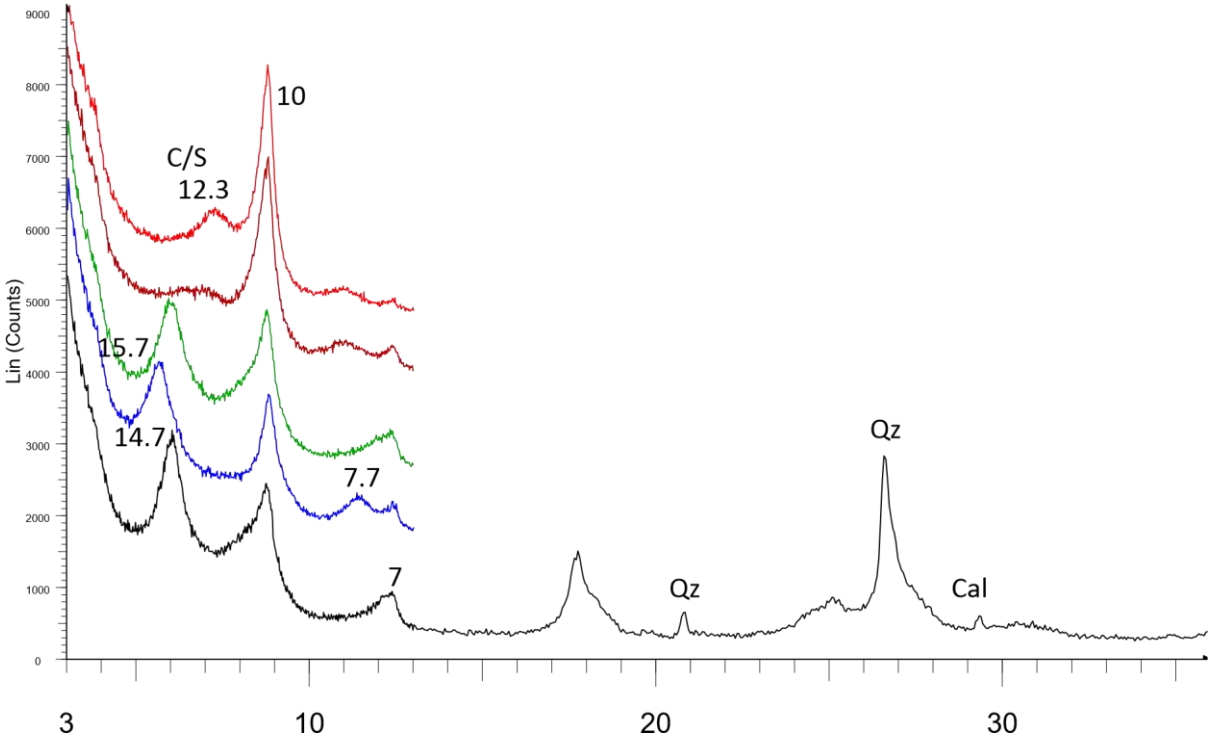
LU17 00194 006 (32304)



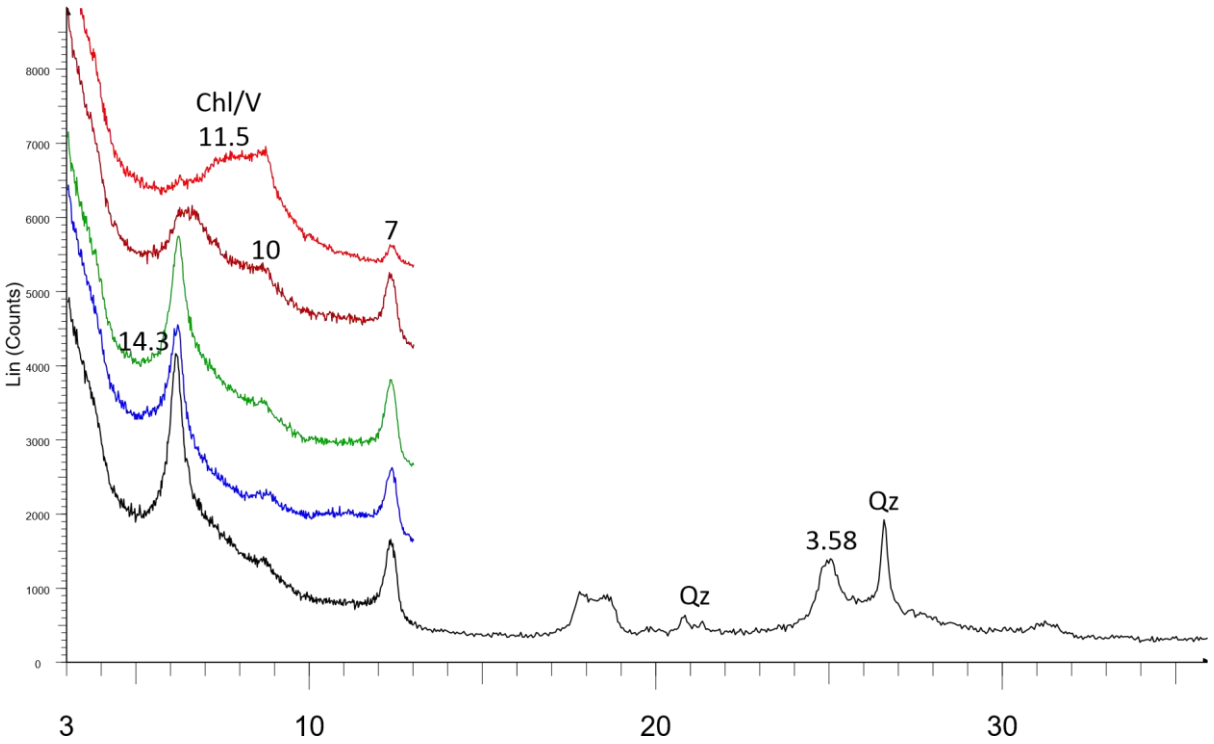
LU17 00194 007 (32340)



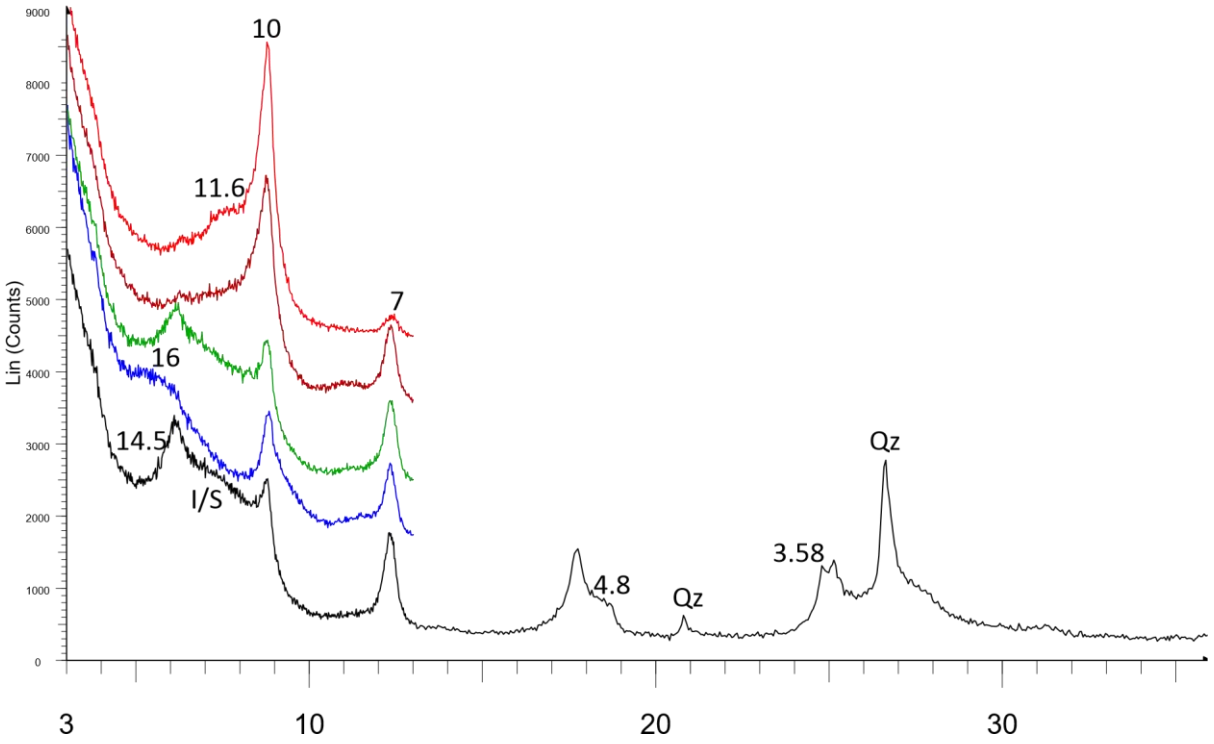
LU17 00194 008 (32354)



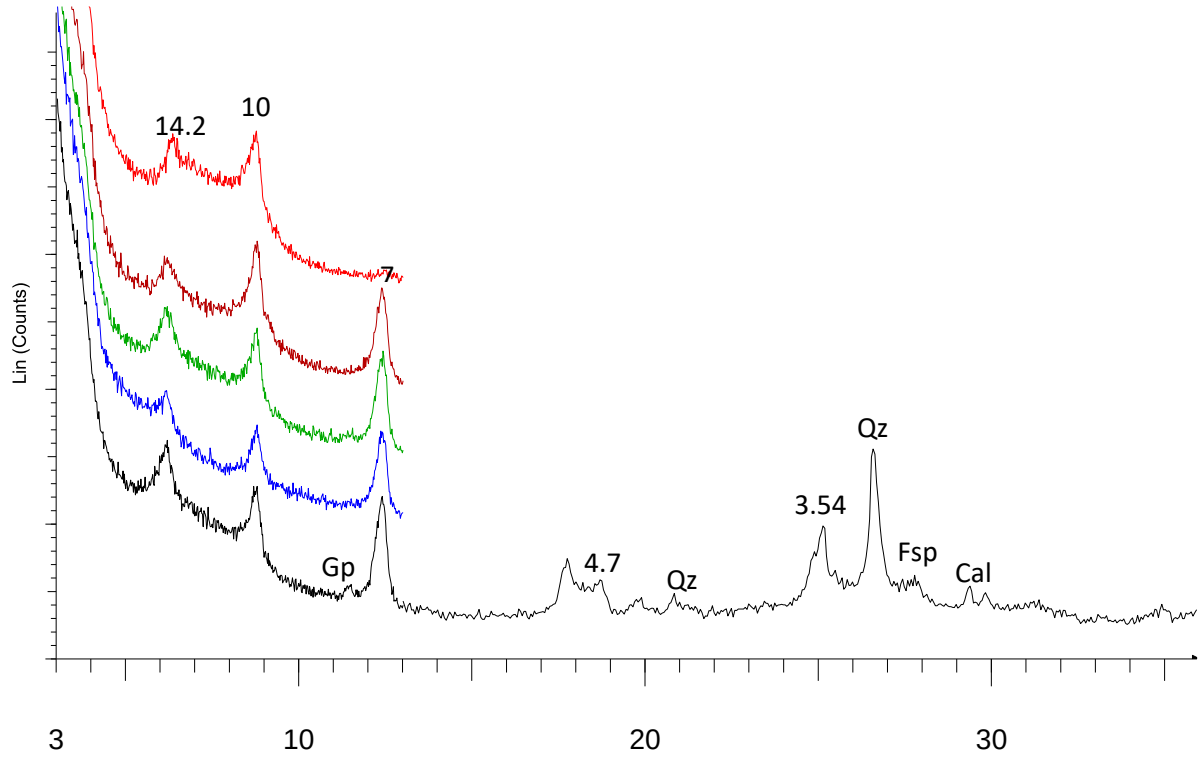
LU17 00194 009 (32362)



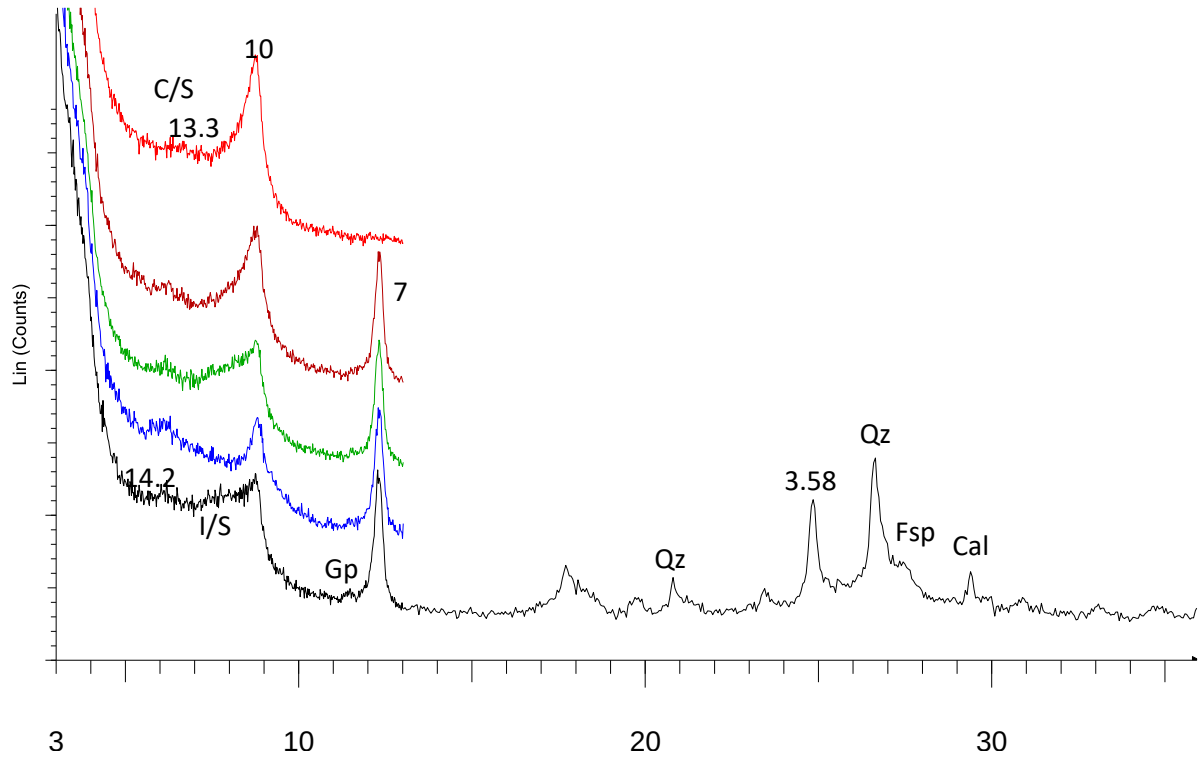
LU17 00194 010 (32409)



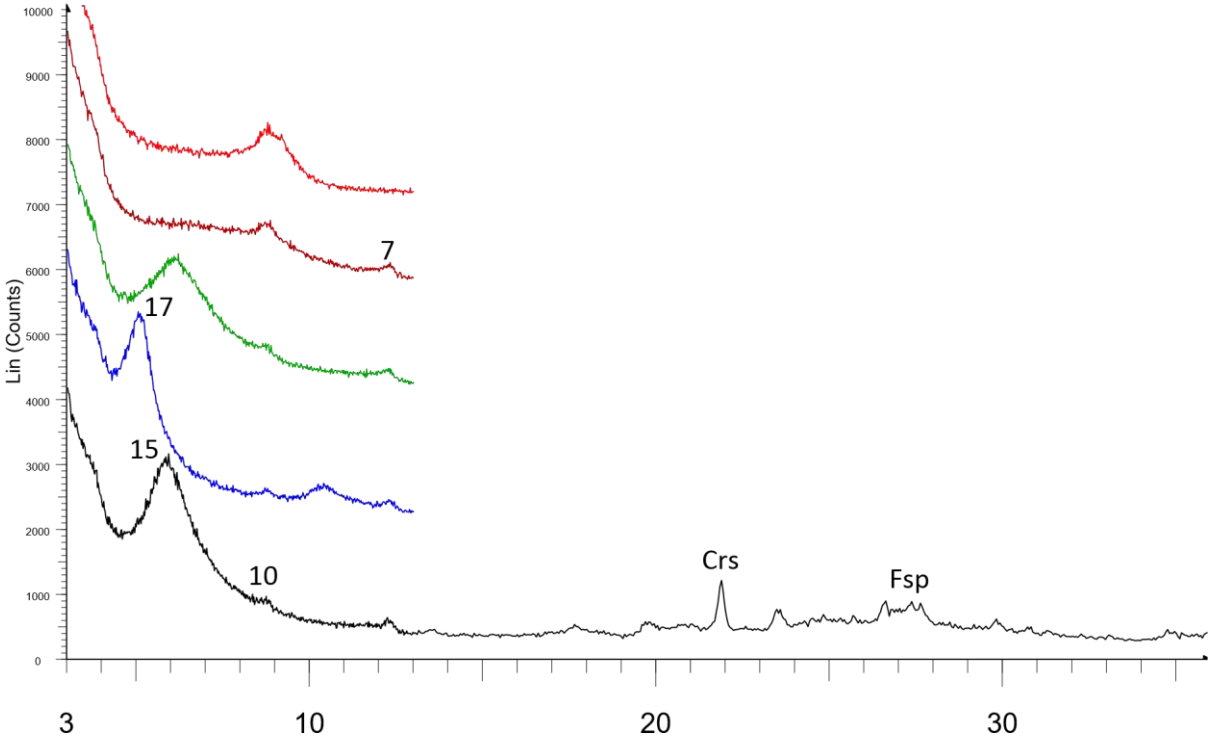
LU17 00194 011 (32542)



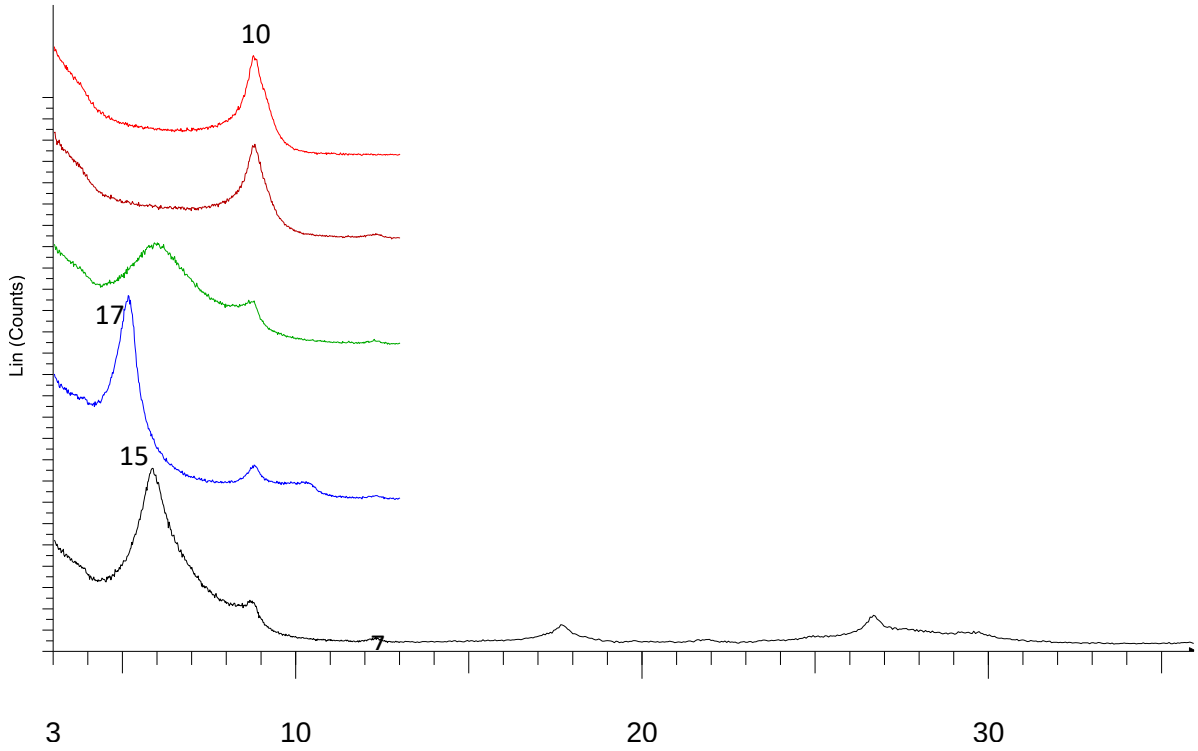
LU17 00194 012 (32693)



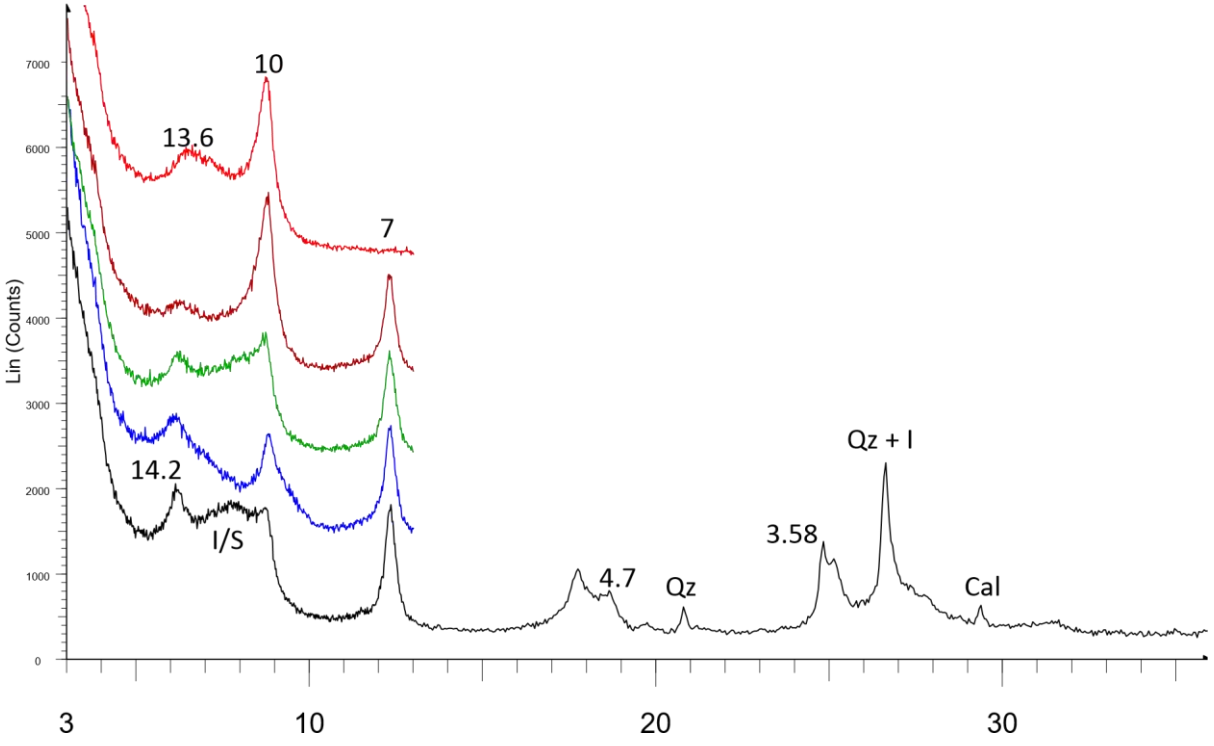
LU17 00194 013 (32863)



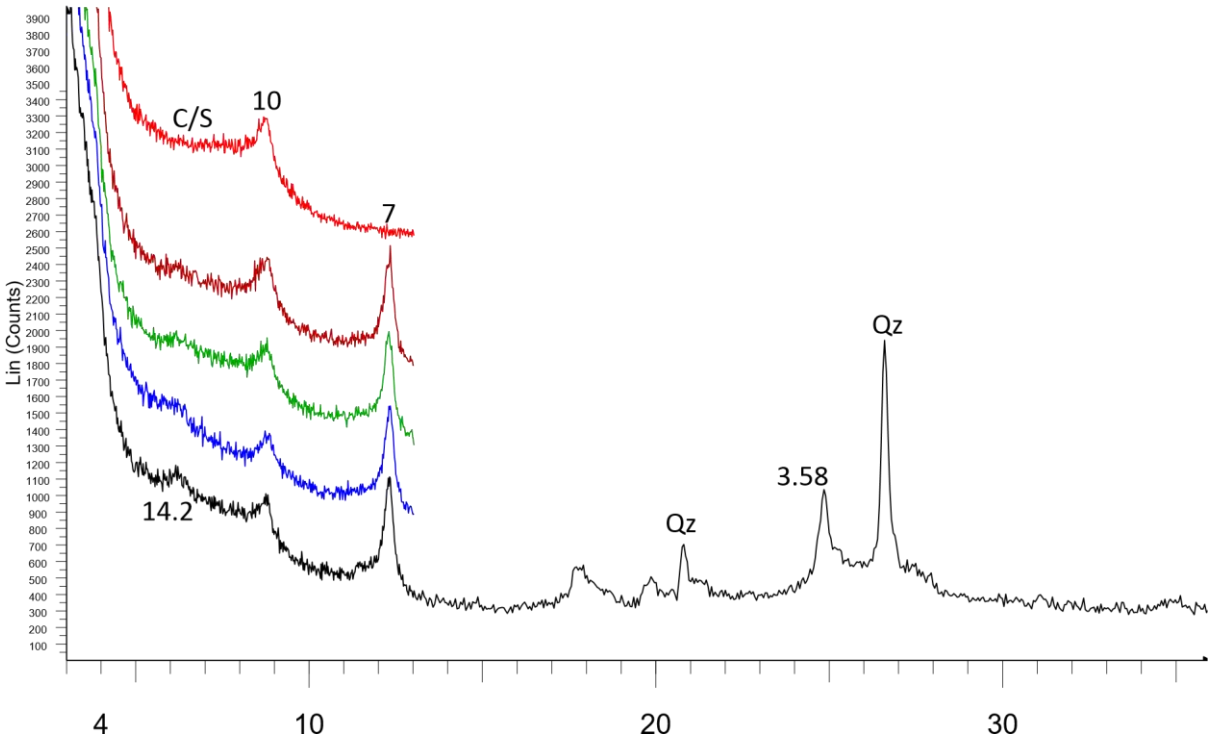
LU17 00194 014 (32881)



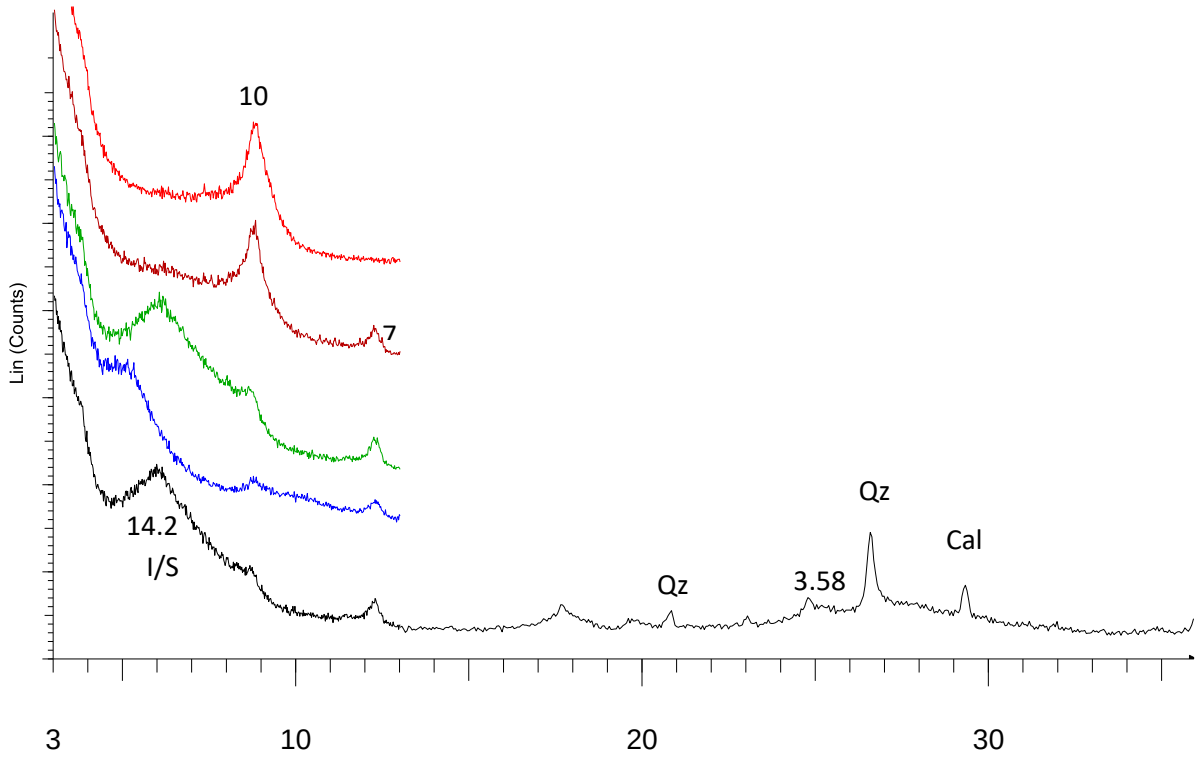
LU17 00194 015 (32938)



LU17 00194 016 (32940)



LU17 00194 017 (33061)



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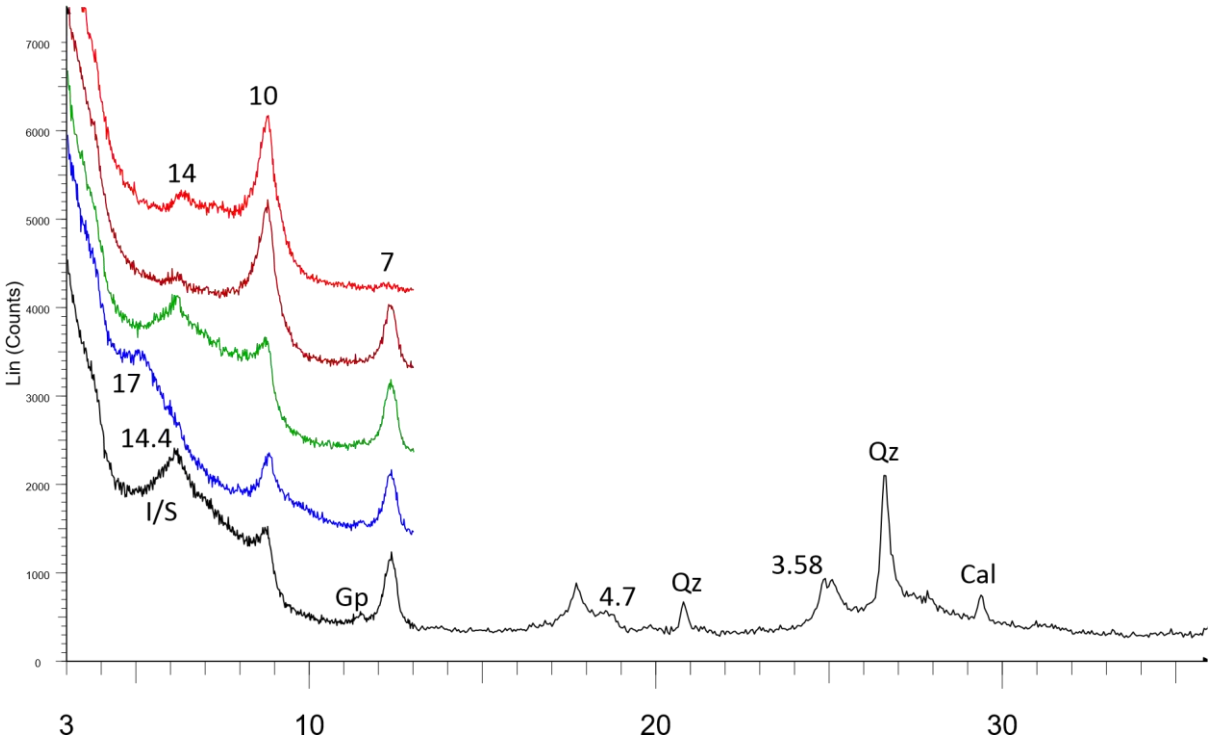
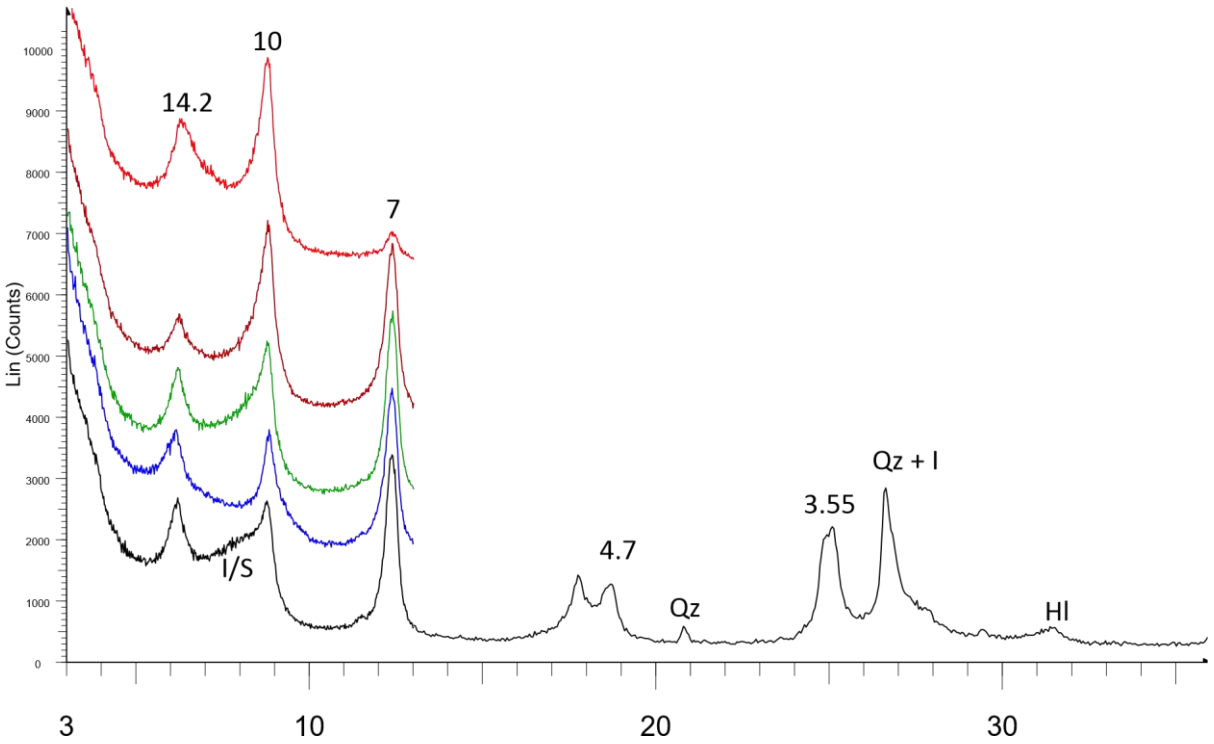
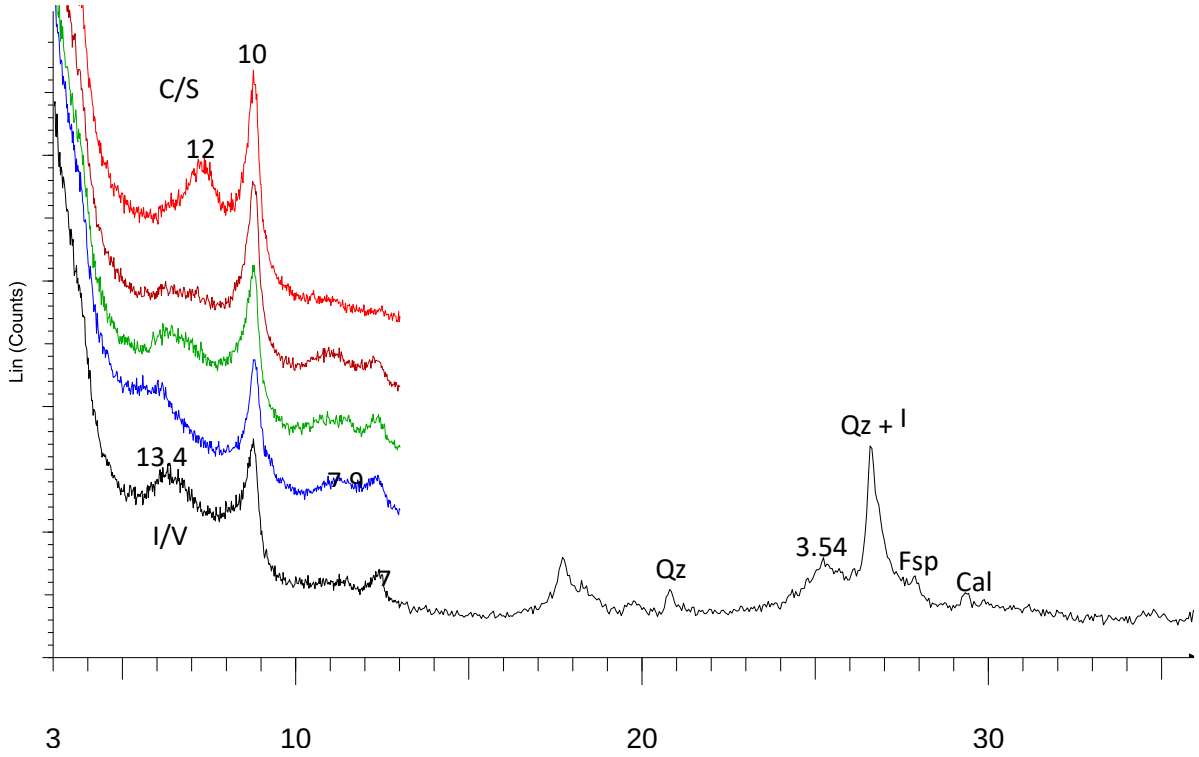


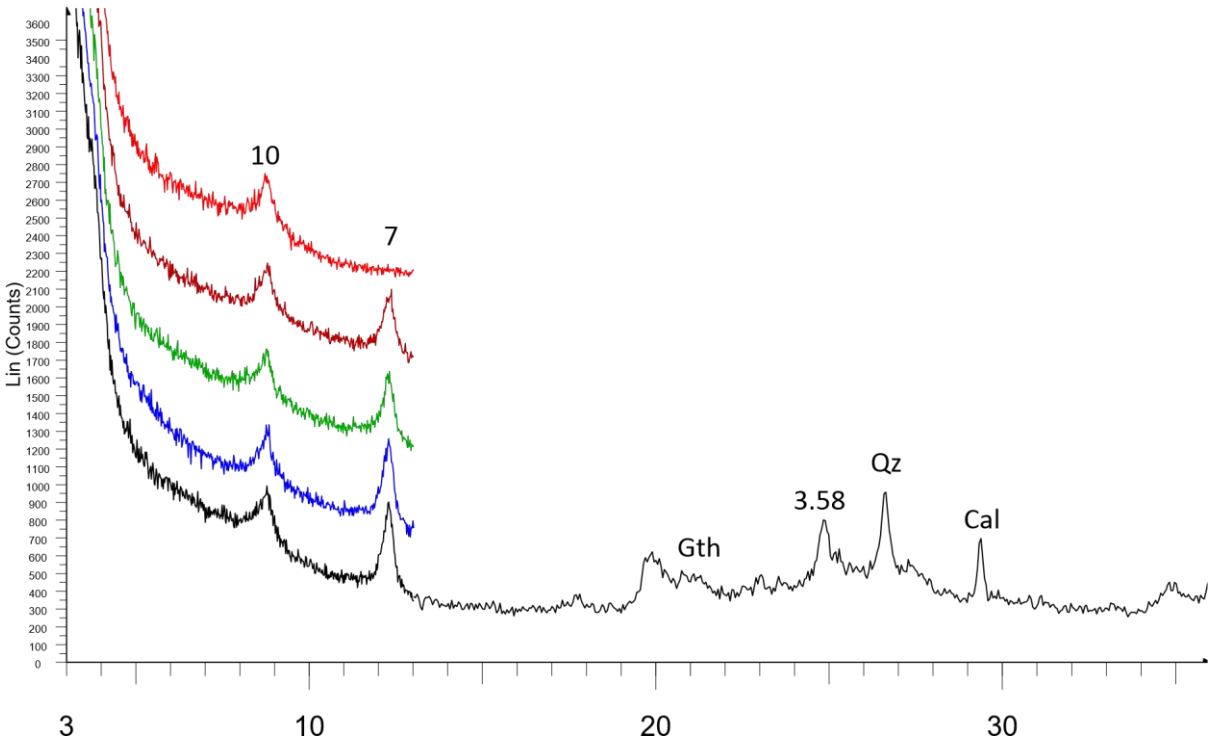
LU17 00194 019 (33242)



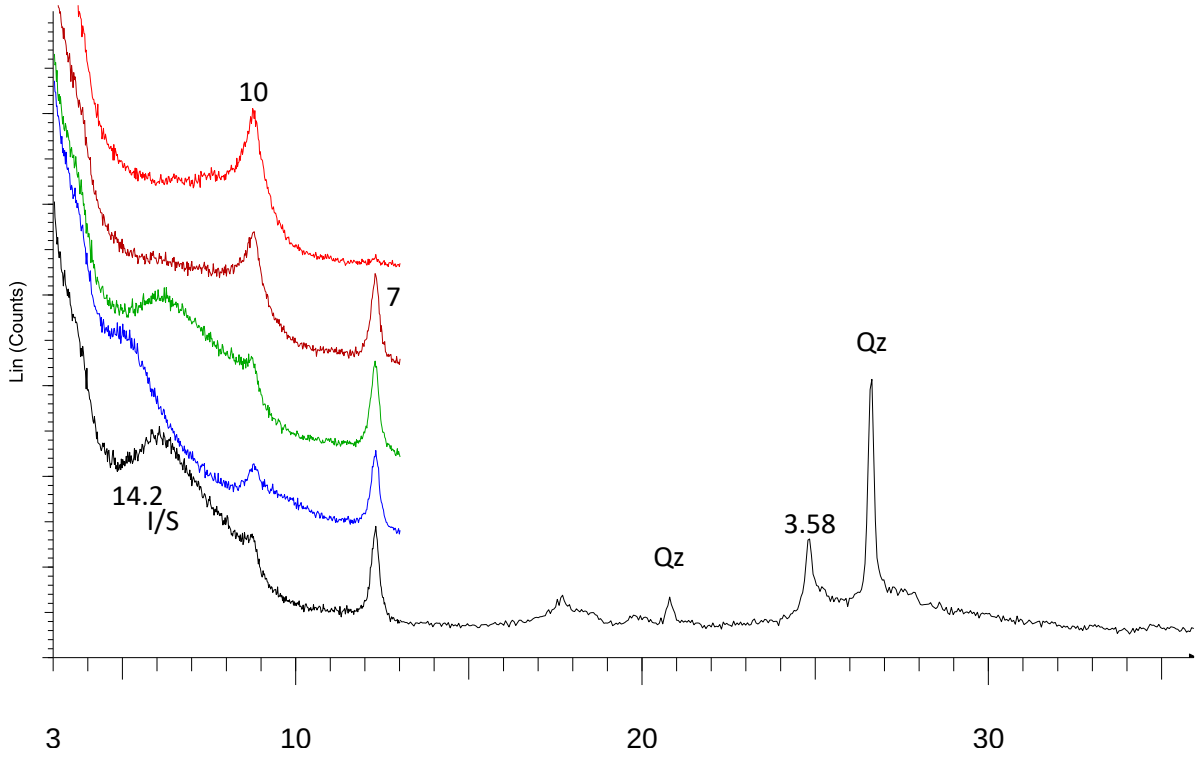
LU17 00194 020 (33272)



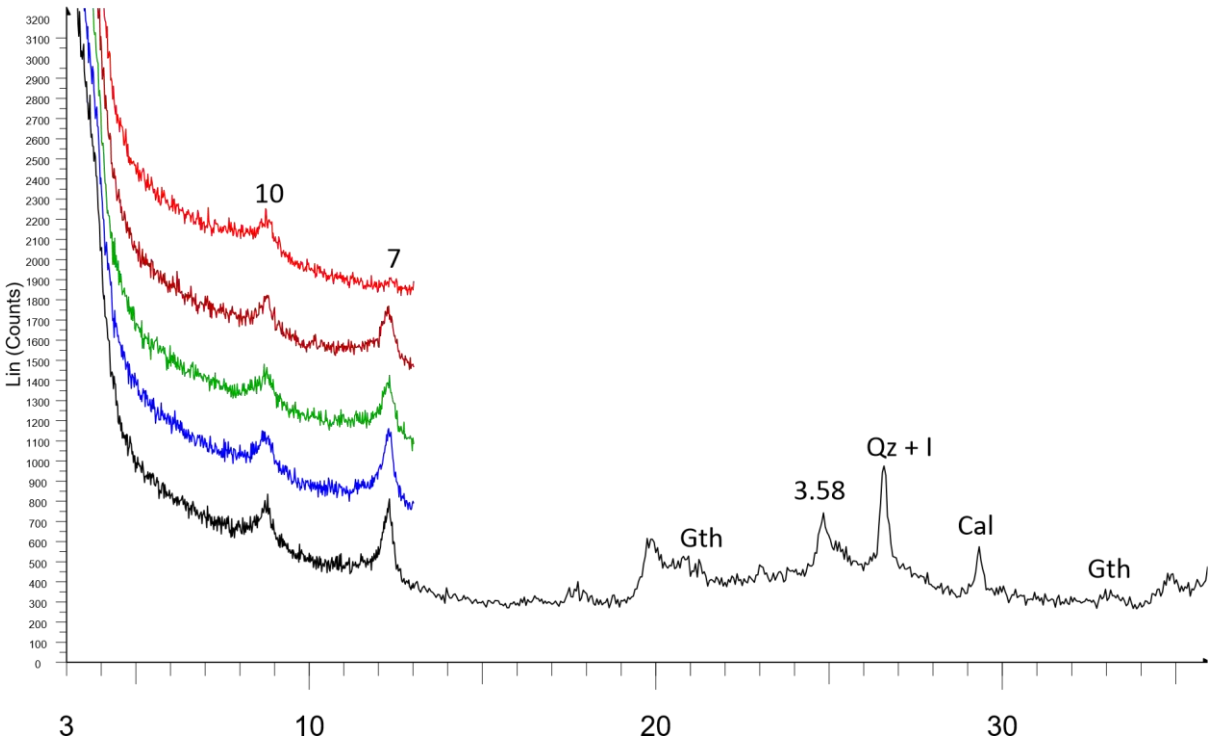
LU17 00194 021 (33431)



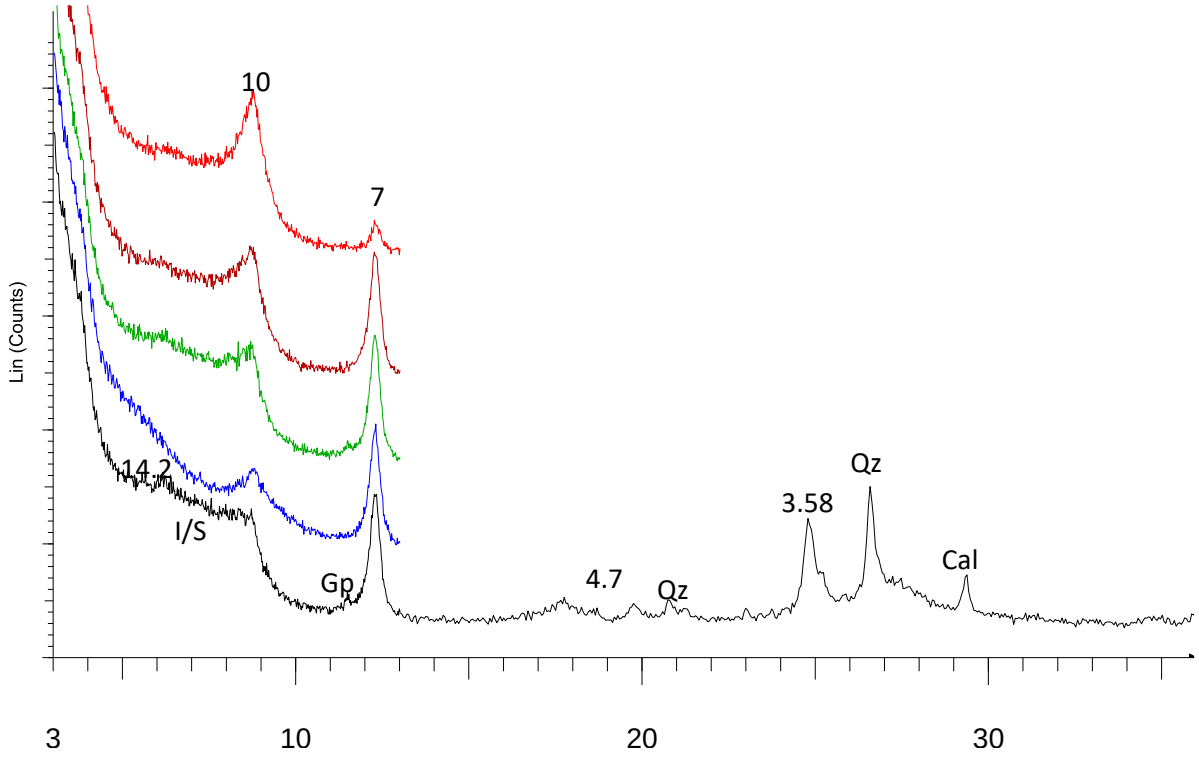
LU17 00194 022 (33481)



LU17 00194 023 (33637)



LU17 00194 024 (33795)



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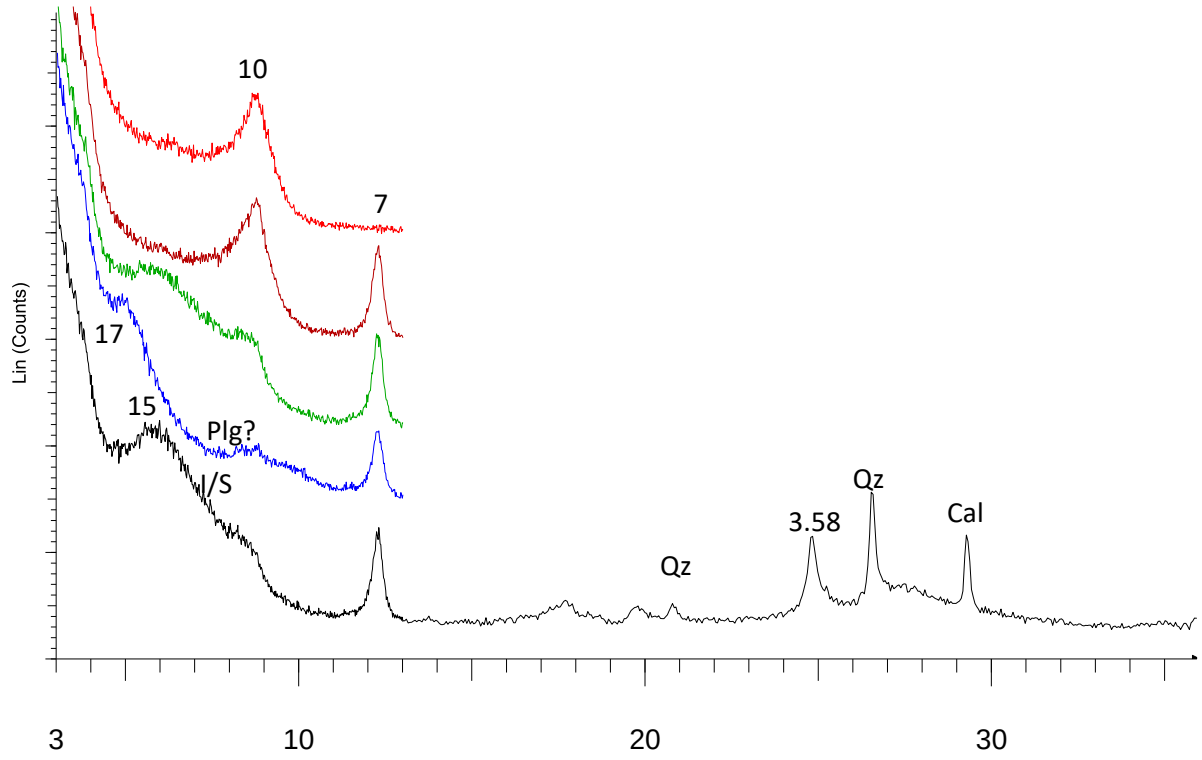

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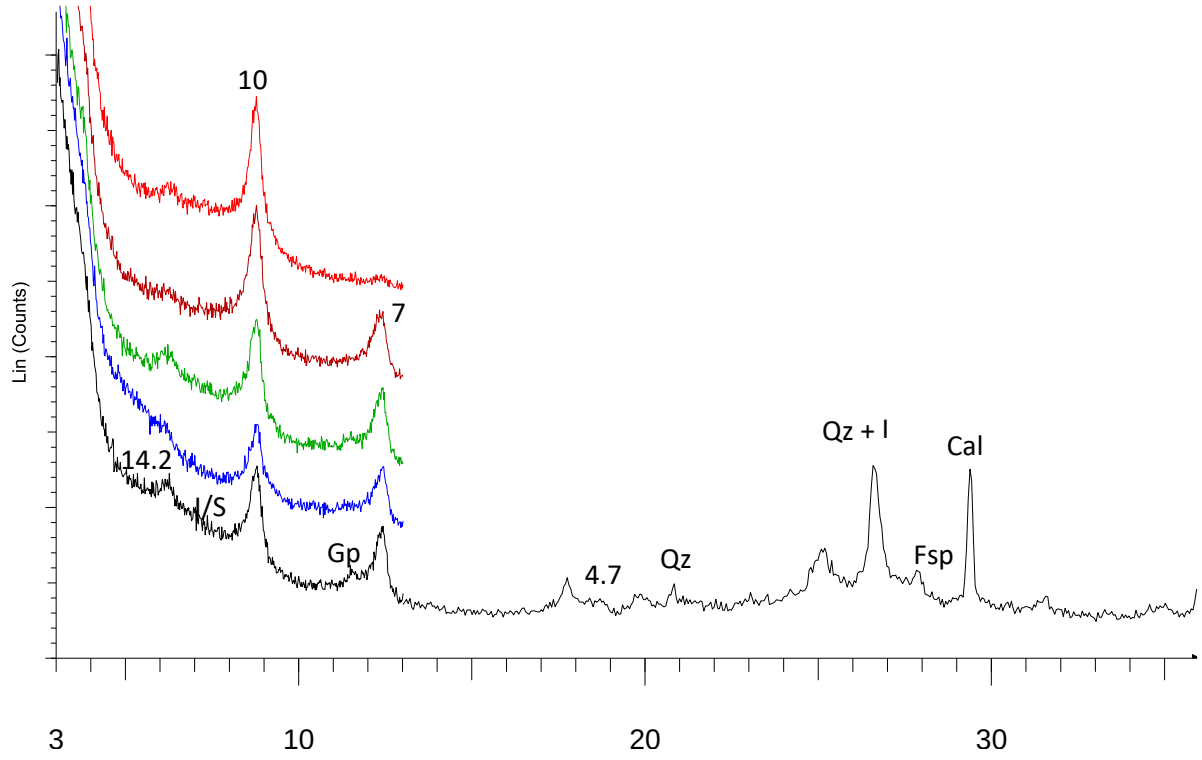
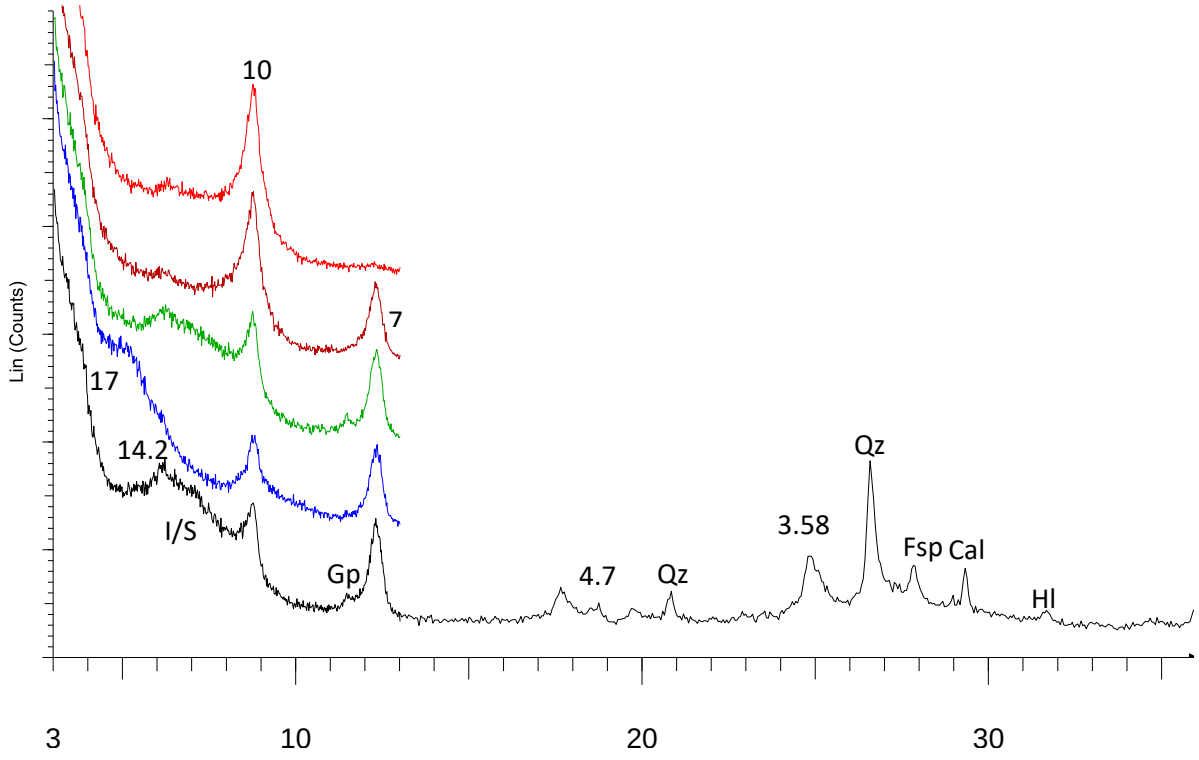
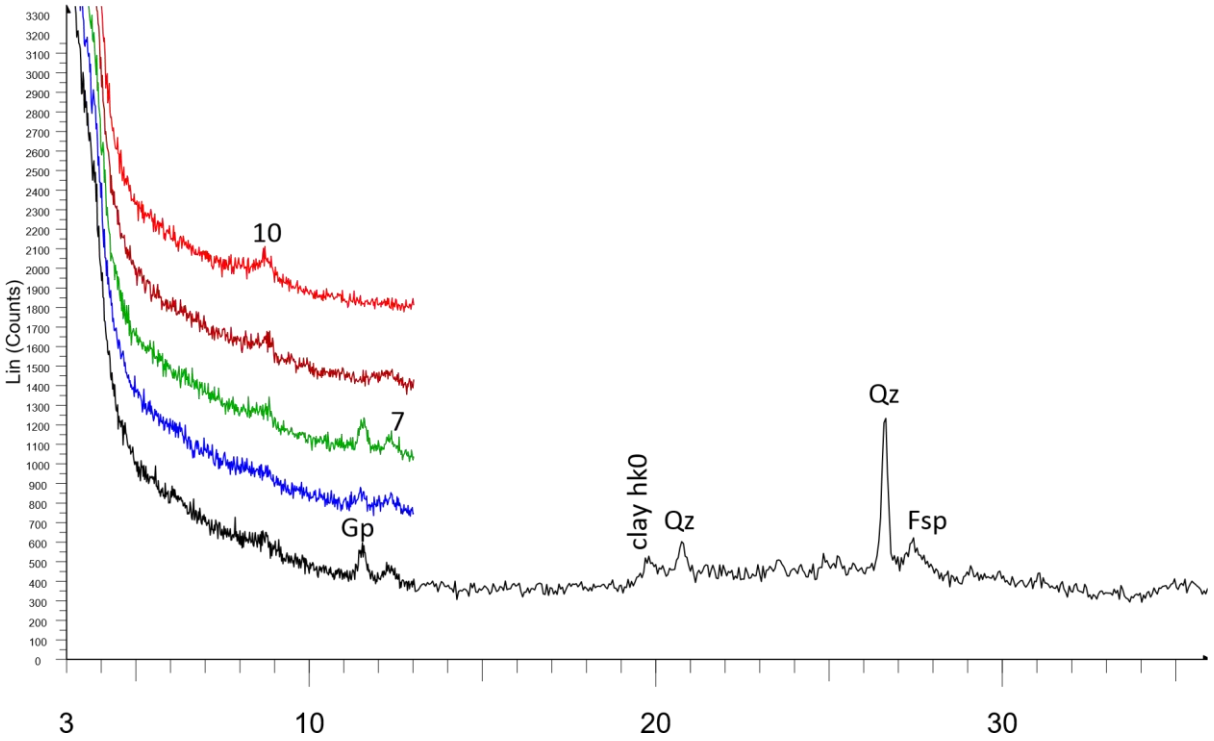


LU17 00194 027 (34014)



LU17 00194 028 (34034)



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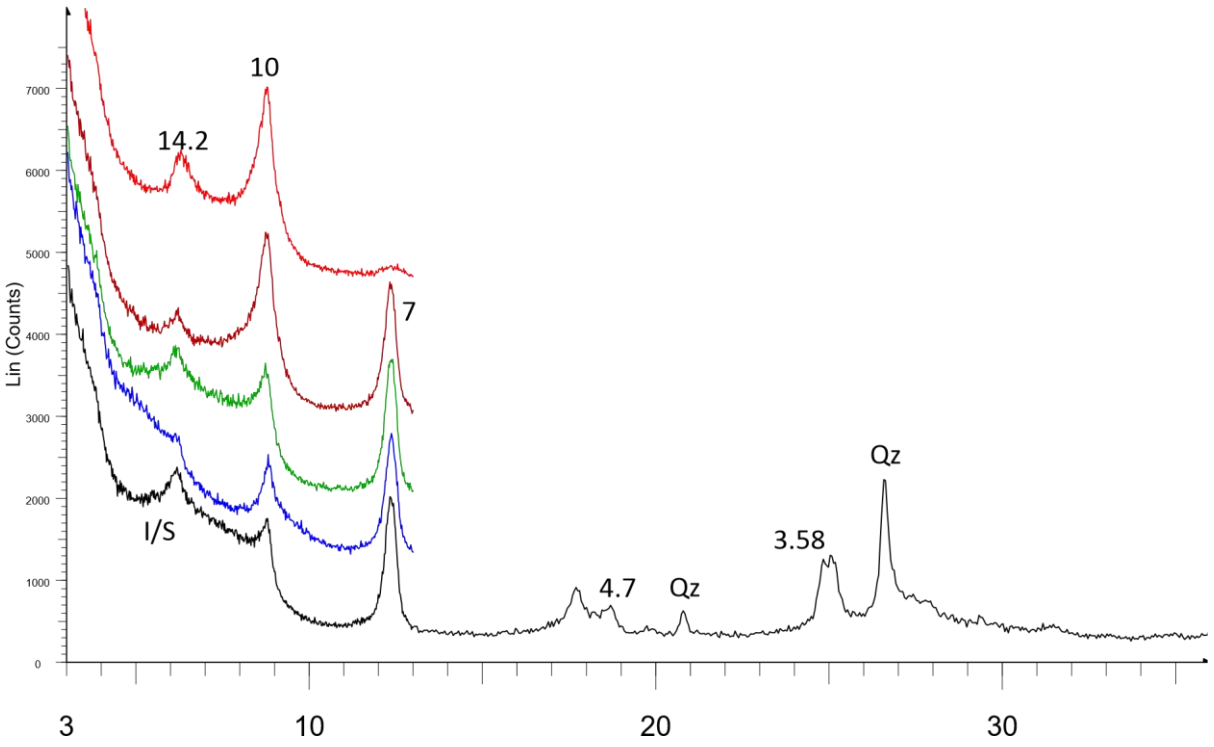

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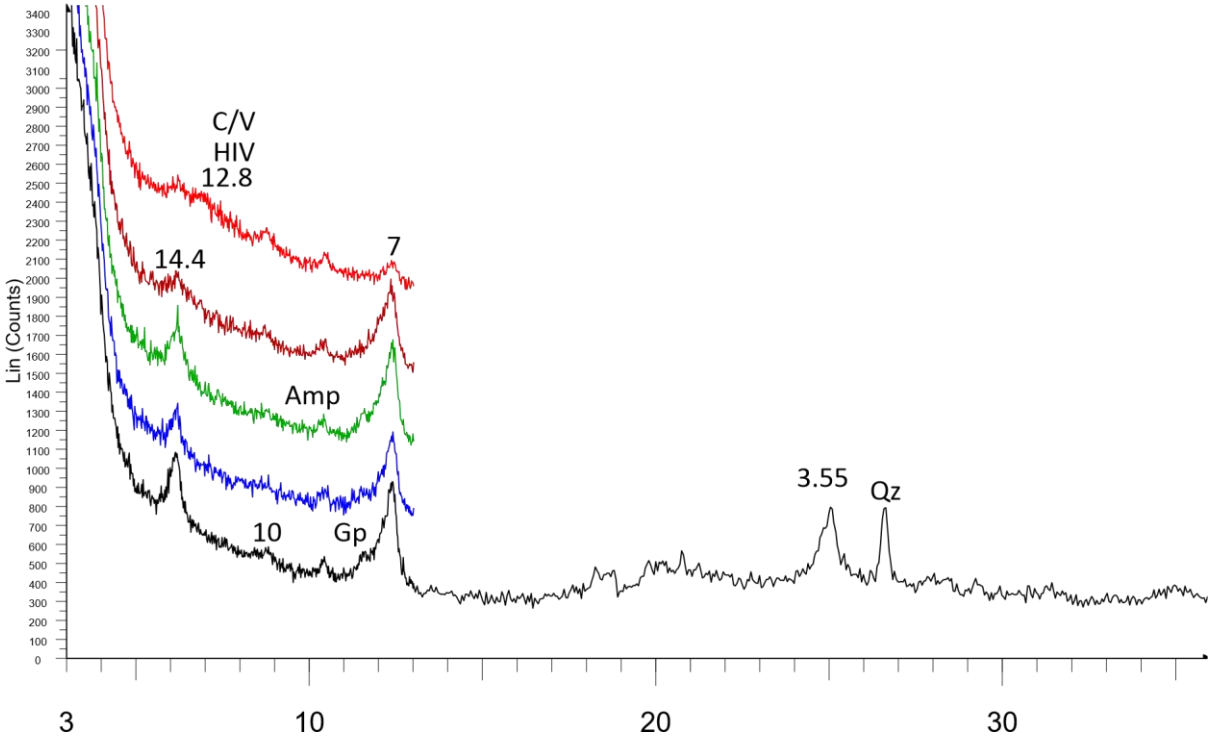
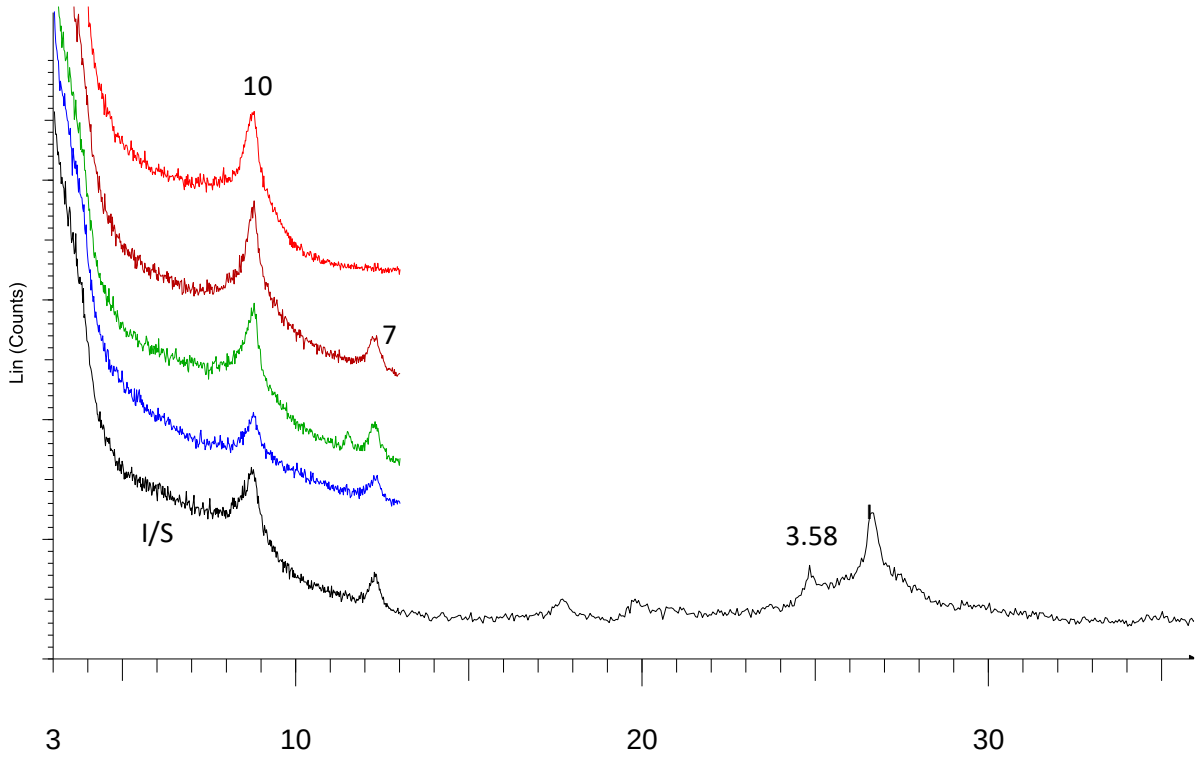
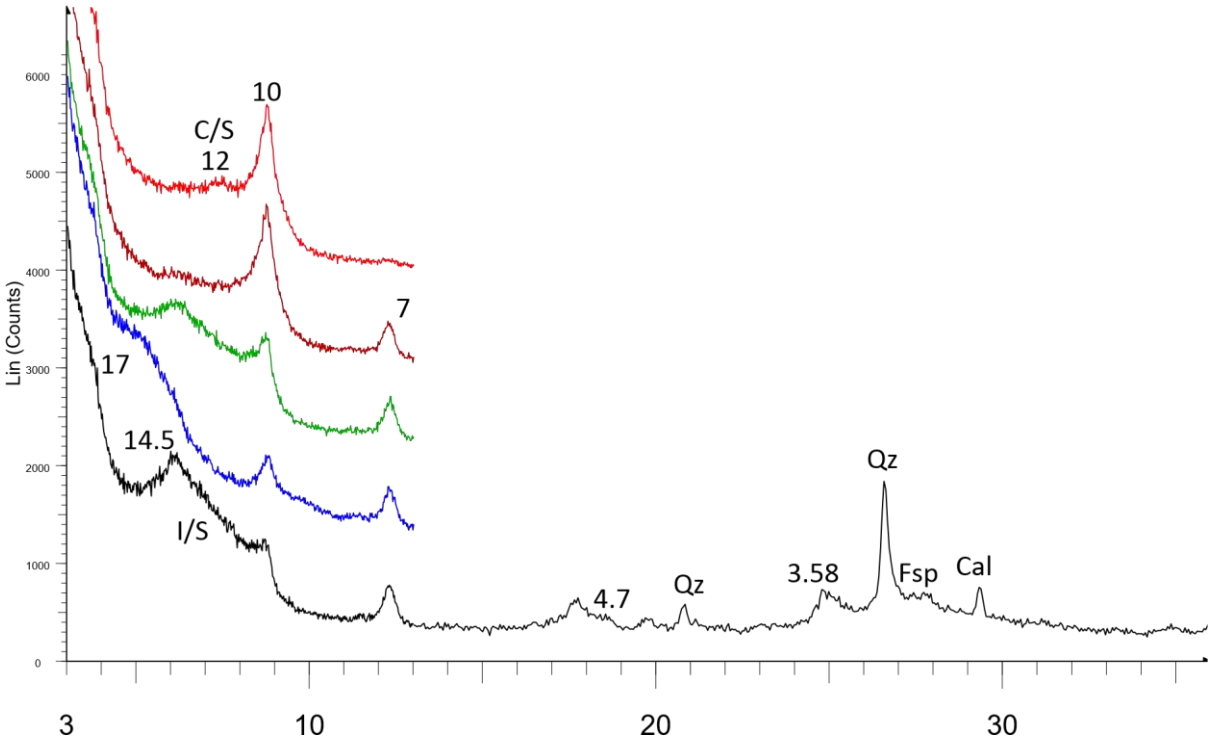


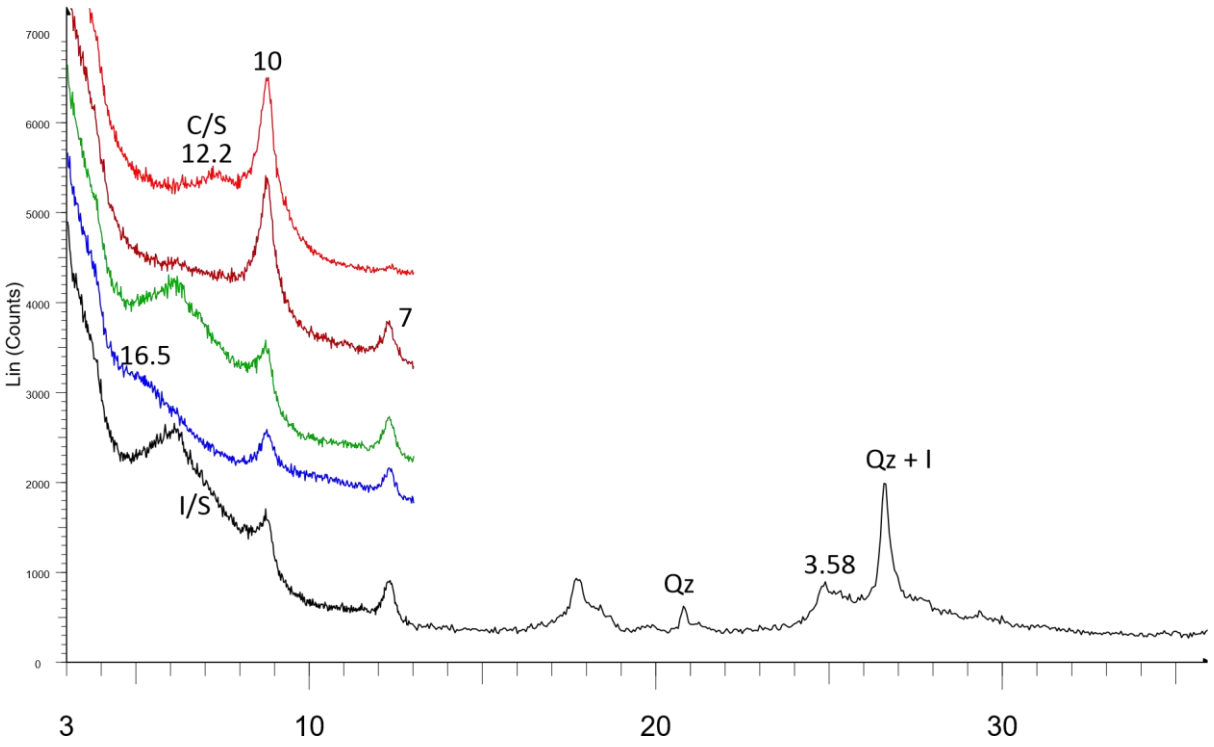
LU17 00194 031 (34301)



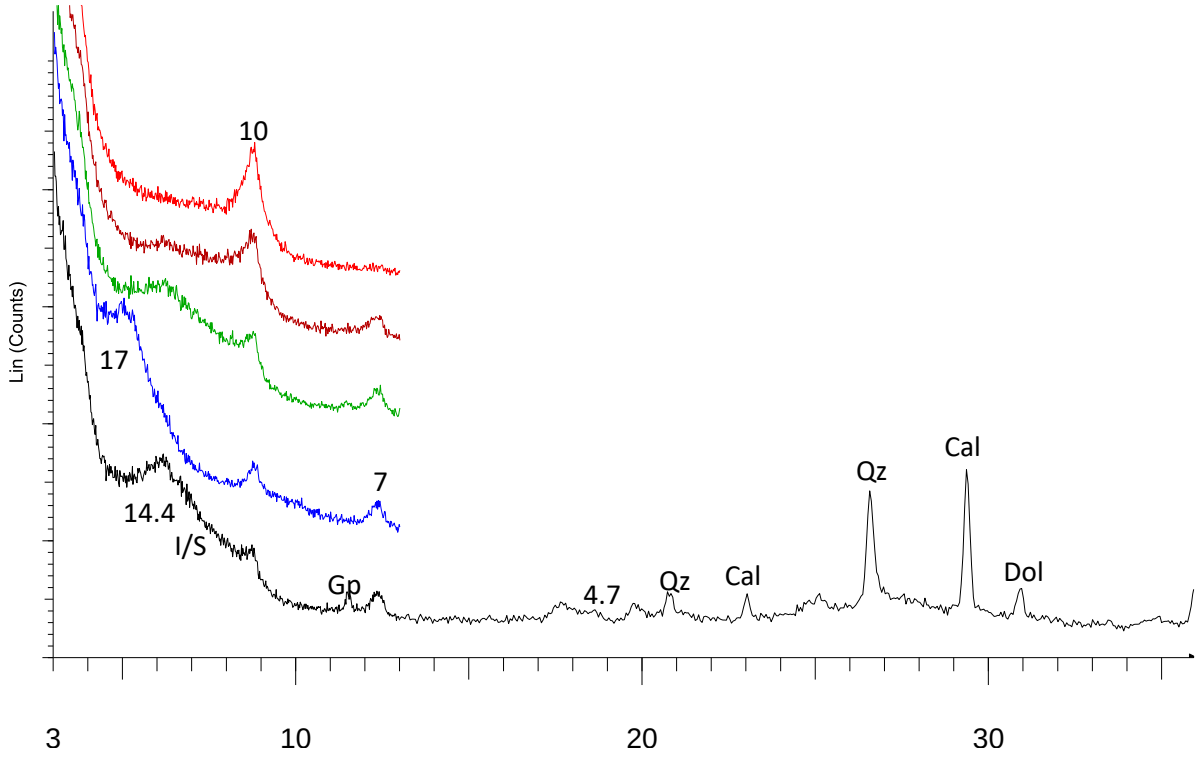
LU17 00194 032 (34326)



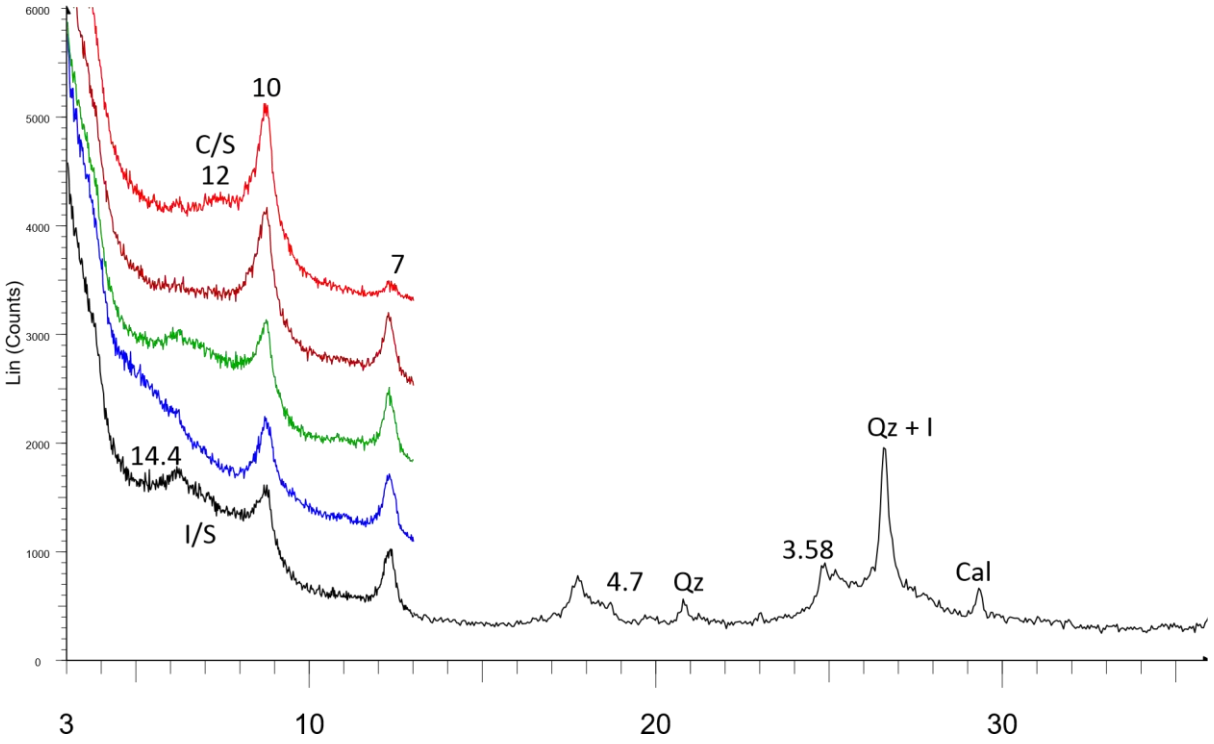
LU17 00194 033 (32284)



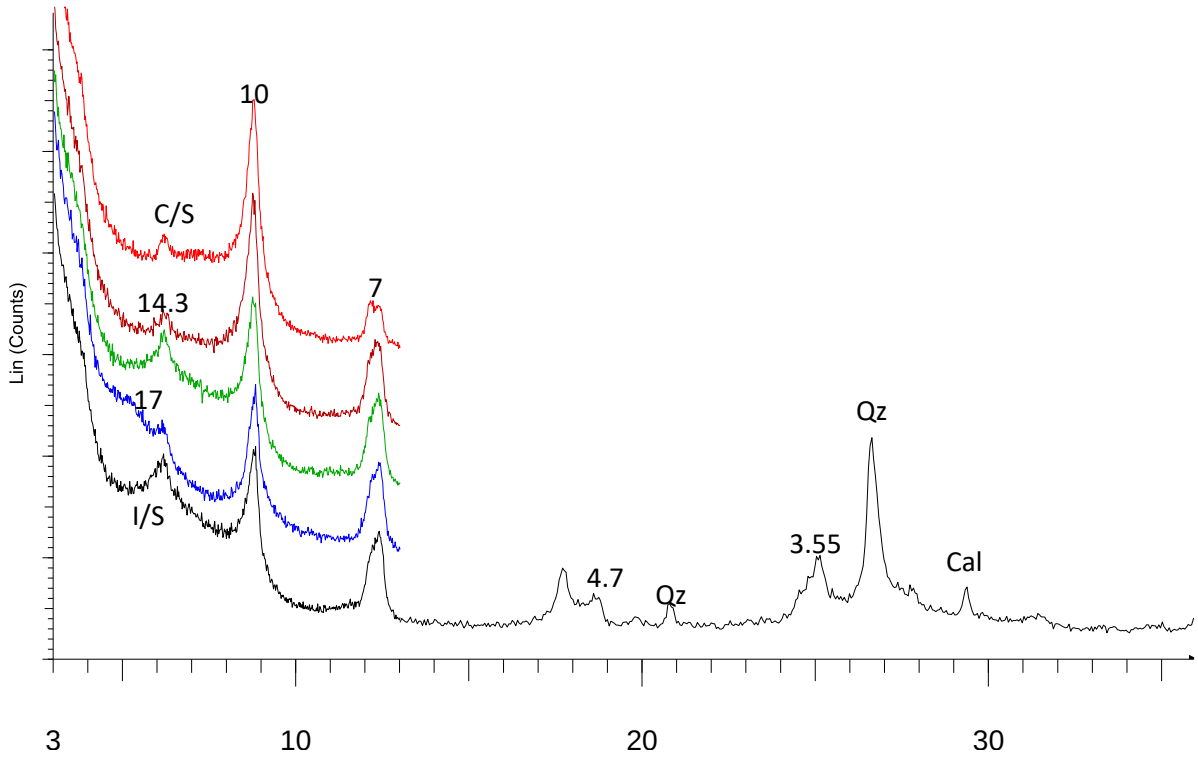
LU17 00194 034 (32637)



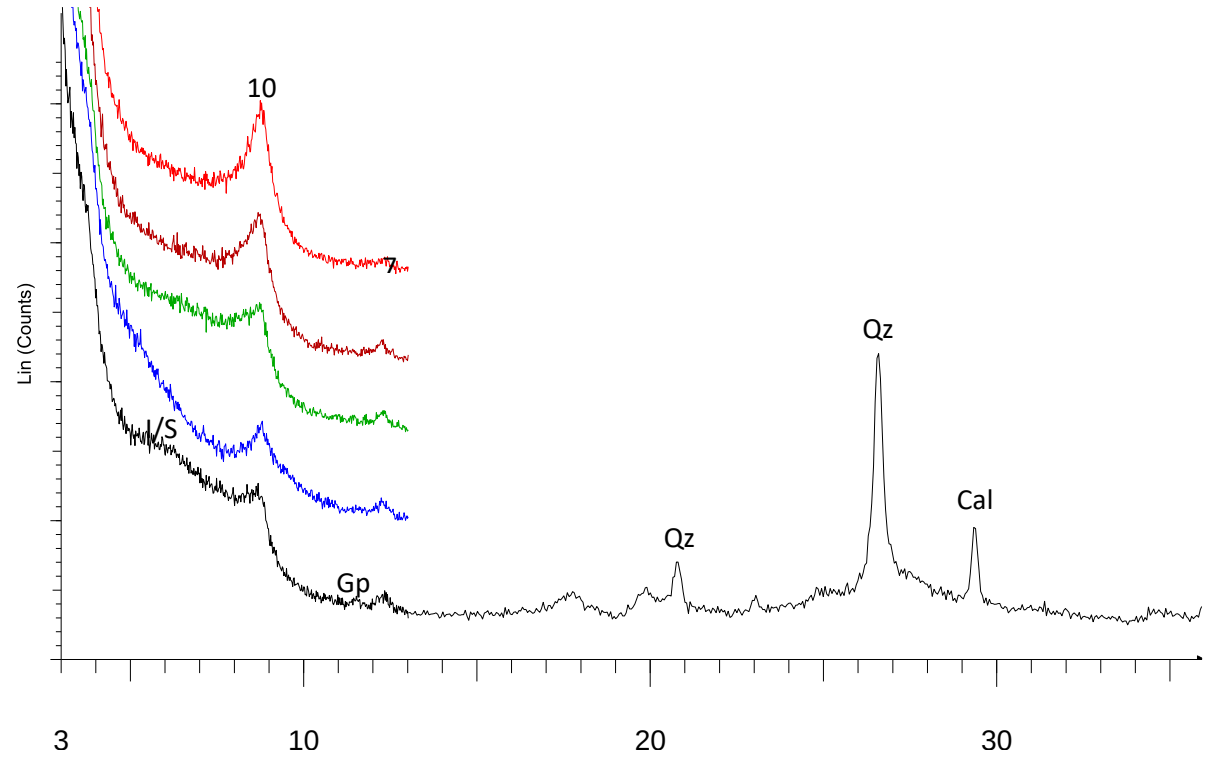
LU17 00194 035 (32373)



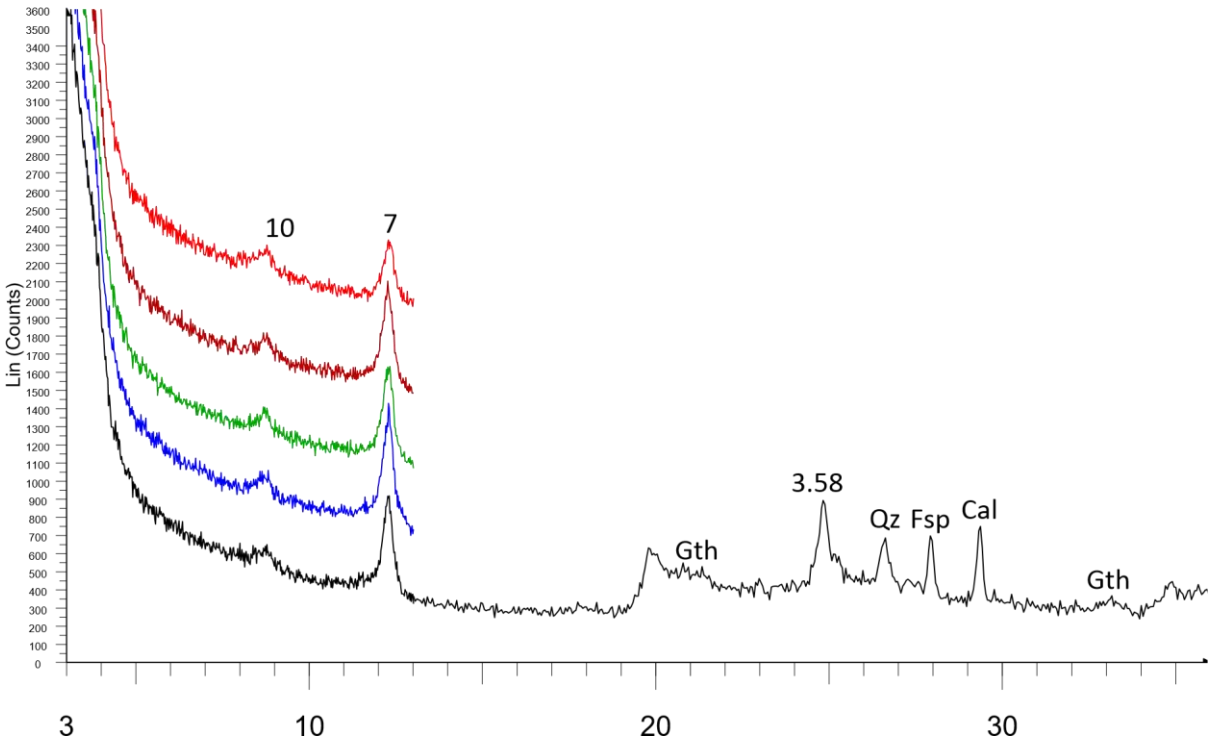
LU17 00194 036 (32392)



LU17 00194 037 (33305)

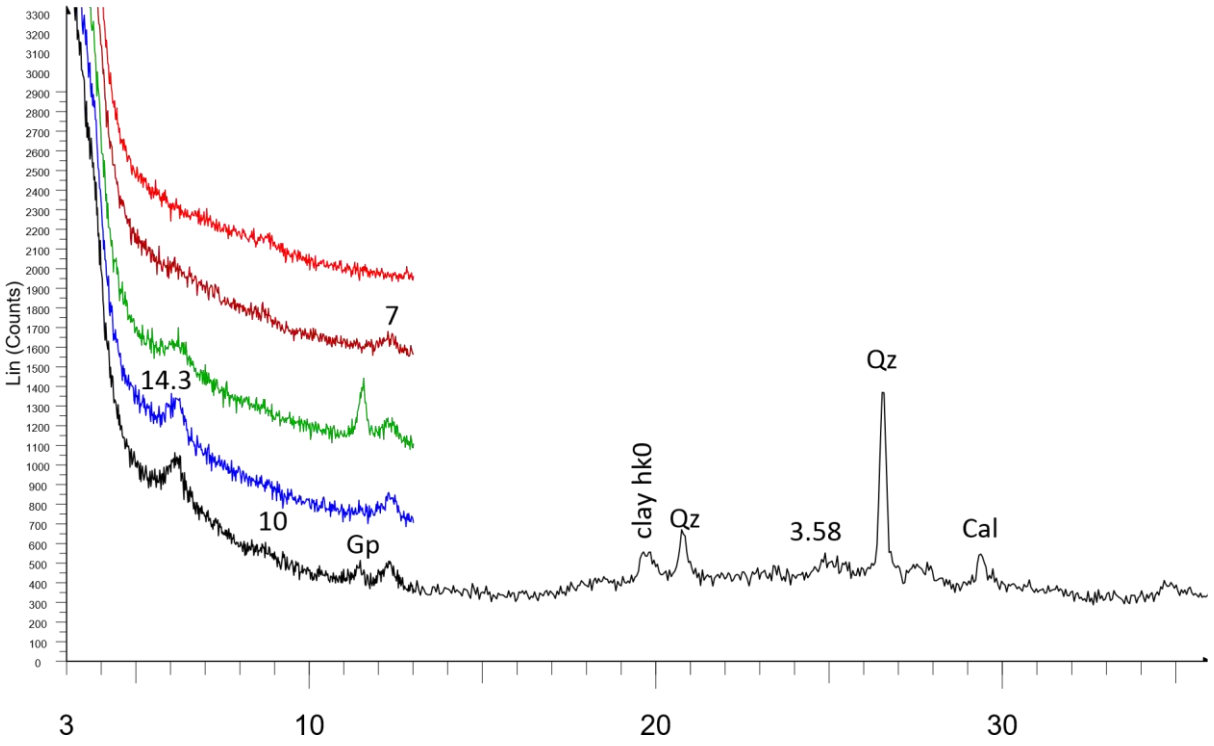


LU17 00194 038 (33454)

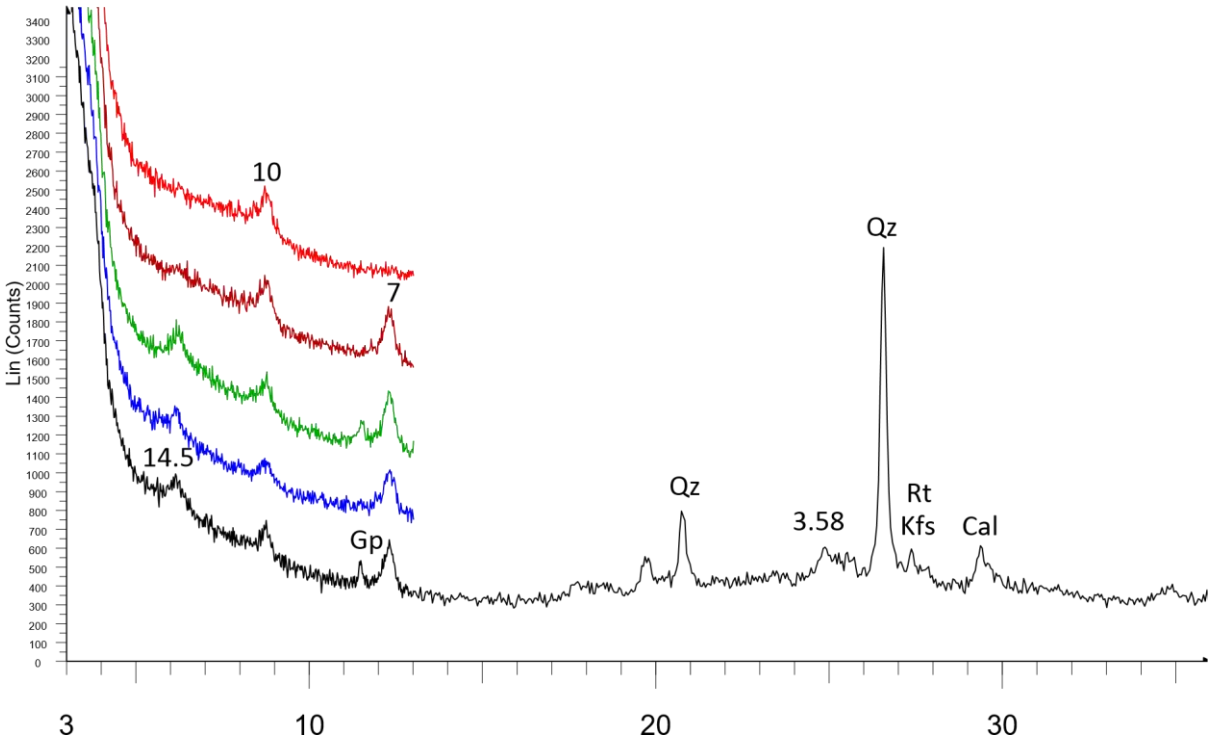


Annex 8. RX Diffractograms from Poland

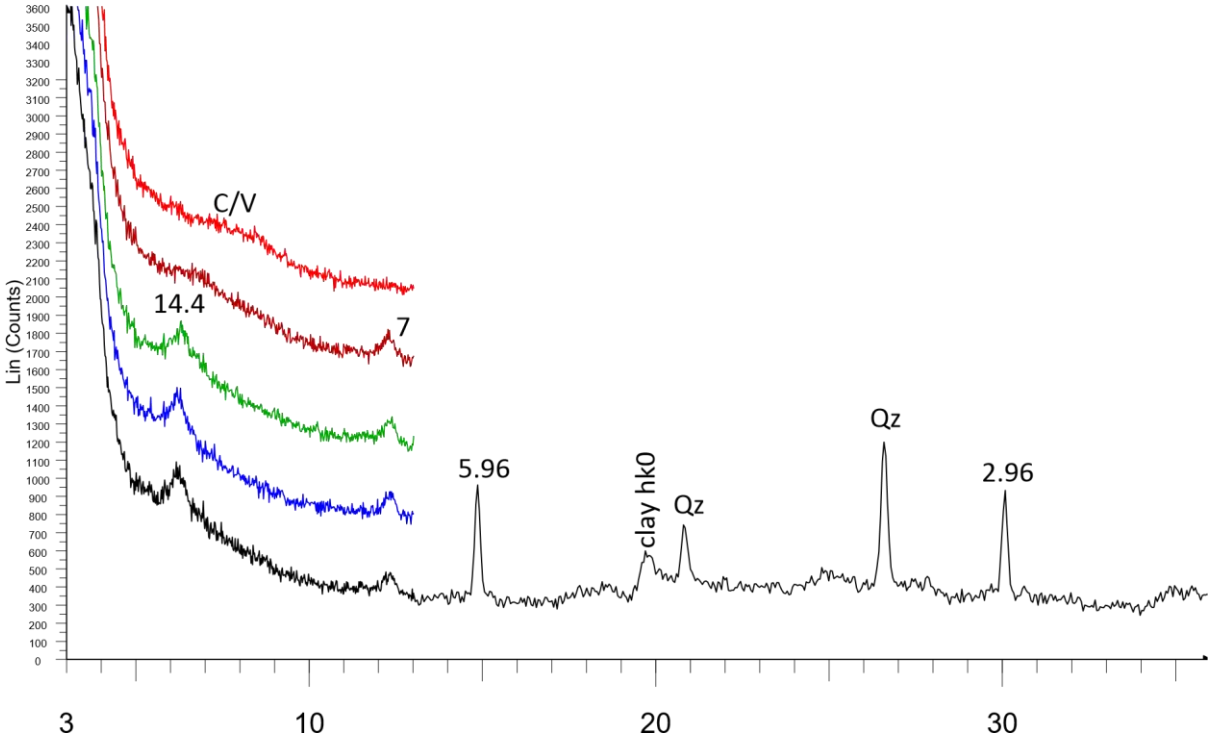
LU17 00195 001 (40028)



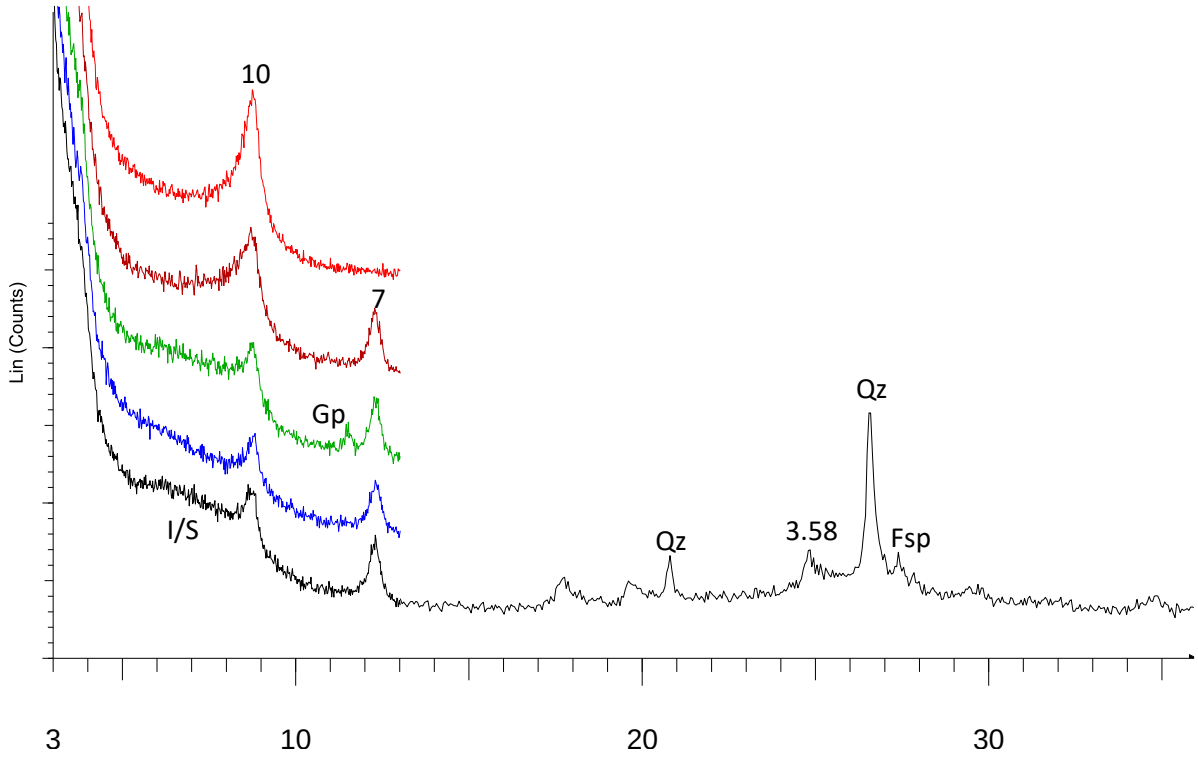
LU17 00195 002 (40135)



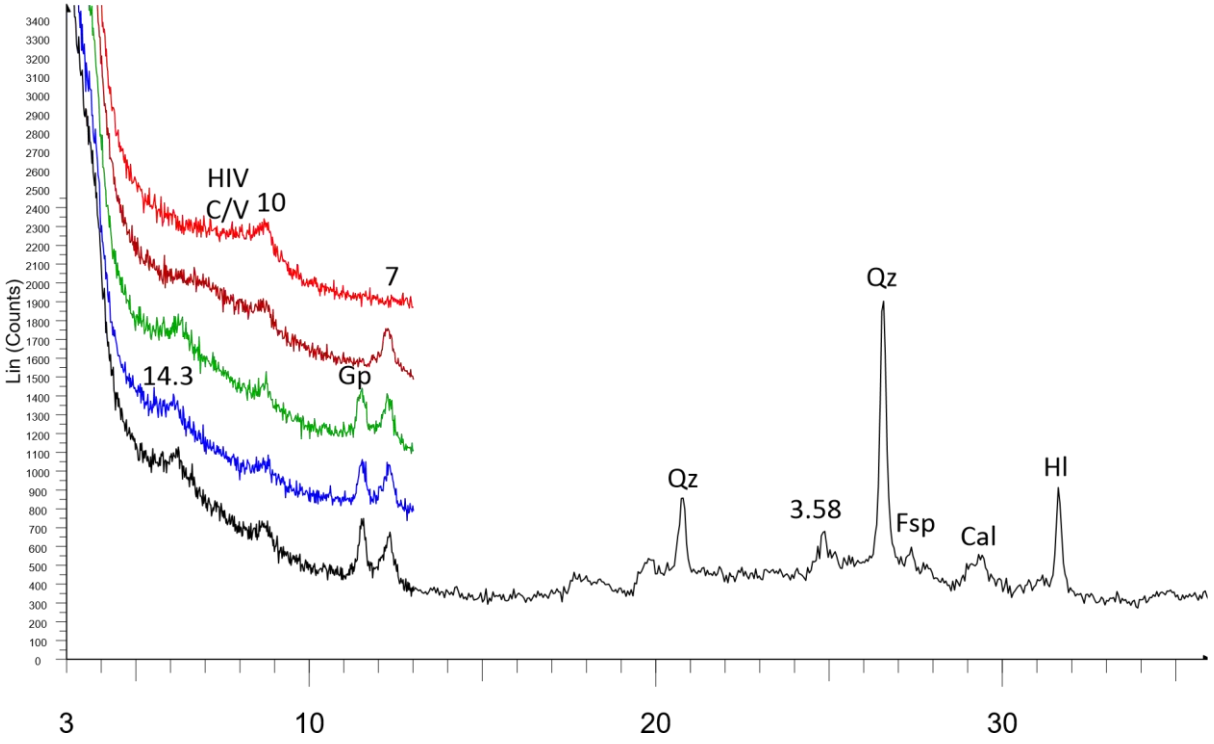
LU17 00195 003 (40228)



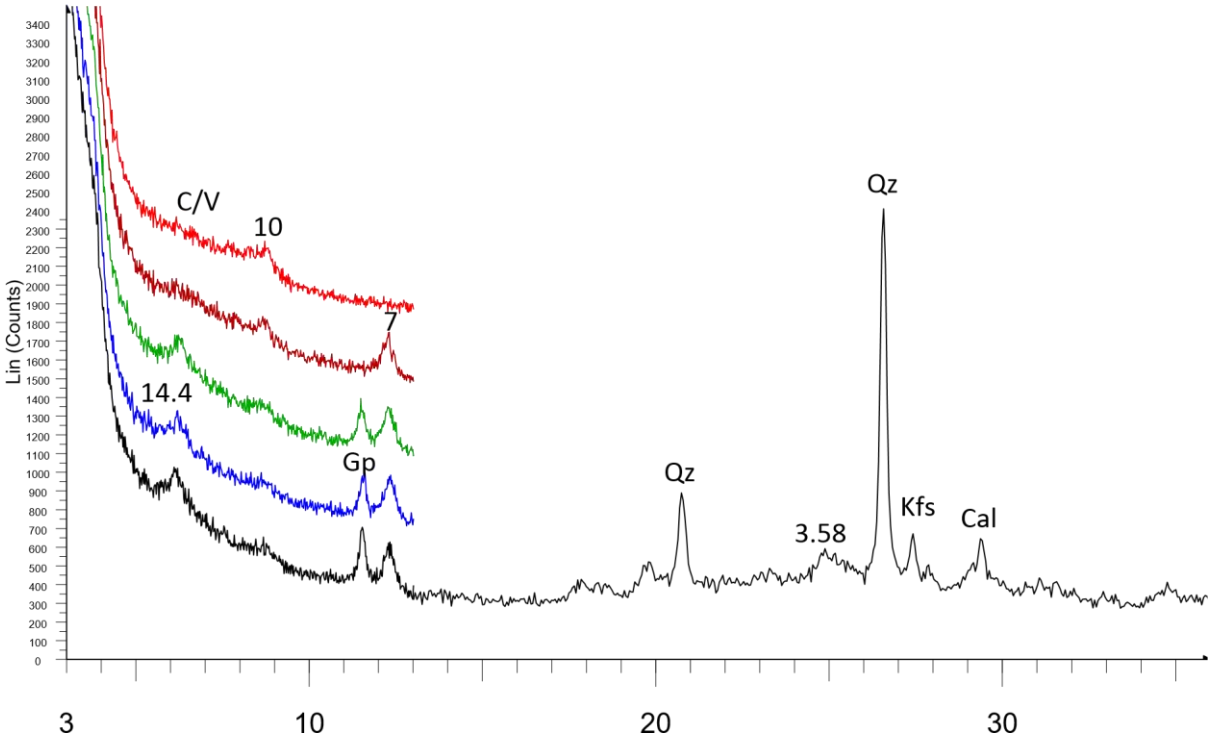
LU17 00195 004 (40256)



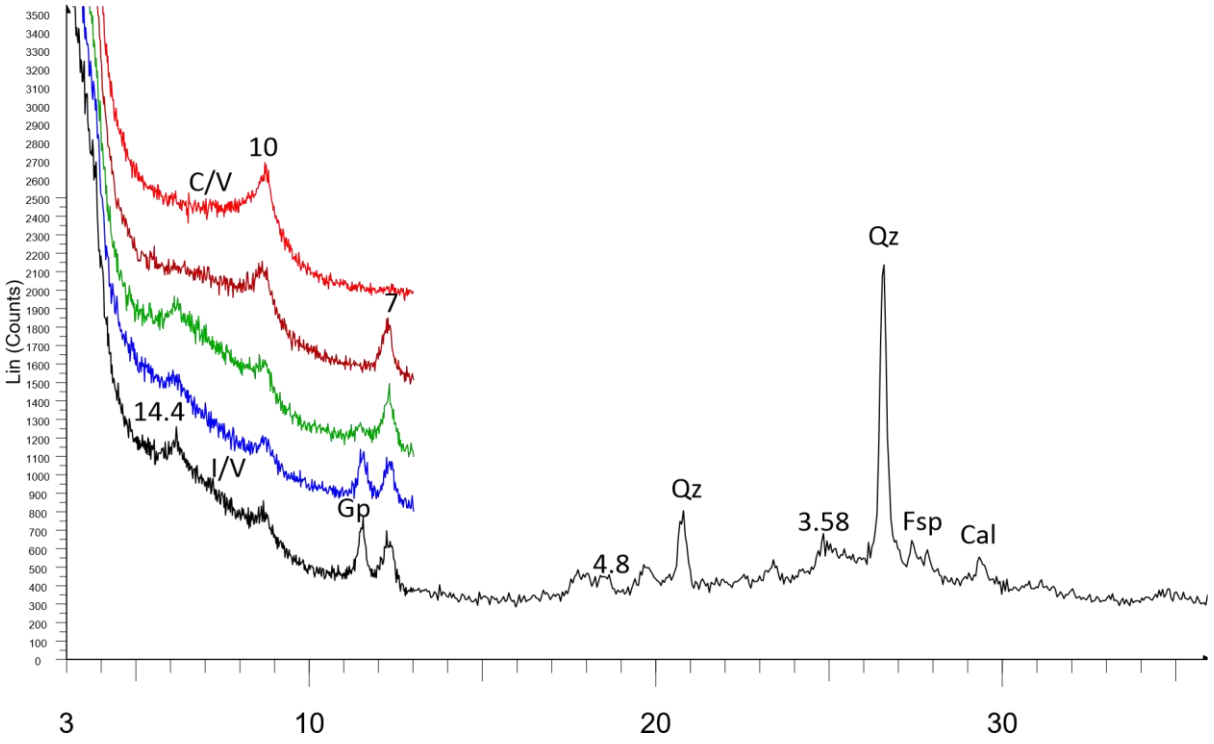
LU17 00195 005 (40313)



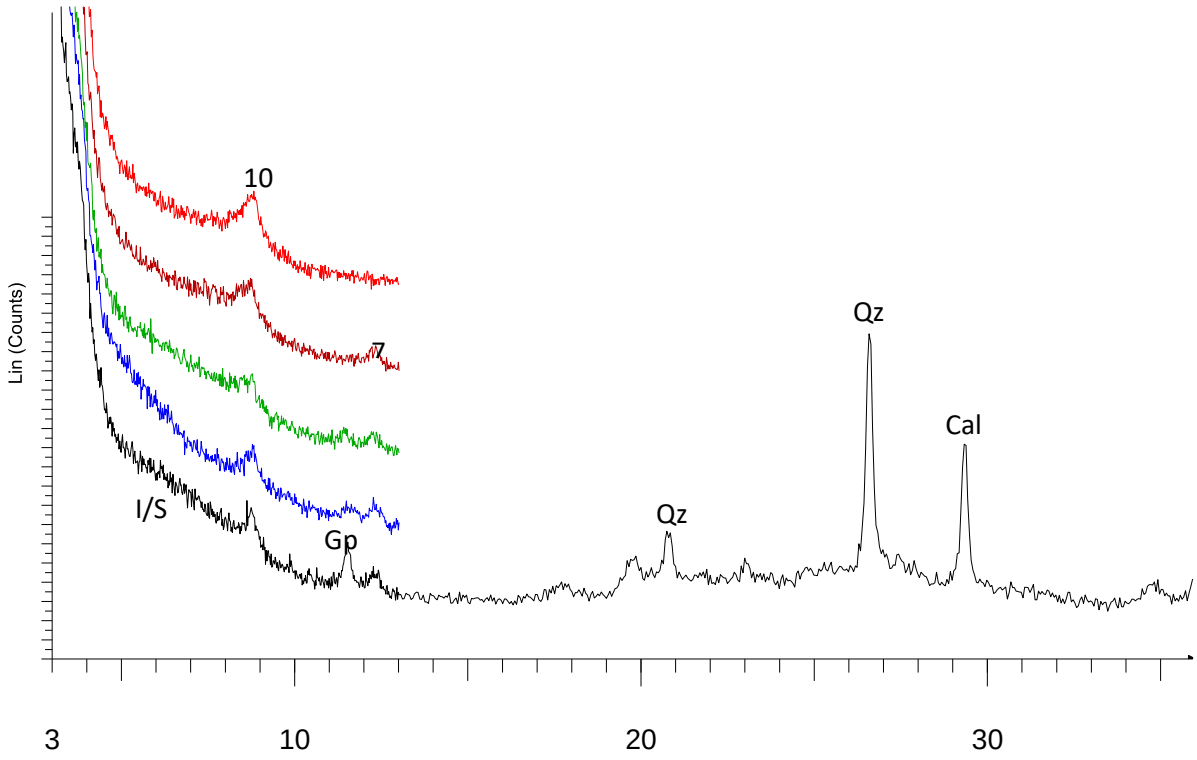
LU17 00195 006 (40495)



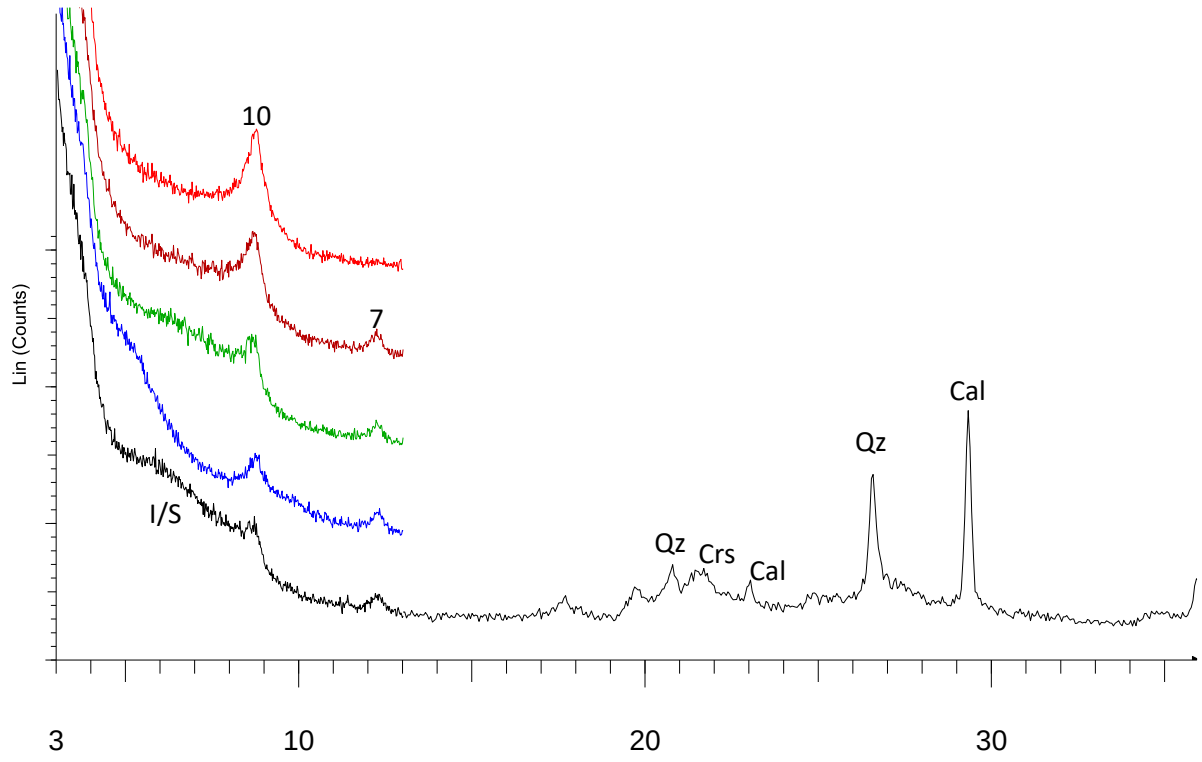
LU17 00195 007 (40703)



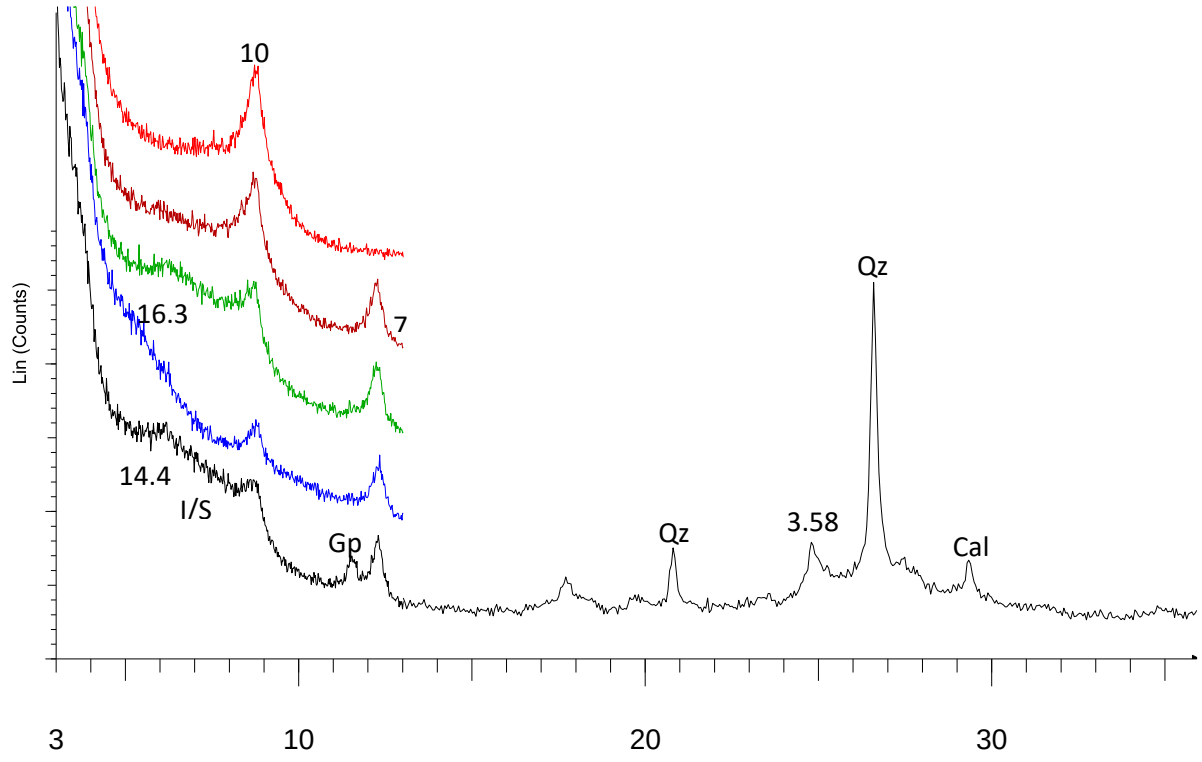
LU17 00195 008 (40771)



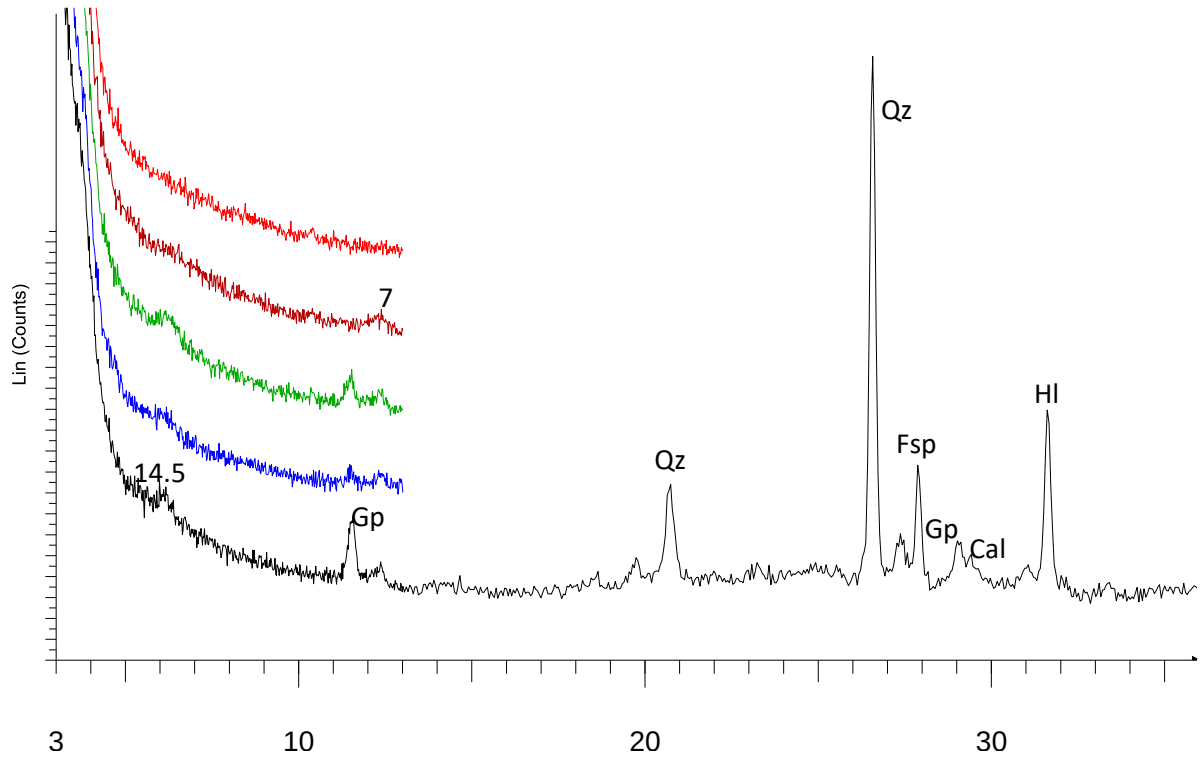
LU17 00195 009 (40786)



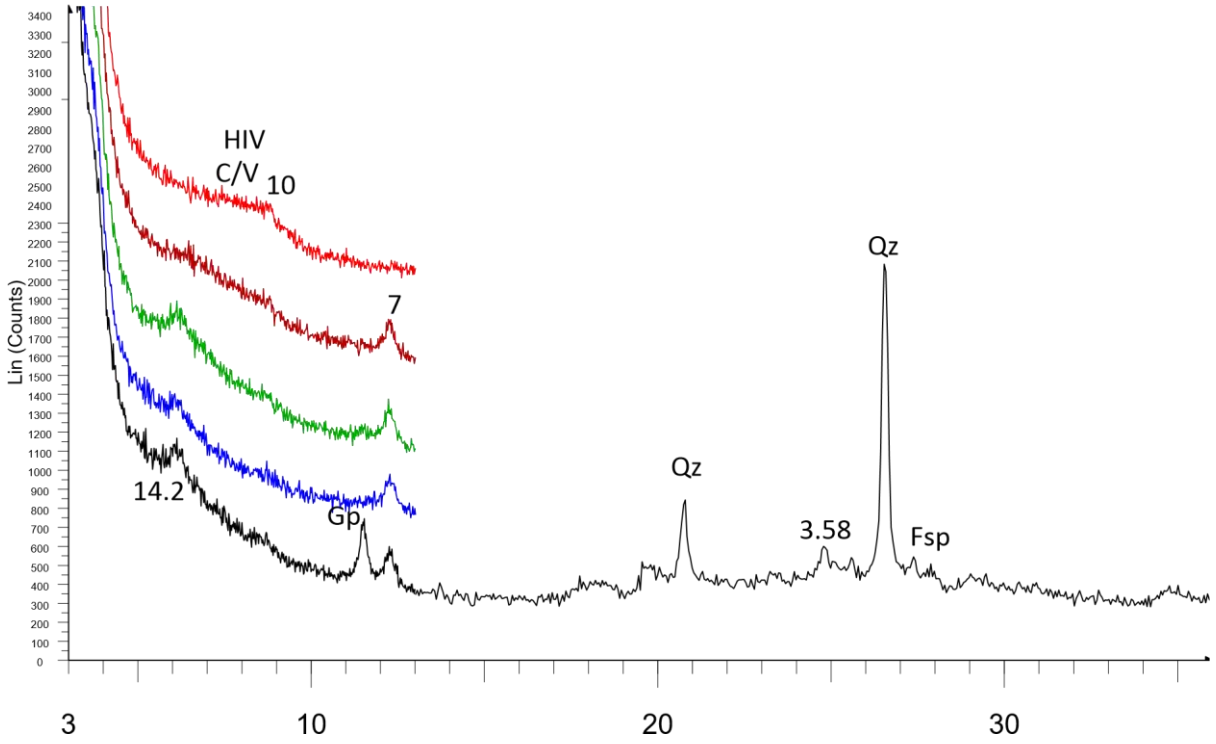
LU17 00195 010 (40788)



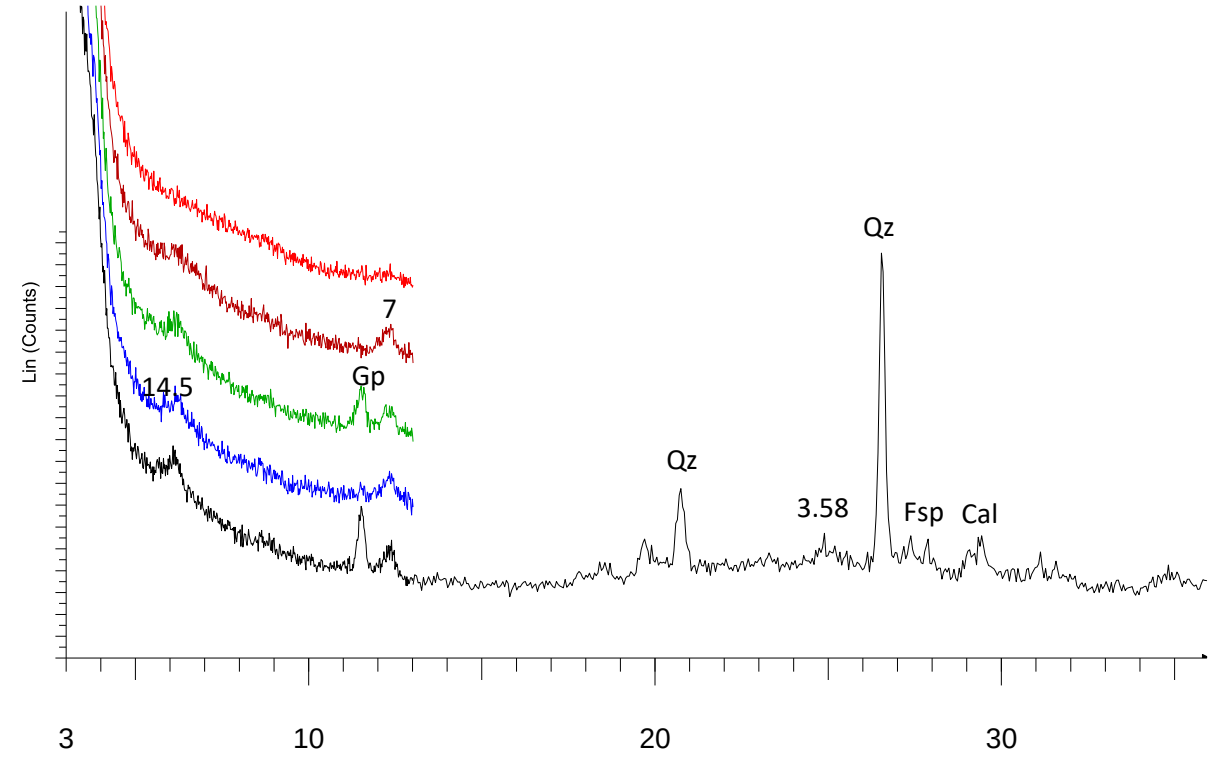
LU17 00195 011 (41148)



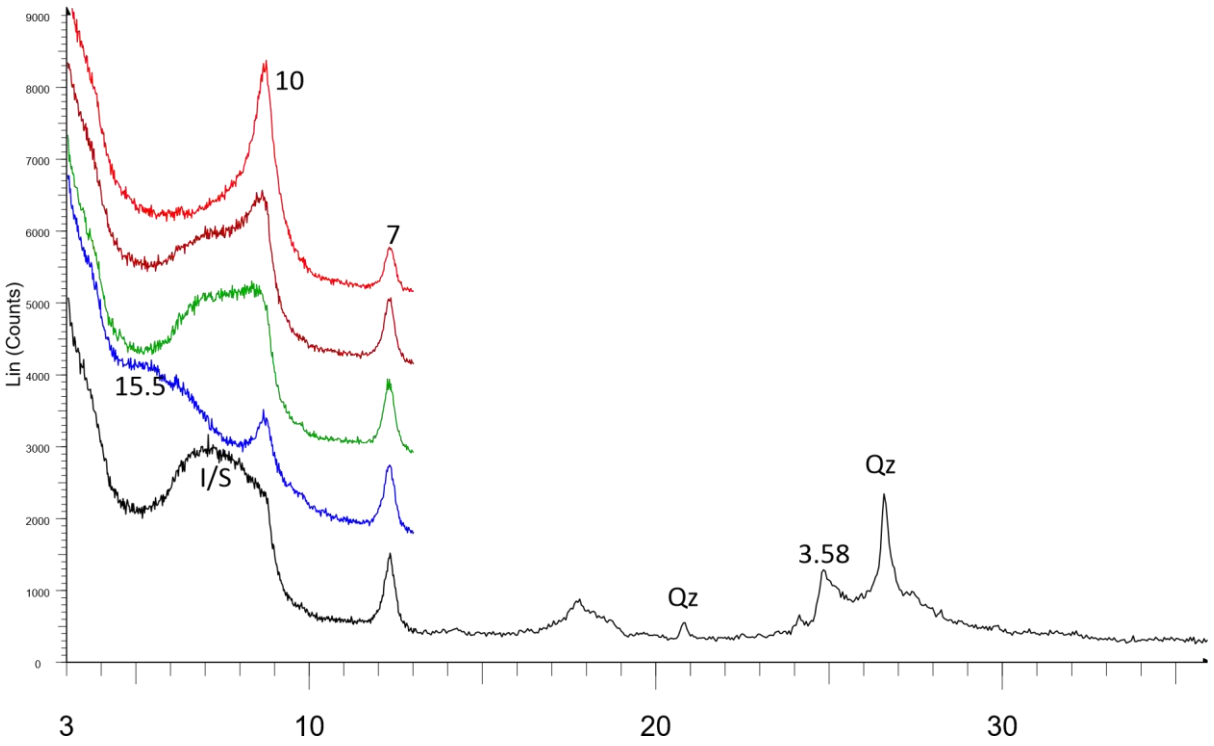
LU17 00195 012 (41209)



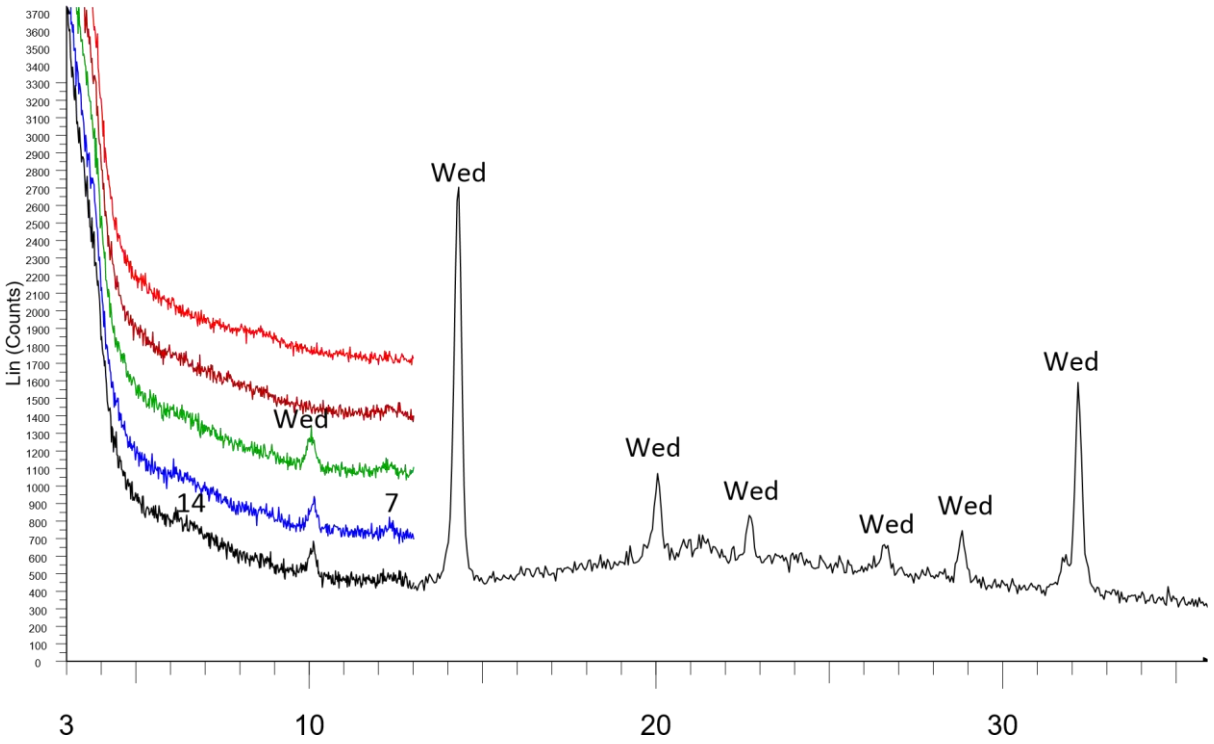
LU17 00195 013 (41275)



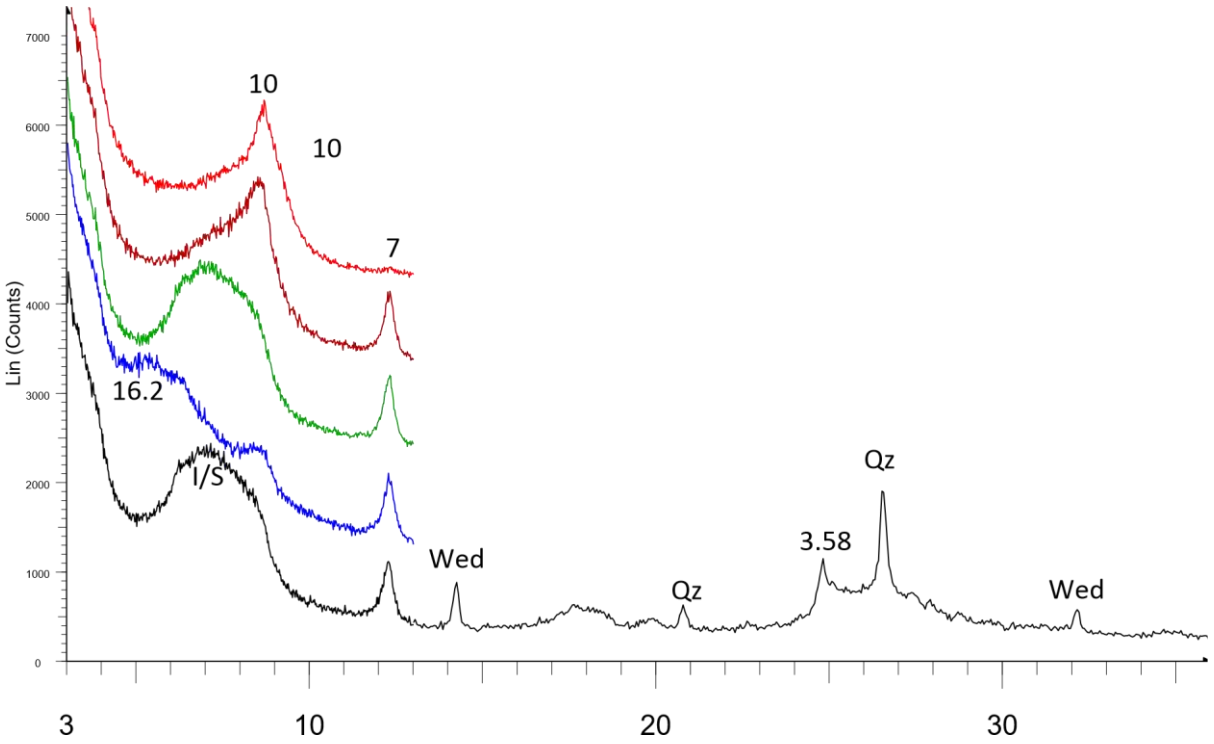
LU17 00195 014 (41520)



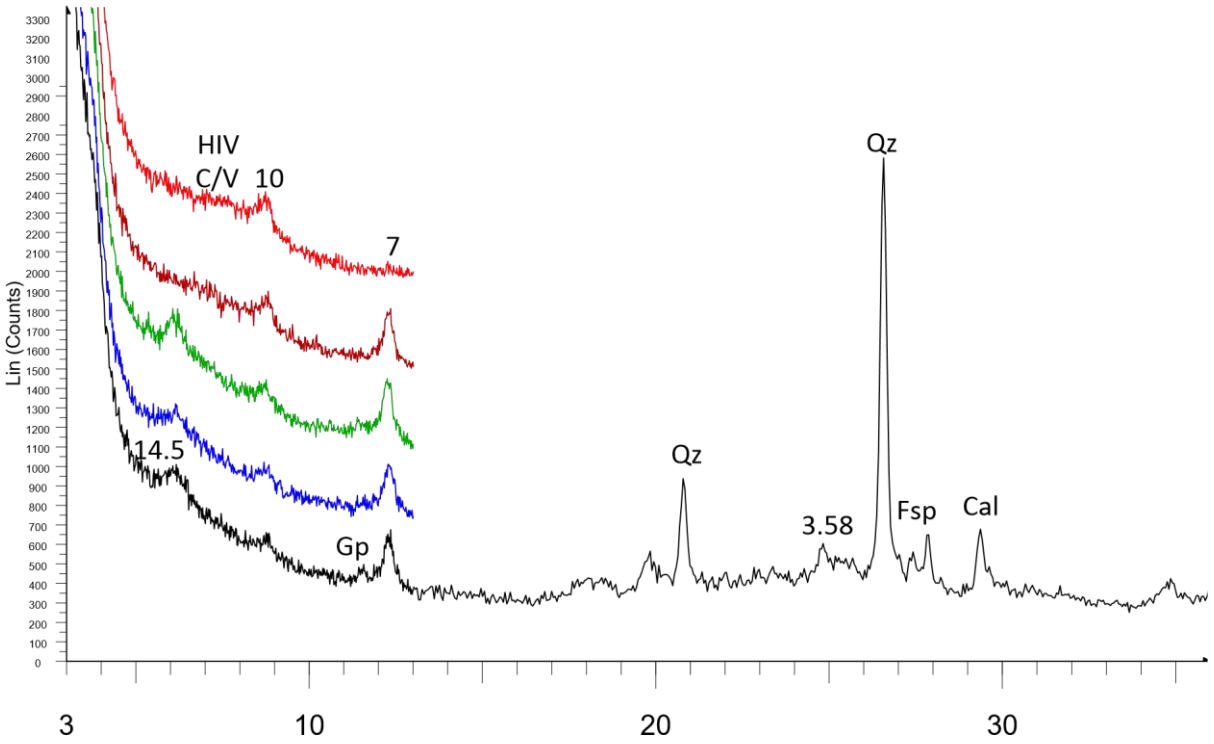
LU17 00195 015 (41543)



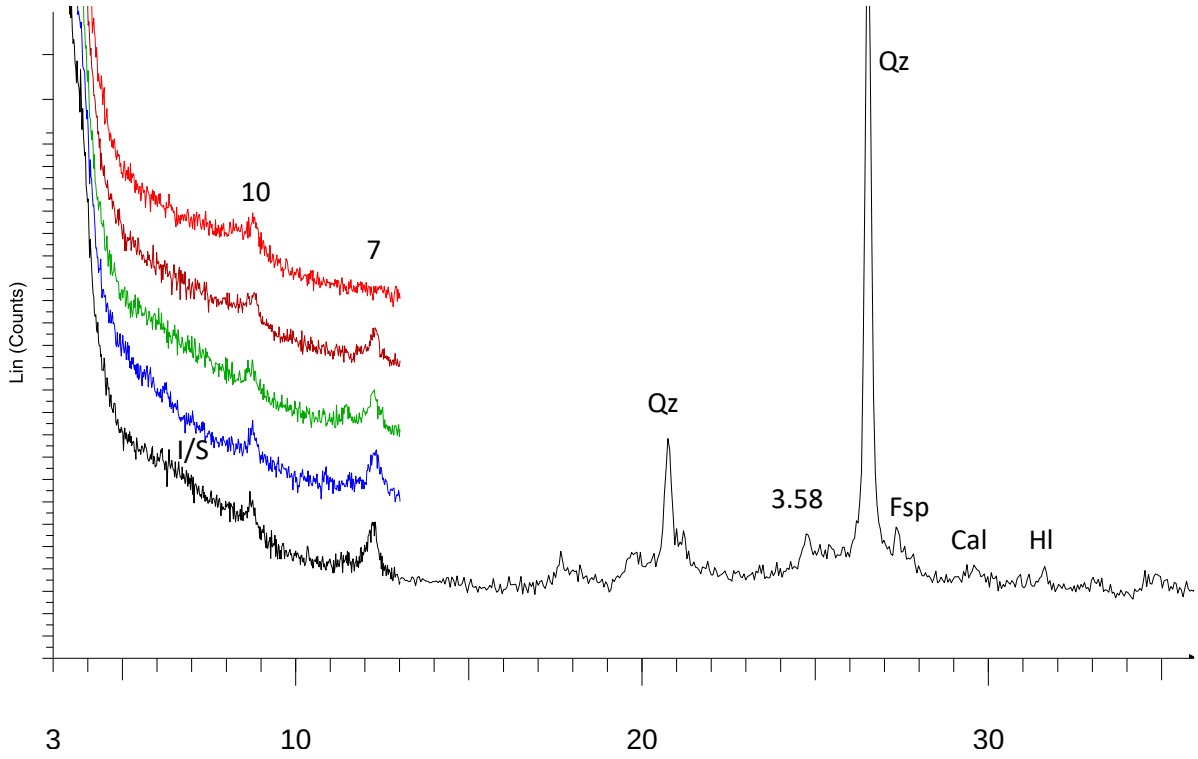
LU17 00195 016 (41639)



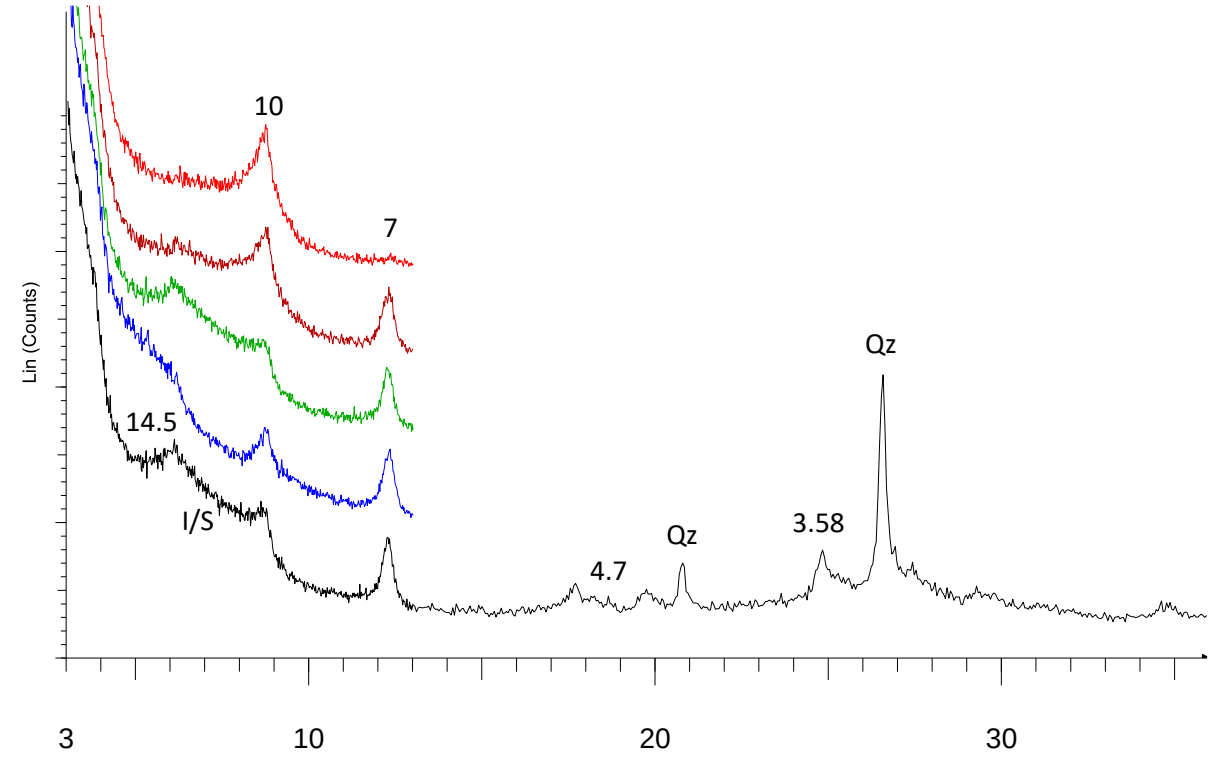
LU17 00195 017 (41771)



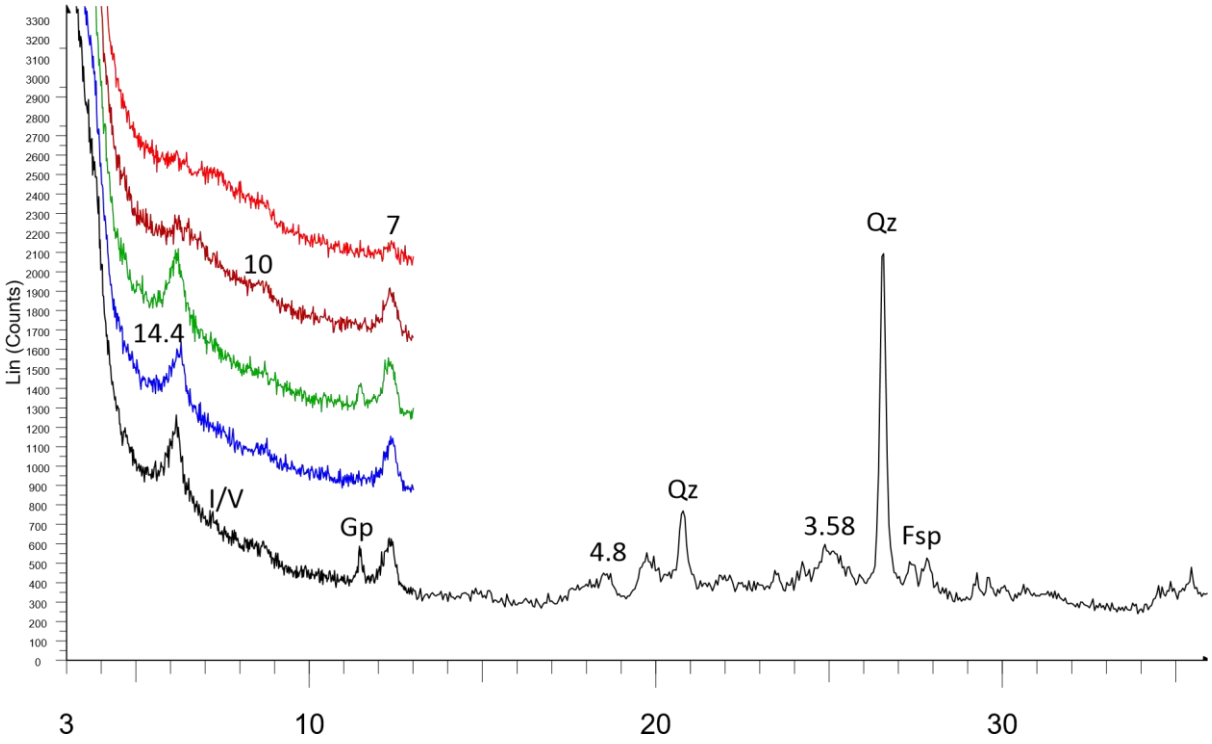
LU17 00195 018 (40072)



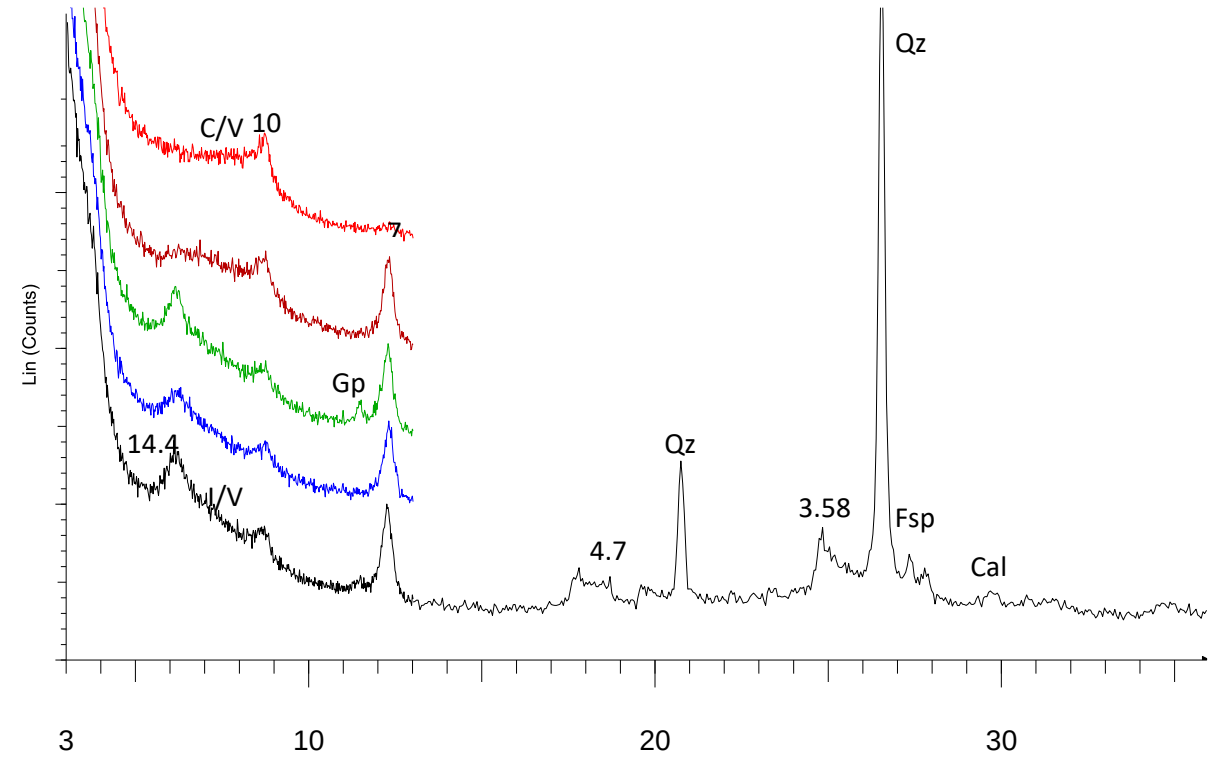
LU17 00195 019 (40148)



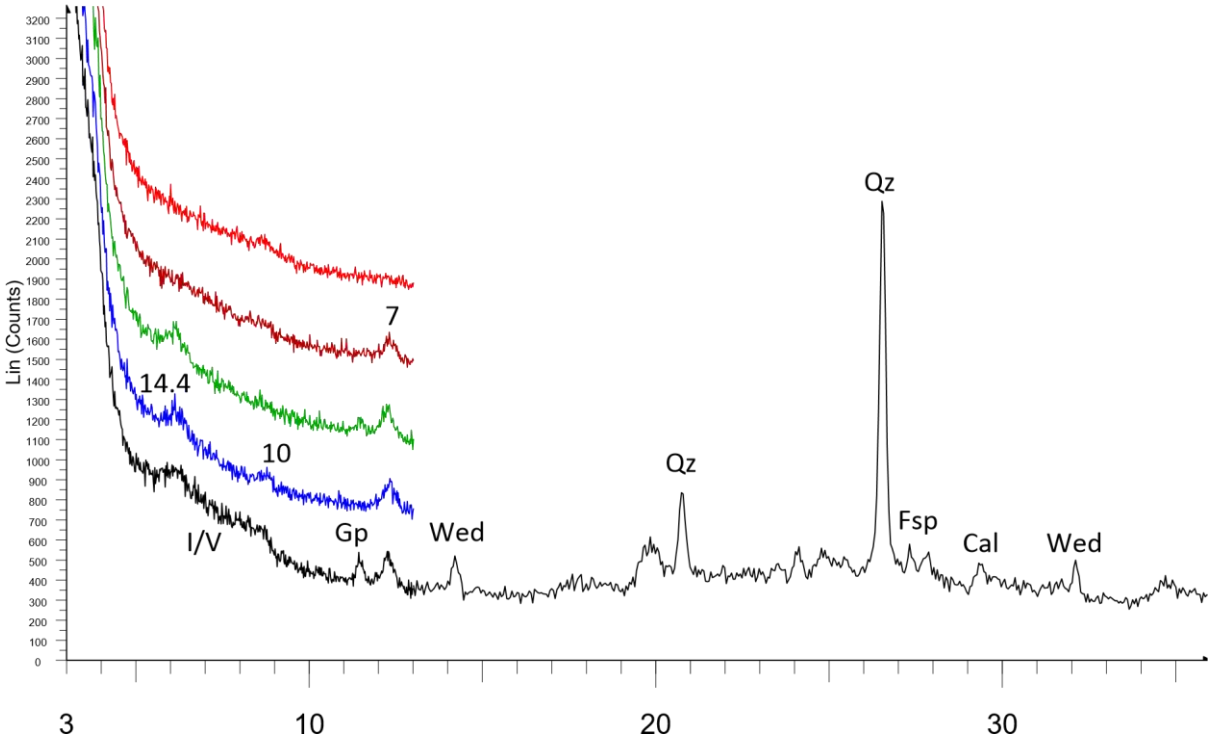
LU17 00195 020 (40432)



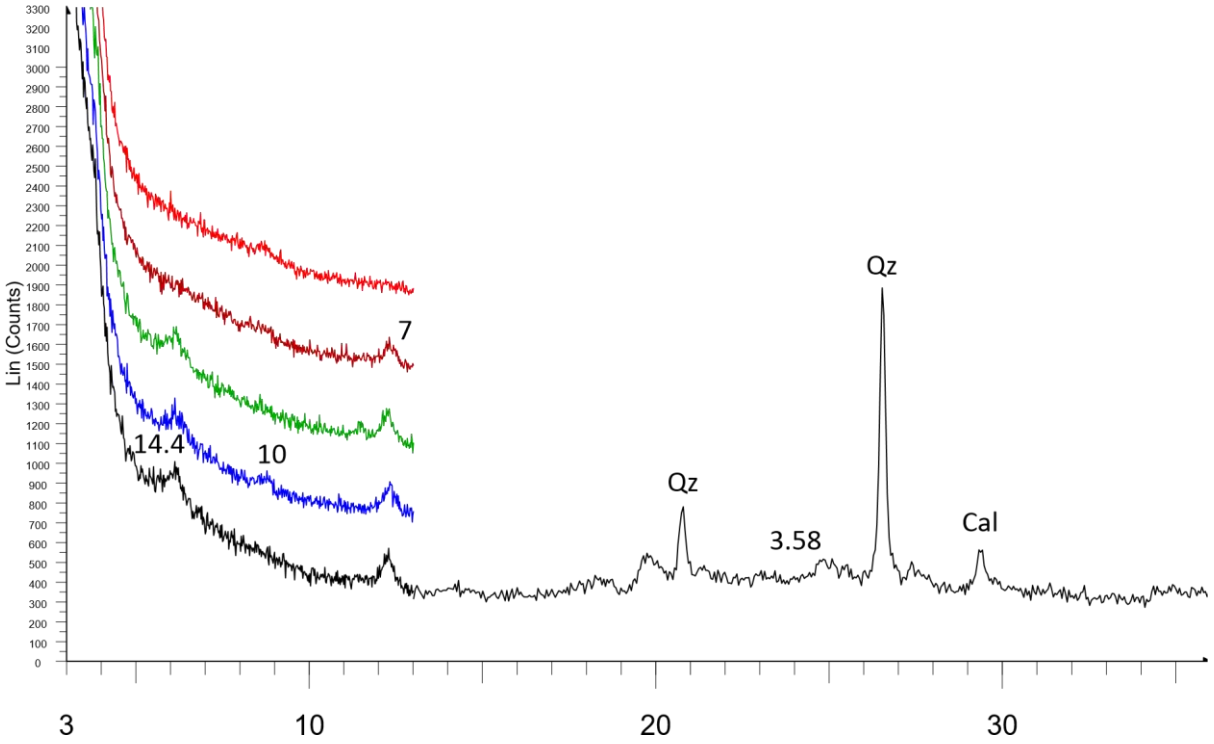
LU17 00195 021 (41045)



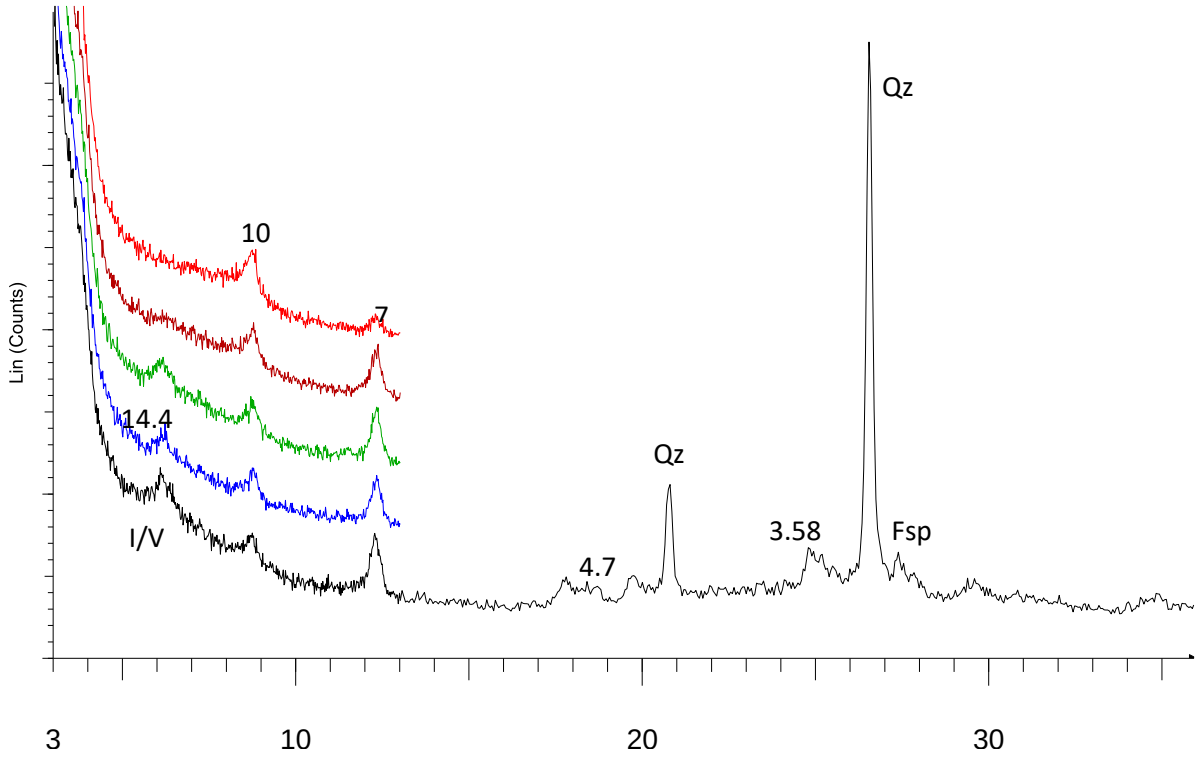
LU17 00195 022 (41099)



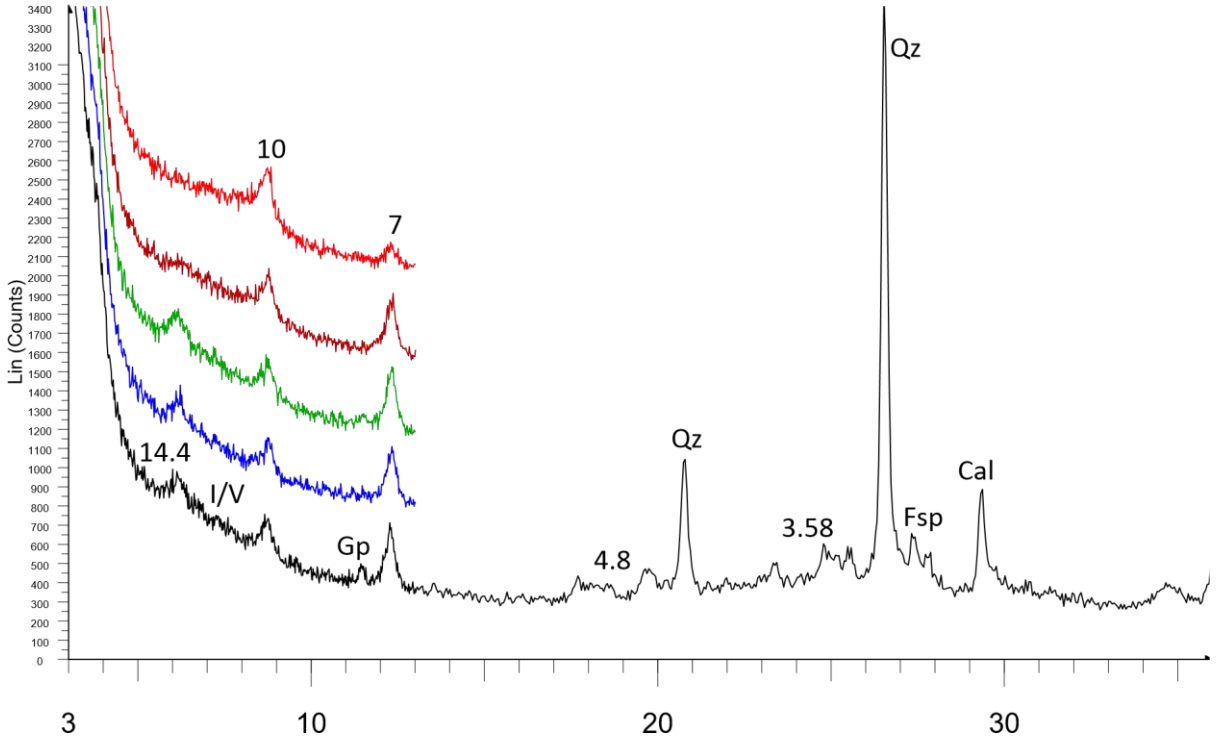
LU17 00195 023 (41187)



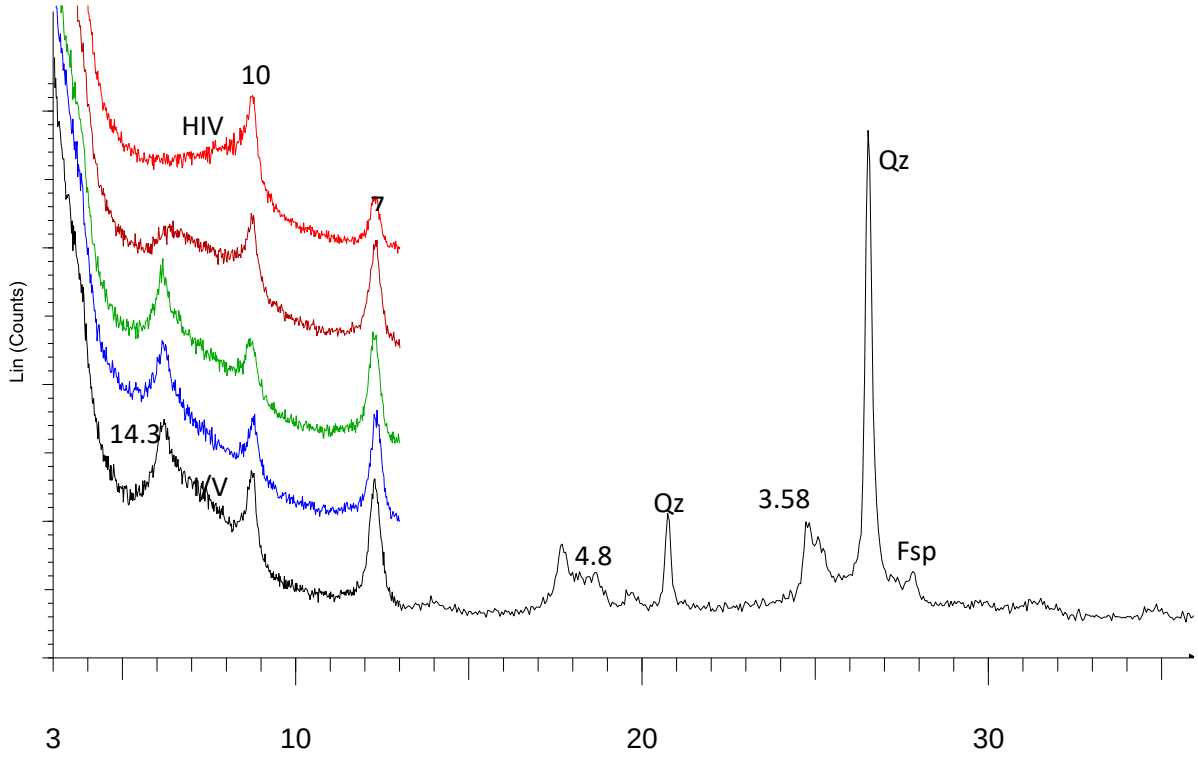
LU17 00195 024 (41332)



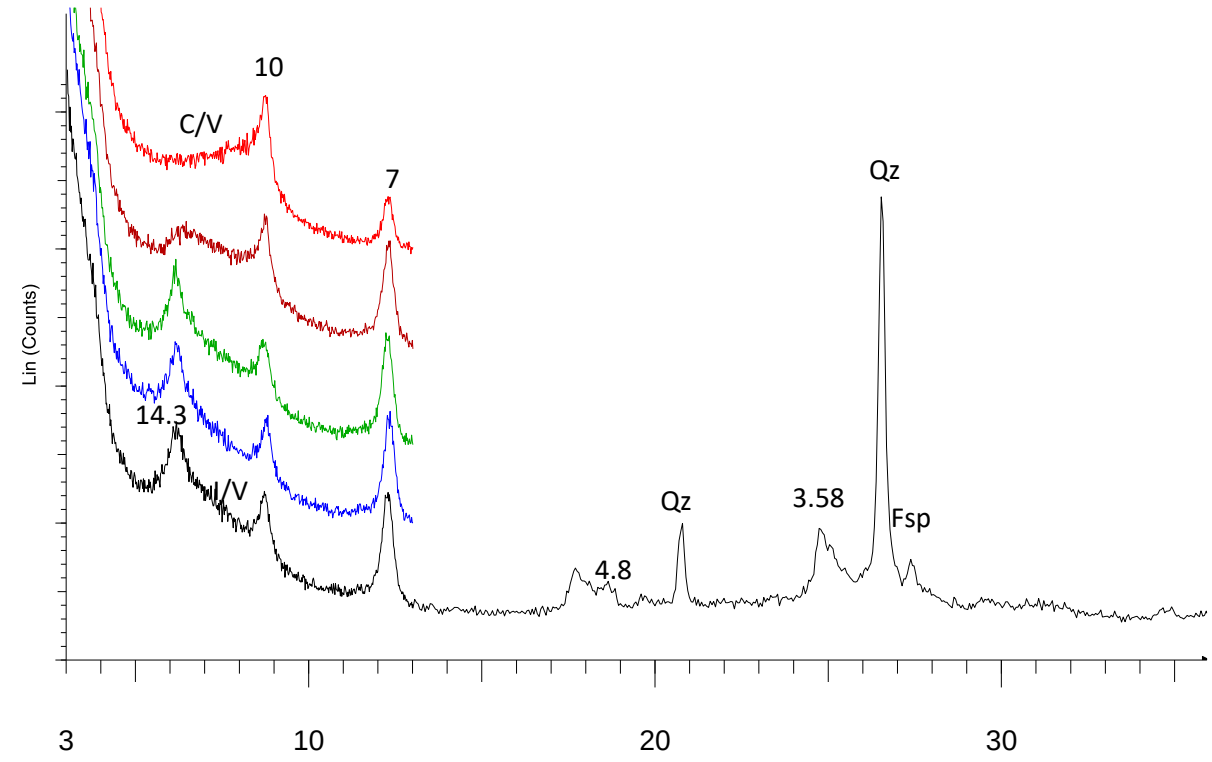
LU17 00195 025 (41340)



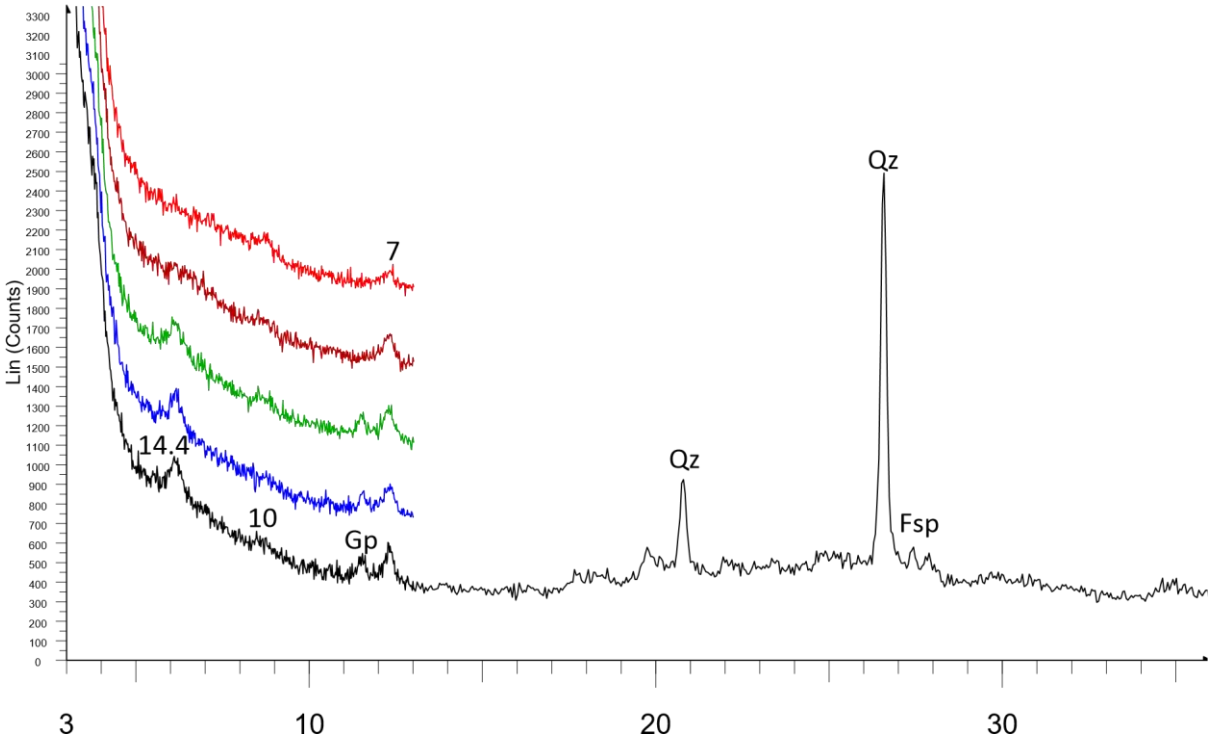
LU17 00195 026 (41426)



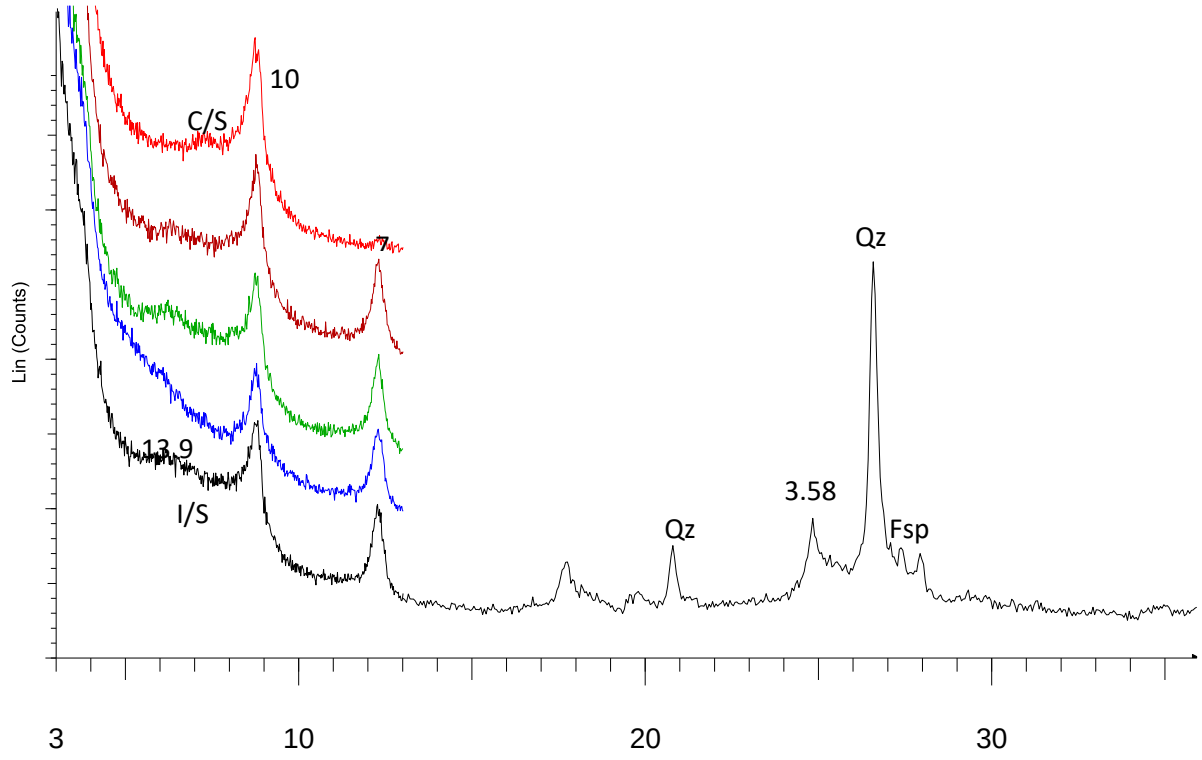
LU17 00195 027 (41437)



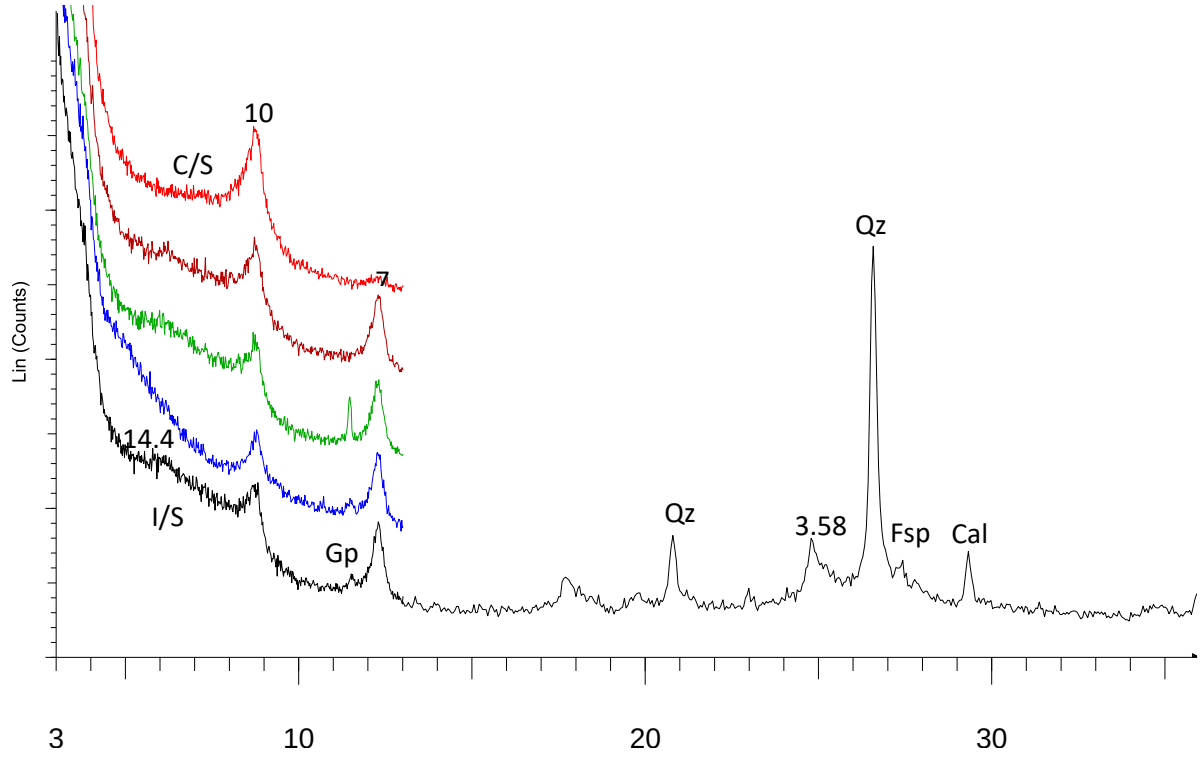
LU17 00195 028 (41633)



LU17 00195 029 (41673)

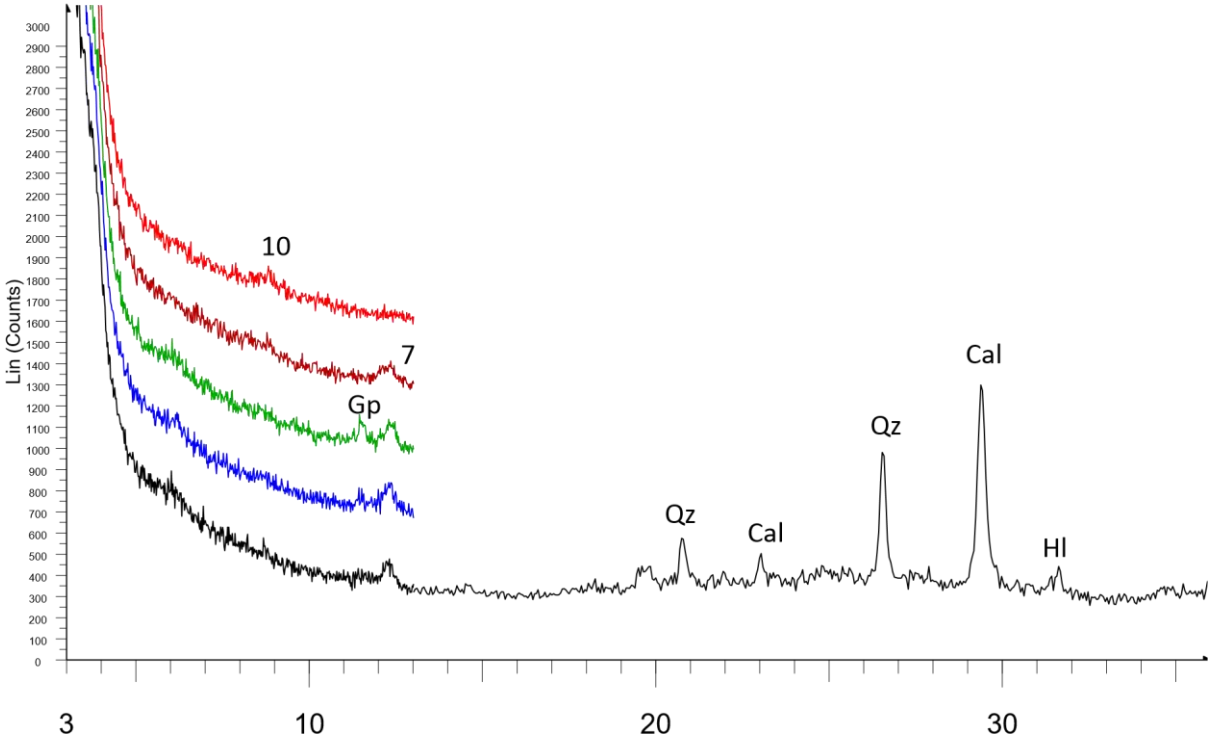


LU17 00195 030 (41767)

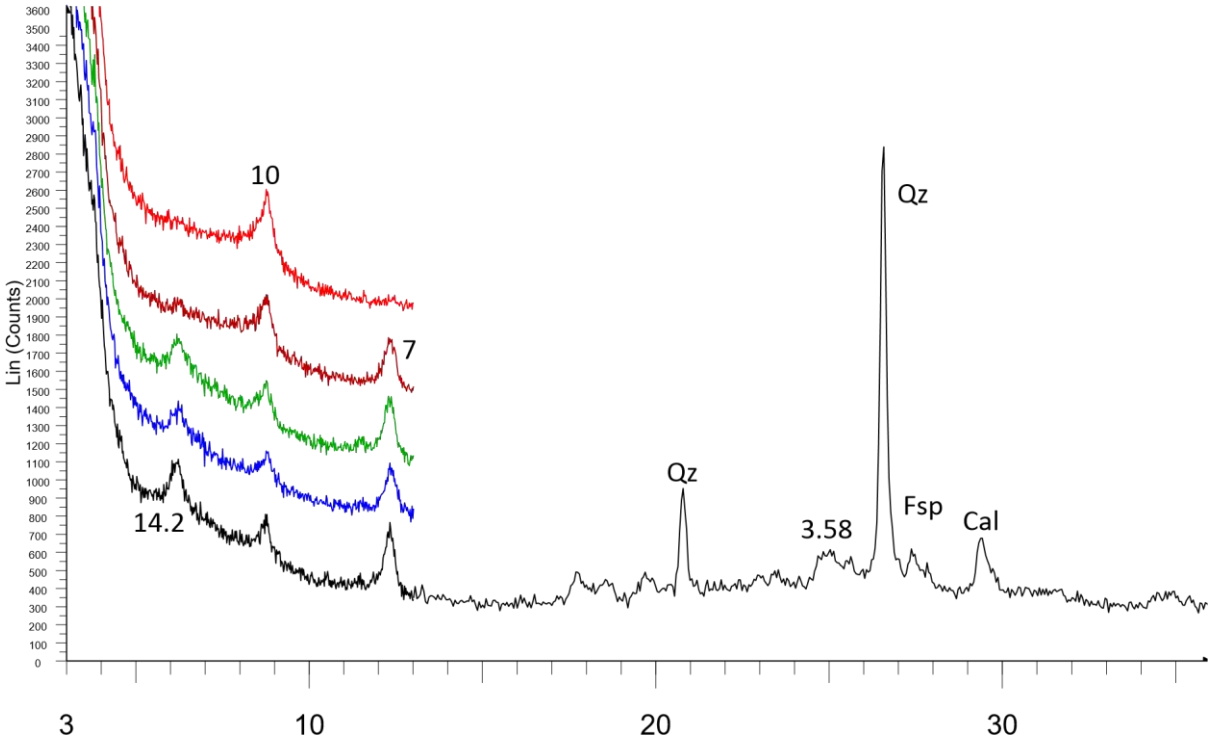


Annex 9. RX Diffractograms from Lithuania

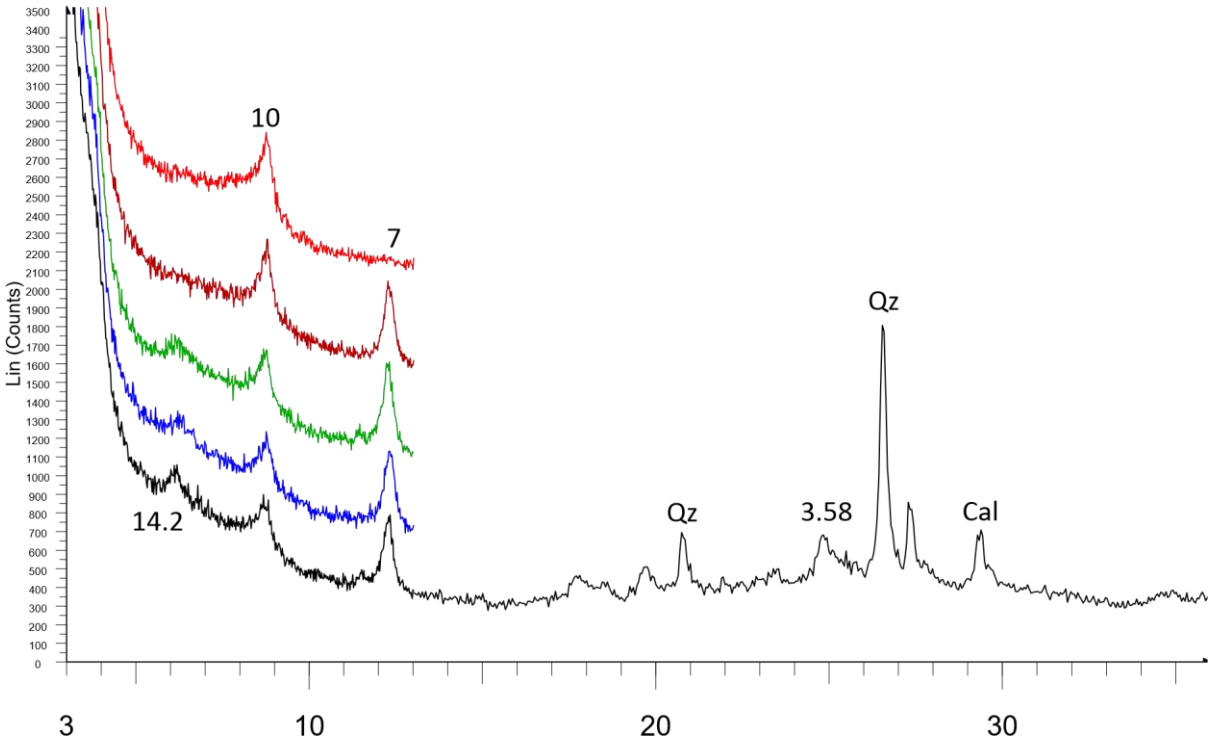
LU17 00196 001 (56004)



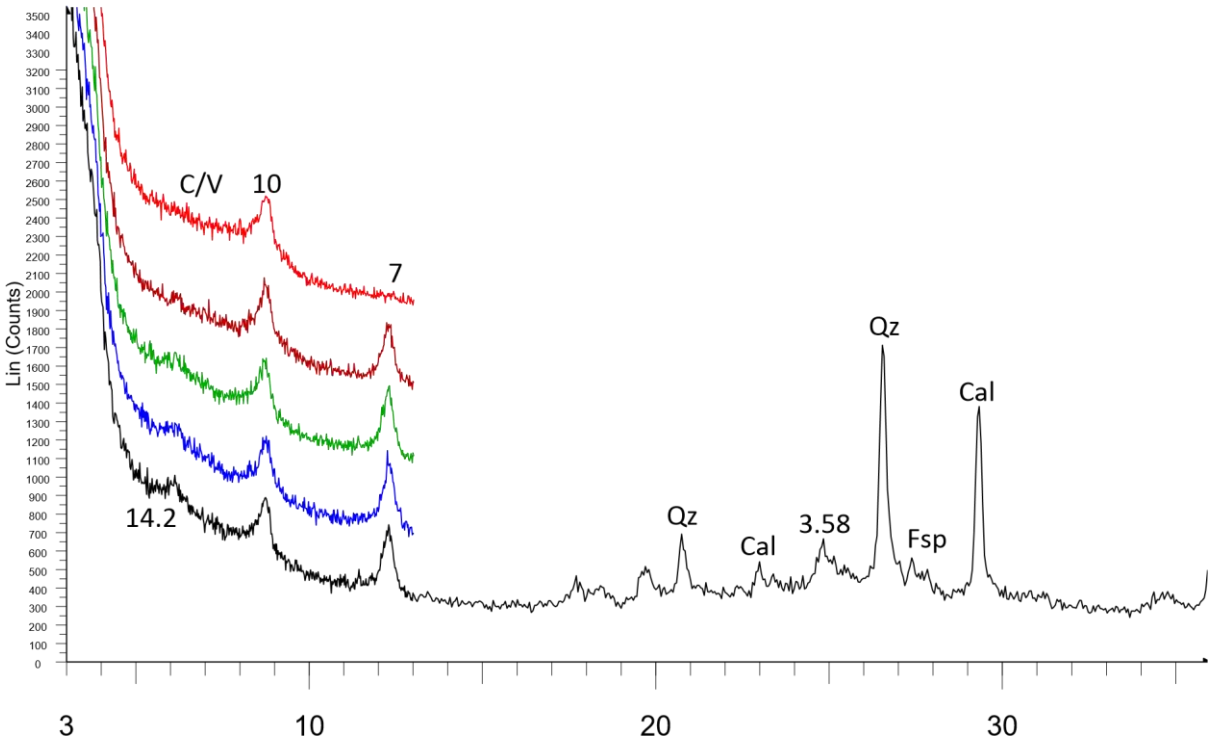
LU17 00196 002 (56025)



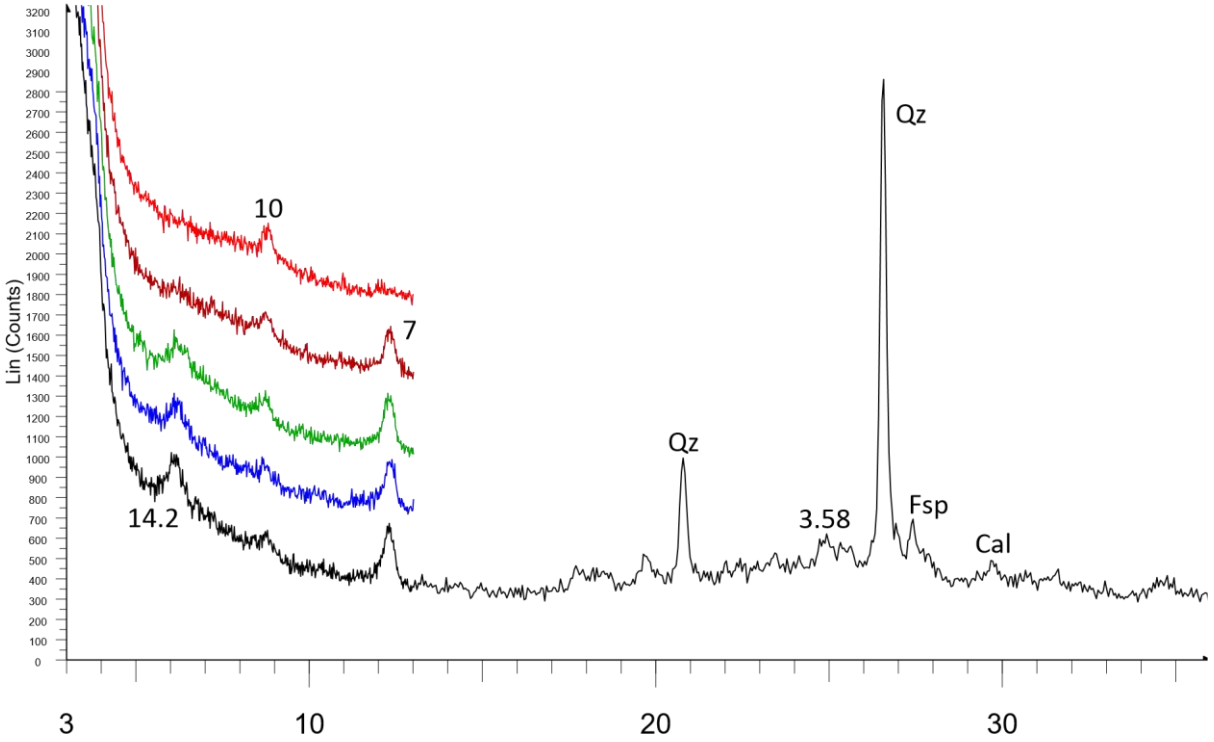
LU17 00196 003 (56050)



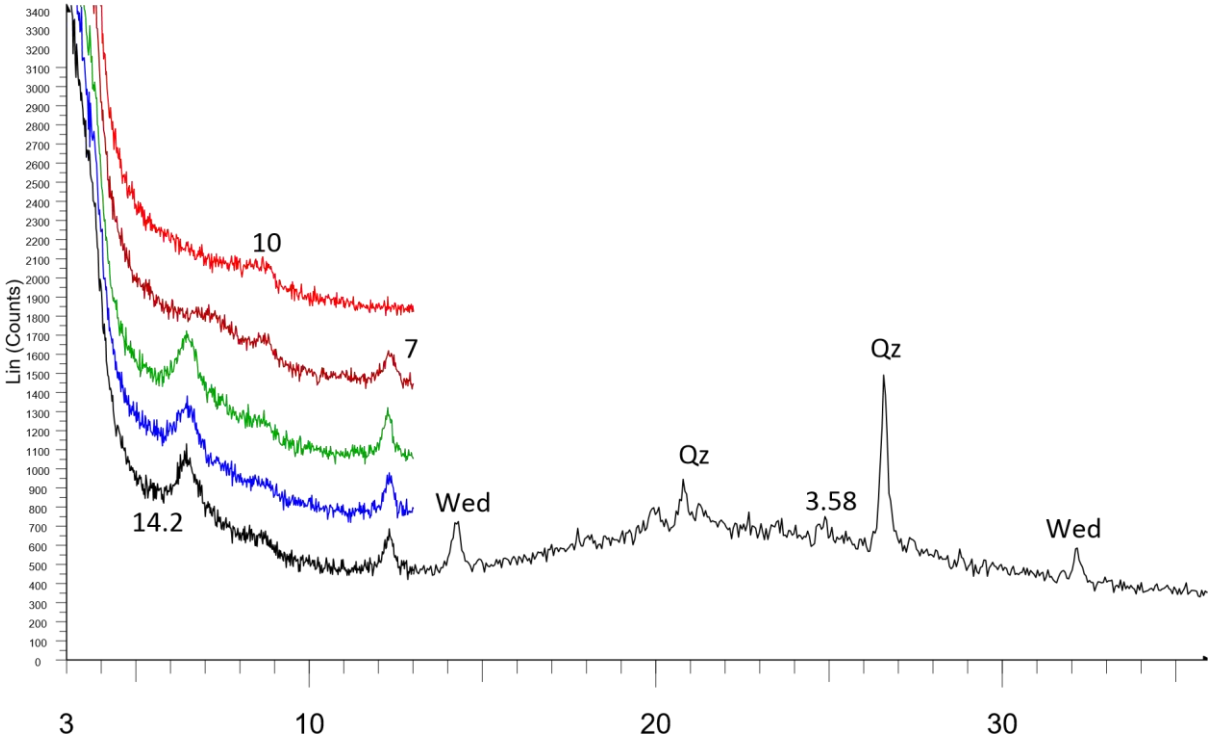
LU17 00196 004 (56067)



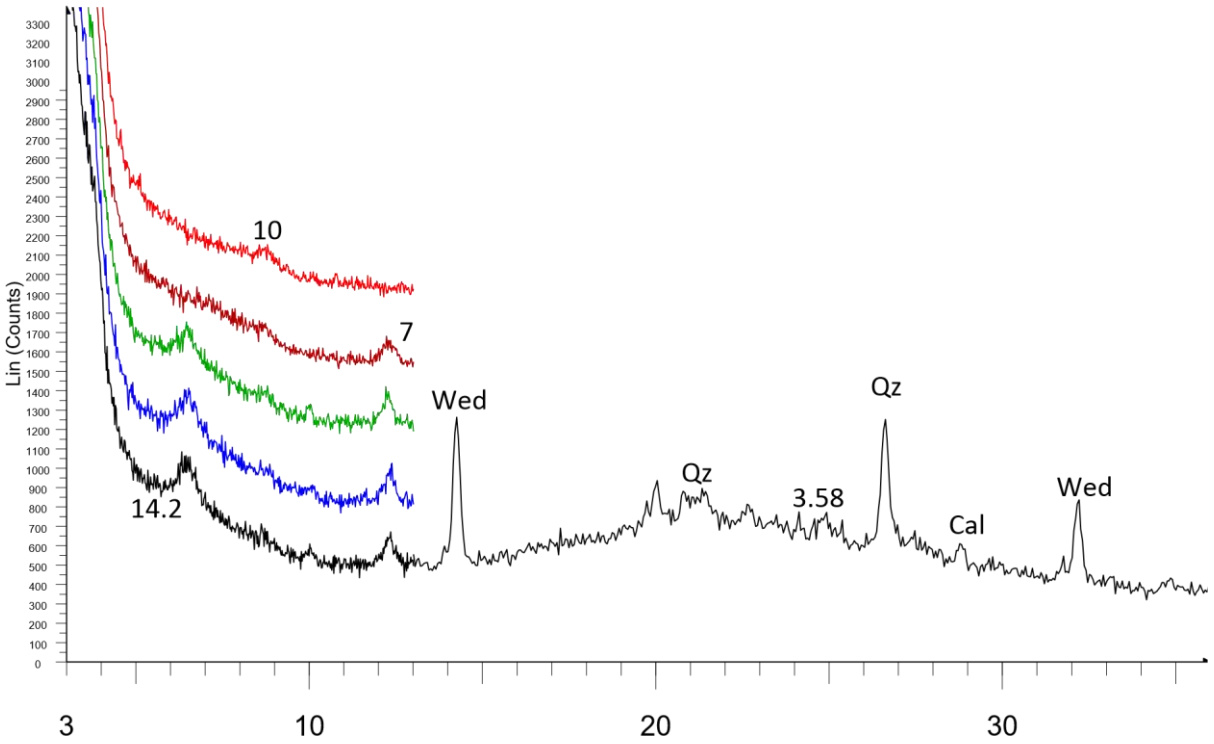
LU17 00196 005 (56203)



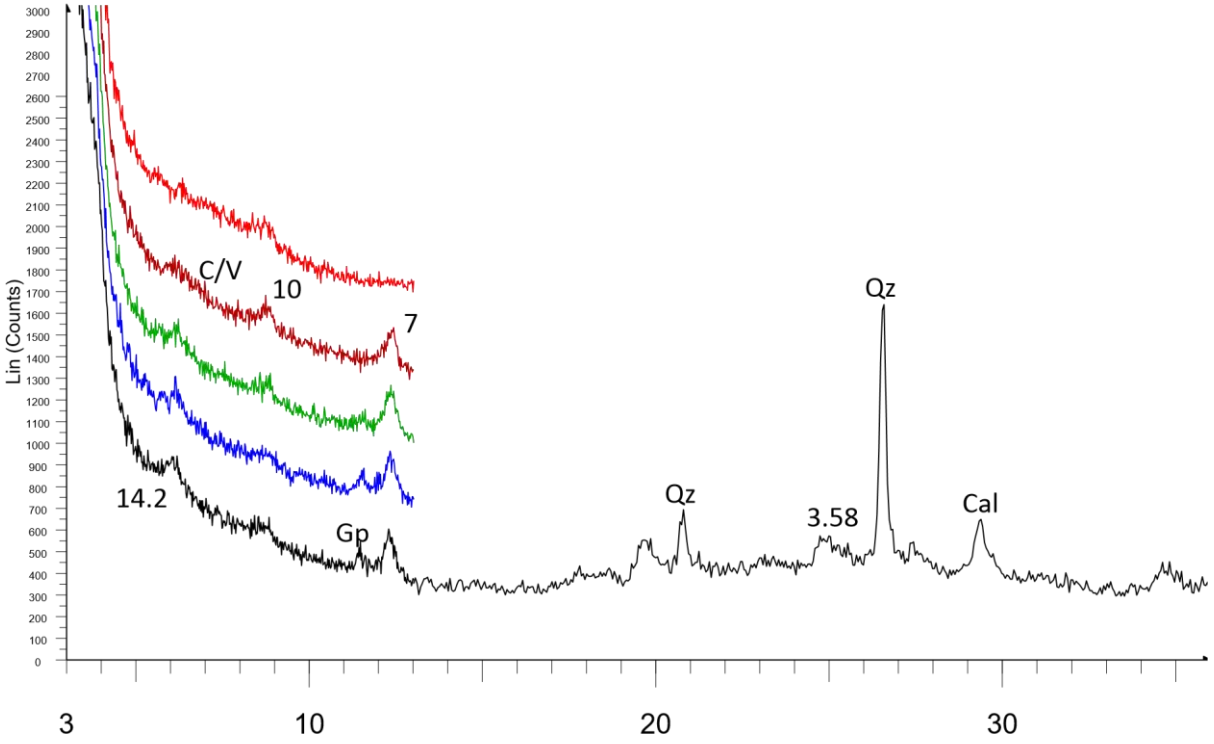
LU17 00196 006/1 (56217)



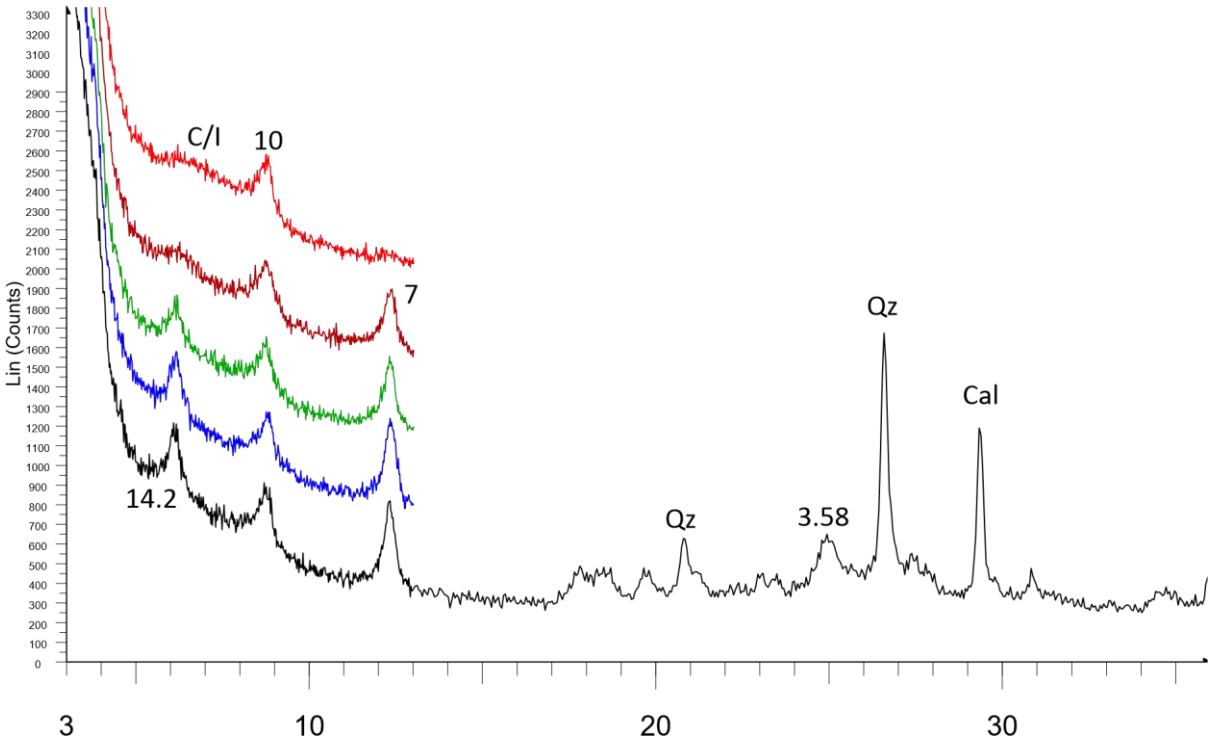
LU17 00196 006/2 (56217)



LU17 00196 007 (56316)

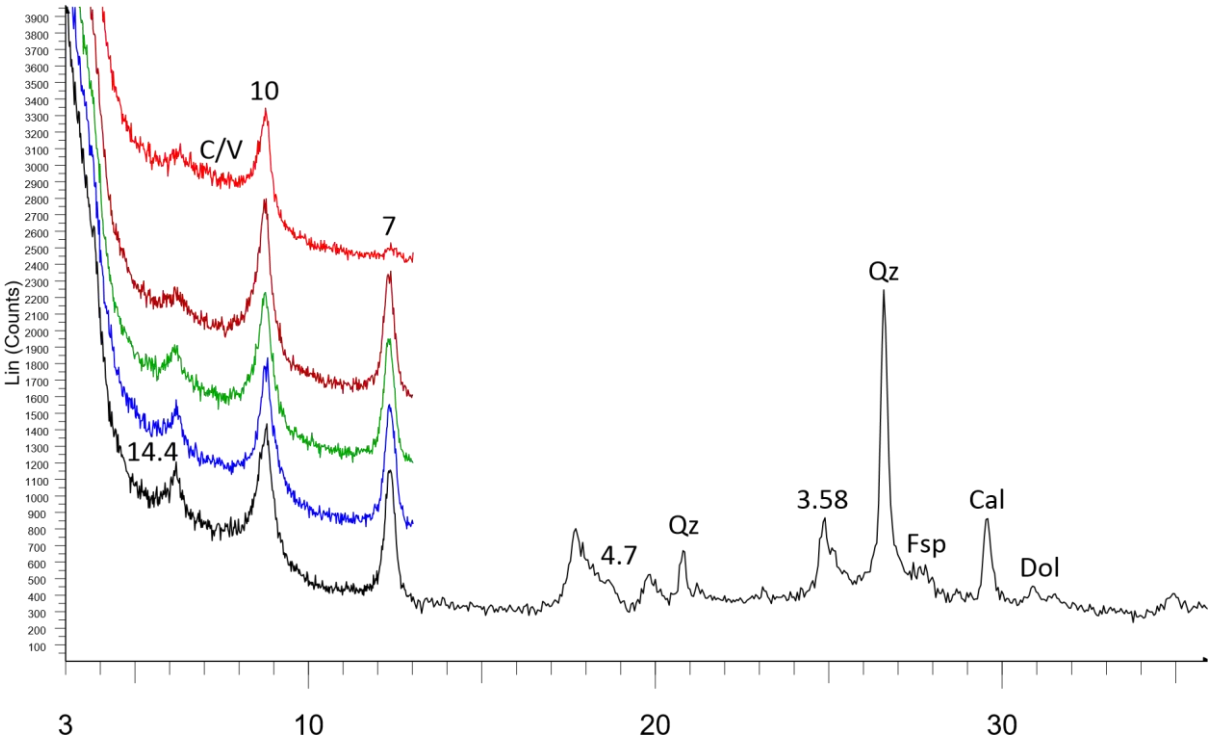


LU17 00196 008 (56351)



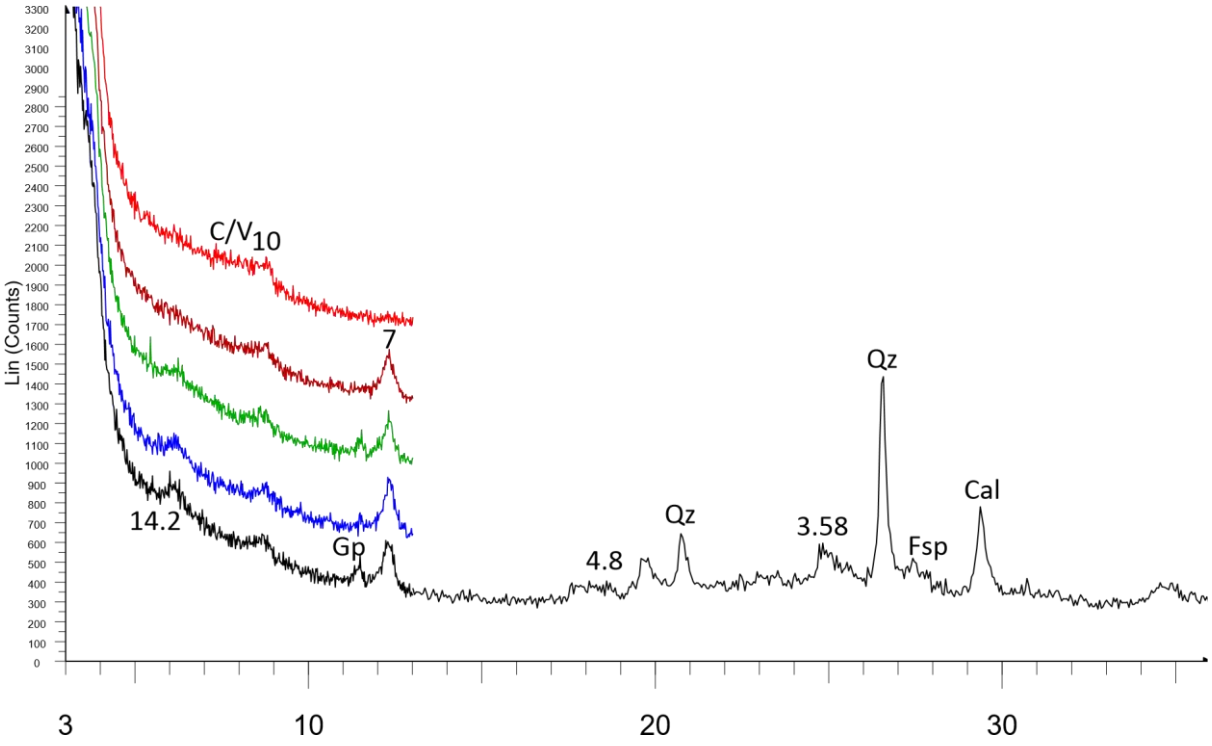
Annex 10. RX Diffractograms from Slovenia

LU17 00197 001 (46014)

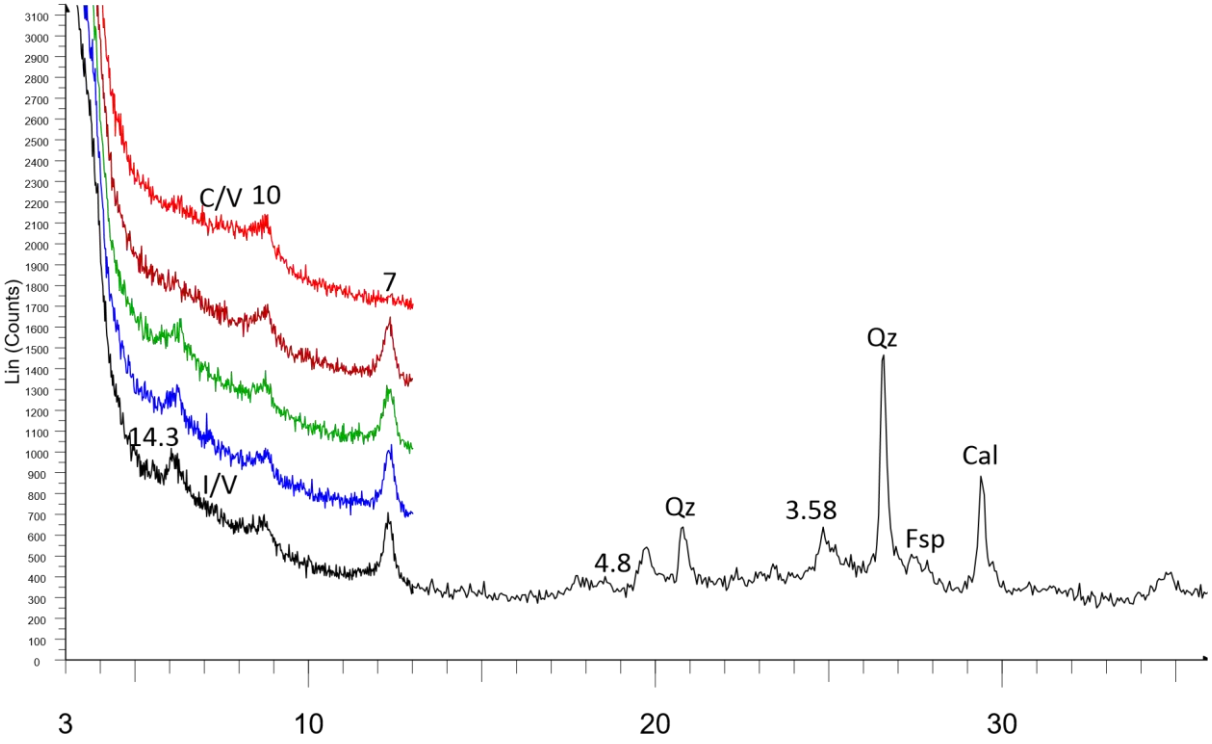


Annex 11. RX Diffractograms from Estonia

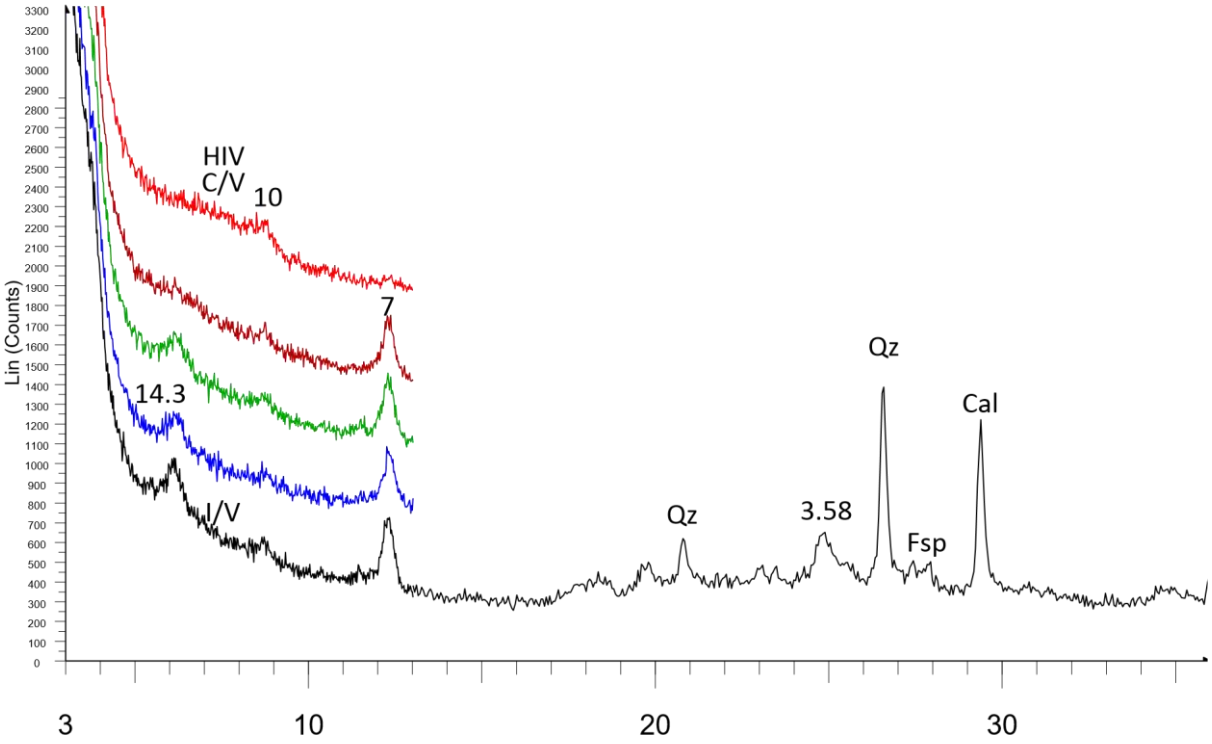
LU17 00198 001 (19120)



LU17 00198 002 (19165)

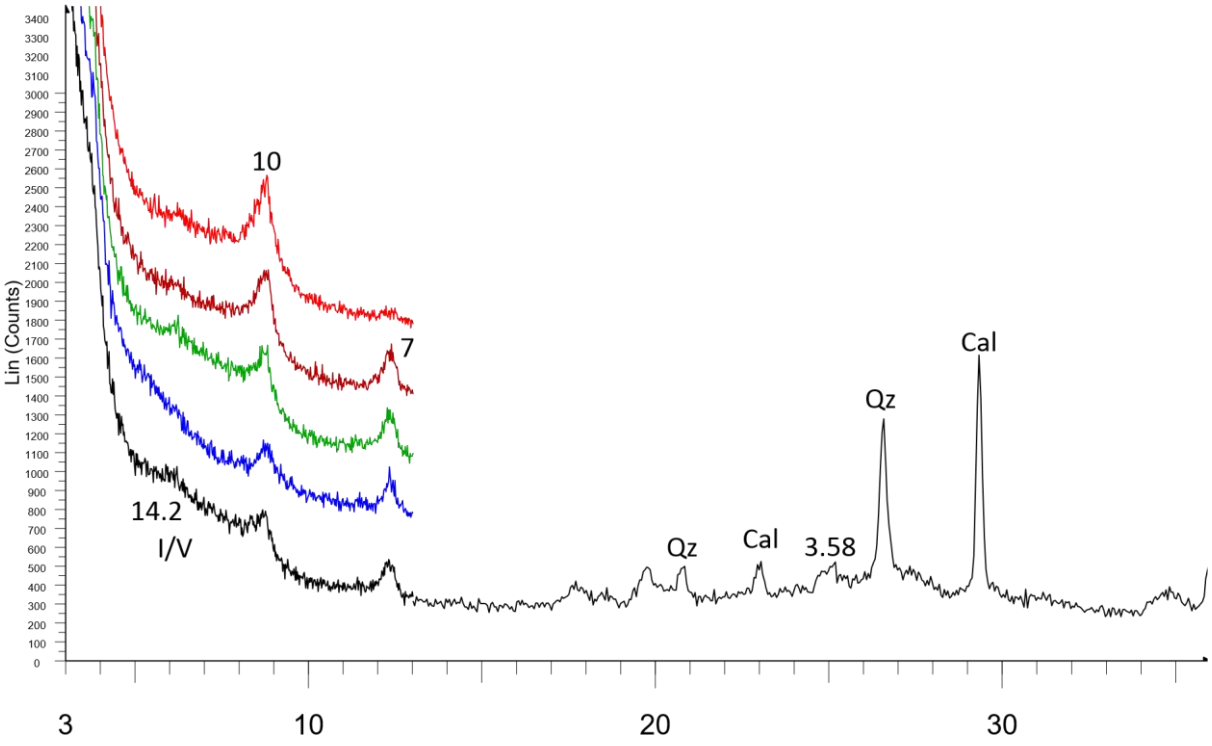


LU17 00198 003 (19169)

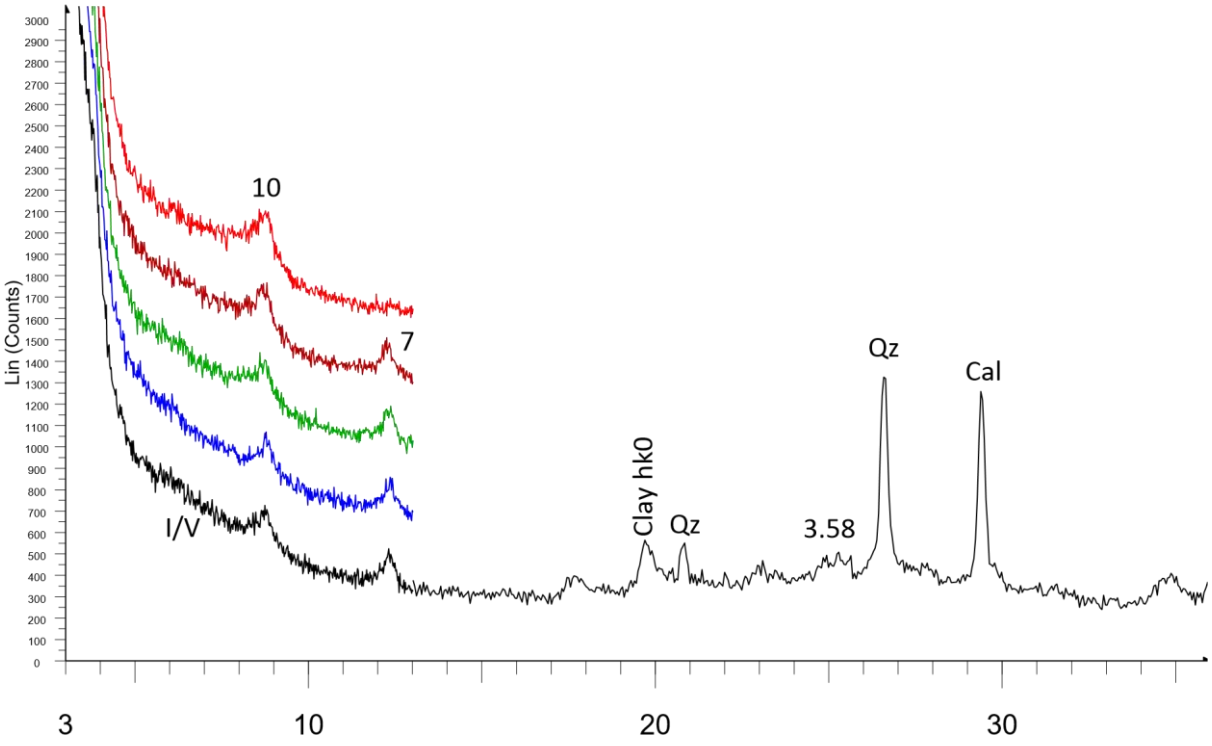


Annex 12. RX Diffractograms from The Netherlands

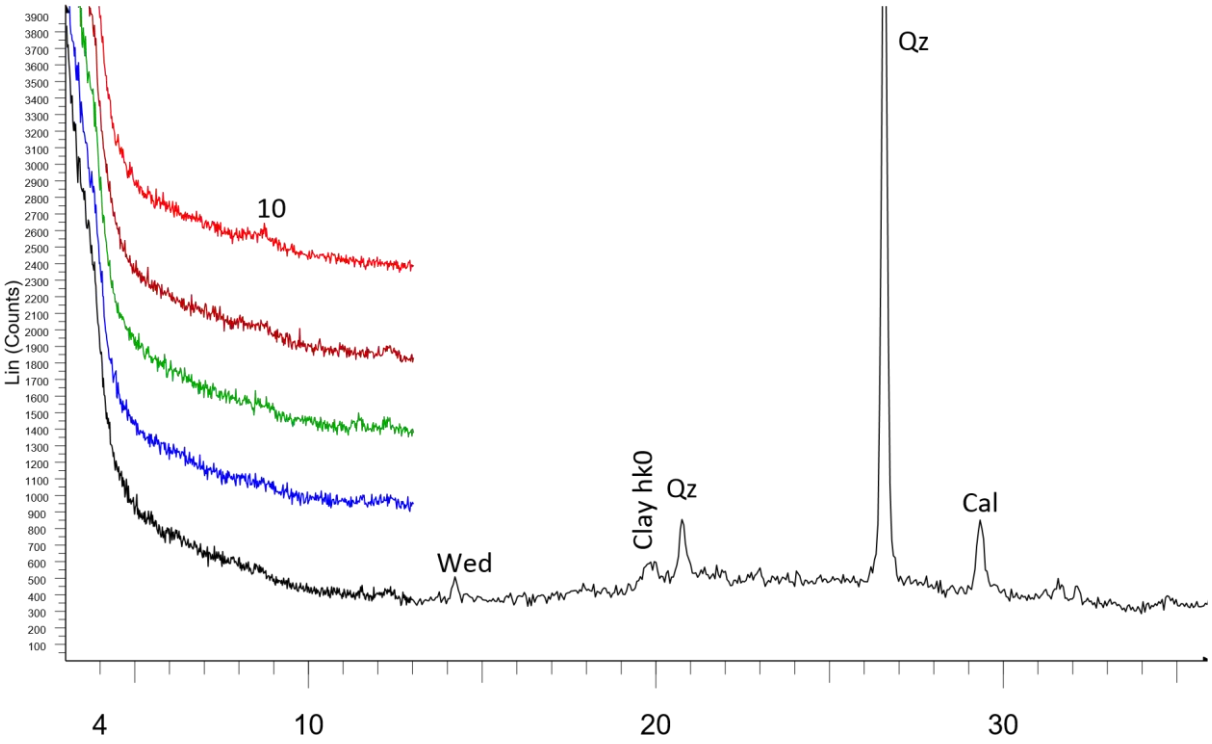
LU17 00199 001 (39151)



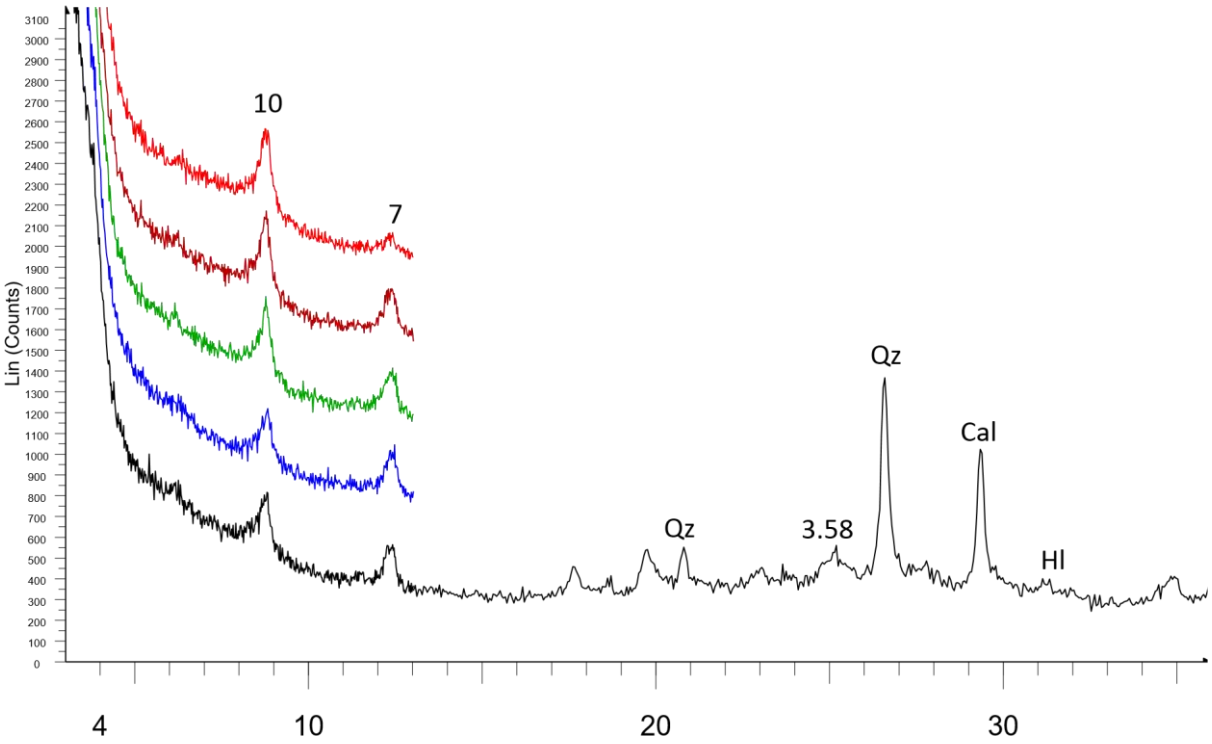
LU17 00199 002 (39194)



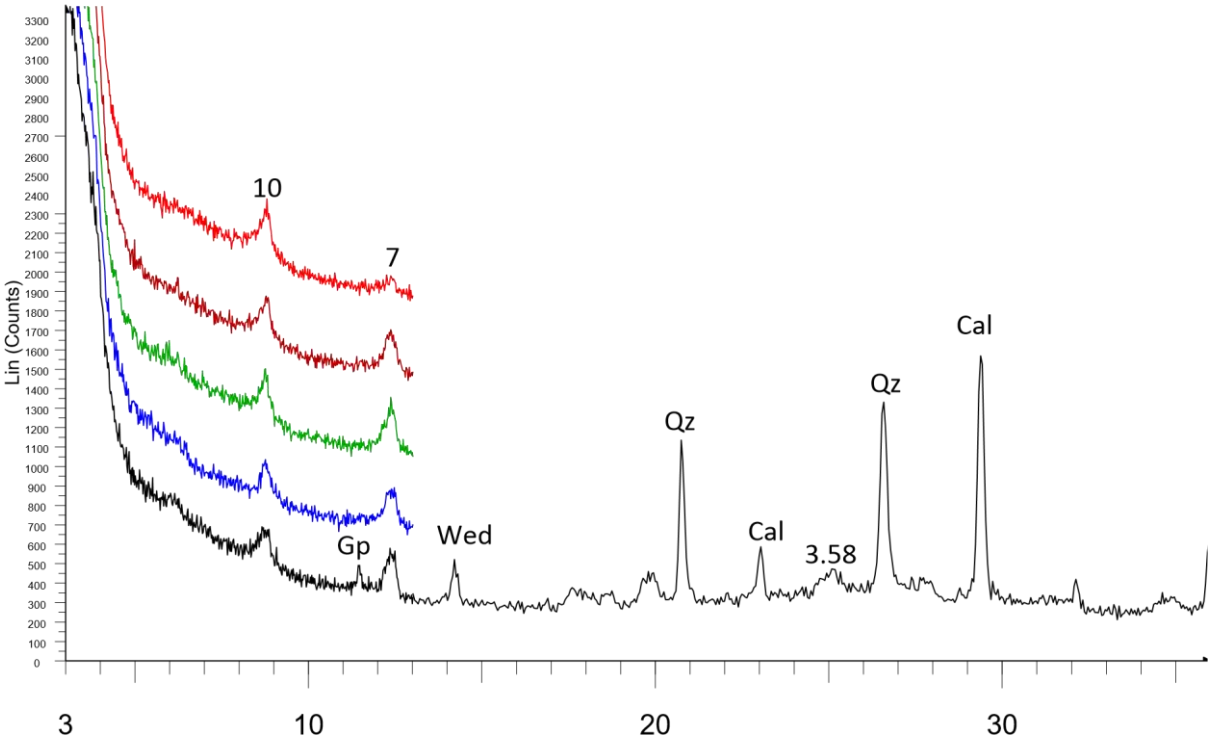
LU17 00199 003 (39055)



LU17 00199 004 (39086)

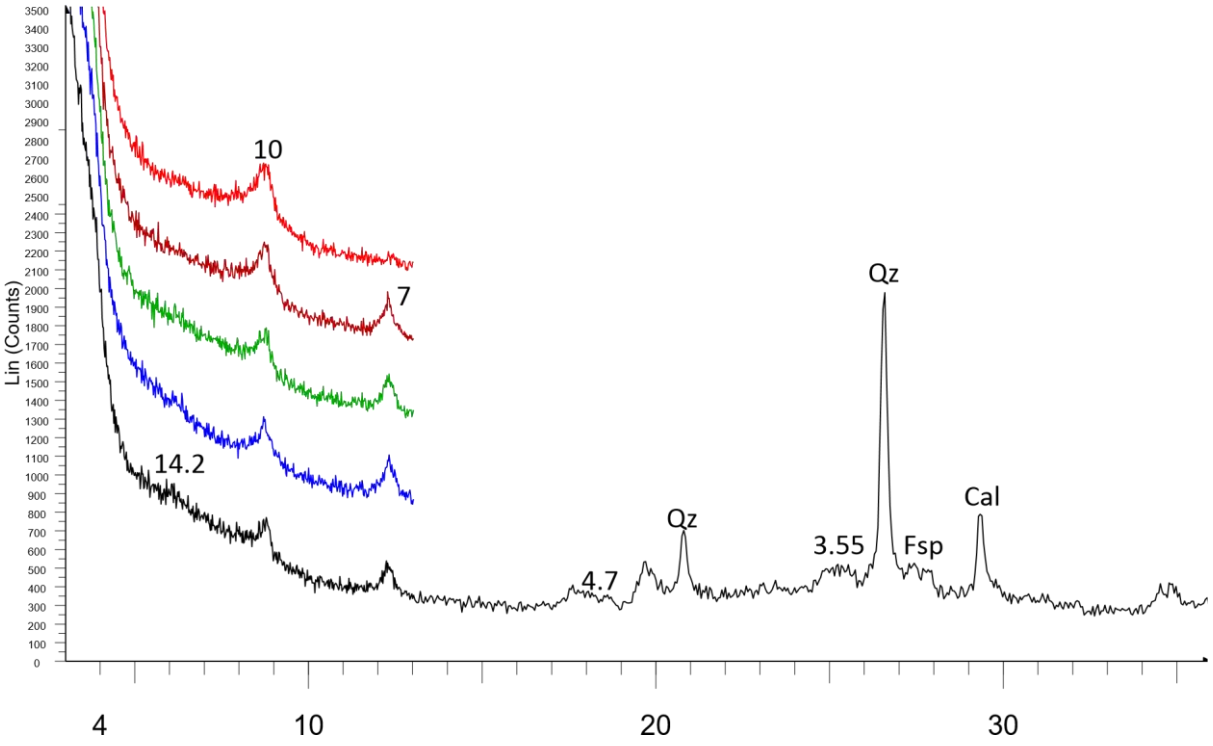


LU17 00199 005 (39153)

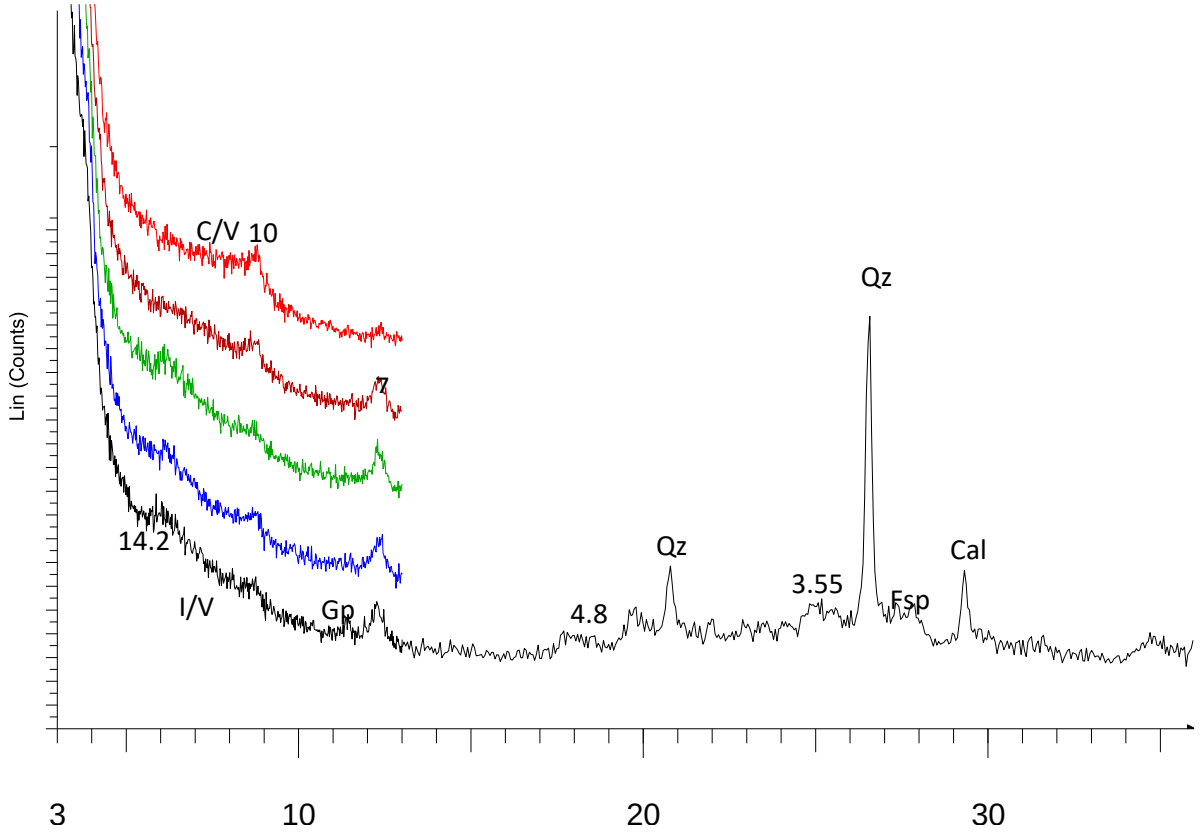


Annex 13. RX Diffractograms from Denmark

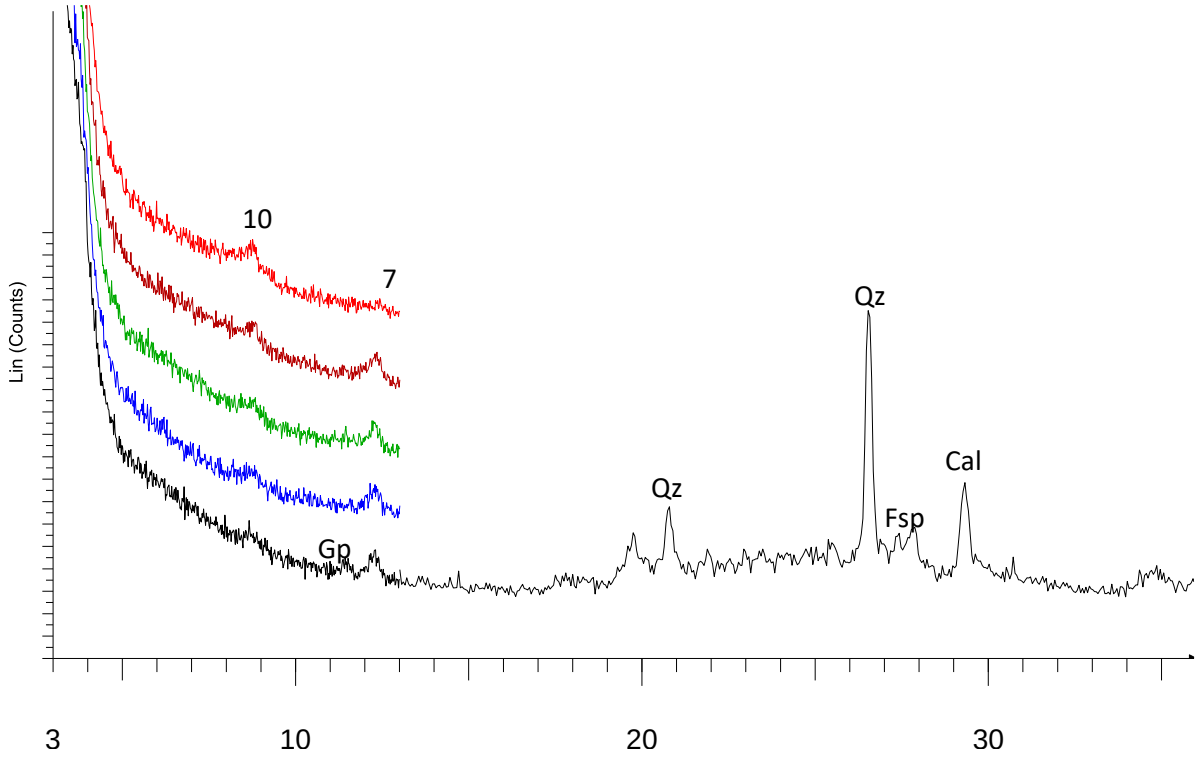
LU17 00200 001 (18003)



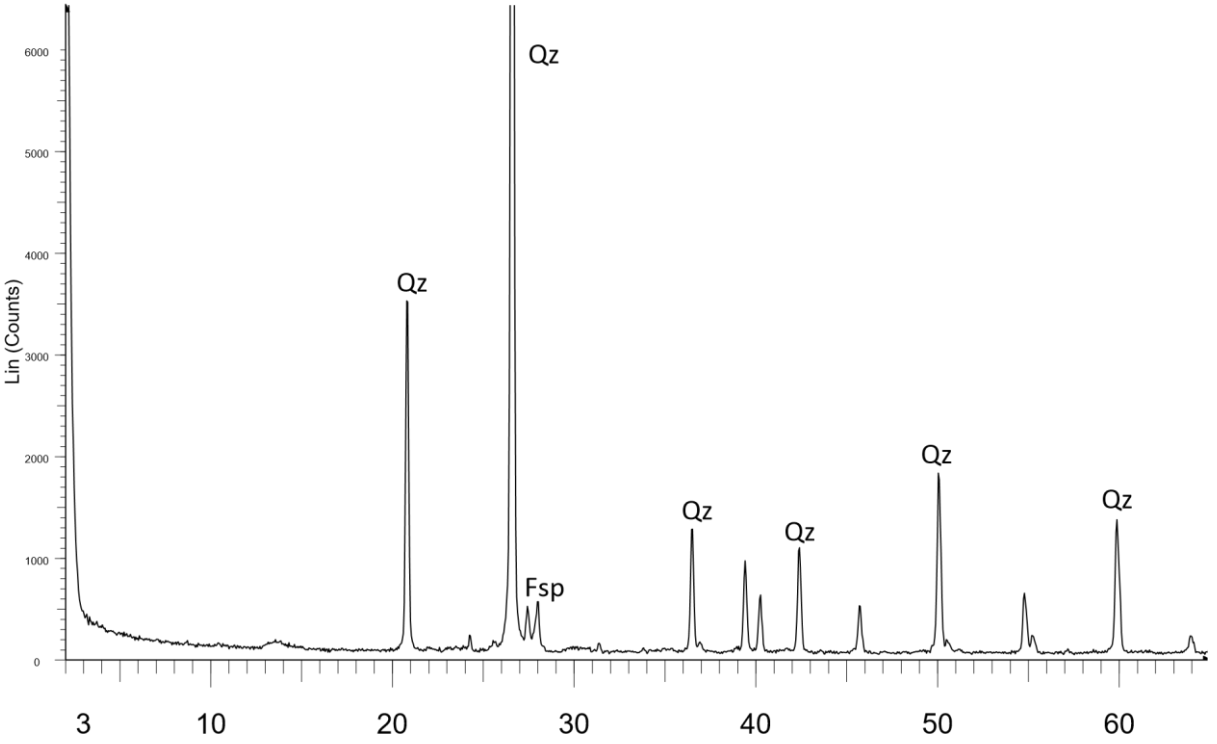
LU17 00200 002 (18028)



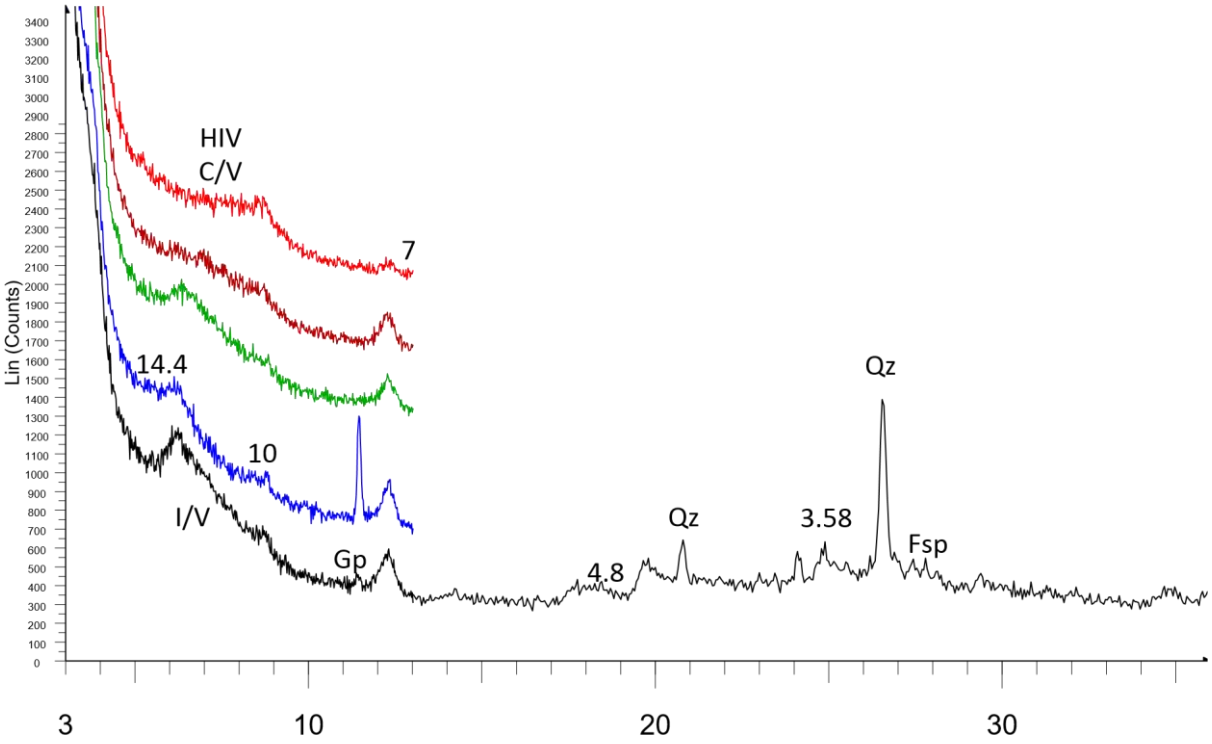
LU17 00200 003 (18079)



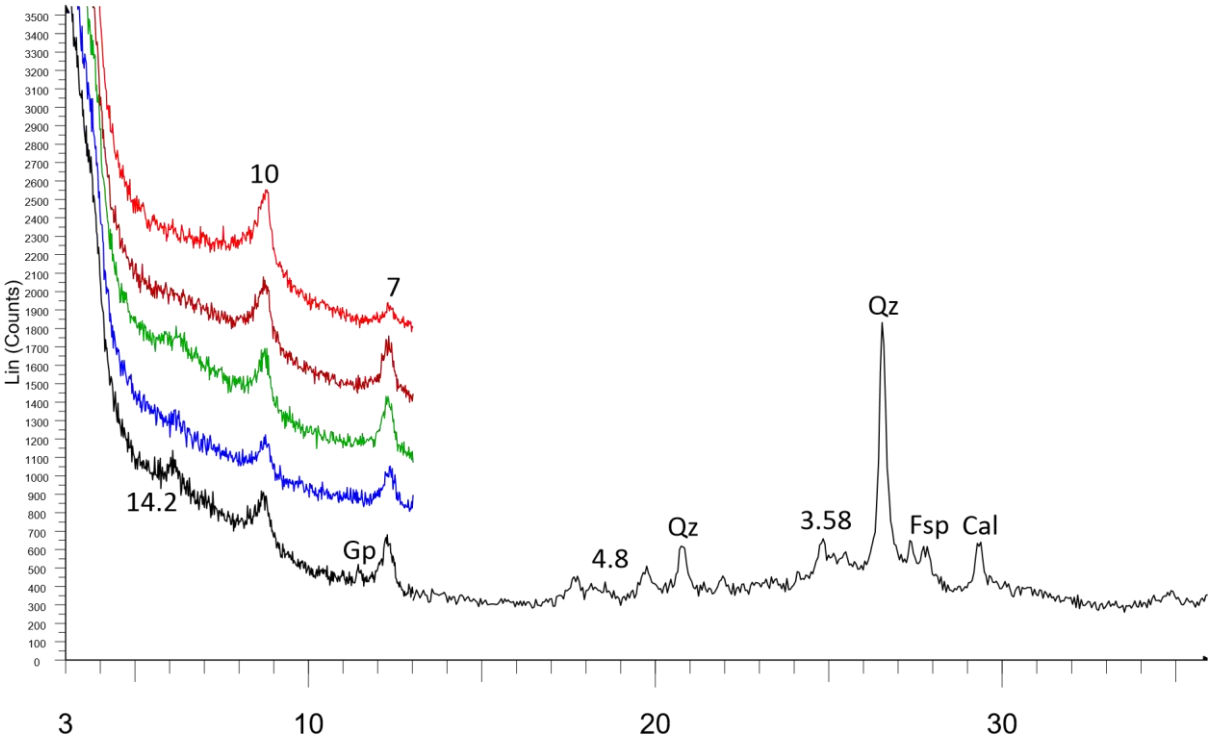
LU17 00200 004 (18096) bulk soil



LU17 00200 005 (18128)

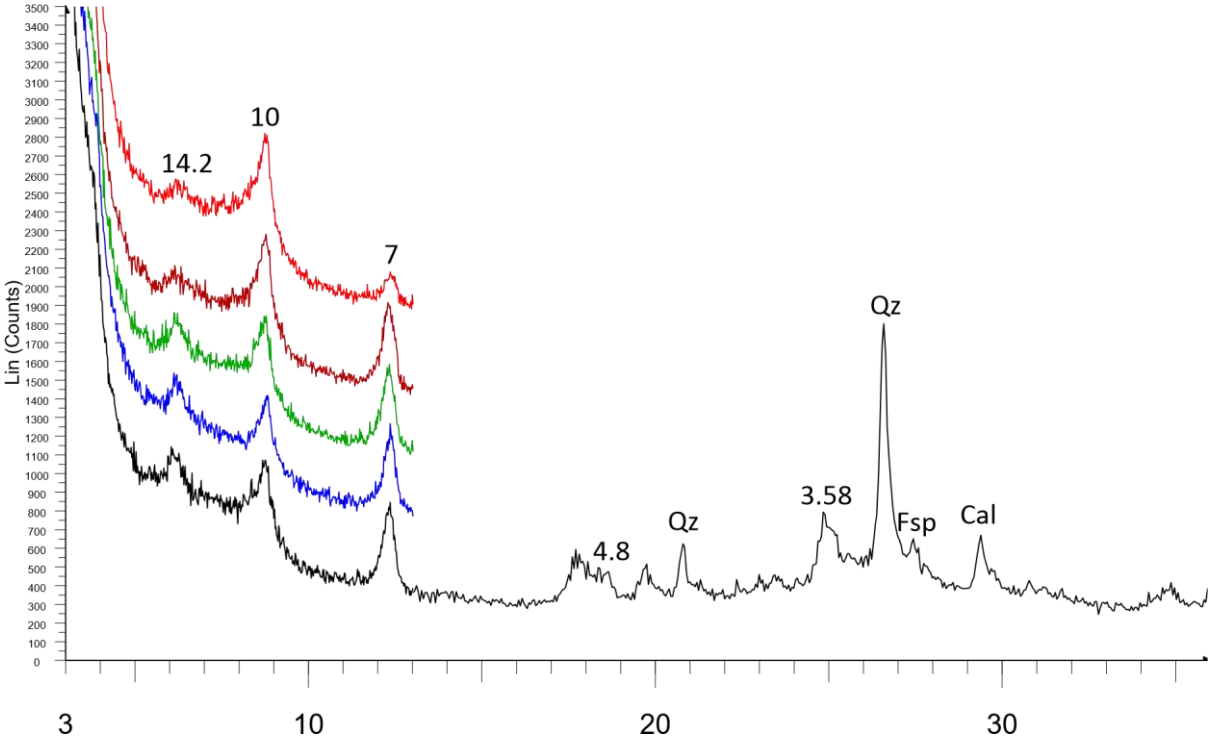


LU17 00200 006 (18202)

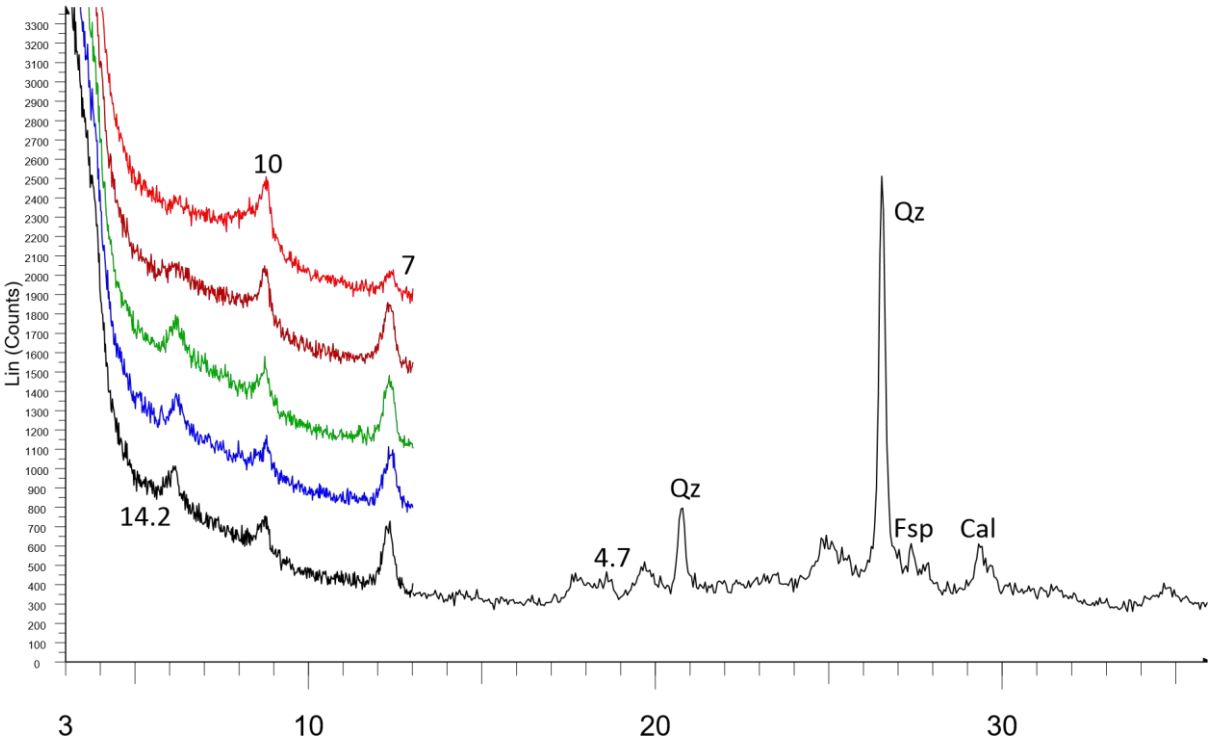


Annex 14. RX Diffractograms from Latvia

LU17 00201 001 (35060)

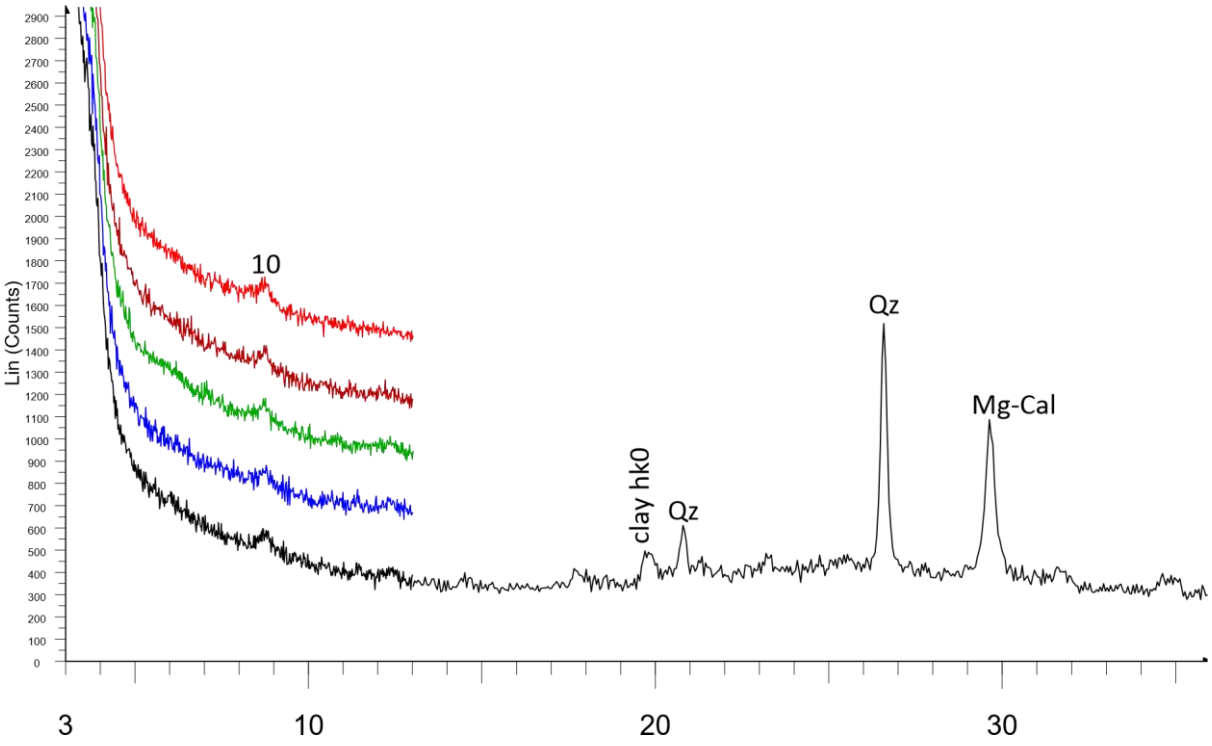


LU17 00201 002 (35069)



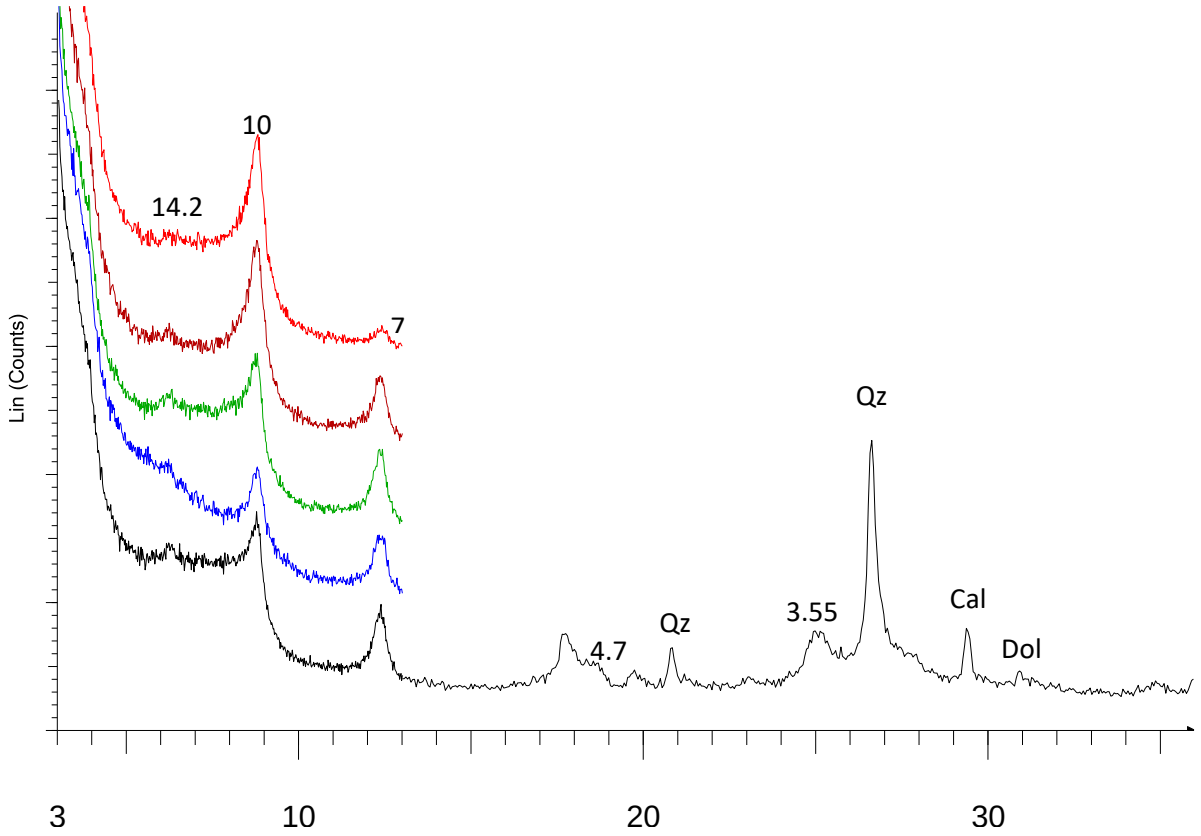
Annex 15. RX Diffractograms from Ireland

LU17 00202 001 (31120)

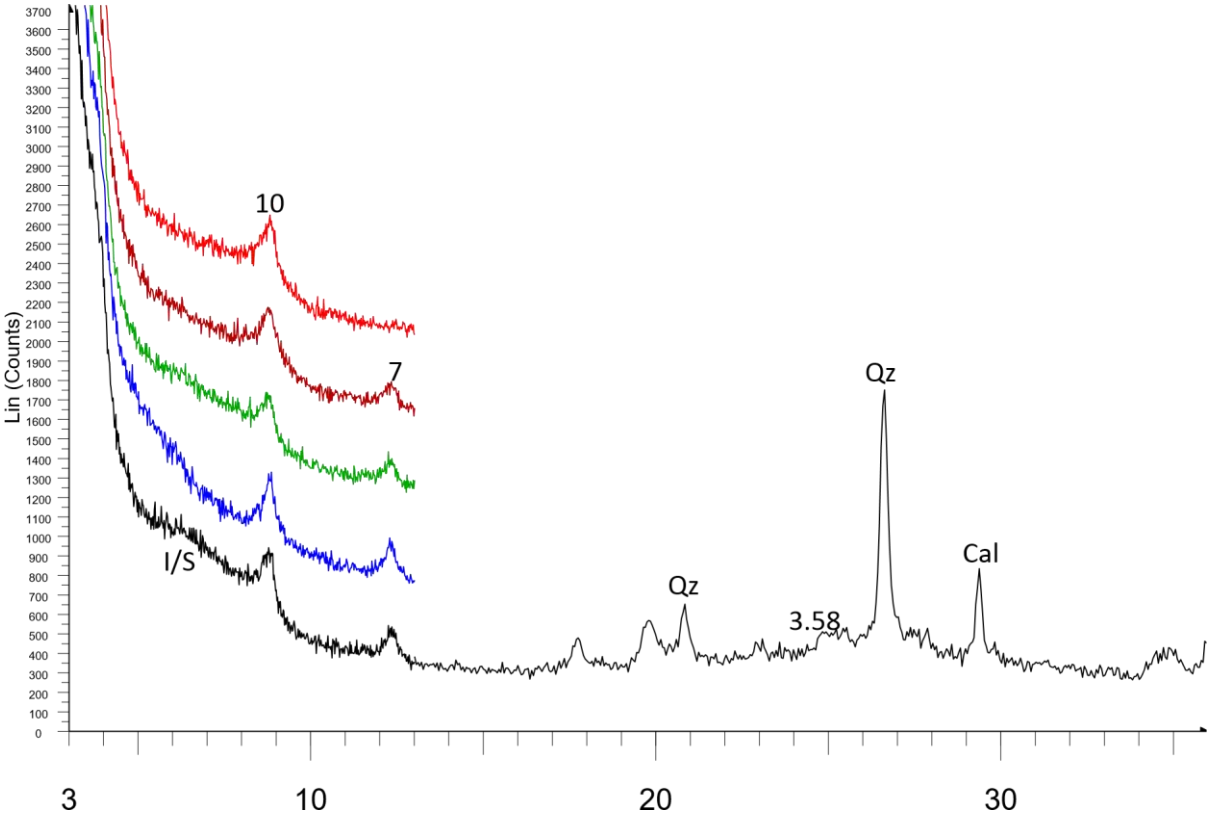


Annex 16. RX Diffractograms from Slovakia

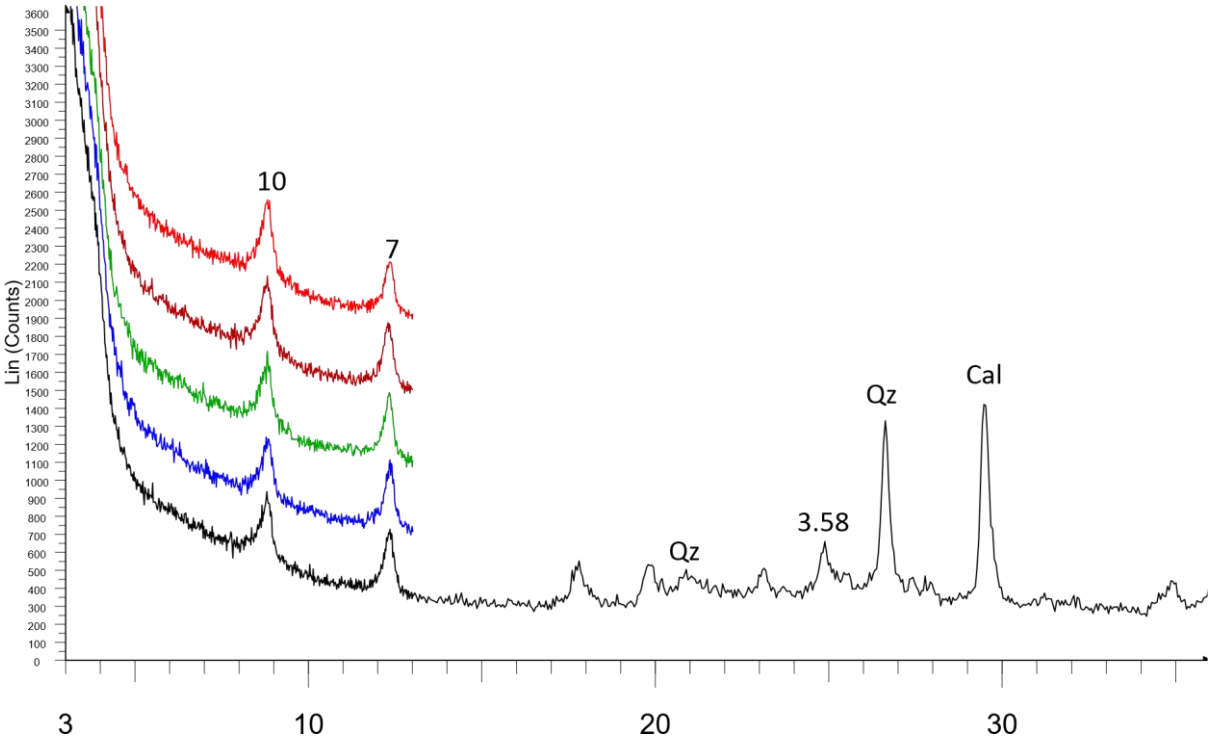
LU17 00203 001 (45009)



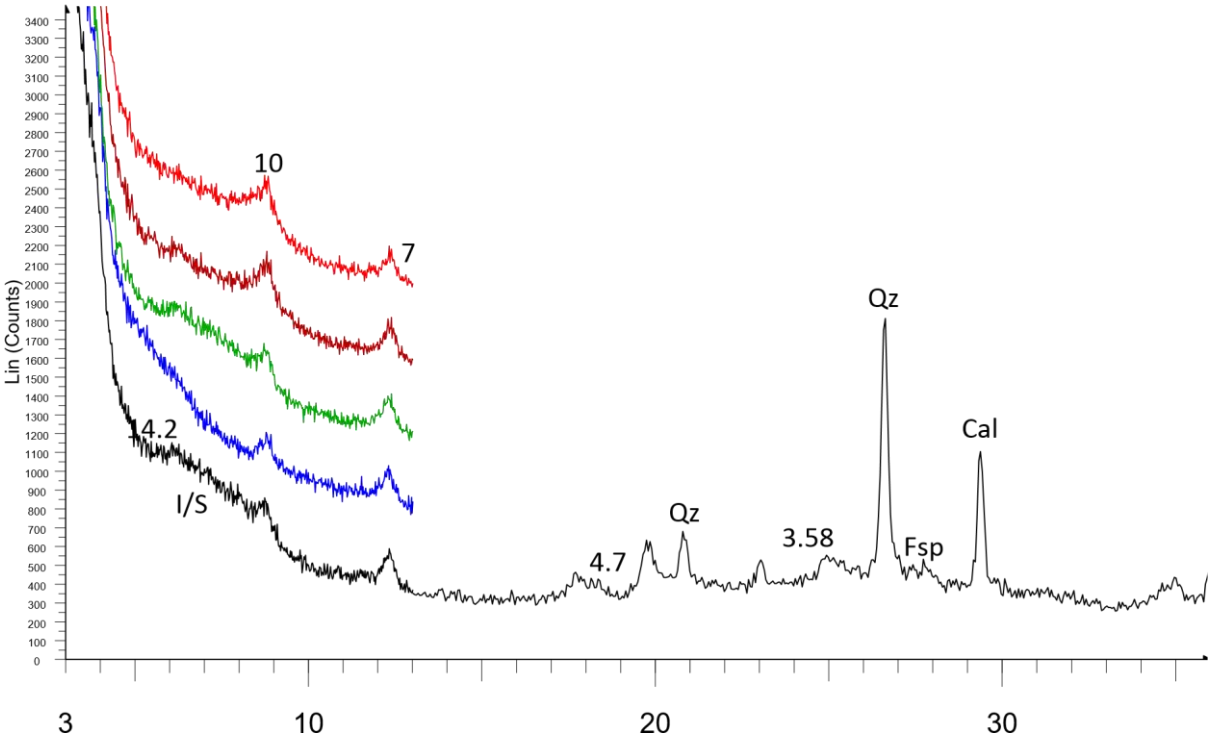
LU17 00203 002 (45019)



LU17 00203 003 (45207)

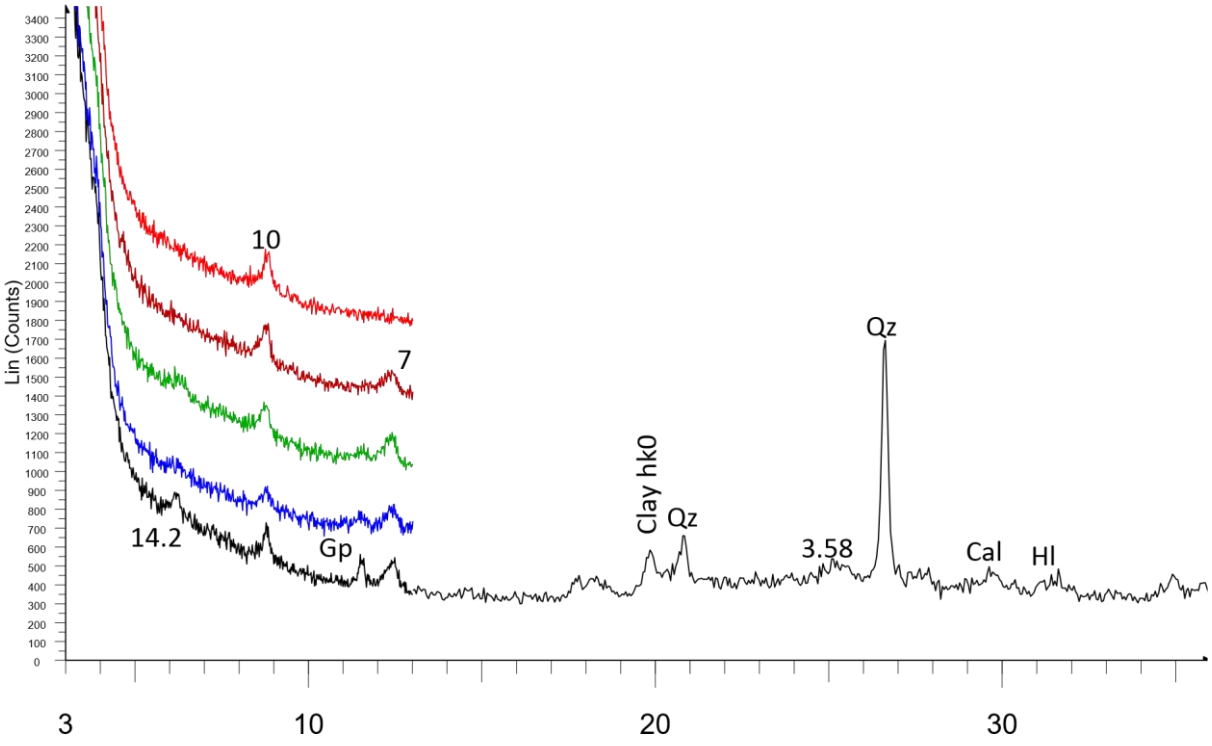


LU17 00203 004 (45219)

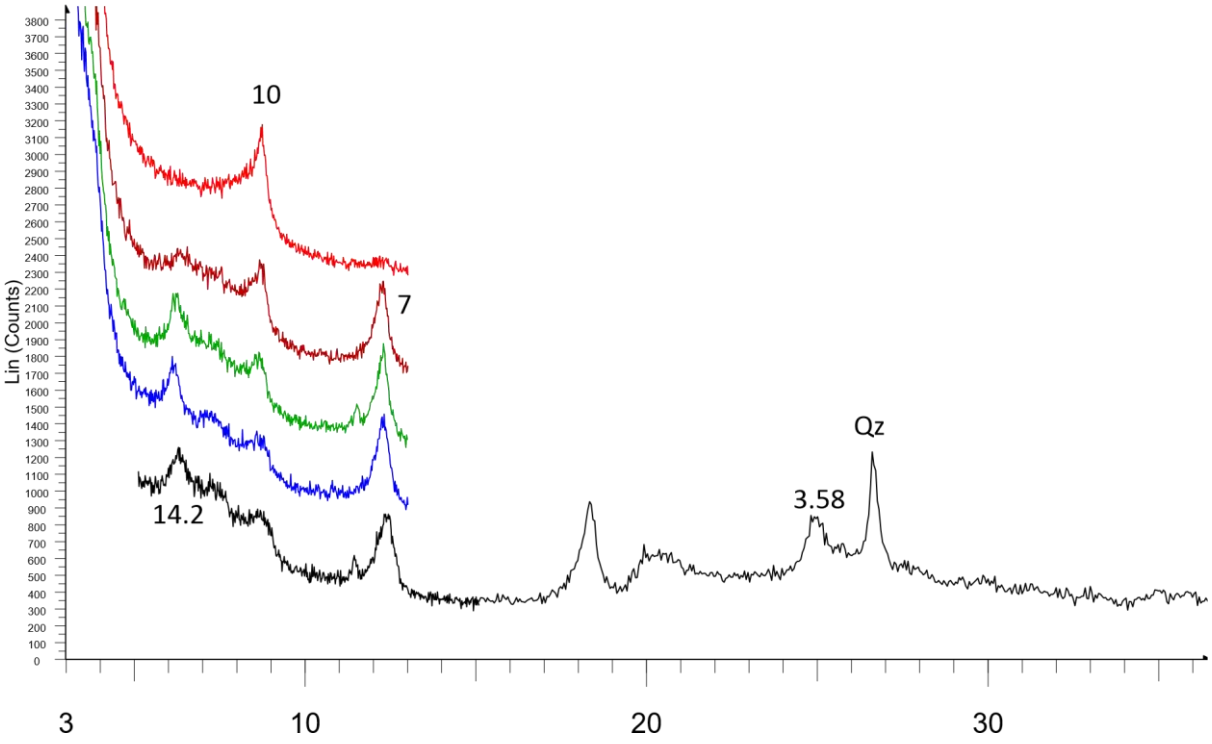


Annex 17. RX Diffractograms from Portugal

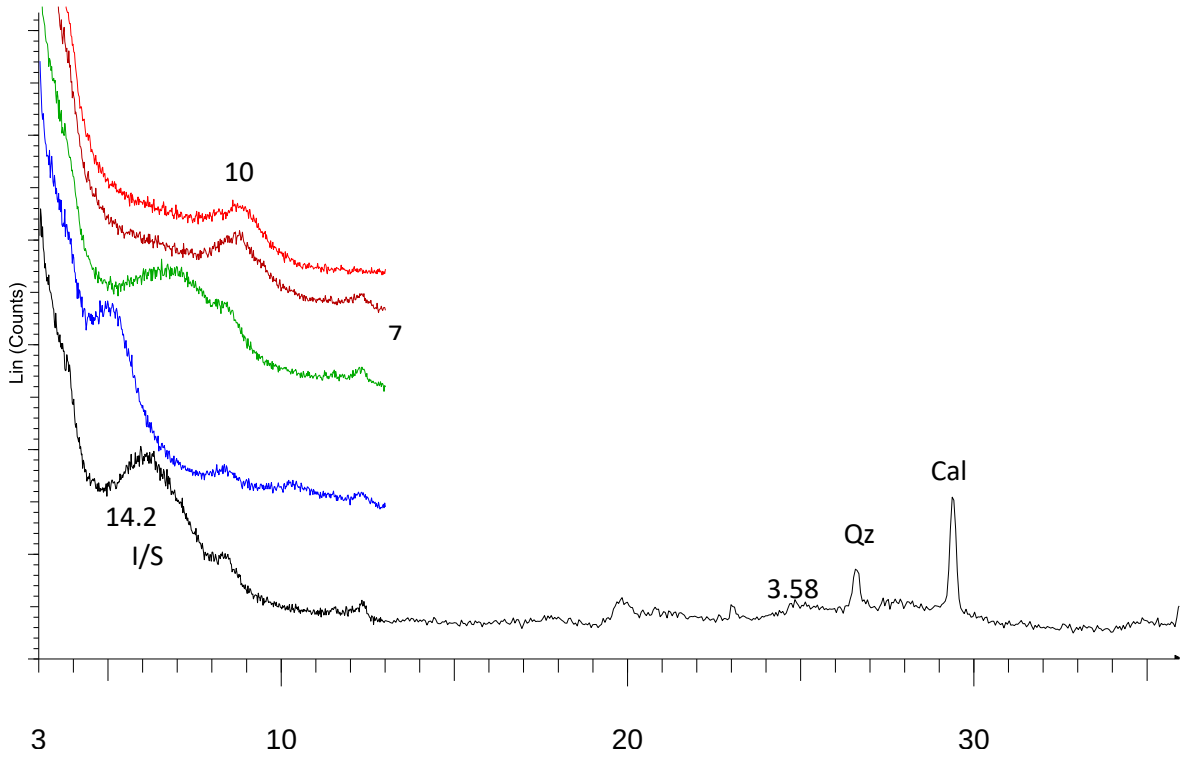
LU17 00204 001 (42010)



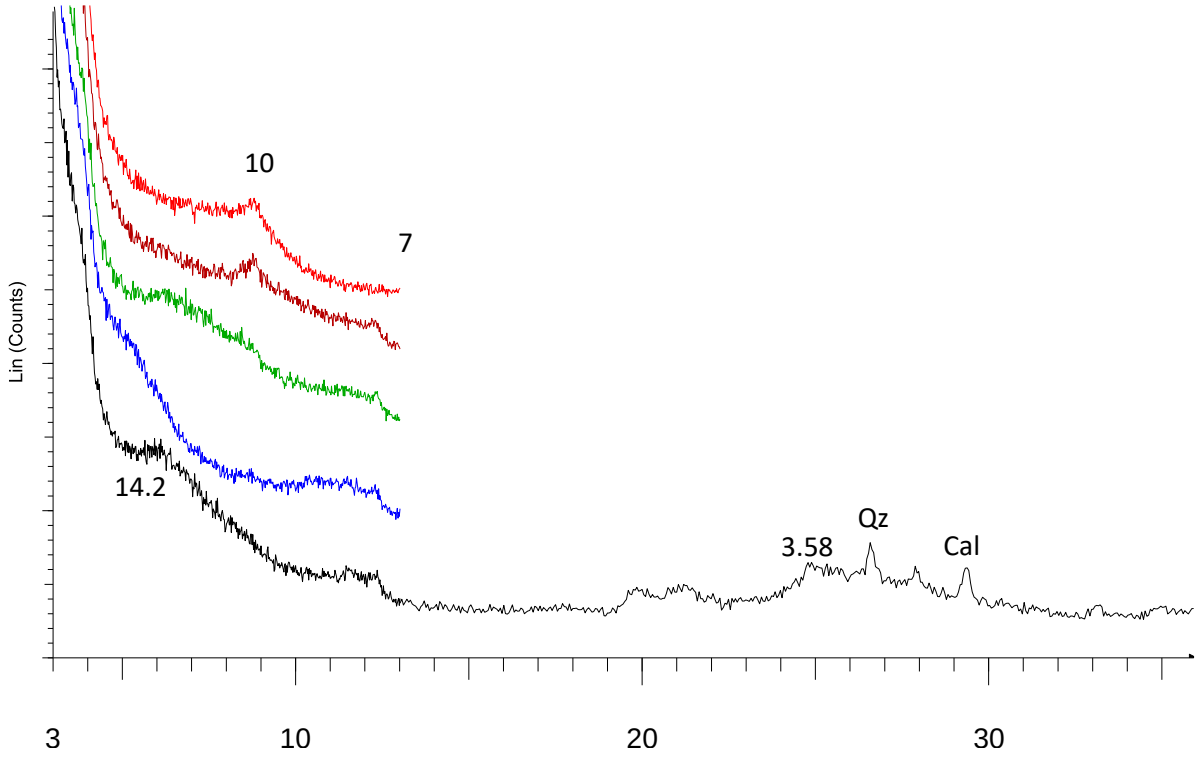
LU17 00204 002 (42027)



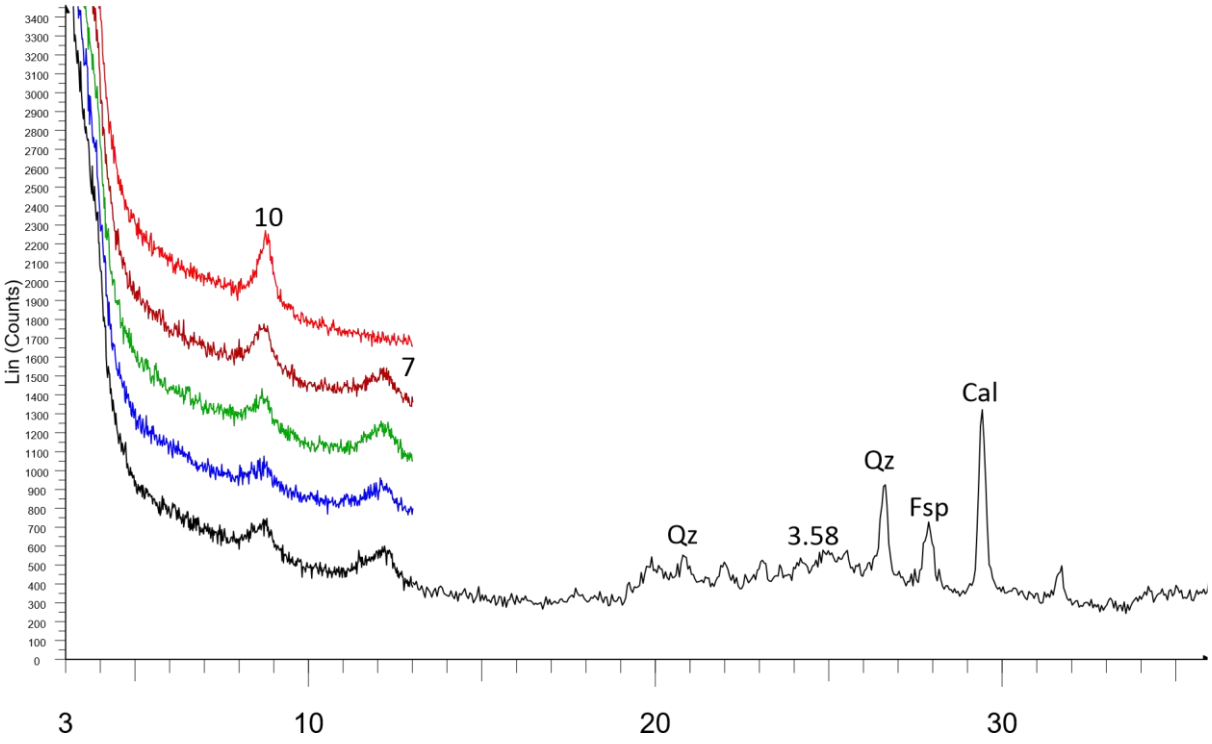
LU17 00204 003 (42137)



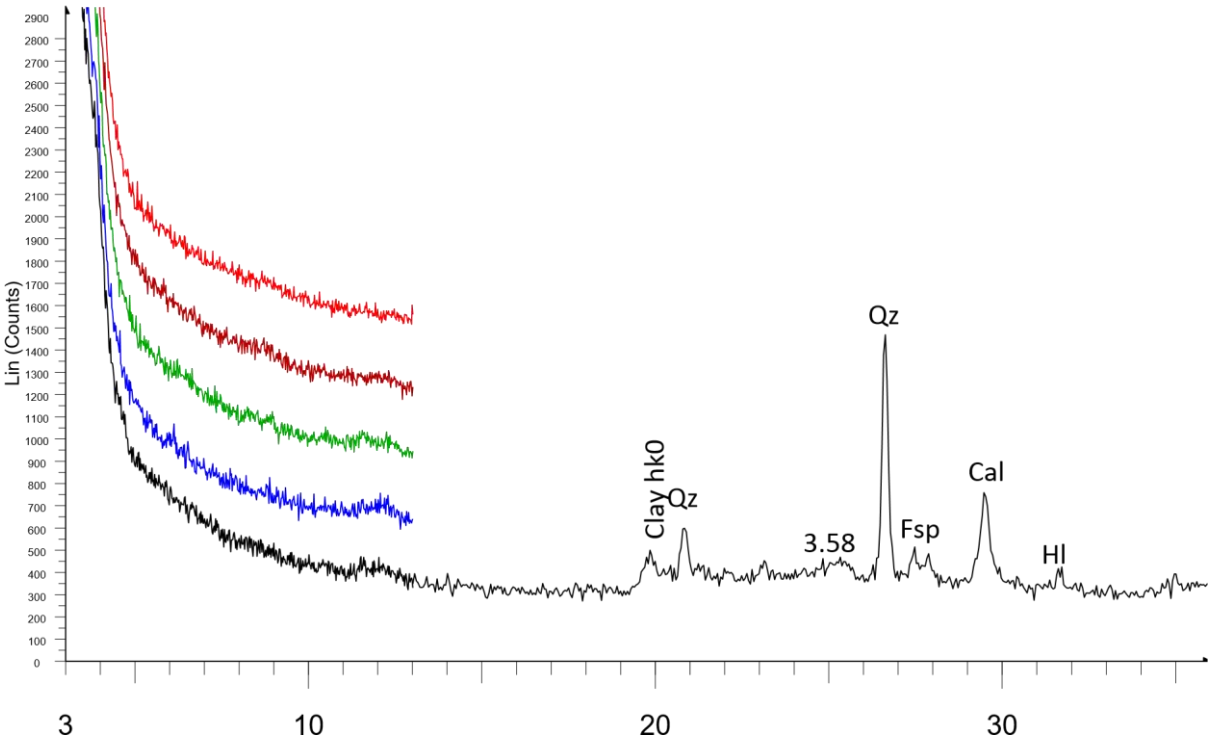
LU17 00204 004 (42141)



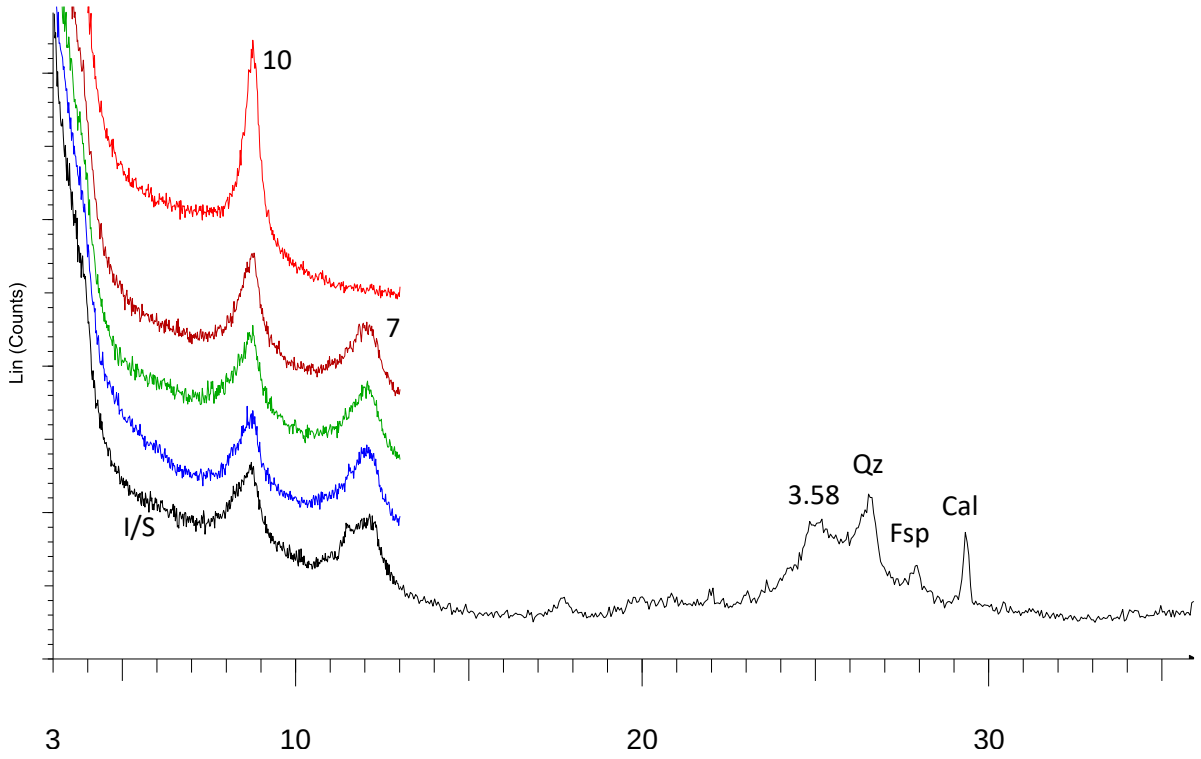
LU17 00204 005 (42171)



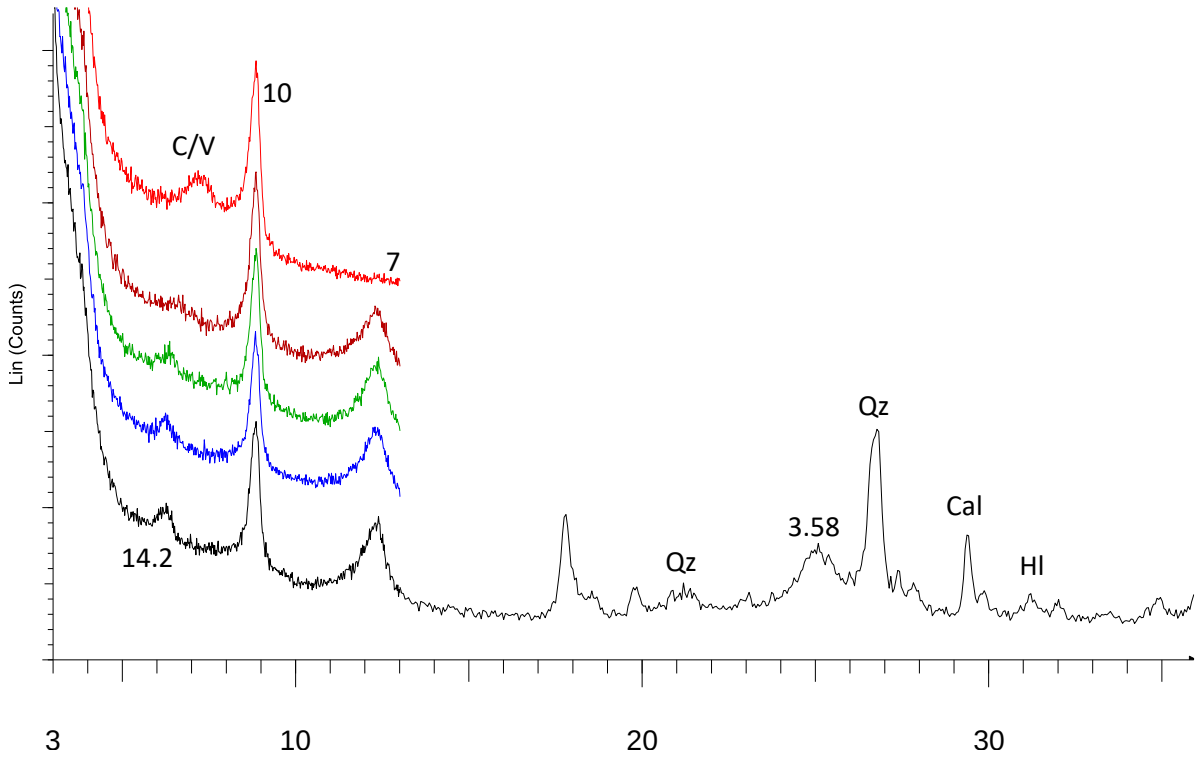
LU17 00204 006 (42178)



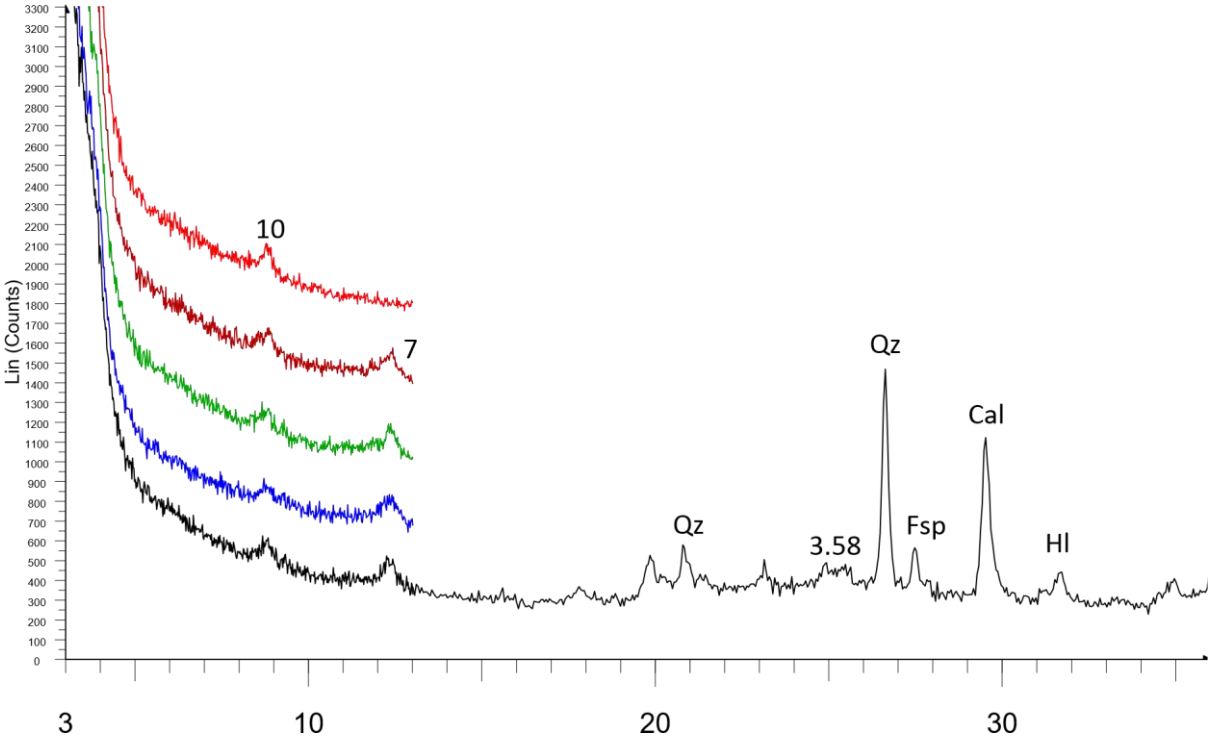
LU17 00204 007 (42202)



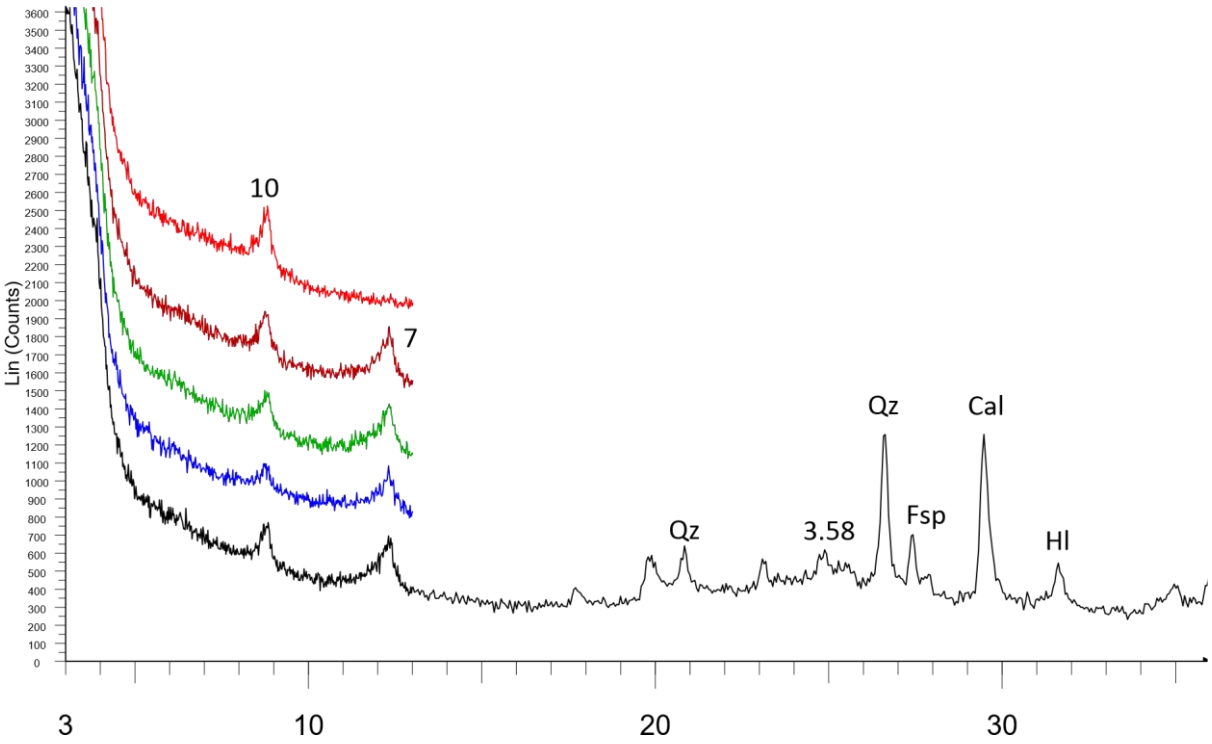
LU17 00204 008 (42315)



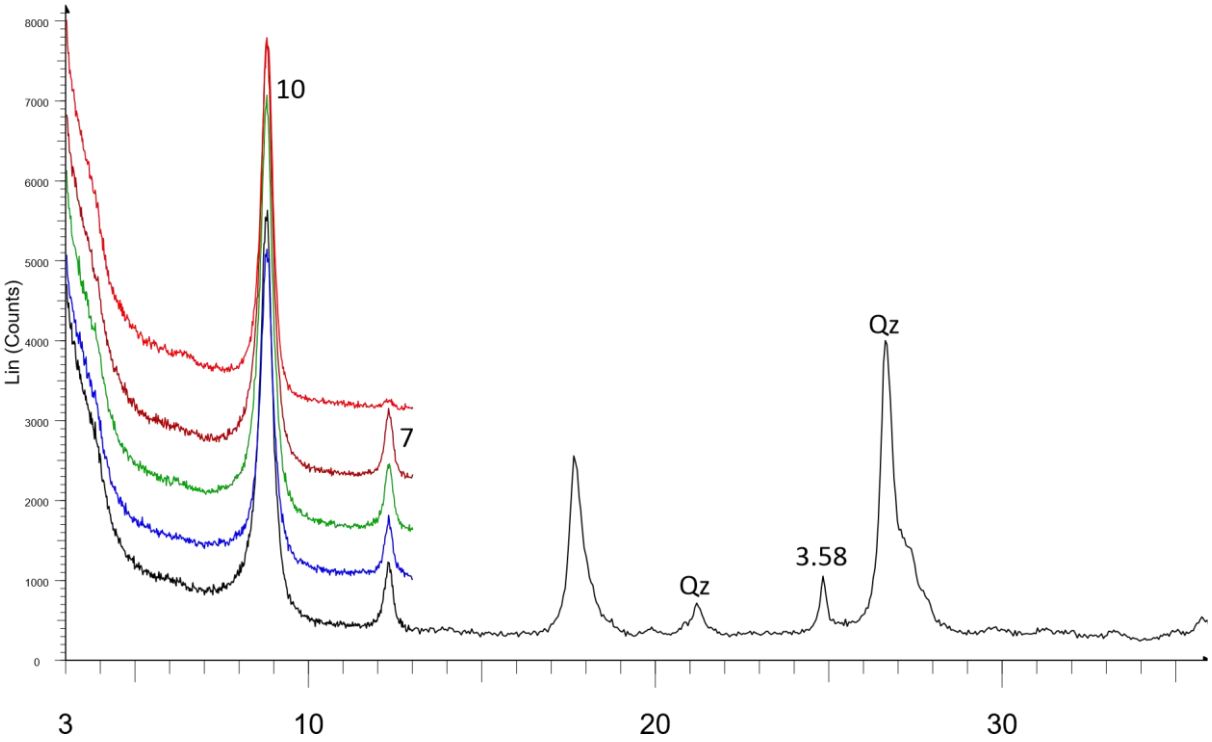
LU17 00204 009 (42383)



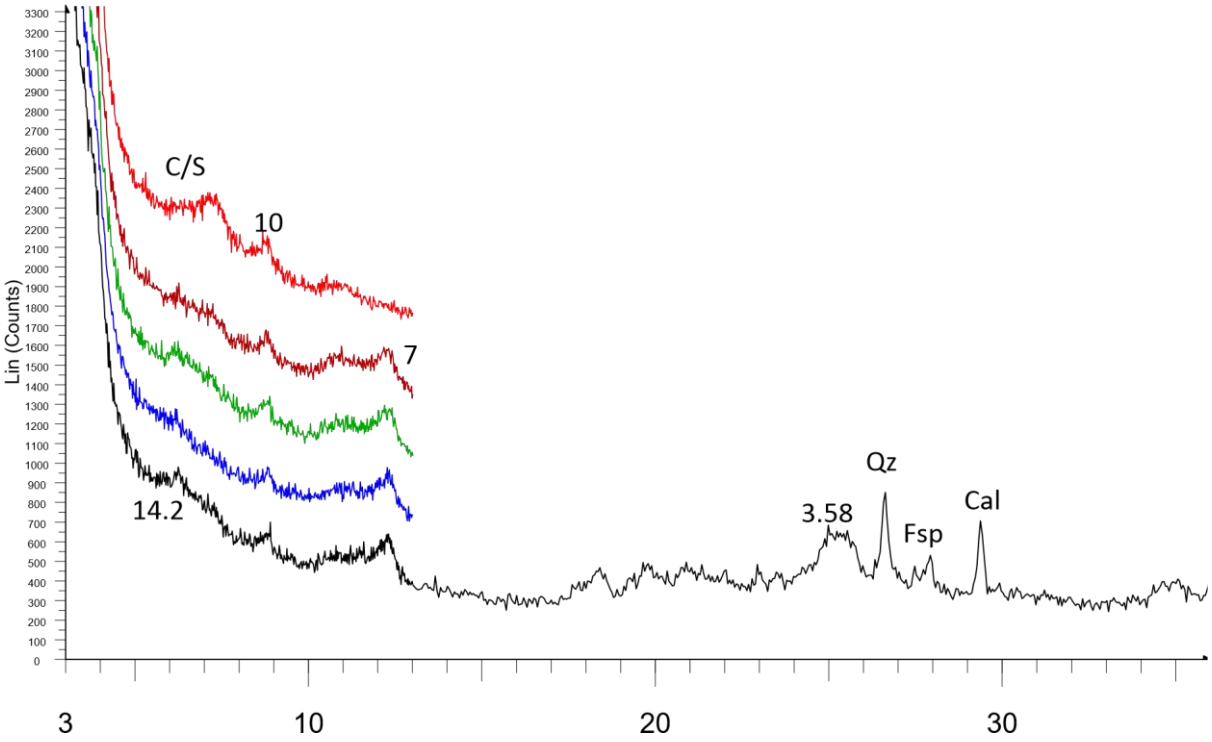
LU17 00204 010 (42412)



LU17 00204 011 (42428)

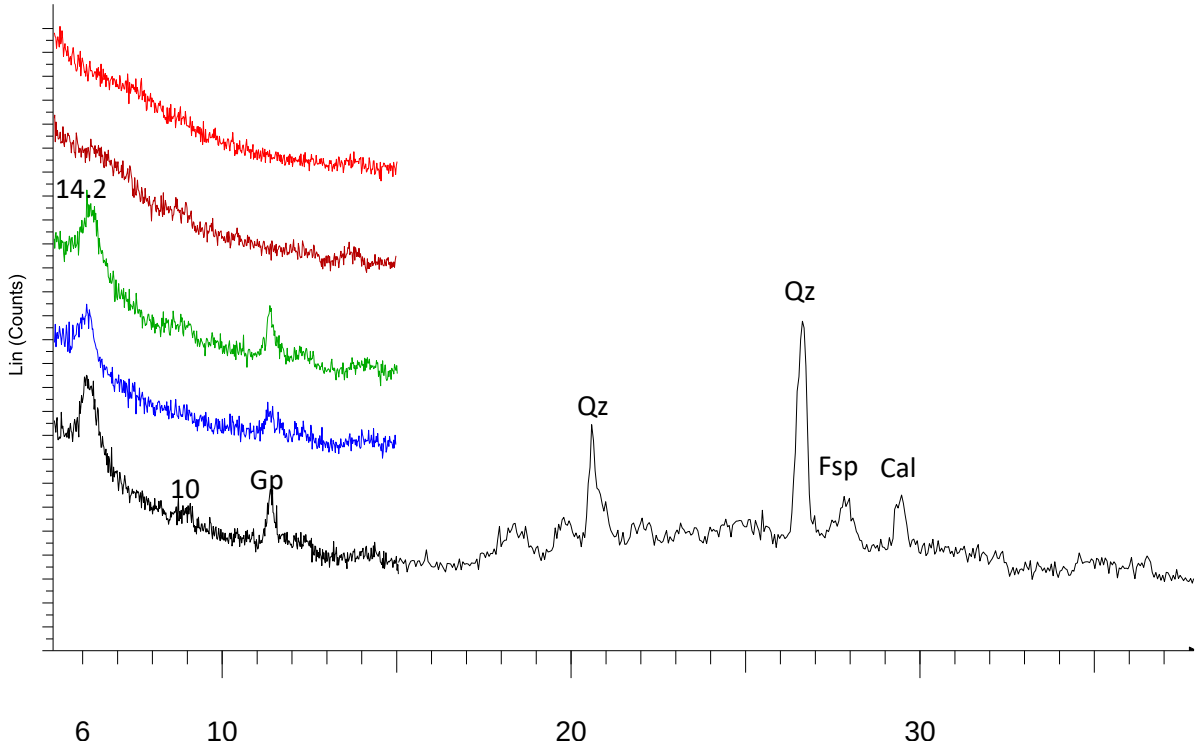


LU17 00204 012 (42431)

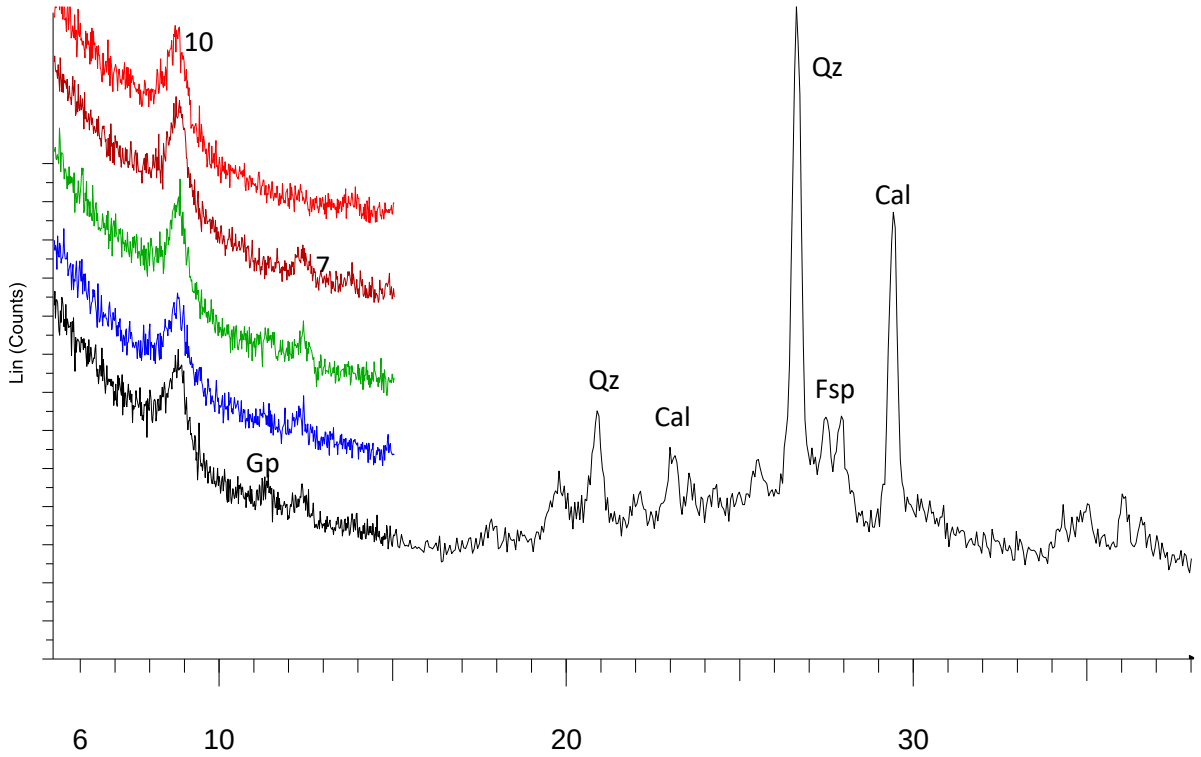


Annex 18. RX Diffractograms from Sweden

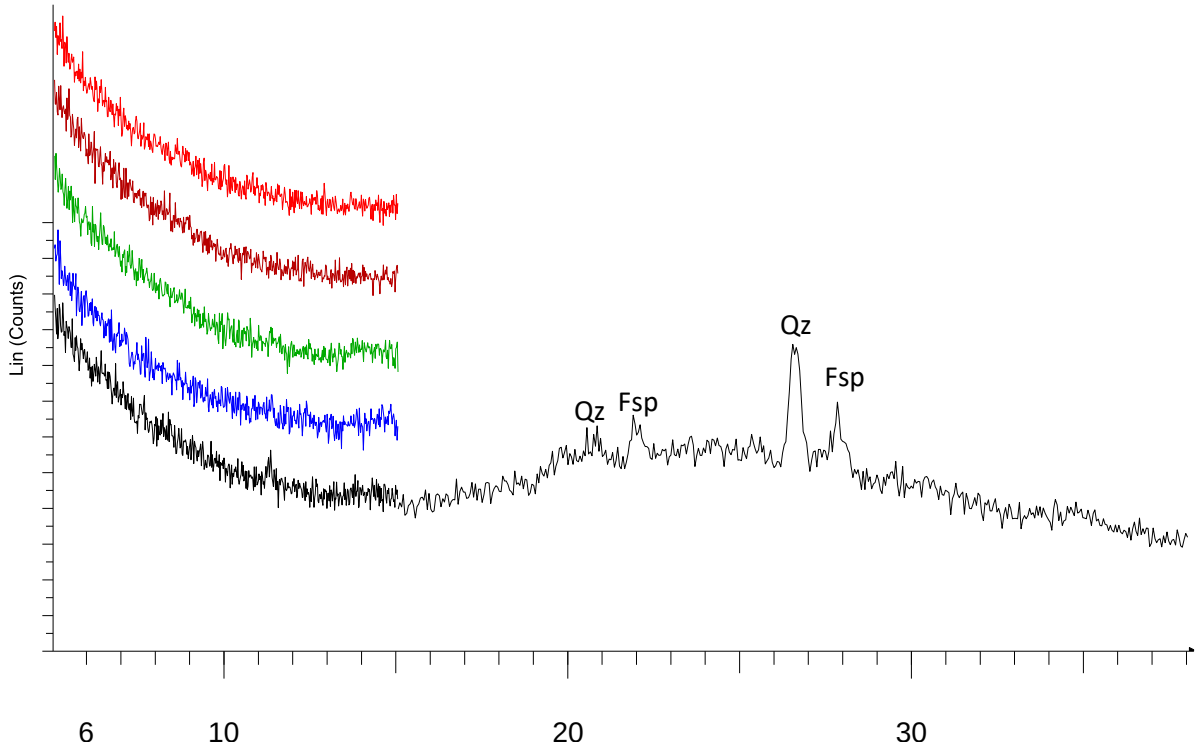
LU17 00205 001 (60023)



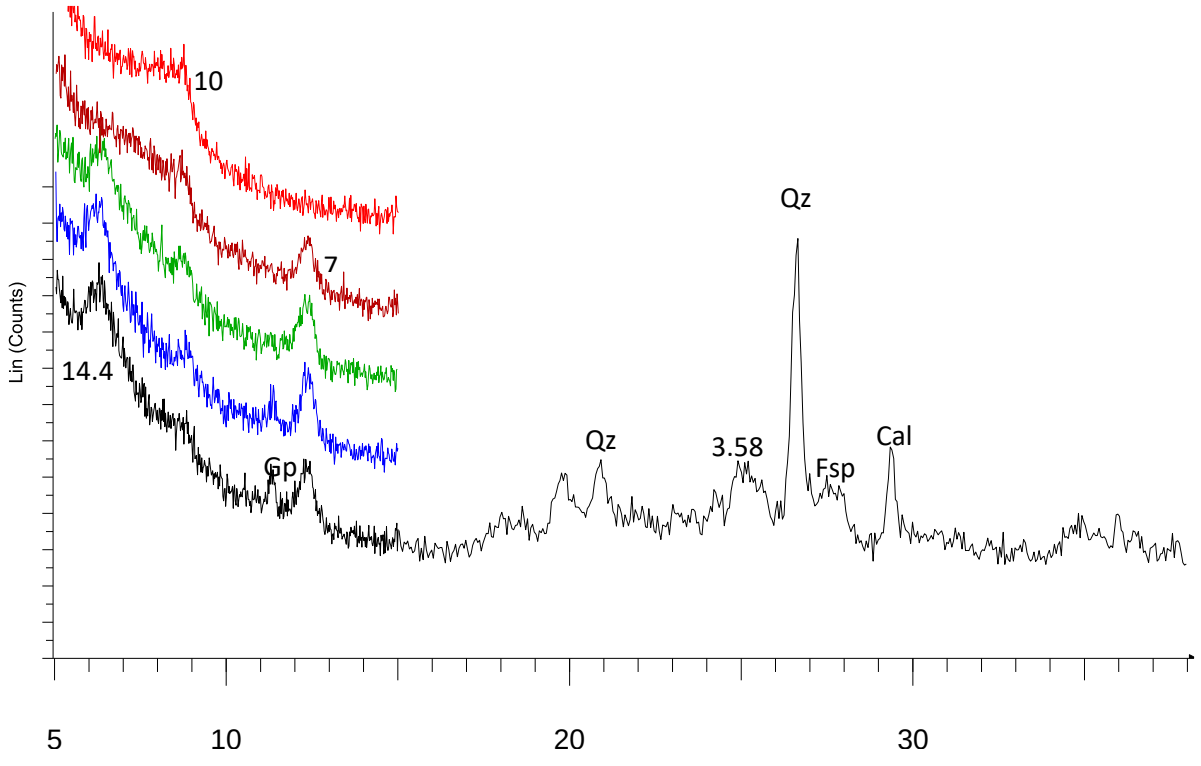
LU17 00205 002 (60434)



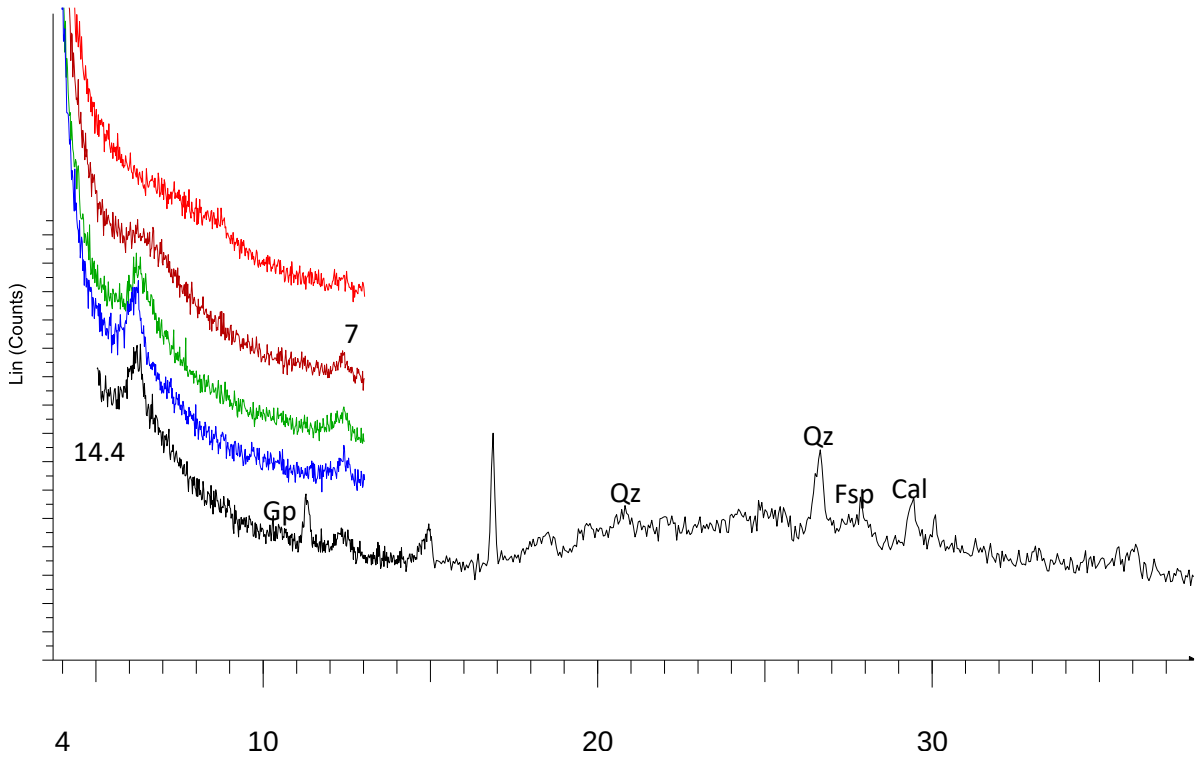
LU17 00205 003 (60643)



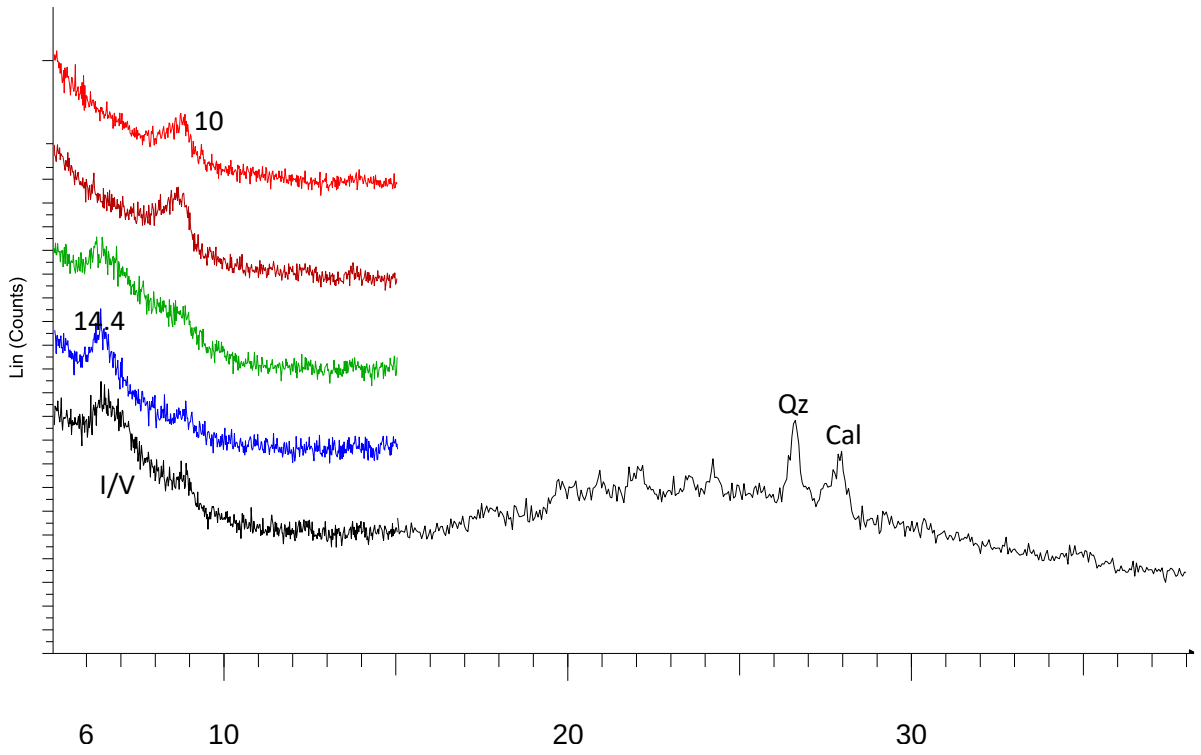
LU17 00205 004 (60856)



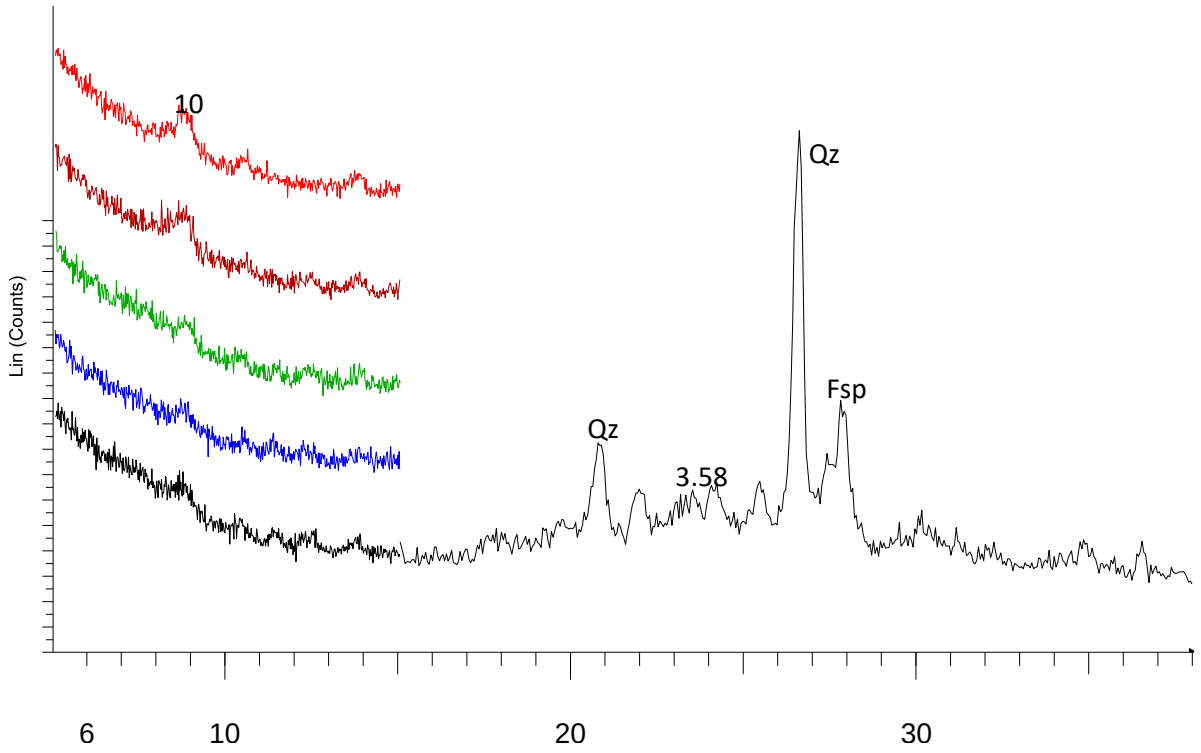
LU17 00205 005 (60974)



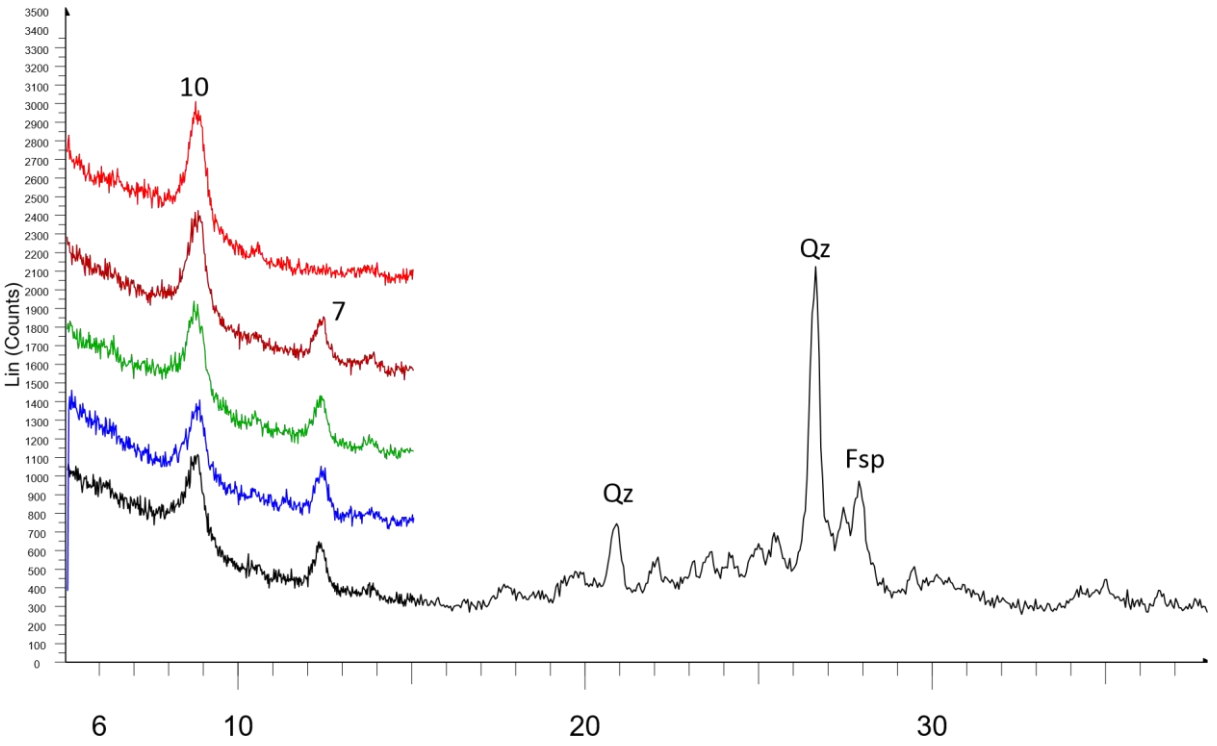
LU17 00205 006 (60975)



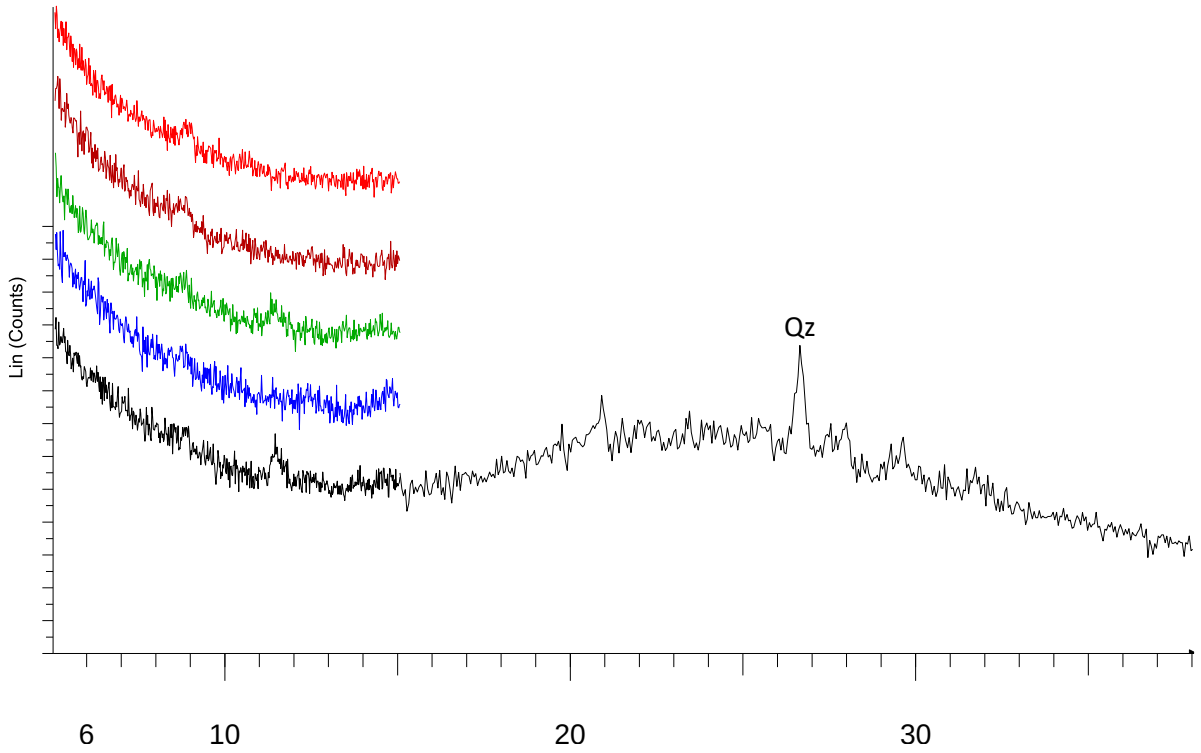
LU17 00205 007 (61077)



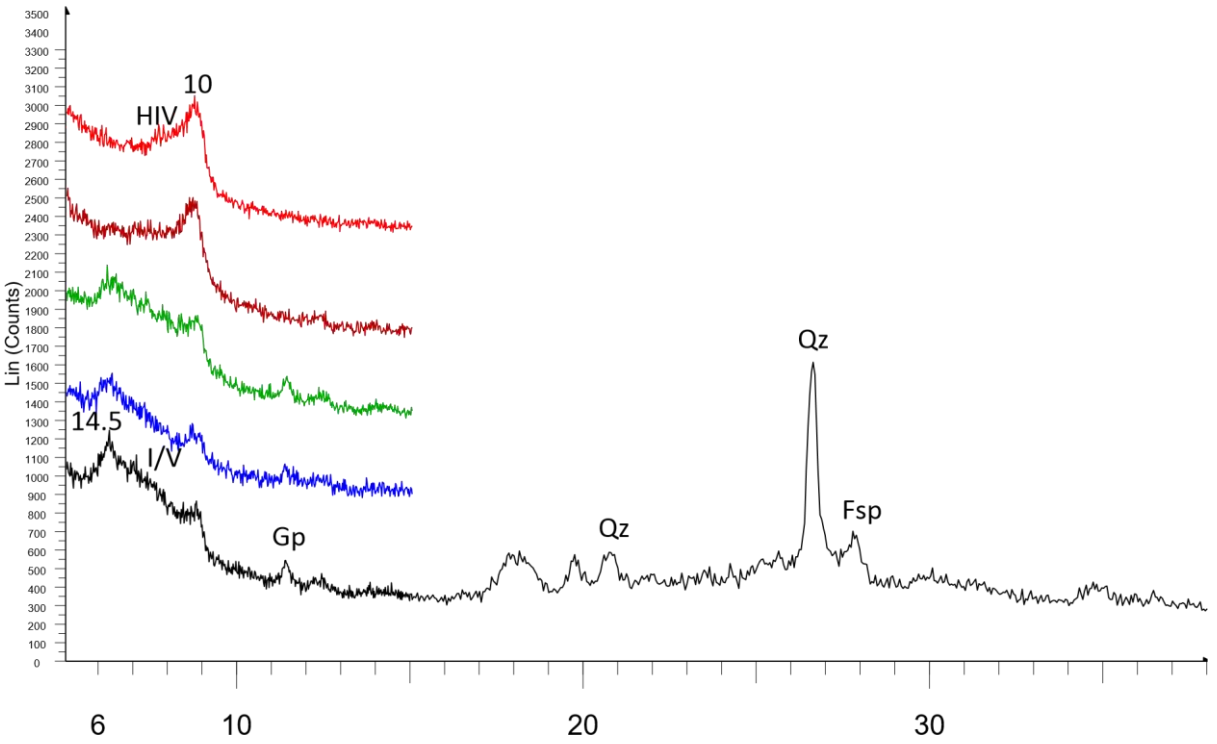
LU17 00205 008 (61411)



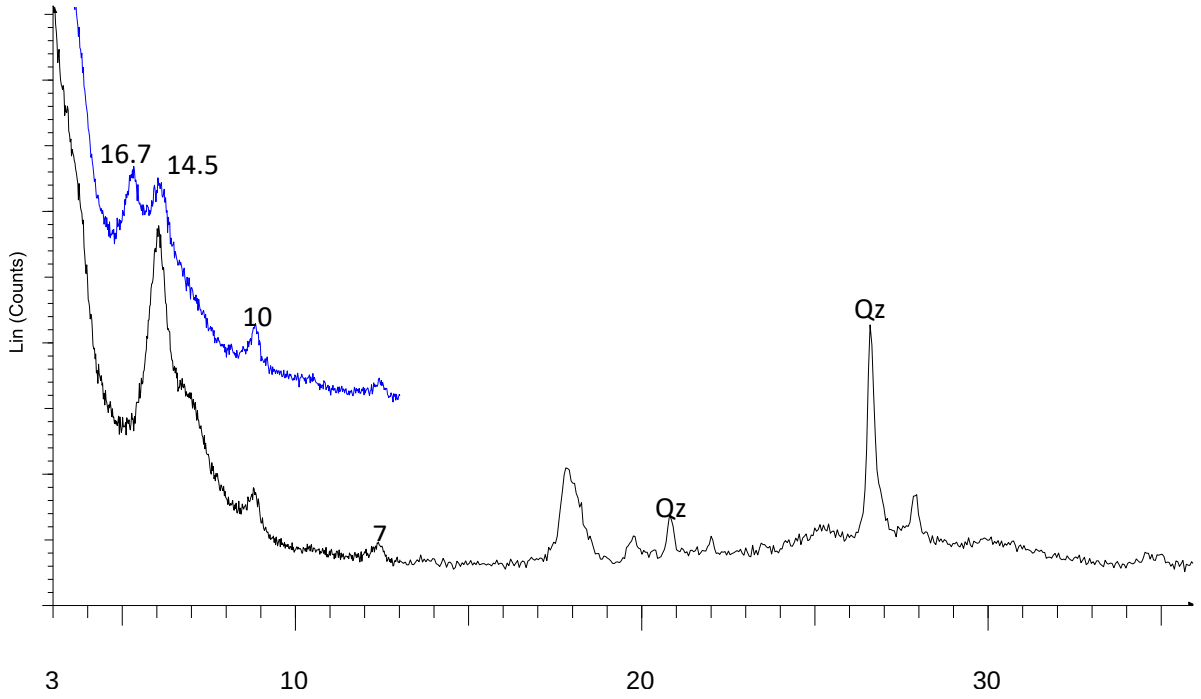
LU17 00205 009 (61627)



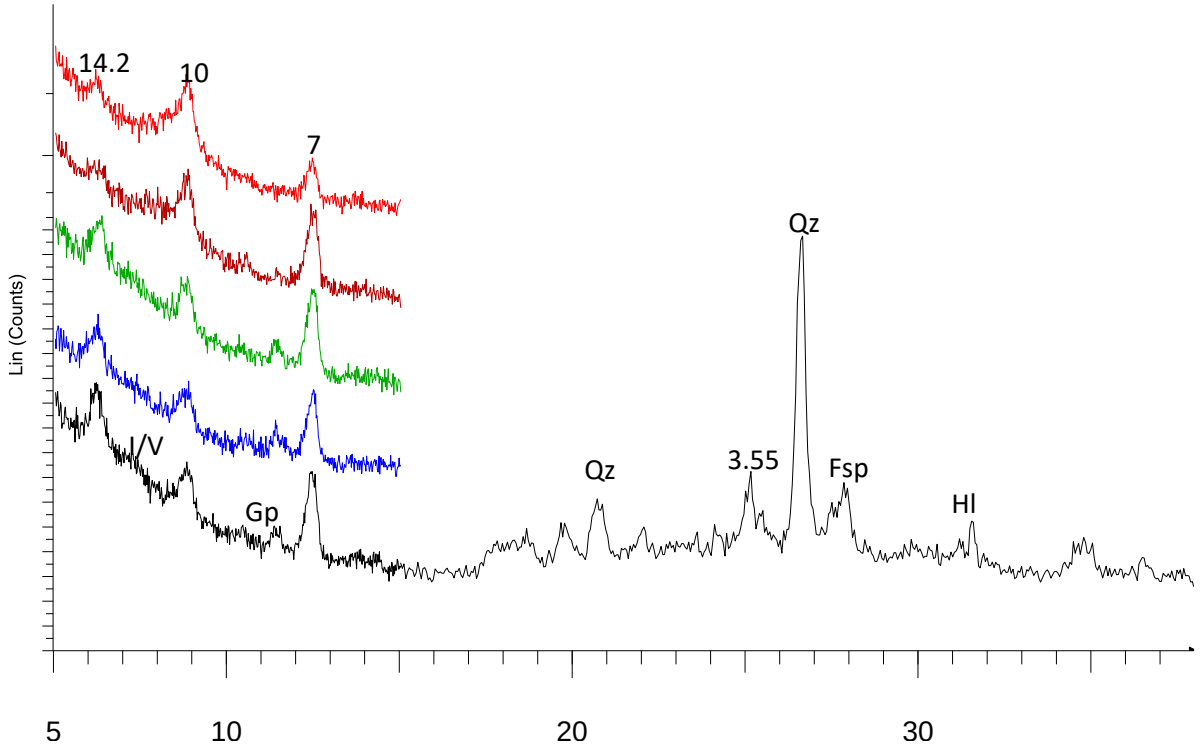
LU17 00205 010 (61695)



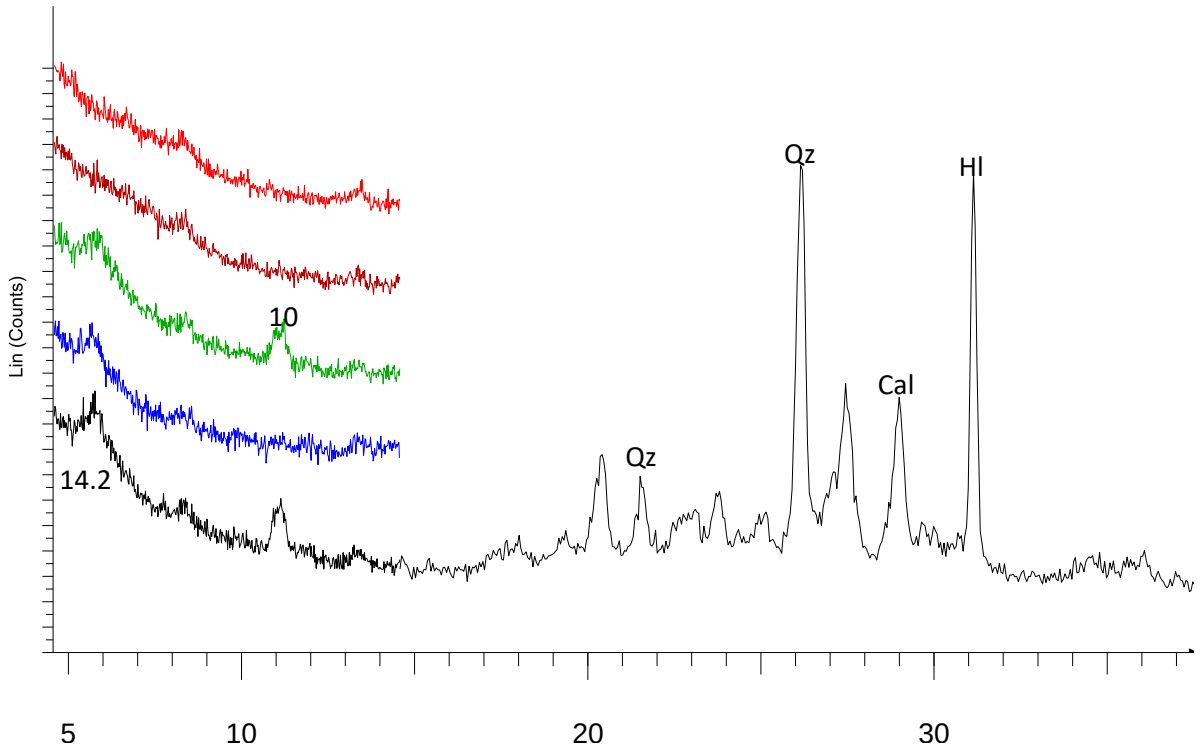
LU 17 00205 010 citrate (61695)



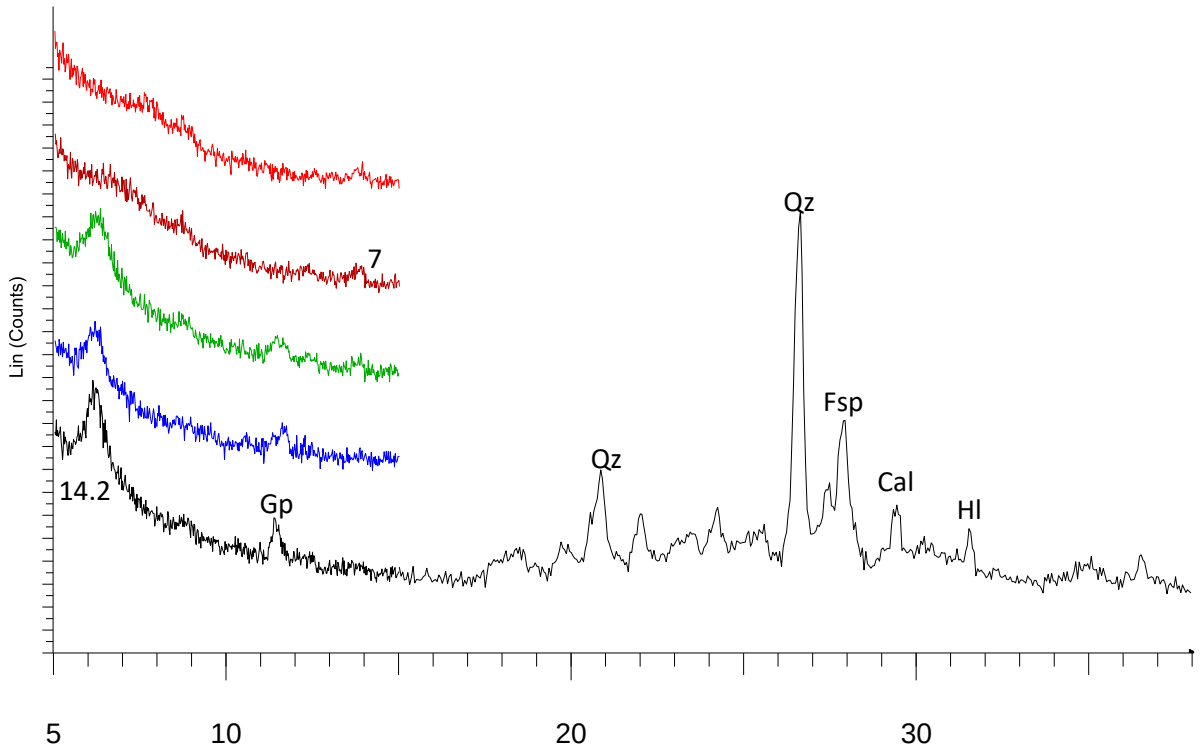
LU17 00205 011 (61713)



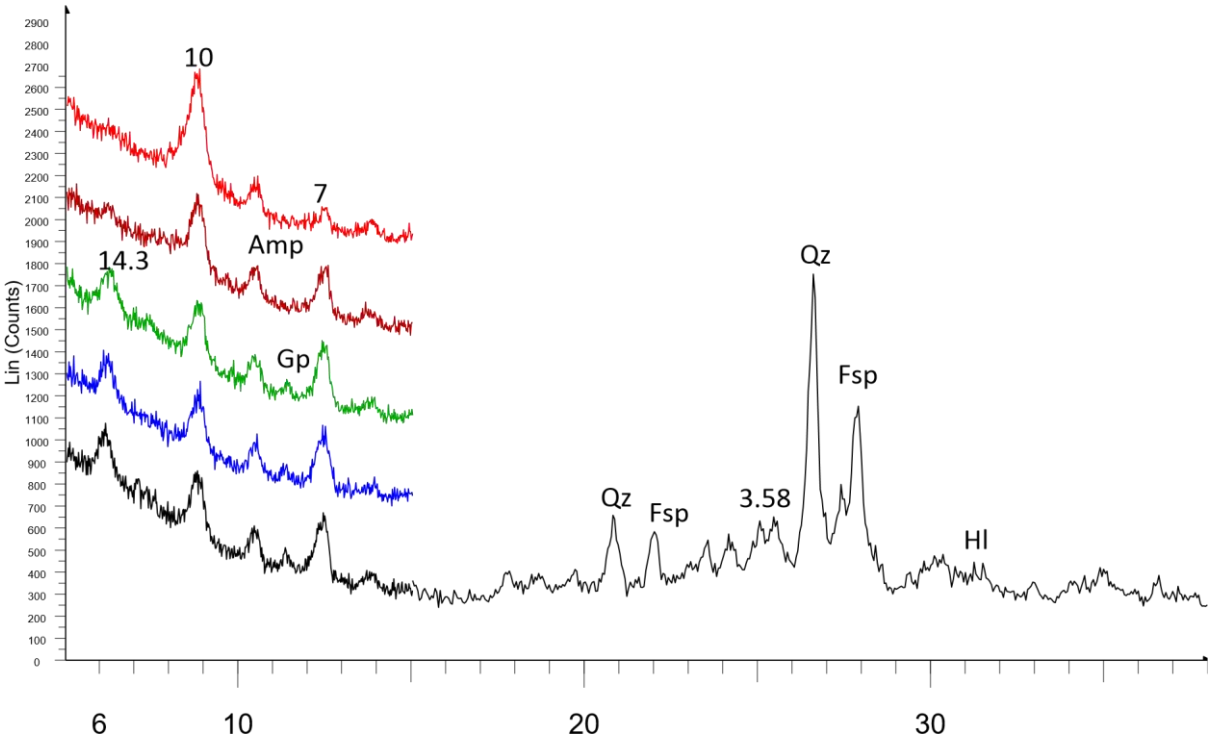
LU17 00205 012 (61786)



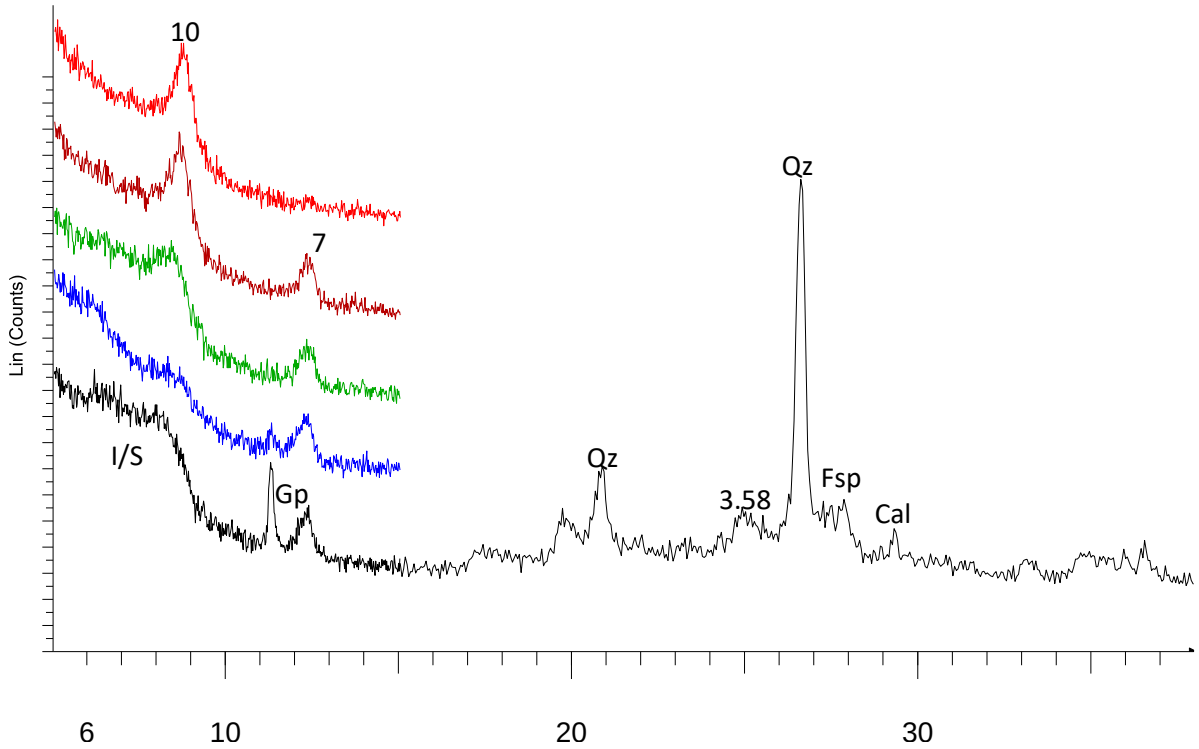
LU17 00205 013 (61800)



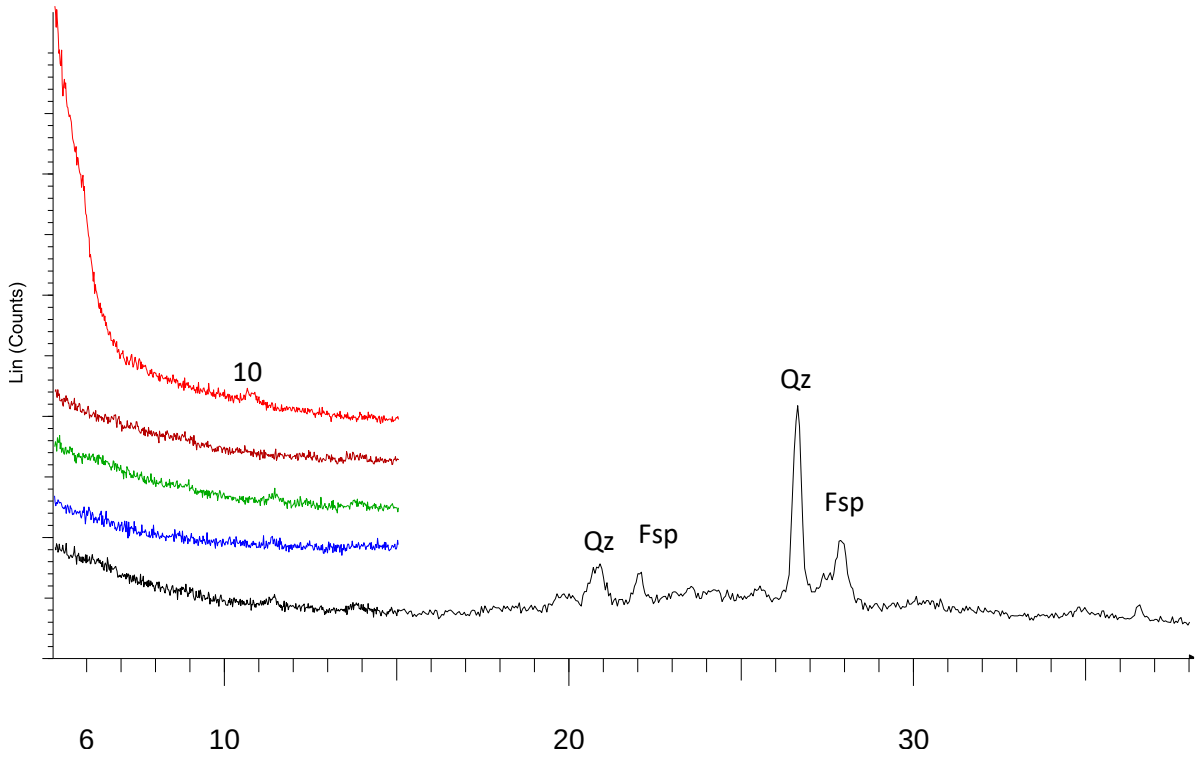
LU17 00205 014 (61854)



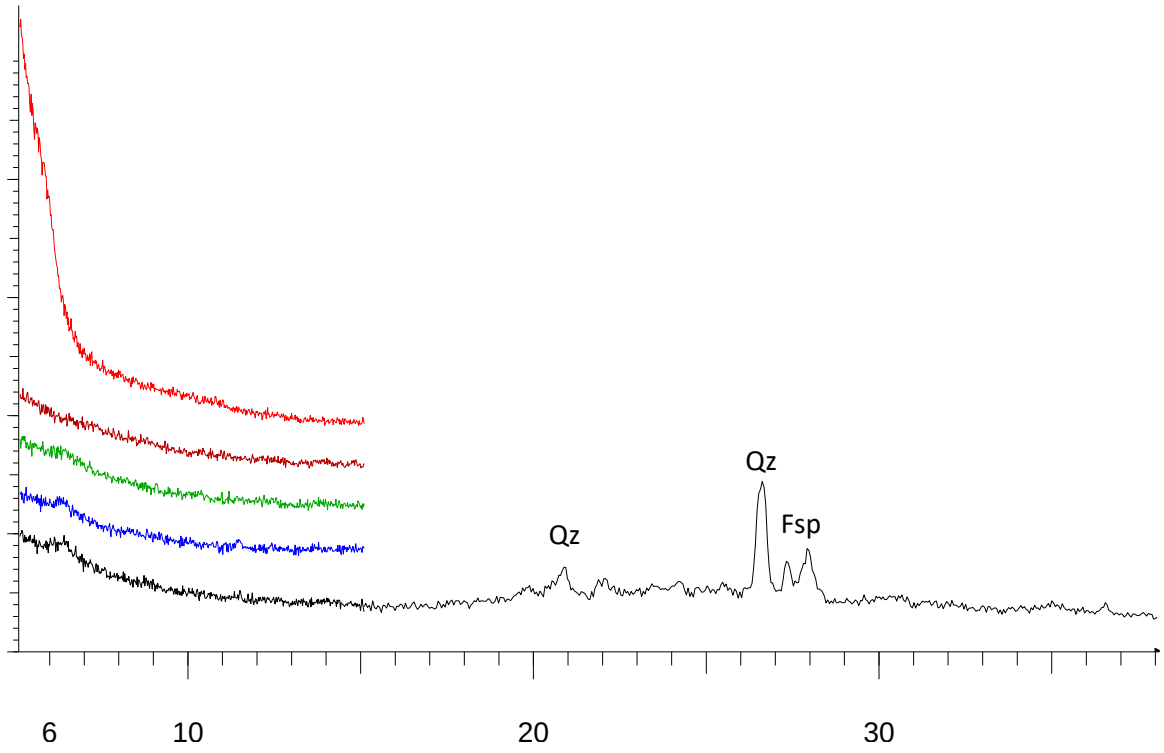
LU17 00205 015 (62101)



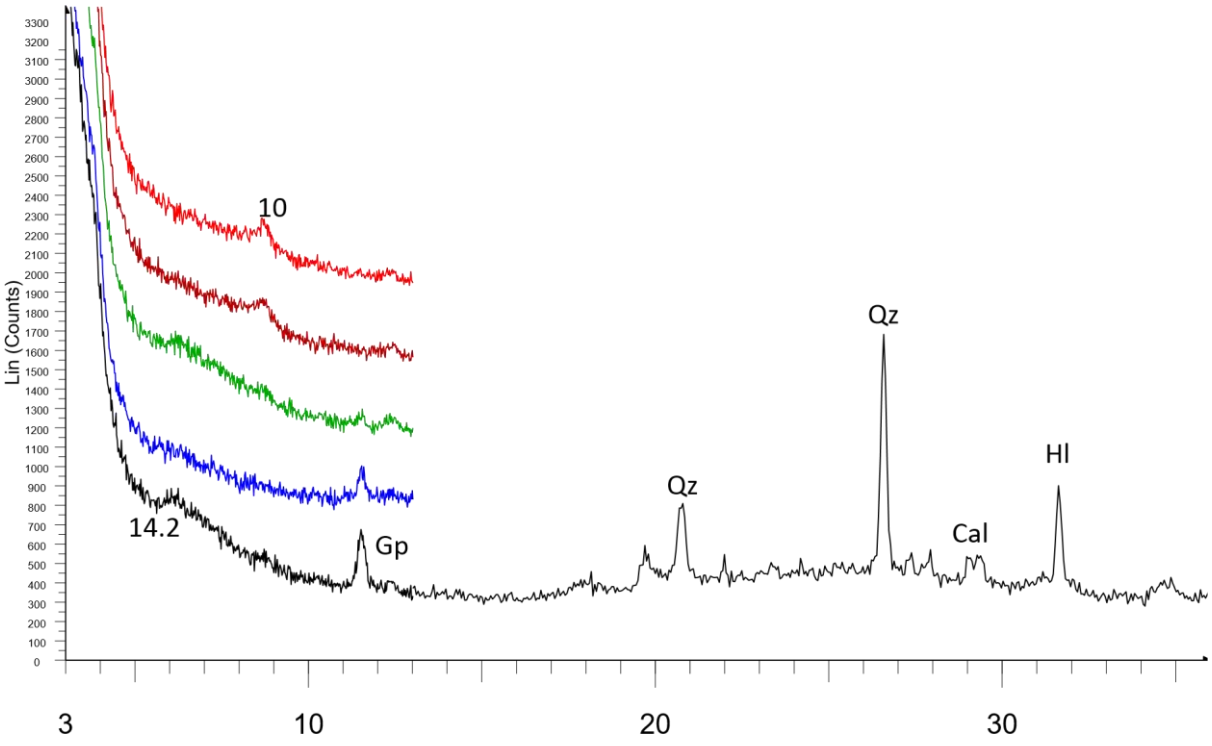
LU17 00205 016 (62227)



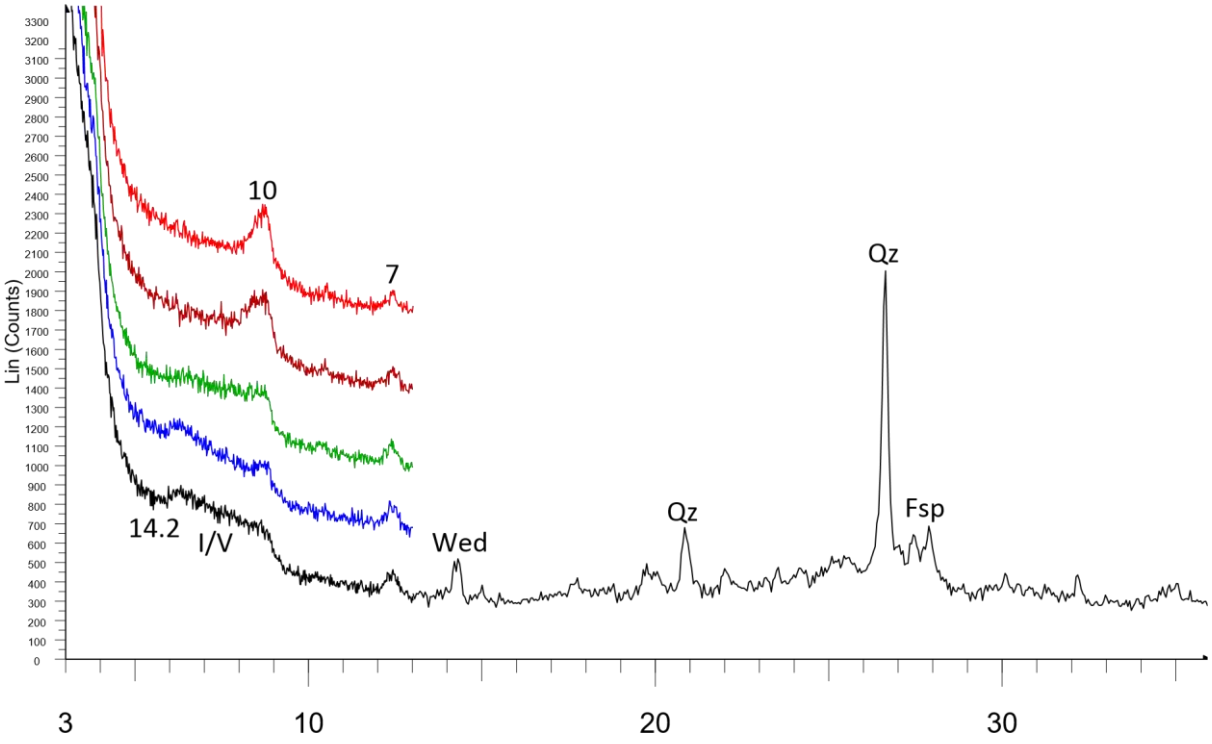
LU17 00205 017 (62332)



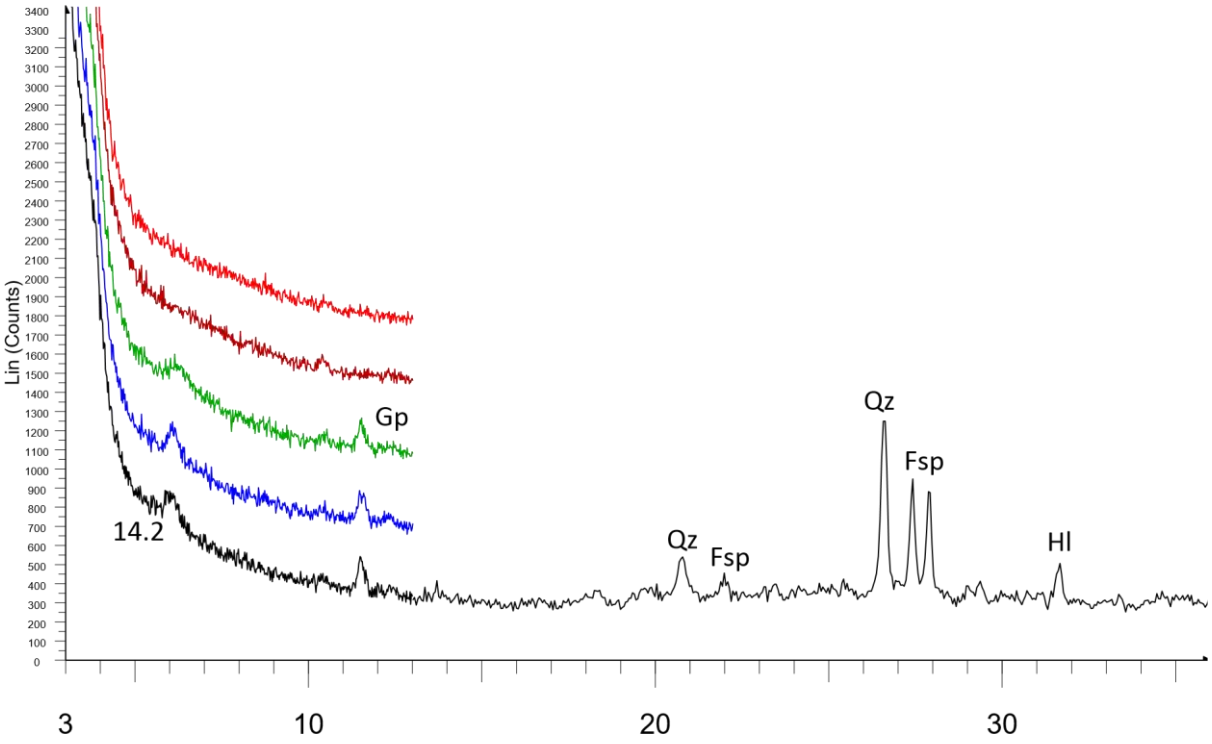
LU17 00205 018 (61374)



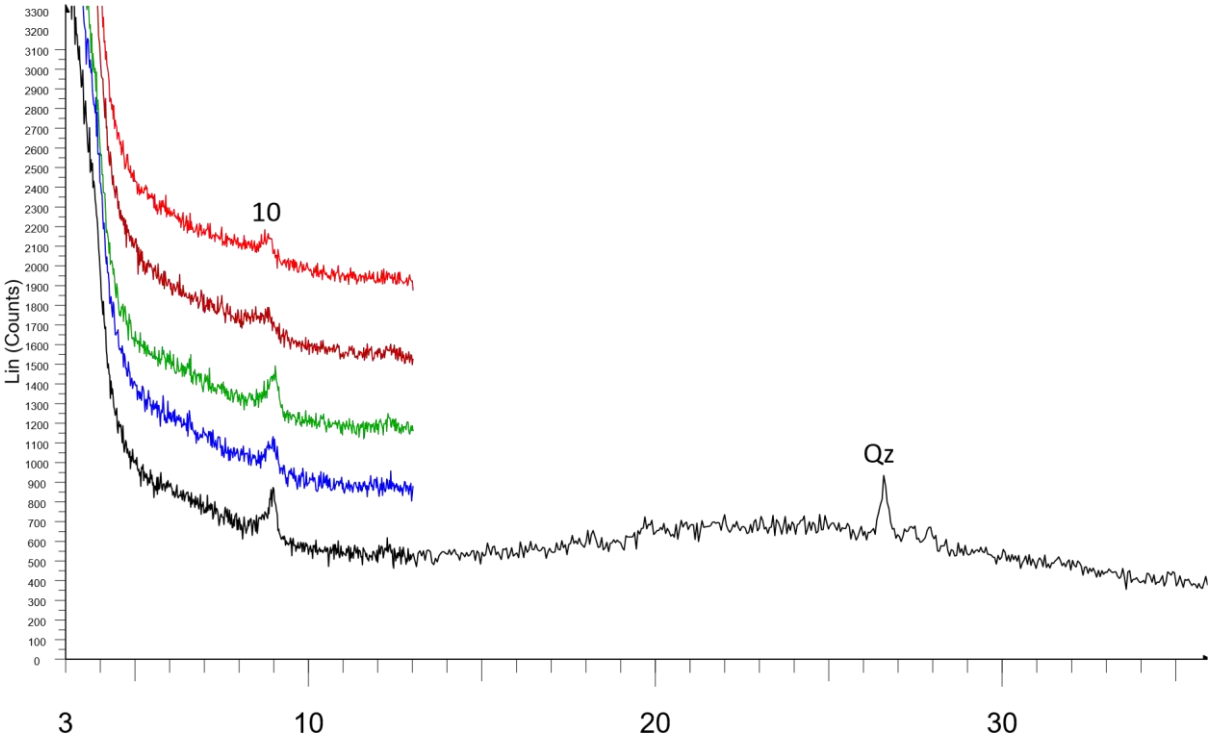
LU17 00205 019 (60047)



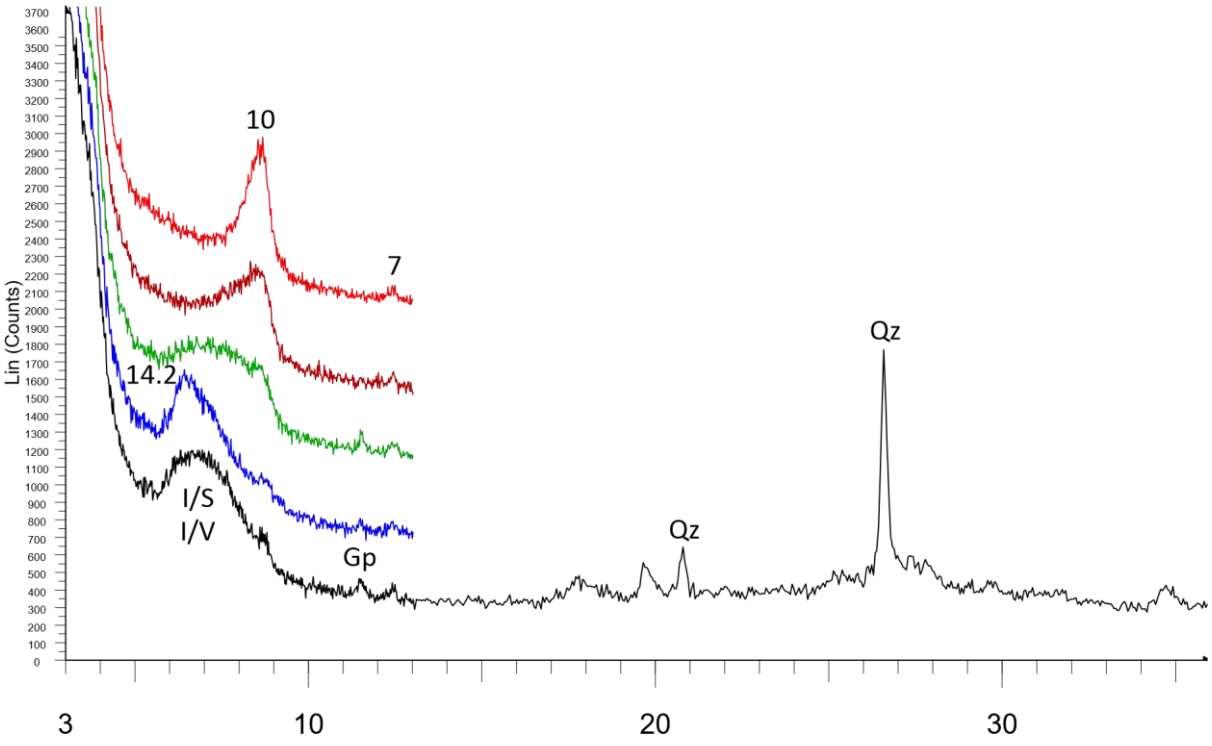
LU17 00205 020 (60543)



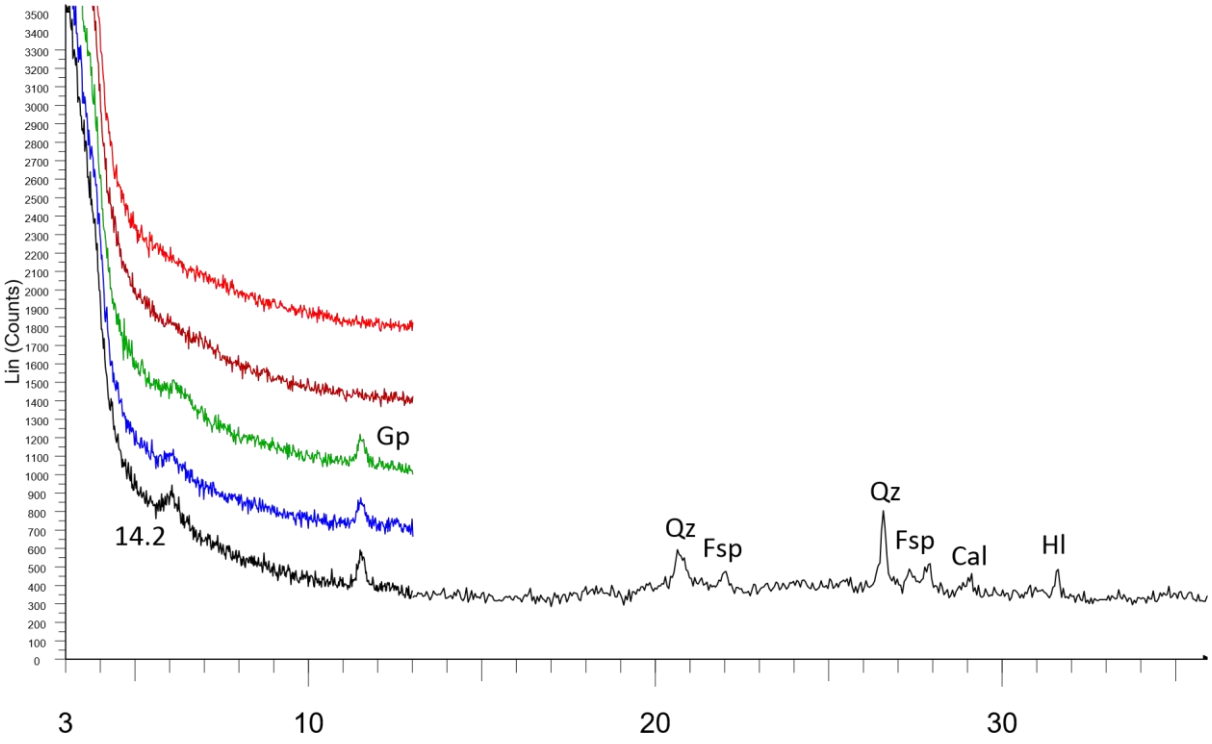
LU17 00205 021 (60631)



LU17 00205 022 (61297)

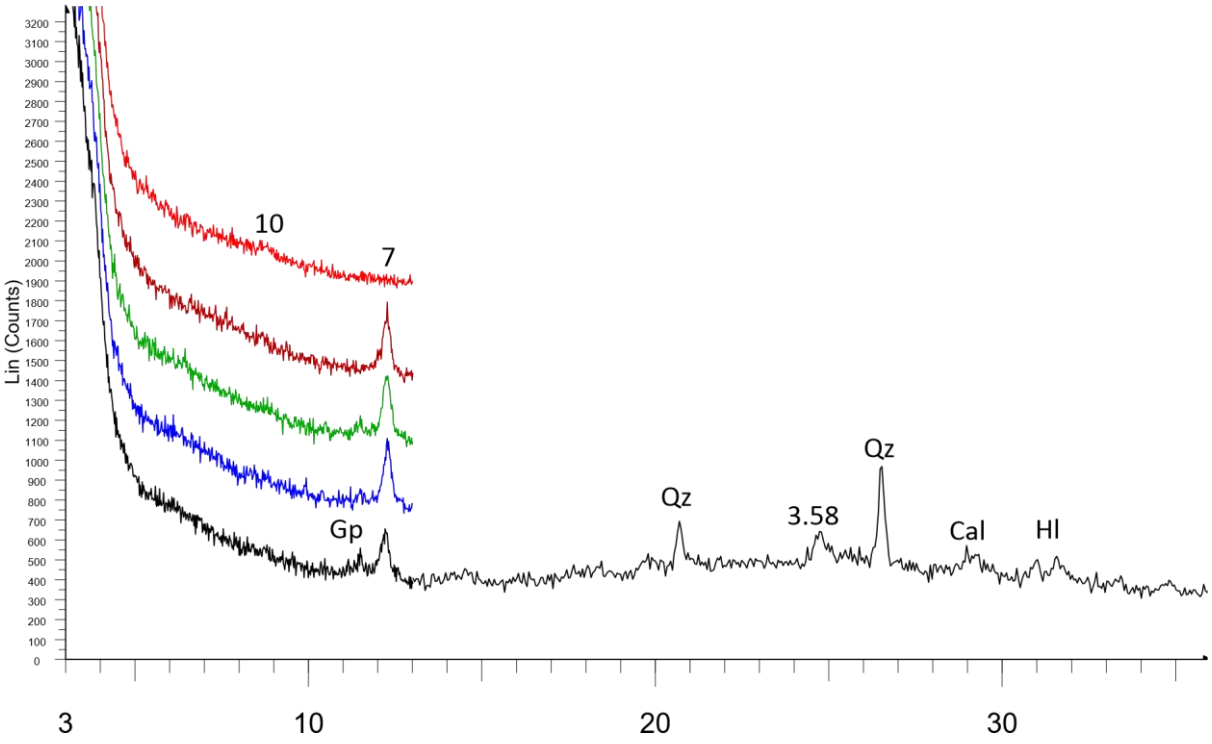


LU17 00205 023 (61883)

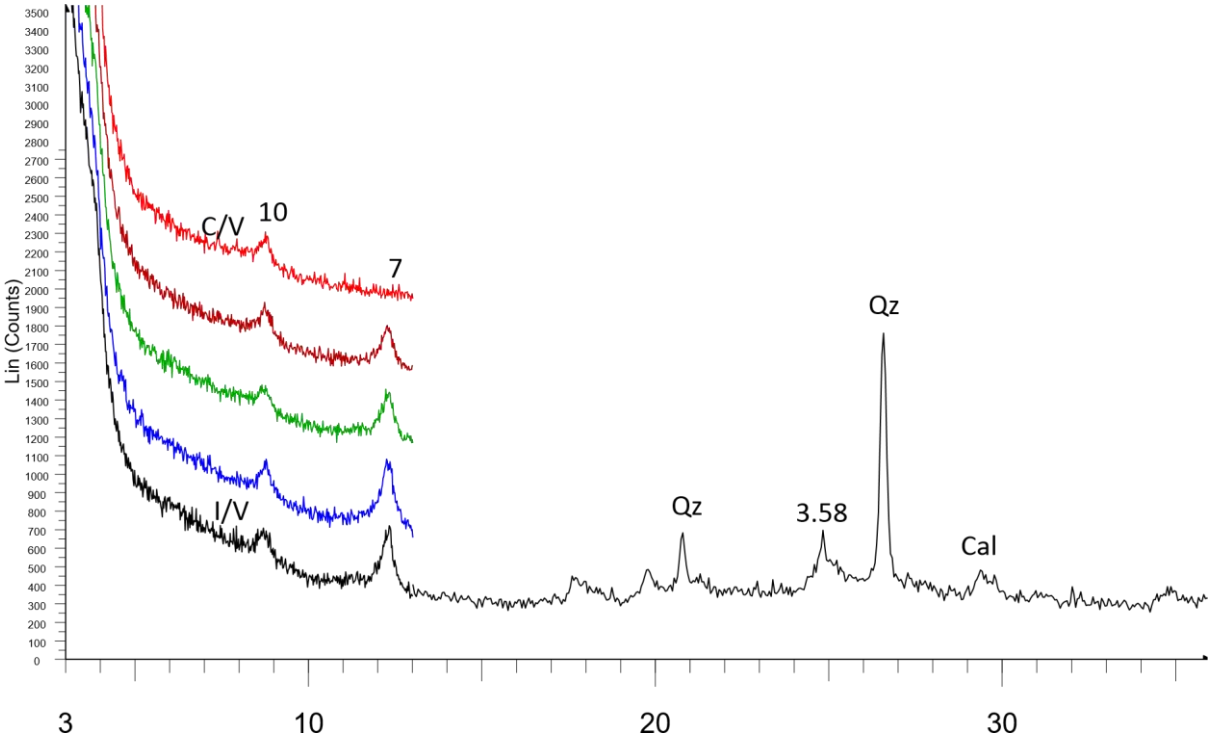


Annex 19. RX Diffractograms from United Kingdom

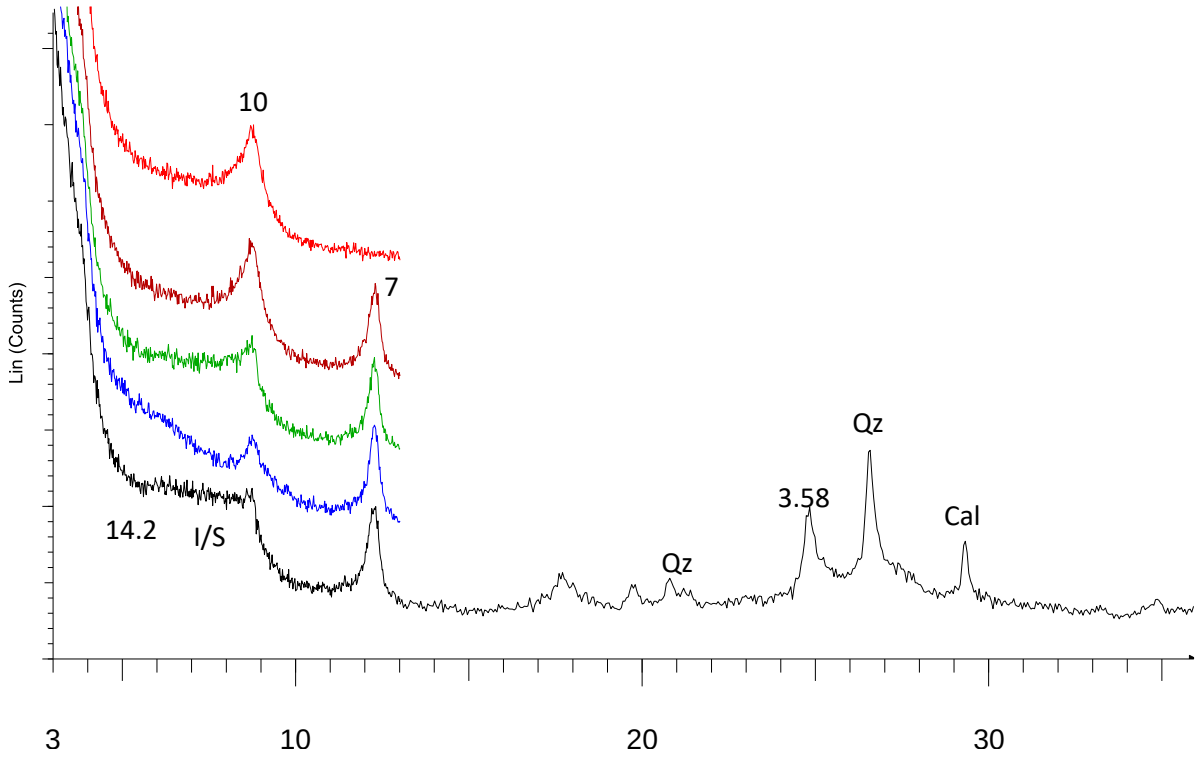
LU17 00206 001 (54074)



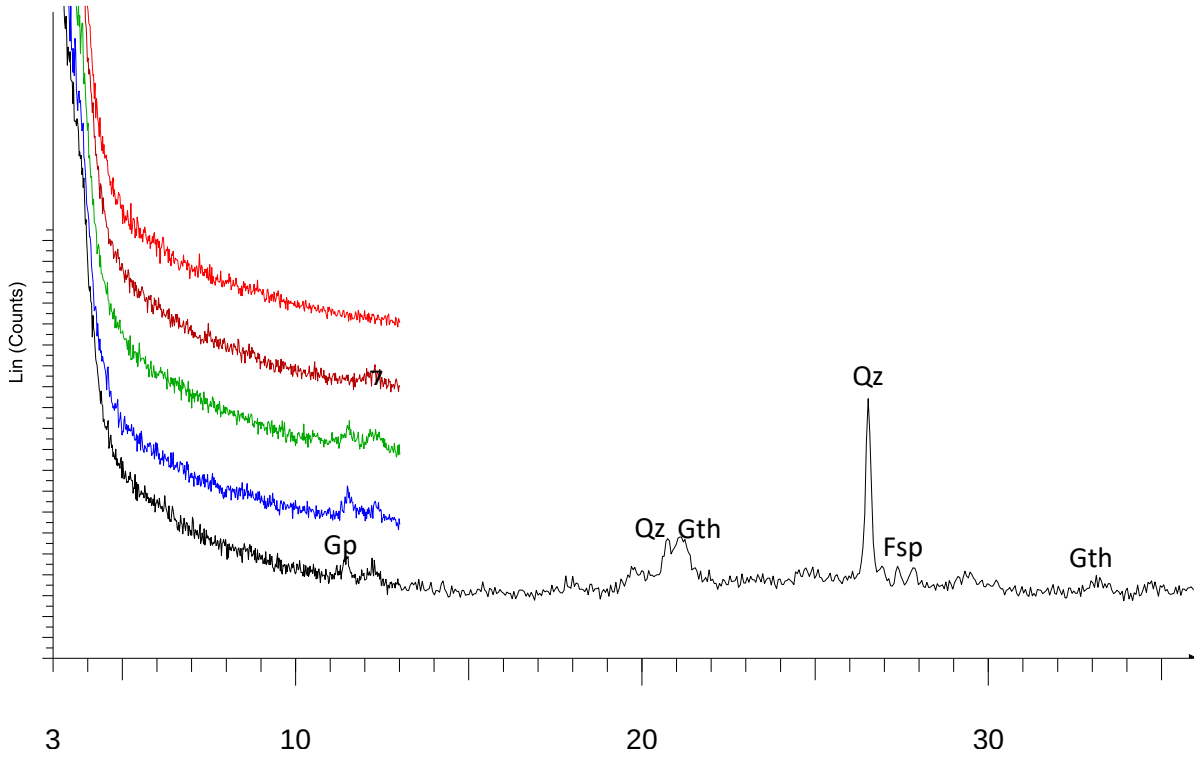
LU17 00206 002 (54142)



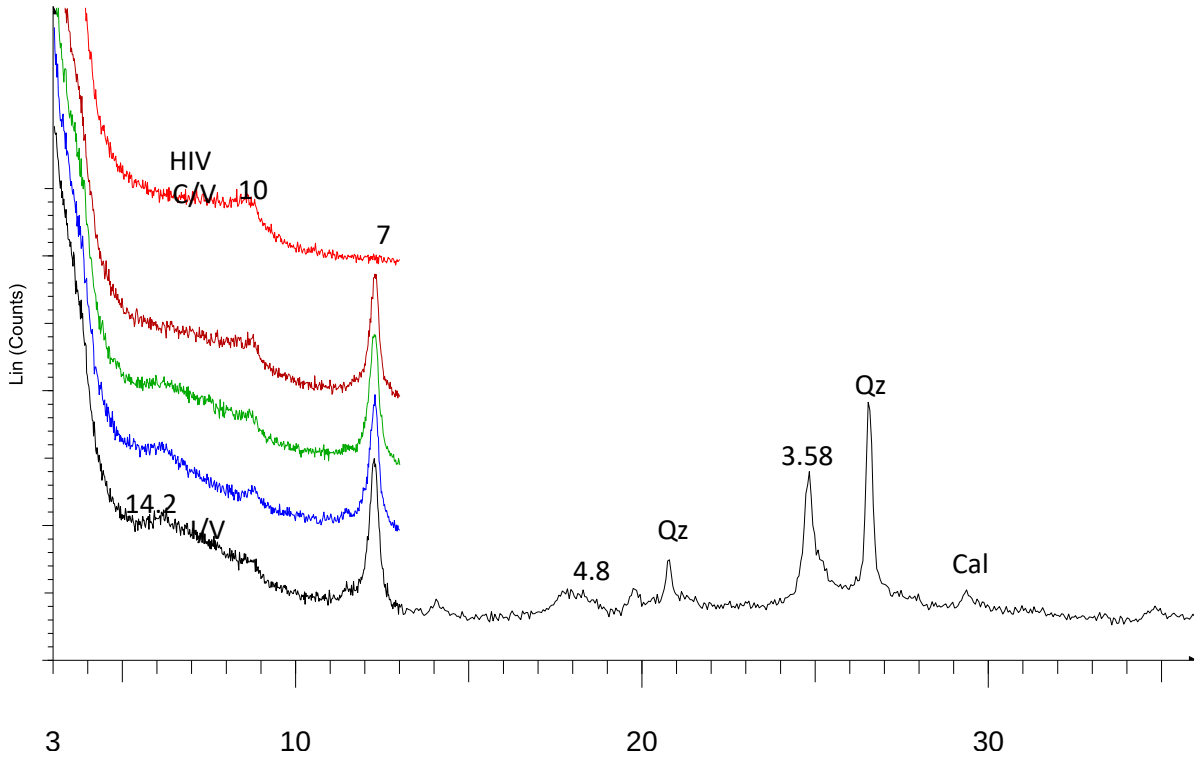
LU17 00206 003 (54162)



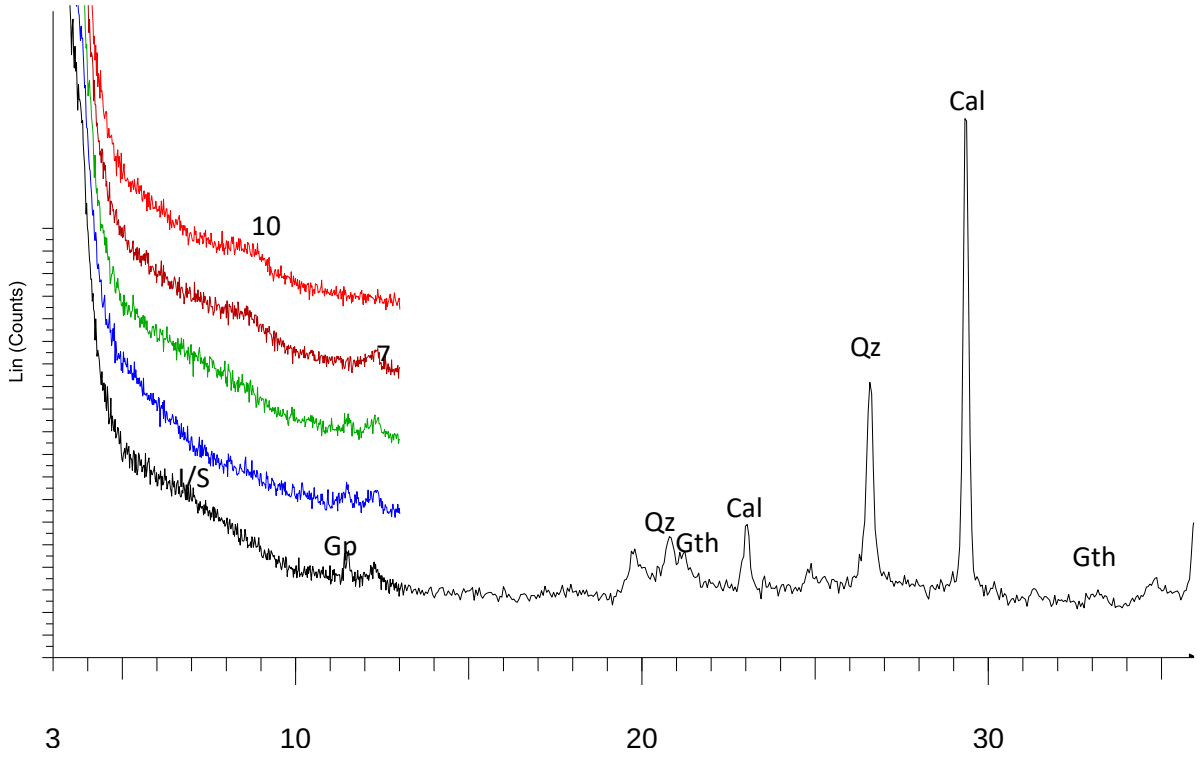
LU17 00206 004 (54179)



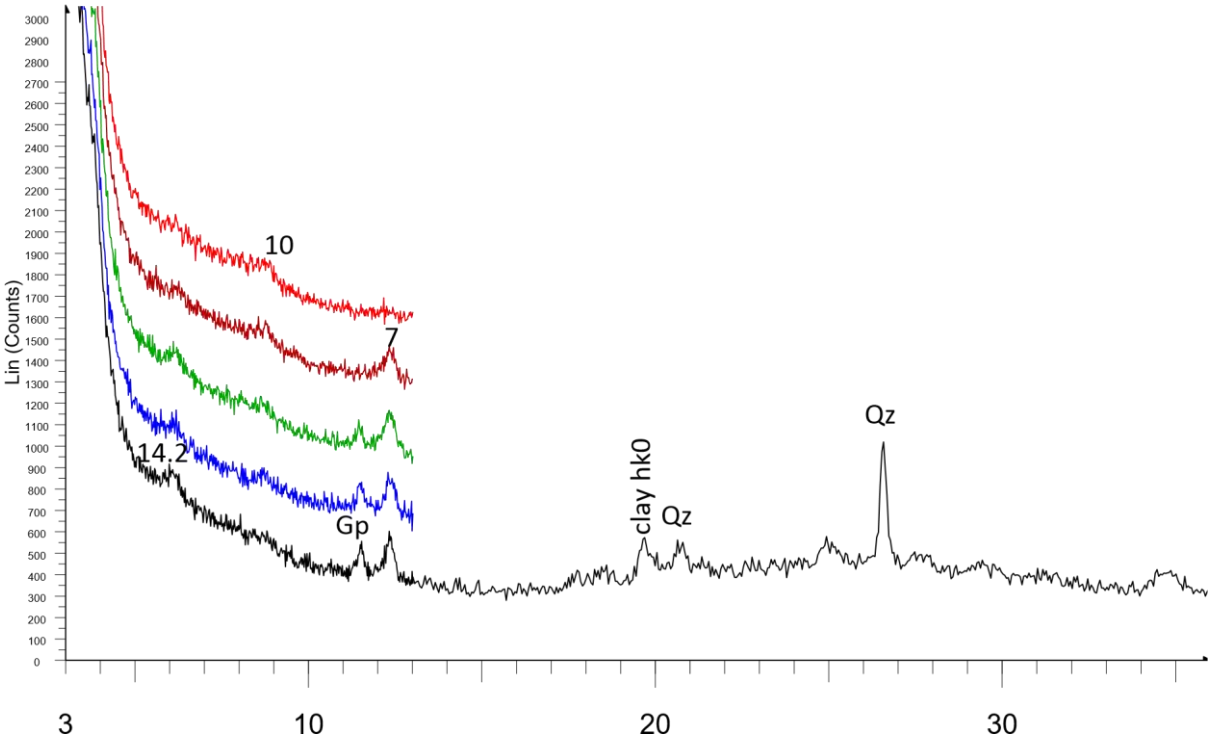
LU17 00206 005 (54180)



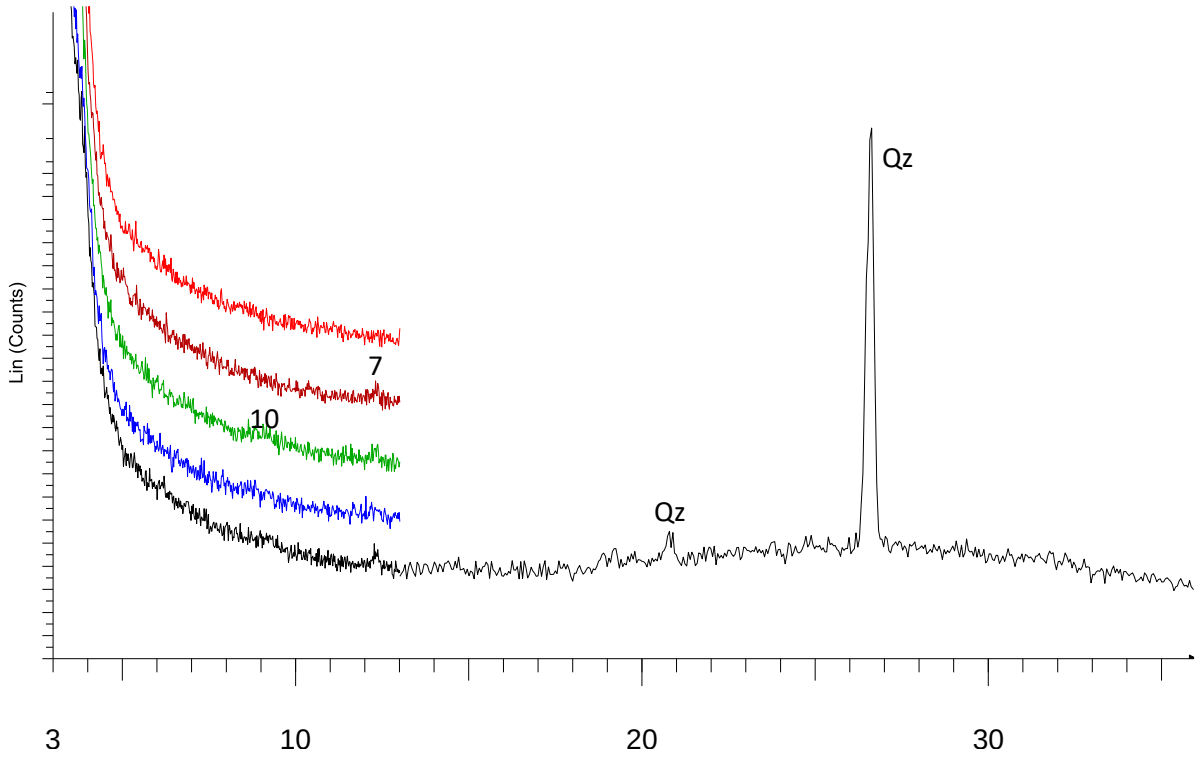
LU17 00206 006 (54181)



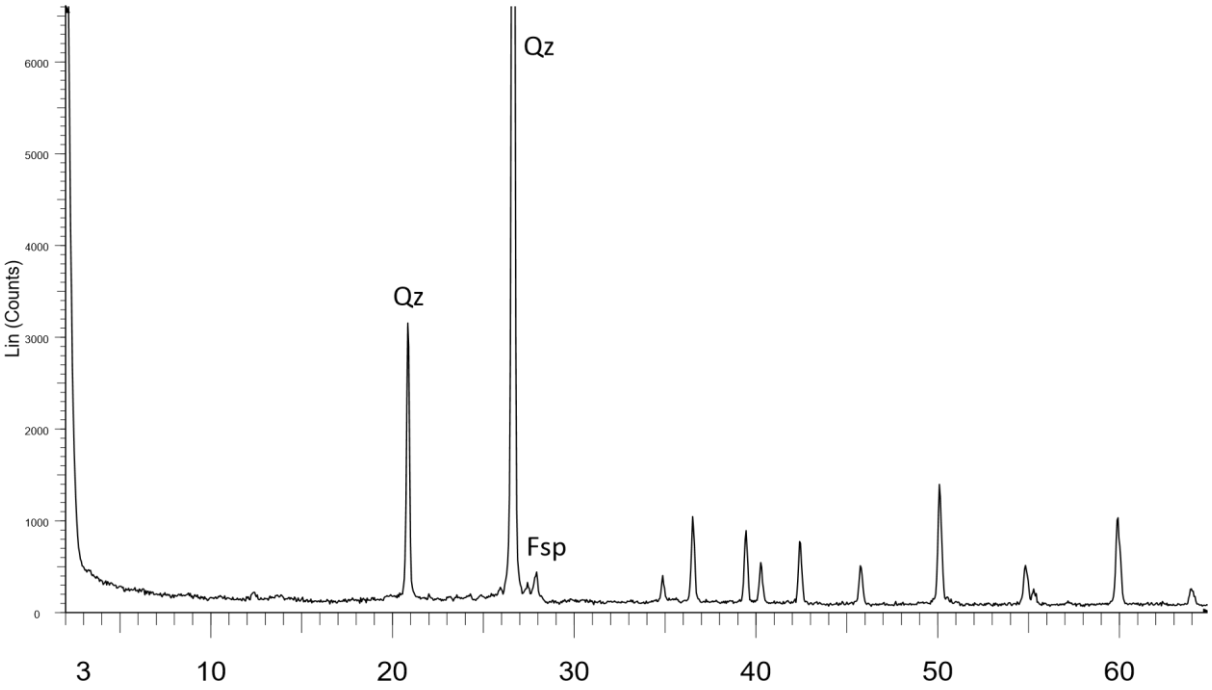
LU17 00206 007 (54215)



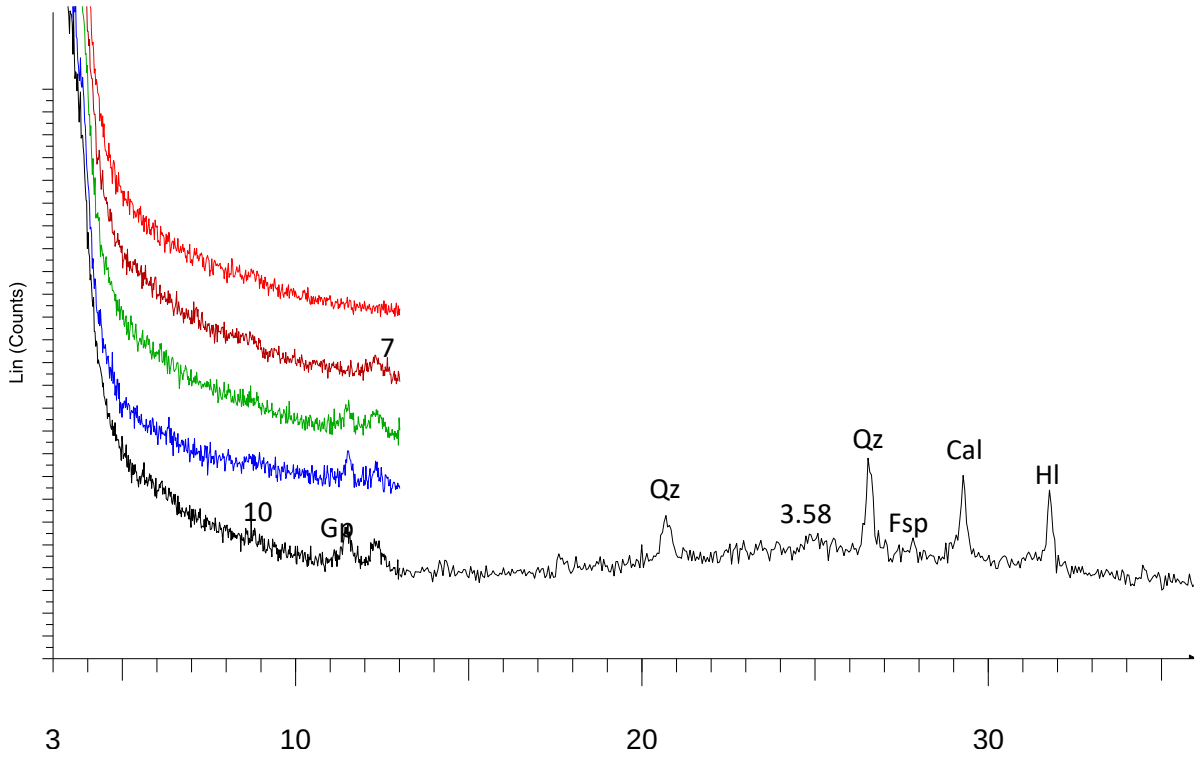
LU17 00206 008 (54263)



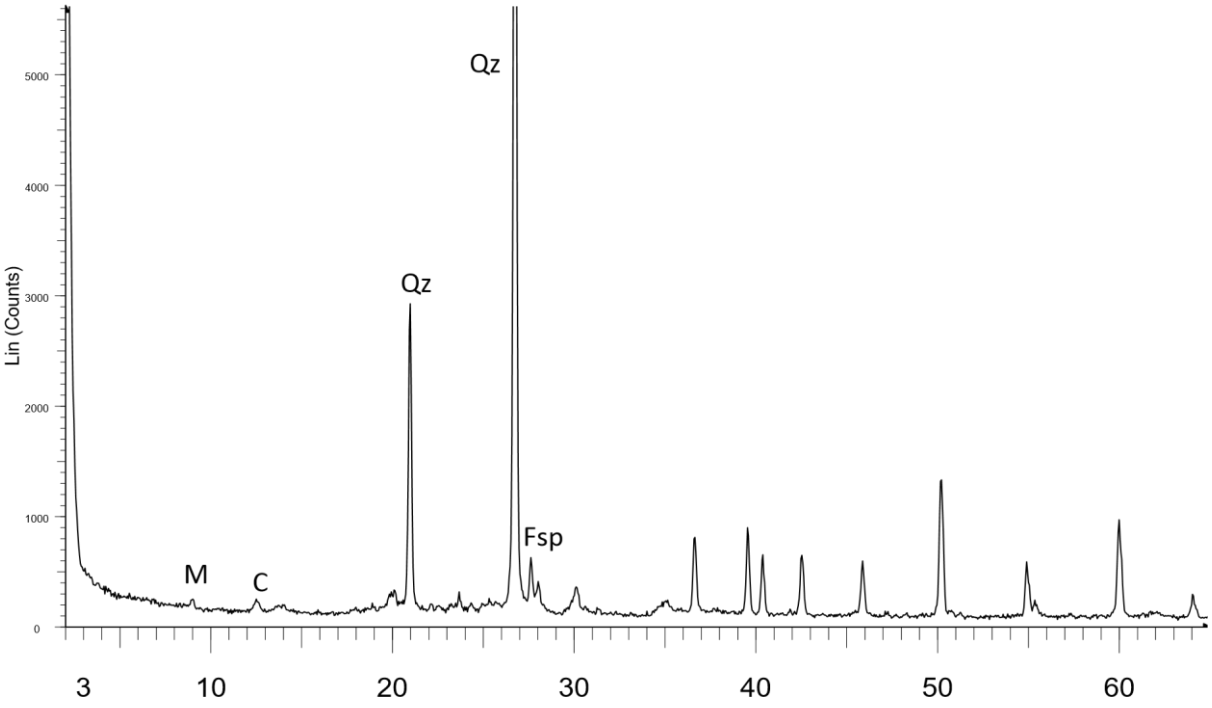
LU17 00206 008 bulk soil



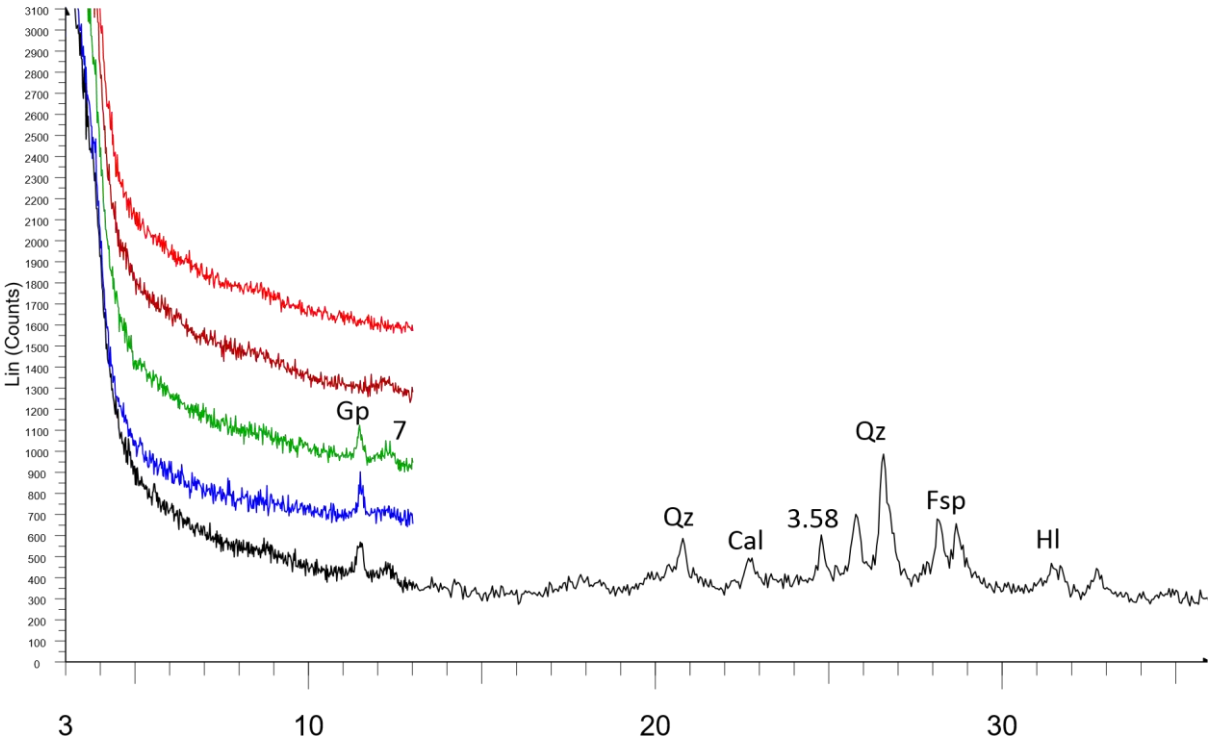
LU17 00206 009 (54306)



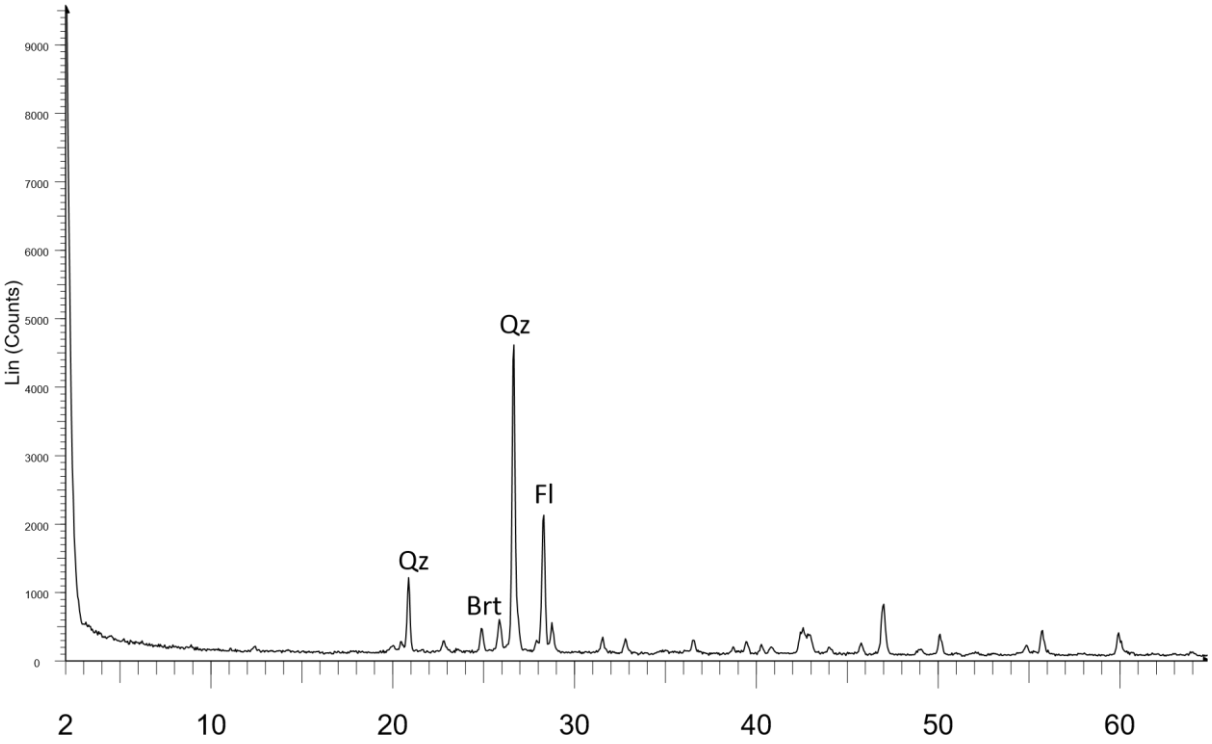
LU17 00206 009 bulk soil



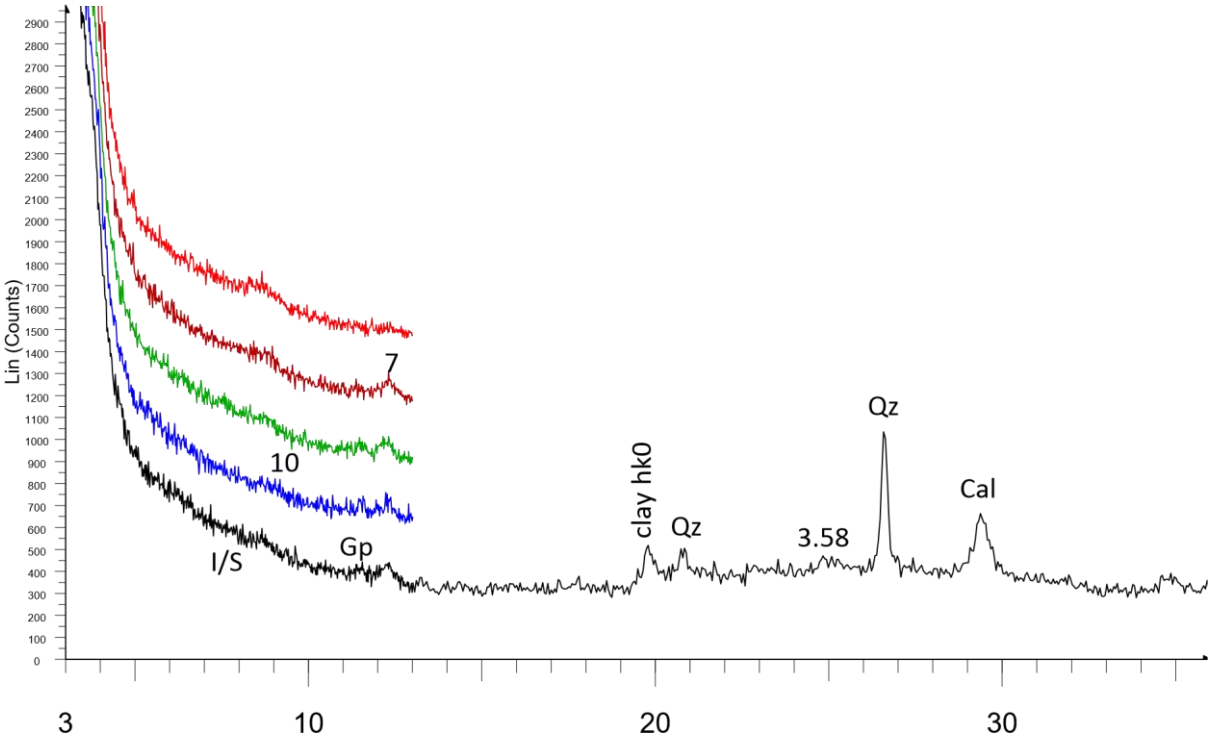
LU17 00206 010 (54318)



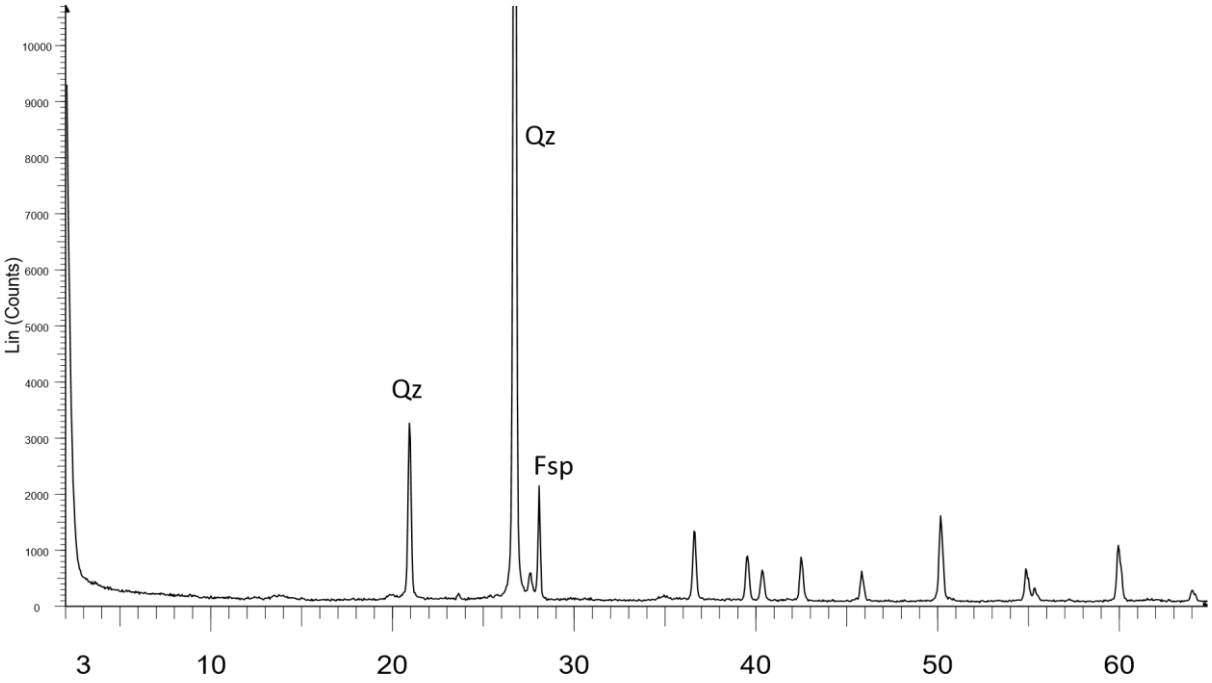
LU17 00206 010 (54318) bulk soil



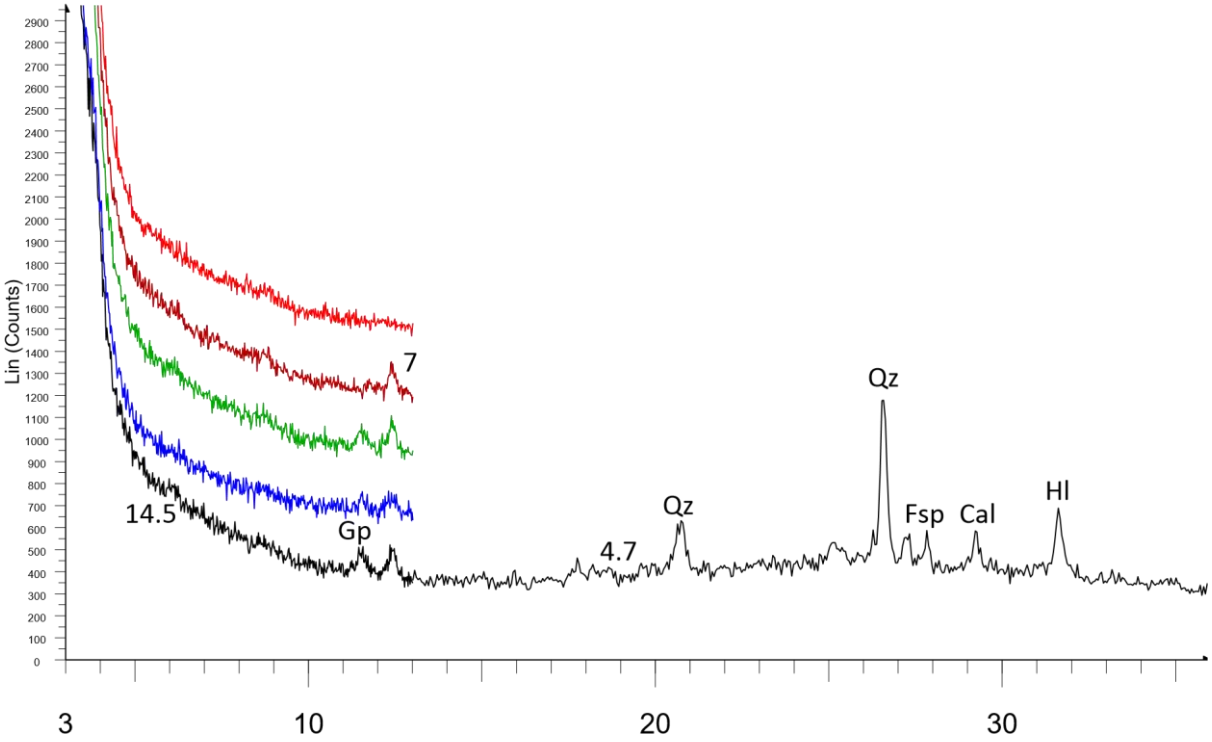
LU17 00206 011 (54693)



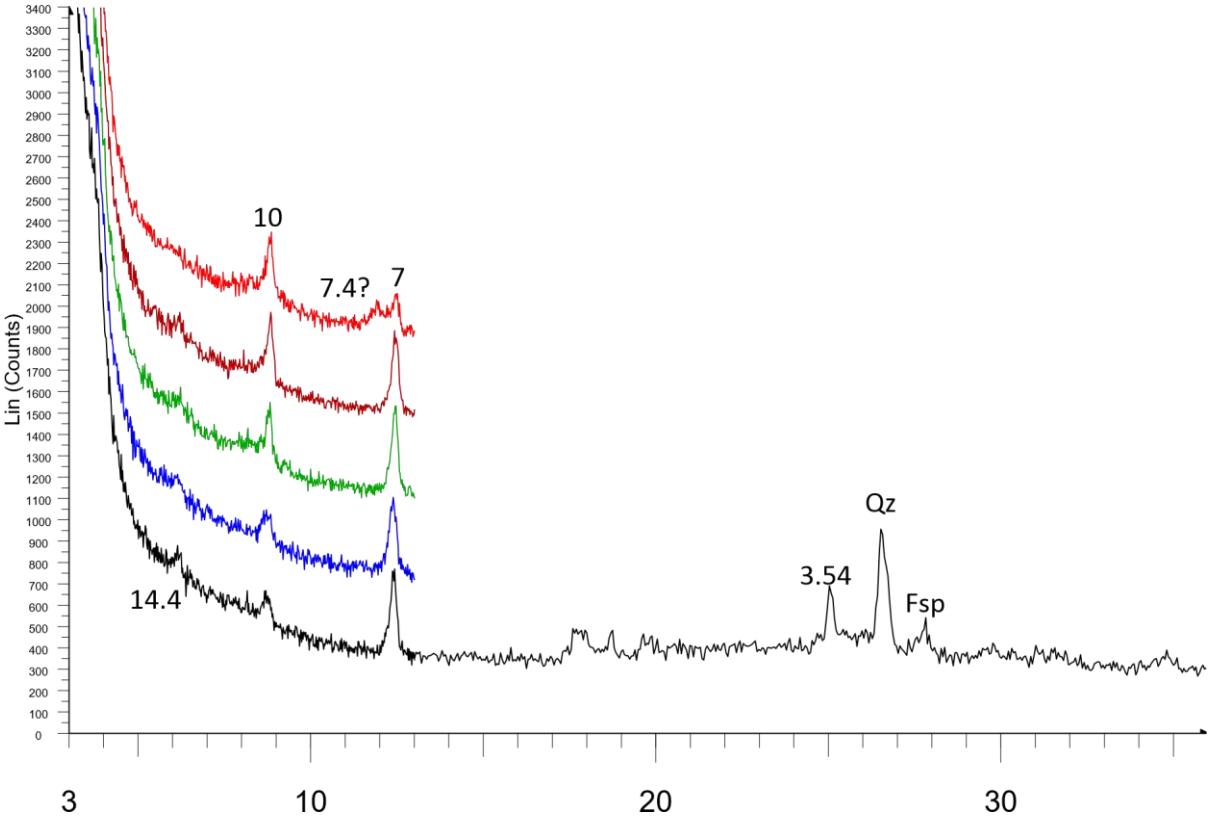
LU17 00206 011 bulk soil



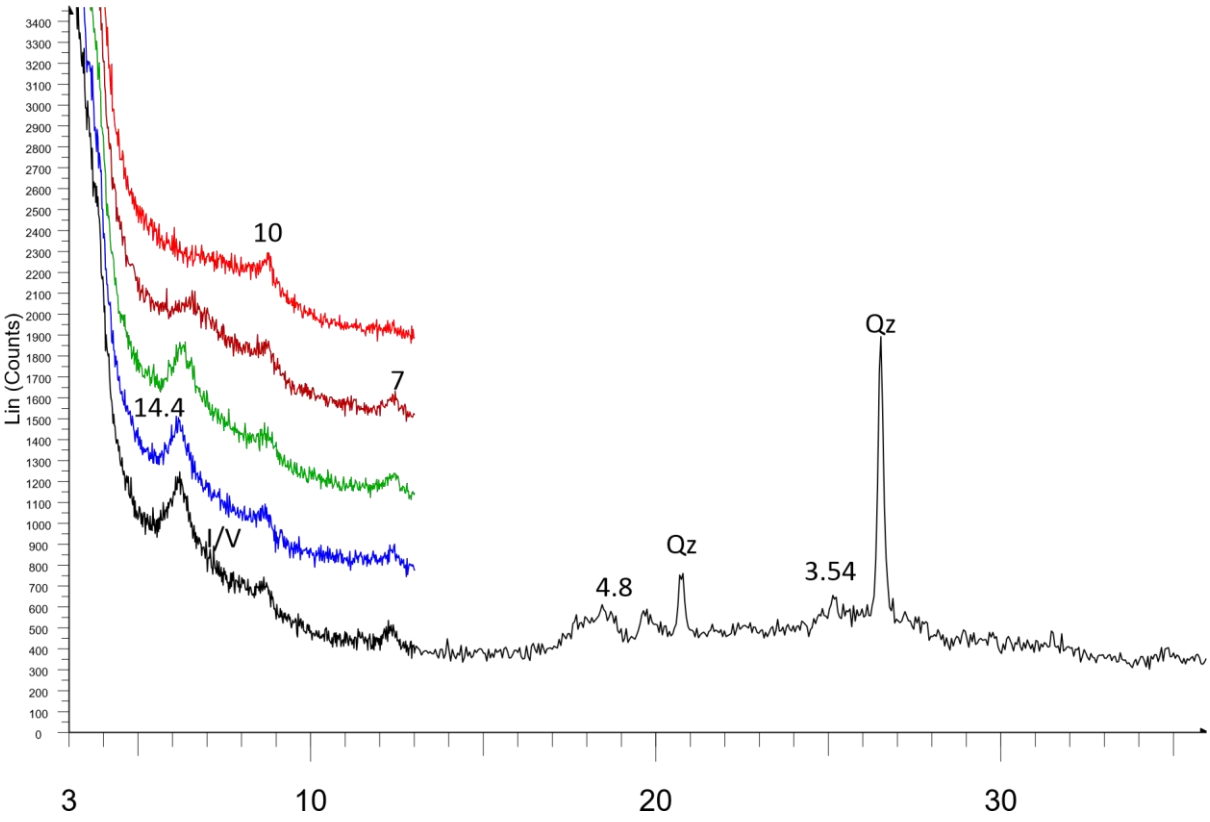
LU17 00206 012 (54747)



LU17 00206 013 (54765)

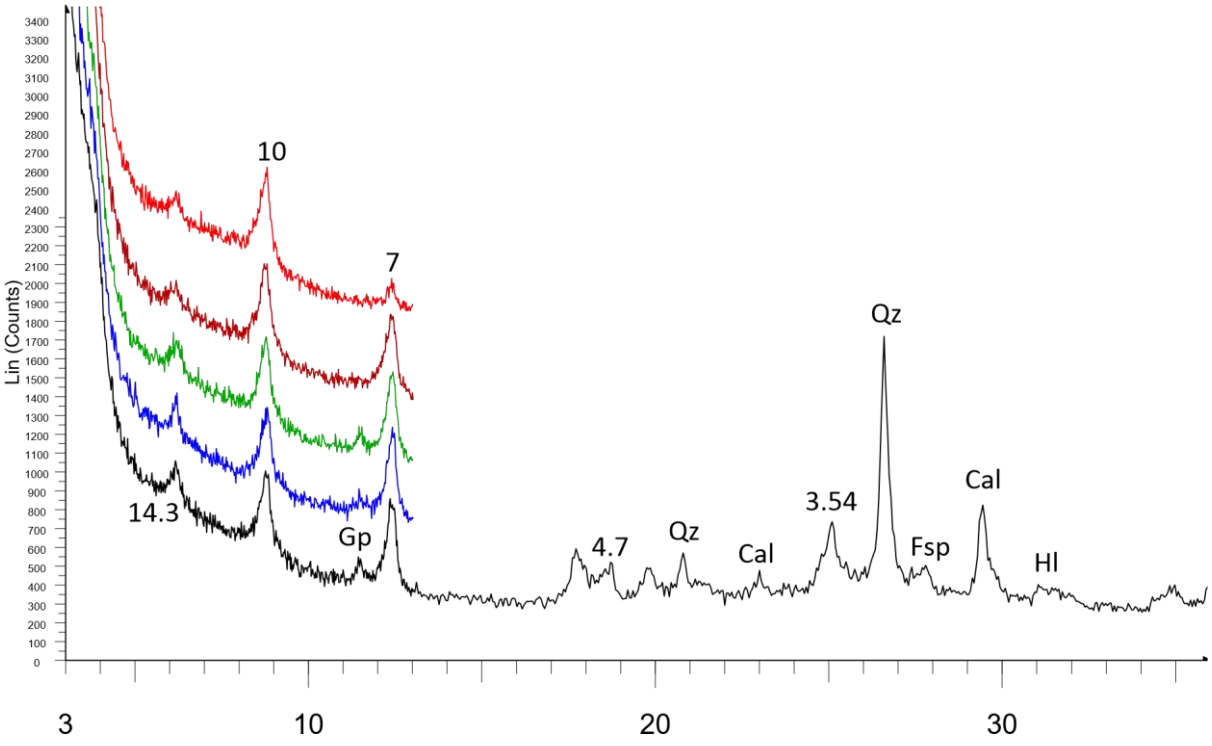


LU17 00206 014 (54943)

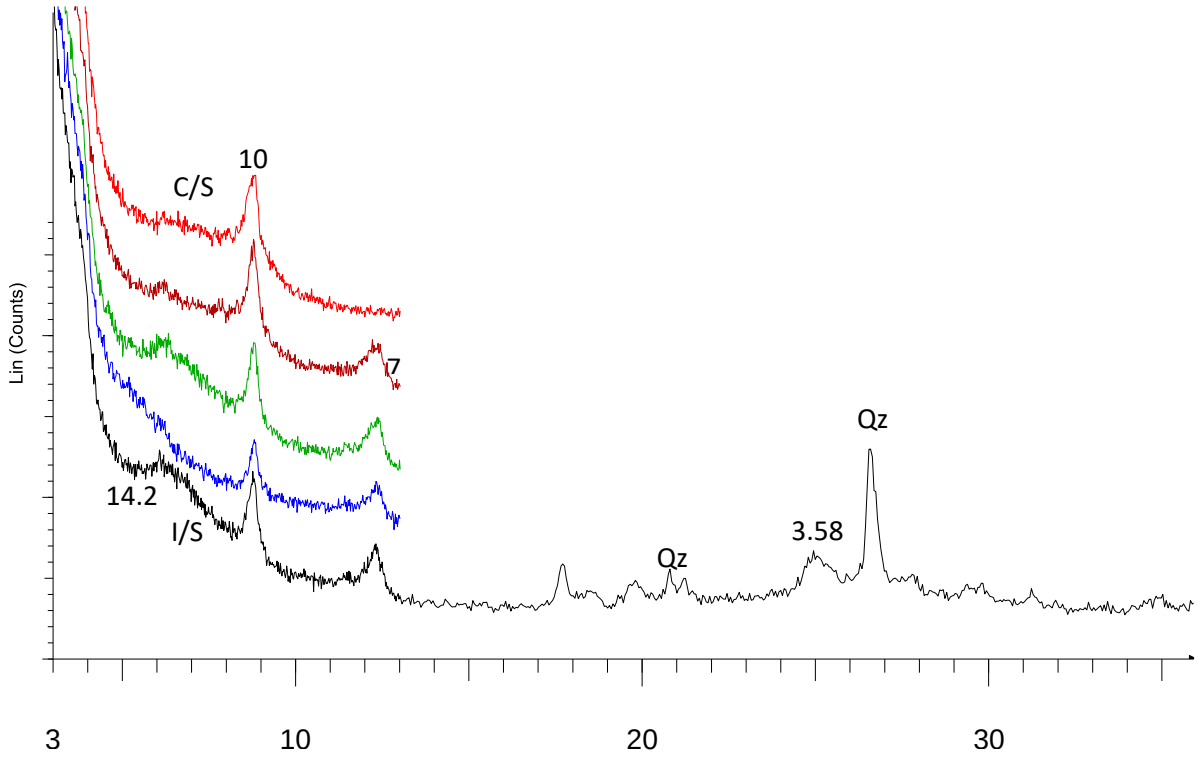


Annex 20. RX Diffractograms from Austria

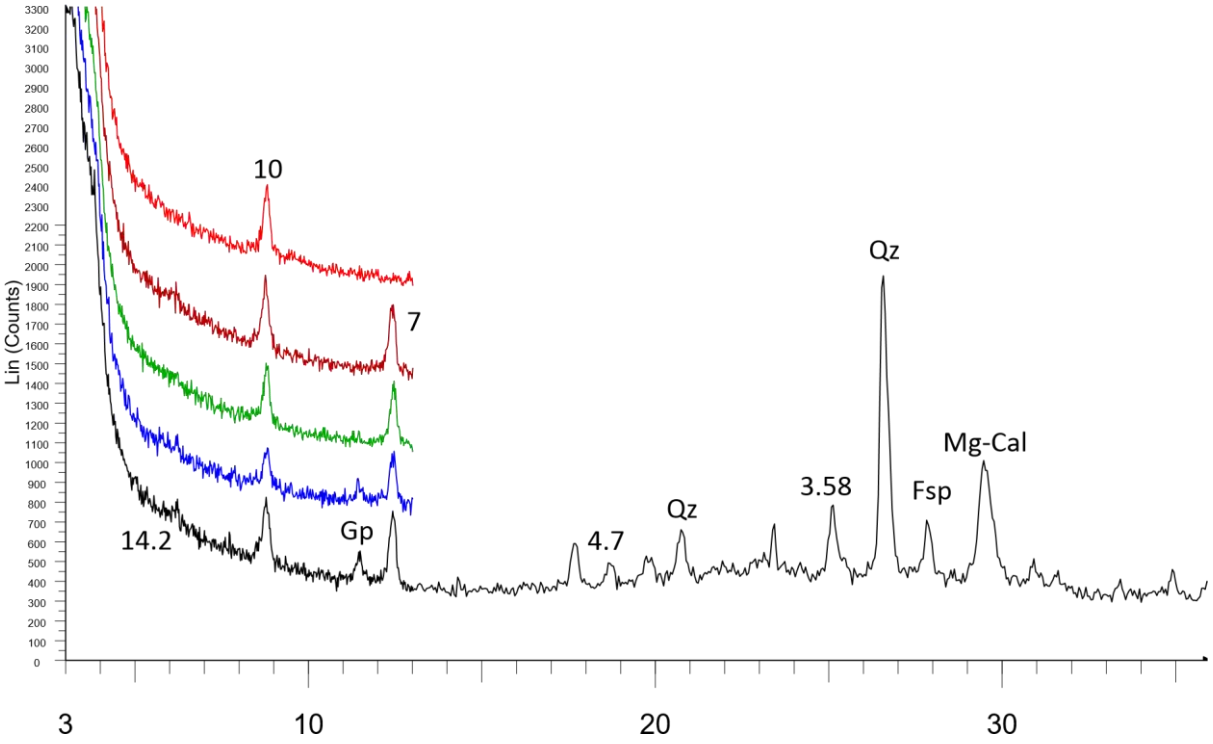
LU17 00207 001 (11176)



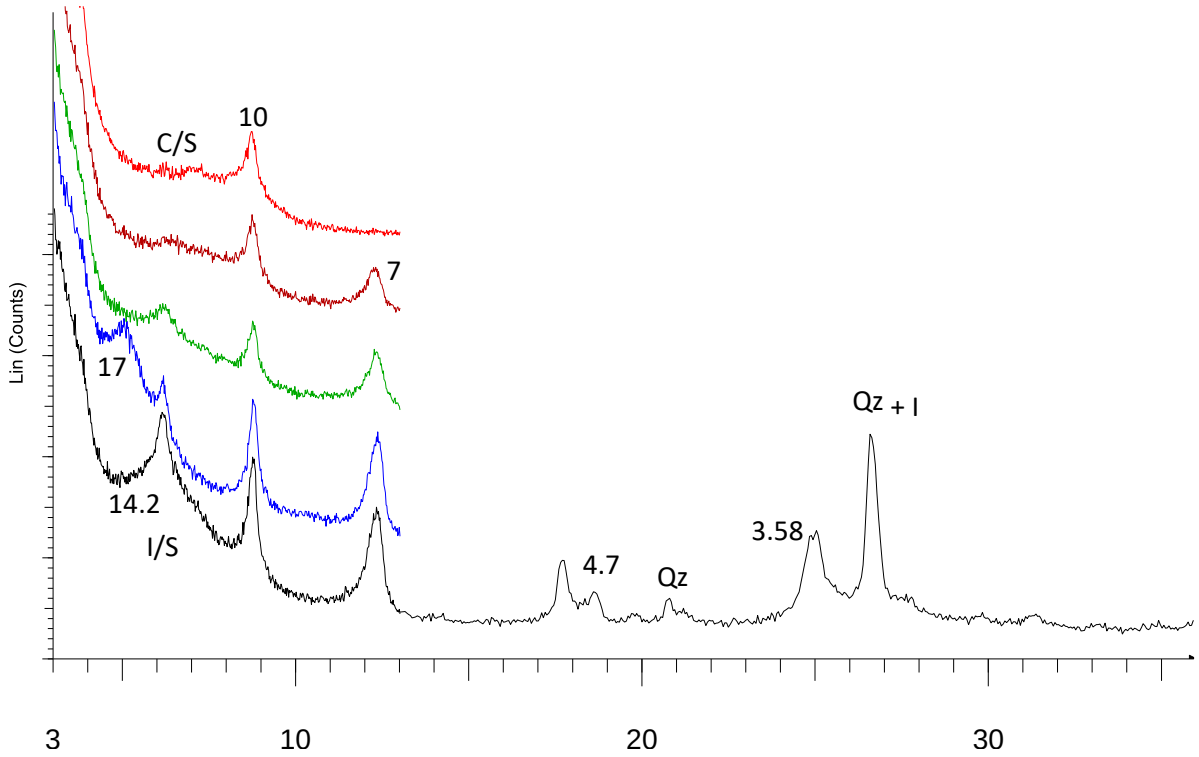
LU17 00207 002 (11211)



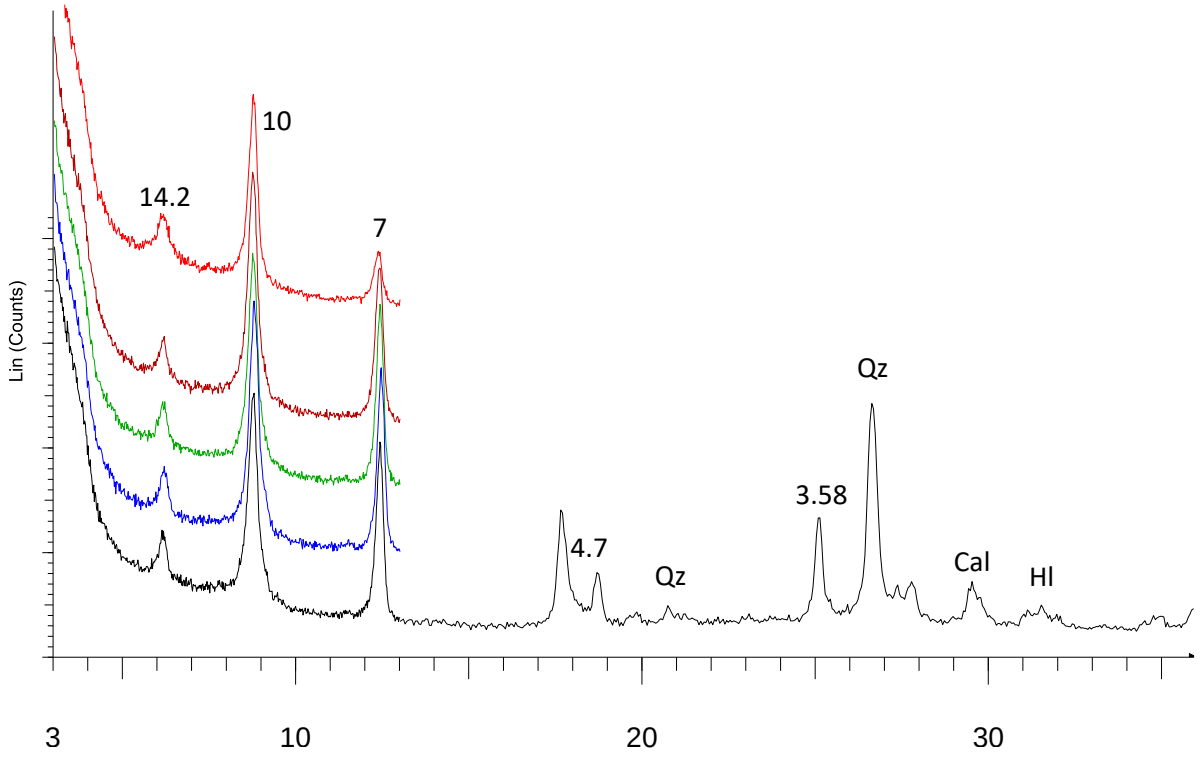
LU17 00207 003 (11307)



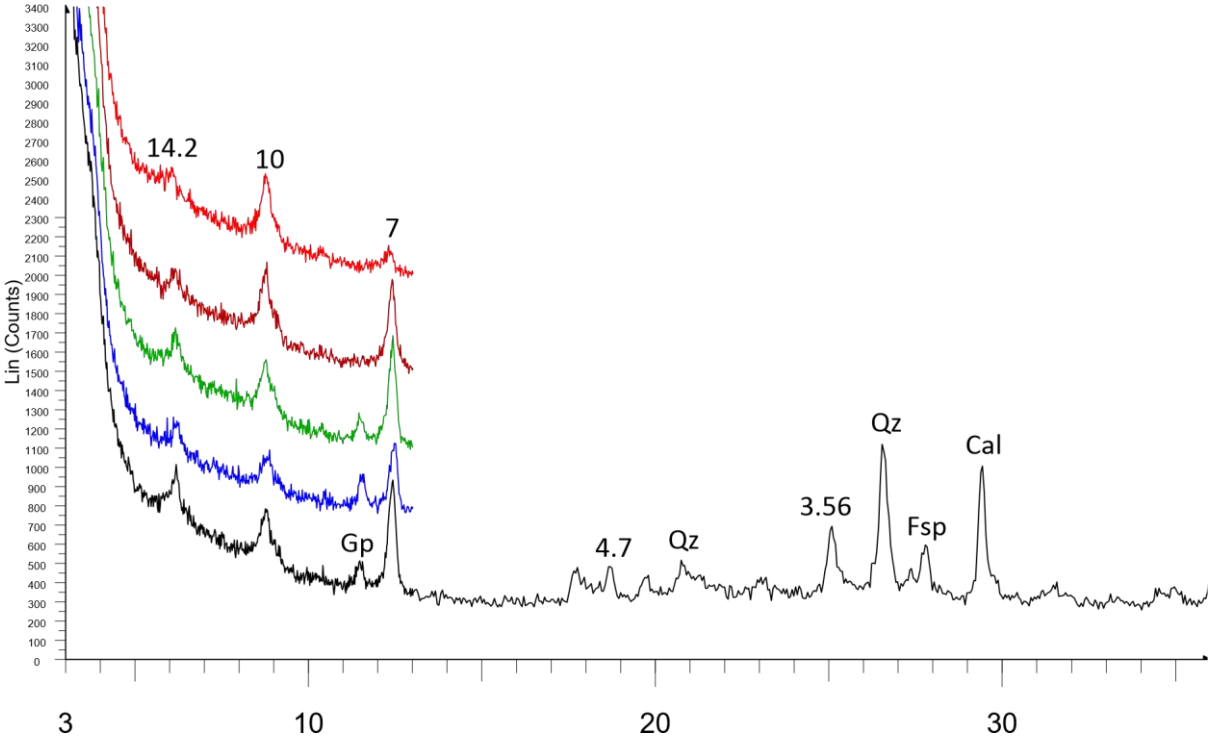
LU17 00207 004 (11335)



LU17 00207 005 (11413)

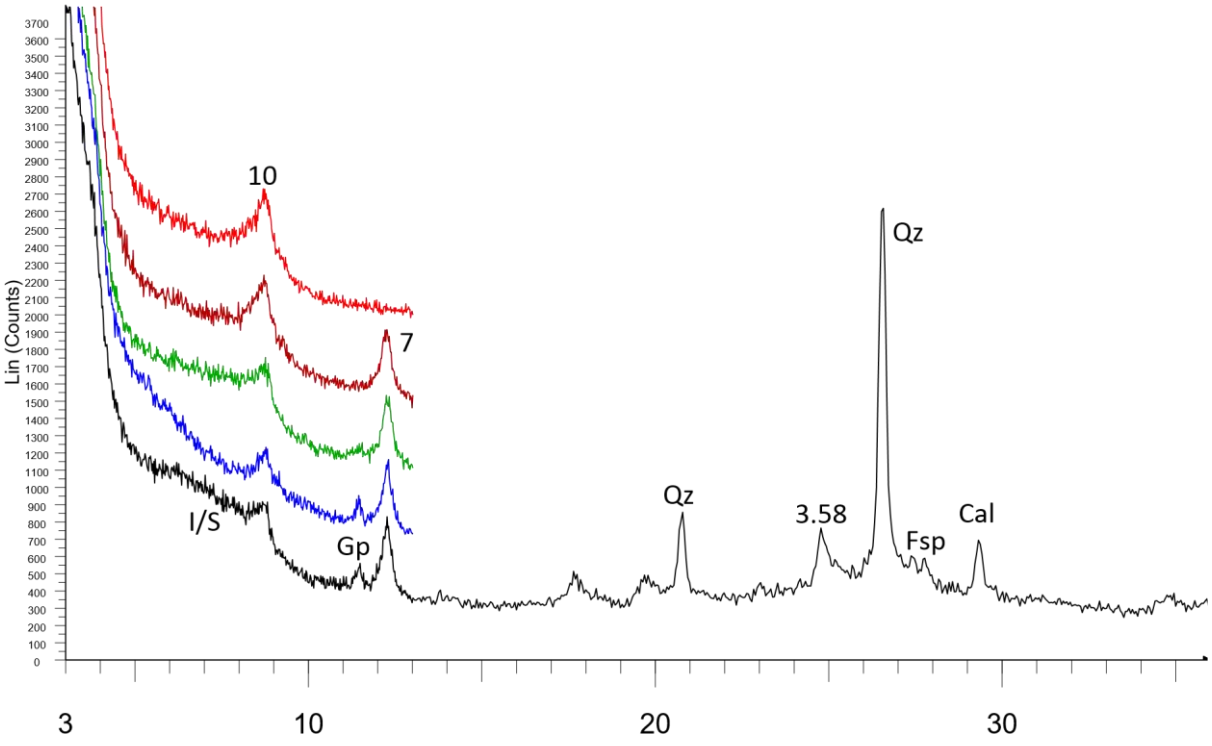


LU17 00207 006 (11425)

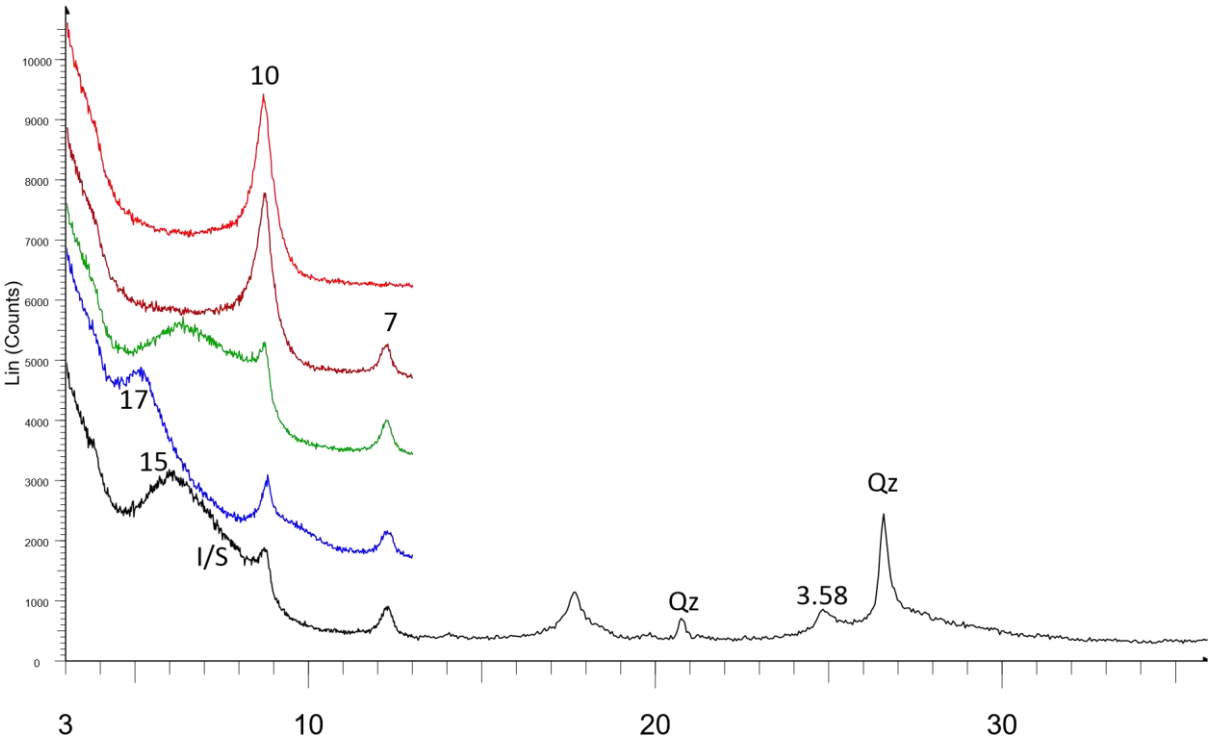


Annex 21. RX Diffractograms from Czechia

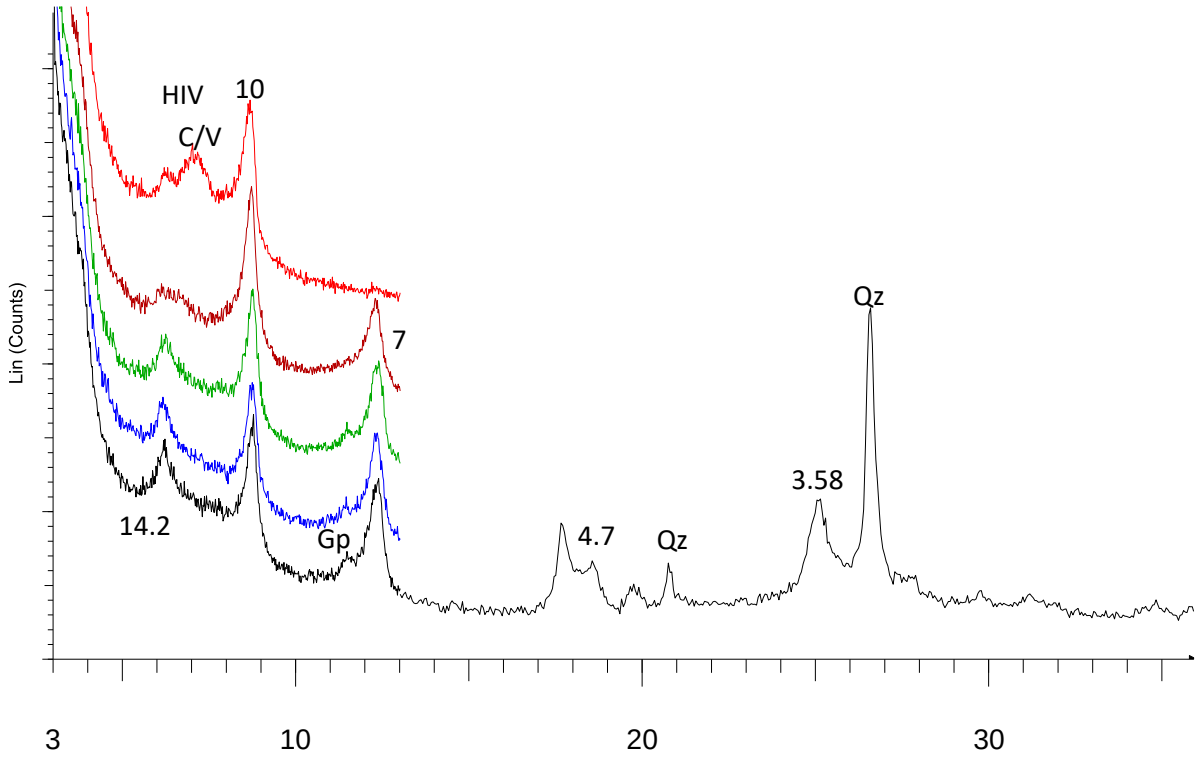
LU17 00208 001 (17029)



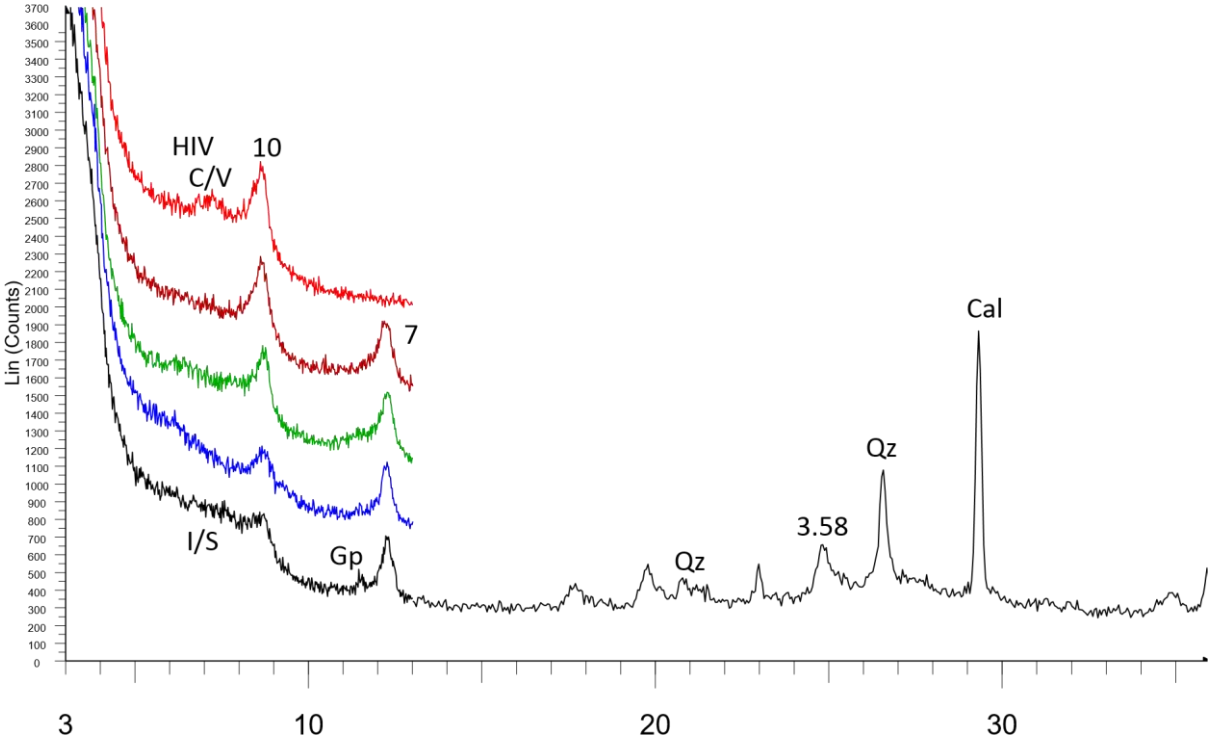
LU17 00208 002 (17123)



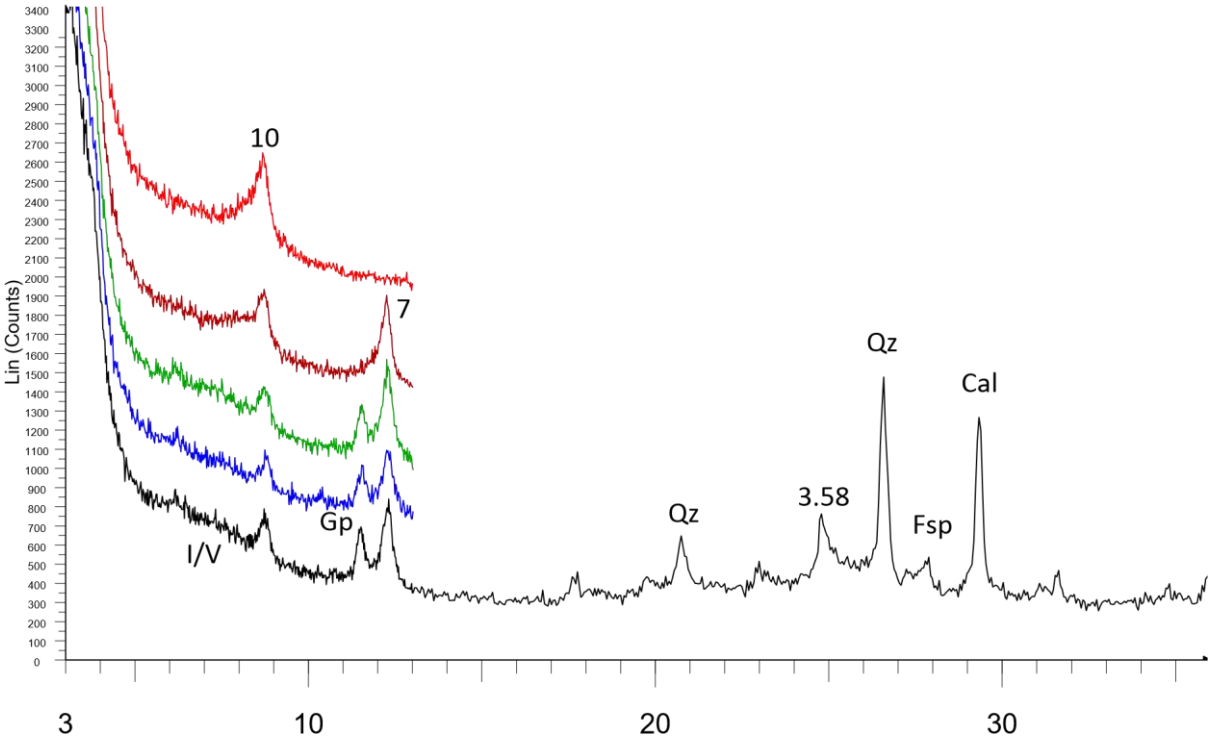
LU17 00208 003 (17165)



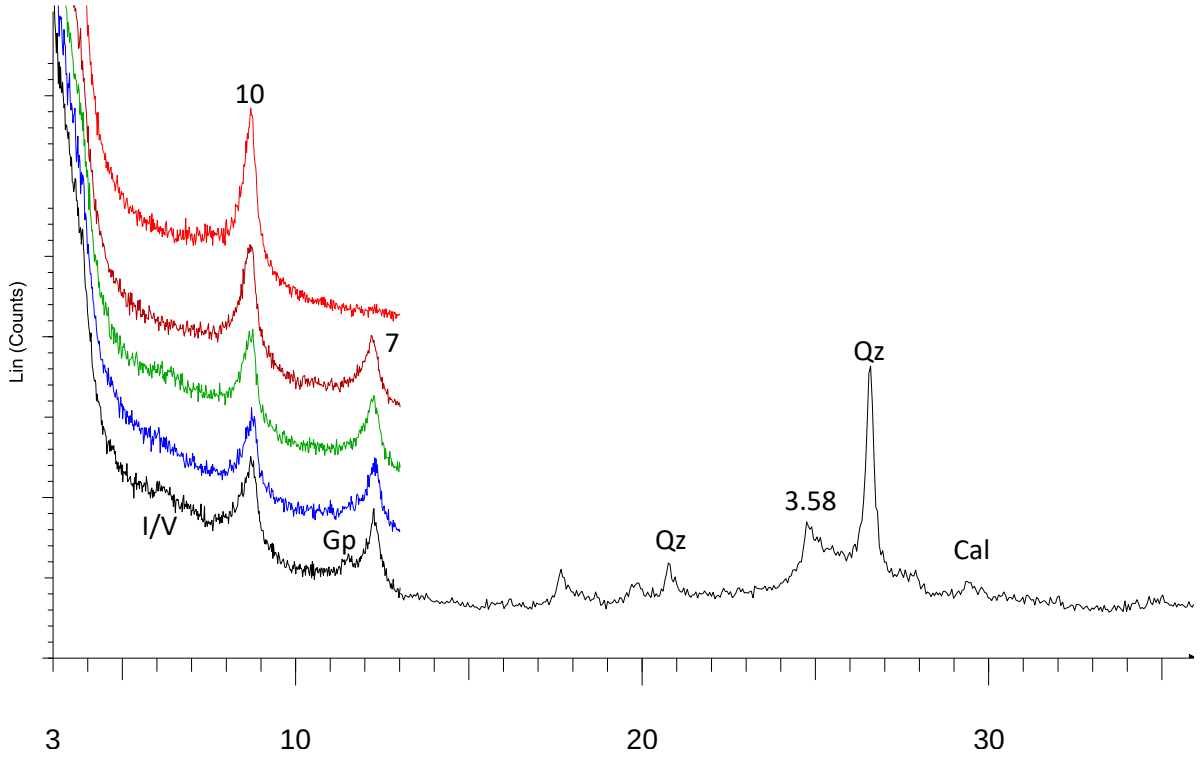
LU17 00208 004 (17228)



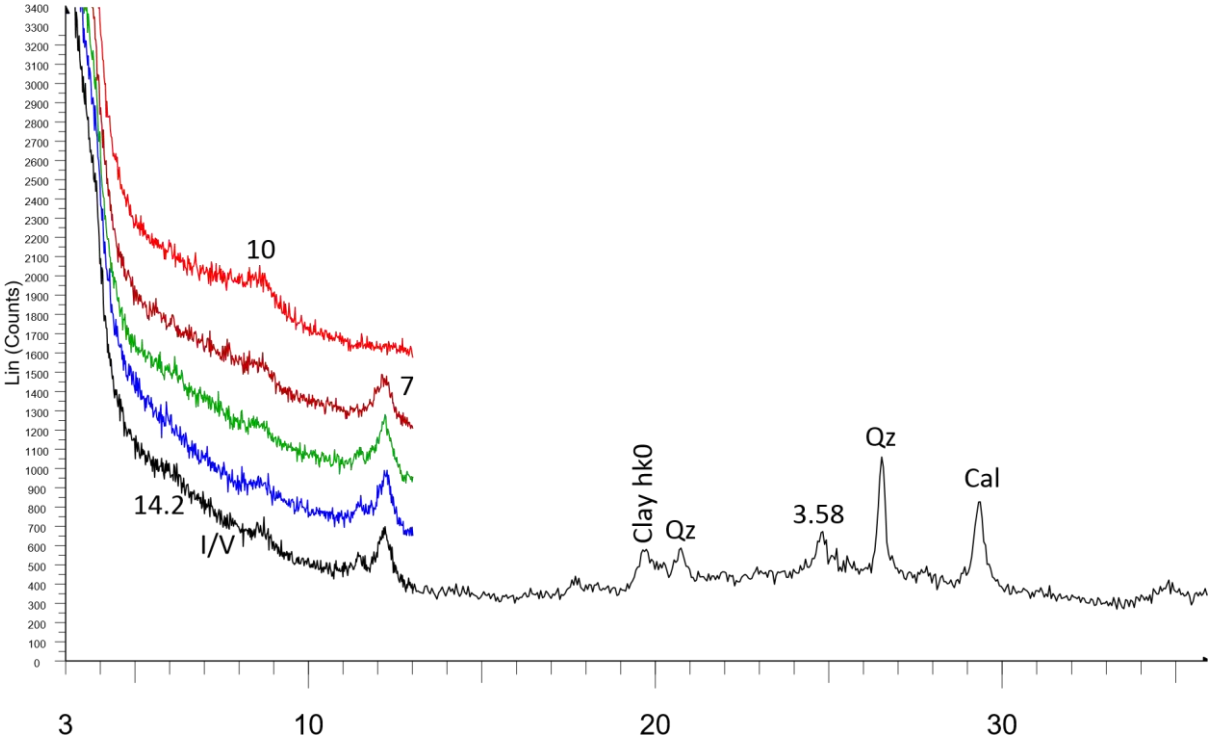
LU17 00208 005 (17230)



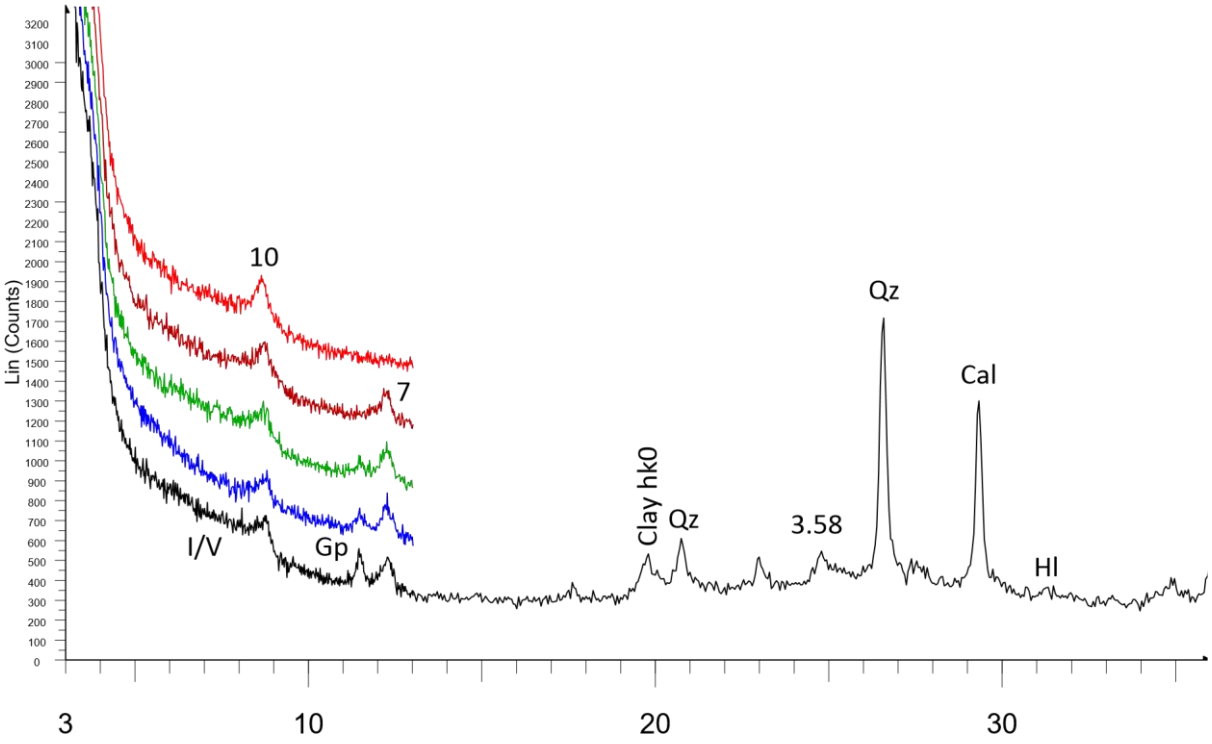
LU17 00208 006 (17231)



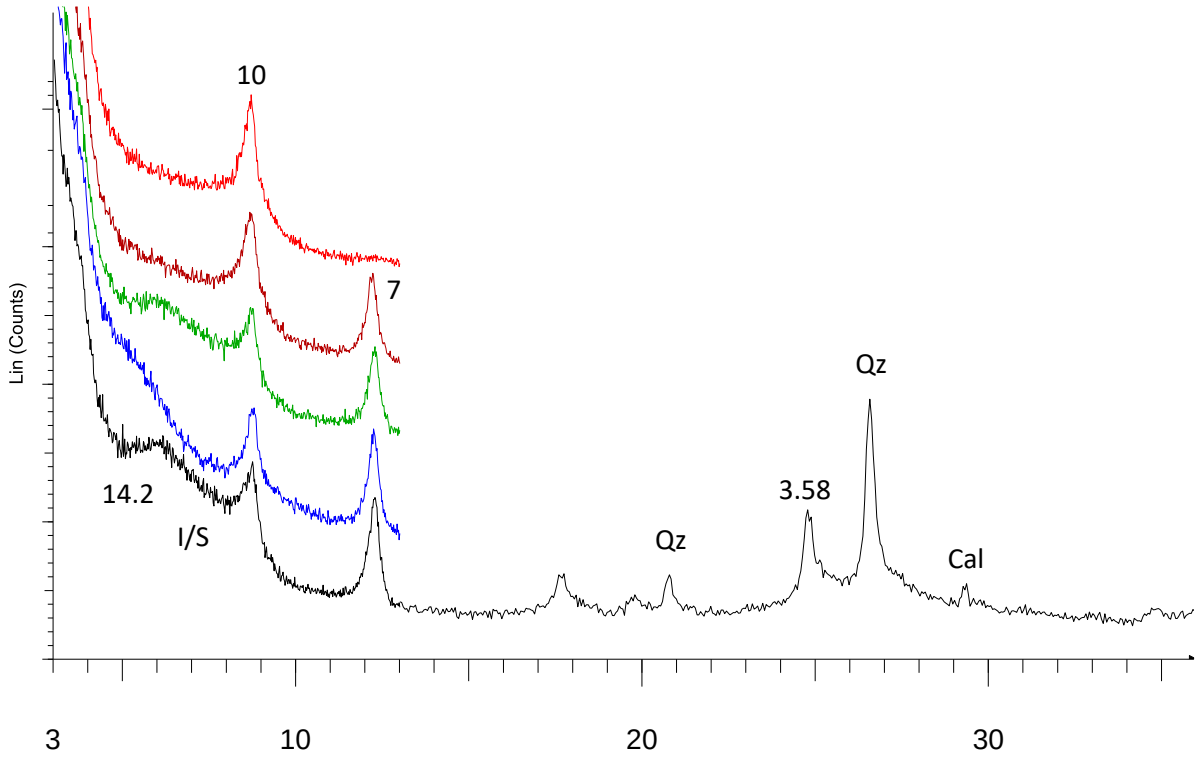
LU17 00208 007 (17262)



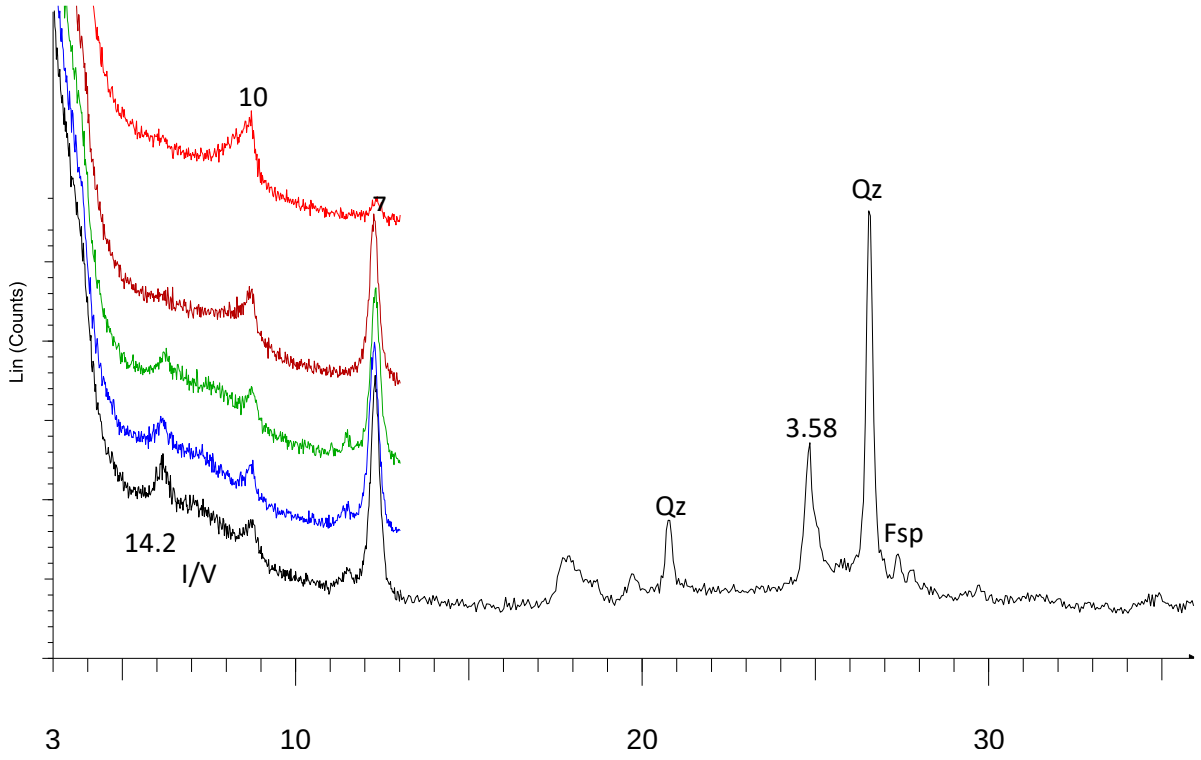
LU17 00208 008 (17283)



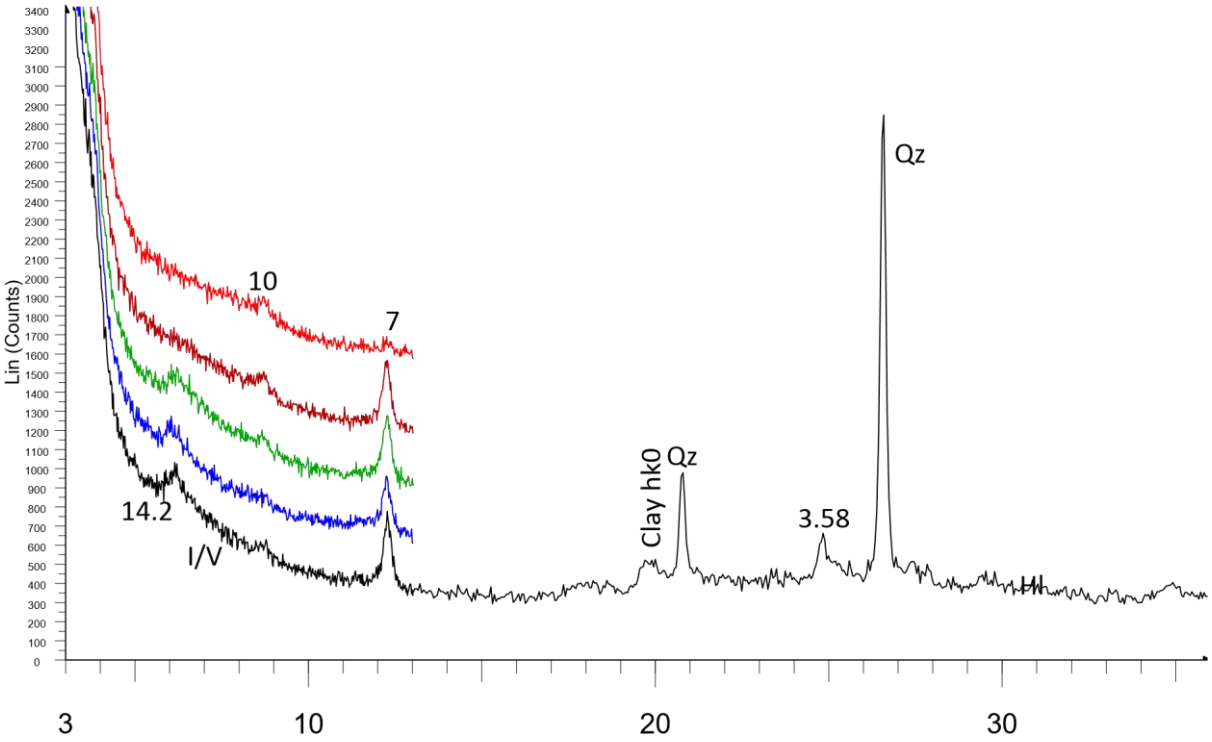
LU17 00208 009 (17285)



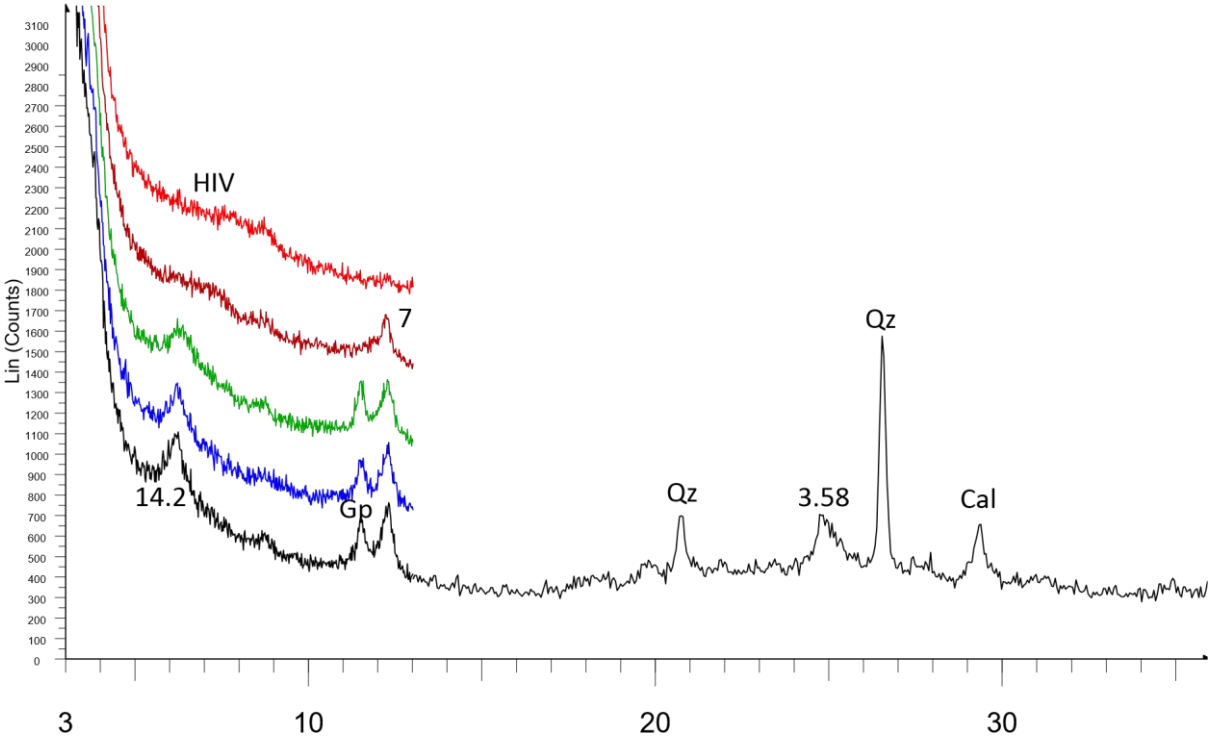
LU17 00208 010 (17296)



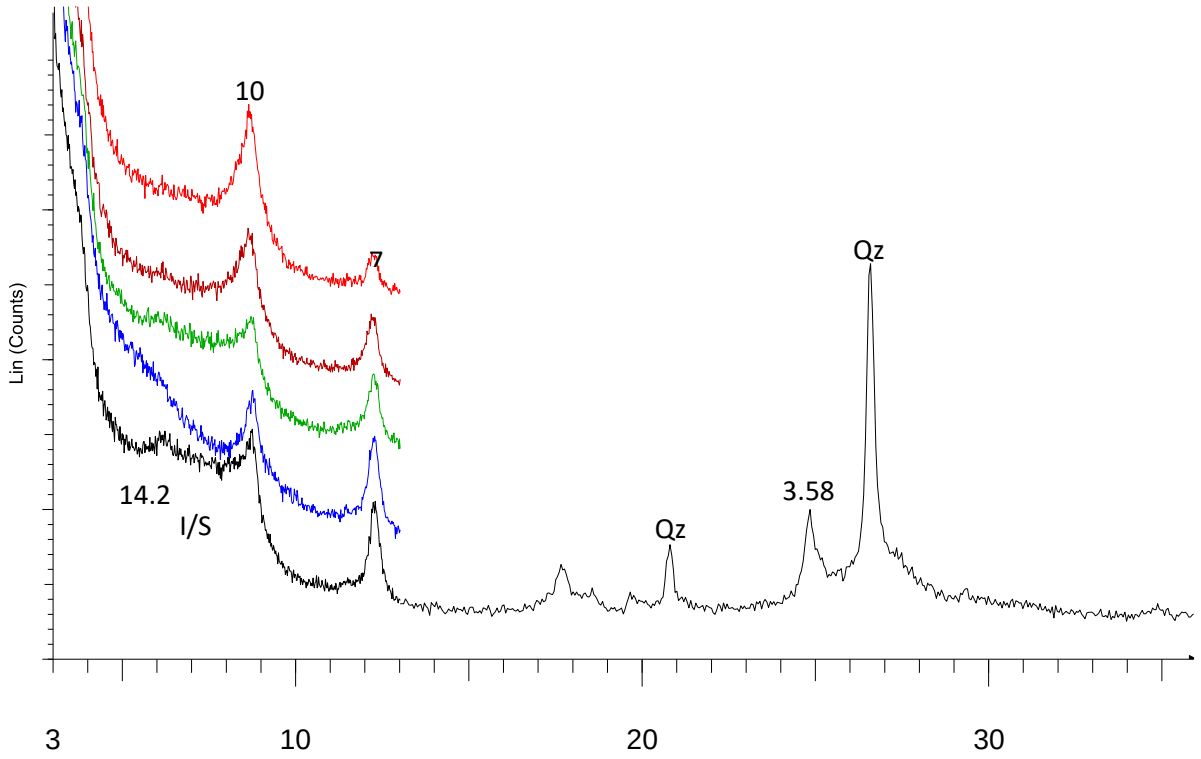
LU17 00208 011 (17307)



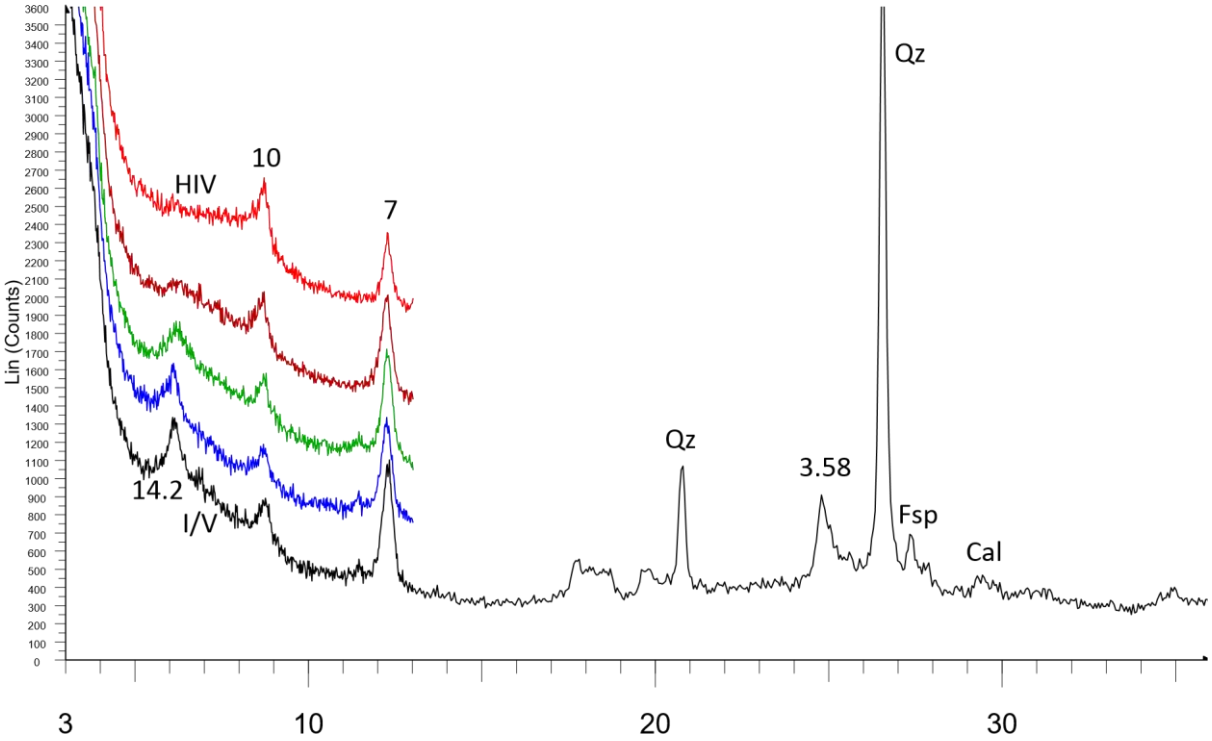
LU17 00208 012 (17389)



LU17 00208 013 (17393)

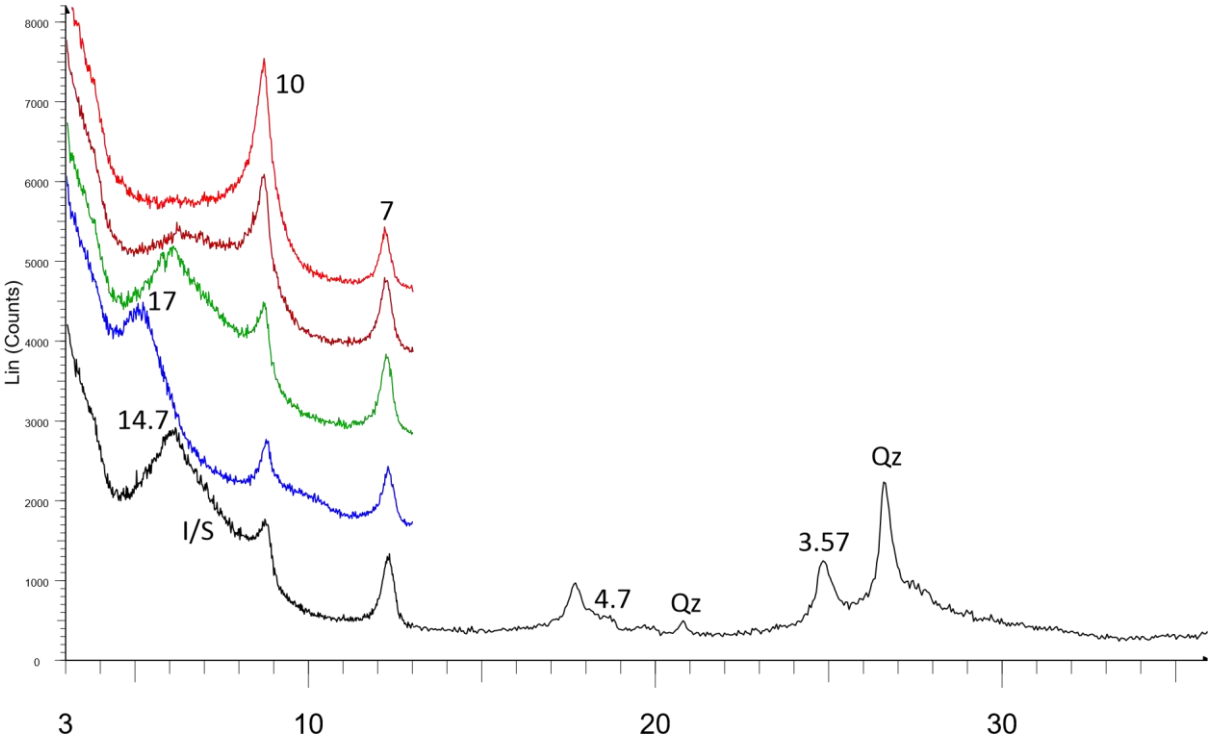


LU17 00208 014 (17431)



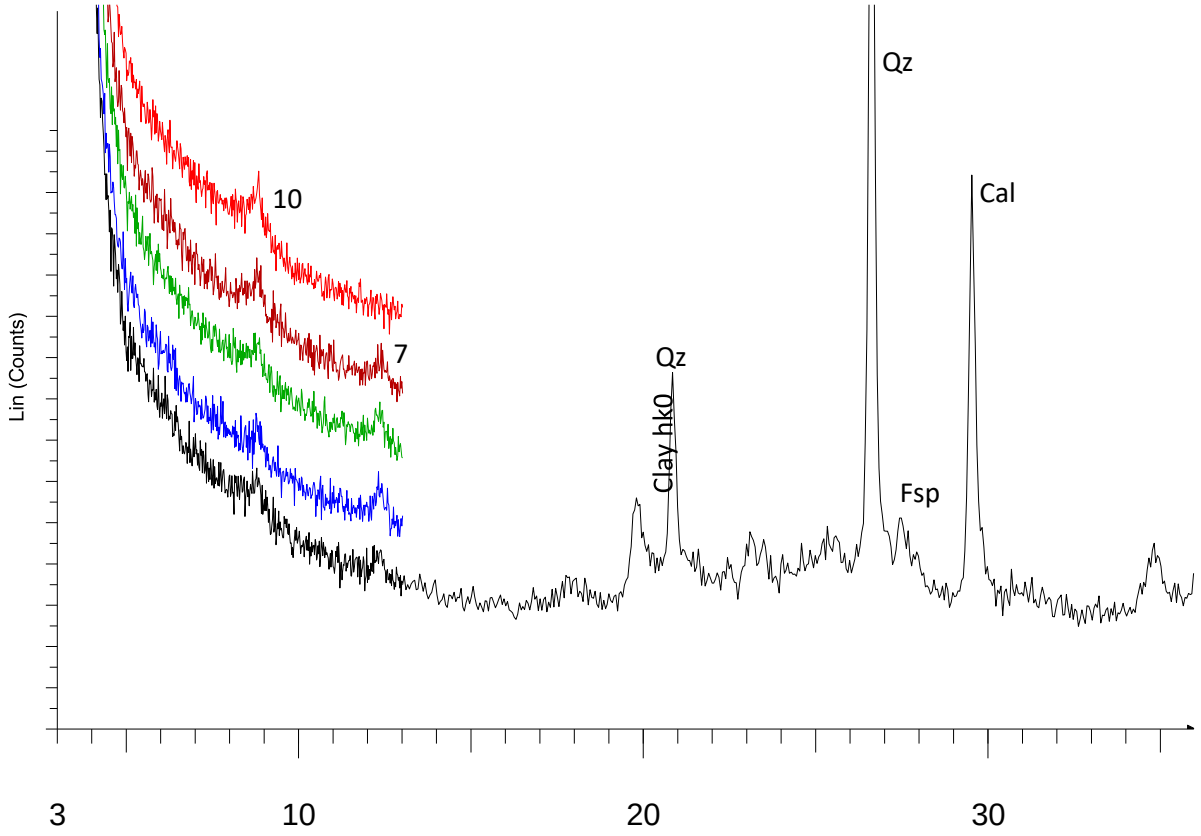
Annex 22 RX Diffractograms from Belgium

LU17 00209 001 (12026)

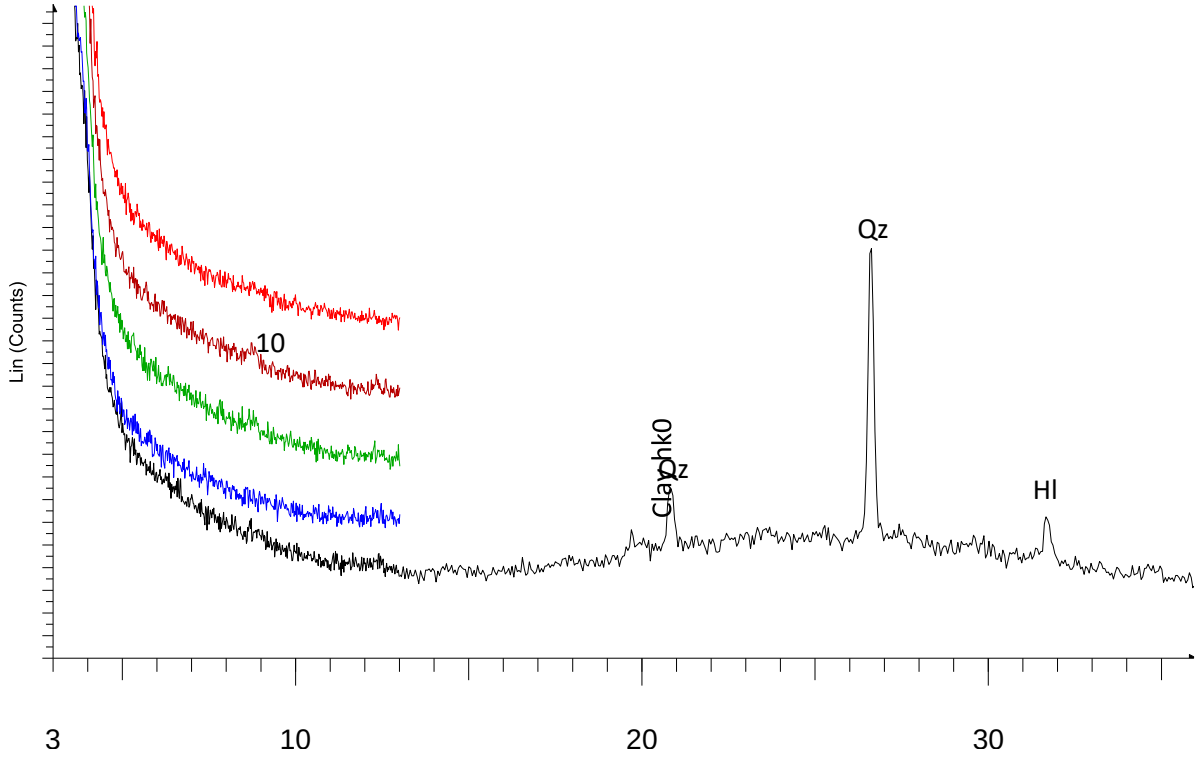


Annex 23. RX Diffractograms from France

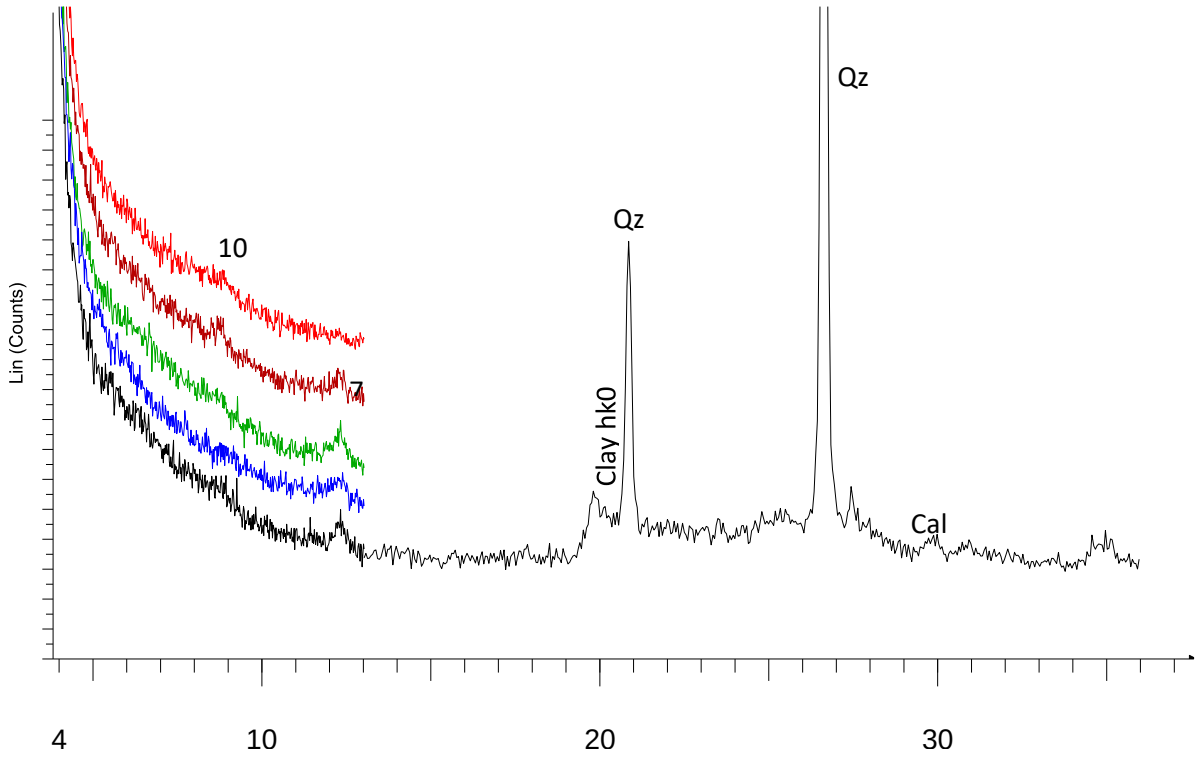
LU17 192 001 (22126)



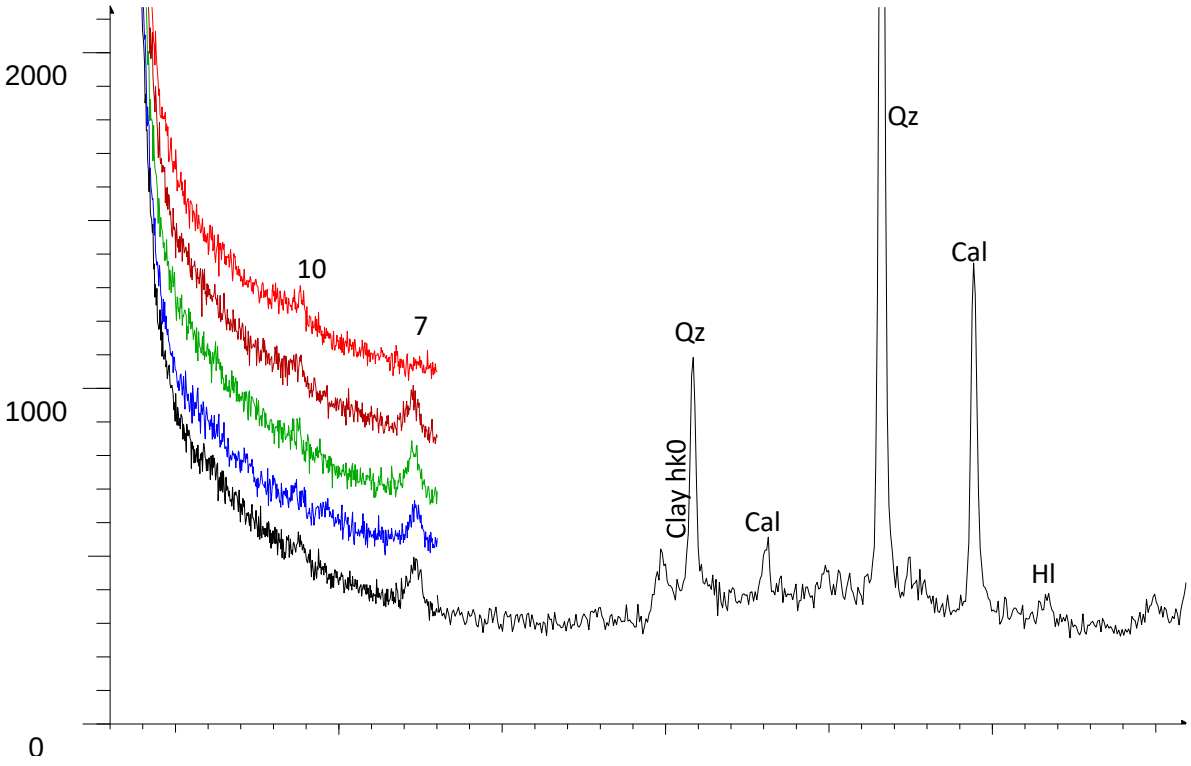
LU17 00192 002 (22132)



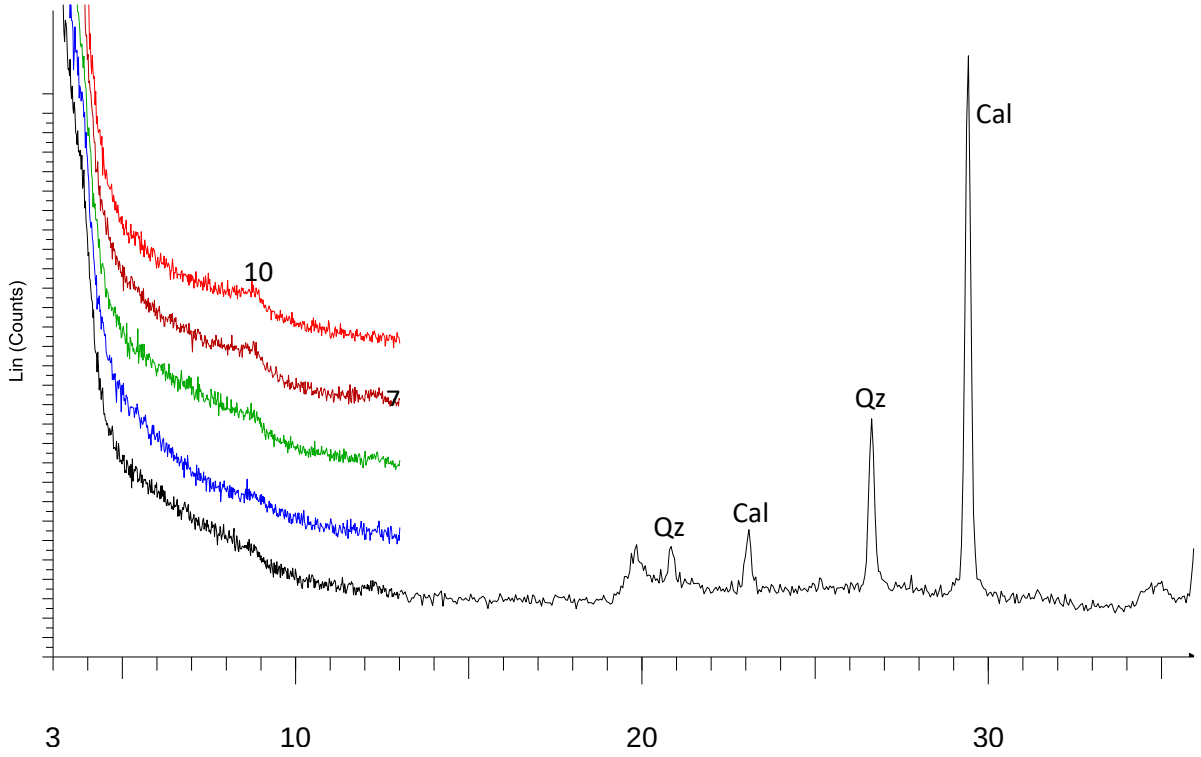
LU17 00192 003 (22142)



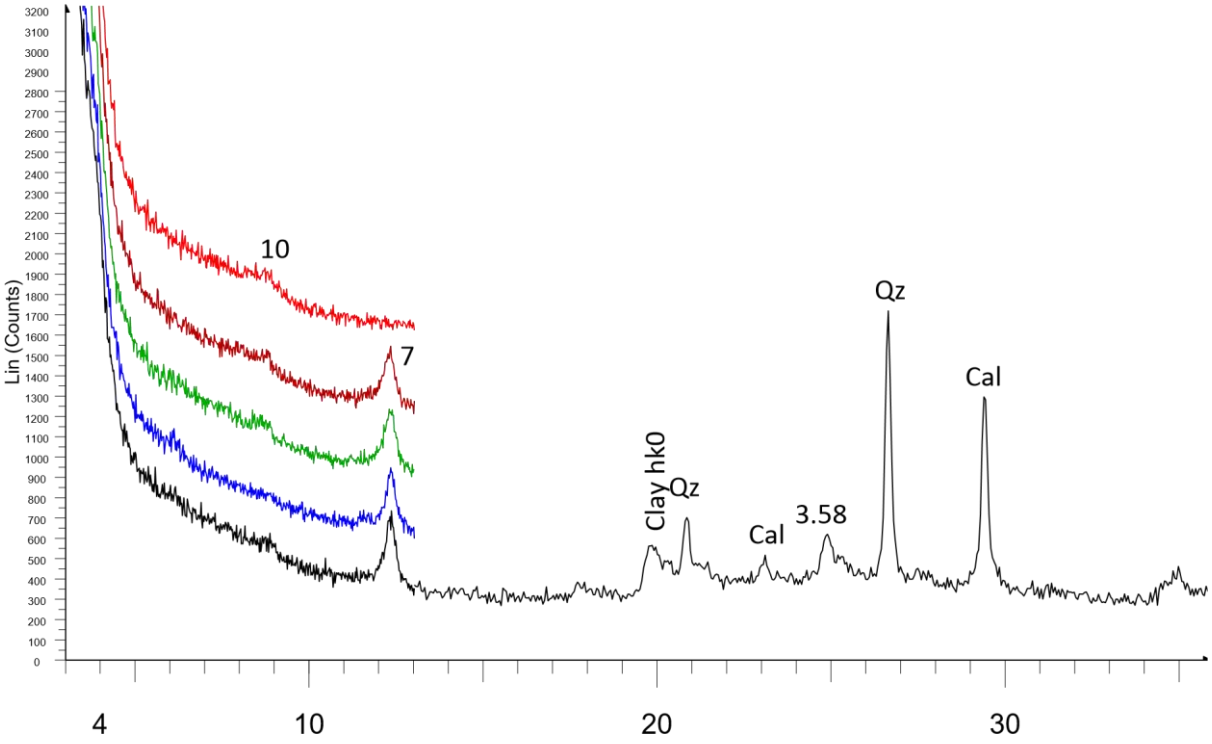
LU17 192 004 (22159)



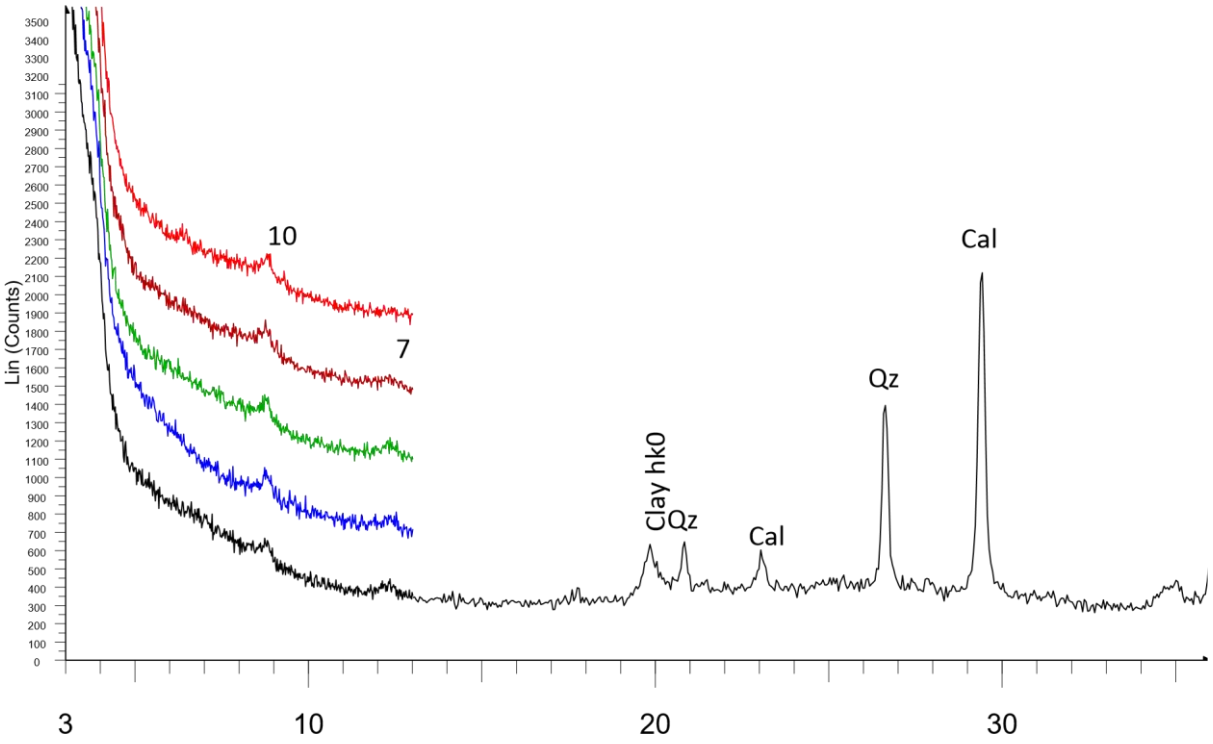
LU17 00192 005 (22173)



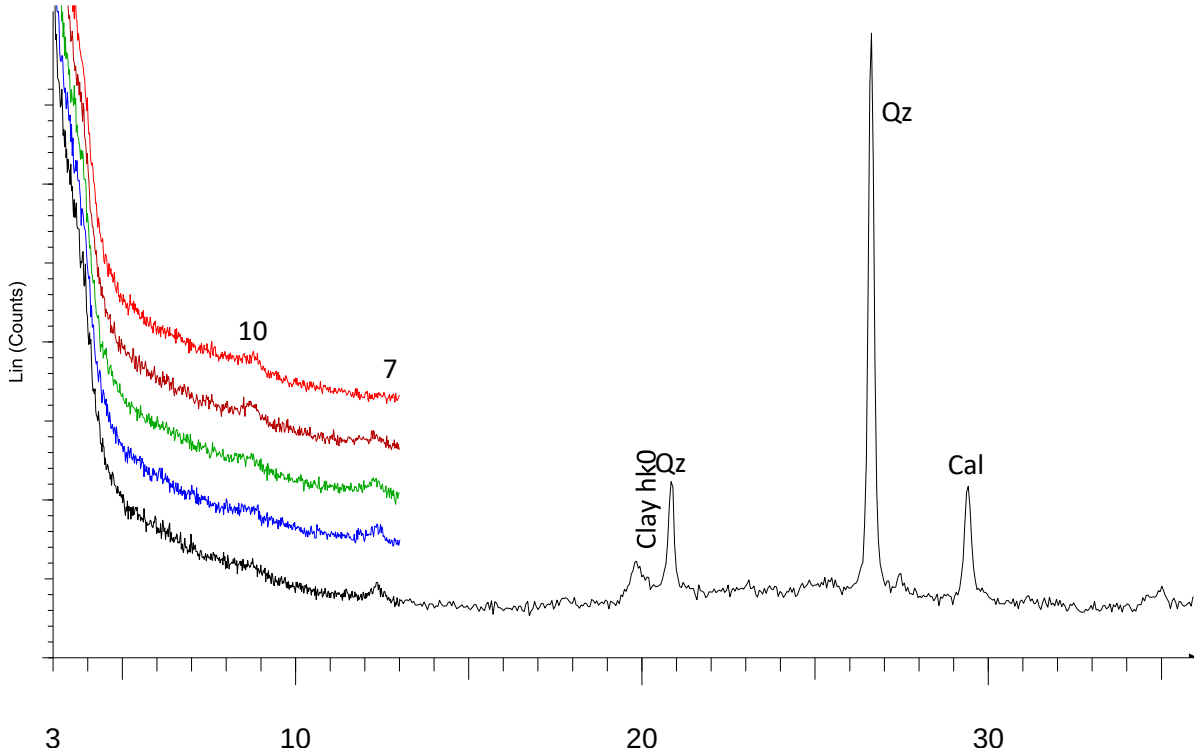
LU17 00192 006 (22201)



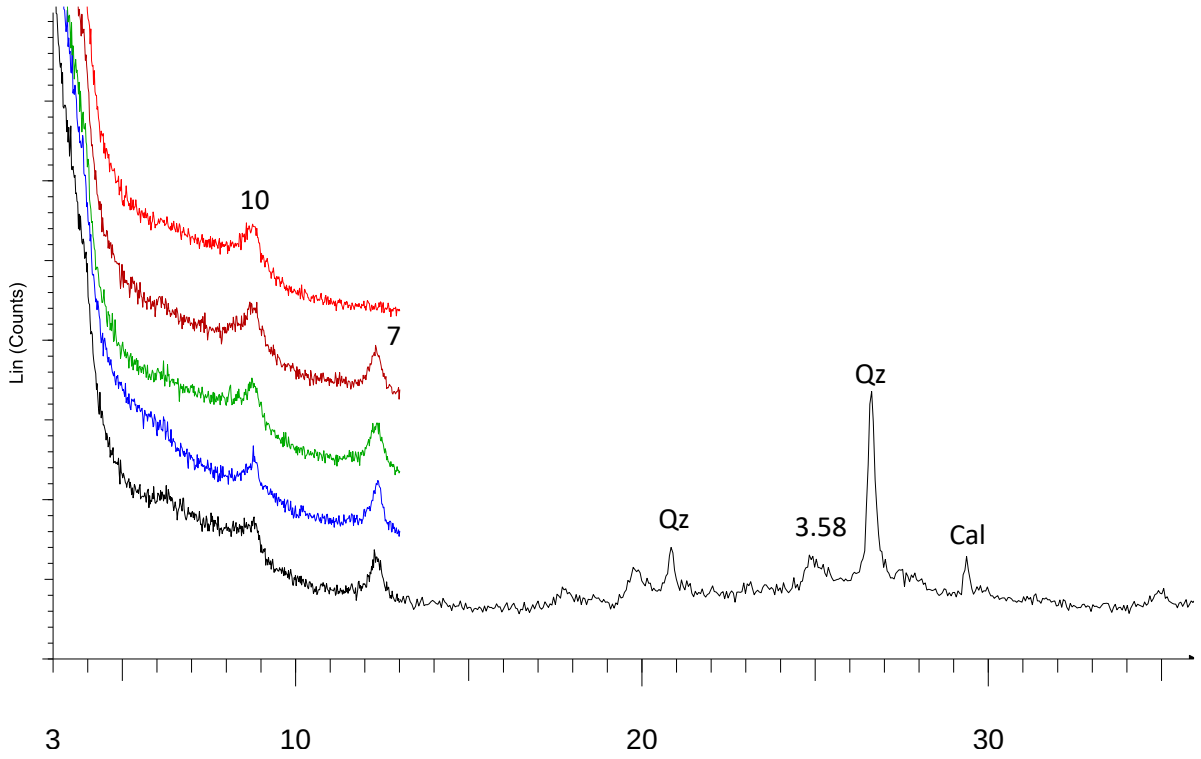
LU17 00192 007 (22290)



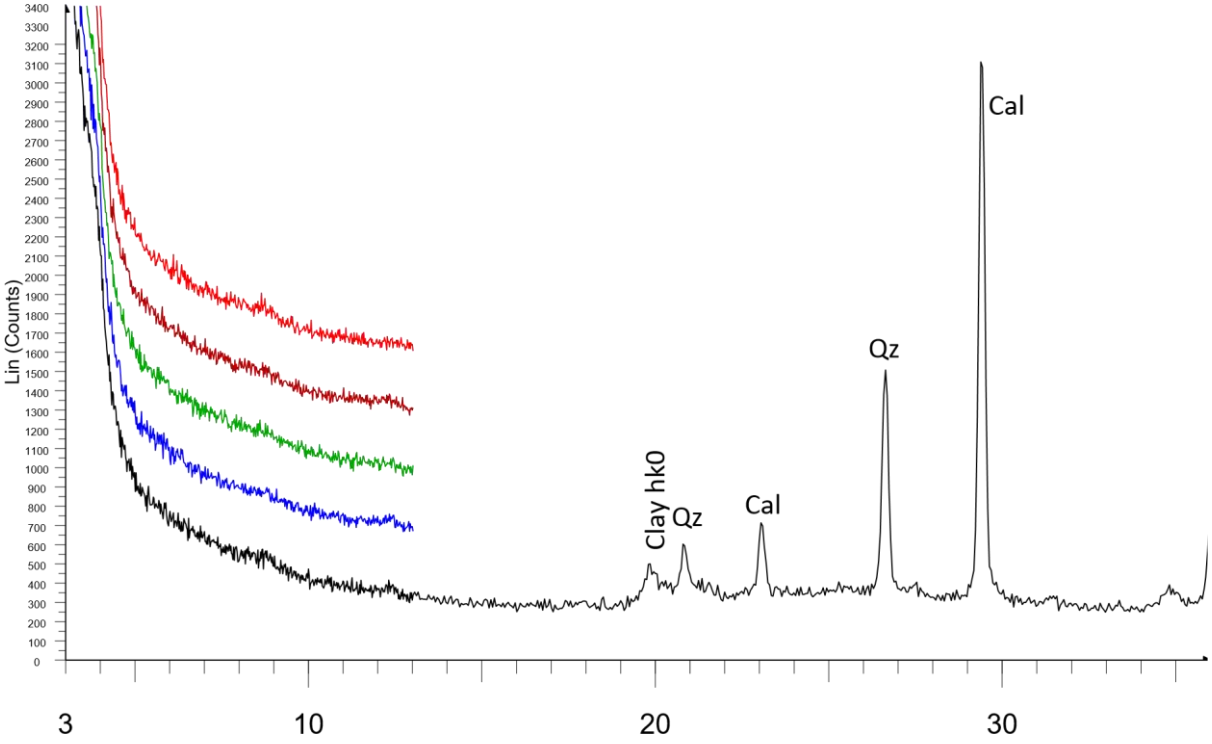
LU17 00192 008 (22295)



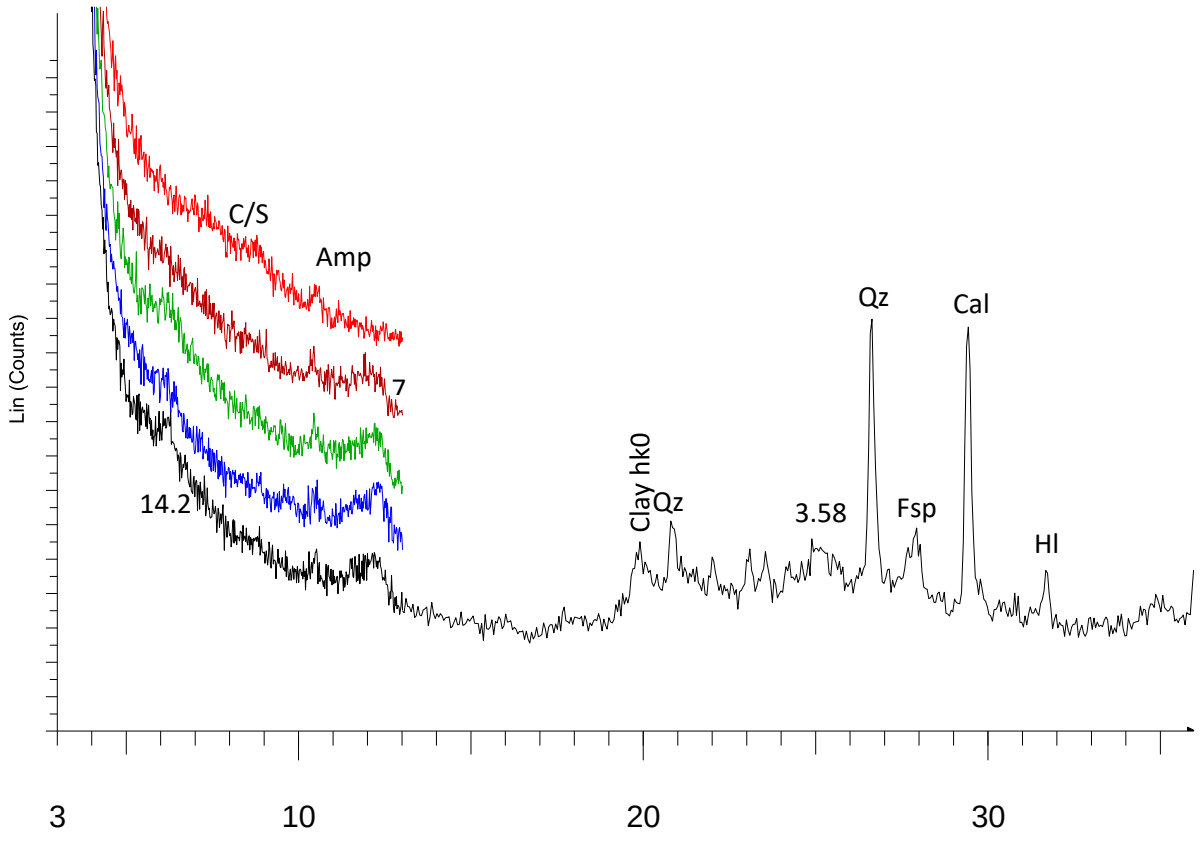
LU17 00192 009 (22354)



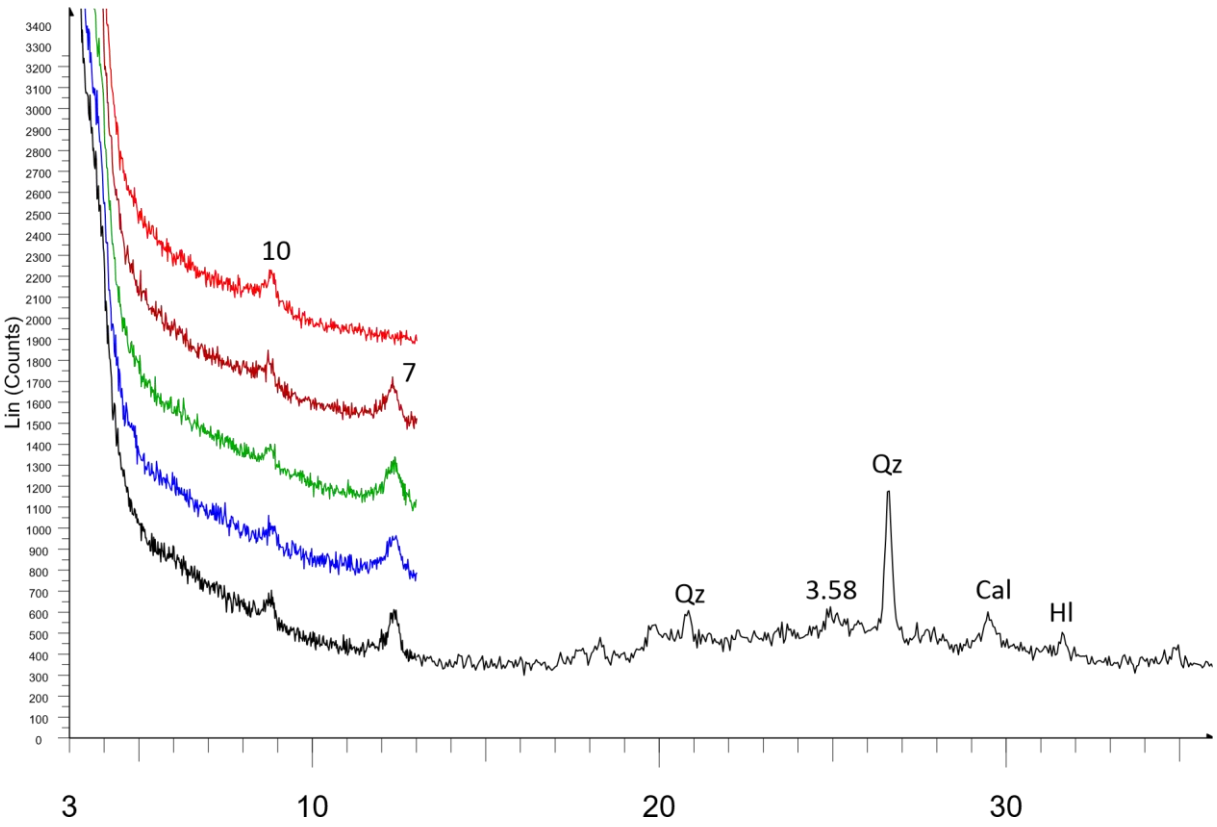
LU17 00192 010



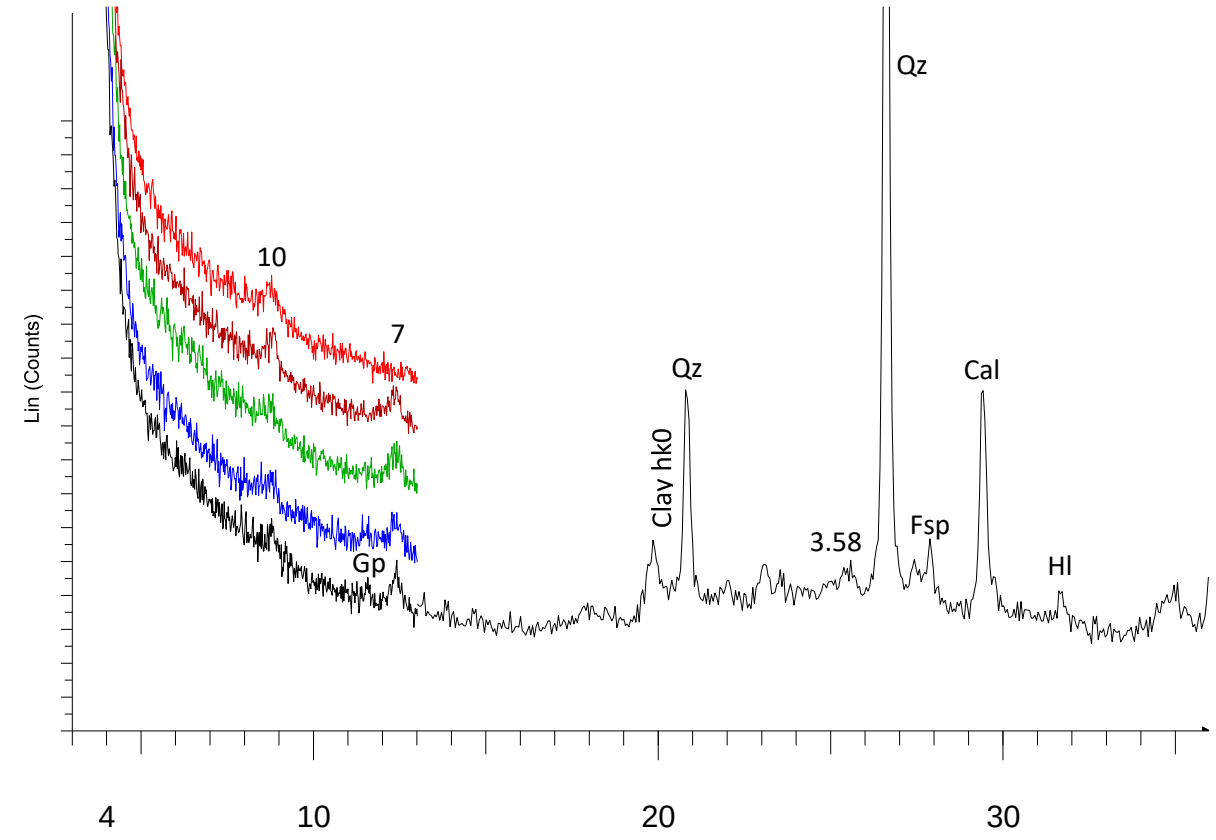
LU17 192 011 (22400)



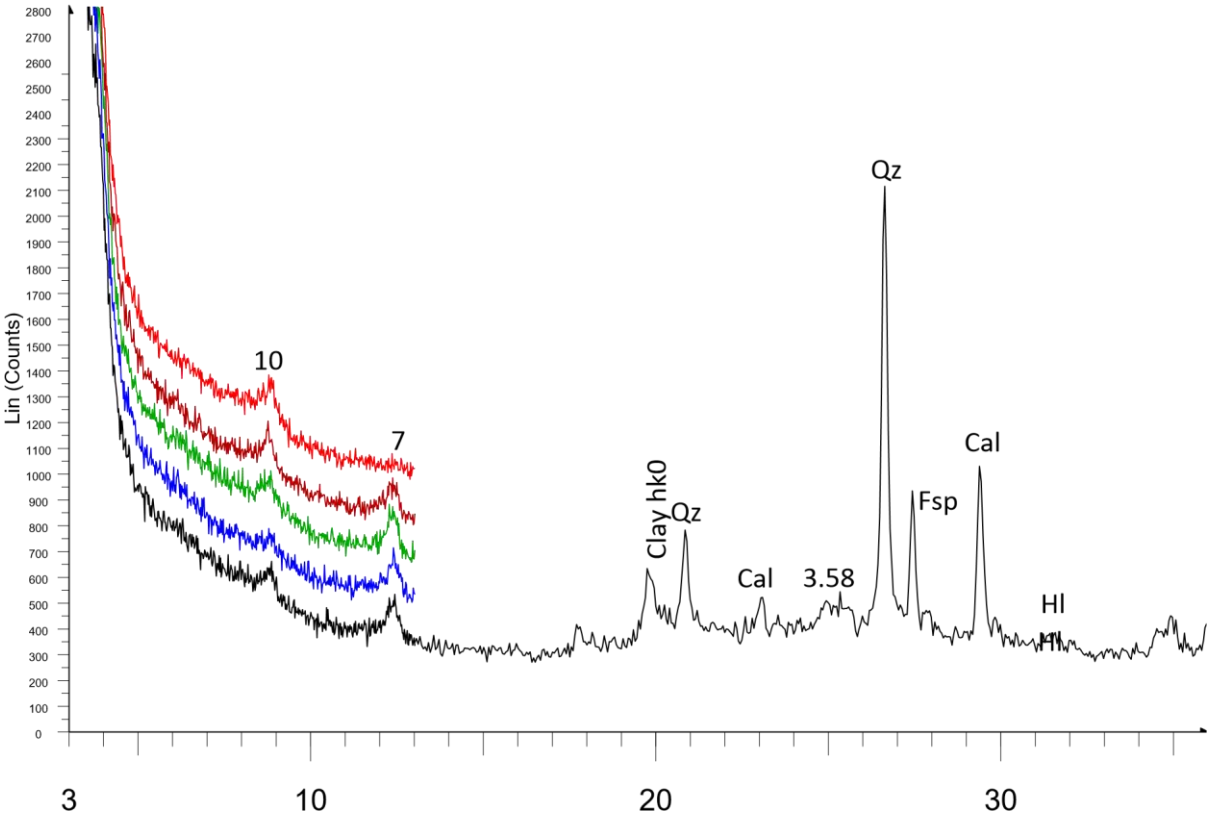
LU17 00192 012 (22461)



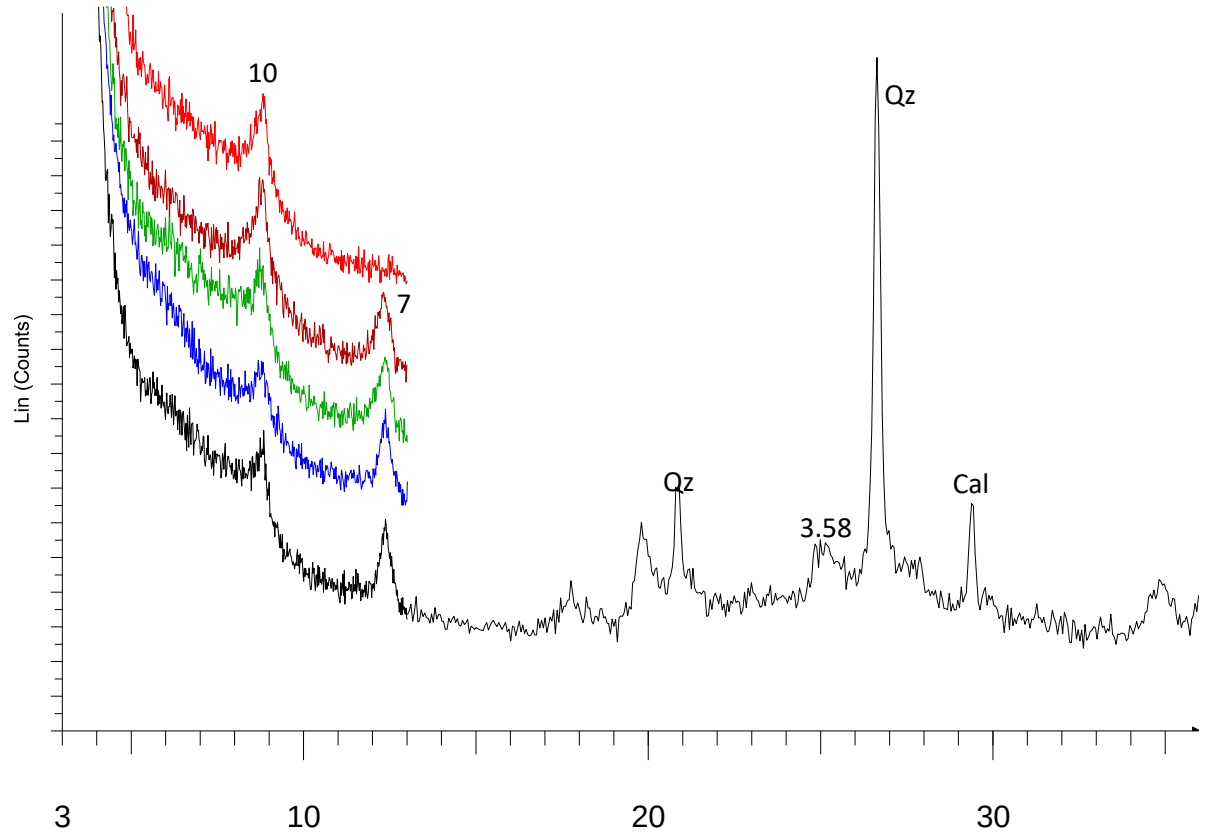
LU17 192 013 (22497)



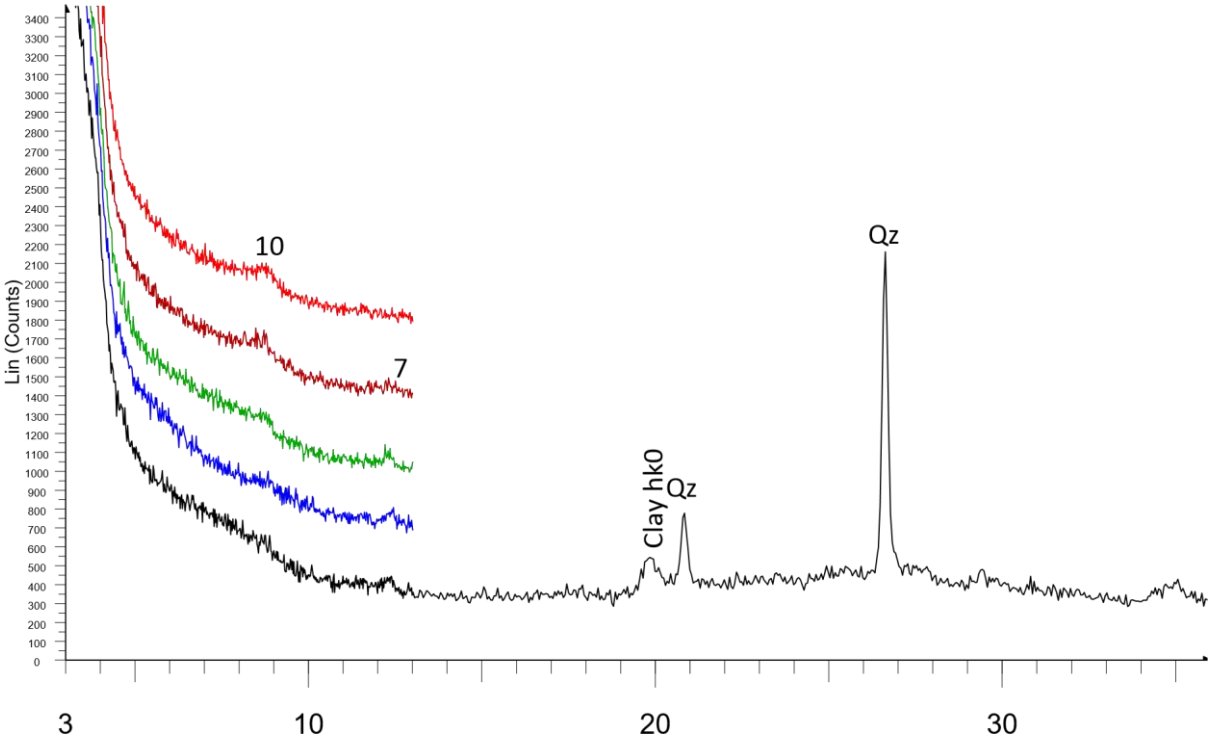
LU17 192 014 (22503)



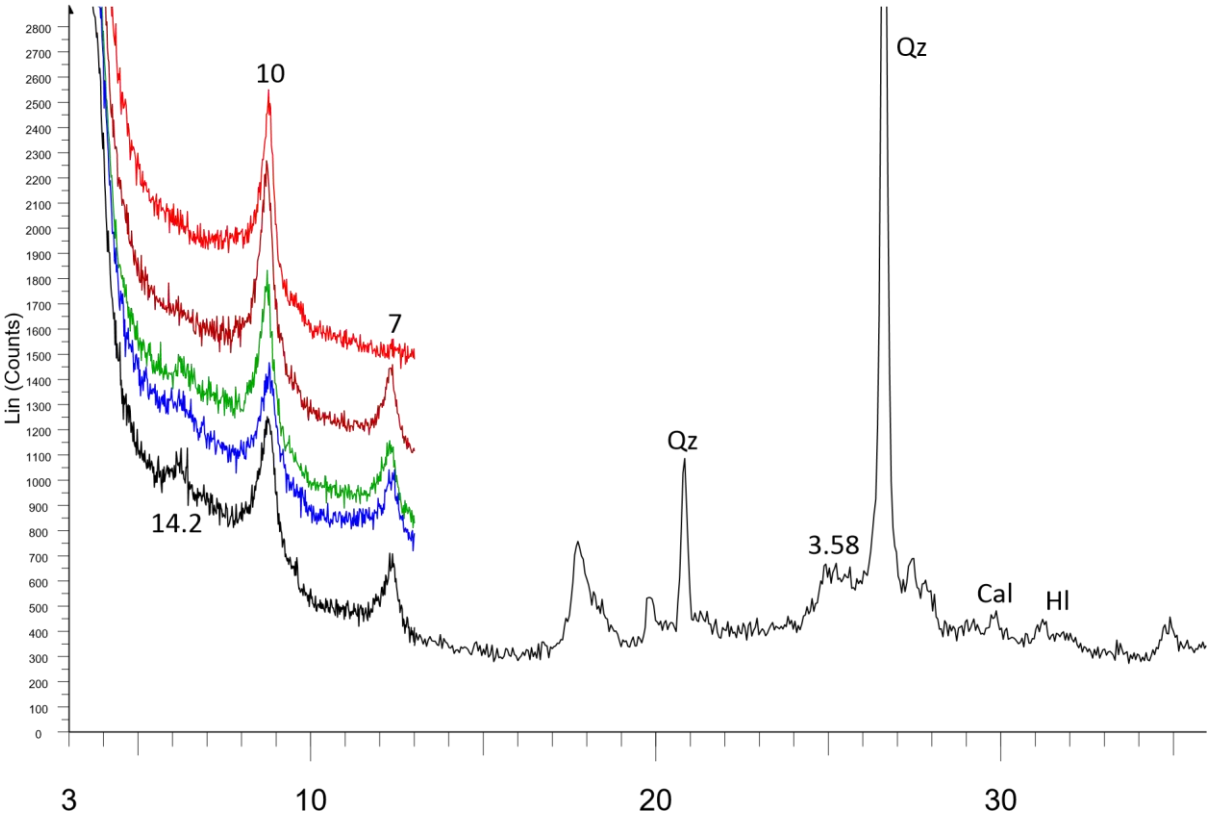
LU17 192 015 (22506)



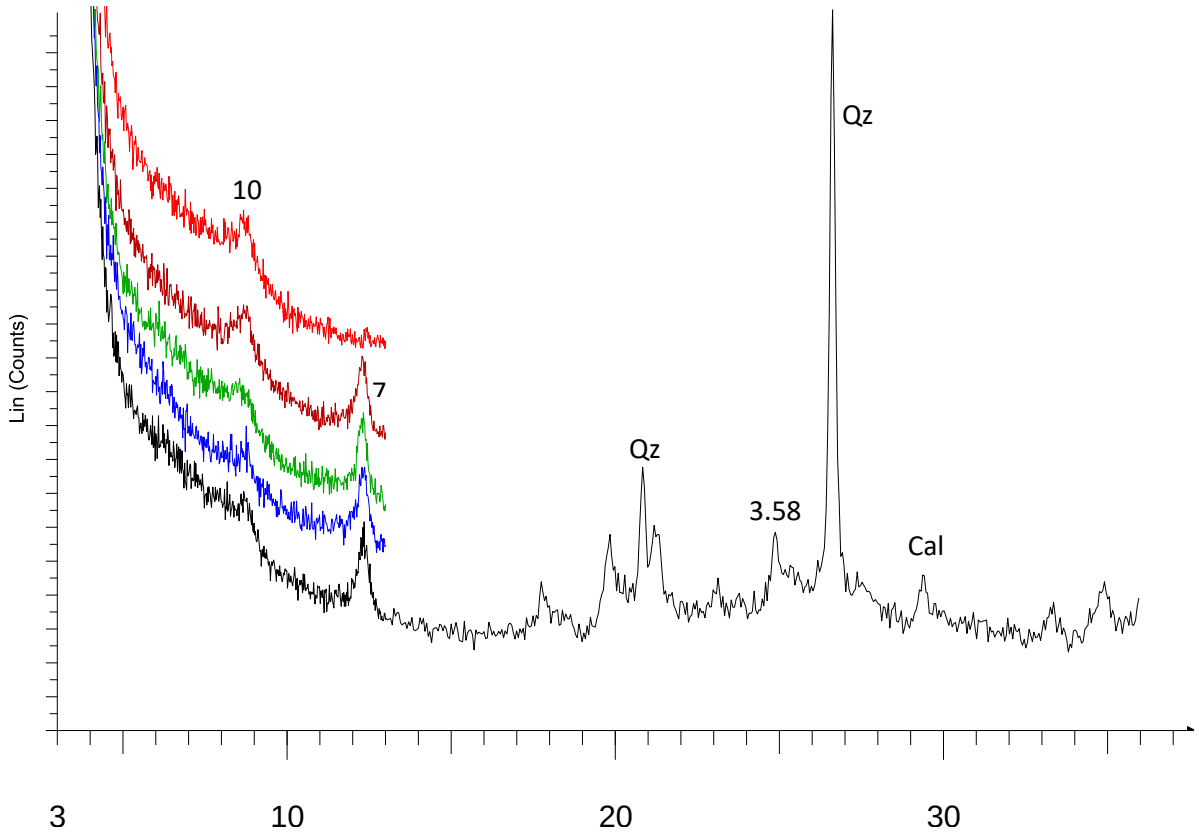
LU17 00192 016 (22675)



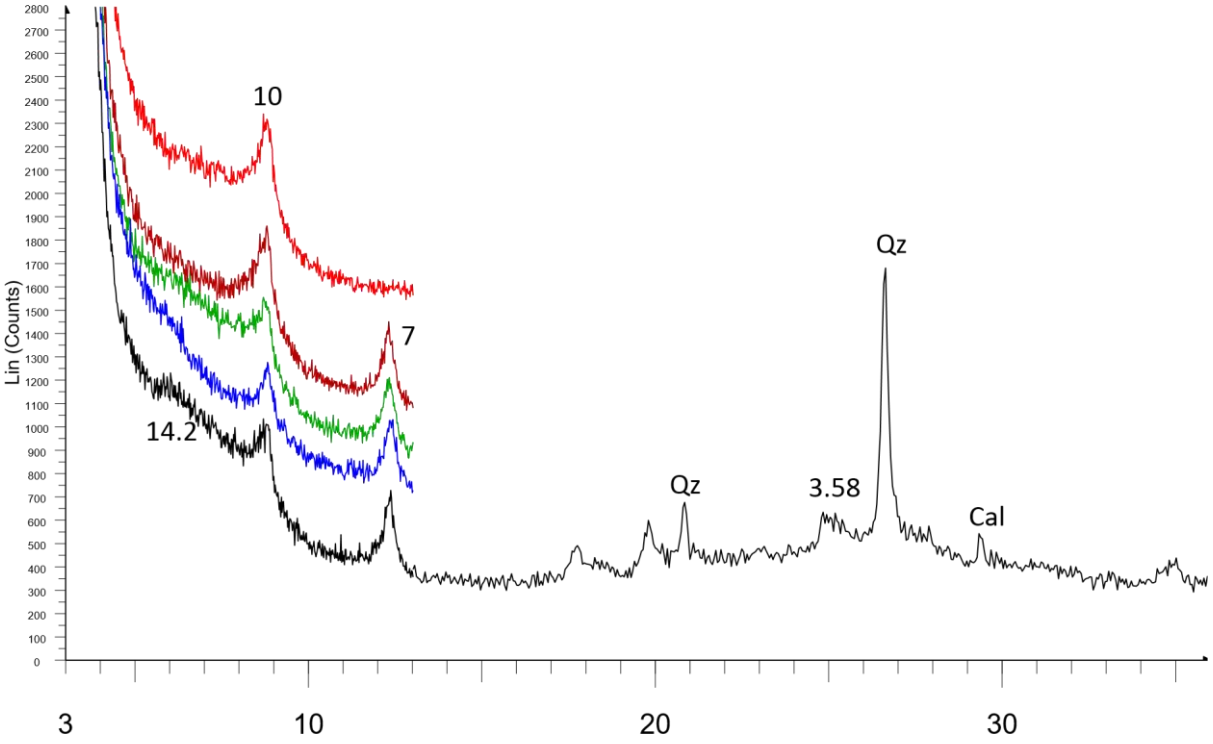
LU17 192 017 (22797)



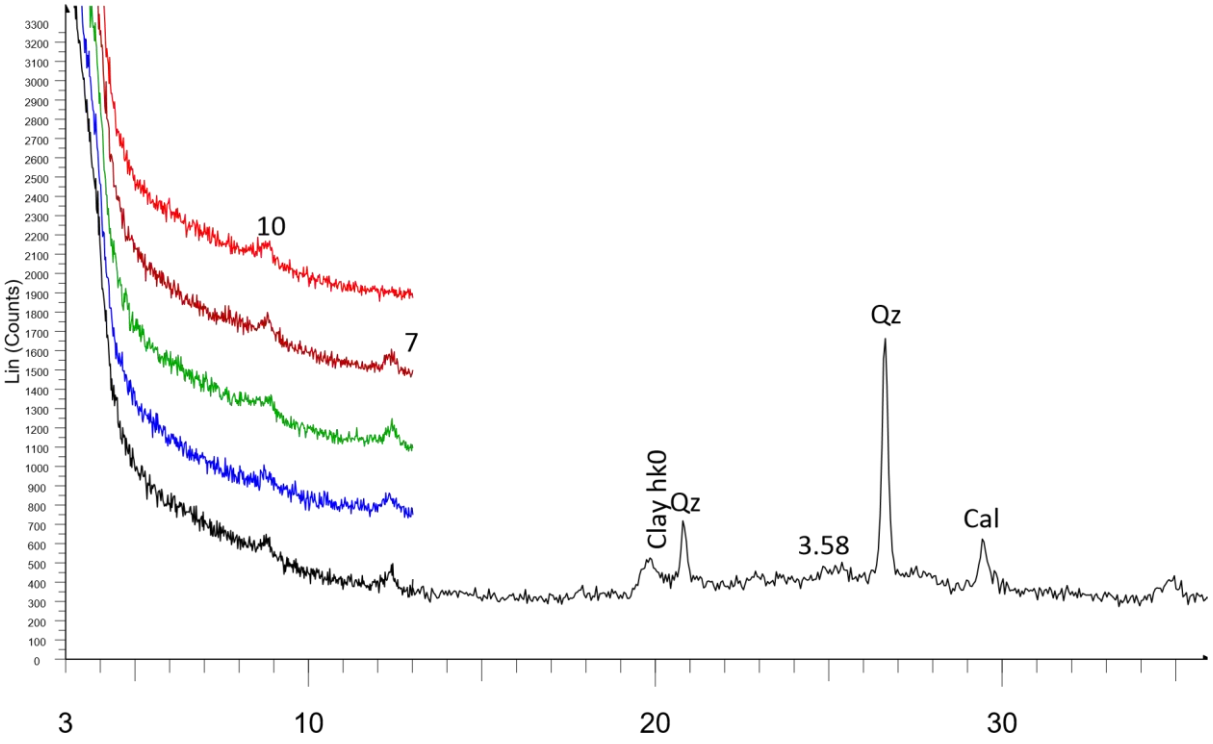
LU17 192 018 (22843)



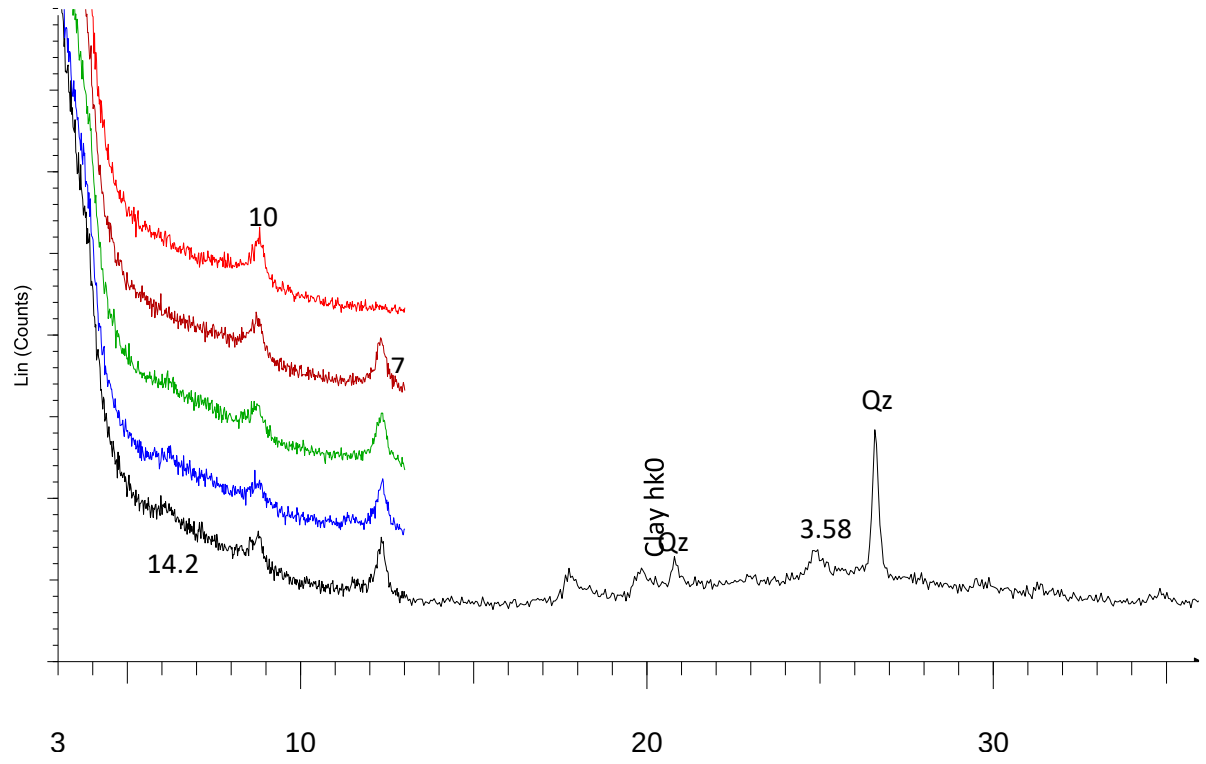
LU17 192 019 (22940)



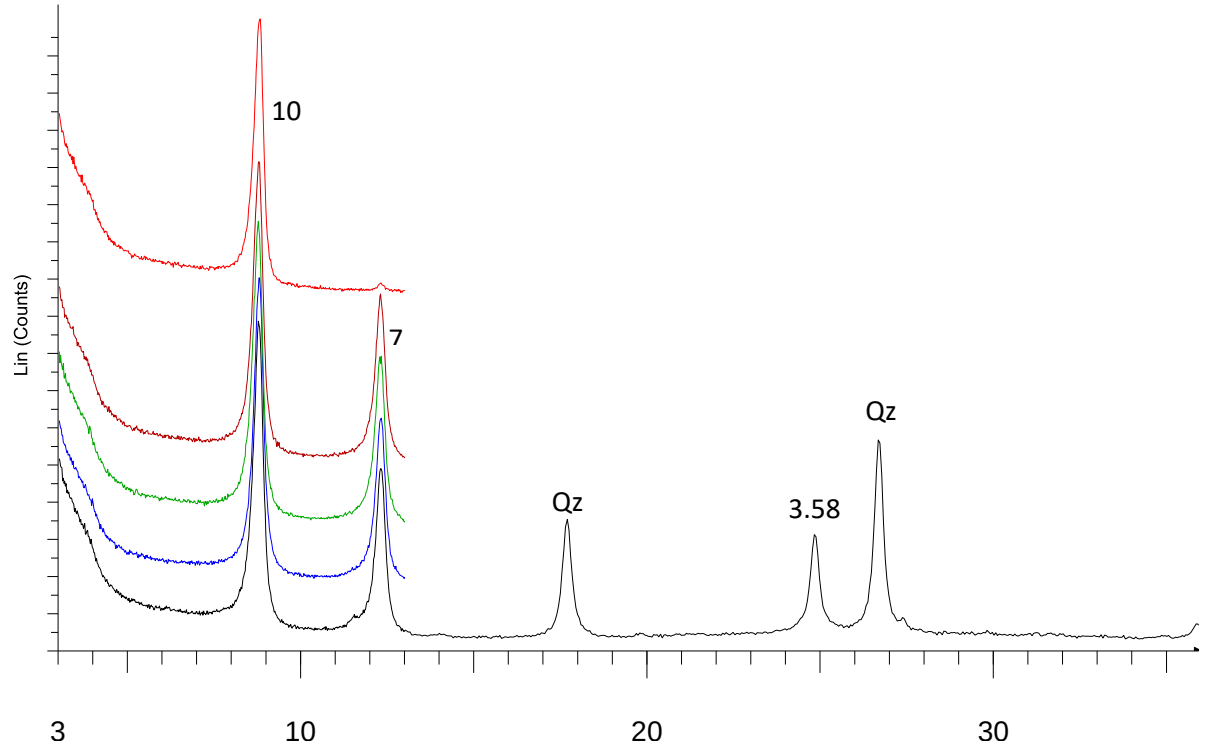
LU17 00192 020 (22950)



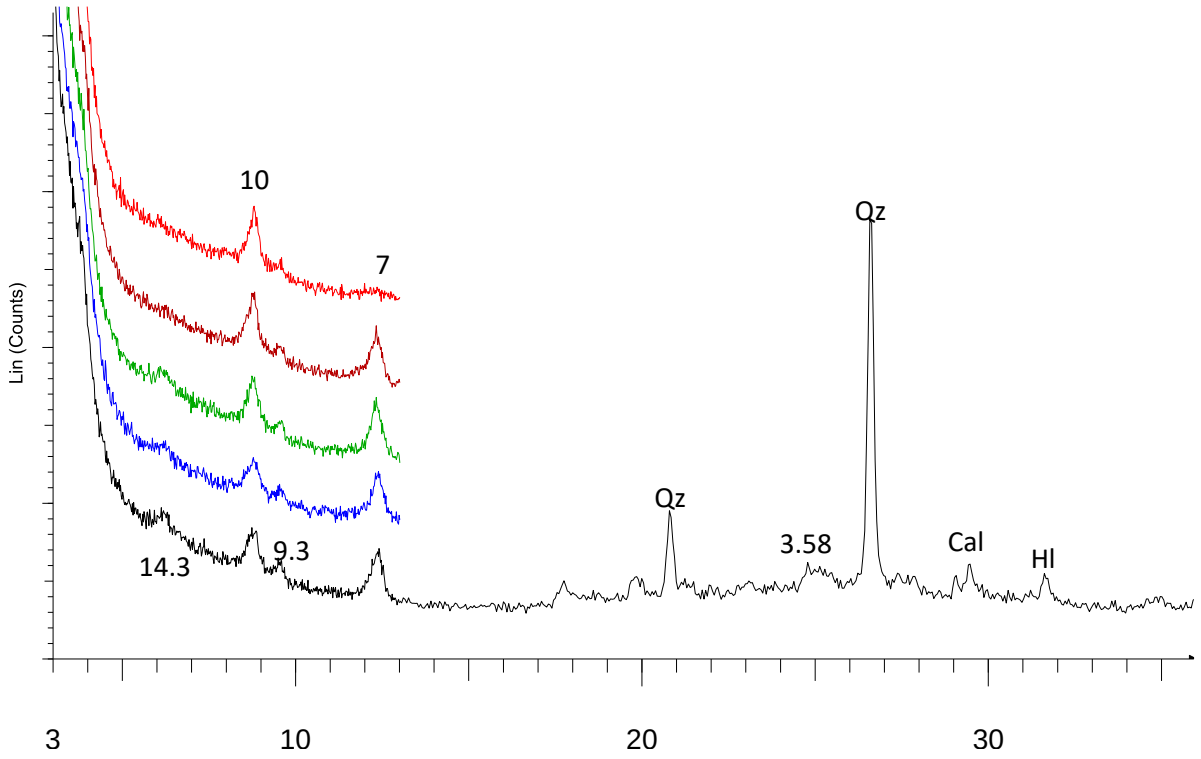
LU17 00192 021 (23135)



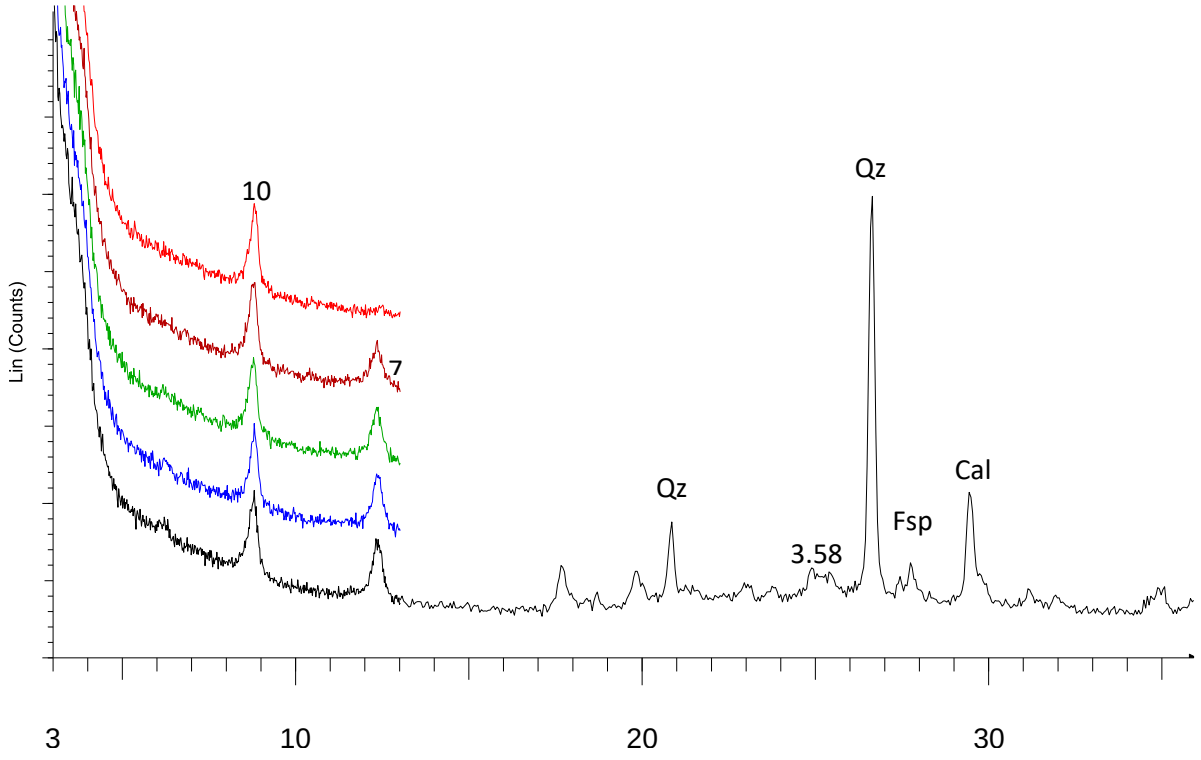
LU17 00192 022 (23217)



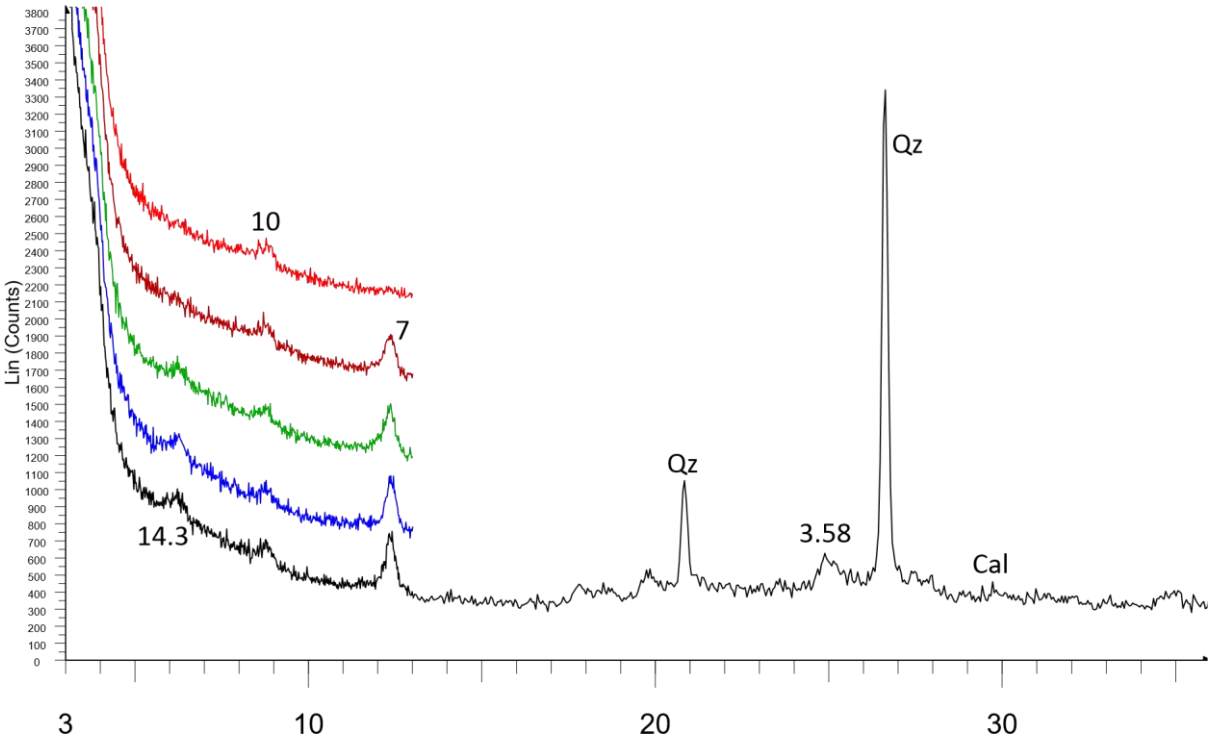
LU17 00192 023 (23219)



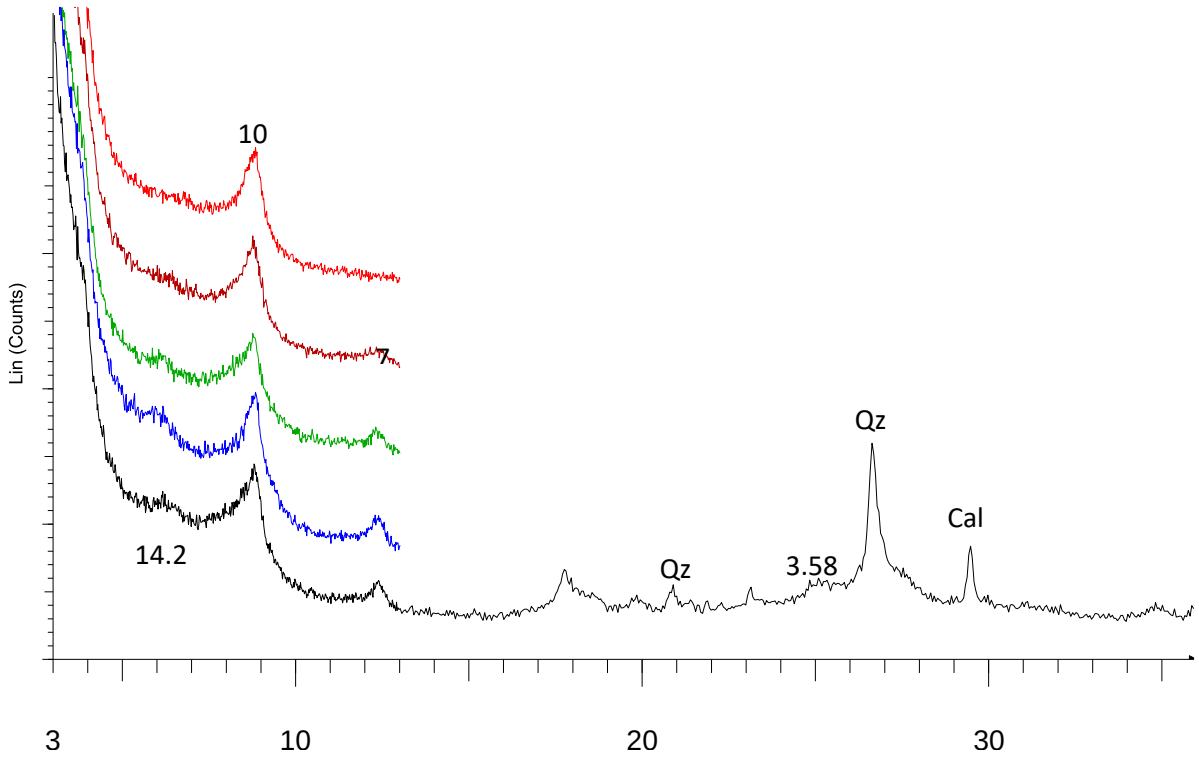
LU17 00192 024



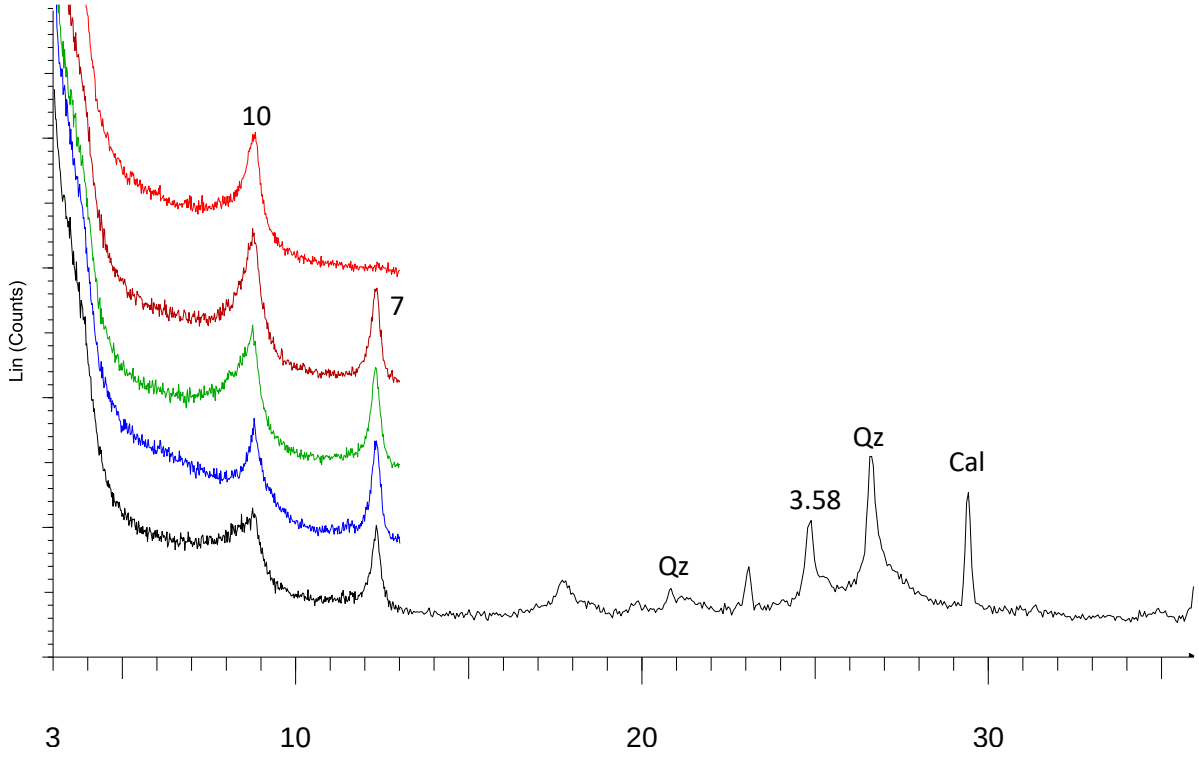
LU17 00192 025 (23245)



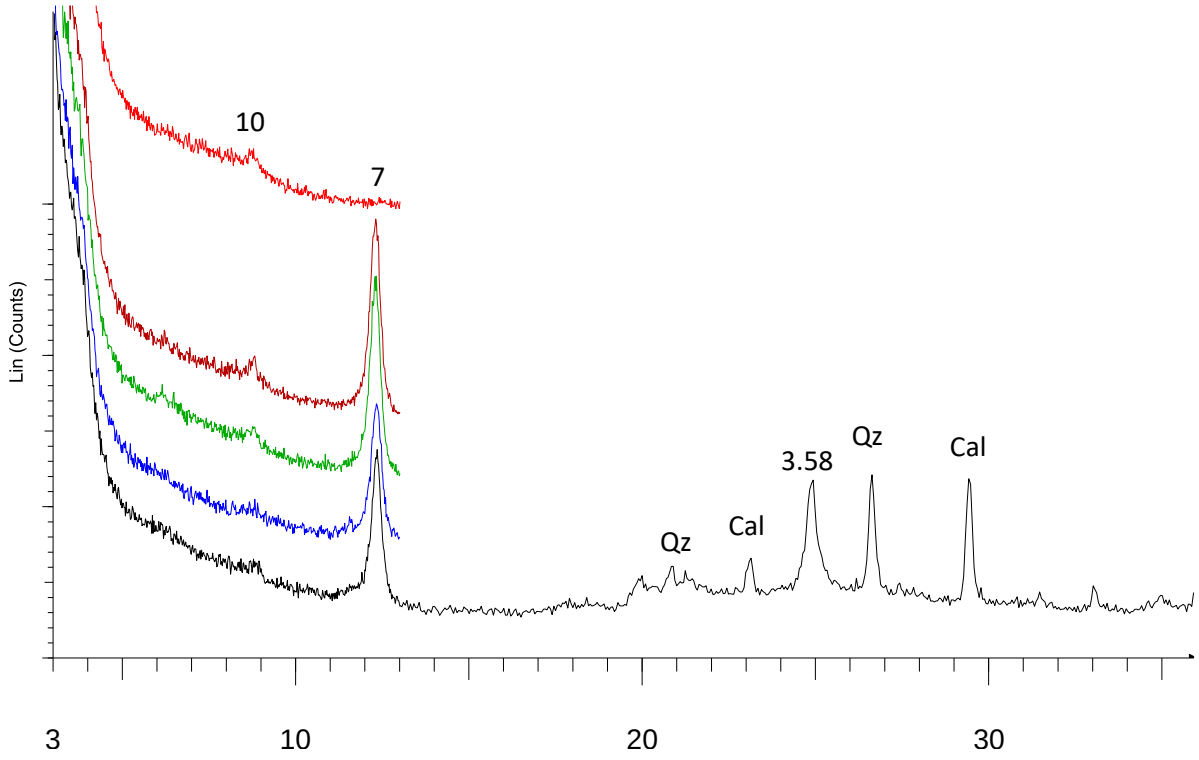
LU17 00192 026 (23257)



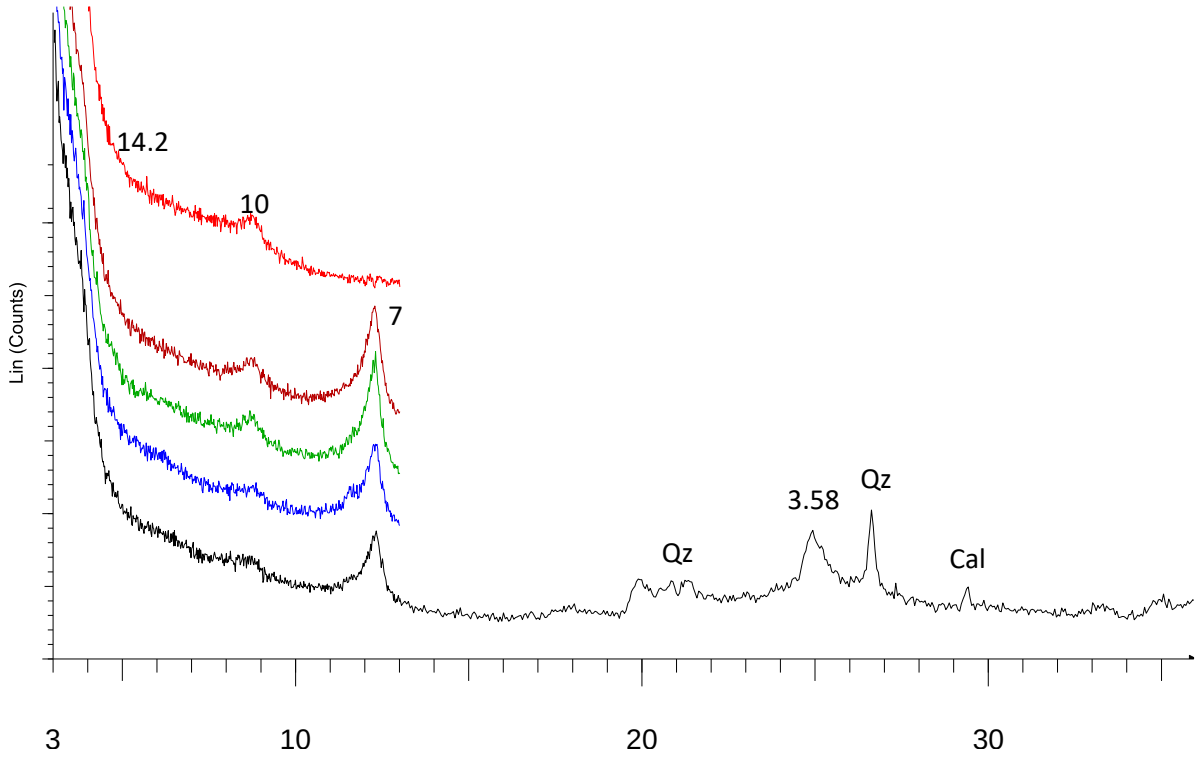
LU17 00192 027 (23262)



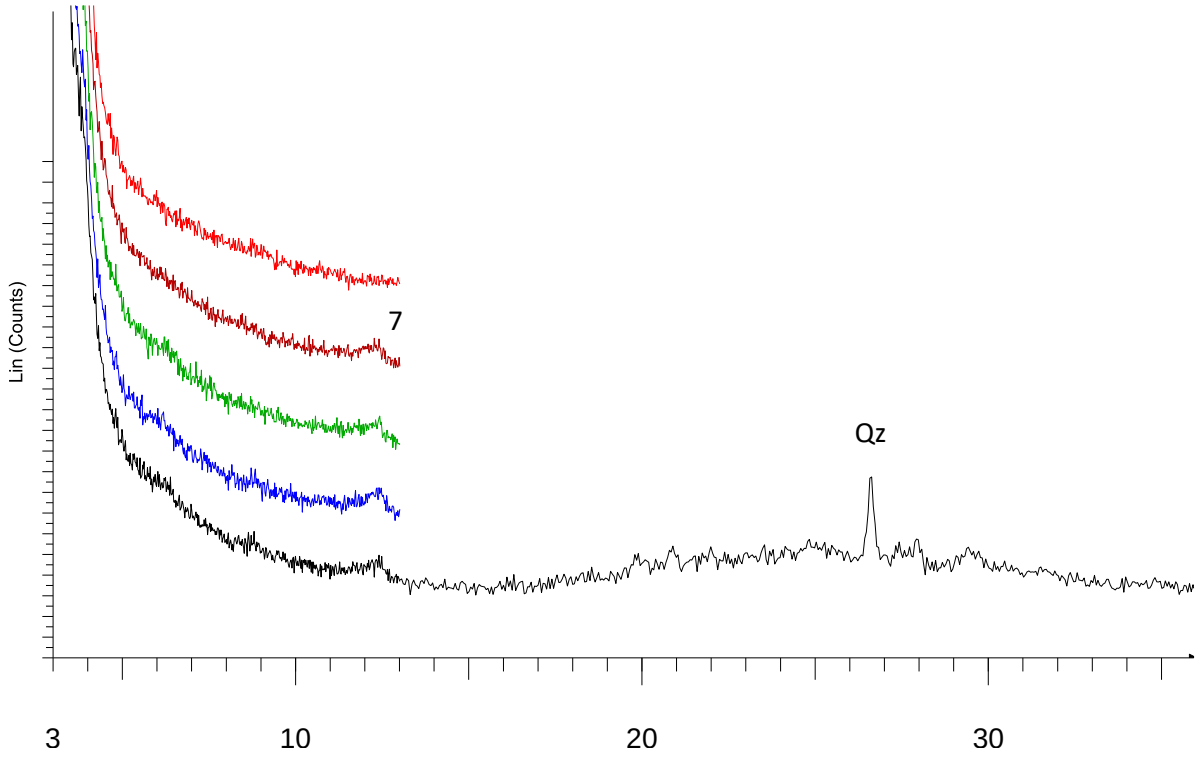
LU17 00192 028 (23453)



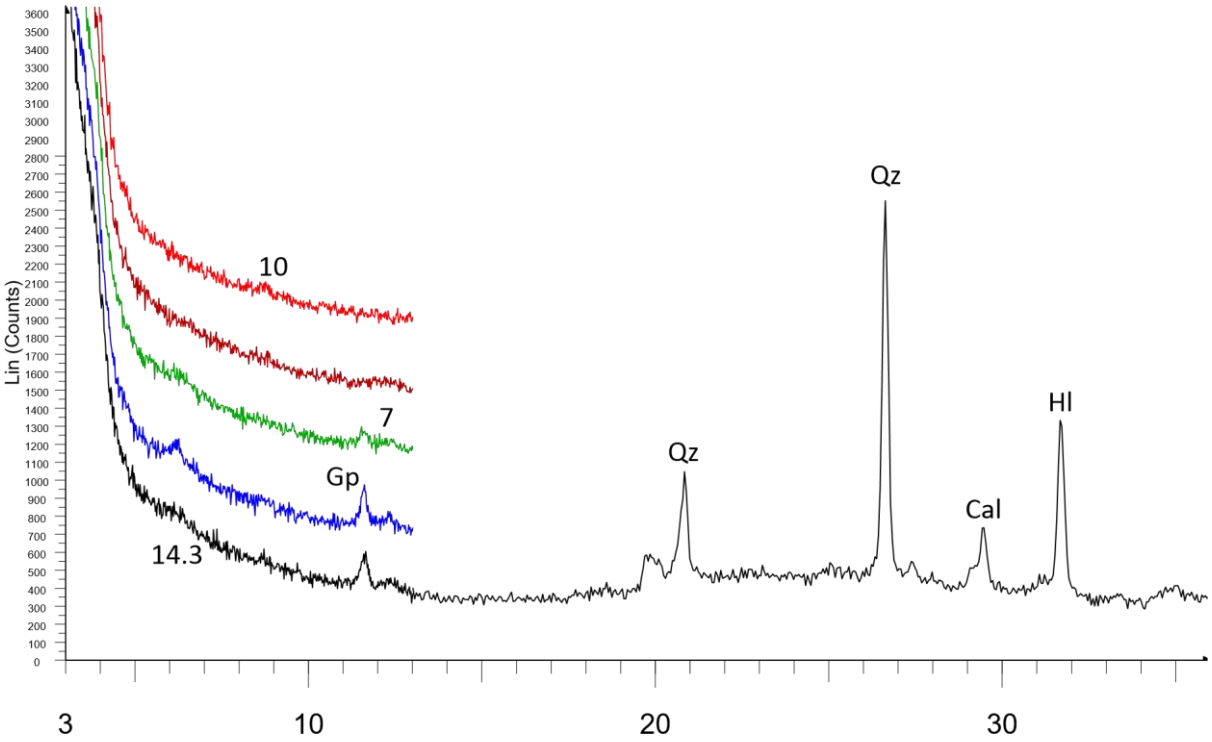
LU17 00192 029 (23533)



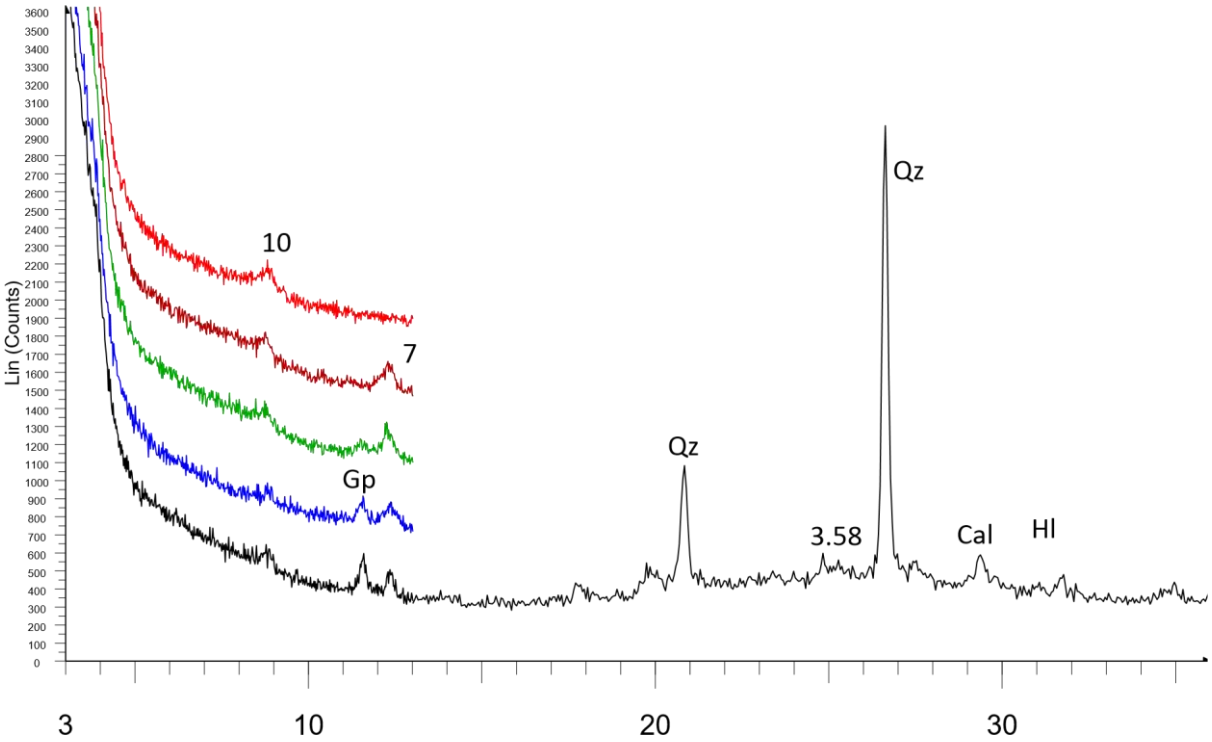
LU17 00192 030 (23693)



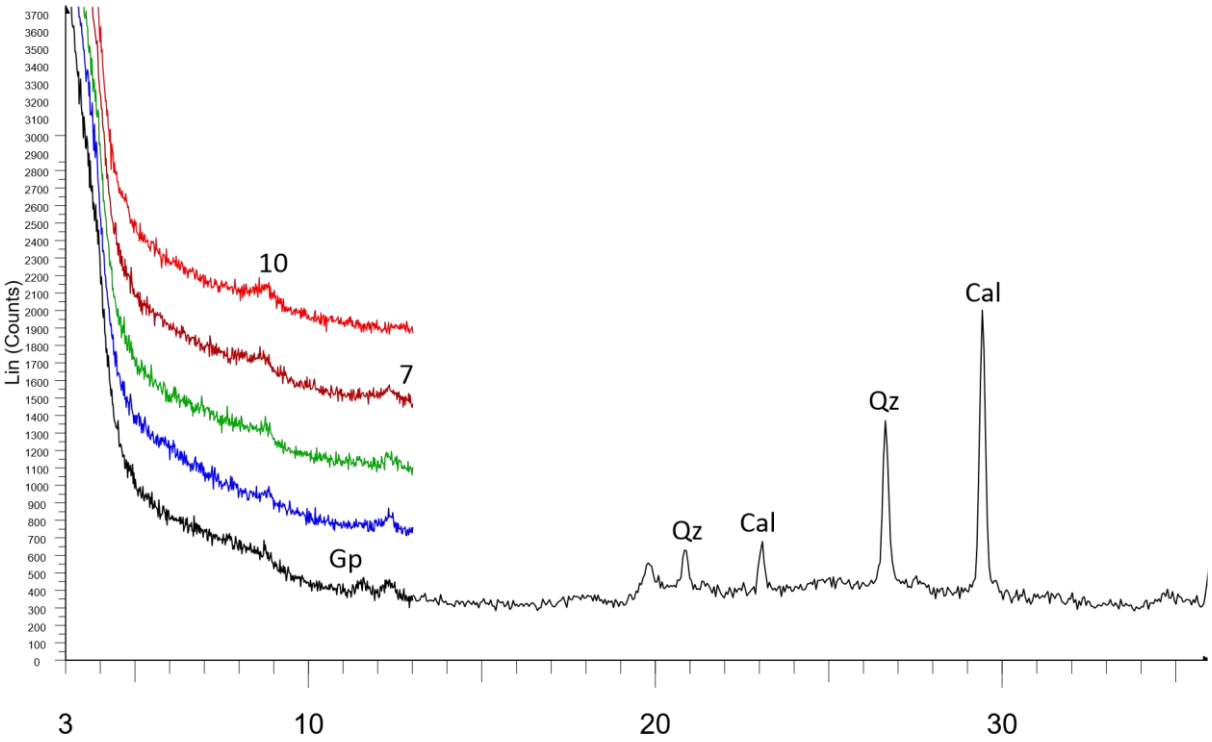
LU17 00192 031 (23771)



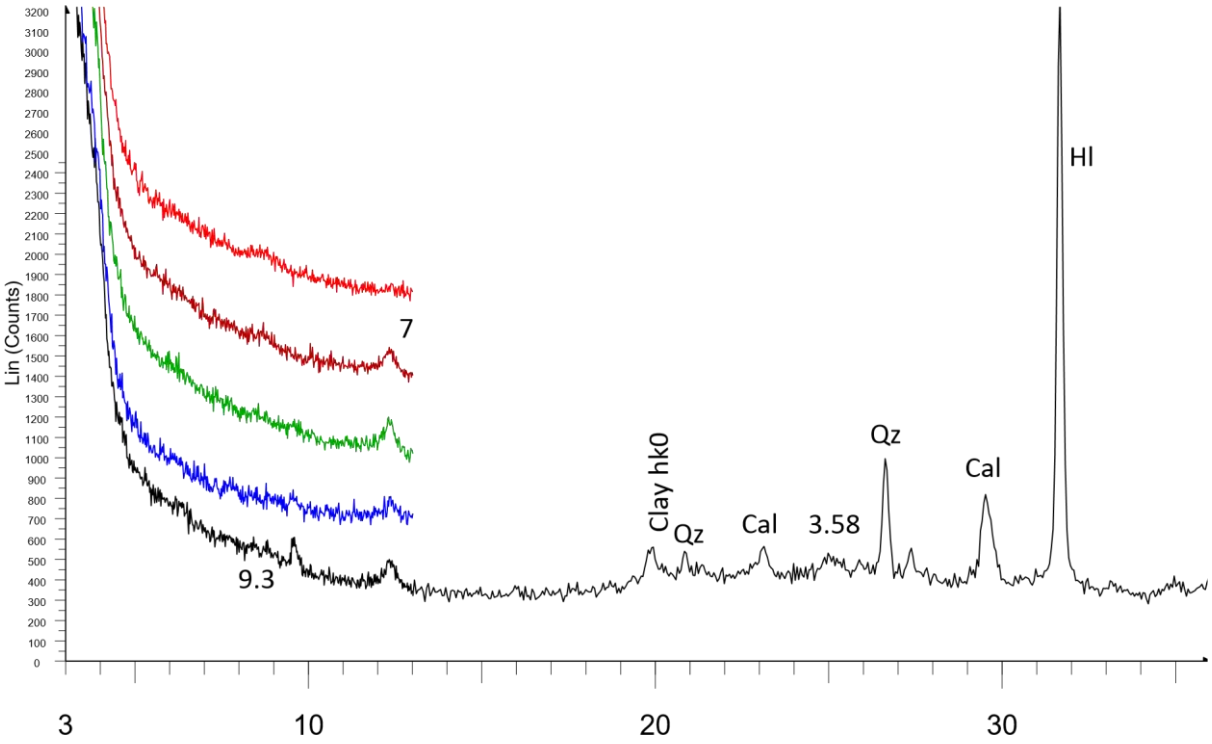
LU17 00192 032 (23811)



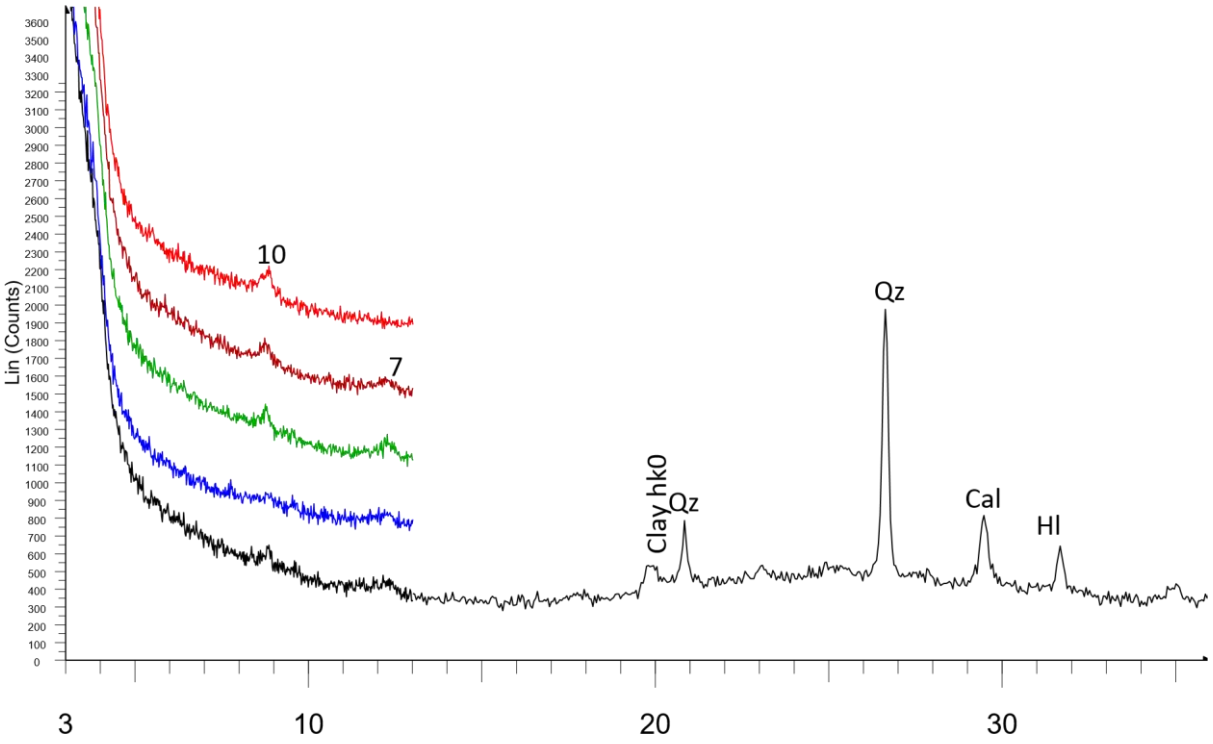
LU17 00192 033 (23813)



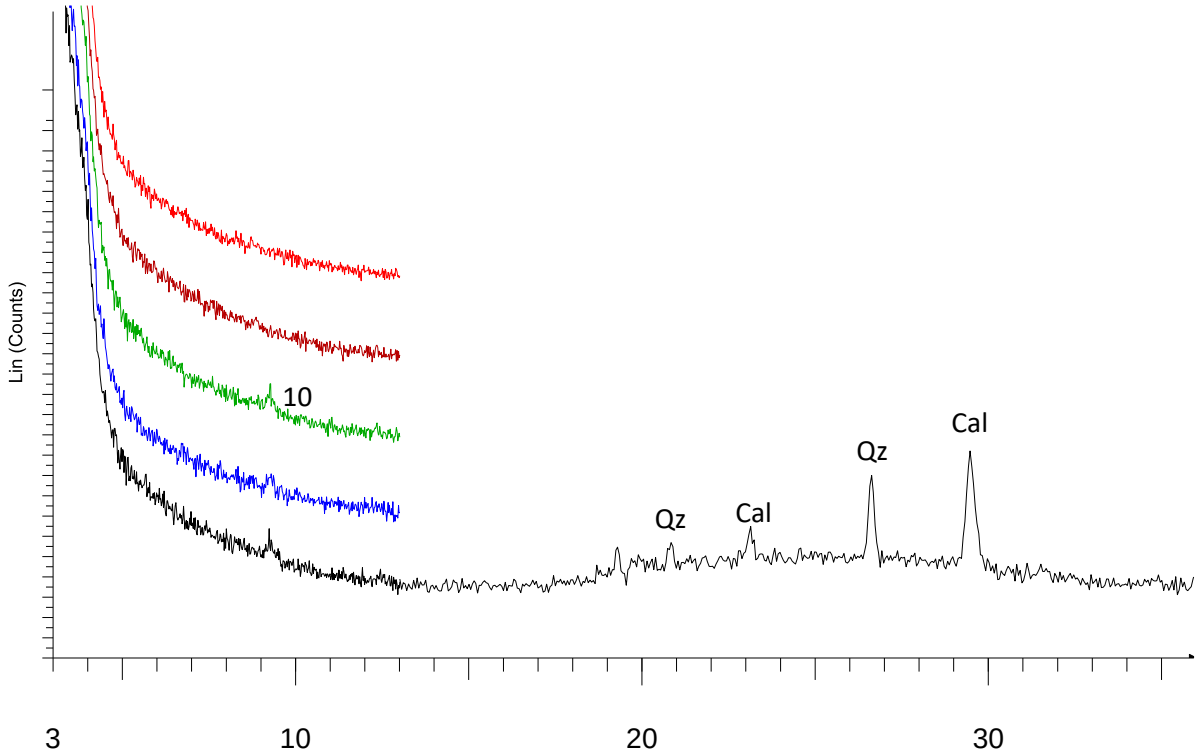
LU17 00192 034 (24038)



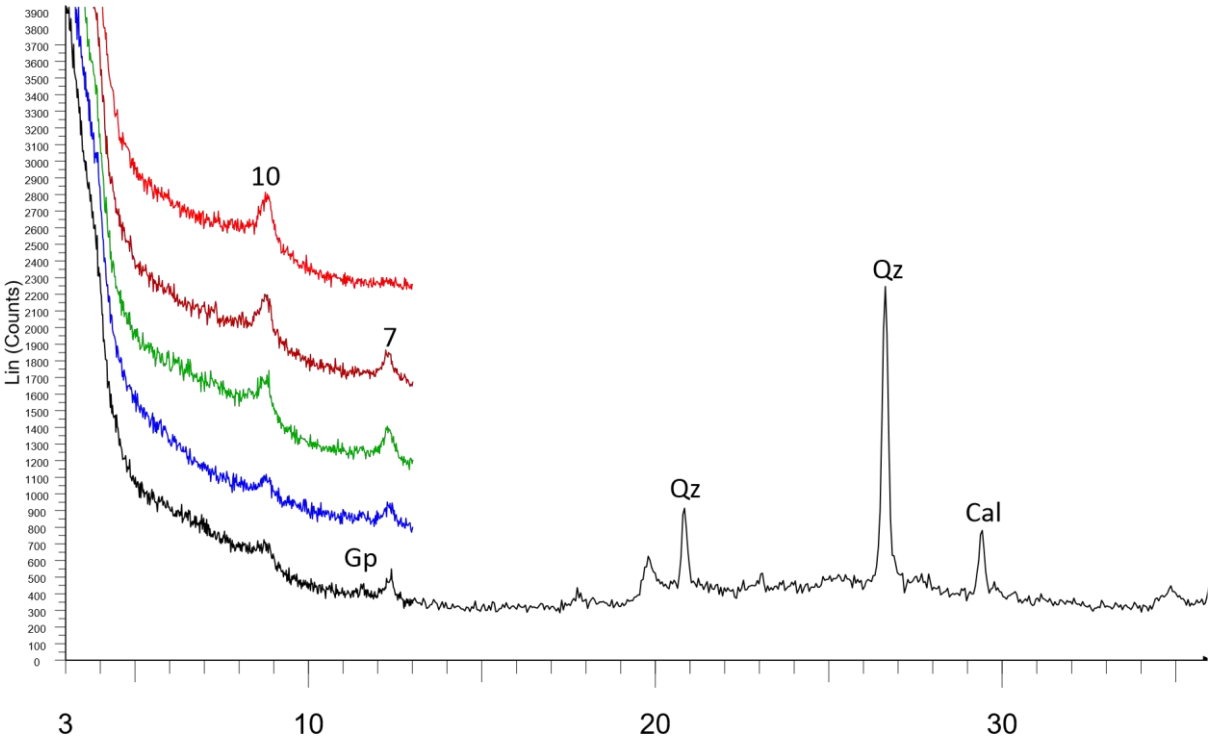
LU17 00192 035 (24100)



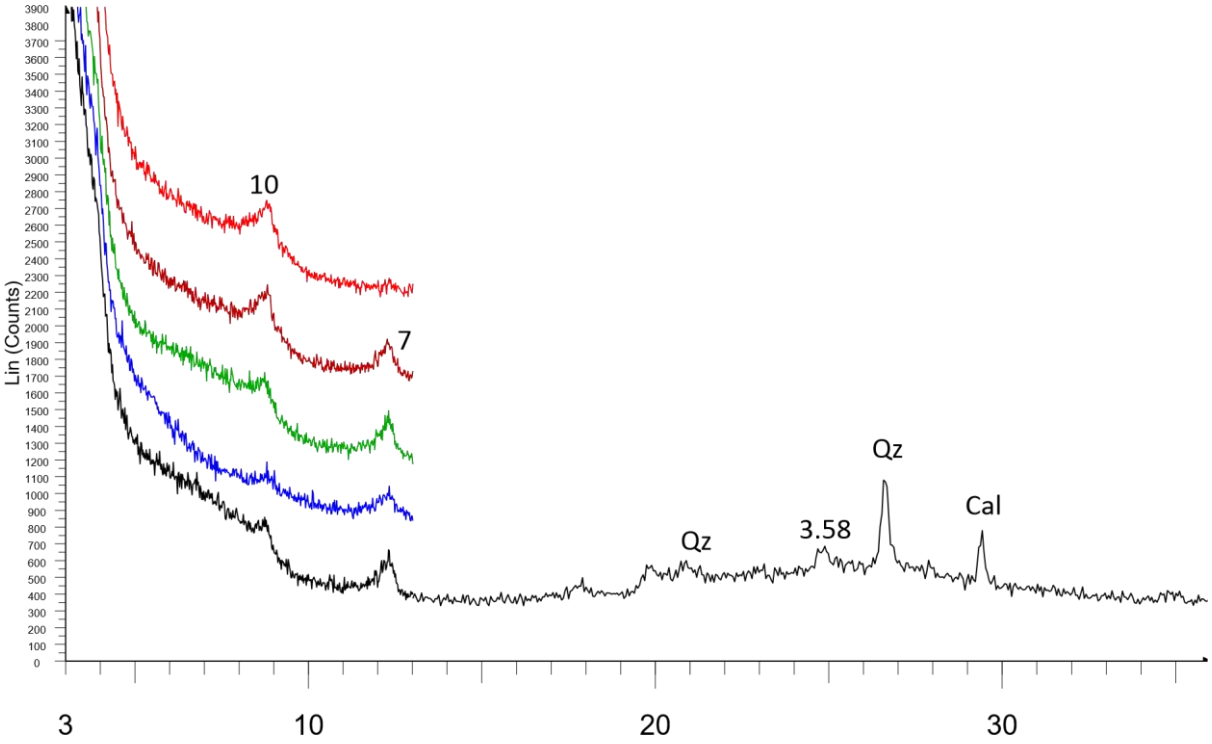
LU17 00192 036 (24191)



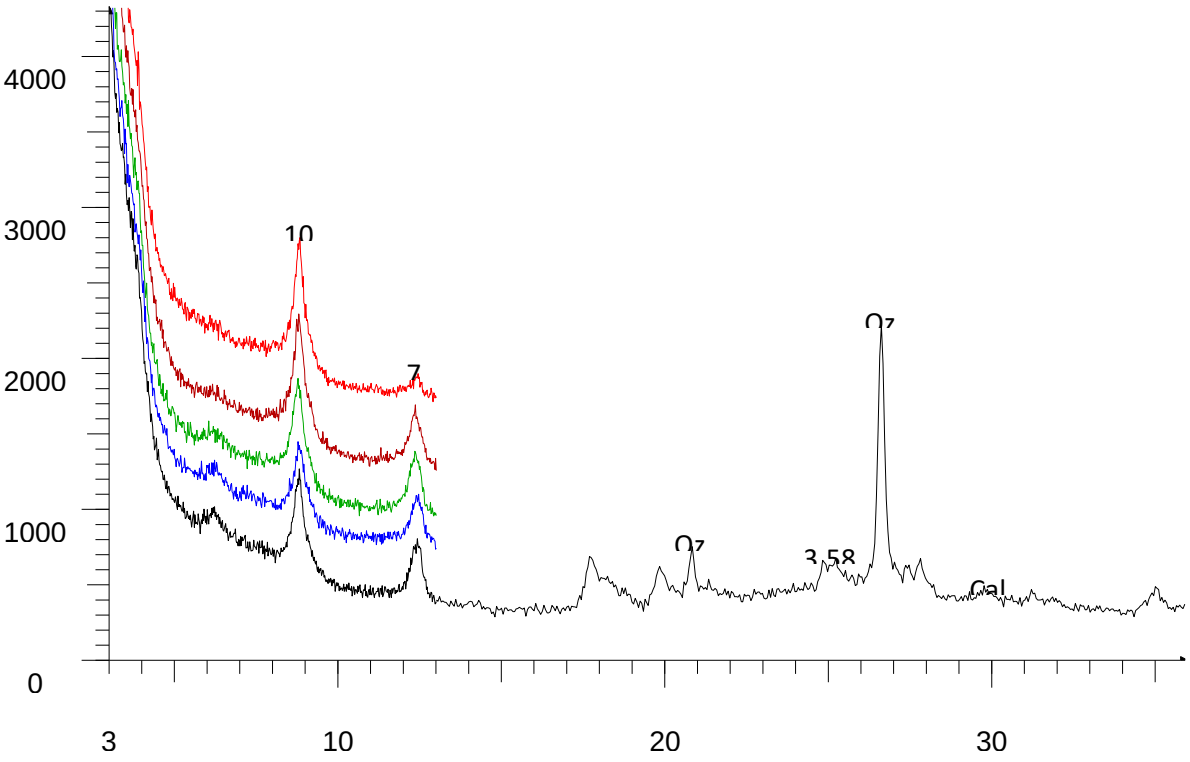
LU17 00192 037 (24230)



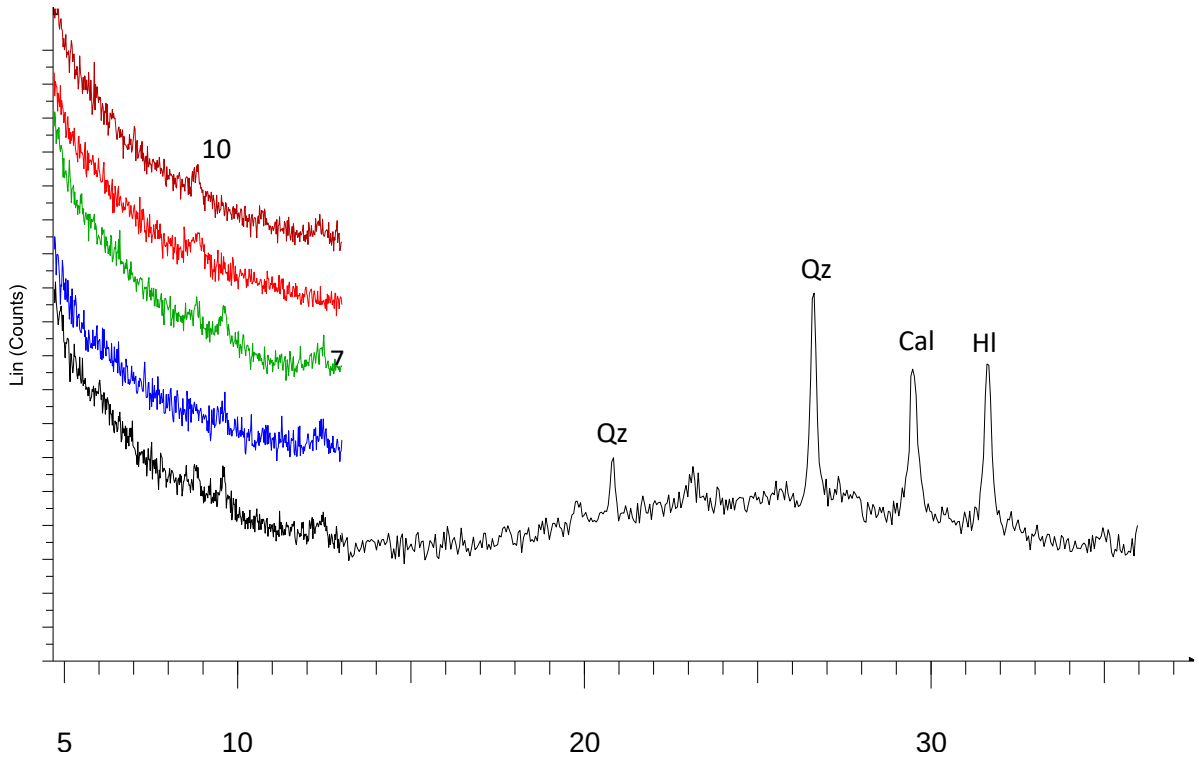
LU17 00192 038 (24236)



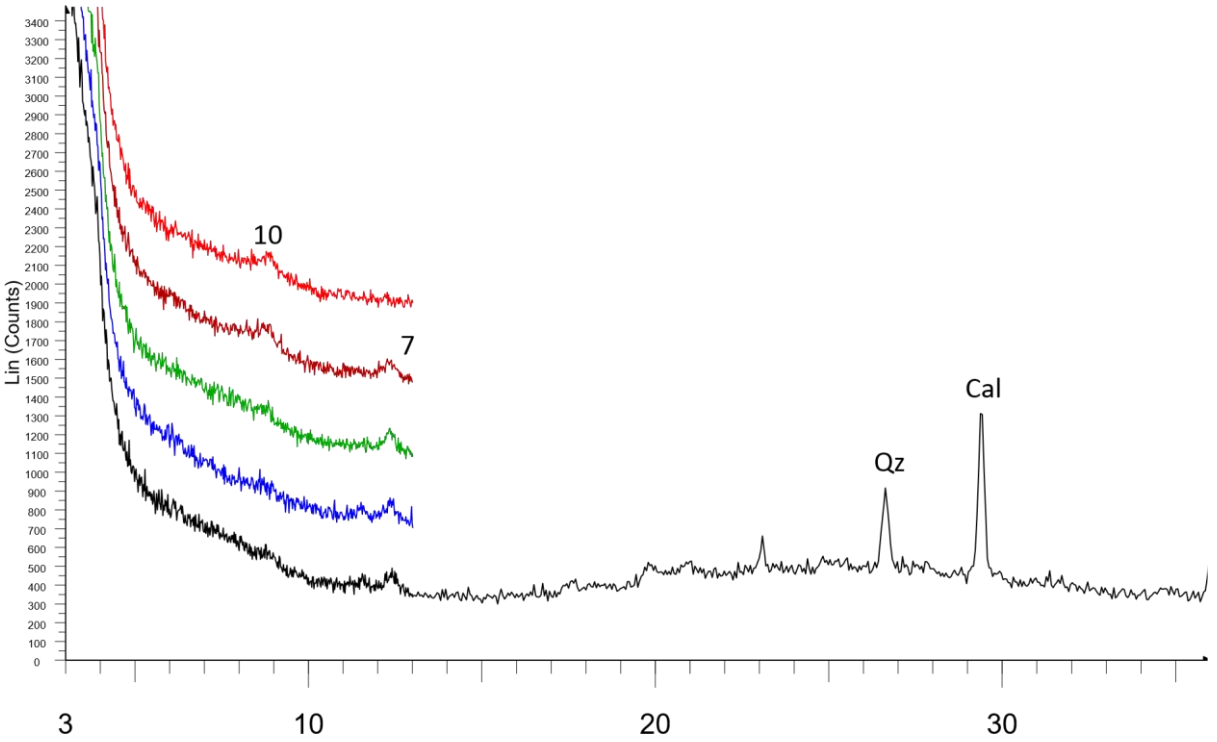
LU17 192 039 (24280)



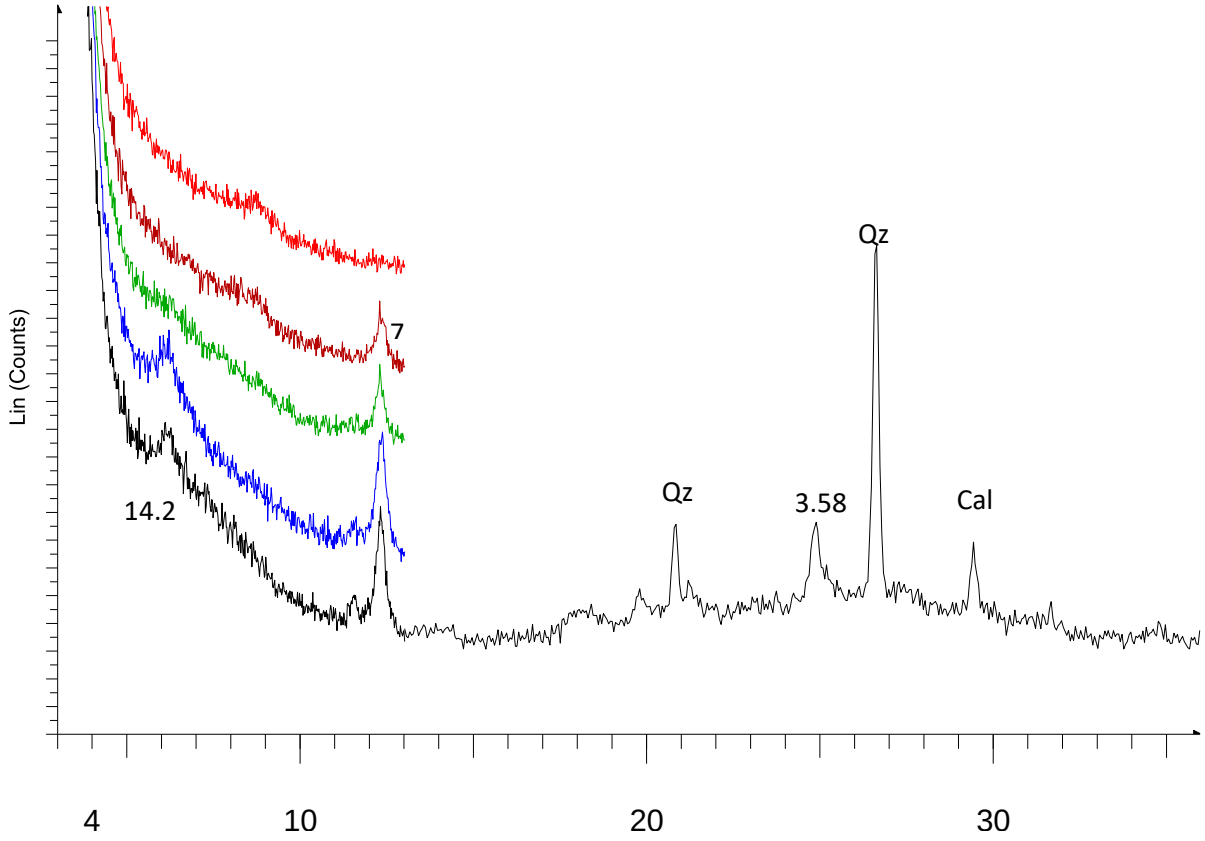
LU17 192 040 (24284)



LU17 00912 041 (24418)



LU17 00192 042 (24432)



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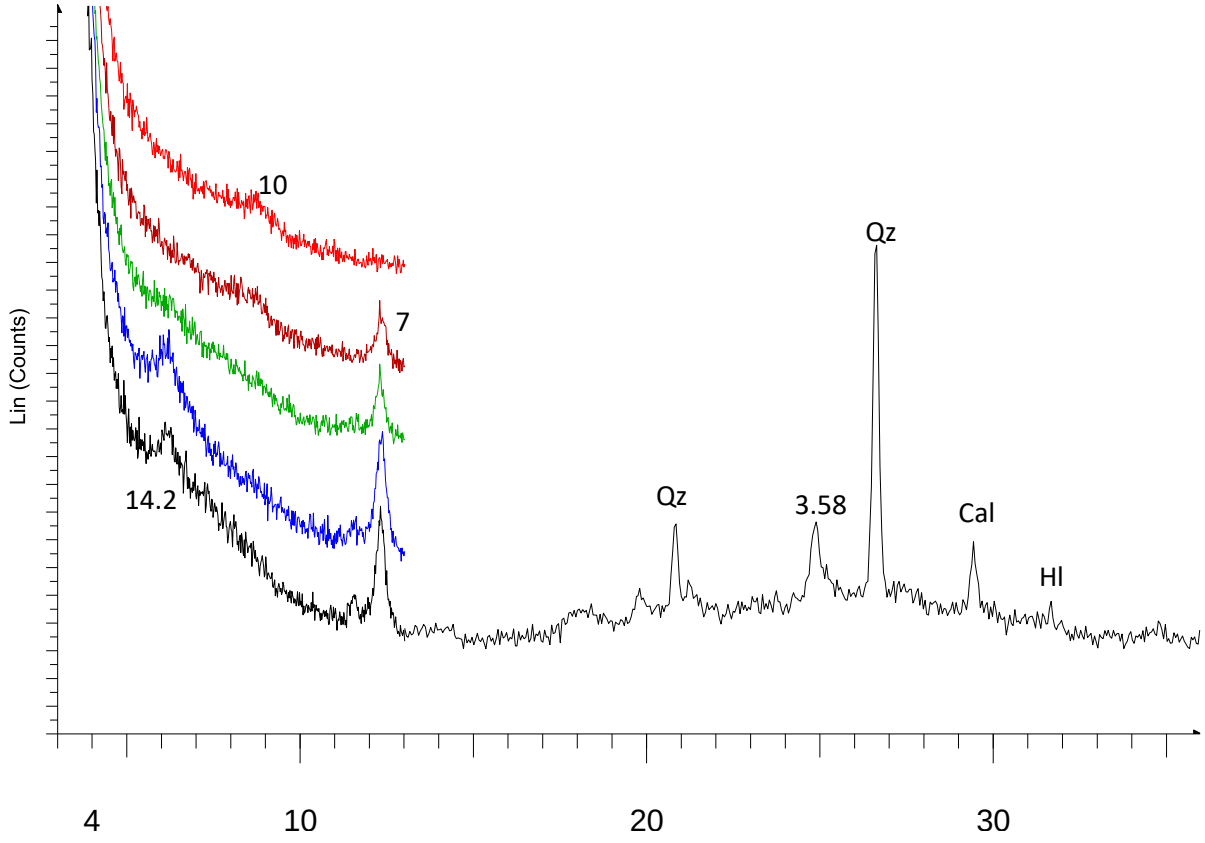

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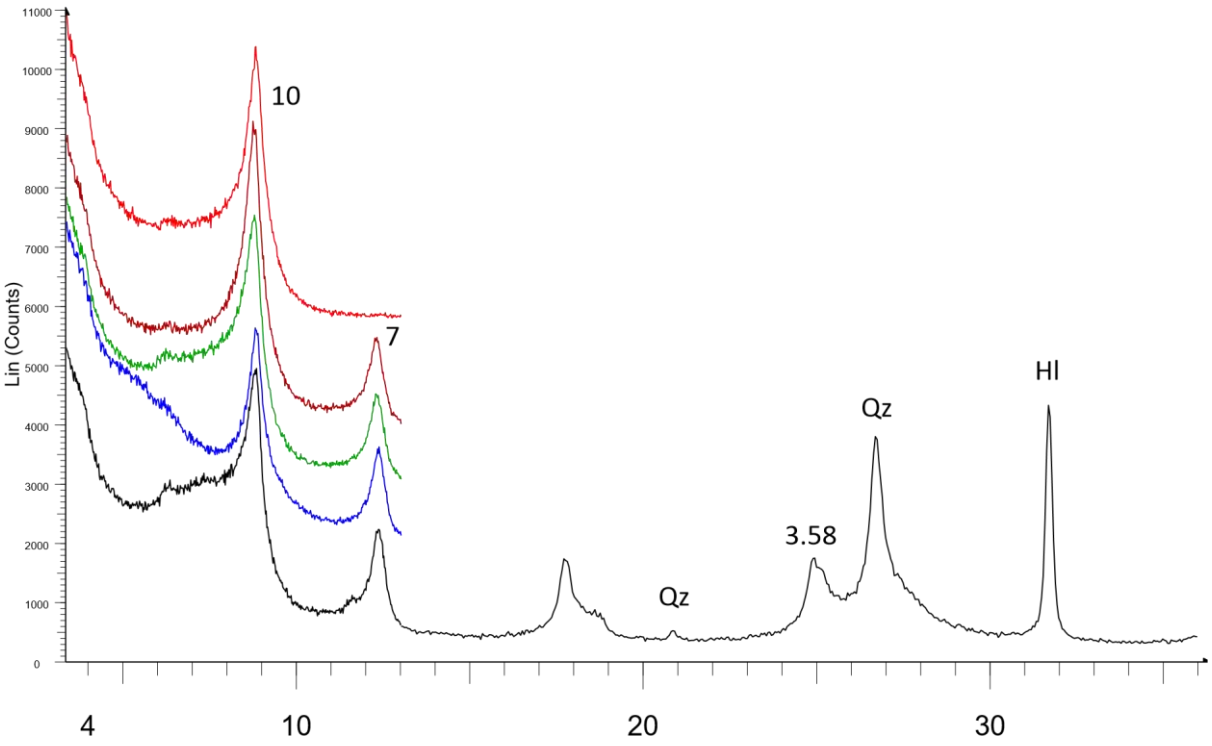

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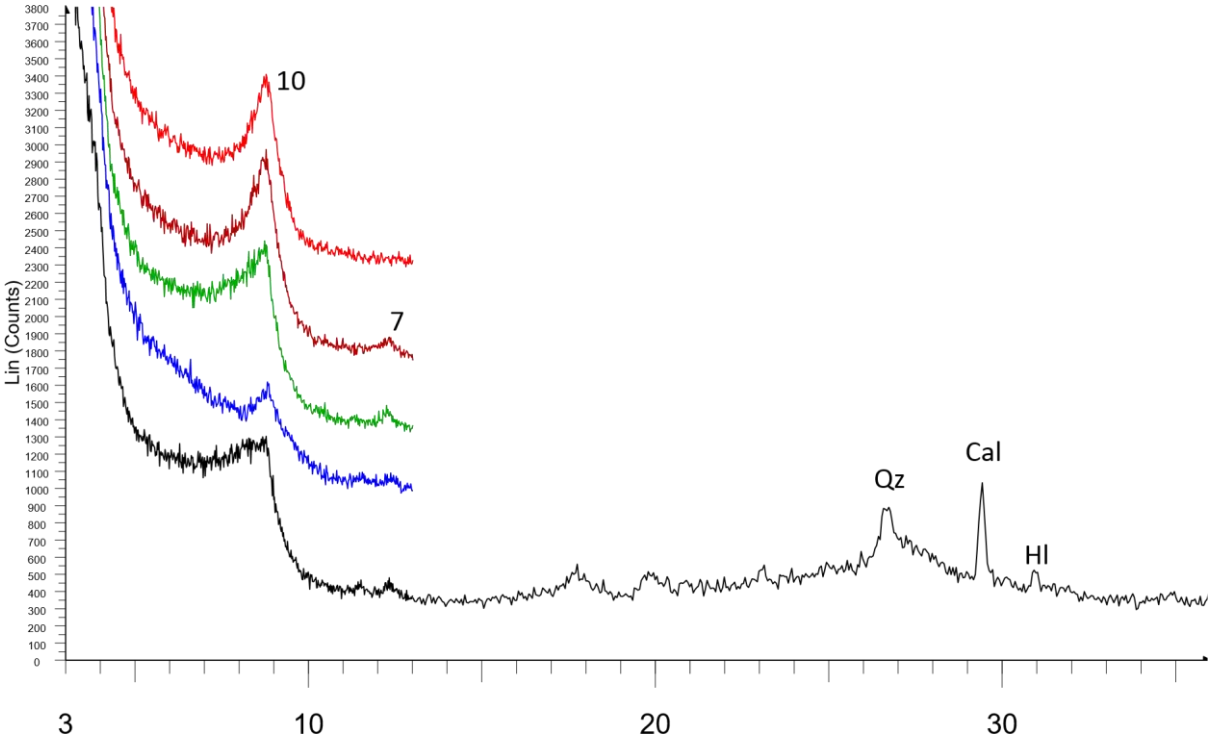

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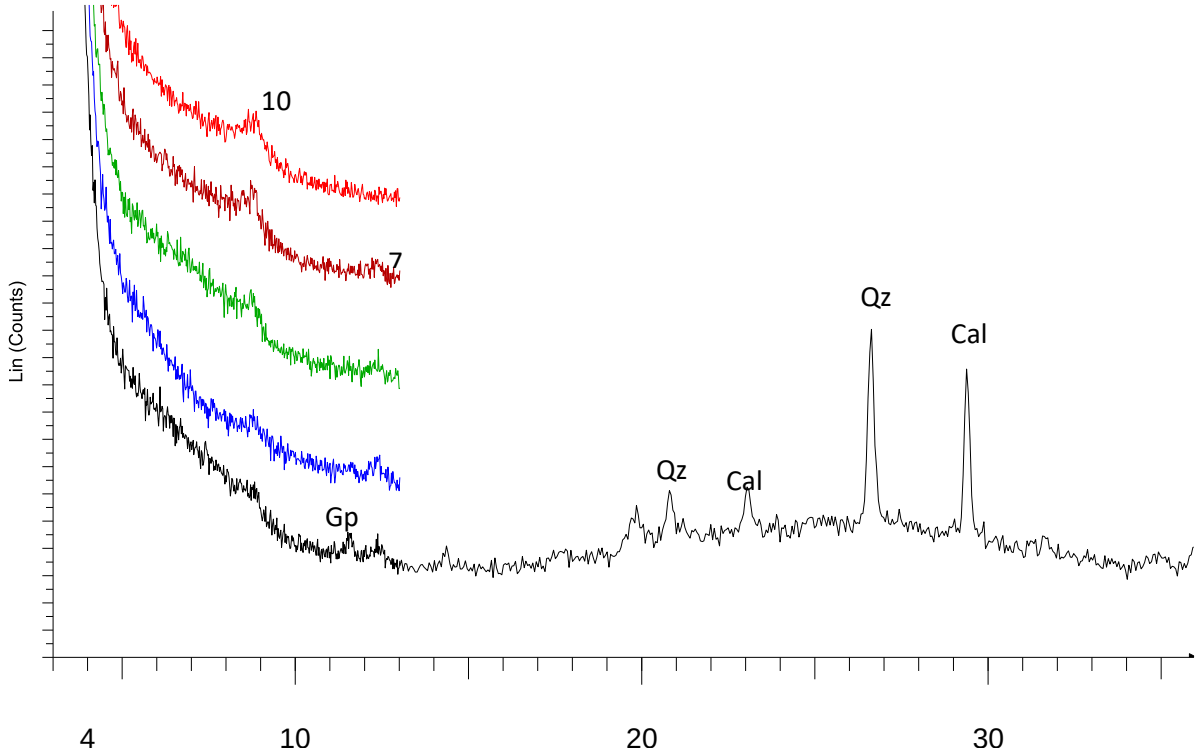

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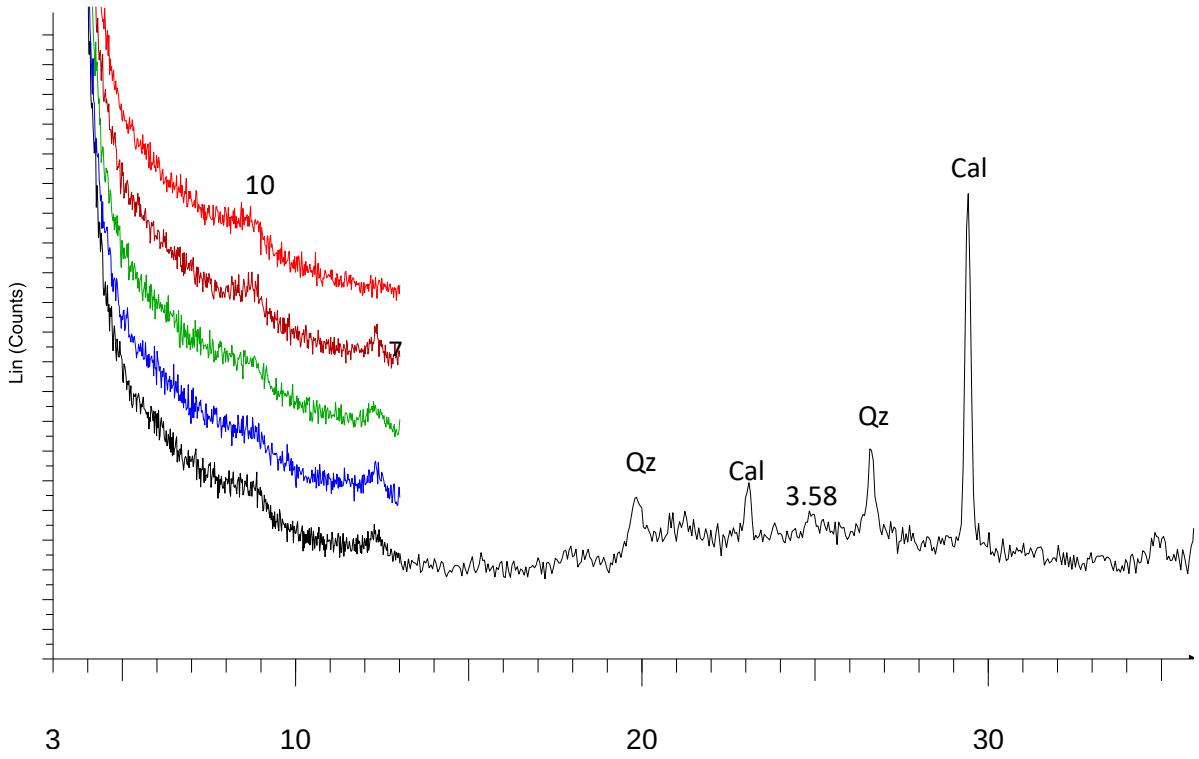

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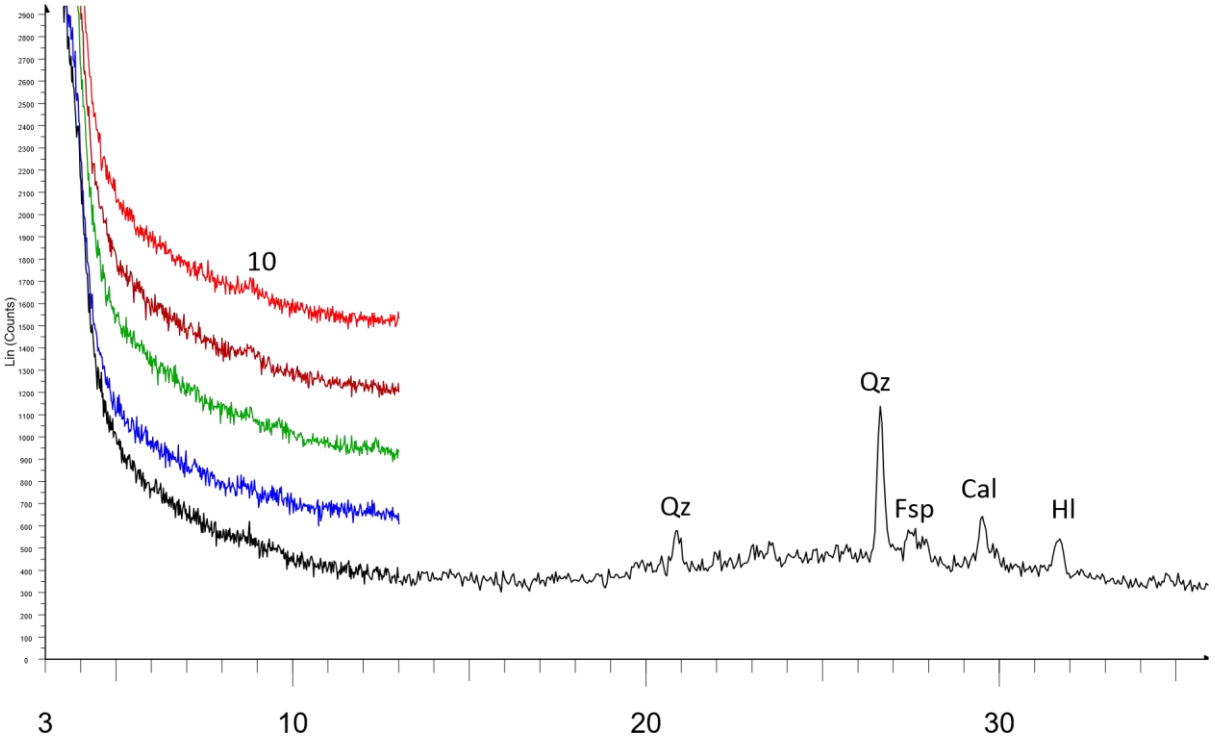

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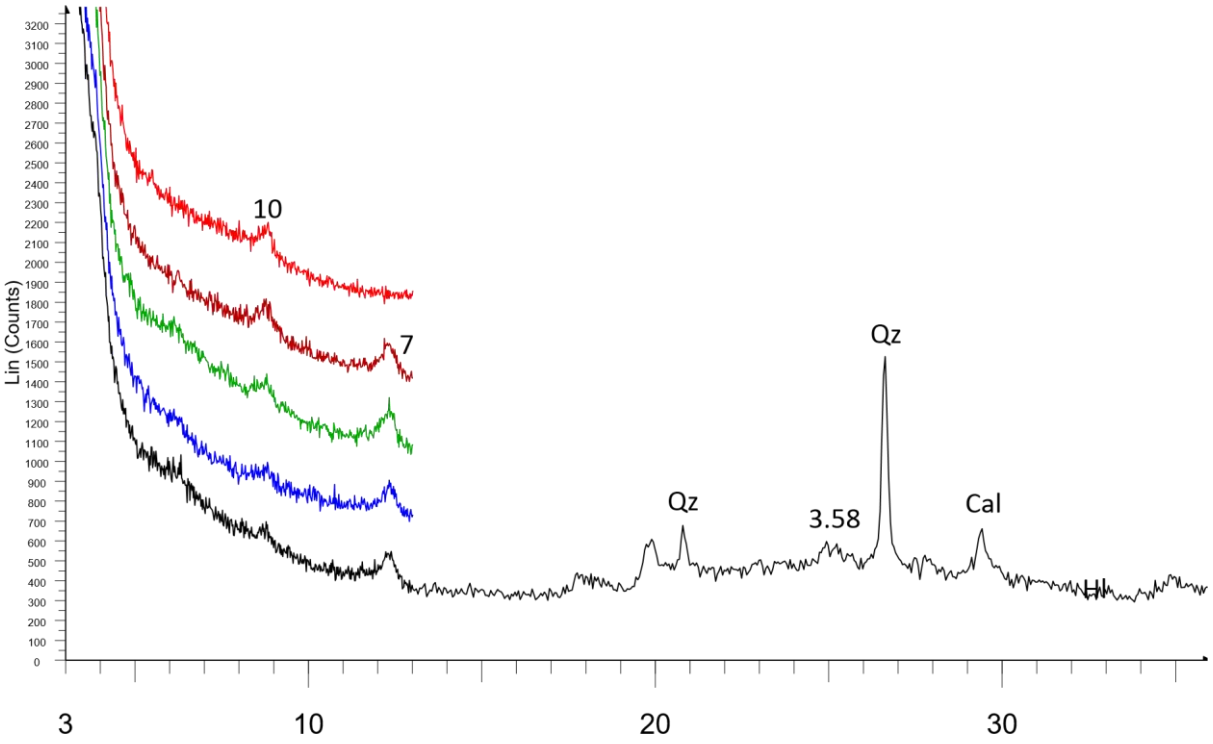

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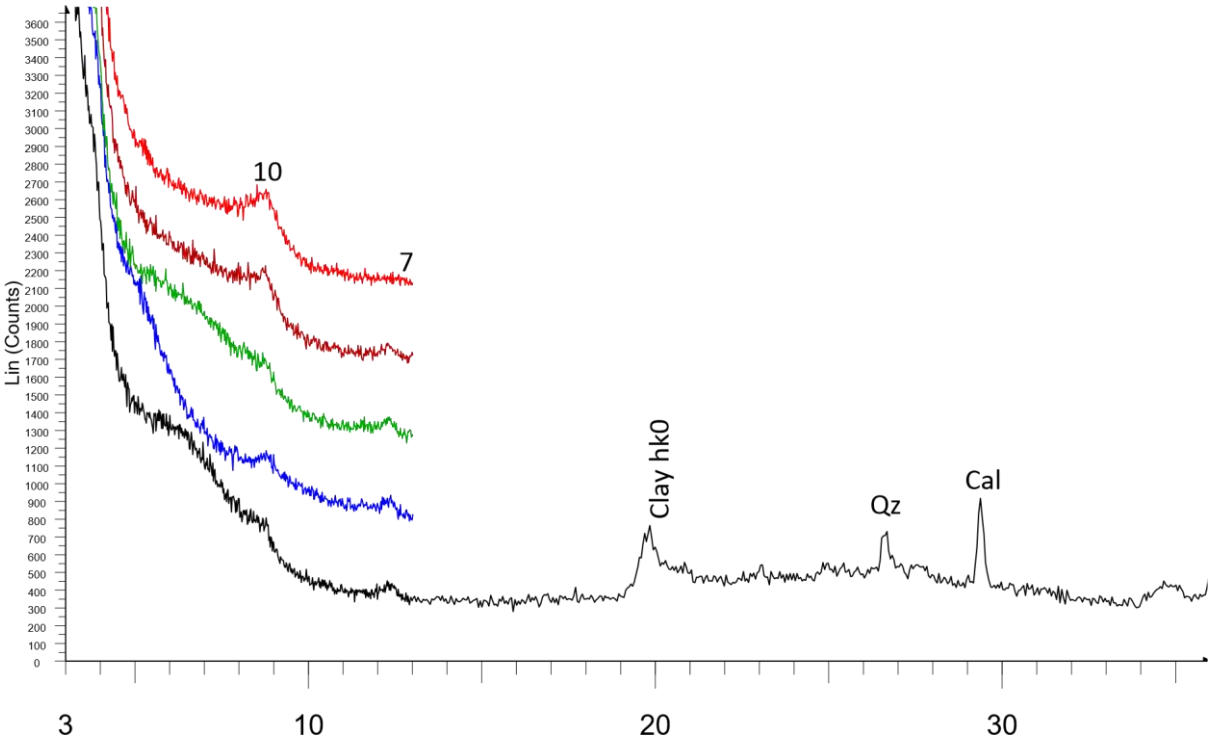

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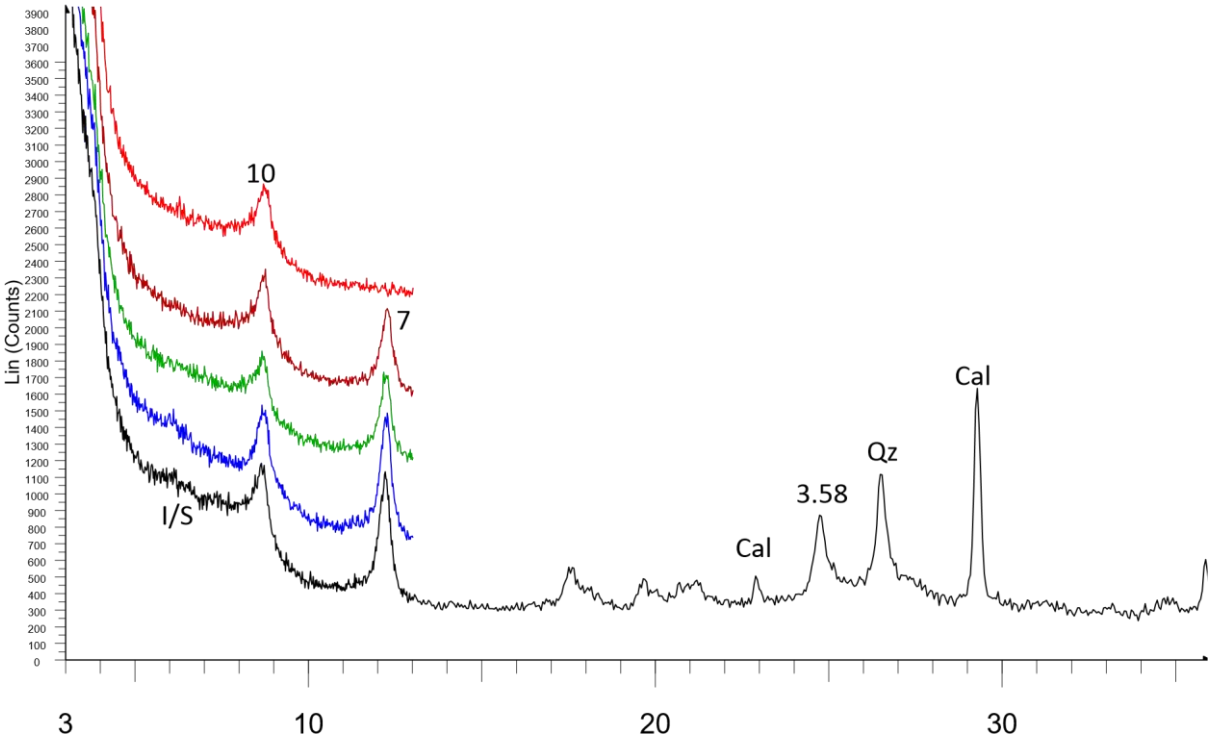

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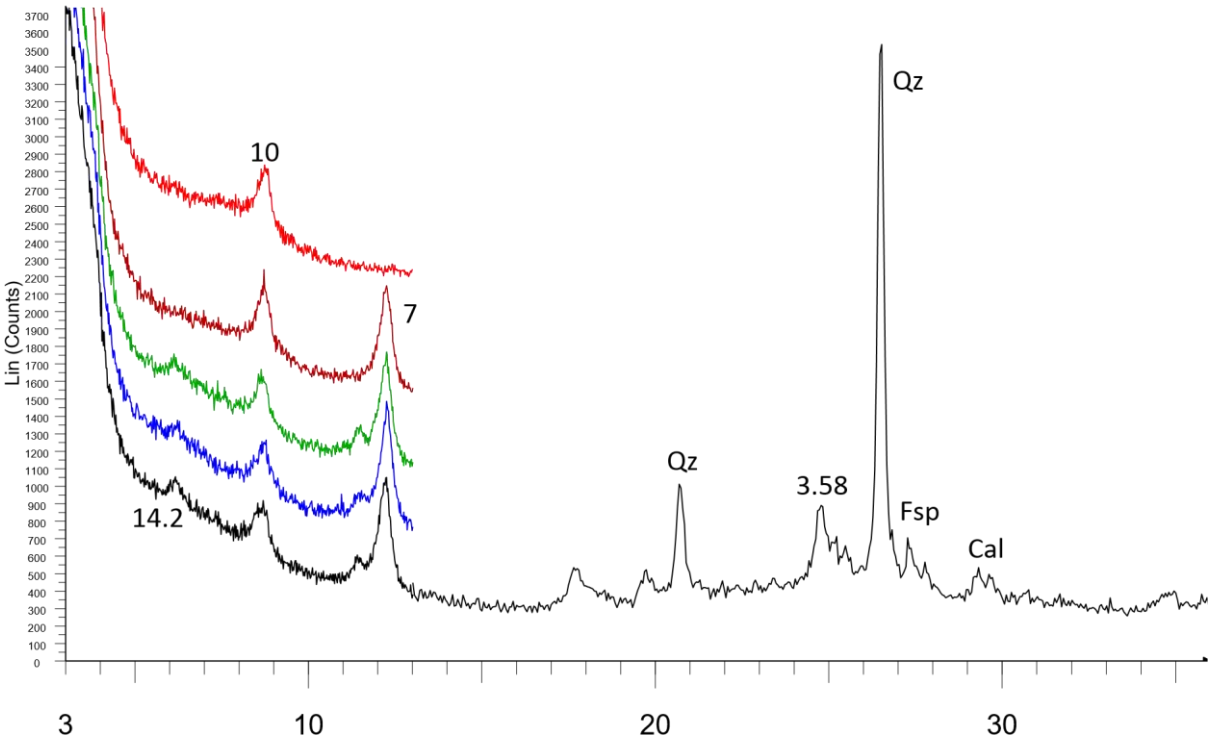

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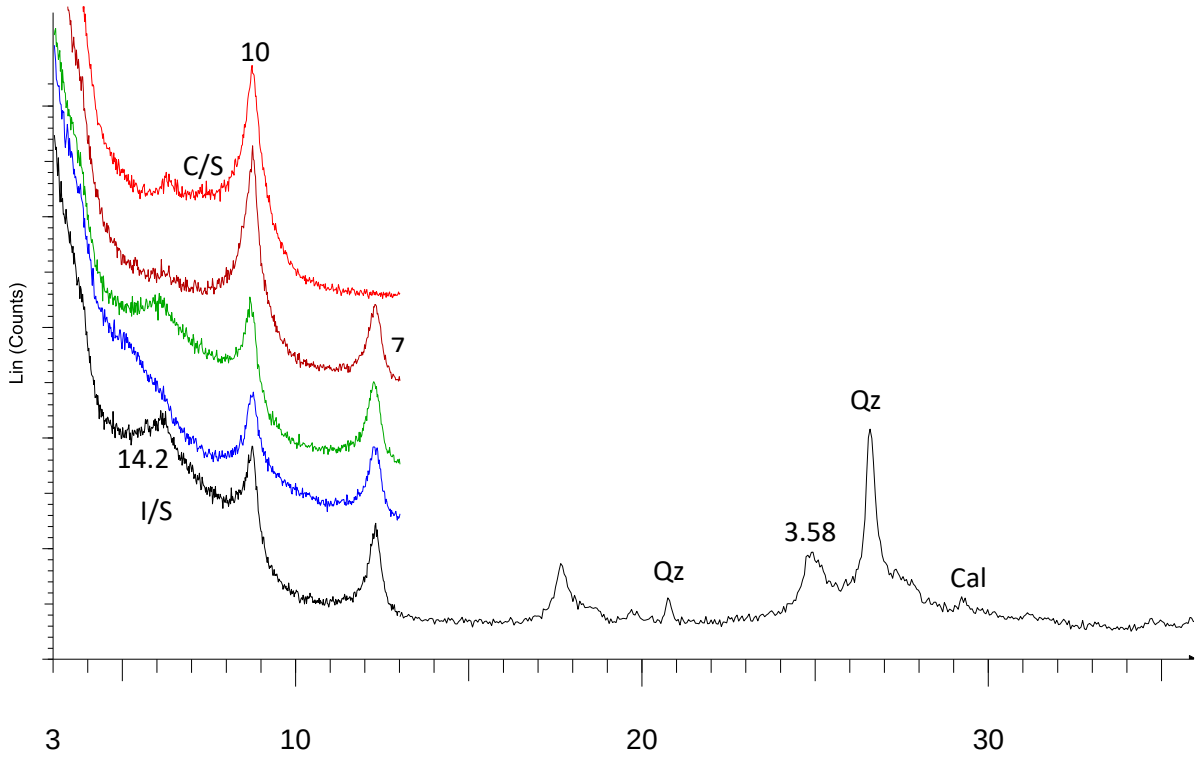

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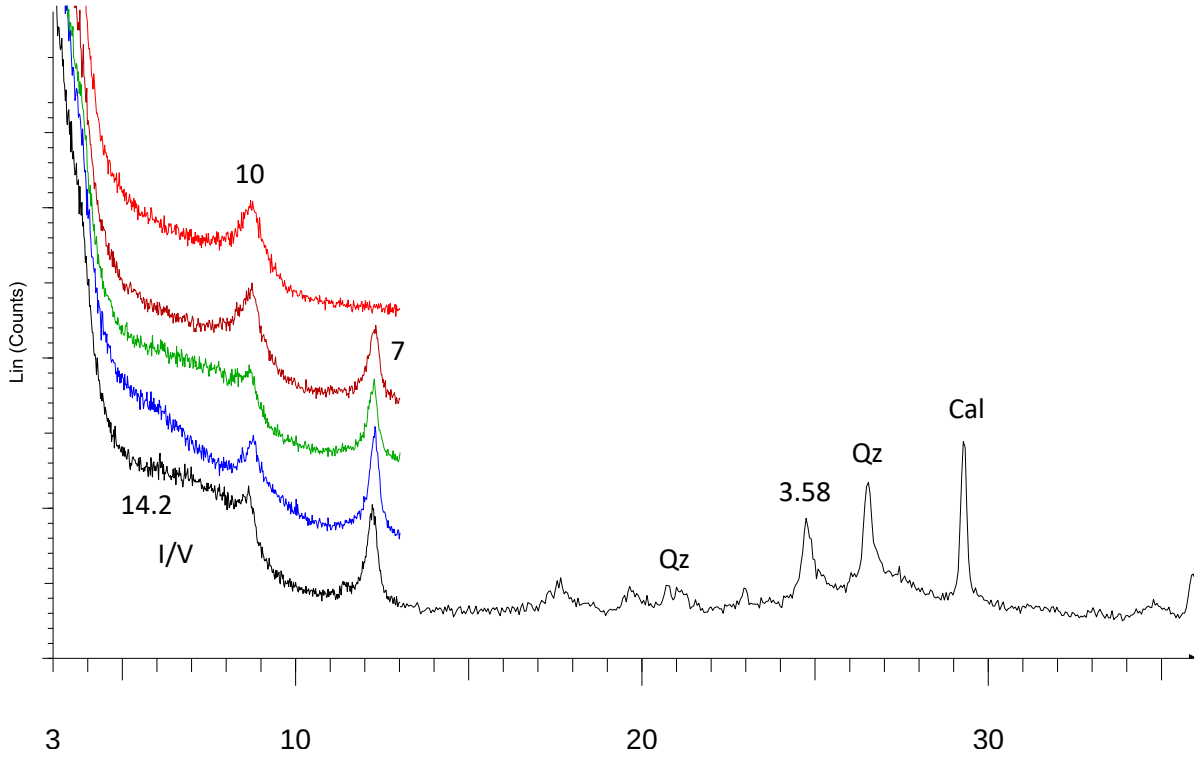

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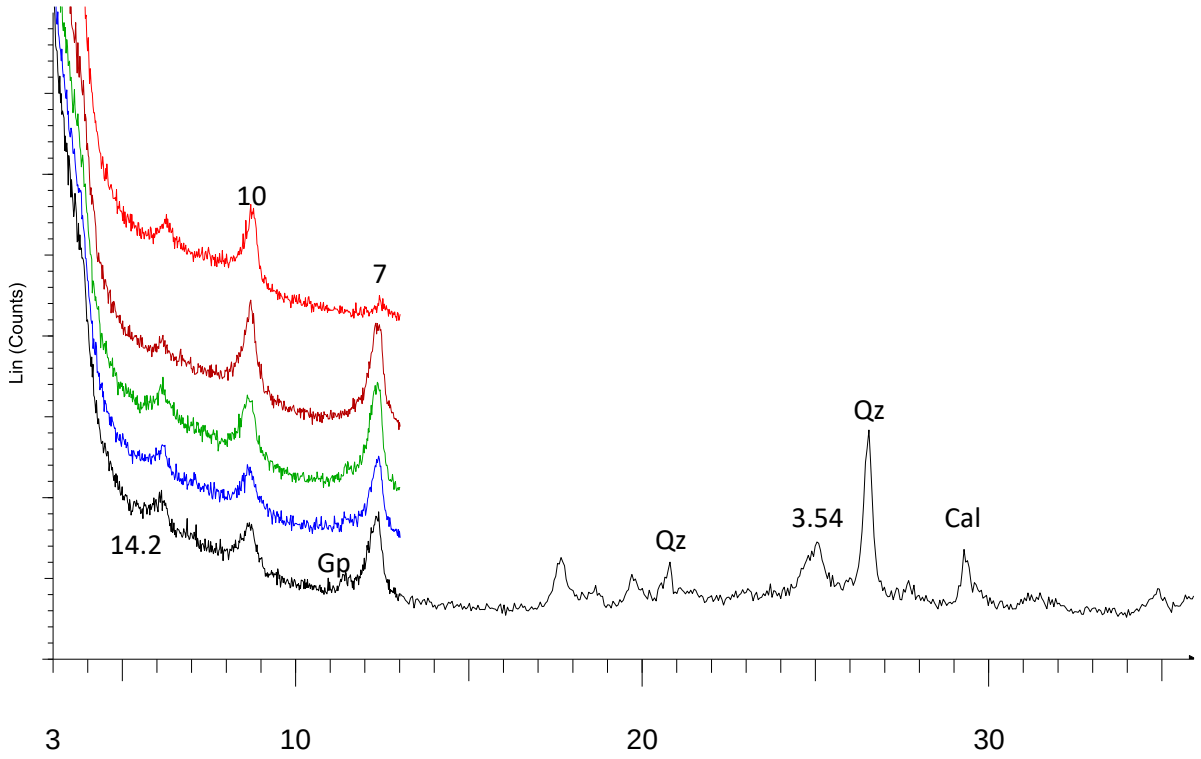

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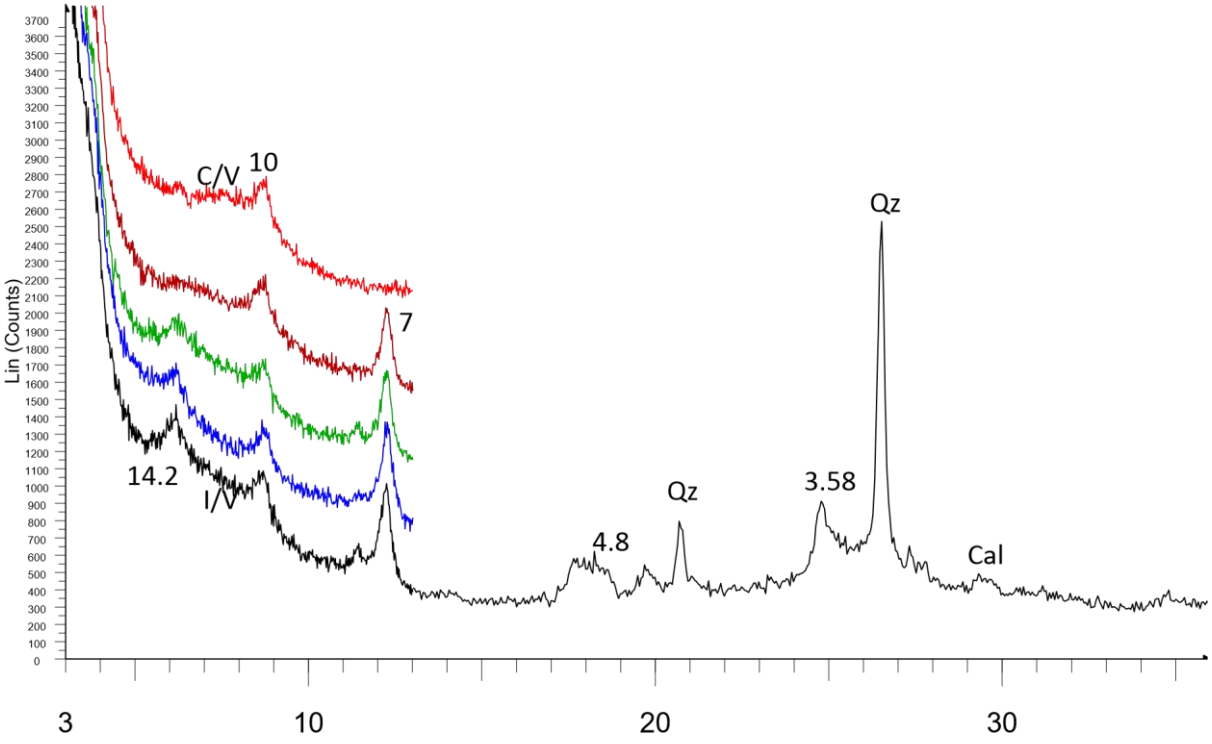

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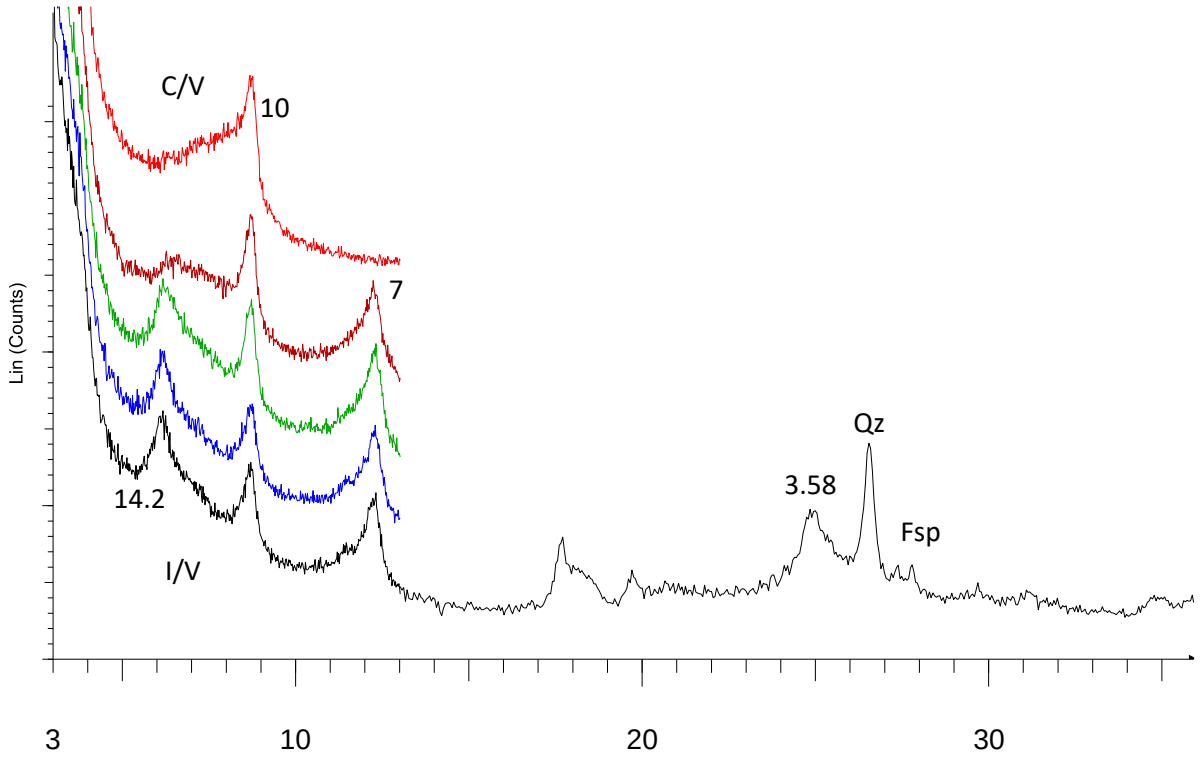
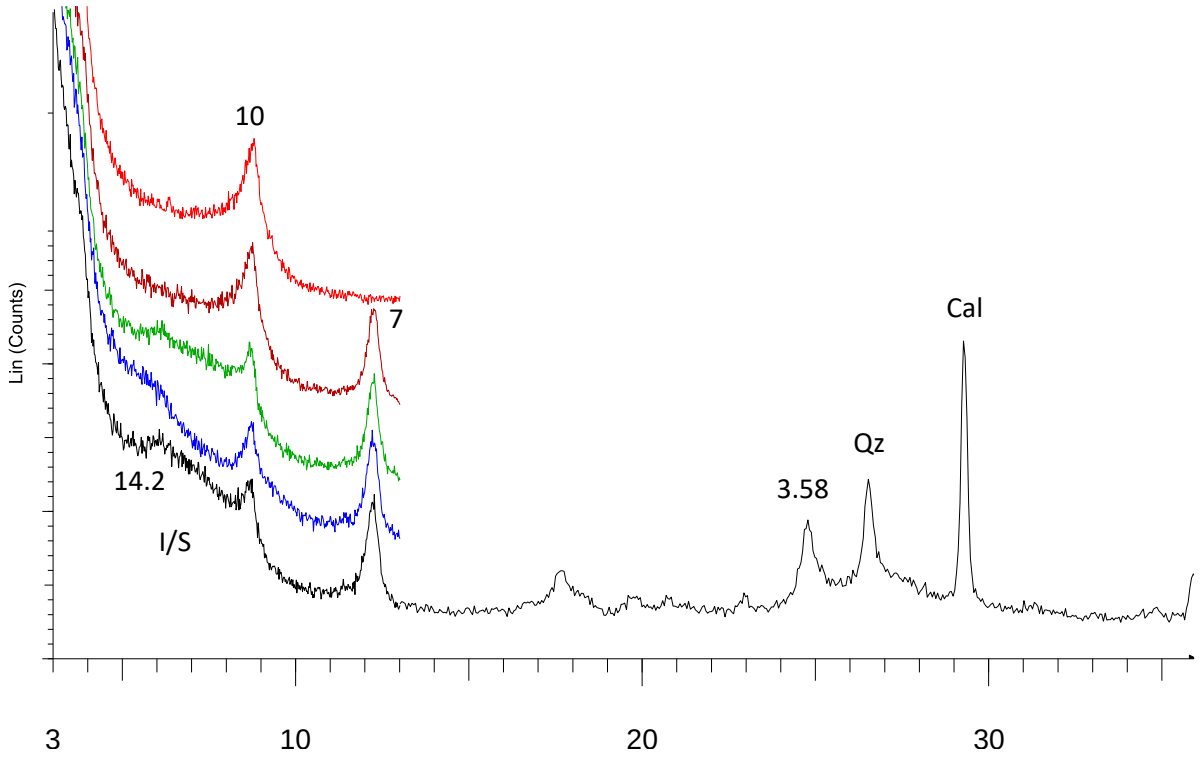


LU17 00210 008 (22901)



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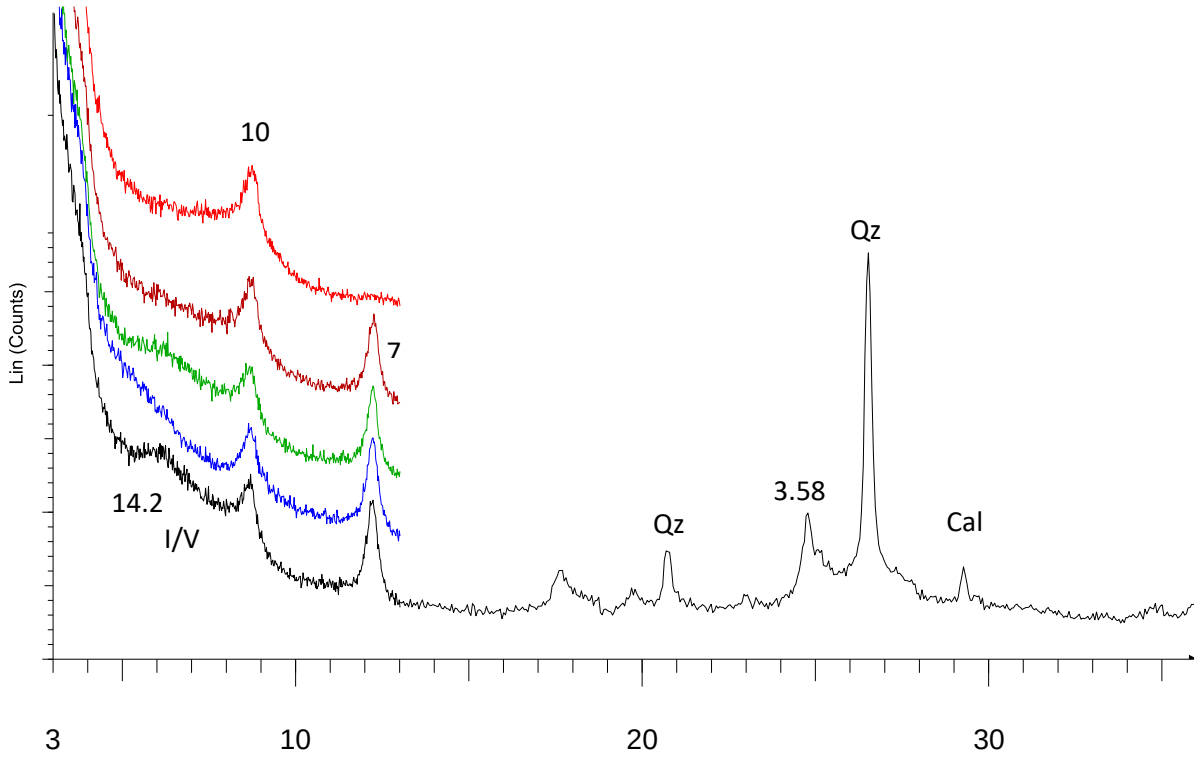

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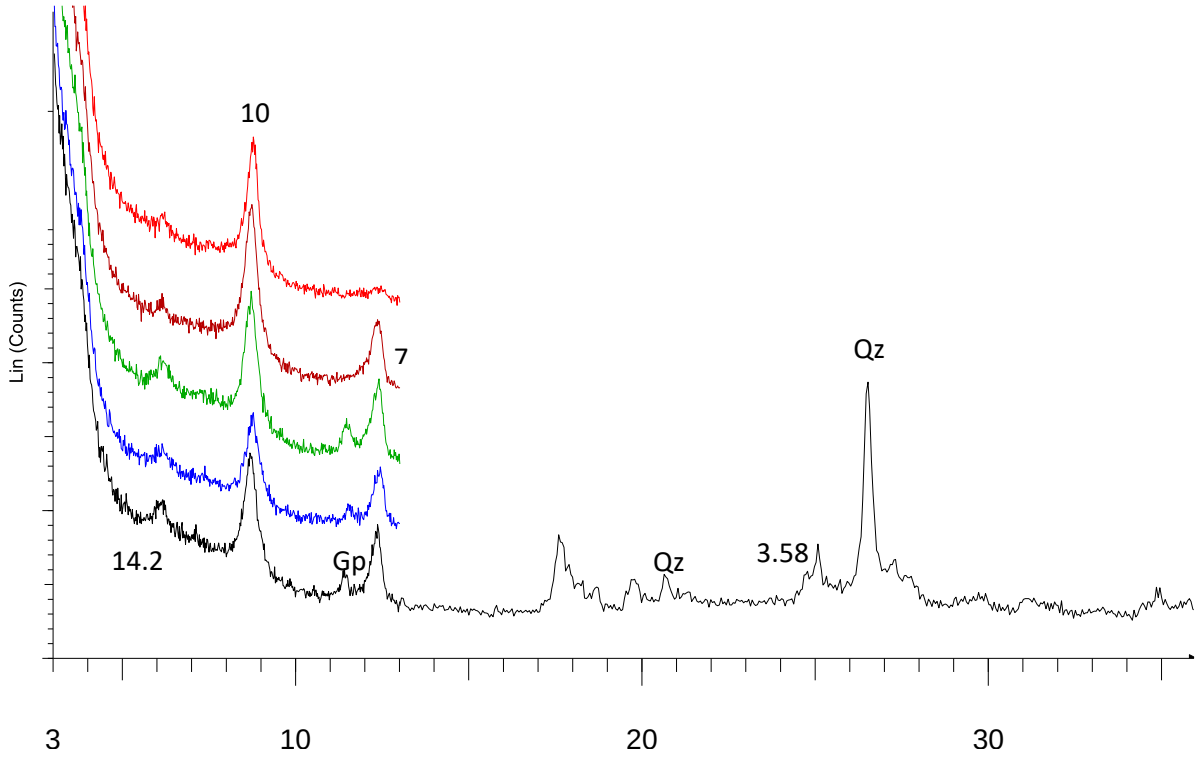

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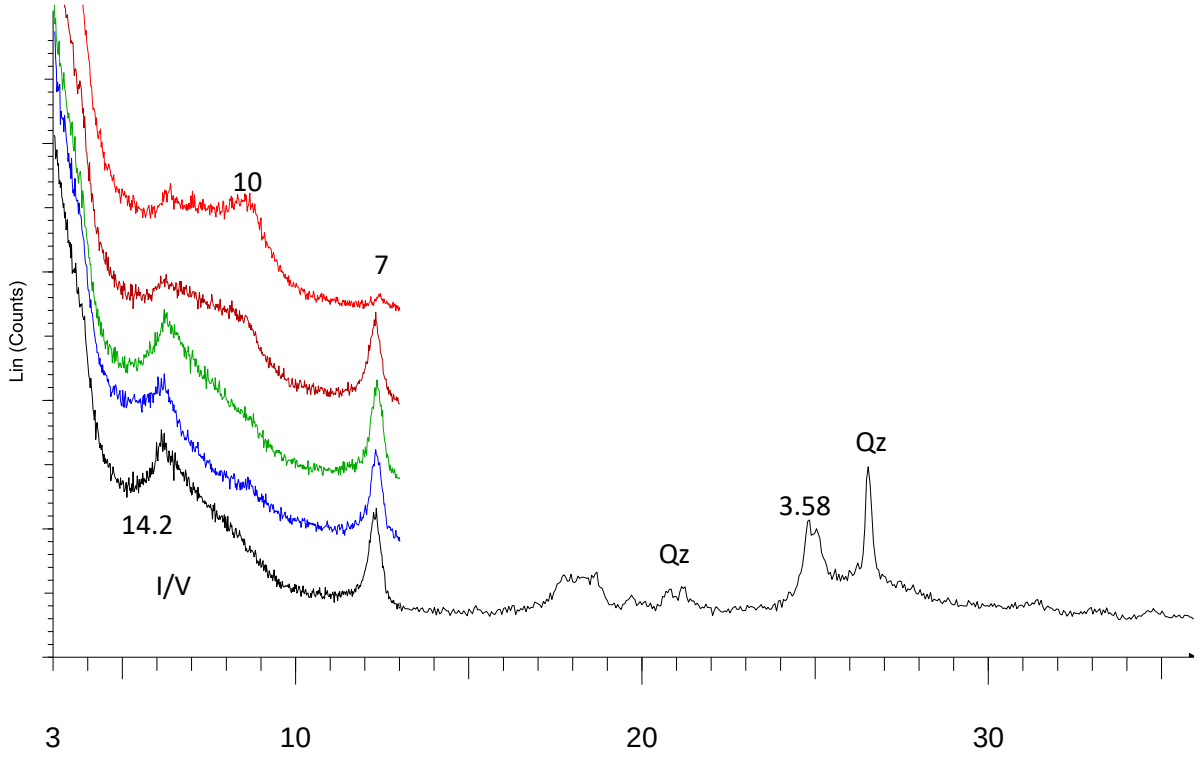

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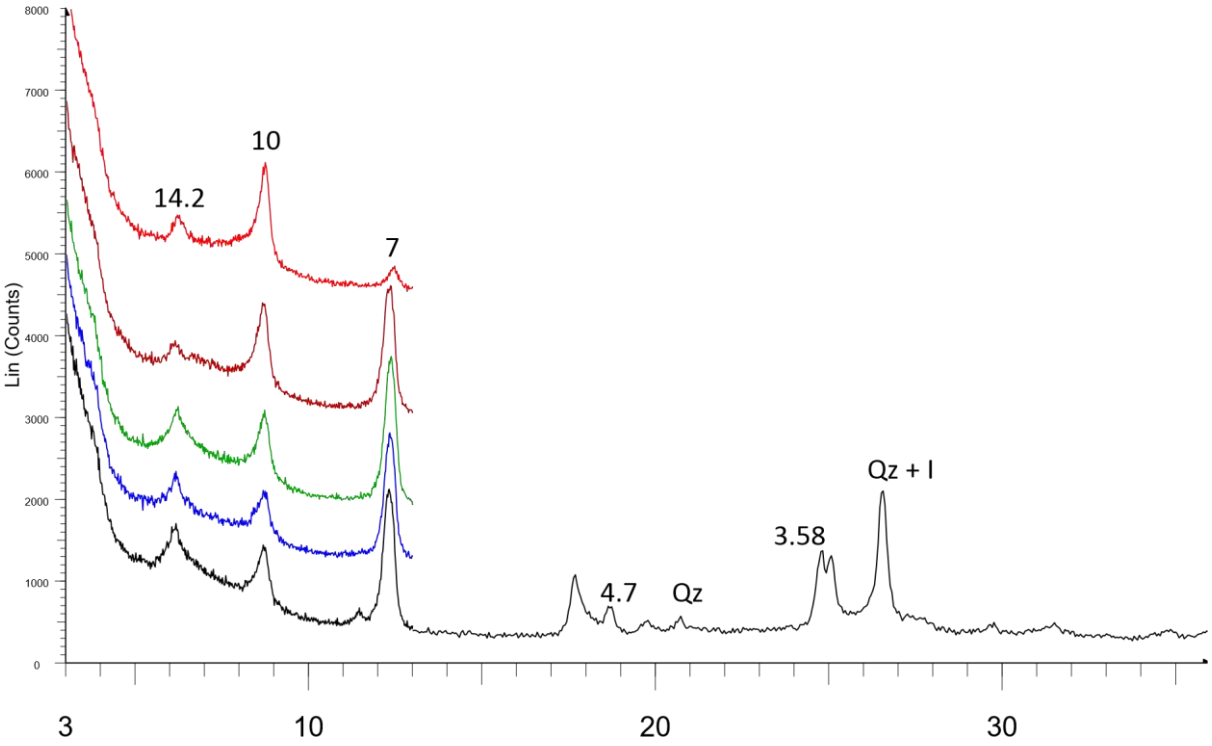

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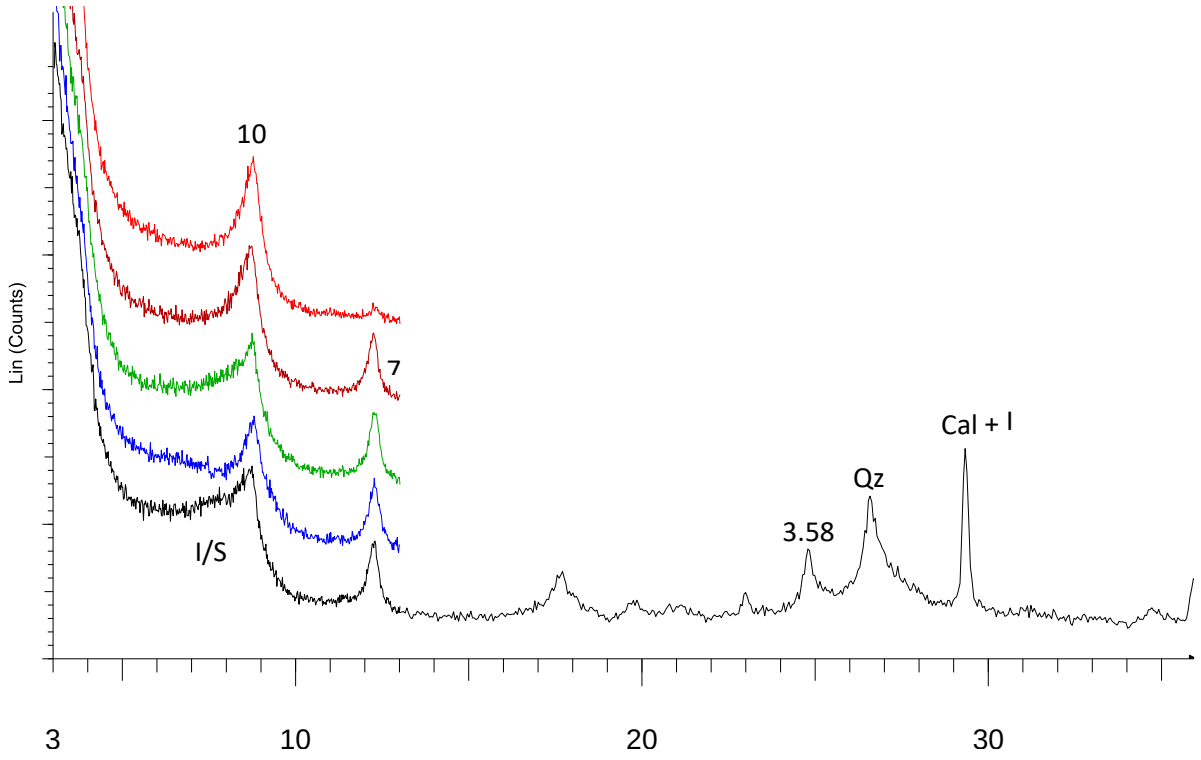

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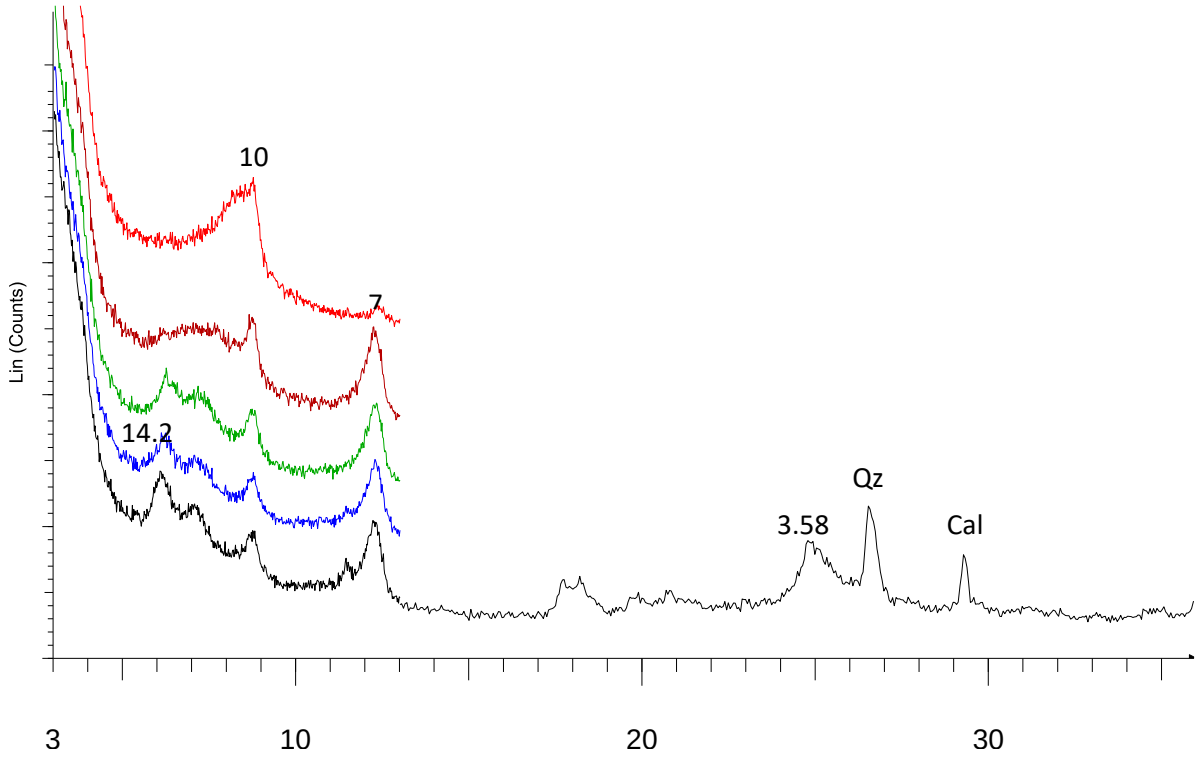

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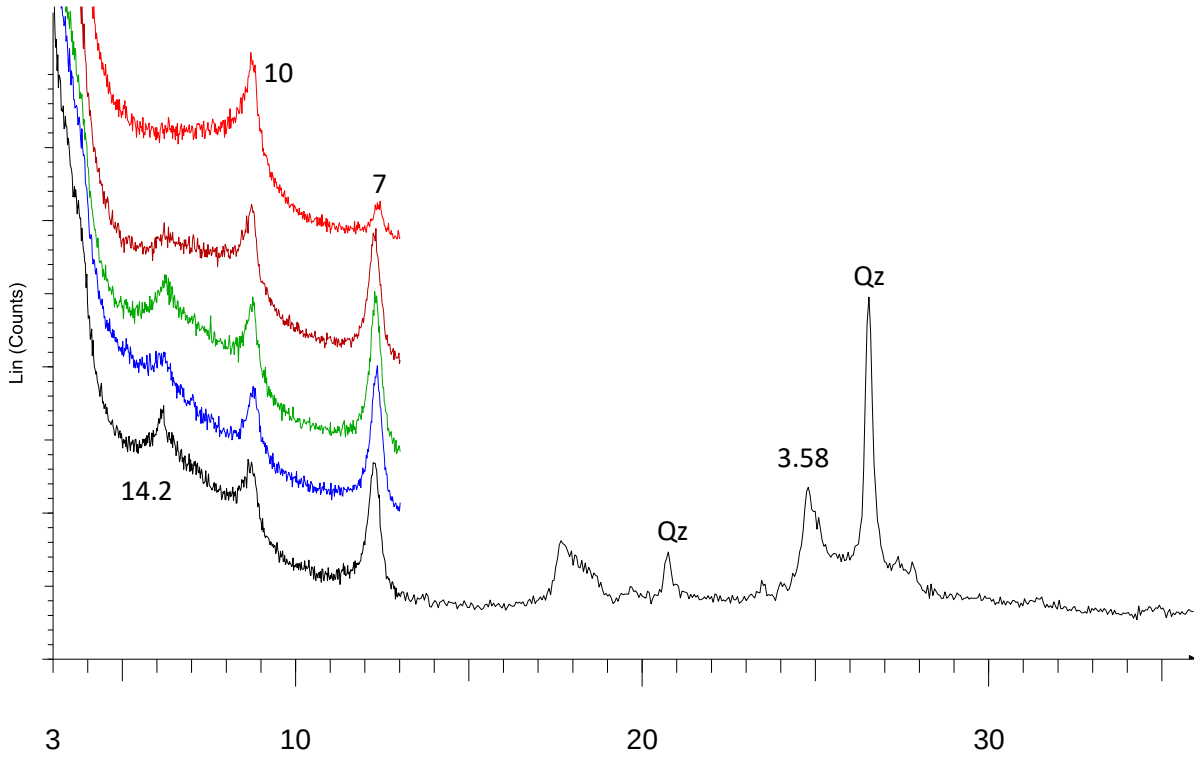

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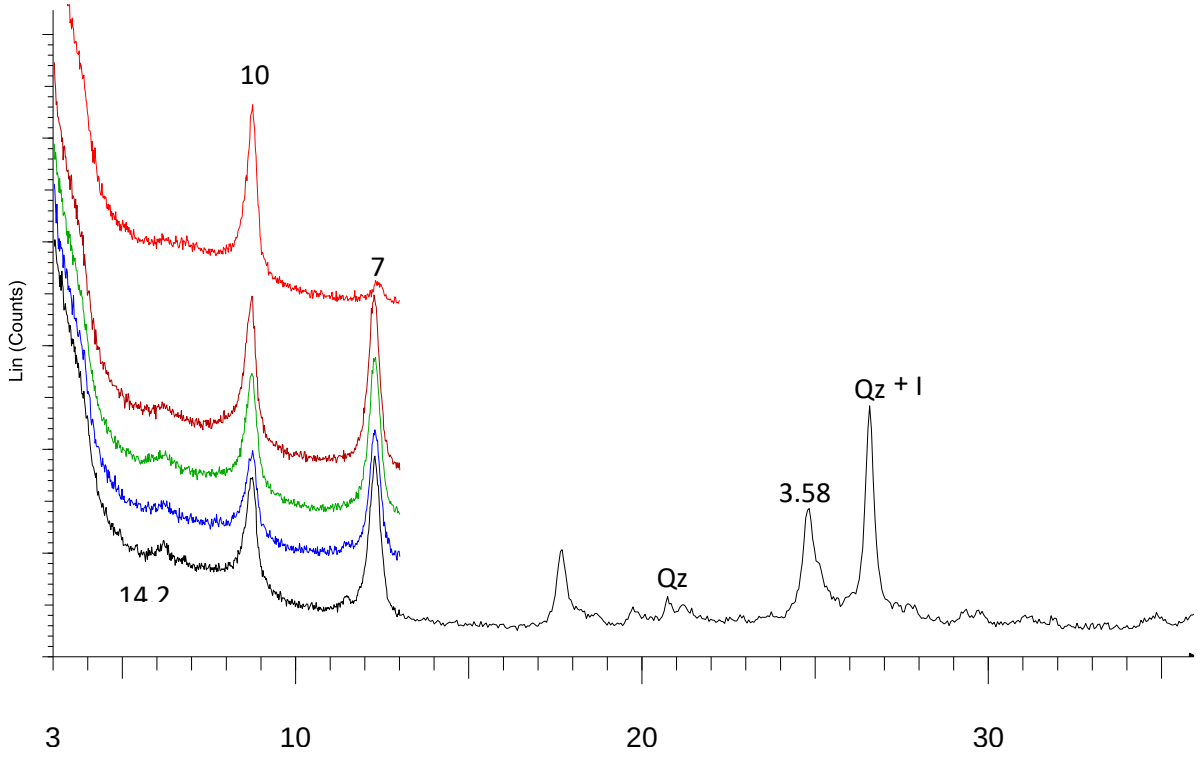

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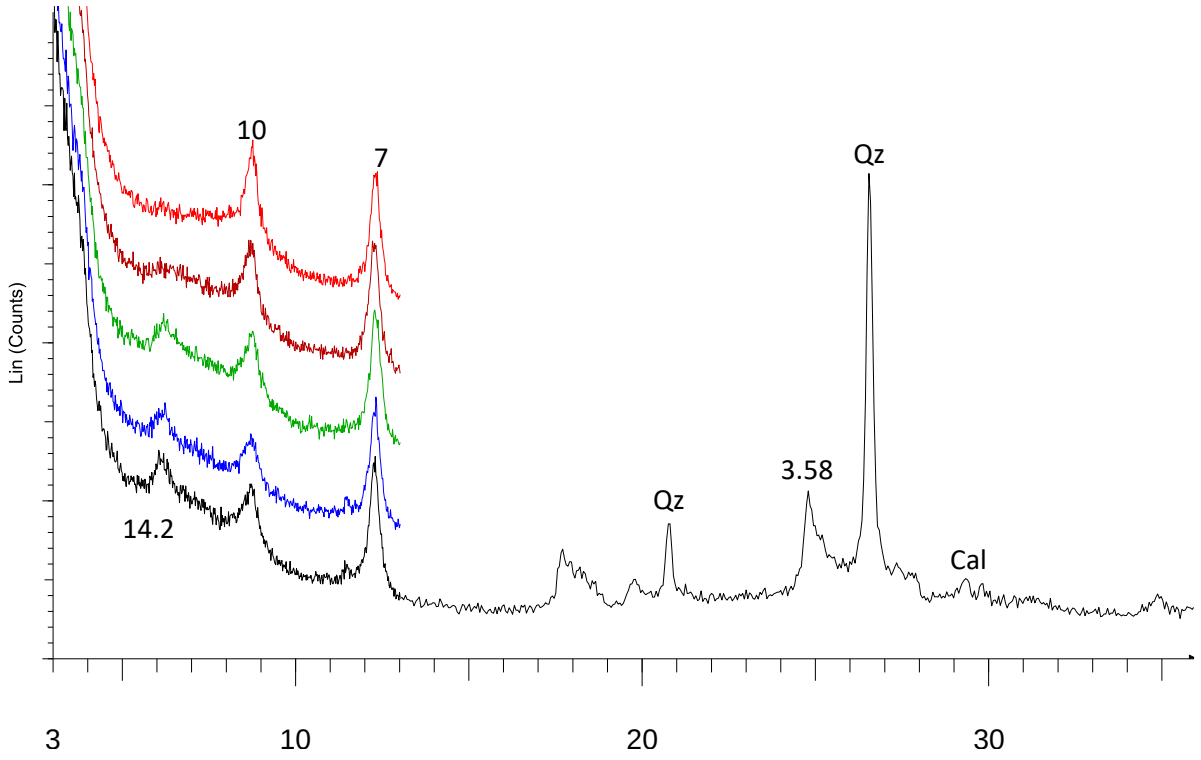
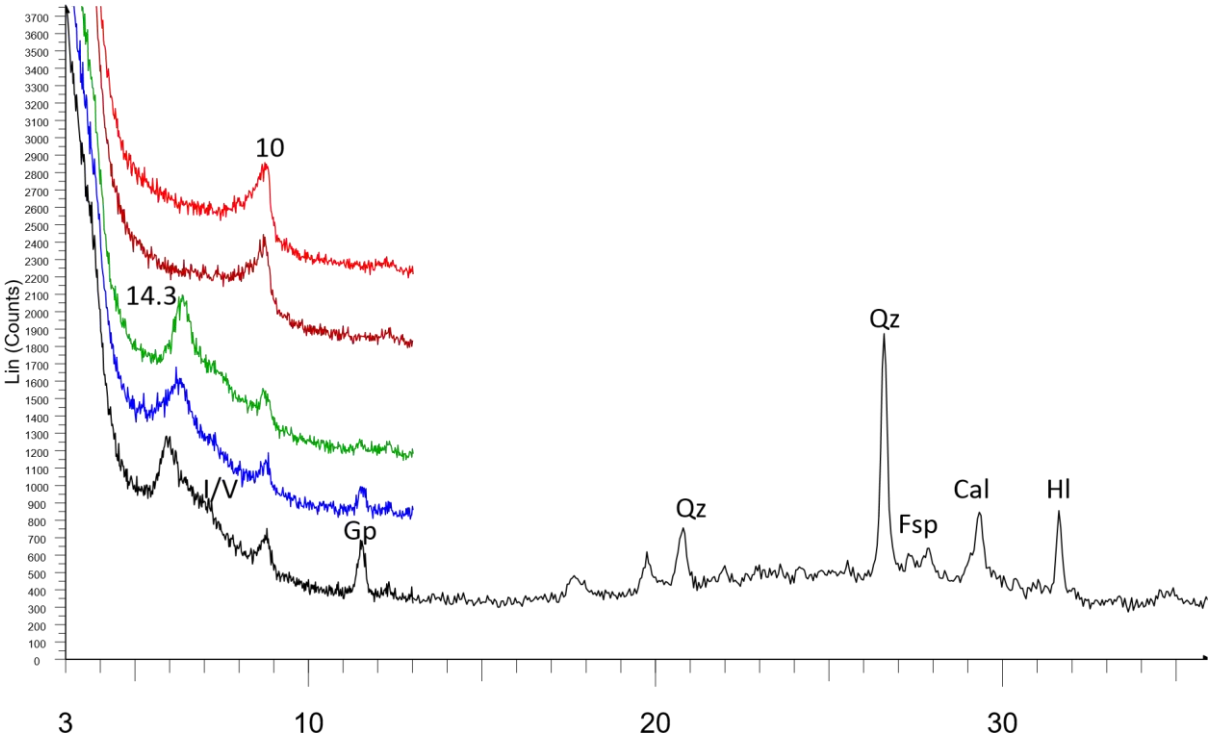
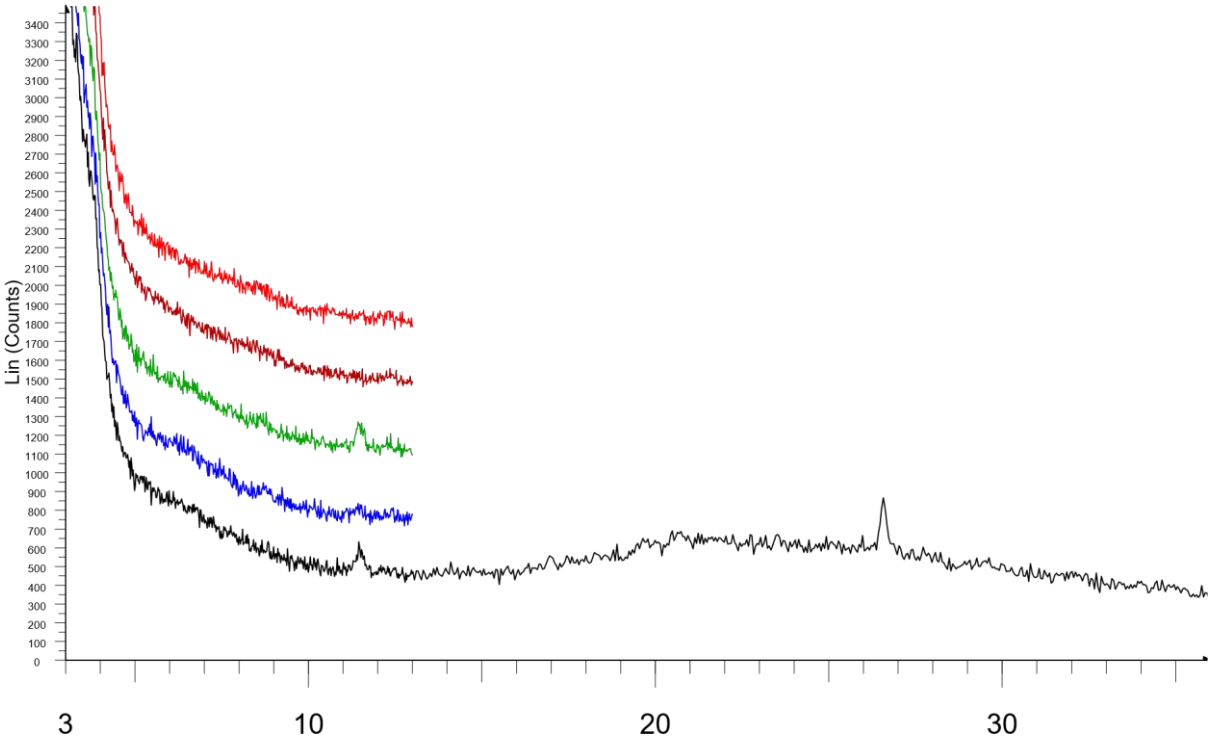


Annex 24. RX Diffractograms from Series

LU17 00081 045



LU17 00089 035



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