Appendix 1

The regulatory framework for sediments of inland waters

1.1 Extra-European guidelines

At worldwide level, different approaches concerning the definition of reference or guidelines about the quality of the lacustrine sediments have been established.

The United States, for example, have not defined environmental quality standards for sediments that are unique in all the States. Each State, in fact, can individually define the reference values and the method to identify the quality standards for sediments.

The Canadian guidelines, instead, derived from the toxicological information available on the official protocol defined by the Canadian Council of Ministers of the Environment (CCME, 1995). This protocol is based on both a modified NSTP (National Status and Trends Program) and on a spiked-sediment toxicity test (SSTT) approach, two different approaches for the calculation of limit values for the evaluation of the sediments contamination. The limit values correspond to the lowest values obtained from the two different approaches. In the first approach, the two reference concentrations are drawn from a database in which chemical and biological data are crossed: the lowest concentration, TEL (Threshold Effect Level) is the value below which dangerous biological effects rarely occur; PEL (Probable Effect Level) is the concentration above which harmful effects frequently occur. If the values fall between the two concentrations adverse effects can occurre. In the second approach, the reference values are obtained from the laboratory toxicity tests. However, as the data obtained by the second method are available only for cadmium and copper, the so-called ISQG (Interim Sediment Quality Guidelines), which correspond to TEL and PEL obtained with the approach NSTP, are actually used.

Australia and New Zealand guidelines (Australian and New Zealand Guidelines for Fresh and Marine Water Quality) are based on the identification of two characteristic concentration values ISQG-Low and High-ISQG for each considered contaminant. The comparison of the sediment values with these limits triggers a list of the actions in accordance with a decision tree.

As concern metals of environmental interest, the lower threshold values proposed in Australia are rather frequently less conservative than the North American values, which are nearly coincident between them. On the other hand, the upper threshold values are proposed by a more limited number of guidelines and in particular the Canadian values are among the most restrictive upper sediment values. So in this study we decided to use them as international environmental benchmarks.

1.2 European guidelines

At European level, a text of considerable importance on the water protection is the Directive 2000/60/EC (23 October 2000), namely the Water Framework Directive. This legislative text collecting and integrating previous provisions about water conservation, aims to *establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater*. Sediments are mentioned in the Article 16, paragraph 7, containing the *strategies against pollution of water*, which states that: *The Commission shall submit proposals for quality standards applicable to the concentrations of the priority substances in*

surface water, sediments or biota. However, the Commission shows the general rules to define environmental quality standards *for definitions of ecological status classifications* based on the types of acute and chronic effects for three different taxa: *Phytoplankton, Macrophytes and phytobenthos, Benthic invertebrate fauna*.
In December 2008, the Directive 2008/105/EC was approved; according to the commitments reported in the Article 16 of the Water Framework Directive 2000/60/EC, aimed to set the standards of environmental quality for priority substances in European surface water environments. However the environmental quality standards (EQS) were defined only for the water column and for three substances concerning the biota. In the absence of extensive and reliable informations about concentrations of priority substances in biota and sediments at a Community level, the Directive stated that *for the majority of substances the establishment of EQS values at Community level should, at this stage, be limited to surface water only. Furthermore, Member States should be able to establish EQS for sediment and/or biota at national level and apply those EQS instead of the EQS for water set out in this Directive.* The Directive 2008/105/EC is essential to identify Environmental Quality Standards for surface water environments at European Common level in order to achieve good chemical status and in general the environmental objectives established by the Framework Directive 2000/60/EC homogeneously throughout the whole Community territory.
Currently, however, at EU level the quality standards for sediments are not yet established. In the presence of this regulatory gap, the different Member States may individually decide what approach to use in relation to the quality of sediment and some decided to use the limiting values for soils.

1.3 Italian guidelines

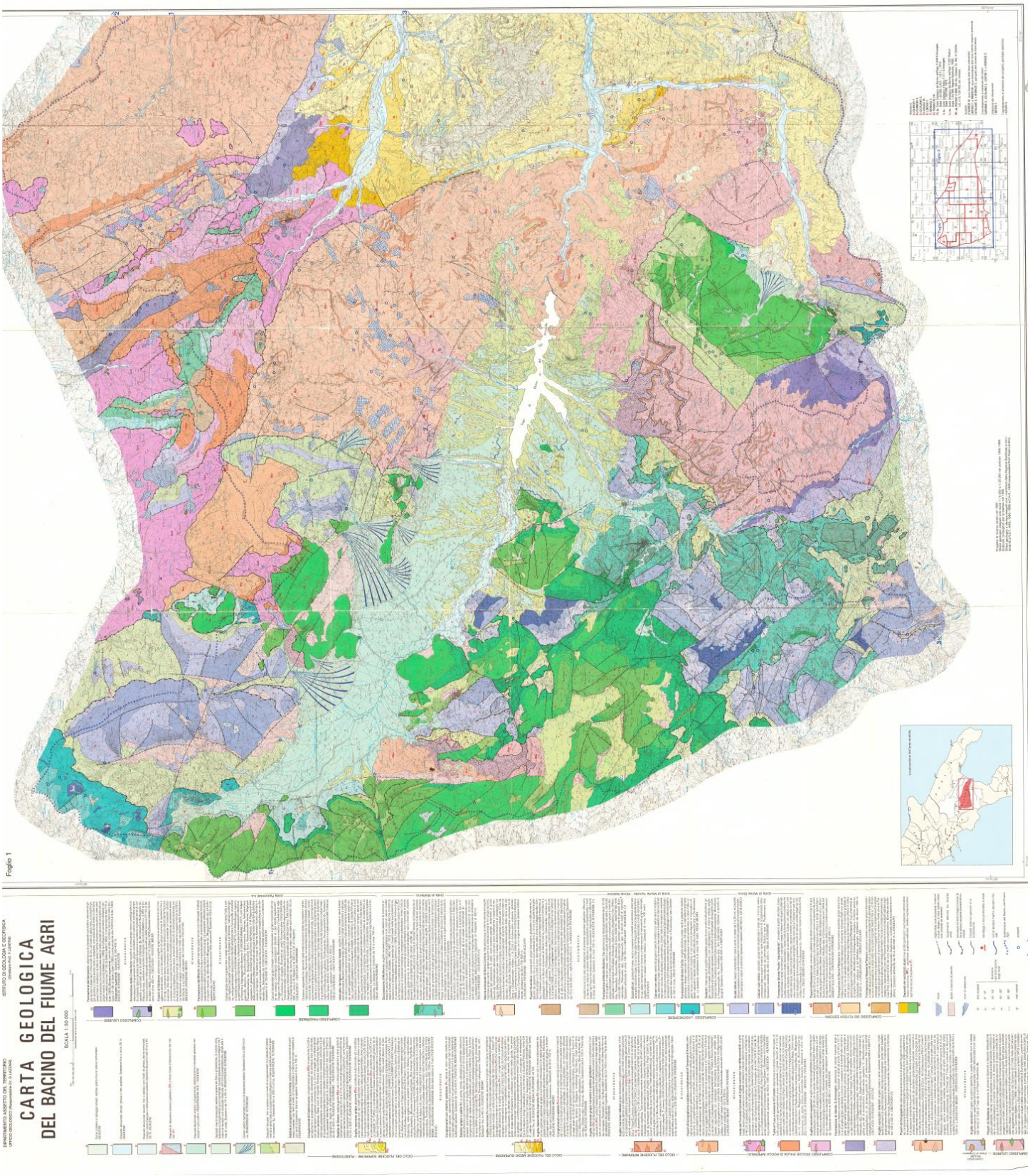
The first regulatory instrument concerning the inland waters was the M.D. 367/2003, which established the quality standards for 150 chemical compounds, more than the 33 priority substances listed in the Community decision 2455/2001/EC of November 2001. The Ministerial Decree identified also the quality standards for sediments of marine and coastal waters, lagoons, coastal ponds but it not take into consideration the sediments of surface freshwaters.
Currently the reference Italian legal text concerning the protection of the environment, born as the implementation of the Directive 60/2000/EC, is the Legislative Decree 152/06 “Norms Concerning the Environment”, commonly called “Single Environmental Text” as it regroups in a single legislative text the environmental laws previously contained in several decrees. In this text, despite the growing interest in the sediments and in its vital importance in defining the quality status of an aquatic system, specific quality standards for sediments of inland waters are not reported. In the absence of regulatory limiting values, the concentration thresholds for soils are often used.
The M.D. 56/09 adapted the Annexes 1 and 3 of the Part Three of the Legislative Decree no. 152/06
to the guidelines issued by the European Commission concerning the technical criteria for the planning of monitoring programs and for reference conditions for surface water bodies. It contained the quality standards for sediments of transition, marine and coastal waters, that are the same of the M.D. 367/03 but reference limits for sediment of inland freshwater are not indicated.
In 2009 the National Agency for Environmental Protection and Technical Services was entrusted from the Ministry for the Environment about the choise of the methodological criteria for the characterization of Saline and Alento stream sediments and the establishing of the thresholds values for the remediation of such sites.

The document “Proposal for evaluating the quality status of the stream sediments in the National Interest site of Saline and Alento streams” proposed the Reference Chemical Levels (RCL) no specific site, which, in analogy to the contamination threshold for soils defined in the Legislative Decree. 152/06, can highlight the traits of water body that require specific investigations and the identification of sections of riverbed for a possible intervention.

However, to date, in Italy there are no reference laws about the methodological approach nor the limiting values for lacustrine sediments.

Appendix 2

Geological map of the high Agri Valley

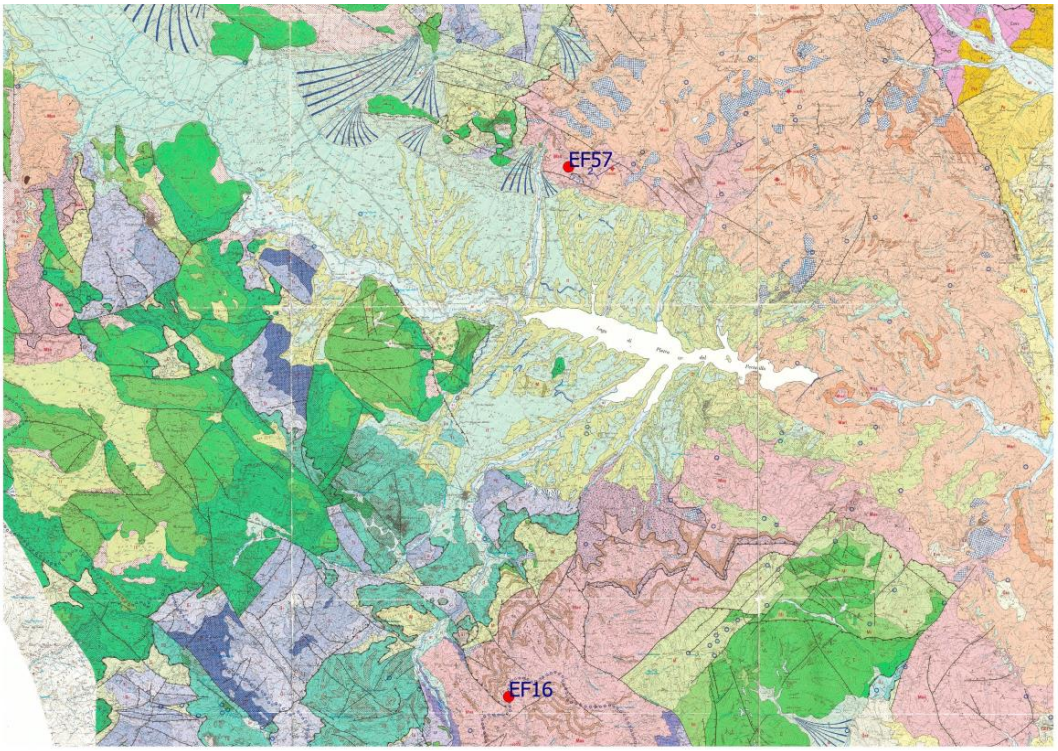


Appendix 3

Schedules of Meso-cenozoic rocks and Quaternary deposits

Formation ALBIDONA FLYSCH

Description Gray-yellowish sandstones (feldspathic litharenites) alternating with marls, clayey marls, clays with abundant silt interbedded with calcareous marls and whitish thick bedded calcareous marls. Southeast of Viggiano, it incorporates recifal calcareous blocks. Downwards it gradually passes to the Saraceno Formation or lies on a chaotic level mainly composed by dark-gray fissile shales, embedding microbreccias of crystalline elements, pillow-lavas, blocks of crystalline rocks, cherts, calcareous marls and calcareous-arenaceous-pelitic alternations belonging to the Saraceno Formation (Valle del Caolo Unit). (Source: Geological map of the Agri catchment, Lentini et al., 1991).

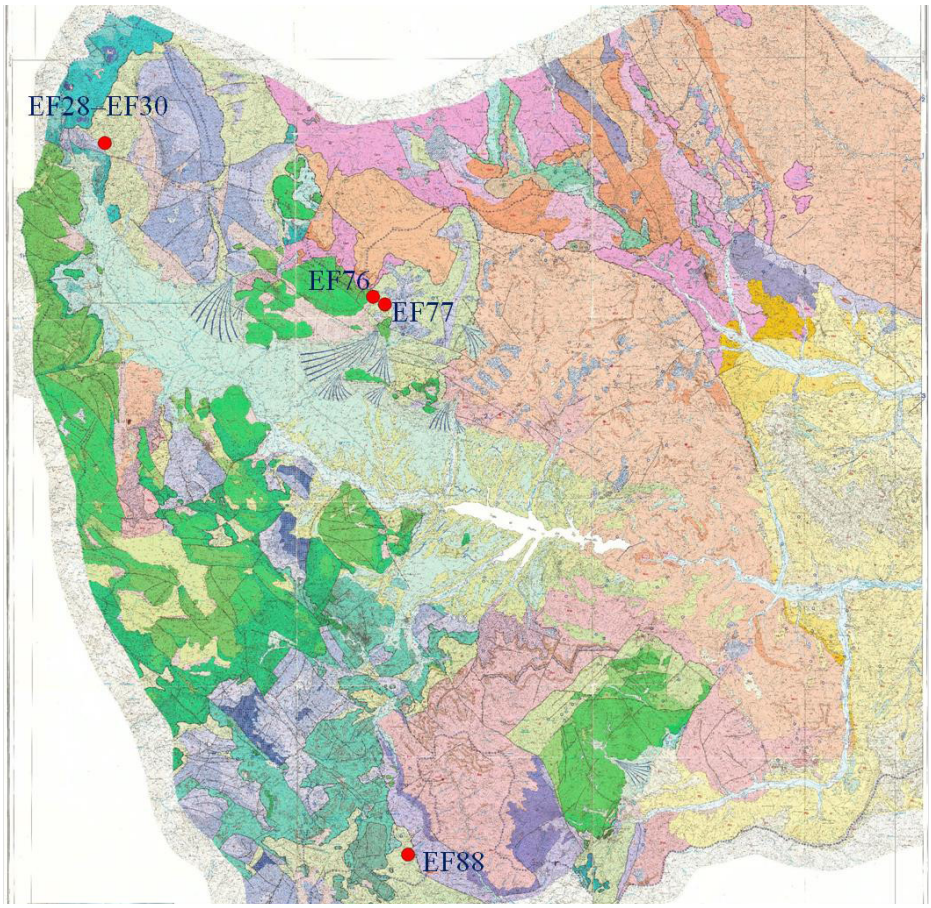


Sample EF 16 (c/da Tempa del Conte)

Sample EF 57 (along the road Viggiano-Corleto)

Formation GALESTRI

Description Thin-bedded shales alternating with gray-brown and gray cherty calcilutites, with pinkish-brown surface alterations, intercalated with gray-whitish marls and silty limestone breccias. The few centimeters to meters bedded calcilutites show the typical fracturing features of the Paesina stone (Source: Geological map of the Agri catchment, Lentini et al., 1991).



Sample EF 28
(locality Cozzi, Marsico Nuovo)

Sample EF 30
(locality Cozzi, Marsico Nuovo)

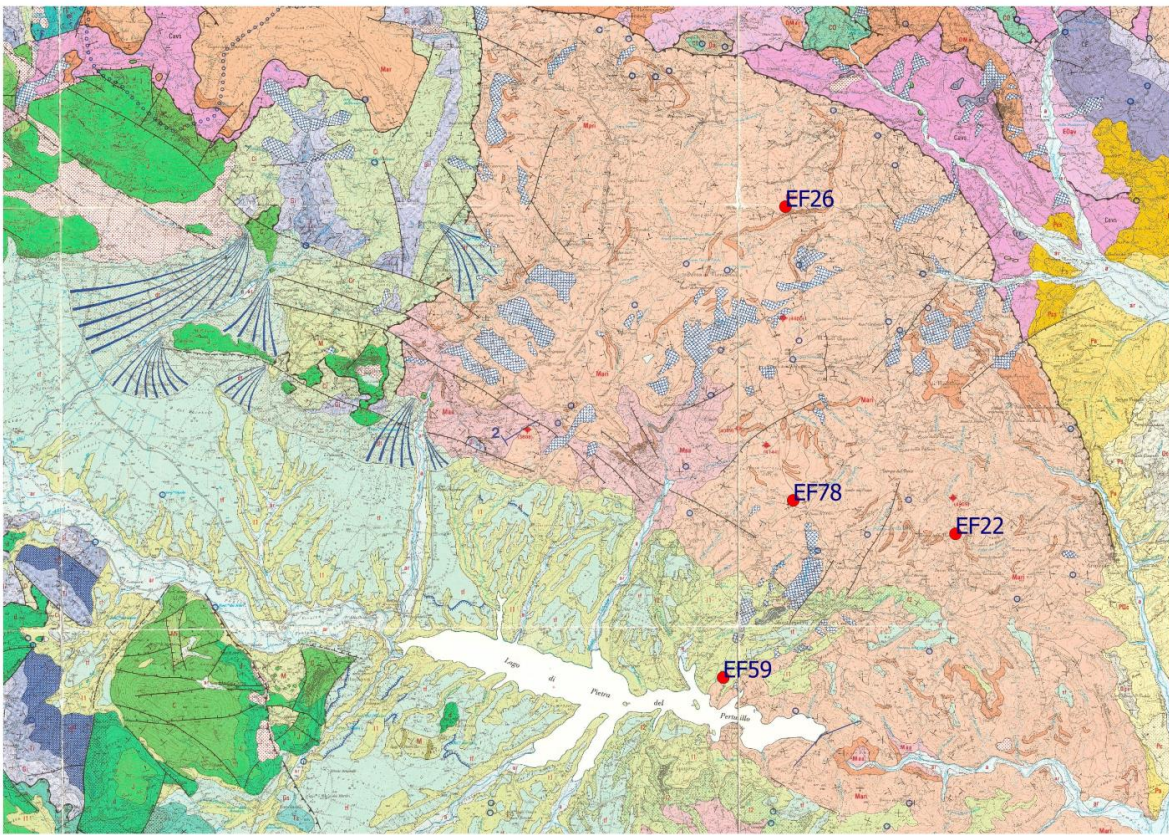
Sample EF 76
(along the road to the Viggiano Mt)

Sample EF 77
(Fosso del Cerro, Viaggiano)

Sample EF88
(c/da Chiaito, Moliterno)

Formation GORGOGLIONE FLYSCH

Description Sandstones alternating with slightly marly clays. The sandstone (feldspathic litharenites and lithic arkose) surface alterations are gray-yellowish and gray-iron when freshly cutted, well-cemented with few centimeters to a few meters bedded layers; there are sometimes considerable thickness levels of coarse sandstones and conglomerates rather inconsistent with abundant sandy matrix. The gray-olive clays and conchoidal fractured clays are abundantly silty and very thick interbedded. Eastward of S.Enoc M. Caldarosa M. and SW of Corleto P. are 10-30 m interbedded gray externally white , conchoidal fractured calcareous marls (b); eastward of S. Enoc M. Caldarosa M. and SW of Corleto P. at the top of the calcareous marls a olistostrome made up by fragments and blocks of the following rock types lies: micaceous sandstones belonging to the Corleto Perticara Formation of to the Albidona Flysch, whitish marly limestones similar to those of S. Archangelo M. Formation, cherts, blackish radiolarites, calcarenites and dark-grey clays. Western of the Caolo river an igneous block appears. (Source: Geological map of the Agri catchment, Lentini et al., 1991).



Sample EF 22
(Serra delle Monache, Montemurro)

Sample EF 26
(locality Tempone, Montemurro)

Sample EF 59
(along the state road 598)

Sample EF 78
(c/da Passo S. Vito, Montemurro)

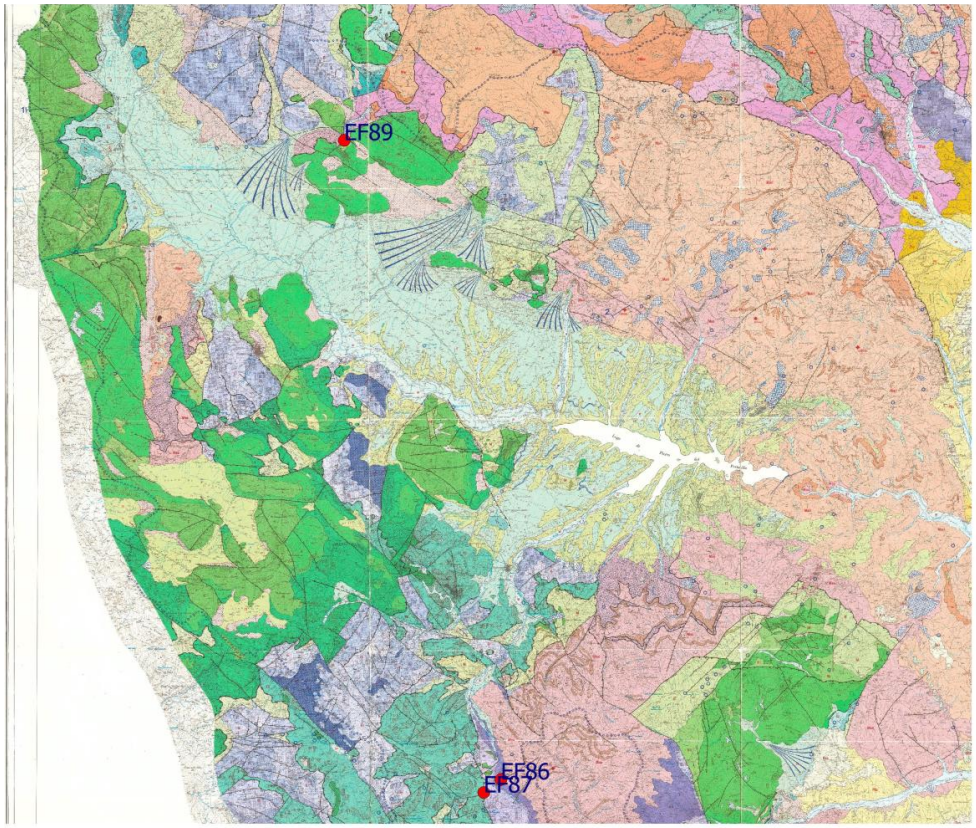
Formation LIGURIAN COMPLEX

Description **Saraceno Formation**

Predominant calcilutites alternating with 2-3 cm up to 30-40 cm bedded gray-brown calcarenites with black cherty lists and dark-gray or sometimes green and reddish shales, with subordinate layers of sandstones; upward the cherty lists became rare, while in the lower part of the alternation with graded layers and gray-brown silty clays, breccias and sandstone intercalations increase (Source: Geological map of the Agri catchment, Lentini et al., 1991).

Crete Nere Formation

Gray-black or greenish shales interbedded with greenish-gray fine grained quartzarenites and gray cherty calcilutites. It is sometimes chaotic due to the tectonics and contains tracks of calcarenites with Nummulites and ophiolites (diabase) (Source: Geological map of the Agri catchment, Lentini et al., 1991).



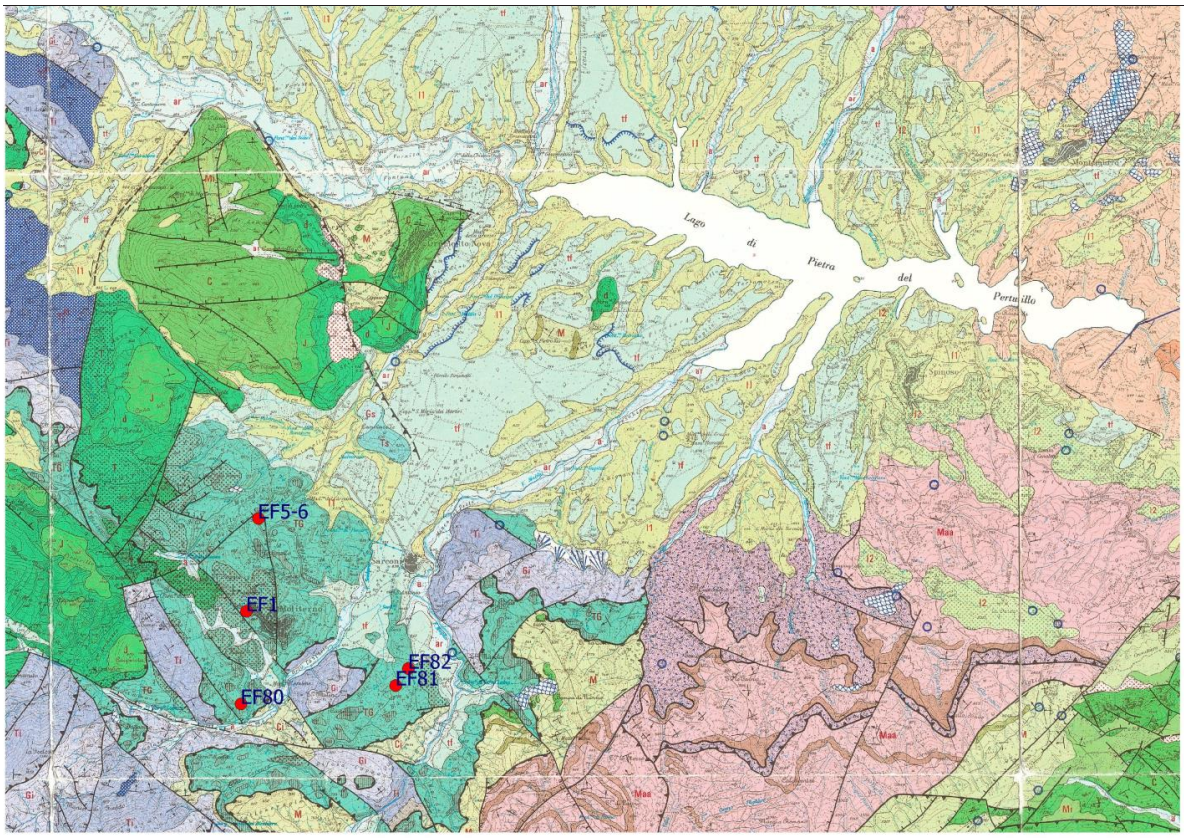
Sample EF 86
(c/da Rimintiello, Moliterno)

Sample EF 87
(c/da Rimintiello, Moliterno)

Sample EF 89
(near the Copone spring, Marsicovetere)

Formation MOLITERNO SUCCESSION

Description Greenish shales with interbedded arkosic gray-brown sandstones and gray-yellowish calcarenites and recifal Ladinian fauna algal bodies, few dozen meters in thickness and limited lateral extent. (...) In the area of Vallone di Leo the formation consists of light brown or, to a lesser extent, red and green shales, with interbedded micaceous subarkosic sandstones. Upwards the formation contains greenish shales with intercalated yellow-brown micaceous sandstones. In different stratigraphic horizons, olistoliths coming from the weathering of the recifal limestones are found. (...) Near the village of Moliterno, the formation is characterized by prevalent varicoloured cherty shales with interbedded marls, limestones and sandstone layers, few meters thick layers or olistoliths of recifal limestones. Upwards the formation is characterized, in this area, by a 50 m thick interval of limestones with chert and dolomitized limestones (Source: Geological map of the Agri catchment, Lentini et al., 1991).



Sample EF 1
(Moliterno village)

Sample EF 5
(along the road Moliterno-Sarconi)

Sample EF 6
(along the road Moliterno-Sarconi)

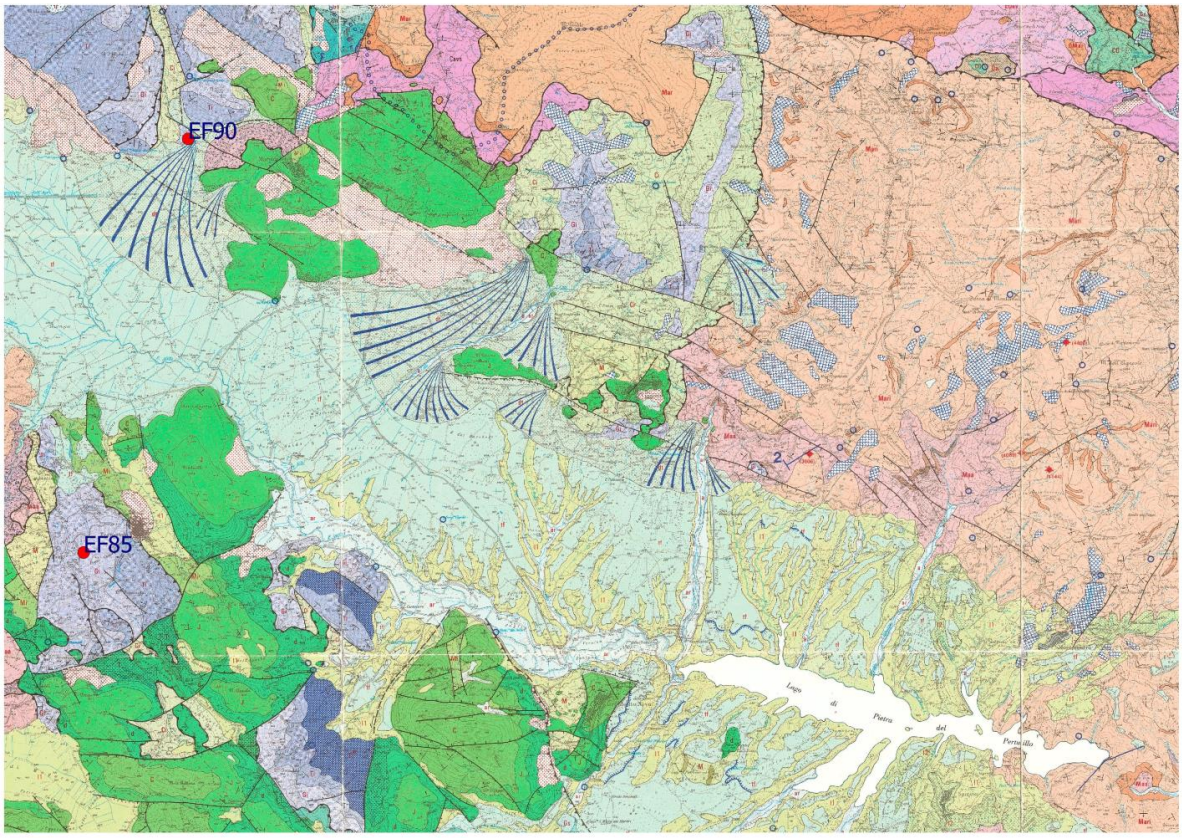
Sample EF 80
(locality Madonna d'Arsieni, Moliterno)

Sample EF 81
(c/da S. Barbara, Sarconi)

Sample EF 82
(c/da S. Barbara, Sarconi)

Formation SCISTI SILICEI

Description Red, green and blackish cm-bedded radiolarites alternating with red cherty shales; here dm-bedded graded totally silicified breccias with arenaceous foraminifera and radiolarians of echinids are frequent interspersed. At the top of the formation alternating laminated gray calcarenites, marly shales and reddish marly limestones were found (Source: Geological map of the Agri catchment, Lentini et al., 1991)

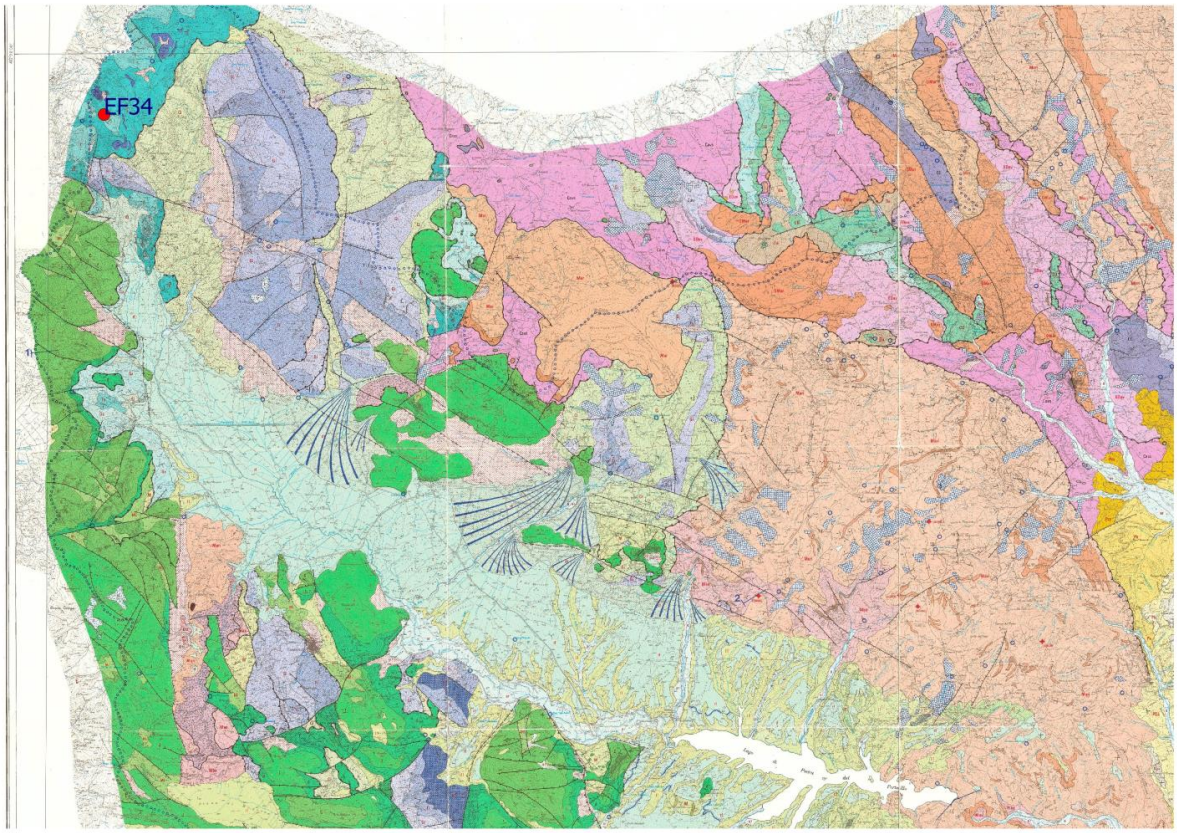


Sample EF 90
(Barricelle village, Marsicovetere)

Sample EF 85
(along the road Tramutola-Montesano)

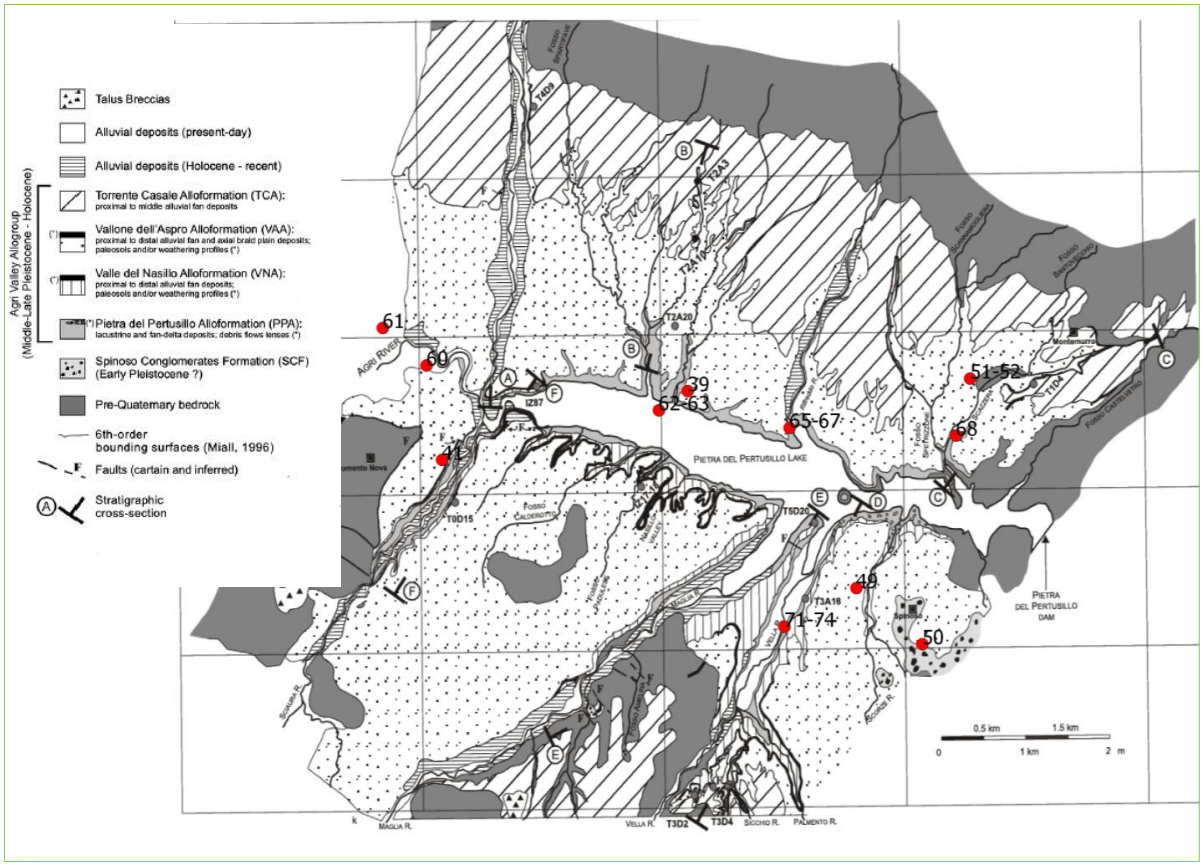
Formation FACITO Mt FORMATION

Description Alternating red and green cherty shales, varicoloured cherts and silicified siltstones. The shales are intercalated with cm-bedded whitish subarkosic sandstones and upwards, brown shales and blackish calcarenites. Recifal calcareous olistoliths are often intercalated (Source: Geological map of the Agri catchment, Lentini et al., 1991)



Sample EF 34
(c/da Cognone, Marsico Nuovo

QUATERNARY DEPOSITS



Sample EF39
(Aspro bridge, Pertusillo lake)

Sample EF 41
(locality Madonna delle Grazie, Grumento Nova)

Appendices

Sample EF49
(Spinoso Village)

Sample EF 50
(Spinoso Village)

Sample EF51-52
(Artificial scarp along the SP11 road, Montemurro)

Sample EF 60
(c/da Cembrina, Viggiano)

Sample EF61
(c/da Cembrina, Viggiano)

Sample EF 62-63
(Pertusillo lake, between the Vallone dell'Aspro and the Spartifave months)

Sample EF65-67
(Rifreddo month, Pertusillo lake)

Sample EF 71-74
(Vella month, Pertusillo lake)

Appendix 4

Details about core drilling and splitting

Core drilling operations

Once the sampling point was identified, the boat was anchored, the corer was lowered up to the water depth and the drill was repeatedly disengaged up to the maximum driving depth. In some cases, the presence of gravel caused the tube to break and the sampling point need to be moved by a few meters. Before being completely extracted from the water, the core was plugged immediately in the lower part and bound in a vertical position on a side of the platform. Some technical data was reported on each individual core (geographical coordinates, the water depth and the height of the sampled core); excess water was removed through a small hole drilled in the tube above the sampled sediment (fig. 1). Then, the excess tube was cut and the core was plugged on the top.

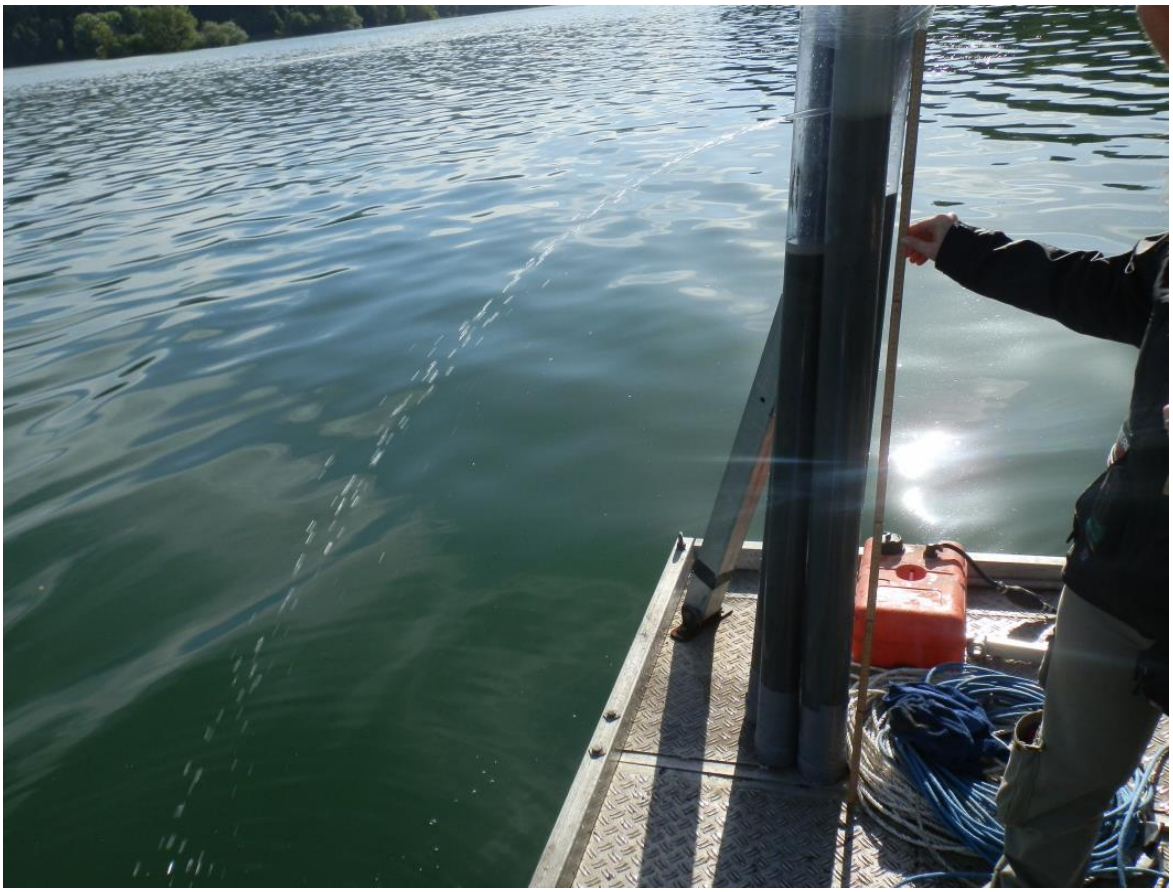


Figure 1. Water expulsion from a just sampled core.

Splitting and sub-sampling of the cores

The way the core samples are stored and opened could modify the concentration of metals by introducing new contaminates in the sample or altering the physical, chemical and biological characteristics. Therefore, the opening and sectioning of the core was preceded by an appropriate selection of materials and techniques capable of minimizing sample contamination sources. The instruments used during the opening phase include:

An electric milling machine to make a linear and thin as possible cut; the depth of penetration of the blade was set at 1.5 mm (the thickness of the tube was of 1.8 mm);

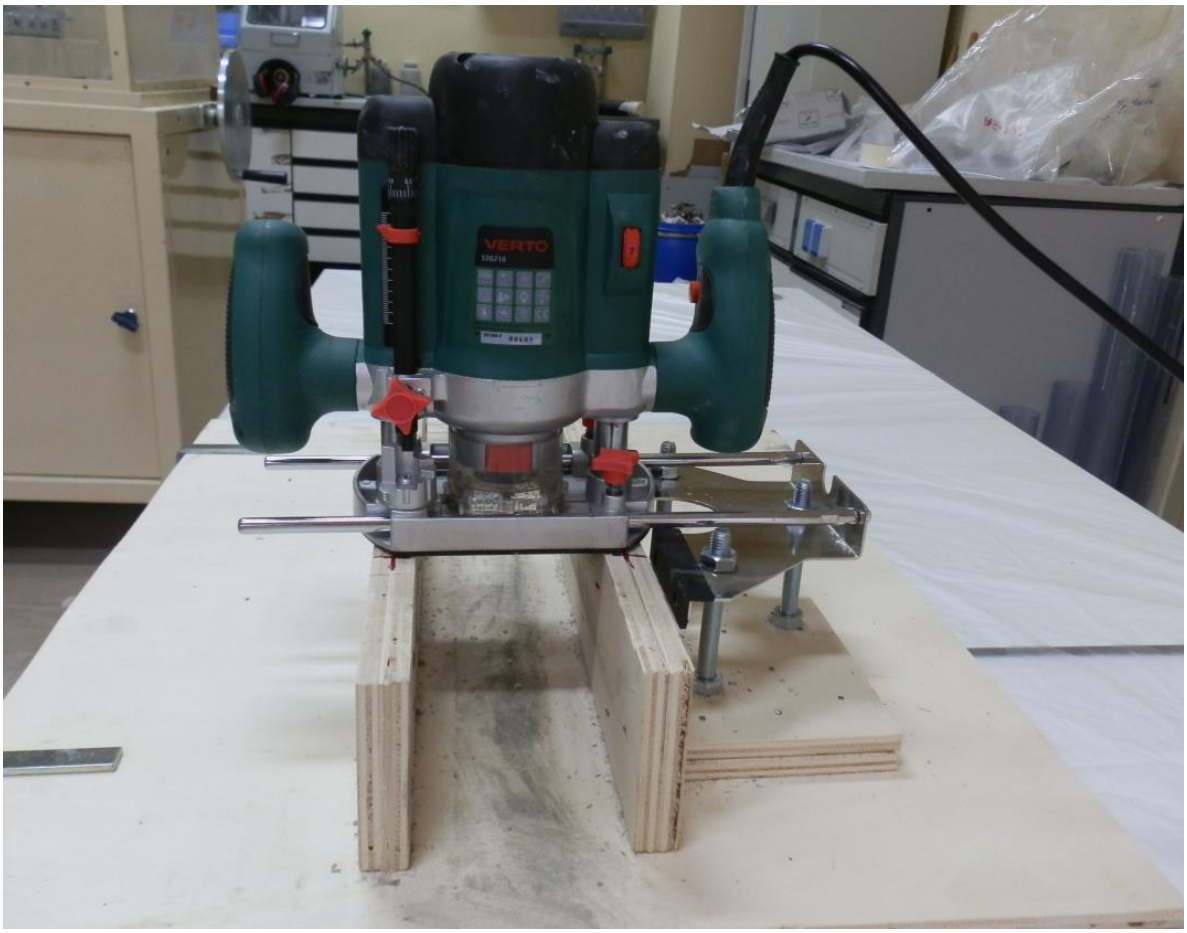


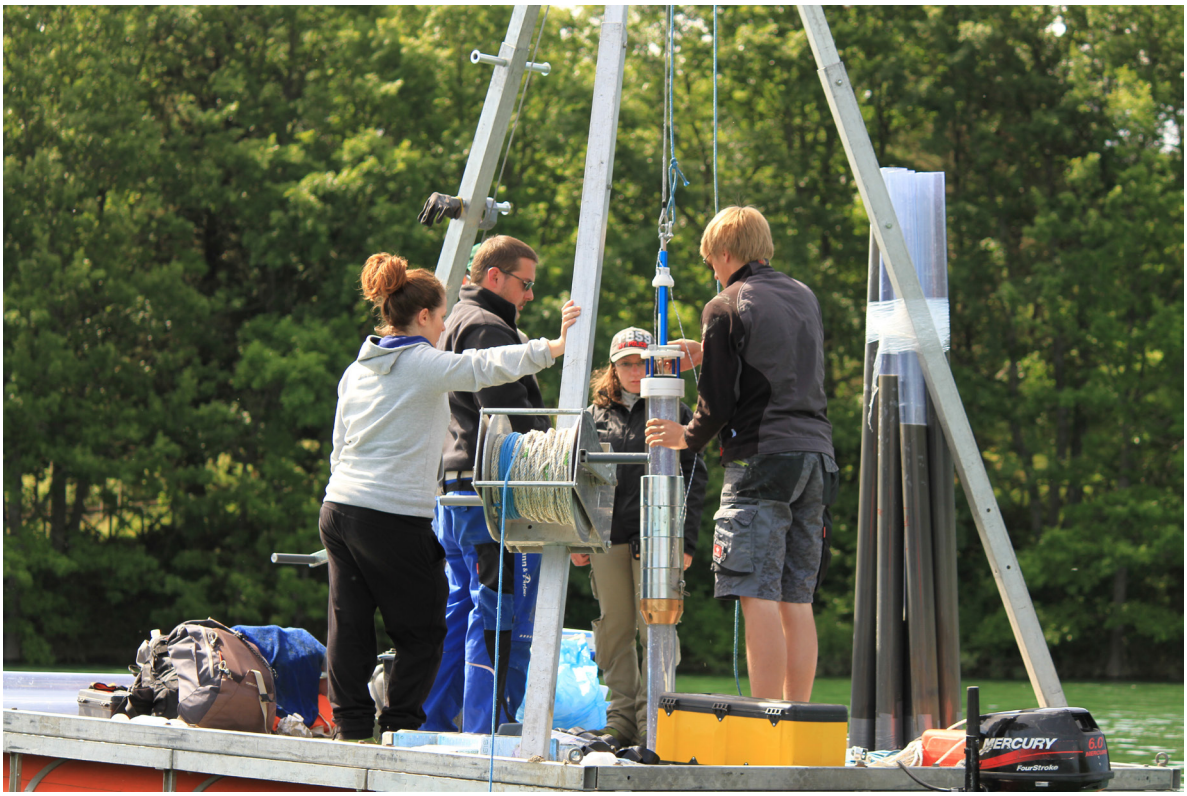
Figure 2. The electric milling machine using during the splitting.

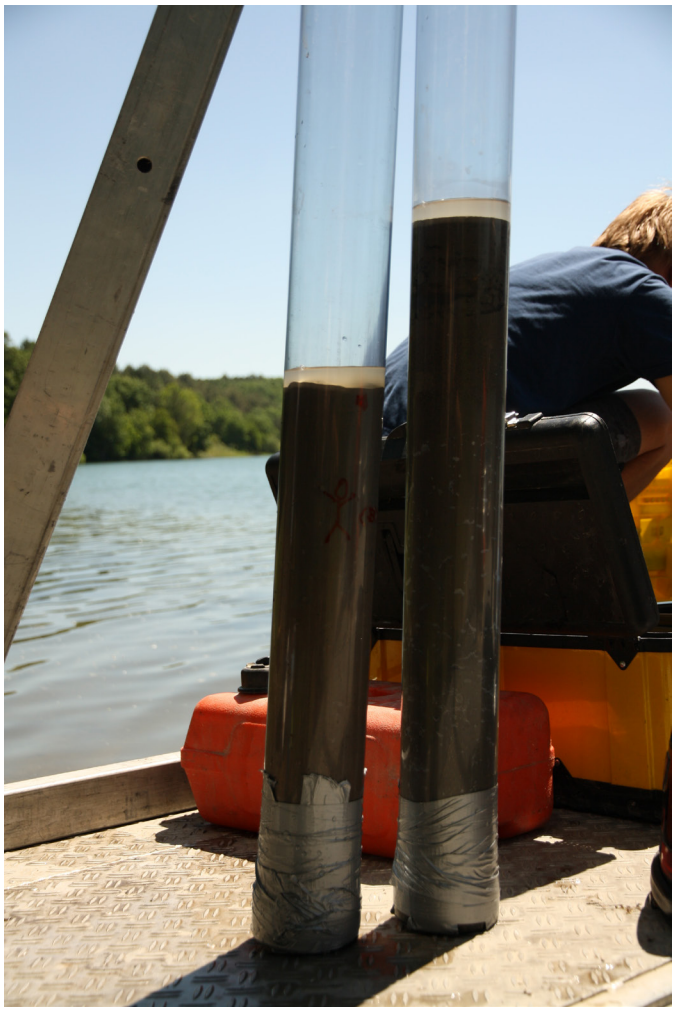
- Wooden support, with equivalent internal diameter to that of the core (9 cm), to minimize rotational movements during cutting; the upper part of the support is open to check the descent of the milling machine blade;
- Steel wire for the opening of the more consolidated cores;

- Stainless steel blades with a length of 1 m for the opening of the shorter cores and 2 m for the opening of greater length cores, all with a width of 15 cm. These blades have a thickness of 0.6 mm. The choice of material was not random since, if on the one hand the metal does not flexes easily, on the other hand the stainless steel minimizes sediment contamination issues;
- Wooden boxes for the positioning and transportation of the cores; 9 cm thick, the same thickness of the cores, longitudinal compartments were created in these boxes in order to store the cores;
- Plexiglass rings: 9 cm diameter to transversely isolate the intervals at which to sample and to help remove the sediment to be analysed;
- 500 g containers made from high density polyethylene (HDPE) since, according to the international protocols (EPA, 2001), is an inert and generally unbreakable material.

The opening of the core consisted in horizontally positioning the tube on the cutting table. Using a ruler two diametrically opposed lines are traced on the tubes. These lines serve as guides during the cutting phase and set the incision depth of the milling machine blade. To avoid contamination of the sediment, the tube was cutted with the blade and then the cut was completed with a cutter. The longitudinal opening of the core was done using a steel wire when the sediment results to be compact, or alternatively with steel plates if the sediment was extremely rich in water.

On the Lake

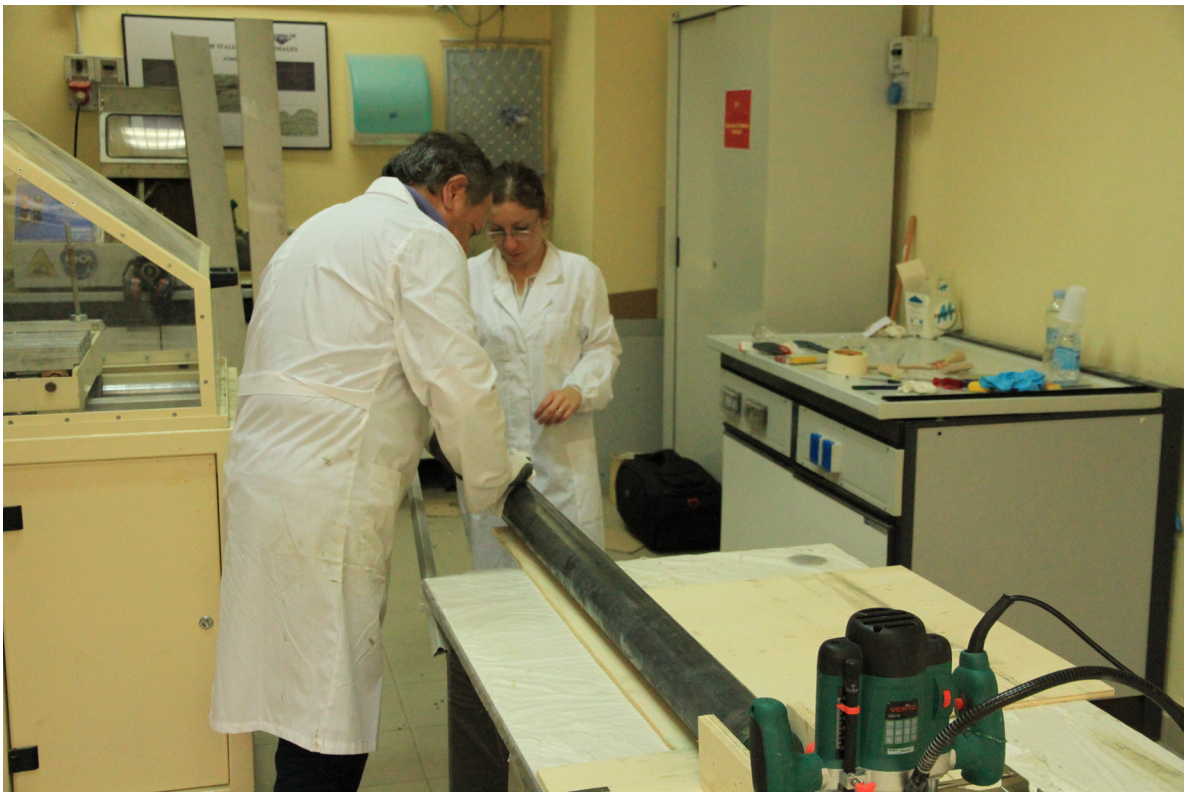

MERCURY
FourStroke

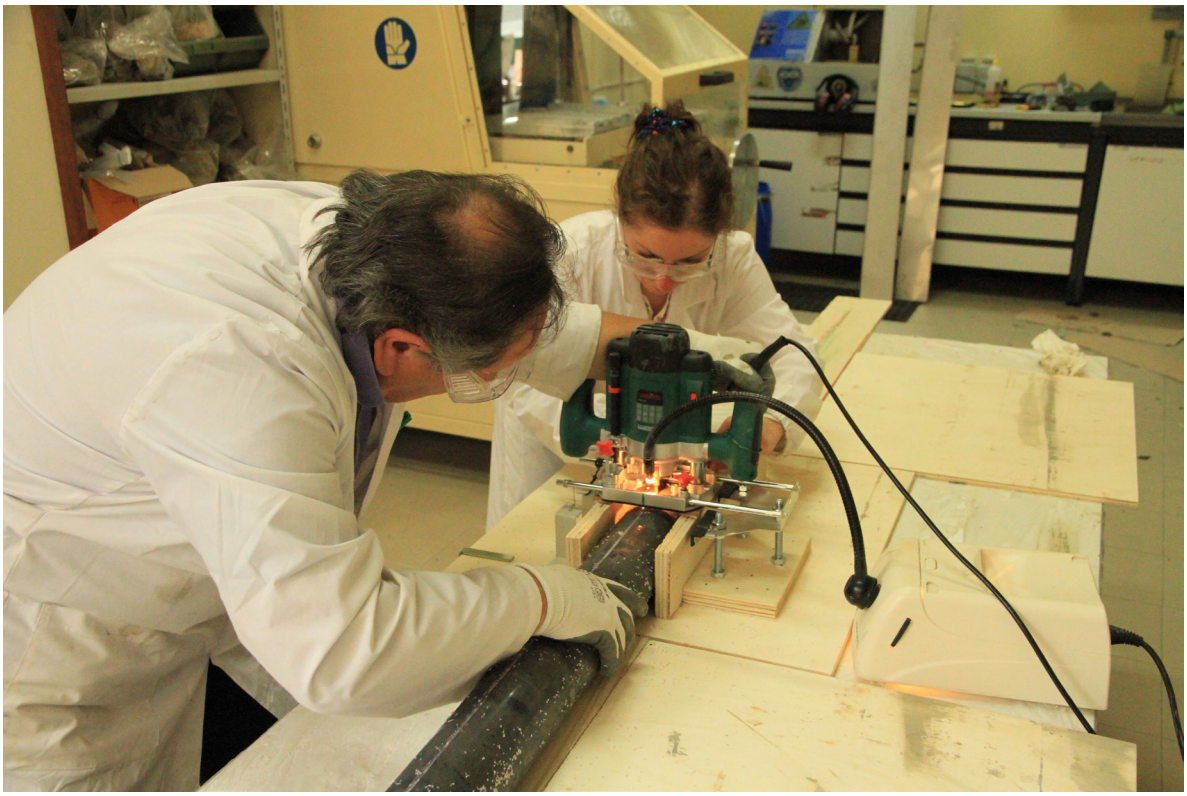


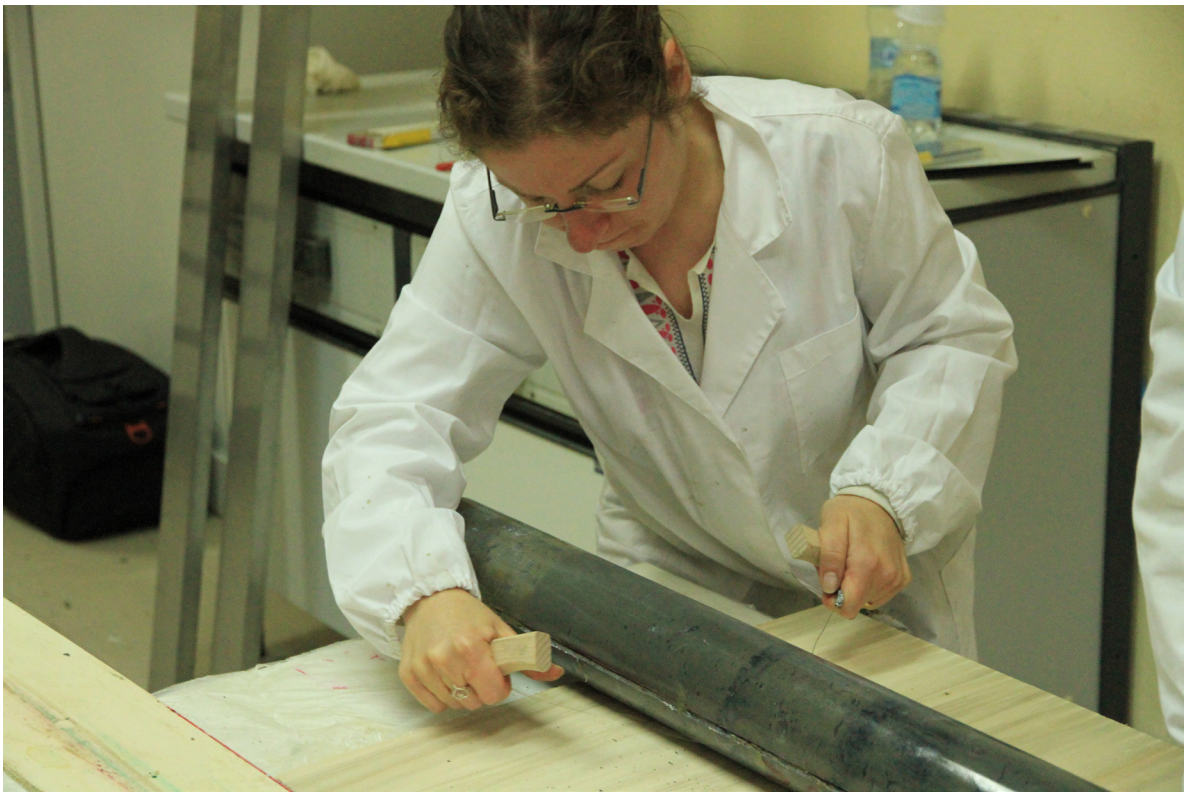

MERCURY

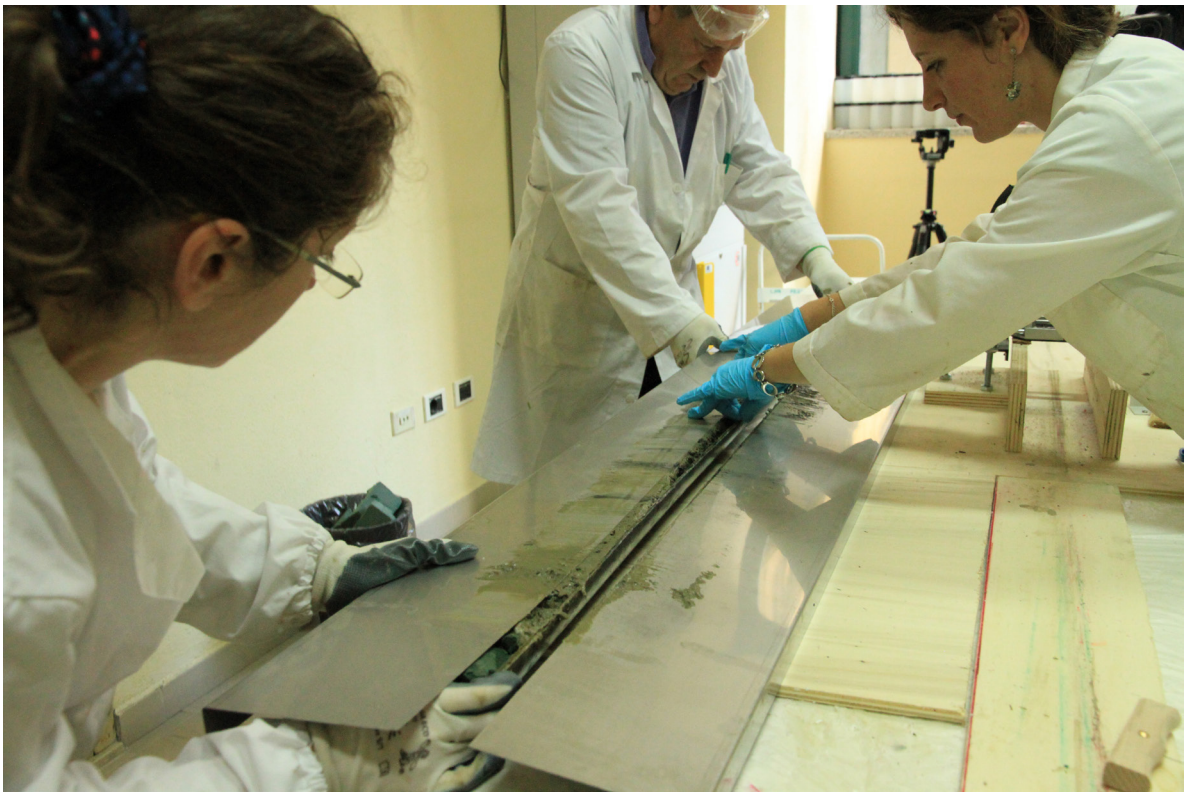

MERCUR

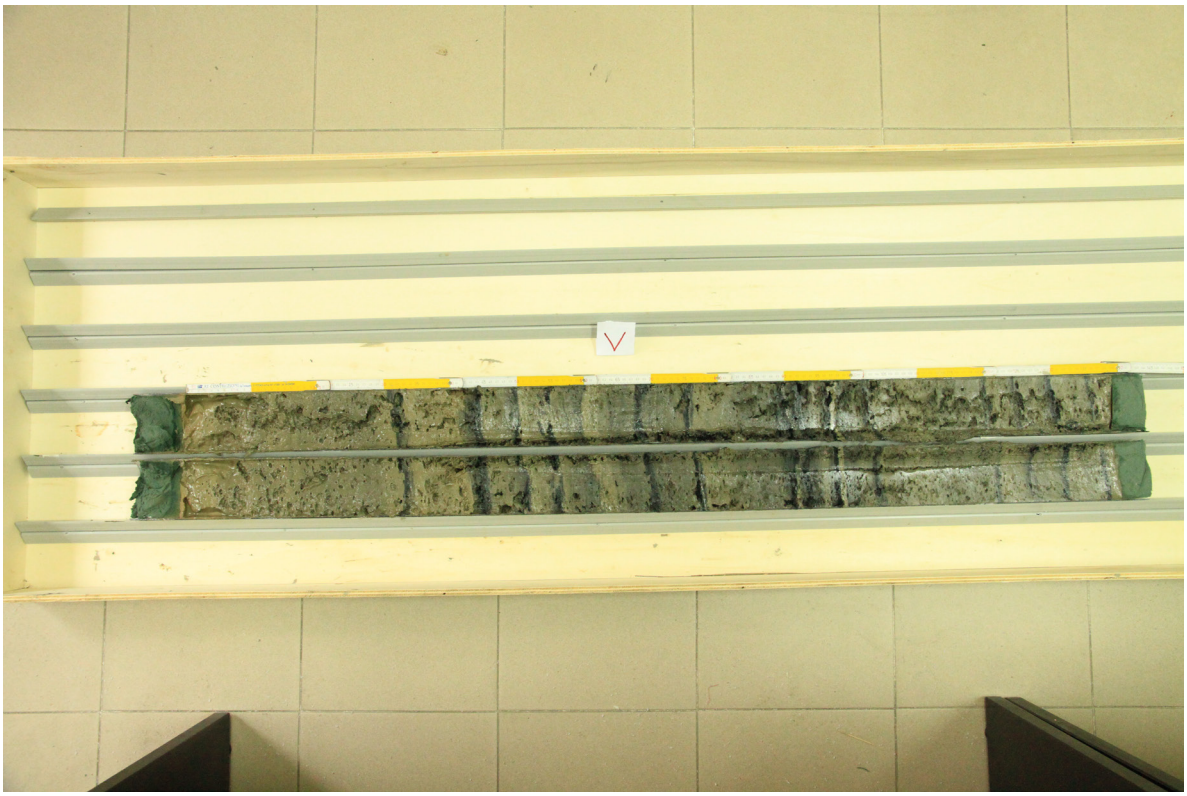
Laboratory

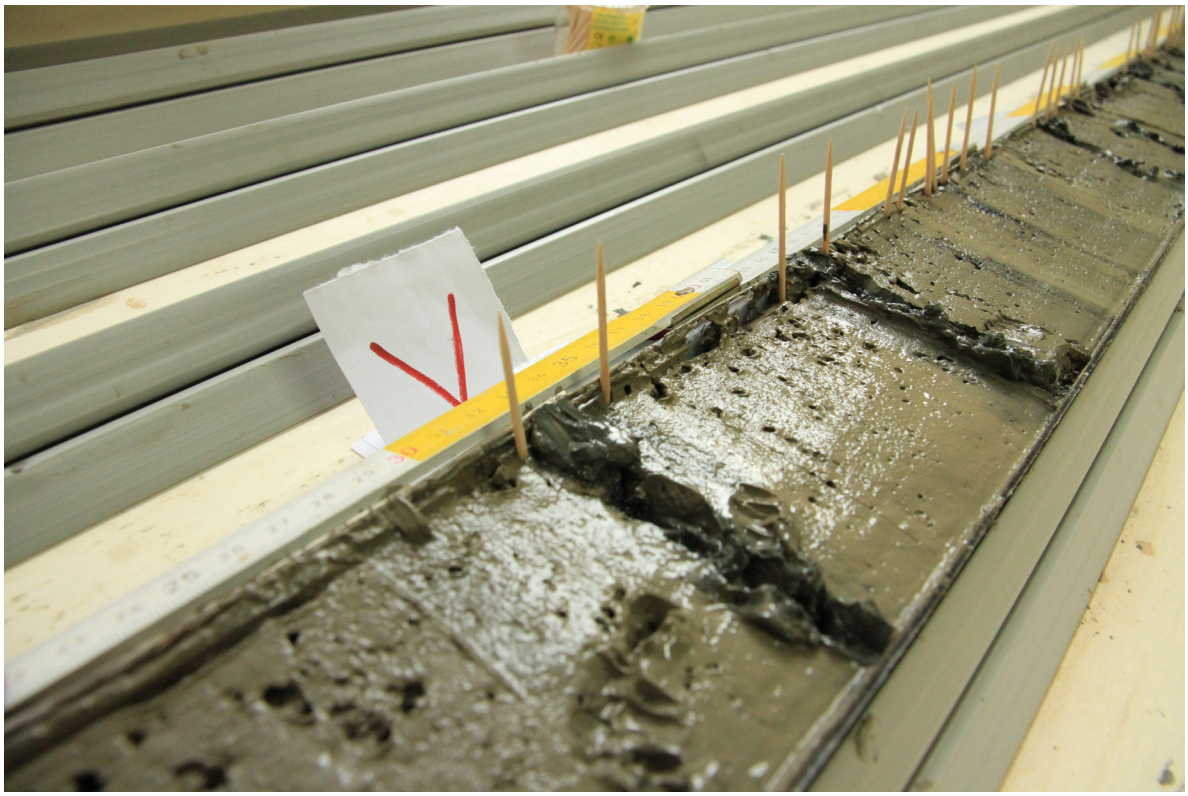


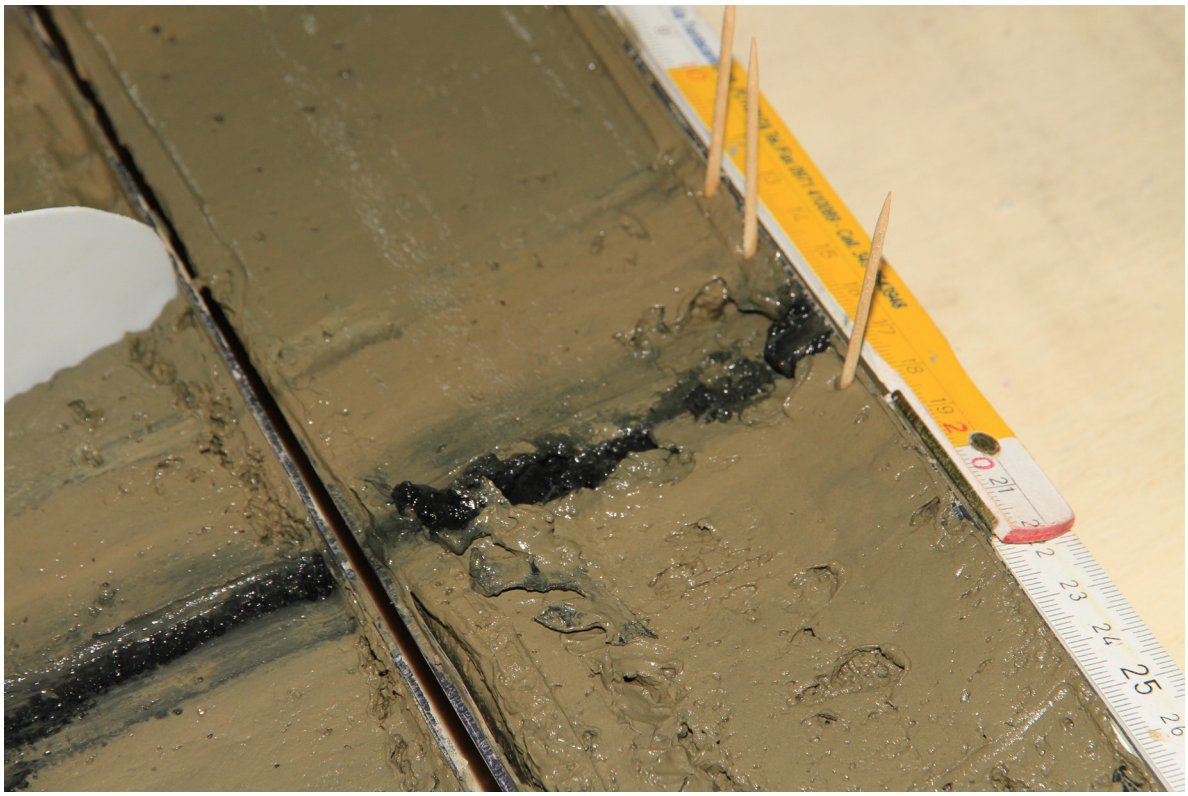


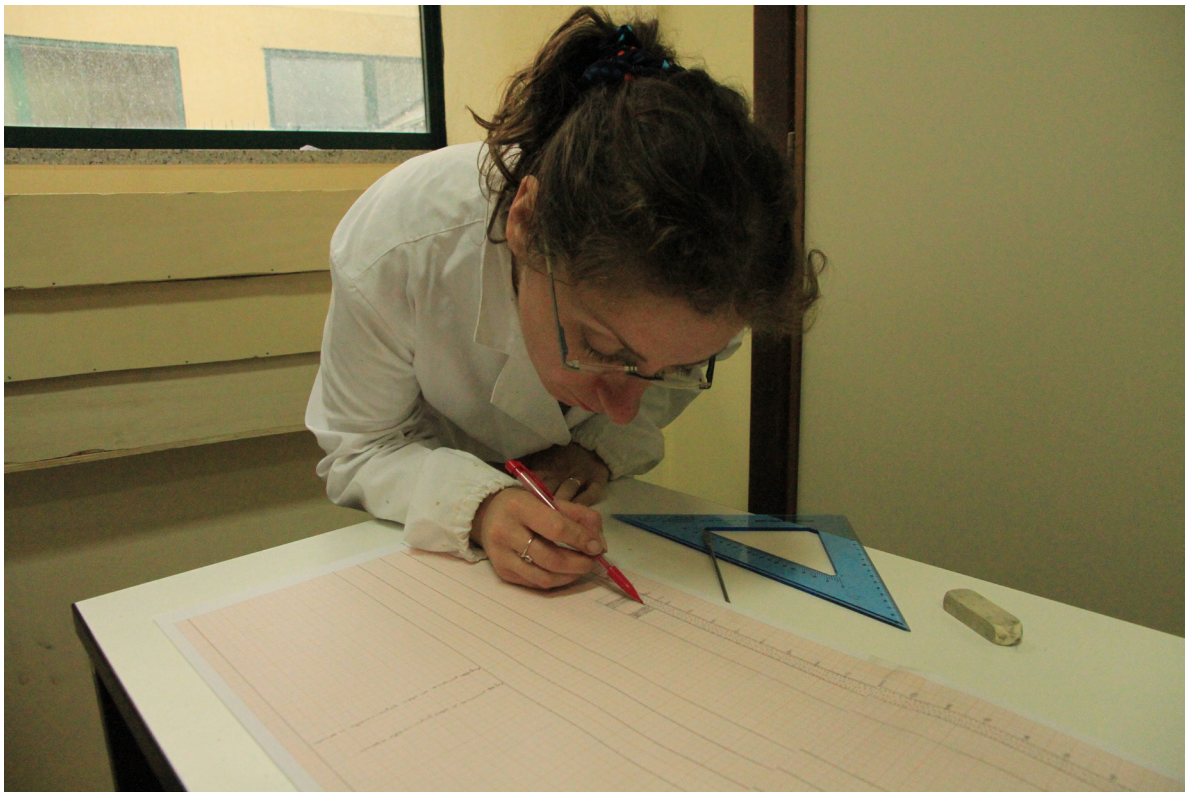


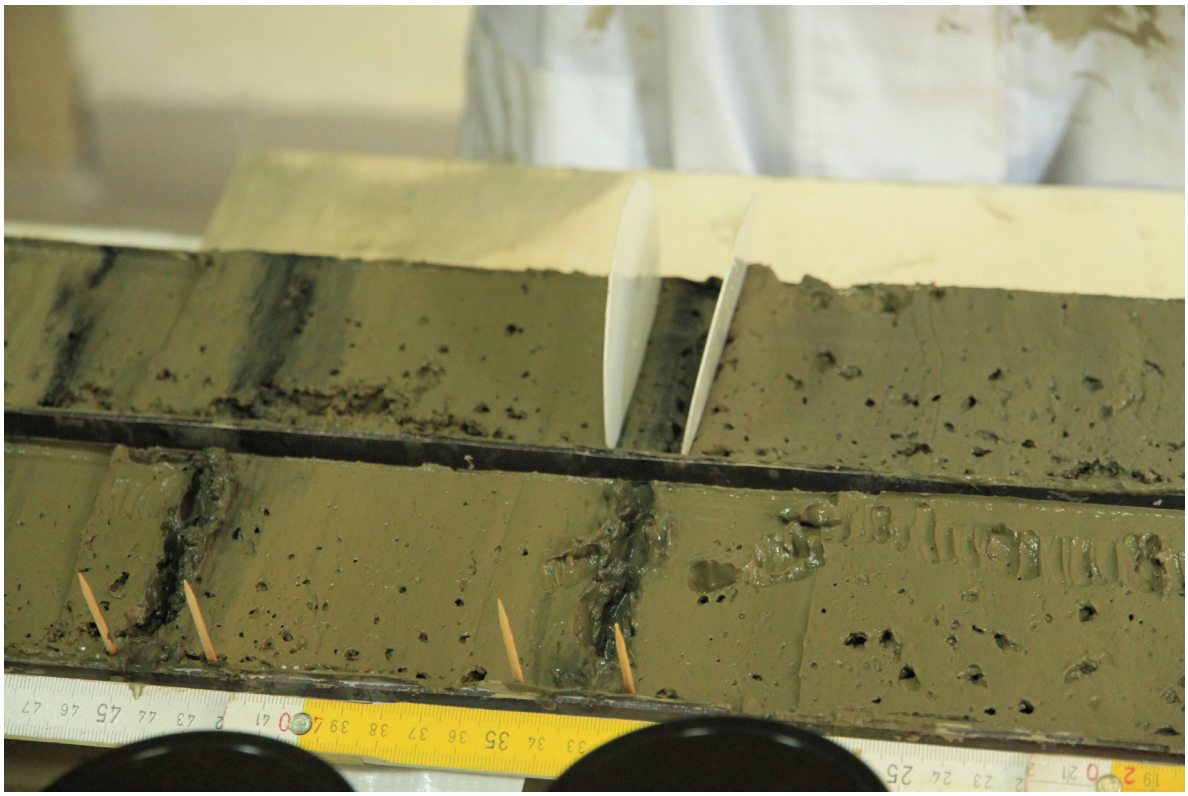












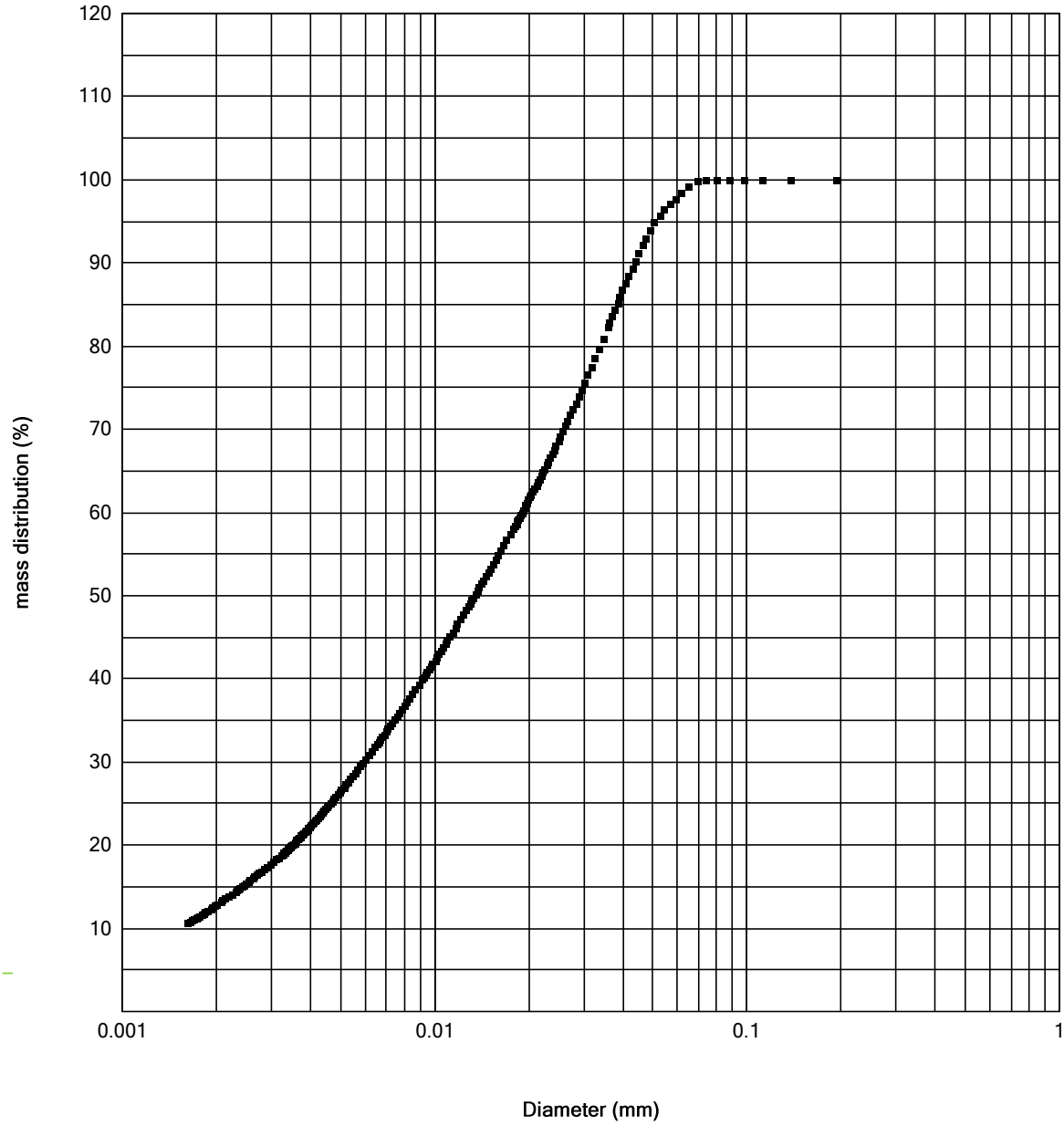
Appendix 5

The granulometric curves of fluvio-lacustrine samples

Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 mag 16 01:35

Sample: EFF2

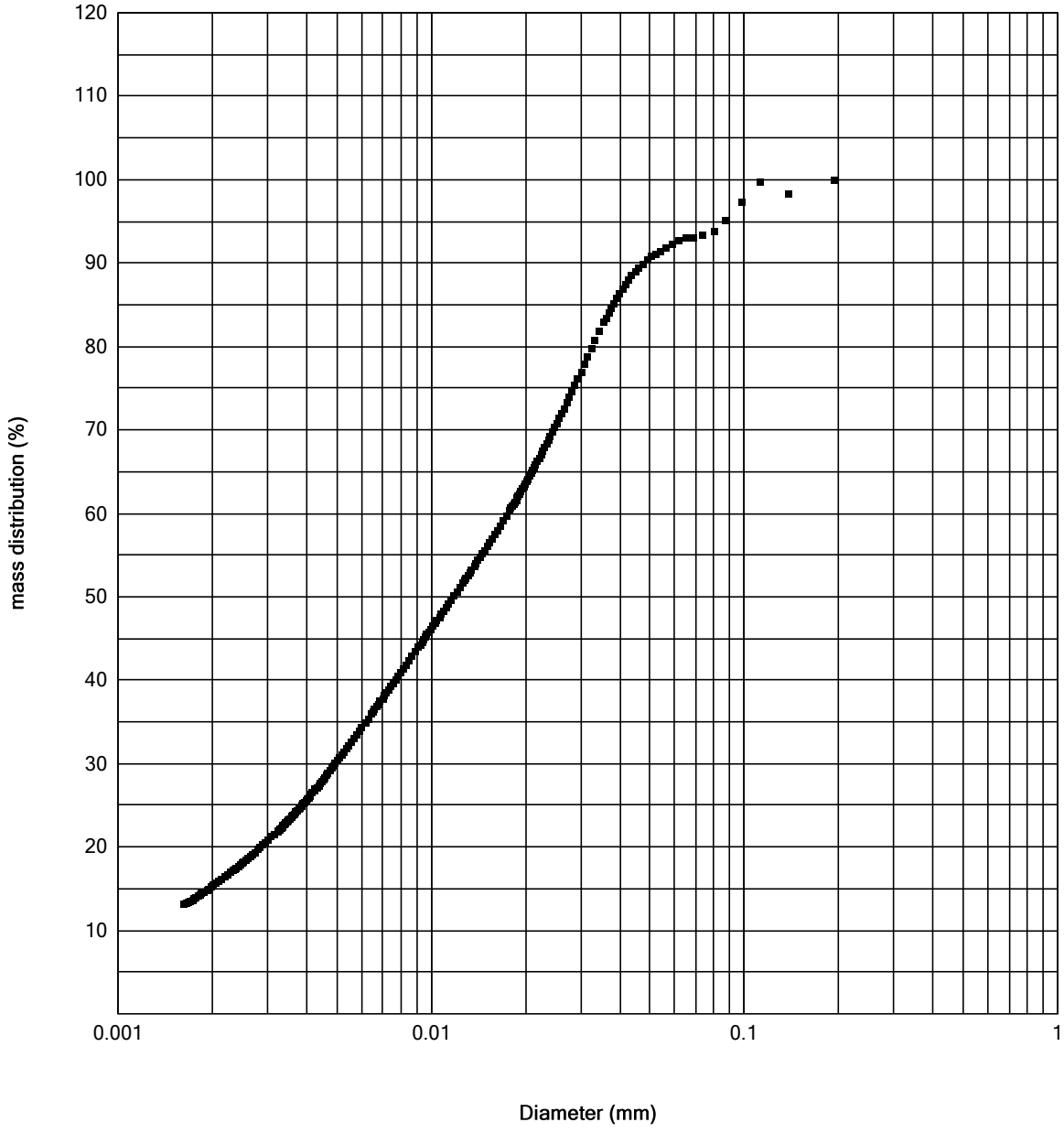
Sand	> 100 µ:	0 g/kg
Sand	100 - 50 µ:	88 g/kg
Coarse Silt	50 - 20 µ:	323 g/kg
Fine Silt	20 - 2 µ:	471 g/kg
Clay	< 2 µ:	118 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 11 03:14

Sample: Sample 1

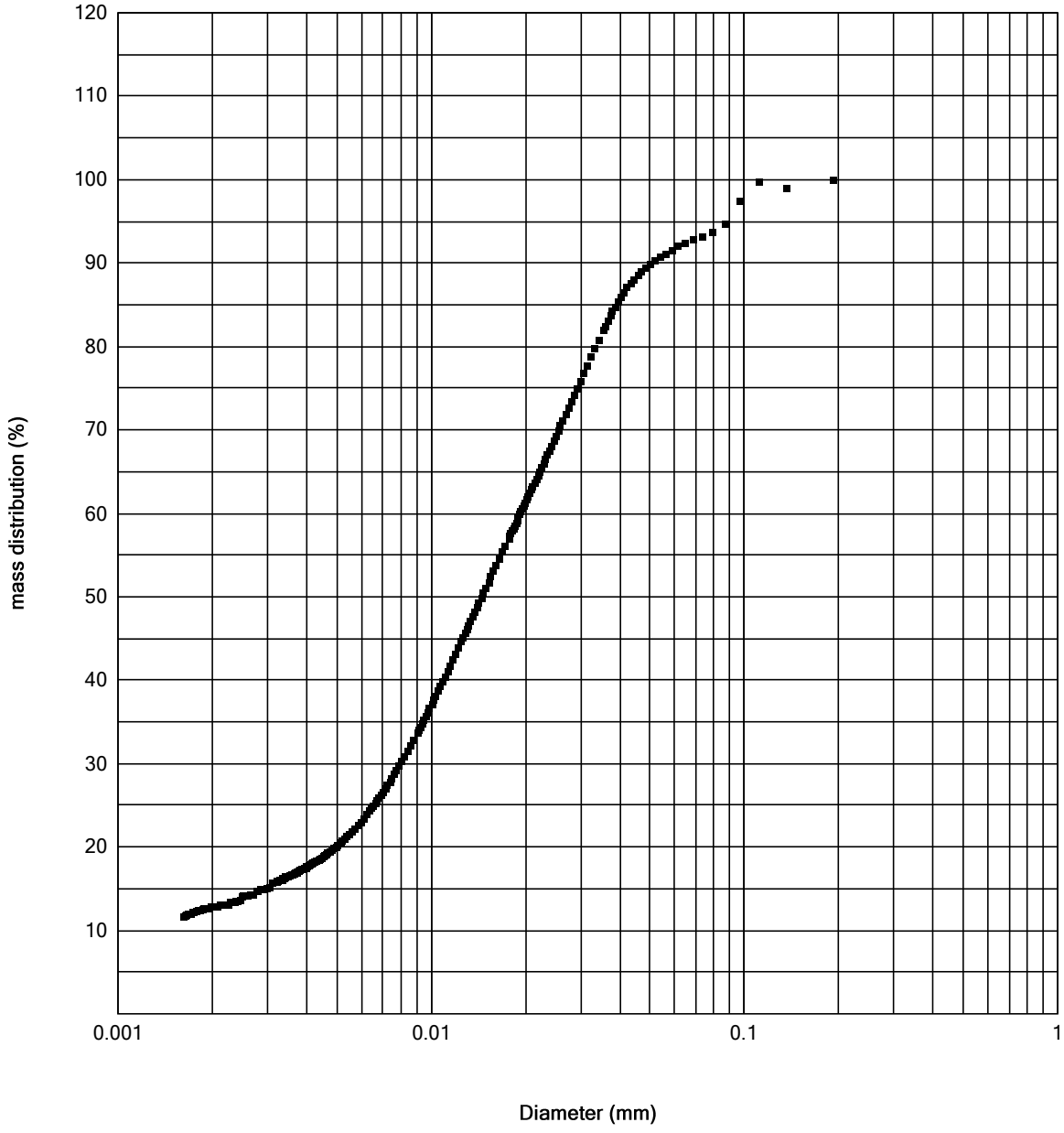
Sand	> 100 µ:	48 g/kg
Sand	100 - 50 µ:	57 g/kg
Coarse Silt	50 - 20 µ:	284 g/kg
Fine Silt	20 - 2 µ:	468 g/kg
Clay	< 2 µ:	143 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 08 03:27

Sample: Sample 1

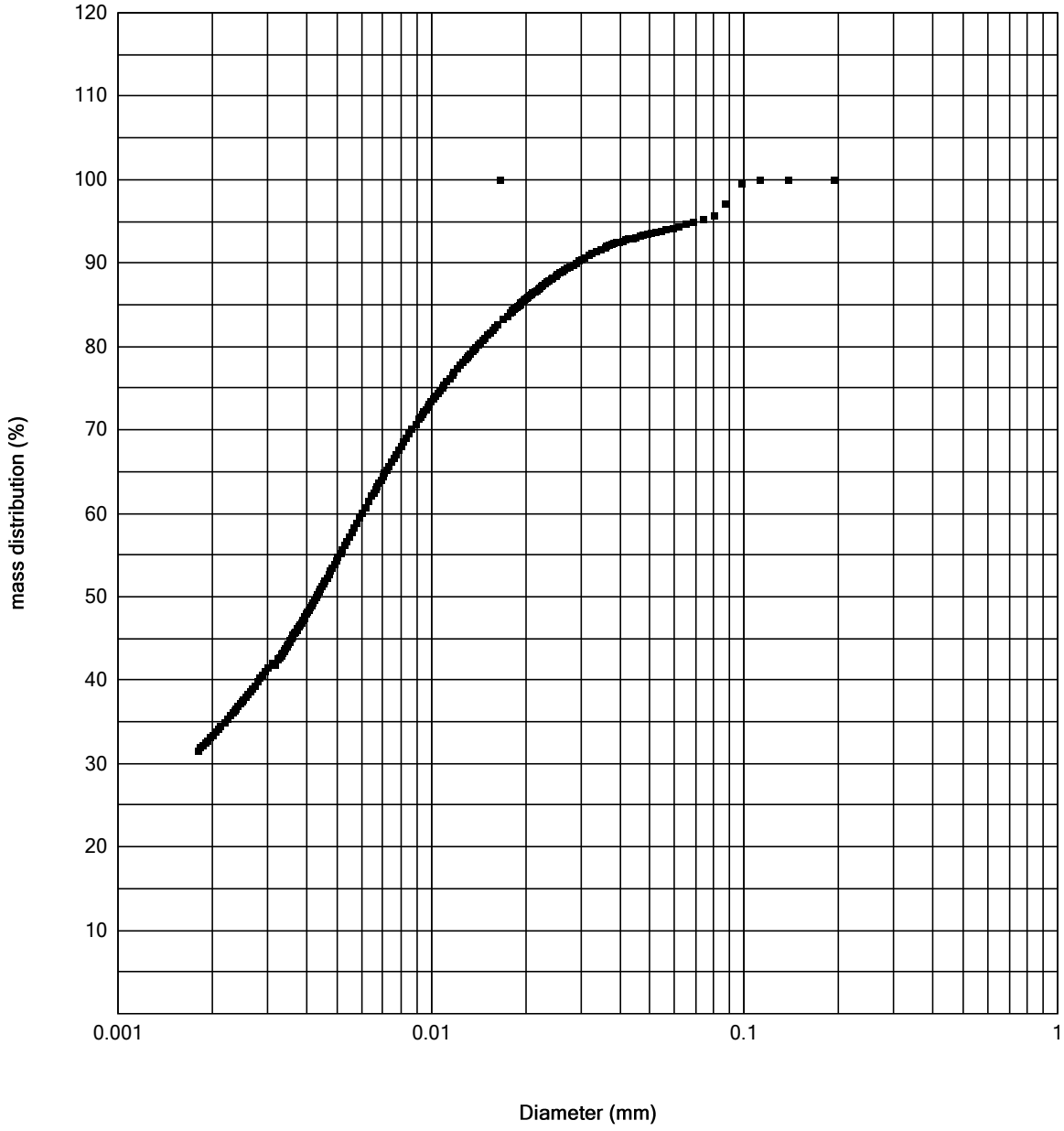
Sand	> 100 µ:	53 g/kg
Sand	100 - 50 µ:	61 g/kg
Coarse Silt	50 - 20 µ:	303 g/kg
Fine Silt	20 - 2 µ:	458 g/kg
Clay	< 2 µ:	125 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 11 08:30

Sample: Sample 1

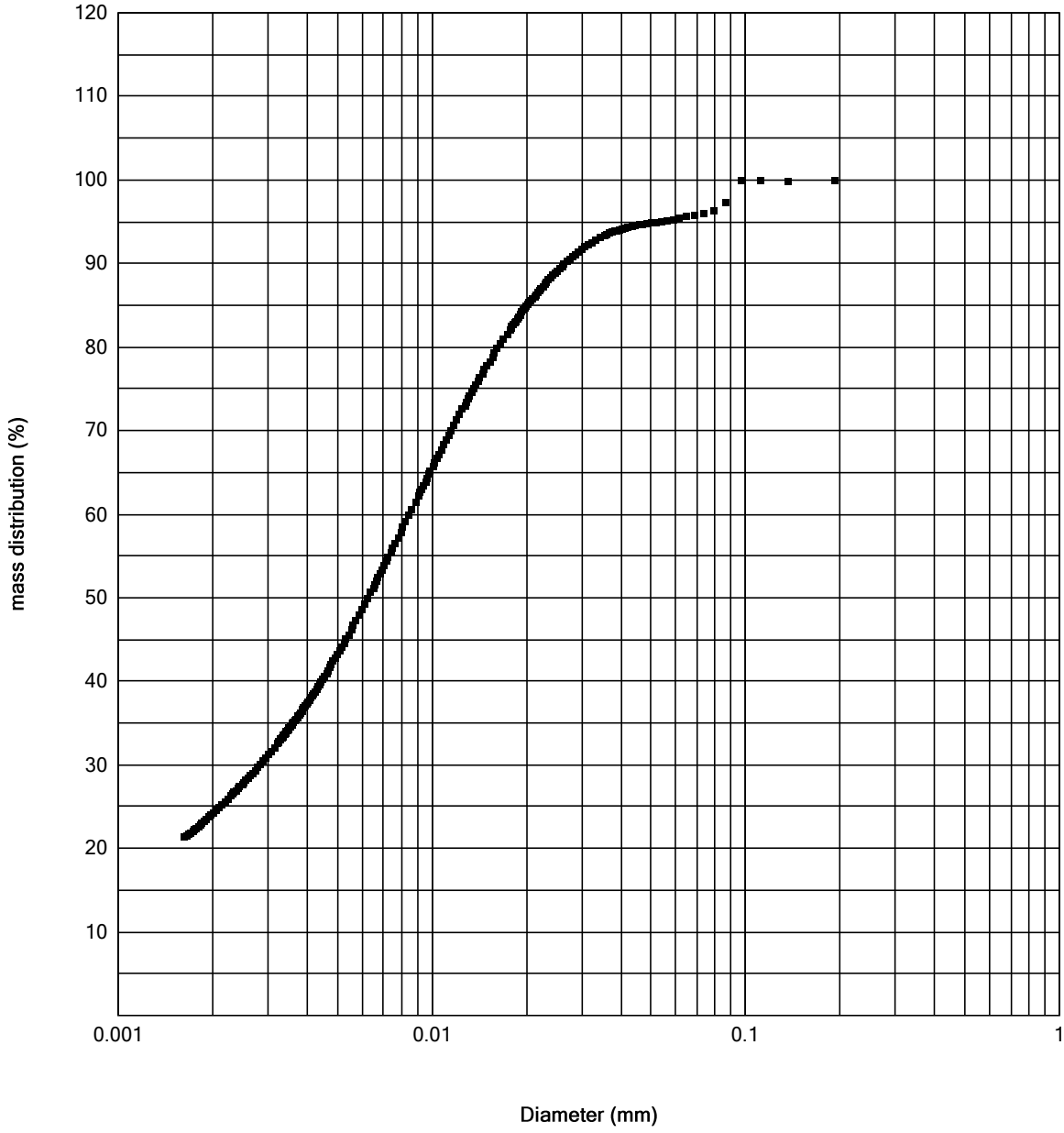
Sand	> 100 µ:	29 g/kg
Sand	100 - 50 µ:	40 g/kg
Coarse Silt	50 - 20 µ:	87 g/kg
Fine Silt	20 - 2 µ:	525 g/kg
Clay	< 2 µ:	320 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 14 05:05

Sample: EFF7

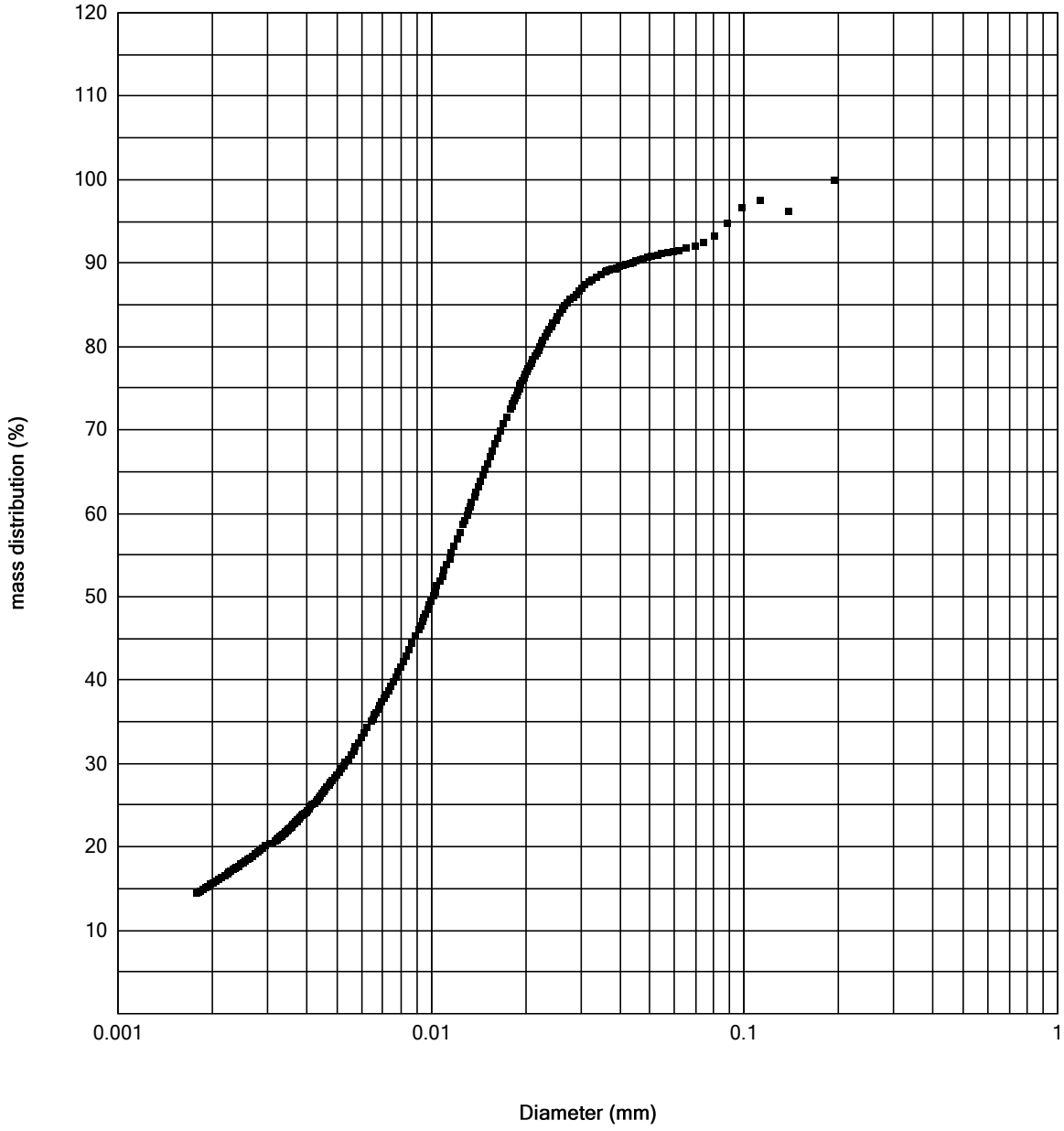
Sand	> 100 µ:	26 g/kg
Sand	100 - 50 µ:	27 g/kg
Coarse Silt	50 - 20 µ:	117 g/kg
Fine Silt	20 - 2 µ:	601 g/kg
Clay	< 2 µ:	229 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 14 10:19

Sample: Sample 1

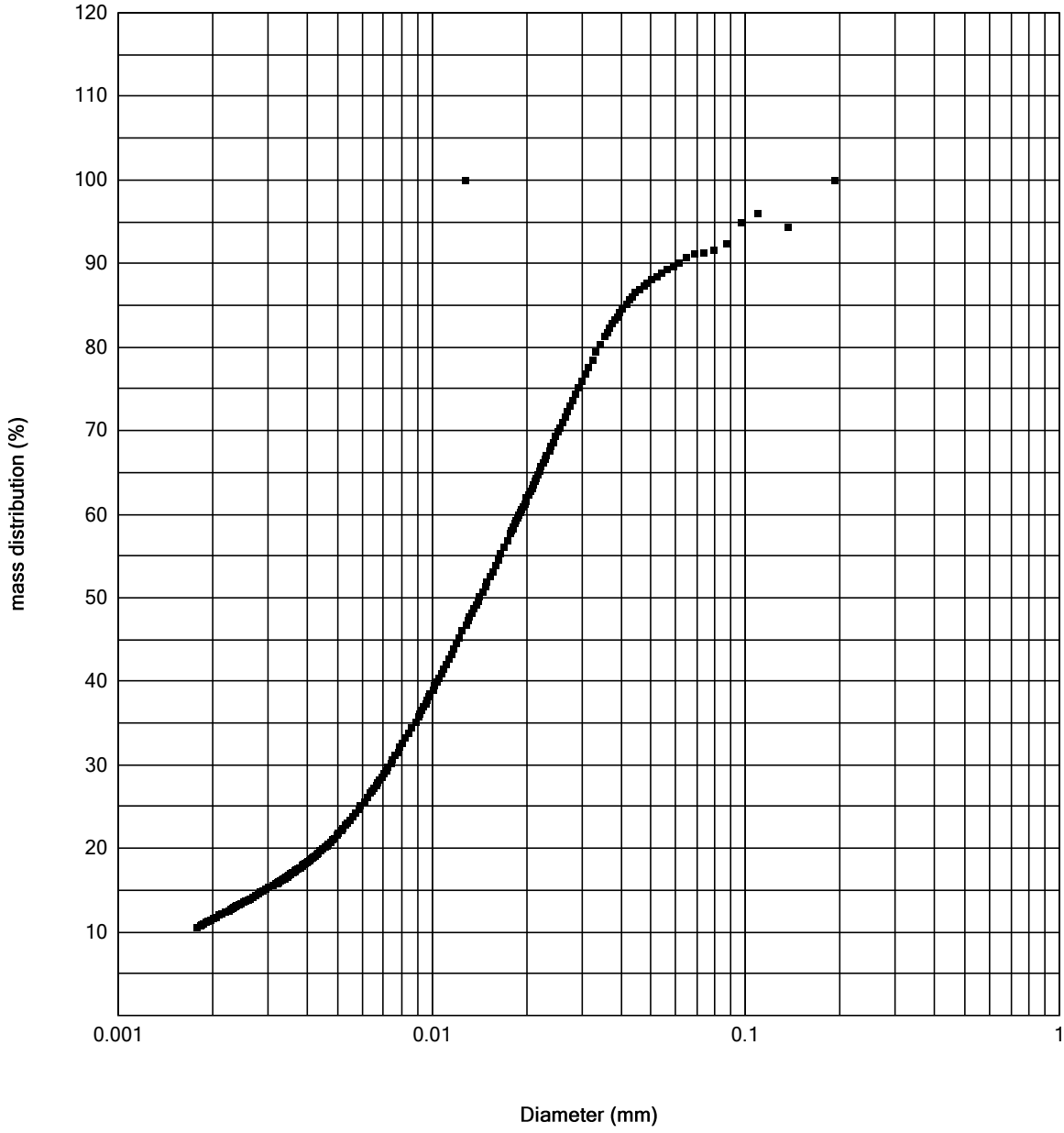
Sand	> 100 µ:	52 g/kg
Sand	100 - 50 µ:	45 g/kg
Coarse Silt	50 - 20 µ:	167 g/kg
Fine Silt	20 - 2 µ:	588 g/kg
Clay	< 2 µ:	148 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 15 10:14

Sample: EFF9

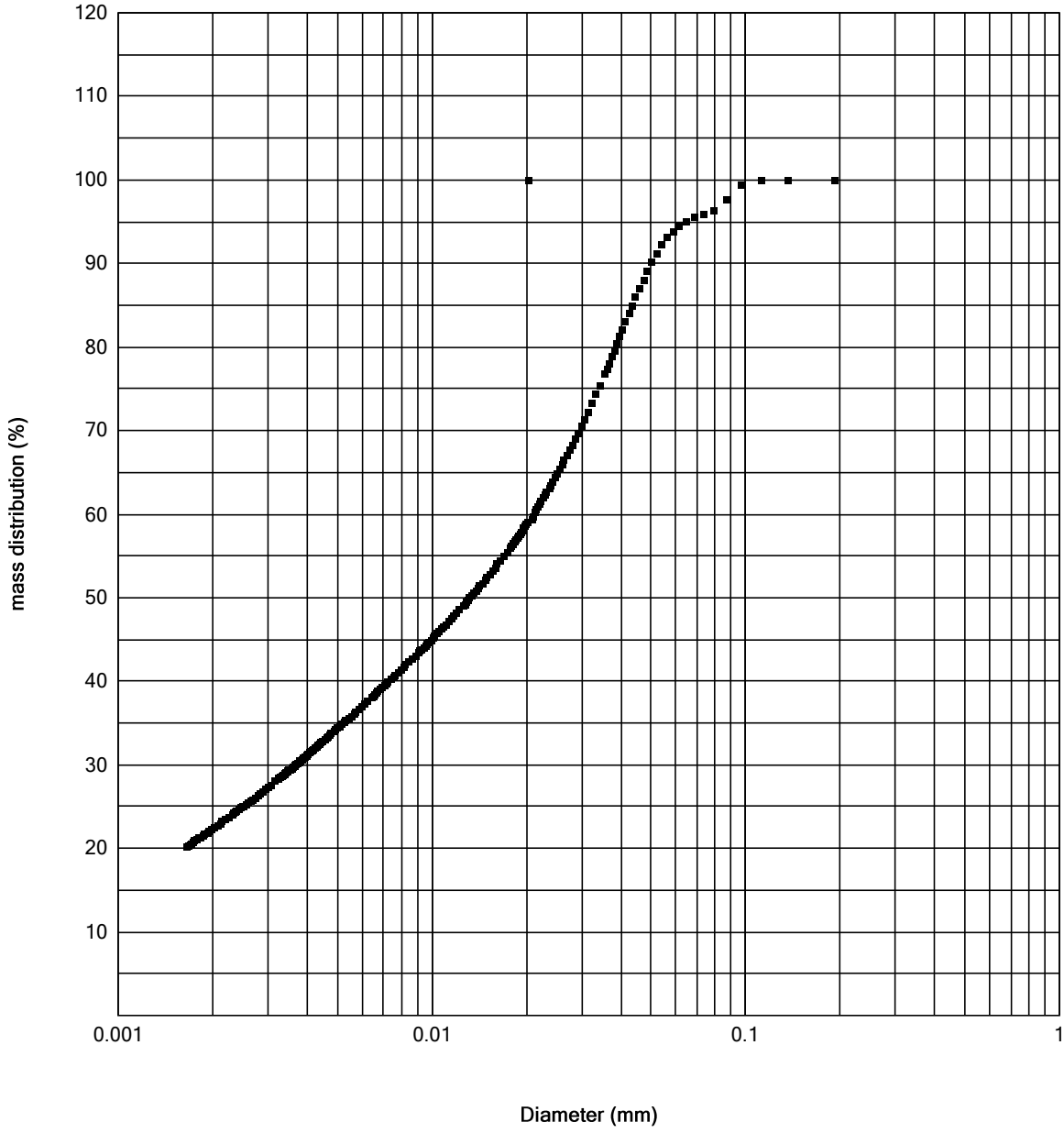
Sand	> 100 µ:	76 g/kg
Sand	100 - 50 µ:	54 g/kg
Coarse Silt	50 - 20 µ:	281 g/kg
Fine Silt	20 - 2 µ:	481 g/kg
Clay	< 2 µ:	108 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 15 05:06

Sample: EFF10

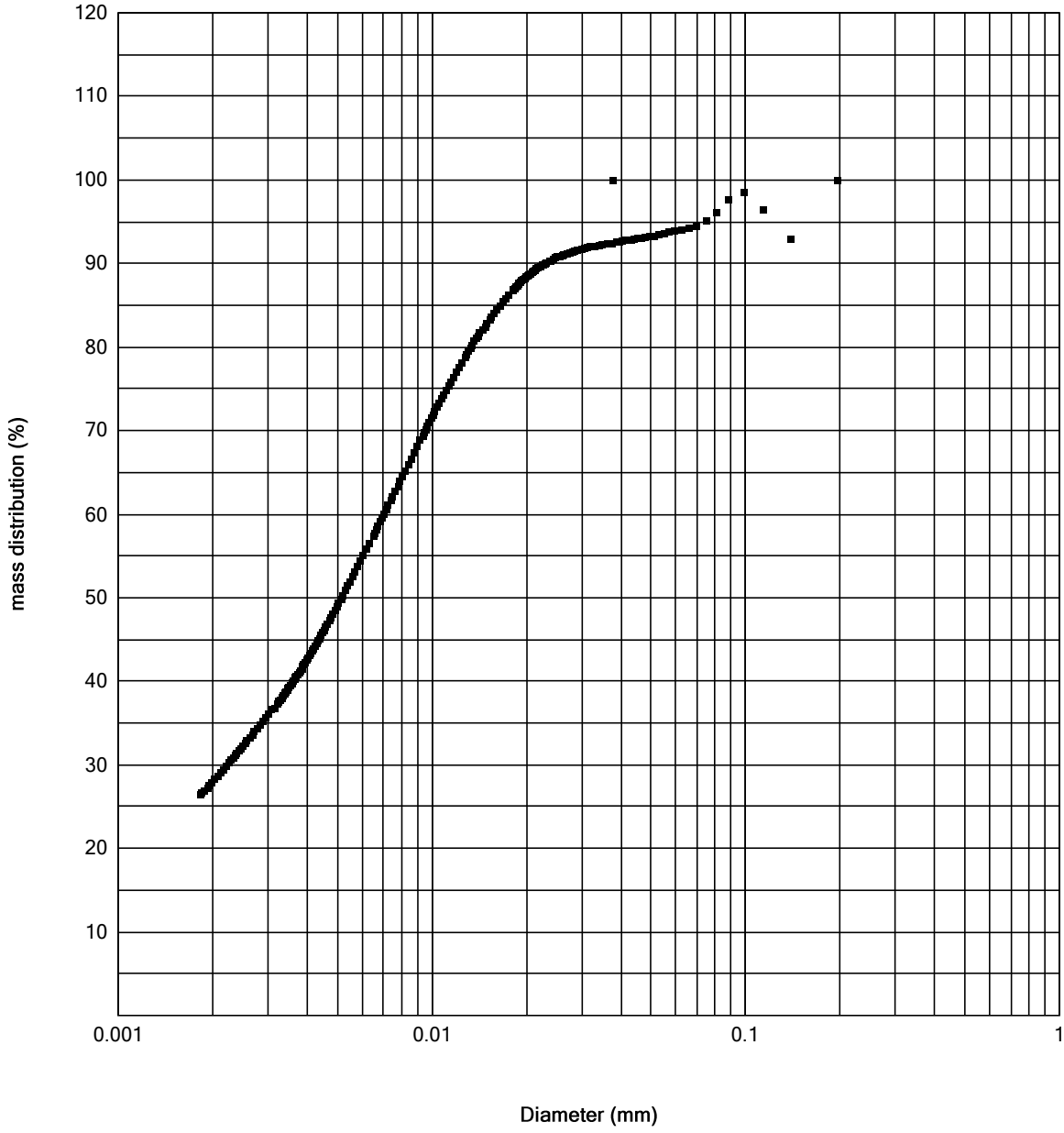
Sand	> 100 µ:	23 g/kg
Sand	100 - 50 µ:	106 g/kg
Coarse Silt	50 - 20 µ:	303 g/kg
Fine Silt	20 - 2 µ:	354 g/kg
Clay	< 2 µ:	214 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 22 10:36

Sample: Sample 1

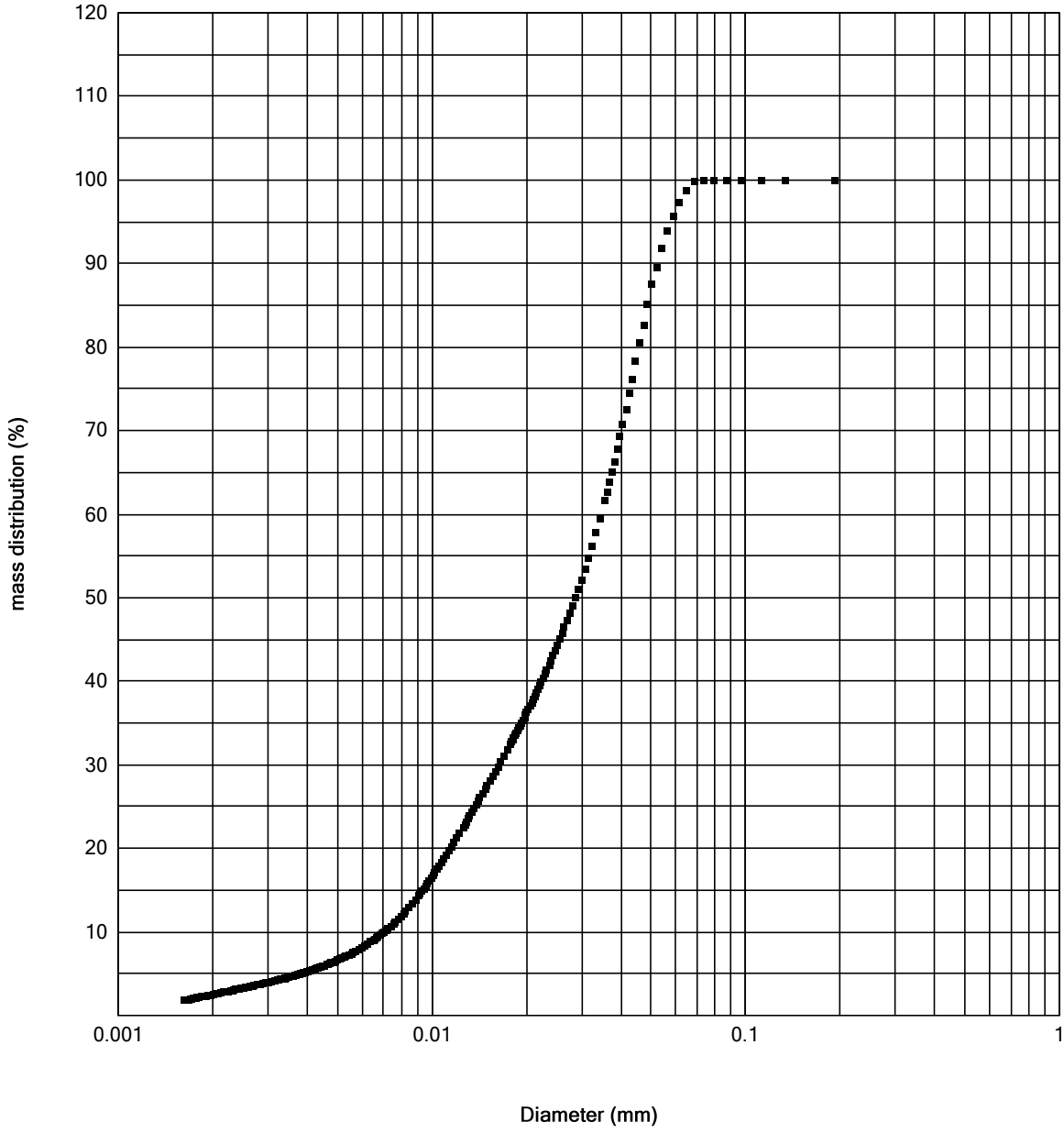
Sand	> 100 µ:	23 g/kg
Sand	100 - 50 µ:	46 g/kg
Coarse Silt	50 - 20 µ:	59 g/kg
Fine Silt	20 - 2 µ:	606 g/kg
Clay	< 2 µ:	265 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 22 05:06

Sample: EFF12

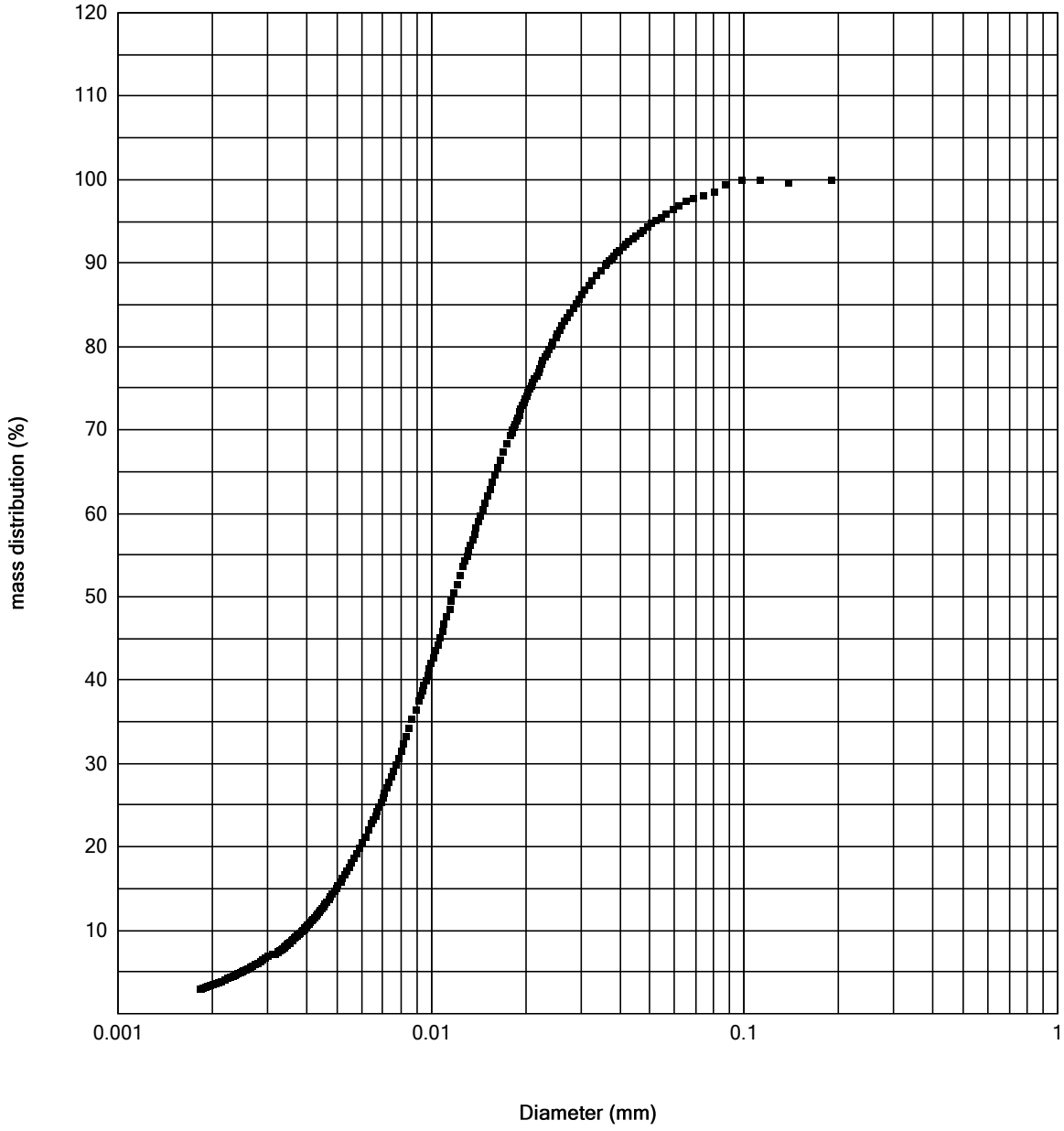
Sand	> 100 µ:	0 g/kg
Sand	100 - 50 µ:	194 g/kg
Coarse Silt	50 - 20 µ:	470 g/kg
Fine Silt	20 - 2 µ:	314 g/kg
Clay	< 2 µ:	23 g/kg



Gibertini Elettronica S.r.L.
via Bellini 29 Novate Milanese (MI)
Analisi del:2014 apr 23 10:33

Sample: EFF13

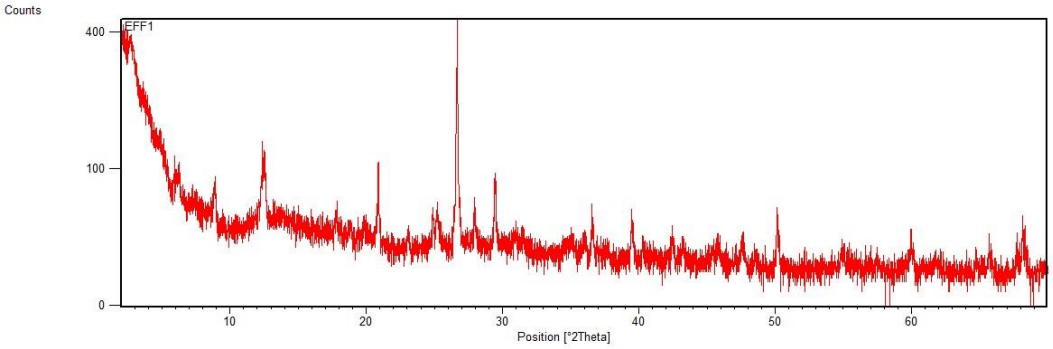
Sand	> 100 µ:	5 g/kg
Sand	100 - 50 µ:	62 g/kg
Coarse Silt	50 - 20 µ:	229 g/kg
Fine Silt	20 - 2 µ:	674 g/kg
Clay	< 2 µ:	30 g/kg

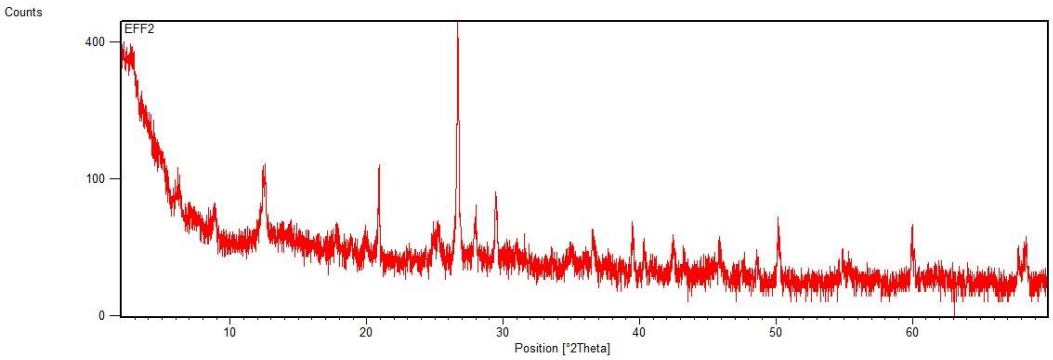


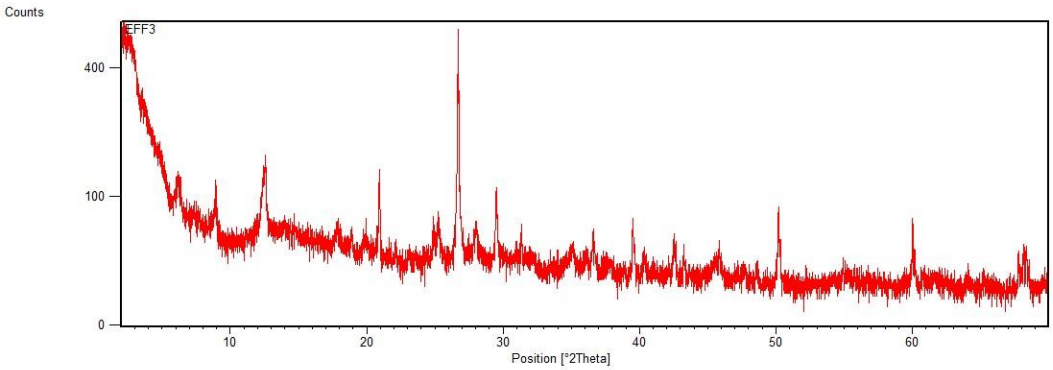
Appendix 6

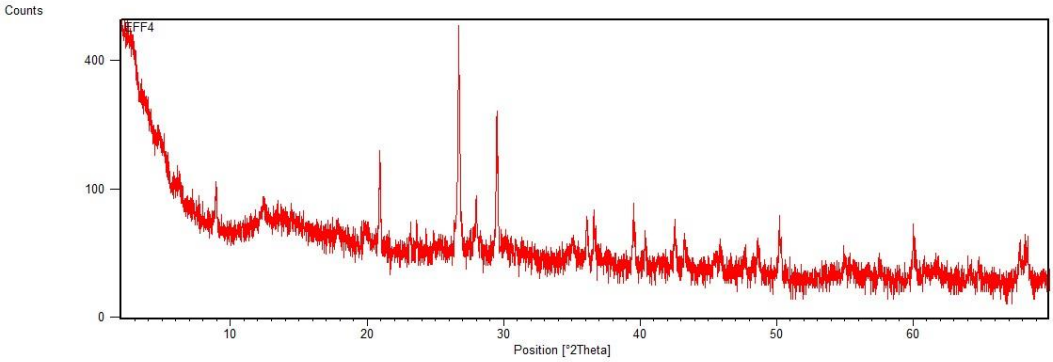
The diffractograms of fluvio-lacustrine and lacustrine samples

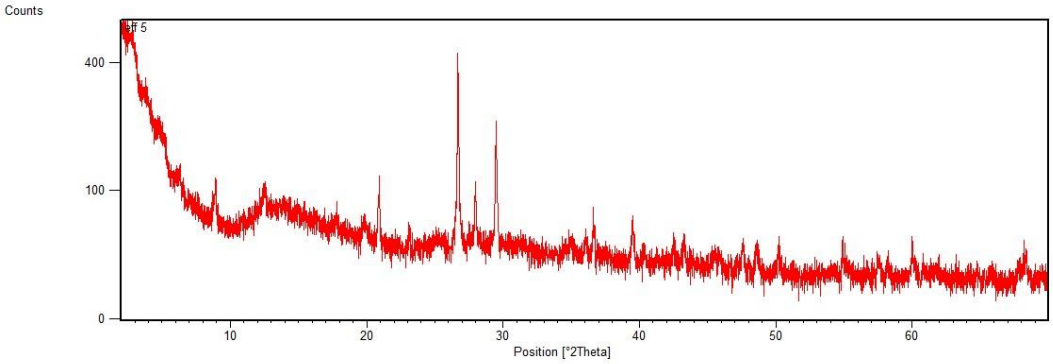
Fluvio-lacustrine sediments

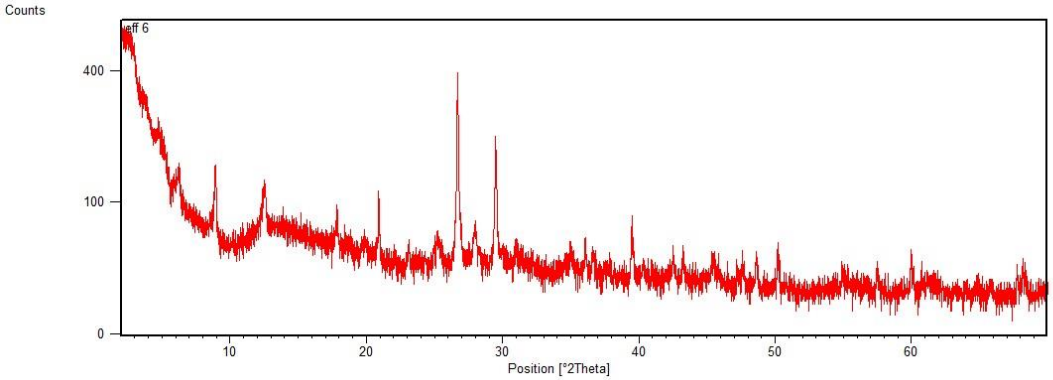


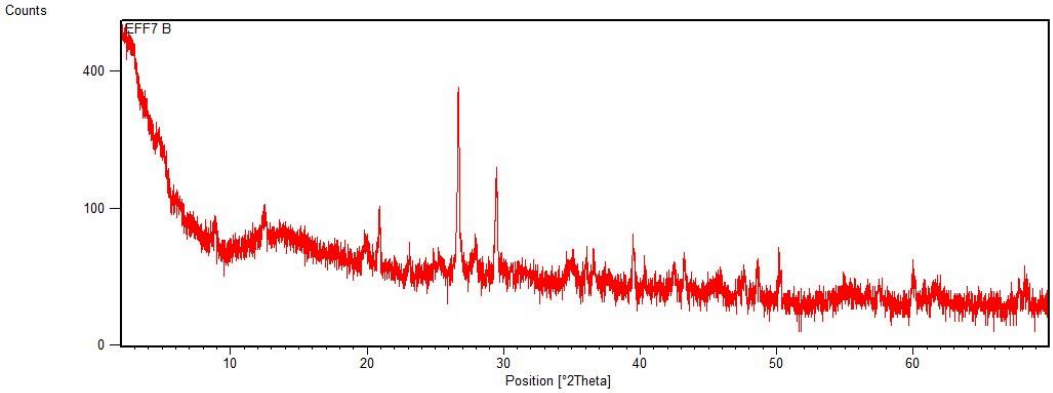


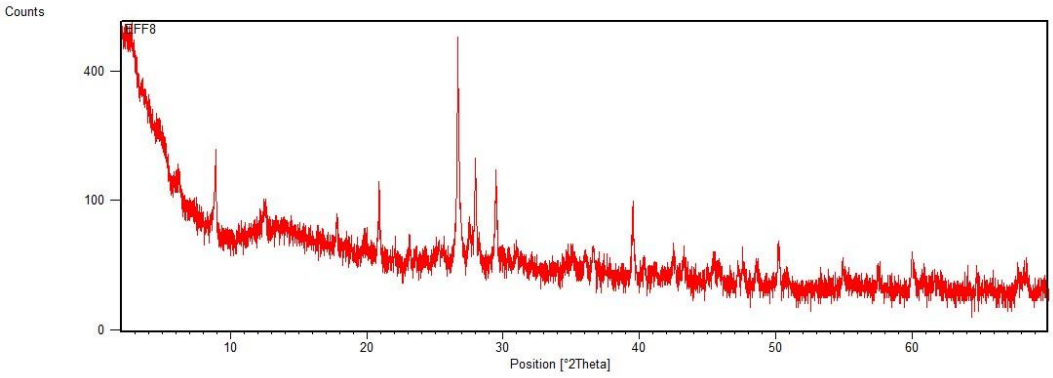


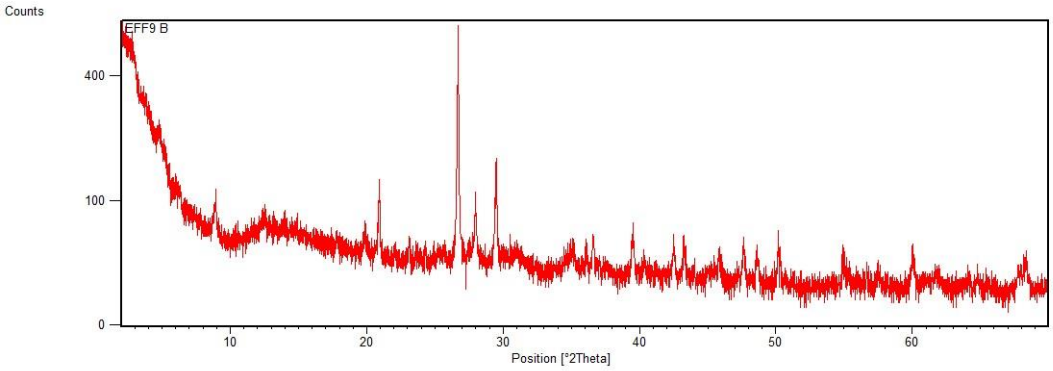

Counts
FF4
400
100
0
10
20
30
40
50
60
Position [°2Theta]

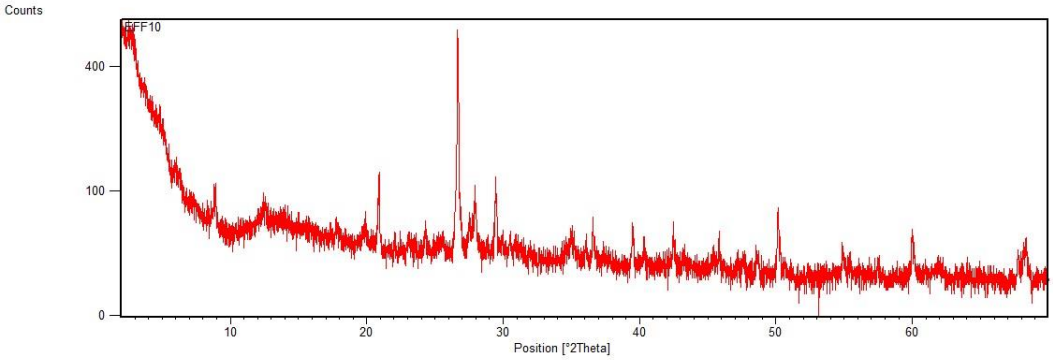

Counts
ff 5
400
100
0
10
20
30
40
50
60
Position [°2Theta]

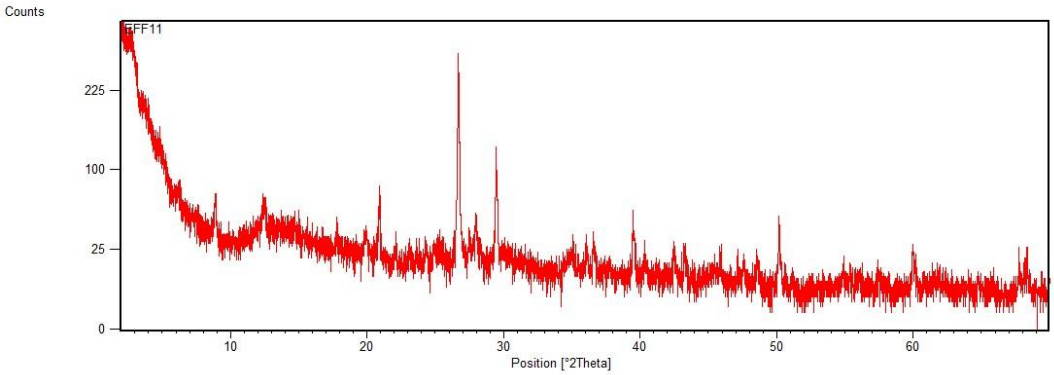

Counts
ff 6
400
100
0
10
20
30
40
50
60
Position [°2Theta]

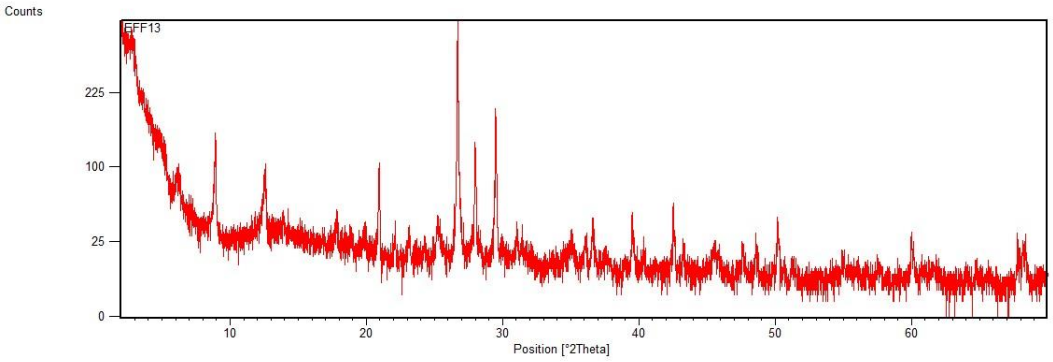

Counts
EFF7 B
400
100
0
10
20
30
40
50
60
Position [°2Theta]

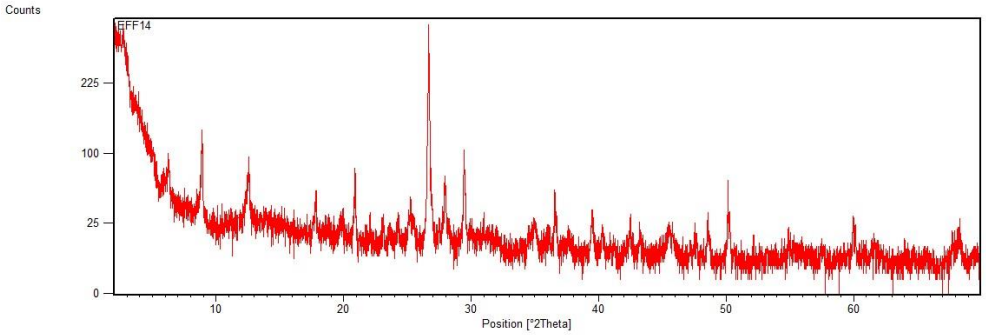

Counts
EFF8
400
100
0
10
20
30
40
50
60
Position [°2Theta]

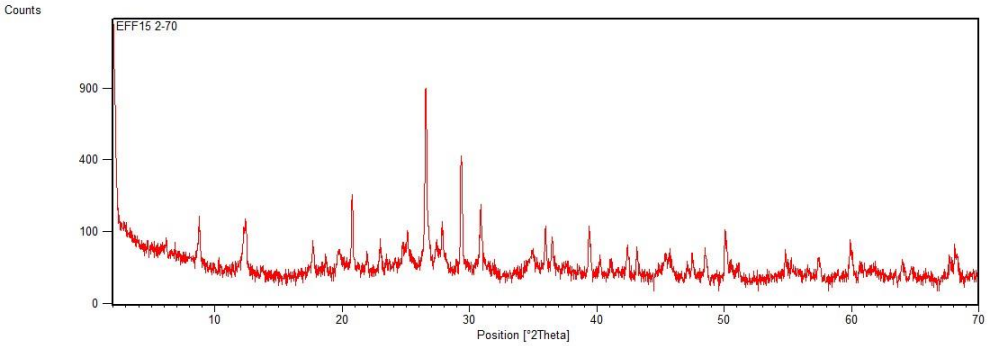

Counts
EFF9 B
400
100
0
10
20
30
40
50
60
Position [°2Theta]

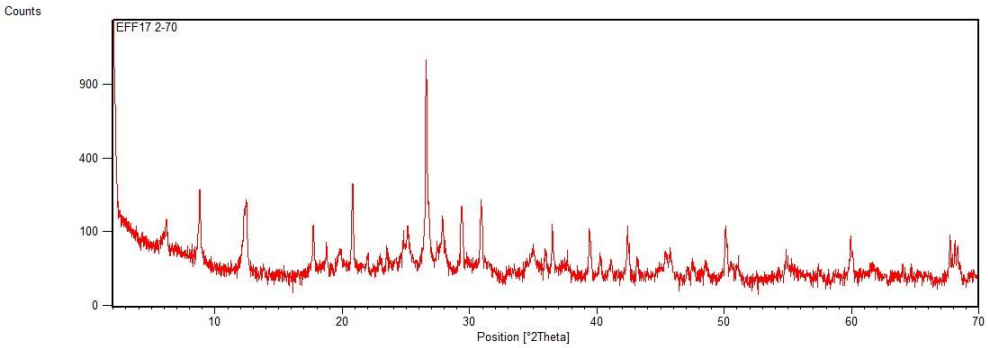

Counts
EFF10
400
100
0
10
20
30
40
50
60
Position [°2Theta]

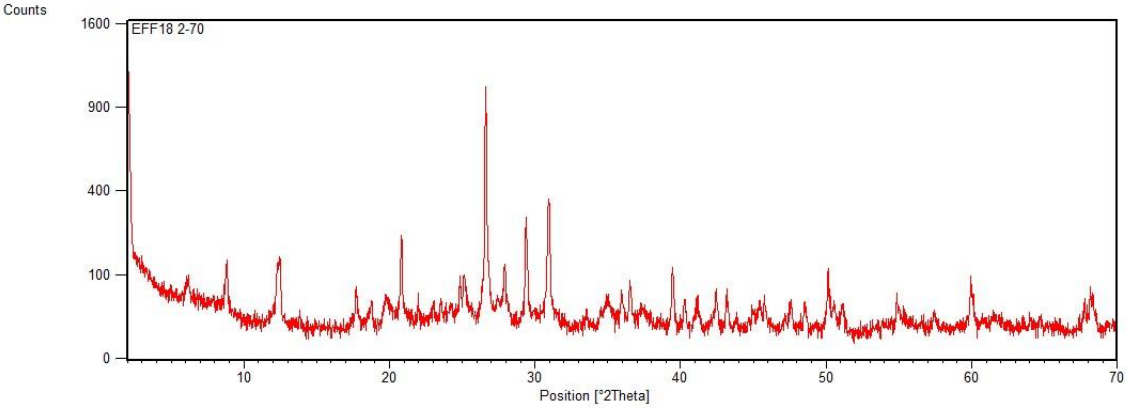

Counts
EFF11
225
100
25
0
10
20
30
40
50
60
Position [°2Theta]


Counts
EFF13
225
100
25
0
10
20
30
40
50
60
Position [°2Theta]

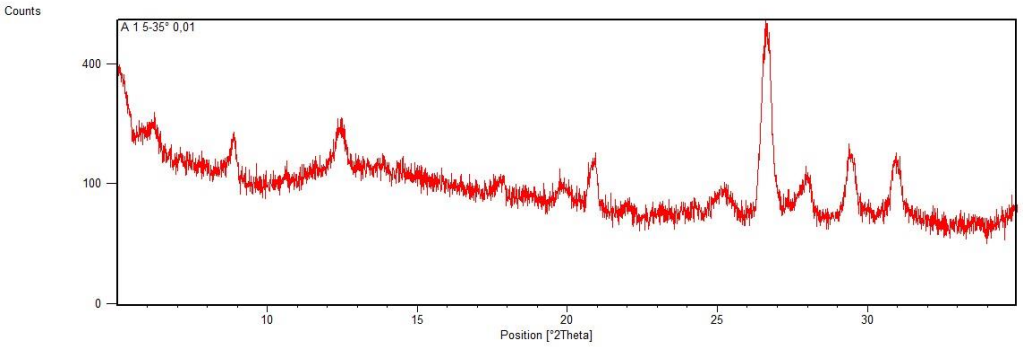

Counts
EFF14
225
100
25
0
10
20
30
40
50
60
Position [°2Theta]

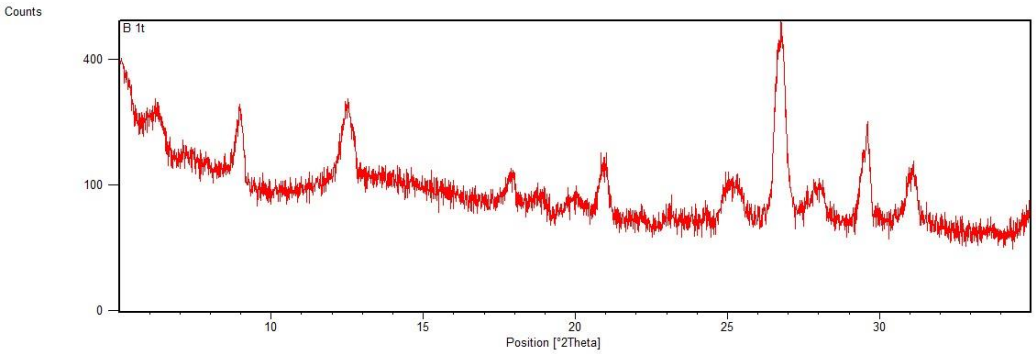

Counts
EFF15 2-70
900
400
100
0
10
20
30
40
50
60
70
Position [°2Theta]

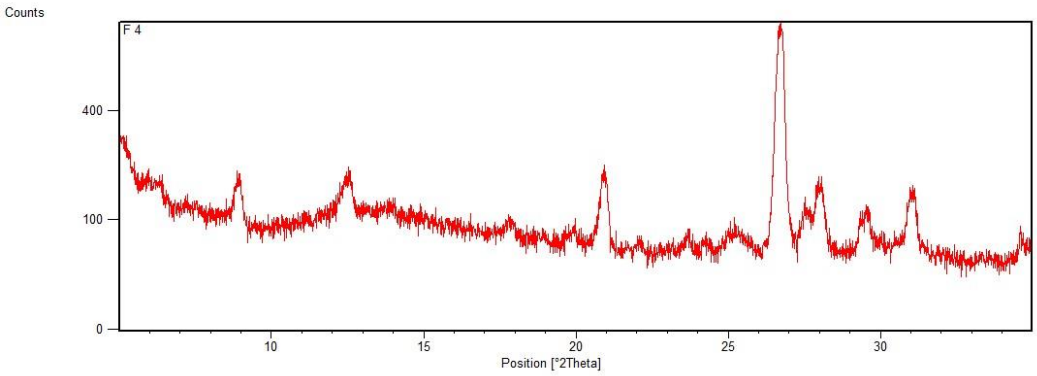

Counts
EFF17 2-70
900
400
100
0
10
20
30
40
50
60
70
Position [°2Theta]

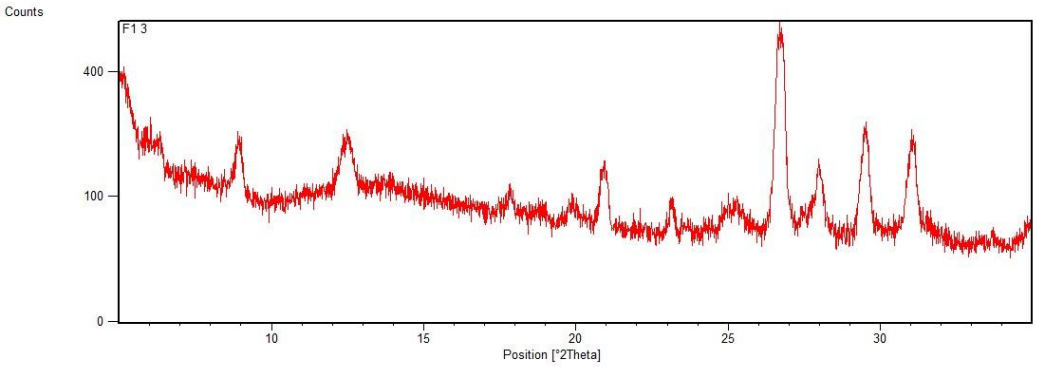

Counts
EFF18 2-70
1600
900
400
100
0
10
20
30
40
50
60
70
Position [°2Theta]

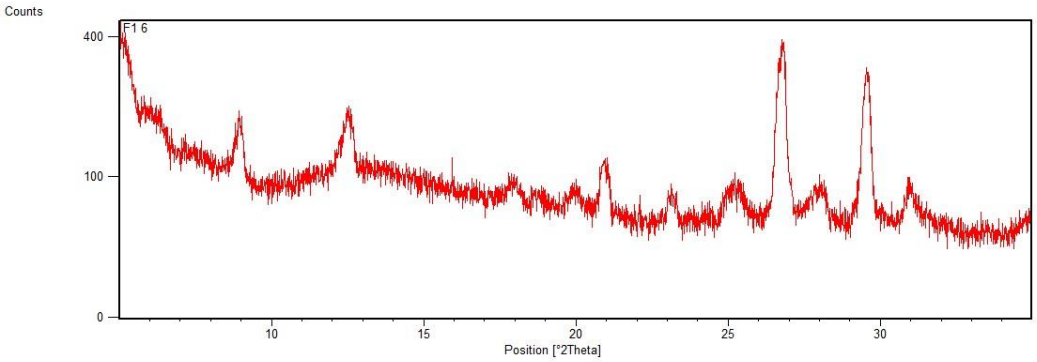
Lacustrine sediments

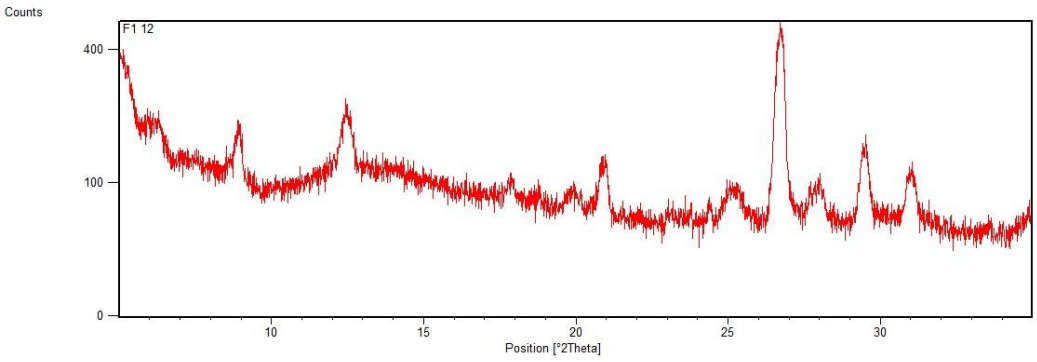


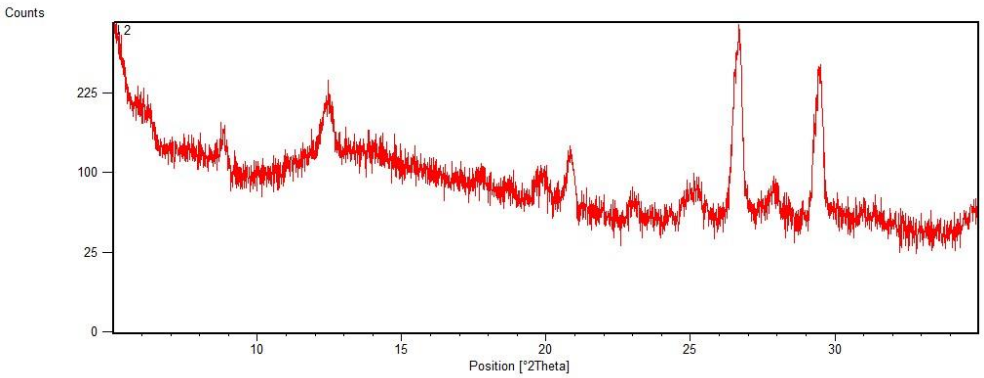


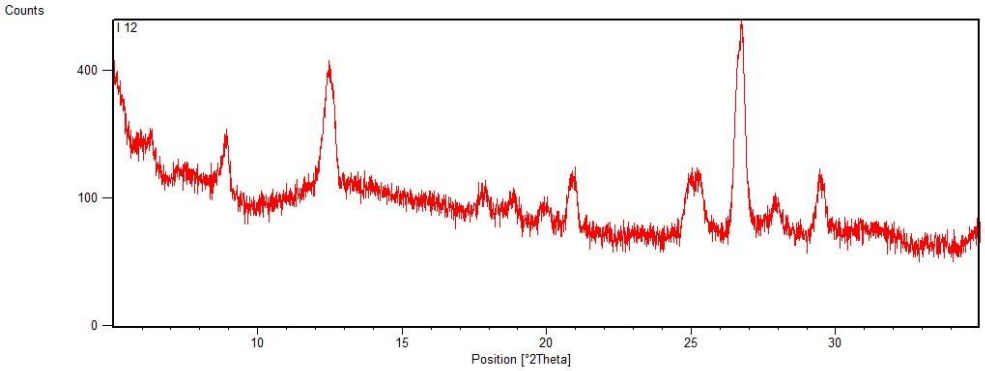


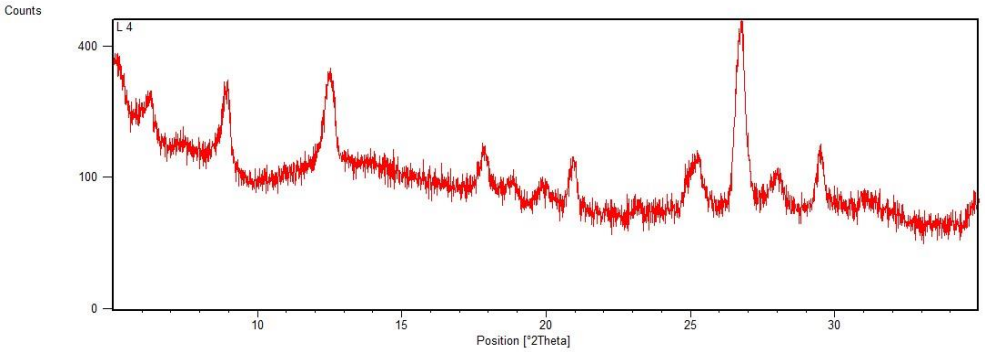

Counts
F1 3
400
100
0
10
15
20
25
30
Position [°2Theta]

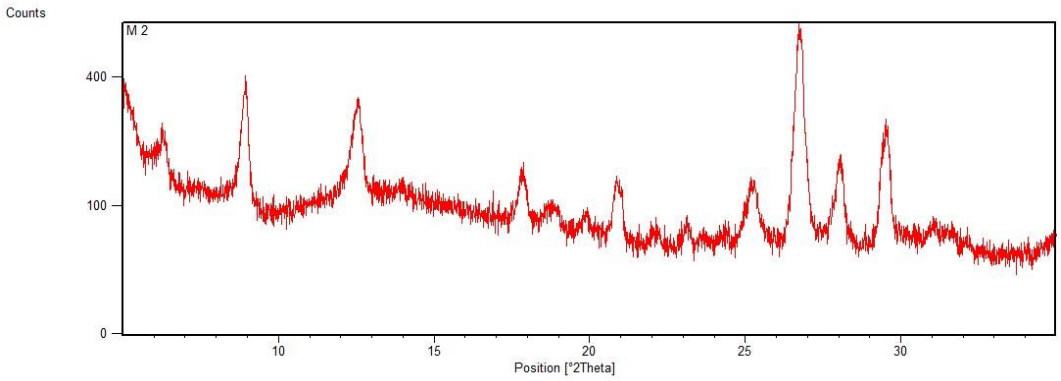

Counts
F1 6
400
100
0
10
15
20
25
30
Position [°2Theta]

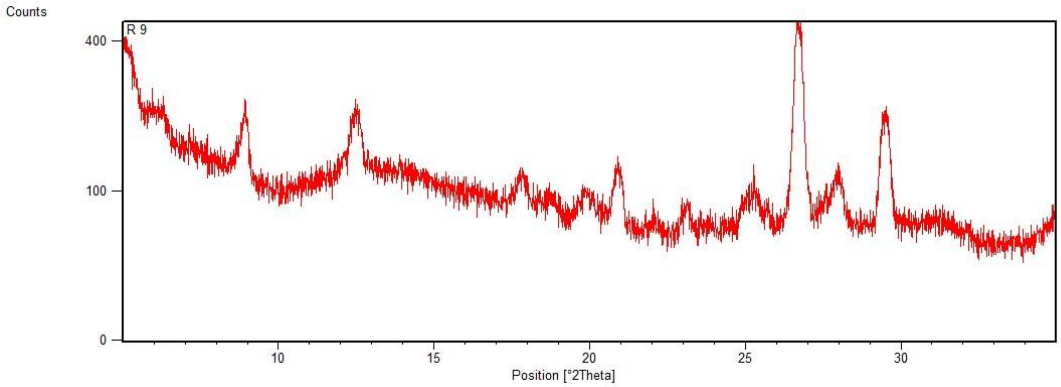

Counts
F1 12
400
100
0
10
15
20
25
30
Position [°2Theta]

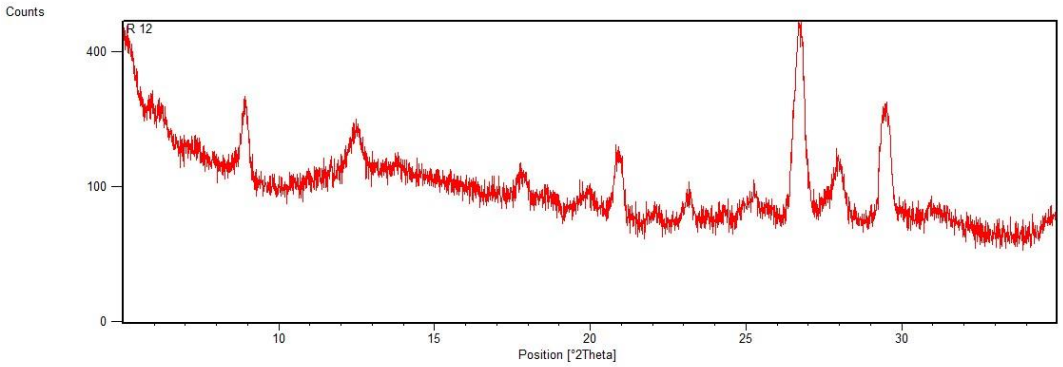

Counts
L 2
225
100
25
0
10
15
20
25
30
Position [°2Theta]

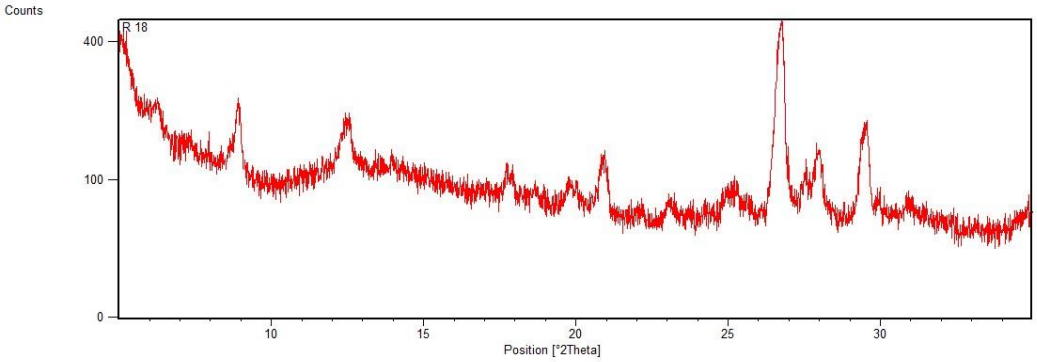

Counts
I 12
400
100
0
10
15
20
25
30
Position [°2Theta]

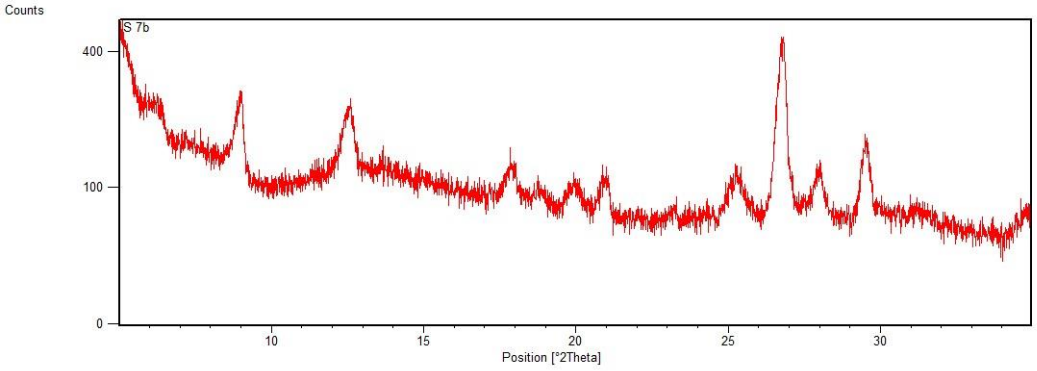

Counts
L 4
400
100
0
10
15
20
25
30
Position [°2Theta]

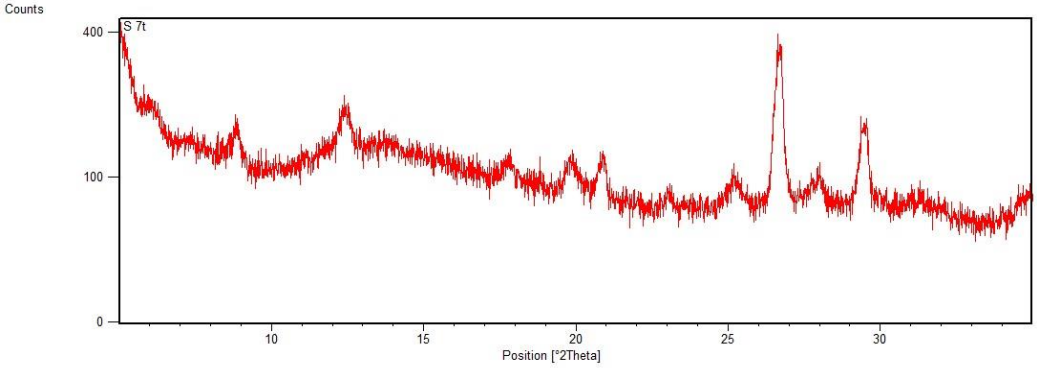

Counts
M 2
400
100
0
10
15
20
25
30
Position [°2Theta]

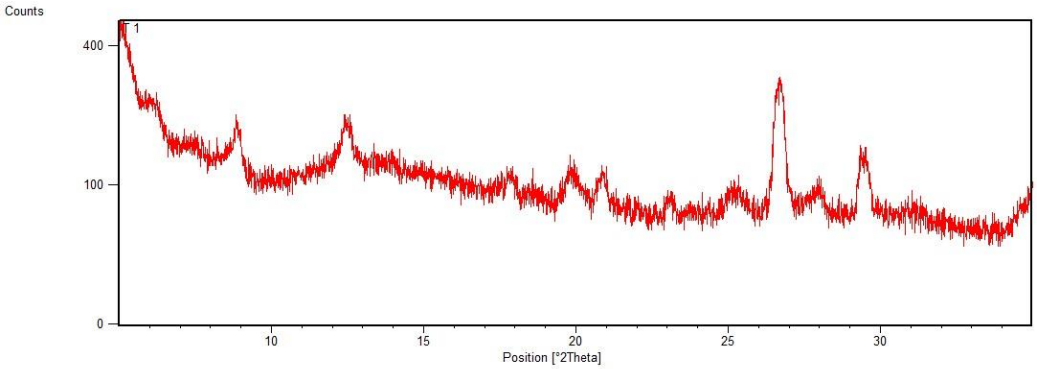

Counts
R 9
400
100
0
10
15
20
25
30
Position [°2Theta]

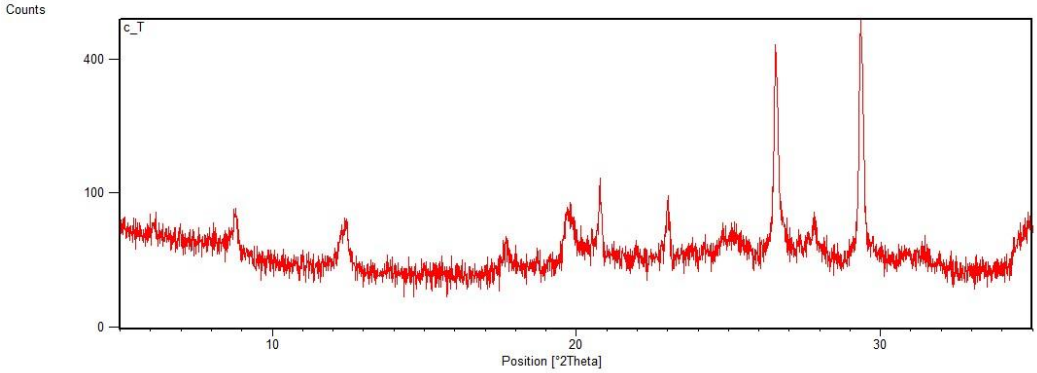

Counts
R 12
400
100
0
10
15
20
25
30
Position [°2Theta]

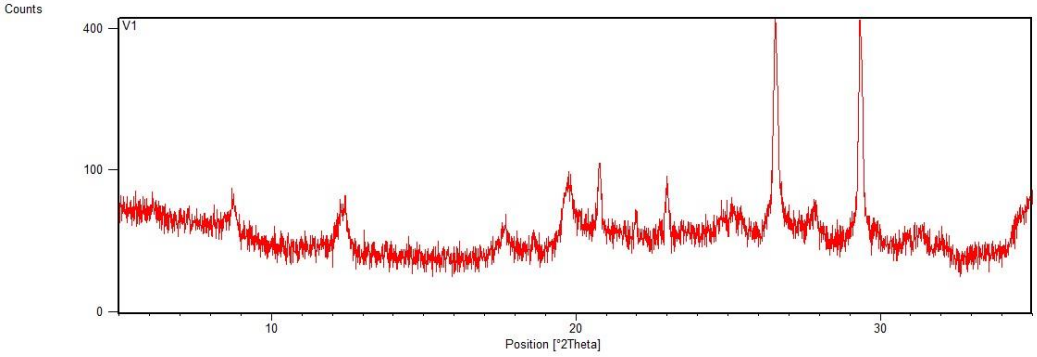

Counts
R 18
400
100
0
10
15
20
25
30
Position [°2Theta]

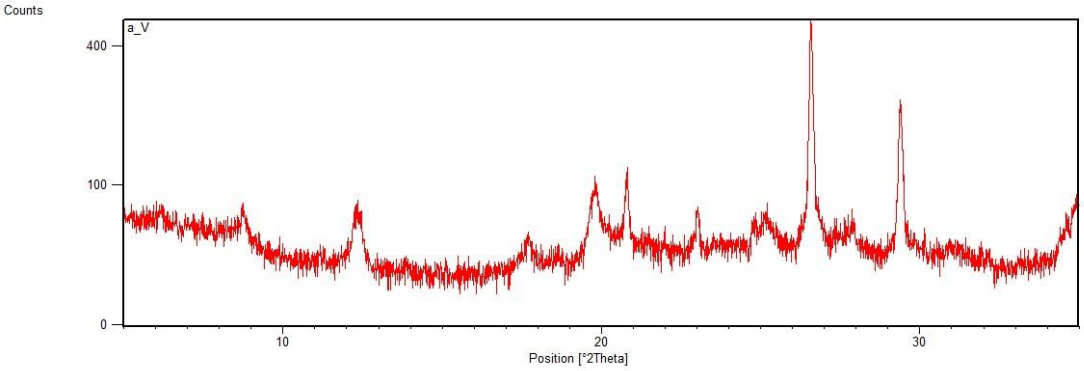

Counts
S 7b
400
100
0
10
15
20
25
30
Position [°2Theta]

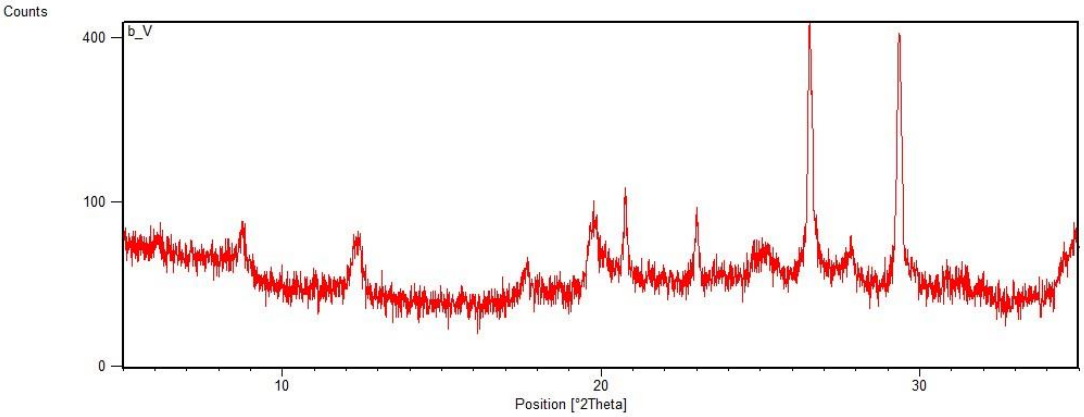

Counts
S 7t
400
100
0
10
15
20
25
30
Position [°2Theta]

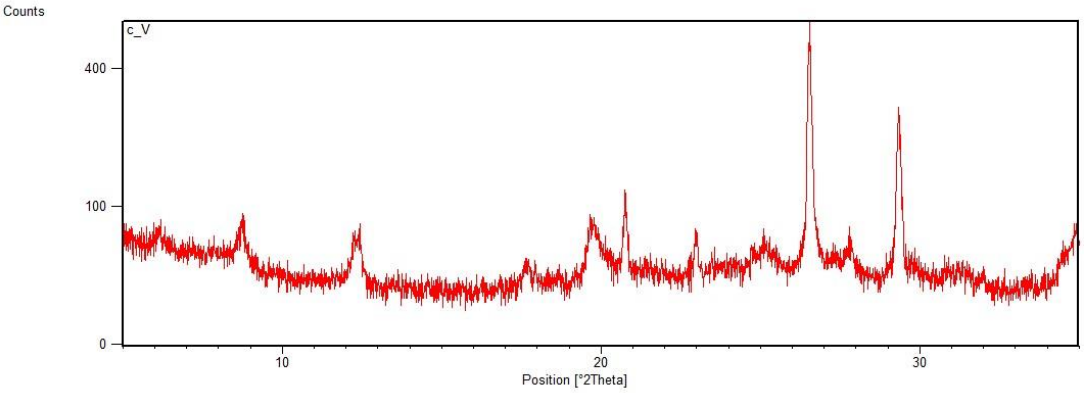

Counts
T 1
400
100
0
10
15
20
25
30
Position [°2Theta]

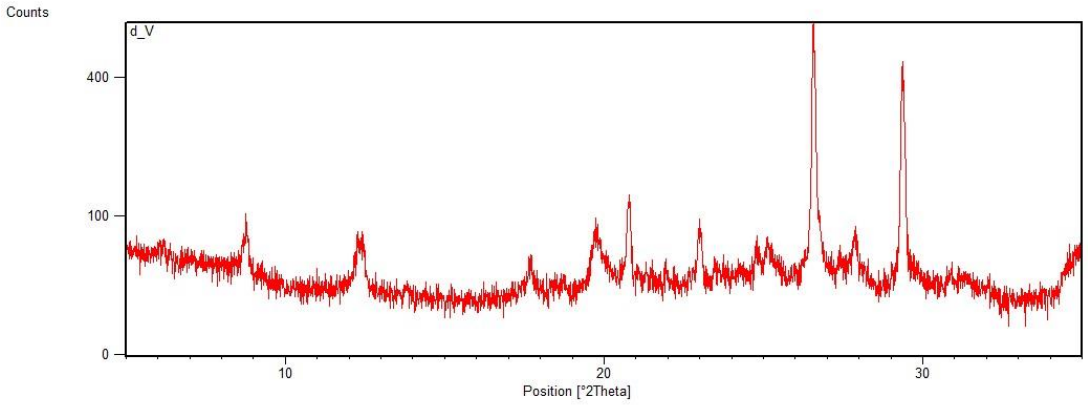

Counts
c_T
400
100
0
10
20
30
Position [°2Theta]


Counts
V1
400
100
0
10
20
30
Position [°2Theta]


Counts
a_V
400
100
0
10
20
30
Position [°2Theta]

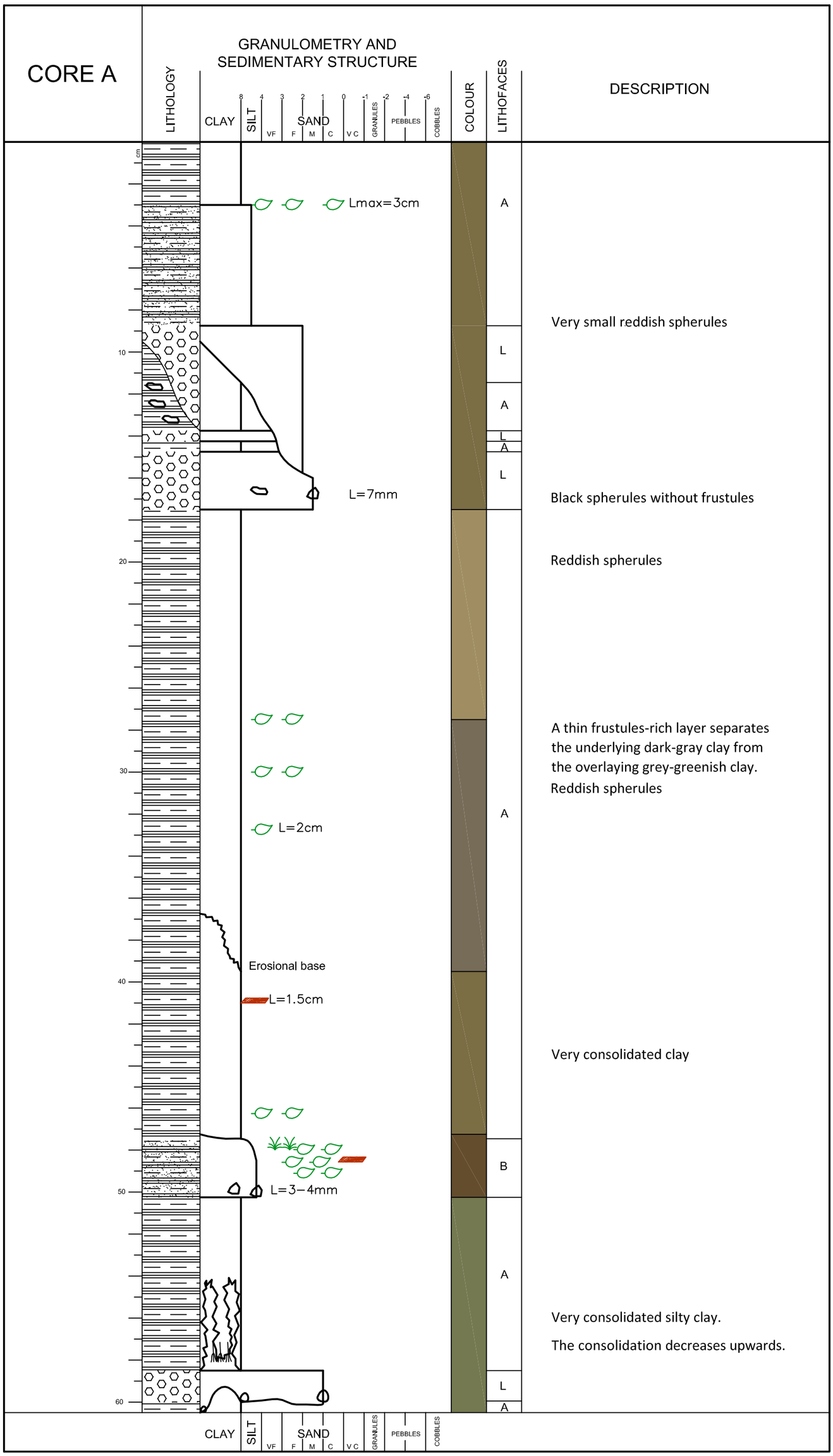

Counts
b_V
400
100
0
10
20
30
Position [°2Theta]

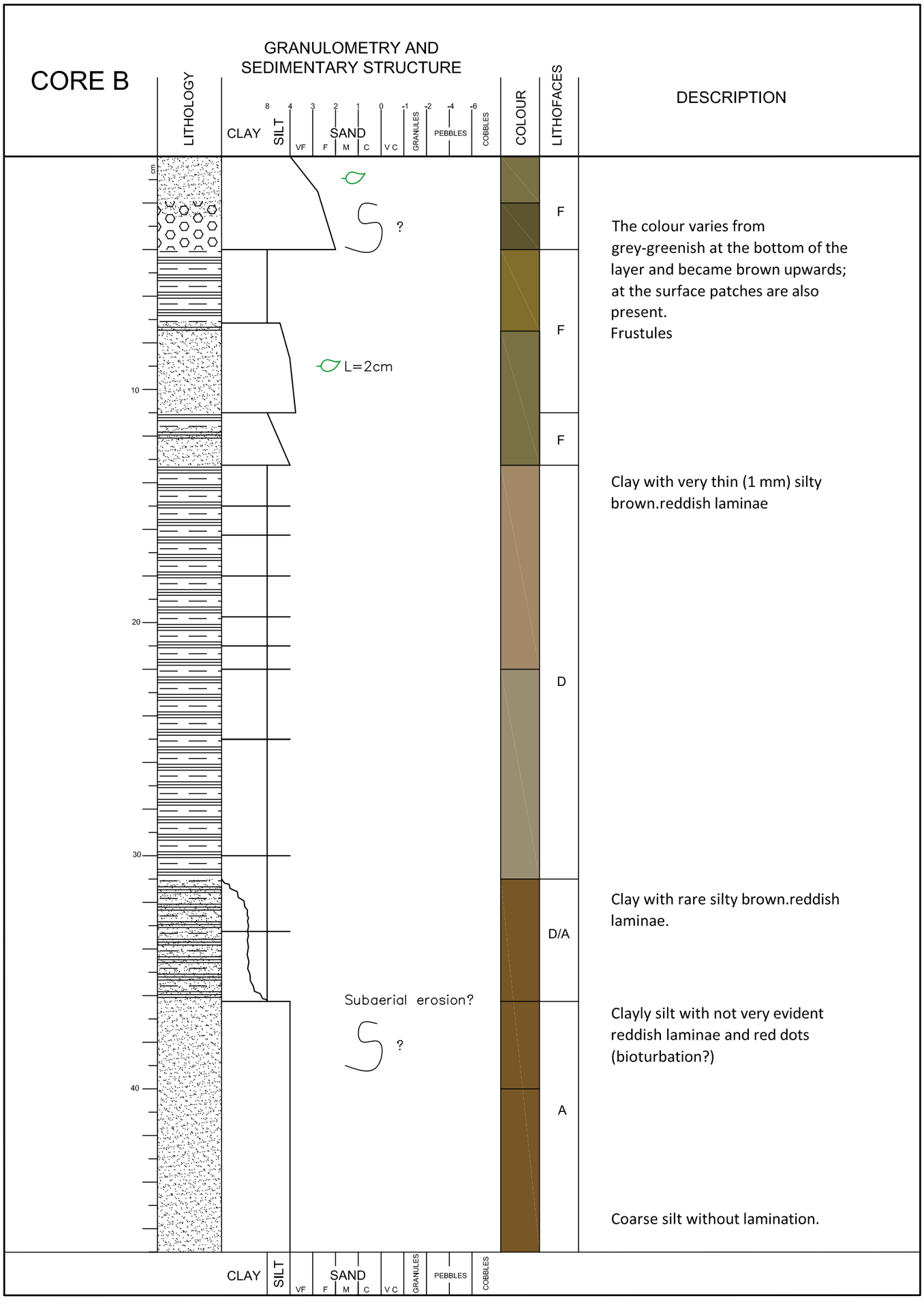

Counts
c_V
400
100
0
10
20
30
Position [°2Theta]

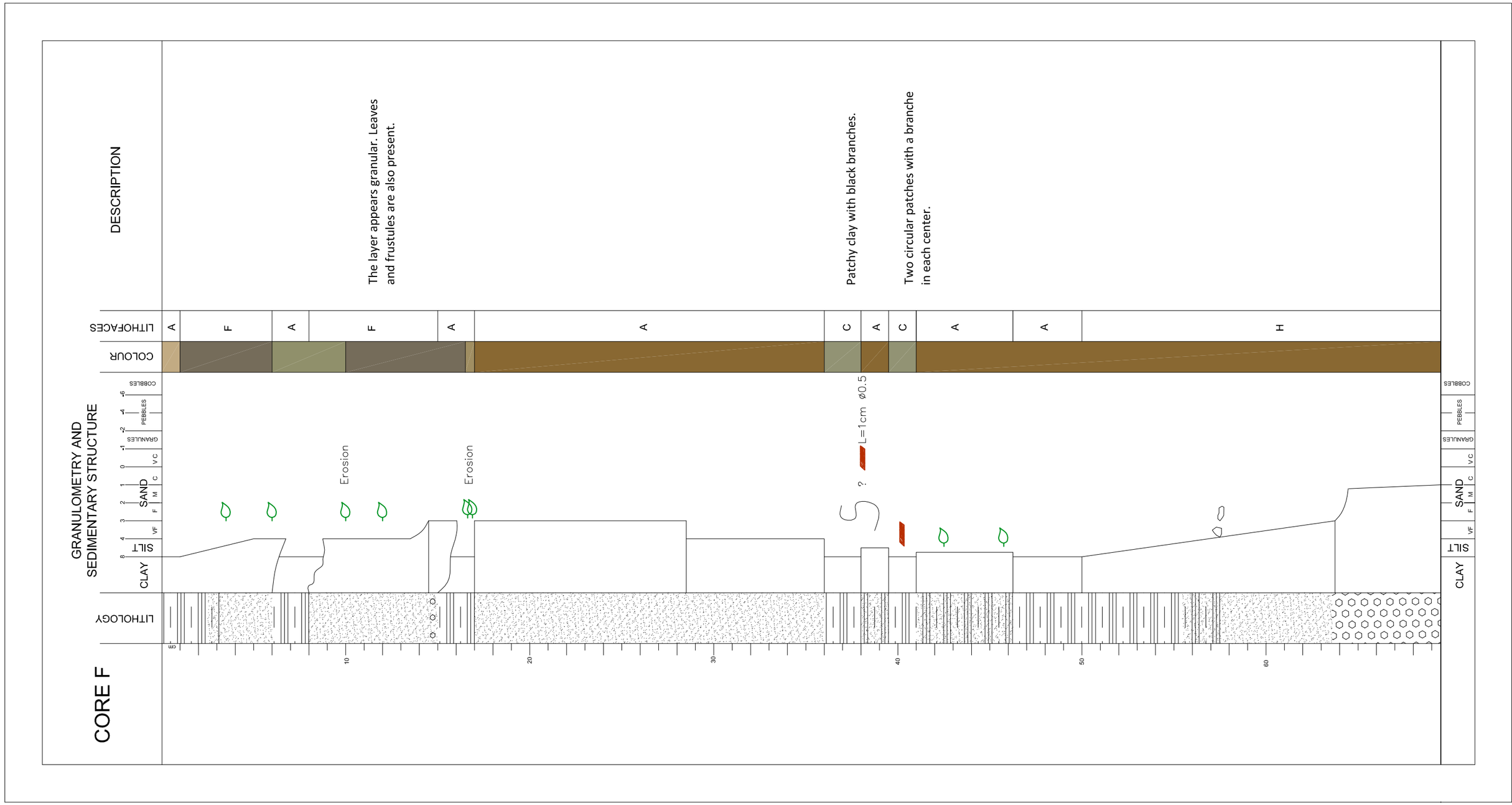

Counts
d_V
400
100
0
10
20
30
Position [°2Theta]

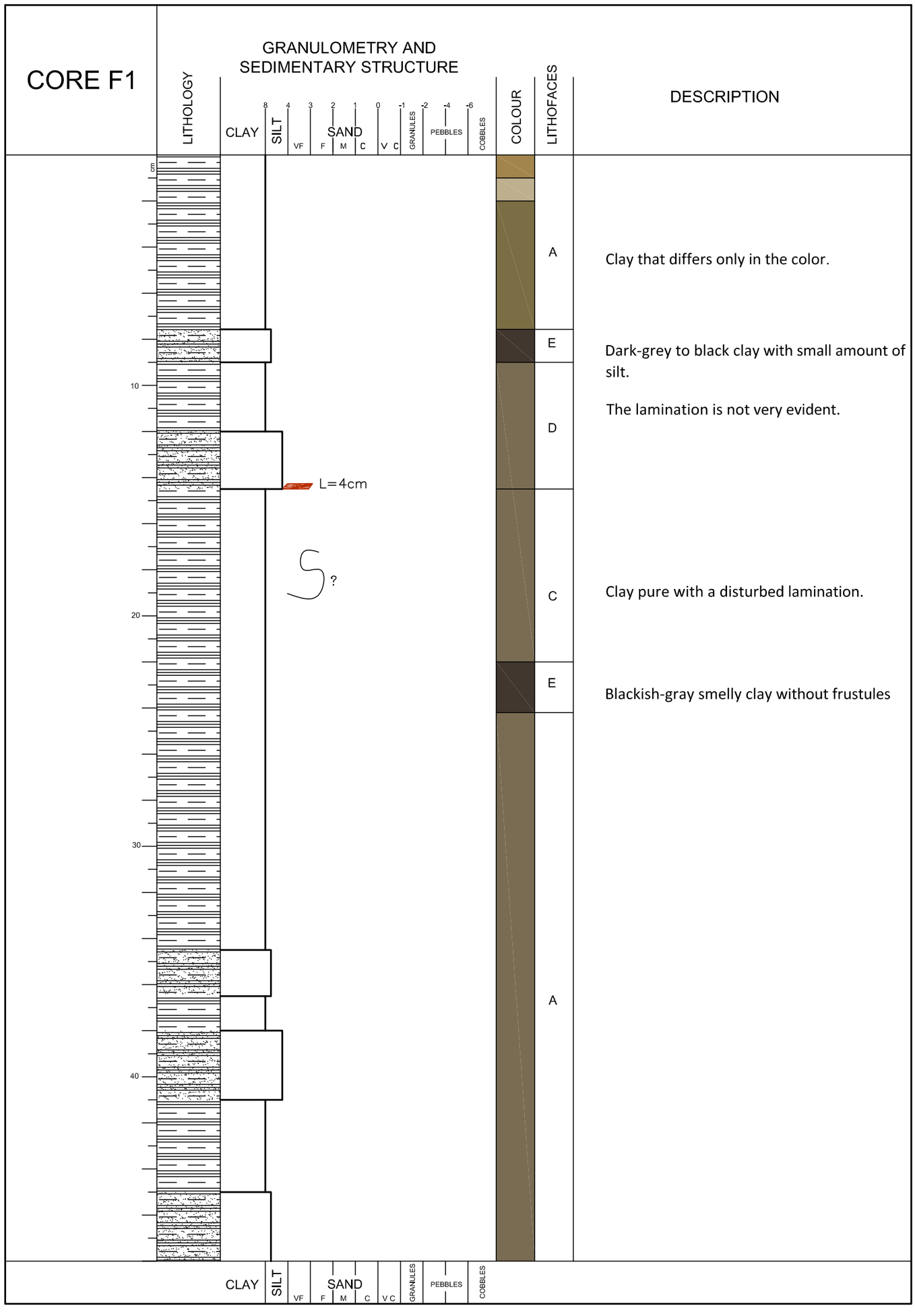
Appendix 7

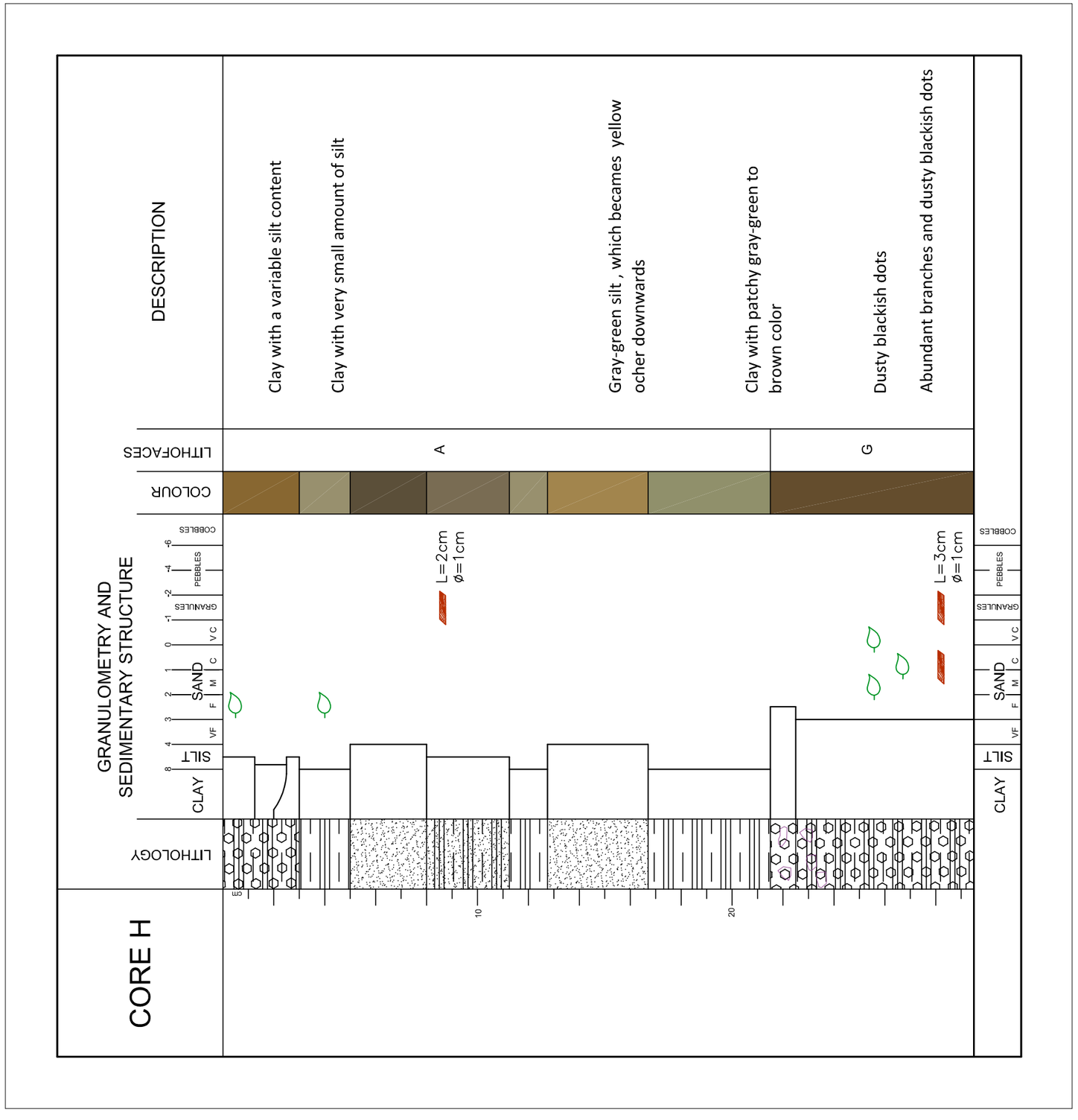
Stratigraphic logs

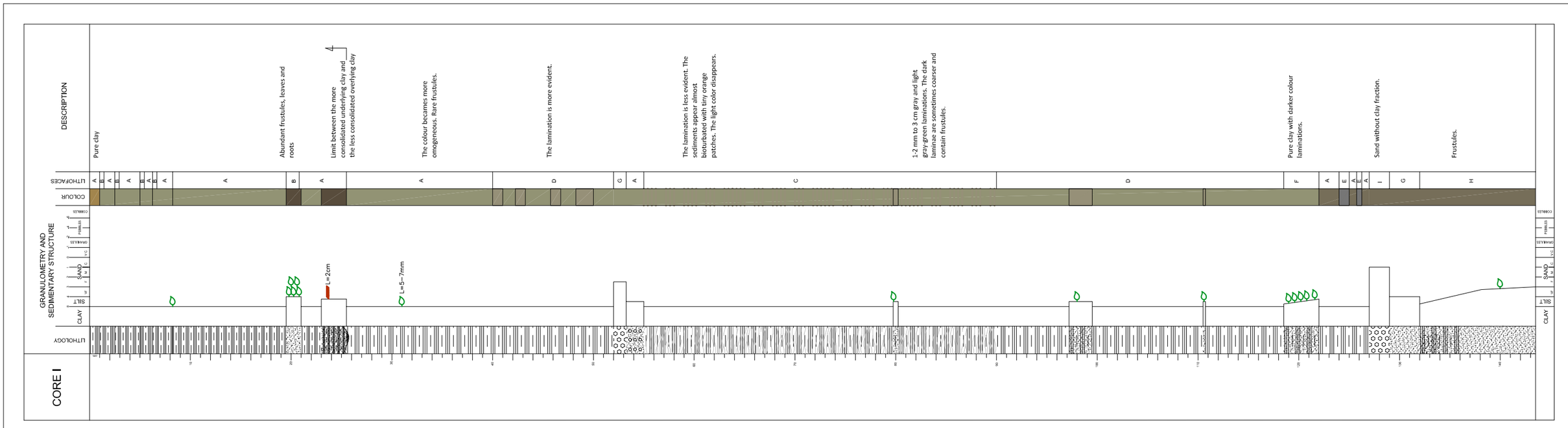

CORE A
LITHOLOGY
GRANULOMETRY AND SEDIMENTARY STRUCTURE
CLAY
SILT
SAND
VF
F
M
C
VC
GRANULES
PEBBLES
COBBLES
COLOUR
LITHOFACES
DESCRIPTION
cm
Lmax=3cm
A
Very small reddish spherules
L
A
L
A
L
L=7mm
Black spherules without frustules
Reddish spherules
A thin frustules-rich layer separates the underlying dark-gray clay from the overlaying grey-greenish clay.
Reddish spherules
L=2cm
A
Erosional base
L=1.5cm
Very consolidated clay
L=3–4mm
B
A
Very consolidated silty clay.
The consolidation decreases upwards.
L
A
10
20
30
40
50
60

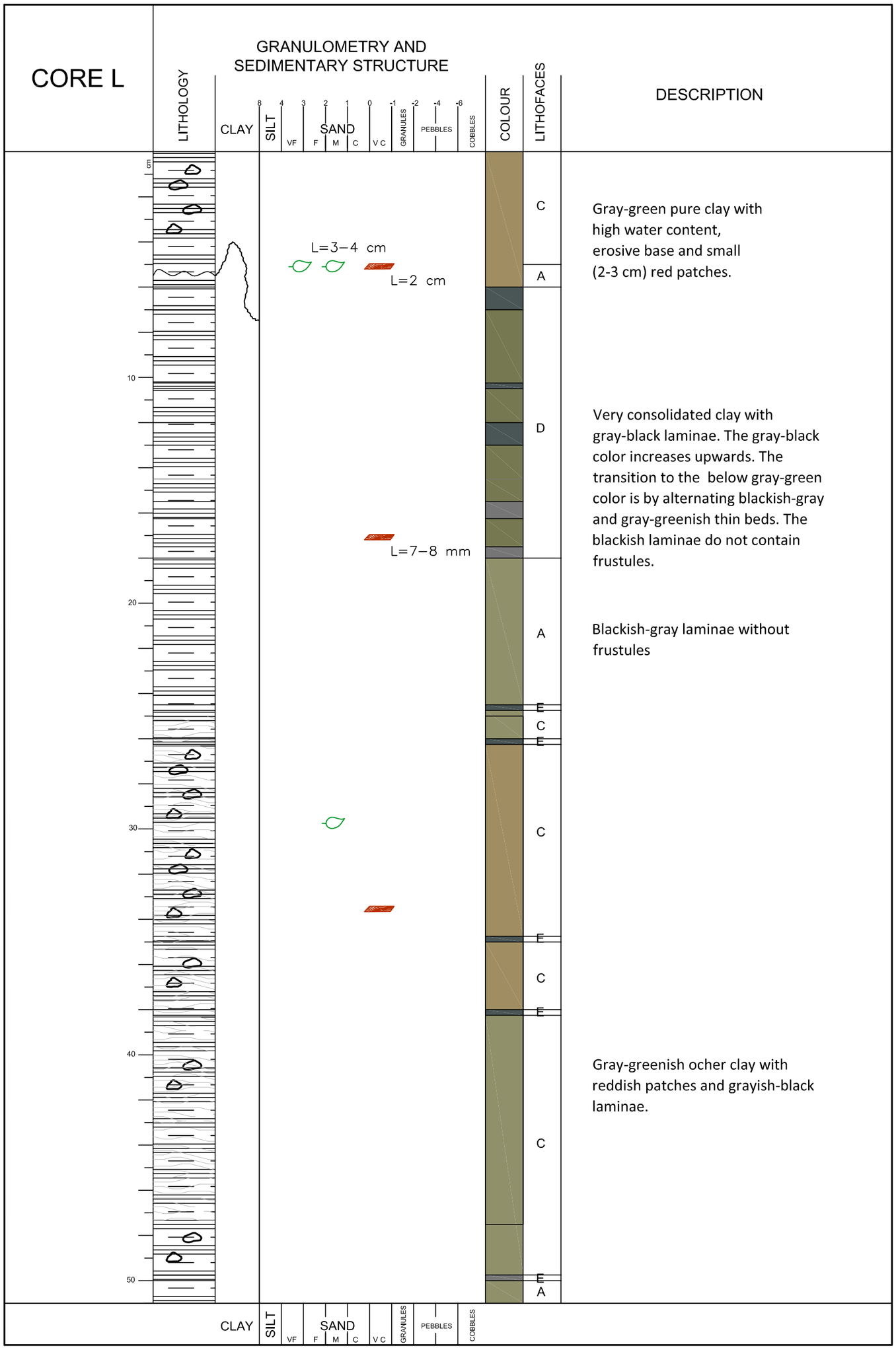

CORE B
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
CLAY
SILT
SAND
VF
F
M
C
V C
GRANULES
PEBBLES
COBBLES
COLOUR
LITHOFACES
DESCRIPTION
cm
10
20
30
40
?
L=2cm
Subaerial erosion?
?
F
F
F
D
D/A
A
The colour varies from grey-greenish at the bottom of the layer and became brown upwards; at the surface patches are also present.
Frustules
Clay with very thin (1 mm) silty brown.reddish laminae
Clay with rare silty brown.reddish laminae.
Clayly silt with not very evident reddish laminae and red dots (bioturbation?)
Coarse silt without lamination.

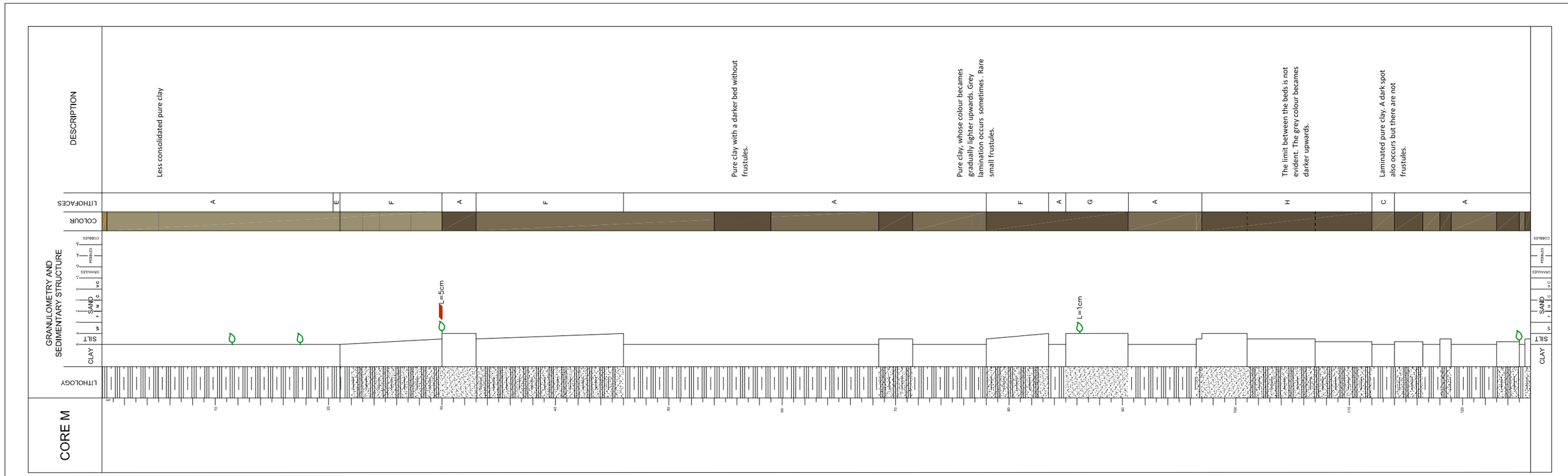

CORE F
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
CLAY
SILT
SAND
VF
F
M
C
VC
GRANULES
PEBBLES
COBBLES
COLOUR
LITHOFACIES
DESCRIPTION
A
F
A
F
A
A
C
A
C
A
A
H
The layer appears granular. Leaves and frustules are also present.
Patchy clay with black branches.
Two circular patches with a branche in each center.
Erosion
Erosion
L=1cm ø0.5
?
5
10
20
30
40
50
60

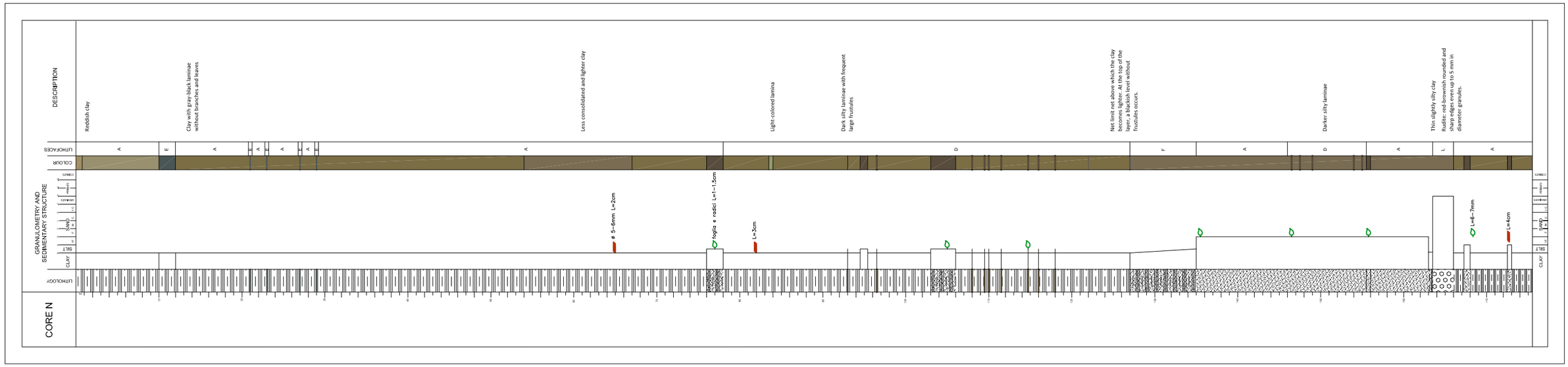

CORE F1
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
CLAY
SILT
SAND
VF
F
M
C
V C
GRANULES
PEBBLES
COBBLES
COLOUR
LITHOFACES
DESCRIPTION
cm
10
20
30
40
L=4cm
A
Clay that differs only in the color.
E
Dark-grey to black clay with small amount of silt.
D
The lamination is not very evident.
C
Clay pure with a disturbed lamination.
E
Blackish-gray smelly clay without frustules
A

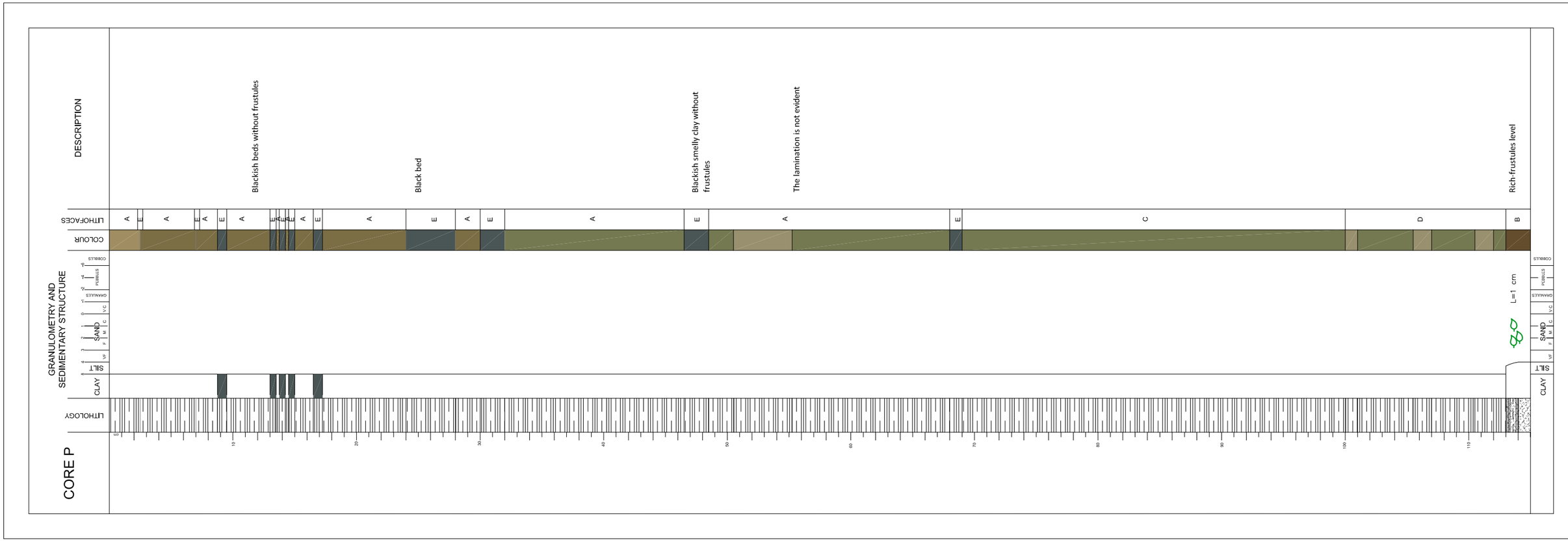

CORE H
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
COLOUR
LITHOFACIES
DESCRIPTION
A
G
Clay with a variable silt content
Clay with very small amount of silt
Gray-green silt , which becames yellow ocher downwards
Clay with patchy gray-green to brown color
Dusty blackish dots
Abundant branches and dusty blackish dots
L=2cm ø=1cm
L=3cm ø=1cm
CLAY
SILT
SAND
PEBBLES
COBBLES
cm

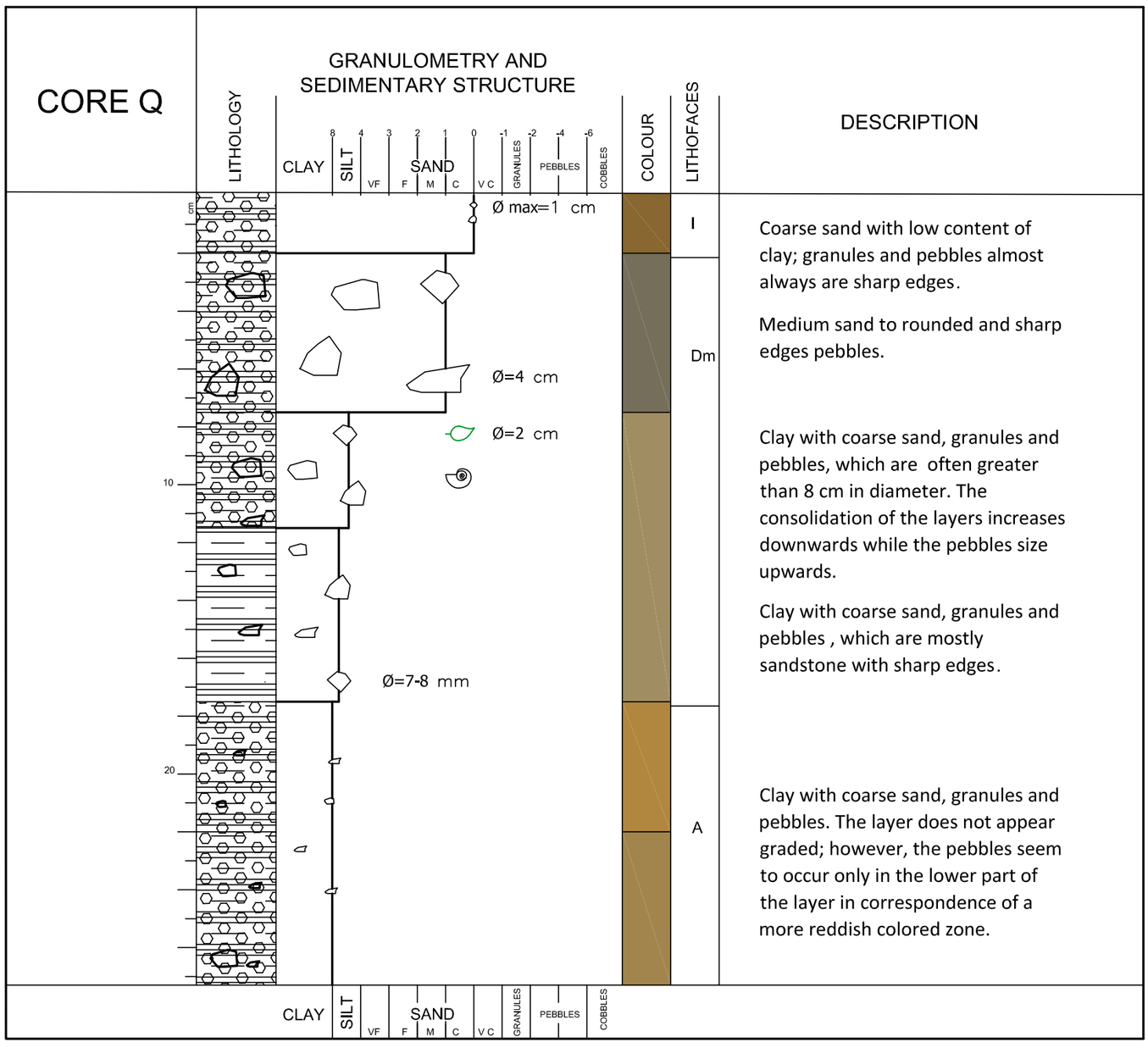

CORE I
DESCRIPTION
Pure clay
Abundant frustules, leaves and roots
Limit between the more consolidated underlying clay and the less consolidated overlying clay
The colour becames more omogeneous. Rare frustules.
The lamination is more evident.
The lamination is less evident. The sediments appear almost bioturbated with tiny orange patches. The light color disappears.
1-2 mm to 3 cm gray and light gray-green laminations. The dark laminae are sometimes coarser and contain frustules.
Pure clay with darker colour laminations.
Sand without clay fraction.
Frustules.
LITHOFACIES
COLOUR
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
COBBLES
PEBBLES
GRANULES
SAND
SILT
CLAY
L=2cm
L=5–7mm

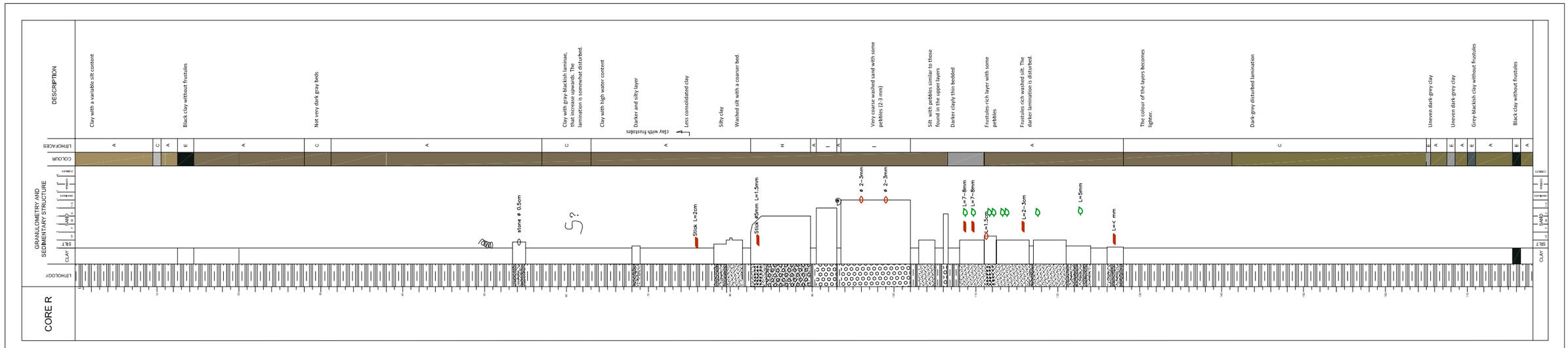

CORE L
LITHOLOGY
GRANULOMETRY AND SEDIMENTARY STRUCTURE
CLAY
SILT
SAND
VF
F
M
C
VC
GRANULES
PEBBLES
COBBLES
COLOUR
LITHOFACES
DESCRIPTION
cm
10
20
30
40
50
L=3–4 cm
L=2 cm
L=7–8 mm
C
A
D
A
E
C
E
C
F
C
E
C
E
A
Gray-green pure clay with high water content, erosive base and small (2-3 cm) red patches.
Very consolidated clay with gray-black laminae. The gray-black color increases upwards. The transition to the below gray-green color is by alternating blackish-gray and gray-greenish thin beds. The blackish laminae do not contain frustules.
Blackish-gray laminae without frustules
Gray-greenish ocher clay with reddish patches and grayish-black laminae.

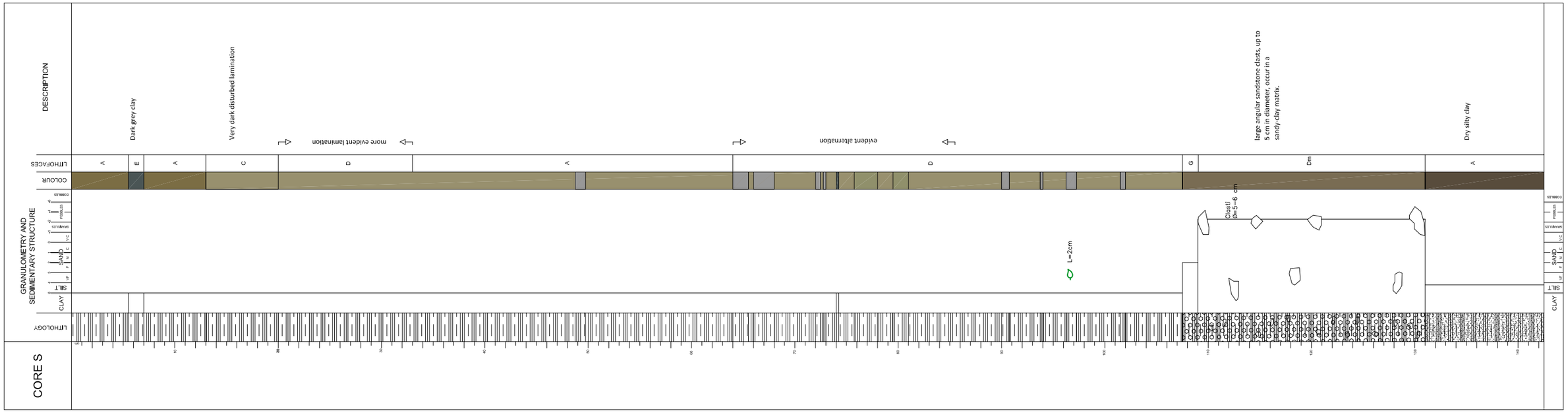

CORE M
LITHOLOGY
CLAY
SILT
SAND f. m. c. v.c
GRANULES
PEBBLES
COBBLES
GRANULOMETRY AND SEDIMENTARY STRUCTURE
COLOUR
LITHOFACIES
DESCRIPTION
Less consolidated pure clay
Pure clay with a darker bed without frustules.
Pure clay, whose colour becames gradually lighter upwards. Grey lamination occurs sometimes. Rare small frustules.
The limit between the beds is not evident. The grey colour becames darker upwards.
Laminated pure clay. A dark spot also occurs but there are not frustules.
L=5cm
L=1cm
5
10
20
30
40
50
60
70
80
90
100
110
120

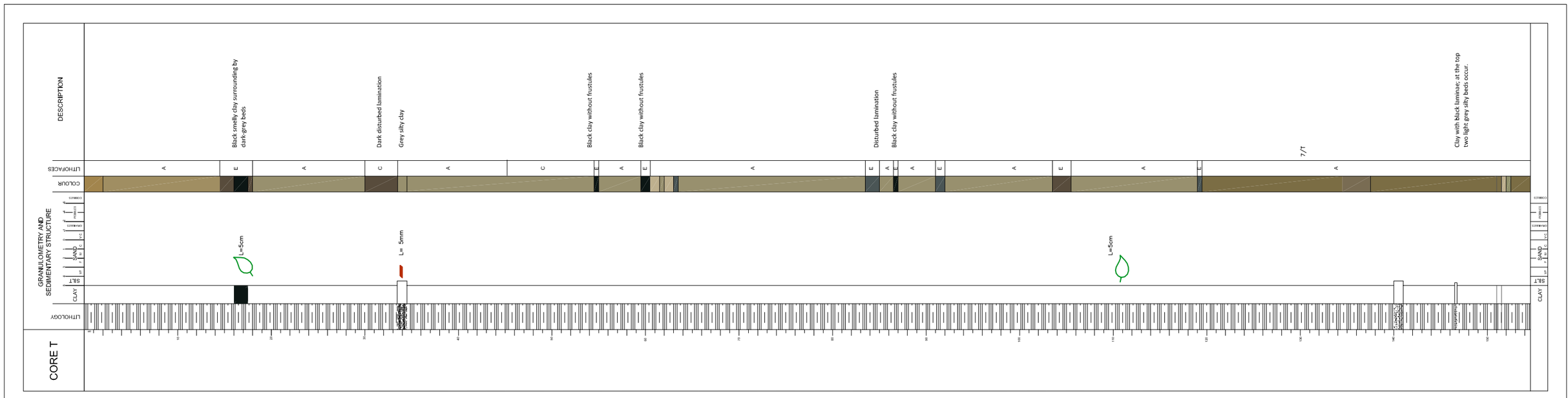

DESCRIPTION
Reddish clay
Clay with gray-black laminae without branches and leaves
Less consolidated and lighter clay
Light-colored lamina
Dark-silty laminae with frequent large frustules
Net limit not above which the clay becomes more dark. Also top of the layer, a blackish level without frustules occurs.
Darker silty laminae
Thin slightly silty clay
Rudite: red-brownish rounded and sharp-edge even up to 5 mm in diameter granule.
LITHOFACIES
COLOUR
GRANULOMETRY AND SEDIMENTARY STRUCTURE
CLAY
SILT
SAND
LITHOLOGY
CORE N
ø 5÷6mm L=2cm
foglia e radici L=1÷1.5cm
L=3cm
L=6÷7mm
L=4cm

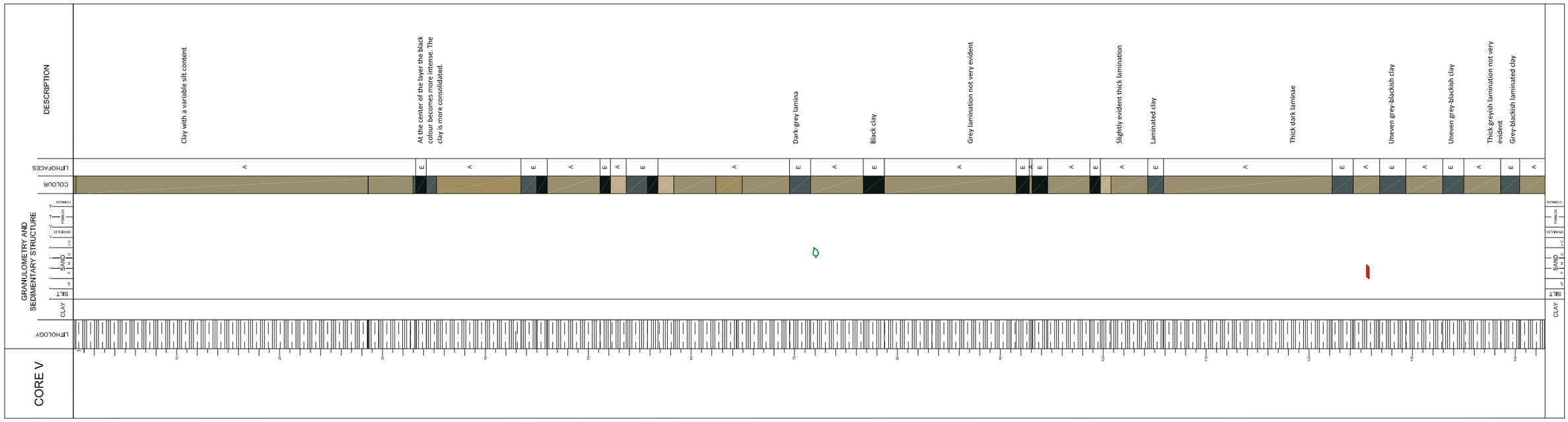

CORE P
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
COLOUR
LITHOFACIES
DESCRIPTION
CLAY
SILT
SAND
GRANULES
PEBBLES
COBBLES
Blackish beds without frustules
Black bed
Blackish smelly clay without frustules
The lamination is not evident
Rich-frustules level
L=1 cm


CORE Q
LITHOLOGY
GRANULOMETRY AND SEDIMENTARY STRUCTURE
CLAY
SILT
VF
F
M
C
SAND
V C
GRANULES
PEBBLES
COBBLES
8
4
3
2
1
0
-1
-2
-4
-6
COLOUR
LITHOFACES
DESCRIPTION
cm
10
20
Ø max=1 cm
Ø=4 cm
Ø=2 cm
Ø=7-8 mm
I
Dm
A
Coarse sand with low content of clay; granules and pebbles almost always are sharp edges.
Medium sand to rounded and sharp edges pebbles.
Clay with coarse sand, granules and pebbles, which are often greater than 8 cm in diameter. The consolidation of the layers increases downwards while the pebbles size upwards.
Clay with coarse sand, granules and pebbles , which are mostly sandstone with sharp edges.
Clay with coarse sand, granules and pebbles. The layer does not appear graded; however, the pebbles seem to occur only in the lower part of the layer in correspondence of a more reddish colored zone.


CORE R
LITHOLOGY
GRANULOMETRY AND SEDIMENTARY STRUCTURE
COLOUR
LITHOFACIES
DESCRIPTION
Clay with a variable silt content
Black clay without frustules
Not very dark gray beds
Clay with gray-blackish laminae, that increase upwards. The lamination is somewhat disturbed.
Clay with high water content
Darker and silty layer
clay with frustules
Less consolidated clay
Silty clay
Washed silt with a coarser bed.
Very coarse washed sand with some pebbles (2-3 mm)
Silt with pebbles similar to those found in the upper layers
Darker clayey thin bedded
Frustules-rich layer with some pebbles
Frustules rich washed silt. The darker lamination is disturbed.
The colour of the layers becomes lighter.
Dark-grey disturbed lamination
Uneven dark-grey clay
Uneven dark-grey clay
Grey blackish clay without frustules
Black clay without frustules
stone ø 0.5cm
S?
Stick L=2cm
Stick ø5mm L=1.5mm
ø 2-3mm
ø 2-3mm
L=7-9mm
L=7-9mm
L=1.5cm
L=2-3cm
L=5mm
L=< mm


CORE S
LITHOLOGY
GRANULOMETRY AND SEDIMENTARY STRUCTURE
COLOUR
LITHOFACIES
DESCRIPTION
Dark grey clay
Very dark disturbed lamination
more evident lamination
evident alternation
large angular sandstone clasts, up to 5 cm in diameter, occur in a sandy-clay matrix.
Dry silty clay
L=2cm
Clasti Ø=5–6 cm
CLAY
SILT
SAND
GRAVELS
PEBBLES
COBBLES


CORE T
GRANULOMETRY AND SEDIMENTARY STRUCTURE
LITHOLOGY
CLAY
SILT
SAND
GRAVELS
COBBLES
COLOUR
LITHOFACIES
DESCRIPTION
Black smelly clay surrounding by dark-grey beds
Dark disturbed lamination
Grey silty clay
Black clay without frustules
Black clay without frustules
Disturbed lamination
Black clay without frustules
7/T
Clay with black laminae; at the top two light grey silty beds occur.
L=5cm
L= 5mm
L=5cm


CORE V
LITHOLOGY
GRANULOMETRY AND SEDIMENTARY STRUCTURE
CLAY
SILT
SAND
GRANULES
PEBBLES
COBBLES
COLOUR
LITHOFACIES
DESCRIPTION
Clay with a variable silt content
At the center of the layer the black colour becomes more intense. The clay is more consolidated.
Dark-grey lamina
Black clay
Grey lamination not very evident
Slightly evident thick lamination
Laminated clay
Thick dark laminae
Uneven grey-blackish clay
Uneven grey-blackish clay
Thick greyish lamination not very evident
Grey-blackish laminated clay

Appendix 8

Certificates of analyses

Quality Analysis ... ***Innovative Technologies***

Date Submitted: 07-Jan-14
Invoice No.: A14-00091
Invoice Date: 20-Jan-14
Your Reference: UNIBAS-DEPT OF SCIENCES

University of Basilicata
Via Dell"ateneo, 10-Edificio 3D
c/o Faculty of Science
Potenza I-85100
Italy

ATTN: Michele Paternoster

CERTIFICATE OF ANALYSIS

18 Pulp samples were submitted for analysis. Quaternary deposits+cross contamination

The following analytical packages were requested: Code 4LITHO (11+) Major Elements Fusion ICP(WRA)/Trace Elements Fusion ICP/MS(WRA4B2)
Code UT-6 Total Digestion ICP & ICP/MS

REPORT **A14-00091**

Notes:
We recommend using option 4B1 for accurate levels of the base metals Cu, Pb, Zn, Ni and Ag. Option 4B-INAA for As, Sb, high W >100ppm, Cr >1000ppm and Sn >50ppm by Code 5D. Values for these elements provided by Fusion ICP/MS, are order of magnitude only and are provided for general information. Mineralized samples should have the Quant option selected or request assays for values which exceed the range of option 4B1. Total includes all elements in % oxide to the left of total.

CERTIFIED BY :

Emmanuel Eseme , Ph.D.
Quality Control

ISO/IEC 17025
SCC Accredited
LAB 266
LAB 266
Accrédité CCN

ACTIVATION LABORATORIES LTD.

1336 Sandhill Drive, Ancaster, Ontario Canada L9G 4V5 TELEPHONE +1.905.648.9611 or +1.888.228.5227 FAX +1.905.648.9613
E-MAIL Ancaster@actlabs.com ACTLABS GROUP WEBSITE www.actlabs.com

Quality Analysis ... **Actlabs** ***Innovative Technologies***

Date Submitted: 25-Apr-14
Invoice No.: A14-02777
Invoice Date: 08-May-14
Your Reference:

University of Basilicata
Via Dell"ateneo, 10-Edificio 3D
c/o Faculty of Science
Potenza I-85100
Italy

ATTN: Michele Paternoster

CERTIFICATE OF ANALYSIS

17 Stream Sediment samples and 1 Water sample were submitted for analysis. FluLac samples except Agri

The following analytical packages were requested:

Code 4LITHO (11+) Major Elements Fusion ICP(WRA)/Trace Elements Fusion ICP/MS(WRA4B2)
Code 6 ICP-OES ICP-OES
Code UT-6 Total Digestion ICP & ICP/MS

REPORT **A14-02777**

Notes:
We recommend using option 4B1 for accurate levels of the base metals Cu, Pb, Zn, Ni and Ag. Option 4B-INAA for As, Sb, high W >100ppm, Cr >1000ppm and Sn >50ppm by Code 5D. Values for these elements provided by Fusion ICP/MS, are order of magnitude only and are provided for general information. Mineralized samples should have the Quant option selected or request assays for values which exceed the range of option 4B1. Total includes all elements in % oxide to the left of total.

CERTIFIED BY :

Emmanuel Eseme , Ph.D.
Quality Control

ISO/IEC 17025
SCC Accredited
LAB 266
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ACTIVATION LABORATORIES LTD.

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E-MAIL Ancaster@actlabs.com ACTLABS GROUP WEBSITE www.actlabs.com

Quality Analysis ...  ***Innovative Technologies***

Date Submitted: 26-Feb-15
Invoice No.: A15-01206
Invoice Date: 12-Mar-15
Your Reference:

University of Basilicata
Via Dell"ateneo, 10-Edificio 3D
c/o Faculty of Science
Potenza I-85100
Italy

ATTN: Michele Paternoster

CERTIFICATE OF ANALYSIS

35 Pulp samples were submitted for analysis. Bedrock + Agri samples

The following analytical package was requested: Code 4B1 Total Digestion ICP (TOTAL)
Code 4LITHO (11+) Major Elements Fusion ICP(WRA)/Trace Elements Fusion ICP/MS(WRA4B2)

REPORT **A15-01206**

Notes:
Unaltered silicates and resistate minerals may not be dissolved. Values which exceed upper limit should be assayed.
We recommend using option 4B1 for accurate levels of the base metals Cu, Pb, Zn, Ni and Ag. Option 4B-INAA for As, Sb, high W >100ppm, Cr >1000ppm and Sn >50ppm by Code 5D. Values for these elements provided by Fusion ICP/MS, are order of magnitude only and are provided for general information. Mineralized samples should have the Quant option selected or request assays for values which exceed the range of option 4B1. Total includes all elements in % oxide to the left of total.

CERTIFIED BY:

Emmanuel Eseme , Ph.D.
Quality Control

SCC Accredited LAB
LAB Accrédité CCN

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E-MAIL Ancaster@actlabs.com ACTLABS GROUP WEBSITE www.actlabs.com

Quality Analysis ...  ***Innovative Technologies***

Date Submitted: 24-May-16
Invoice No.: A16-04607
Invoice Date: 07-Jun-16
Your Reference:

University of Basilicata
Via Dell"ateneo, 10-Edificio 3D
c/o Faculty of Science
Potenza I-85100
Italy

ATTN: Michele Paternoster

CERTIFICATE OF ANALYSIS

48 Soil samples were submitted for analysis. lacustrine bulk+clay samples

The following analytical package(s) were requested: Code 4LITHO (11+) Major Elements Fusion ICP(WRA)/Trace Elements Fusion ICP/MS(WRA4B2)

REPORT **A16-04607**

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Notes:

We recommend using option 4B1 for accurate levels of the base metals Cu, Pb, Zn, Ni and Ag. Option 4B-INAA for As, Sb, high W >100ppm, Cr >1000ppm and Sn >50ppm by Code 5D. Values for these elements provided by Fusion ICP/MS, are order of magnitude only and are provided for general information. Mineralized samples should have the Quant option selected or request assays for values which exceed the range of option 4B1. Total includes all elements in % oxide to the left of total.

CERTIFIED BY:

Emmanuel Eseme , Ph.D.
Quality Control

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