



**Employer:**

Lulea University of Technology, Sweden  
Civil, Environment and Natural Resources Engineering  
971 87 Lulea

**Commission:**

Uniaxial Compressive Strength (UCS)  
and creep testing of rock samples.

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Wrocław, May 2020



## PART 1: UNIAXIAL COMPRESSION TESTS

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## BACKGROUND AND PURPOSE

This report has been completed for submission to Luleå University of Technology (LTU), Department of Civil, Environment and Natural Resources Engineering, according to grant agreement No. U/0180/635/2019, applied from 2019 November 01 to 2020 May 01, between Lulea University of Technology and Wroclaw University of Science and Technology.

The Rock Mechanics Laboratory within the Faculty of Geoengineering, Mining and Geology at Wroclaw University of Science and Technology was requested to carry out the tests:

- UCS tests (strain controlled) on 25 rock samples, clearly marked for UCS tests.
- Creep tests on 8 biotite rock samples, clearly marked for creep tests.

The report contains:

- Test methodology
- Results
- Conclusion
- Raw data in digital format
- Photographs of test samples and test setup

The list of cylindrical laboratory samples provided by the Employer is presented in Table 1.

Table 1. Laboratory samples.

<b>I.p.</b>	<b>1</b>	<b>200-18, MUJ8820</b>		<b>weight</b>	<b>diameter</b>	<b>height</b>	<b>s=h/d</b>
	<b>Sample ID</b>	<b>Test</b>	<b>Type of rock</b>	<b>g</b>	<b>mm</b>	<b>mm</b>	<b>--</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
1	UCS 1A BSF	Uniaxial Compressive Test	Biotite Schist	300,93	38,52	84,76	2,20
2	UCS 1B BSF	Uniaxial Compressive Test	Biotite Schist	353,96	38,54	83,34	2,16
3	UCS 1A MGN	Uniaxial Compressive Test	Magnetite	436,78	38,44	88,22	2,30
4	UCS 1A GRA	Uniaxial Compressive Test	Granite	301,41	38,62	93,60	2,42
5	UCS 1B GRA	Uniaxial Compressive Test	Granite	300,03	38,70	92,10	2,38
	<b>2</b>	<b>201-18, MUJ8821</b>					
	<b>Sample ID</b>	<b>Test</b>	<b>Rock Type</b>				
6	UCS 2A BSF	Uniaxial Compressive Test	Biotite Schist	295,64	38,54	86,80	2,25
7	UCS 2A APA	Uniaxial Compressive Test	Apatite	286,72	38,50	78,54	2,04



8	UCS 2B APA	Uniaxial Compressive Test	Apatite	327,01	38,50	89,10	2,31
9	UCS 2A RGL	Uniaxial Compressive Test	Red-grey leptite	357,74	38,48	78,62	2,04
10	UCS 2A PEG	Uniaxial Compressive Test	Pegmatite	264,31	38,50	88,00	2,28
11	UCS 2A GRL	Uniaxial Compressive Test	Grey-red leptite	279,76	38,54	83,00	2,15
	<b>3</b>	<b>201-18, MUJ8822</b>					
	<b>Sample ID</b>	<b>Test</b>	<b>Rock Type</b>				
12	UCS 3A BSF	Uniaxial Compressive Test	Biotite Schist	314,04	38,54	85,90	2,23
13	UCS 3B BSF	Uniaxial Compressive Test	Biotite Schist	307,33	38,50	85,84	2,22
14	UCS 3A PEG	Uniaxial Compressive Test	Pegmatite	290,82	38,64	97,14	2,51
15	UCS 3B PEG	Uniaxial Compressive Test	Pegmatite	254,35	38,64	83,54	2,16
16	UCS 3A MGN	Uniaxial Compressive Test	Magnetite	459,31	38,54	86,72	2,25
17	UCS 3B MGN	Uniaxial Compressive Test	Magnetite	495,11	38,64	95,00	2,46
18	UCS 3A RGL	Uniaxial Compressive Test	Grey-red leptite	312,10	38,50	87,80	2,28
19	UCS 3B RGL	Uniaxial Compressive Test	Grey-red leptite	311,12	38,60	85,88	2,22
	<b>4</b>	<b>164-18, MUJ8795</b>					
	<b>Sample ID</b>	<b>Test</b>	<b>Rock Type</b>				
20	UCS 4A BSF	Uniaxial Compressive Test	Biotite Schist	304,09	38,54	92,20	2,39
21	UCS 4B BSF	Uniaxial Compressive Test	Biotite Schist	295,60	38,50	88,88	2,31
22	UCS 4A GRA	Uniaxial Compressive Test	Granite	296,95	38,44	91,94	2,39
23	UCS 4B GRA	Uniaxial Compressive Test	Granite	305,82	38,44	92,40	2,40
24	UCS 4A MGN	Uniaxial Compressive Test	Magnetite	336,38	38,50	75,68	1,96
25	UCS 4B MGN	Uniaxial Compressive Test	Magnetite	458,39	38,50	90,40	2,35

## 1. RESEARCH APPARATUS

The tests were carried out on the MTS testing machine 816.03 (Fig. 1).

Table 2. Specification of testing machine

Compression rating	kN	1045
Tension rating	kN	150



Actuator displacement	mm	100
Load frame spring load	N/m	$2.6 \times 10^9$
Estimated Weight	kg	3252
Floor Loading (width×depth)	mm	1295×1168

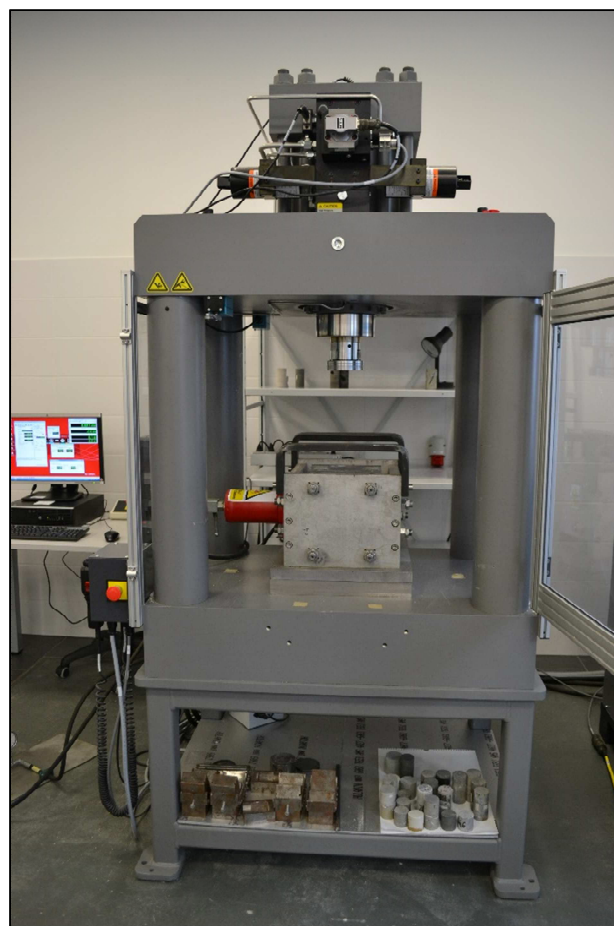


Fig. 1. Testing machine MTS 816.03

## 2. LABORATORY TESTS

A suitable machine was being used for applying and measuring axial load to the specimen. Test specimens were of circular cylinders having a height to diameter ratio of 1.96-2.51. The diameter of the test specimen was measured to the nearest 0.02 mm by averaging two diameters measured at right



angles to each other at about the upper-height, in the middle of height and the lower height of the specimen. The specimen was loaded continuously at a constant rate of stress increment such that the failure could occur within 5-10 min of loading. Alternatively the force rate increment remained within the limits of 0.1-0.2 kN/s. The maximum load subjected to the specimen was being recorded in kilonewtons. The uniaxial compressive strength of the specimen was calculated as the ratio of maximum load carried by the specimen during the test, to the original cross-sectional area of the sample:

$$UCS = \frac{\text{critical force}}{\text{cross - sectional area}}, MPa$$

The results of laboratory tests are presented in the following Table No. 3:

Table 3. Physical and mechanical parameters of rocks.

l.p.	Sample ID	ø	h	F	V	γ	F	UCS	ε
		mm	mm	mm <sup>2</sup>	mm <sup>3</sup>	g/cm <sup>3</sup>	kN	MPa	‰
1	2	3	4	5	6	7	8	9	10
1	Biotite Schist	38,52	84,76	1164,8	99136,9	3,04	61,58	52,87	6,01
2	Biotite Schist	38,54	83,34	1166,0	97173,2	3,64	37,60	32,25	7,08
3	Magnetite	38,44	88,22	1159,9	102756,5	4,25	146,32	126,14	8,16
4	Granite	38,62	93,60	1170,8	108 570,6	2,78	109,95	93,91	8,12
5	Granite	38,70	92,10	1175,7	108 280,7	2,77	217,01	184,58	9,55
6	Biotite Schist	38,54	86,80	1166,0	101 207,5	2,93	60,6	51,97	10,37
7	Apatite	38,50	78,54	1163,6	91 386,5	3,14	103,54	88,99	8,53
8	Apatite	38,50	89,10	1163,6	103 673,8	3,15	99,68	85,67	9,65
9	Red-grey leptite	38,48	78,62	1162,4	91 384,6	2,82	207,74	178,72	9,80
10	Pegmatite	38,50	88,00	1163,6	102 393,8	2,58	153,99	132,34	8,64
11	Grey-red leptite	38,54	83,00	1166,0	96 776,8	2,89	153,89	131,98	11,08
12	Biotite Schist	38,54	85,90	1166,0	100 158,1	3,14	99,42	85,27	5,70
13	Biotite Schist	38,50	85,84	1163,6	99 880,5	3,08	95,45	82,03	7,69
14	Pegmatite	38,64	97,14	1172,0	113 852,3	2,55	126,46	107,90	8,54
15	Pegmatite	38,64	83,54	1172,0	97 912,6	2,60	301,59	257,32	12,32
16	Magnetite	38,54	86,72	1166,0	101 114,2	4,54	105,54	90,52	9,46
17	Magnetite	38,64	95,00	1172,0	111 344,2	4,45	121,38	103,56	7,58
18	Red-grey leptite	38,50	87,80	1163,6	102 161,1	3,05	88,28	75,87	5,35
19	Red-grey leptite	38,60	85,88	1169,6	100 446,8	3,10	67,48	57,69	4,19
20	Biotite Schist	38,54	92,20	1166,0	107 503,8	2,83	110,68	94,92	10,85
21	Biotite Schist	38,50	88,88	1163,6	103 417,8	2,86	43,24	37,16	9,90
22	Granite	38,44	91,94	1159,9	106 645,1	2,78	248,03	213,83	10,12
23	Granite	38,44	92,40	1159,9	107 178,7	2,85	192,33	165,81	9,96
24	Magnetite	38,50	75,68	1163,6	88 058,7	3,82	71,12	61,12	8,19
25	Magnetite	38,50	90,40	1163,6	105 186,4	4,36	36,50	31,37	xxx



### 3. CHARACTERISTICS OF THE ROCK SAMPLES

Below are presented 25 rock samples' cards. They contain the basic information about the sample(s) (dimension, critical load, UCS) and photographs of the samples before, during and after the tests.

SYMBOLS:

$\emptyset$  – diameter, mm

h – height, mm

F – maximum load, kN

UCS – Uniaxial Compressive Strength, MPa

$\varepsilon$  – critical deformation, ‰

$\nu$  – Poisson's ratio, -

E – Modulus of elasticity.

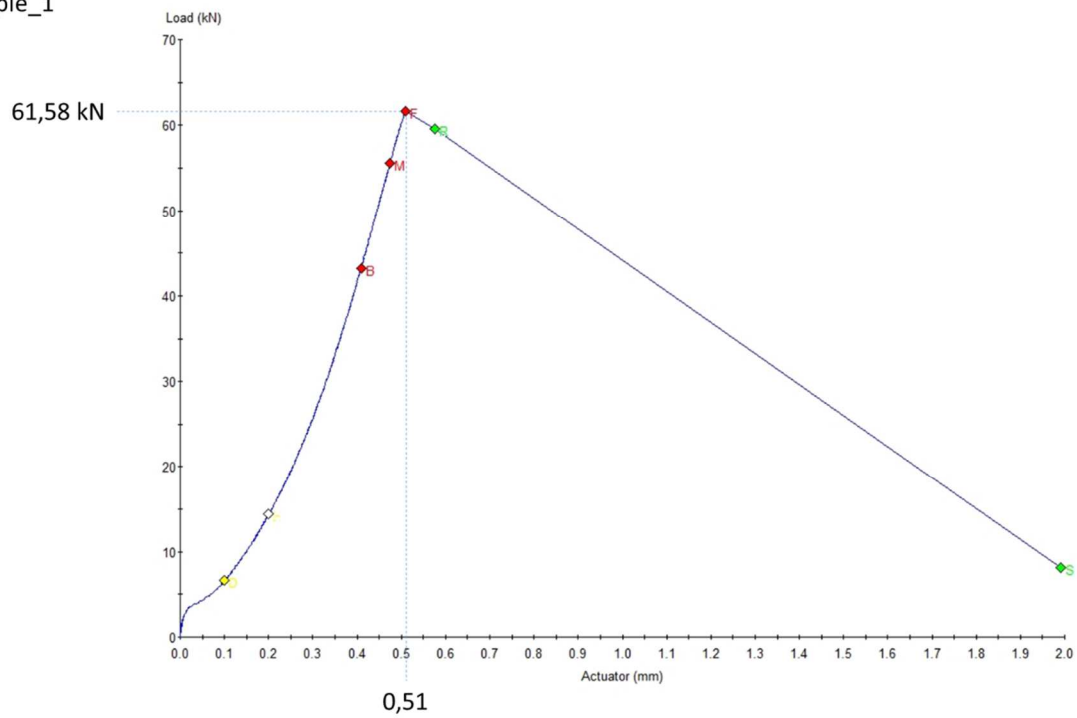


Biotite Schist UCS 1A BSF

200-18 MUJ8820	Ø, mm	h,mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 1A BSF	38,52	84,76	61,58	52,87	6,01	13,77	0,13



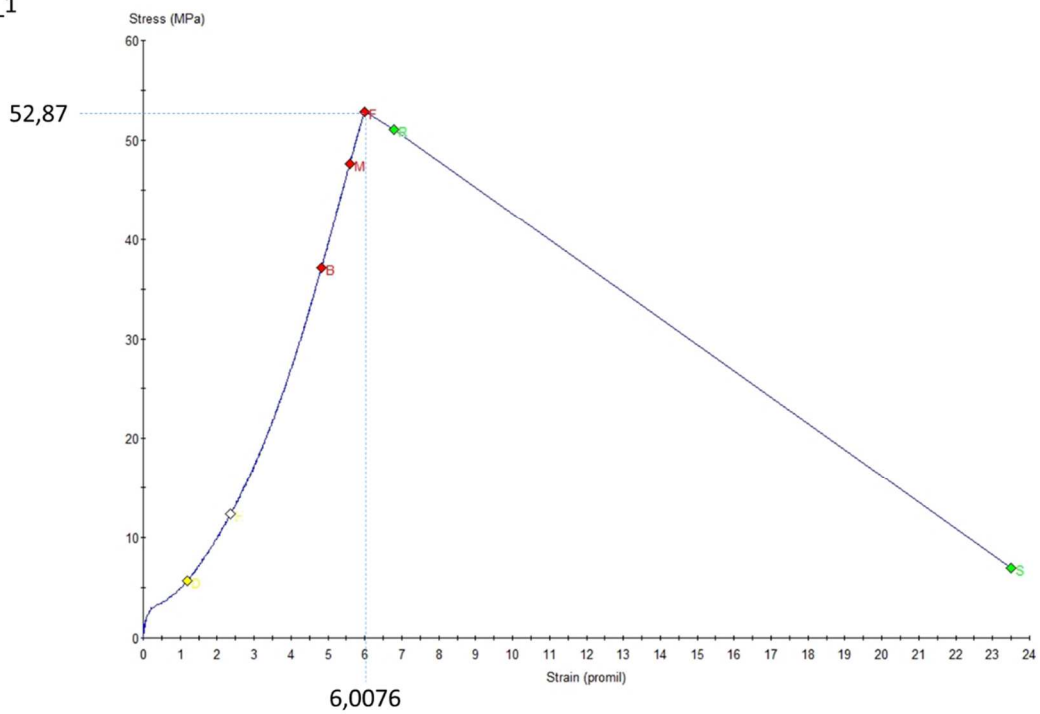
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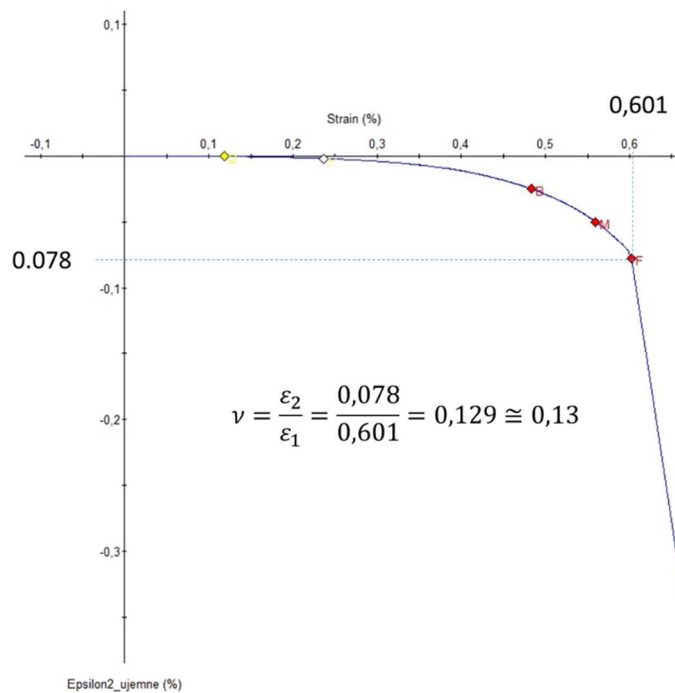




Sample\_1



Sample\_1



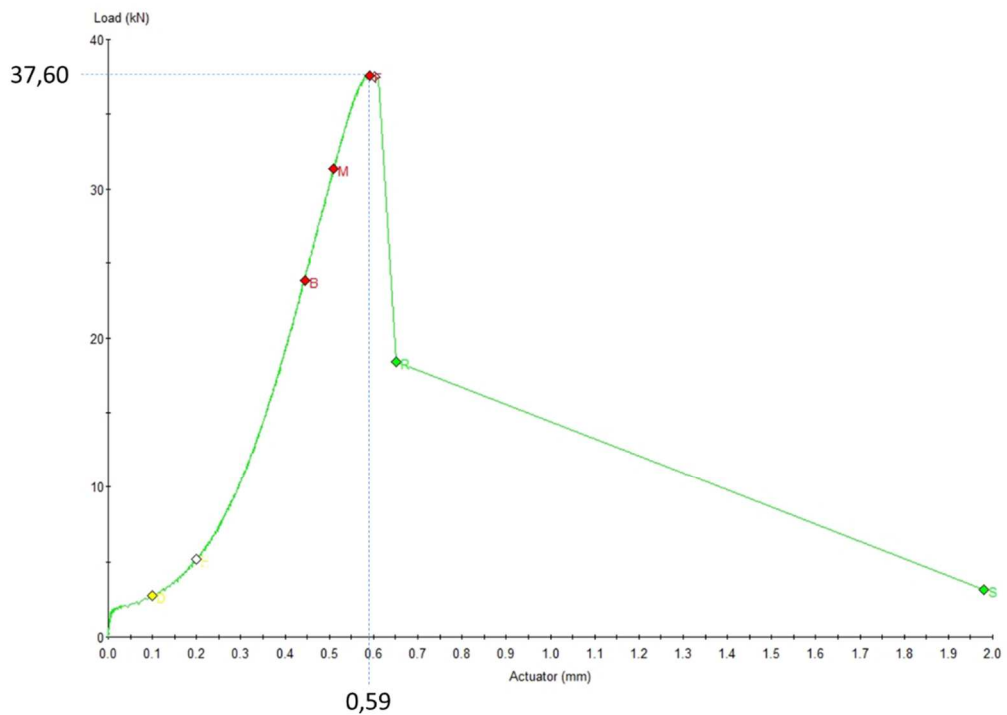


Biotite Schist UCS 1B BSF

200-18 MUJ8820	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 1B BSF	38,54	83,34	37,60	32,25	7,08	4,95	0,13

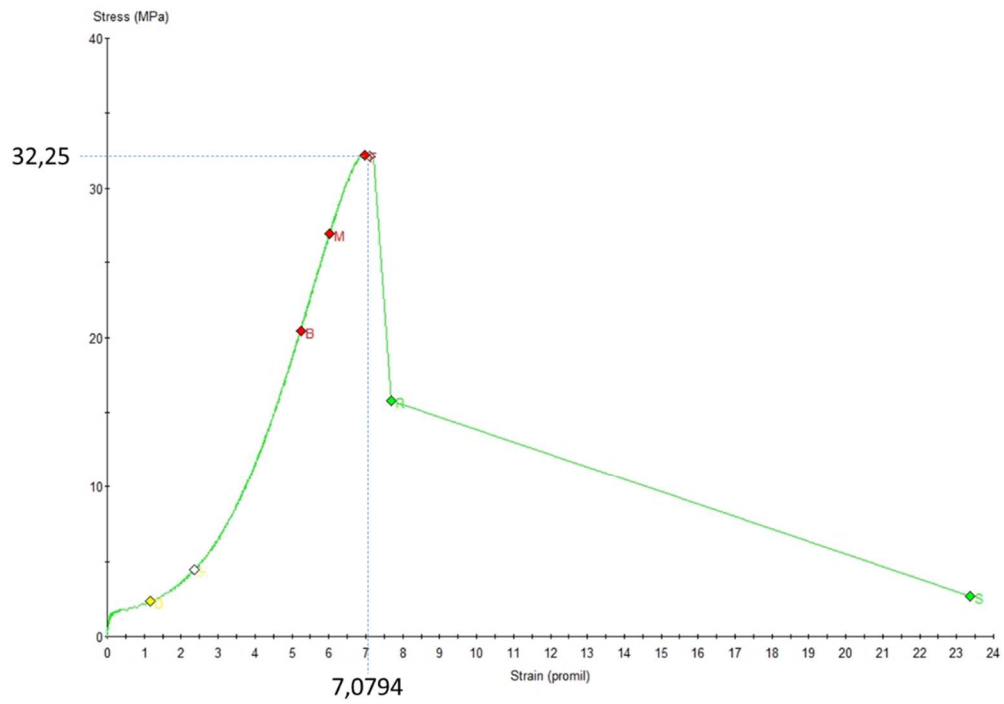


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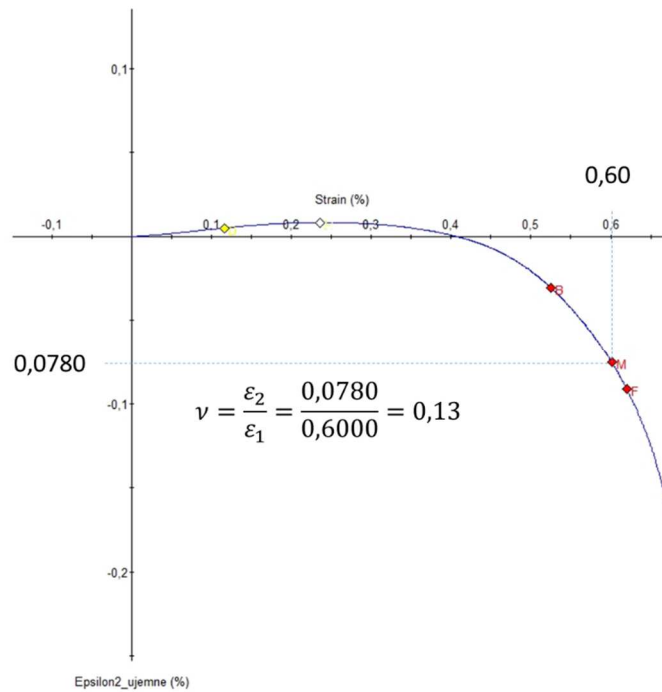




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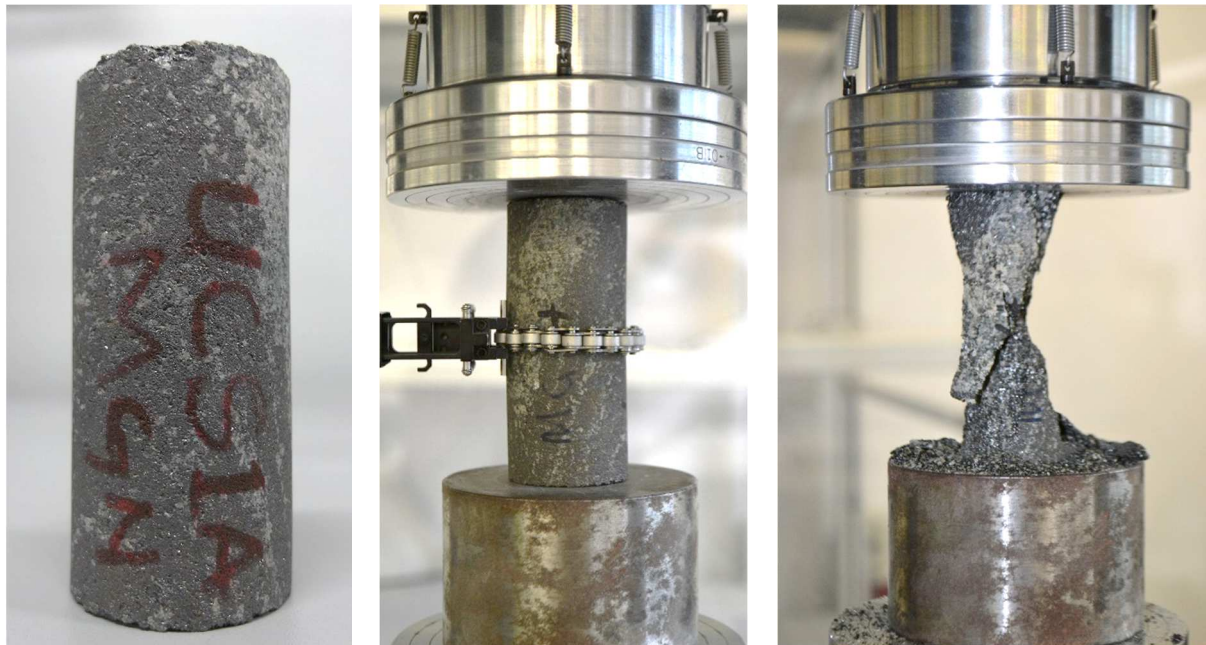
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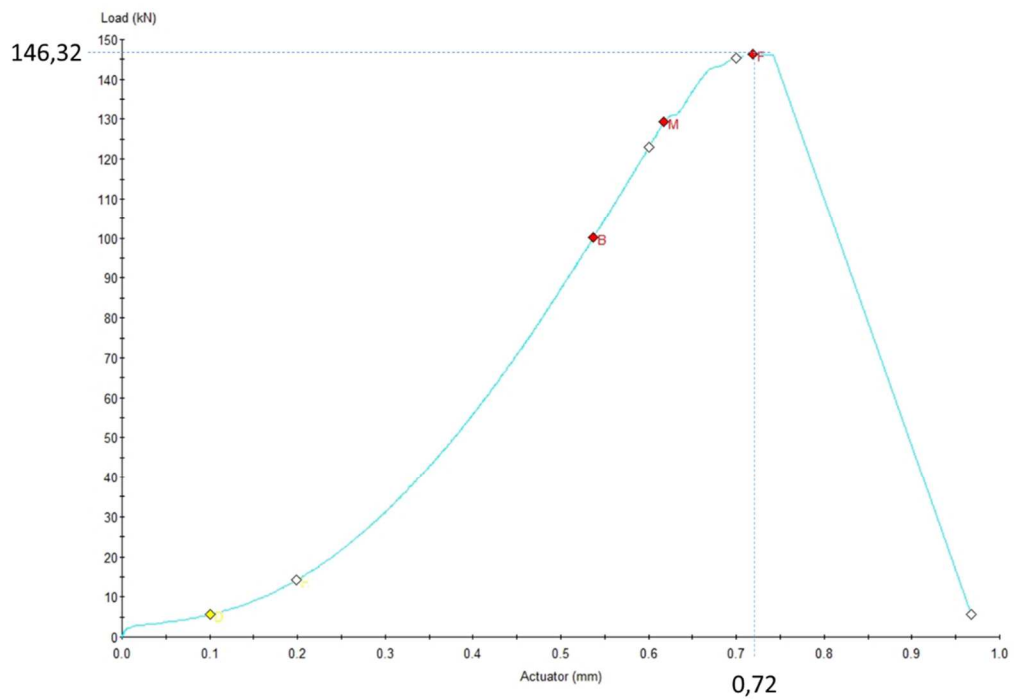


Magnetite UCS 1A MGN

200-18 MUJ8820	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 1A MGN	38,44	88,22	146,32	126,14	8,16	11,59	0,10

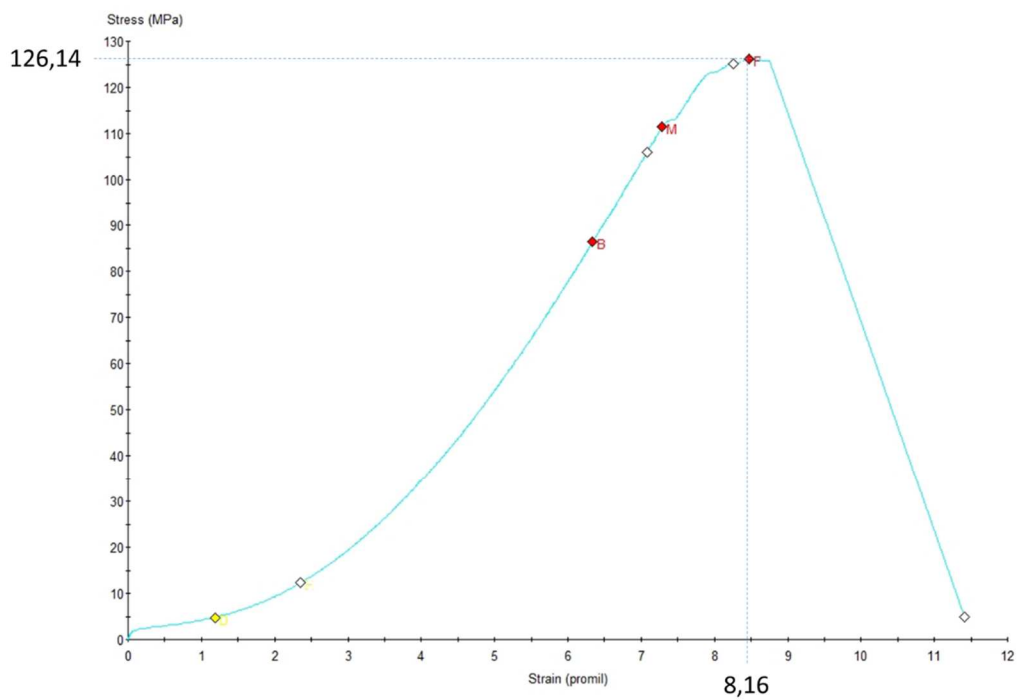


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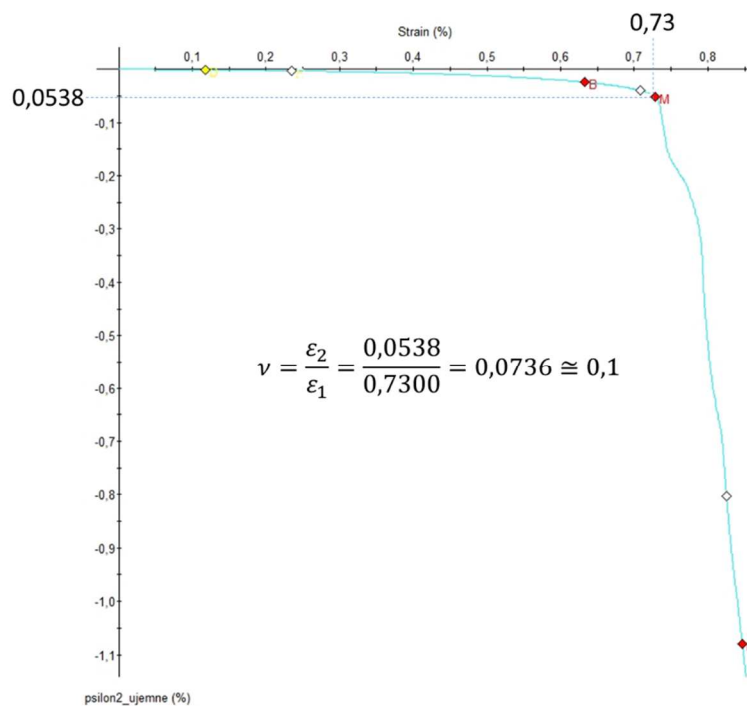




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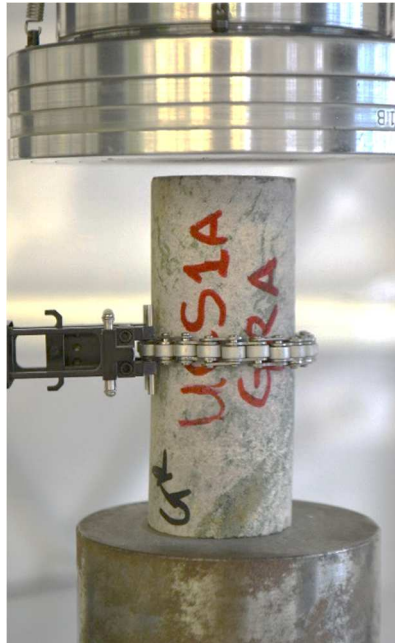
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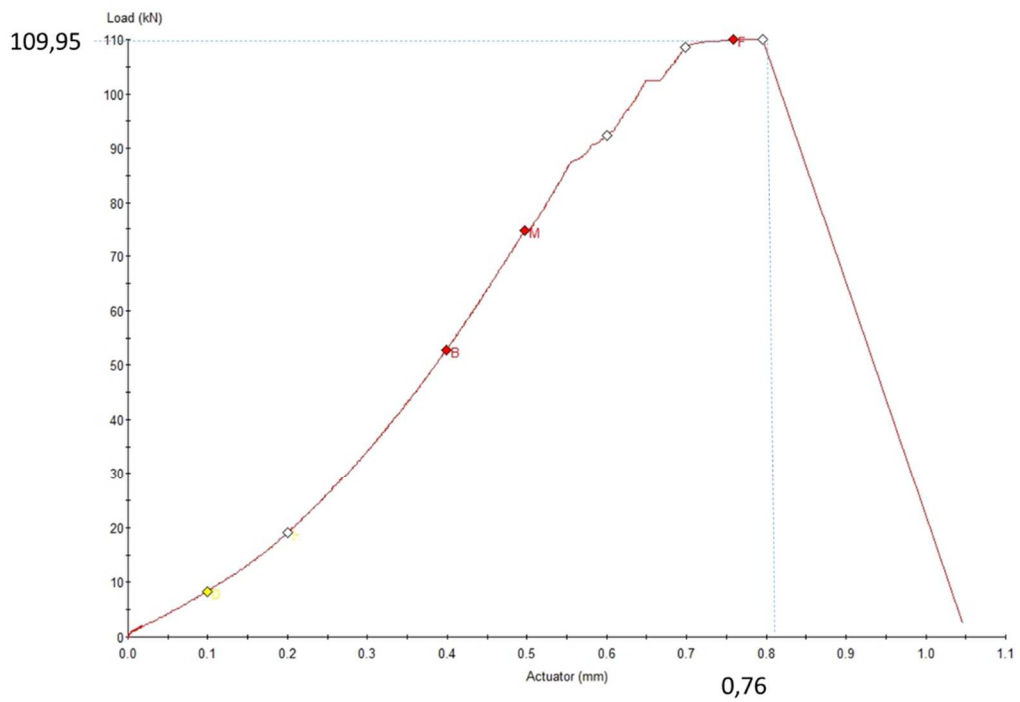


Granite UCS 1A GRA

200-18 MUJ8820	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 1A GRA	38,62	93,60	109,95	93,91	8,12	7,13	0,03

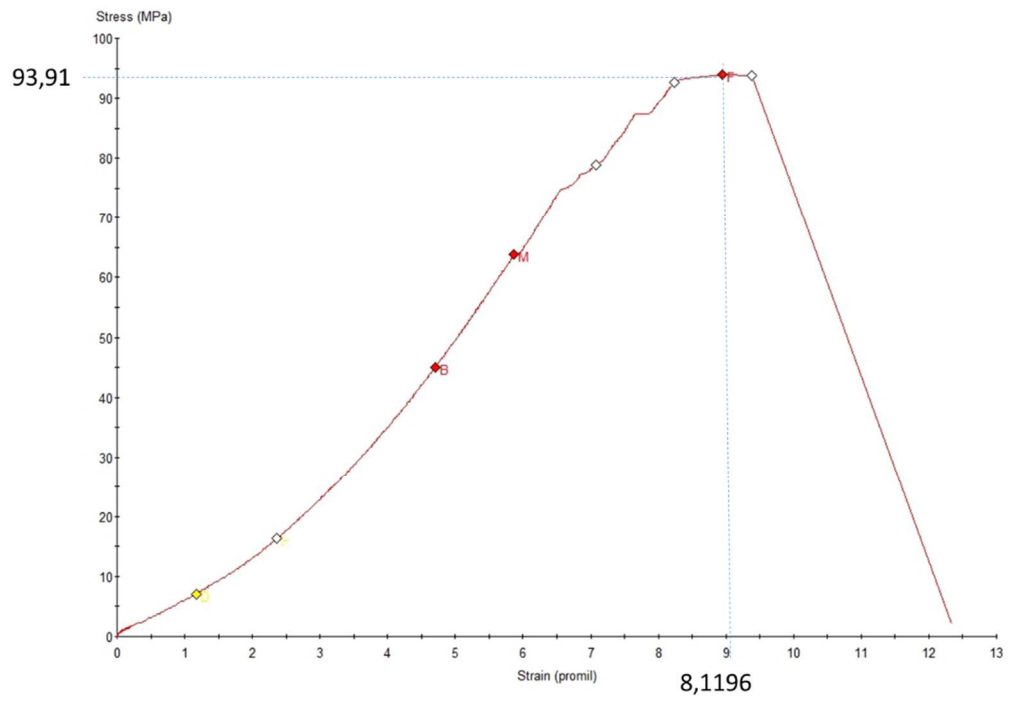


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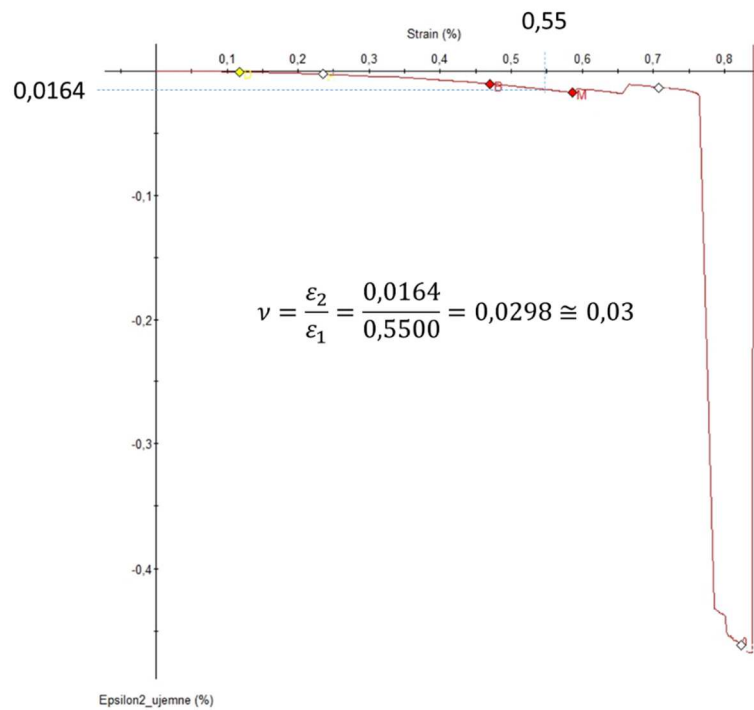




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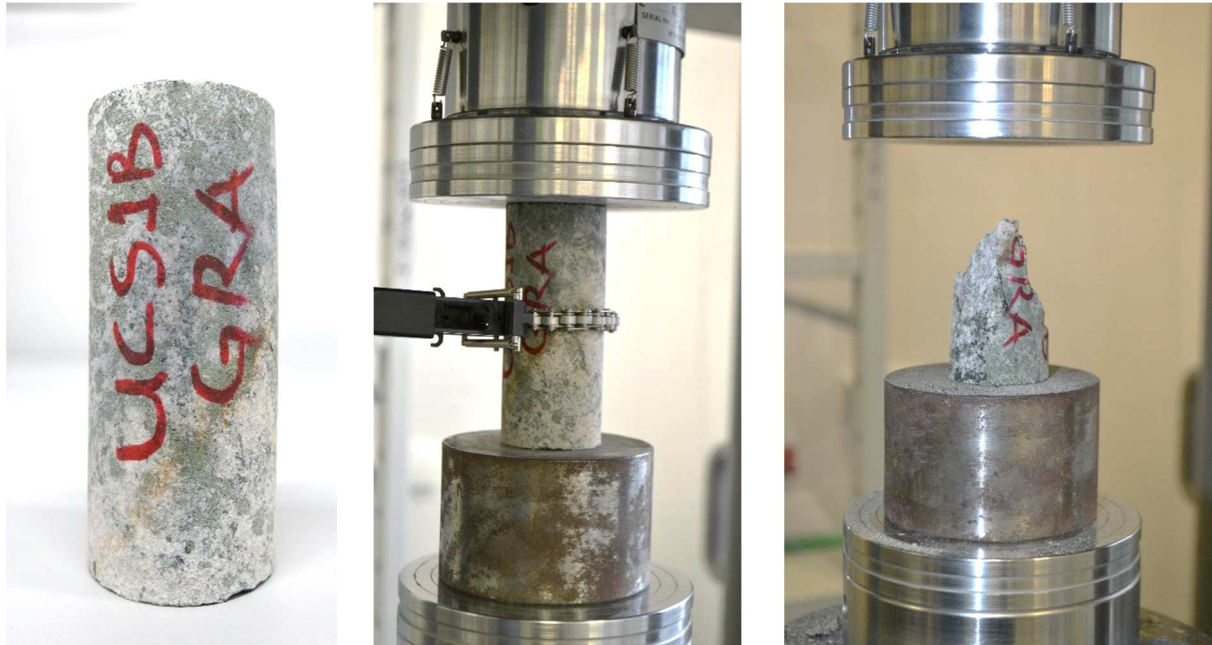
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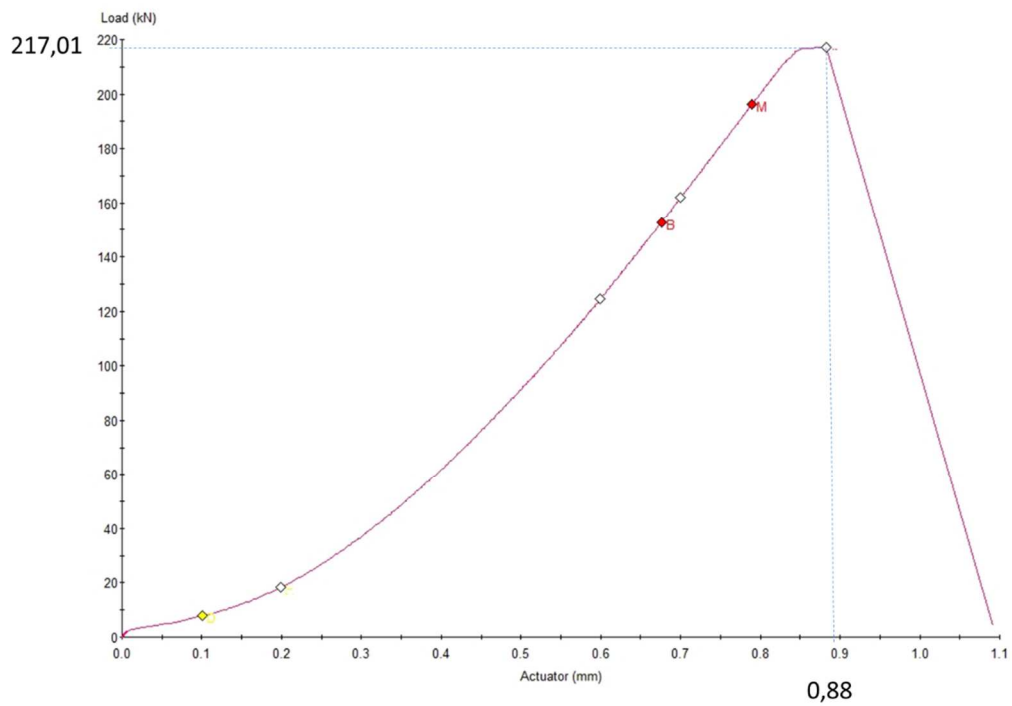


Granite UCS 1B GRA

200-18 MUJ8820	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 1B GRA	38,70	92,10	217,01	184,58	9,55	12,23	0,06



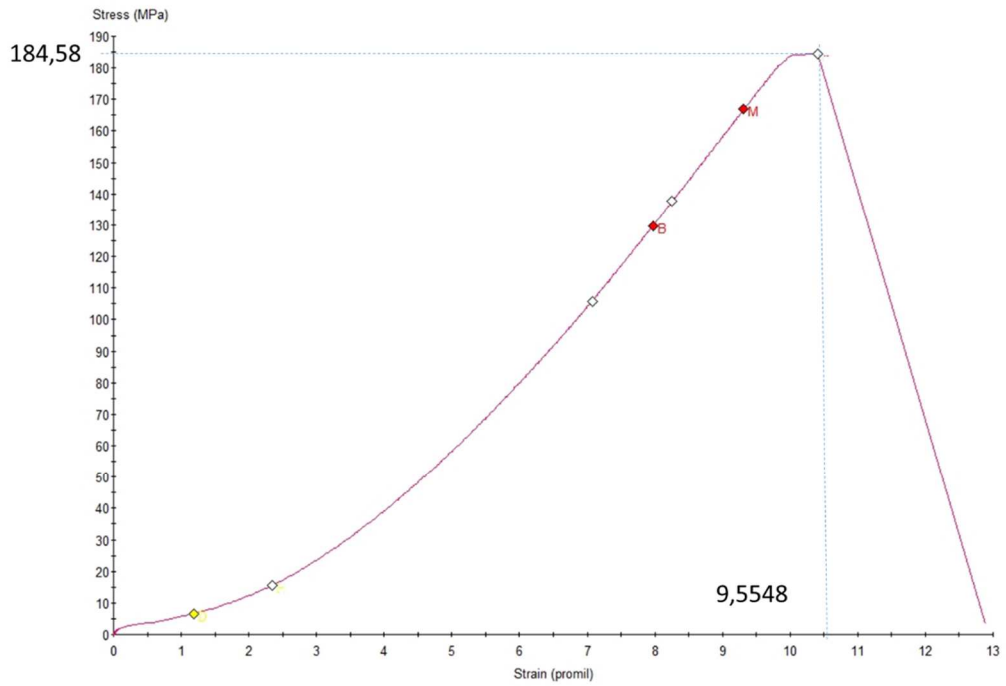
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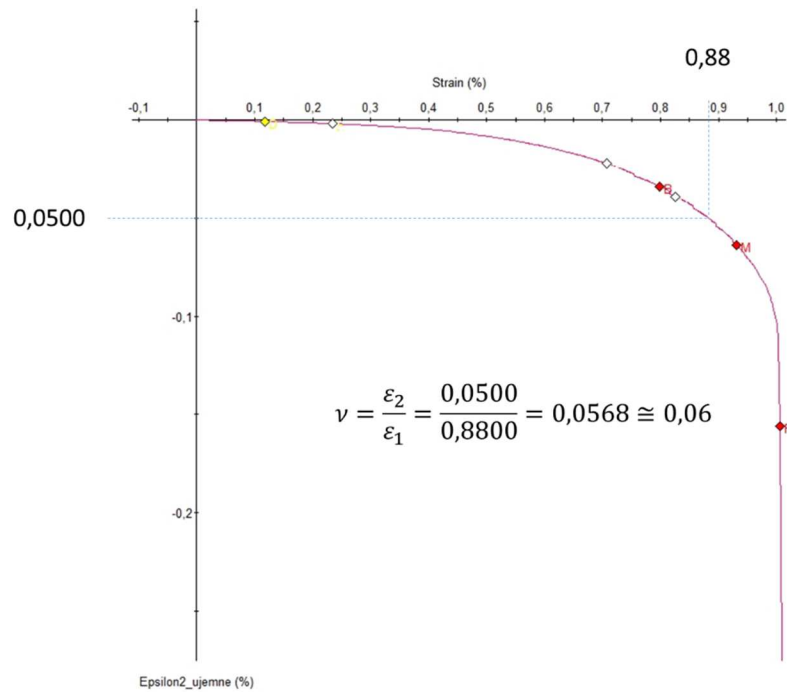




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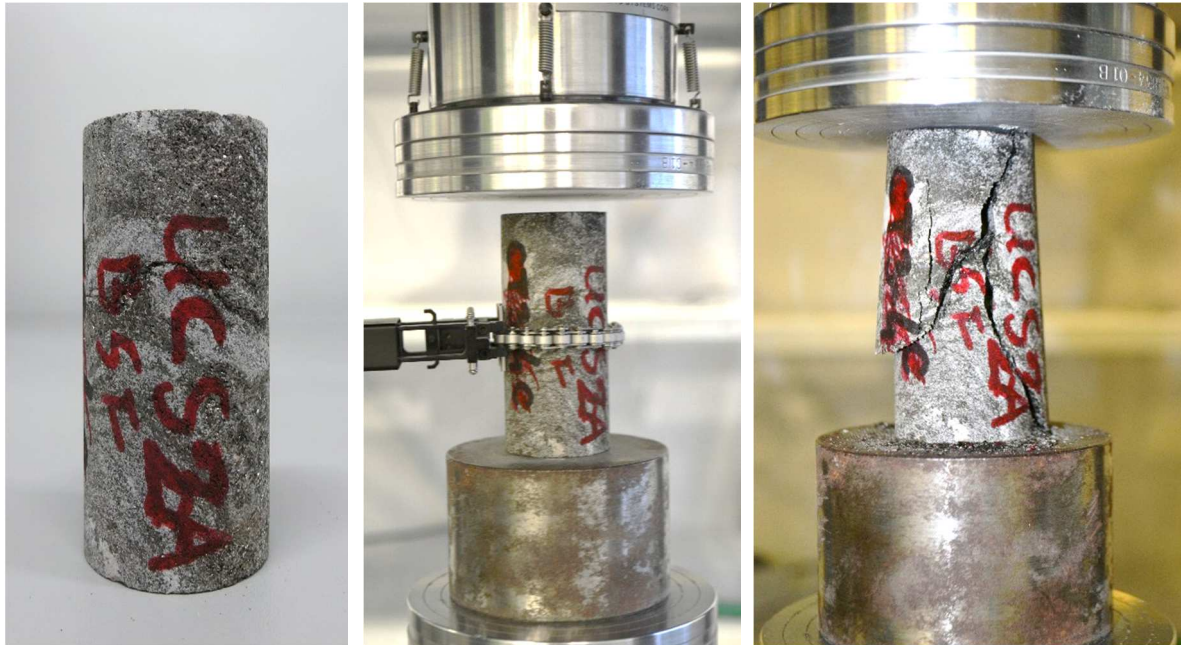
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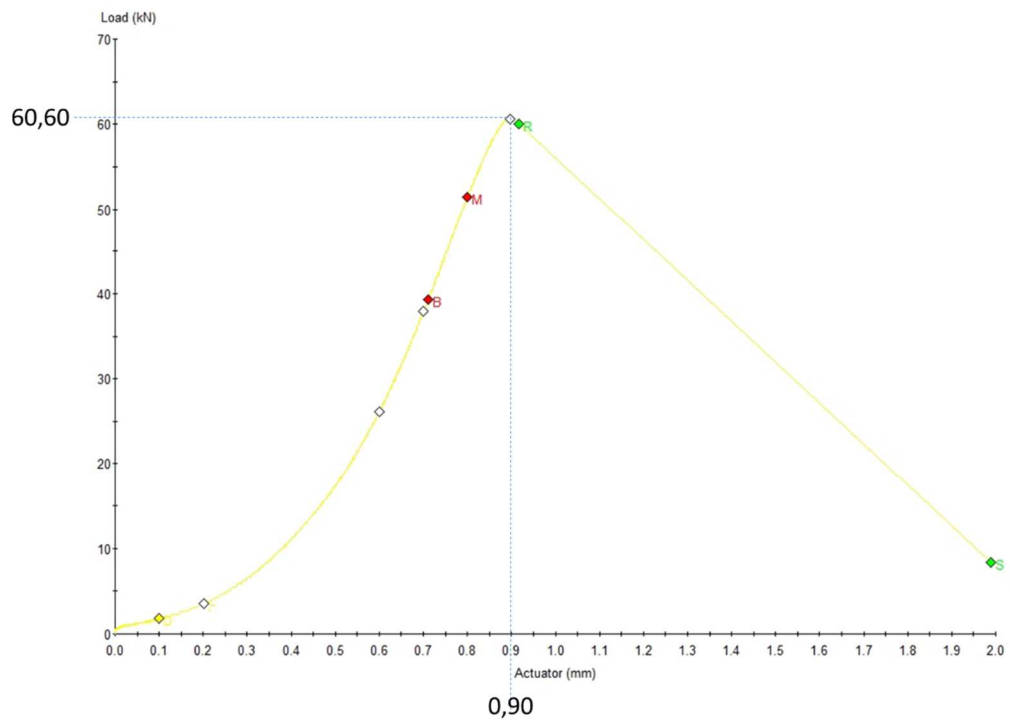


Biotite Schist UCS 2A BSF

201-18 MUJ8821	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	v,-
UCS 2A BSF	38,54	86,80	60,6	51,97	10,37	4,37	0,13

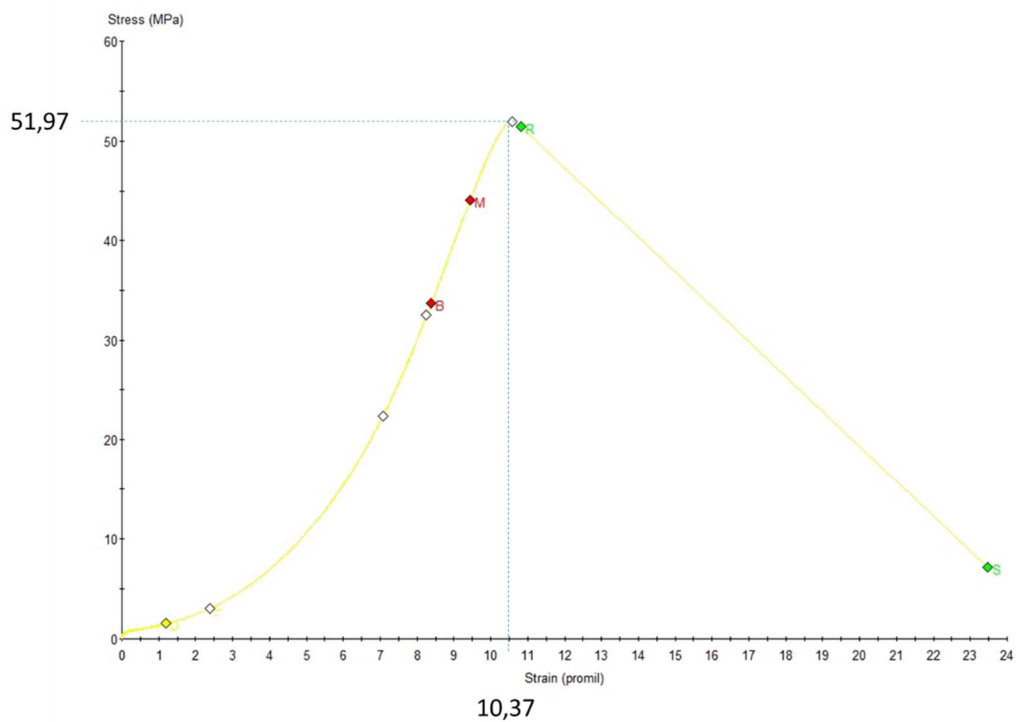


Sample\_6

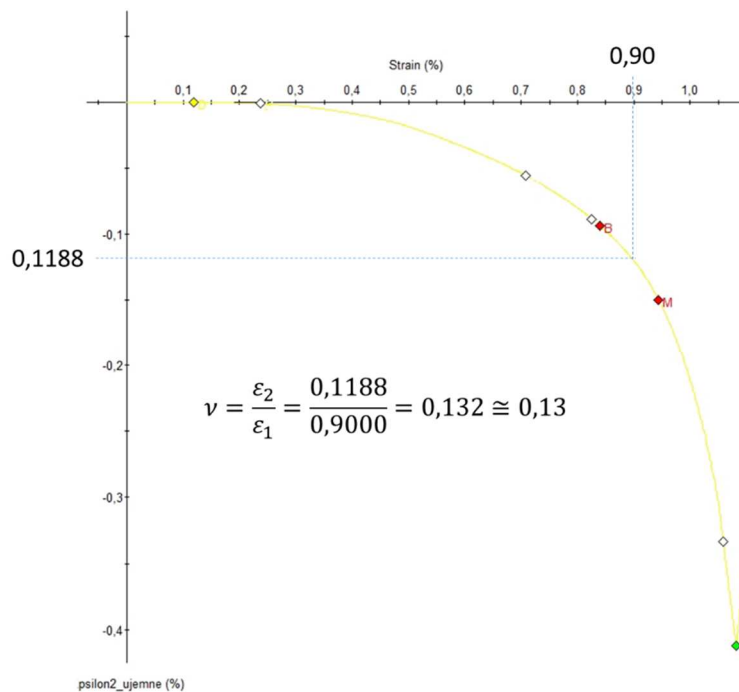




Sample\_6



Sample\_6



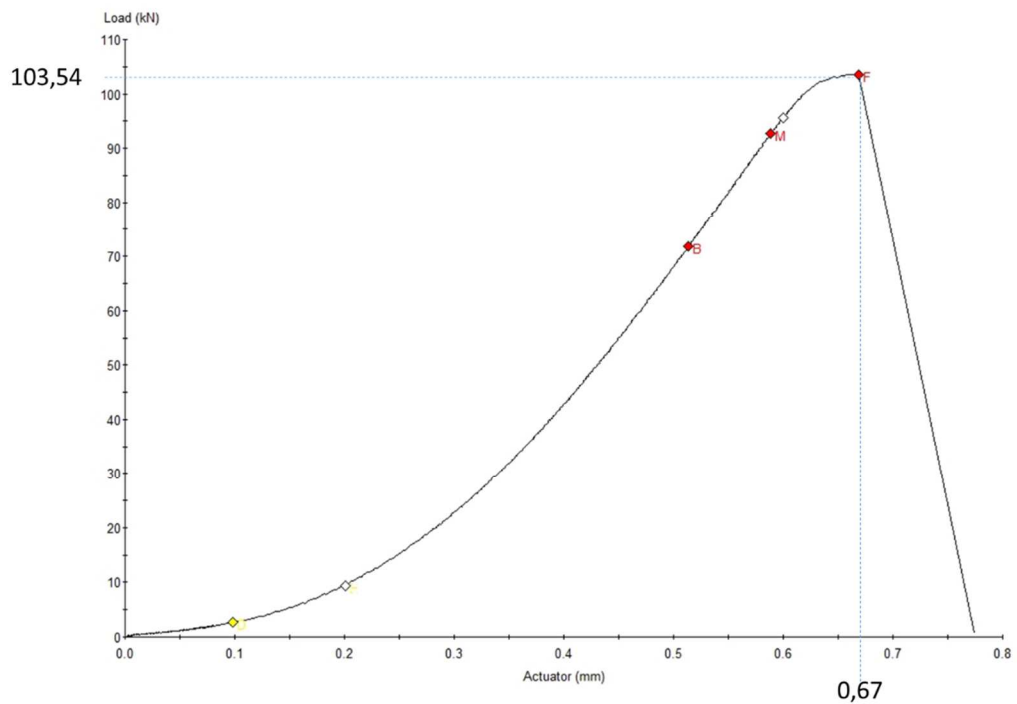


Apatite UCS 2A APA

201-18 MUJ8821	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	v,-
UCS 2A APA	38,50	78,54	103,54	88,99	8,53	8,90	0,10

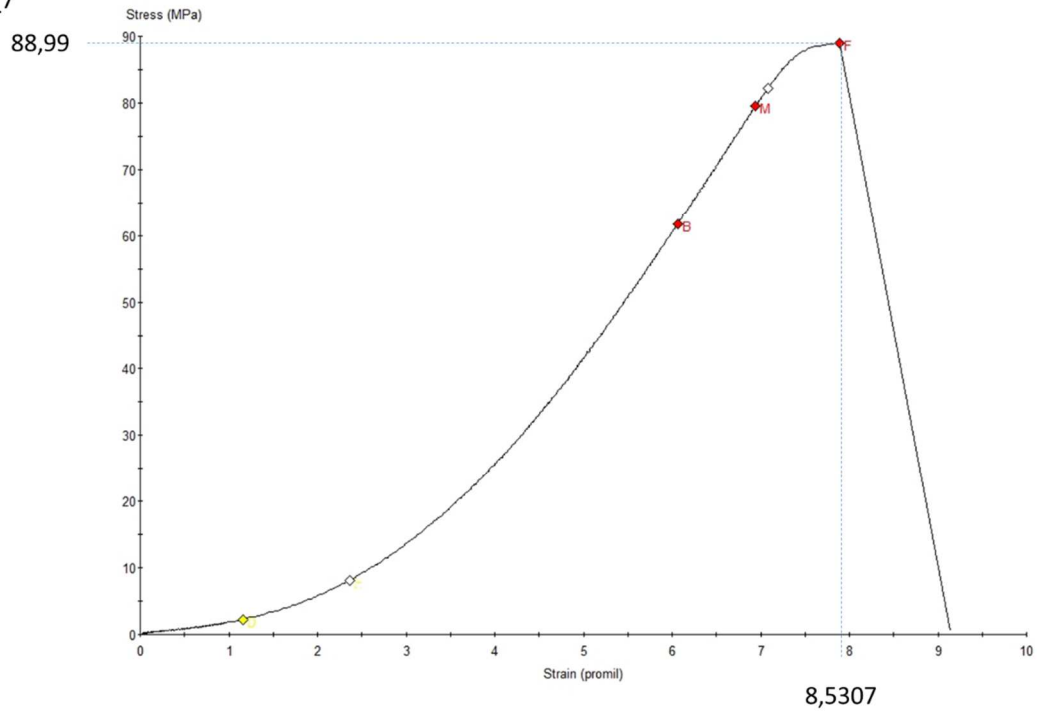


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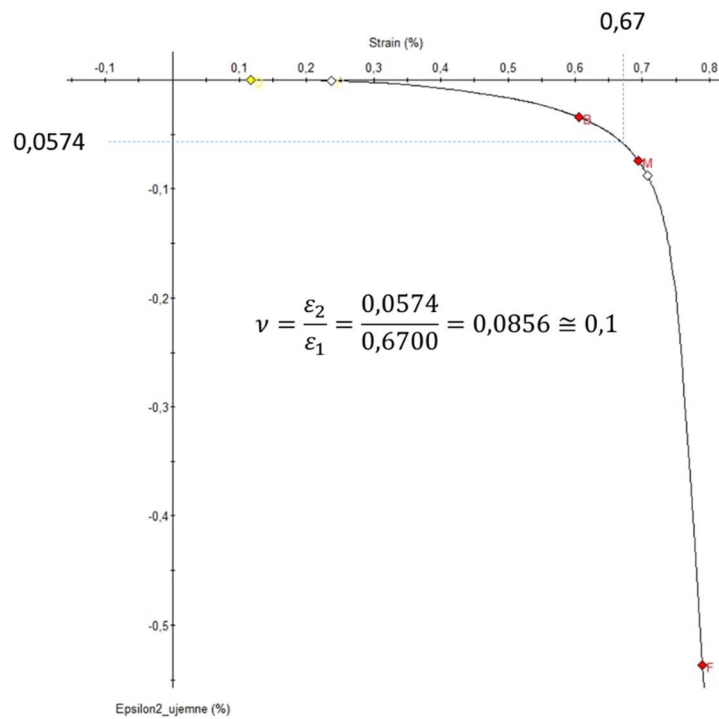




Sample\_7



Sample\_7



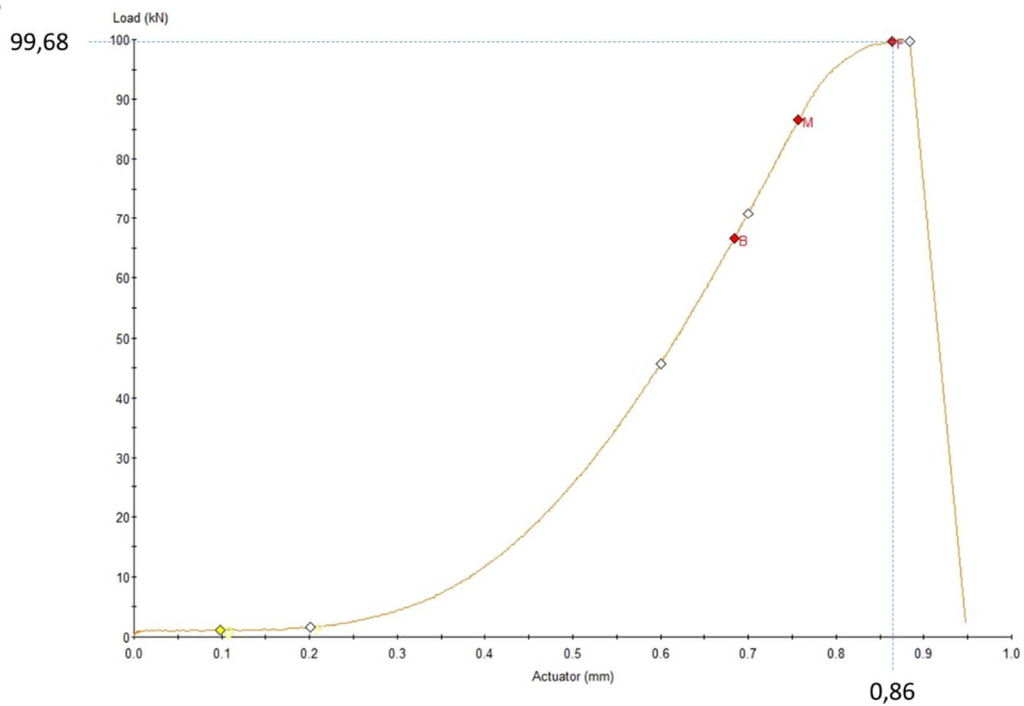


Apatite UCS 2B APA

201-18 MUJ8821	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	v,-
UCS 2B APA	38,50	89,10	99,68	85,67	9,65	8,74	0,07

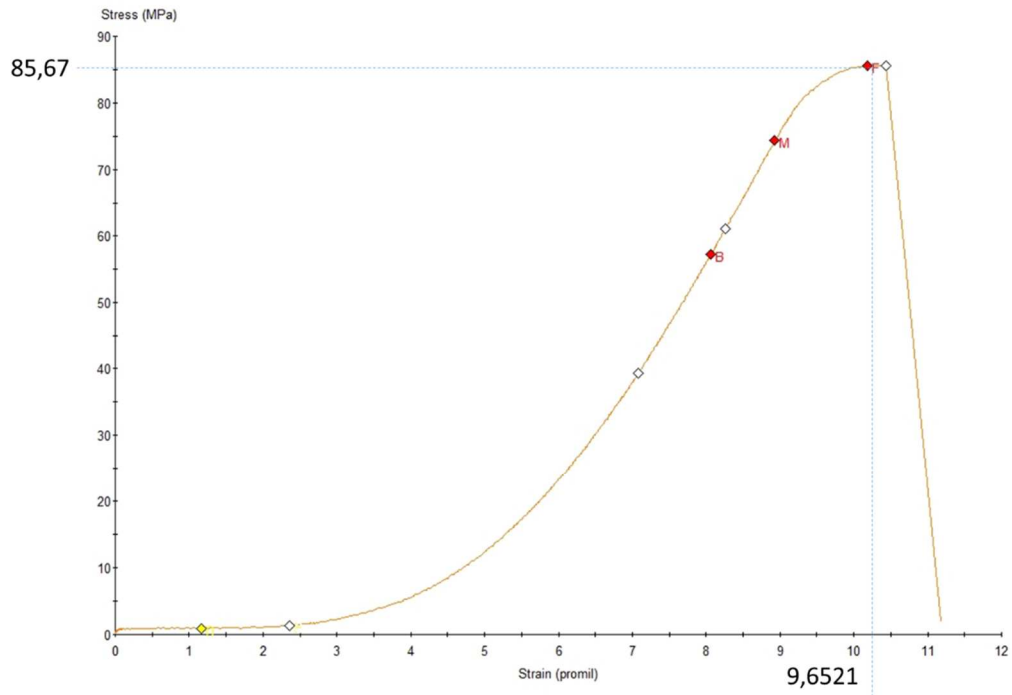


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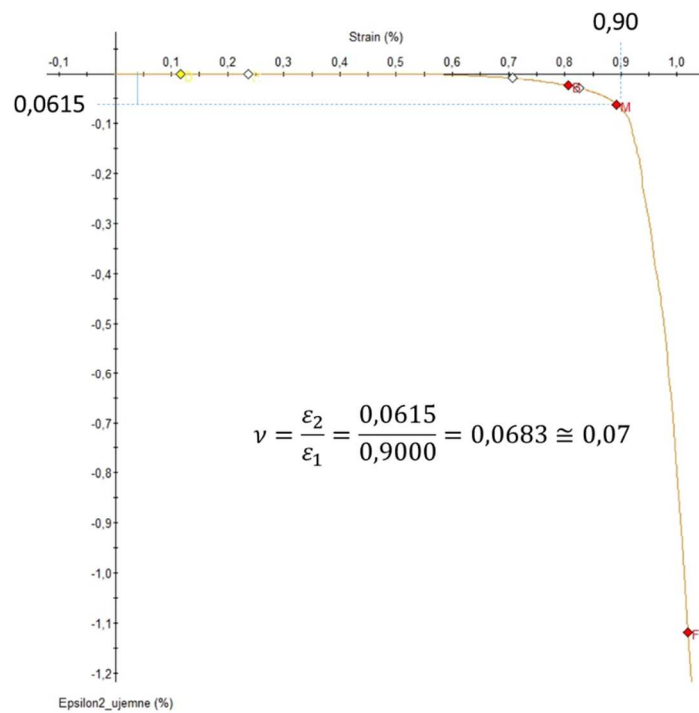




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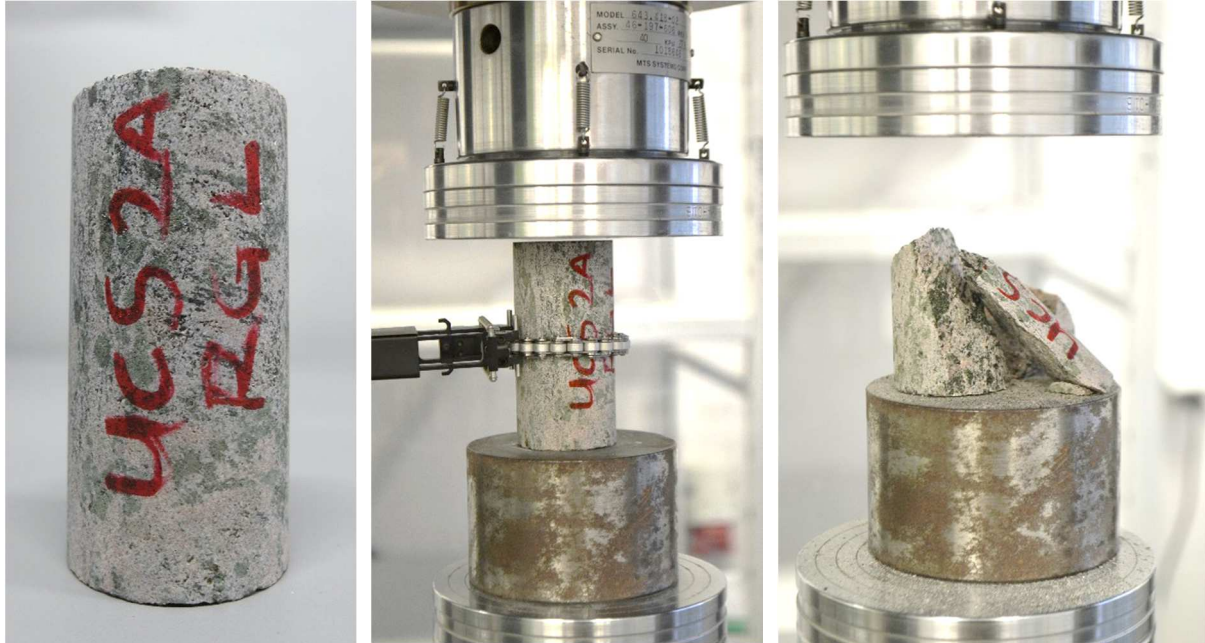
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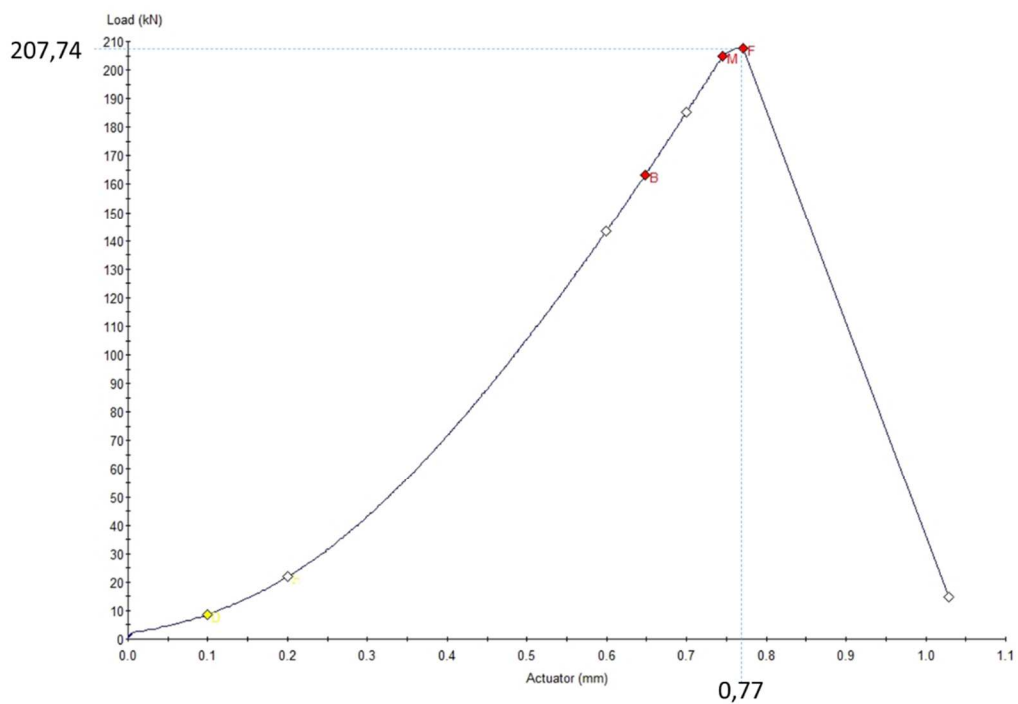


Red-grey leptite UCS 2A RGL

201-18 MUJ8821	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰		v, -
UCS 2A RGL	38,48	78,62	207,74	178,72	9,79	13,68	0,06



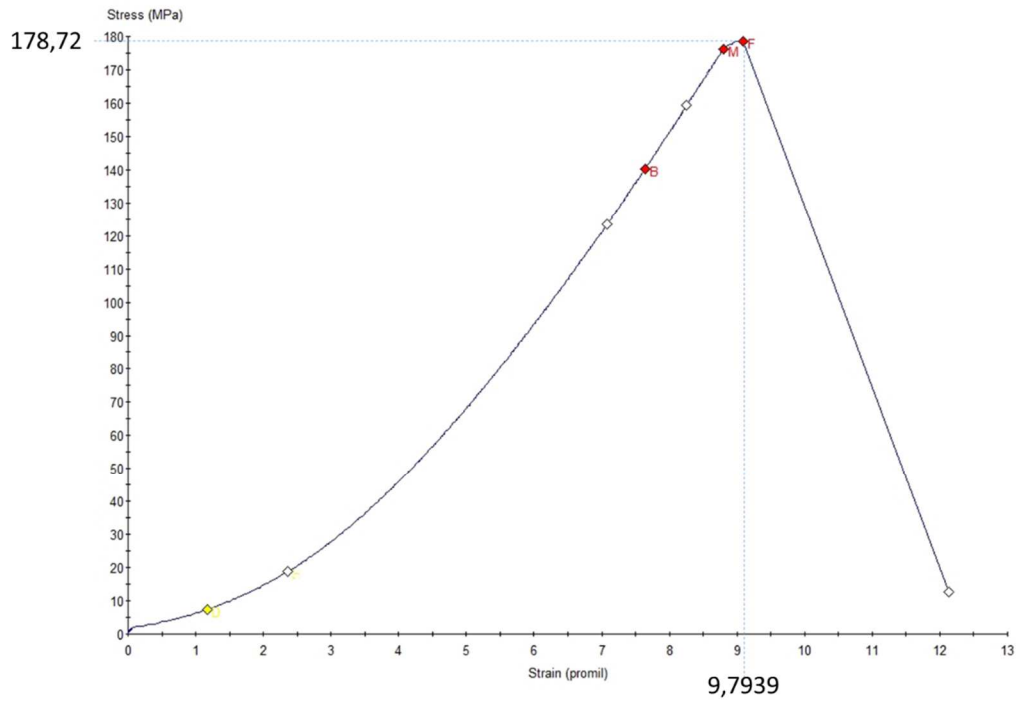
Sample\_9



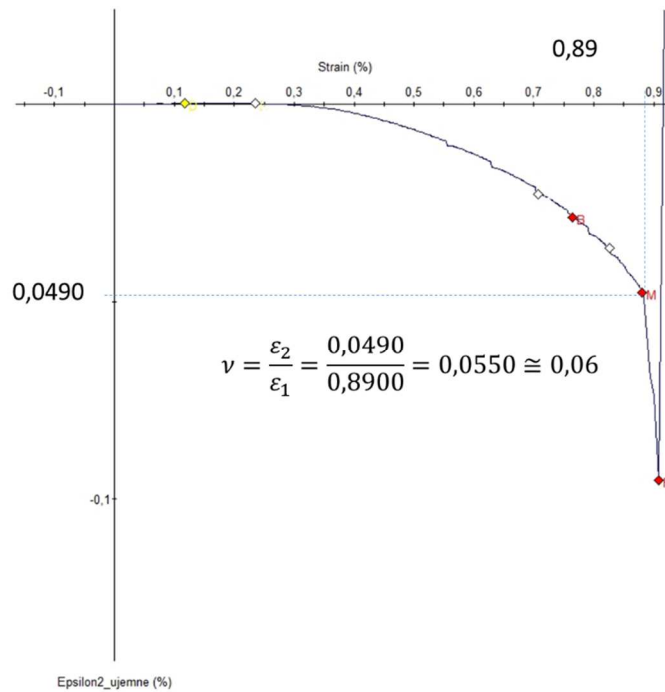




Sample\_9



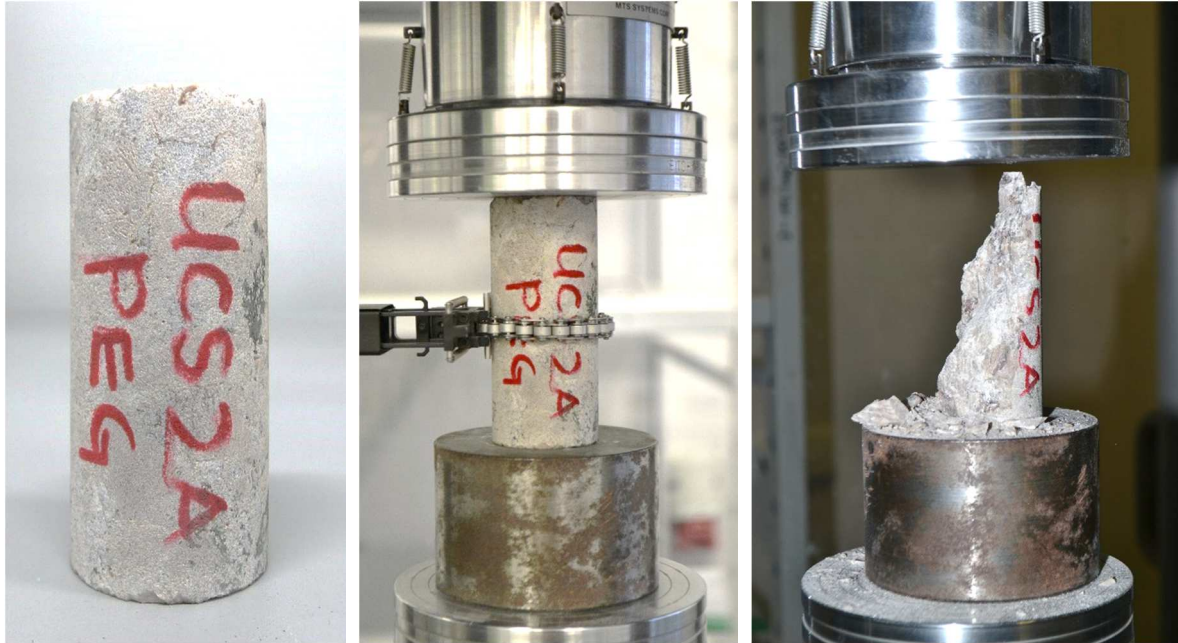
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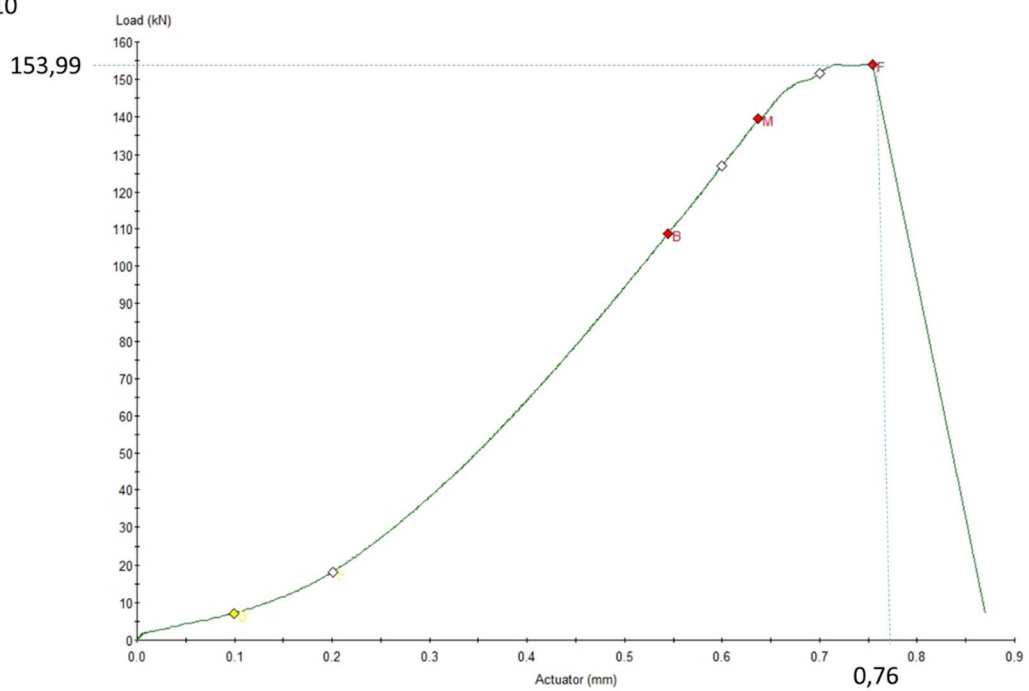


Pegmatite UCS 2A PEG

201-18 MUJ8821	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 2A PEG	38,50	88,00	153,99	132,34	8,63	10,59	0,11

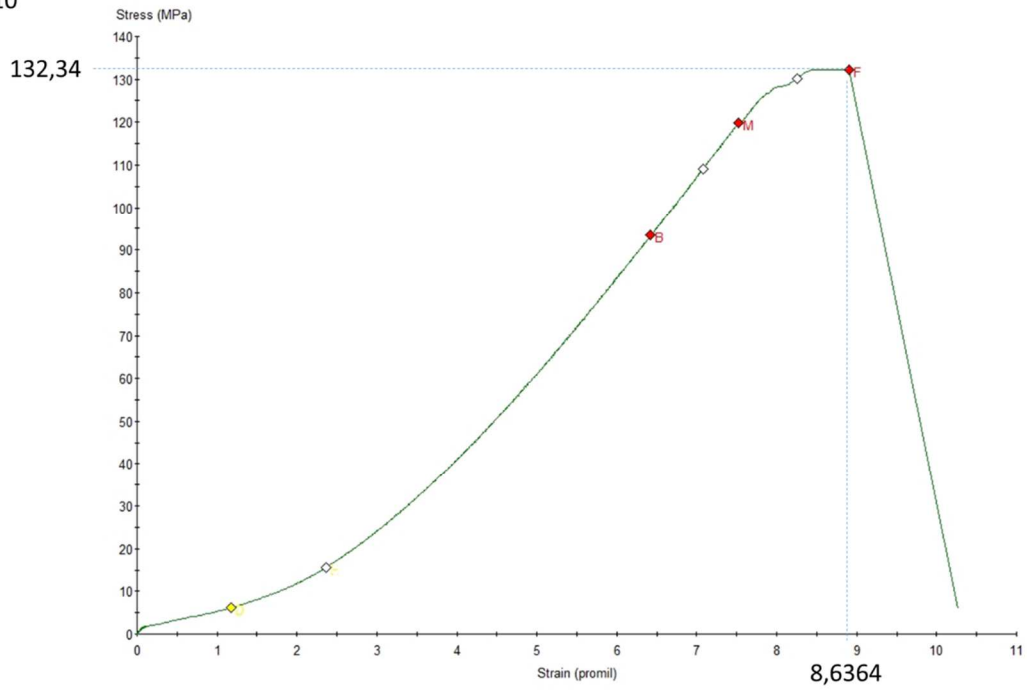


Sample\_10

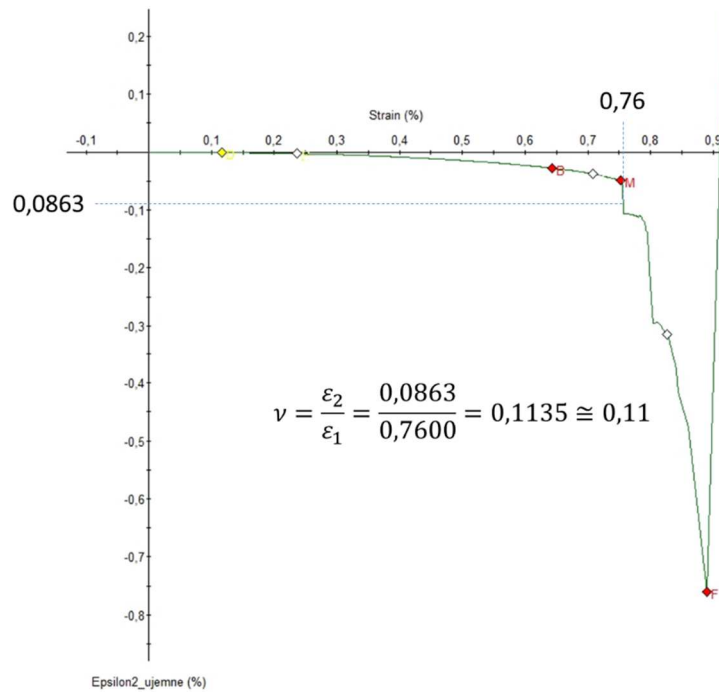




Sample\_10



Sample\_10



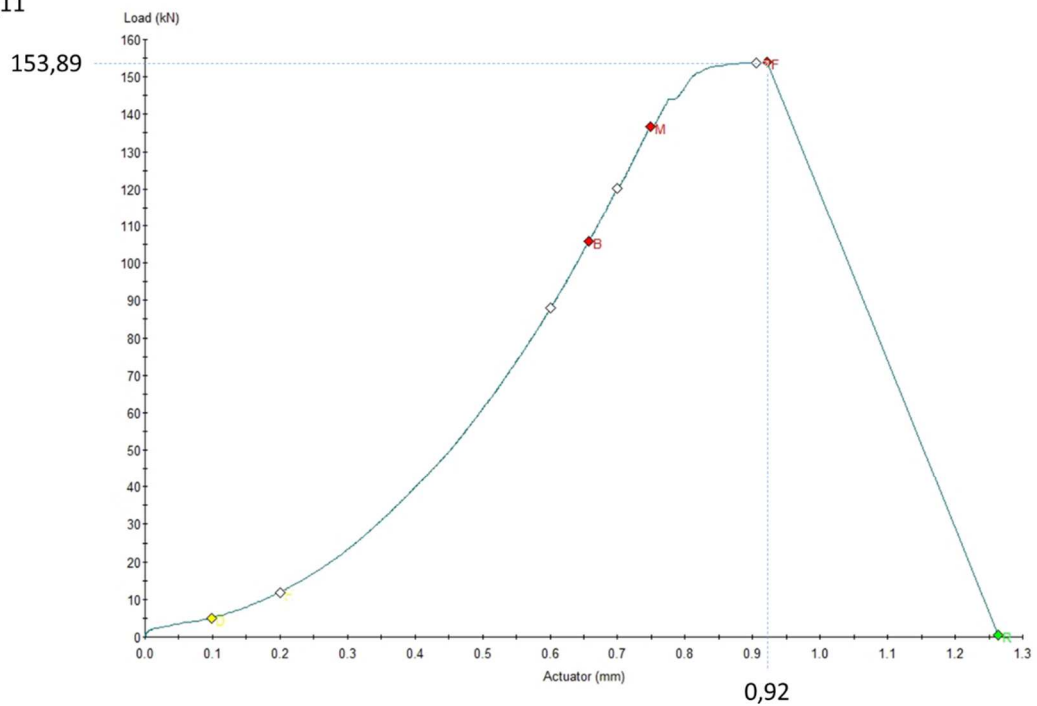


Grey-red leptite UCS 2A GRL

201-18 MUJ8821	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 2A GRL	38,54	83,00	153,89	131,98	11,01	10,80	0,12

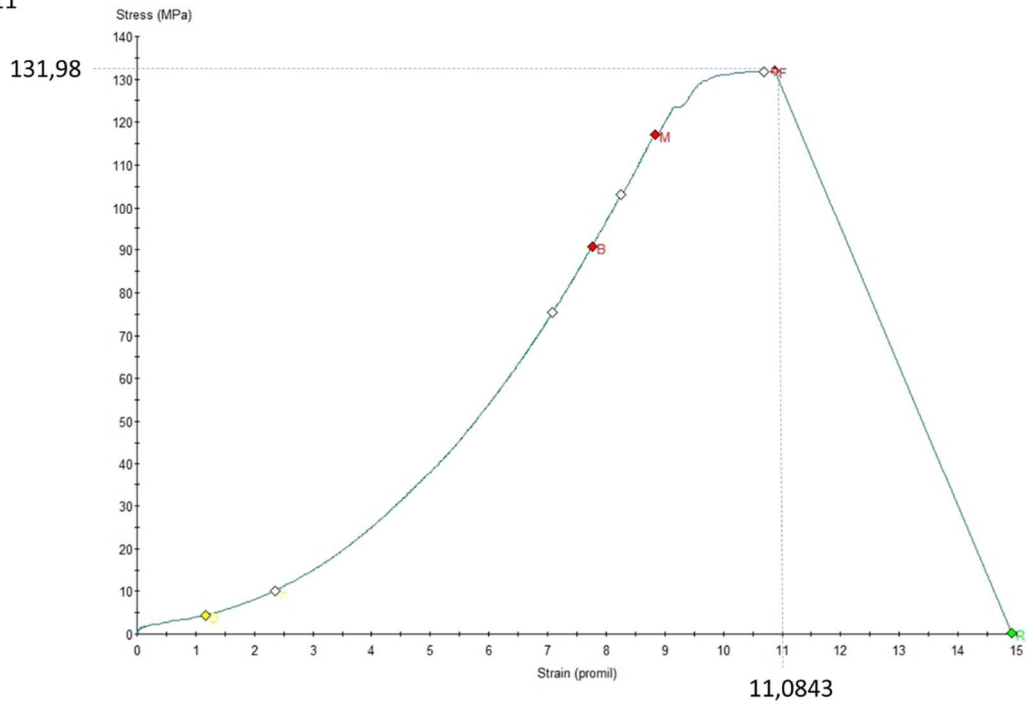


Sample\_11

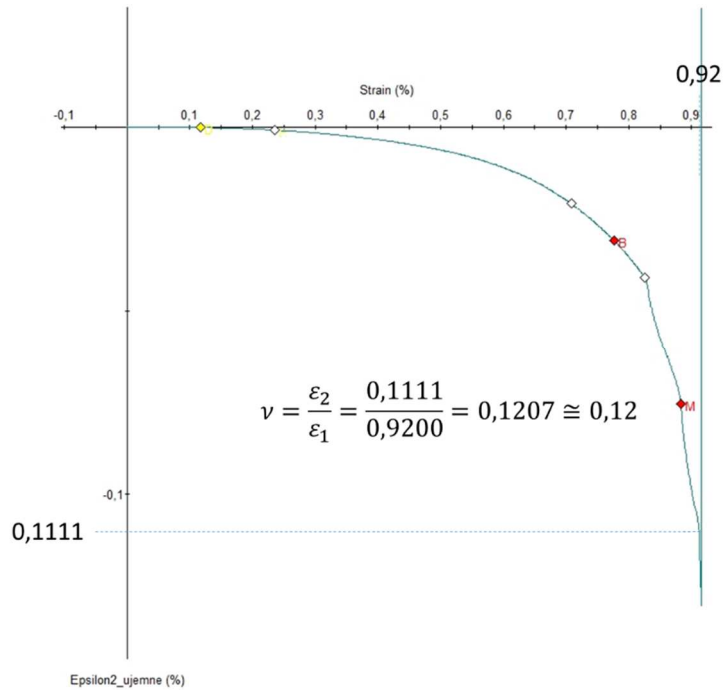




Sample\_11



Sample\_11



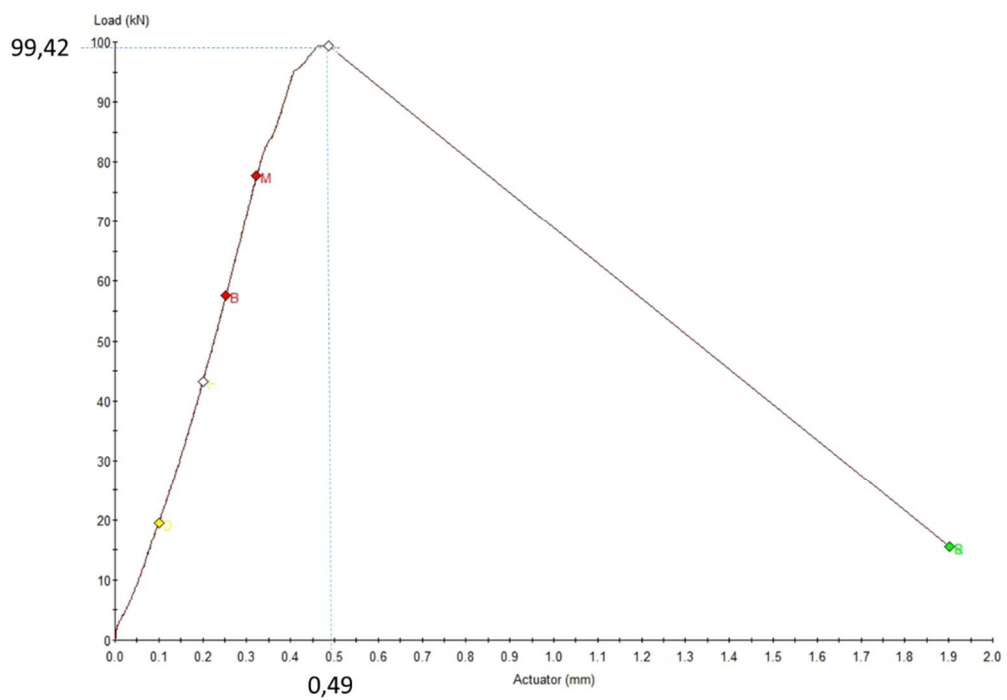


Biotite Schist UCS 3A BSF

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3A BSF	38,54	85,90	99,42	85,27	5,70	9,25	0,30

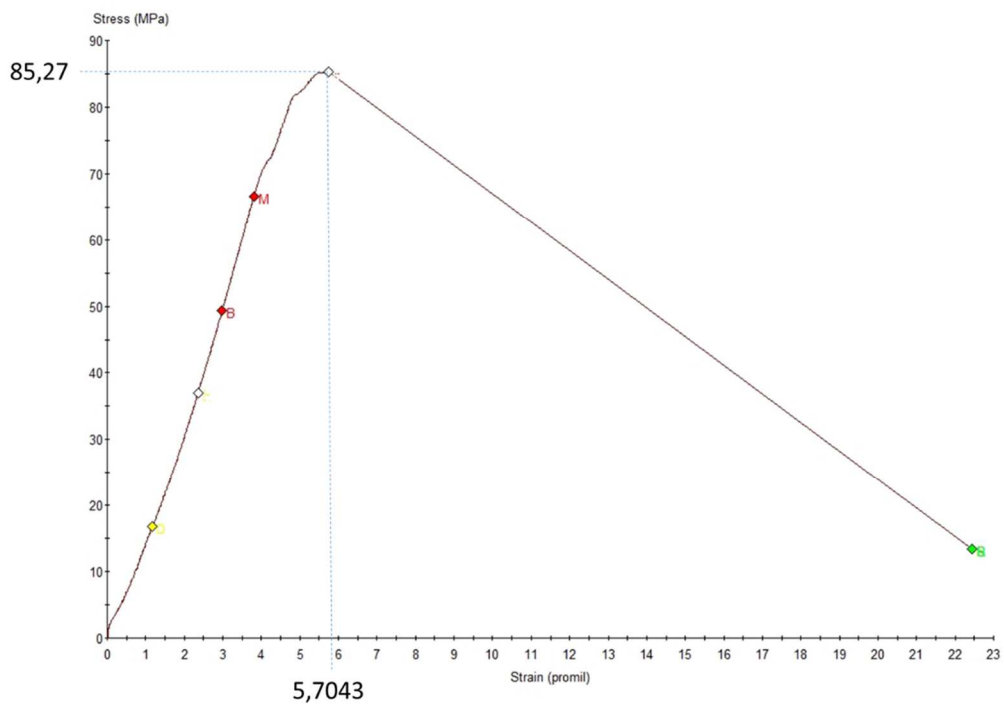


Sample\_12

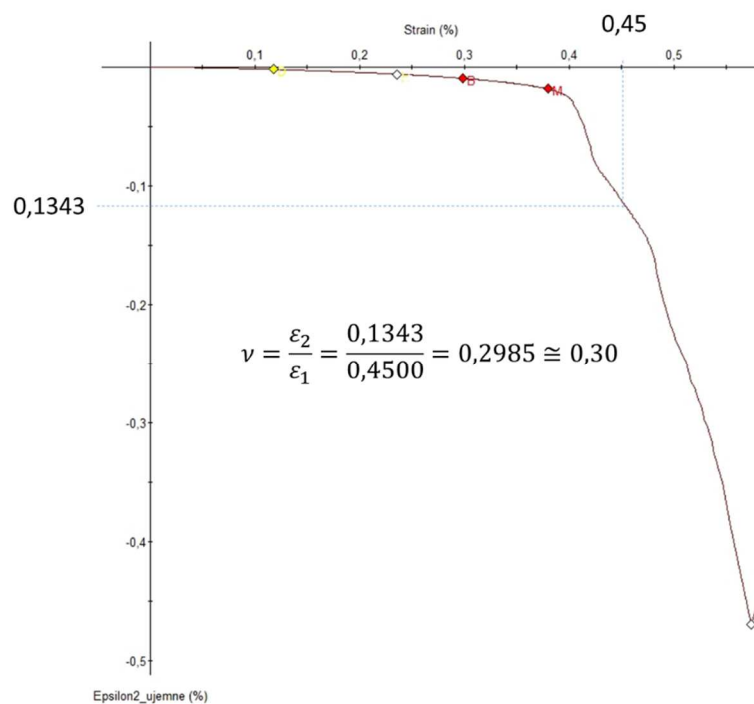




Sample\_12



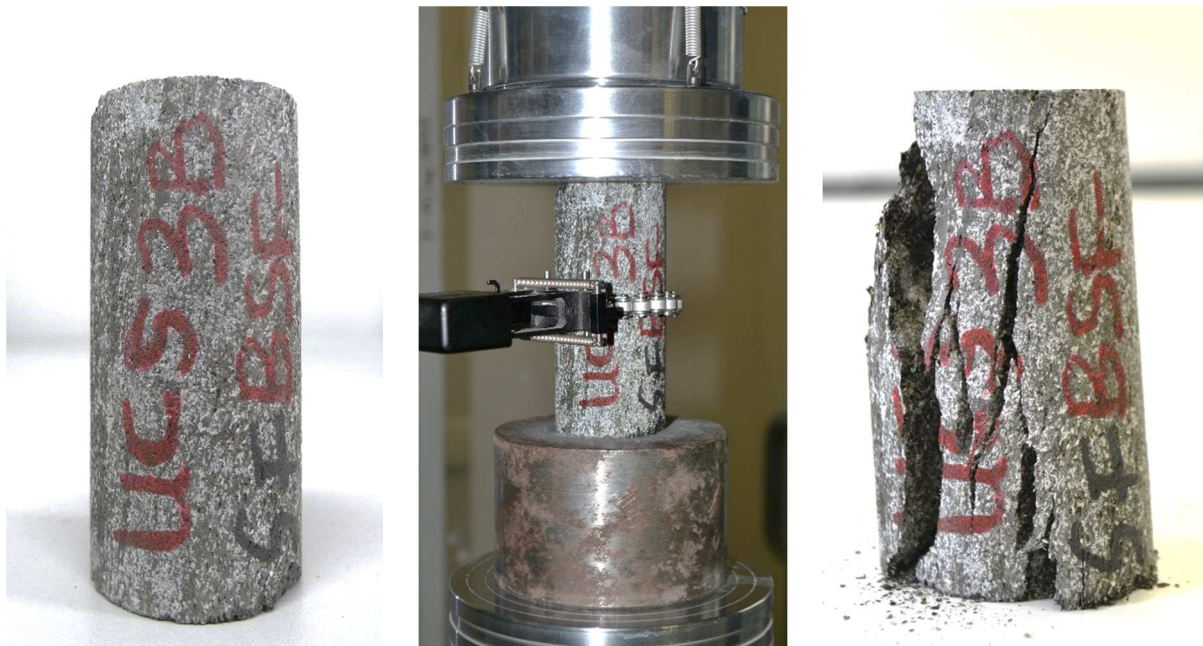
Sample\_12



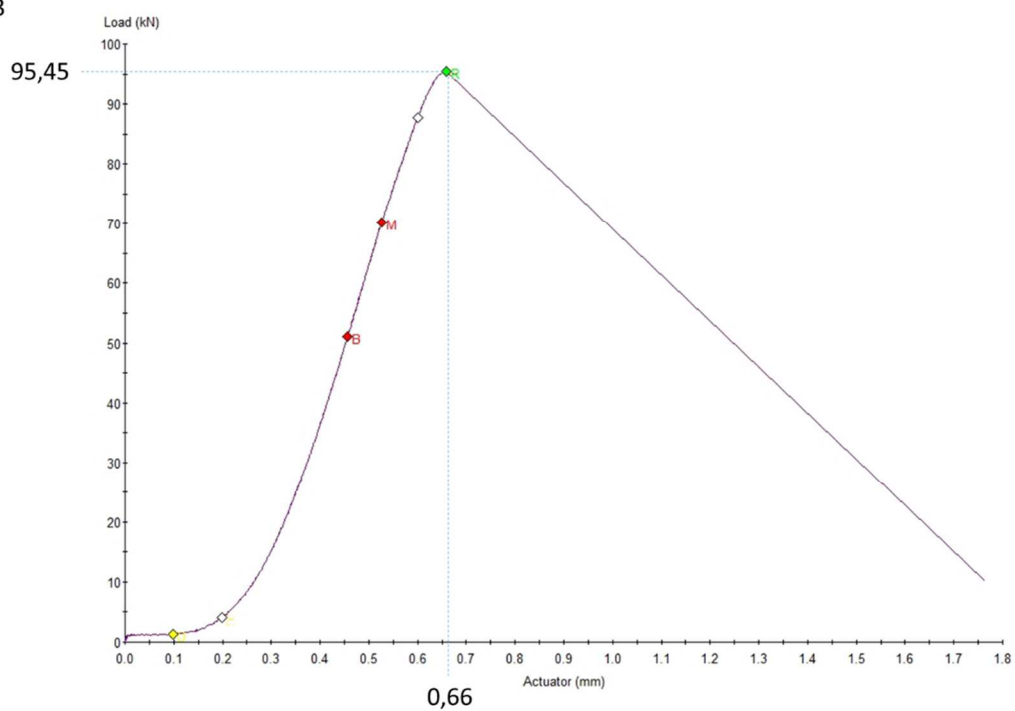


Biotite Schist UCS 3B BSF

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3B BSF	38,50	85,84	95,45	82,03	7,69	8,84	0,11



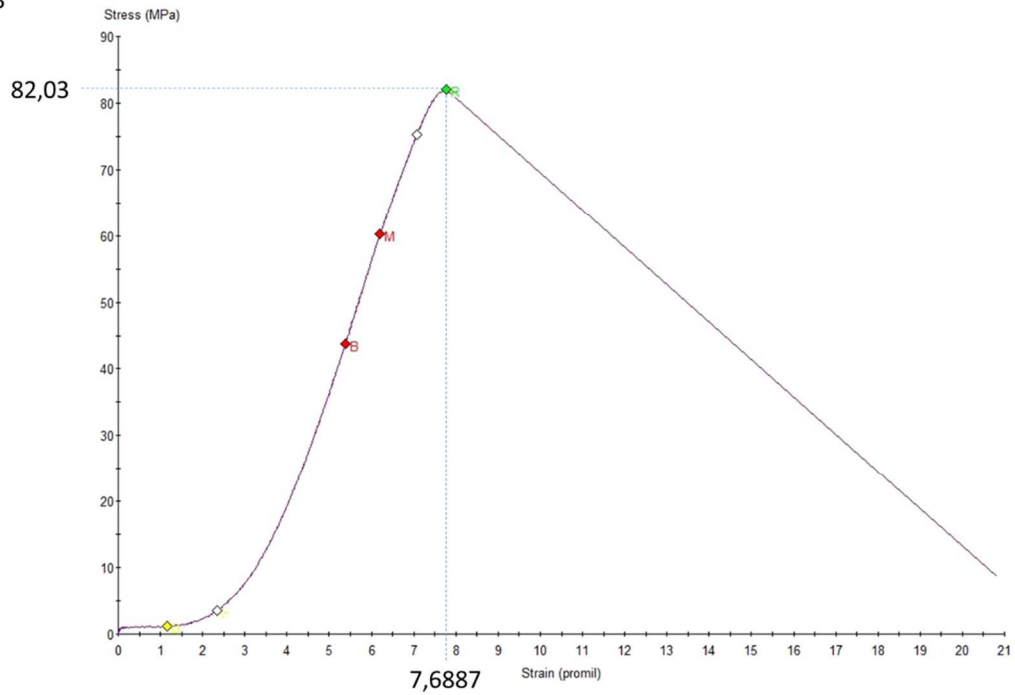
Sample\_13



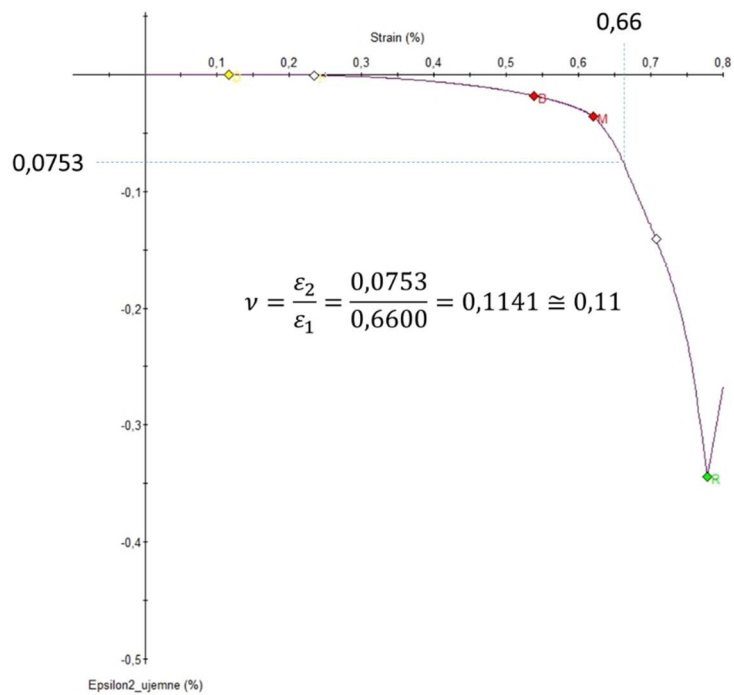




Sample\_13



Sample\_13



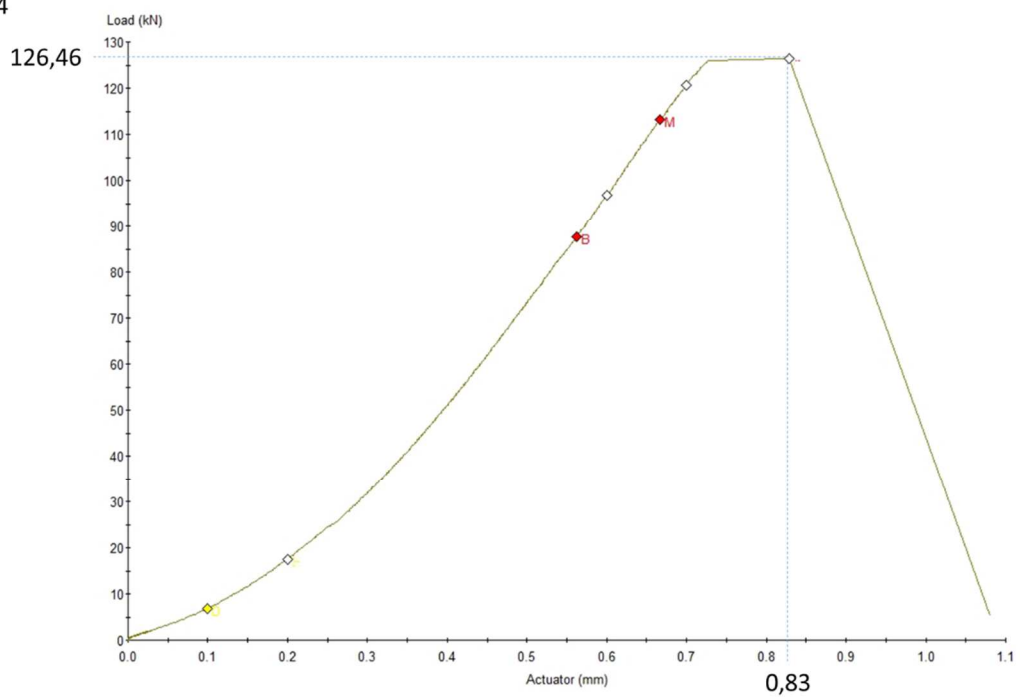


Pegmatite UCS 3A PEG

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3A PEG	38,64	97,14	126,46	107,90	8,54	7,87	0,04

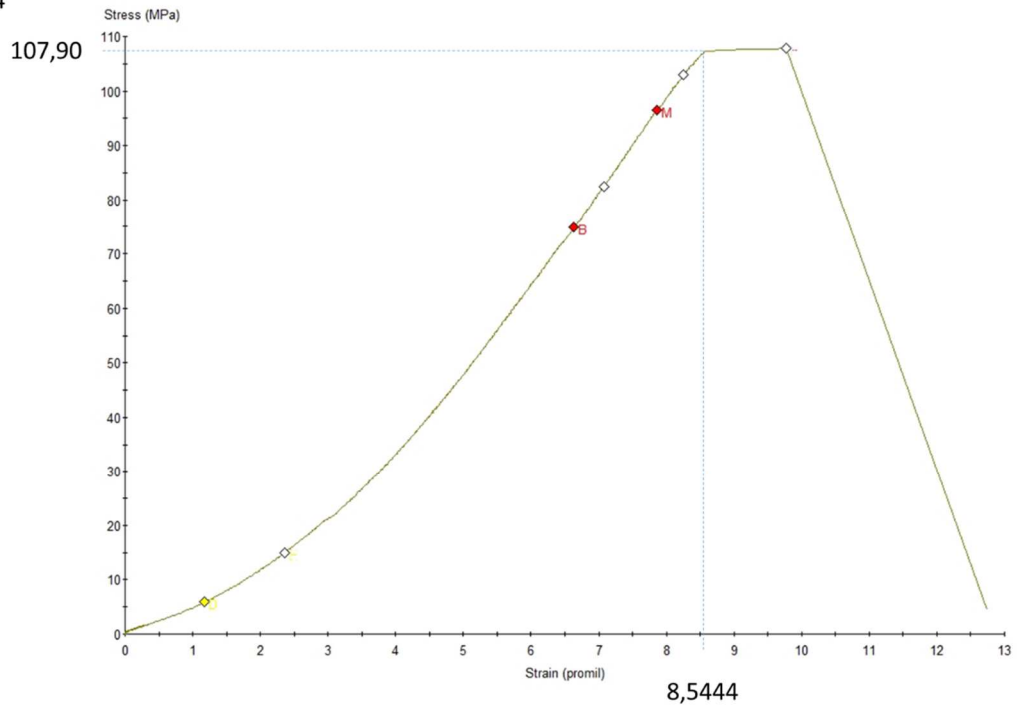


Sample\_14

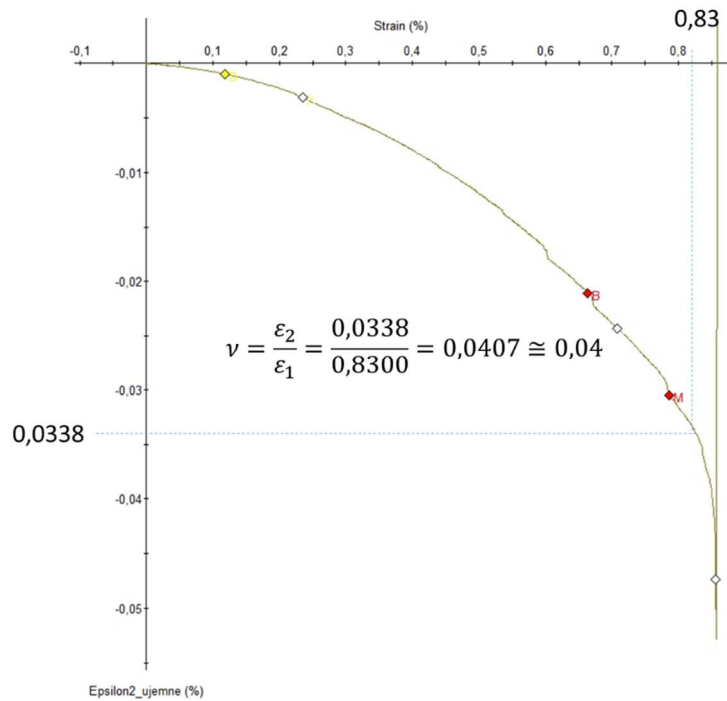




Sample\_14



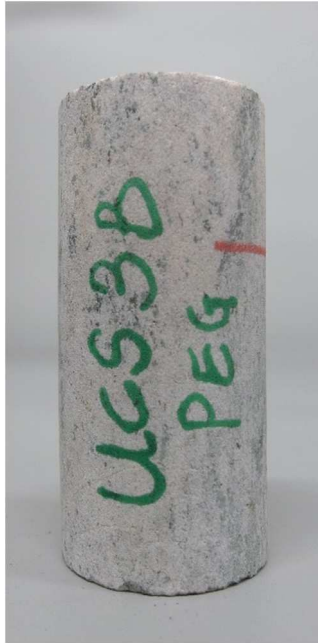
Sample\_14



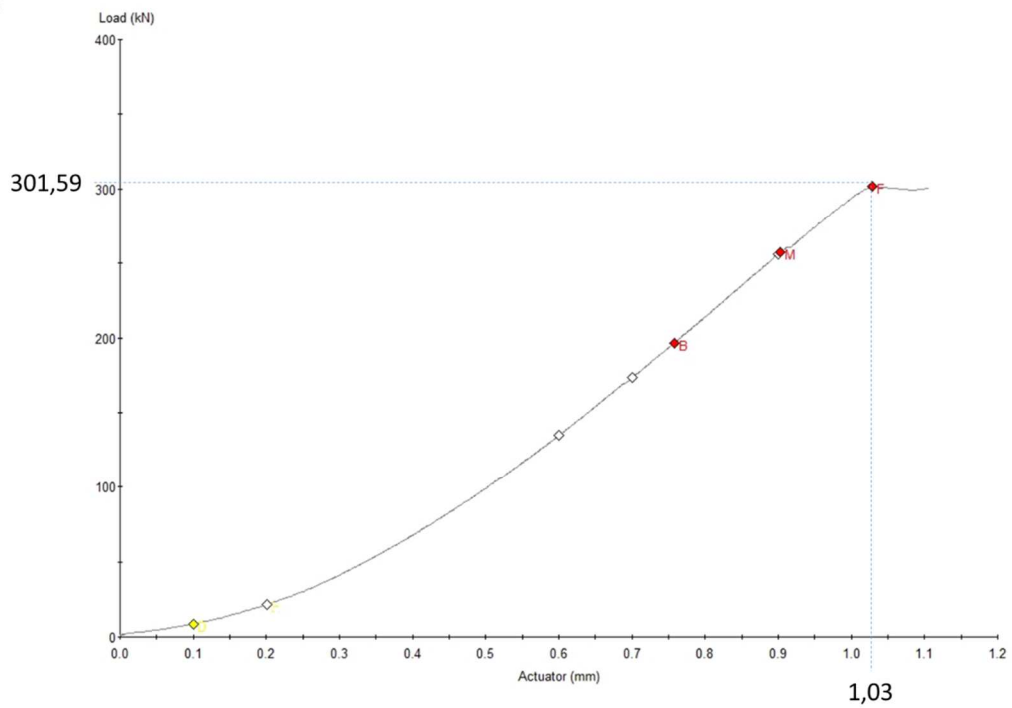


Pegmatite UCS 3B PEG

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3B PEG	38,64	83,54	301,59	257,32	12,32	13,40	0,1

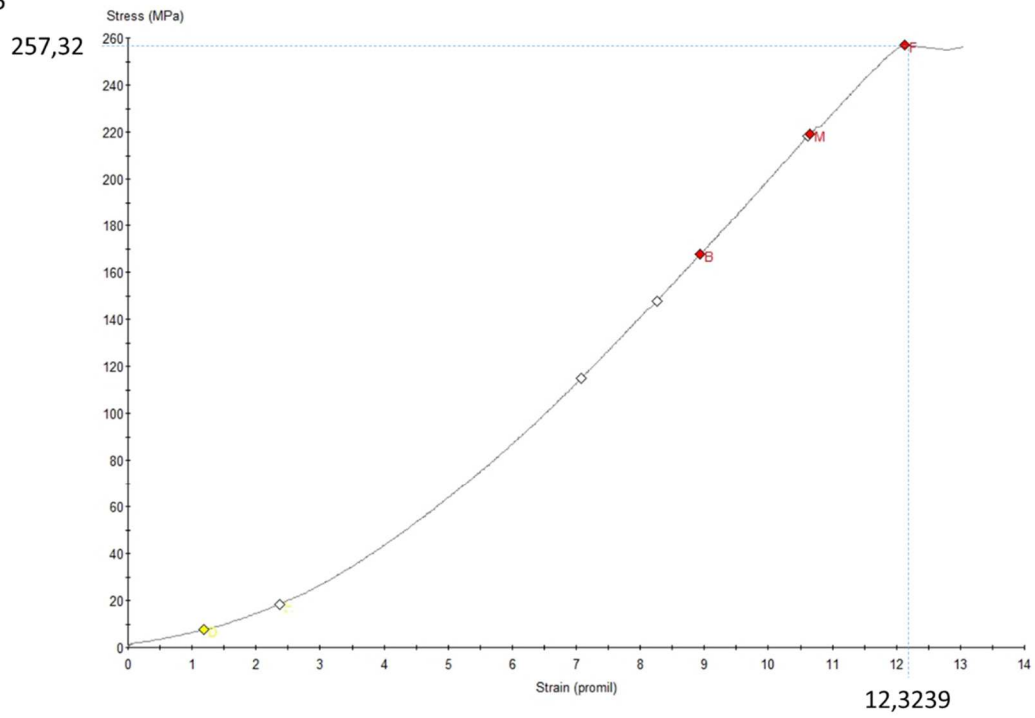


Sample\_15

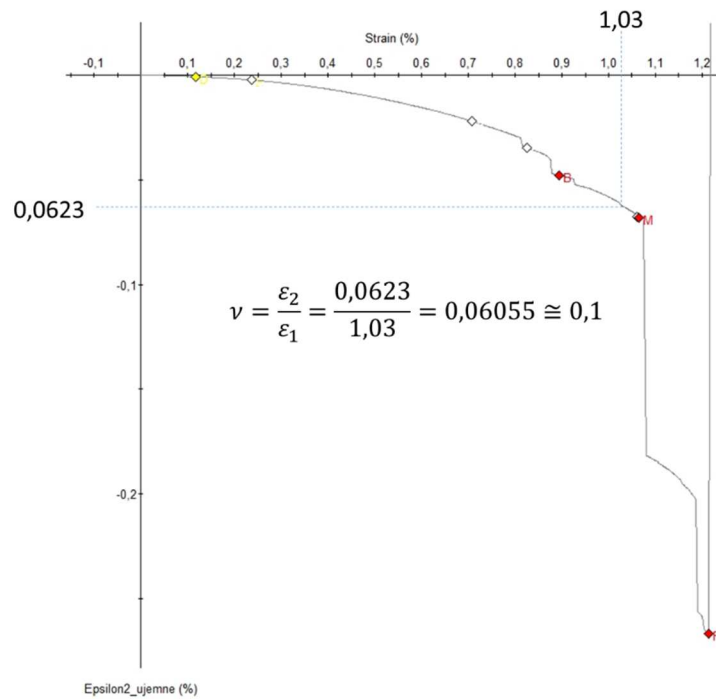




Sample\_15



Sample\_15



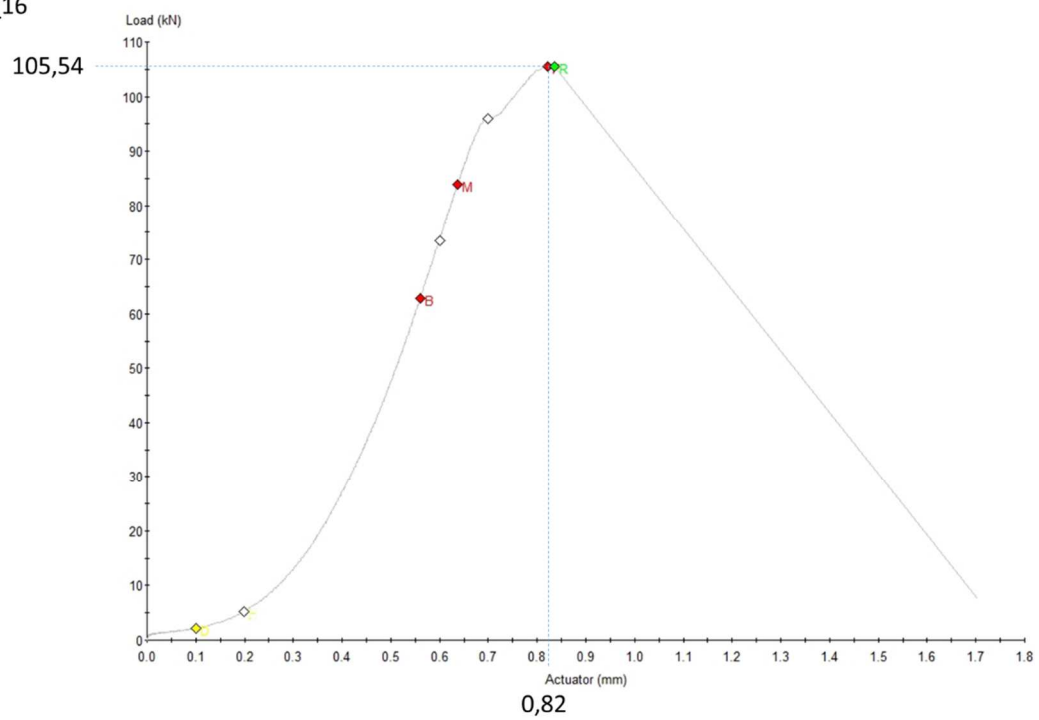


### Magnetite UCS 3A MGN

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3A MGN	38,54	86,72	105,54	90,52	9,46	8,79	0,23

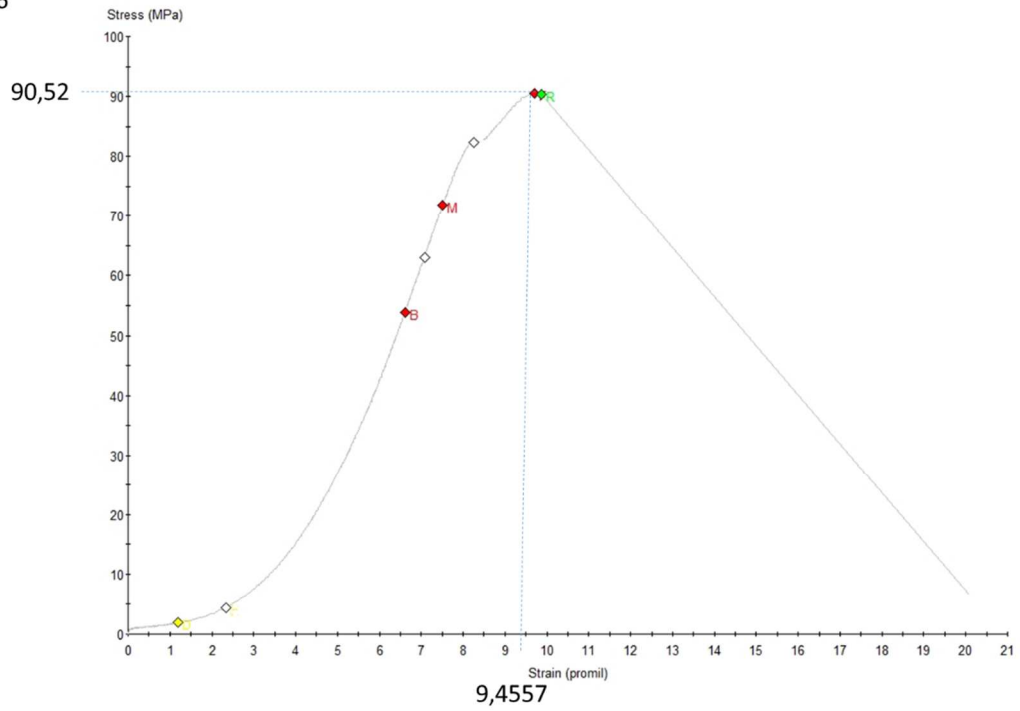


Sample\_16

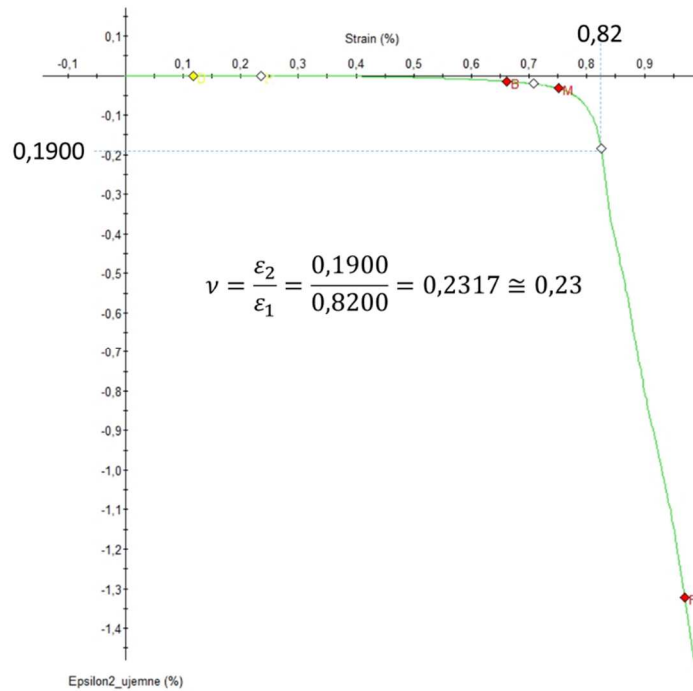




Sample\_16



Sample\_16



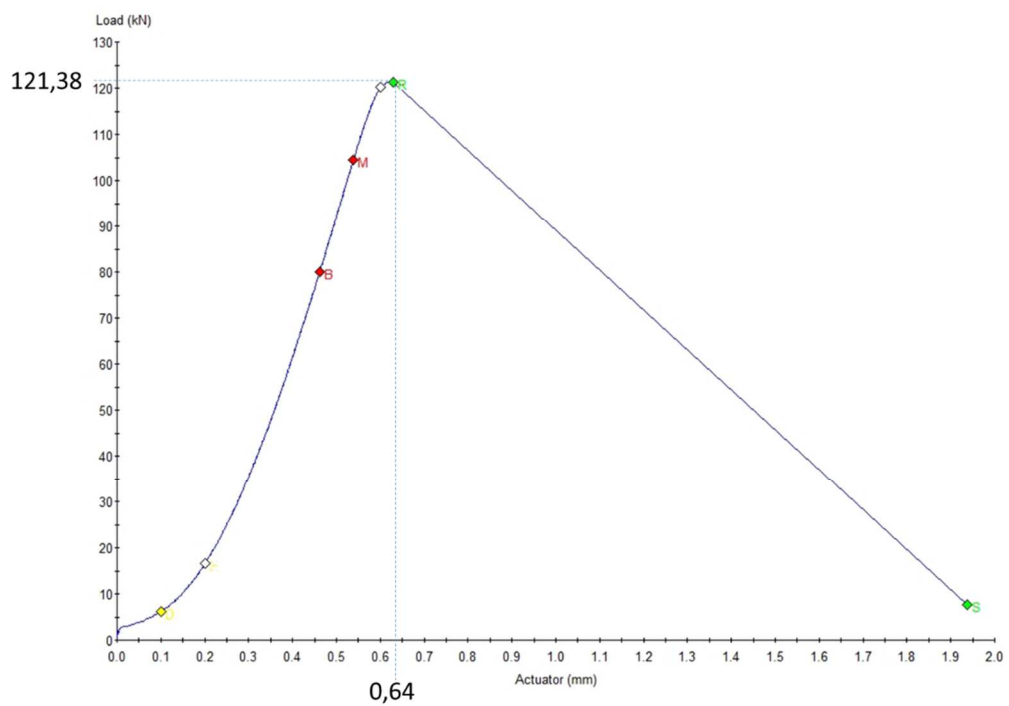


Magnetite UCS 3B MGN

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν, -
UCS 3B MGN	38,64	95,00	121,38	103,56	7,78	10,18	0,14



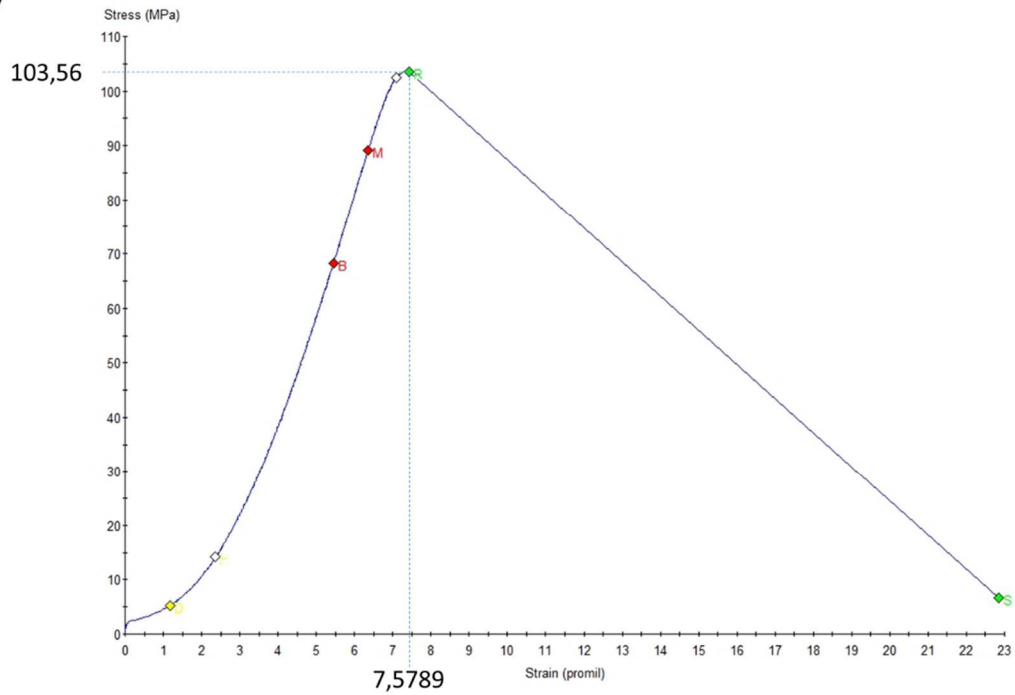
Sample\_17



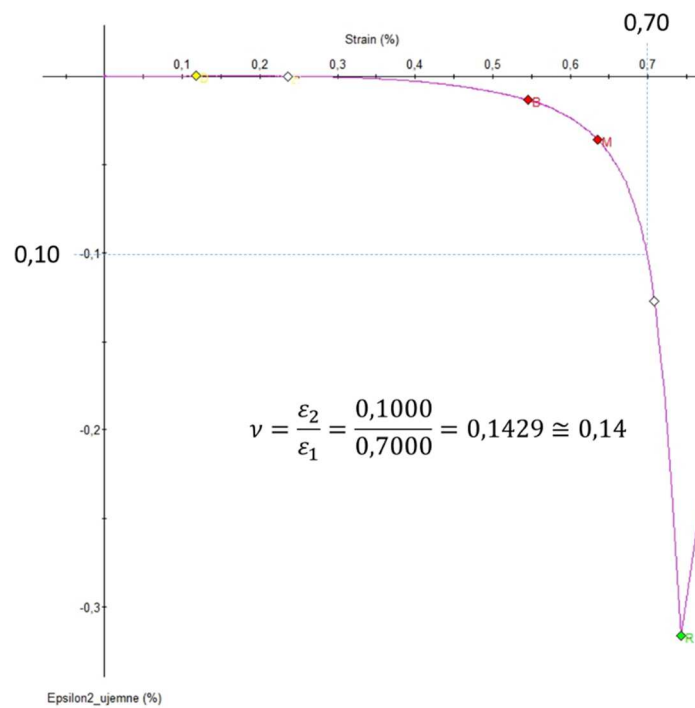




Sample\_17



Sample\_17



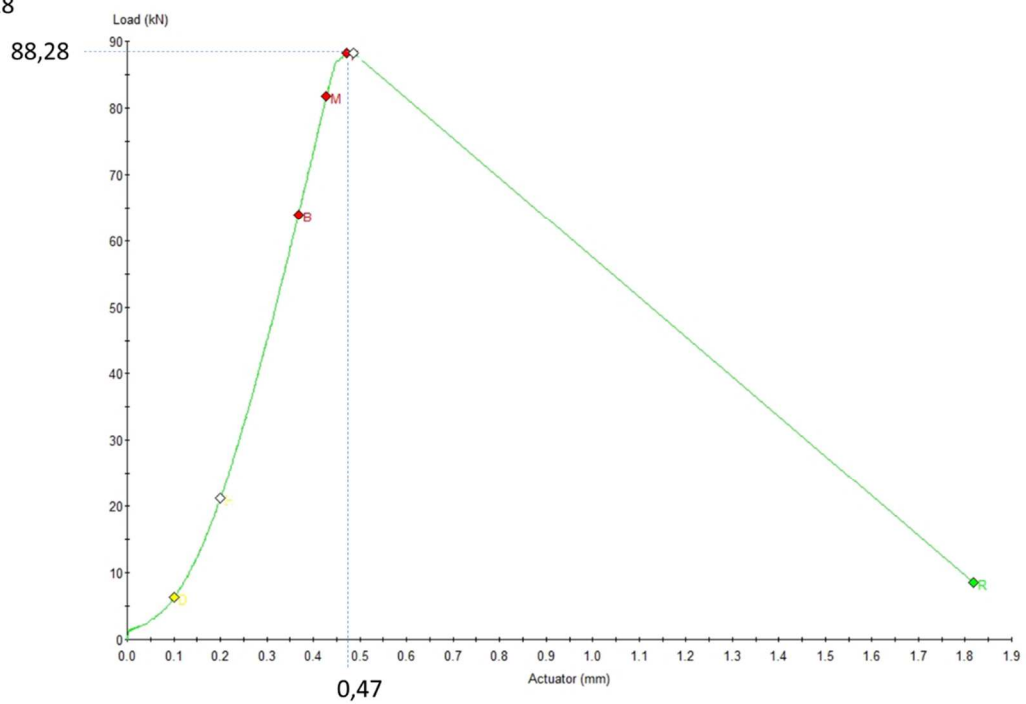


Red-grey leptite UCS 3A RGL

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3A RGL	38,50	87,80	88,28	75,87	5,35	9,48	0,04

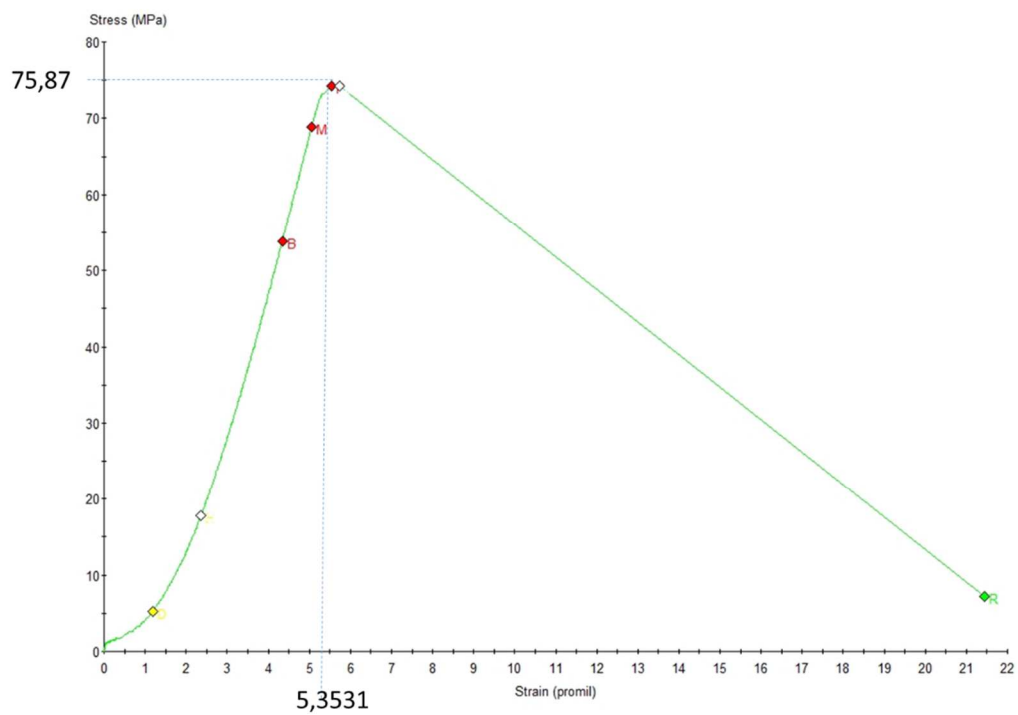


Sample\_18

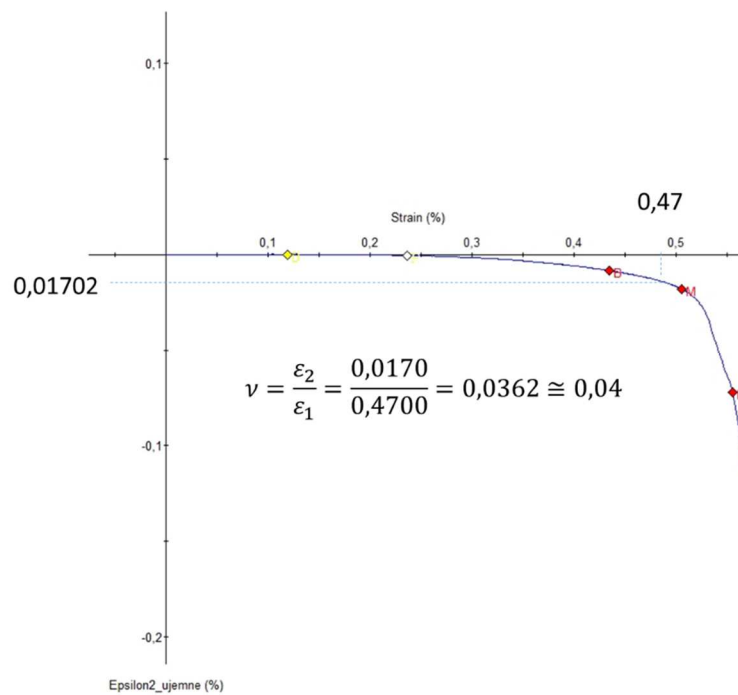




Sample\_18



Sample\_18



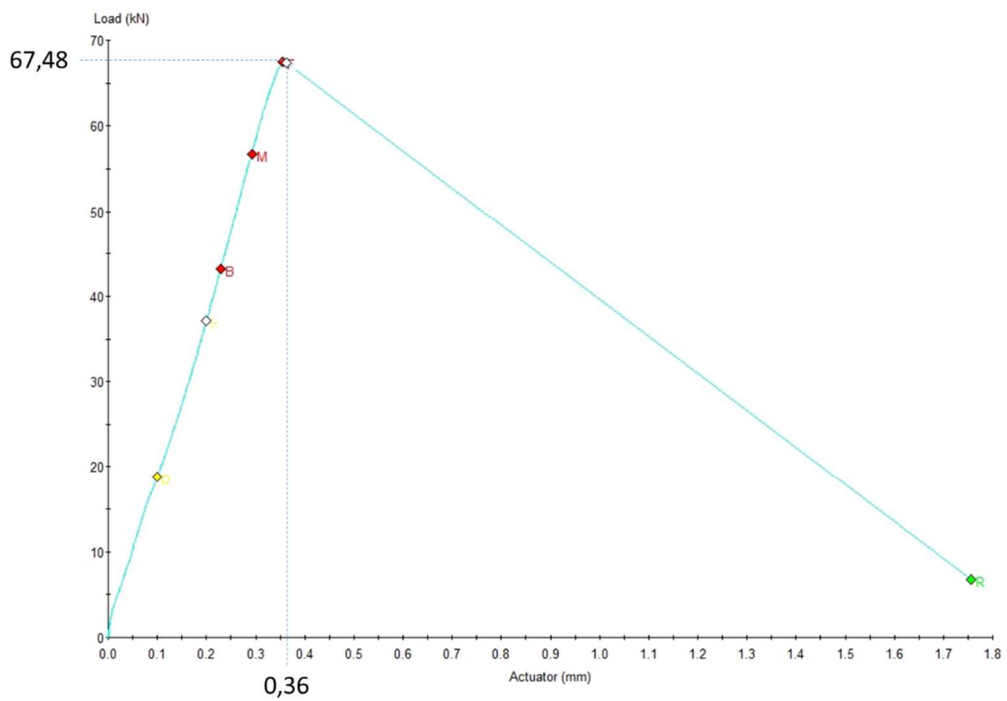


Red-gray leptite UCS 3B RGL

201-18 MUJ8822	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 3B RGL	38,60	85,88	67,48	57,69	4,19	6,94	0,16

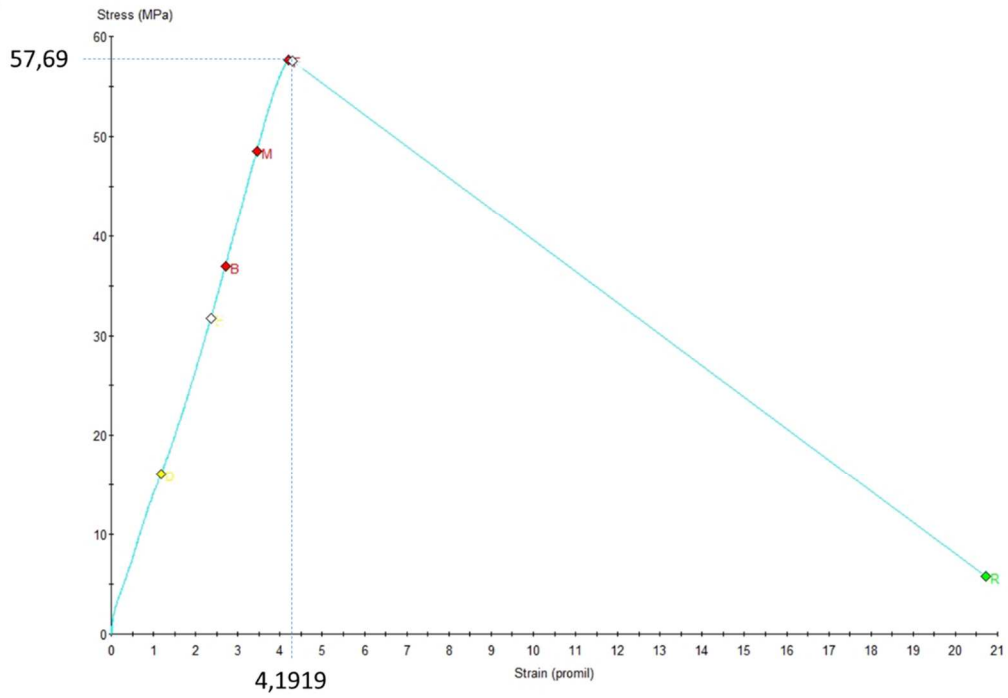


Sample\_19

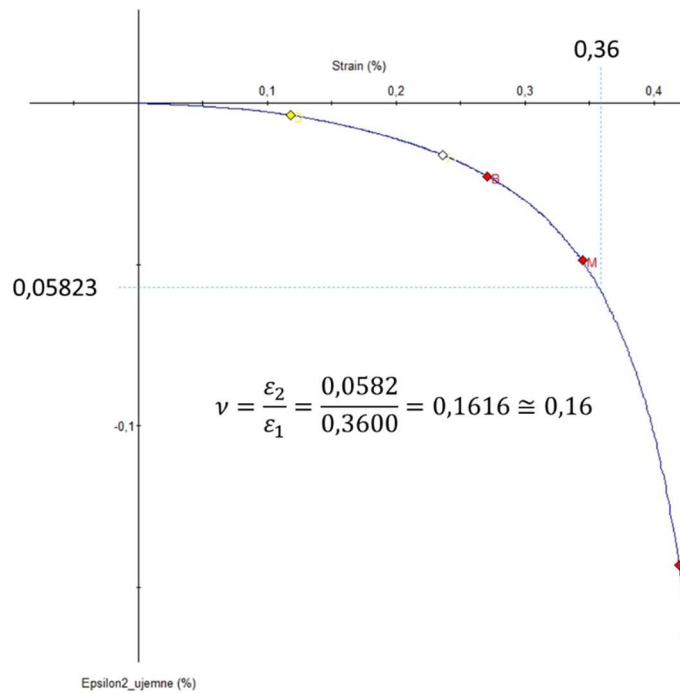




Sample\_19



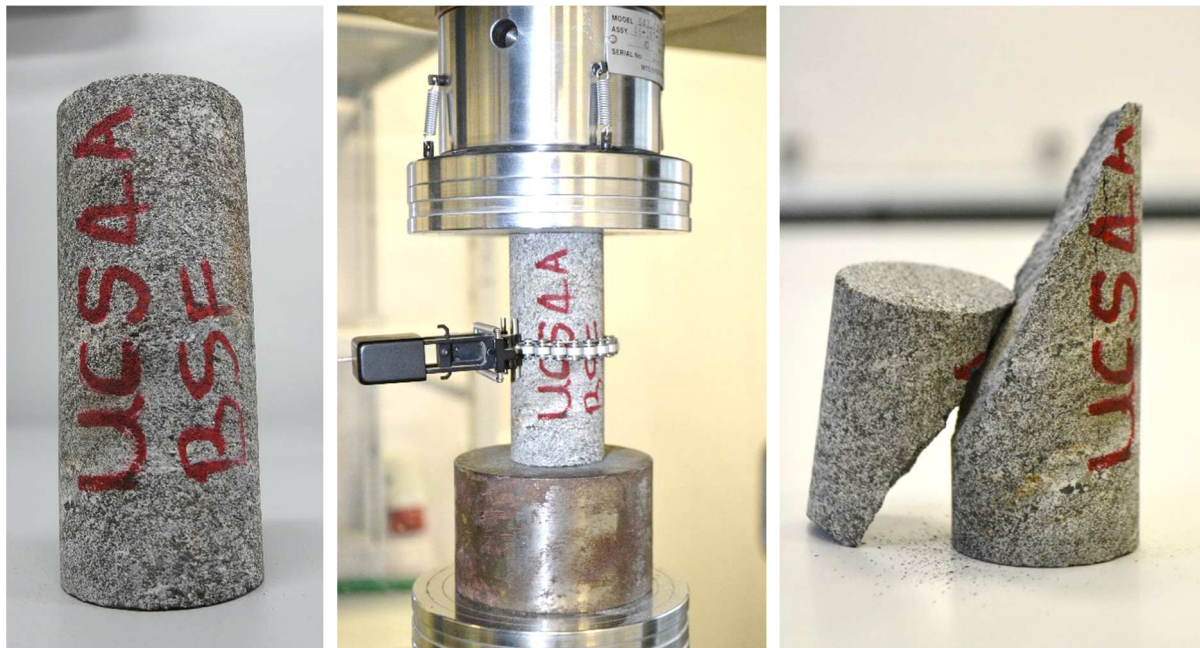
Sample\_19



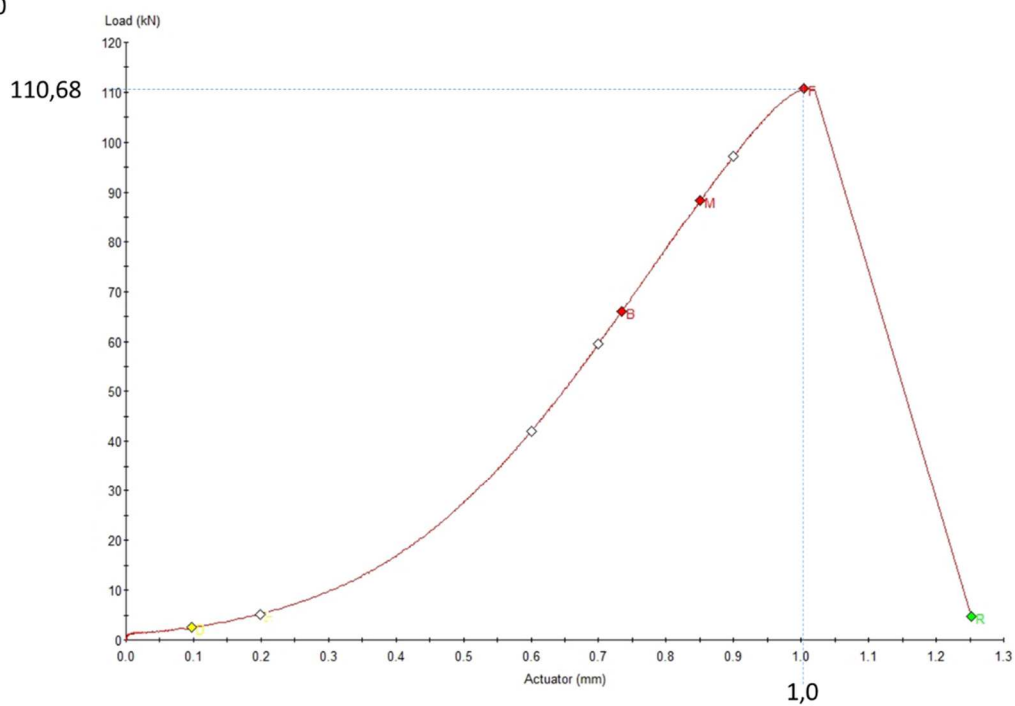


Biotite Schist UCS 4A BSF

164-18 MUJ8795	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰		v, -
UCS 4A BSF	38,54	92,20	110,68	94,92	10,85	6,13	0,07

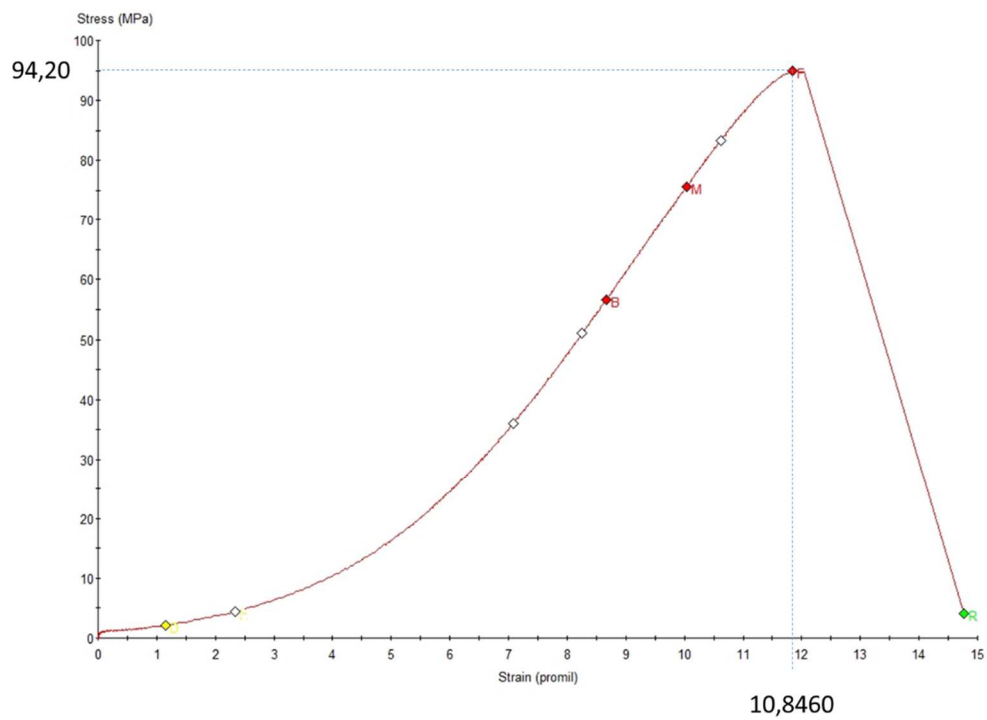


Sample\_20

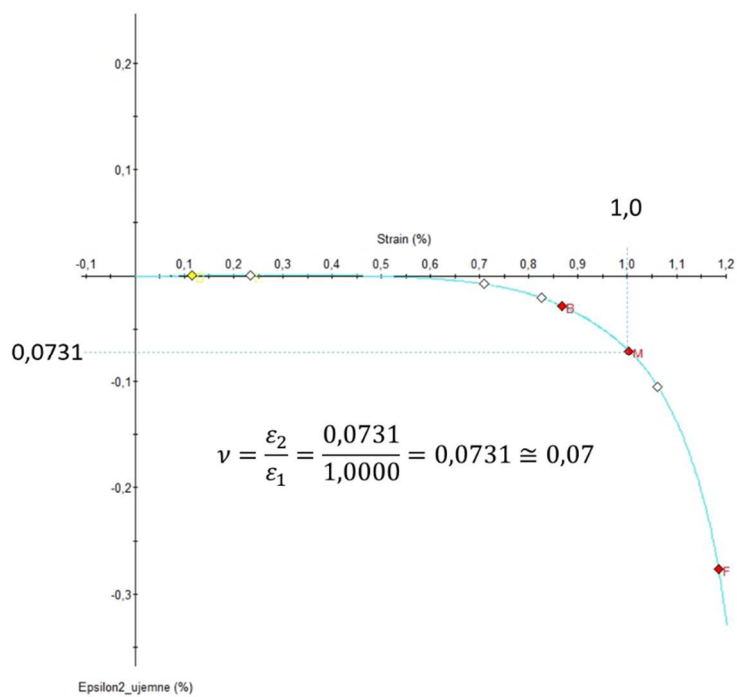




Sample\_20



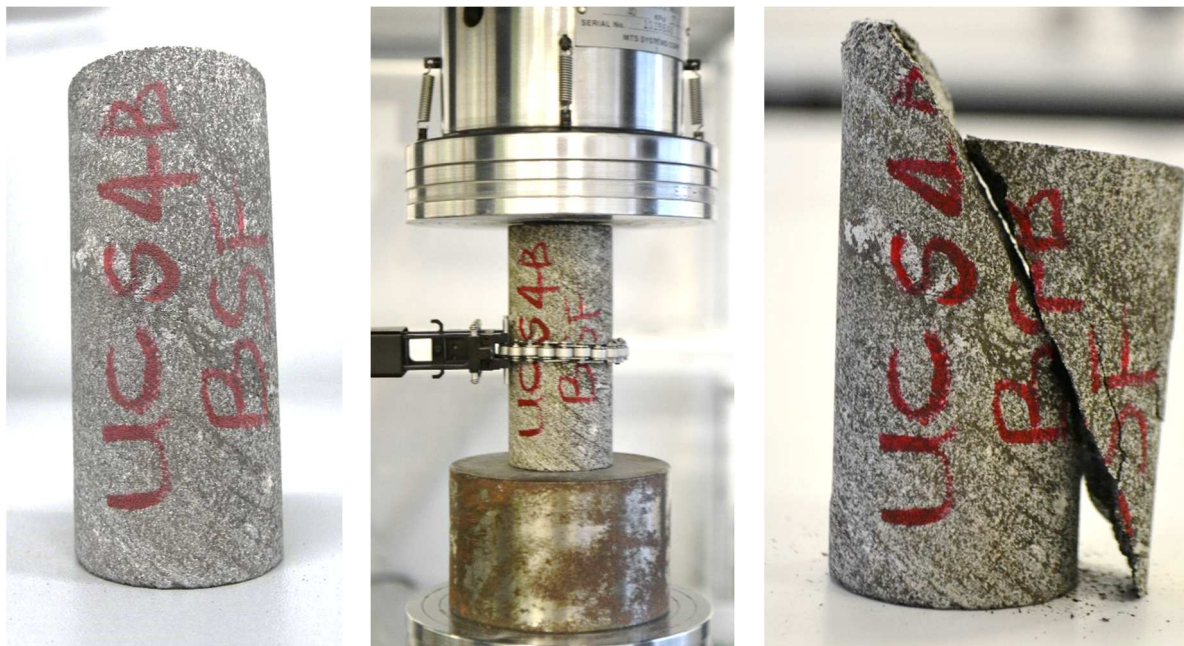
Sample\_20



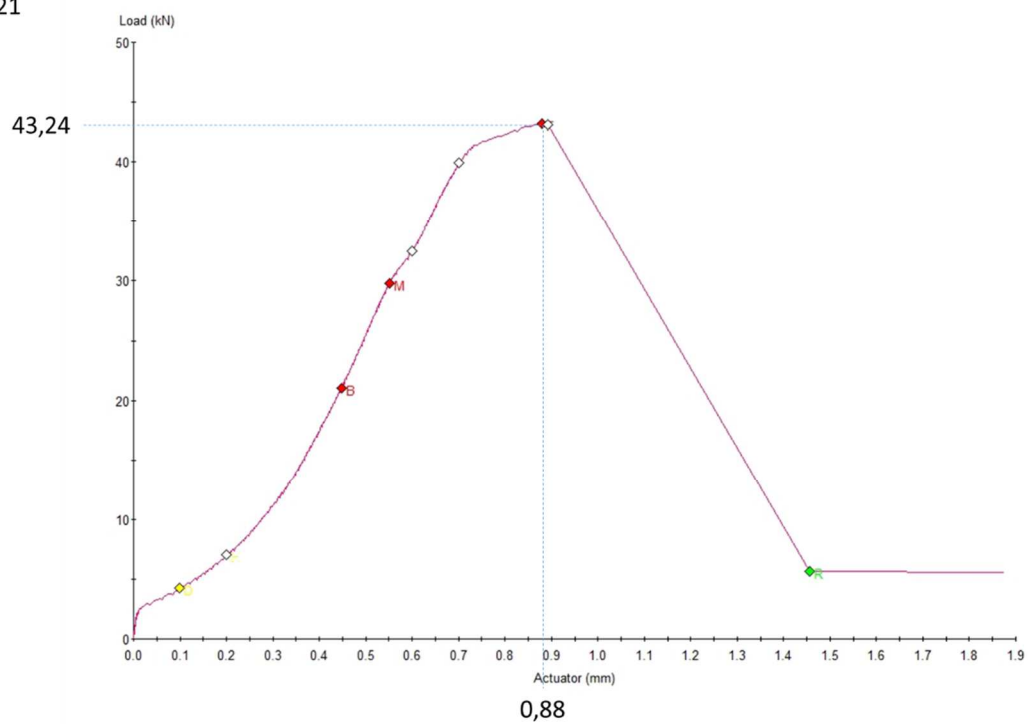


Biotite Schist UCS 4B BSF

164-18 MUJ8795	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 4B BSF	38,50	88,88	43,24	37,16	9,90	2,76	0,40



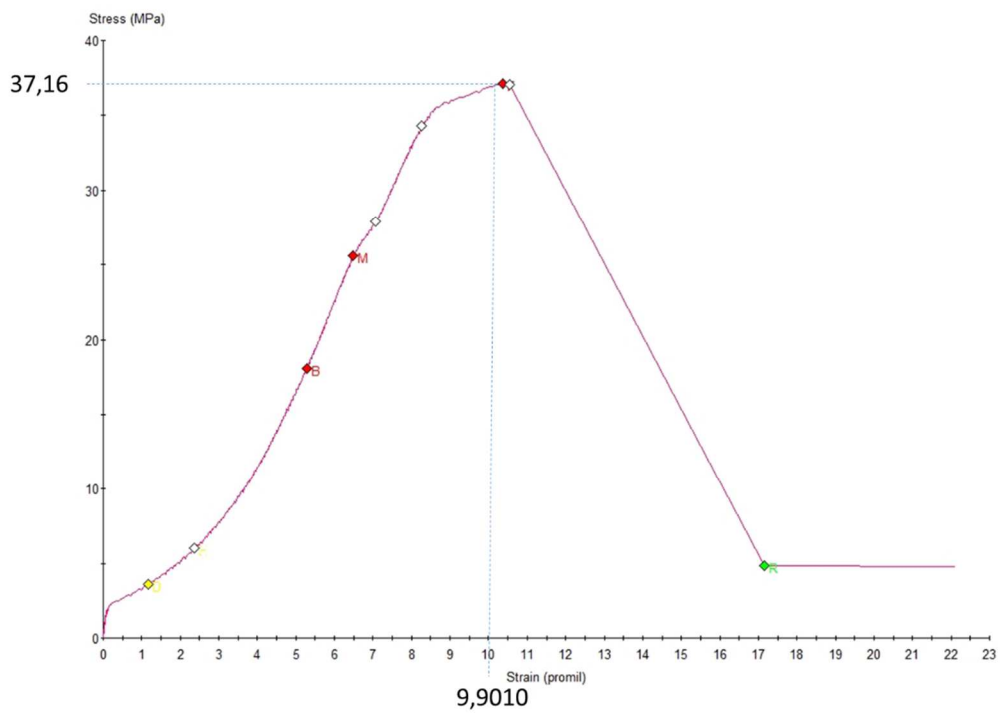
Sample\_21



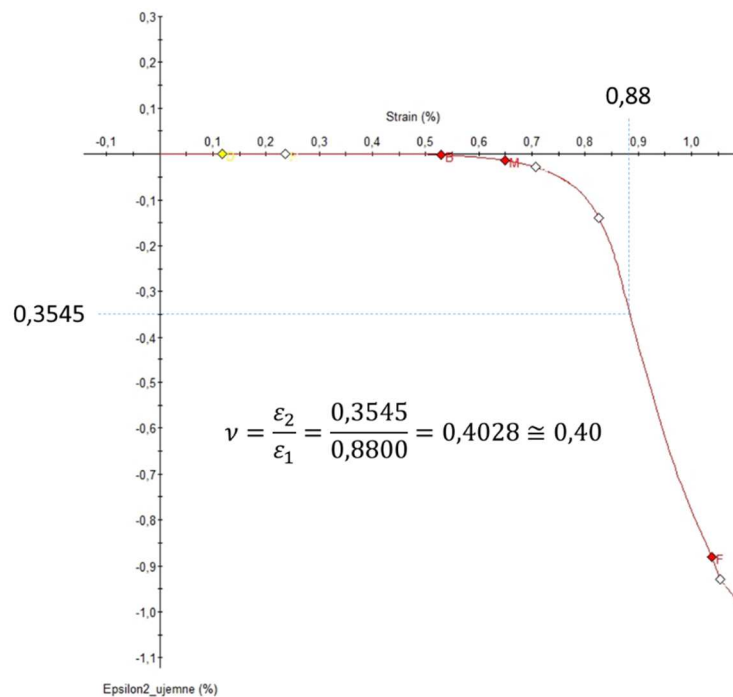




Sample\_21



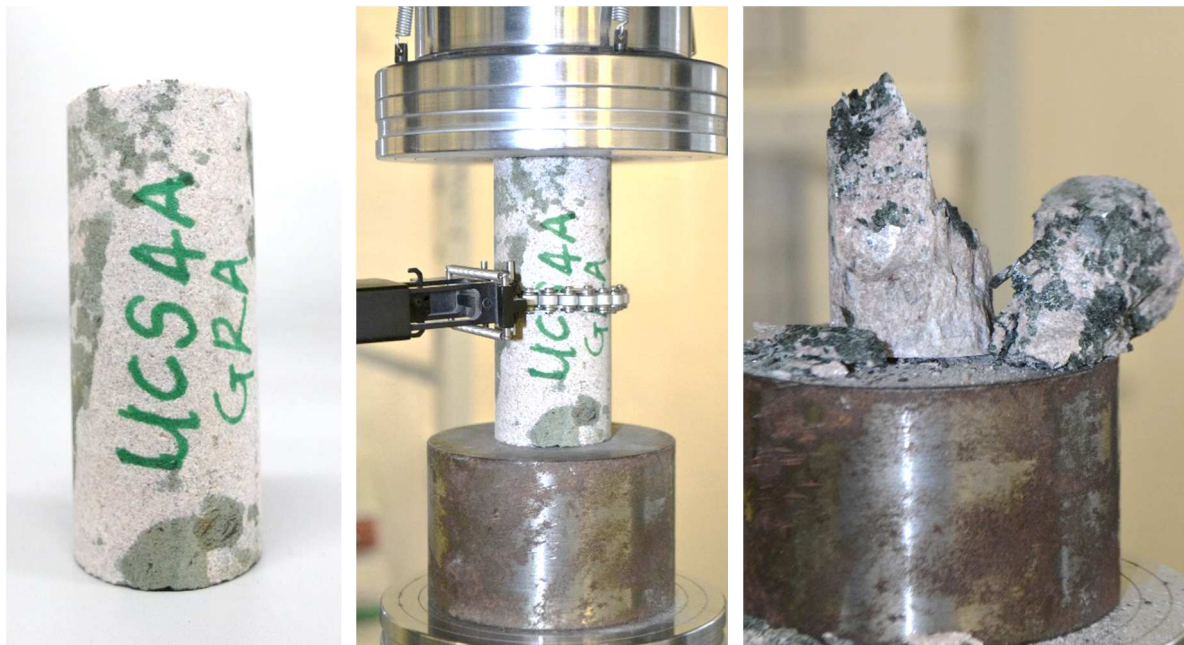
Sample\_21



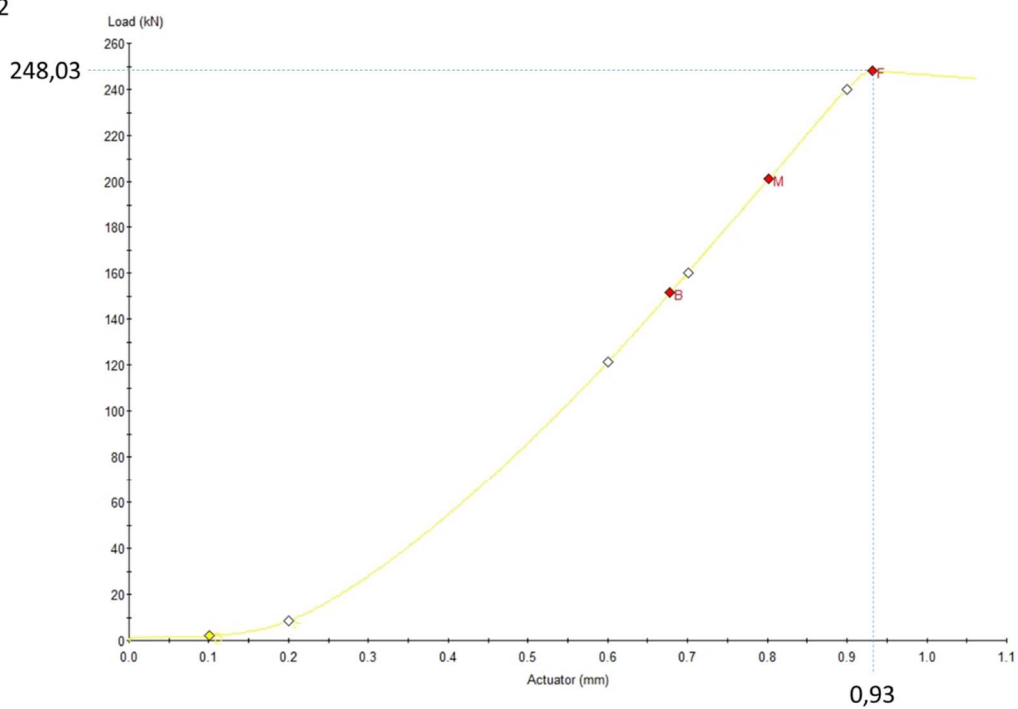


Granite UCS 4A GRA

164-18 MUJ8795	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 4A GRA	38,44	91,94	248,03	213,83	10,11	12,95	0,04

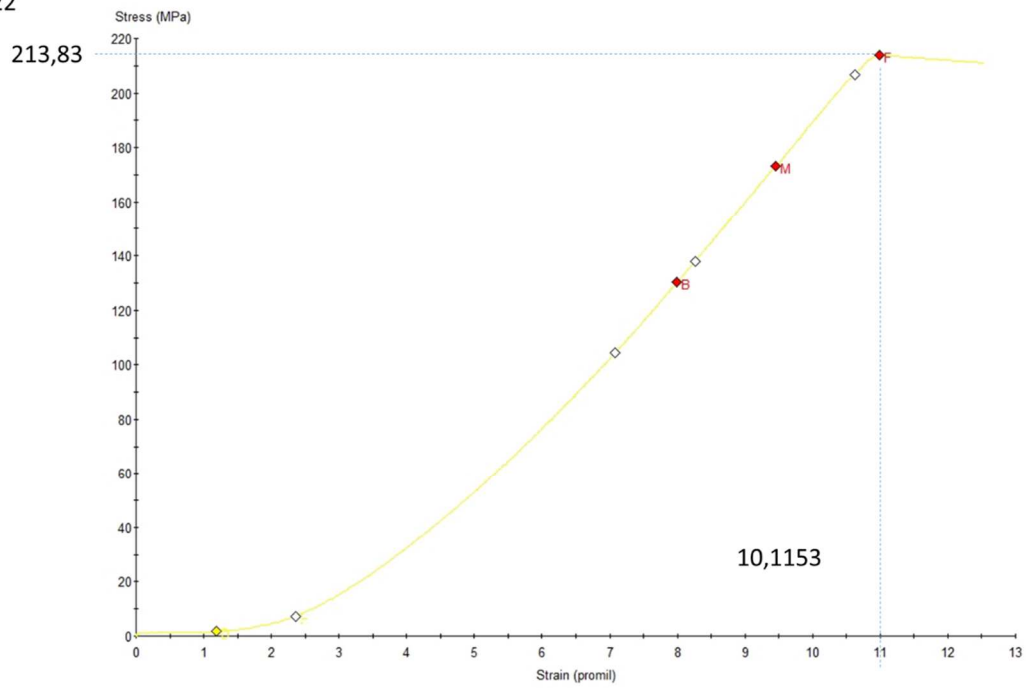


Sample\_22

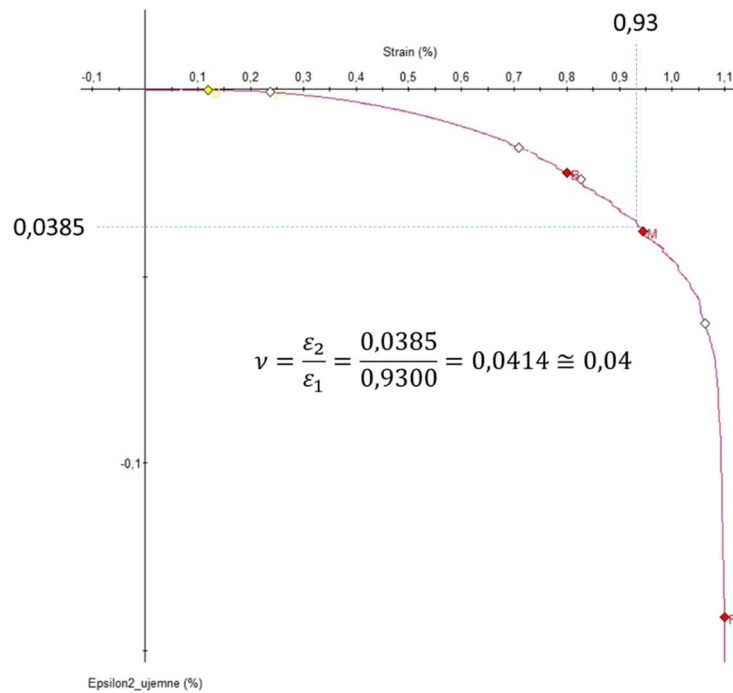




Sample\_22



Sample\_22



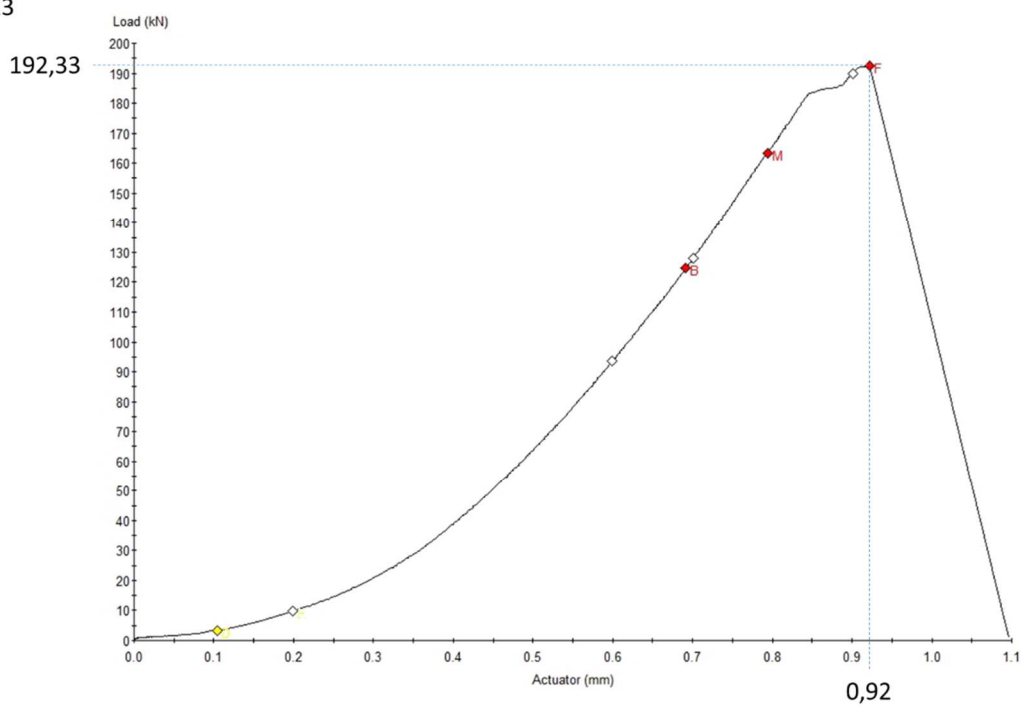


Granite UCS 4B GRA

164-18 MUJ8795	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 4B GRA	38,44	92,40	192,33	165,81	9,96	12,23	0,06

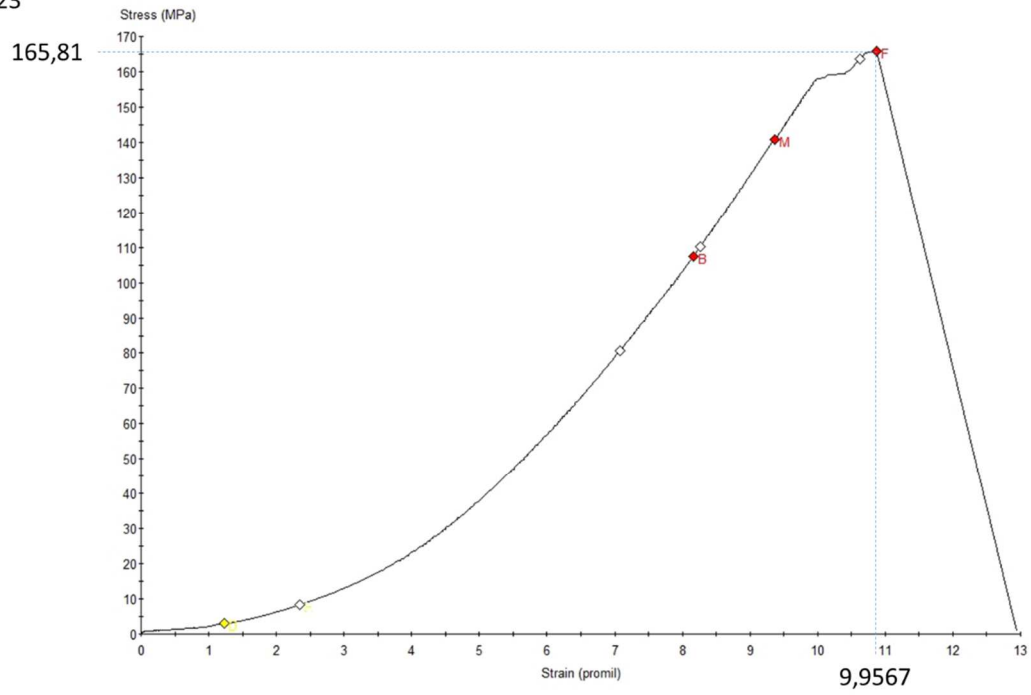


Sample\_23

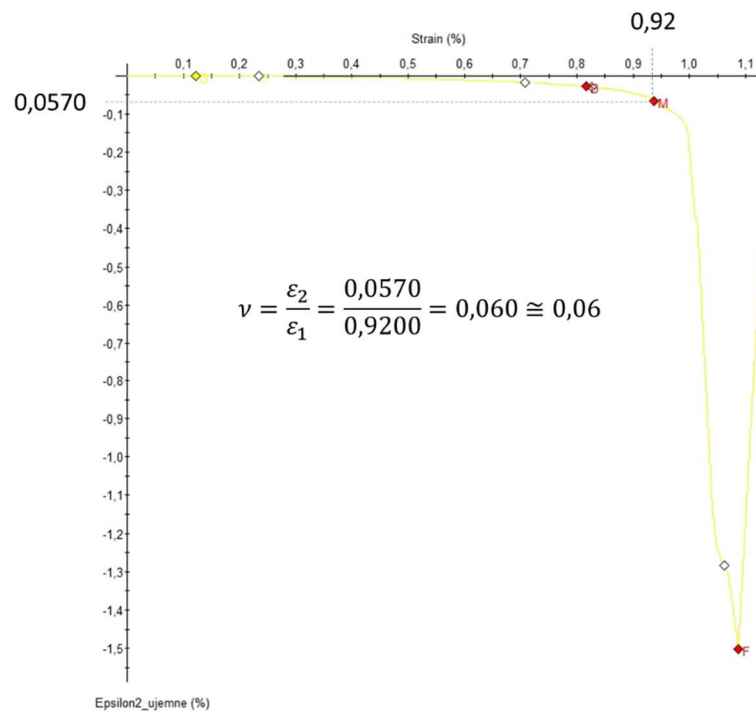




Sample\_23



Sample\_23



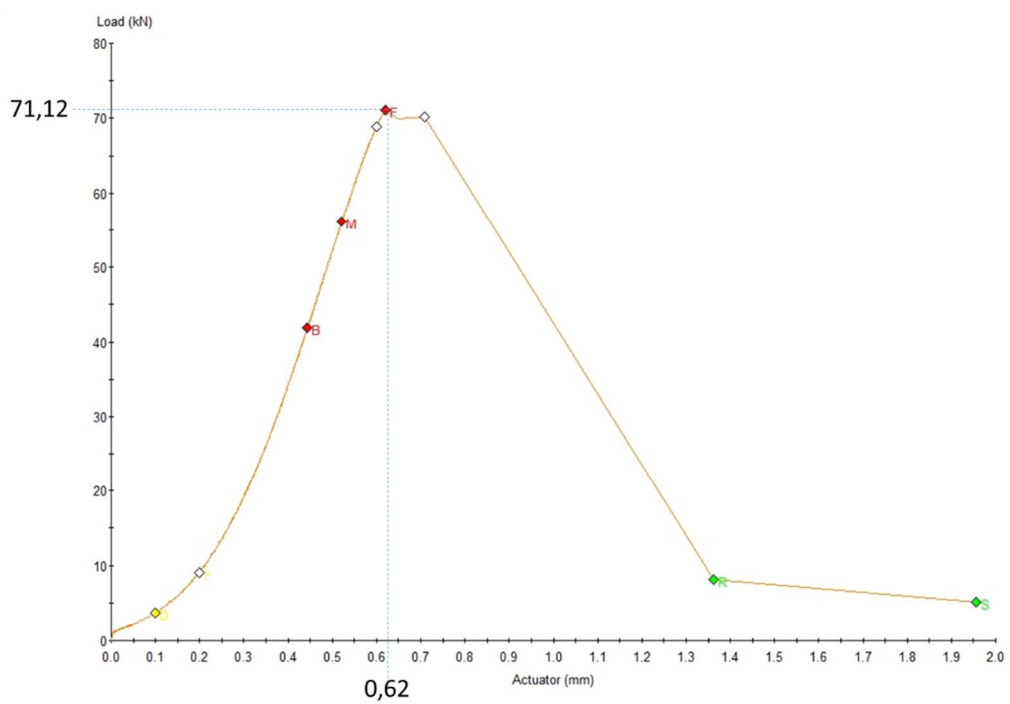


### Magnetite UCS 4A MGN

164-18 MUJ8795	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν,-
UCS 4A MGN	38,50	75,68	71,12	61,12	8,19	13,38	0,05

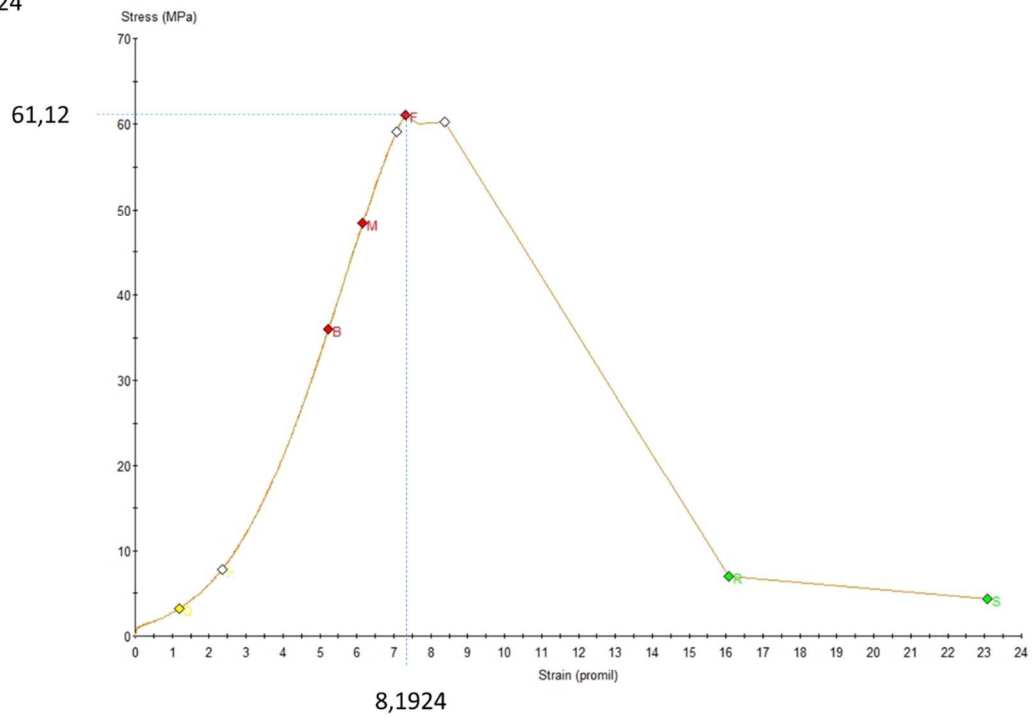


Sample\_24

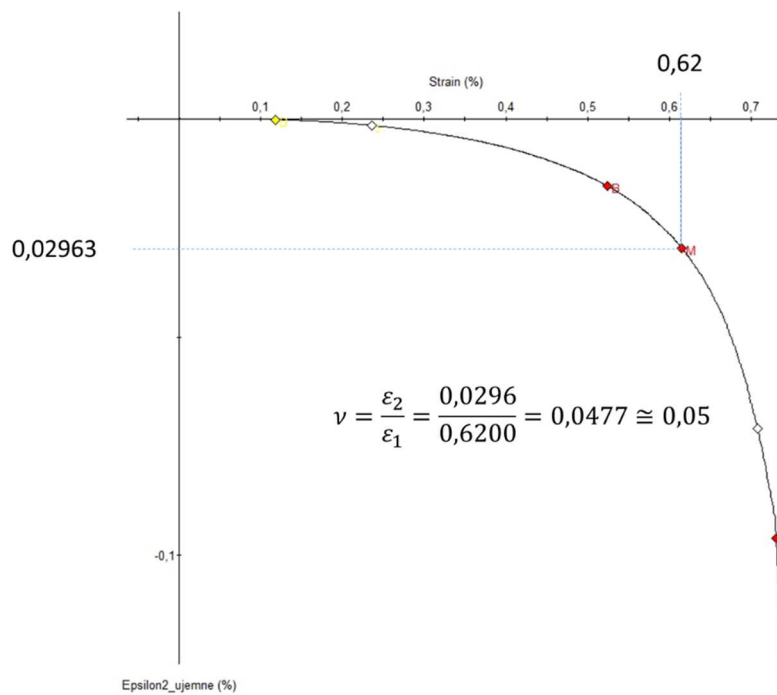




Sample\_24



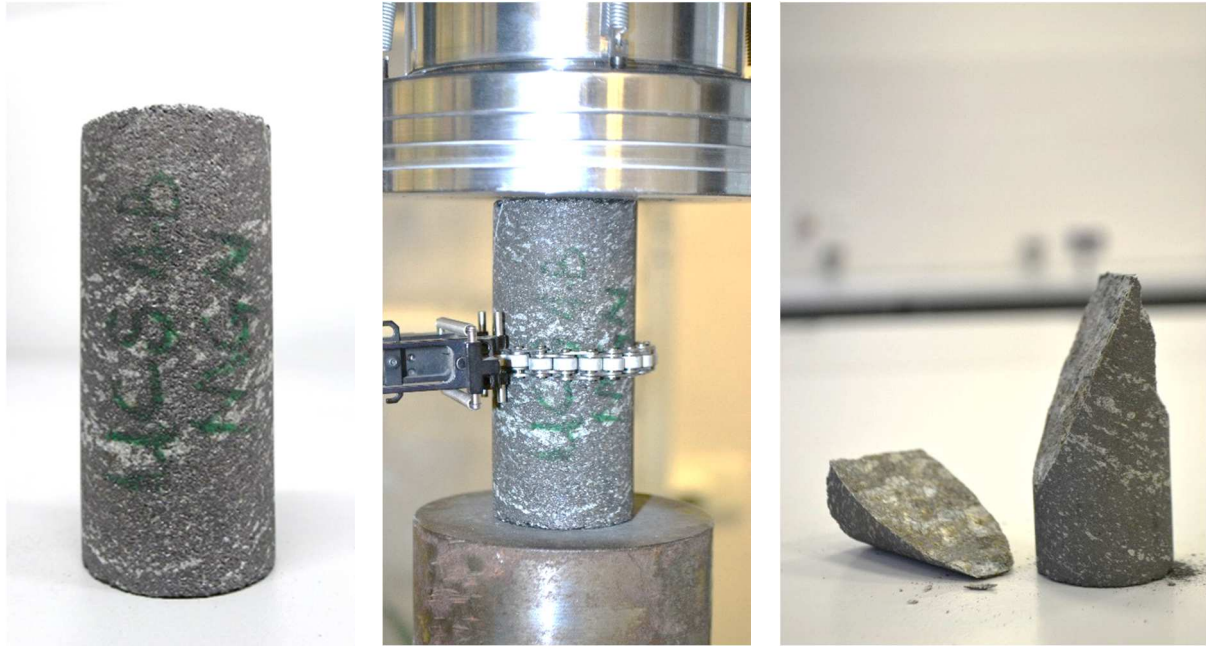
Sample\_24





### Magnetite UCS 4B MGN

164-18 MUJ8795	Ø, mm	h, mm	F, kN	UCS, MPa	ε, ‰	E, GPa	ν, -
UCS 4B MGN	38,50	90,40	36,50	31,37	xxx	xxx	xxx



### 4. CONCLUSIONS

The basis of the work was to conduct series of strength tests in a uniaxial stress state mode, on 25 different rock samples. During the tests, the load course (increase in force as a function of piston lowering) was recorded. Based on the obtained data, stress-strain characteristics were plotted and the deformation parameters (Poisson's ratio and modulus of elasticity) was determined. Each laboratory sample has an individual card. During the last test, a power failure occurred, so no load was recorded on the sample.





## PART 2: CREEP TESTS UNDER UNIAXIAL COMPRESSION

### 5. TEST PROCEDURE AND METHOD

A servo-hydraulically-controlled creep tester of type M001 built by MIEMAR Ltd was used for the creep tests under uniaxial compression (UCc). The each of the 5 creep testers is designed to carry out tests on one specimen under axial loads of up to 100 kN (Fig. 2).



1 – glycerol pressure gauge, 2 – hydraulic accumulator, 3 – upper bearing, 4 – control valve, 5 – hydraulic cylinder, 6 – high pressure hydraulic hose, 7 – analog displacement sensors, 8 – upper pressure plate, 9 – bottom pressure plate, 10 – analog load cell, 11 – spacer cylinder, 12 – magnetic stand

Fig. 2 Creep tester M001 of Rock Mechanics Laboratory of the Faculty of Geoengineering, Mining and Geology at Wrocław University of Science and Technology

Data is collected during uniaxial creep tests by two analog displacement sensors whose average was used as the measured value to register the axial specimen compression. A load cell determines the load on the specimen immediately between the specimen and the pressure plate at the bottom of the apparatus. The constant specimen load is controlled by the hydraulic accumulator.

During the uniaxial creep tests, the readings have been collected at interval of 1÷7 days and then saved electronically. Evaluating the uniaxial creep tests involves converting the measured changes in length into elastic-creep strains in accordance with



$$\varepsilon_1 = \frac{1}{2} \frac{\Delta_L + \Delta_R}{h_0} 100\% = \frac{\Delta_{av}}{h_0} 100\%$$

(where  $\varepsilon_1$  – technical strain, %,  $\Delta_L$  and  $\Delta_R$  – axial deformation measured with two analog displacement gauges, mm,  $h_0$  – length of unstressed specimen, mm,  $\Delta_{av}$  – measured average axial deformation of the specimen, mm)

and plotting them against test time in a strain vs time diagrams.



TABLE 1: CREEP TEST No. 1 – SAMPLE CT-1A BSF

		200-18, MUJ8820														
Sample ID		Test	Rock Type													
CT 1A BSF		Creep Test	Biotite Schist													
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	∅, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain ε <sub>L</sub> , %	Creep rate. 1/d	Modulu s E, GPa	Air Moisture, %	Air Temp. °C
1	06.10.2019	0	0	38,54	1165,99		0,00	85,200	0,00	0	0,000	0,00000			22	22,0
1	06.10.2019	0,358	0,326	38,54	1165,99	20	17,15	85,200	0,358	0,326	0,342	0,40141		4,272	22	22,0
4	09.10.2019	0,382	0,336	38,54	1165,99	20	17,15	85,200	0,382	0,336	0,359	0,42136			22	22,0
6	11.10.2019	0,385	0,337	38,54	1165,99	20	17,15	85,200	0,385	0,337	0,361	0,42371			22	20,7
8	13.10.2019	0,386	0,337	38,54	1165,99	20	17,15	85,200	0,386	0,337	0,362	0,42430			30	20,9
12	17.10.2019	0,385	0,335	38,54	1165,99	20	17,15	85,200	0,385	0,335	0,360	0,42254			43	21,0
17	22.10.2019	0,383	0,332	38,54	1165,99	20	17,15	85,200	0,383	0,332	0,358	0,41960			44	20,7
22	27.10.2019	0,383	0,332	38,54	1165,99	20	17,15	85,200	0,383	0,332	0,358	0,41960			34	20,5
27	02.11.2019	0,381	0,330	38,54	1165,99	20	17,15	85,200	0,381	0,330	0,356	0,41725			23	20,4
33	08.11.2019	0,380	0,328	38,54	1165,99	20	17,15	85,200	0,380	0,328	0,354	0,41549			32	20,2
34	09.11.2019	0,379	0,328	38,54	1165,99	20	17,15	85,200	0,379	0,328	0,354	0,41491			44	20,5
37	13.11.2019	0,381	0,327	38,54	1165,99	20	17,15	85,200	0,381	0,327	0,354	0,41549			33	20,8
39	15.11.2019	0,379	0,326	38,54	1165,99	20	17,15	85,200	0,379	0,326	0,353	0,41373			30	21,1
40	16.11.2019	0,381	0,327	38,54	1165,99	20	17,15	85,200	0,381	0,327	0,354	0,41549			38	21,6
41	17.11.2019	0,379	0,326	38,54	1165,99	20	17,15	85,200	0,379	0,326	0,353	0,41373			34	20,9
44	20.11.2019	0,379	0,326	38,54	1165,99	20	17,15	85,200	0,379	0,326	0,353	0,41373			30	20,9
46	22.11.2019	0,379	0,327	38,54	1165,99	20	17,15	85,200	0,379	0,327	0,353	0,41432			28	20,9
47	23.11.2019	0,378	0,325	38,54	1165,99	20	17,15	85,200	0,378	0,325	0,352	0,41256			32	21,1
51	27.11.2019	0,377	0,325	38,54	1165,99	20	17,15	85,200	0,377	0,325	0,351	0,41197			30	21,0
53	29.11.2019	0,377	0,325	38,54	1165,99	20	17,15	85,200	0,377	0,325	0,351	0,41197			28	21,0
55	31.11.2019	0,378	0,325	38,54	1165,99	20	17,15	85,200	0,378	0,325	0,352	0,41256			47	21,6
58	03.12.2019	0,378	0,325	38,54	1165,99	20	17,15	85,200	0,378	0,325	0,352	0,41256			44	21,5
60	05.12.2019	0,377	0,325	38,54	1165,99	20	17,15	85,200	0,377	0,325	0,351	0,41197			25	21,2



62	07.12.2019	0,375	0,323	38,54	1165,99	20	17,15	85,200	0,375	0,323	0,349	0,40962			39	20,8
66	11.12.2019	0,377	0,324	38,54	1165,99	20	17,15	85,200	0,377	0,324	0,351	0,41138			30	21,4
69	14.12.2019	0,376	0,323	38,54	1165,99	20	17,15	85,200	0,376	0,323	0,350	0,41021			38	21,2
75	20.12.2019	0,376	0,322	38,54	1165,99	20	17,15	85,200	0,376	0,322	0,349	0,40933			32	21,2
81	26.12.2019	0,376	0,322	38,54	1165,99	20	17,15	85,200	0,376	0,322	0,349	0,40962			46	21,3
87	02.01.2020	0,376	0,322	38,54	1165,99	20	17,15	85,200	0,376	0,322	0,349	0,40962			48	21,3
93	09.01.2020	0,376	0,3215	38,54	1165,99	20	17,15	85,200	0,376	0,322	0,349	0,40933			32	21,6
94	10.01.2020	0,376	0,322	38,54	1165,99	20	17,15	85,200	0,376	0,322	0,349	0,40962			36	22

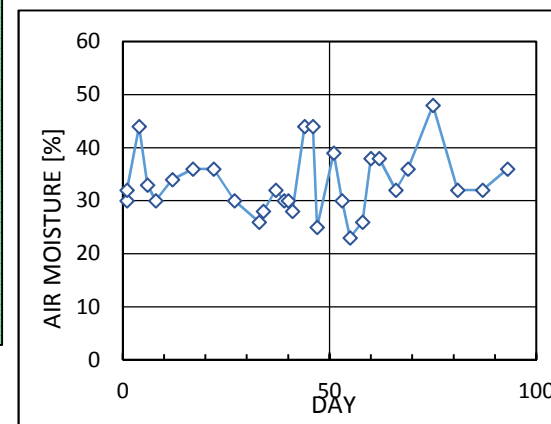
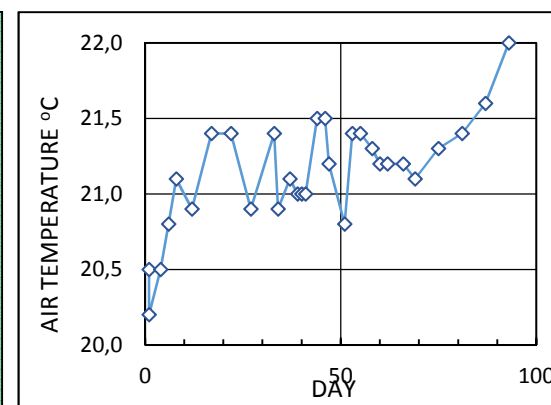
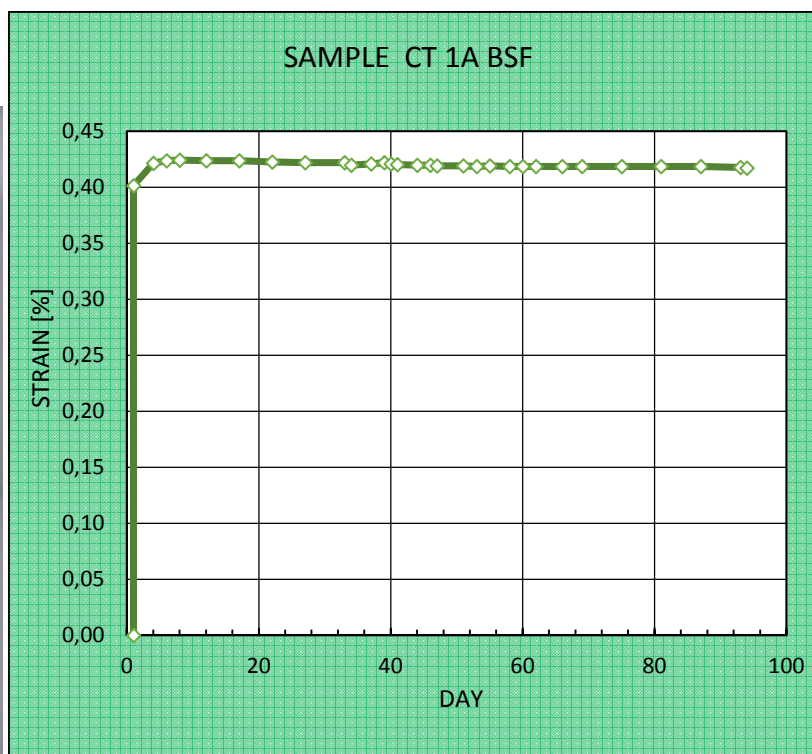




TABLE 2: CREEP TEST No. 2 – SAMPLE CT-1B BSF

	1	200-18, MUJ8820													
	Sample ID	Test	Rock Type												
	CT 1B BSF	Creep Test	Biotite Schist												
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	Ø, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain, %	Modulus E, GPa	Air Moisture, %	Air Temp. °C
1	06.10.2019	0	0	38,54	1165,99	20	17,15	81,88	0	0	0,000	0,000			
1	06.10.2019	0,103	0,115	38,54	1165,99	20	17,15	81,88	0,103	0,115	0,109	0,133	12,89	30	20,5
4	09.10.2019	0,118	0,195	38,54	1165,99	20	17,15	81,88	0,118	0,195	0,157	0,191		32	20,2
6	11.10.2019	0,109	0,22	38,54	1165,99	20	17,15	81,88	0,109	0,220	0,165	0,201		44	20,5
8	13.10.2019	0,116	0,216	38,54	1165,99	20	17,15	81,88	0,116	0,216	0,166	0,203		33	20,8
12	17.10.2019	0,124	0,222	38,54	1165,99	20	17,15	81,88	0,124	0,222	0,173	0,211		30	21,1
17	22.10.2019	0,123	0,223	38,54	1165,99	20	17,15	81,88	0,123	0,223	0,173	0,211		34	20,9
22	27.10.2019	0,124	0,222	38,54	1165,99	20	17,15	81,88	0,124	0,222	0,173	0,211		36	21,4
27	02.11.2019	0,124	0,224	38,54	1165,99	20	17,15	81,88	0,124	0,224	0,174	0,213		36	21,4
33	08.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		30	20,9
34	09.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		26	21,4
37	13.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		28	20,9
39	15.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		32	21,1
40	16.11.2019	0,123	0,224	38,54	1165,99	19	16,30	81,88	0,123	0,224	0,174	0,212		30	21,0
41	17.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		30	21,0
44	20.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		28	21,0
46	22.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		44	21,5
47	23.11.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		44	21,5
51	27.11.2019	0,121	0,223	38,54	1165,99	19	16,30	81,88	0,121	0,223	0,172	0,210		25	21,2
53	29.11.2019	0,123	0,224	38,54	1165,99	19	16,30	81,88	0,123	0,224	0,174	0,212		39	20,8
55	31.11.2019	0,123	0,224	38,54	1165,99	19	16,30	81,88	0,123	0,224	0,174	0,212		30	21,4
58	03.12.2019	0,122	0,224	38,54	1165,99	19	16,30	81,88	0,122	0,224	0,173	0,211		23	21,4
60	05.12.2019	0,123	0,224	38,54	1165,99	19	16,30	81,88	0,123	0,224	0,174	0,212		26	21,3
62	07.12.2019	0,123	0,224	38,54	1165,99	18	15,44	81,88	0,123	0,224	0,174	0,212		38	21,2
66	11.12.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212		38	21,2



69	14.12.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212	32	21,2
75	20.12.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212	36	21,1
81	26.12.2019	0,123	0,224	38,54	1165,99	20	17,15	81,88	0,123	0,224	0,174	0,212	48	21,3
87	02.01.2020	0,123	0,224	38,54	1165,99	19	16,30	81,88	0,123	0,224	0,174	0,212	32	21,4
93	09.01.2020	0,123	0,224	38,54	1165,99	19	16,30	81,88	0,123	0,224	0,174	0,212	32	21,6
94	10.01.2020	0,123	0,225	38,54	1165,99	19	16,30	81,88	0,123	0,225	0,174	0,213	36	22

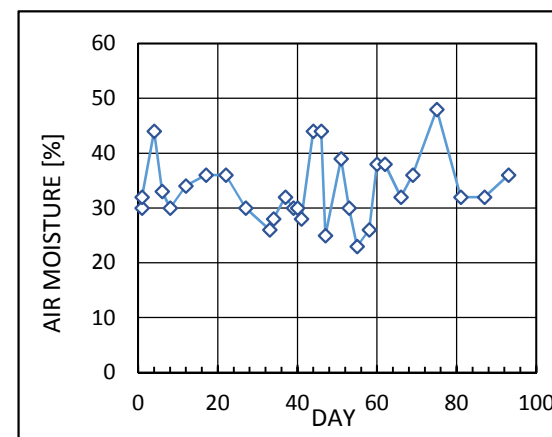
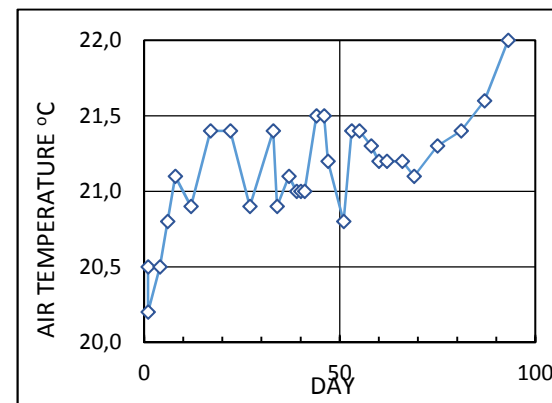
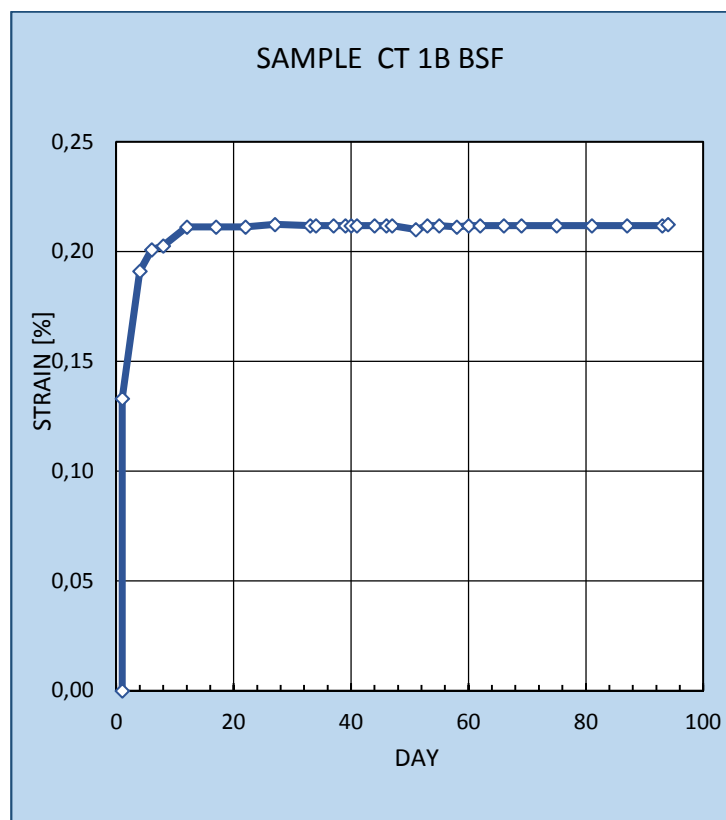




TABLE 3: CREEP TEST No. 3 – SAMPLE CT-2A BSF

	2	201-18, MUJ8821													
	Sample ID	Test	Rock Type												
	CT 2A BSF	Creep Test	Biotite Schist												
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	∅, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain, %	Modulus E, MPa	Air Moisture, %	Air Temp. °C
1	06.10.2019	0	0	38,70	1175,69	0	0,00	91,58	0	0	0,000	0,000			
1	06.10.2019	0,179	0,169	38,70	1175,69	30	25,52	91,58	0,179	0,169	0,174	0,190	13432	30	20,5
4	09.10.2019	0,190	0,170	38,70	1175,69	30	25,52	91,58	0,190	0,170	0,180	0,197		32	20,2
6	11.10.2019	0,195	0,174	38,70	1175,69	30	25,52	91,58	0,195	0,174	0,185	0,201		44	20,5
8	13.10.2019	0,202	0,180	38,70	1175,69	30	25,52	91,58	0,202	0,180	0,191	0,209		44	21,1
11	16.10.2019	0,222	0,193	38,70	1175,69	30	25,52	91,58	0,222	0,193	0,208	0,227		33	20,8
14	19.10.2019	0,232	0,202	38,70	1175,69	30	25,52	91,58	0,232	0,202	0,217	0,237		32	20,8
17	22.10.2019	0,245	0,212	38,70	1175,69	30	25,52	91,58	0,245	0,212	0,229	0,250		30	21,1
22	27.10.2019	0,318	0,273	38,70	1175,69	30	25,52	91,58	0,318	0,273	0,296	0,323		38	21,6
27	02.11.2019	0,323	0,287	38,70	1175,69	30	25,52	91,58	0,323	0,287	0,305	0,333		34	20,9
32	07.11.2019	0,341	0,289	38,70	1175,69	30	25,52	91,58	0,341	0,289	0,315	0,344		36	21,4
34	09.11.2019	0,342	0,289	38,70	1175,69	30	25,52	91,58	0,342	0,289	0,316	0,345		30	20,9
37	13.11.2019	0,343	0,292	38,70	1175,69	30	25,52	91,58	0,343	0,292	0,318	0,347		28	20,9
39	15.11.2019	0,344	0,293	38,70	1175,69	30	25,52	91,58	0,344	0,293	0,319	0,348		32	21,1
40	17.11.2019	0,345	0,294	38,70	1175,69	30	25,52	91,58	0,345	0,294	0,320	0,349		30	21,0
41	19.11.2019	0,346	0,294	38,70	1175,69	30	25,52	91,58	0,346	0,294	0,320	0,349		28	21,0
44	21.11.2019	0,346	0,294	38,70	1175,69	30	25,52	91,58	0,346	0,294	0,320	0,349		47	21,6
46	23.11.2019	0,351	0,296	38,70	1175,69	30	25,52	91,58	0,351	0,296	0,324	0,353		44	21,5
47	27.11.2019	0,353	0,298	38,70	1175,69	30	25,52	91,58	0,353	0,298	0,326	0,355		25	21,2
51	29.11.2019	0,355	0,300	38,70	1175,69	30	25,52	91,58	0,355	0,300	0,328	0,358		39	20,8
53	31.11.2019	0,354	0,299	38,70	1175,69	30	25,52	91,58	0,354	0,299	0,327	0,357		30	21,4
55	03.12.2019	0,356	0,300	38,70	1175,69	30	25,52	91,58	0,356	0,300	0,328	0,358		23	21,3
58	05.12.2019	0,355	0,300	38,70	1175,69	30	25,52	91,58	0,355	0,300	0,328	0,358		26	21,2



60	07.12.2019	0,356	0,301	38,70	1175,69	30	25,52	91,58	0,356	0,301	0,329	0,359		38	21,2
62	11.12.2019	0,356	0,301	38,70	1175,69	30	25,52	91,58	0,356	0,301	0,329	0,359		32	21,4
68	14.12.2019	0,356	0,301	38,70	1175,69	30	25,52	91,58	0,356	0,301	0,329	0,359		32	21,2
69	19.12.2019	0,356	0,301	38,70	1175,69	30	25,52	91,58	0,356	0,301	0,329	0,359		36	21,1
75	21.12.2019	0,356	0,301	38,70	1175,69	30	25,52	91,58	0,356	0,301	0,329	0,359		46	21,3
76	26.12.2019	0,356	0,301	38,70	1175,69	30	25,52	91,58	0,356	0,301	0,329	0,359		48	21,3
81	02.01.2020	0,357	0,304	38,70	1175,69	30	25,52	91,58	0,357	0,304	0,331	0,361		32	21,4
88	06.01.2020	0,358	0,302	38,70	1175,69	30	25,52	91,58	0,358	0,302	0,330	0,360		38	21
90	09.01.2020	0,358	0,302	38,70	1175,69	30	25,52	91,58	0,358	0,302	0,330	0,360		32	21,6
94	10.01.2020	0,358	0,302	38,70	1175,69	30	25,52	91,58	0,358	0,302	0,330	0,360		36	22

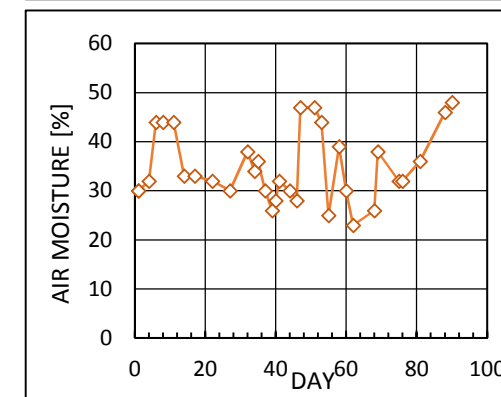
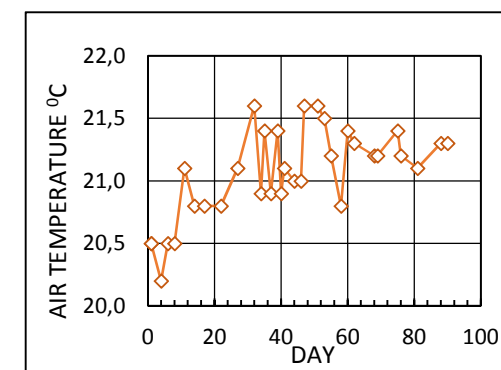
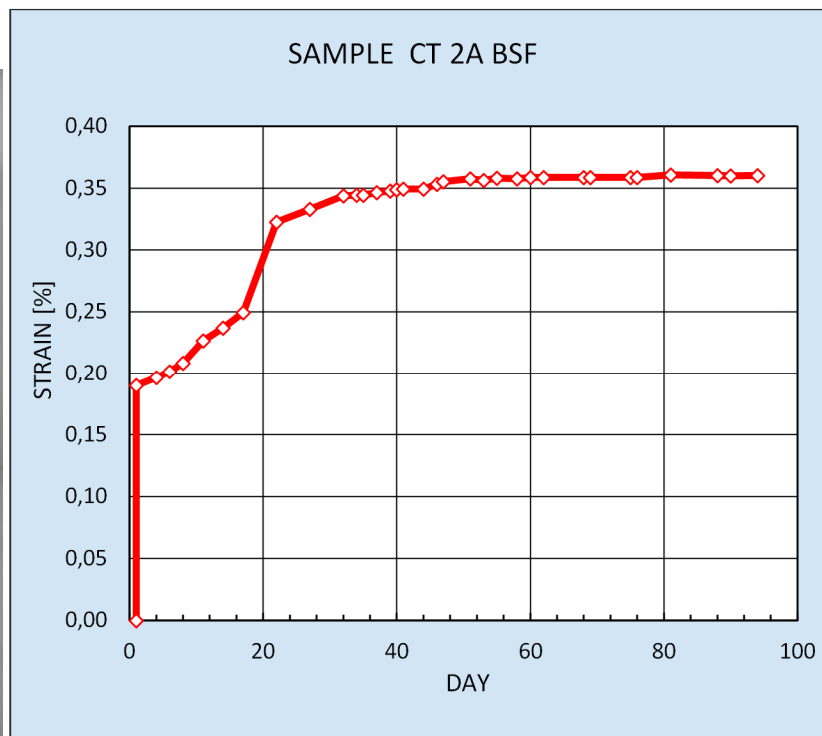






TABLE 4: CREEP TEST No. 4 – SAMPLE CT-2B BSF

2		201-18, MUJ8821													
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	Ø, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain, %	Modulus E, MPa	Air Moisture, %	Air Temp. °C
1	06.10.2019	0,0000	0,0000	38,60	1169,62	0	0,00	82,00	0,000	0,0000	0,000	0,000		30	20,5
1	06.10.2019	0,1590	0,1720	38,60	1169,62	20	17,10	82,00	0,159	0,17200	0,166	0,202	8465	30	20,5
4	09.10.2019	0,1600	0,1750	38,60	1169,62	20	17,10	82,00	0,160	0,17500	0,168	0,204		32	20,2
6	11.10.2019	0,1630	0,1770	38,60	1169,62	20	17,10	82,00	0,163	0,17700	0,170	0,207		44	20,5
8	13.10.2019	0,1660	0,1820	38,60	1169,62	20	17,10	82,00	0,166	0,18200	0,174	0,212		44	20,5
11	16.10.2019	0,1660	0,1850	38,60	1169,62	20	17,10	82,00	0,166	0,18500	0,176	0,214		44	21,1
14	19.10.2019	0,1650	0,1860	38,60	1169,62	20	17,10	82,00	0,165	0,18600	0,176	0,214		33	20,8
17	22.10.2019	0,1710	0,1900	38,60	1169,62	20	17,10	82,00	0,171	0,19000	0,181	0,220		33	20,8
22	27.10.2019	0,1710	0,1910	38,60	1169,62	20	17,10	82,00	0,171	0,19100	0,181	0,221		32	20,8
27	02.11.2019	0,1710	0,1900	38,60	1169,62	20	17,10	82,00	0,171	0,19000	0,181	0,220		30	21,1
32	07.11.2019	0,1710	0,1890	38,60	1169,62	20	17,10	82,00	0,171	0,18900	0,180	0,220		38	21,6
34	09.11.2019	0,1710	0,1890	38,60	1169,62	20	17,10	82,00	0,171	0,18900	0,180	0,220		34	20,9
35	10.11.2019	0,1710	0,1890	38,60	1169,62	20	17,10	82,00	0,171	0,18900	0,180	0,220		36	21,4
37	13.11.2019	0,1700	0,1880	38,60	1169,62	20	17,10	82,00	0,170	0,18800	0,179	0,218		30	20,9
39	15.11.2019	0,1690	0,1870	38,60	1169,62	20	17,10	82,00	0,169	0,18700	0,178	0,217		26	21,4
40	17.11.2019	0,1700	0,1880	38,60	1169,62	20	17,10	82,00	0,170	0,18800	0,179	0,218		28	20,9
41	19.11.2019	0,1690	0,1870	38,60	1169,62	20	17,10	82,00	0,169	0,18700	0,178	0,217		32	21,1
44	21.11.2019	0,1680	0,1860	38,60	1169,62	20	17,10	82,00	0,168	0,18600	0,177	0,216		30	21,0
46	23.11.2019	0,1680	0,1860	38,60	1169,62	20	17,10	82,00	0,168	0,18600	0,177	0,216		28	21,0
47	27.11.2019	0,1680	0,1860	38,60	1169,62	20	17,10	82,00	0,168	0,18600	0,177	0,216		47	21,6
51	29.11.2019	0,1710	0,1920	38,60	1169,62	20	17,10	82,00	0,171	0,19200	0,182	0,221		47	21,6
53	31.11.2019	0,1720	0,1920	38,60	1169,62	20	17,10	82,00	0,172	0,19200	0,182	0,222		44	21,5



55	03.12.2019	0,1710	0,1920	38,60	1169,62	20	17,10	82,00	0,171	0,19200	0,182	0,221	25	21,2
58	05.12.2019	0,1710	0,1920	38,60	1169,62	20	17,10	82,00	0,171	0,19200	0,182	0,221	39	20,8
60	07.12.2019	0,1710	0,1860	38,60	1169,62	20	17,10	82,00	0,171	0,18600	0,179	0,218	30	21,4
62	11.12.2019	0,1715	0,1910	38,60	1169,62	20	17,10	82,00	0,172	0,19100	0,181	0,221	23	21,3
68	14.12.2019	0,1710	0,1905	38,60	1169,62	20	17,10	82,00	0,171	0,19050	0,181	0,220	26	21,2
69	19.12.2019	0,1710	0,1910	38,60	1169,62	20	17,10	82,00	0,171	0,19100	0,181	0,221	38	21,2
75	21.12.2019	0,1710	0,1910	38,60	1169,62	20	17,10	82,00	0,171	0,19100	0,181	0,221	32	21,4
76	26.12.2019	0,1710	0,1910	38,60	1169,62	20	17,10	82,00	0,171	0,19100	0,181	0,221	32	21,2
81	02.01.2020	0,1710	0,1910	38,60	1169,62	20	17,10	82,00	0,171	0,19100	0,181	0,221	36	21,1
88	06.01.2020	0,1710	0,1900	38,60	1169,62	20	17,10	82,00	0,171	0,19000	0,181	0,220	46	21,3
90	09.01.2020	0,1700	0,1890	38,60	1169,62	20	17,10	82,00	0,170	0,18900	0,180	0,219	48	21,3

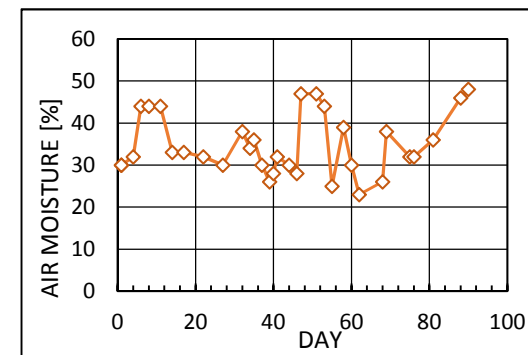
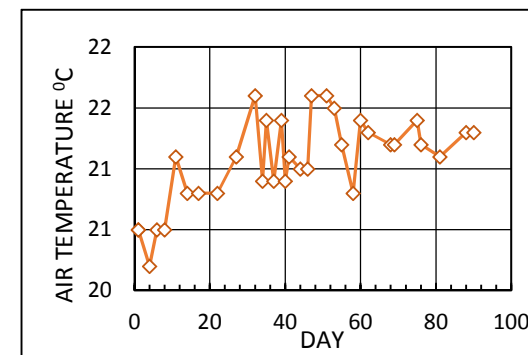
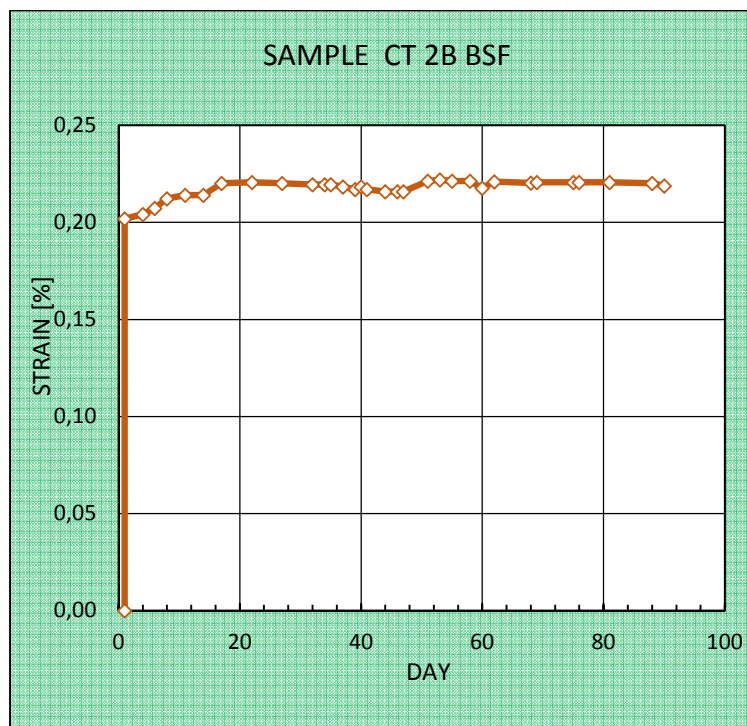




TABLE 5: CREEP TEST No. 5 – SAMPLE CT-3A BSF

3		201-18, MUJ8822													
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	Ø, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain %	Modulus E, Mpa	Air Moisture, %	Temp. °C
	Sample ID	Test	Rock Type												
	CT 3A BSF	Creep Test	Biotite Schist												
1	12.01.2020	0	0	38,52	1164,78	0	0,00	81,980	0	0	0,000	0,00000			
1	12.01.2020	0,144	0,124	38,52	1164,78	20	17,17	81,980	0,144	0,124	0,134	0,16345	10505	45	21,8
4	15.01.2020	0,145	0,127	38,52	1164,78	20	17,17	81,980	0,145	0,127	0,136	0,16589		12	21,2
8	19.01.2020	0,147	0,124	38,52	1164,78	20	17,17	81,980	0,147	0,124	0,136	0,16528		12	21,2
14	25.01.2020	0,147	0,124	38,52	1164,78	20	17,17	81,980	0,147	0,124	0,136	0,16528		12	21,2
21	01.02.2020	0,147	0,126	38,52	1164,78	20	17,17	81,980	0,147	0,126	0,137	0,16650		26	21,9
30	10.02.2020	0,148	0,126	38,52	1164,78	20	17,17	81,980	0,148	0,126	0,137	0,16711		28	21,0
37	17.02.2020	0,147	0,126	38,52	1164,78	20	17,17	81,980	0,147	0,126	0,137	0,16650		20	21,9
49	29.02.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		26	21,2
56	07.03.2020	0,147	0,125	38,52	1164,78	20	17,17	81,980	0,147	0,125	0,136	0,16589		26	22,2
64	15.03.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		27	22,2
69	20.03.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		22	21,3
77	28.03.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		32	22,1
88	07.04.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		32	21,9
98	17.04.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		26	21,7
101	20.04.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		28	21,8
108	27.04.2020	0,146	0,126	38,52	1164,78	20	17,17	81,980	0,146	0,126	0,136	0,16589		32	22,2
110	29.04.2020	0,147	0,126	38,52	1164,78	20	17,17	81,980	0,147	0,126	0,137	0,16650		68	22,1

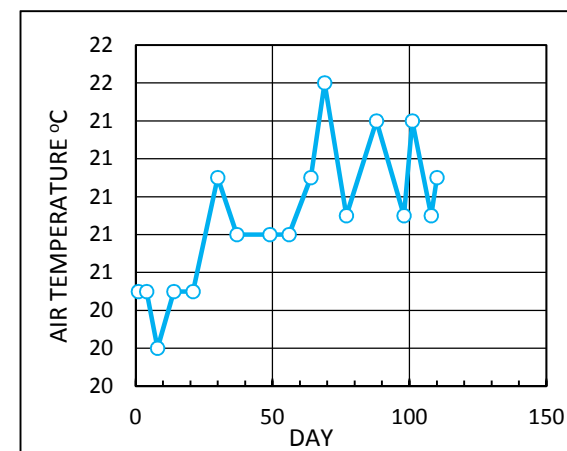
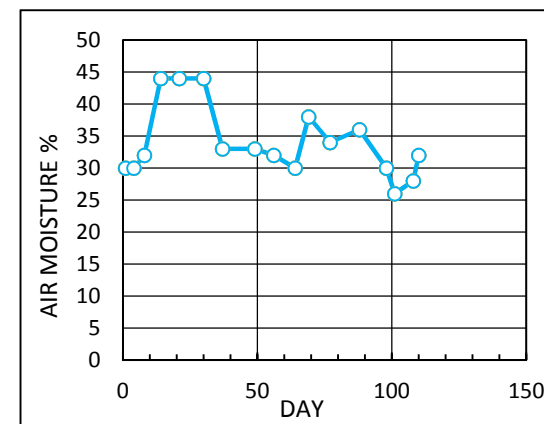
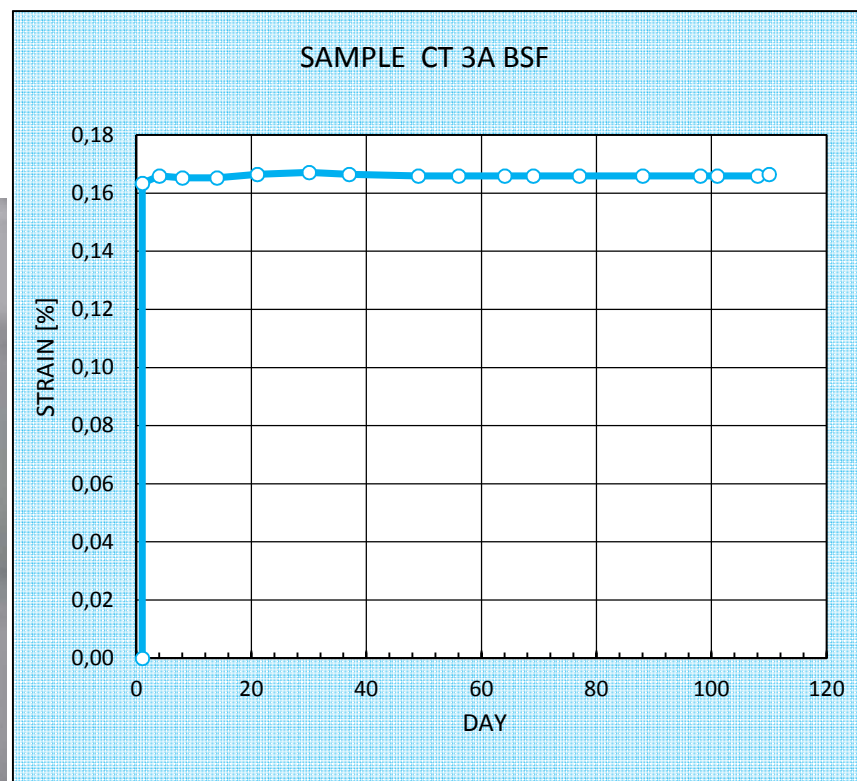




TABLE 6: CREEP TEST No. 6 – SAMPLE CT-3B BSF

	3	201-18, MUJ8822													
	Sample ID	Test	Rock Type												
	CT 3B BSF	Creep Test	Biotite Schist												
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	Ø, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain %	Modulus E, Mpa	Air Moisture, %	Temp. °C
1	12.01.2020	0	0	38,50	1163,57	0	0,00	87,4	0,00	0	0,000	0,000			
1	12.01.2020	0,113	0,174	38,50	1163,57	20	17,19	87,4	0,113	0,174	0,144	0,164	10481	50	21,4
4	15.01.2020	0,114	0,174	38,50	1163,57	20	17,19	87,4	0,114	0,174	0,144	0,165		50	21,4
8	19.01.2020	0,119	0,174	38,50	1163,57	20	17,19	87,4	0,119	0,174	0,147	0,168		12	21,2
14	25.01.2020	0,116	0,174	38,50	1163,57	20	17,19	87,4	0,116	0,174	0,145	0,166		12	21,2
21	01.02.2020	0,115	0,174	38,50	1163,57	20	17,19	87,4	0,115	0,174	0,145	0,165		26	21,4
30	10.02.2020	0,115	0,174	38,50	1163,57	20	17,19	87,4	0,115	0,174	0,145	0,165		28	21,0
37	17.02.2020	0,116	0,174	38,50	1163,57	20	17,19	87,4	0,116	0,174	0,145	0,166		20	21,9
49	29.02.2020	0,117	0,175	38,50	1163,57	20	17,19	87,4	0,117	0,175	0,146	0,167		26	21,2
56	07.03.2020	0,118	0,174	38,50	1163,57	20	17,19	87,4	0,118	0,174	0,146	0,167		26	22,2
64	15.03.2020	0,119	0,174	38,50	1163,57	20	17,19	87,4	0,119	0,174	0,147	0,168		27	22,2
69	20.03.2020	0,119	0,175	38,50	1163,57	20	17,19	87,4	0,119	0,175	0,147	0,168		22	21,3
77	28.03.2020	0,117	0,18	38,50	1163,57	20	17,19	87,4	0,117	0,180	0,149	0,170		32	22,1
88	07.04.2020	0,117	0,18	38,50	1163,57	20	17,19	87,4	0,117	0,180	0,149	0,170		32	21,9
98	17.04.2020	0,117	0,18	38,50	1163,57	20	17,19	87,4	0,117	0,180	0,149	0,170		26	21,7
101	20.04.2020	0,117	0,181	38,50	1163,57	20	17,19	87,4	0,117	0,181	0,149	0,170		28	21,8
108	27.04.2020	0,116	0,181	38,50	1163,57	20	17,19	87,4	0,116	0,181	0,149	0,170		32	22,2
110	29.04.2020	0,116	0,181	38,50	1163,57	20	17,19	87,4	0,116	0,181	0,149	0,170		68	22,1

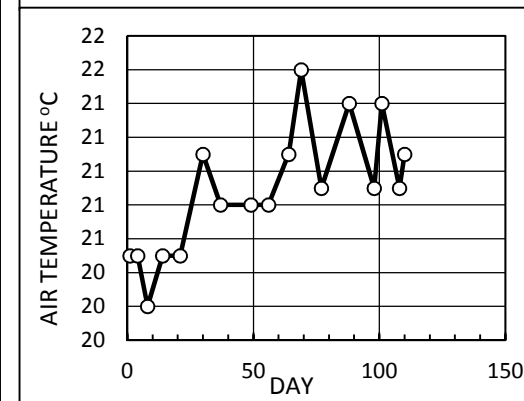
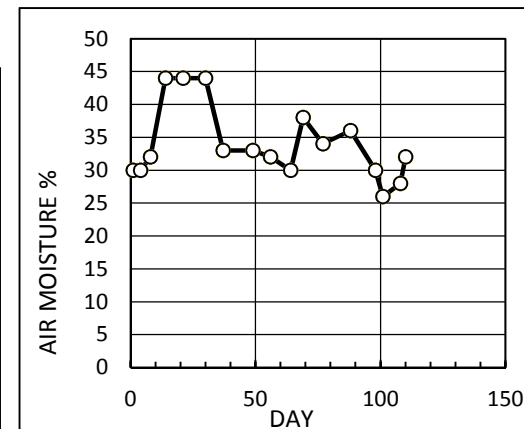
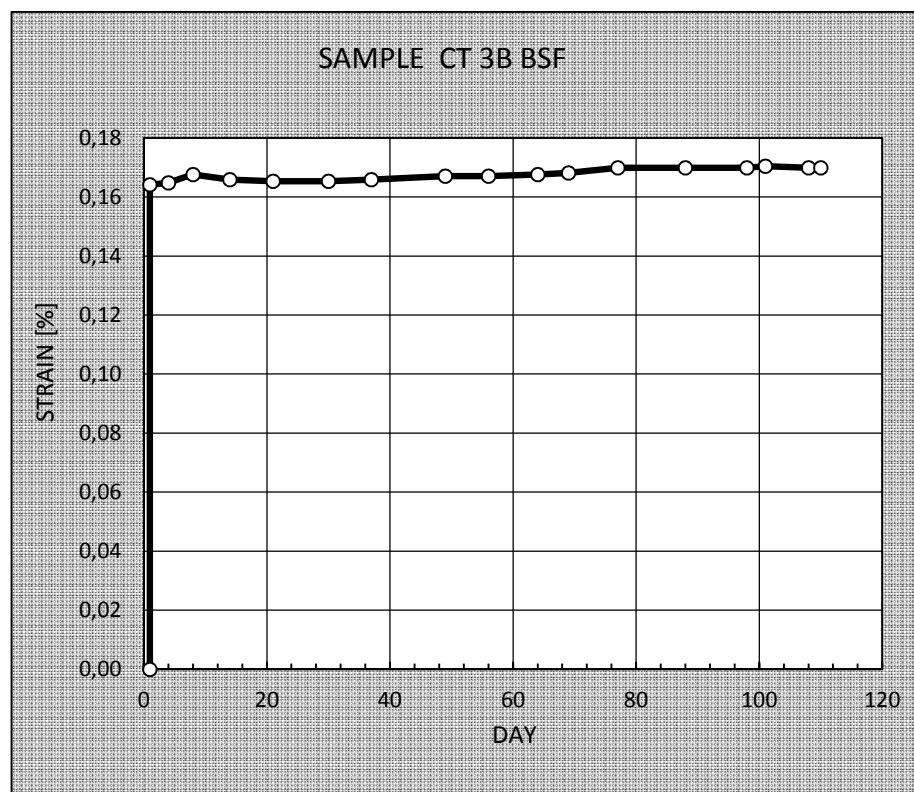




TABLE 7: CREEP TEST No. 7 – SAMPLE CT-4A BSF

	4	164-18 MUJ8795													
	Sample ID	Test	Rock Type												
	CT 4A BSF	Creep Test	Biotite Schist												
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	Ø, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain %	Modulus E, Mpa	Air Moisture, %	Temp. °C
1	12.01.2020	0	0	38,50	1163,57	0	0,00	79,78	0,00	0					
1	12.01.2020	0,248	0,258	38,50	1163,57	30	25,78	79,78	0,248	0,258	0,253	0,317	8132	30	20,5
4	15.01.2020	0,261	0,263	38,50	1163,57	30	25,78	79,78	0,261	0,263	0,262	0,328		30	20,5
8	19.01.2020	0,261	0,262	38,50	1163,57	30	25,78	79,78	0,261	0,262	0,262	0,328		32	20,2
14	25.01.2020	0,261	0,262	38,50	1163,57	30	25,78	79,78	0,261	0,262	0,262	0,328		44	20,5
21	01.02.2020	0,262	0,262	38,50	1163,57	30	25,78	79,78	0,262	0,262	0,262	0,328		44	20,5
30	10.02.2020	0,262	0,262	38,50	1163,57	30	25,78	79,78	0,262	0,262	0,262	0,328		44	21,1
37	17.02.2020	0,262	0,261	38,50	1163,57	30	25,78	79,78	0,262	0,261	0,261	0,327		33	20,8
49	29.02.2020	0,262	0,261	38,50	1163,57	30	25,78	79,78	0,262	0,261	0,262	0,328		32	20,8
56	07.03.2020	0,263	0,260	38,50	1163,57	30	25,78	79,78	0,263	0,260	0,262	0,328		30	21,1
64	15.03.2020	0,262	0,261	38,50	1163,57	30	25,78	79,78	0,262	0,261	0,262	0,328		38	21,6
69	20.03.2020	0,262	0,261	38,50	1163,57	30	25,78	79,78	0,262	0,261	0,262	0,328		34	20,9
77	28.03.2020	0,262	0,261	38,50	1163,57	30	25,78	79,78	0,262	0,261	0,262	0,328		34	20,9
88	07.04.2020	0,262	0,260	38,50	1163,57	30	25,78	79,78	0,262	0,260	0,261	0,327		36	21,4
98	17.04.2020	0,262	0,260	38,50	1163,57	30	25,78	79,78	0,262	0,260	0,261	0,327		30	20,9
101	20.04.2020	0,262	0,260	38,50	1163,57	30	25,78	79,78	0,262	0,260	0,261	0,327		26	21,4
108	27.04.2020	0,262	0,260	38,50	1163,57	30	25,78	79,78	0,262	0,260	0,261	0,327		28	20,9
110	29.04.2020	0,261	0,259	38,50	1163,57	30	25,78	79,78	0,261	0,259	0,260	0,326		32	21,1

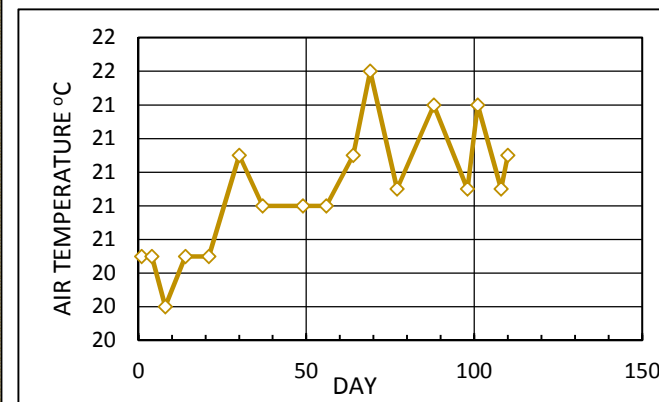
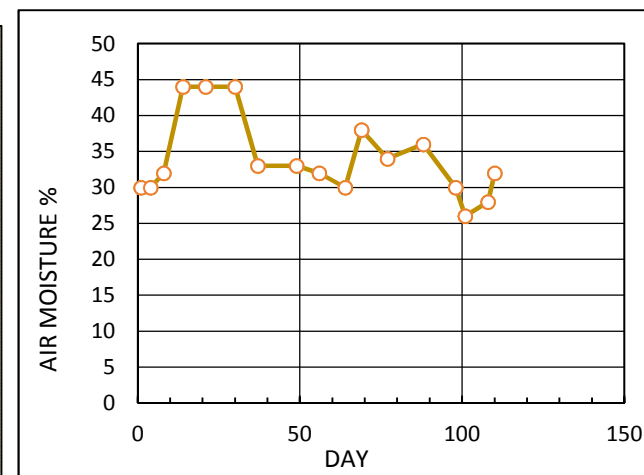
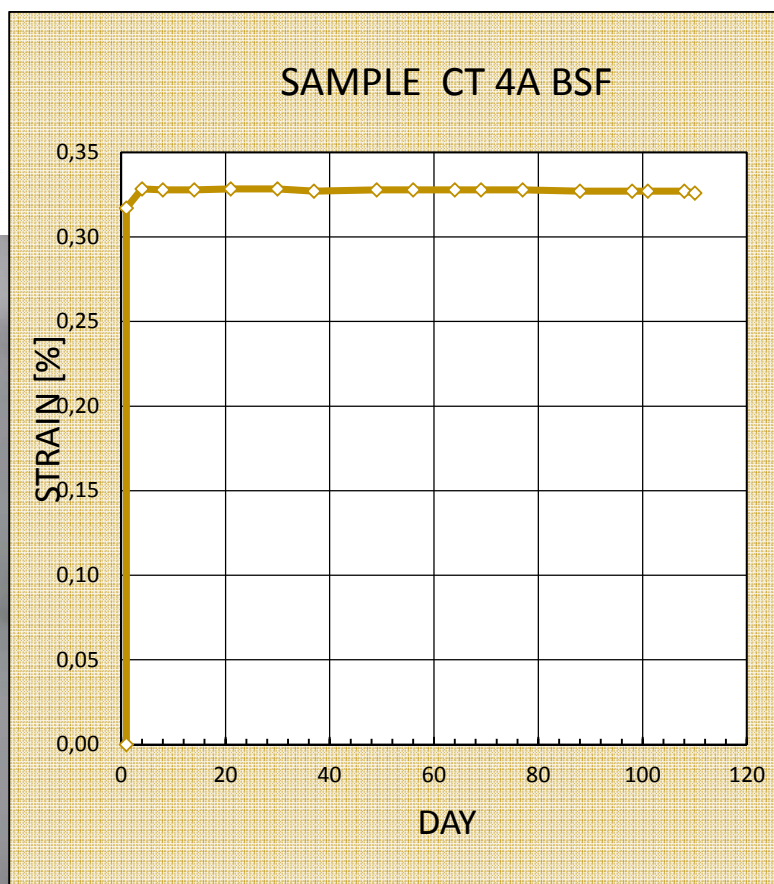
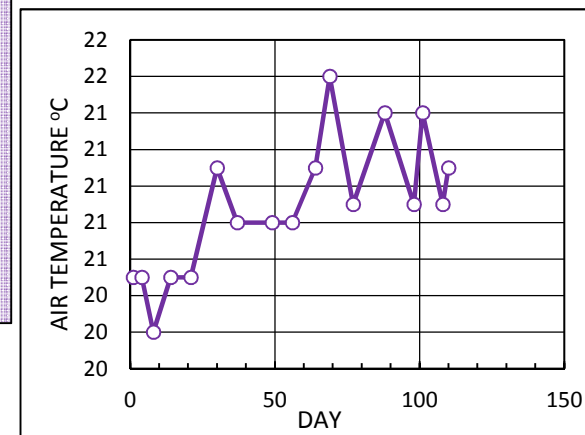
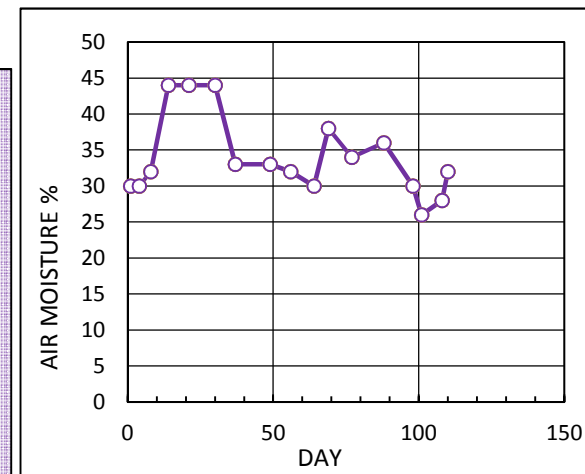
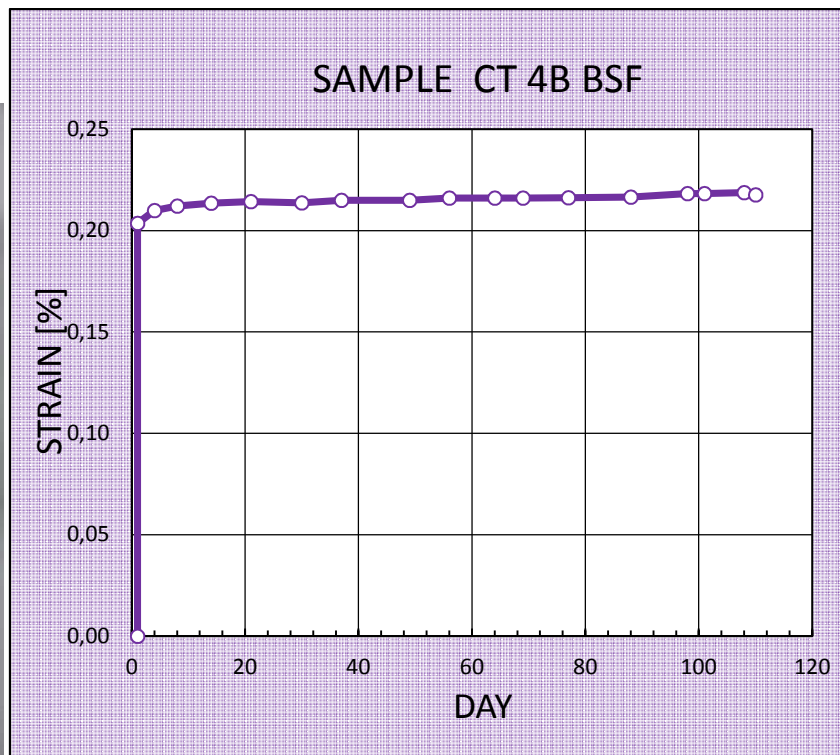






TABLE 8: CREEP TEST No. 8 – SAMPLE CT-4B BSF

4		201-18, MUJ8821													
Sample ID		Test		Rock Type:											
CT 4B BSF		Creep Test		Biotite Schist											
Day	Date	Analog sensor 1(L)	Analog sensor 2(R)	Ø, mm	F, mm <sup>2</sup>	Force, kN	Stress, MPa	h <sub>0</sub> , mm	Δ <sub>L</sub> , mm	Δ <sub>R</sub> , mm	Δ <sub>av</sub> , mm	Strain %	Modulus E, MPa	Air Moisture, %	Temp. °C
1	12.01.2020	0	0	38,48	1162,36	0	0,00	89,12	0	0	0,000	0,000		30	20,5
1	12.01.2020	0,1730	0,1900	38,48	1162,36	30	25,81	89,12	0,173	0,190	0,182	0,204	12900	30	20,5
4	15.01.2020	0,1730	0,2010	38,48	1162,36	30	25,81	89,12	0,173	0,201	0,187	0,210		30	20,5
8	19.01.2020	0,1730	0,2050	38,48	1162,36	30	25,81	89,12	0,173	0,205	0,189	0,212		32	20,2
14	25.01.2020	0,1730	0,2075	38,48	1162,36	30	25,81	89,12	0,173	0,208	0,190	0,213		44	20,5
21	01.02.2020	0,1730	0,2090	38,48	1162,36	30	25,81	89,12	0,173	0,209	0,191	0,214		44	20,5
30	10.02.2020	0,1730	0,2080	38,48	1162,36	30	25,81	89,12	0,173	0,208	0,191	0,214		44	21,1
37	17.02.2020	0,1730	0,2100	38,48	1162,36	30	25,81	89,12	0,173	0,210	0,192	0,215		33	20,8
49	29.02.2020	0,1730	0,2100	38,48	1162,36	30	25,81	89,12	0,173	0,210	0,192	0,215		33	20,8
56	07.03.2020	0,1740	0,2110	38,48	1162,36	30	25,81	89,12	0,174	0,211	0,193	0,216		32	20,8
64	15.03.2020	0,1740	0,2110	38,48	1162,36	30	25,81	89,12	0,174	0,211	0,193	0,216		30	21,1
69	20.03.2020	0,1740	0,2110	38,48	1162,36	30	25,81	89,12	0,174	0,211	0,193	0,216		38	21,6
77	28.03.2020	0,1740	0,2115	38,48	1162,36	30	25,81	89,12	0,174	0,212	0,193	0,216		34	20,9
88	07.04.2020	0,1740	0,2120	38,48	1162,36	30	25,81	89,12	0,174	0,212	0,193	0,217		36	21,4
98	17.04.2020	0,1750	0,2140	38,48	1162,36	30	25,81	89,12	0,175	0,214	0,195	0,218		30	20,9
101	20.04.2020	0,1750	0,2140	38,48	1162,36	30	25,81	89,12	0,175	0,214	0,195	0,218		26	21,4
108	27.04.2020	0,1750	0,2150	38,48	1162,36	30	25,81	89,12	0,175	0,215	0,195	0,219		28	20,9
110	29.04.2020	0,1750	0,2130	38,48	1162,36	30	25,81	89,12	0,175	0,213	0,194	0,218		32	21,1





## 6. CONCLUDING REMARKS

The results determined from the creep tests under uniaxial compression are shown above in tables 1- 8. The loaded samples manifest moderate creep behavior, of unknown origin.

No. of sample	Load kN	Elastic strain	Average creep rate 1/d	Modulus of Elasticity MPa
CT 1A BSF	20	4,01E-3	2,5E-6	12900
CT 1B BSF	20	1,33E-3	8,9E-6	8132
CT 2A BSF	30	1,9E-3	1,9E-5	10481
CT 2B BSF	20	2,02E-3	8,8E-6	10505
CT 3A BSF	20	1,63E-3	2,2E-7	8465
CT 3B BSF	20	1,64E-3	6,7E-7	13432
CT 4A BSF	30	3,17E-3	5,5E-7	12890
CT 4B BSF	30	2,04E-3	1,4E-6	4272