



BOA

Bentonite characterisation



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Mia Tiljander 31.1.2012

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Bentonite

A material formed as a result of volcanic ash sedimentation, that are rich of smectite minerals.

- ❖ Smectite is a group name from minerals that have **high swelling property** and **cation exchange capacity**.
- ❖ Most common smectite mineral is **montmorillonite** that is Na-Ca-smectite.

Common accessory minerals are illite/mica, chlorite, quartz, cristobalite, K-feldspar, plagioclase, kaolinite, gypsum, calcite, dolomite, hematite, pyrite and anatase.

Mineralogical studies

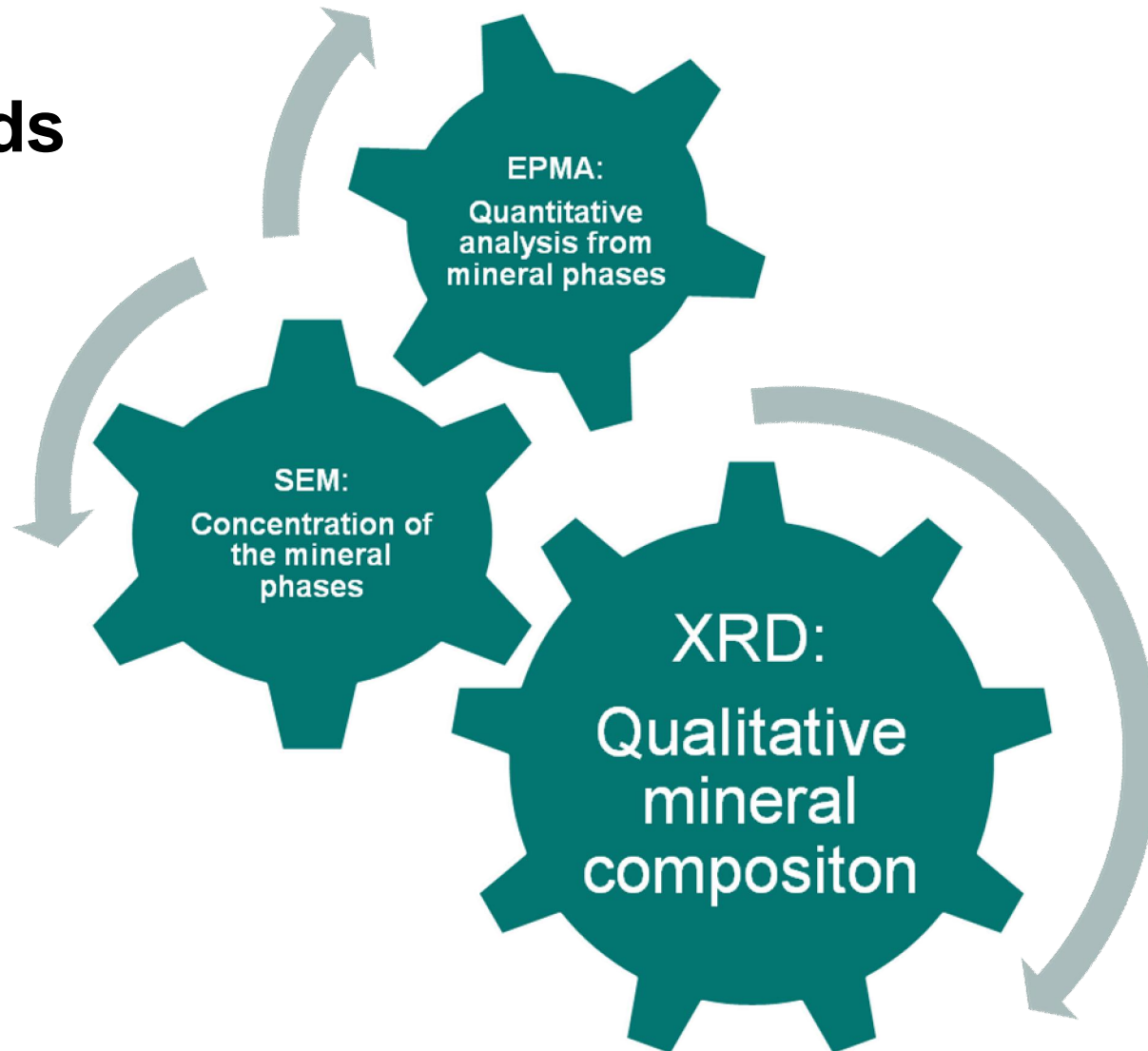
Related to

- 1.dissolution studies and
- 2.bentonite microstructure studies

mineralogy of the starting material and
mineralogical changes during and after laboratory tests

The aim of the this research is to improve mineralogical analysis techniques and knowledge about the behaviour of clay minerals.

Methods



XRD analyses

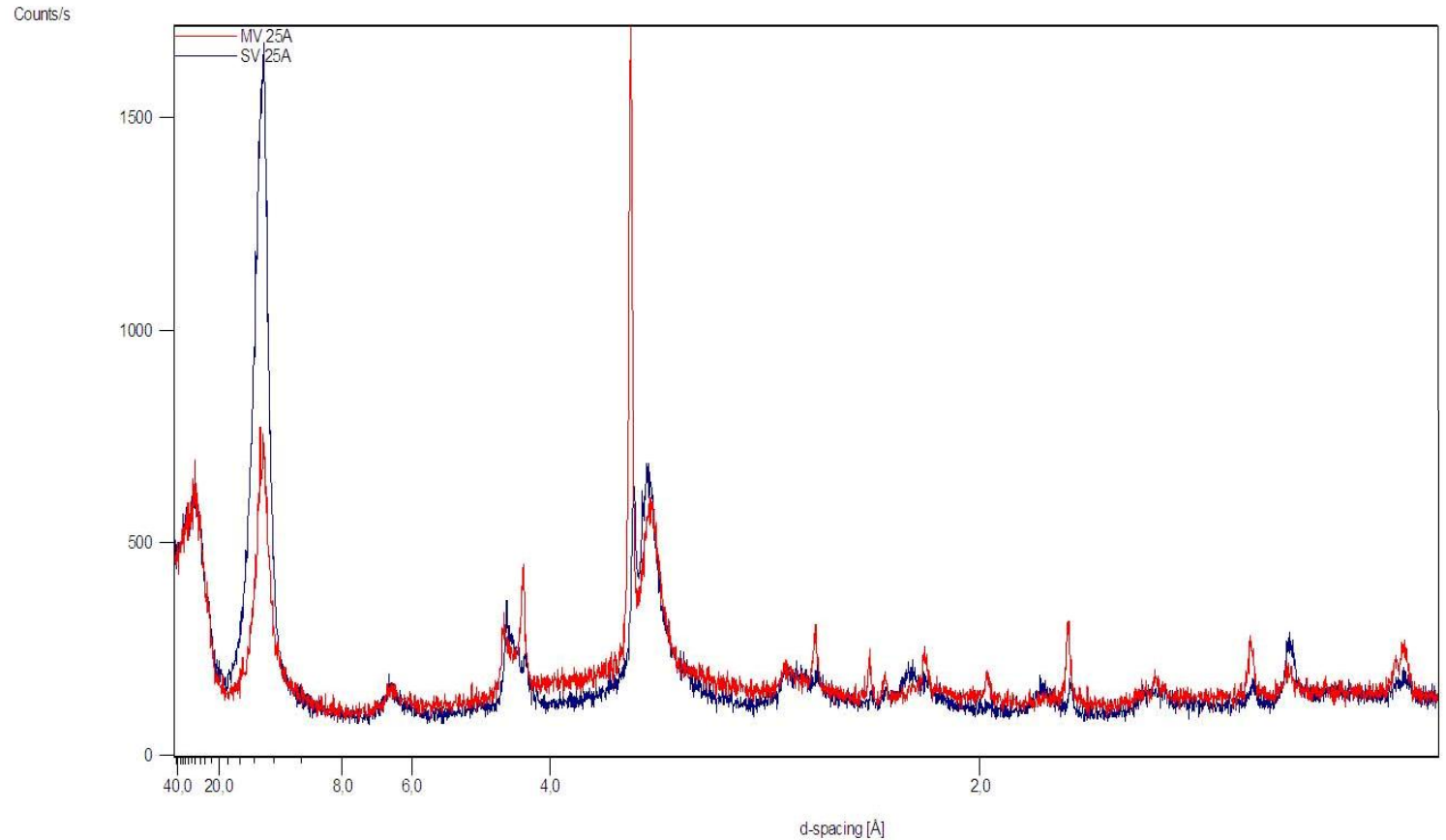
- Source materials
 1. SWY-2-Original (SWY-2-O)
 - Na-rich montmorillonite
 2. SWY-2-Purified (SWY-2-P)
 - Freeze dried and purified SWY-2-O –material (purification done in VTT/Emmi)
- + analyses after dissolution tests (all together 11)

Name	Smectite %	Quartz %	others
SWY-2-O	80	15	K-feldspar, Calcite
SWY-2-P	95	5	none
SWY-2-P light	96	4	none
SWY-2-P dark	99	1	none
MV 25A	80	20	none
SV 25A	98	2	none
VMV 60A	95	5	none
VMV 25A	95	5	none
VSV 25A	95	5	calcite

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In addition, two small samples were analysed, but the percentage estimation was not reliable.

All the results are semiquantitative.



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Greene-Kelly test

..to make a difference between montmorillonite and beidellite

- **Montmorillonite** Si in the tetrahedrons and mainly Al in the octahedrons
Ratio between tetrahedral (x_t) and octahedral (x_o) charges $x_o / x_t > 1$
Diocahedral
- **Beidellite** Si and Al in the tetrahedrons and mainly Al in the octahedrons
Ratio between tetrahedral (x_t) and octahedral (x_o) charges $x_o / x_t < 1$
Diocahedral

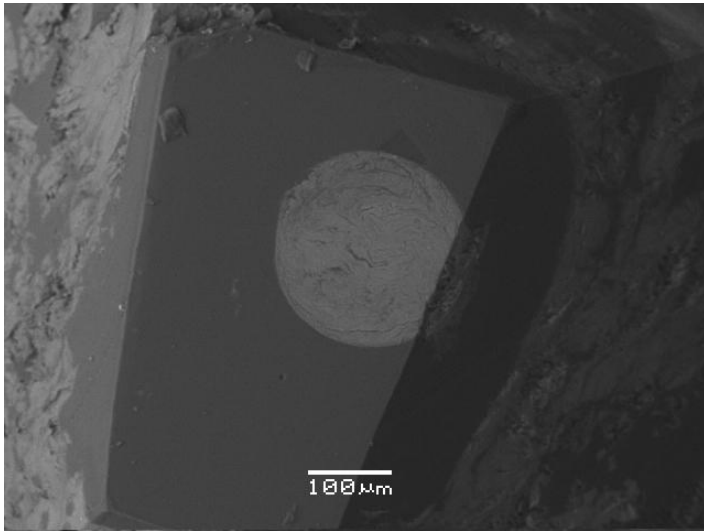
...Li-exchange method is not yet ready for use...

2. SEM (Scanning electron microscope)

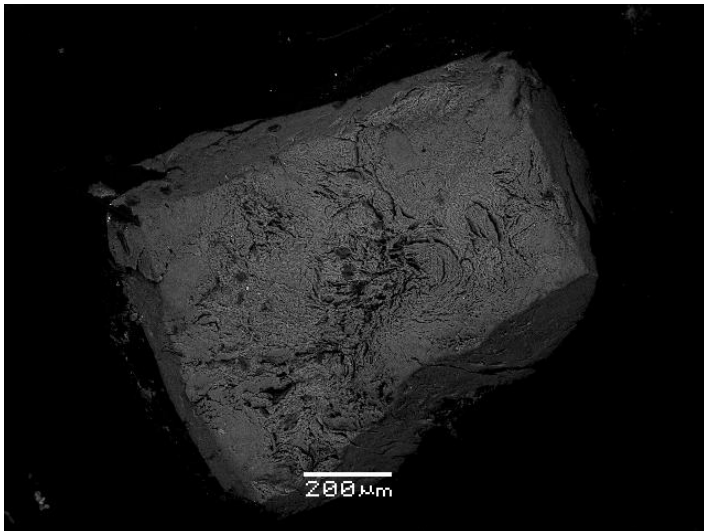
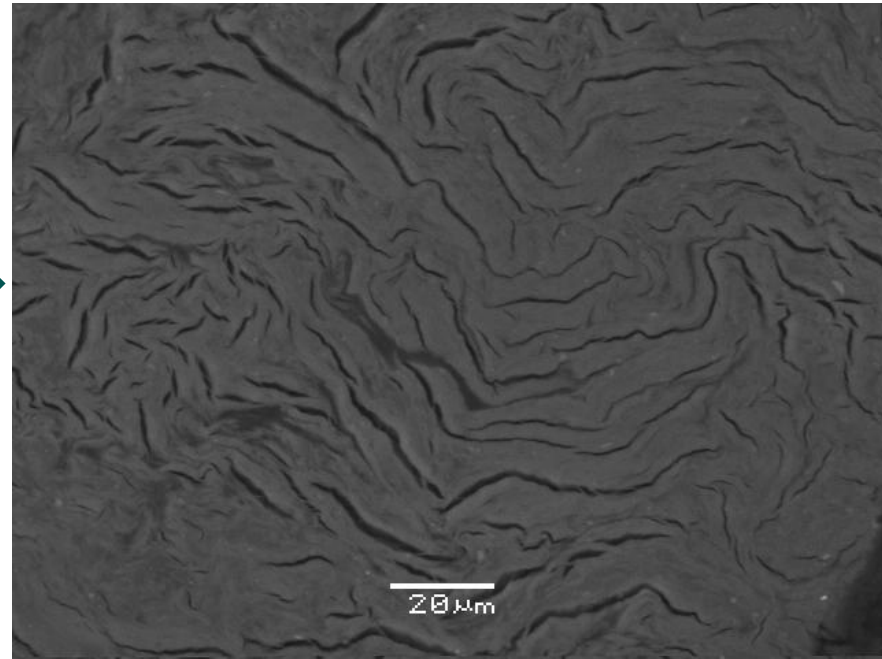
The length of the cylinders is 1.5 cm and diameter 7 mm.

Samples:
Michal
Matusewicz





Sample Ca-m A



Sample Na-m E

Sample	MgO	Al ₂ O ₃	SiO ₂	FeO	CaO	Na ₂ O	
MX-80 A	2.7	20.7	69.7	4.0	-	-	ave of 2
MX-80 noname	2.9	24.0	71.6	2.6	-	-	ave of 15
MX-80 D	2.8	22.9	72.0	2.3	-	-	ave of 3
MX-80 D	2.6	21.0	72.8	2.5	1.7	-	ave of 8
MX-80 F	2.8	22.3	72.2	2.7	-	-	ave of 11
MX-80 F	3.2	22.8	70.2	2.4	1.0	1.4	ave of 8
Ca-m A	2.4	21.7	70.5	2.8	2.6	-	ave of 32
Na-m A metal	2.5	22.6	73.2	2.6	-	-	ave of 3
Na-m A	2.4	21.6	73.3	2.6	-	-	ave of 21
Na-m A	2.4	22.3	72.1	2.4	-	0.7	ave of 9
Na-m E	2.2	21.8	70.4	2.9	-	2.6	ave of 15

Analyses from the clay matrix were surprisingly similar.



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Electron microprobe (EPMA)



Samples Ca-A and MX-F



Samples Swy-2-O and Swy-2-P

	% *	Swy-2-O **	Swy-2-P**
SiO ₂	59.6	58.2	59.4
Al ₂ O ₃	21.1	18.7	18.8
MgO	3.3	2.4	2.2
Na ₂ O	2.5	0.3	0.6
FeO	-	3.4	3.1
H ₂ O ⁺	4.5		
H ₂ O ⁻	8.9		
Tot. H ₂ O	13.4	16.7	15.5
Tot.	99.9		

•Theoretical composition (w-%) of montmorillonite. Olin et.al. 2011. Coupled behaviour of bentonite buffer. Results PUSKURI-project. VTT Research Notes 2587. 85 p.

** average of three best results

Plans for the year 2012

- **XRD:** analyses of materials from dissolution tests
- **SEM:** more detailed studies of the same samples that were preliminary studied in 2011, including Feature-analysis.
 - Estimation the amounts of accessory minerals
- **EPMA:** improve sampling technique to get more reliable quantitative analysis from clay matrix.