

# BOA and Safety Functions of Buffer

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## Definitions

- Physicochemical reality (PC): final disposal conditions, sodium bentonite
  - Evolving external conditions, material properties and processes changing them
- Bentonite buffer must fulfil some safety functions (SF): closing of spent fuel, beneficial chemical conditions, mechanical protection
  - Transport by diffusion only, no corrosion of copper, dampening of dislocations
  - Predictable conditions
- Several research methods are available (RM): main division to experimental, theoretical and computational methods
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## Hierarchy

- Purpose-Structure-State-Performance
- Purpose is set by SF, which is sub entity of PA-analysis
- SF defines also part of structure for the buffer research, however mainly without couplings
- Most part of structure is obtained understanding of PC
- State of work varies, and those of highest importance may be not be best known and must studied
- There are also differences in performance of sub systems: in some cases present level of knowledge is not performing very well compared to needs set by SF

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LS-TUPER

Very limited set of  
parameters and processes

Performance and safety analysis:  
prediction evolution – estimation of  
RN release

BOA

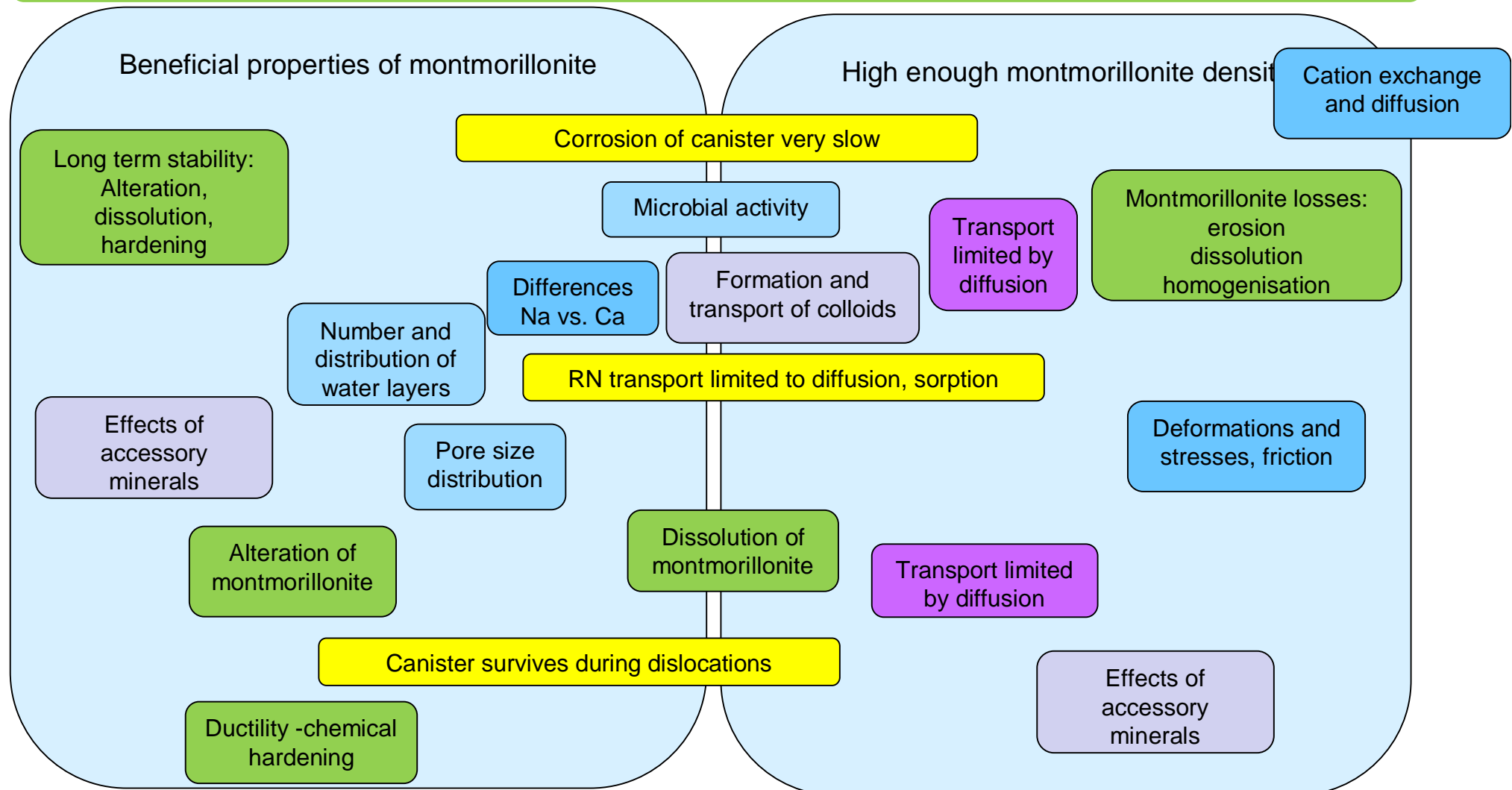
Selected set of quantities guarantying beneficial  
properties – and set of processes altering them

Safety functions:  
protect canister, and limit and delay  
release of RN

Physicochemical reality: repository conditions and bentonite buffer

## Structure & processes vs. PA

Safety functions: protect canister, and limit and delay release of RN

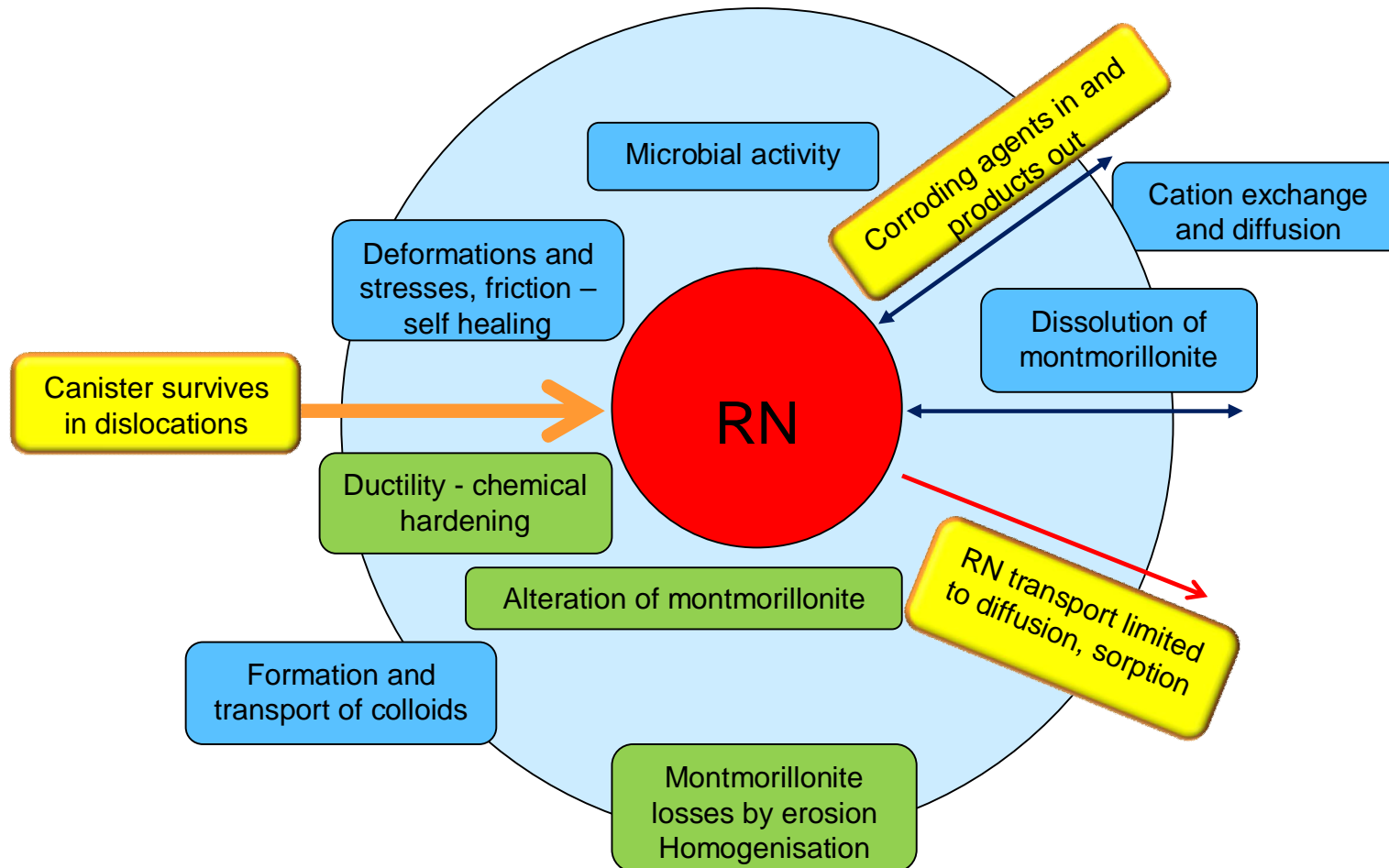


**Safety functions: protect canister, and limit and delay release of RN**  
**Processes related to these shown below**

Boxes of blue colour = BOA

Boxes of green colour = other issues

Boxes of yellow colour = safety functions

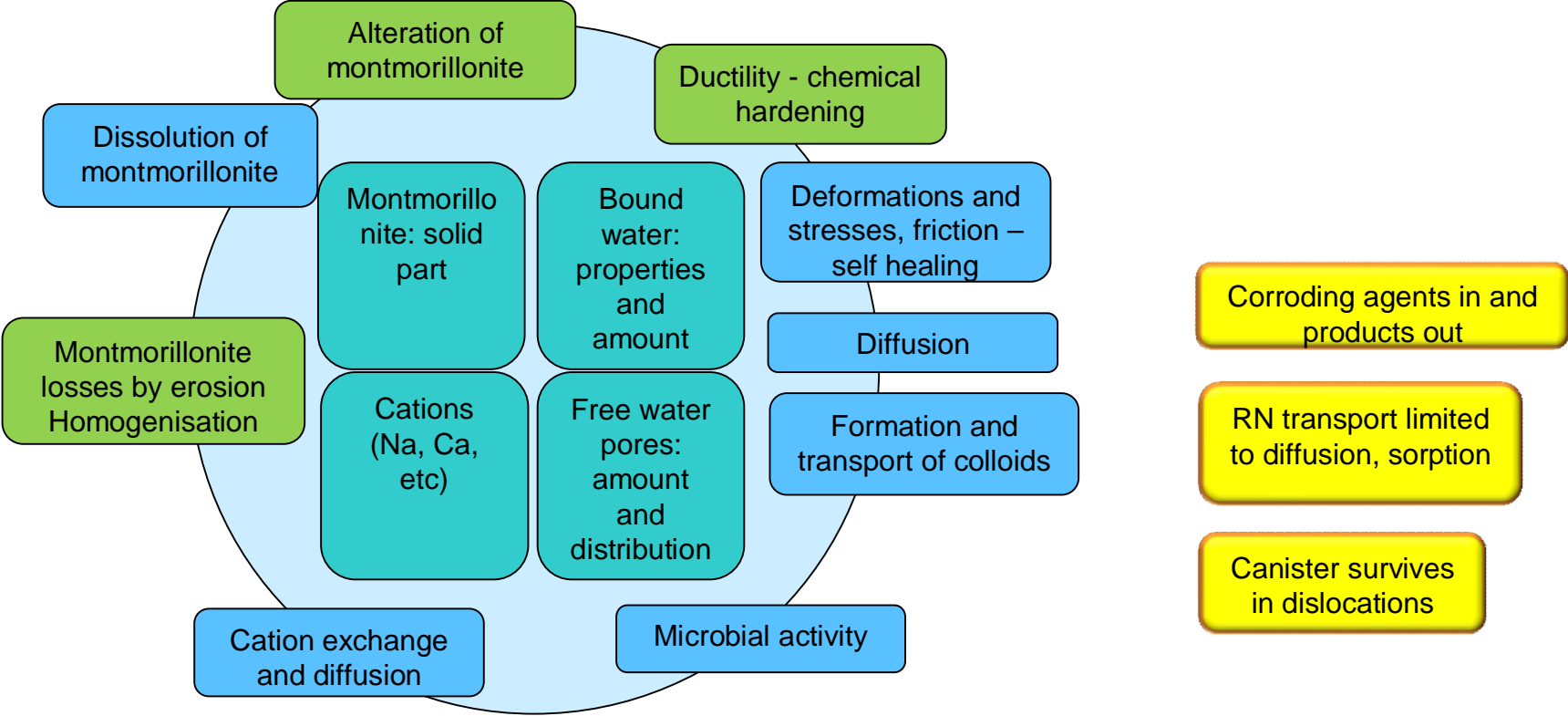


## Structure related to processes

Boxes of blue colour = BOA

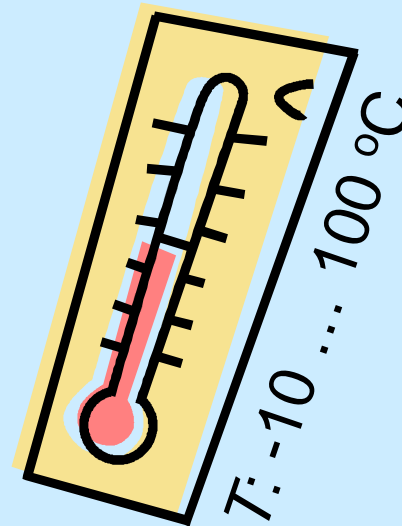
Boxes of green colour = other issues

Boxes of yellow colour = safety functions





$P: 0.1 \dots 4 \text{ MPa}$

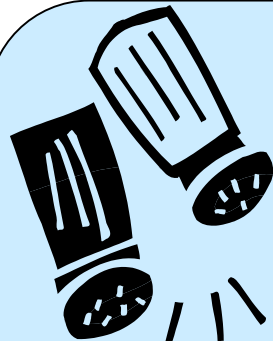


$T: -10 \dots 100 \text{ } ^\circ\text{C}$

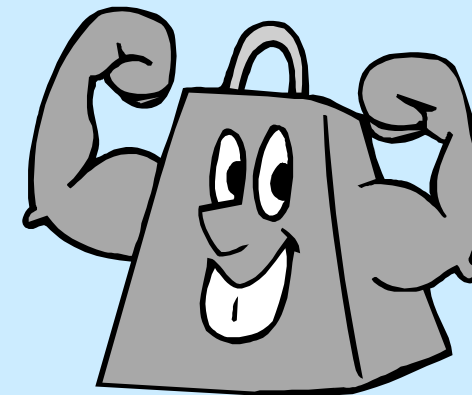


$S: 0.3 \dots 1$

## Conditions



$I: 0.01 \text{ mM} \dots 1 \text{ M}$   
 $1 \text{ mg/L} \dots 100 \text{ g/L}$   
 Na-Ca-Cl



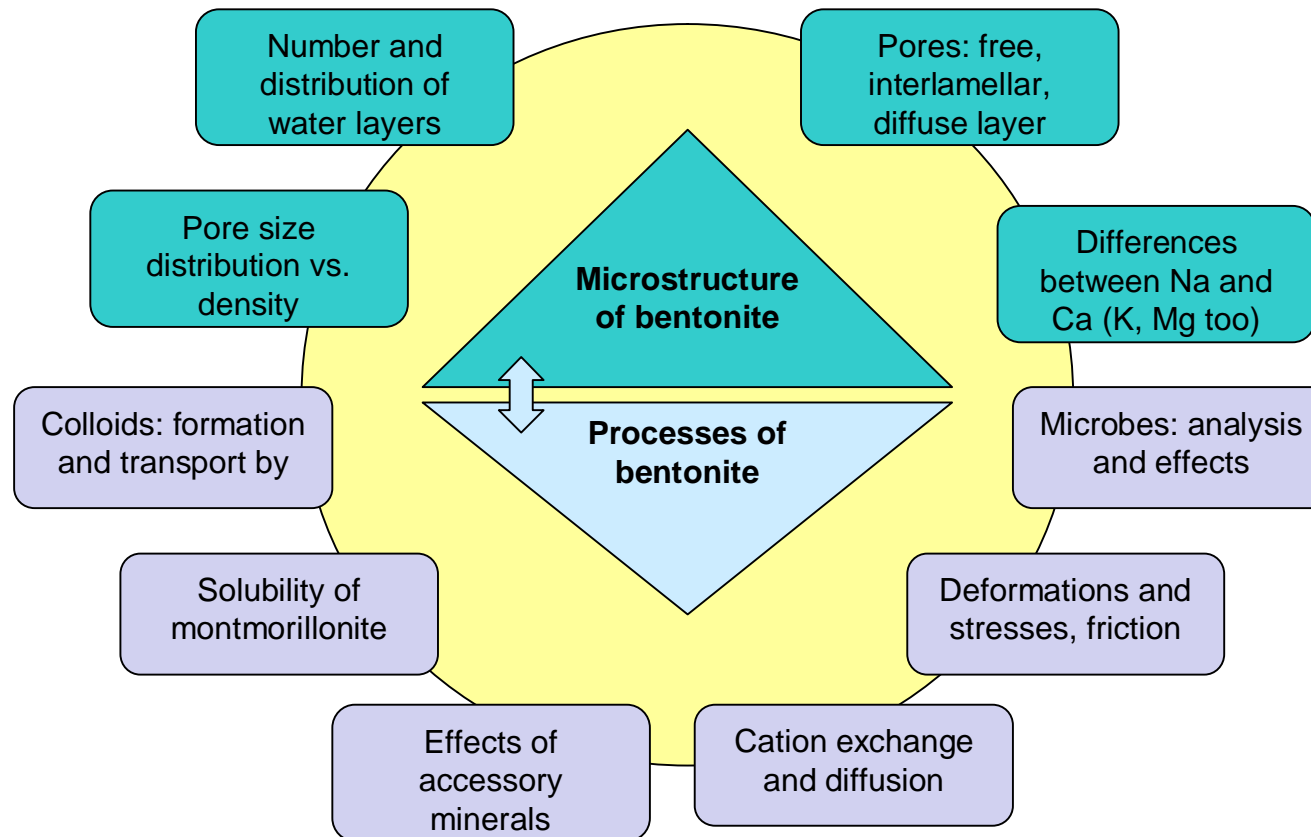
$\rho_d: 1 \dots 1\,700 \text{ kg/m}^3$



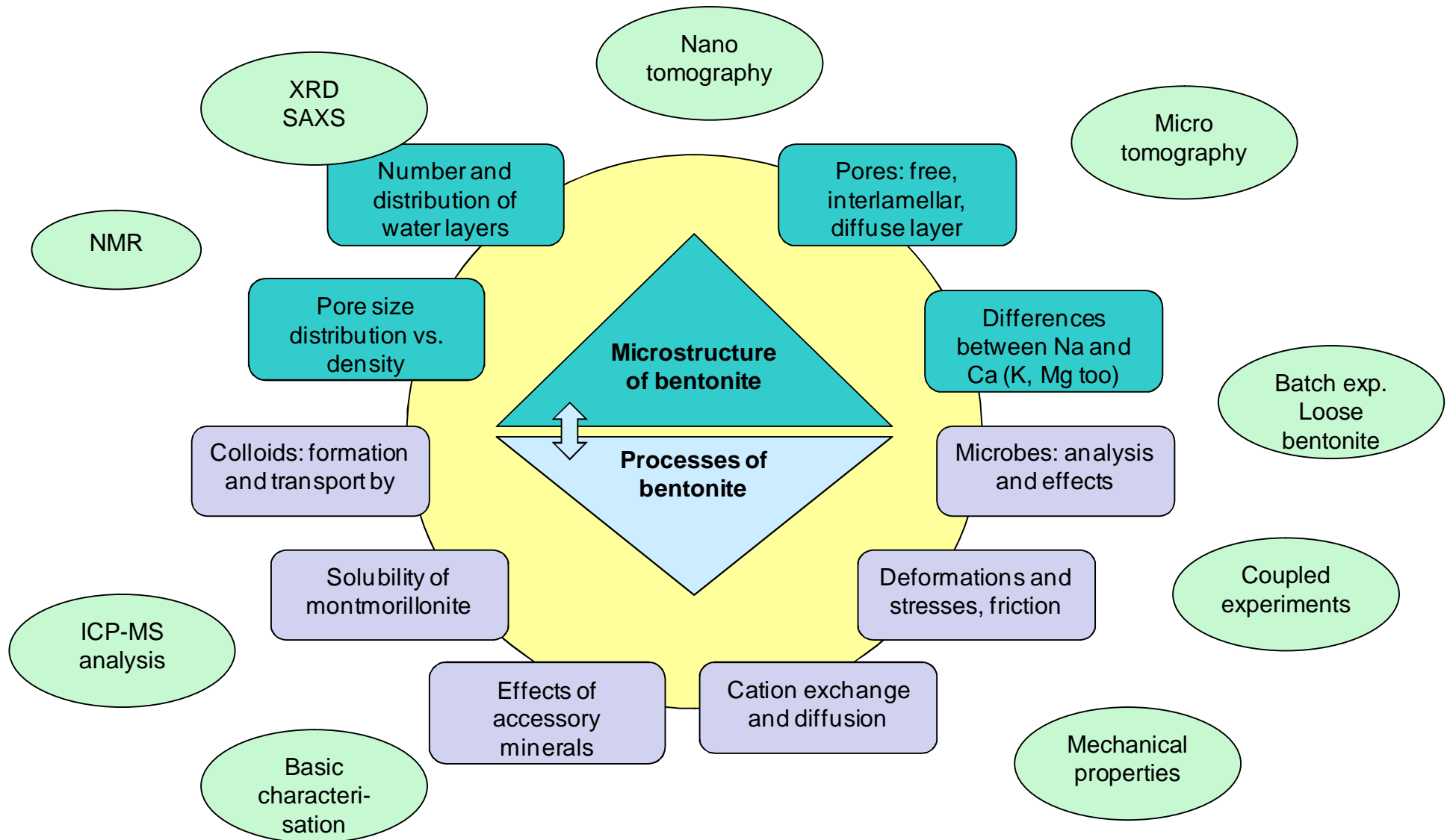
## Scales and bentonite characteristics

- Colloidal size
- Pore size
- Laboratory
- Small scale
- Pilot scale
- Repository scale
- Relative amount of montmorillonite
- Cationic form of montmorillonite
- Accessory minerals
- Grain size, initial water content

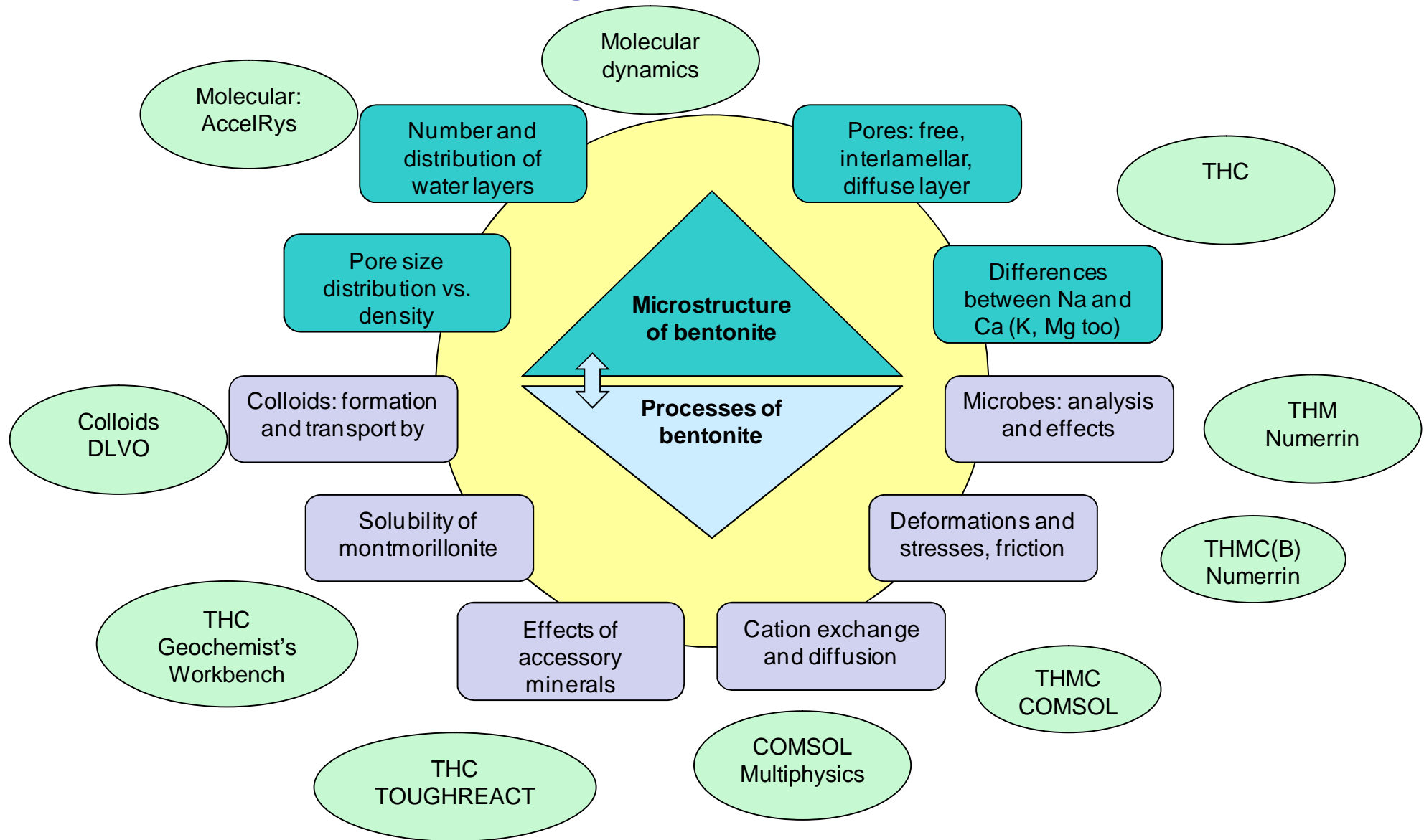
## Structure and processes



## Experimental methods



# Modelling methods and tools



## Goals

- THMC(B)-model, which good enough over predicted conditions
  - Concept based on experimental observations
  - All needed data can be measured
  - Consistent model mathematics
  - Implementation possible by present computing resources
- Karakterisointi- ja analyysimenetelmät, joilla voidaan tehdä tarvittavat määritykset
  - Riittävän tarkka ja luotettava kokeellinen määrittäminen
- Prosessikokeet, jotka tukevat mallinnusta ja joiden toteutusta auttavat sopivat karakterisointi- ja analyysimenetelmät
  - Tarkoin valittu joukko kokeita ja testejä
- Tavoitteena EI ole ratkaista joukko ongelmia, vaan tuottaa toimintamalli, jolla bentoniittia voidaan tutkia tehokkaasti



**VTT luo teknologiasta  
liiketoimintaa**