

# **Dolomite and limestone cement Experimental results and thermodynamic modelling**

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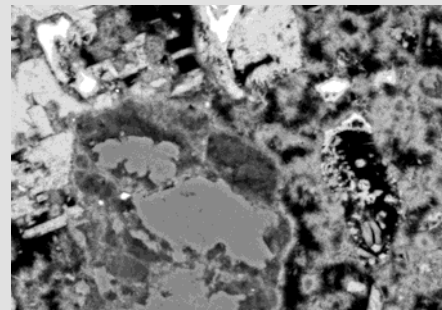
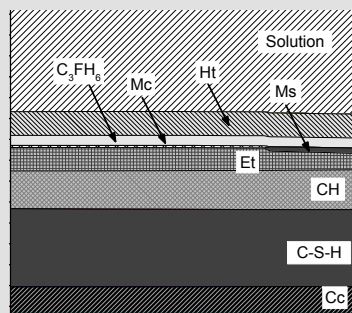
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# Outline

- **Background**
- **Results (Portland dolomite cement)**
  - Mechanical performance
  - Hydration
  - Phases assemblage: modelling and experimental results
  - Microstructure
- **Conclusion**

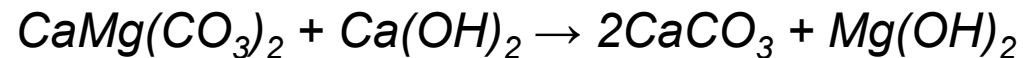


## ■ Background

### Dolomite as a supplementary cementitious material

- ➔ properties not well investigated as for other composite cement systems

#### ■ Alkali carbonate reaction



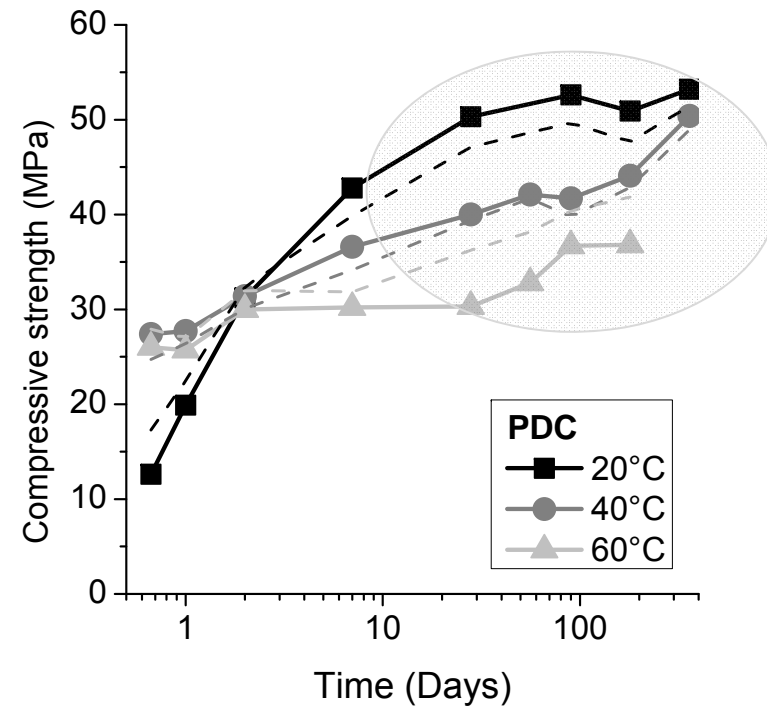
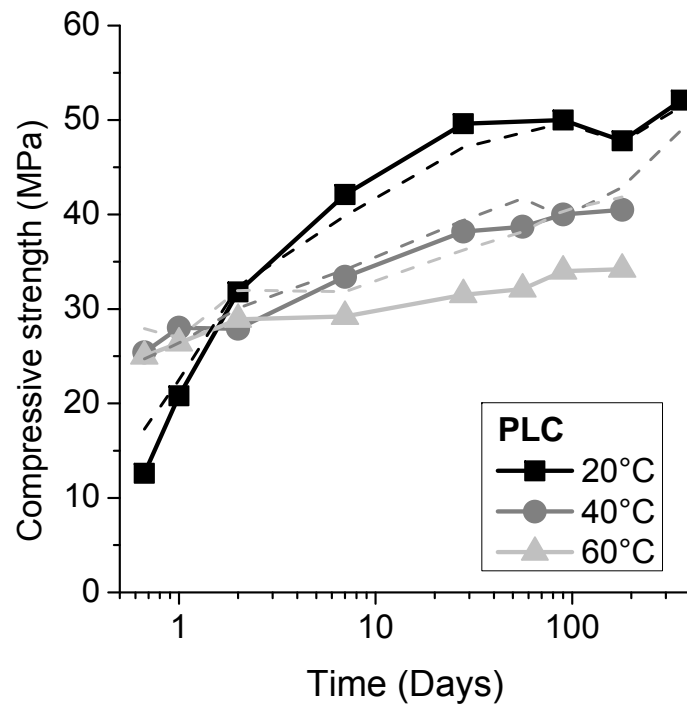
- Potential expansion

#### ■ Impact of magnesium on hydration

- Impact on the kinetics of hydration
- Stable phase composition
- Impact on the hydrates composition

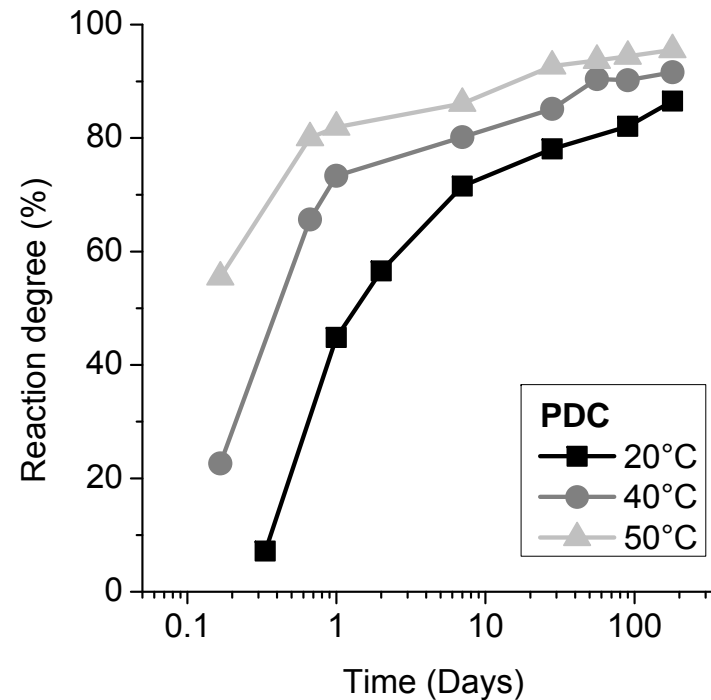
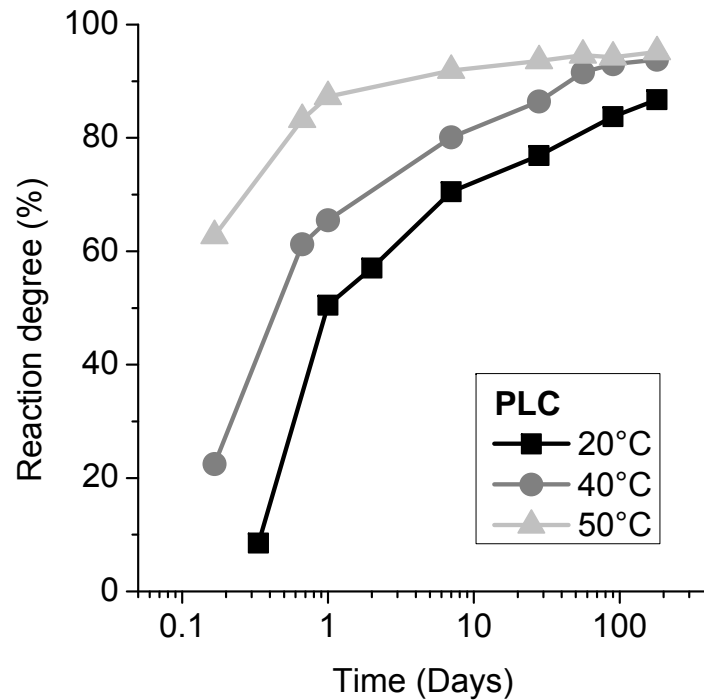
## Mechanical performance

- Similar compressive strength of PLC and PDC
- Higher temperature reduces final strength



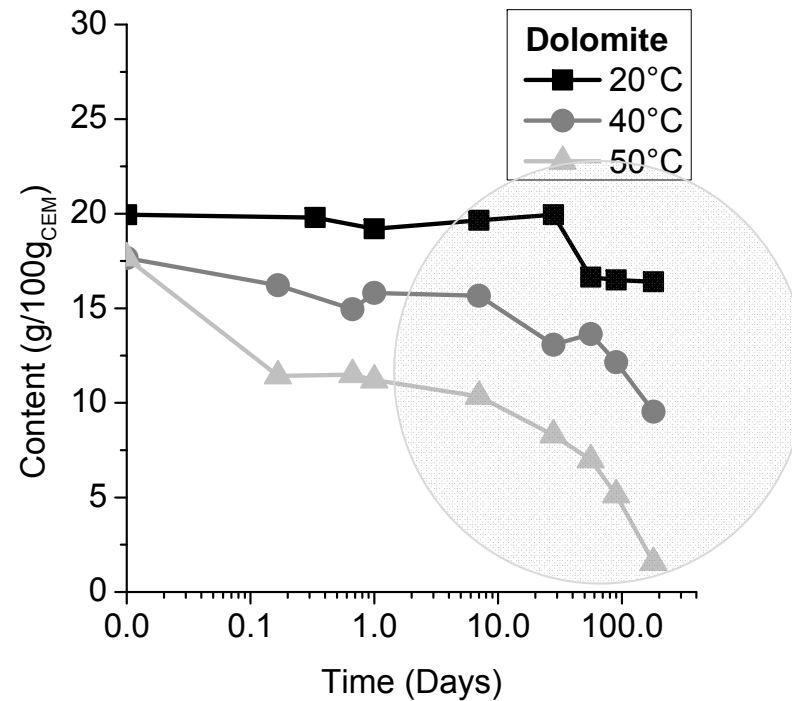
# Hydration

- **Similar reaction rate of PLC and PDC**
  - No strong effect of Mg after 1 day
- **Strong acceleration by temperature**



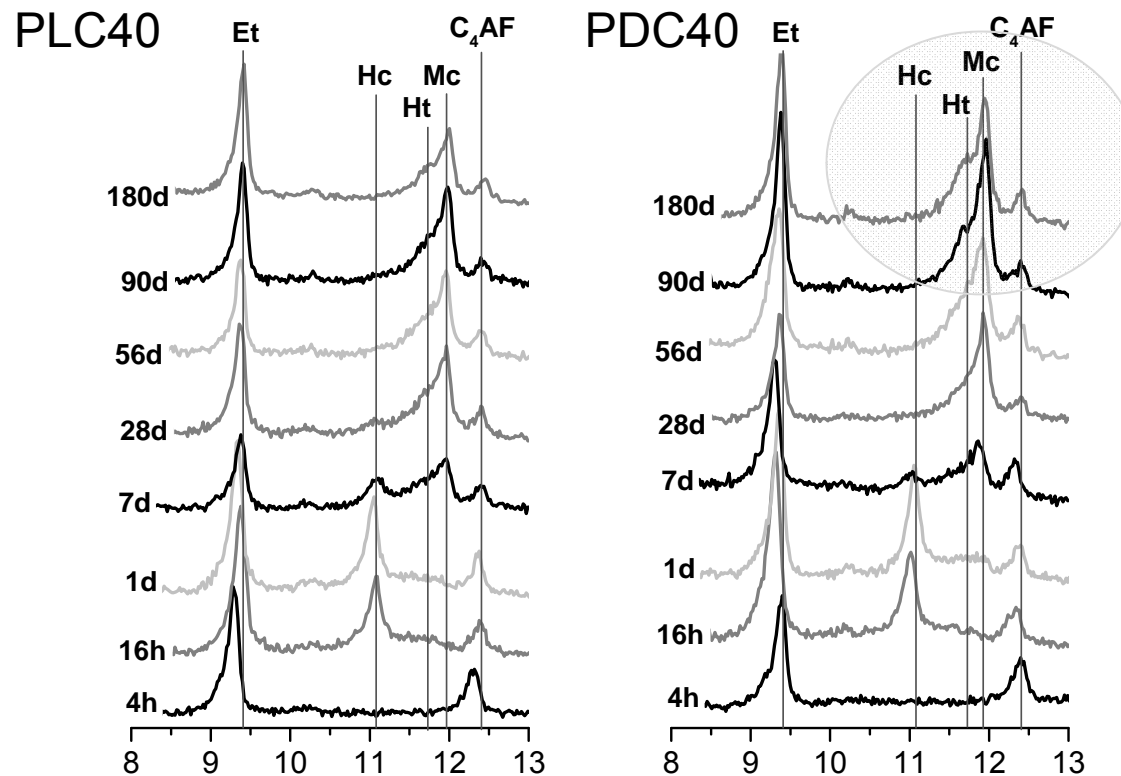
## Hydration

- **Temperature accelerates dissolution of dolomite**
  - 20°C – reaction limited at 180 days
  - 60°C – 90% of dolomite dissolves at 180 days



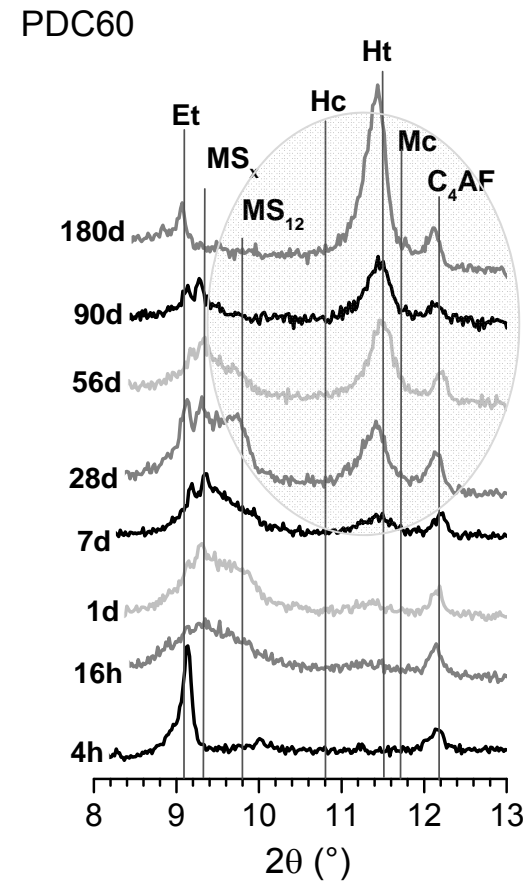
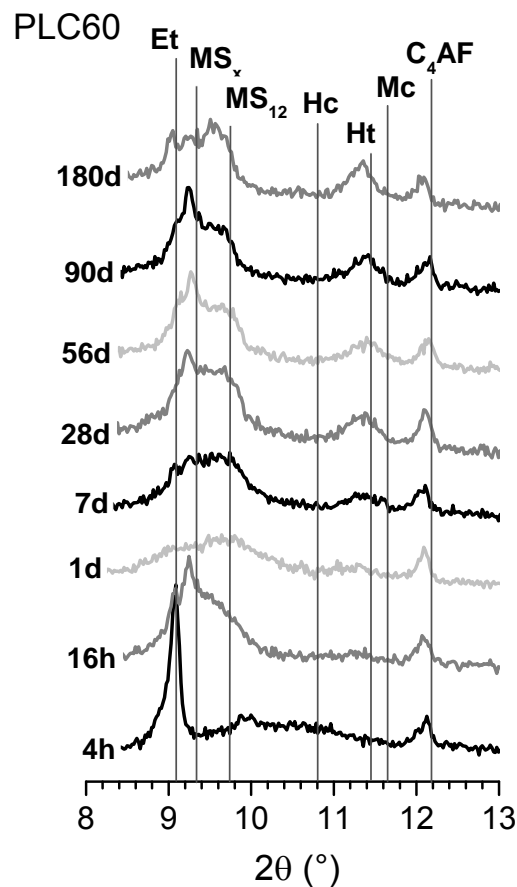
## Phase assemblage at 40°C

- No significant differences, low reaction degree of dolomite



## Phase assemblage at 60°C

- Magnesium bounds alumina to form hydrotalcite

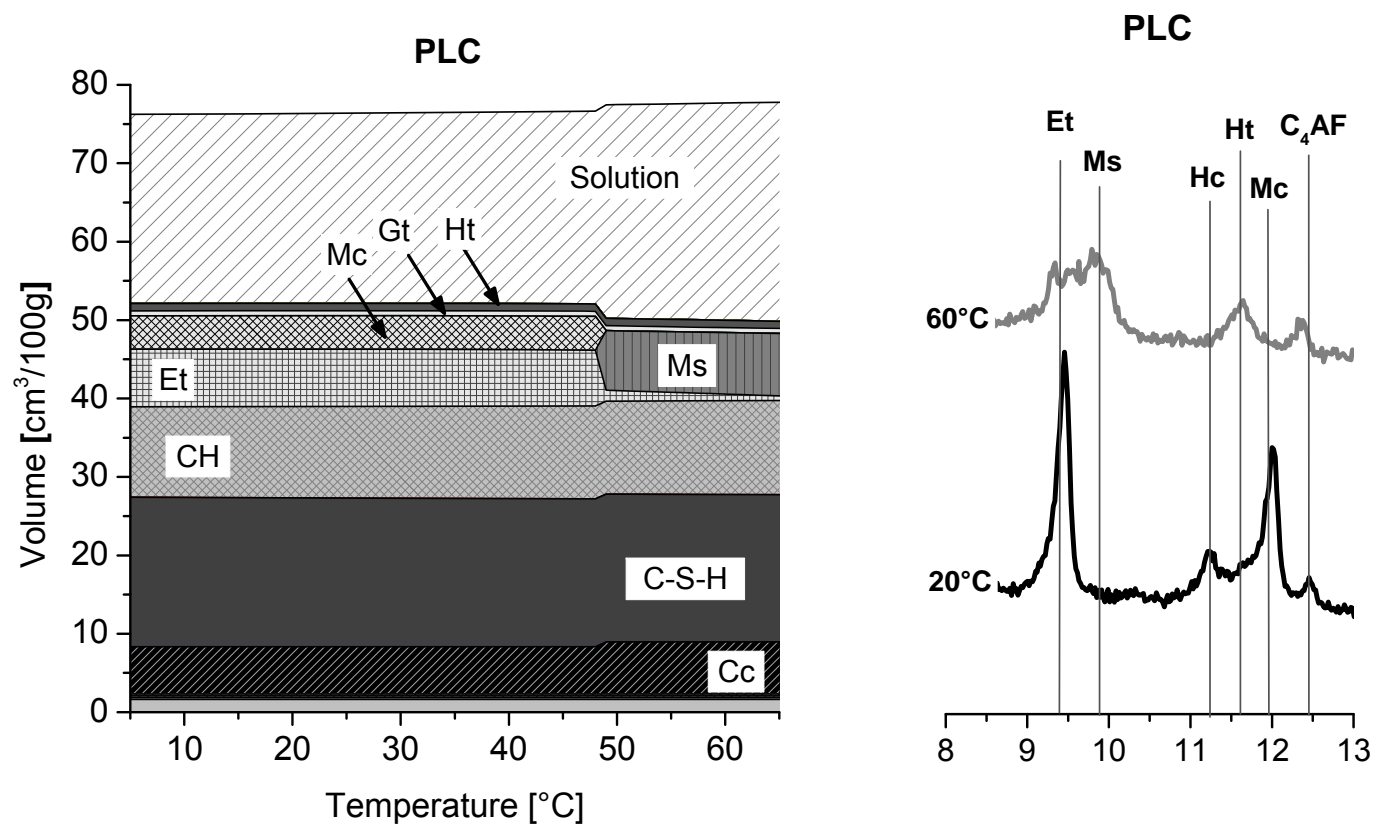




# Phase assemblage, effect of temperature

## ■ Temperature changes the phase assemblage

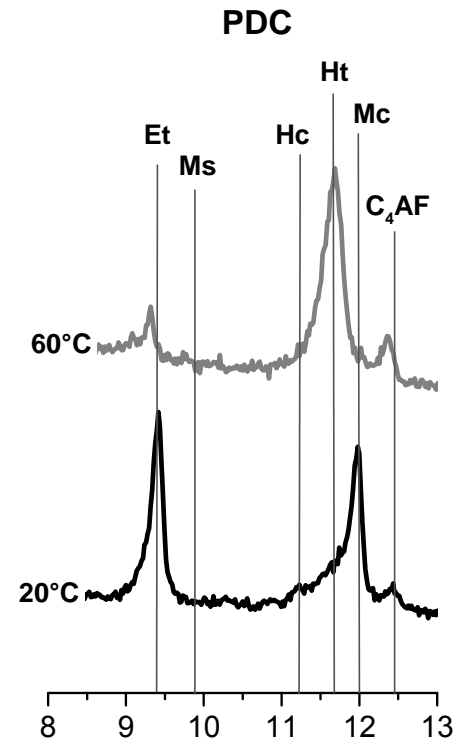
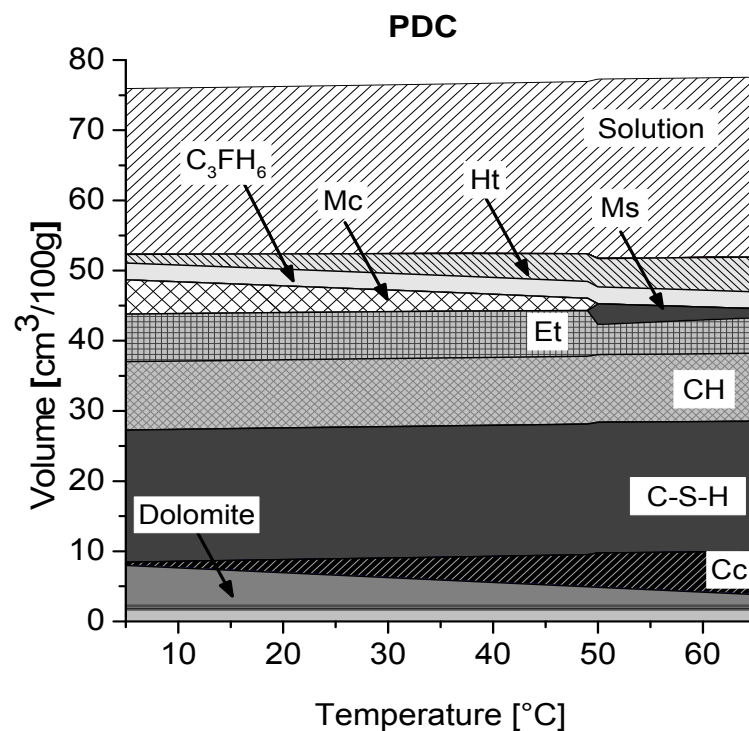
- AFt not stable above ~ 50°C



# Phase assemblage, effect of temperature

## ■ Dolomite changes the phase assemblage

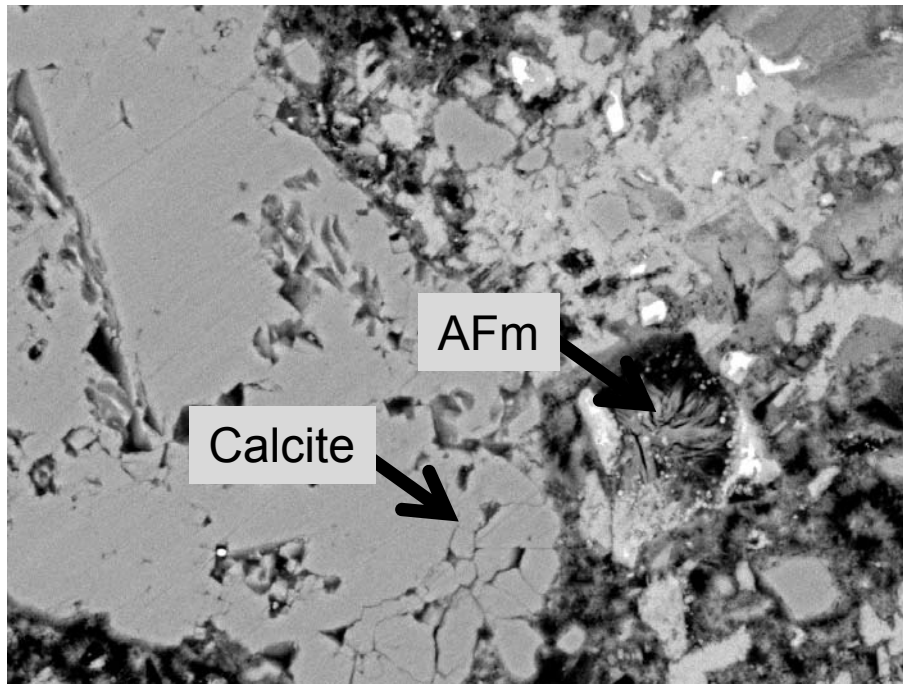
- AFm → Hydrotalcite ( $\text{Mg}_4\text{Al}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$ )
- Modelling does not predict correctly ( $\text{Mg}/\text{Al} > 2$ , AFt less stable than Ht?)



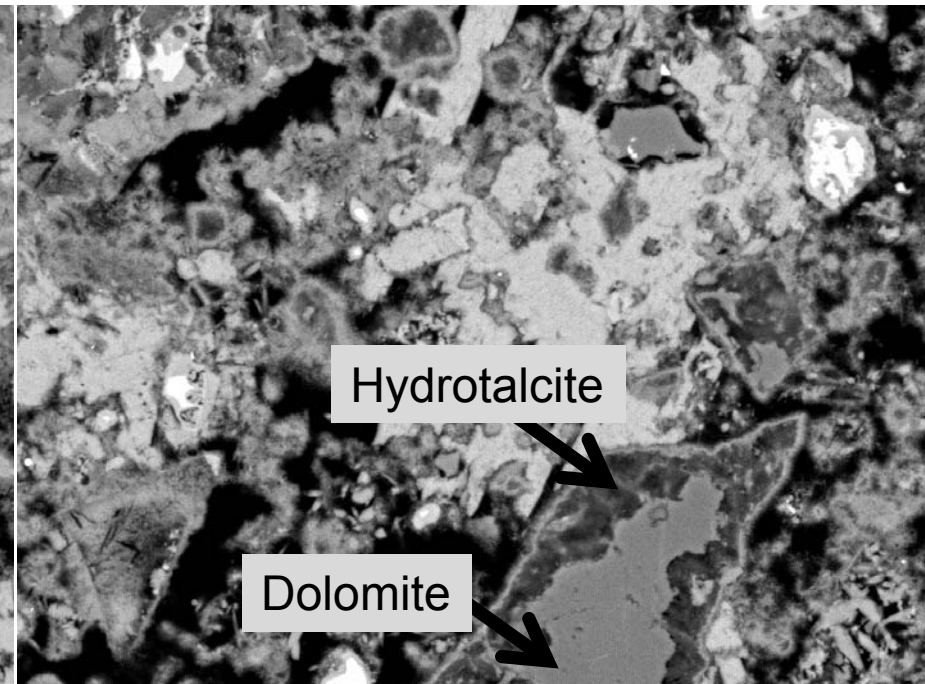
## Microstructure

### ■ Partially / fully reacted dolomite grains at 60°C

PLC 60



PDC 60



## ■ Conclusions

- **Compressive strength similar for PLC and PDS systems**
- **Dolomite is not thermodynamically stable and dissolves in cement matrix**
  - Process is very slow at 20°C
- **Main hydration product of dolomite is hydrotalcite in cement matrix**
  - Presence of brucite not confirmed
- **Magnesium react strongly with alumina**
  - Decrease of Al/Si ratio of C-S(A)-H
  - Destabilization of AFm



# For better building