Dolomite and limestone cement
Experimental results and thermodynamic modelling

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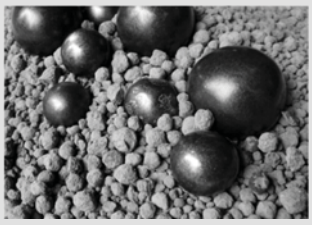
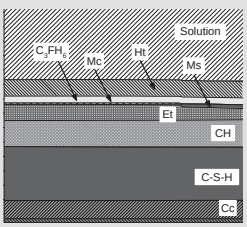
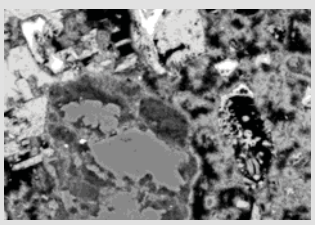
Outline

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

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Background

Dolomite as a supplementary cementitious material

➡ **properties not well investigated as for other composite cement systems**

- **Alkali carbonate reaction**

$$CaMg(CO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2$$

  - Potential expansion
- **Impact of magnesium on hydration**
  - Impact on the kinetics of hydration
  - Stable phase composition
  - Impact on the hydrates composition

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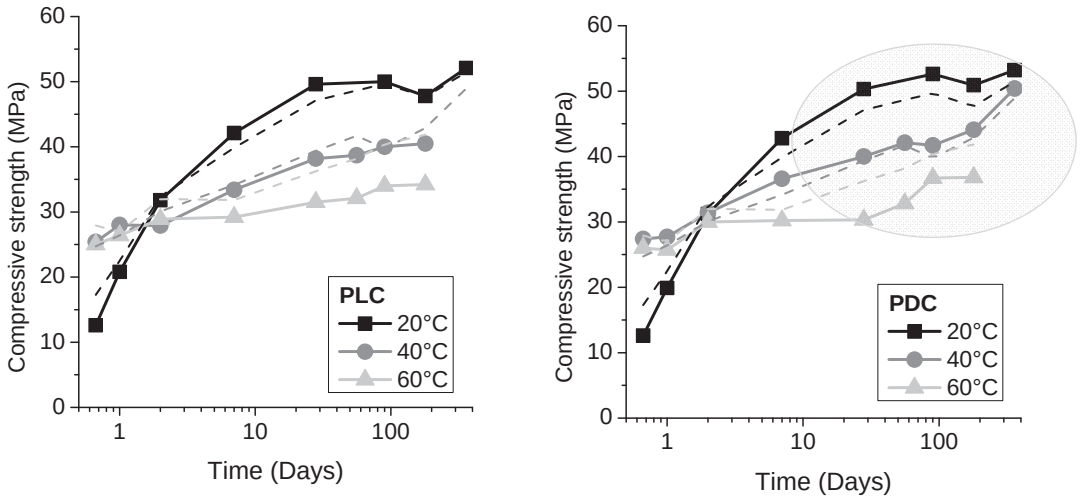
Mechanical performance

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



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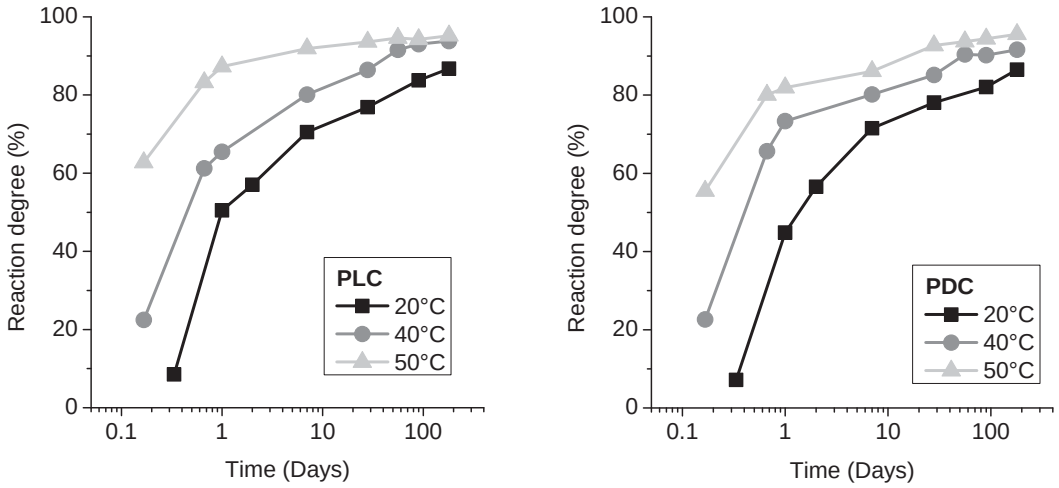
Hydration

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



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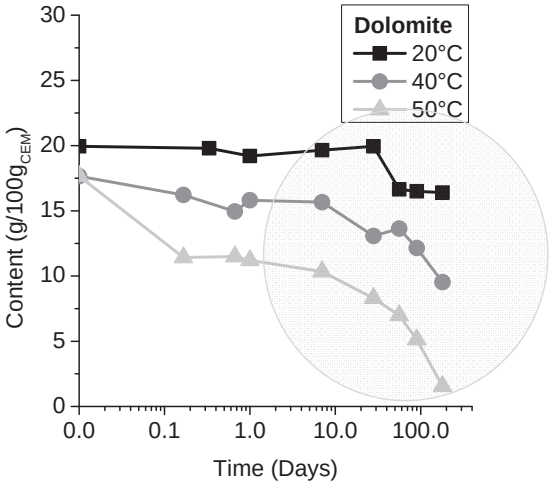
Hydration

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



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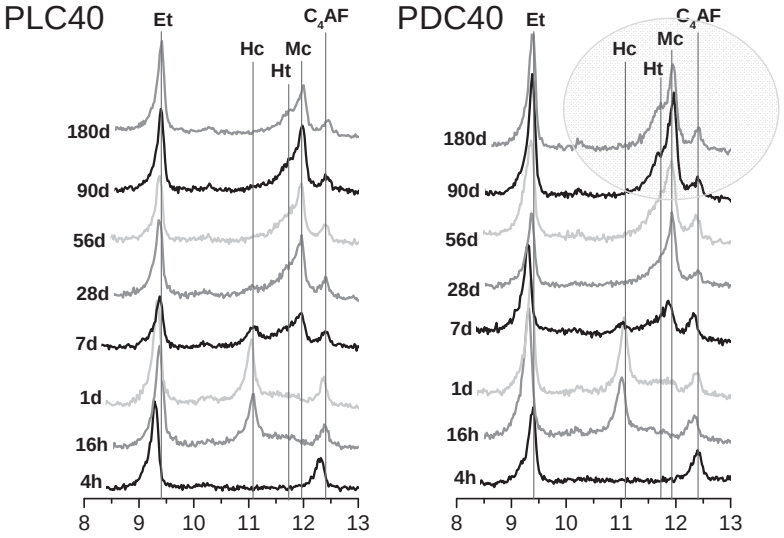
Phase assemblage at 40°C

- No significant differences, low reaction degree of dolomite



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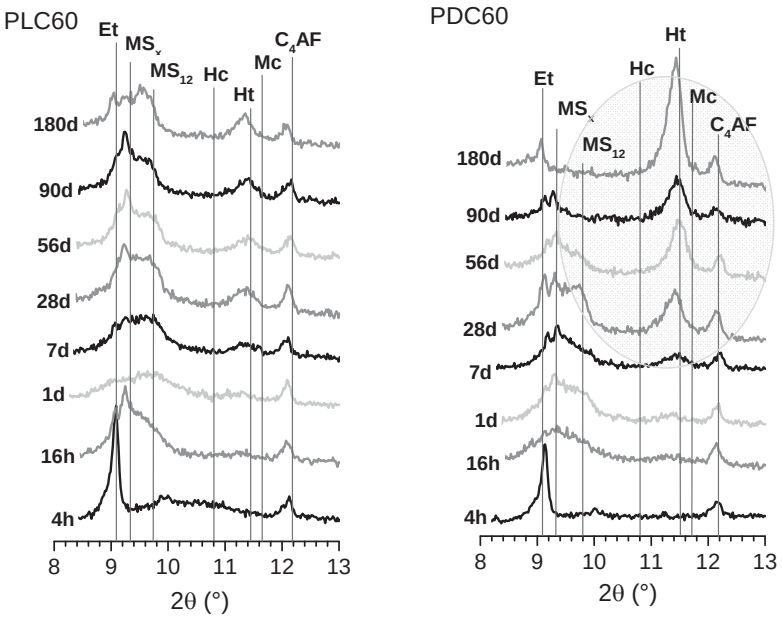
Phase assemblage at 60°C

- Magnesium bounds alumina to form hydrotalcite



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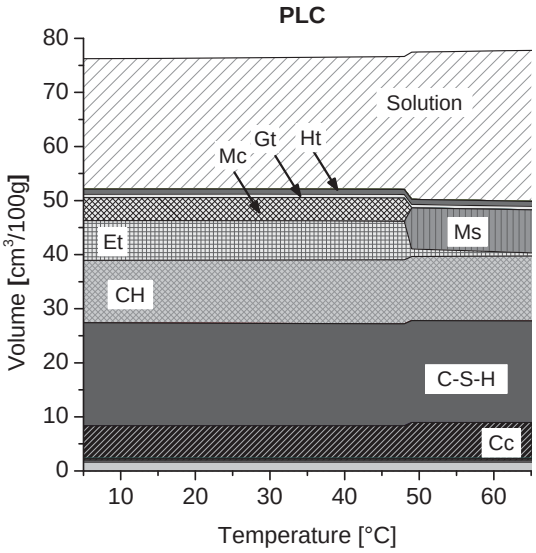
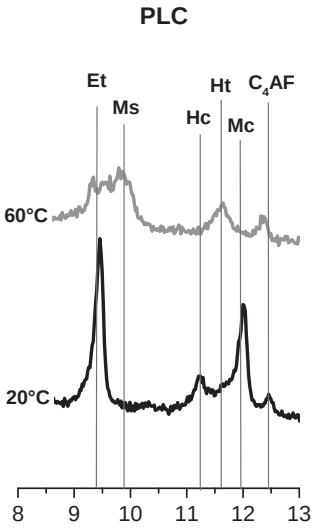
Phase assemblage, effect of temperature

- **Temperature changes the phase assemblage**
  - AFt not stable above ~ 50°C





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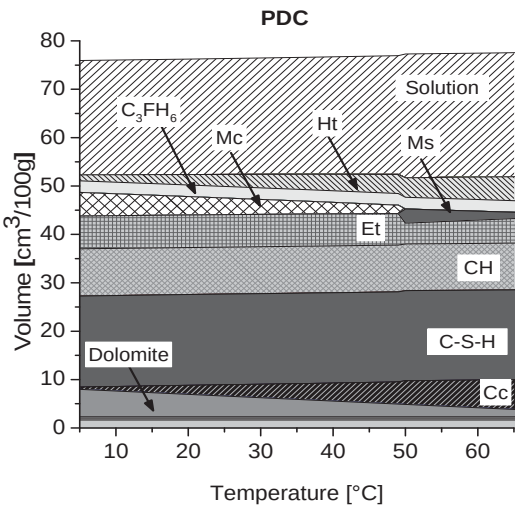
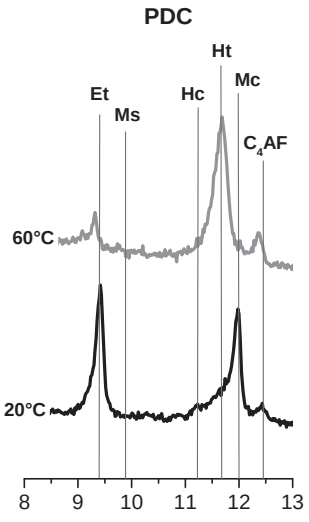
Phase assemblage, effect of temperature

- **Dolomite changes the phase assemblage**
  - AFm → Hydrotalcite ($Mg_4Al_2O_7 \cdot 10H_2O$)
  - Modelling does not predict correctly (Mg/Al > 2, AFt less stable than Ht?)





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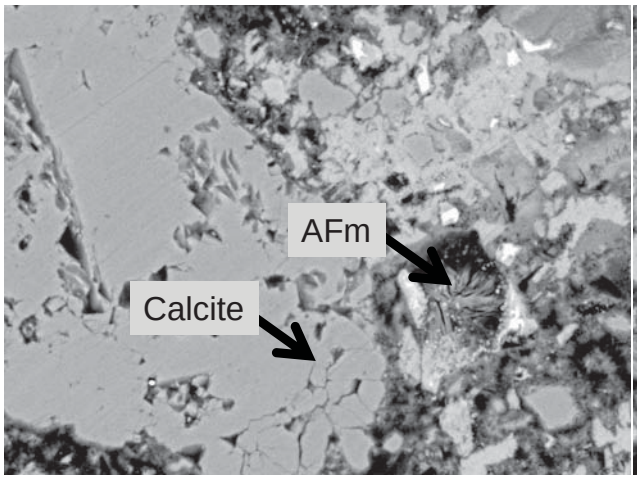
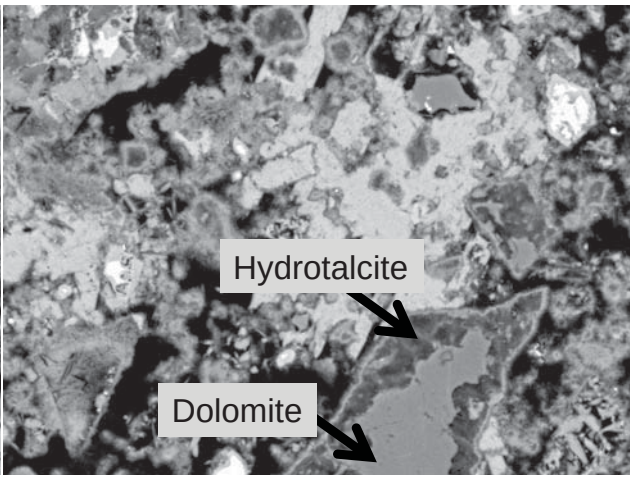
Microstructure

- **Partially / fully reacted dolomite grains at 60°C**

PLC 60



PDC 60



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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

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