Hydratation und Bindemittelgefüge von Romanzementmörteln / Matrixmikrostruktur

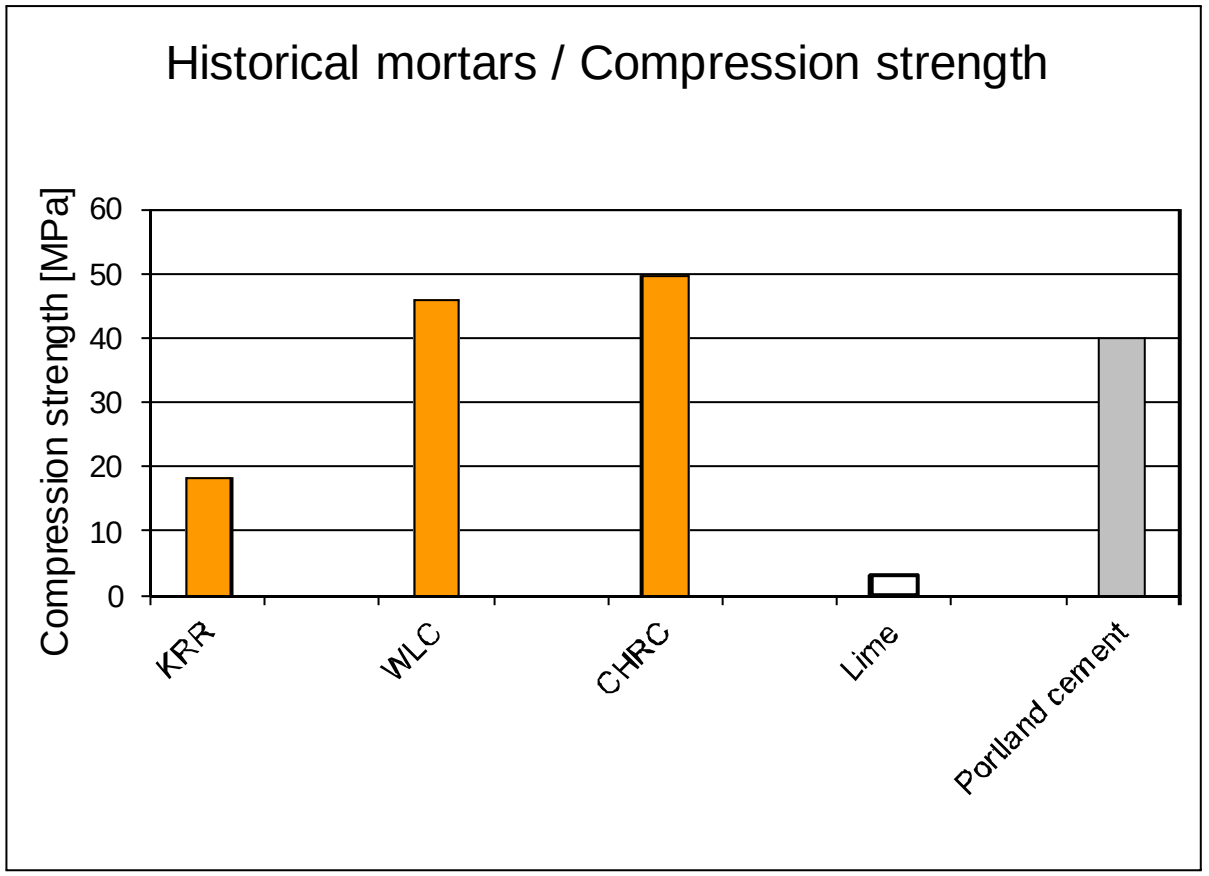
Karol Bayer / Johannes Weber
Universität Pardubice / Universität für angewandte Kunst Wien

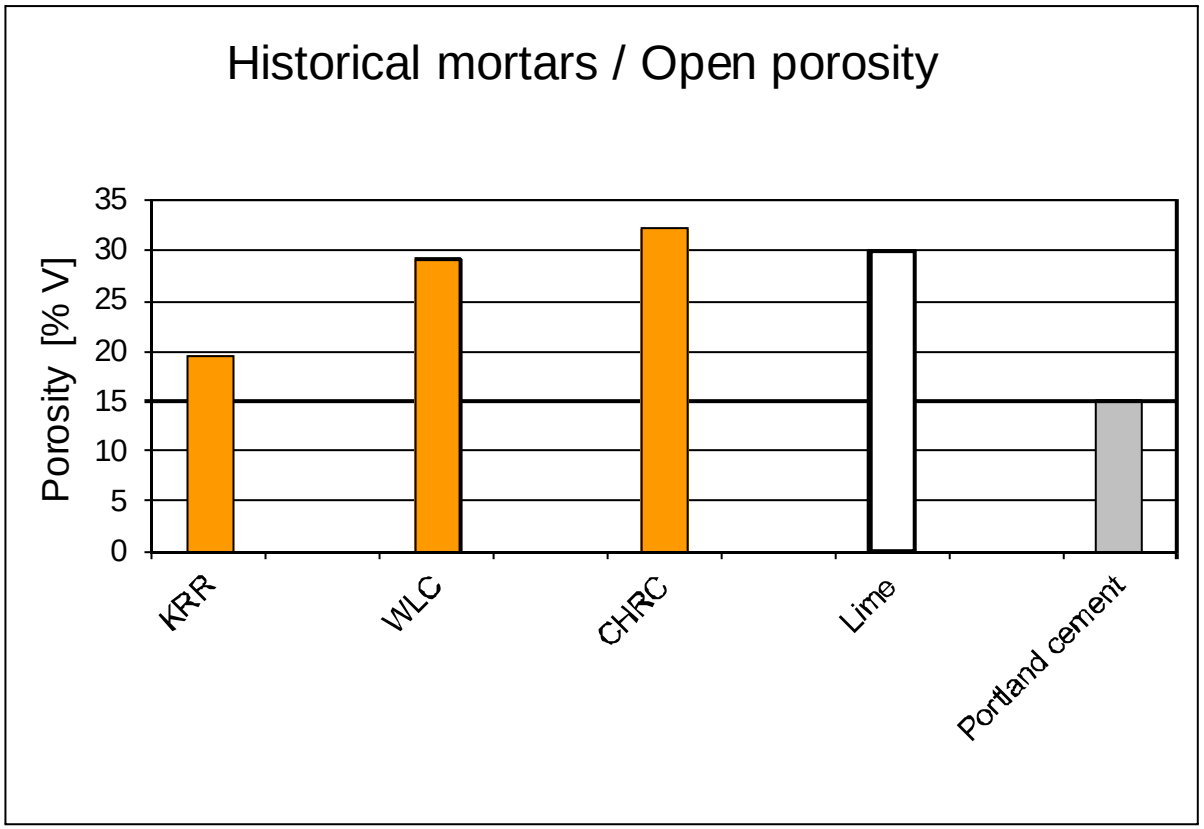
Typical properties of RC-mortars

- Quick setting
- Yellowish to reddish color
- Good durability
- High strength / high porosity






Historical mortars / Compression strength
Compression strength [MPa]
60
50
40
30
20
10
0
KRR
WLC
CHRC
Lime
Portland cement


Historical mortars / Open porosity
Porosity [% V]
35
30
25
20
15
10
5
0
KRR
WLC
CHRC
Lime
Portland cement

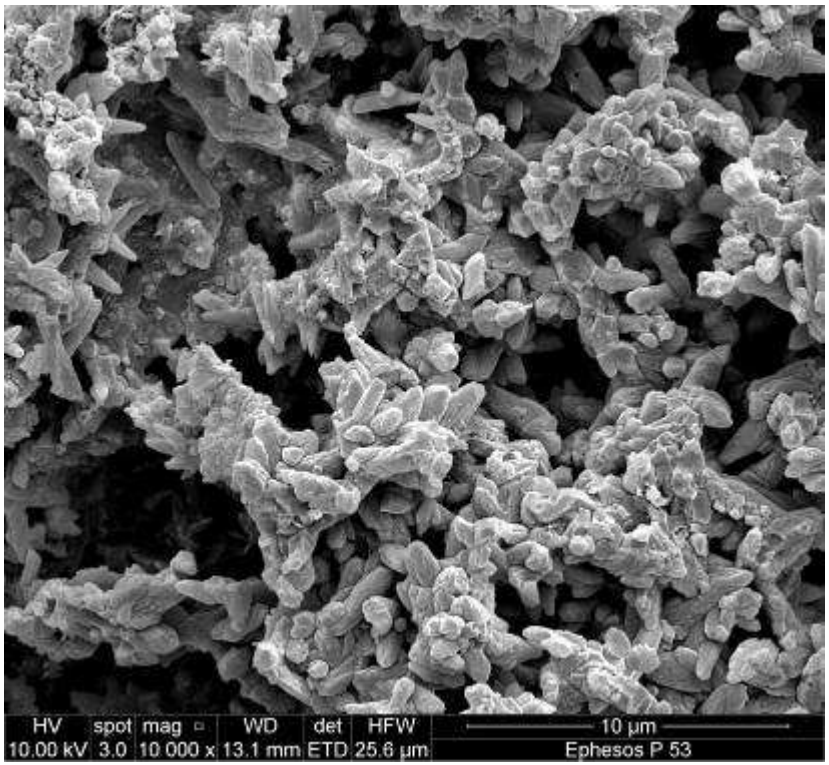
Physico-mechanical properties of RC-mortars in average

-hard, brittle, porous mortars with high water uptake and high water vapour permeability

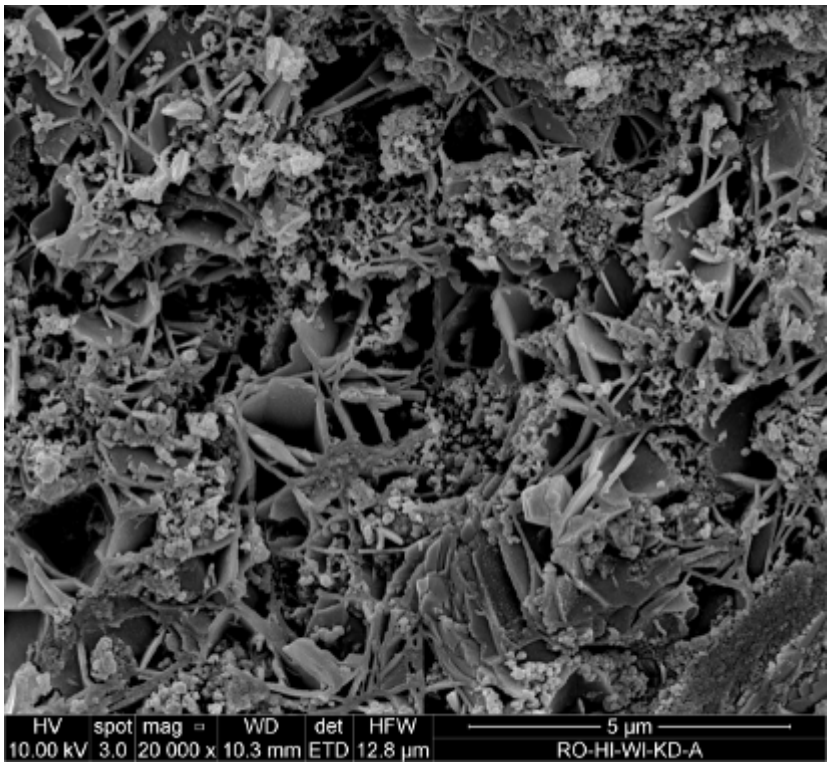
Historical RC mortars	Compression strength (N/mm^2)	Tensile strength (N/mm^2)	Elasticity modulus (kN/mm^2)	Bulk density (g/cm^3)	Open porosity (% V)	Water uptake (% M)	WAC ($g/m^2\sqrt{h}$)	Water vapour permeabilty 10^{-10} (kg/m^2sPa)
RC render	56.8	1.6±0.8(?)	11.4	1.47	37.1	25.0	12.75	4
RC cast	47.9±2.5	2.0±0.7	18.2±1.7	1.62	30.7±2.1	18.6±1.7	7.0±0.7	3

Historical RC-mortar

Variation in microstructure – different morphology of hydration products, dense and porous areas



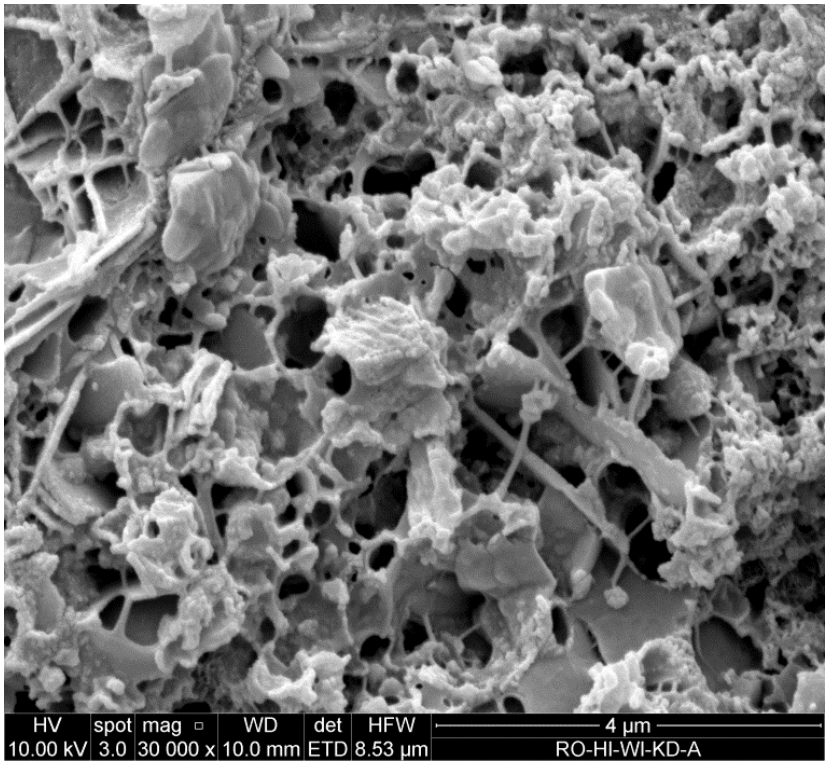
Lime mortar, Ephesos

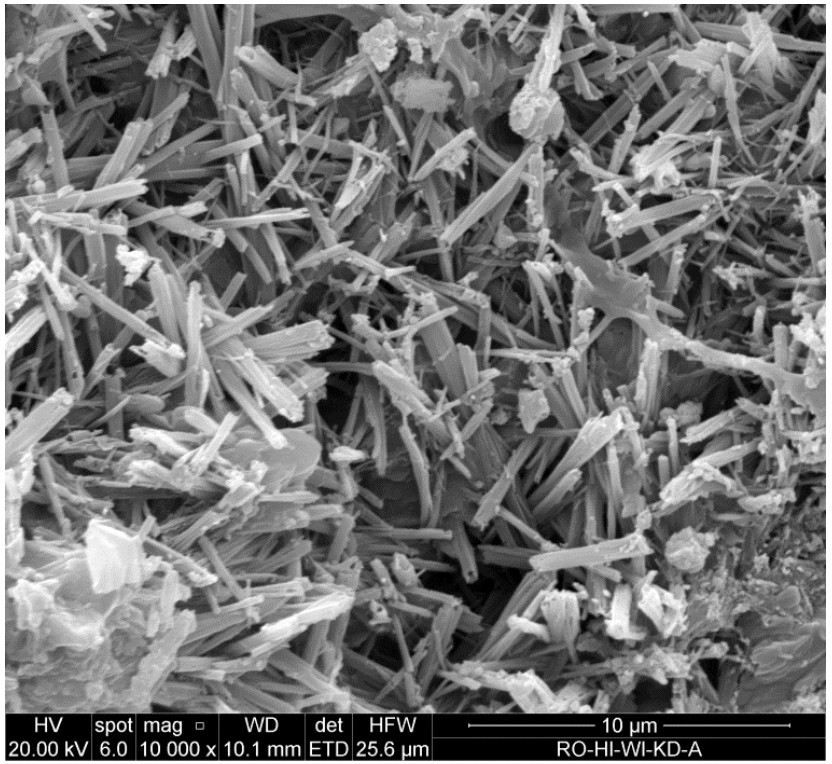


Kulissendepot, Vienna (1870), rendering

Historical mortar

Variation in microstructure – different morfology of hydration products, dense and porous areas

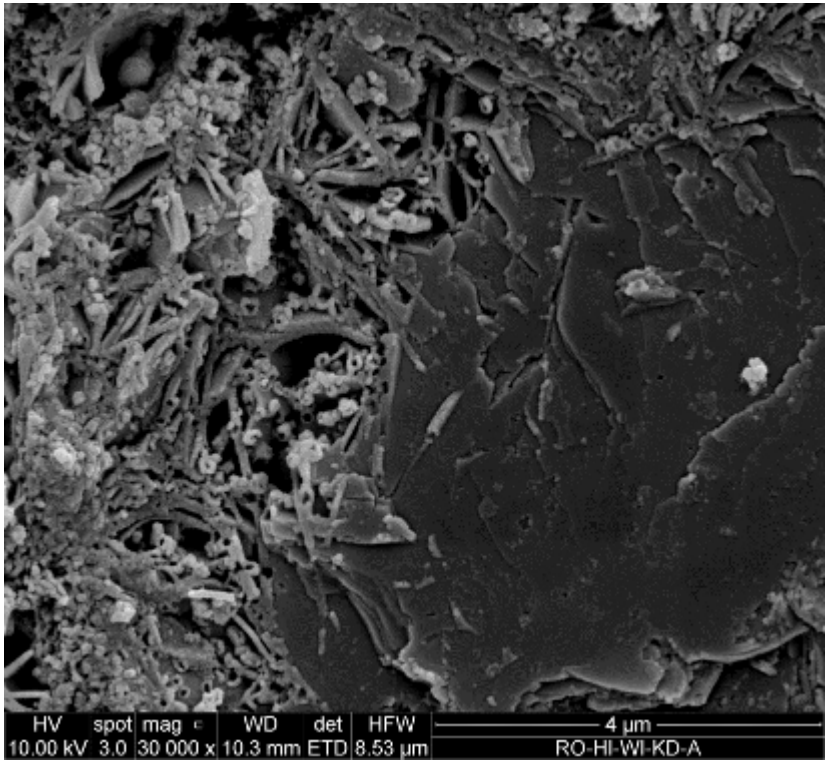


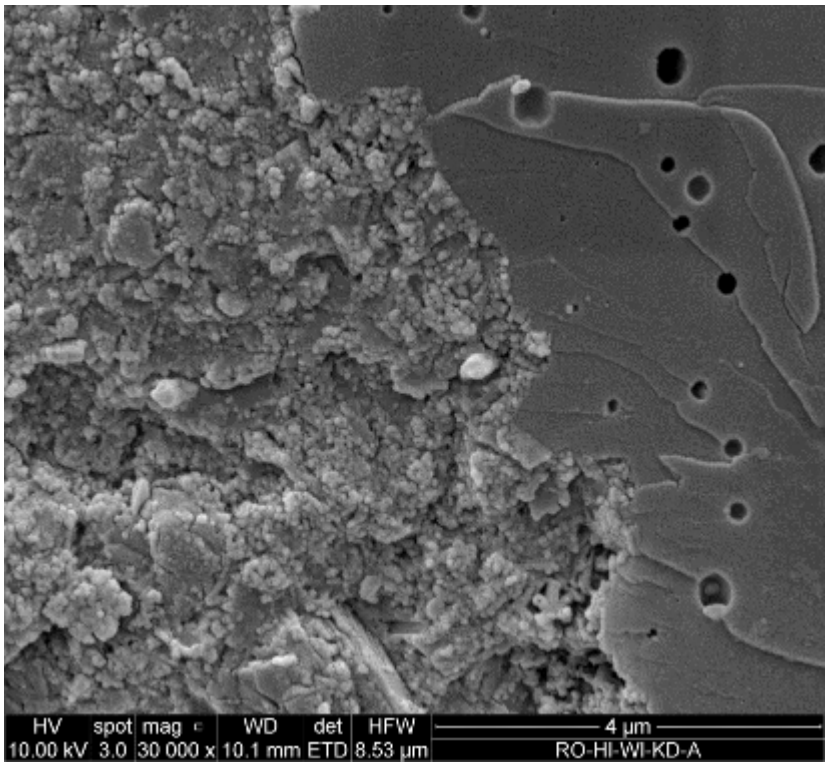


Kulissendepot, Vienna (1870), rendering

Historical mortar

Variation in microstructure – different morfology of hydration products, dense and porous areas

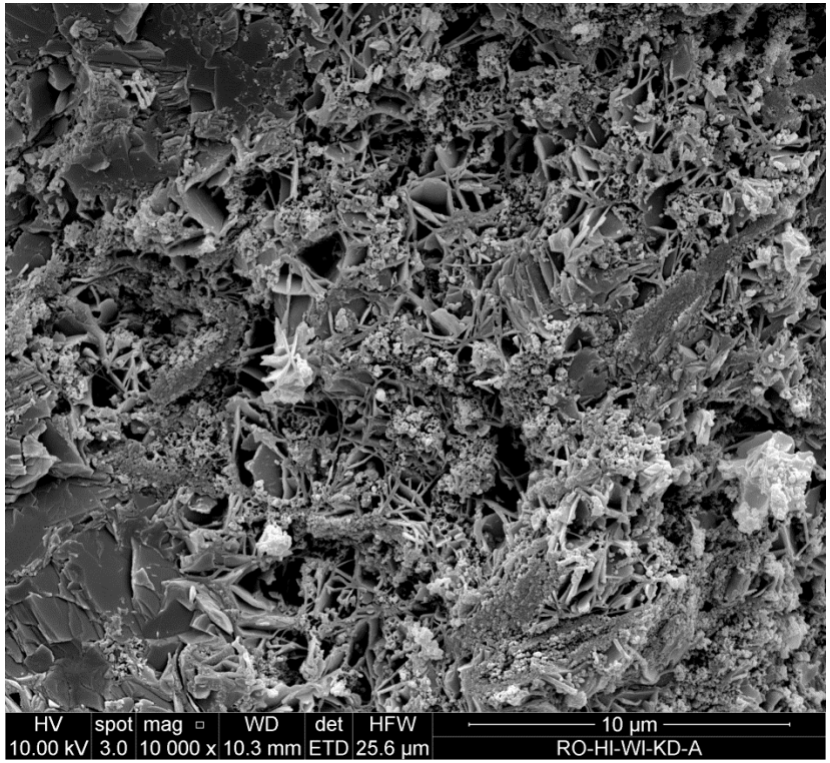




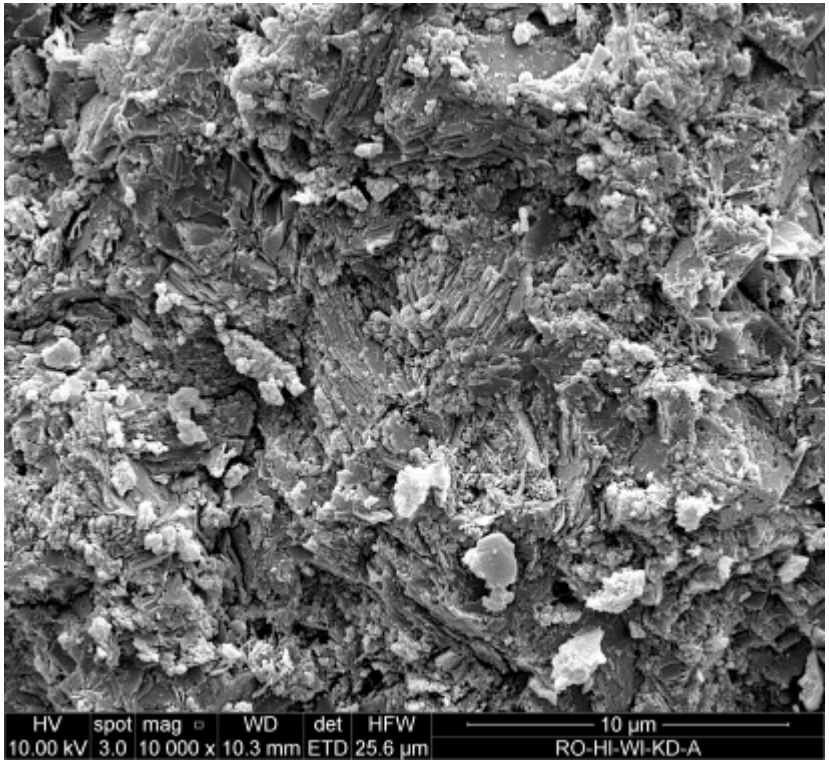
Kulissendepot, Vienna (1870), rendering

Historical mortar

Sulphation on surface – densification of matrix microstructure



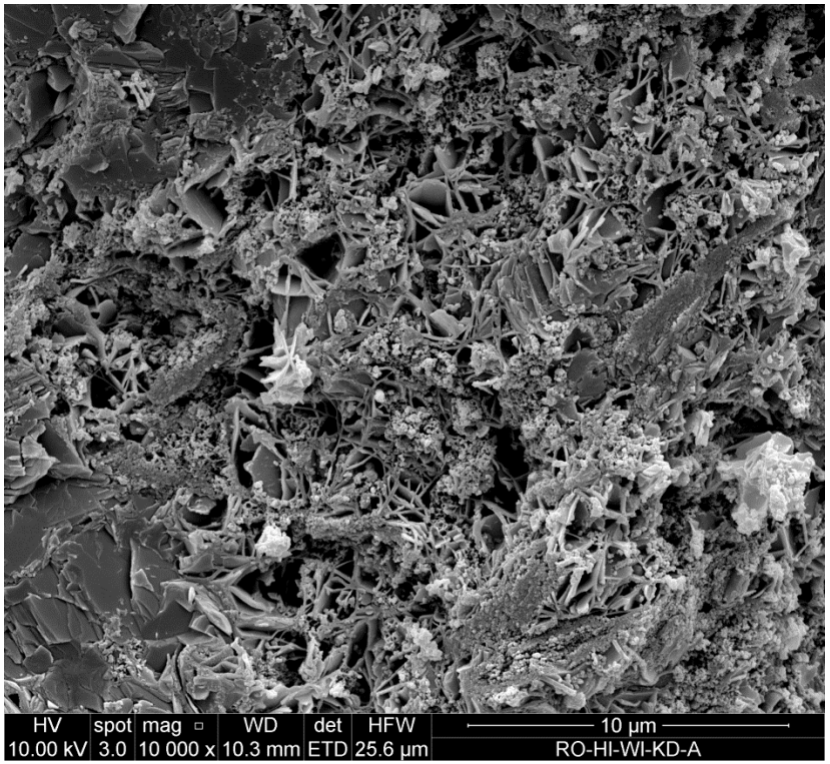
Matrix without sulphation



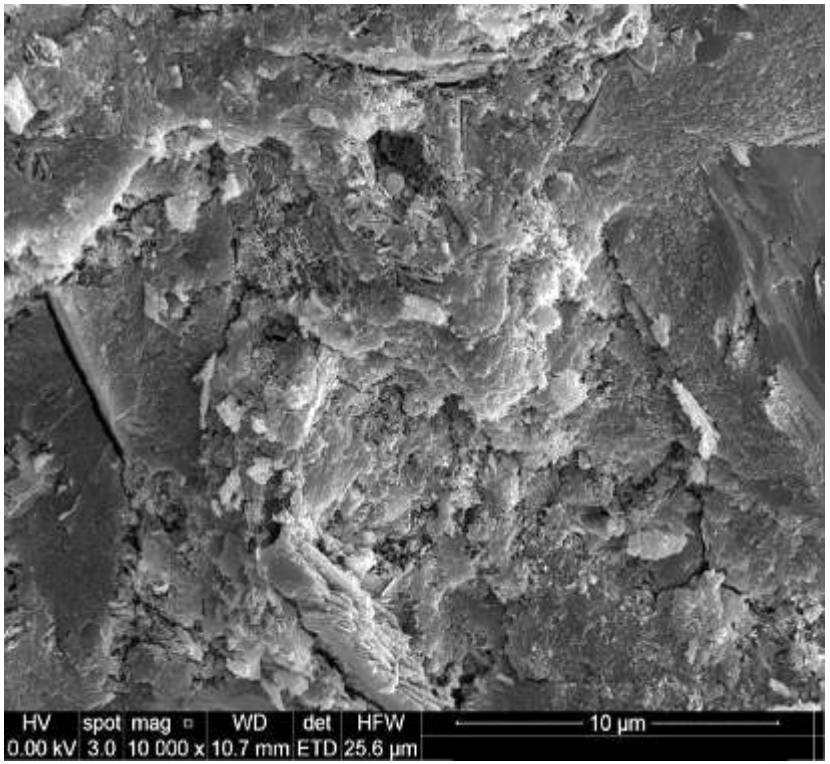
High sulphation of the matrix

Historical mortar

Comparison of microstructure – RC and PC-mortar



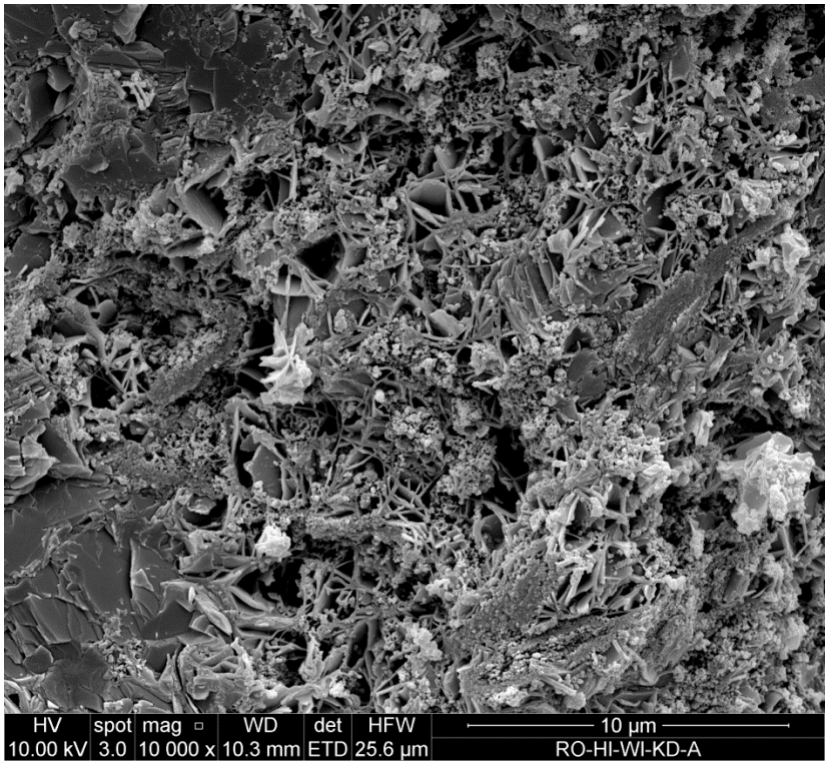
Kulissendepot, Vienna (1870), rendering



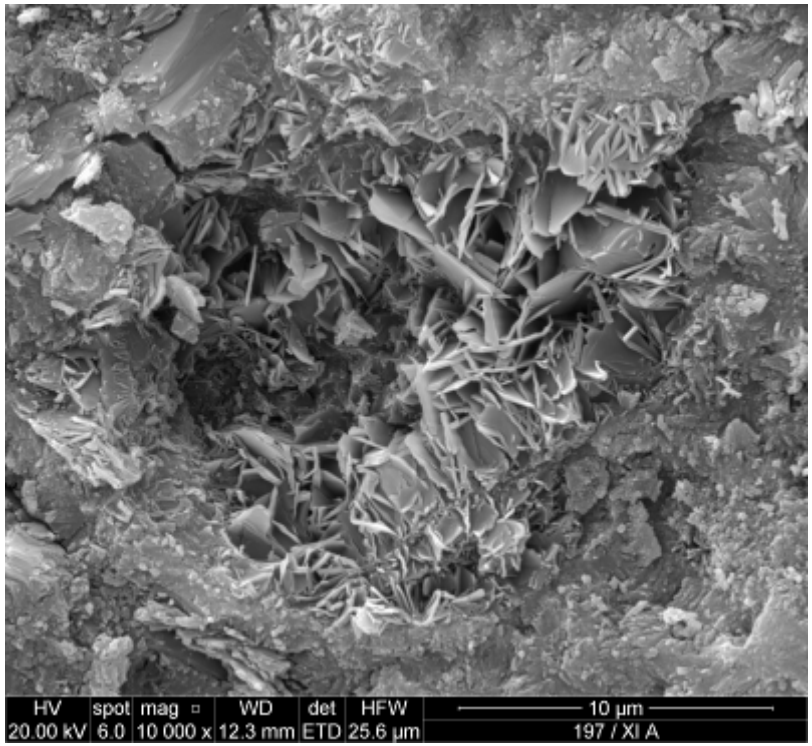
PC-mortar, Mauzoleum Hinze, Frauendorf, Germany

Historical mortar

Comparison of microstructure – RC and PC-mortar



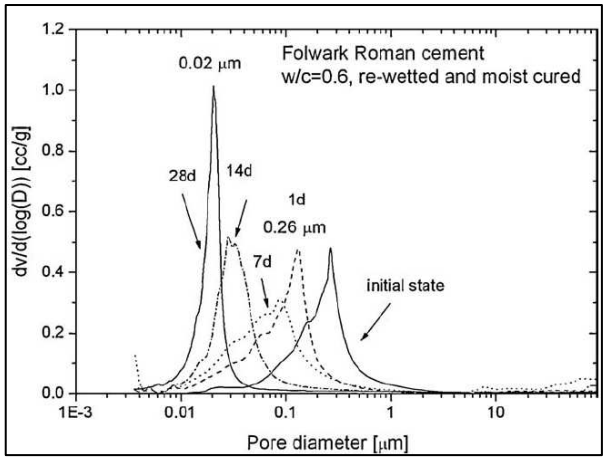
Kulissendepot, Vienna (1870), rendering

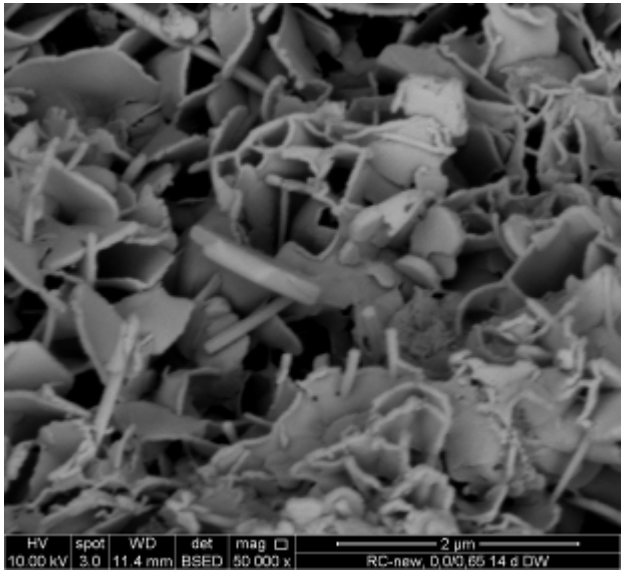


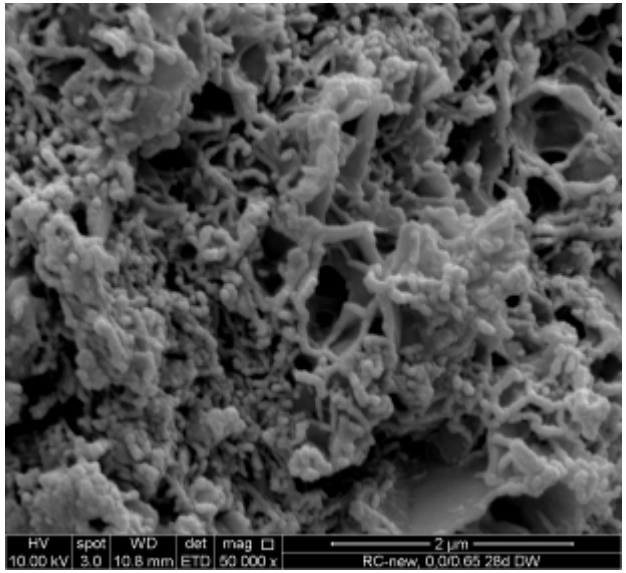
PC-mortar, Mauzoleum Hinze, Frauendorf, Germany

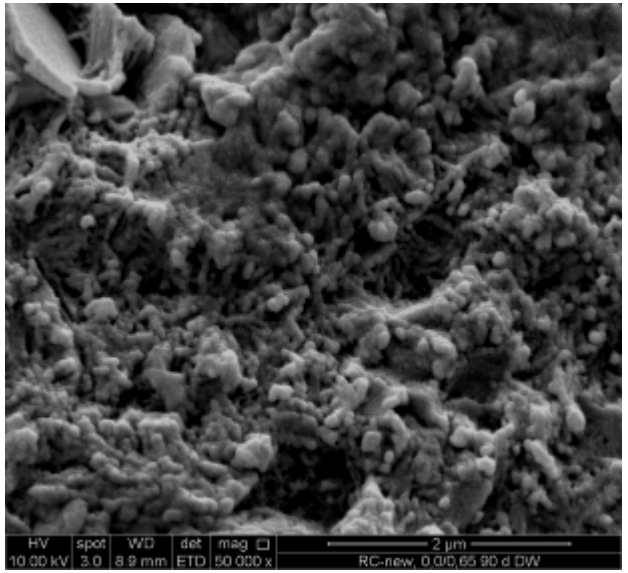
Recently produced mortar

Development on microstructure during hydration of RC-paste retarded with CA cured in wet conditions





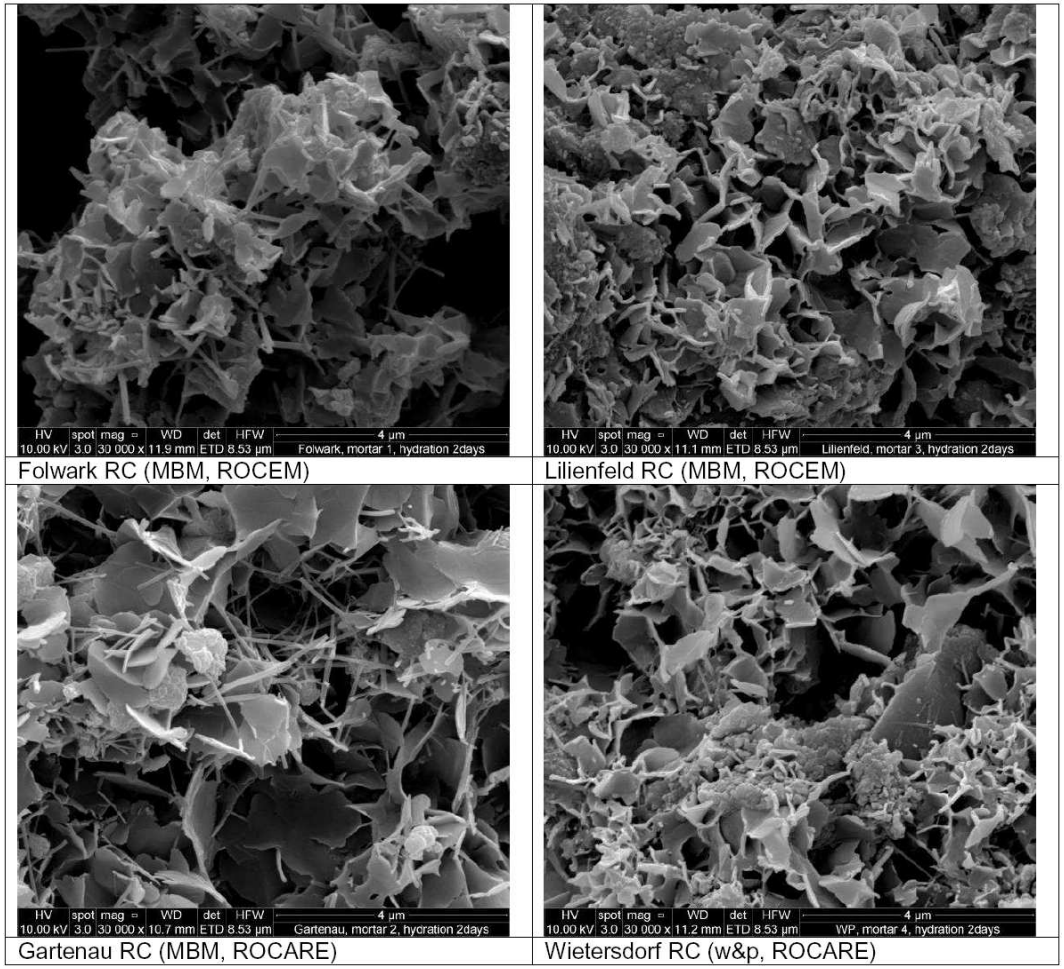




14 d 28 d 90 d

Recently produced mortar

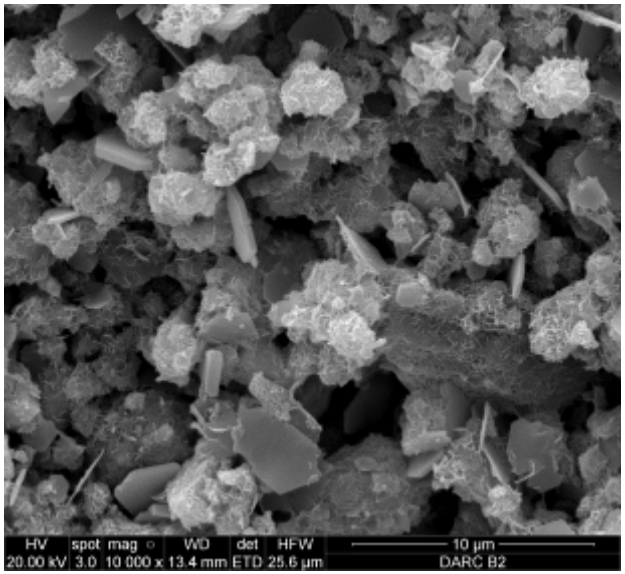
Comparison of matrix-microstructure of different RC binder, early hydration (2 days)

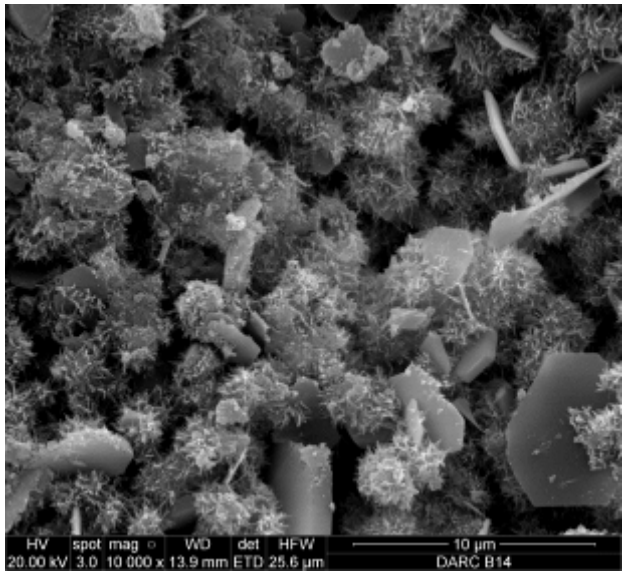


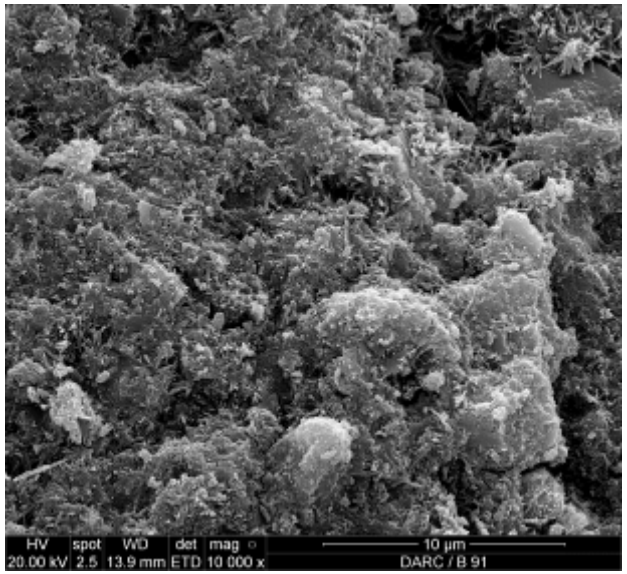
- all four binders very similar structures of their 2 day-hydrates
- highly porous matrix - mainly platy, partly needle-like compounds (characteristic microstructure for the early age Roman cement matrix)

Recently produced mortar – deactivated RC

Development on microstructure of DARC-mortar cured in wet conditions





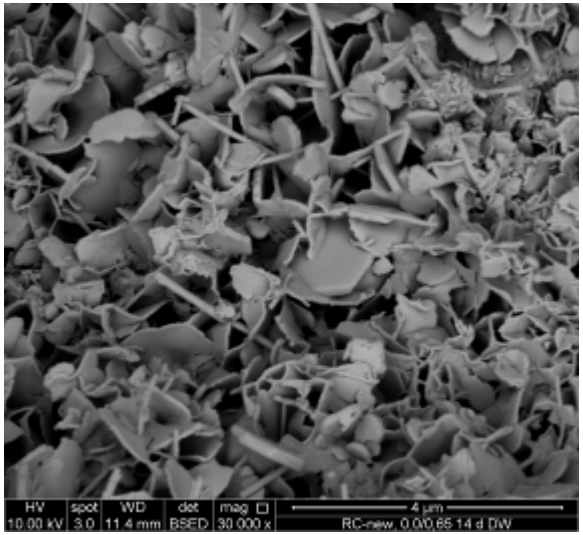


2 d 14 d 91 d

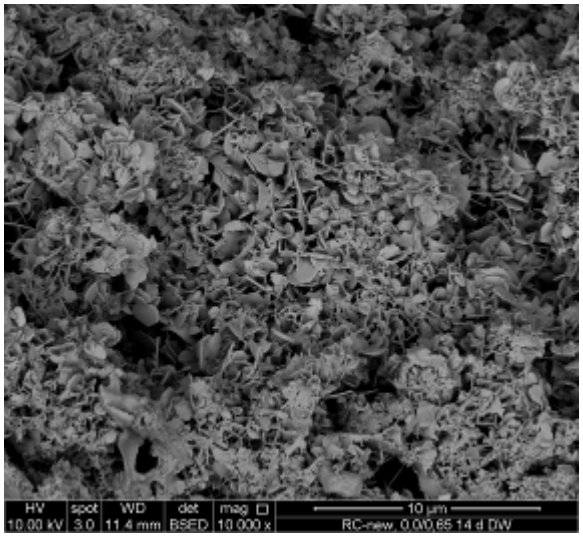
Sample	Cement	Sand	c/s	Deact. Water	Storage Time	Retarder	w/c	125 rpm mix	2 day flex (MPa)	2 day comp (MPa)	7 day flex (MPa)	7 day comp (MPa)	14 day comp (MPa)
B	Gartenau	WP	1:2	10%	30 min	-	0.675	1 min	0.15	0.95	0.52	3.23	7.54

Recently produced mortar

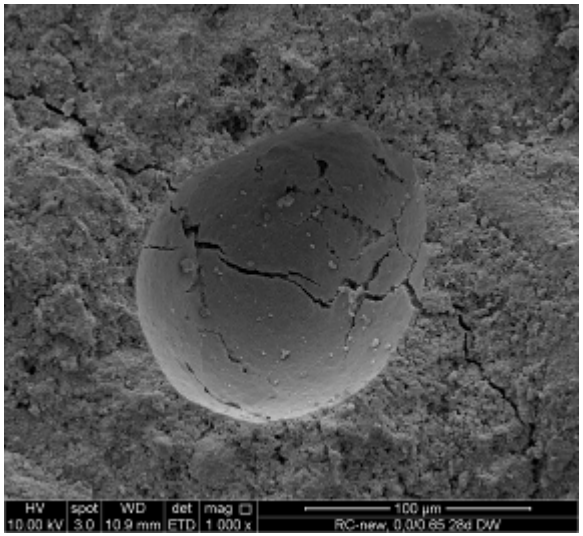
Pore structure – basically three types of pores



„Matrix“ pores – mainly in the range of 0,1 – 0,5 µm



„Air-void“ pores – mainly in the range of 1 – 5 µm



Air bubbles – up to 500 µm

Conclusion

- correlation of matrix structure and the RC-mortar properties

- in historical and recent RC card-house structure of the matrix

- different RC-binder – similar matrix and morphology of hydration products

- densification of the matrix during the hydration

- loss of card-house structure during the hydration in wet conditions

