

H₂O-NaCl fluid inclusions in wonderland

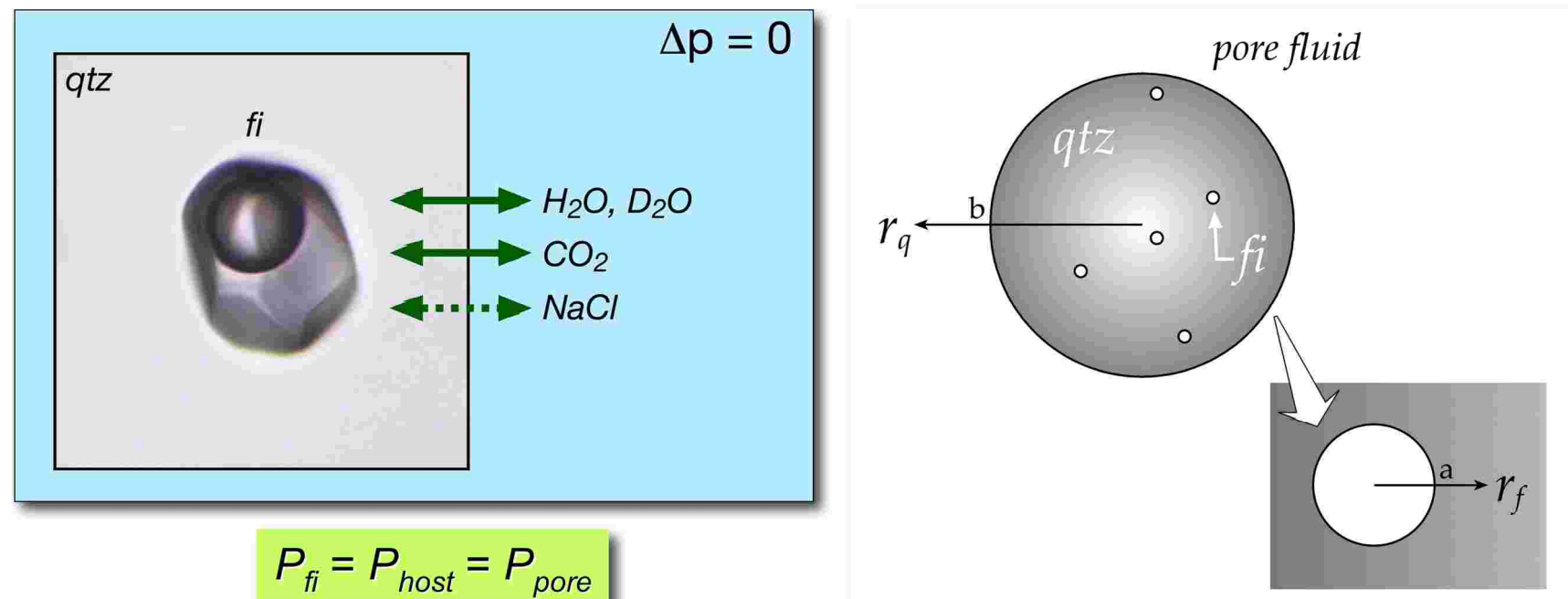
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Synthesis and Re-equilibration of Fluid Inclusions

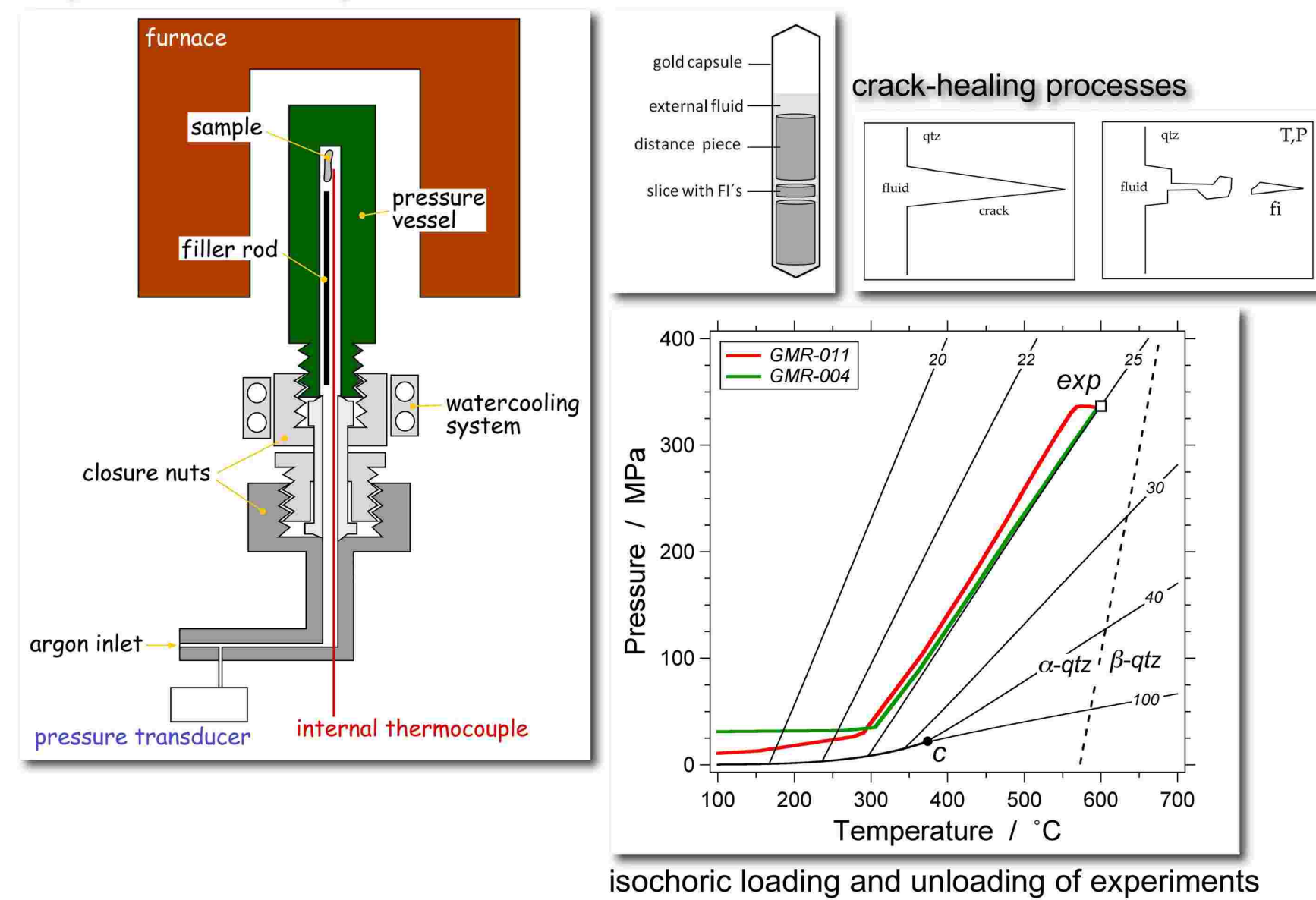
are fluid inclusions able to modify their contents
at constant temperature and pressure conditions?

gradients in fugacity at constant T and P



diffusion model
Bakker (2009, Lithos, vol.112, 277-288)

Experimental Setup



Quality Experimental Setup

1. experimental conditions

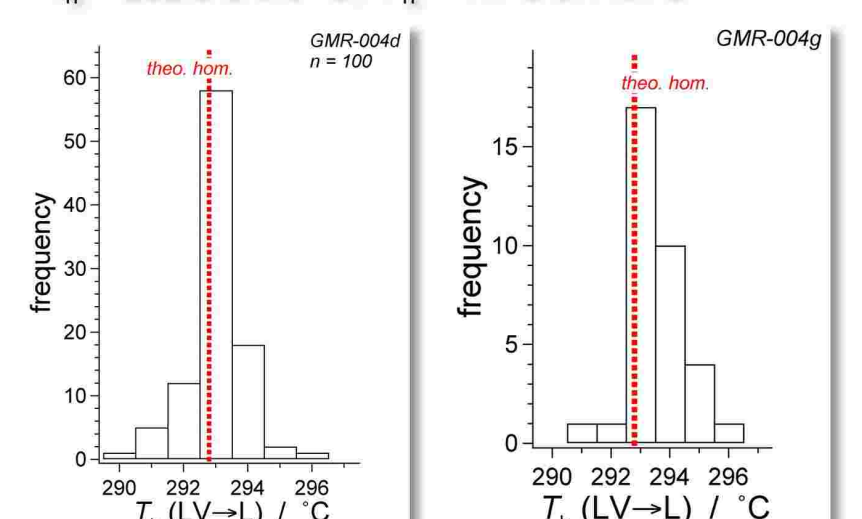
pure H₂O
600.6 ± 0.4 °C
336.3 ± 0.5 MPa
457.4 hours

equation of state
Haar et al. (1984) program "LonerHGK"
www.fluids.unileoben.ac.at

$V_m(f) = 25.032 \pm 0.022 \text{ cm}^3 \cdot \text{mol}^{-1}$

2. homogenization conditions

$T_h = 292.5 \pm 0.8 \text{ °C}$, $P_h = 7.7 \pm 0.1 \text{ MPa}$

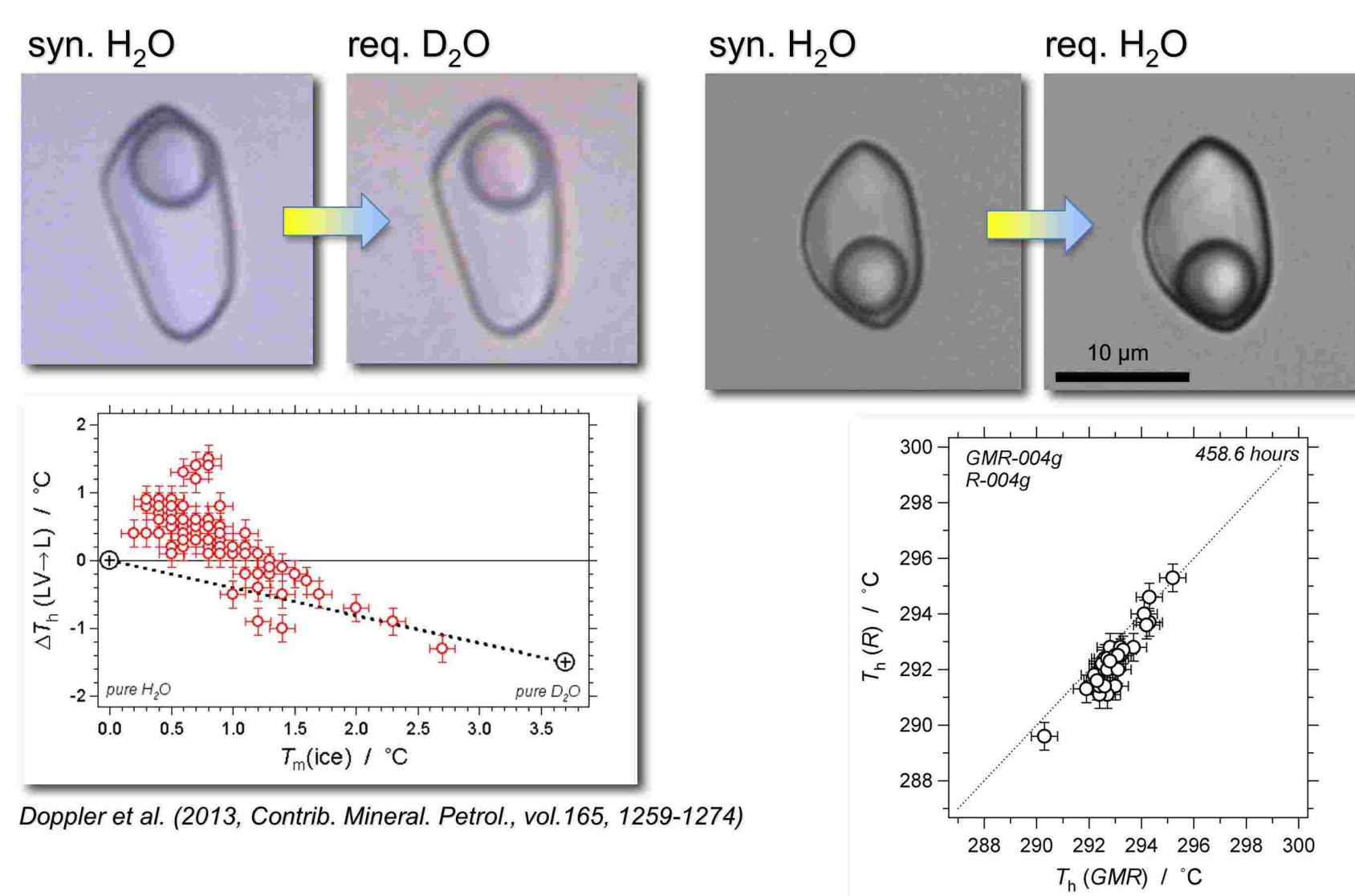


3. predicted Th

correction of quartz molar volume (e.g. Hosieni et al. 1985)
at experimental conditions: $V_m(\text{qtz}) = 23.154 \text{ cm}^3 \cdot \text{mol}^{-1}$
at homogenization conditions: $V_m(\text{qtz}) = 22.927 \text{ cm}^3 \cdot \text{mol}^{-1}$

isochore correction: $V_m(f) = 24.79 \pm 0.02 \text{ cm}^3 \cdot \text{mol}^{-1}$ → $T_h = 292.8 \text{ °C}$

Re-equilibration of pure H₂O fluid inclusions



Synthesis H₂O-NaCl fluid inclusions

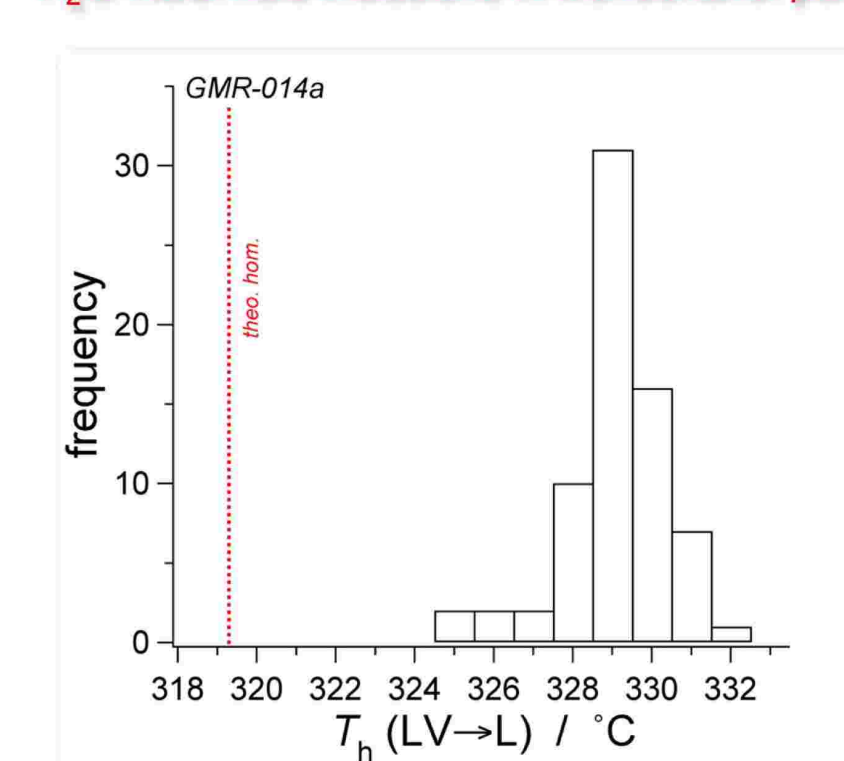
Experimental conditions

10, 16.3, 19.8 mass % NaCl
600.6 ± 0.4 °C
336.3 ± 0.5 MPa
457.4 hours

equation of state
Driesner (2007) program "AqSo DH"
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Predicted $T_h = 319.3 \text{ °C}$

H₂O-NaCl fluid inclusions in wonderland: part 1



Re-equilibration of H₂O-NaCl synthetic fluid inclusions

constant temperature and pressure: pure H₂O environment
600 °C
337 MPa

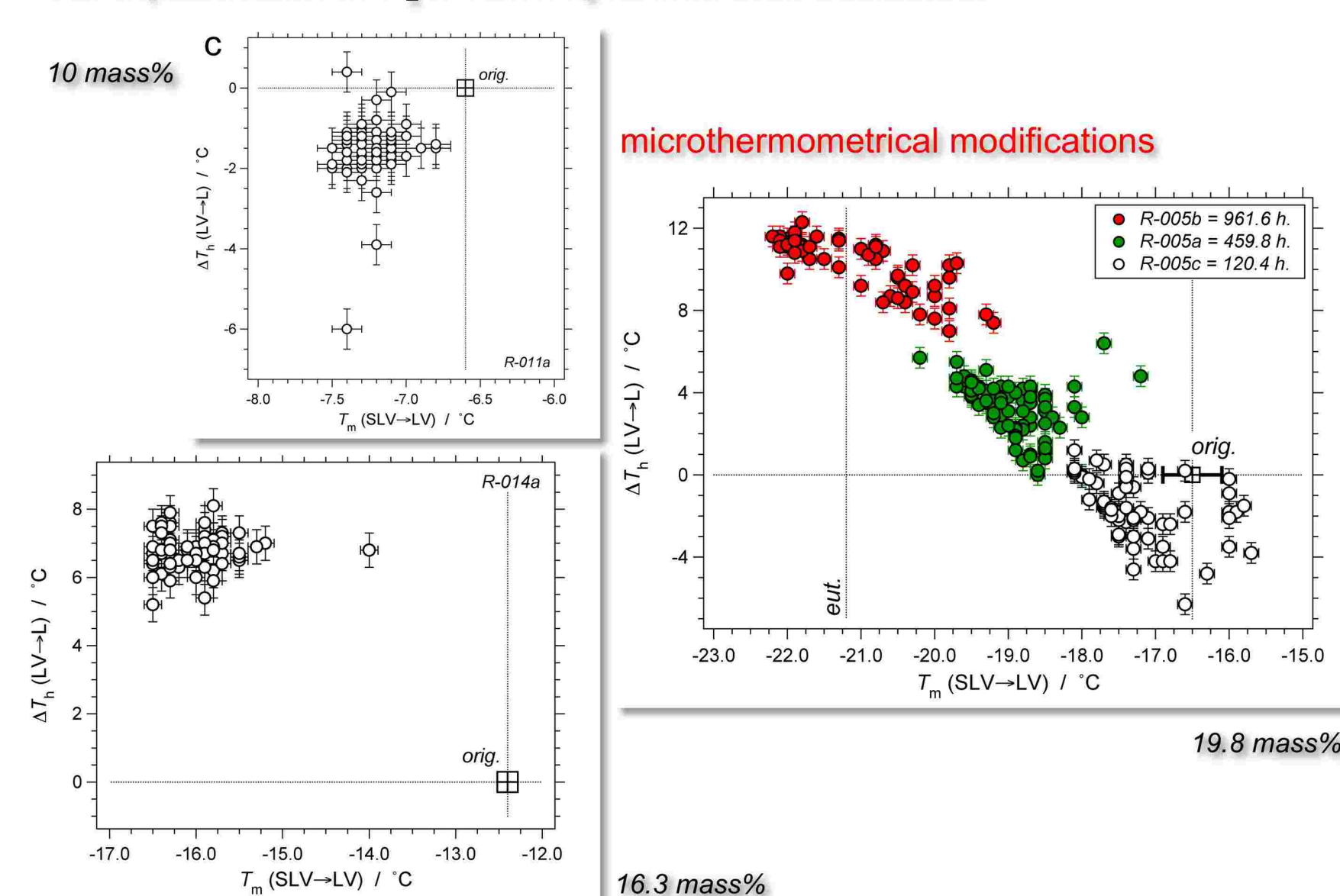
gradients in water fugacity, $\Delta(f_{\text{H}_2\text{O}})$

	mass % NaCl		
	10.0	16.3	19.8
120	X	X	R-005c -10.6 MPa
460	R-011a -6.4 MPa	X	R-005a -12.6 MPa
960	X	R-014a -10.7 MPa	R-005b -13.2 MPa

Re-equilibration of H₂O-NaCl synthetic fluid inclusions

	mass % NaCl		
	10.0	16.3	19.8
120	X	X	
460		X	
960	X		

Re-equilibration of H₂O-NaCl synthetic fluid inclusions



Re-equilibration of H₂O-NaCl synthetic fluid inclusions

diffusion model

calculated with program "ReqDiff" (Bakker, 2009)
www.fluids.unileoben.ac.at

$\Delta f = 0.0 \text{ MPa}$

19.58 mass% NaCl
 $\Delta P = +23.5 \text{ MPa}$
 $\Delta V_m = -1.3\%$

$T_m(\text{ice}) = -16.2 \text{ °C}$

$T_h(\text{LV} \rightarrow \text{L}) = 315.6 \text{ °C}$

$\Delta T_h = -8.7 \text{ °C}$

preferential H₂O leakage model

calculated with program "AqSo DH"
www.fluids.unileoben.ac.at

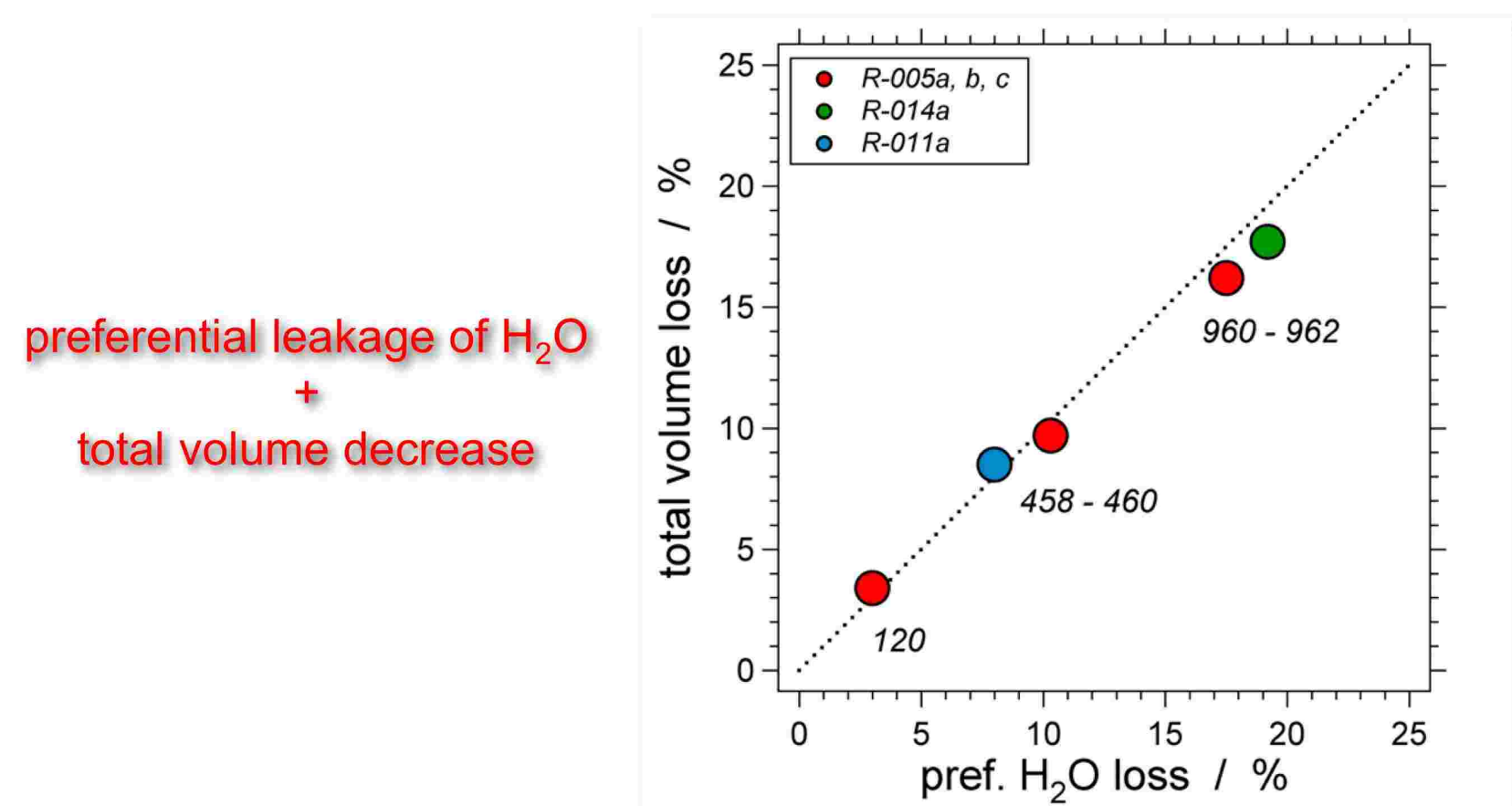
loss%	x(NaCl)	mass%	V_m	T_m	T_h
0	0.07072	19.80	23.733	-16.5	329.7
5	0.07417	20.63	24.890	-17.6	361.5
10	0.07800	21.53	26.164	-18.8	393.6
15	0.08218	22.51	27.577	-20.2	427.9

H₂O-NaCl synthetic fluid inclusions
in wonderland part 2

?

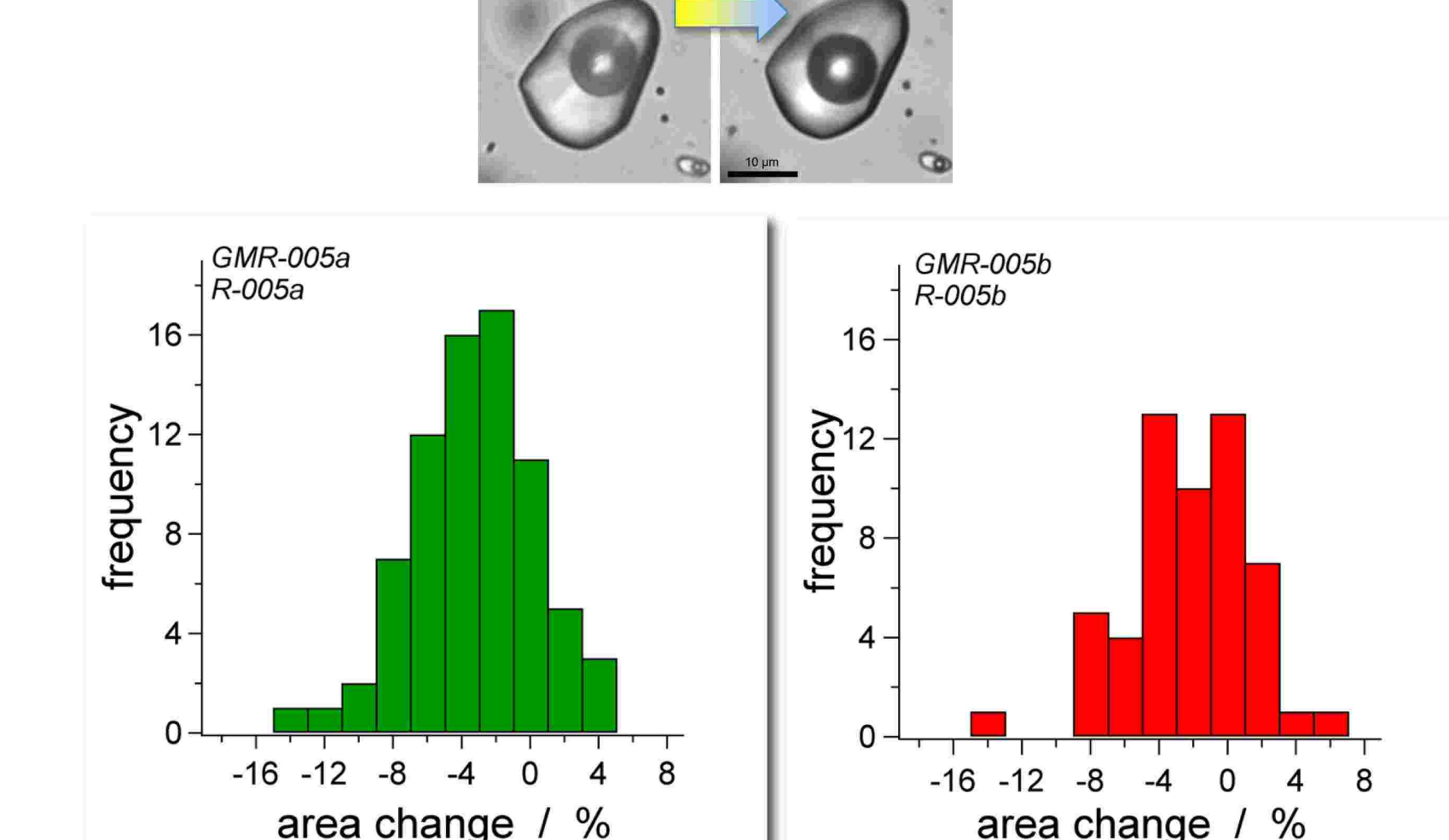
Re-equilibration of H₂O-NaCl synthetic fluid inclusions

Are the observed T_m and corresponding T_h values consistent?



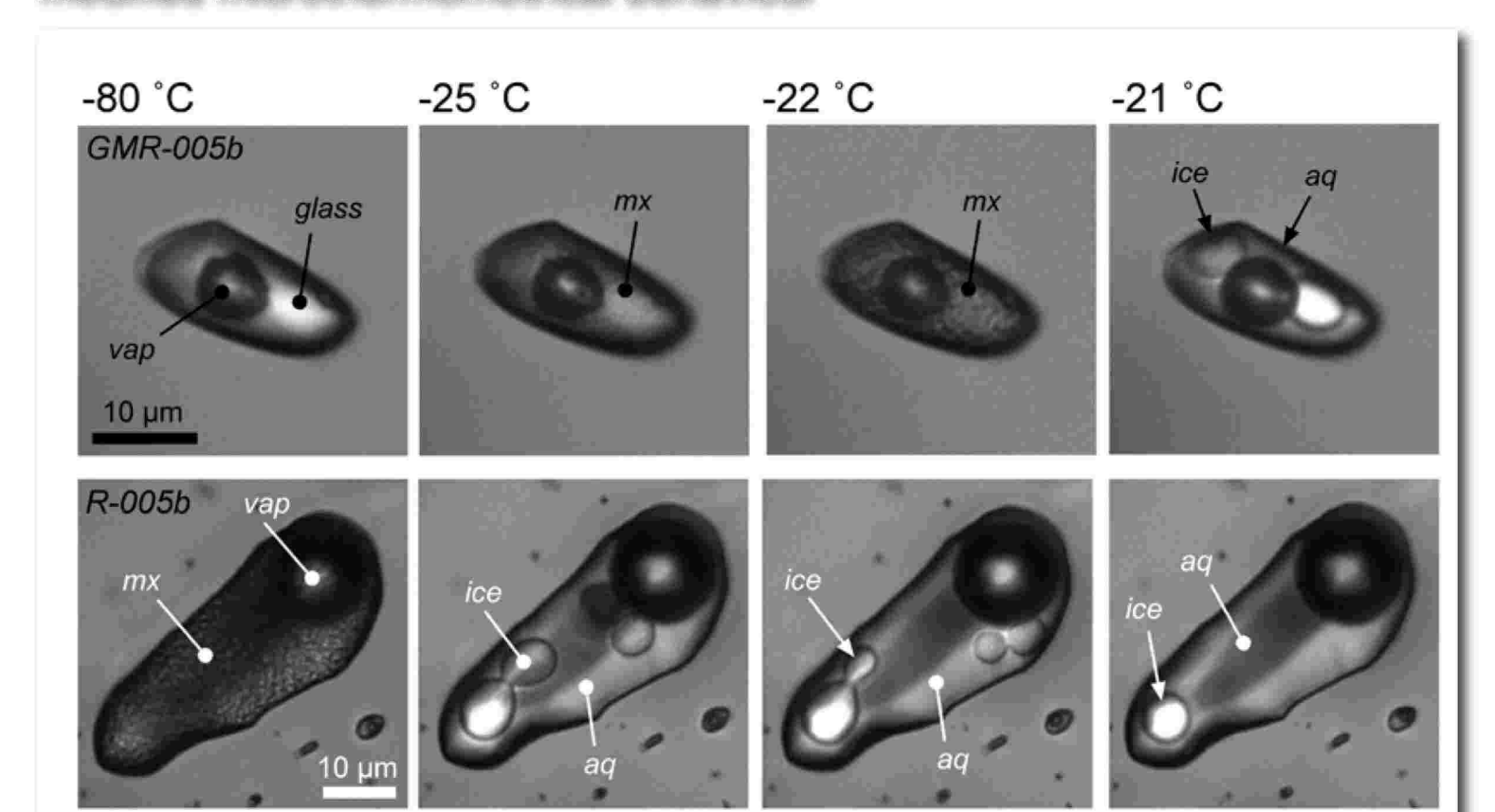
Re-equilibration of H₂O-NaCl synthetic fluid inclusions

total volume decrease?



Re-equilibration of H₂O-NaCl synthetic fluid inclusions

modified microthermometrical behaviour



H₂O-NaCl synthetic fluid inclusions in wonderland part 3

Conclusions

- if diffusion leads to larger pressure gradients: fugacity gradients are not the major driving force in fluid inclusion modification
- preferential H₂O-loss is the major process for any modification scenario, triggered by pressure gradients
- H₂O-loss is combined with quartz (host material) "flow" towards inclusions (time dependent process) = fluid inclusions become smaller and loose water simultaneously