






Identification of salts in fluid inclusions
by combined Raman Spectroscopy
and low temperature Microthermometry

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Salt identification in fluid inclusions:

 Optical methods	refractive index birefringence crystal habit	dissolved species ?
 Bulk analysis	laser ablation crush-leach	} element ratio ion ratio
 PIXE		
 Microthermometry	melting T dissolving T eutectic/peritectic	optical difficulties equivalent salinity
 Raman Spectroscopy	salts and dissolved simple ions = Raman inactive	

Low temperature Raman Spectroscopy

Dubessy et al. (1982)

Detection of monatomic ions

salt-hydrates

crystalline hydrate at low T = characteristic spectrum

Samson & Walker (2000)

Mixed salt-hydrates (NaCl-CaCl₂-H₂O)

Conclusions

1. identification of salts dissolved in aqueous solution

2. exact estimation of temperatures of phase changes

(eutectic, peritectic, etc ...)

(final melting temperatures)

Synthetic Fluid Inclusions: MgCl_2



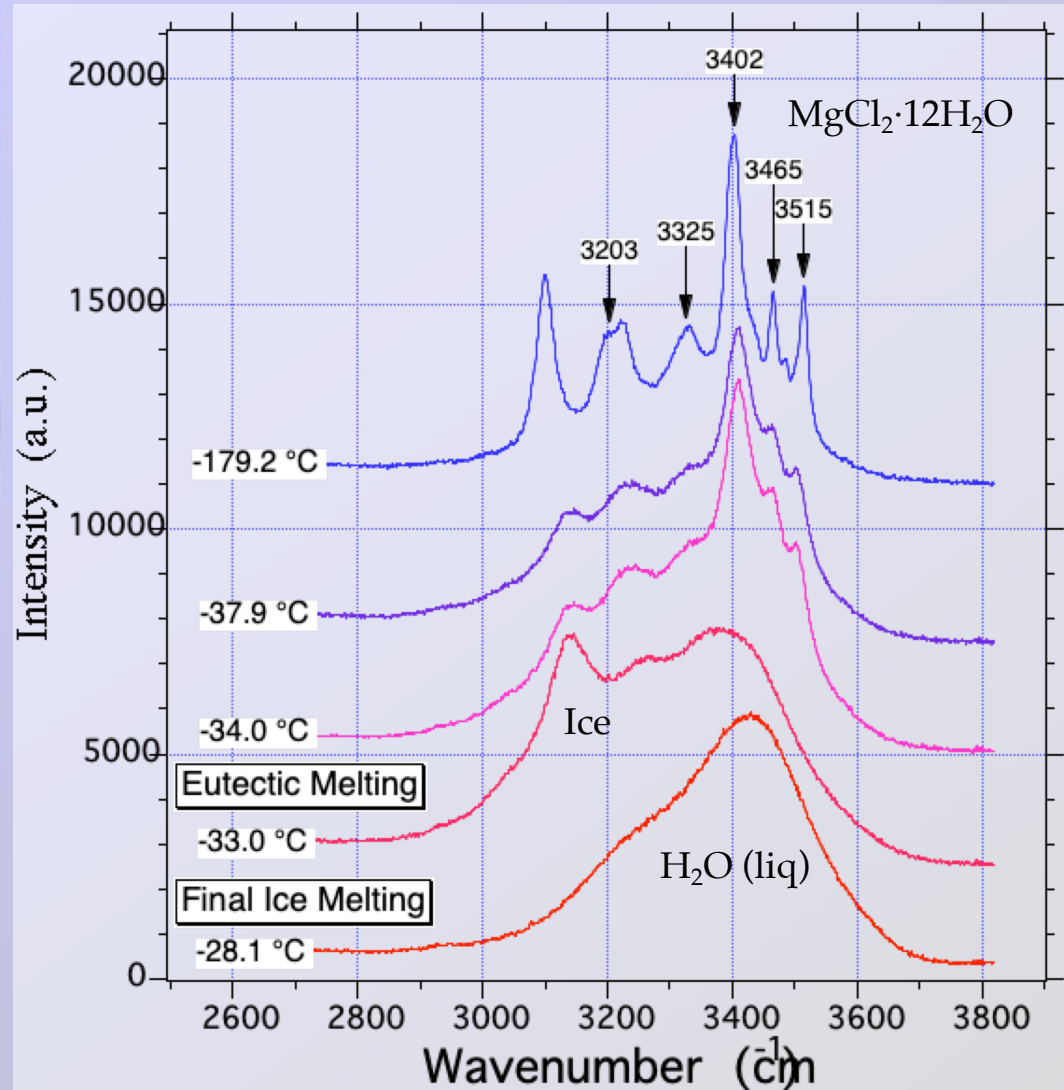
$T_n \approx -90^\circ\text{C}$

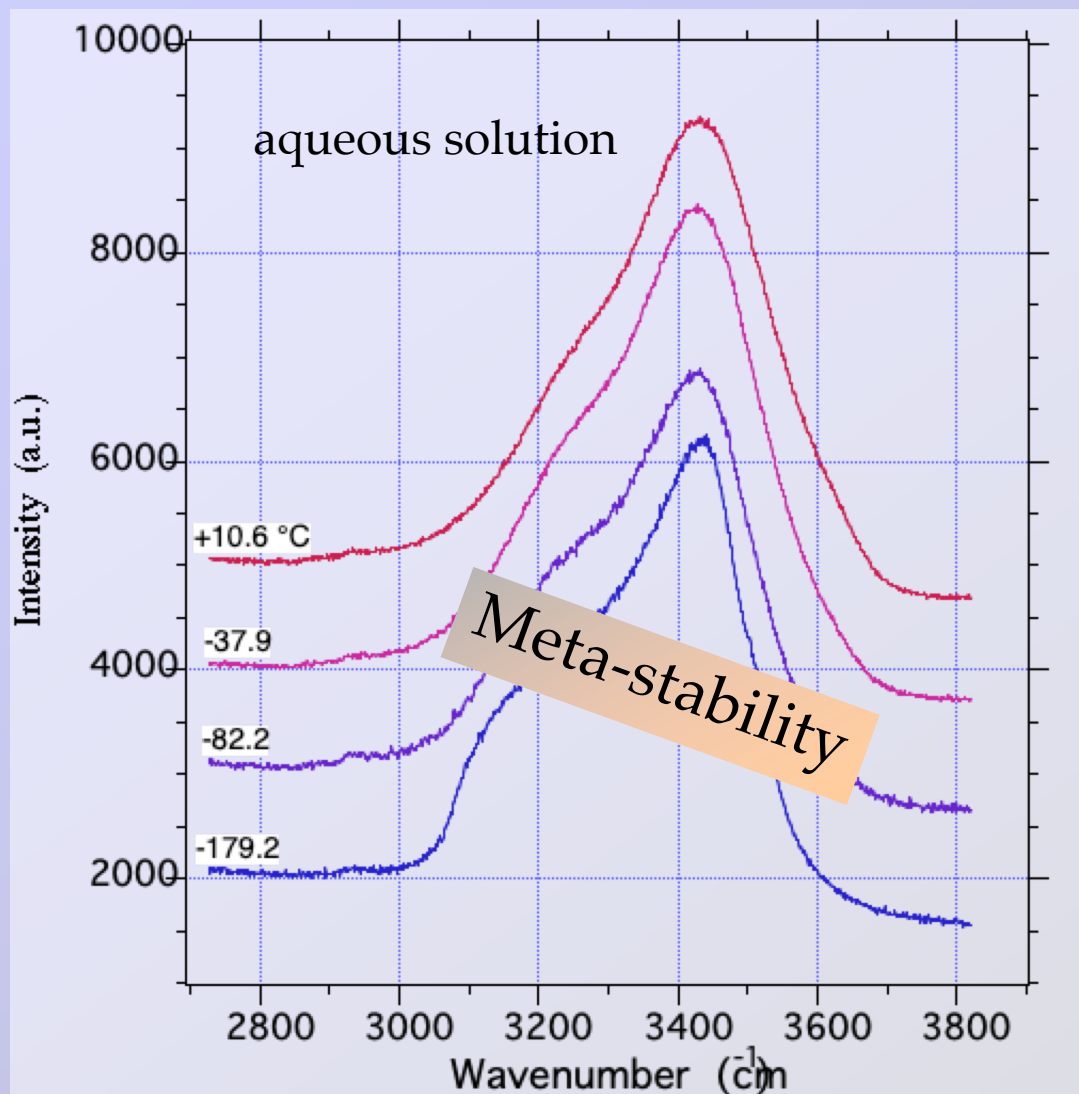
-70°C : granular texture

-45°C : fine texture (+vap)
one ice crystal (+liq+vap)

T_e = between -34 and -32°C

$T_m(\text{ice}) = -29.6^\circ\text{C}$





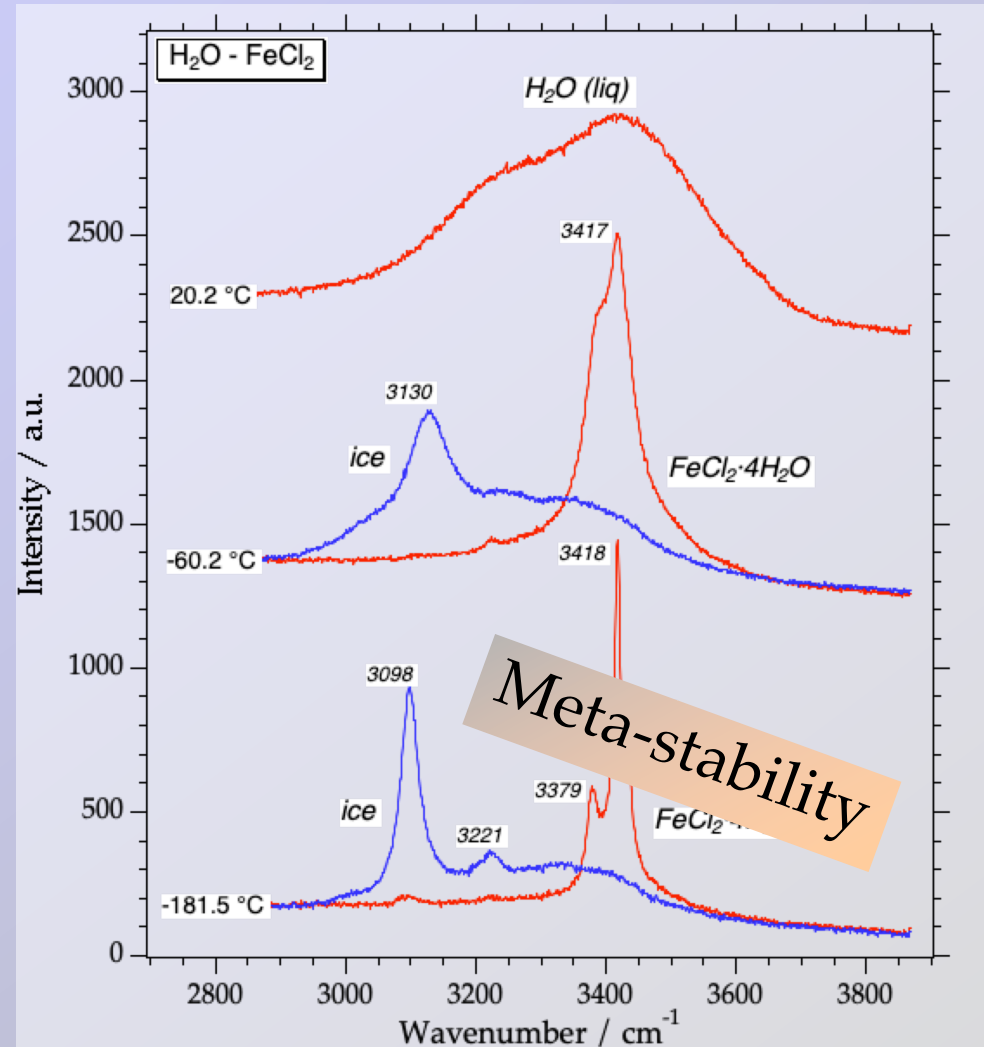
Synthetic Fluid Inclusions: FeCl_2

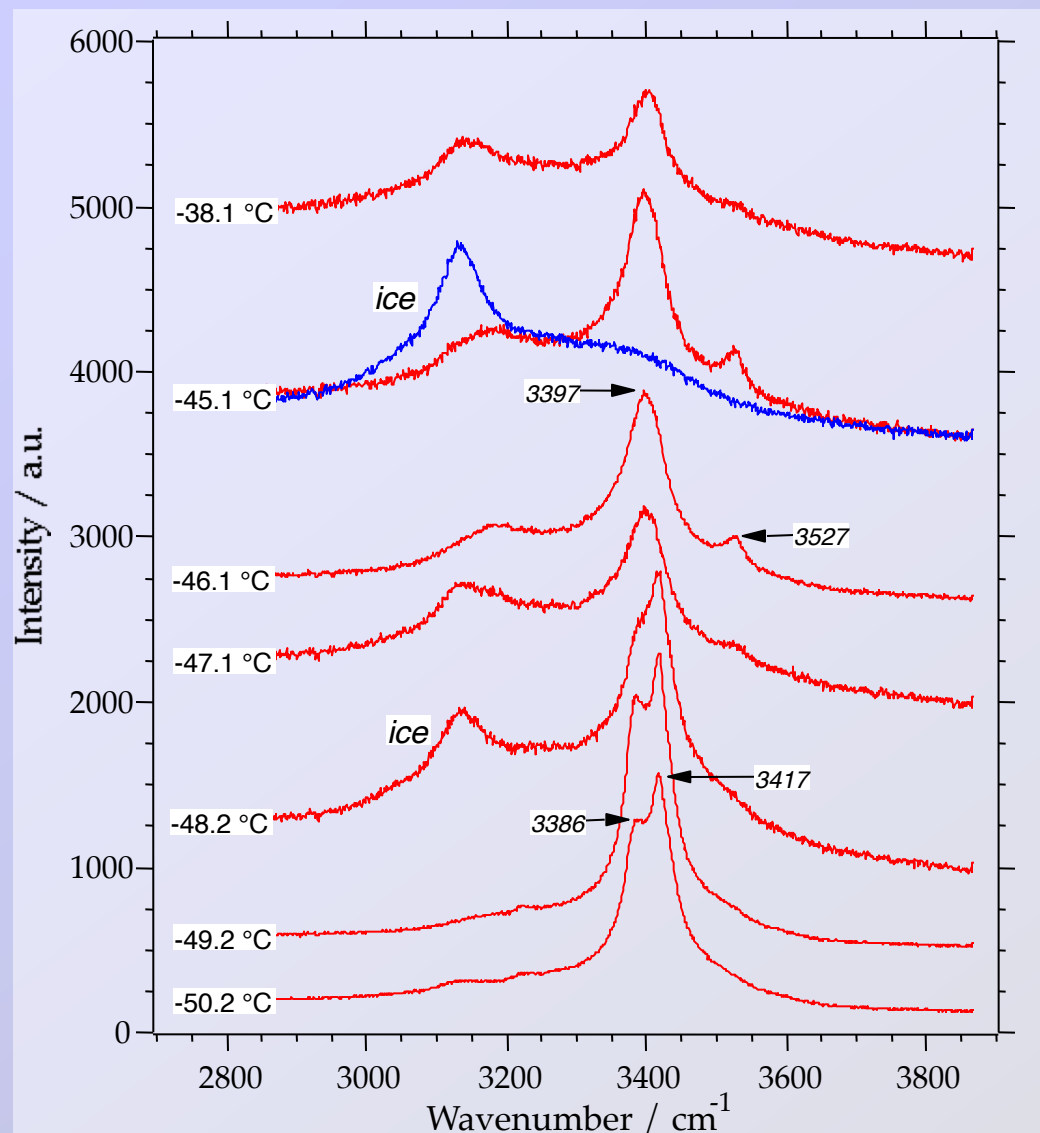


$T_n \approx -50\text{ }^\circ\text{C}$

$T_m(\text{ice}) = -8.7\text{ }^\circ\text{C}$

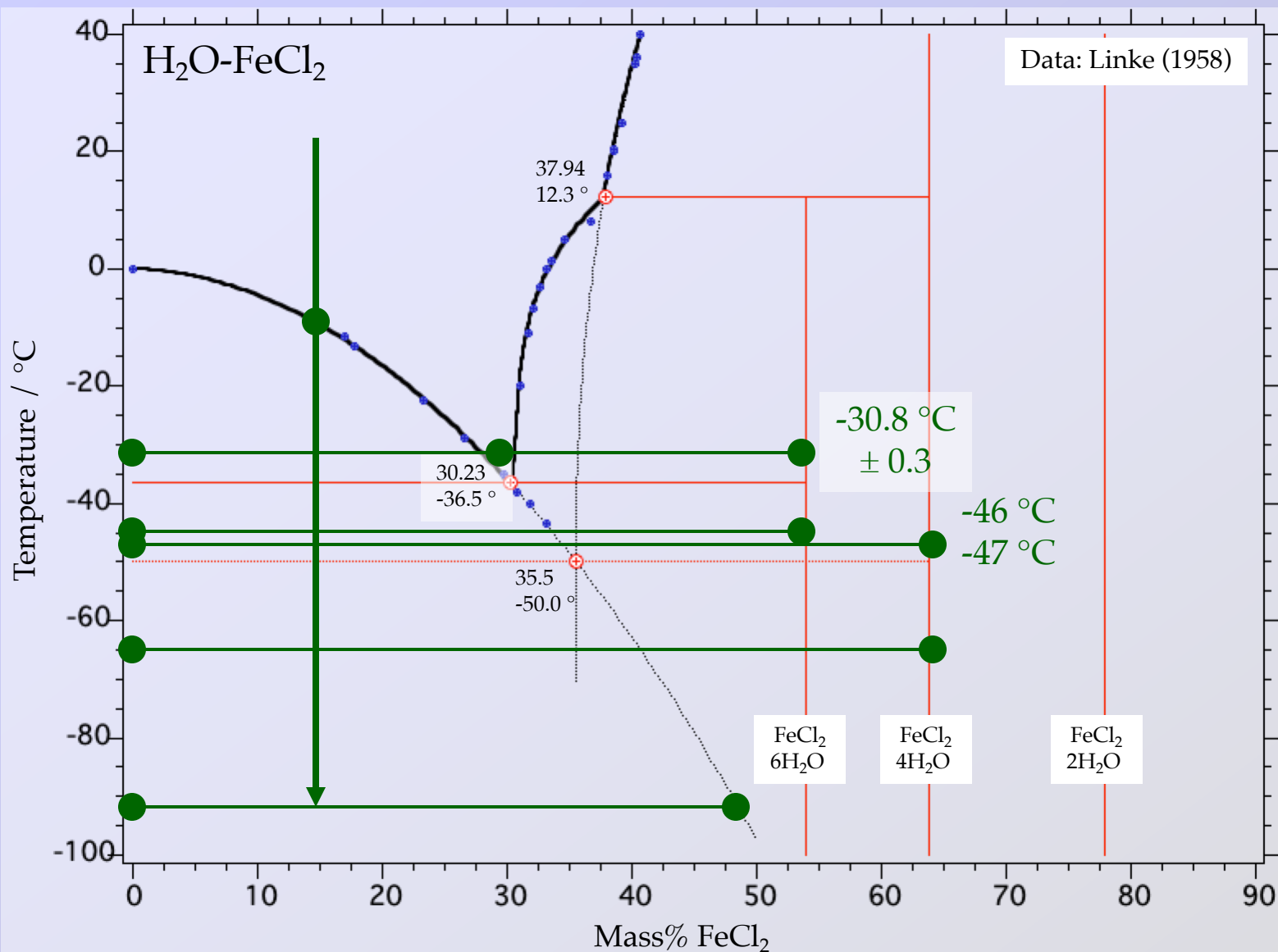
$T_e \approx \text{between } -35 \text{ and } -28\text{ }^\circ\text{C}$



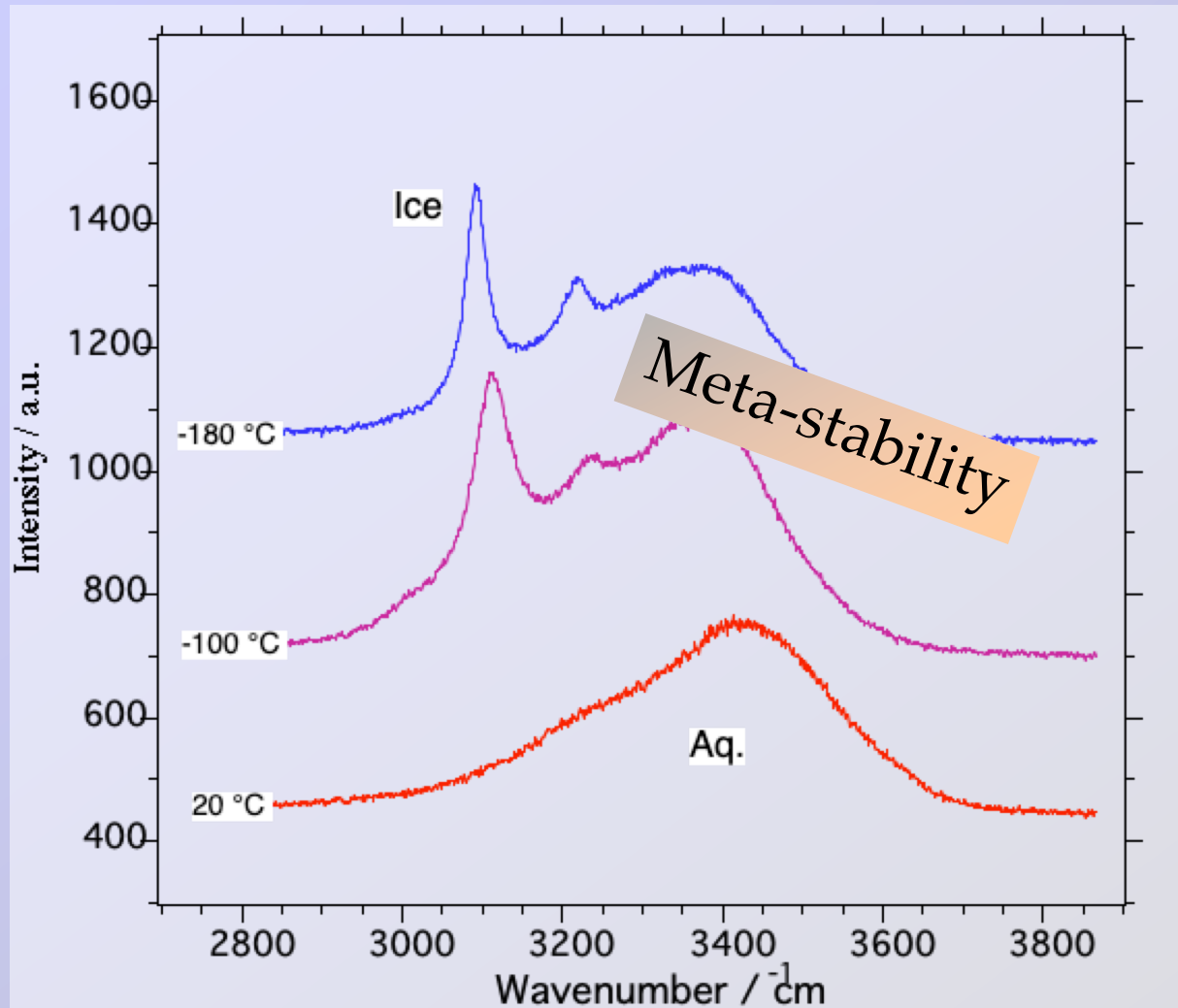


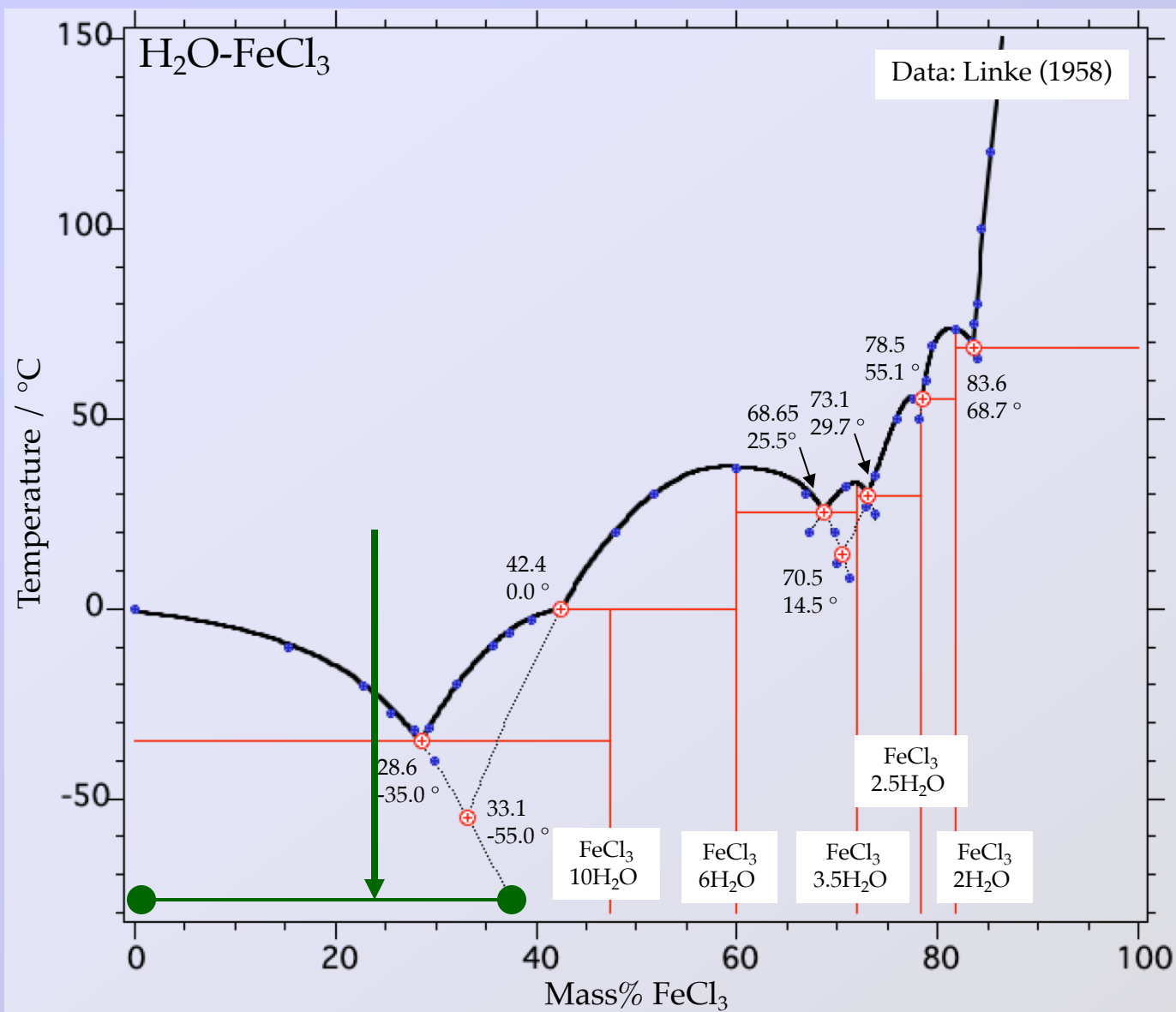
$\text{FeCl}_2 \cdot 6\text{H}_2\text{O}$
+ Ice

$\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$
+ Ice



Synthetic Fluid Inclusions: FeCl_3

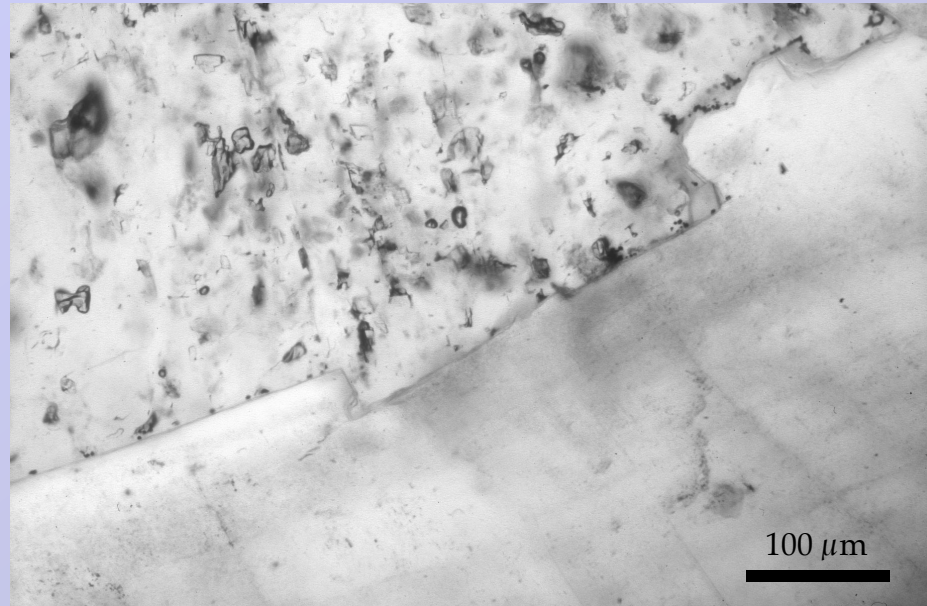




Muschelkalk (Upper Rhein Graben, SW Germany)

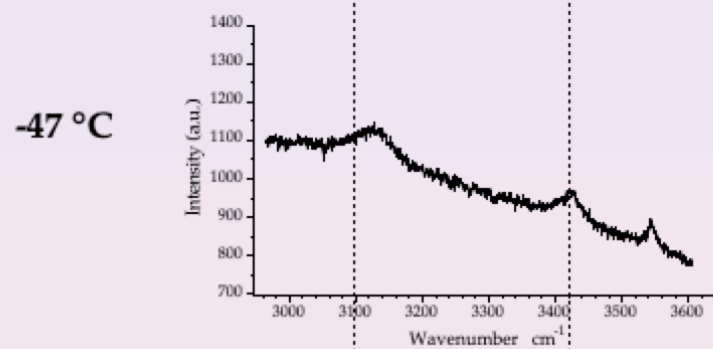
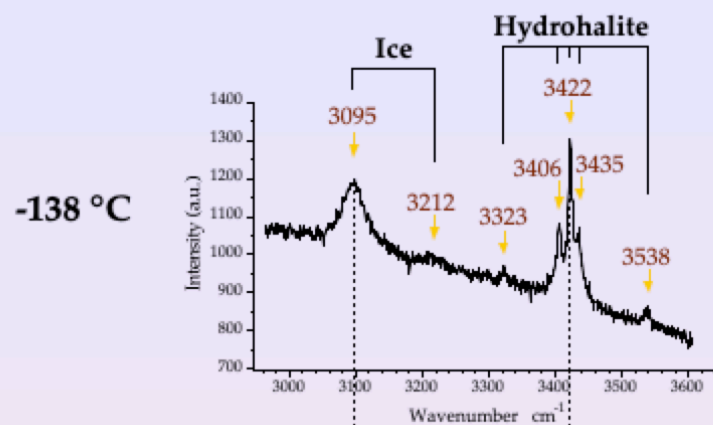
Drilling Core Rot3

calcite



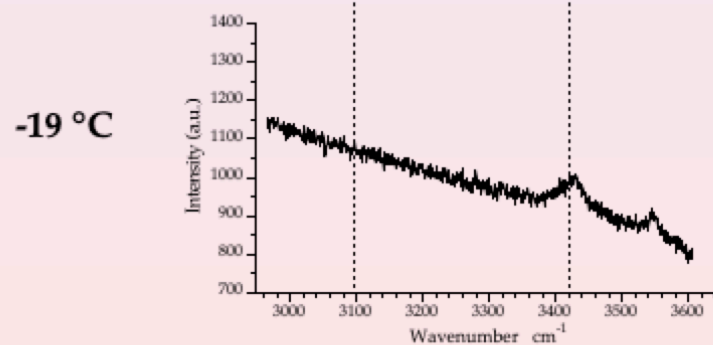
saddle dolomite

Contact between saddle-dolomite and calcite within a fossil fragment from sample R3B. The dolomite reveals a high concentration of tiny inclusions (shading of crystal), whereas the calcite has large irregular fluid inclusions



Final melting Ice (= Te?)

-23.4 °C



Final melting Hydrohalite

+4.6 °C

Carboniferous carbonates (Cantabrian Zone, NW Spain)

Fluid inclusions in dolomite (sample VCBD1B)

