Karlsruhe Institute of Technology

MulT_predict

A multicomponent geothermometer with integrated sensitivity analyses

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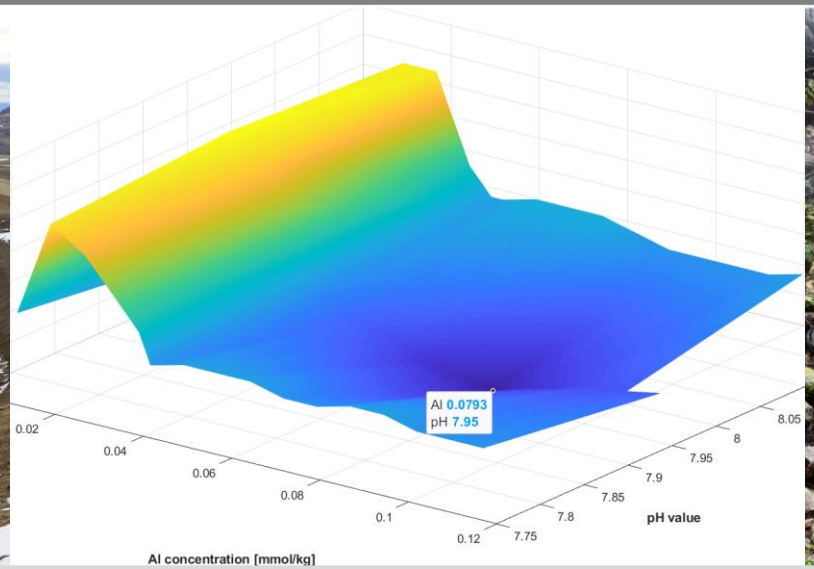
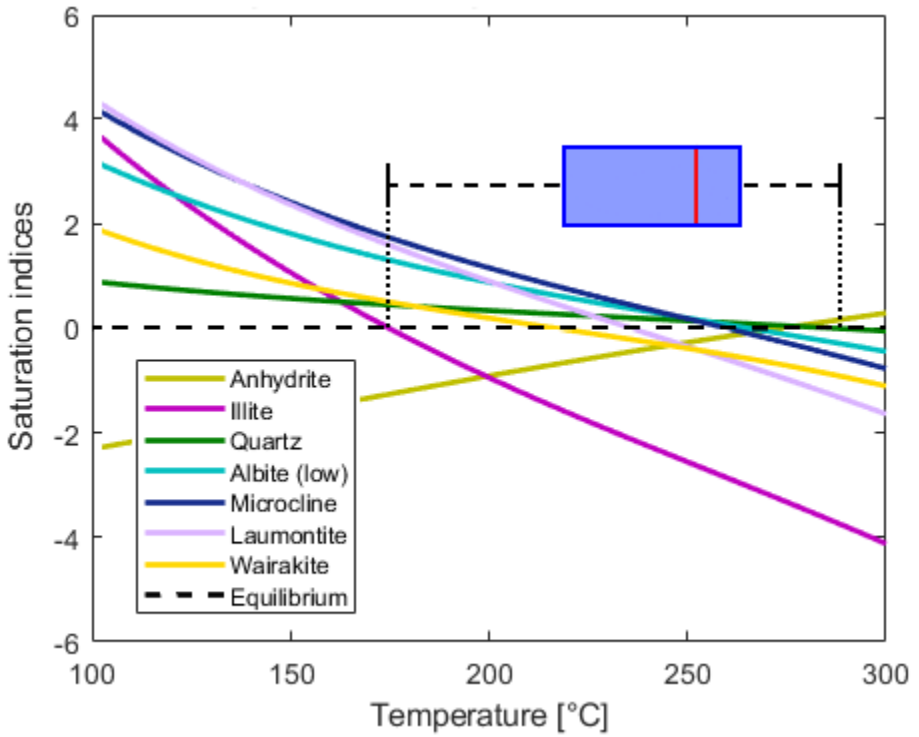


Multicomponent geothermometry

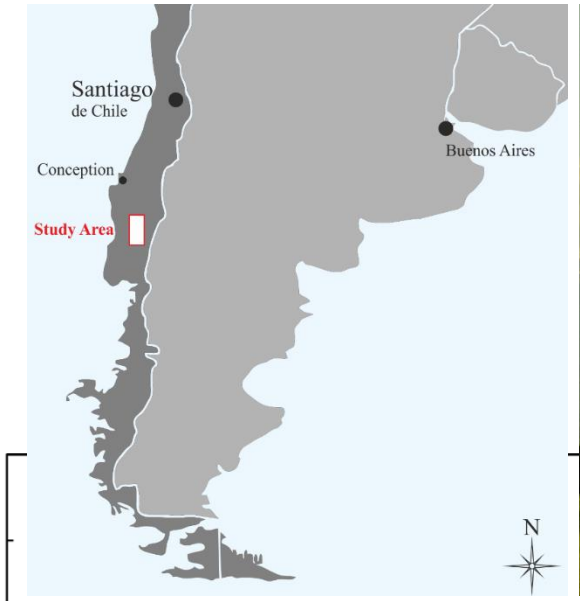
- Basic assumptions:
  - Mineral assemblage and fluid are in equilibrium
  - Temperature-dependent reaction between minerals and fluid
- Temperature determination based on saturation state of reservoir minerals

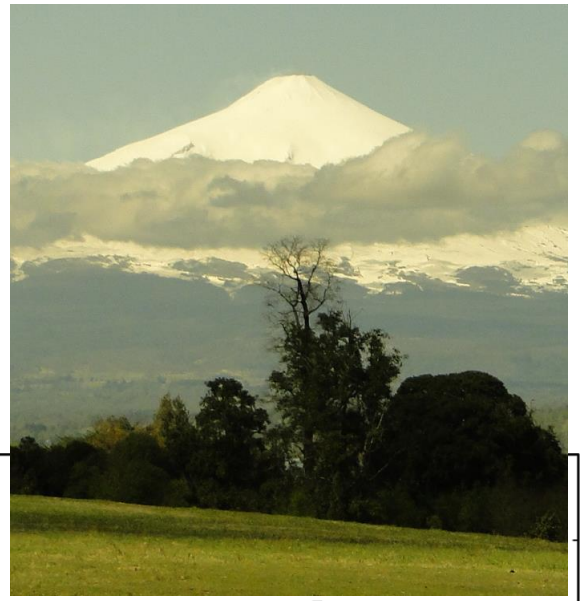


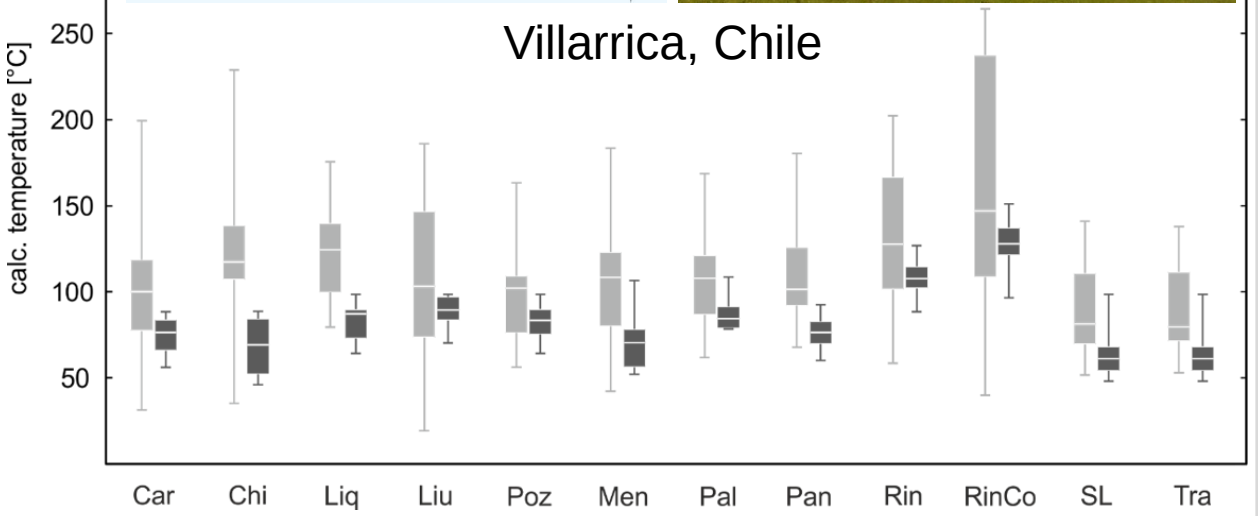
Motivation

- Uncertainties of classical solute geothermometers (n = 23) are often >200K (e.g. Villarrica)
- Uncorrected multicomponent geothermometry is more precise but systematically too cool

- **Goal:** Create a precise green field exploration tool with minimal input data







Interference of equilibrium

- **Boiling** resulting in steam loss
- **Mixing** resulting in dilution
- **Chemical variation** due to re-equilibration, degassing, sampling, laboratory etc.
- **Lithology** to reconstruct the reservoir mineral assemblage

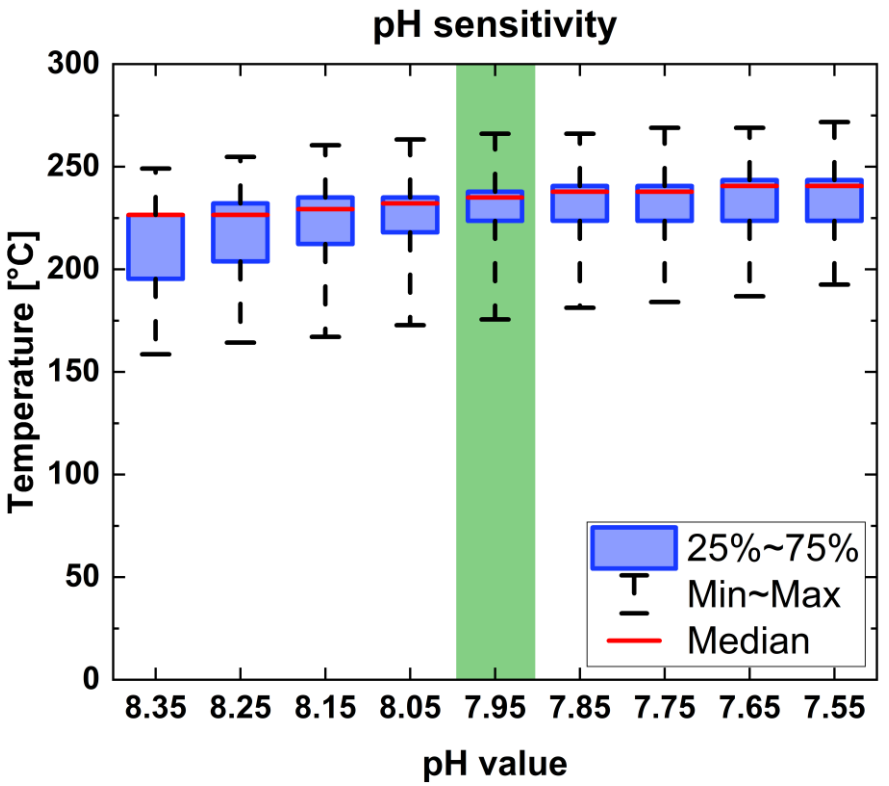
→ Uncertainties in the reservoir temperature estimation

Numerical reconstruction

- best-fit reservoir temperature estimation via reconstruction of reservoir conditions

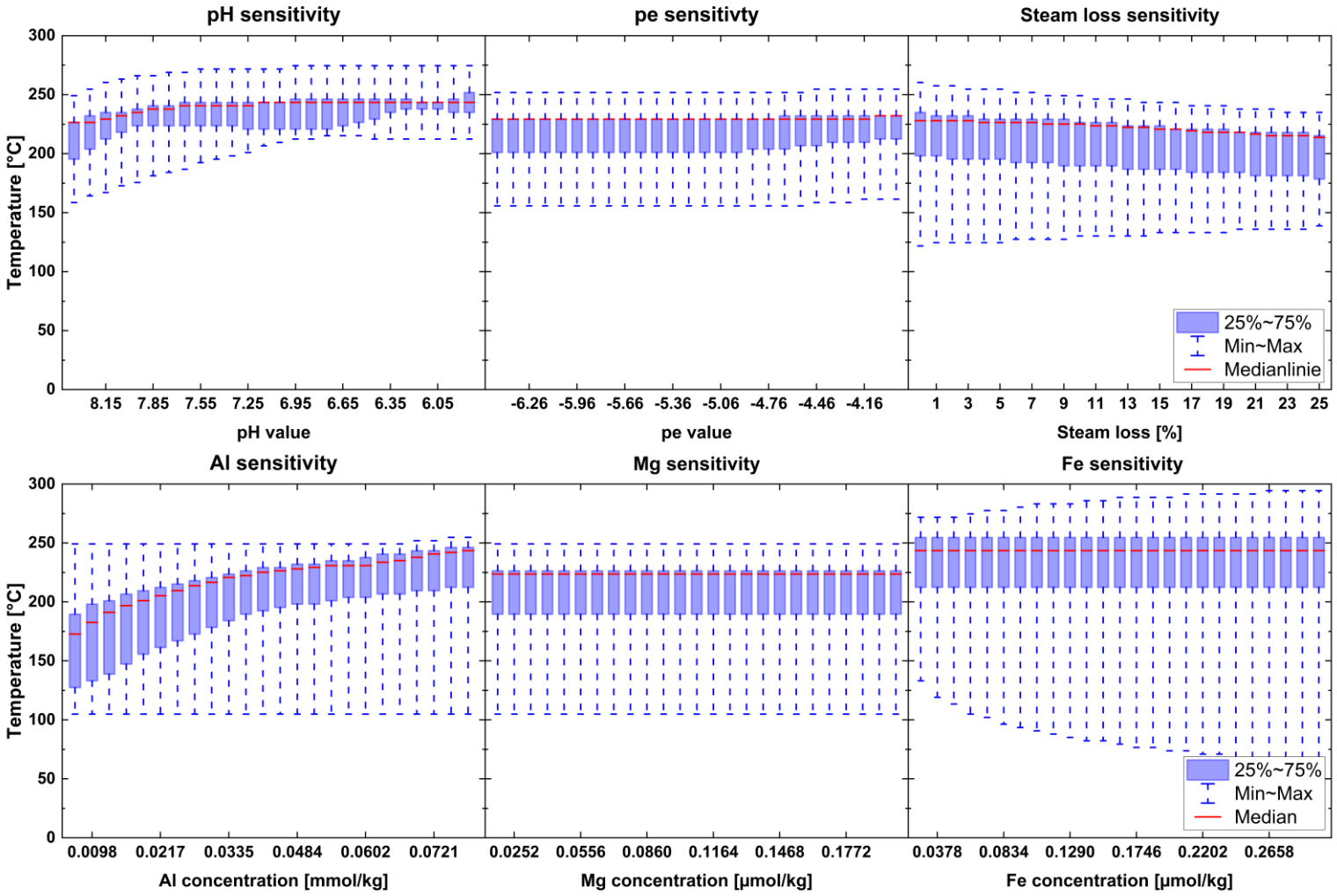
- Similar approaches require an additional gas analysis [e.g. WATCH (Arnórsson, Bjarnason), iGeoT (Spycher, Finsterle)]

→ Reconstruction via integrated sensitivity analysis to minimize equilibrium temperature spread



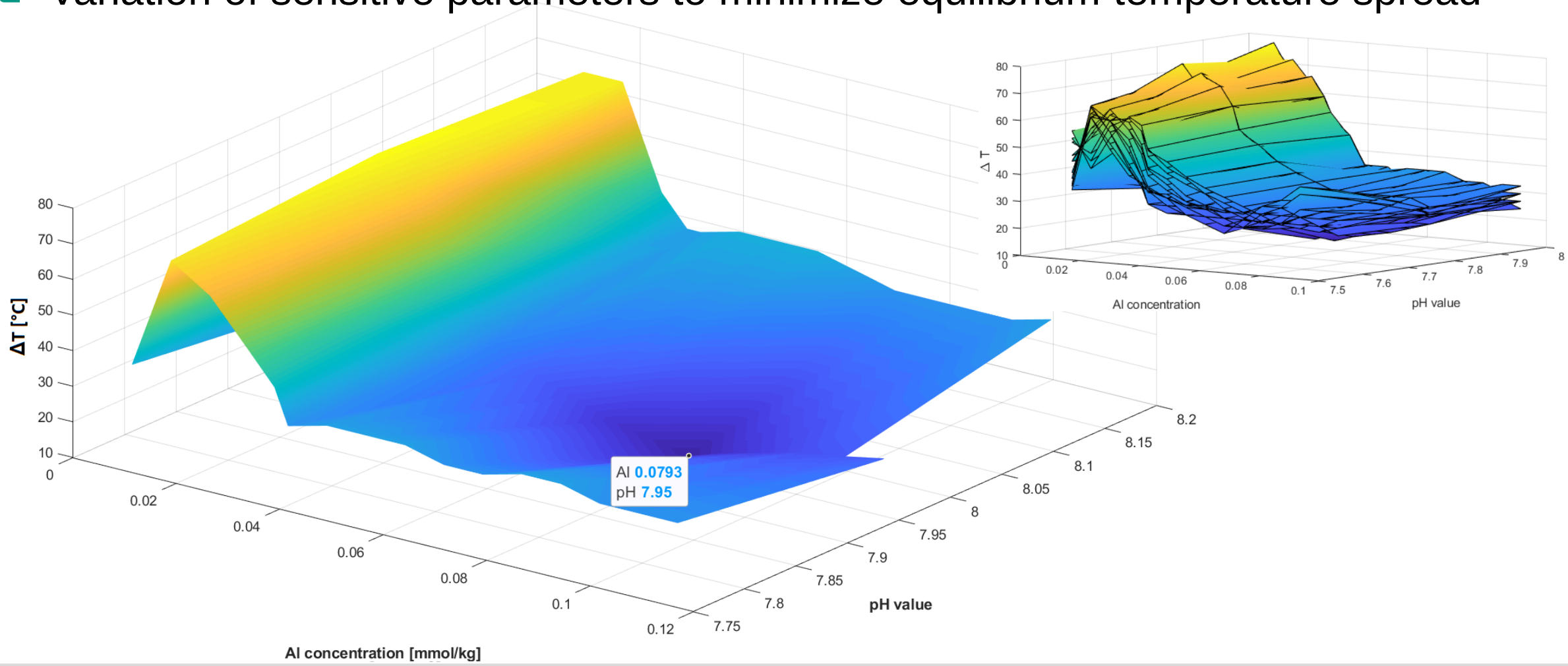
Sensitive parameters

- System parameters vulnerable to secondary processes
- Trace elements which are main components of minerals
  - **pH value**
  - **Steam loss**
  - **Al concentration**



Integrated sensitivity analysis

- Variation of sensitive parameters to minimize equilibrium temperature spread



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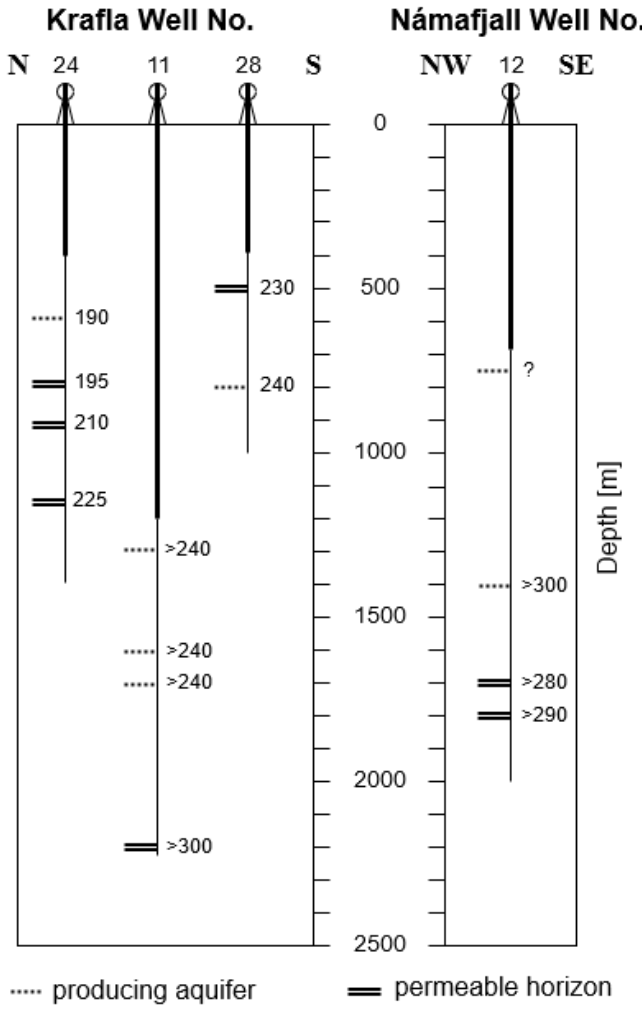
Method Validation

- Applying MulT_predict to well-studied geothermal systems with measured *in-situ* temperatures

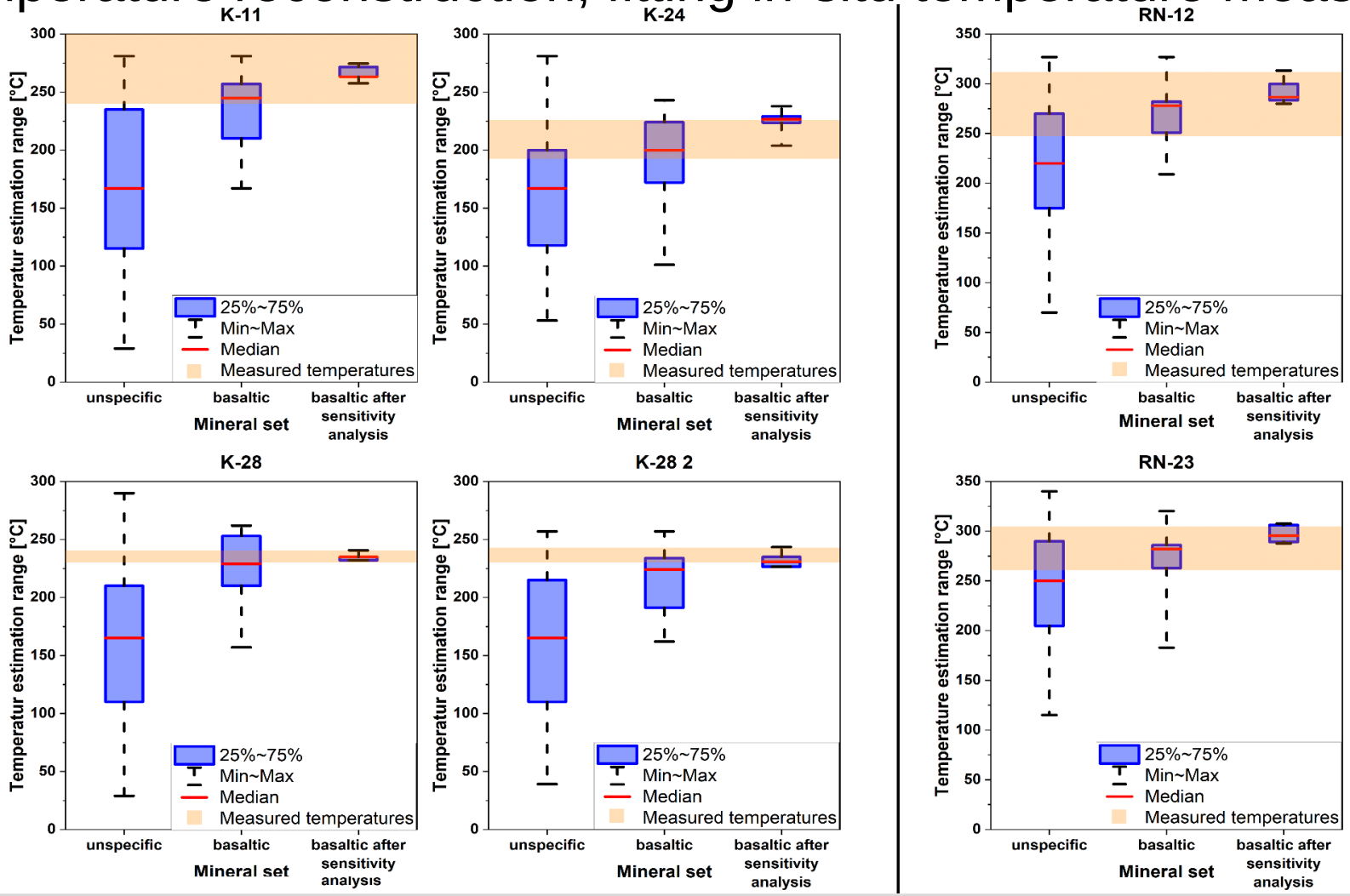
➡ **Krafla** and **Reykjanes** (Iceland)

- Development of basaltic mineral assemblage
- Testing the tool for robustness in saline brines



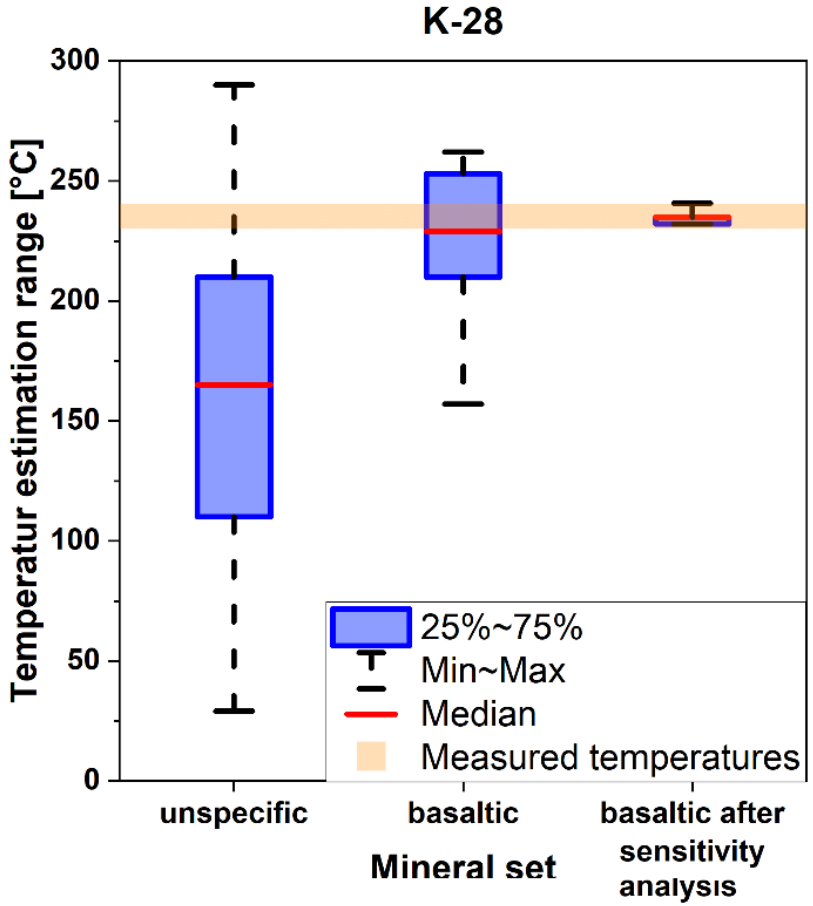
Results

- Precise temperature reconstruction, fitting in-situ temperature measurements



Conclusion

- **Increase of applicability:** Significant reduction of required input data
- **Proof-of-concept:** Reconstruction of *in-situ* conditions based only on equilibria of reservoir minerals is valid
- **High accuracy:** Calculated temperatures match measured temperatures
- **Robustness:** no interference from salinity



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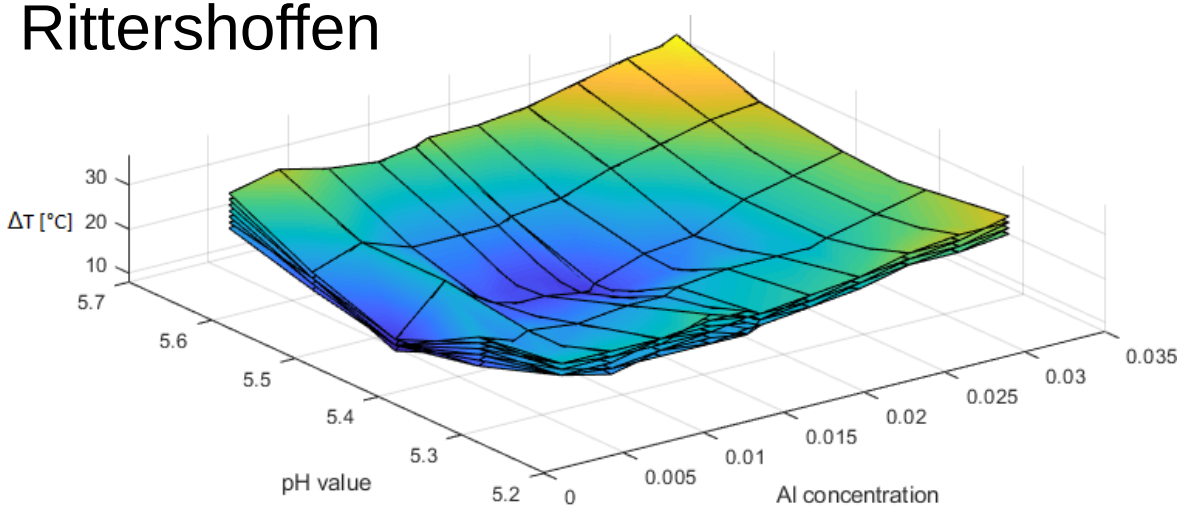

Soultz-sous-Forêts