MulT_predict
A multicomponent geothermometer with integrated sensitivity analyses

L. H. Ystroem, F. Nitschke, S. Held, T. Kohl
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
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

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Lars H. Ystroem, Fabian Nitschke, Sebastian Held, Thomas Kohl

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Institute of Applied Geosciences (AGW)
Division of Geothermics
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.
Électricité de Strasbourg Géothermie (ÉSG)

Rittershoffen

Soultz-sous-Forêts

Temperature estimations

Temperature Range [°C]

Rittershoffen GRT 1

Soultz-sous-Forêts

209°C

162°C

25%~75%

Min~Max

Median