

A Bayesian approach for thermal history reconstruction in basin modeling

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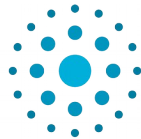
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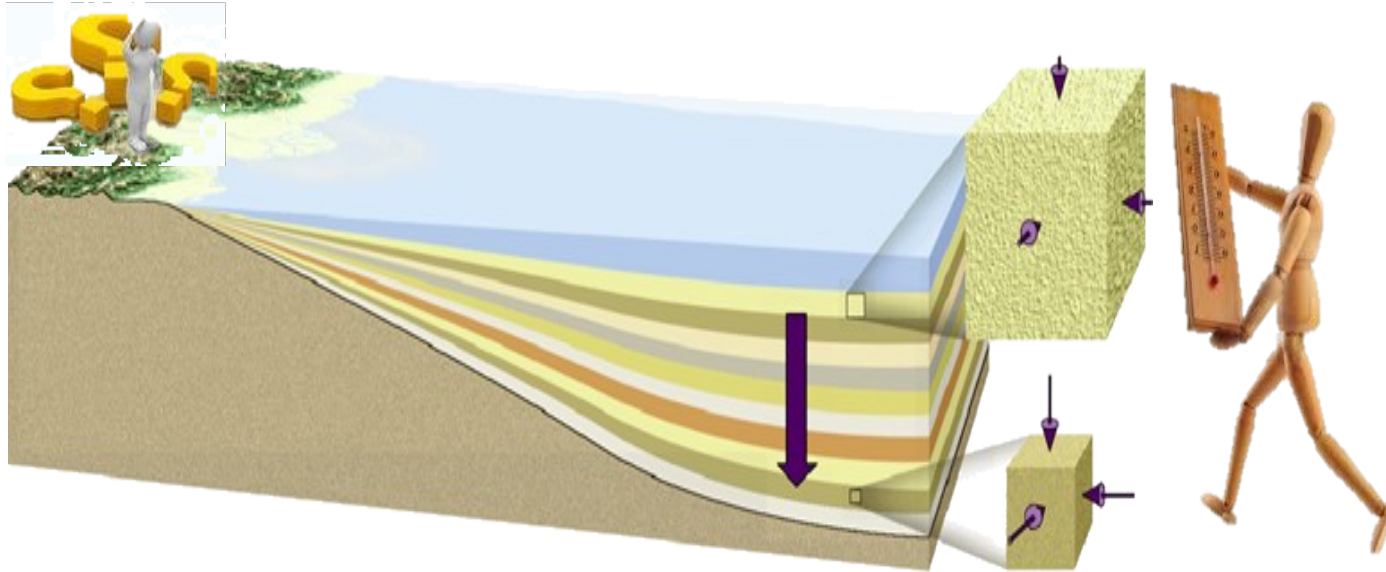
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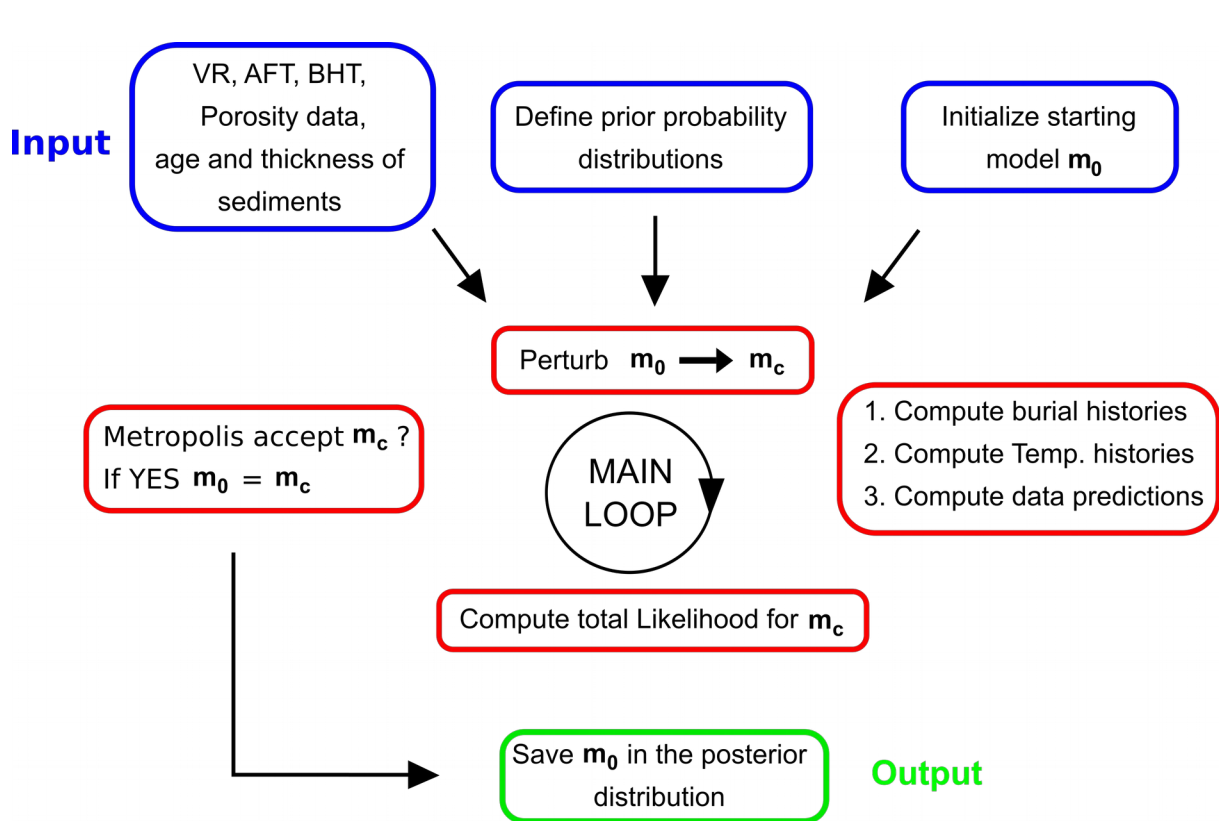


Introduction



The main objective of this work is to provide a **new tool** to quantify the **UNCERTAINTY** on **heat flow history** and **magnitude of erosion** in a sedimentary basin given thermal indicator (VR, AFT and BHT) and porosity data at a single borehole.

Workflow of the algorithm

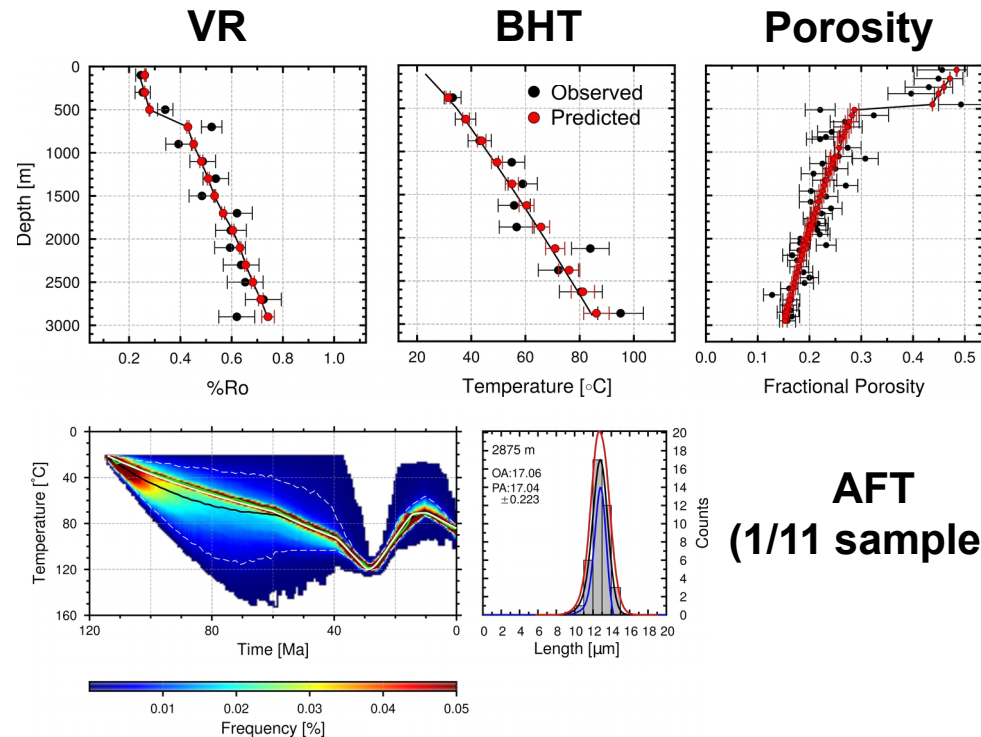
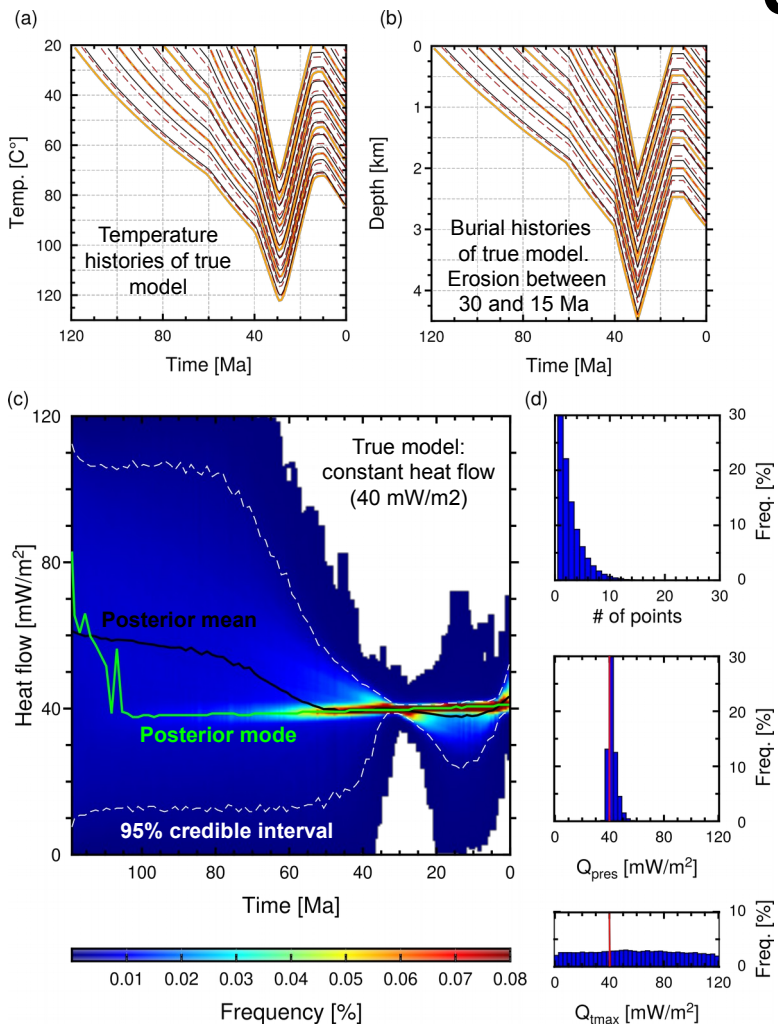


- Joint inversion of **VR, AFT, BHT and porosity data**
- Stratigraphic constraints as input
- Flexible prior probability distributions

- **Bayesian** inversion framework: reversible jump Markov chain Monte Carlo (rjMCMC)
- **Model parameters:** heat flow history at the base of the sediments and magnitude of erosion
- Burial histories are partially unknown

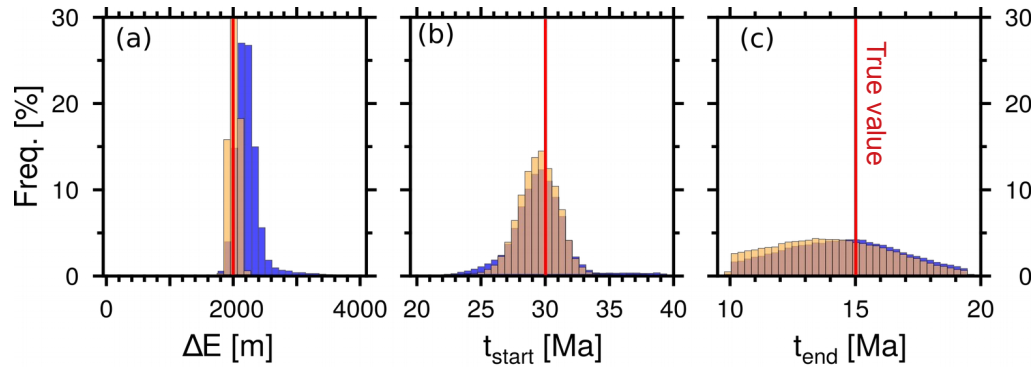
- **Formal uncertainties** on model parameters
- Correlation between parameters
- Uncertainties on data and geological constraints are propagated in the final solution

Synthetic test

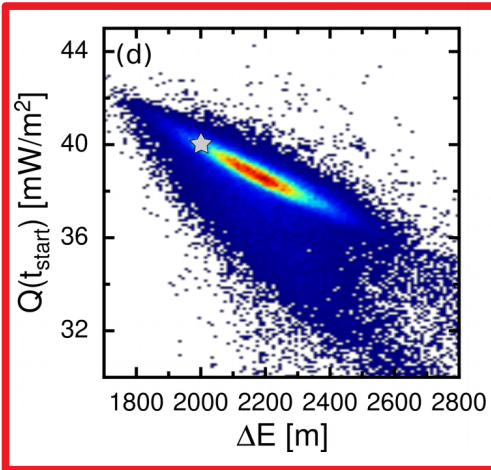


Posterior uncertainties on heat flow (and temperature) history reflects time-dependent resolution of thermal calibration data.

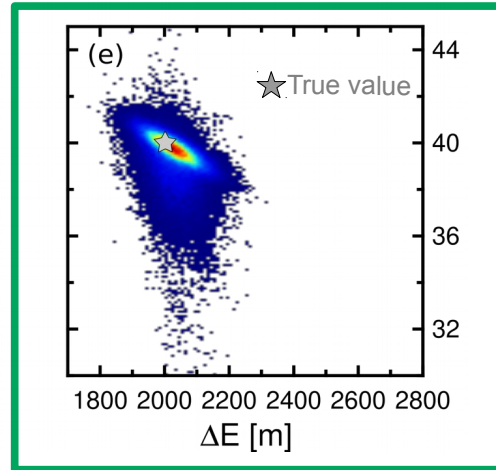
The role of porosity data on estimating erosion



Including porosity data in the inversion (yellow histograms) provides better constraints on the amount of erosion experienced by the sedimentary basin and reduces the trade-off between erosion and heat flow in the inversion

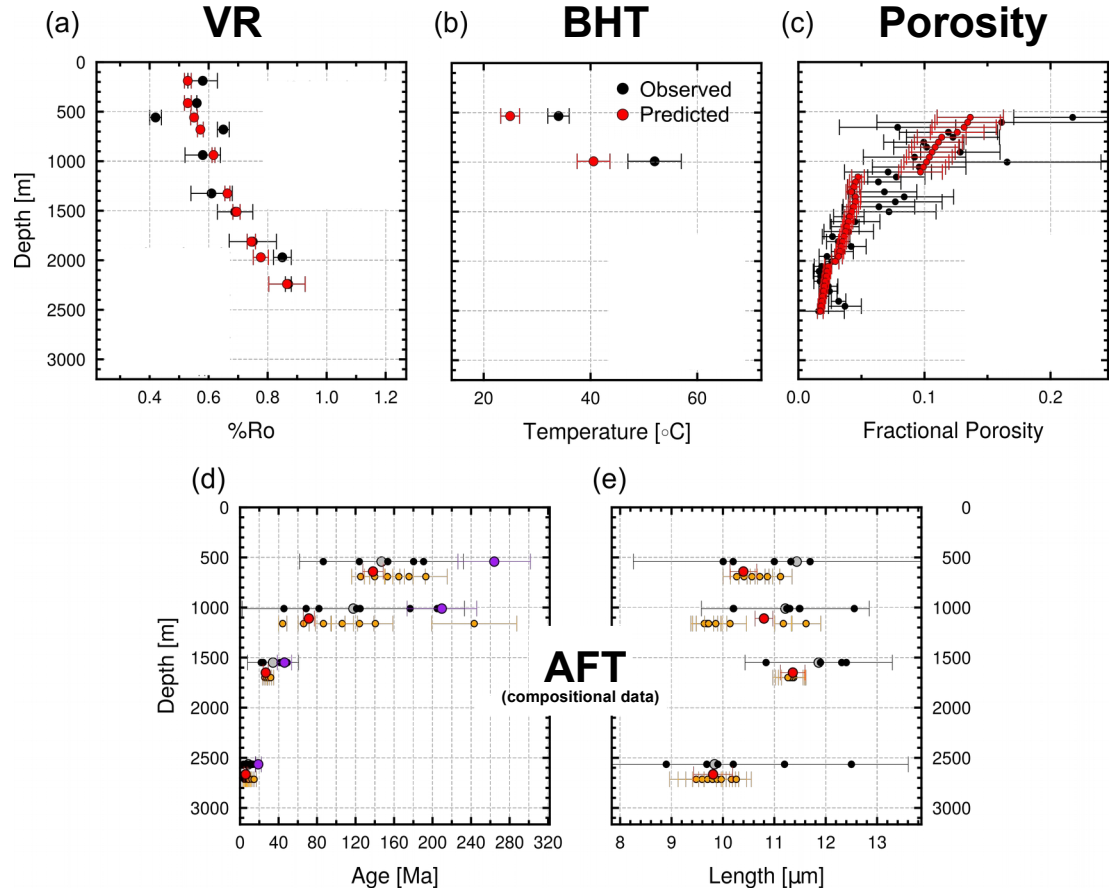
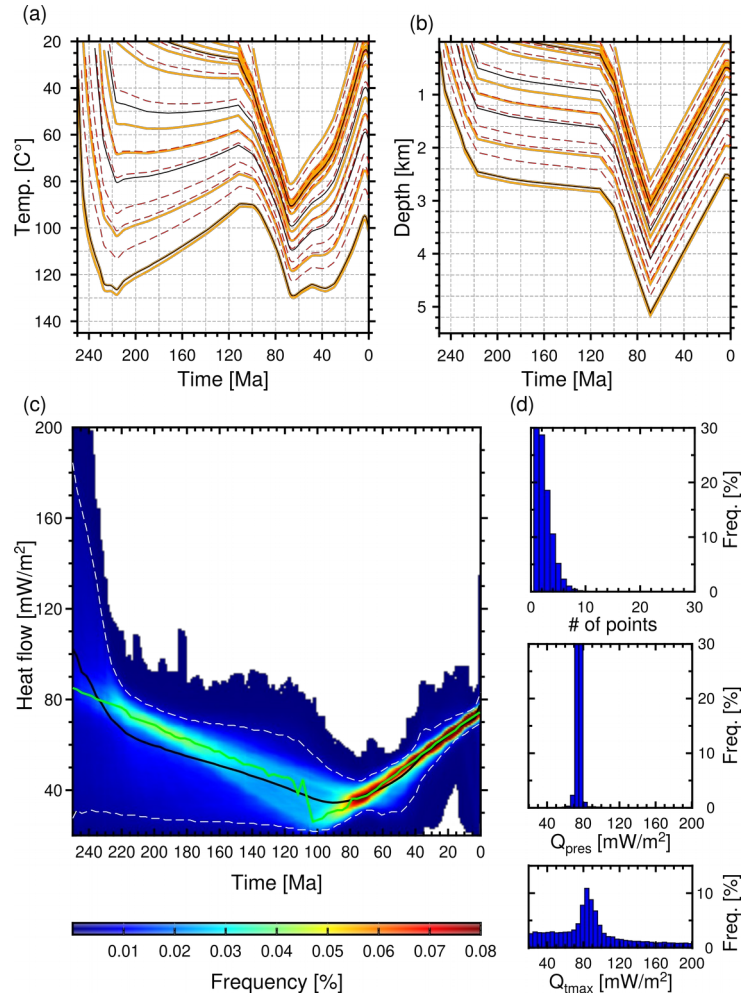


Without porosity data

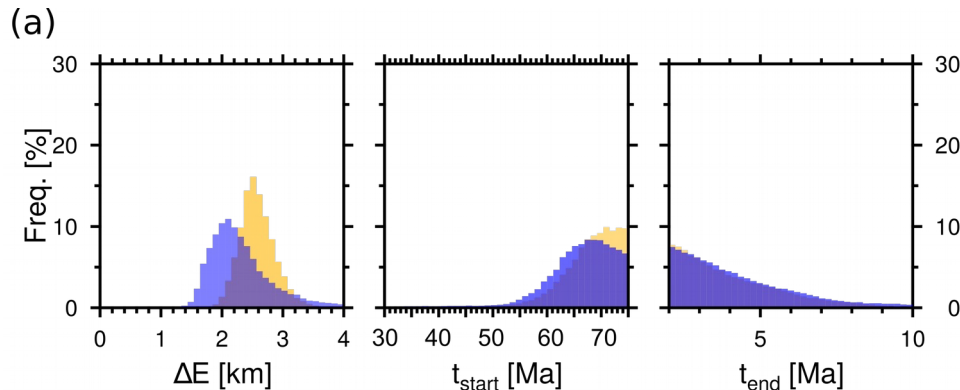


With porosity data

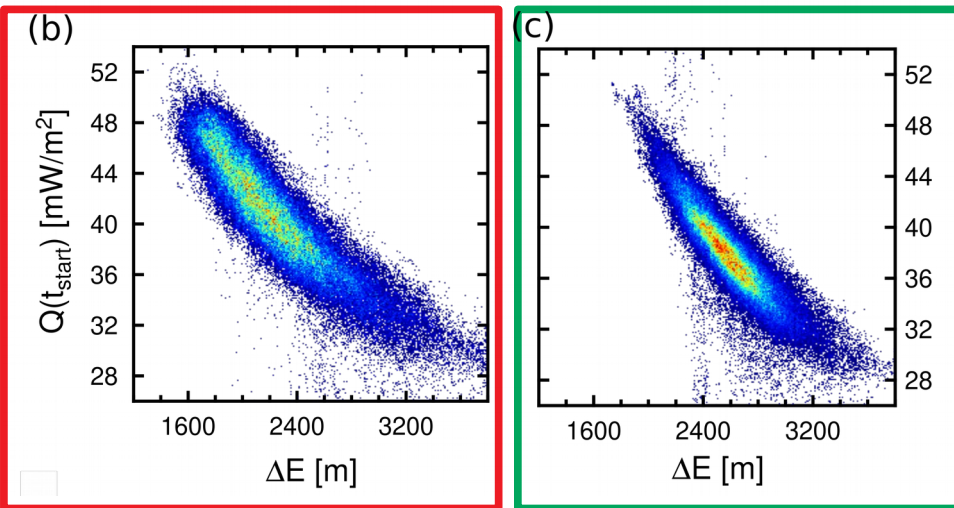
Real data (unidentified well in the Barents Sea)



Real data – amount of erosion



Including porosity data in the inversion (yellow histograms) provides better constraints on the amount of erosion (mean $\sim 2500\text{m}$).



Without porosity data **With porosity data**

Results are in agreement with previous studies (Ktenas et al. 2018, Licciardi et al. 2019) based only on porosity data.

Our algorithm is able to reconcile thermal and porosity data (when dealing with unknown amount of erosion), which is usually a difficult task in basin modeling