Chair of Hydrogeology
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Stochastic 3D facies modeling for characterization of strongly exploited shallow aquifer systems in the area of Munich

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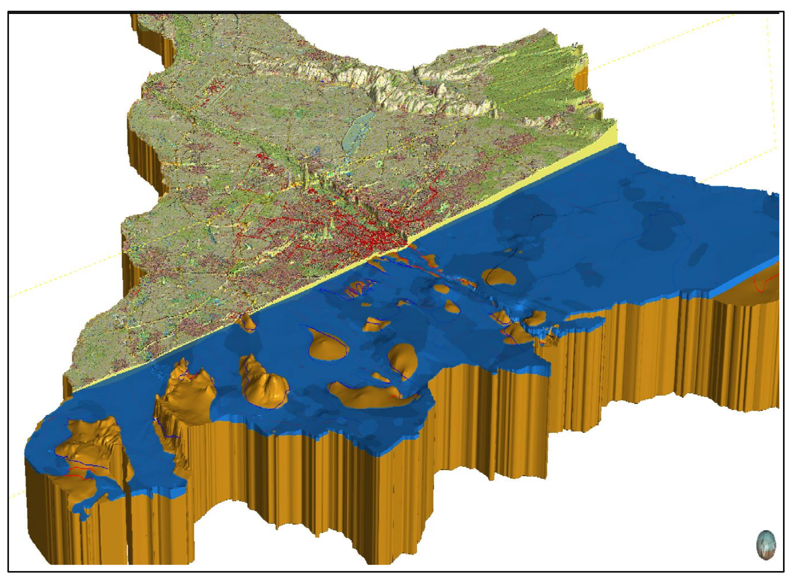
Introduction

The groundwater resources of the Munich Gravel Plain



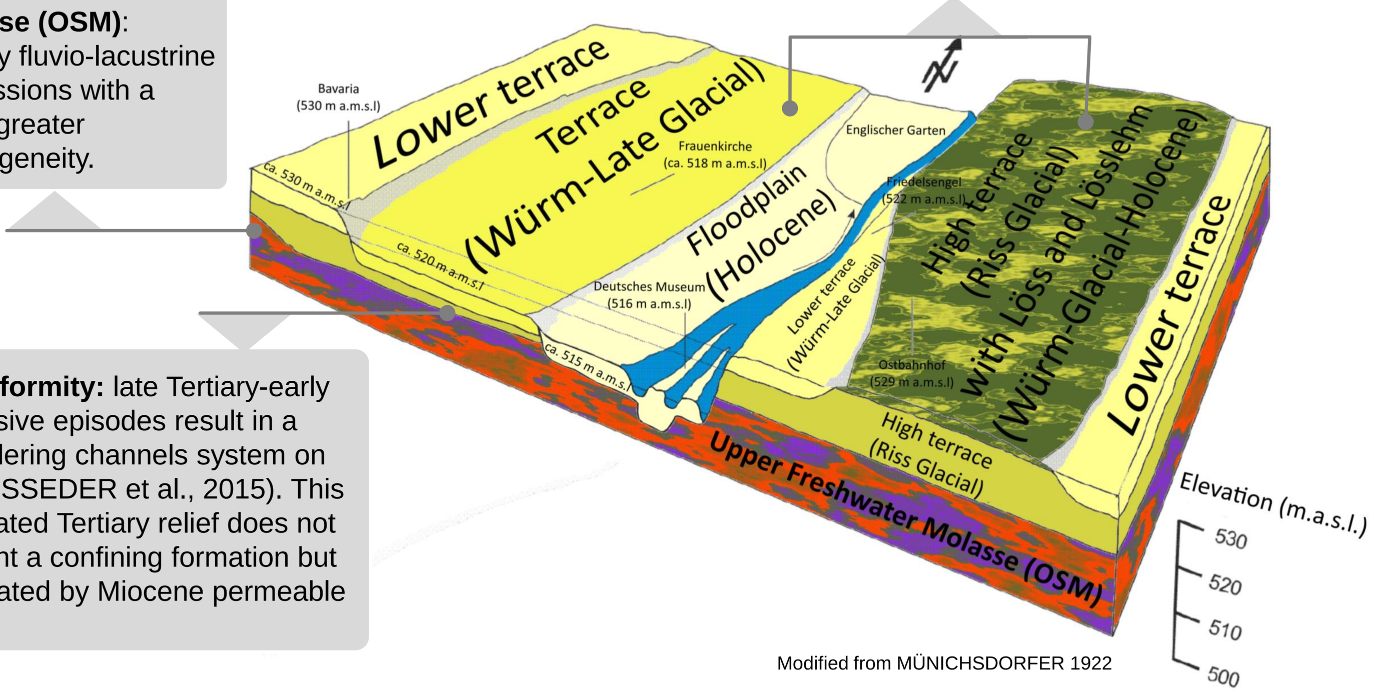
- One of the largest **groundwater reserves** in Germany.
- Glacial-fluvial deposited gravels with **highly permeable hydraulic conductivities** in the range of 10^{-2}-10^{-4} m/s (ZOSSEDER et al., 2015)
- **Multitude of uses**: water supply, drinking water and **geothermal heating and cooling** (1.968 GSHP-installation).

Geological setting

- Munich is situated in the **North Alpine Foreland Basin**.

Munich Gravel Plain: Quaternary glacio-fluvial coarse-grained gravels forming a terraces morphological and geological architecture.

Upper Freshwater Molasse (OSM): Tertiary fluvio-lacustrine successions with a much greater heterogeneity.

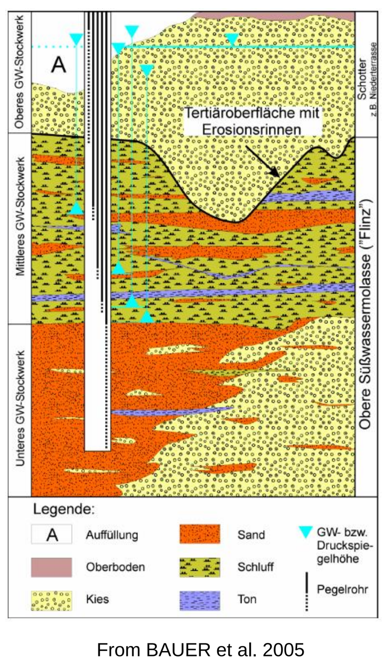


Erosive unconformity: late Tertiary-early Quaternary erosive episodes result in a dynamic meandering channels system on Tertiary top (ZOSSEDER et al., 2015). This highly differentiated Tertiary relief does not always represent a confining formation but locally is dominated by Miocene permeable sand deposits.

Modified from MÜNICHSDORFER 1922

Aquifer systems

Lower aquifer systems: belonging to the Upper Freshwater Molasse are formed by different confined sandy to gravelly deposits intercalated between impervious confining formations in several hundred meters in depth.

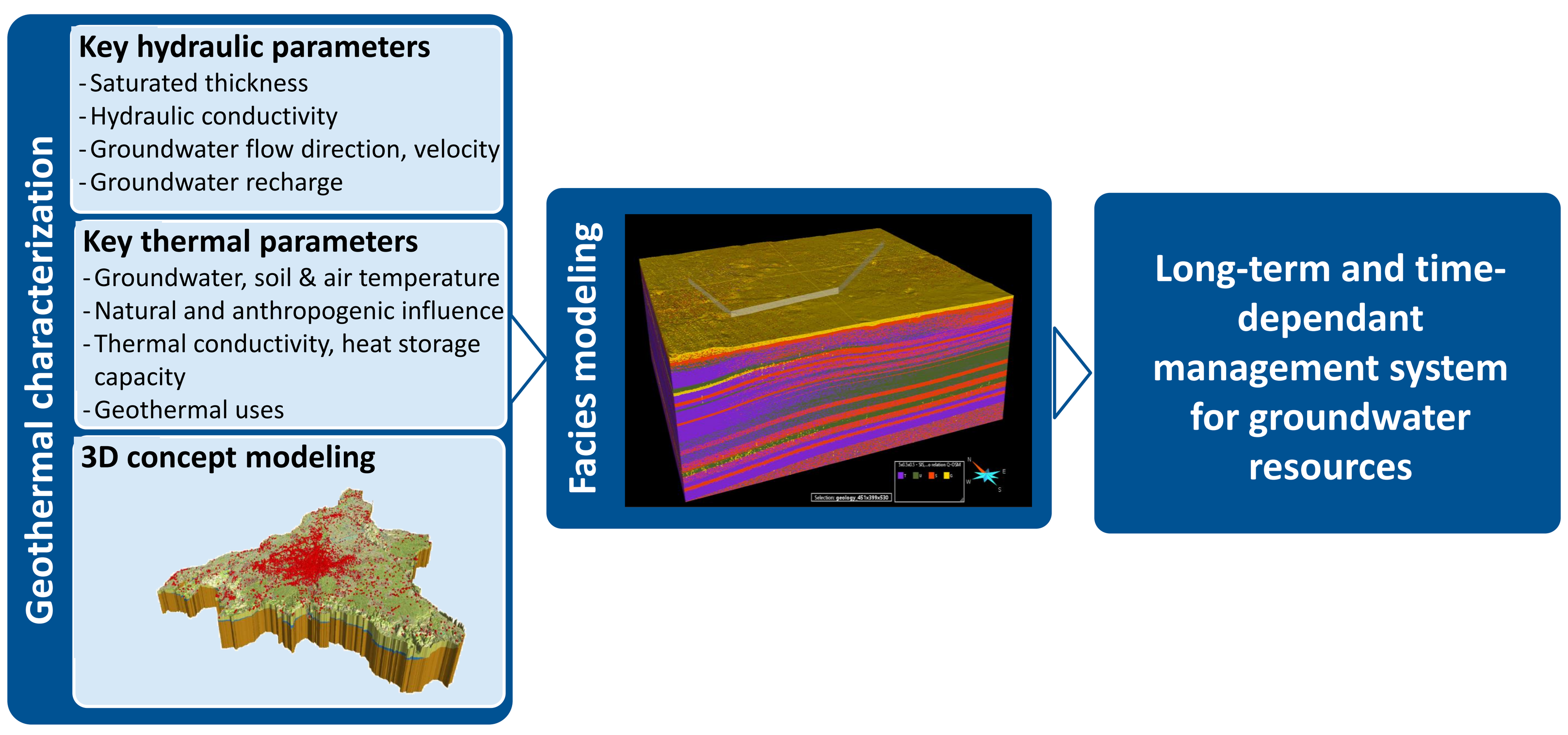


From BAUER et al. 2005

Upper aquifer system: consists of a few meters to a few tens of meters of Quarternary gravel terraces. Also belonging to this unconfined aquifer system are the underlying sandy Miocene strata, if the clay-silt confining layer lacks. According to current water legislation only the upper phreatic aquifer system can be subject of exploitation for geothermal purposes.

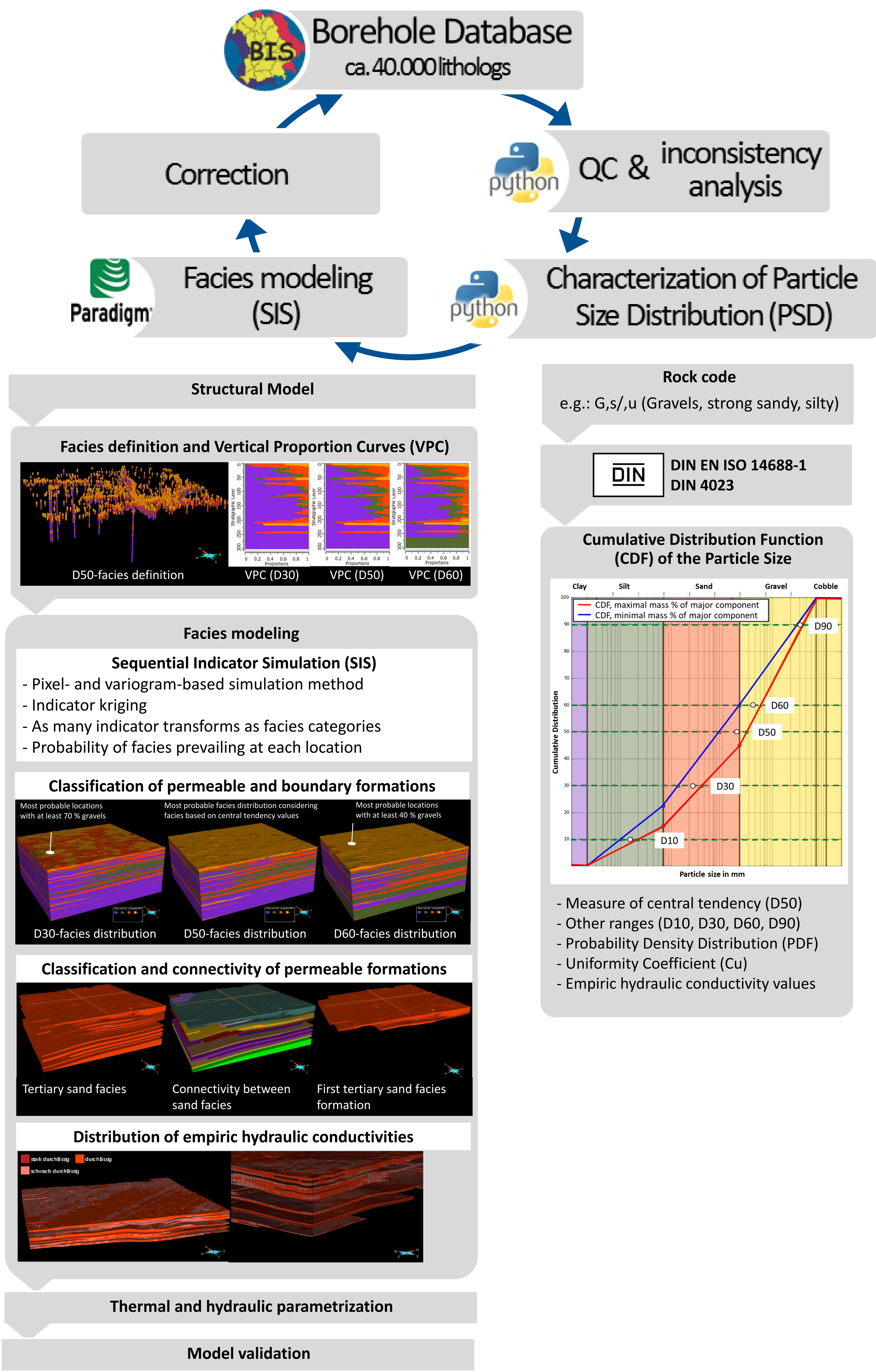
Motivation and Objectives

The very favorable hydrogeological conditions has led to a widespread proliferation of geothermal installations. This great development requires a long-term energy management strategy for optimizing the aquifer geothermal exploitation. For this purpose a **geothermal characterization of the Munich Gravel Plain was performed between 2012 and 2015**, which included the development of a **conceptual stratigraphic and groundwater 3D model** (ZOSSEDER et al. 2015).



The results of the geothermal characterization indicate the importance to investigate the spatial variability of phenomena linked to thermal and hydraulic processes. In order to clarify these questions, the geological geometry and continuity play a major role. The construction of detailed 3D geological models based on facies distributions gives information concerning the sedimentation environment . Combined analysis of this depositional information and relevant thermal and hydraulic data measured in the field allow to analyze the **influence of facies on groundwater**.

Methodology



Conclusions

- Definition of the **hydraulic basin of the upper aquifer system** including the underlying sandy Miocene strata to the upper hydrogeological unit.
- Better understanding of the **groundwater distribution and the interaction processes** between the upper and lower aquifer systems.
- Assessment of **influence of facies on groundwater dynamics and thermal processes** and consequences on actual and future geothermal installations.

Acknowledgements

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