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Please fill in your abstract title.	Calibration of Forward Depositional Models with Well Log Data Based on Advanced Bayesian Optimisation Methodology

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Abstract

Objective and scope:
Forward depositional modeling builds subsurface depositional systems in chronological order by approximating the physical processes controlling deposition over geological time. Currently, the poor hard data reproduction from forward modeling is the most practical limitation for quantitative depositional forward models for reservoir quality prediction. The objective of this study is to introduce a new workflow that can greatly improve the hard data reproduction and reduce the associated computation time.

Methods, Procedures, Process:
In this study, Bayesian optimization is implemented for depositional data calibration. The forward model calibration to well log data is formulated as an optimization problem. Latin hyper-cube sampling (LHS) is used to generate a set of initial models. The misfit between the simulated model and the well log data is calculated. Then, adaptive kriging surrogate modeling is used to sequentially find a minimum to the error function in the permitted parameter space. This iterative procedure will stop when the misfit meets predefined convergence criteria.

Results, Observations, Conclusions:
The proposed inversion principle is implemented using an open source carbonate depositional package as a forward modeling engine, pseudo-well log data are created from unconditional forward modelling. Lithotype categorical data from the model are picked as the targeting calibration property. The final results of the optimization are the key input parameter ranges for the depositional modelling to assess the associated geological uncertainties. It was found that the proposed automated well log calibration can greatly improve the efficiency of the model calibration process. The Bayesian optimization methodology can significantly reduce the CPU time required to achieve the model calibration with reasonable accuracy. This automated inversion methodology will greatly improve the overall model calibration process compared to the conventional trial and error strategy.

Novel/Additive information:
In this work, depositional model calibration with well log data is performed automatically based on inverse problem theory. The proposed optimization workflow could be generalized and implemented for other depositional modeling inversion with relatively simple code customizations to formulate and compute the misfit function.