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Effect discussion and workflow establishment of machine learning algorithm in logging classification: A case study from the classification of sepiolite bearing strata in the first member of Maokou Formation

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The carbonate reservoir in the first member of Maokou Formation (Maokou-1 Member) of Middle Permian in Sichuan Basin have the characteristics of self-generating and, self-storage. Maokou-1 Member is expected to become a new field of unconventional gas reservoir exploration in carbonate rocks. The organic matter and pore development of Maokou-1 Member carbonate rocks are closely related to sepiolite bearing strata. Aiming to predict the sepiolite bearing strata from logging data, with core observation, microscopic analysis, XRD analysis. After sensitivity analysis, CNL, DEN, GR, RT, RXO and AC logging curves are selected as features. To overcome the imbalance among different features, this work introduces SMOTE algorithm. Comparison of classification and content prediction for sepiolite bearing strata among CatBoost, XGBoost, LightGBM, random forest and ANN models indicates CatBoost has good performance in binary and multi classification and XGBoost has a good performance in the regression. The prediction process of sepiolite bearing strata is put forward. The prediction process of sepiolite bearing strata is as follows: (1) Binary classification via CatBoost to judge the existence of sepiolite bearing strata; (2) Multi classification via Catboost to discriminate the type of sepiolite bearing strata; (3) Regression via XGBoost to predict the talc content; (4) Using talc content to calculate effective thickness of sepiolite bearing strata in different types.

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