CLAIMS

1. A method for managing hydrocarbons for a subsurface region comprising:

performing a first petrophysical inversion for the subsurface region with hydrocarbon flood parameters to generate hydrocarbon flood results, the hydrocarbon flood parameters representing an assumption of hydrocarbon flooding in all available pore space in the subsurface region;

performing a second petrophysical inversion for the subsurface region with brine flood parameters to generate brine flood results, the brine flood parameters representing an assumption of brine flooding in all available pore space in the subsurface region;

identifying a first set of misfits in the hydrocarbon flood results;

identifying a second set of misfits in the brine flood results;

generating a trial fluid saturation model based on at least one of the first set of misfits and the second set of misfits;

performing a third petrophysical inversion for the subsurface region with the trial fluid saturation model to generate final results;

generating the fluid saturation model for the subsurface region based on the final results; and

identifying potential hydrocarbon-bearing formations in the subsurface region based on the fluid saturation model;

extracting hydrocarbons from the hydrocarbon-bearing formations identified by the fluid saturation model.

2. The method of claim 1, wherein at least one of the first, second, and third petrophysical inversions comprises a facies-based inversion.

3. The method of claim 1 or claim 2, further comprising at least one of:

identifying potential hydrocarbon-bearing formations in the subsurface region based on the fluid saturation model;

generating an image of the subsurface region based on the fluid saturation model; and

managing hydrocarbons in the subsurface region based on the fluid saturation model.

4. The method of claim 1 or any one of claims 2-3, wherein at least one of the first set of misfits and the second set of misfits comprises at least one of:

porosity misfits;

volume of clay misfits;

seismic data misfits; and

P-wave velocity misfits.

5. A method for managing hydrocarbons for a subsurface region comprising:

performing a first petrophysical inversion for the subsurface region with brine flood parameters to generate brine flood results, the brine flood parameters representing an assumption of brine flooding in all available pore space in the subsurface region;

classifying rock types in the subsurface region based on the brine flood results, wherein the rock types comprise at least one artificial rock type;

generating a trial fluid saturation model based on the classified rock types;

performing a second petrophysical inversion for the subsurface region with the trial fluid saturation model to generate final results;

generating the fluid saturation model for the subsurface region based on the final results;

identifying potential hydrocarbon-bearing formations in the subsurface region based on the fluid saturation model; and

extracting hydrocarbons from the hydrocarbon-bearing formations identified by the fluid saturation model.

6. The method of claim 5, wherein at least one of the first and second petrophysical inversions comprises a facies-based inversion.

7. The method of claim 5 or claim 6, further comprising generating an image of the subsurface region based on the fluid saturation model.

8. The method of claim 5 or any one of claims 6-7, further comprising managing hydrocarbons in the subsurface region based on the fluid saturation model.

9. The method of claim 5 or any one of claims 6-8, further comprising utilizing a machine learning system to classify the rock types.

10. The method of claim 5 or any one of claims 6-9, further comprising performing one or more additional petrophysical inversions for the subsurface region with the at least one artificial rock type prior to generating the final results.

11. The method of claim 5 or any one of claims 6-10, wherein classifying the rock types comprises generating one or more cross-plots of porosity and volume of clay.

12. A method for managing hydrocarbons for a subsurface region comprising:

using a computer, performing a first petrophysical inversion for the subsurface region with brine flood parameters to generate inversion results, the brine flood parameters representing an assumption of brine flooding in all available pore space in the subsurface region;

using the computer, iteratively repeating until convergence:

classifying rock types in the subsurface region based on the inversion results, wherein the rock types comprise at least one artificial rock type;

generating a trial fluid saturation model based on the classified rock types;

performing a trial petrophysical inversion for the subsurface region with the trial fluid saturation model to generate trial results;

updating the inversion results with the trial results; and

checking for convergence;

using the computer, generating the fluid saturation model for the subsurface region based on the inversion results;

using the computer, identifying potential hydrocarbon-bearing formations in the subsurface region based on the fluid saturation model; and

extracting hydrocarbons from the hydrocarbon-bearing formations identified by the fluid saturation model.

13. The method of claim 12, wherein at least one of the first petrophysical inversion and the trial petrophysical inversions comprises a facies-based inversion.

14. The method of claim 12 or claim 13, wherein the check for convergence comprises:

comparing the inversion results from a prior iteration to the trial results to determine a remaining error estimate; and

determining whether the remaining error estimate is below a selected error threshold.

15. The method of claim 12 or any one of claims 13-14, wherein the trial petrophysical inversion inverts for water saturation.

16. The method of claim 12 or any one of claims 13-15, further comprising managing hydrocarbons in the subsurface region based on the fluid saturation model.

17. The method of claim 12 or any one of claims 13-16, further comprising utilizing a machine learning system to classify the rock types.

18. The method of claim 12 or any one of claims 13-17, wherein the trial petrophysical inversion utilizes the at least one artificial rock type.