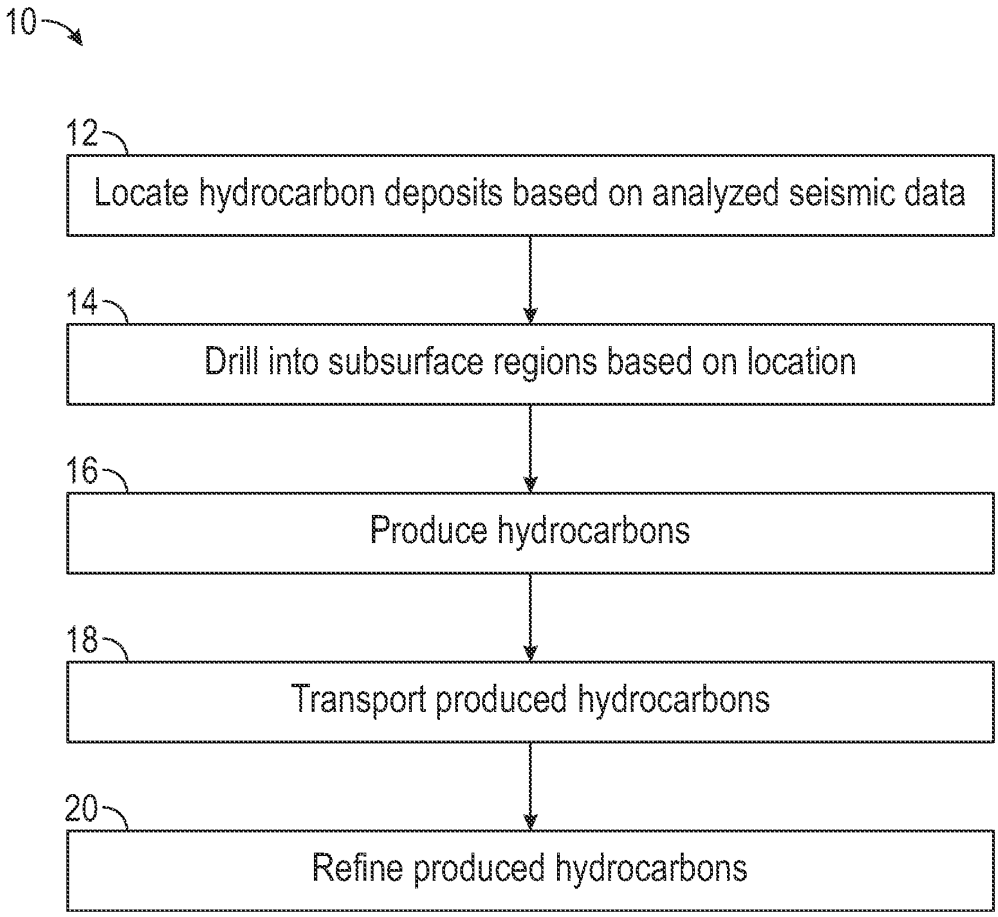

10
12
Locate hydrocarbon deposits based on analyzed seismic data
14
Drill into subsurface regions based on location
16
Produce hydrocarbons
18
Transport produced hydrocarbons
20
Refine produced hydrocarbons

FIG. 1

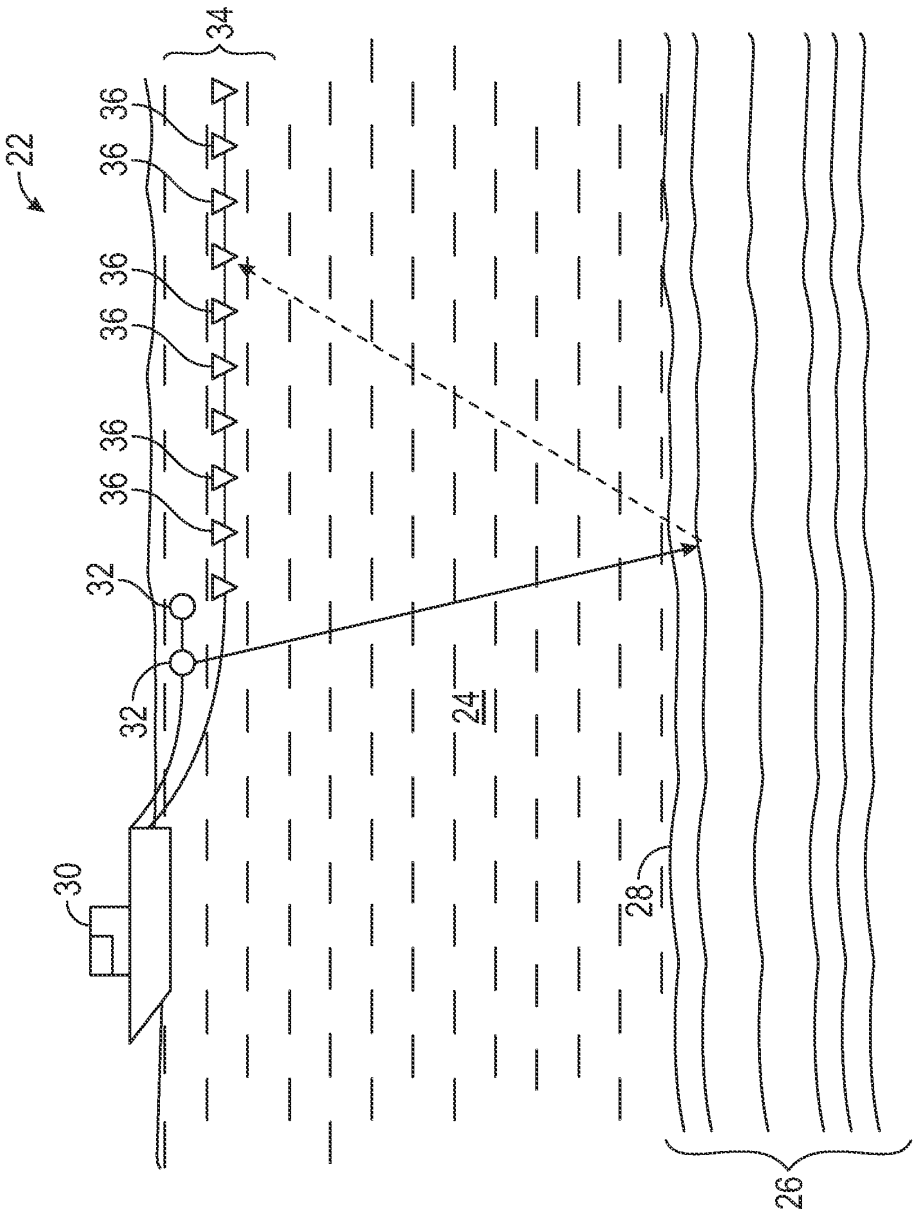


FIG. 2

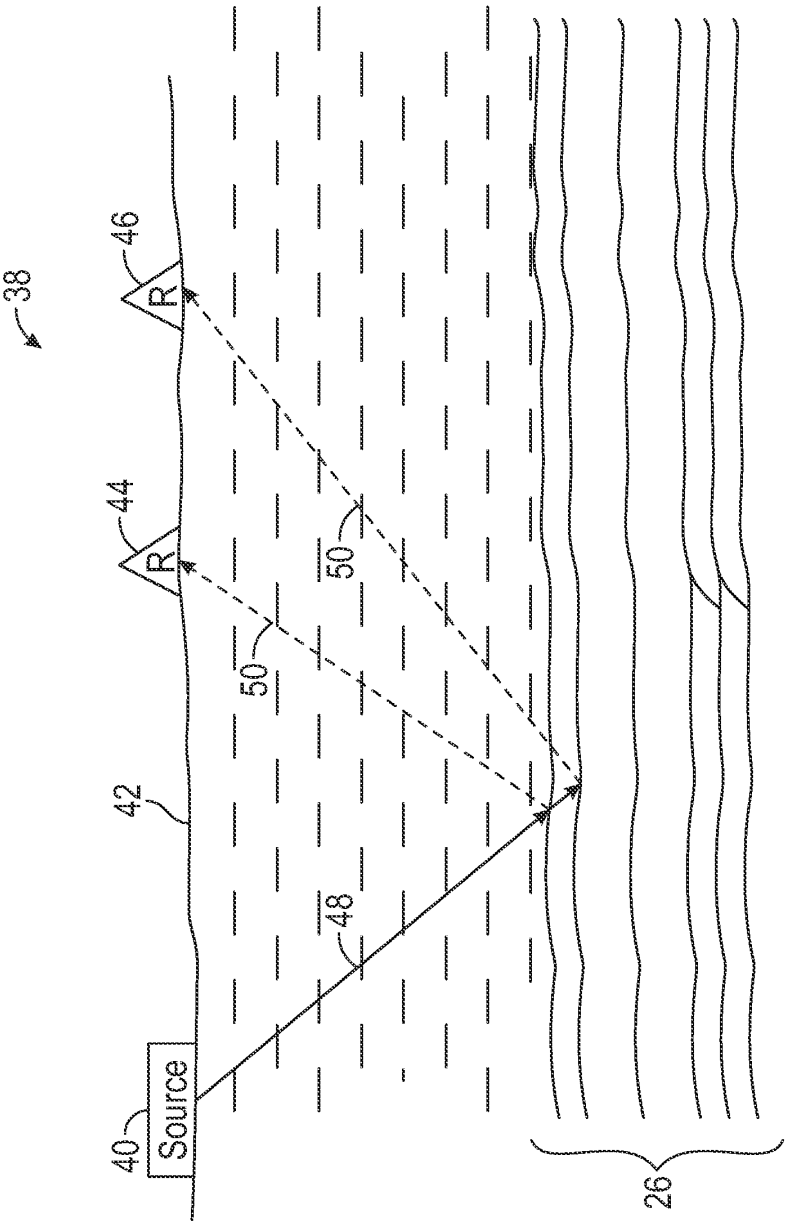


FIG. 3

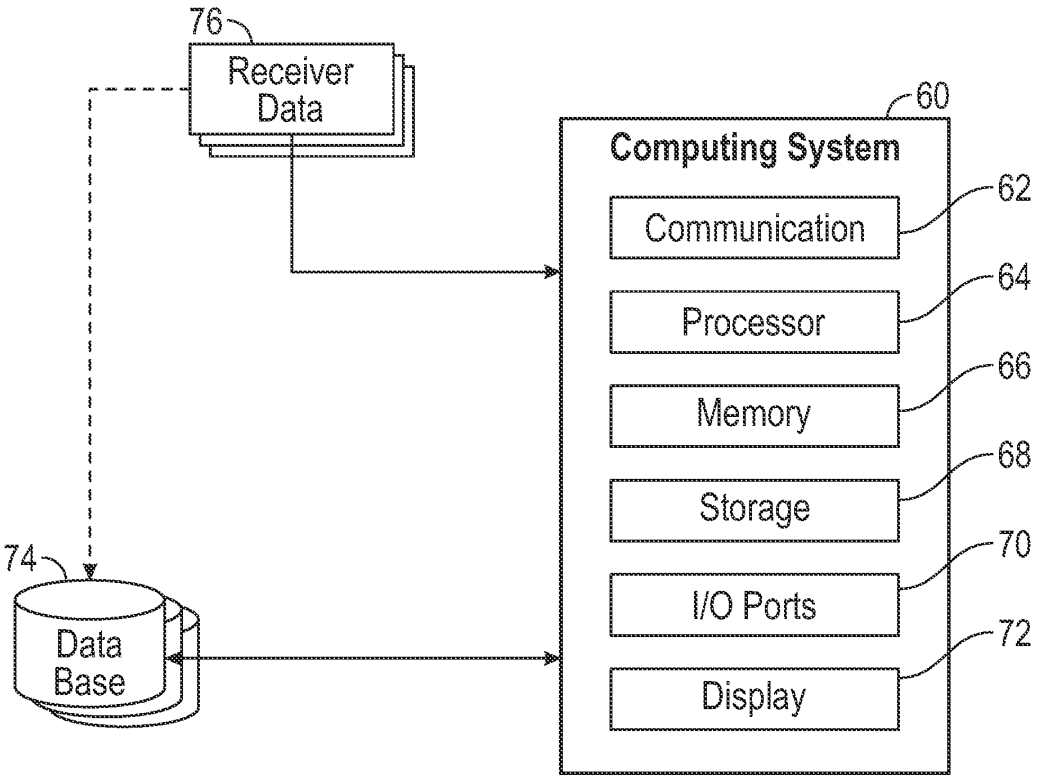

76
Receiver Data
60
Computing System
62
Communication
64
Processor
66
Memory
68
Storage
70
I/O Ports
72
Display
74
Data Base

FIG. 4

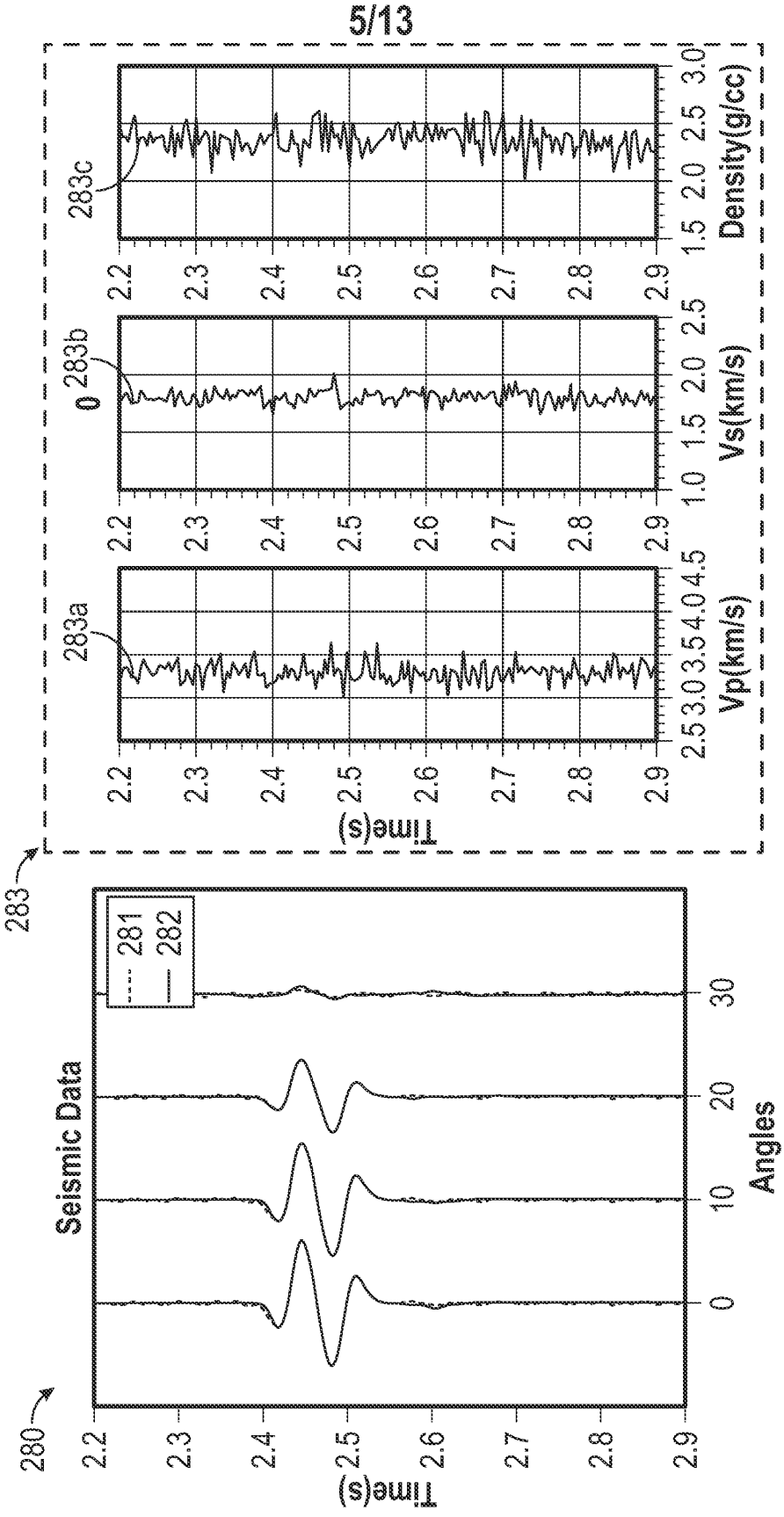

280
Seismic Data
281
282
Angles
0
10
20
30
Time(s)
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
283
283a
Vp(km/s)
2.5
3.0
3.5
4.0
4.5
283b
Vs(km/s)
1.0
1.5
2.0
2.5
283c
Density(g/cc)
1.5
2.0
2.5
3.0

FIG. 5

FIG. 6

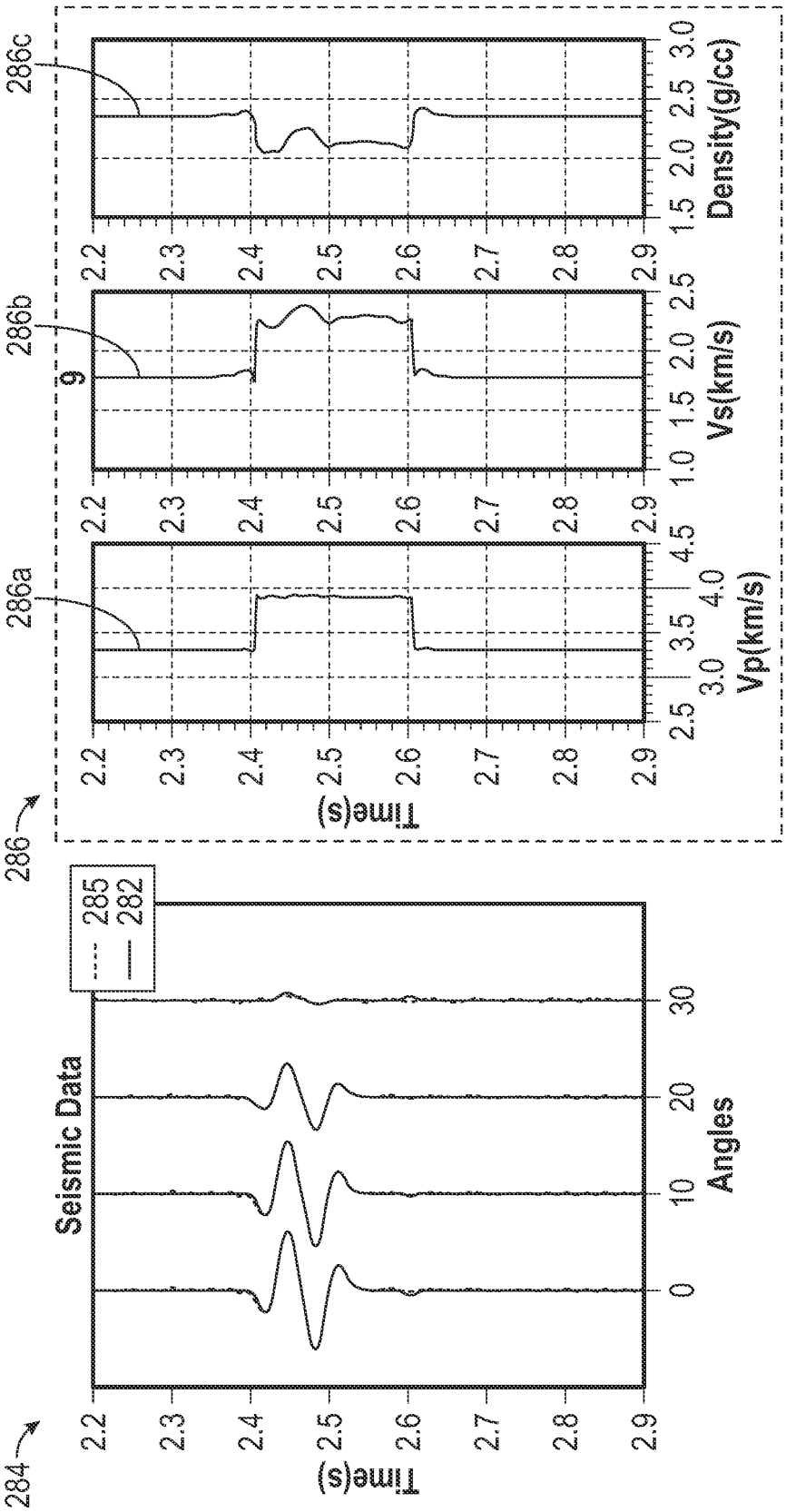

286
286a
286b
286c
Vp(km/s)
Vs(km/s)
Density(g/cc)
Time(s)
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
2.5
3.0
3.5
4.0
4.5
1.0
1.5
2.0
2.5
1.5
2.0
2.5
3.0
9

FIG. 8

284
Seismic Data
285
282
Time(s)
Angles
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
0
10
20
30

FIG. 7

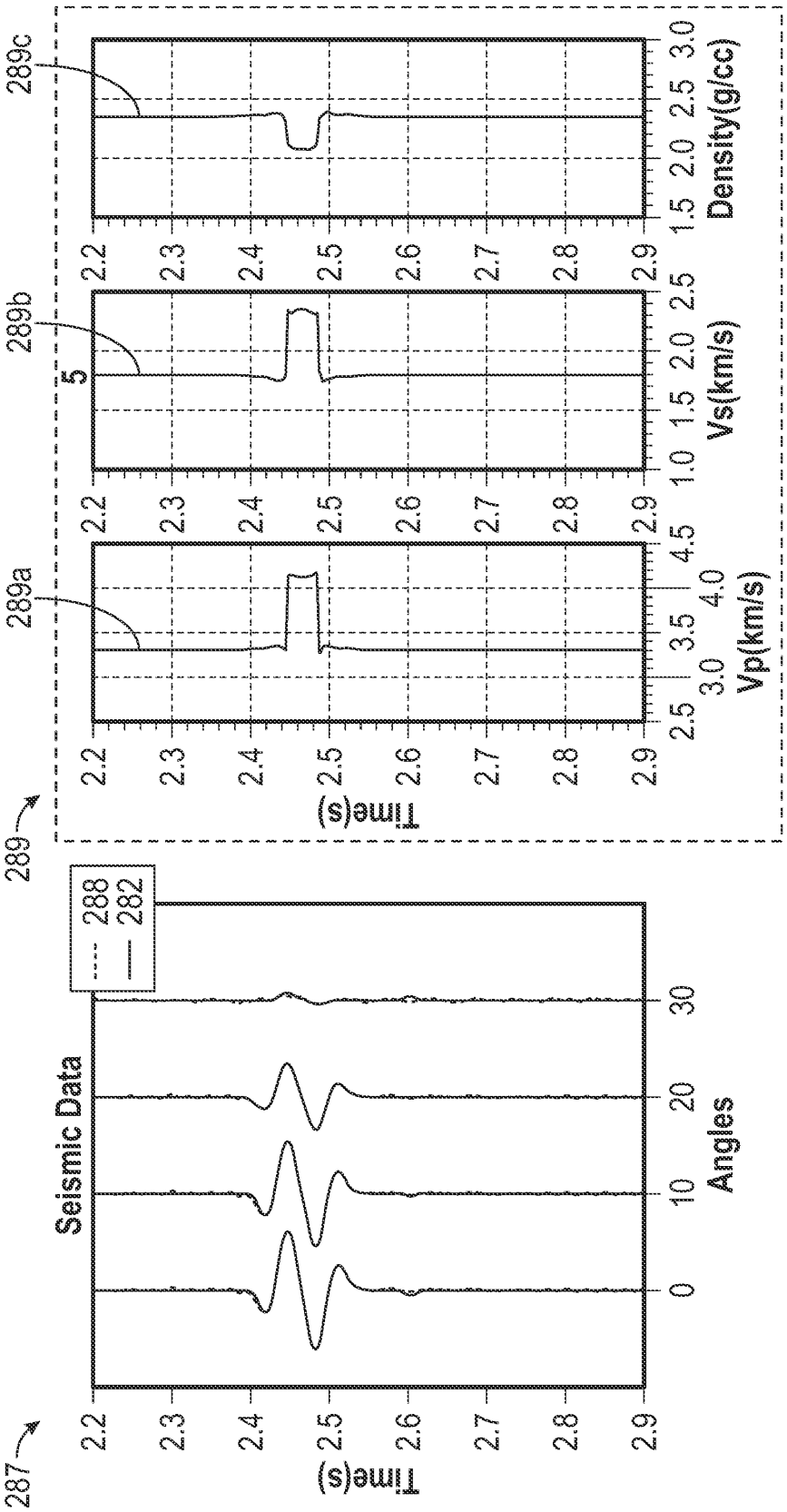

289
289a
289b
289c
Vp(km/s)
Vs(km/s)
Density(g/cc)
Time(s)
287
Seismic Data
288
282
Angles
Time(s)

FIG. 10

FIG. 9

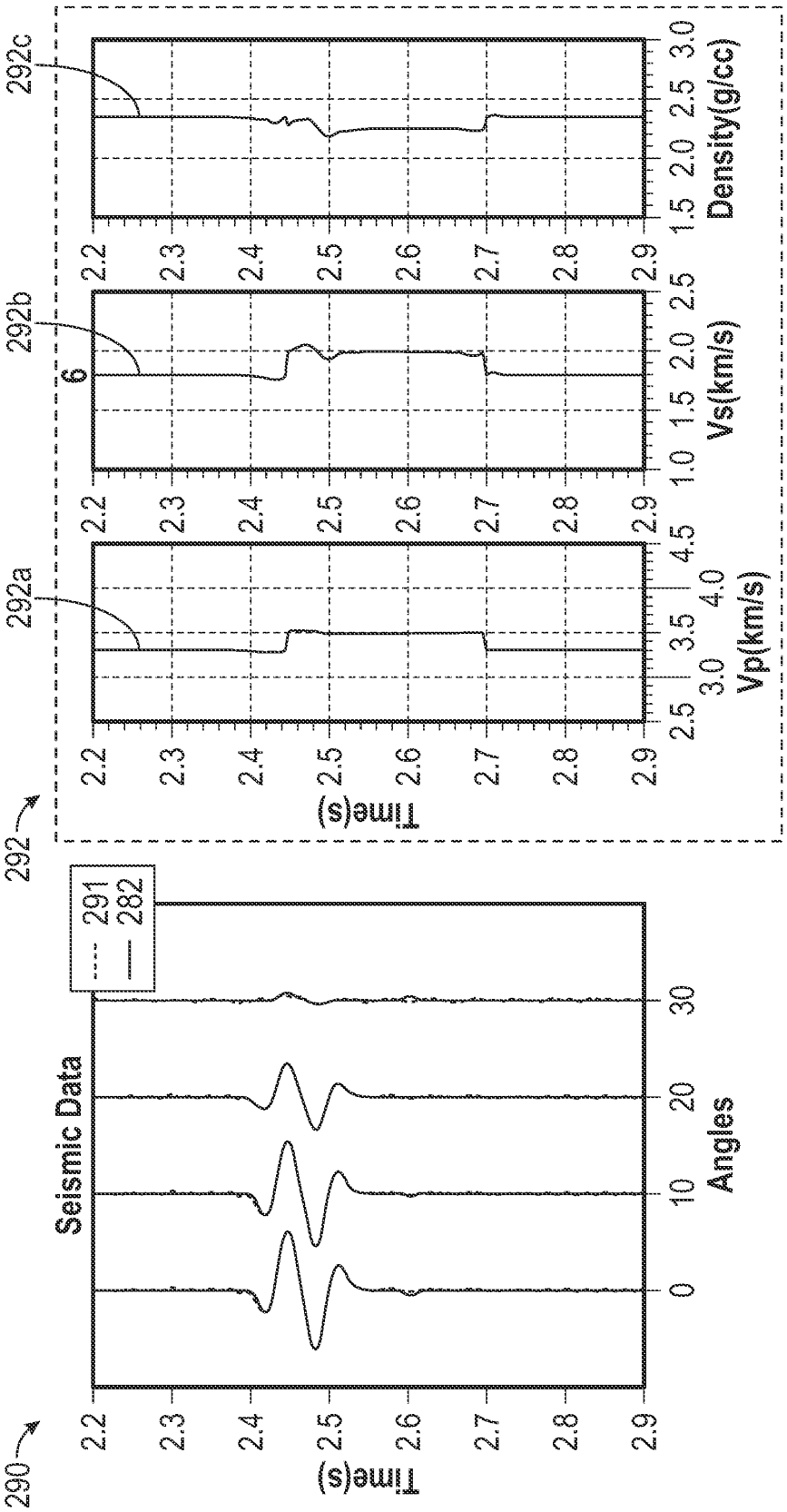

290
Seismic Data
291
282
Time(s)
Angles
0
10
20
30
292
292a
292b
292c
Vp(km/s)
Vs(km/s)
Density(g/cc)
6

FIG. 11

FIG. 12

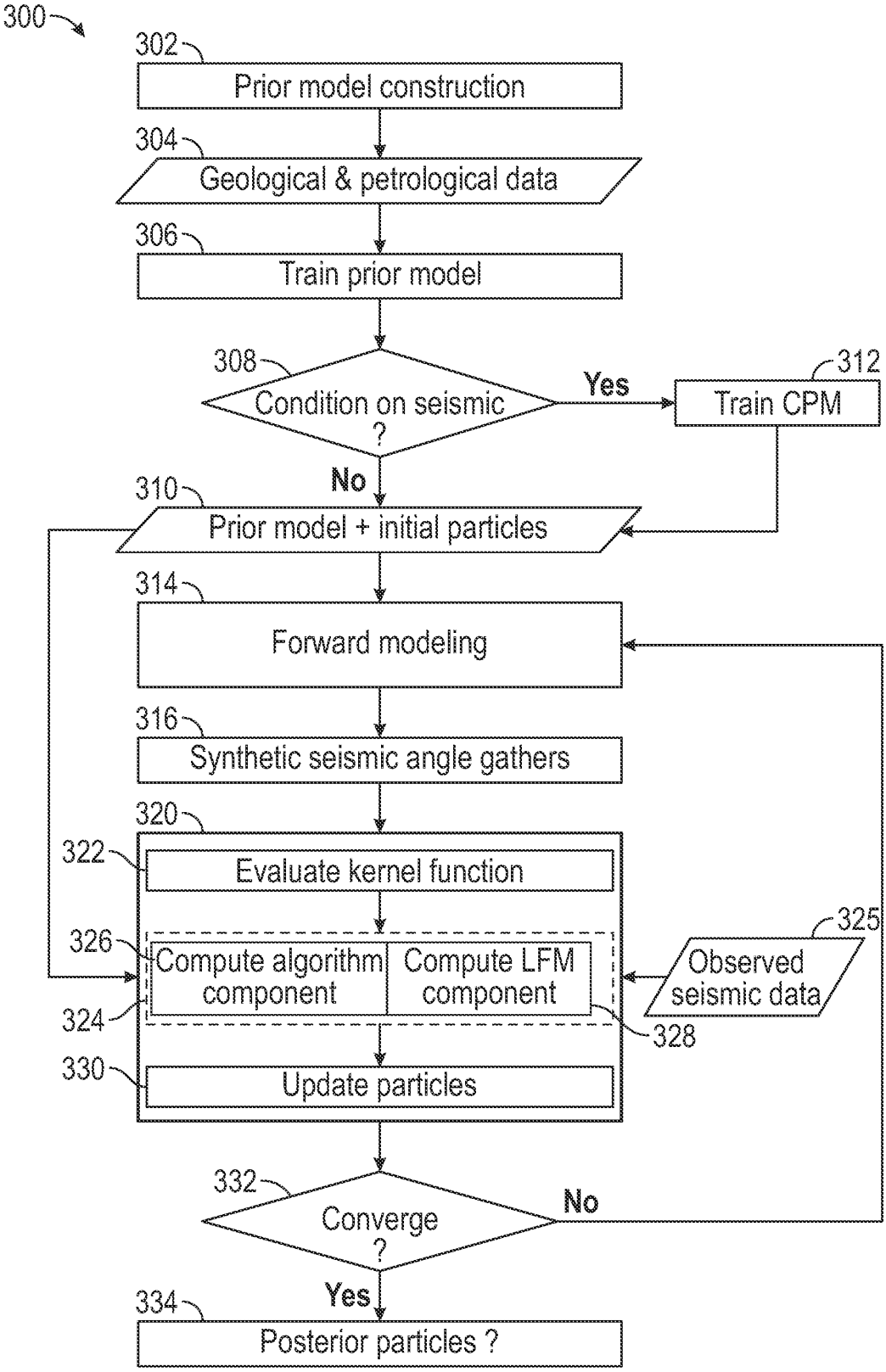

300
302
Prior model construction
304
Geological & petrological data
306
Train prior model
308
Condition on seismic ?
Yes
312
Train CPM
No
310
Prior model + initial particles
314
Forward modeling
316
Synthetic seismic angle gathers
320
322
Evaluate kernel function
326
Compute algorithm component
Compute LFM component
324
328
325
Observed seismic data
330
Update particles
332
Converge ?
No
Yes
334
Posterior particles ?

FIG. 13

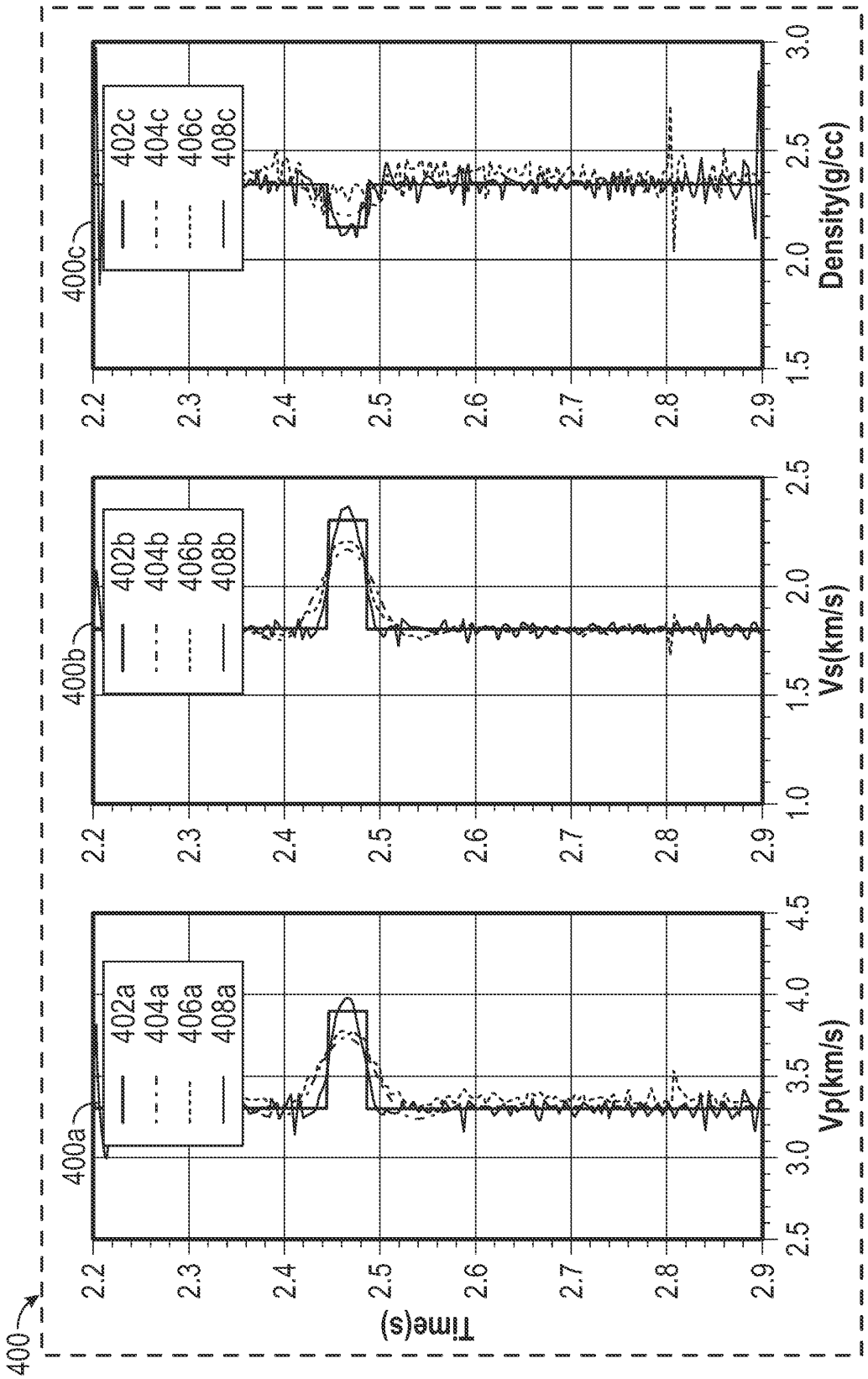

400
400a
400b
400c
402a
404a
406a
408a
402b
404b
406b
408b
402c
404c
406c
408c
Time(s)
Vp(km/s)
Vs(km/s)
Density(g/cc)

FIG. 14

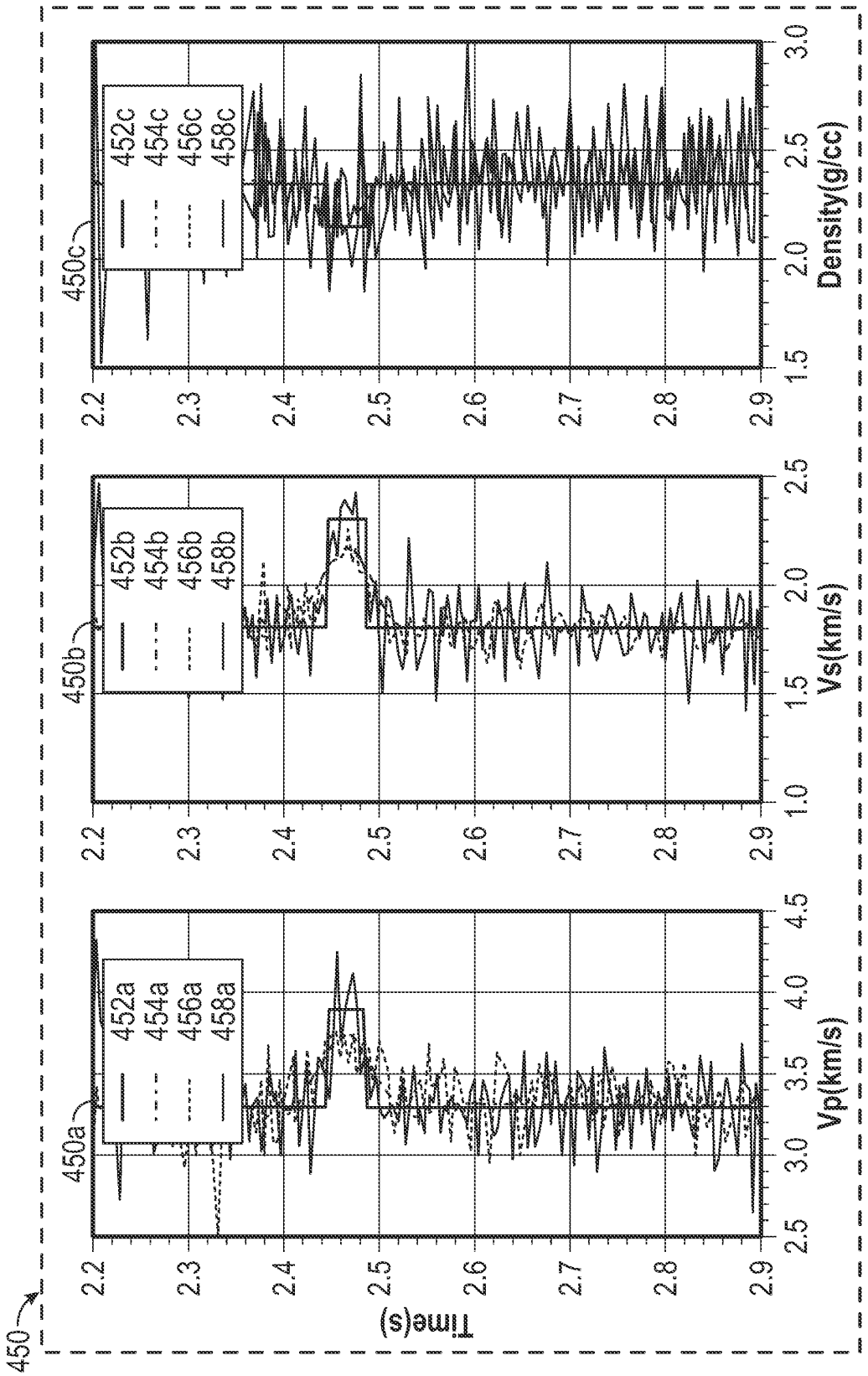

450
450a
452a
454a
456a
458a
Vp(km/s)
450b
452b
454b
456b
458b
Vs(km/s)
450c
452c
454c
456c
458c
Density(g/cc)
Time(s)

FIG. 15

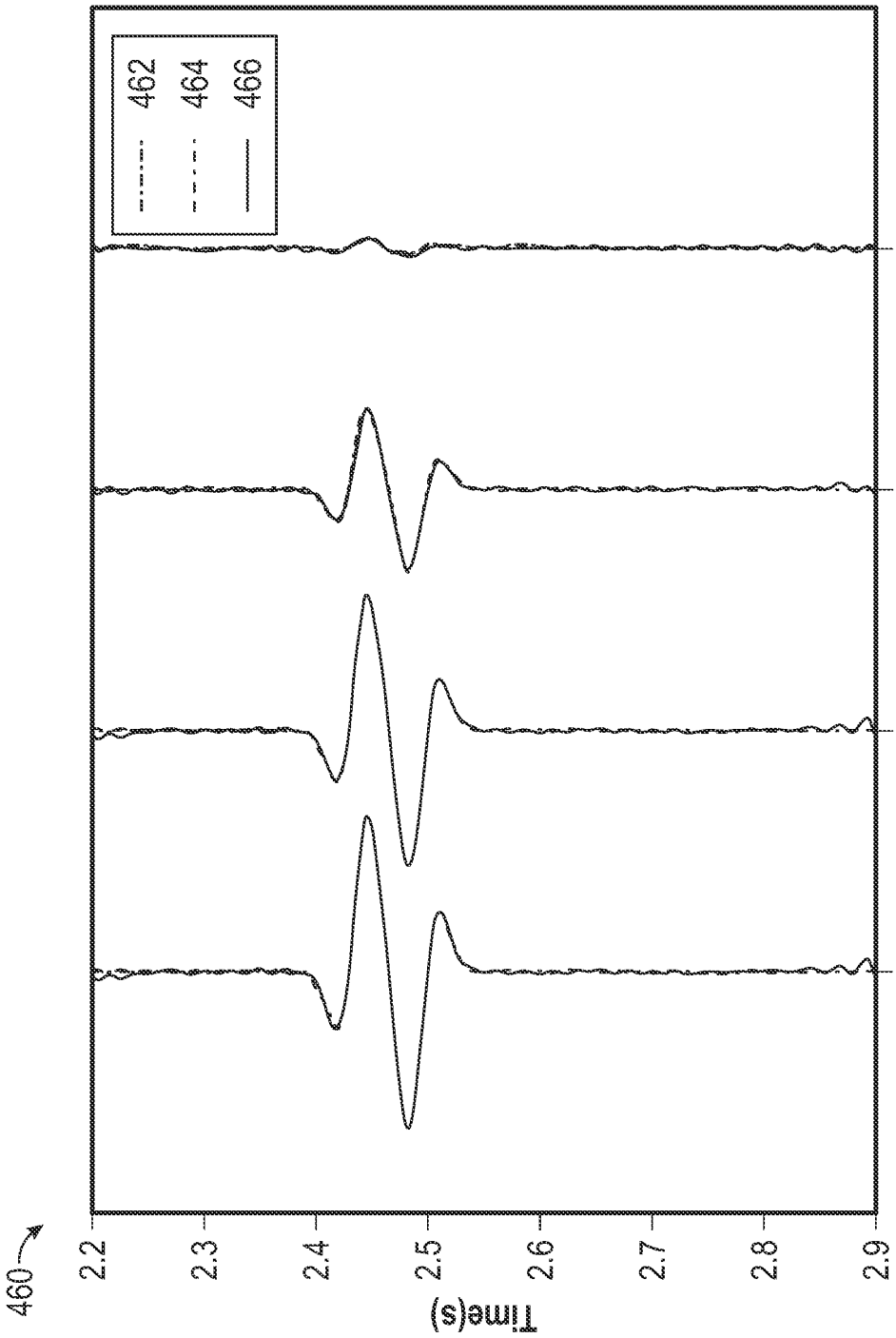


FIG. 16

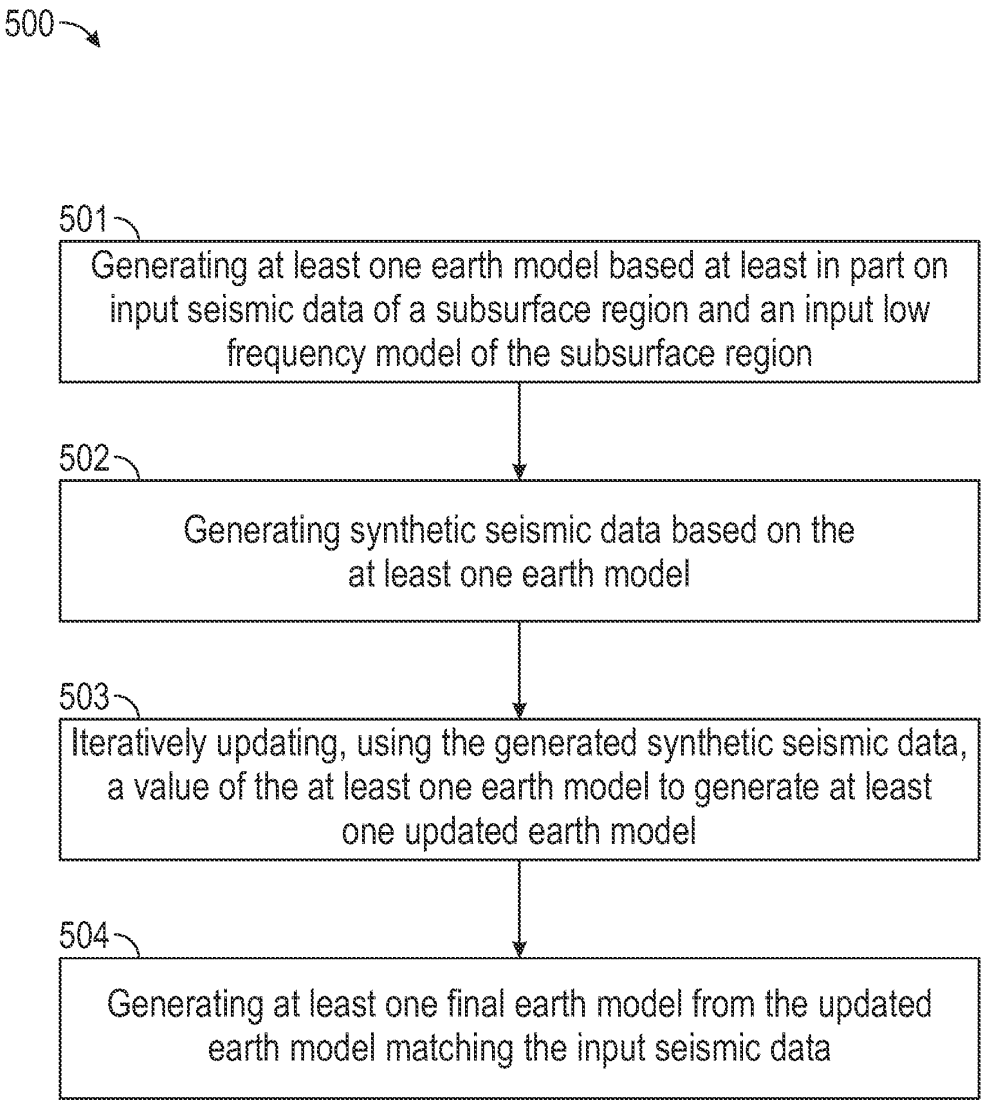

500
501
Generating at least one earth model based at least in part on input seismic data of a subsurface region and an input low frequency model of the subsurface region
502
Generating synthetic seismic data based on the at least one earth model
503
Iteratively updating, using the generated synthetic seismic data, a value of the at least one earth model to generate at least one updated earth model
504
Generating at least one final earth model from the updated earth model matching the input seismic data

FIG. 17