Isotropic VSP processing of oriented 3 Components

Early example of 3C orientation and extraction of P-P reflection polarisation aimed to improved reliability of structural dip and structural imaging of the borehole vicinity in a deep well; onshore Offset - VSP dataset, vibroseis

by H. Japiot, C. Goloubinoff, C. Naville, CGG, Massy

courtesy of SNEA-P – BOUSSENS, France, 1989

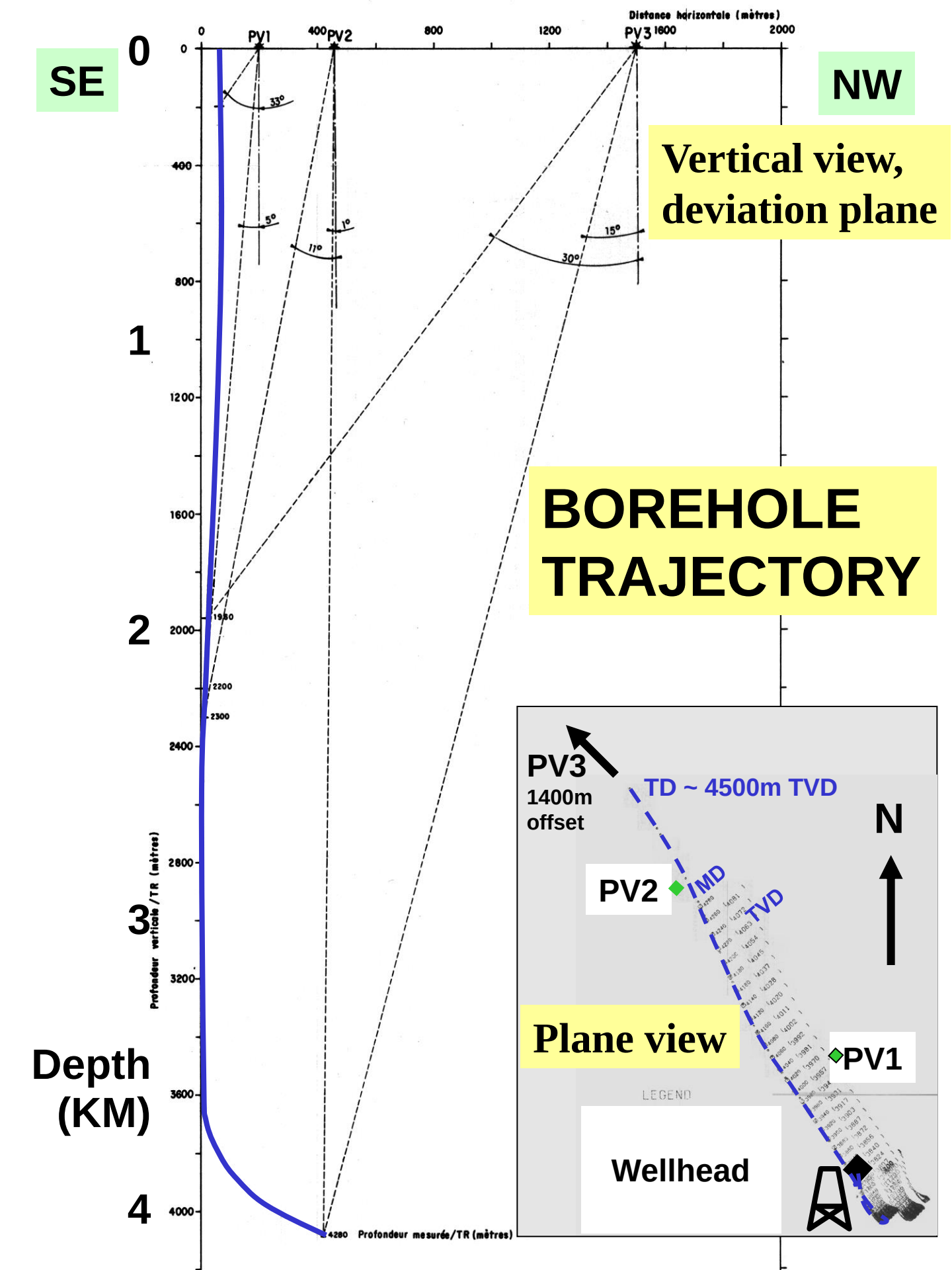
This early example of a complex VSP case study,, shows the unique structural solution of a 3C VSP seismic response after difficult orientation, no inclinometer was combined with the VSP tool.

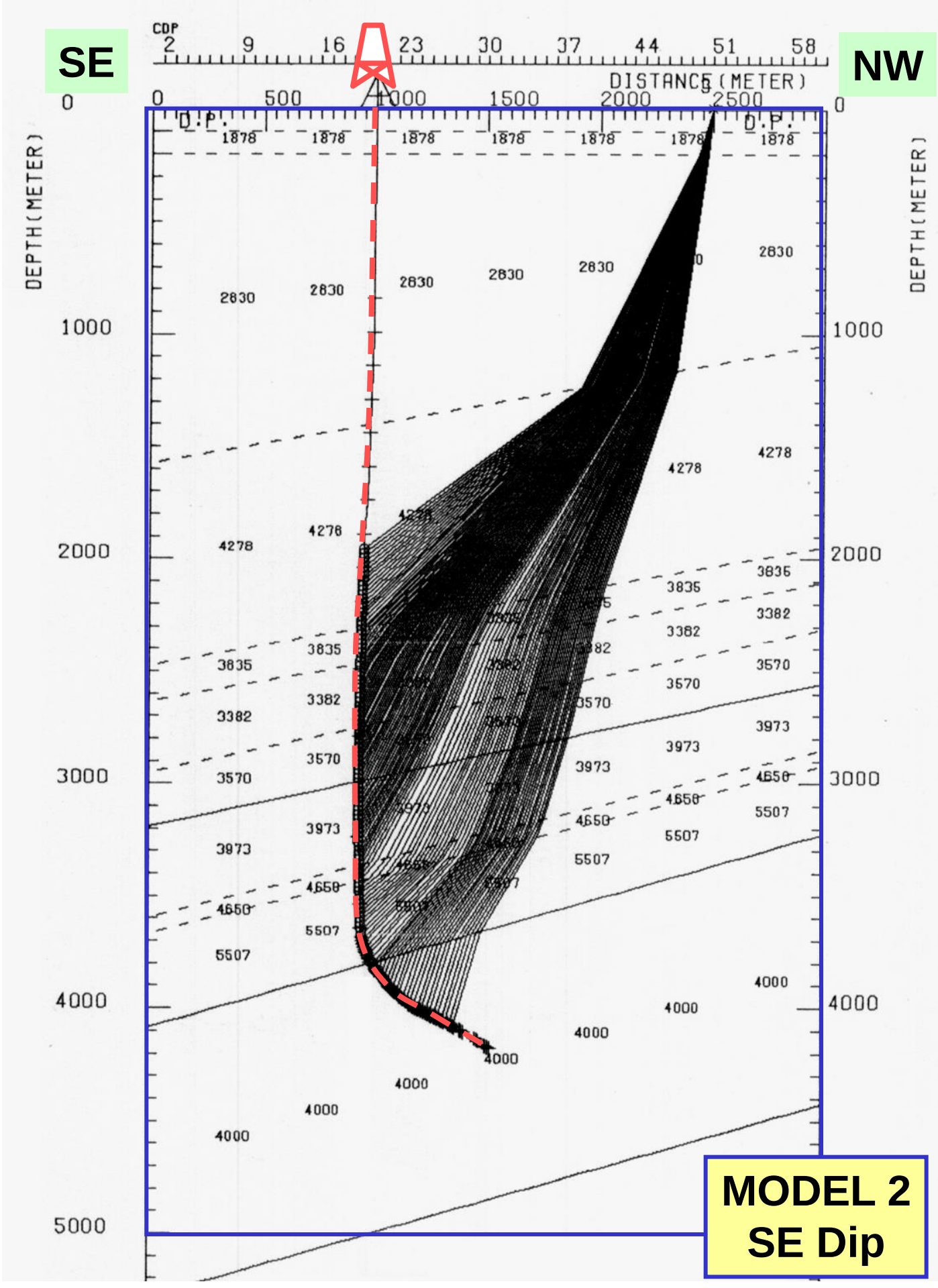
Several ray-tracing results and corresponding VSPCDP stack images illustrate the different dipping structures considered in the borehole vicinity (Models 1 to 4).

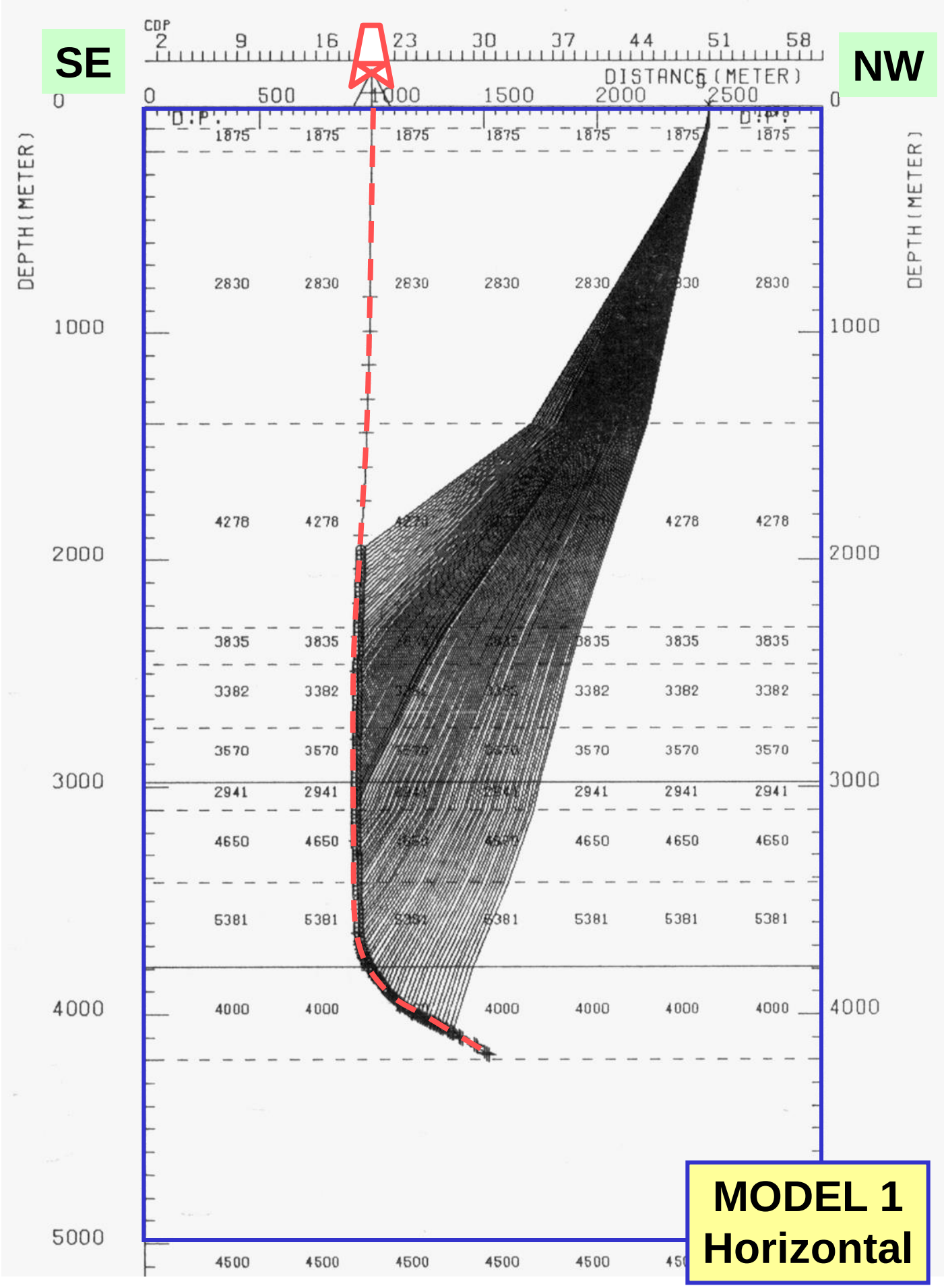
The O-VSP imaging process was initially achieved with the single vertical component, and performed according to several dip hypotheses (Models 1,2,3), as the geologist interpreter was uncertain about the actual dipping trends of the overburden and of the deep reservoir interval from the available surface seismic images and other borehole data…

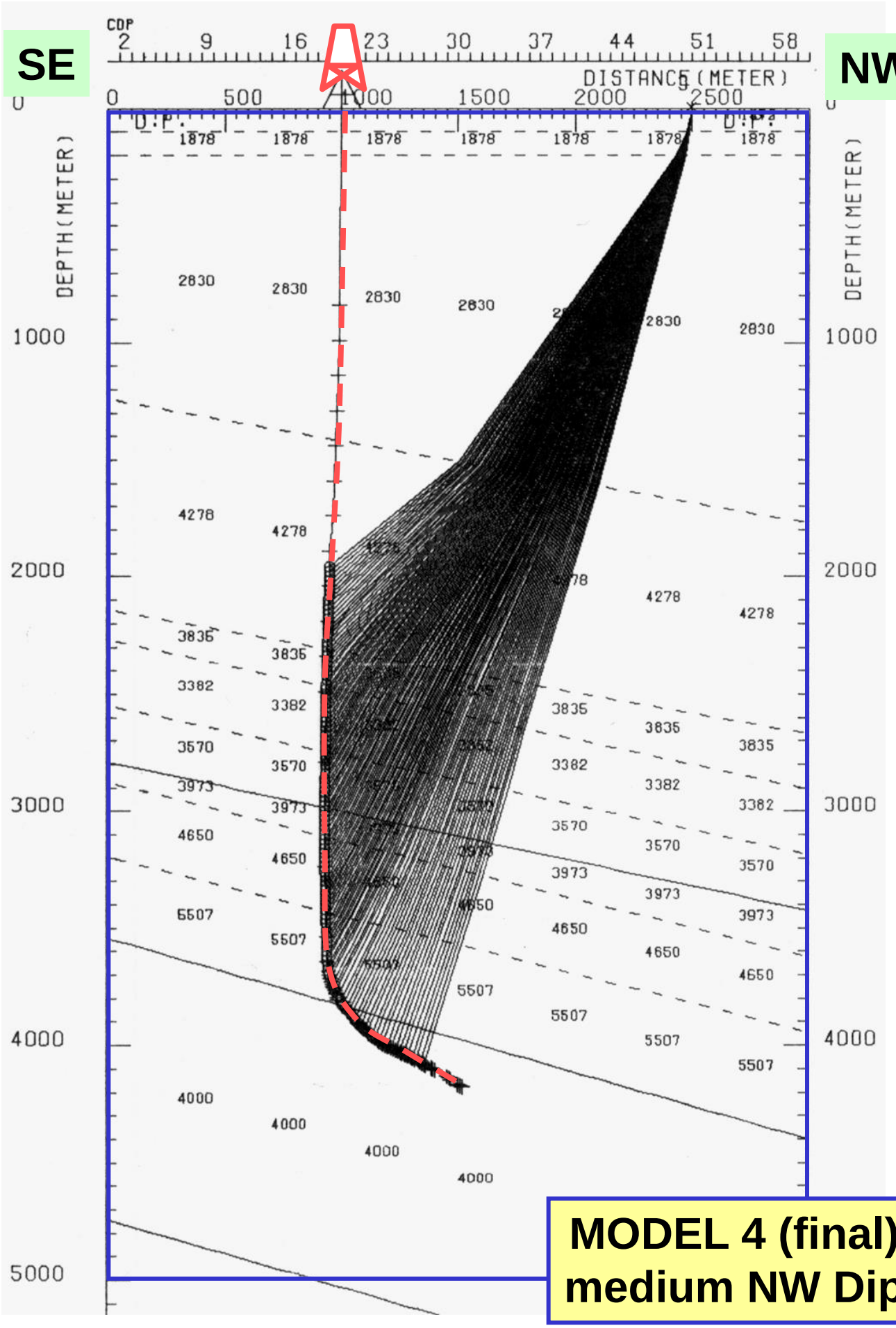
In order to settle this dilemma, 3C processing was attempted by CGG: it successfully resulted in **the image labeled "Model 4",** built **as the unique dipping structural VSPCDP stack image compatible with the 3C polarization of observed P-P seismic reflections.**

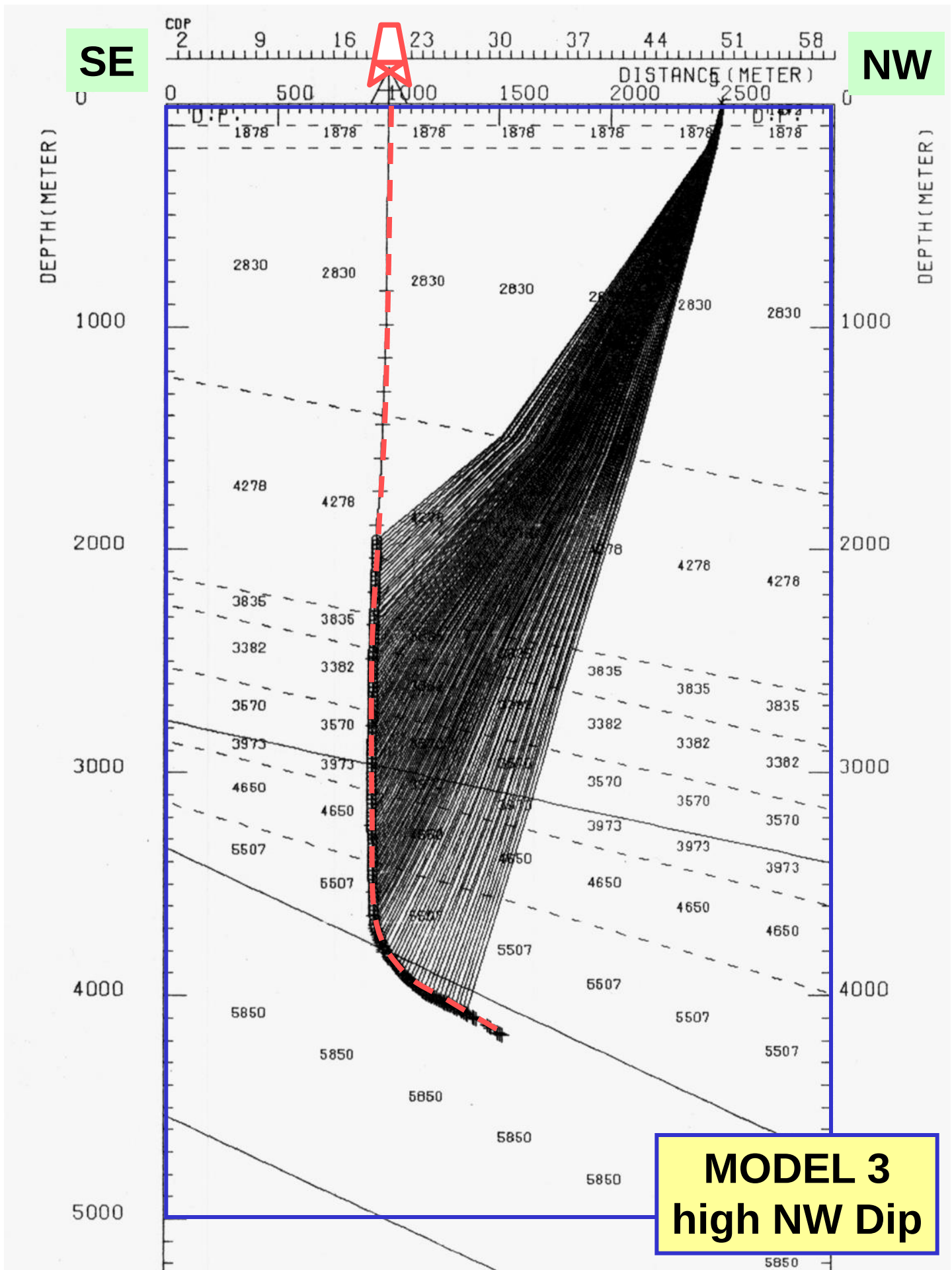
courtesy of SNEA-P – BOUSSENS, France, 1989

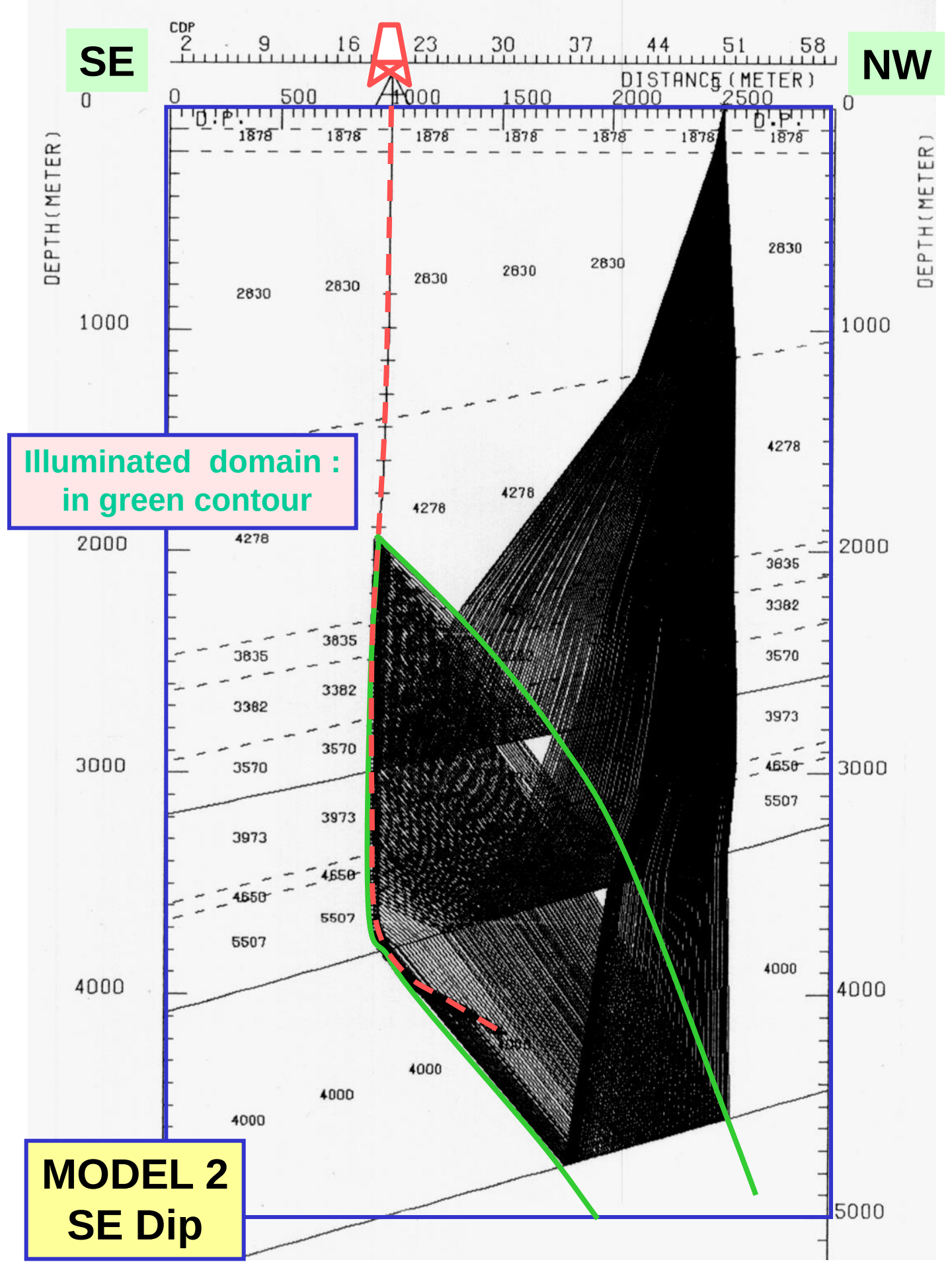

SE
NW
Vertical view, deviation plane
BOREHOLE TRAJECTORY
Distance horizontale (mètres)
PV1
PV2
PV3
0
400
800
1200
1600
2000
33°
5°
1°
17°
15°
30°
Profondeur verticale/TR (mètres)
Profondeur mesurée/TR (mètres)
4280
Depth (KM)
0
1
2
3
4
PV3
1400m offset
TD ~ 4500m TVD
N
PV2
MD
TVD
Plane view
PV1
LEGEND
Wellhead

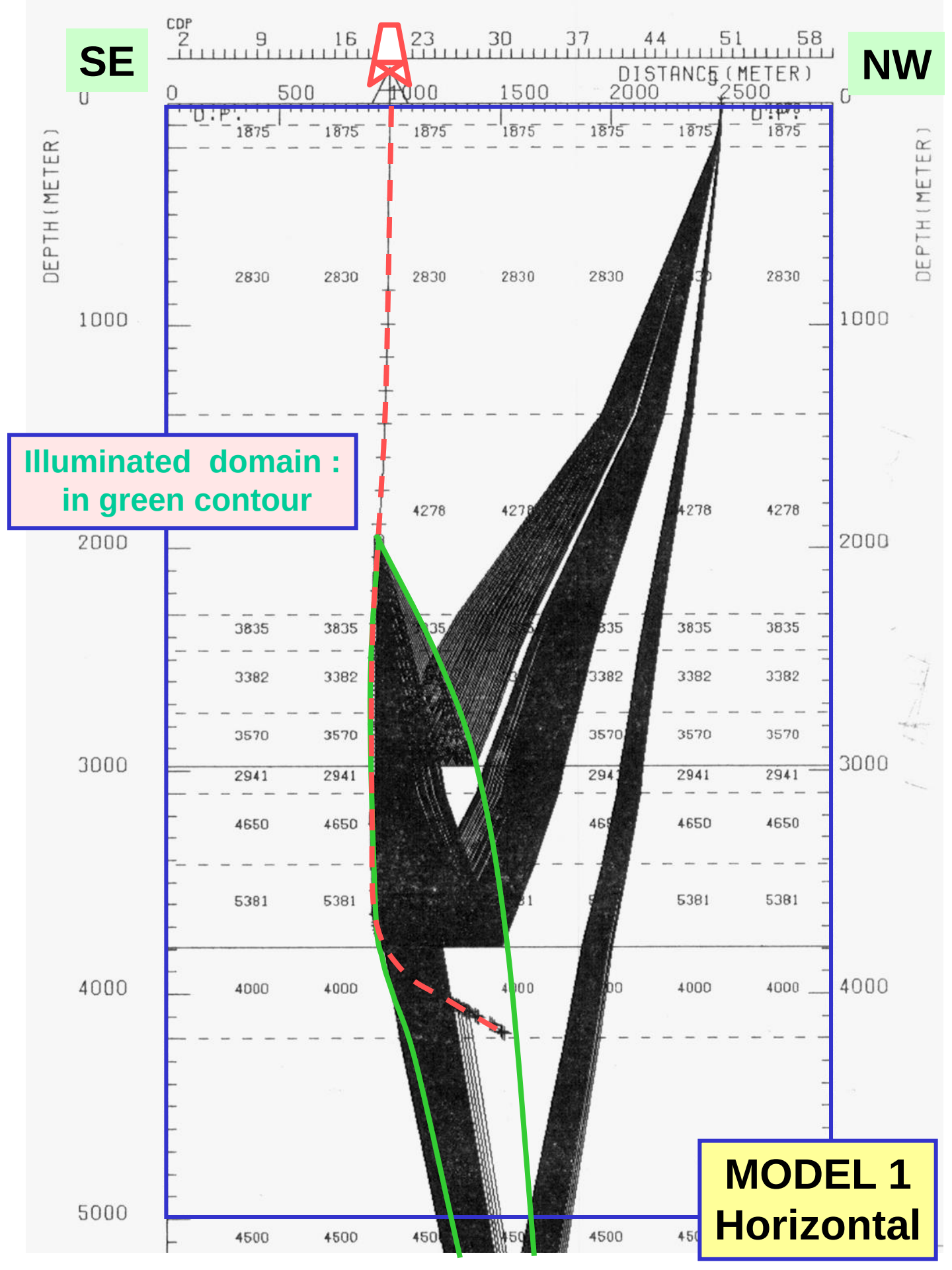

SE
NW
CDP
2 9 16 23 30 37 44 51 58
DISTANCE (METER)
0 500 1000 1500 2000 2500
D.P.
1878
DEPTH (METER)
0
1000
2000
3000
4000
5000
2830
4278
3835
3382
3570
3973
4650
5507
4000
MODEL 2
SE Dip

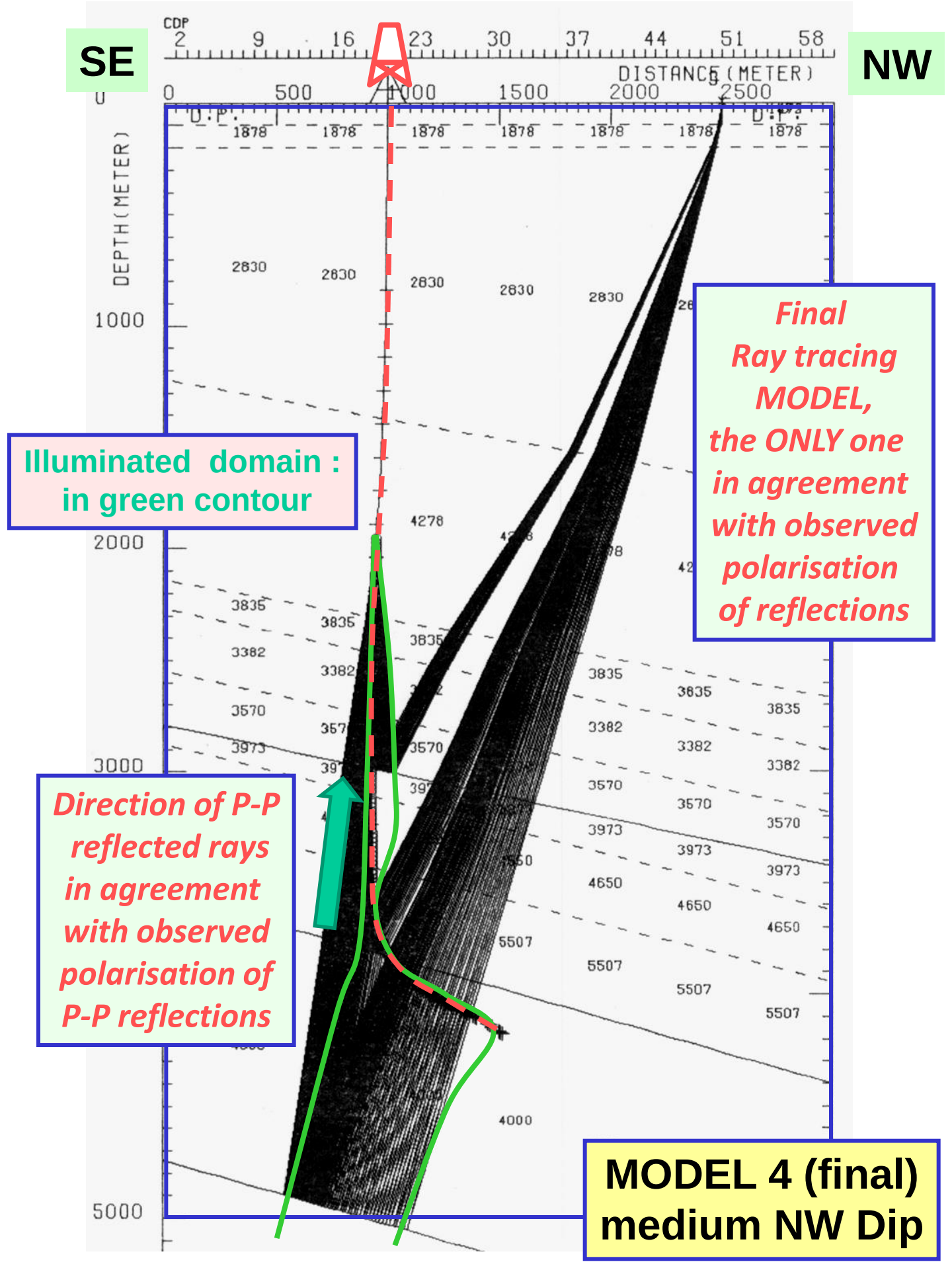

SE
NW
CDP
2
9
16
23
30
37
44
51
58
DISTANCE (METER)
0
500
1000
1500
2000
2500
DEPTH (METER)
1000
2000
3000
4000
5000
1875
2830
4278
3835
3382
3570
2941
4650
5381
4000
4500
MODEL 1
Horizontal

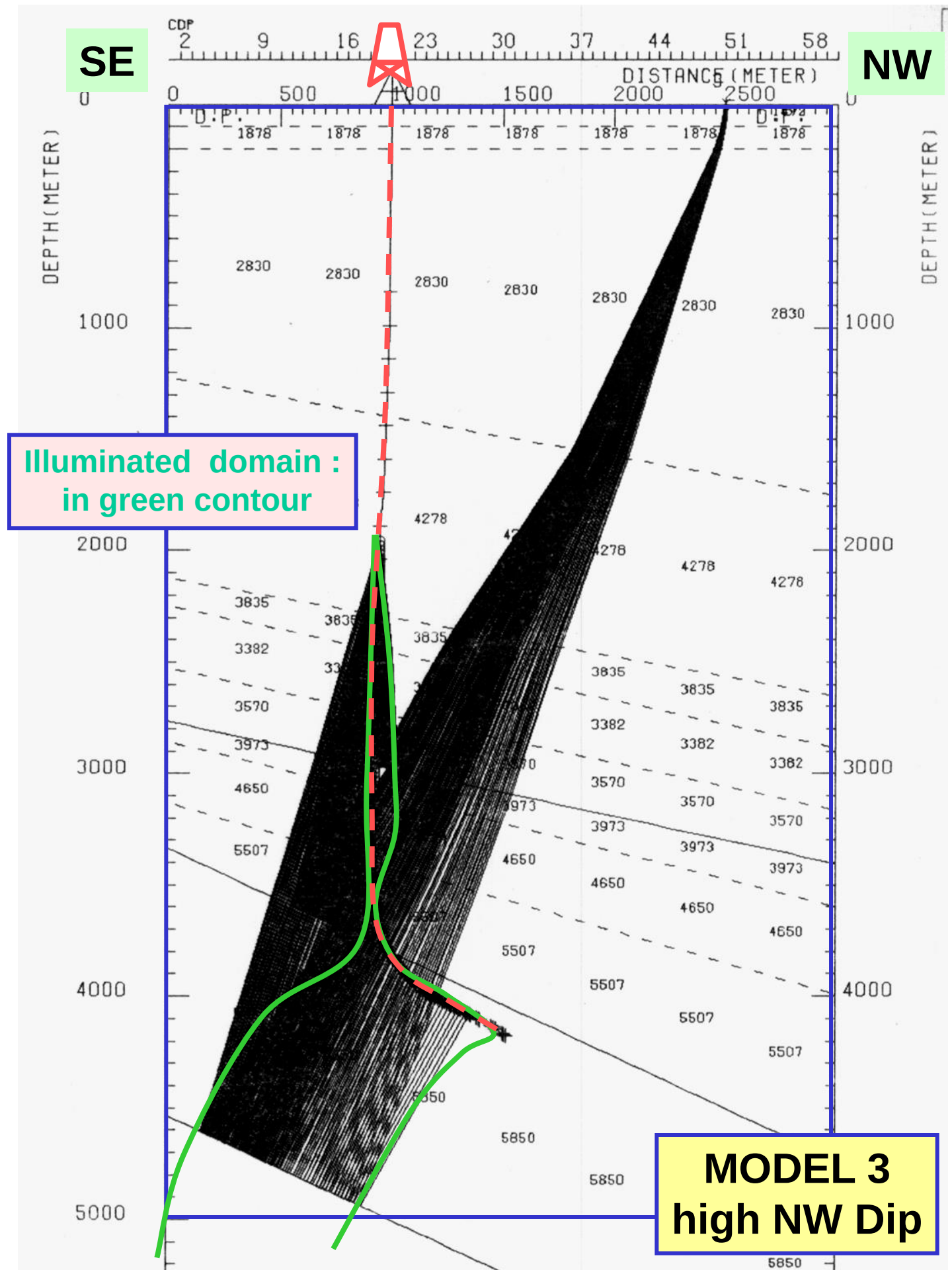

SE
NW
CDP
2 9 16 23 30 37 44 51 58
DISTANCE (METER)
0 500 1000 1500 2000 2500
DEPTH (METER)
1000
2000
3000
4000
5000
1878
2830
4278
3835
3382
3570
3973
4650
5507
4000
MODEL 4 (final)
medium NW Dip


SE
NW
CDP
2 9 16 23 30 37 44 51 58
DISTANCE (METER)
0 500 1000 1500 2000 2500
DEPTH (METER)
1000
2000
3000
4000
5000
1878
2830
4278
3835
3382
3570
3973
4650
5507
5850
MODEL 3
high NW Dip


SE
NW
CDP
2 9 16 23 30 37 44 51 58
DISTANCE (METER)
0 500 1000 1500 2000 2500
DEPTH (METER)
0 1000 2000 3000 4000 5000
O.P.
1878
2830
4278
3835
3382
3570
3973
4650
5507
4000
Illuminated domain : in green contour
MODEL 2
SE Dip

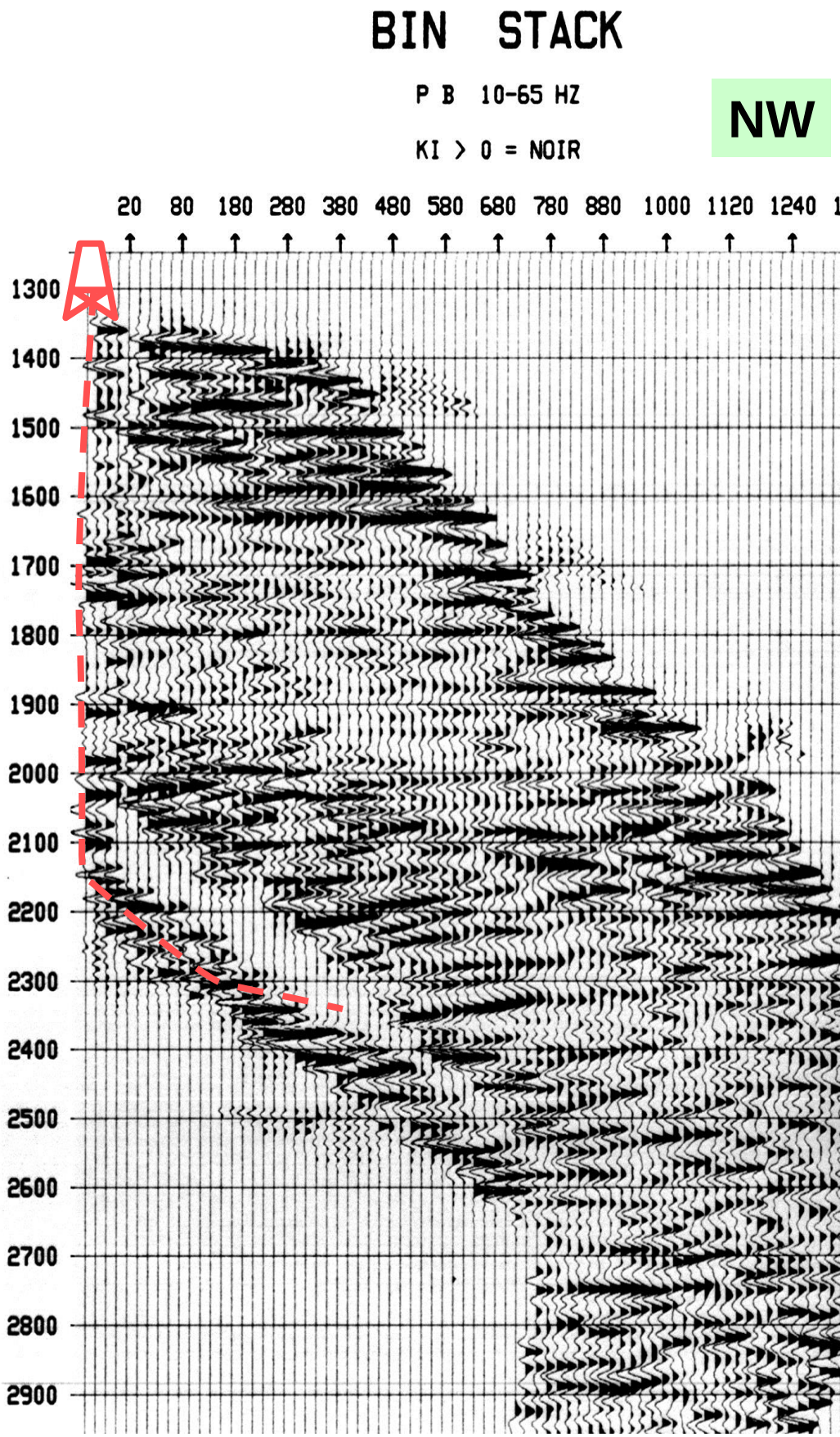

SE
NW
CDP
2
9
16
23
30
37
44
51
58
DISTANCE (METER)
0
500
1000
1500
2000
2500
DEPTH (METER)
1000
2000
3000
4000
5000
1875
2830
4278
3835
3382
3570
2941
4650
5381
4000
4500
Illuminated domain :
in green contour
MODEL 1
Horizontal


SE
NW
CDP
2 9 16 23 30 37 44 51 58
DISTANCE (METER)
0 500 1000 1500 2000 2500
DEPTH (METER)
1000
2000
3000
5000
1878
2830
4278
3835
3382
3570
3973
4650
5507
4000
Illuminated domain : in green contour
Final Ray tracing MODEL, the ONLY one in agreement with observed polarisation of reflections
Direction of P-P reflected rays in agreement with observed polarisation of P-P reflections
MODEL 4 (final) medium NW Dip


SE
NW
CDP
2 9 16 23 30 37 44 51 58
DISTANCE (METER)
0 500 1000 1500 2000 2500
DEPTH (METER)
1000
2000
3000
4000
5000
1878
2830
4278
3835
3382
3570
3973
4650
5507
5850
Illuminated domain : in green contour
MODEL 3
high NW Dip

SE

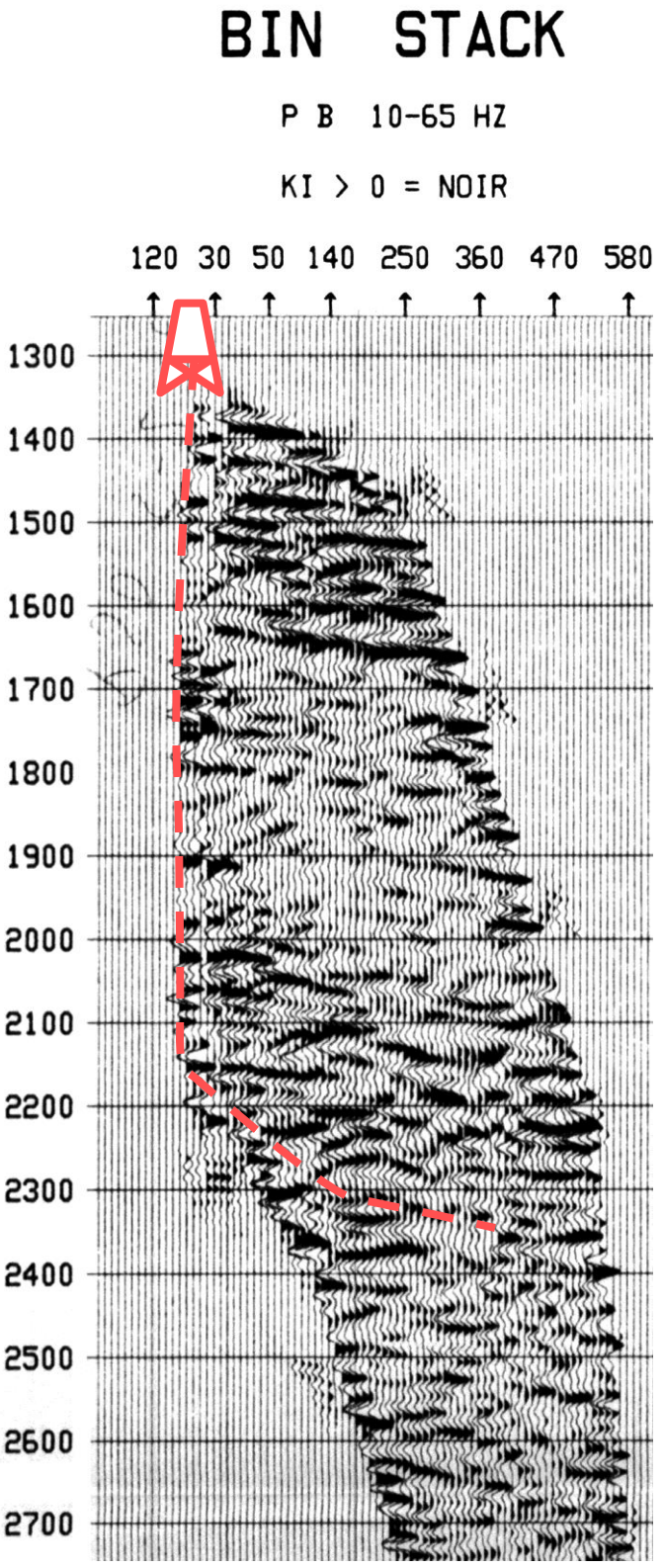
NW



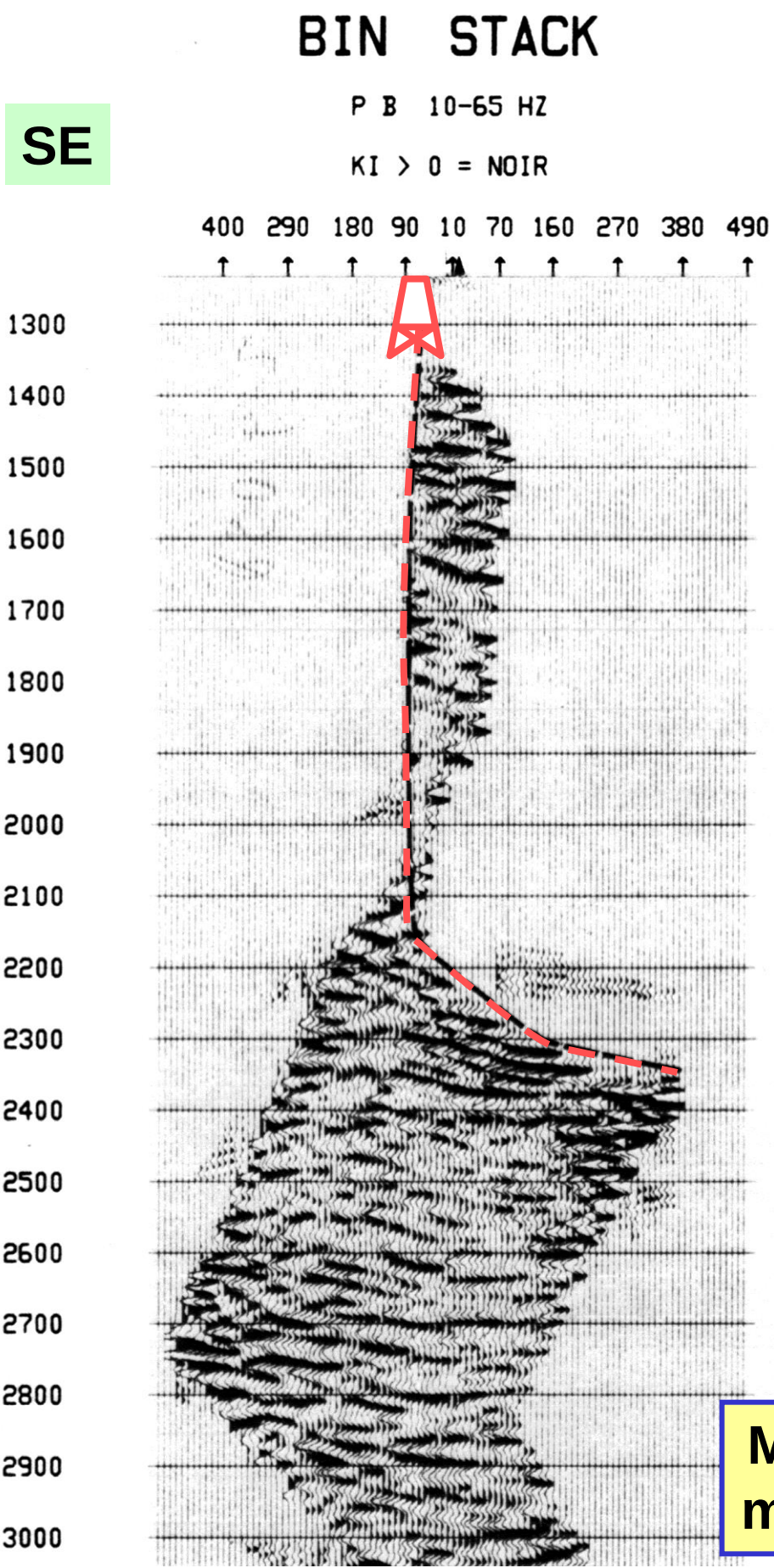
MODEL 2
SE Dip

SE

NW



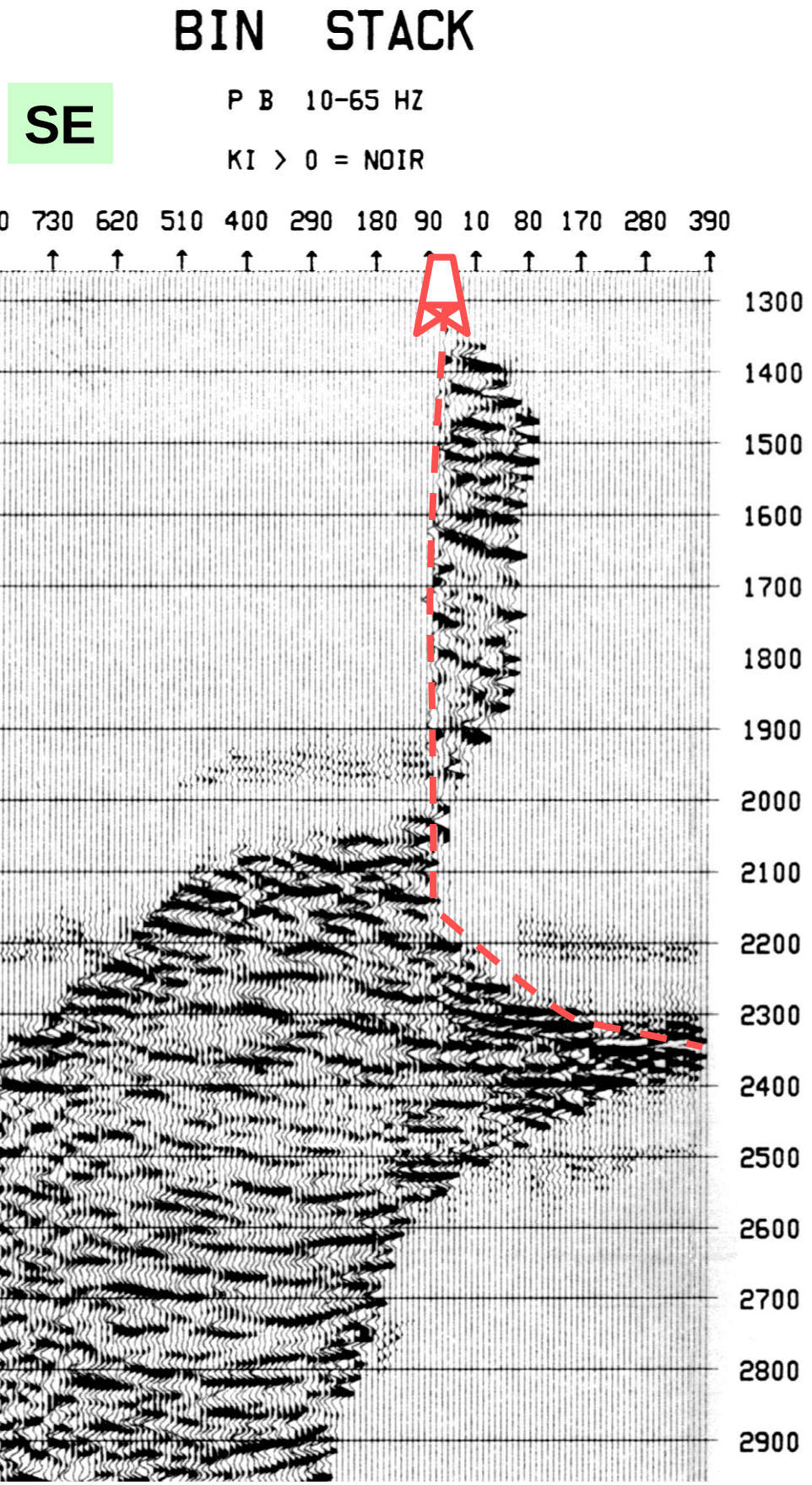
MODEL 1
Horizontal



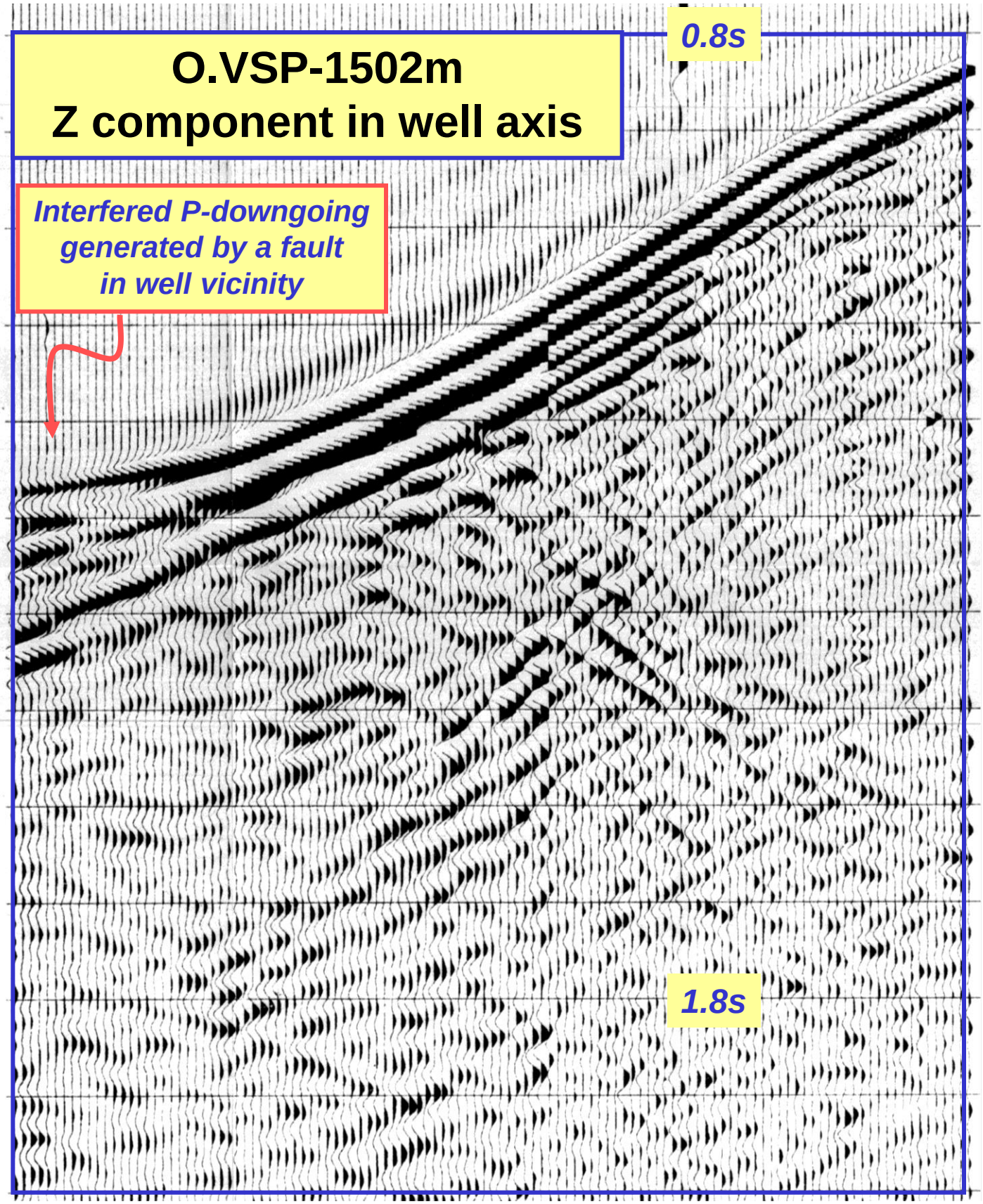
SE

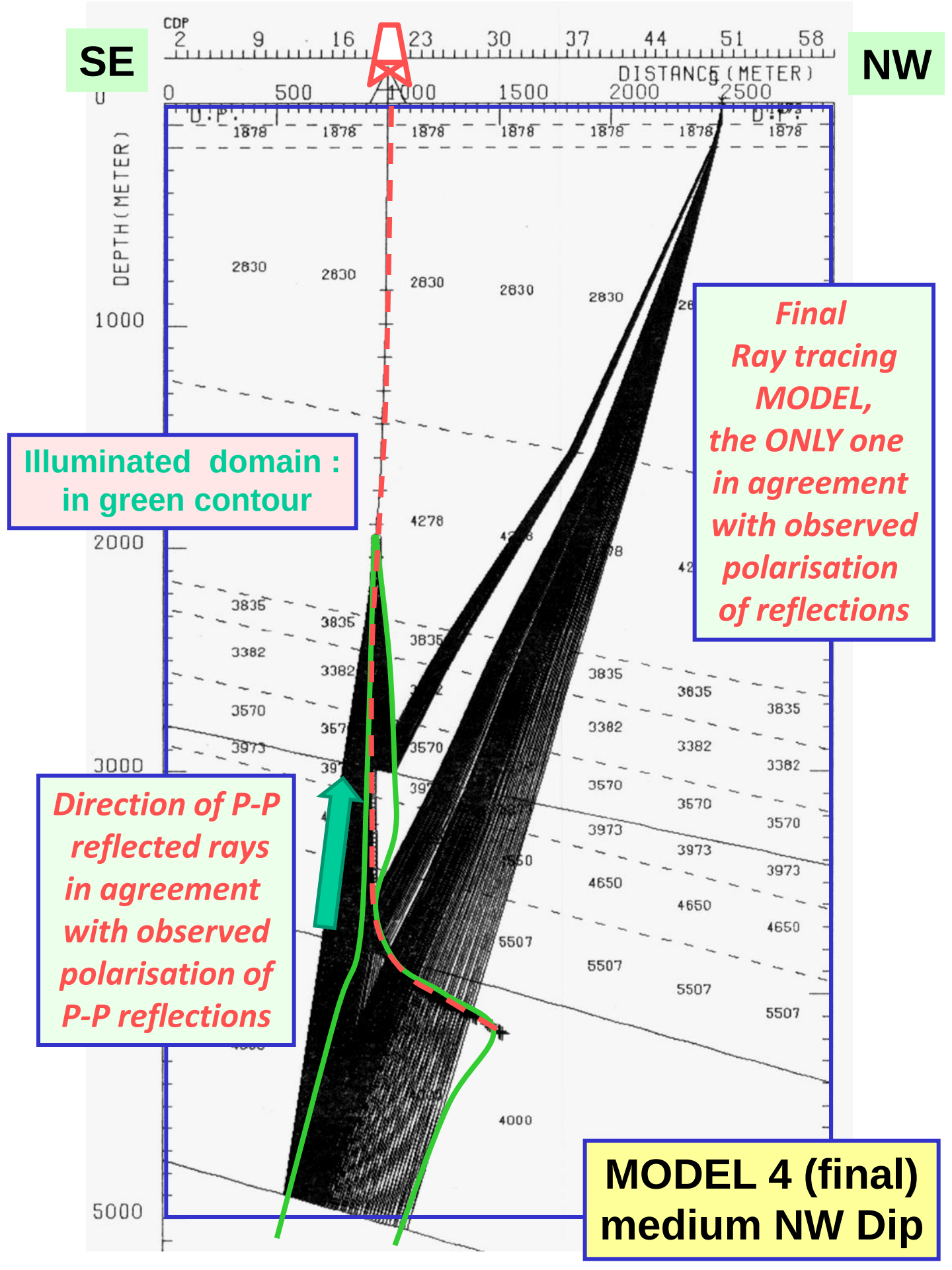
NW

MODEL 4 (final)
medium NW Dip



MODEL 3
high NW Dip


O.VSP-1502m
Z component in well axis
Interfered P-downgoing
generated by a fault
in well vicinity
0.8s
1.8s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DEPTH (METER)
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Illuminated domain : in green contour
Final Ray tracing MODEL, the ONLY one in agreement with observed polarisation of reflections
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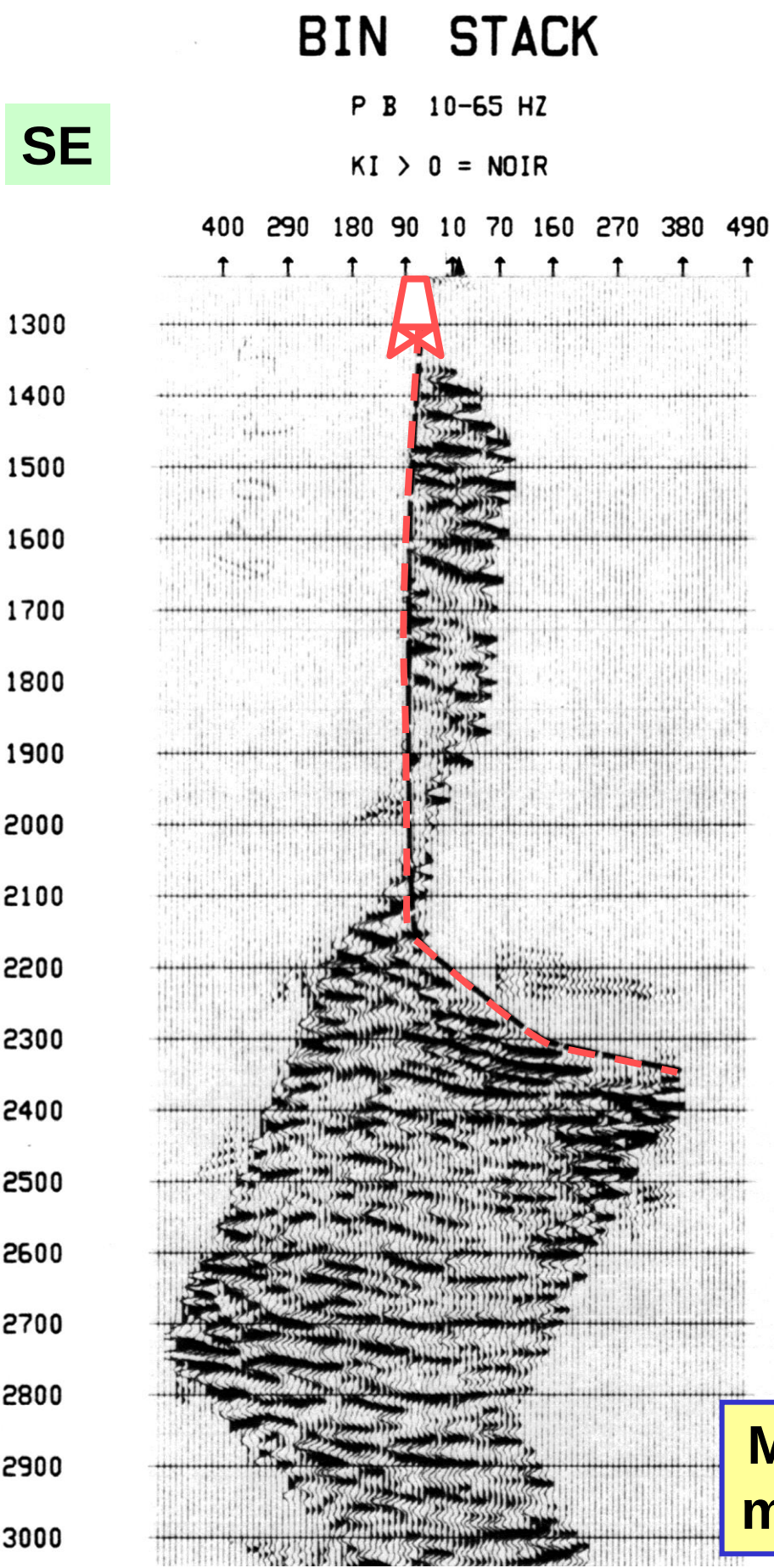
MODEL 4 (final) medium NW Dip



SE

NW

MODEL 4 (final)
medium NW Dip