Kinematic structural forward modeling for fault trajectory prediction in seismic interpretation

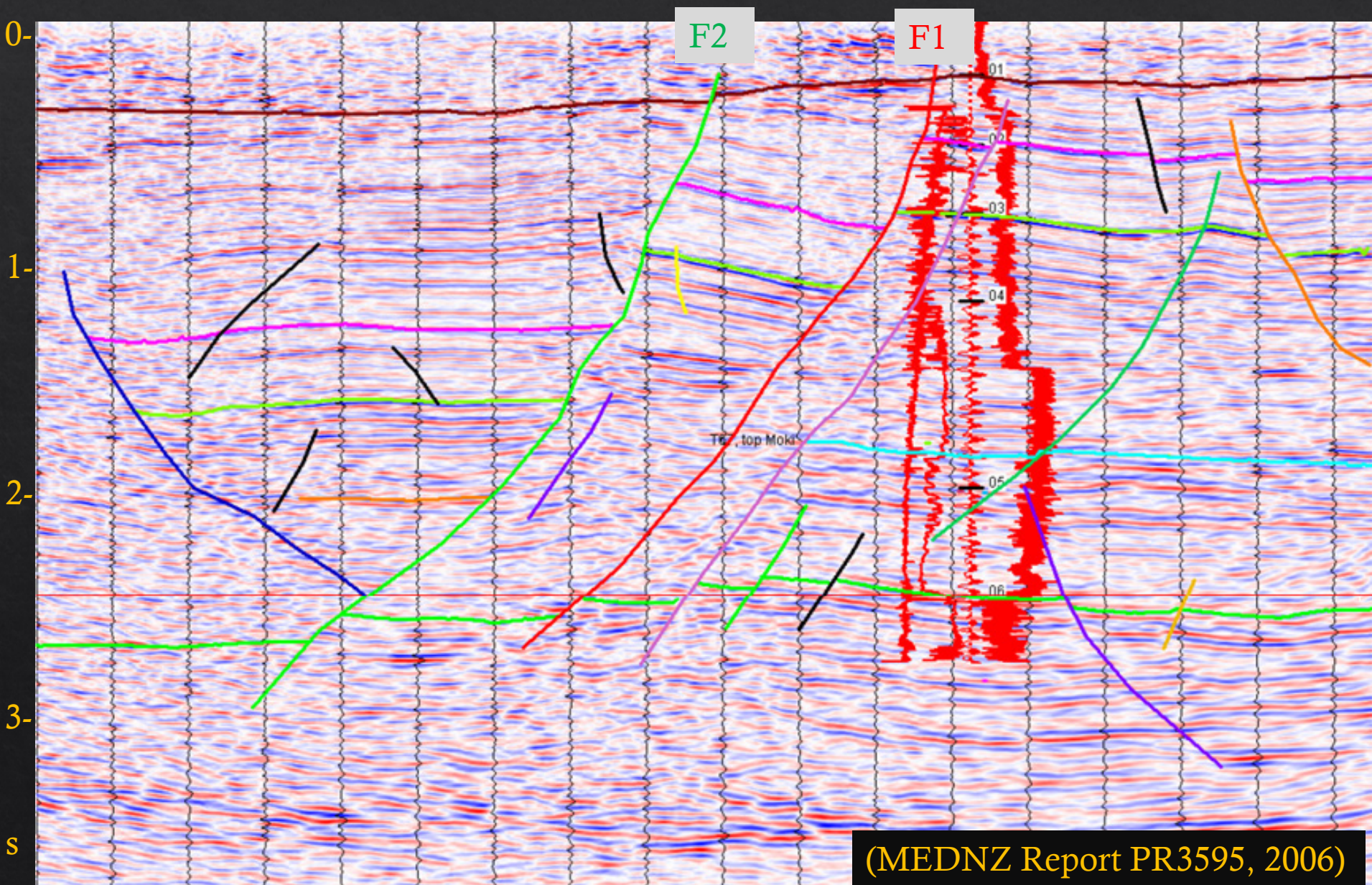## Mohammed Alarfaj and Don C. Lawton

25th Annual CREWES Sponsor's Meeting

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CREWES

UNIVERSITY OF CALGARY

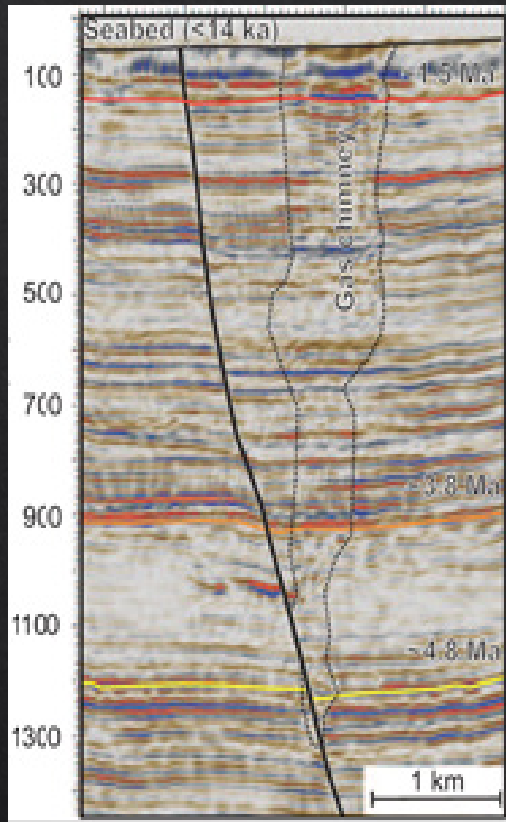# Fault interpretation near an exploration well

(MEDNZ Report PR3595, 2006)

Outline

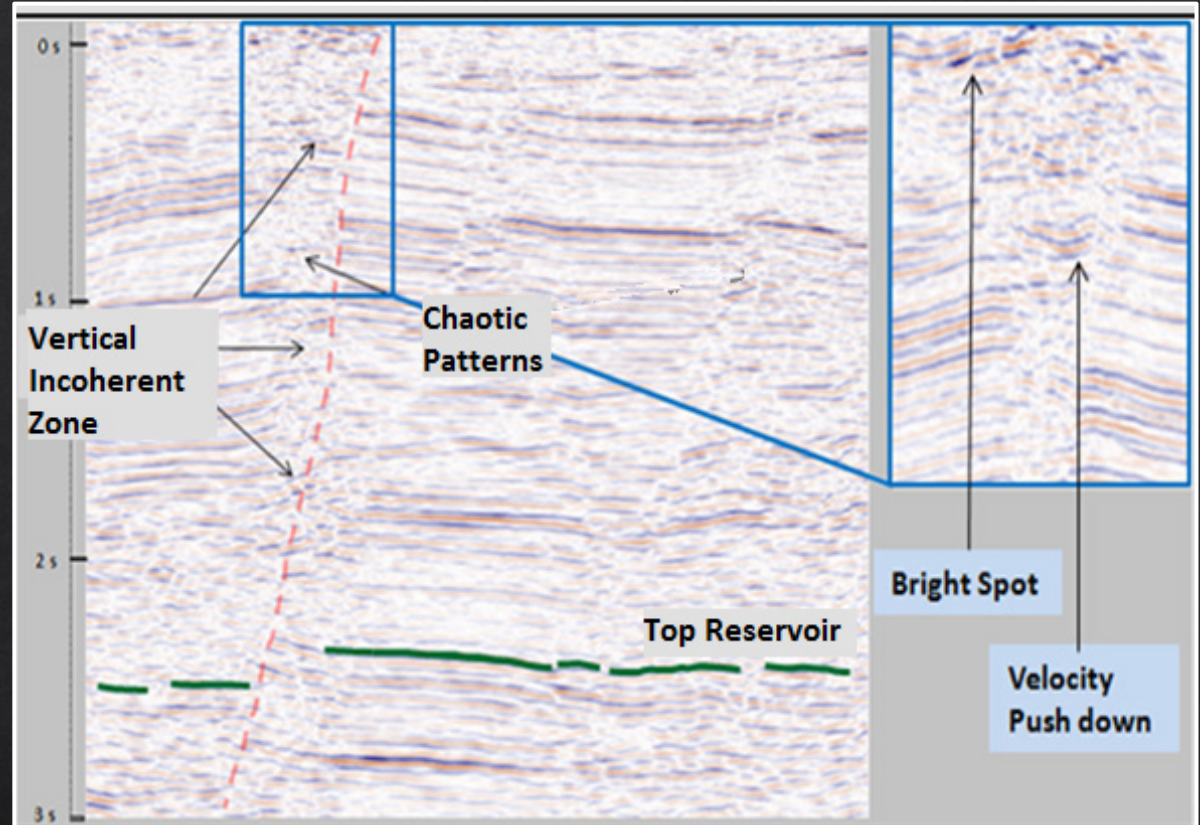Introduction

Kinematic modeling: extensional fault-bend fold

Fault geometry prediction from seismic images

Conclusions

# Introduction: previous work and motivation

(Ilg et al., 2012)

(Alarfaj and Lawton, 2012)

- Steeply inclined conical shape exhibiting low-amplitude and low coherency chaotic reflectors in the deep section
- Bright spots in the shallow section
- reduced p-wave velocities, increased p-wave attenuation , and increased scattering of acoustic energy .
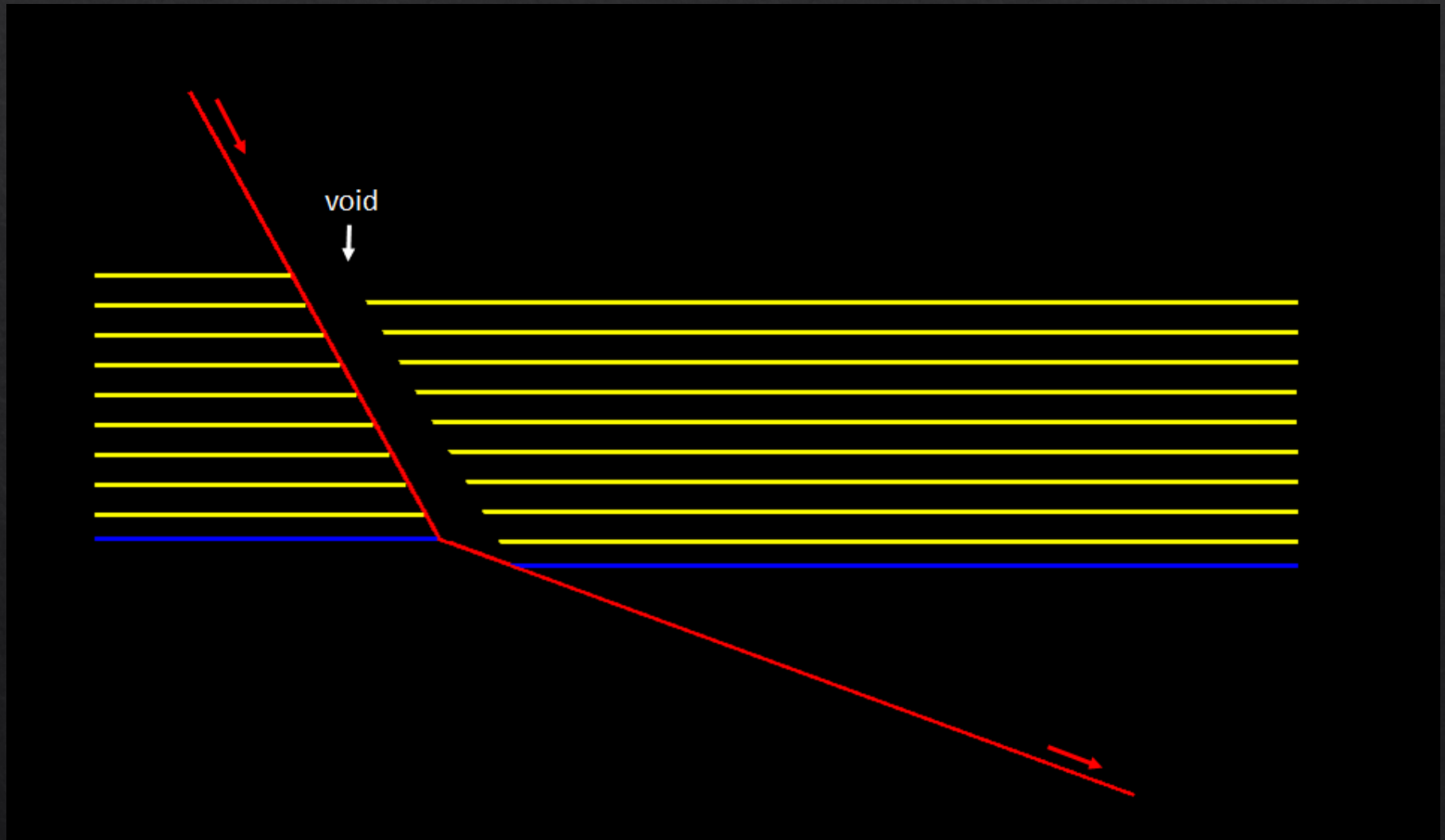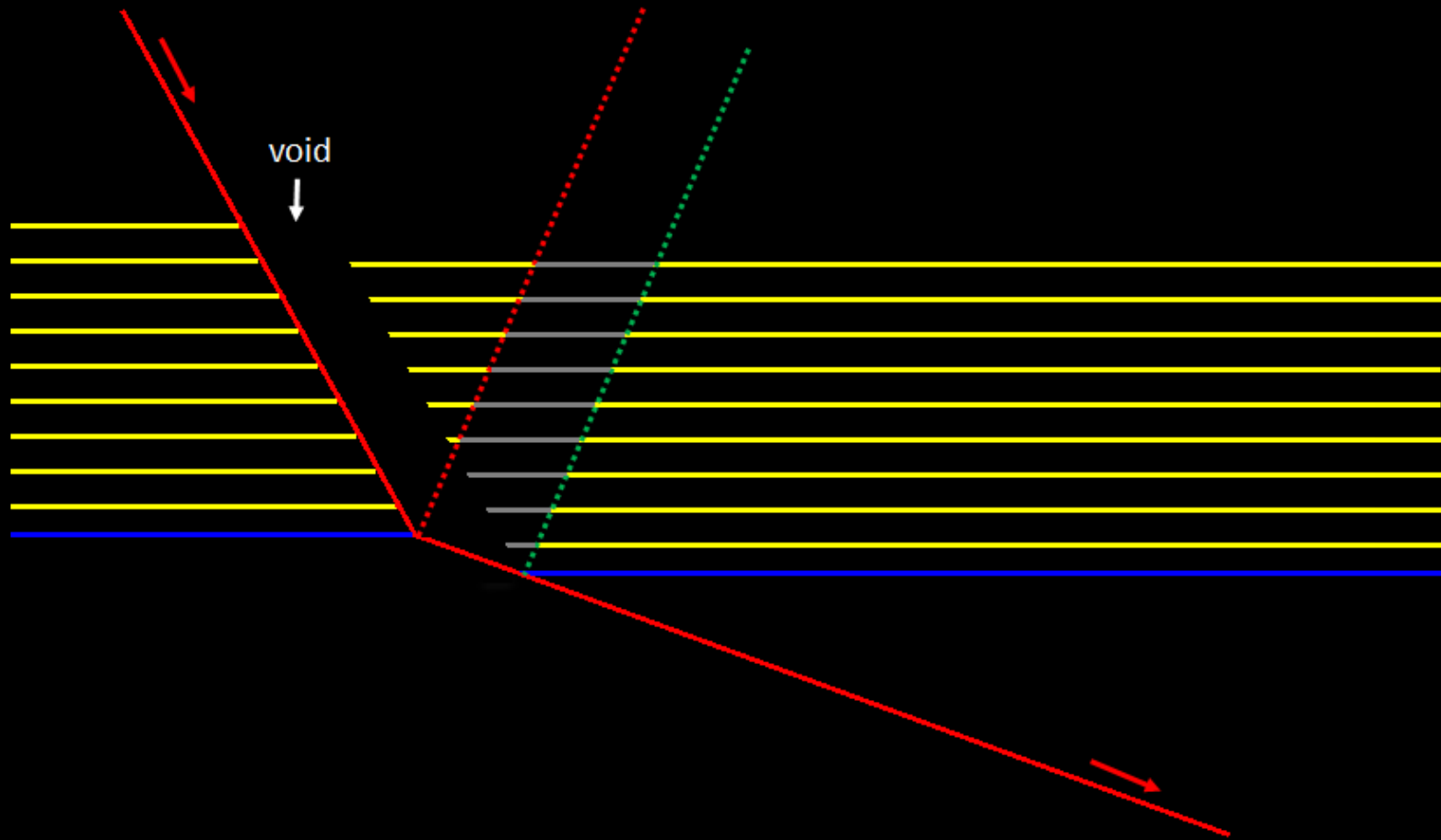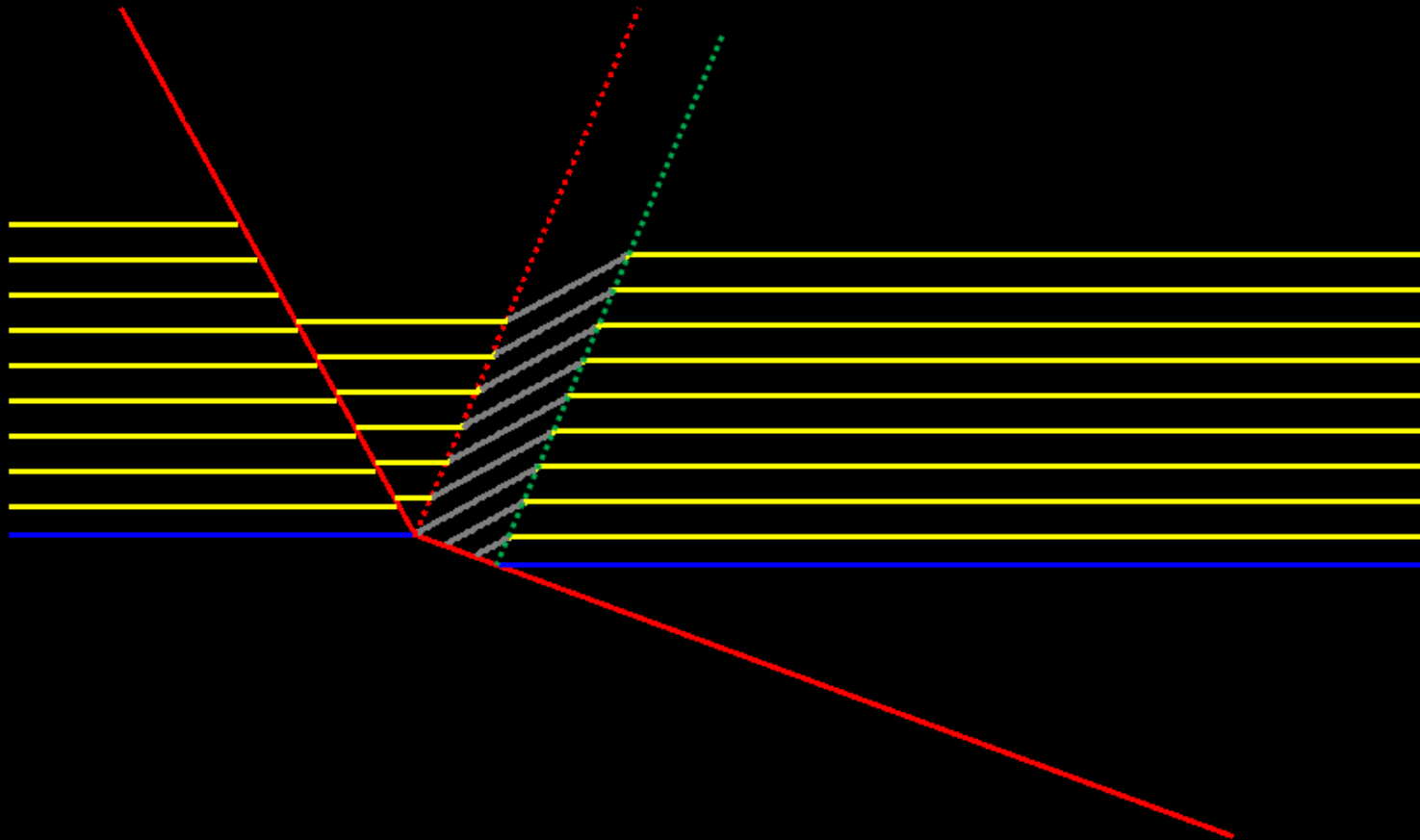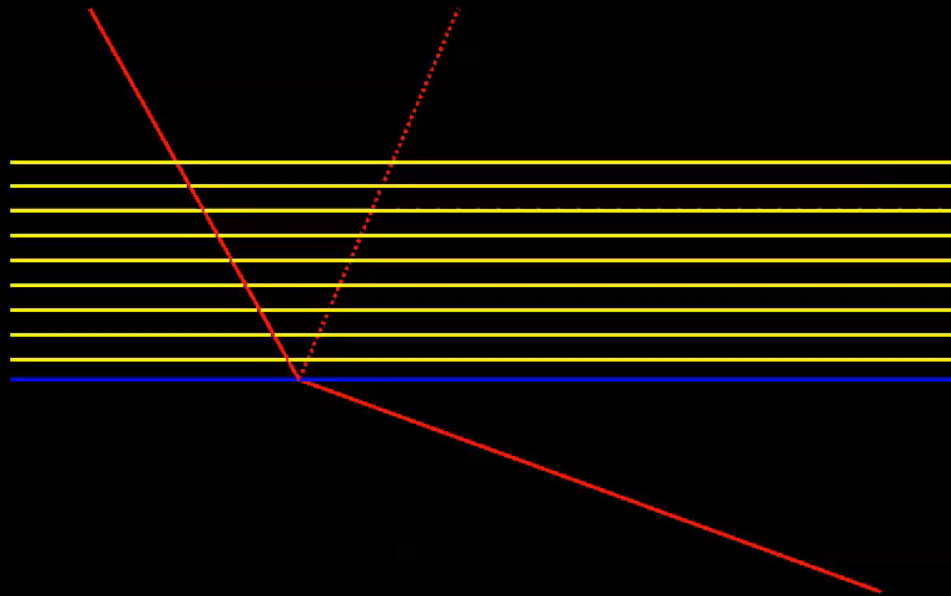
Modeling: Planar Normal Fault
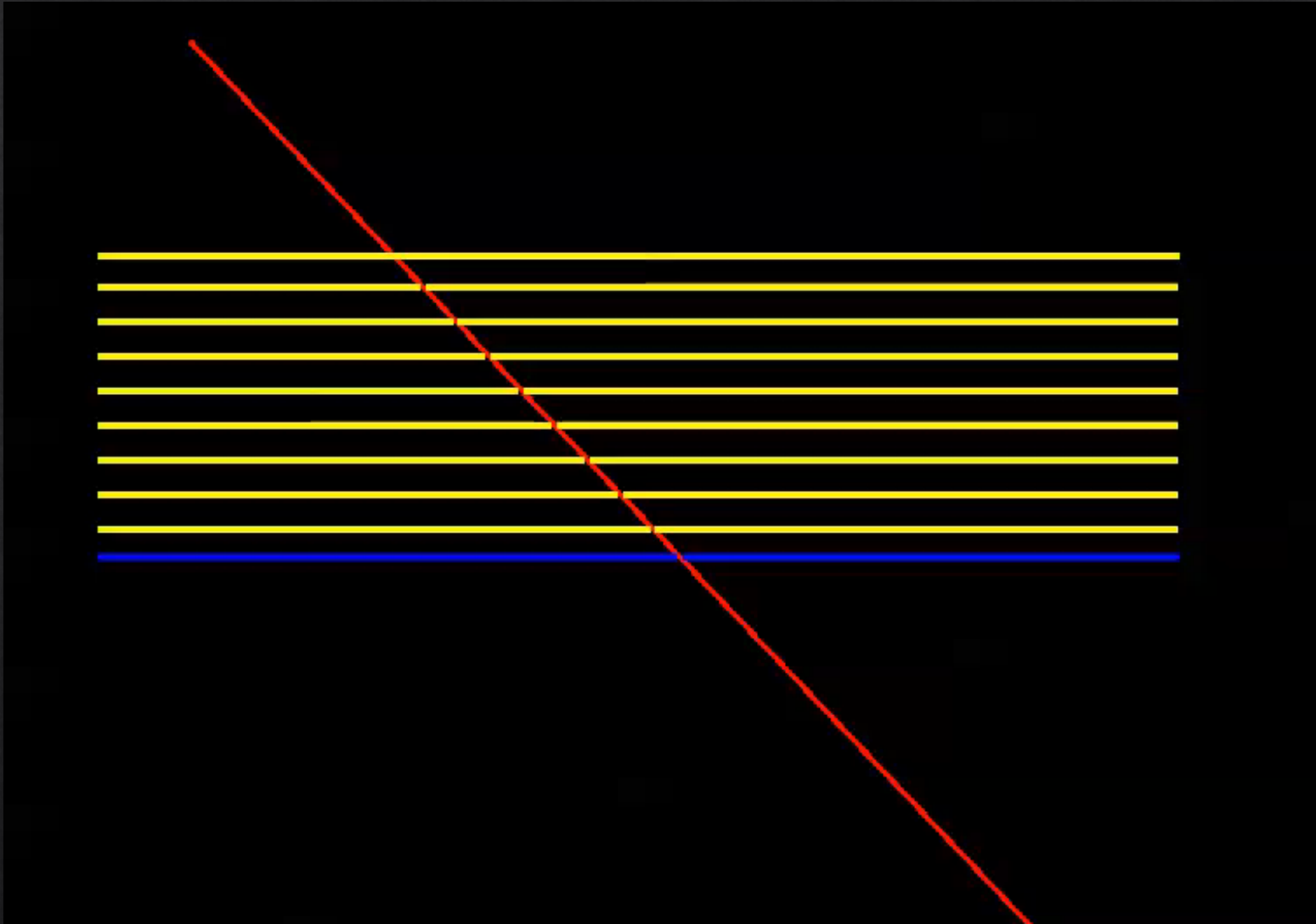
Modeling: Non-planar fault (concave-upward bend)
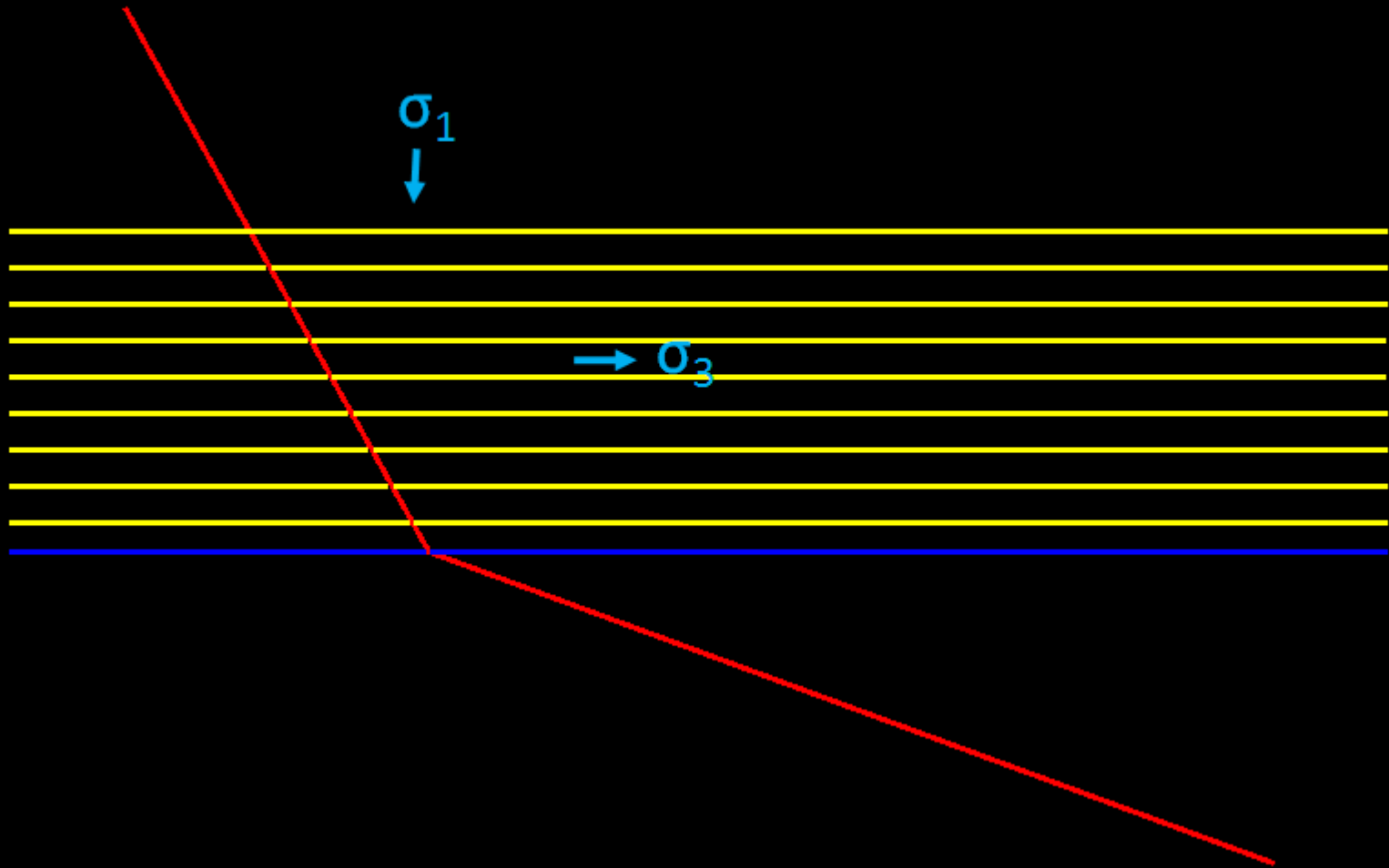
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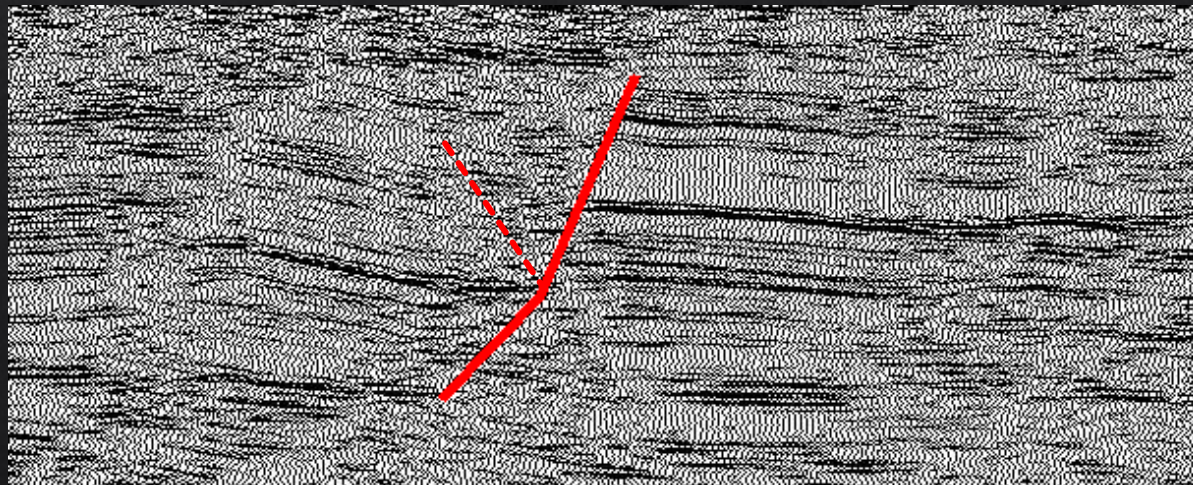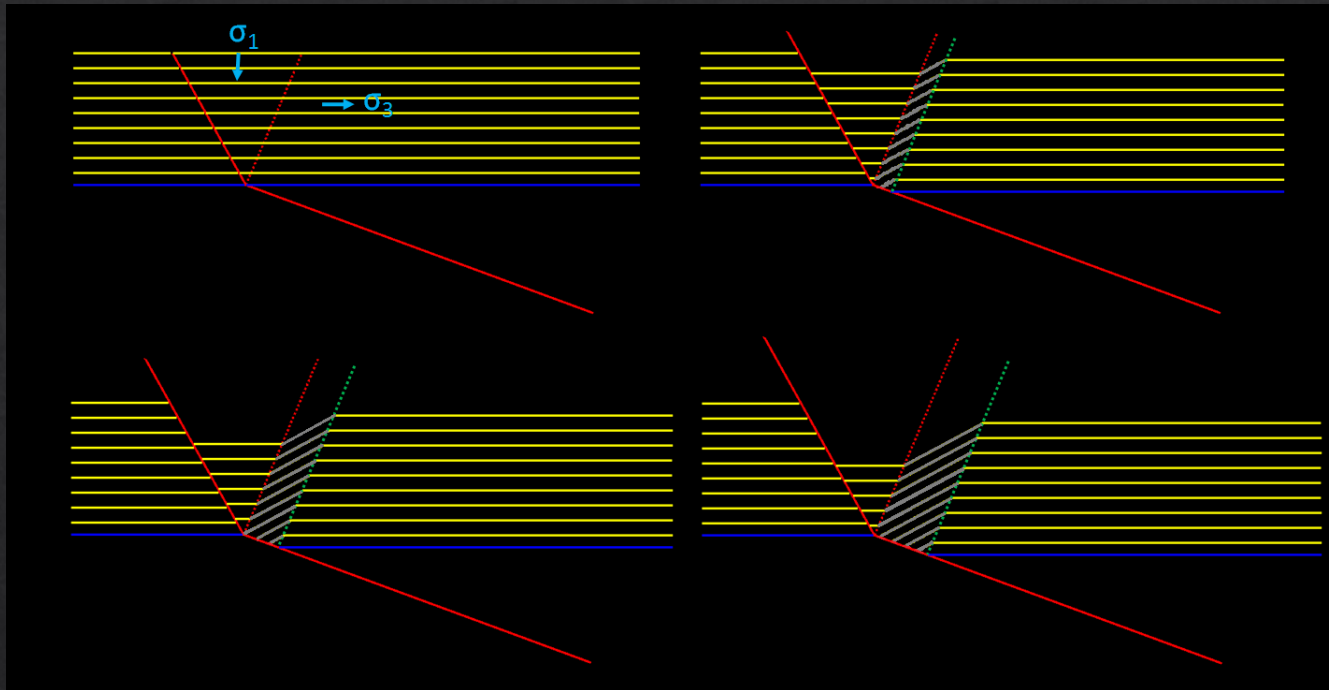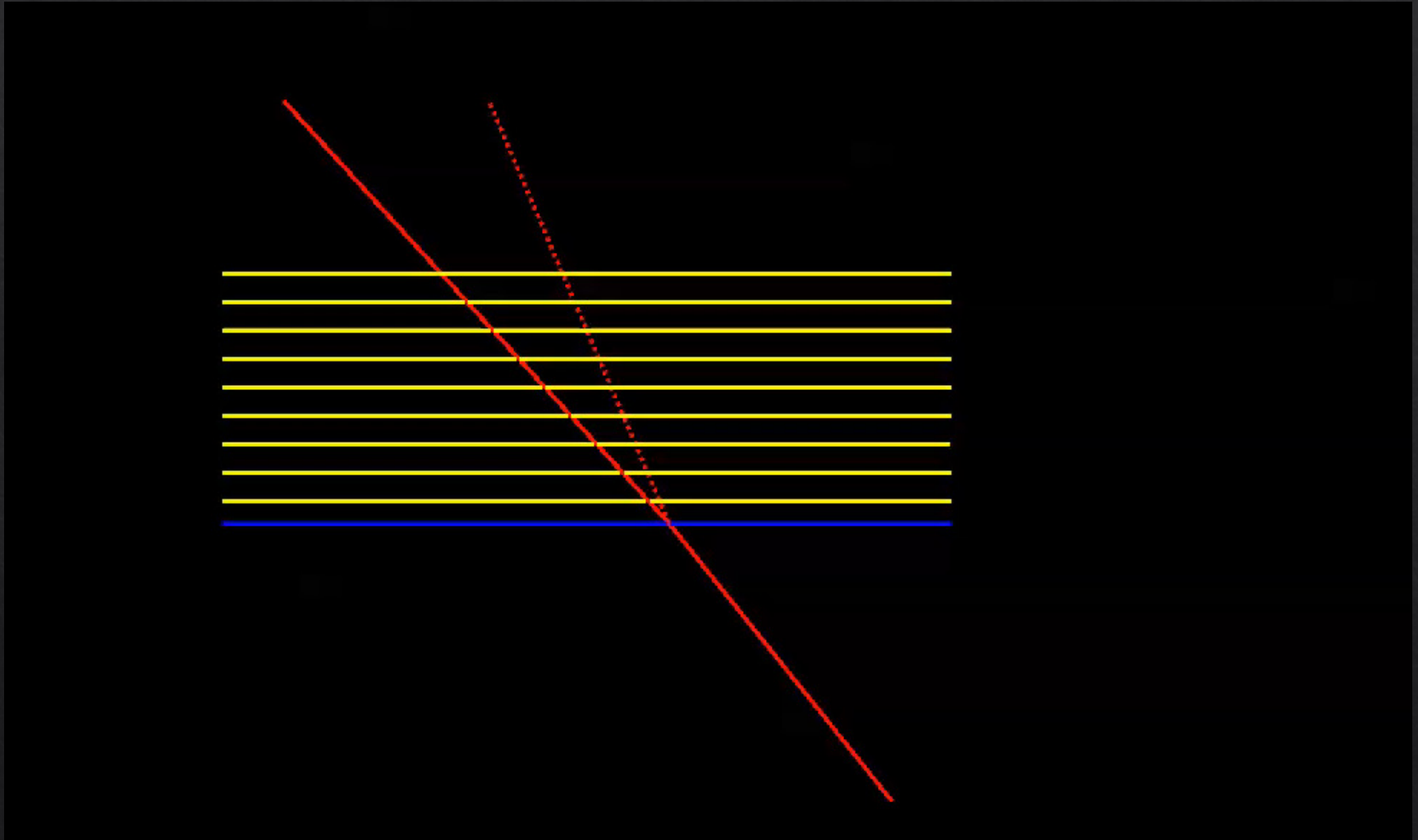
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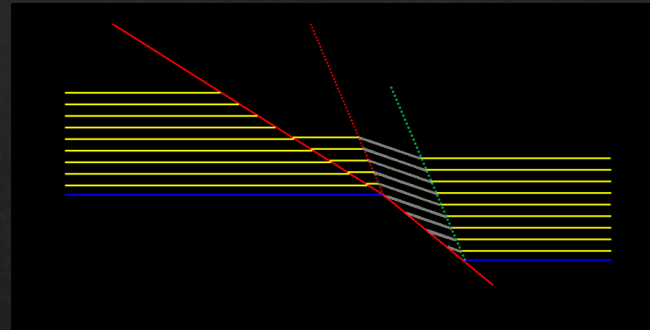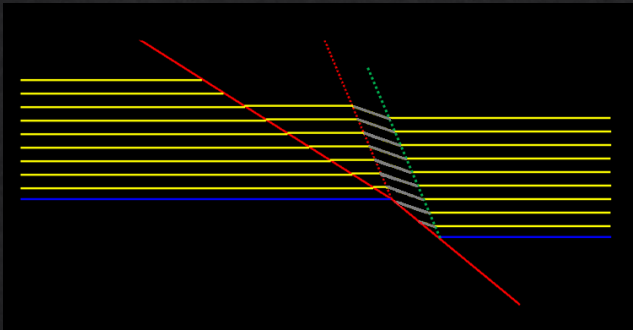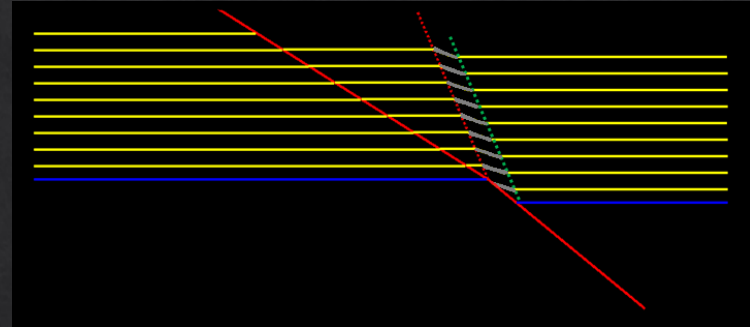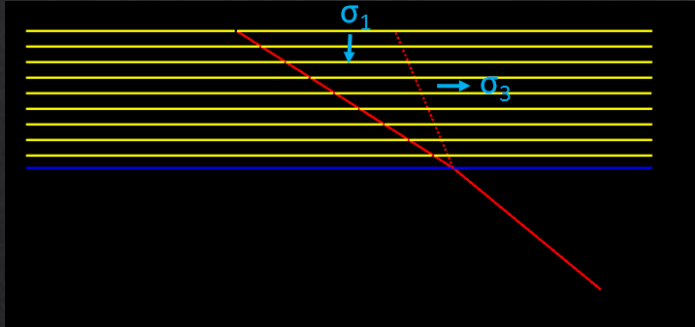
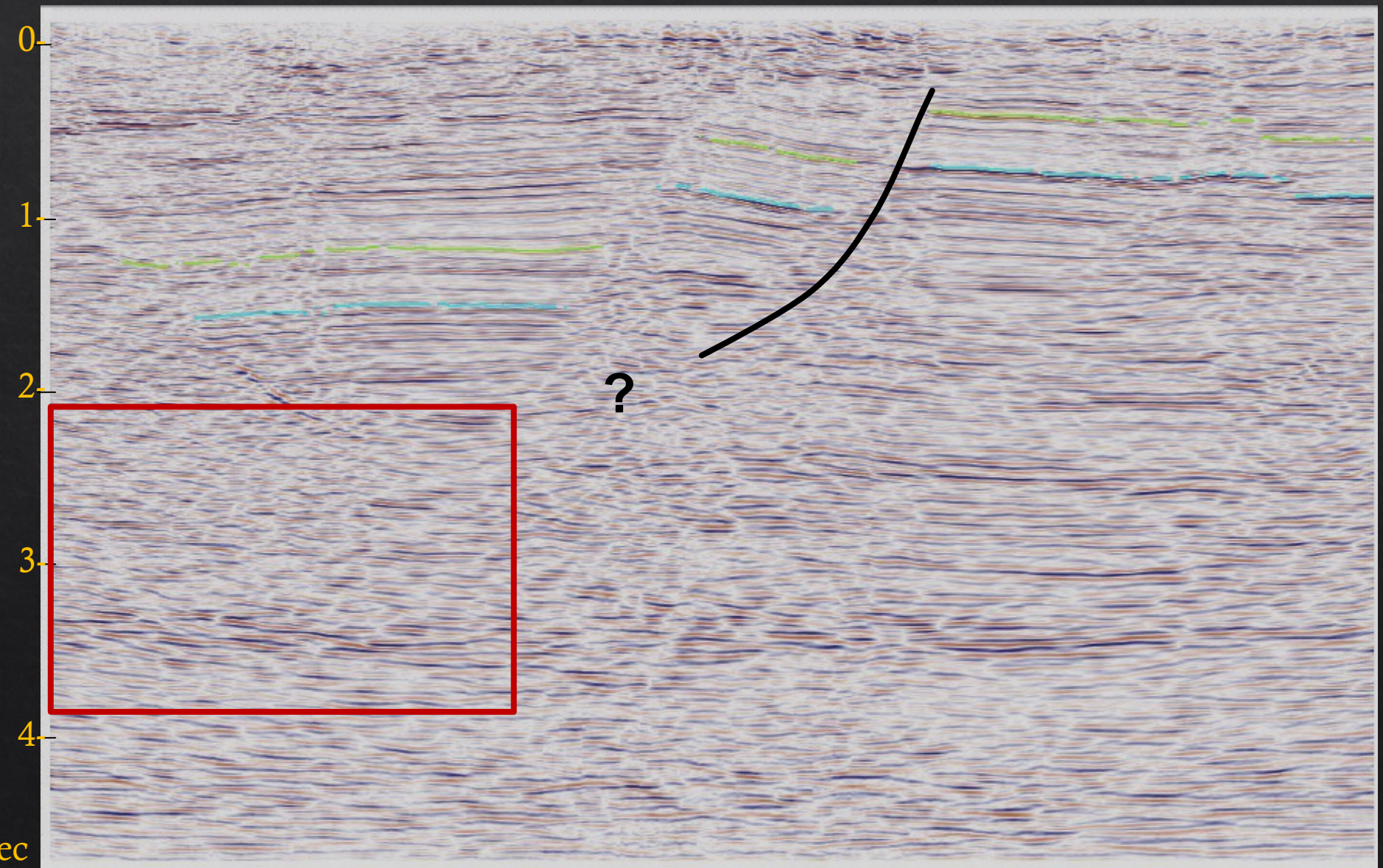# Modeling: concave-upward bend (seismic reflections)

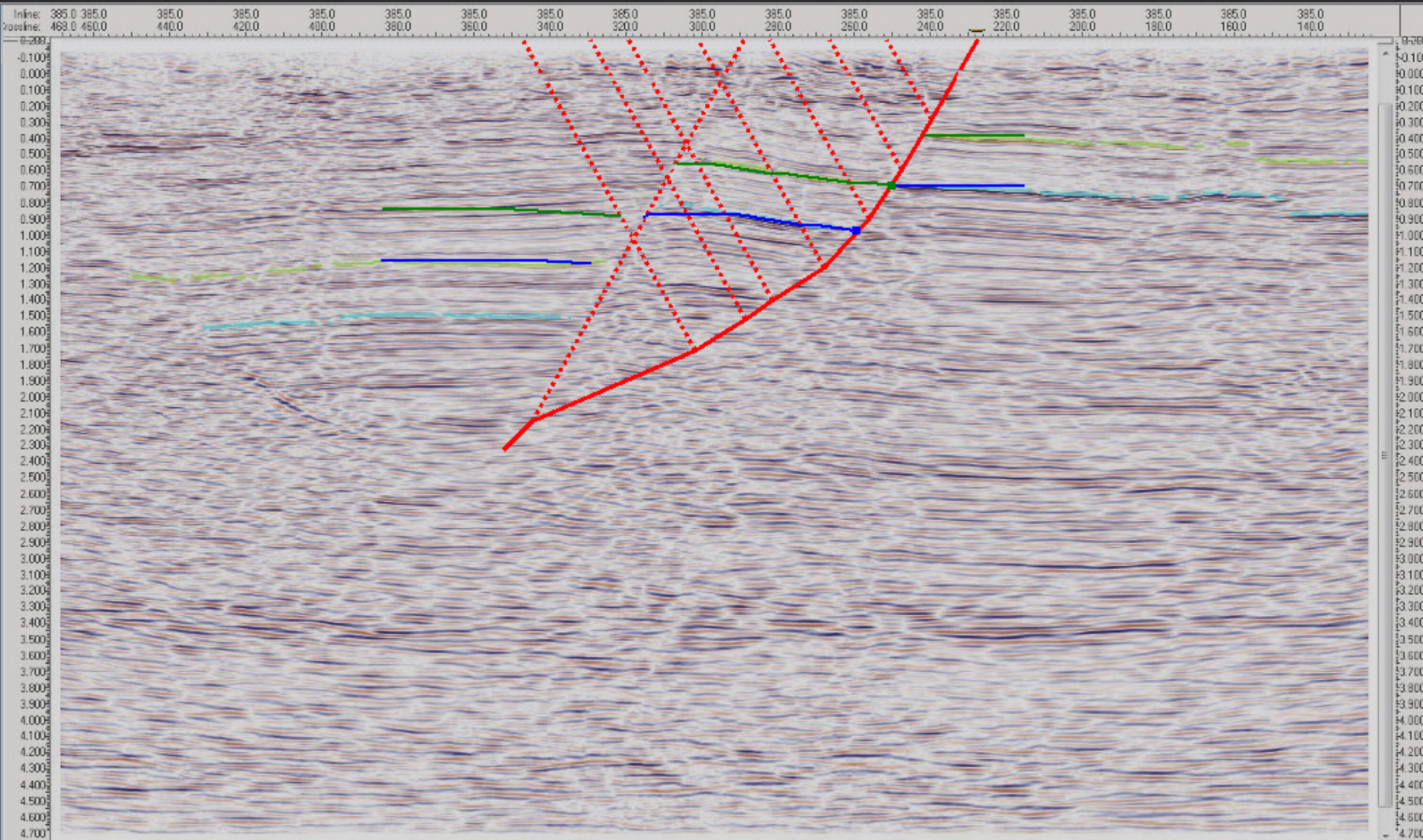# Modeling: Deformation over Convex-upward Bend

Modeling: convex-upward bend (seismic reflections)
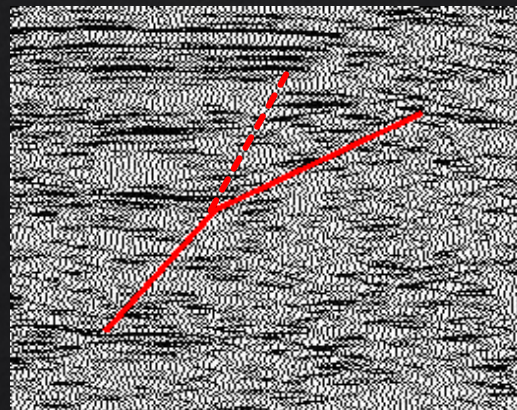
Fault Prediction from Seismic Data

Fault Prediction

Interpreted (light color) and modeled (dark color) horizons

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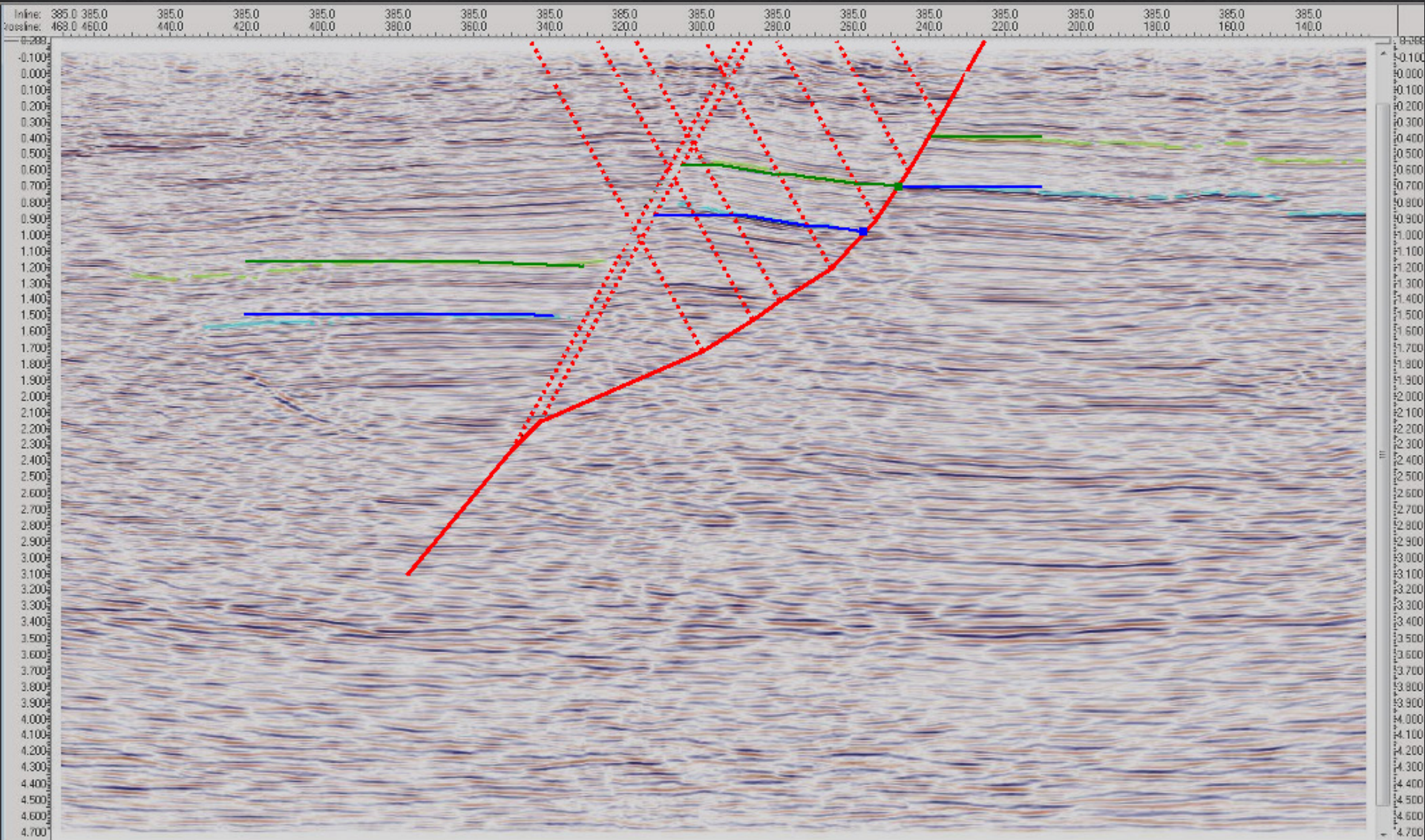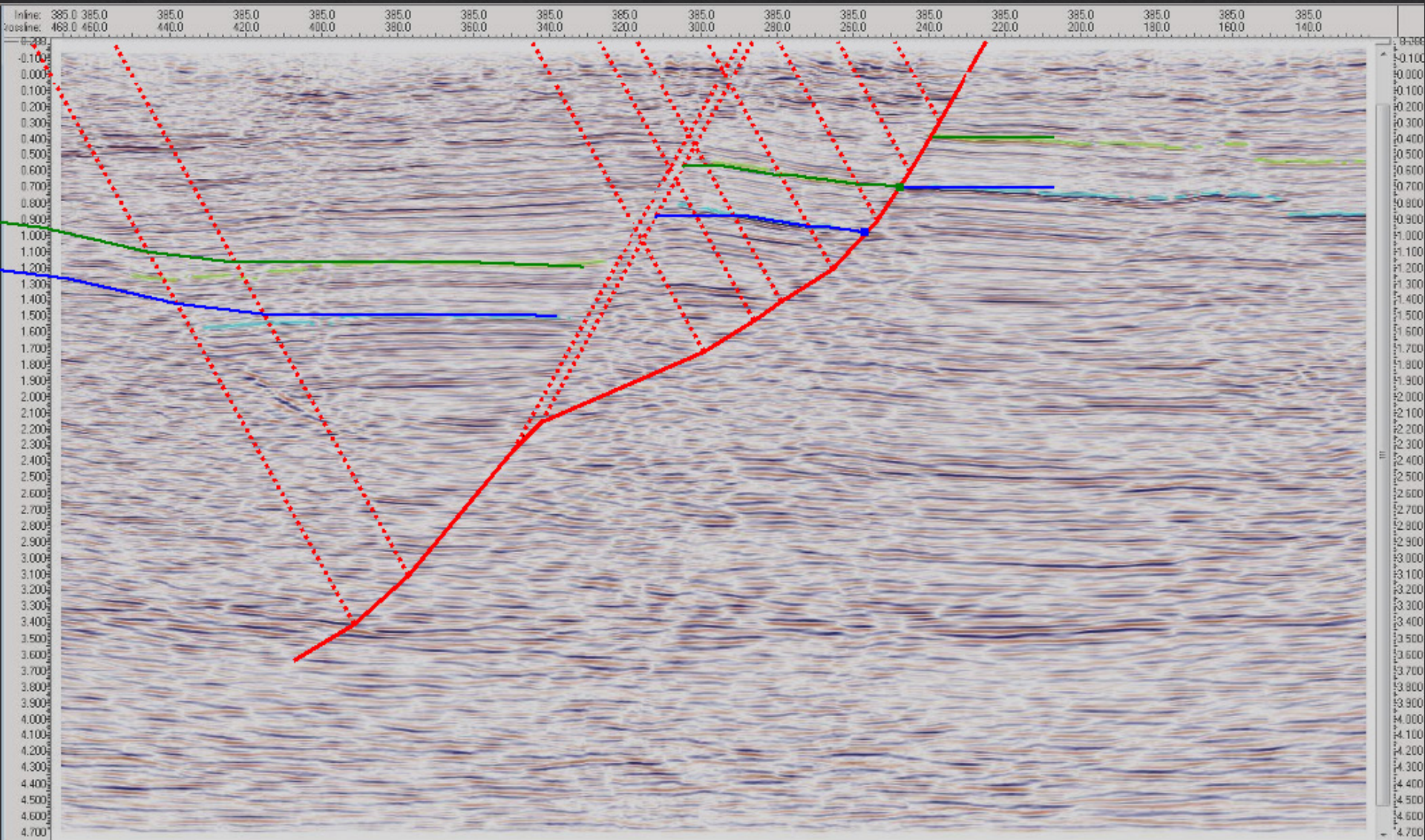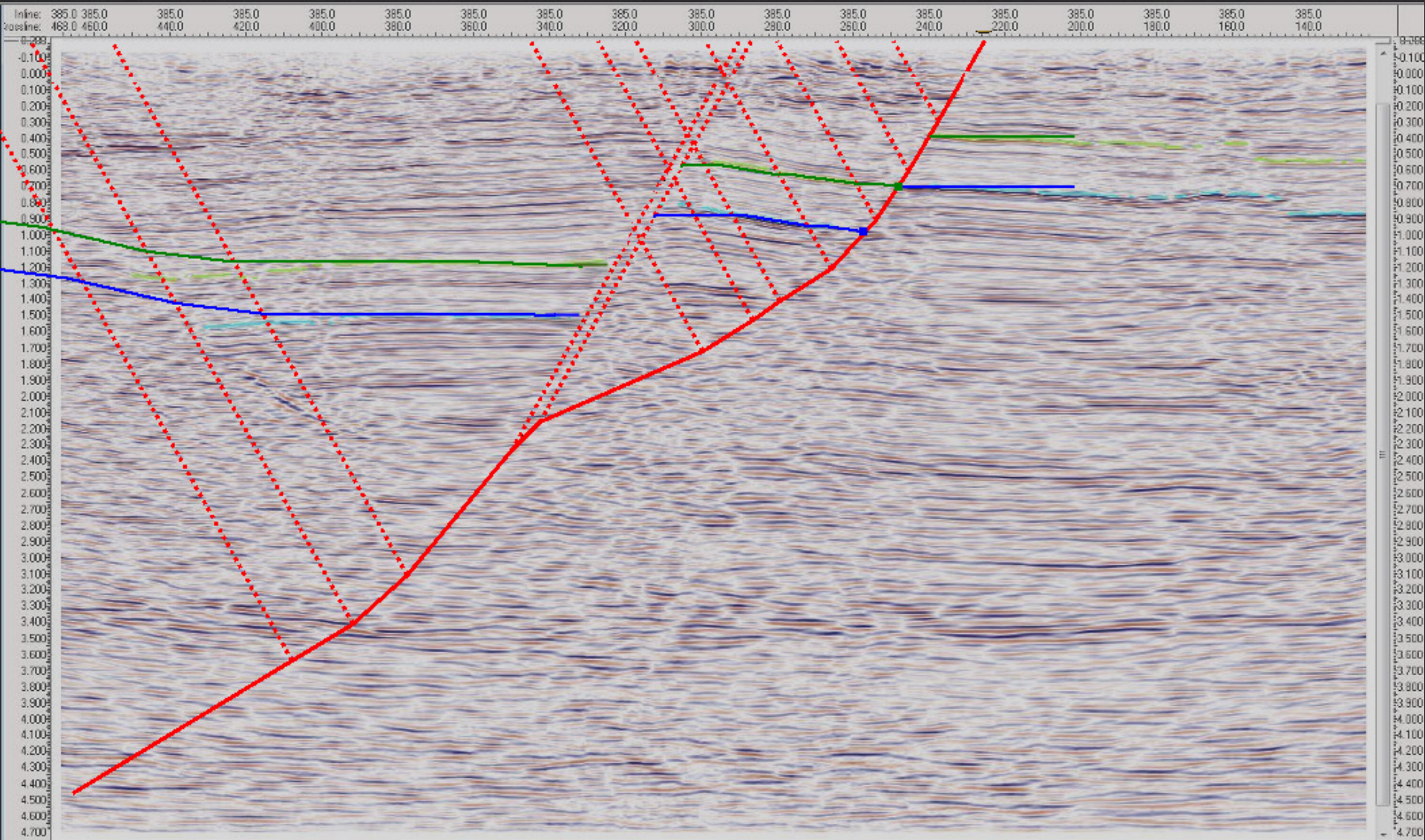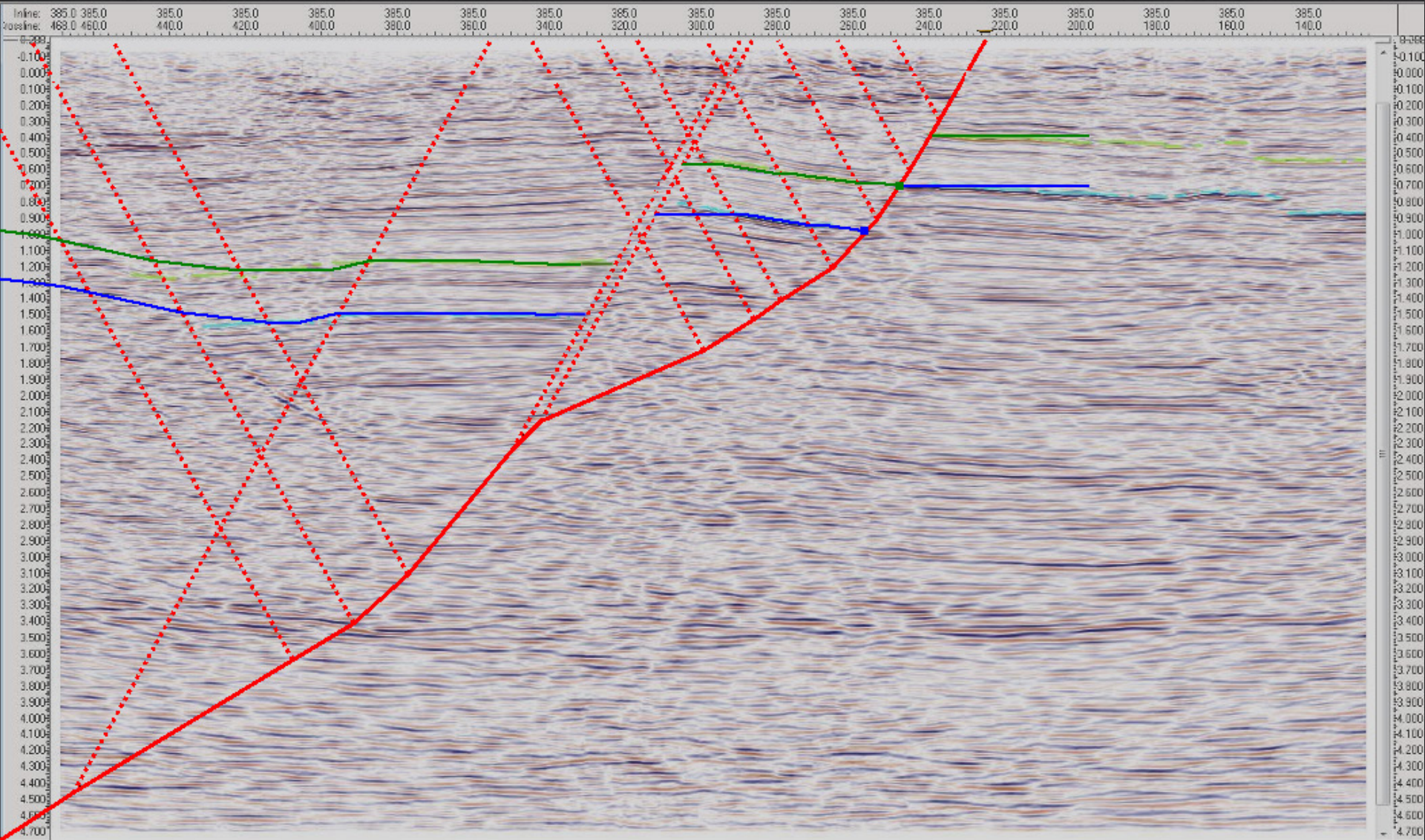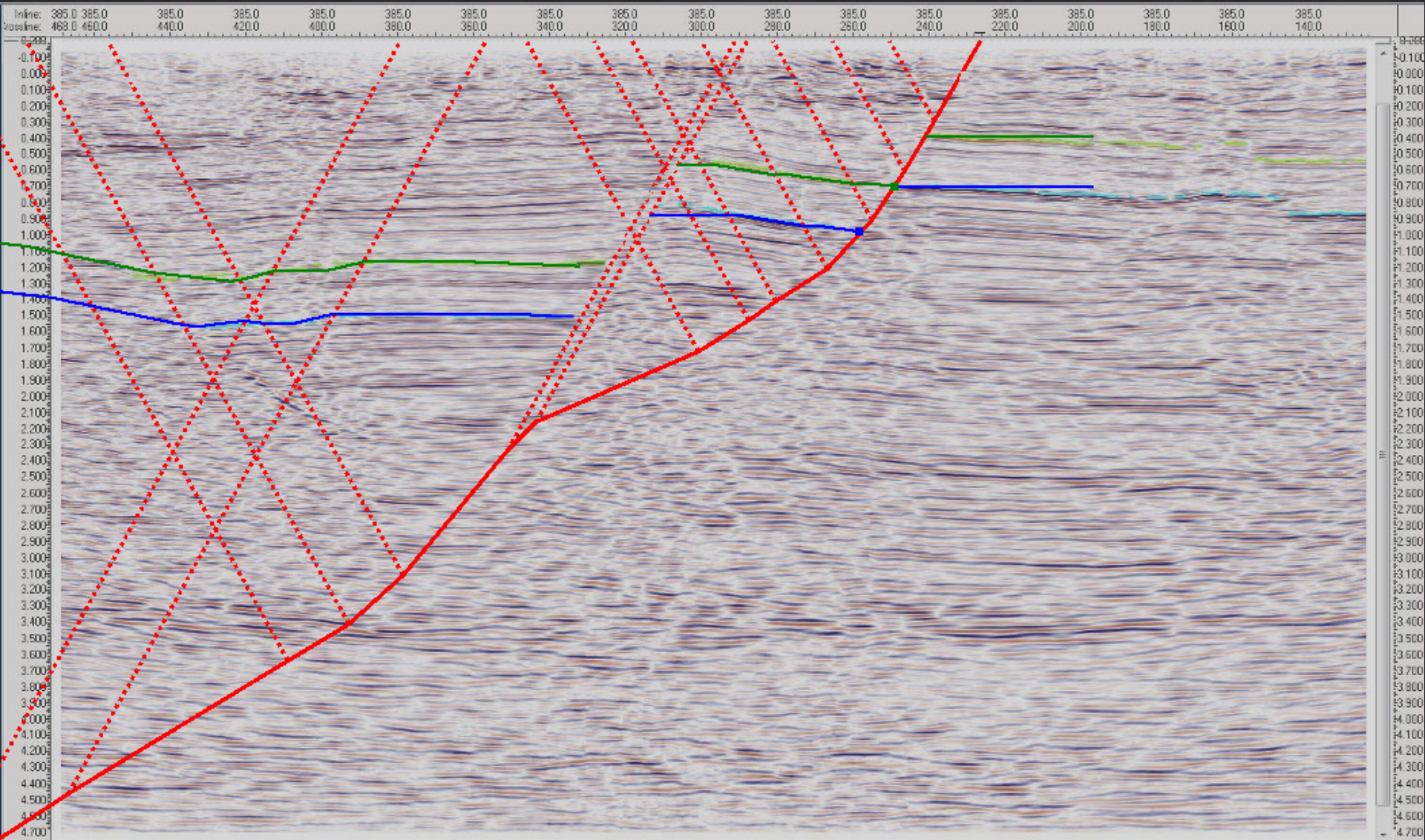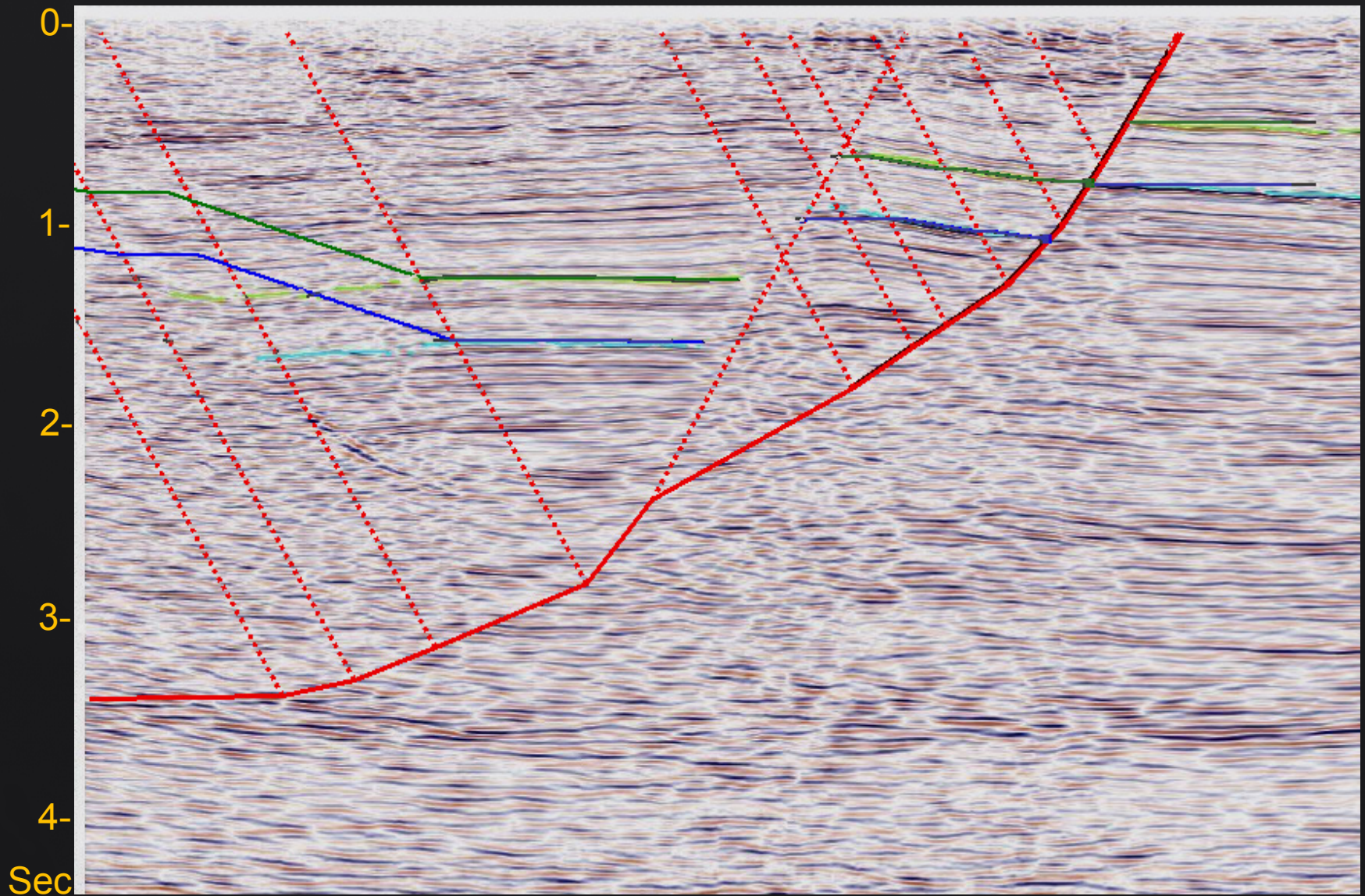
Fault Prediction

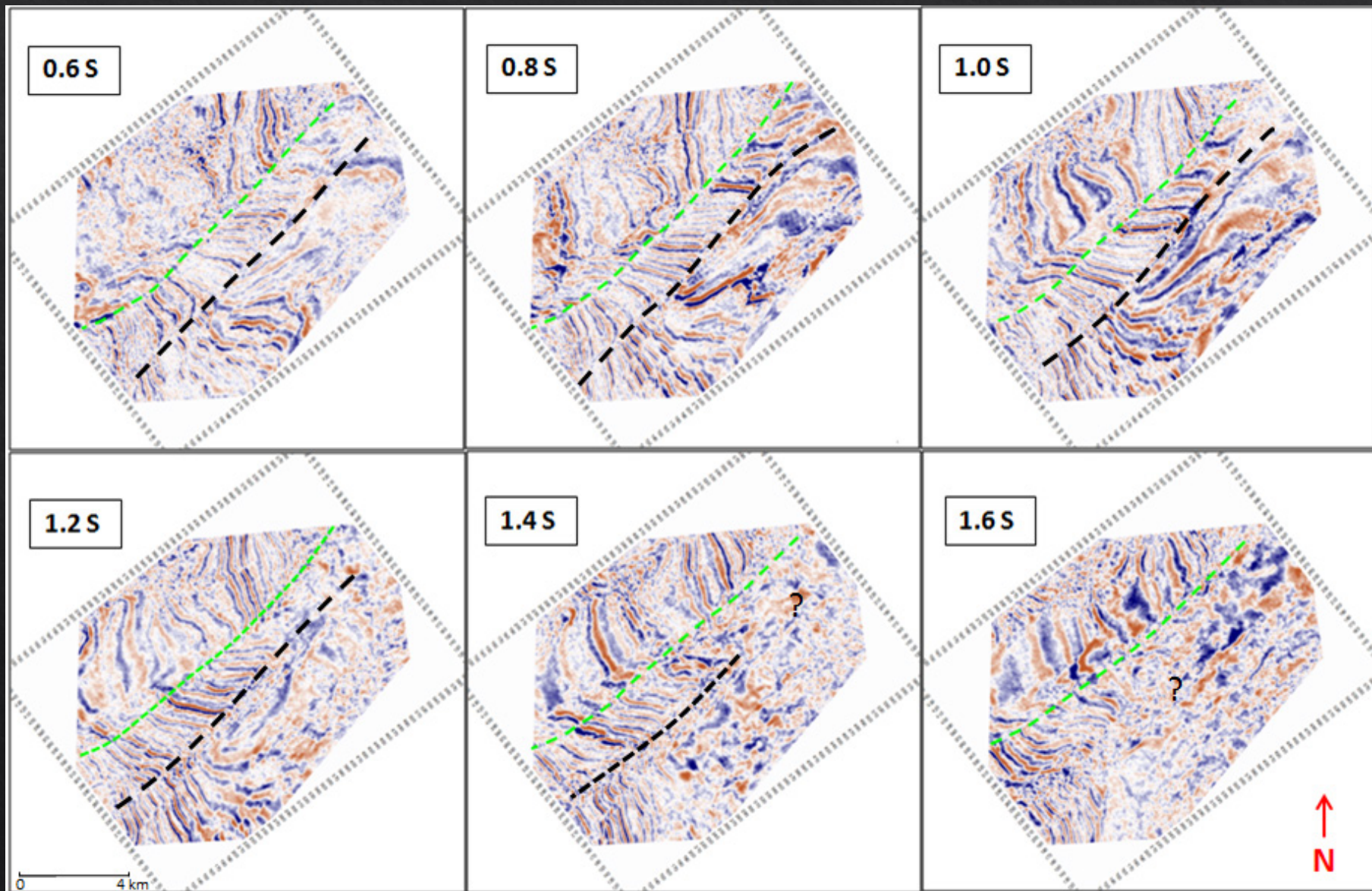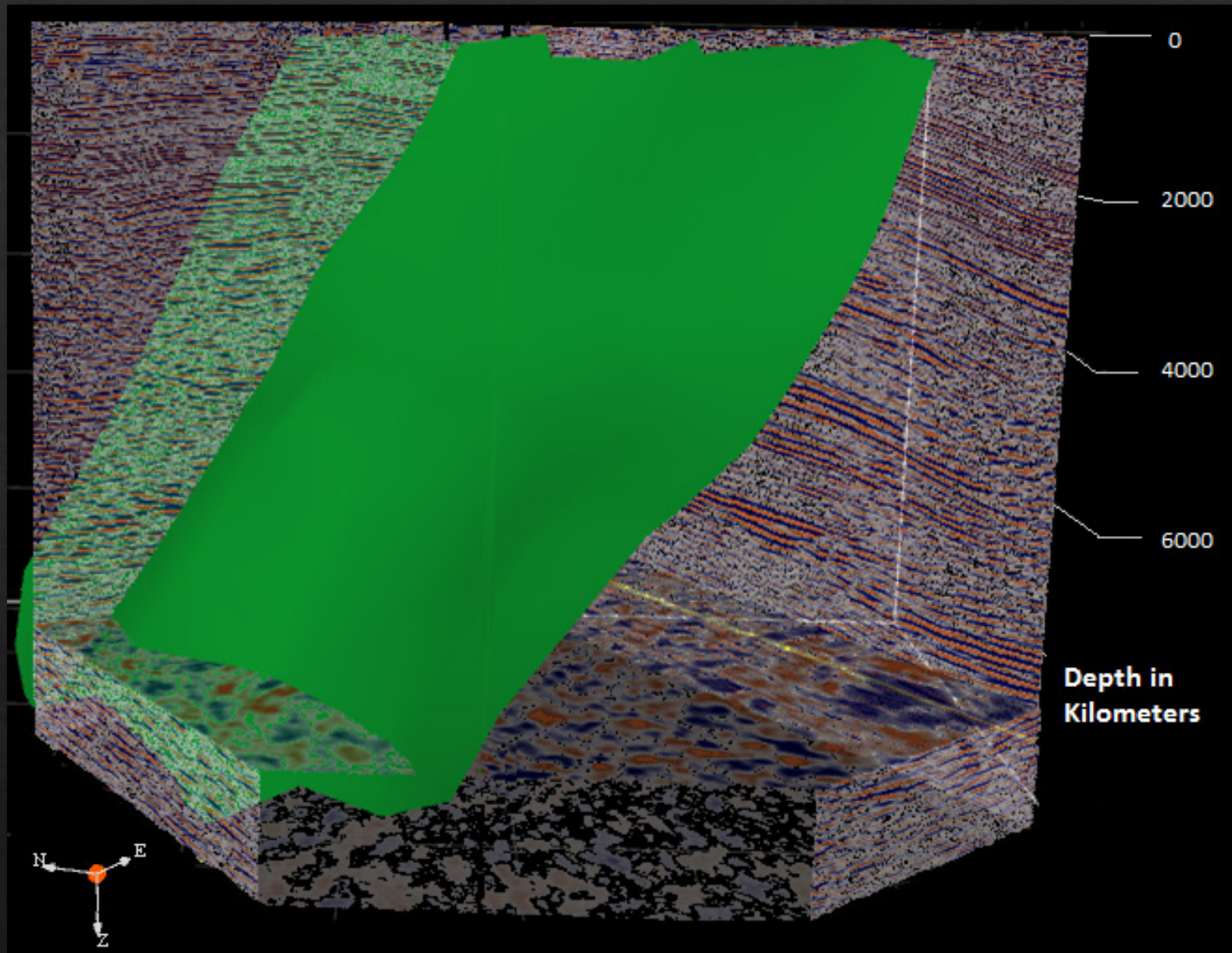**Interpreted (light color) and modeled (dark color) horizons**

Fault Prediction

Interpreted (light color) and modeled (dark color) horizons

Fault geometry throughout the survey

Fault Geometry in 3D

Conclusions

- Kinematic forward model explains the unique relationship between a fault's shape and deformation in its hangingwall

- Fault geometry can be predicted at depth by modeling the interpreted seismic reflections and dip domains of shear axial surfaces

- The main fault in the modeled seismic data appears to have a ramp-flat geometry and offset the deep reflectors

Acknowledgements

- Dr. Don C. Lawton

- CREWES and CREWES sponsors

- Saudi Aramco for sponsoring my MSc program

- Nunns and Rogan LLC for providing STRUCTURESOLVER

- Dr. Alan Nunns for his consultation on the modeling software STRUCTURESOLVER