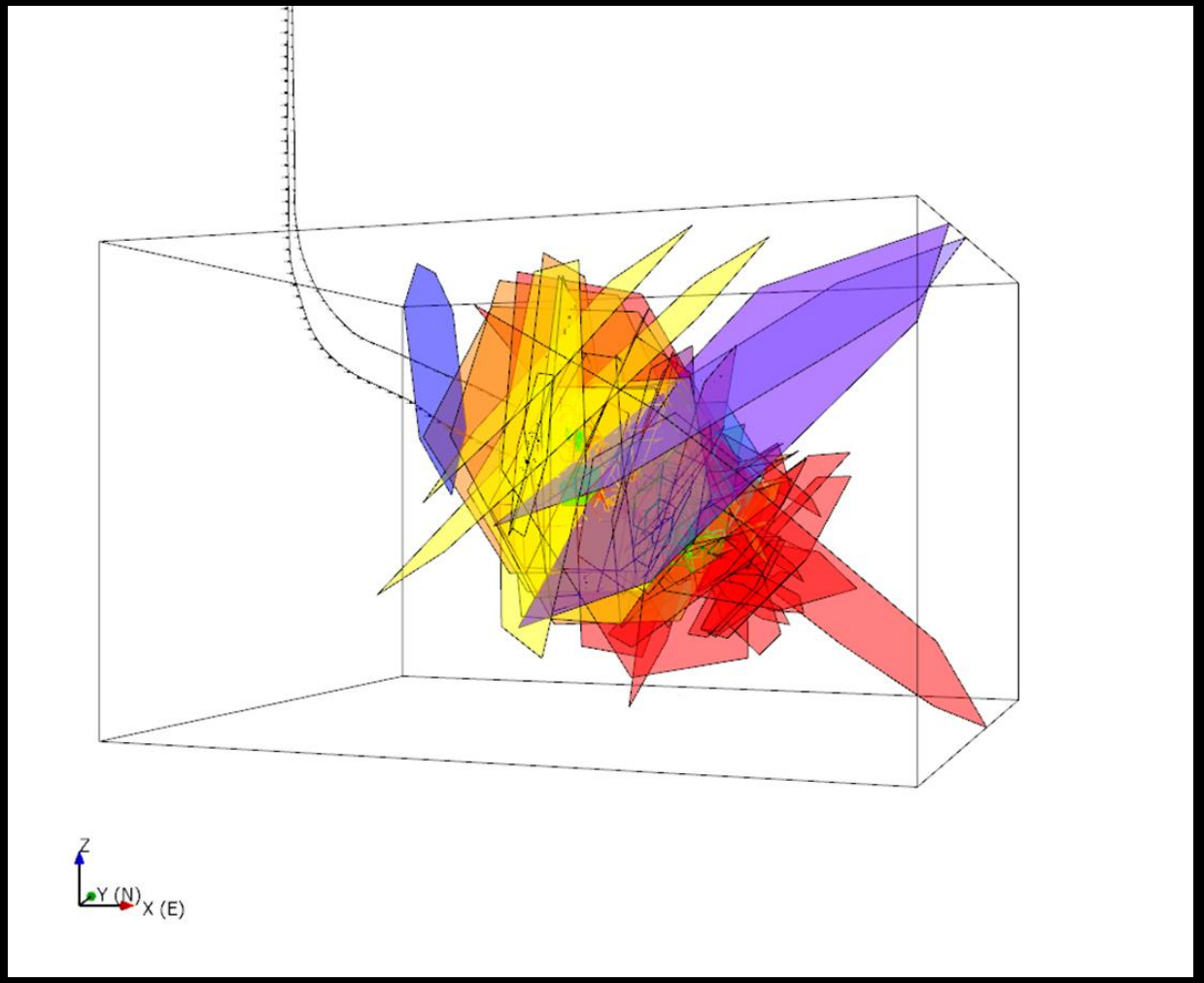
DFN UPDATE 2025 V1 NOTES FOR GDR RELEASE



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Overview

The 2025 v1 DFN includes 131 individual fractures which were identified using many data sets:

- Static FMI logs
- Fracture interpretations from both FMI and UBI logs with aperture estimates when available
- Updated microearthquake (MEQ) catalogs from both surface nodal arrays and geophones at depth with a focus on temporal evolution to highlight individual fracture segments
- K-cluster analysis for rock type categorization using multiple well log sources
- Frac hit locations and magnitudes along 16B(78)-32
- Stimulation stages and perforation intervals in 16A(78)-32 and 16B(78)-32
- Spinner log flow estimates in 16A(78)-32 and 16B(78)-32

Stochastic fractures with radius values between 20 and 150 m are also provided away from well control.

Included Files

Fracture, well trajectory, and region box files are provided in two coordinate frames:

- Global coordinates with Imperial units (ft)
- Local coordinates with SI units (m)

Fracture file formats:

- Ascii csv files include fracture center coordinates, orientation in both fracture pole trend/plunge and strike/dip designations (these are equivalent), as well as a fracture radius so circular fracture shapes are assumed and may extend outside the model region boundaries.
- FracMan fab files including hexagonal fracture vertex coordinates (clipped to model region). While these files include hydraulic property values for permeability, compressibility, and aperture, those values should be overridden to suit the planned modeling task as they have not been reviewed or calibrated.
- Surface files have also been provided in the GOCAD ts format to show the combined fracture set surfaces.

Well trajectories for 16A(78)-32 and 16B(78)-32

Model region boundaries in both GOCAD ts and FracMan sab file formats

Spreadsheets in both csv and Excel file formats that may be useful for modeling activities including:

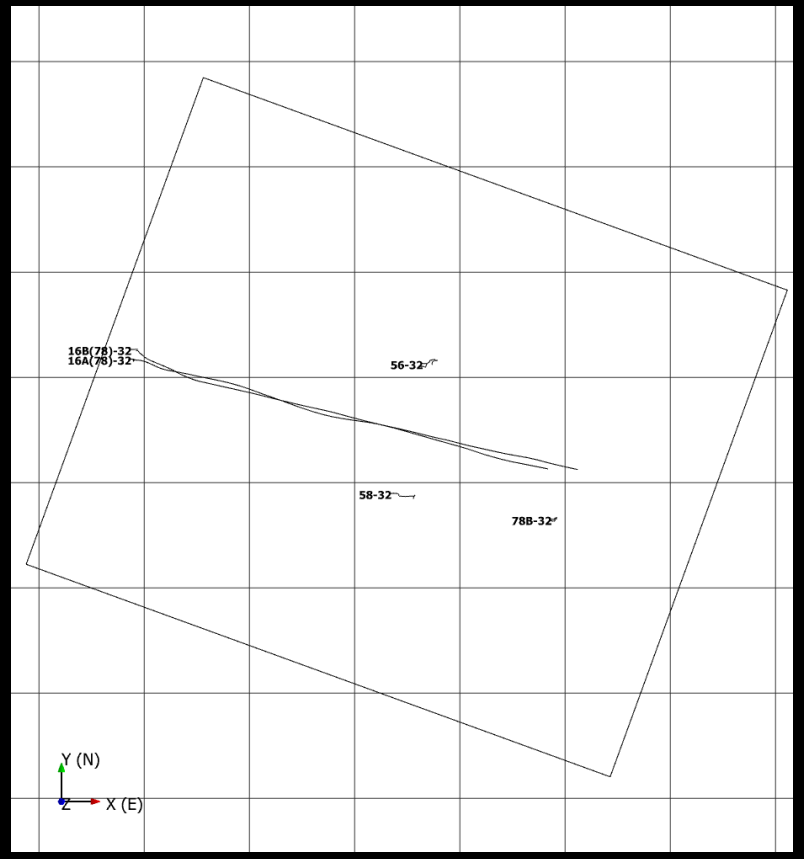
- Well stage and perforation intervals for both 16A(78)-32 and 16B(78)-32 along with the discrete fractures intersecting
  - Perforation intervals
  - Stimulation stages
  - The entire well
- The nearest discrete fractures to the injection and production well intervals

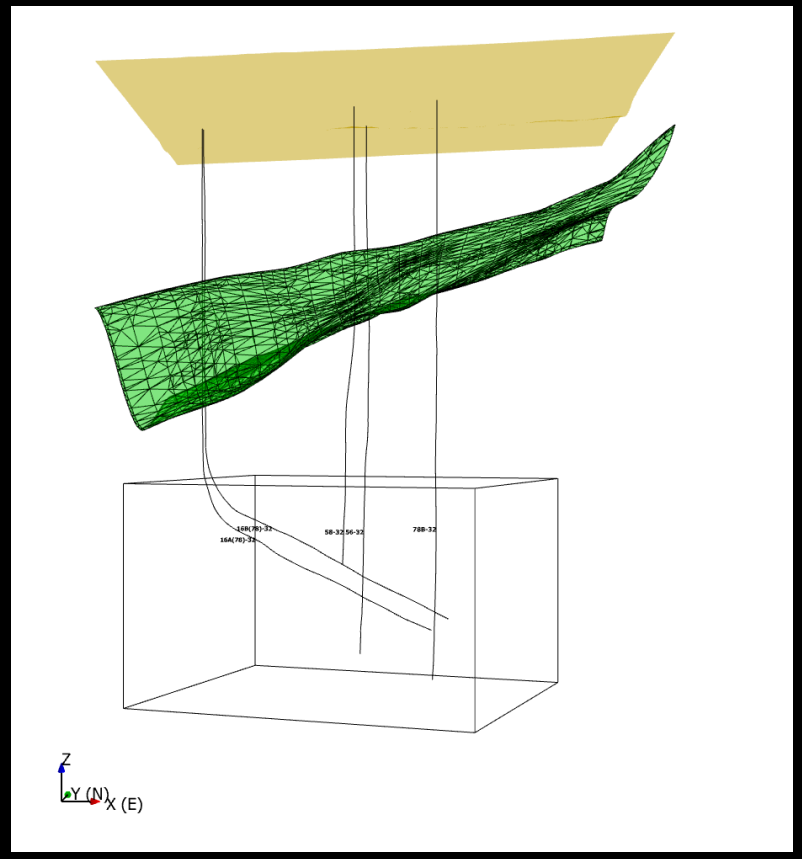
Limitations

- The 2025 v1 DFN only describes the geometry of the flow pathways, not hydraulic properties such as aperture, permeability, or compressibility which may be variable within an individual fracture plane.
- Fracture sizes are estimated based on available MEQ intersections, evidence of intersection with one or more of the five deep wells in the reservoir based on log data, estimates of aperture from FMI logs, or magnitudes of frac hits on 16B(78)-32. Modelers are encouraged to adjust fracture sizes as required for their particular simulation objectives.
- The 2025 v1 DFN was developed primarily to support the simulation of flow between 16A(78)-32 and 16B (78)-32. Other significant fractures may be discovered with more attention to the data sets for 58-32, 78B-32, and 56-32 as well as regions on 16A(78)-32 and 16B(78)-32 outside of the current modeling region.

Model Region

- Region somewhat enlarged from 2024 DFN
- Dimensions: Local [m] (1,800 x 1,500 x 1,100)
  Global [ft] (5,905.51 x 4,921.26 x 3,608.92)
- Rotated 20 degrees from N-S and E-W coordinate frame to align with the maximum horizontal stress direction of N20E and minimum horizontal stress direction at N110E
- Center point (X, Y, Z): Local [m] (0, 250, 400)
  Global [ft] (1,100,495.35; 13,987,026.19; -2,460.63)



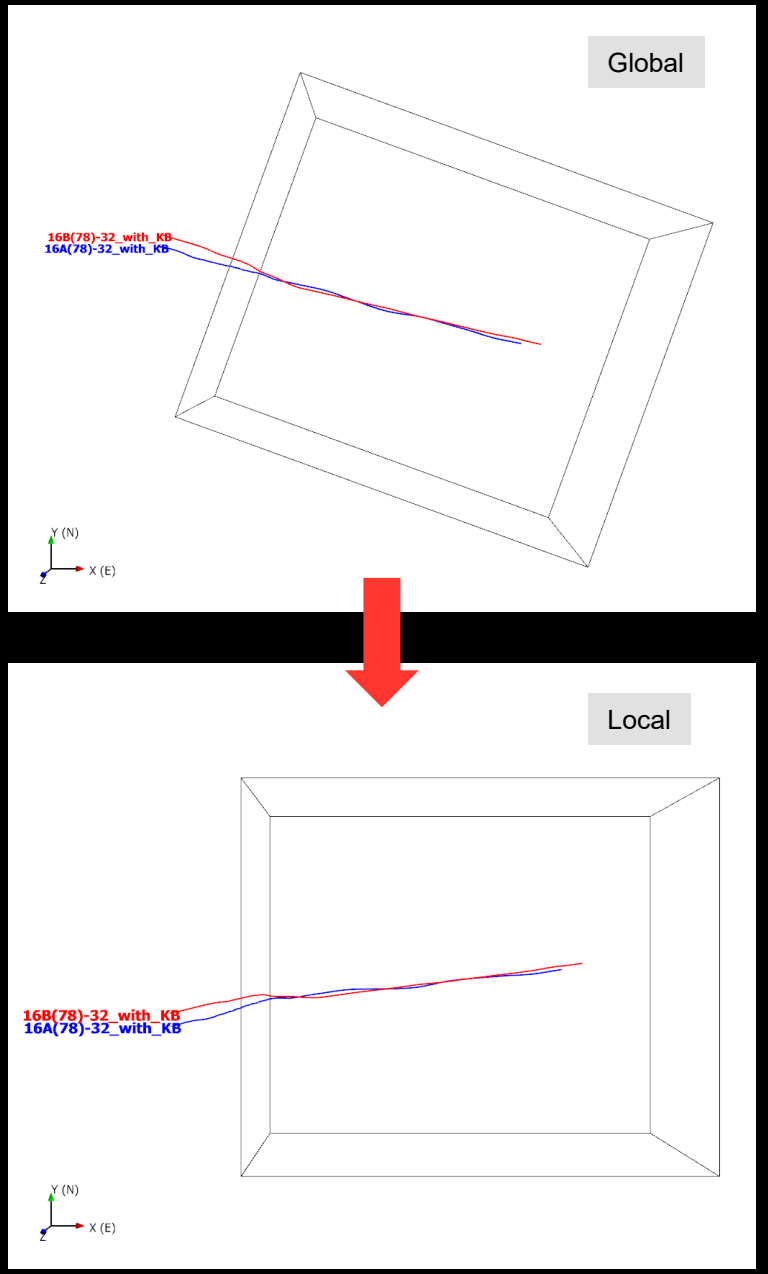


Local Coordinate Frame

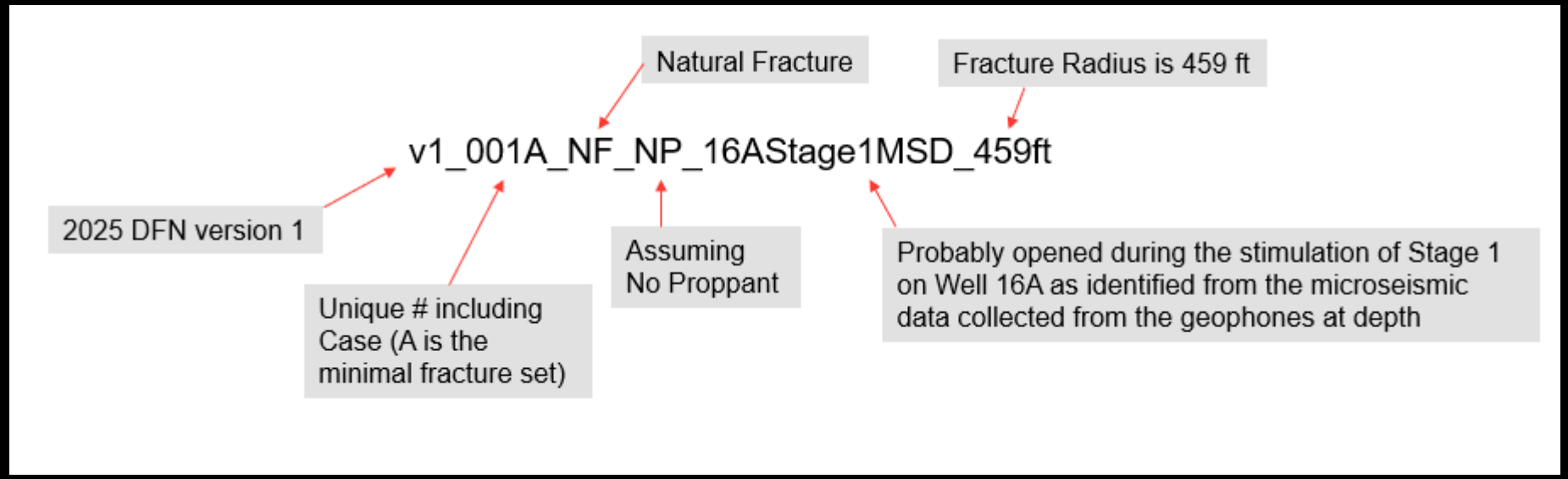
There are subfolders for Global Coordinates and Local Coordinates. The local coordinate frame is the same as was used for the 2024 DFN models. Coordinate are provided in meters.

To move from the global to the local coordinate frame, fractures and wells were

a) rotated 20 degrees counterclockwise looking down about the global point (335376.400482041, 4263189.99998761, 250.093546450195) to better align with the principal stresses; and
b) translated by (-335408.68, -4263010.9, 1150.).



Fracture Naming Convention



DFN Version

- v1: All the fractures in the 2025 DFN version 1 have names starting with “v1”

Numeric Identifier

- Three-digit number that is unique for the location and orientation of the fracture (but not size). The combination of the numeric identifier and the Case will be unique. The numbering generally reflects the order in which the fracture locations were revealed from microseismic data, so fractures associated with the16A Stage 1 stimulation have the smallest numbers.

Case Options

- A: Minimal fracture set required to connect 16A with 16B
- B: Additional fractures (in addition to Case A) required to match observed microseismic data, significant features from well log data, and frac hits on 16B
- S: Significant, large-scale structural fractures that may or may not be involved in current stimulated flow paths and may be larger versions of either Case A or Case B fractures

Fracture Type (assumed)

- NF: Natural Fracture
- HF: Hydraulic Fracture

Proppant (early draft, this label may be modified after getting feedback)

- PP: Presumed to be filled with proppant (intersecting or close to a stimulation stage that used proppant). Stages with pumped proppant include 16A Stages 3R, 4, 5, 8, 9, 10 and 16B Stages 1, 2, 3, 4.
- NP: Assumed to have no proppant

Primary Evidence Source

- Stimulation stage where fractures were identified (primarily) from microseismic activity – currently 16A Stages 1 – 10. This is followed by a data type source:
  - FH: Included primarily to reach a frac hit location on 16B
  - FMI16A: Identified from the Schlumberger fracture interpretation of 16A FMI
  - FMI16AH: Identified from the Handwerger fracture interpretation of 16A FMI
  - FMI16B: Identified from the Schlumberger fracture interpretation of 16B FMI
  - HF: Added as a new hydraulic fracture (generally only done if there is no evidence of a natural fracture)
  - MSD: Location, size, and orientation selected based on microseismic data collected at depth
  - MSS: Location, size, and orientation selected based on microseismic data collected at the surface
  - MSDS: Combination of both MSD and MSS
  - PF: Included primarily to intersect a well at a perforation interval
  - UBI16B: Identified from the Schlumberger fracture interpretation of 16B UBI

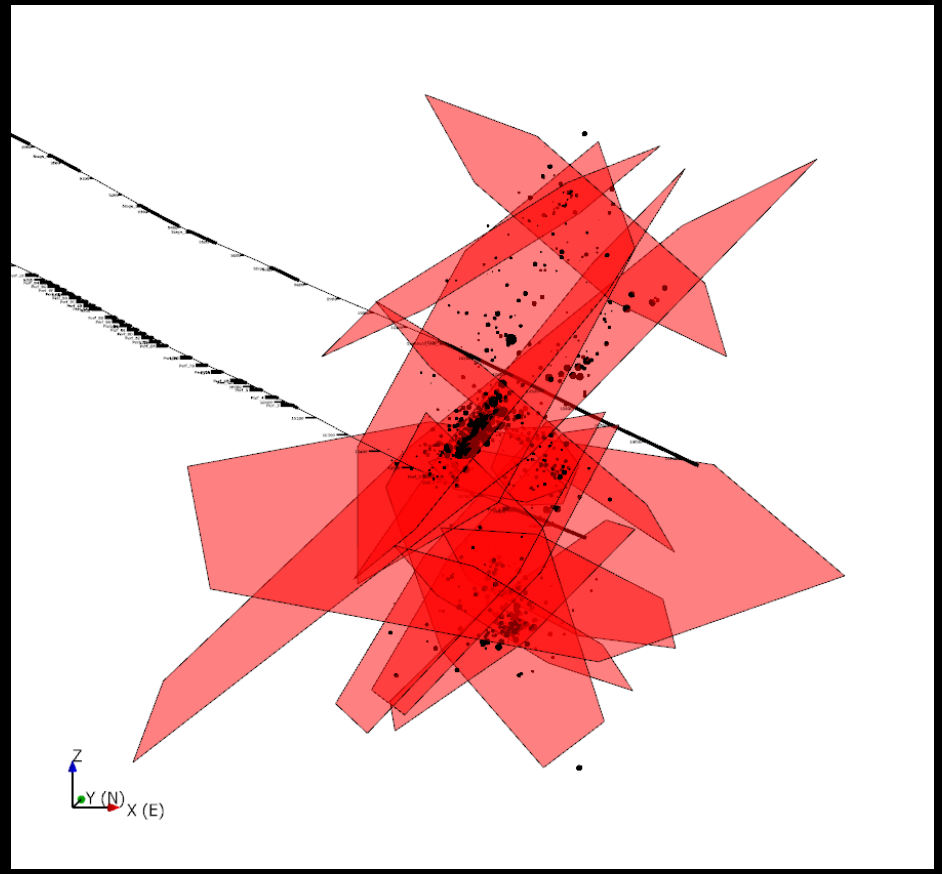
Fracture Radius

- Circular fractures are assumed for modeling convenience. The radius is included in the name for easy sorting of larger and smaller fractures. This may be useful for assigning fracture apertures and permeability/transmissivity as larger fractures tend to have larger hydraulic apertures. The largest features may also reveal lithology boundaries or fault zones.

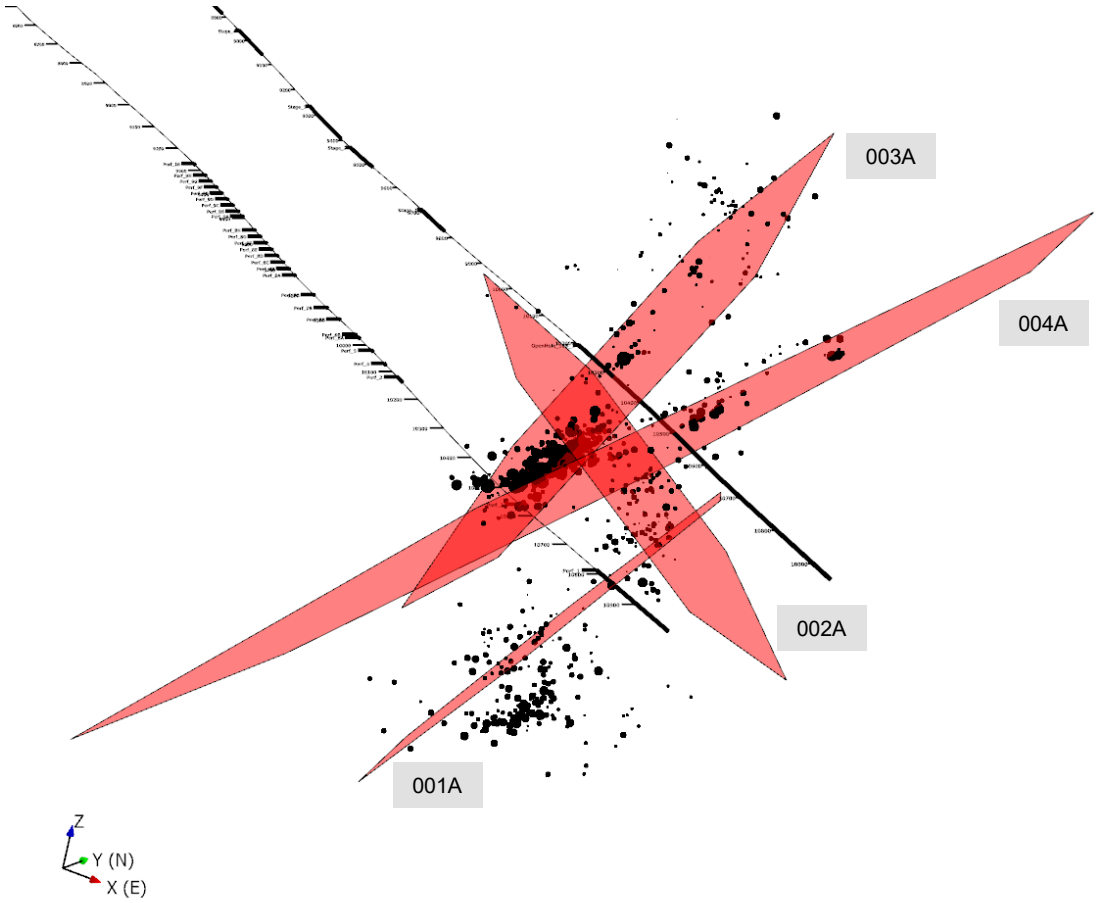
Screen Shots of Discrete Fracture Subsets

Note: Point data shows relevant microseismic points scaled by magnitude

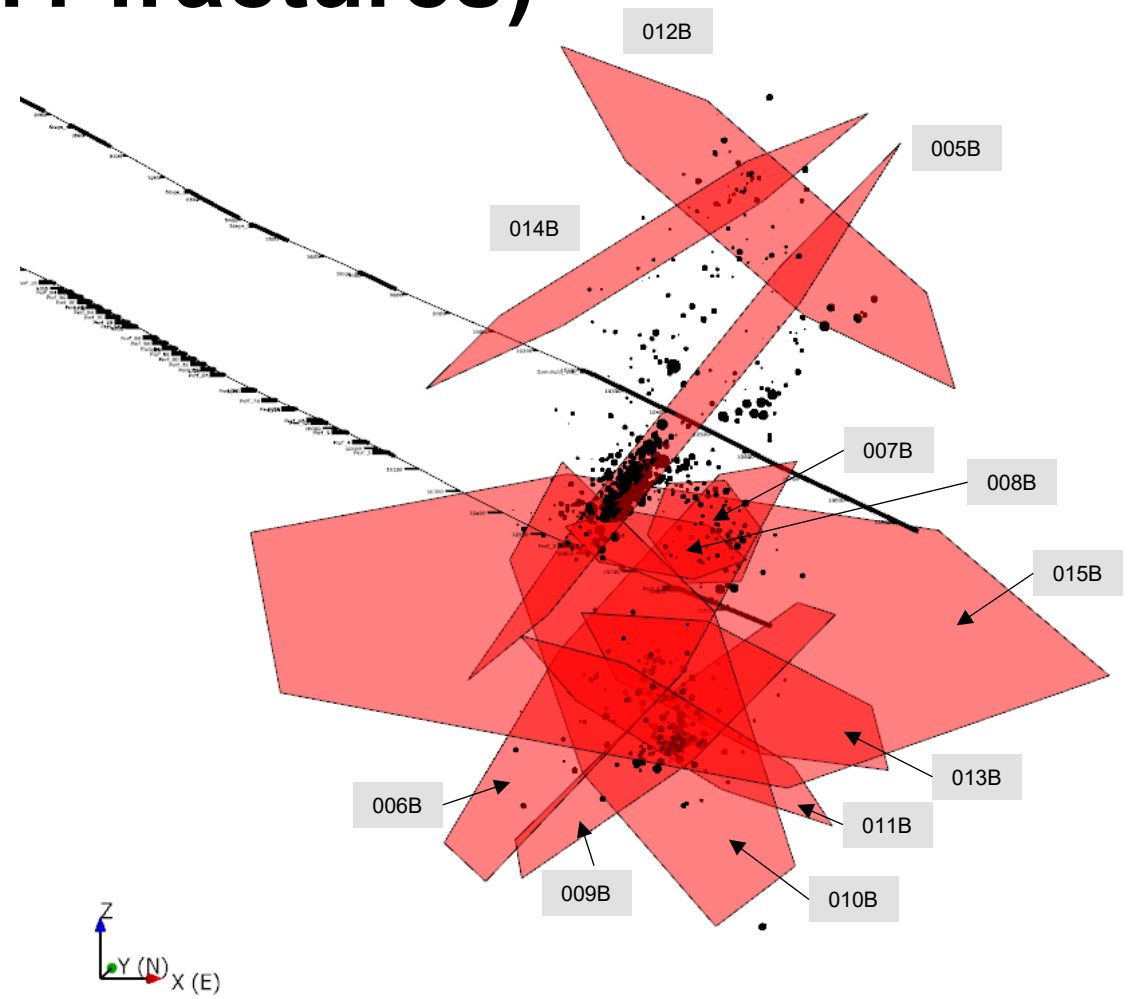
Stage 1 (15 fractures Cases A and B)



Stage 1 Case A (4 fractures)

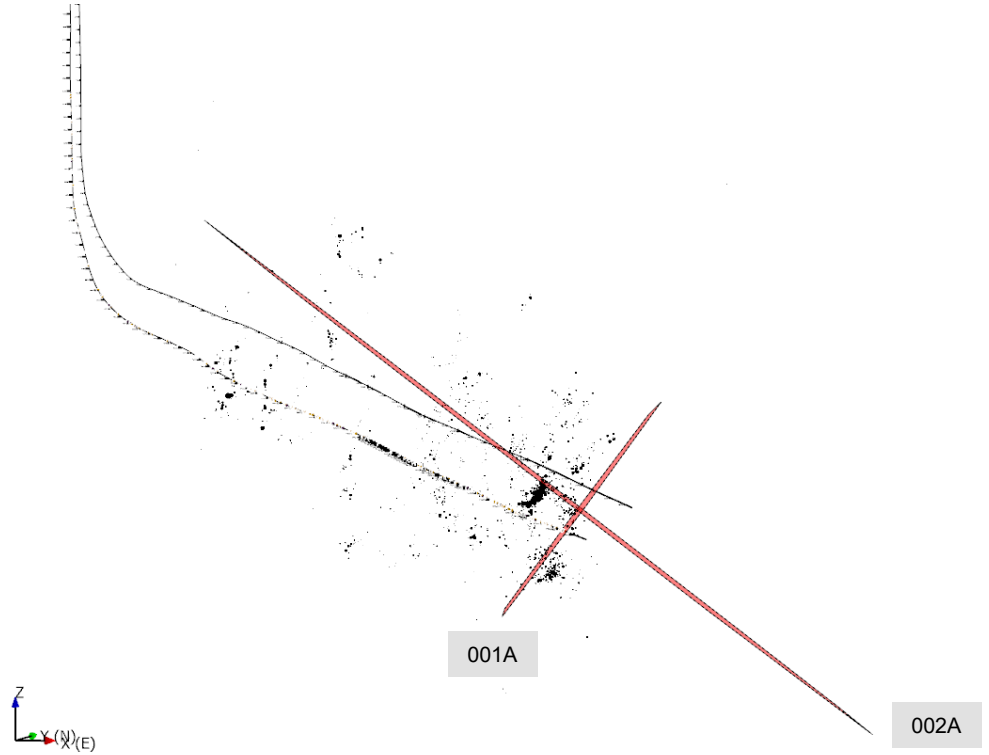


Stage 1 Case B (11 fractures)

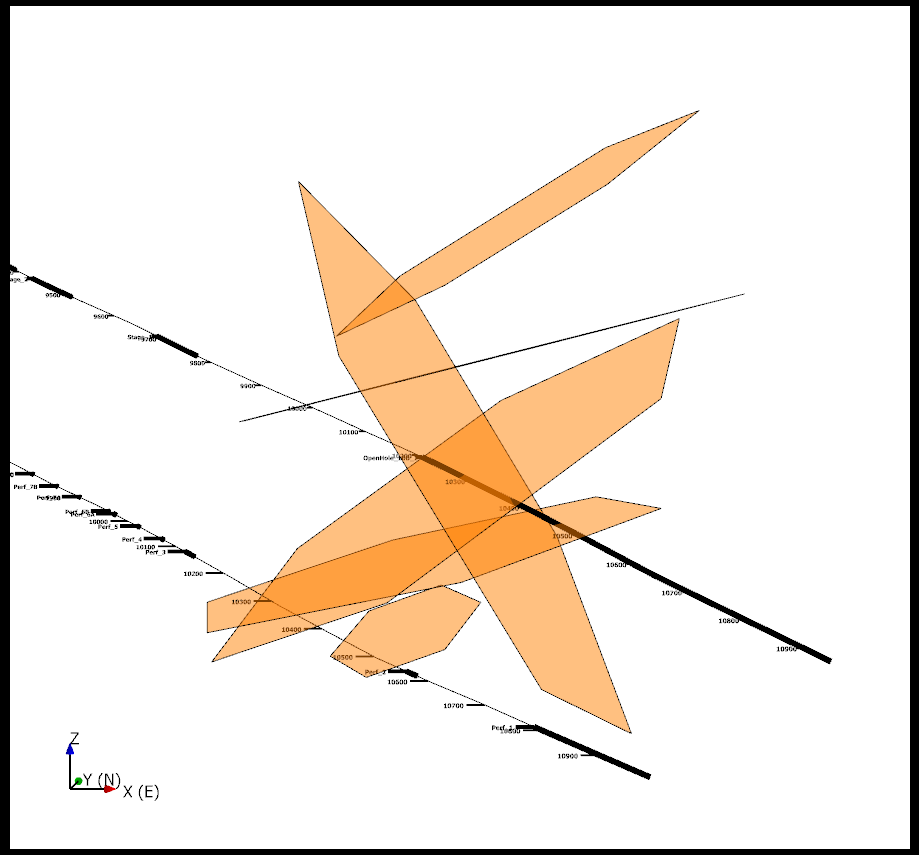


Stage 1 Case S (2 fractures)

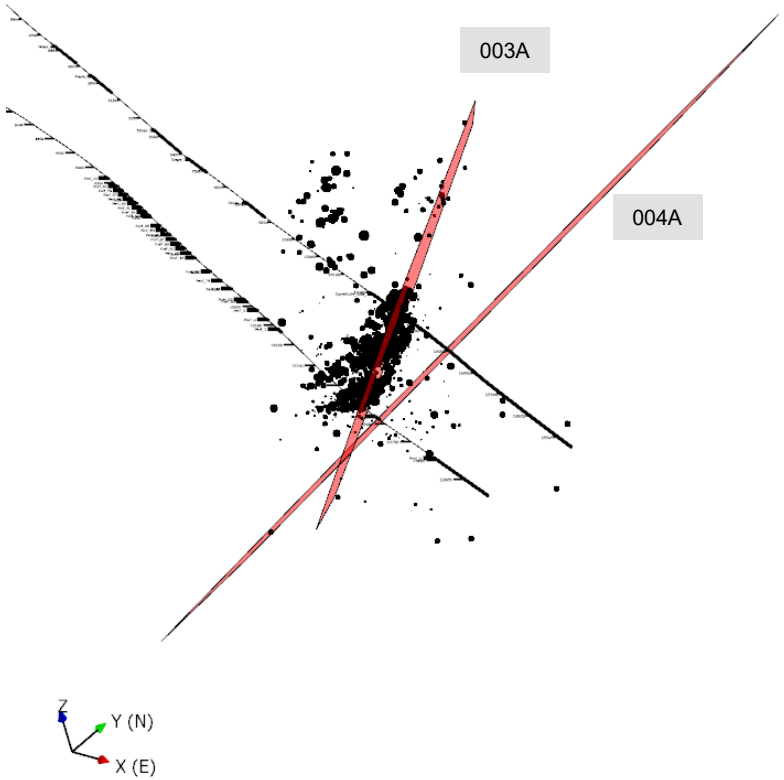
Note these are larger versions of fractures already described in Stage 1 Case A)



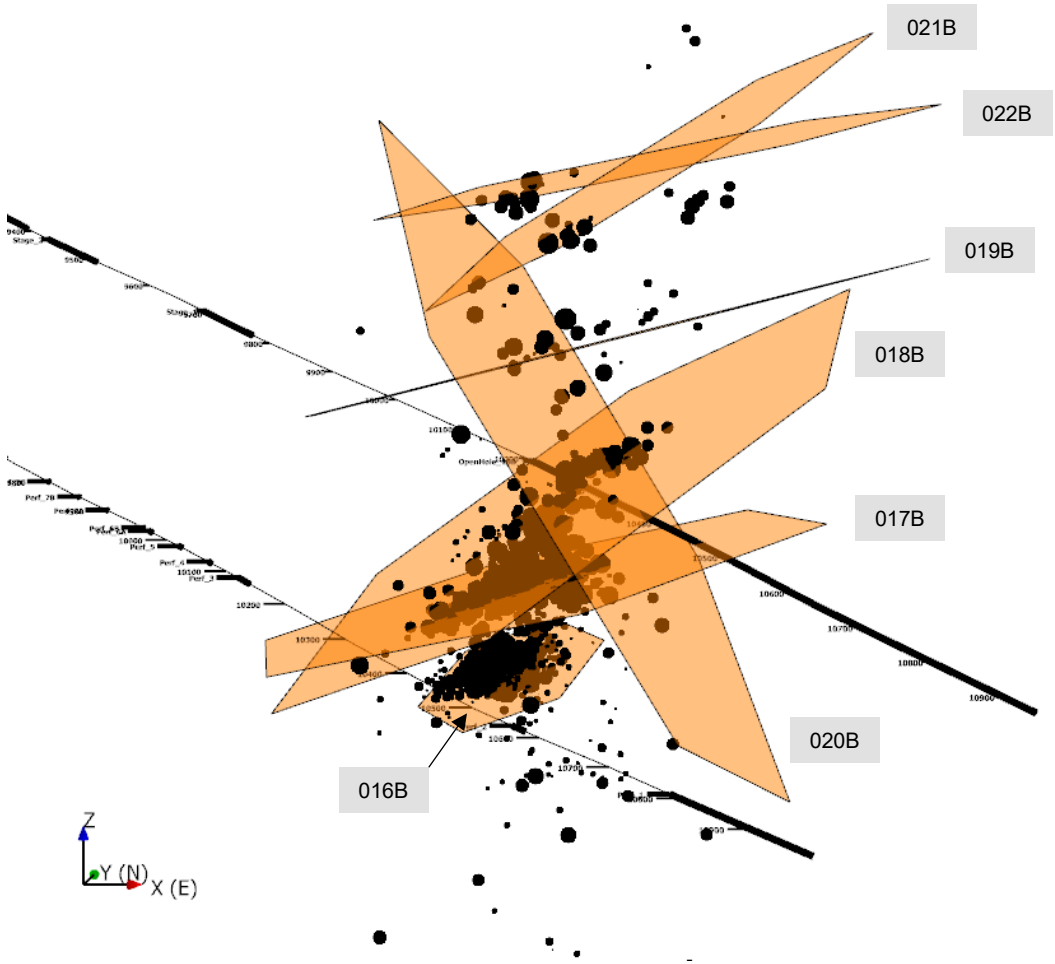
Stage 2 (7 fractures Cases A and B)



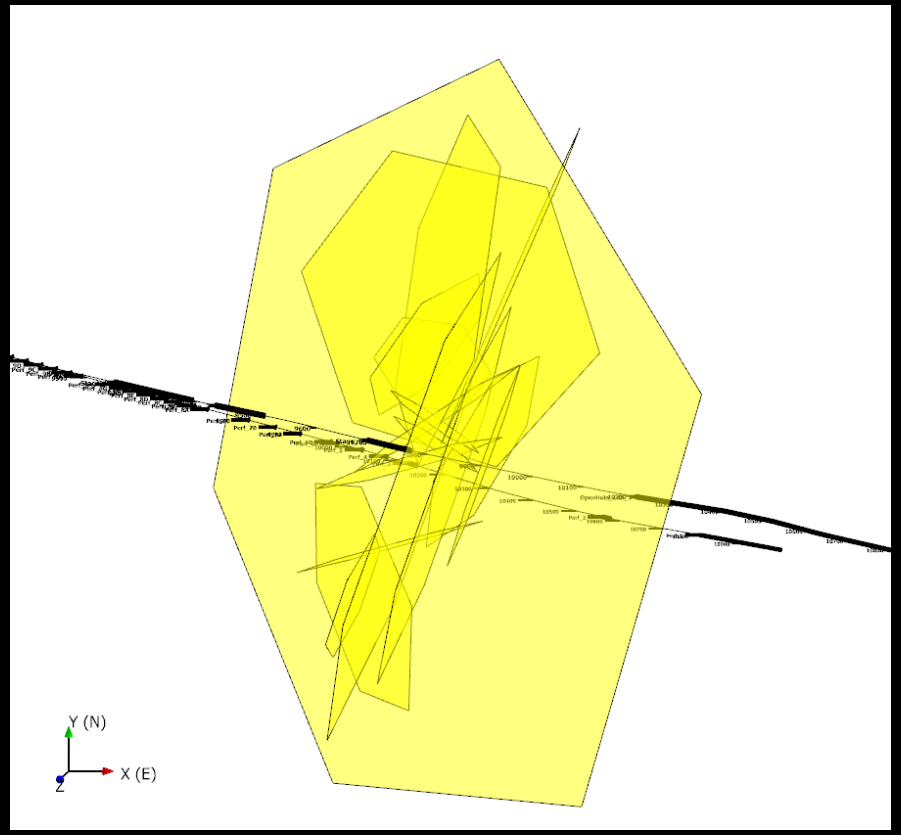
Stage 2 Case A (0 fractures – already good connection from Stage 1 Case A fractures)

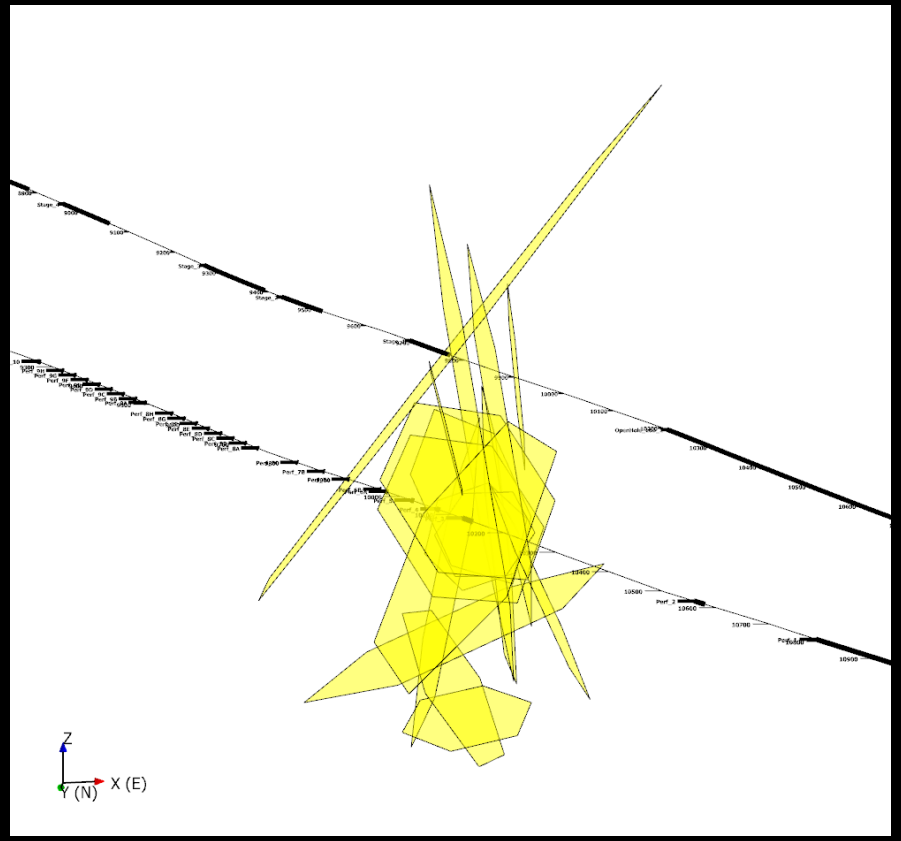


Stage 2 Case B (7 fractures)

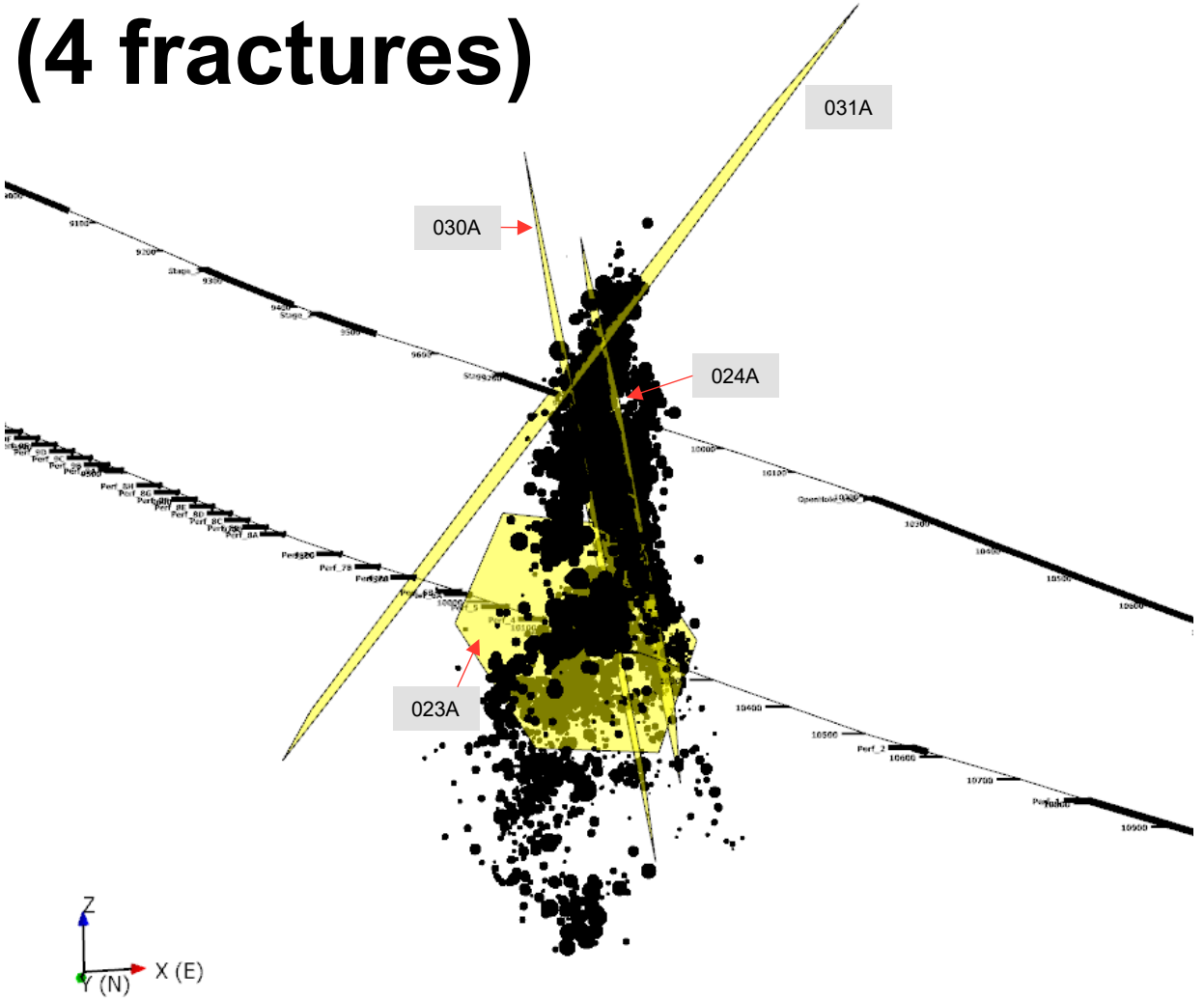


Stage 3 (17 fractures Cases A and B)

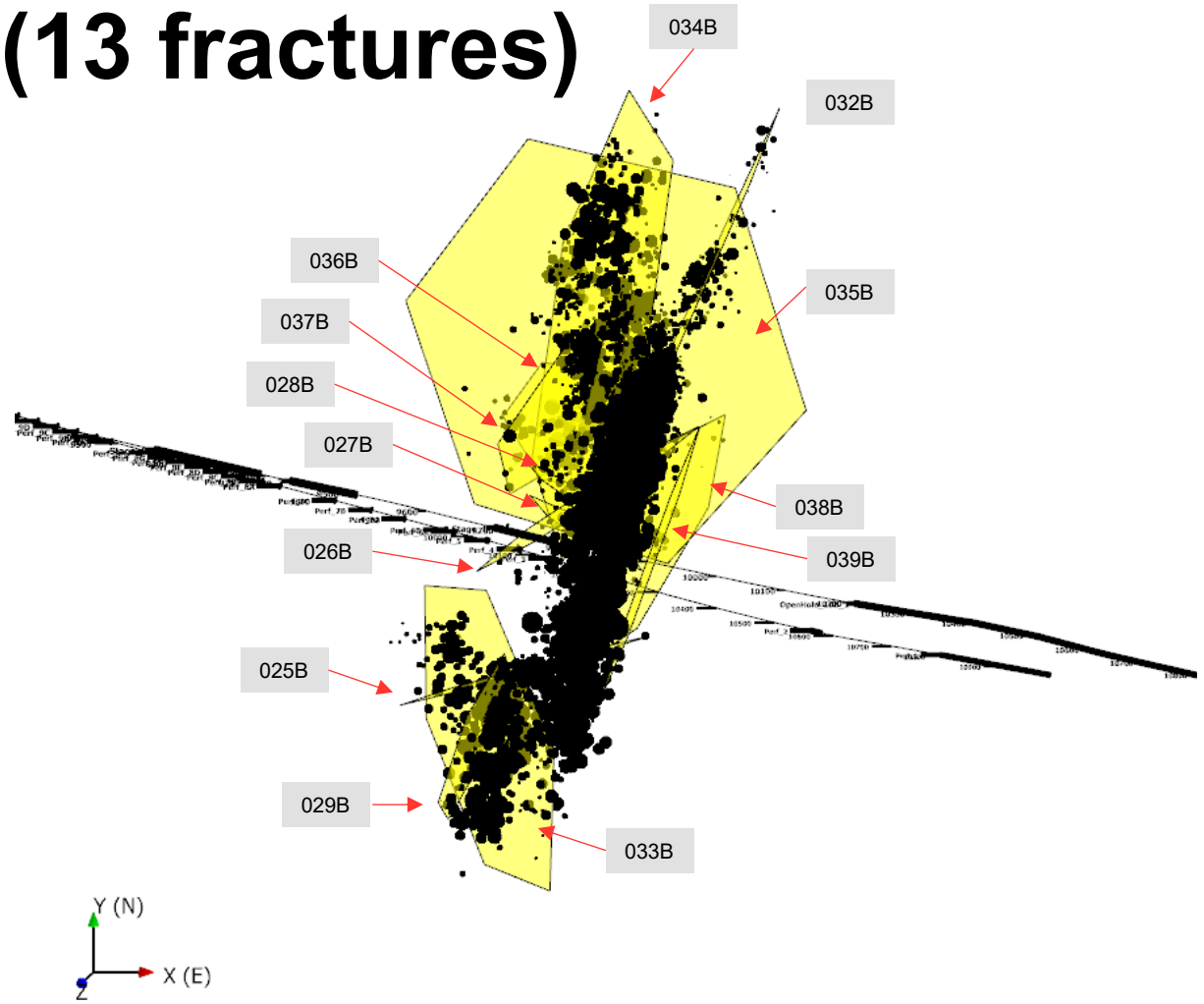




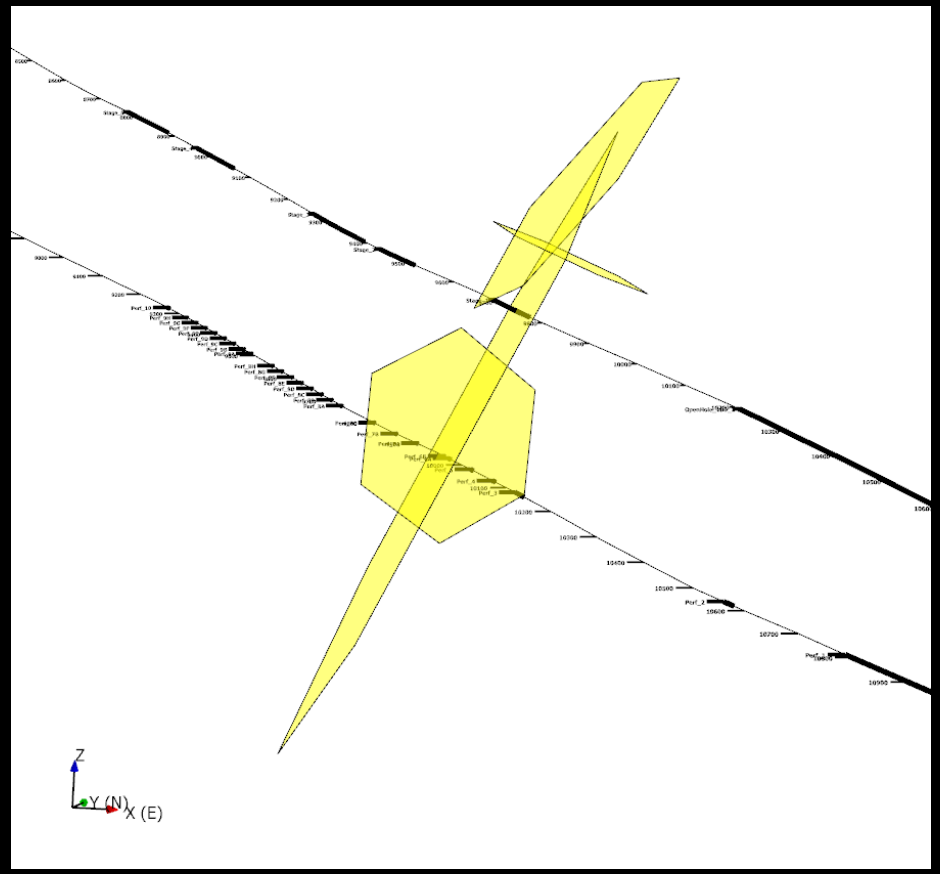
Stage 3 Case A (4 fractures)



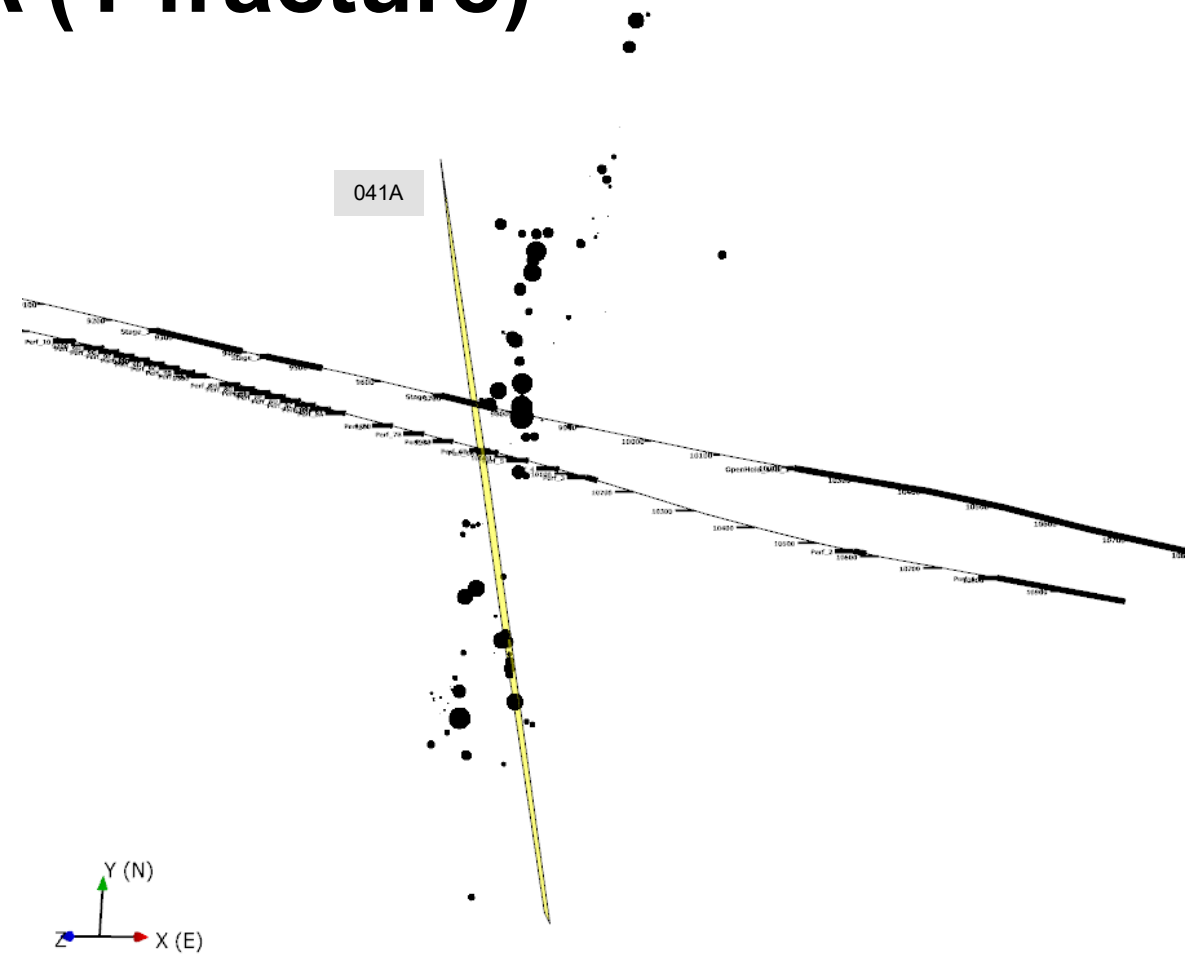
Stage 3 Case B (13 fractures)



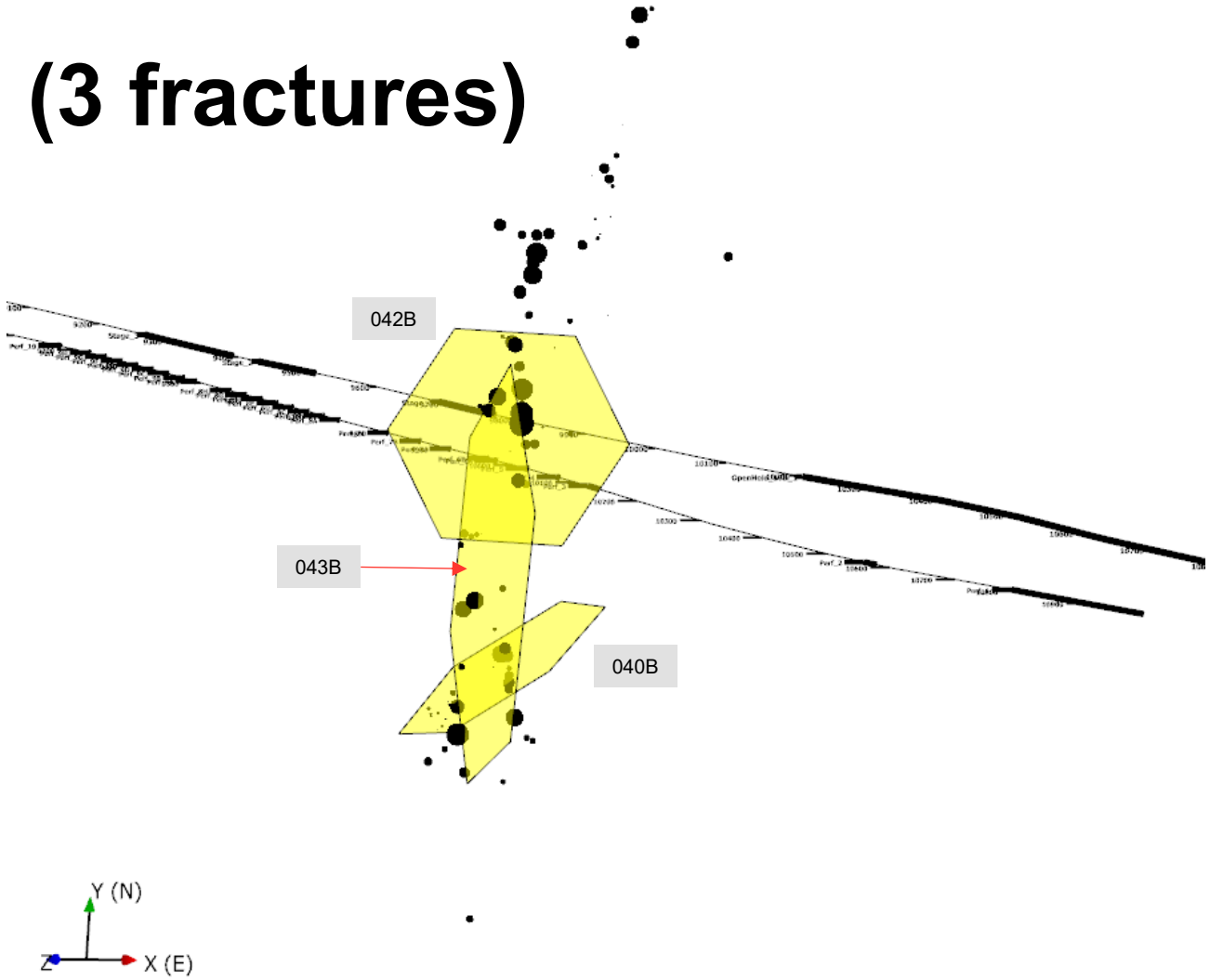
Stage 3R (4 fractures Cases A and B)



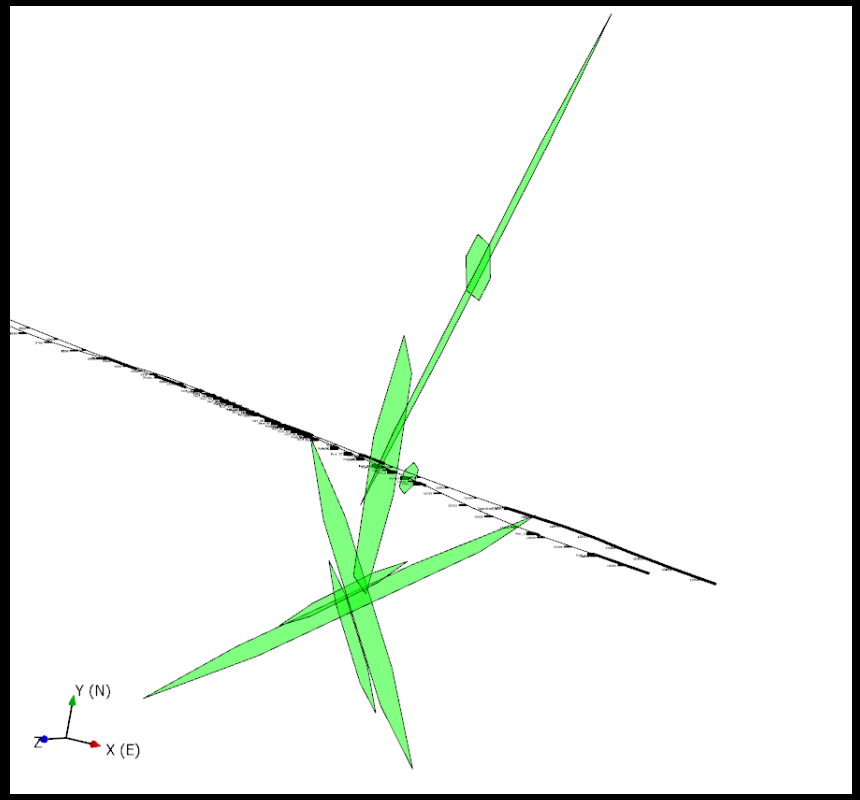
Stage 3R Case A (1 fracture)



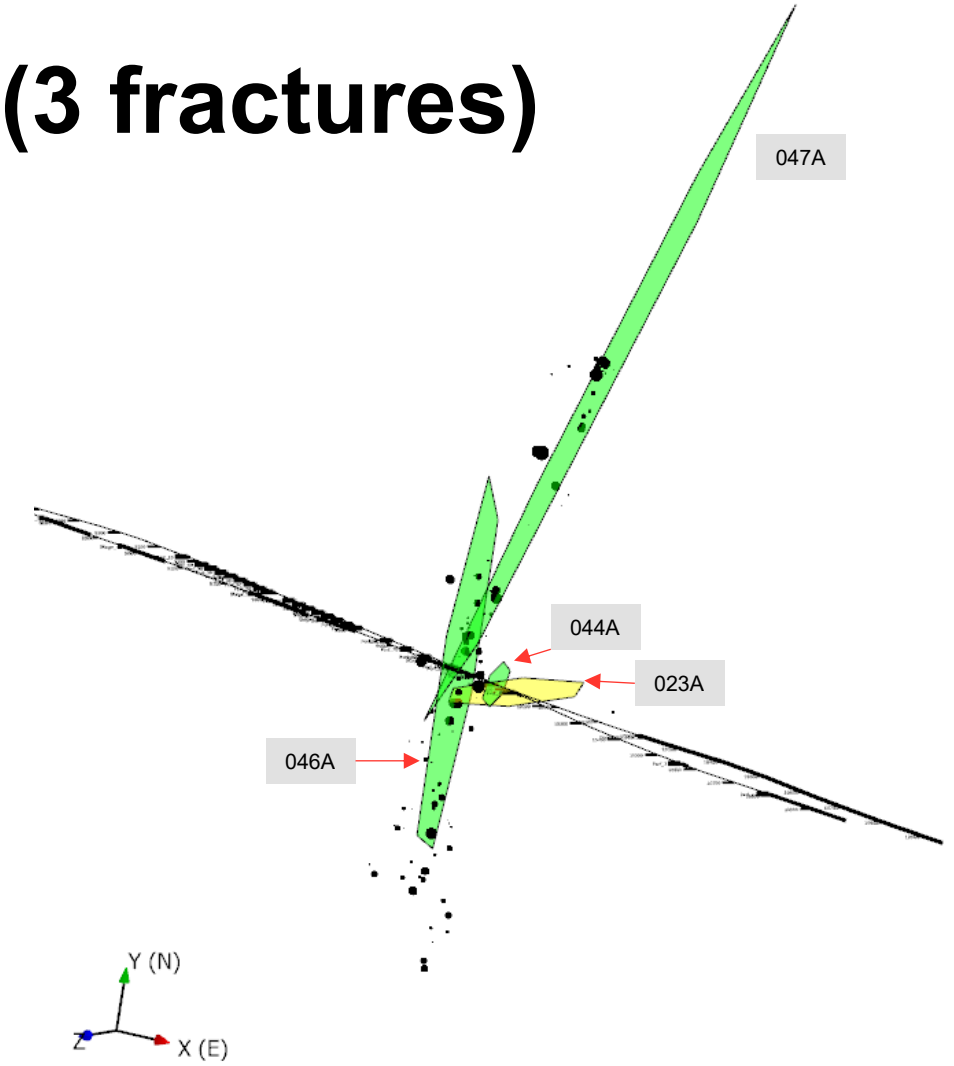
Stage 3R Case B (3 fractures)



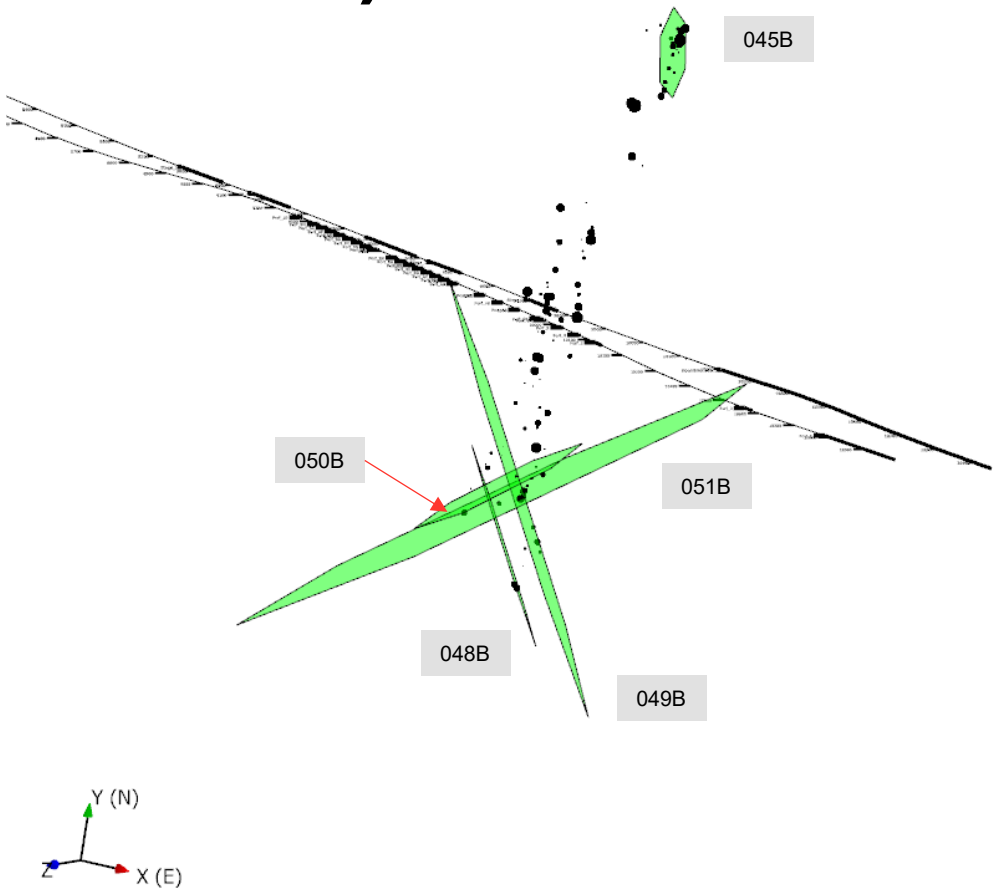
Stage 4 (8 fractures Cases A and B)



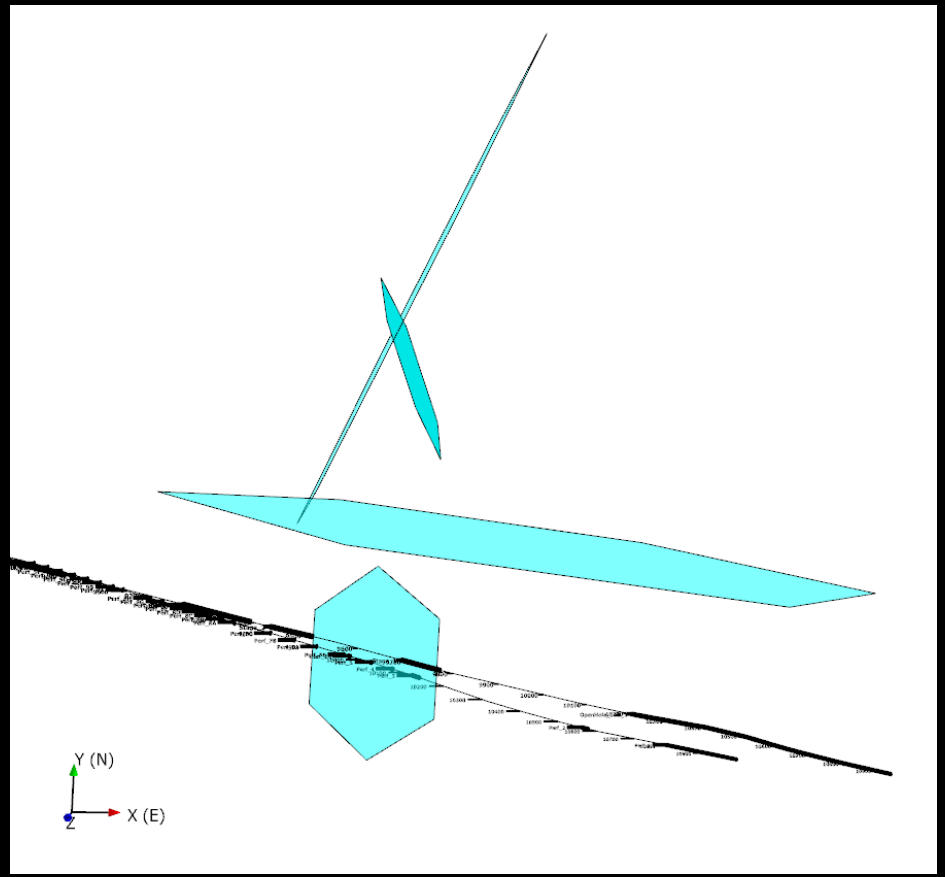
Stage 4 Case A (3 fractures)



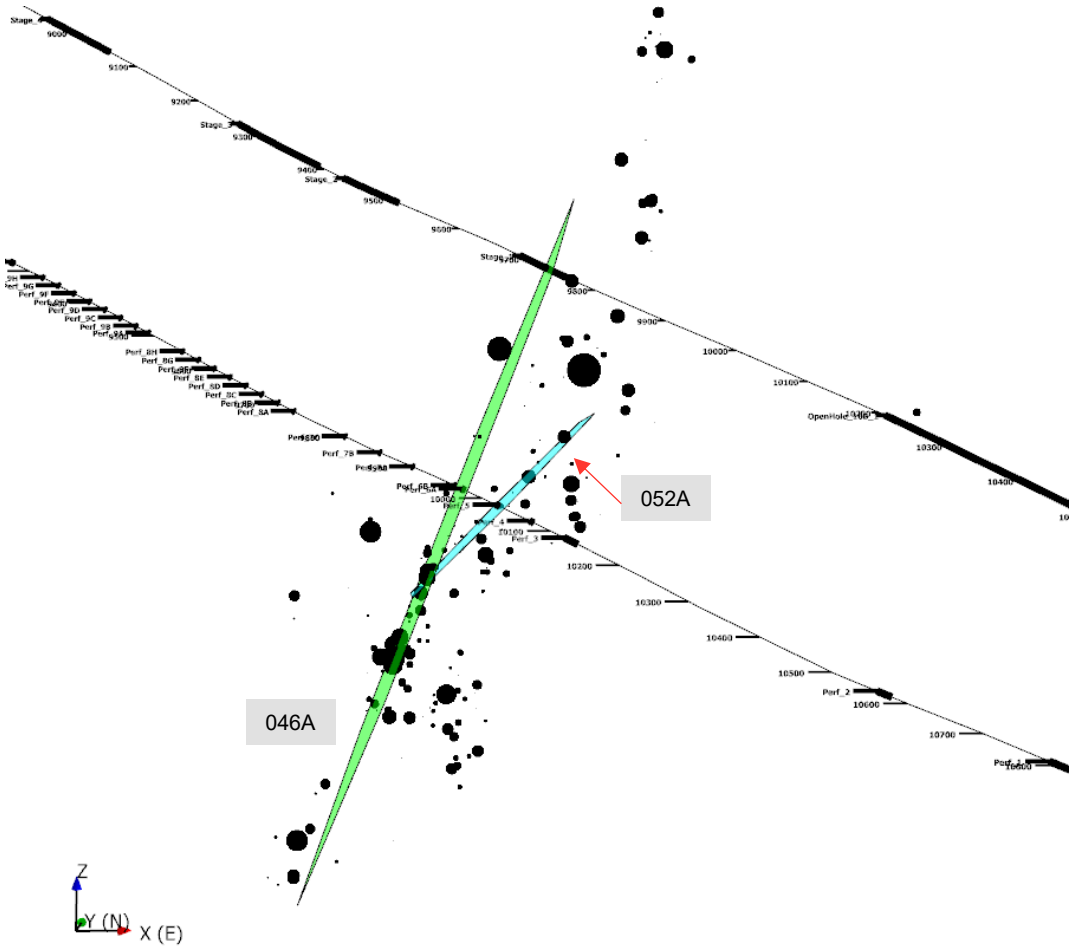
Stage 4 Case B (5 fractures)



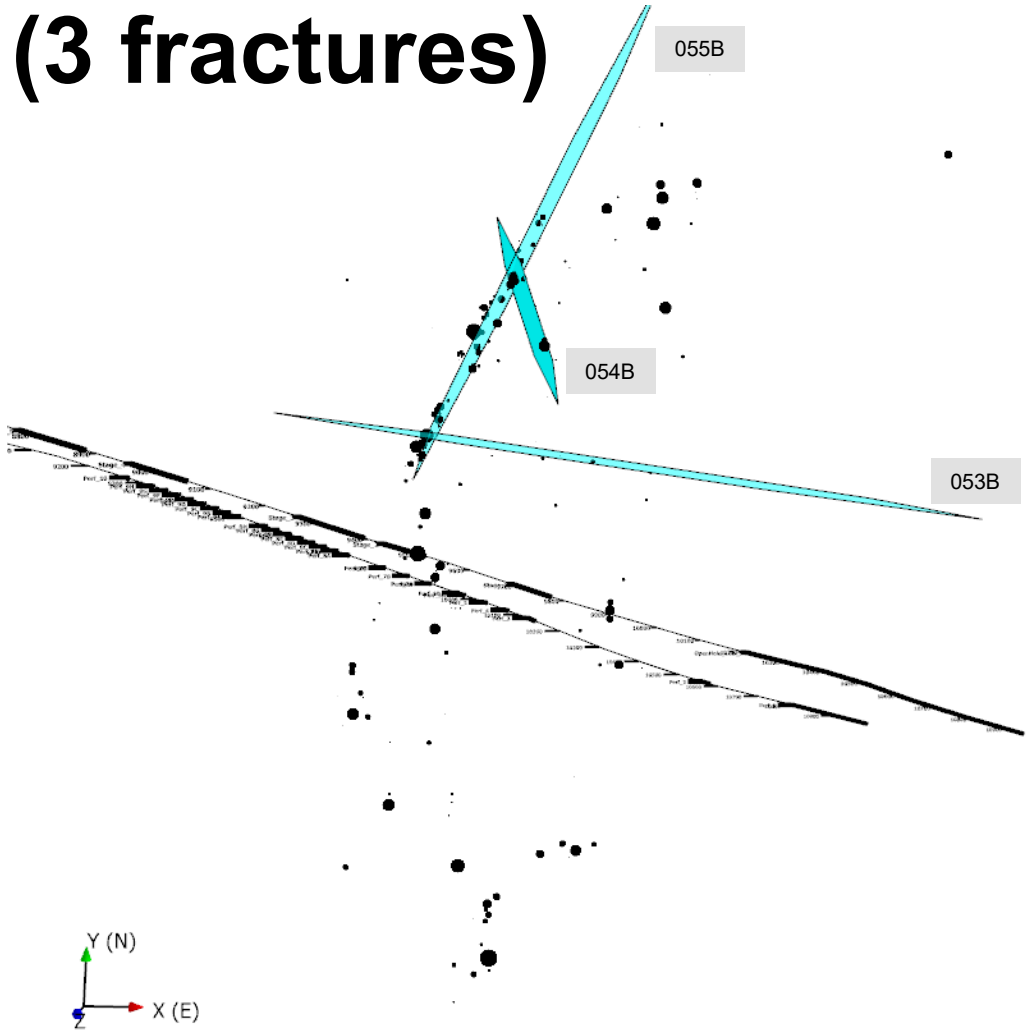
Stage 5 (4 fractures Cases A and B)



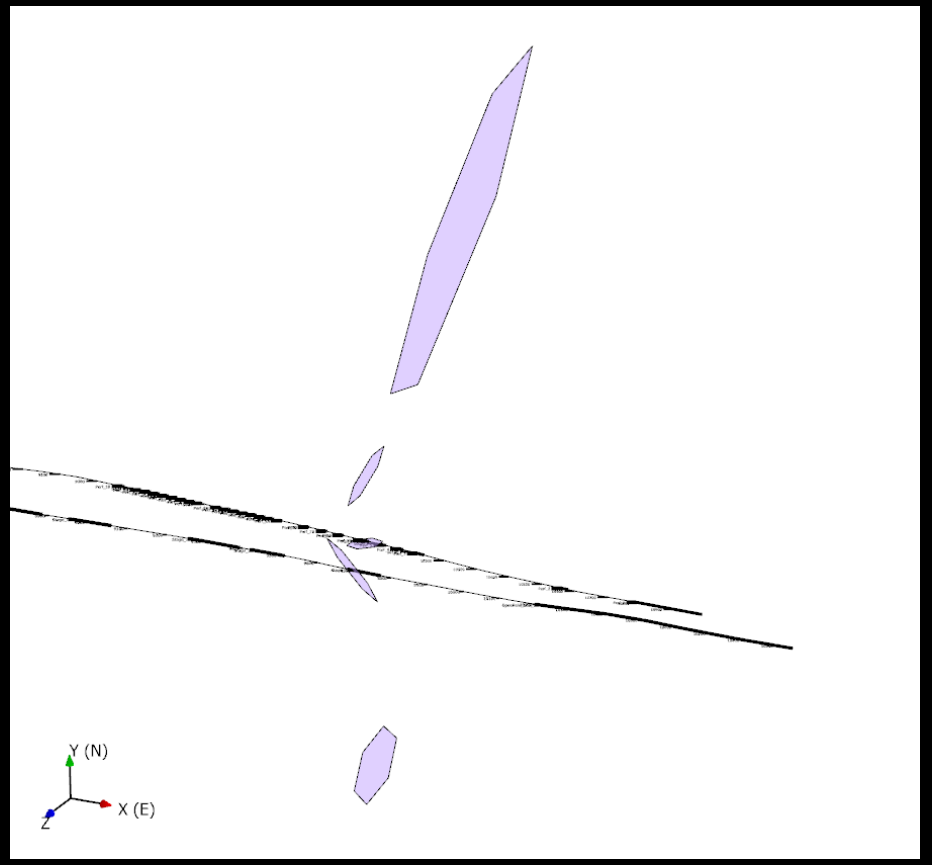
Stage 5 Case A (1 fracture)



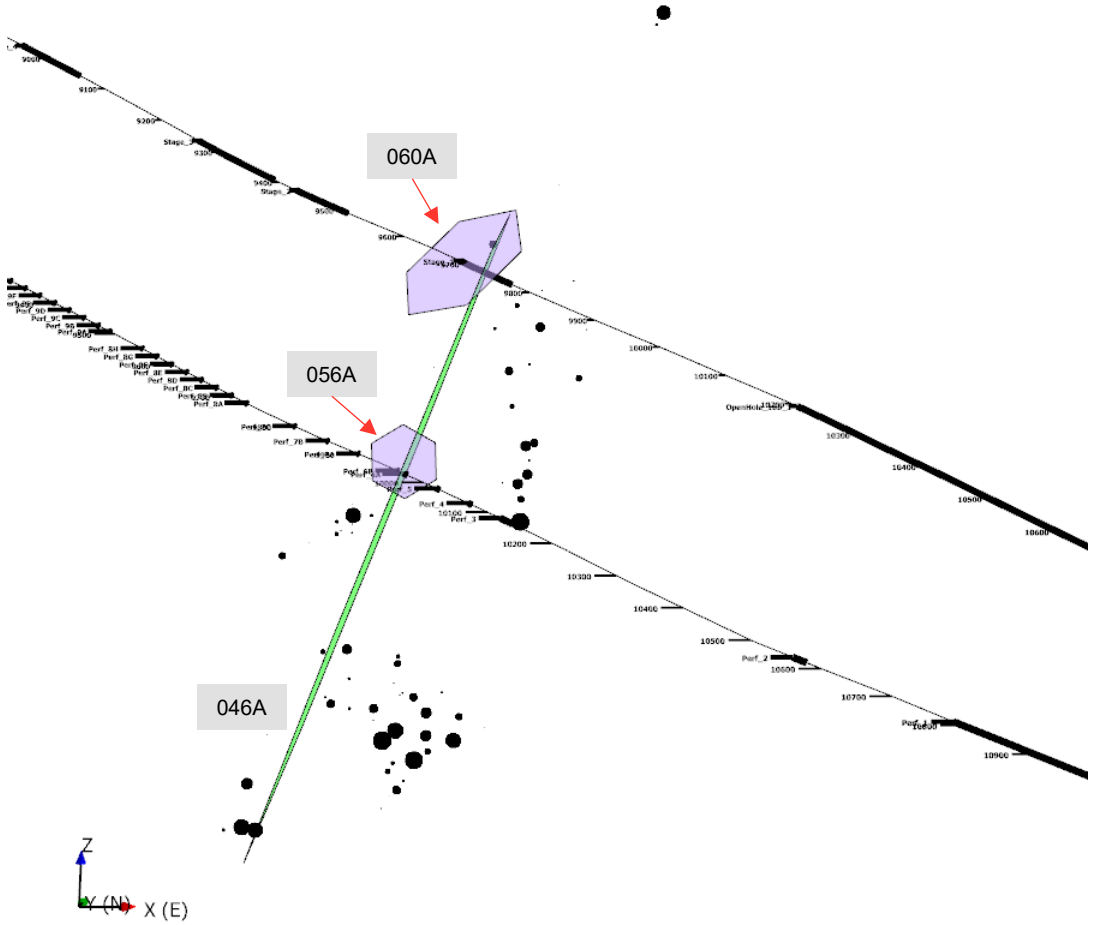
Stage 5 Case B (3 fractures)



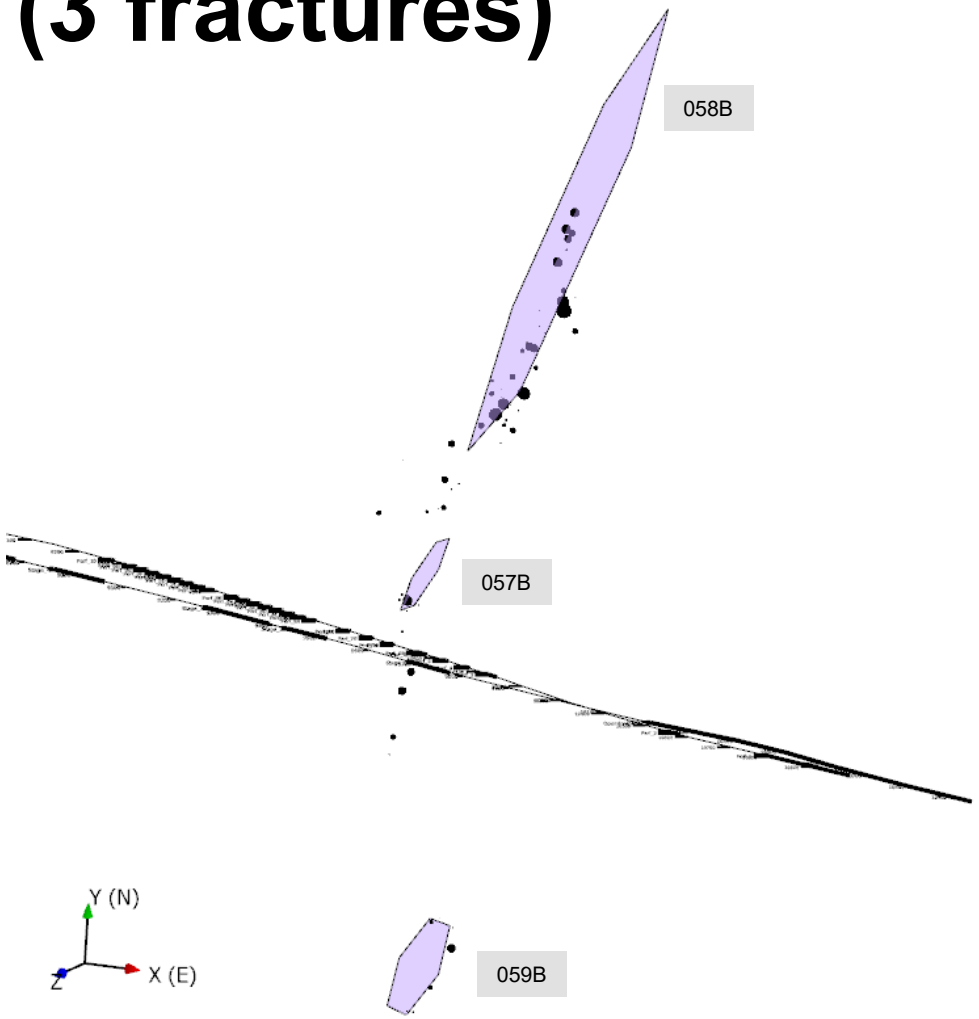
Stage 6A (5 fractures Cases A and B)



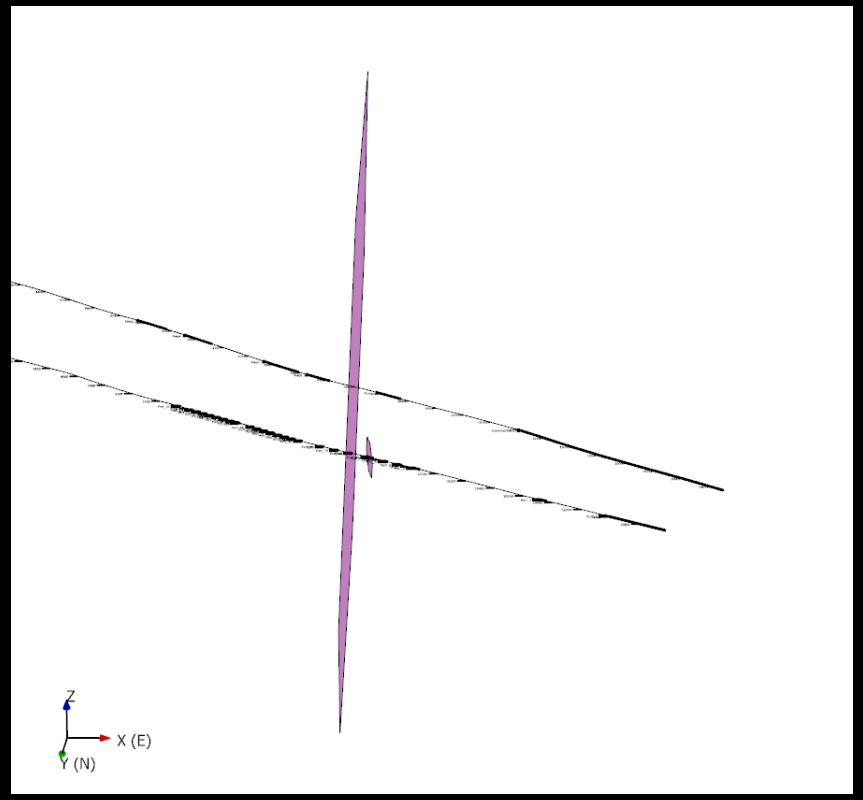
Stage 6A Case A (2 fractures)



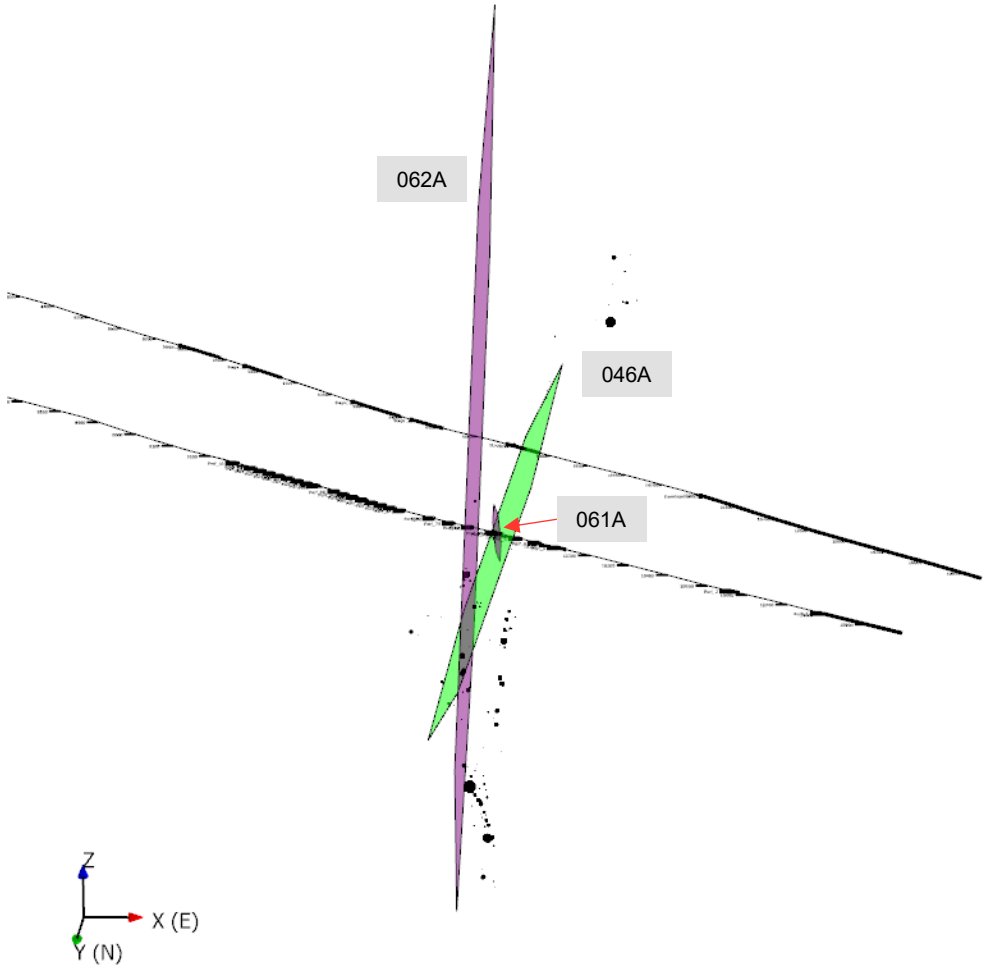
Stage 6A Case B (3 fractures)



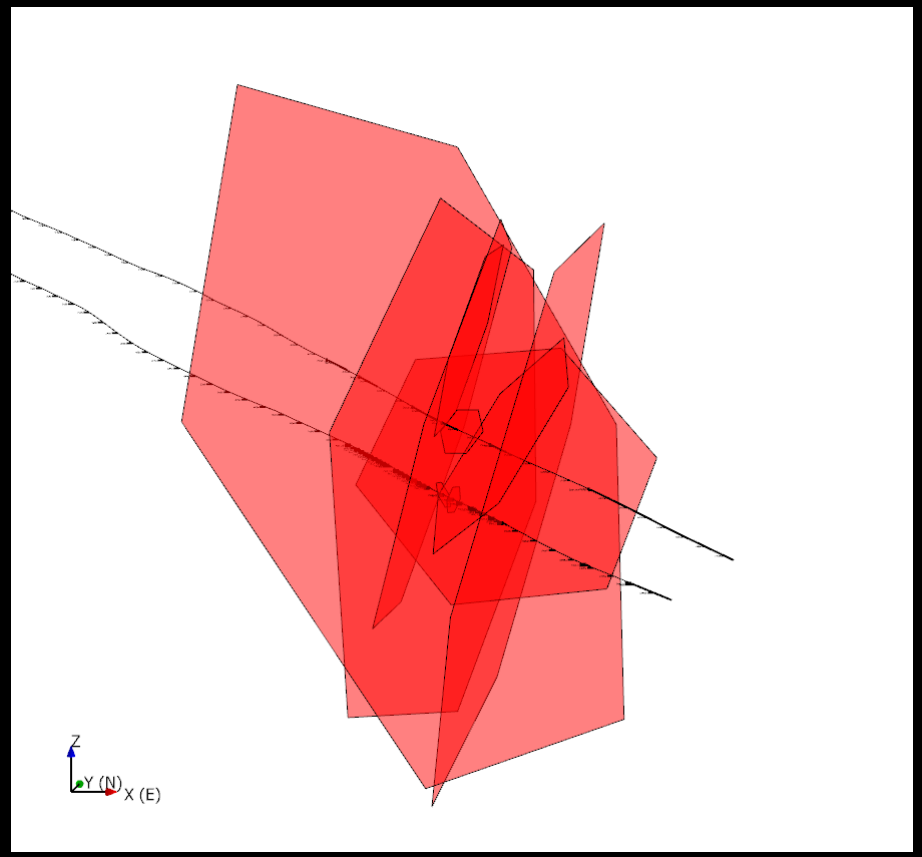
Stage 6B (2 fractures Case A)



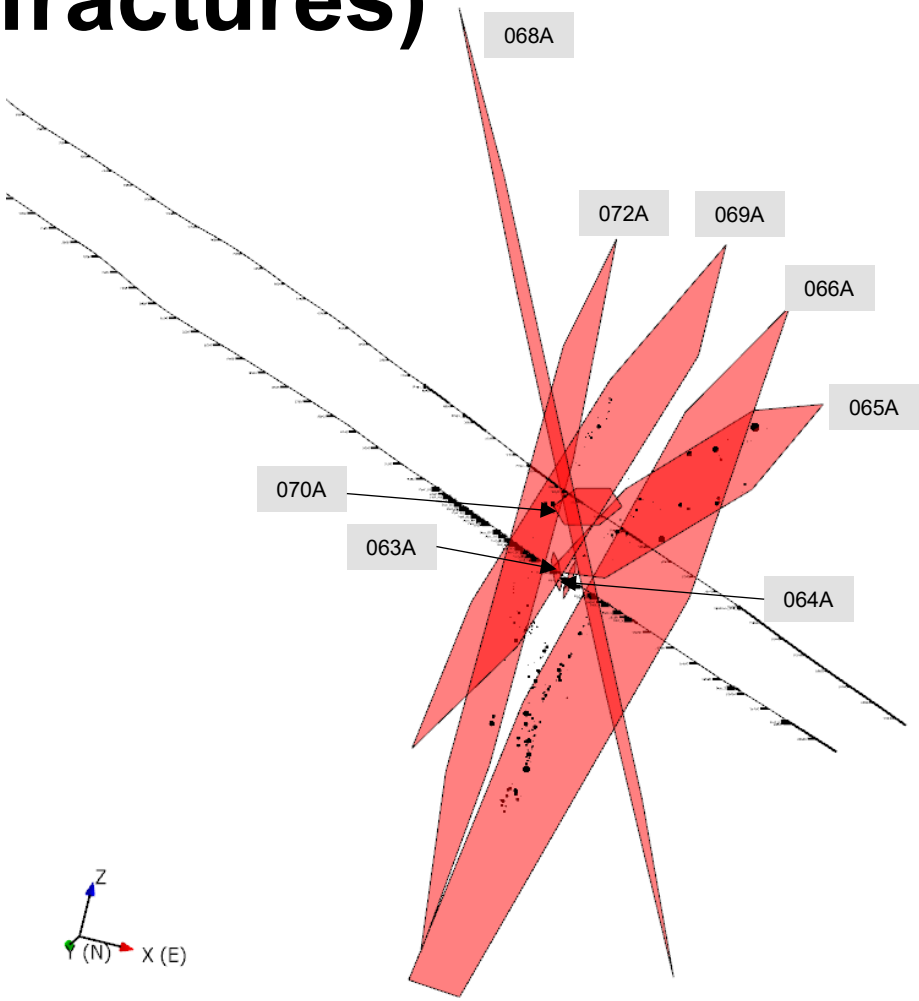
Stage 6B Case A (2 fractures)



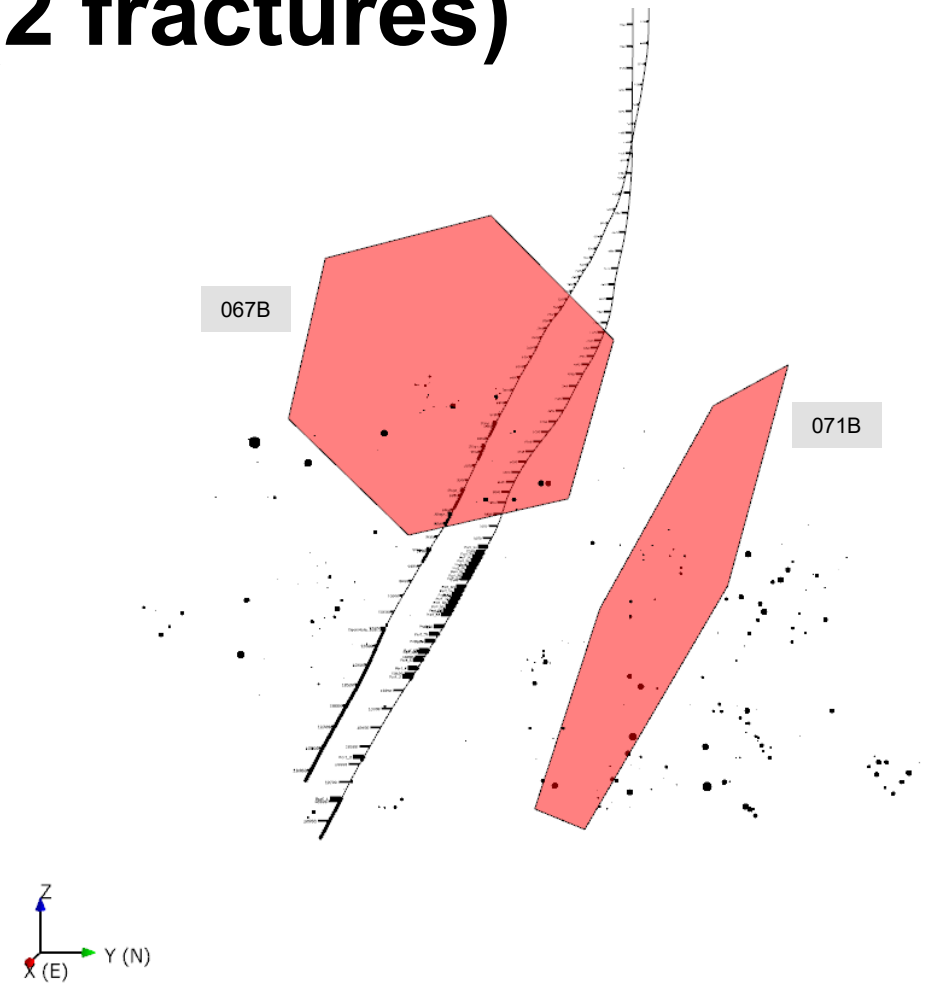
Stage 7 (10 fractures Cases A and B)



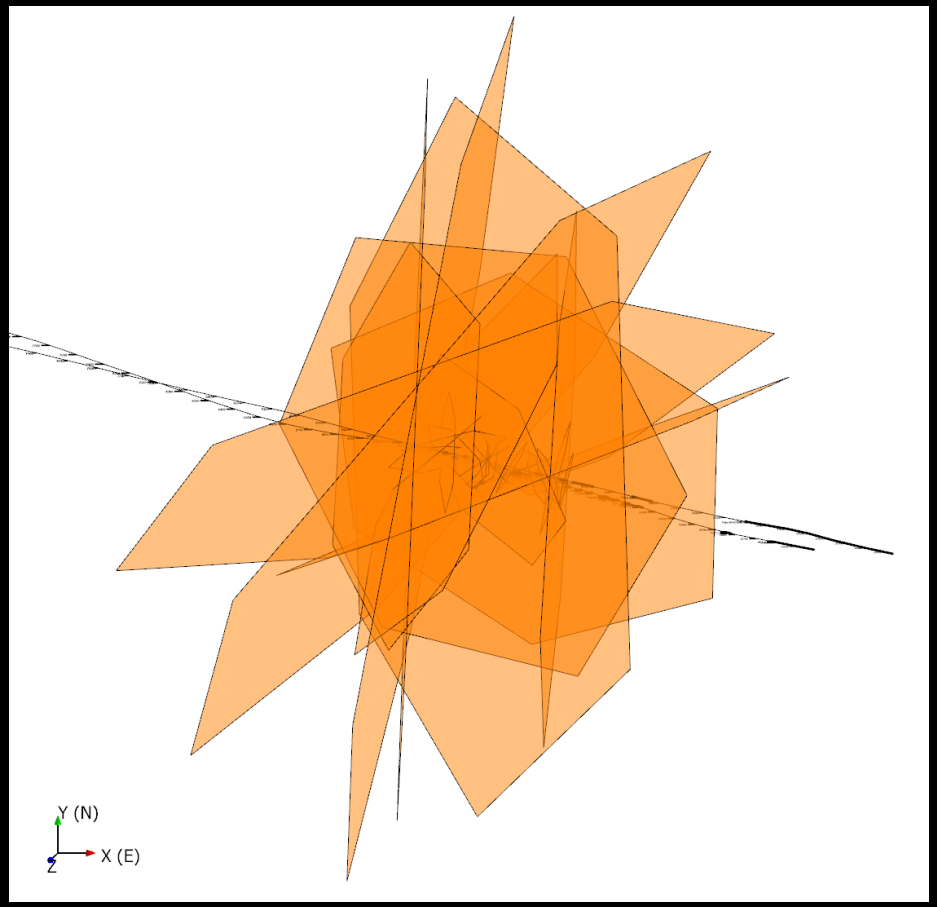
Stage 7 Case A (8 fractures)



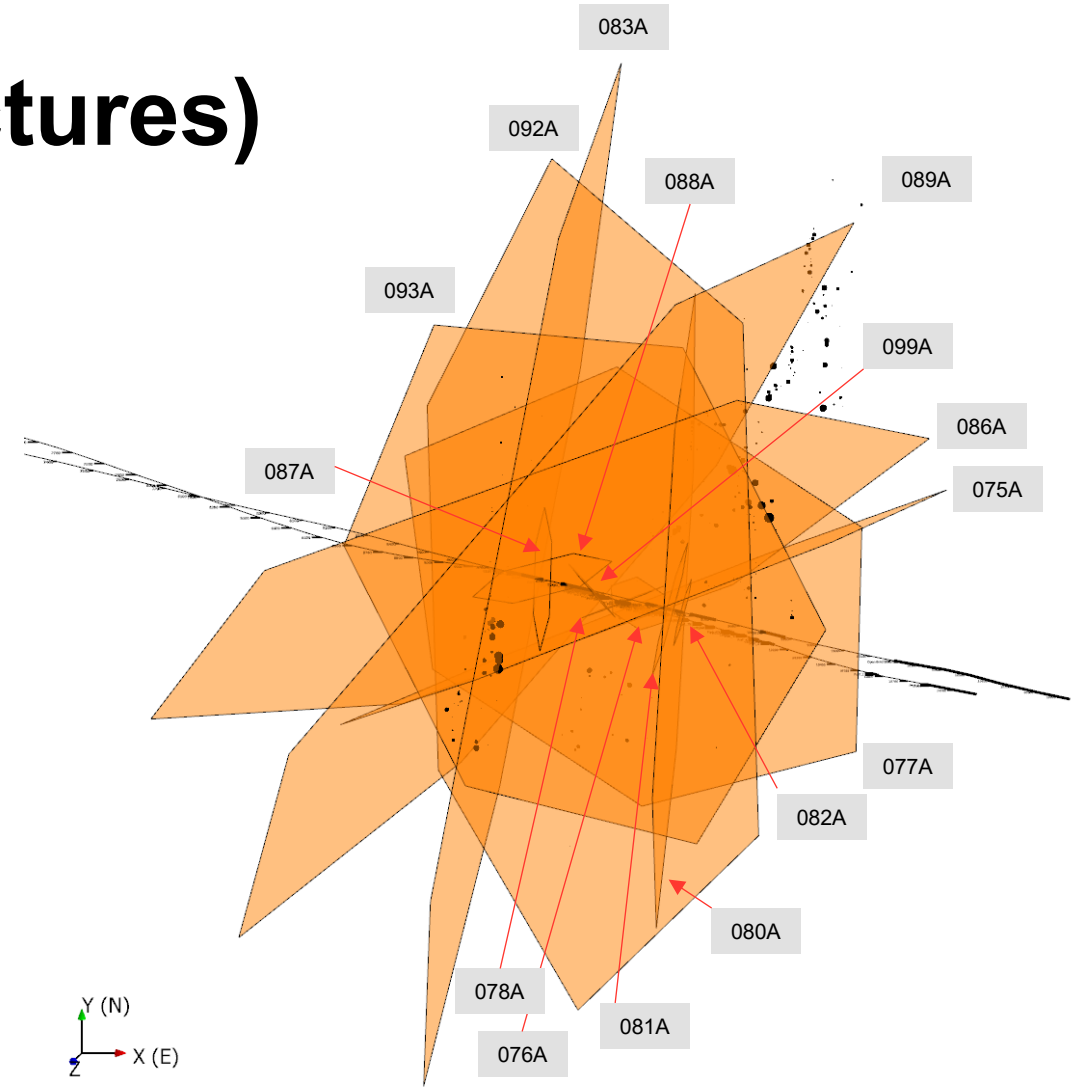
Stage 7 Case B (2 fractures)



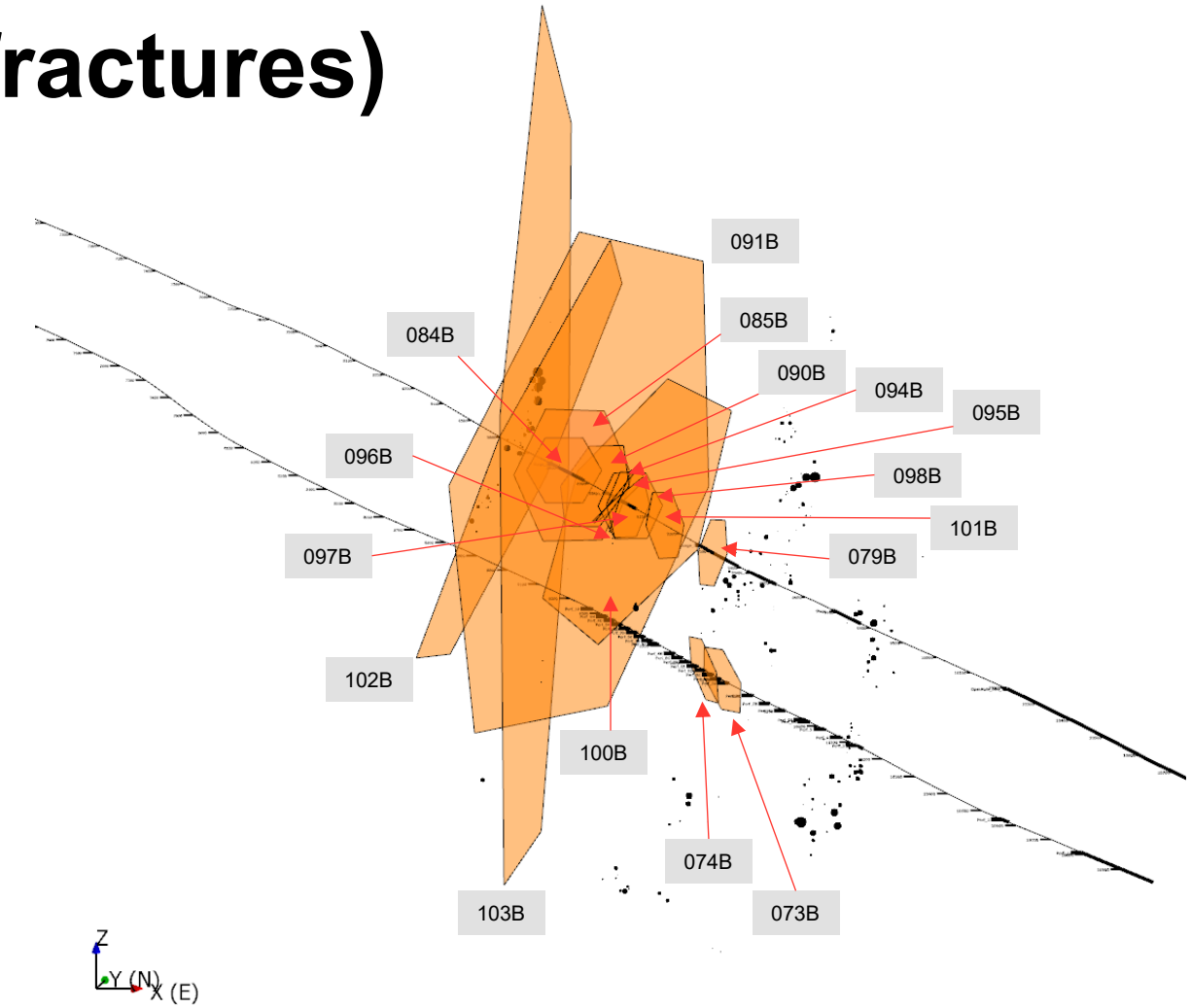
Stage 8 (31 fractures Cases A and B)



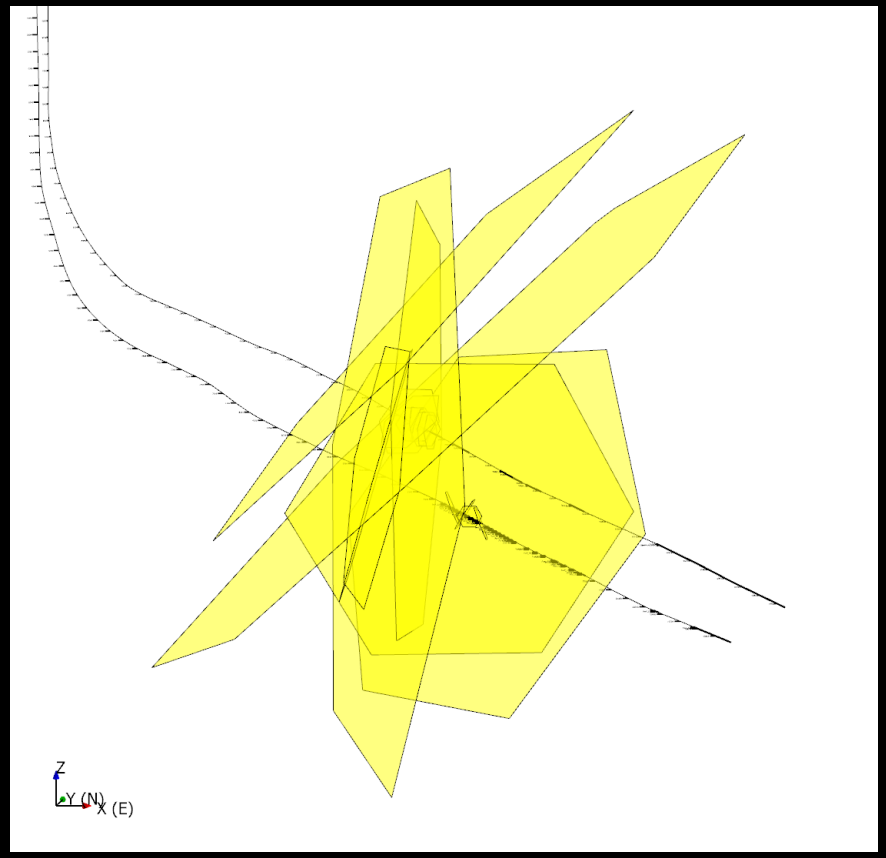
Stage 8 Case A (15 fractures)



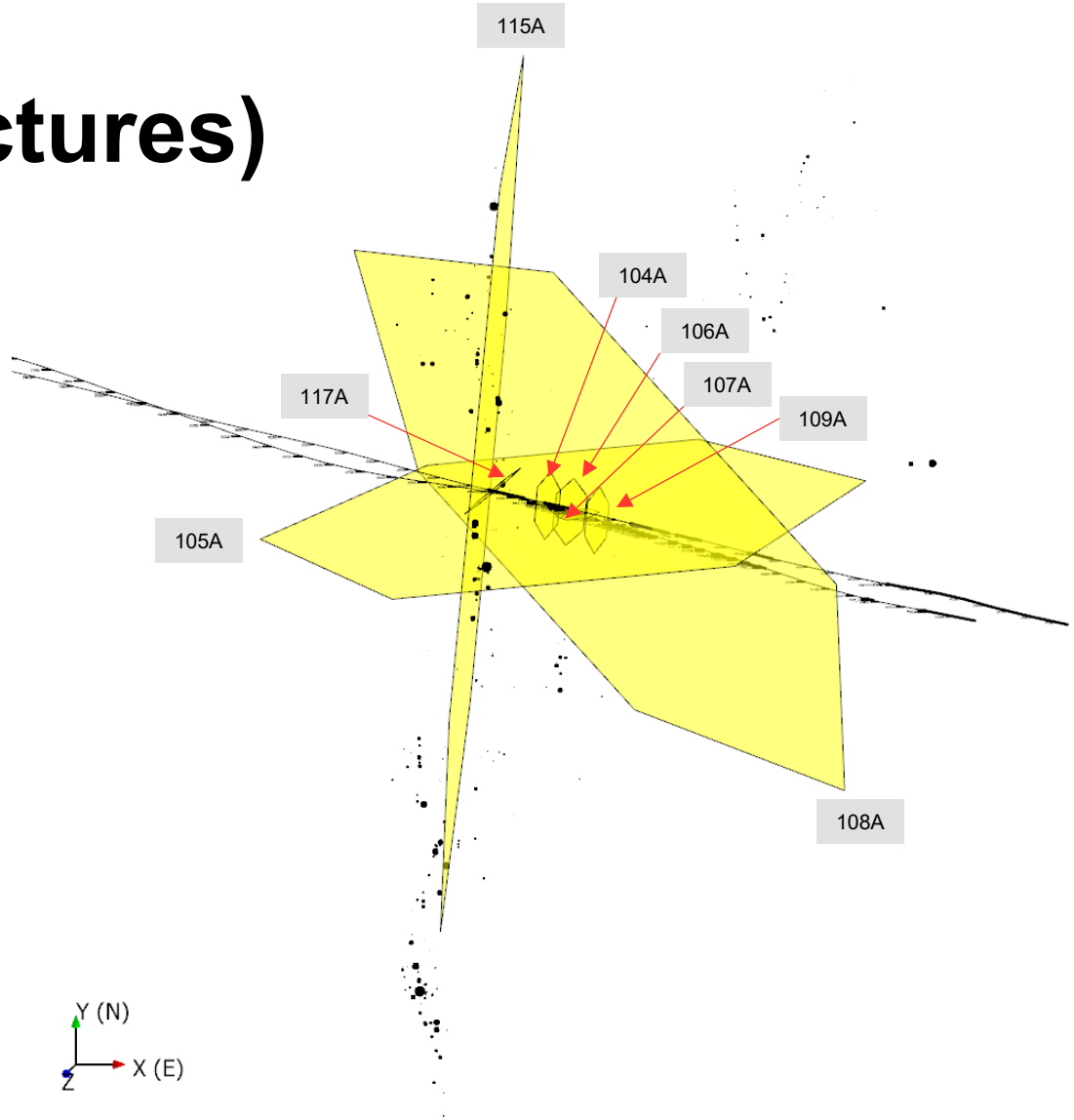
Stage 8 Case B (16 fractures)



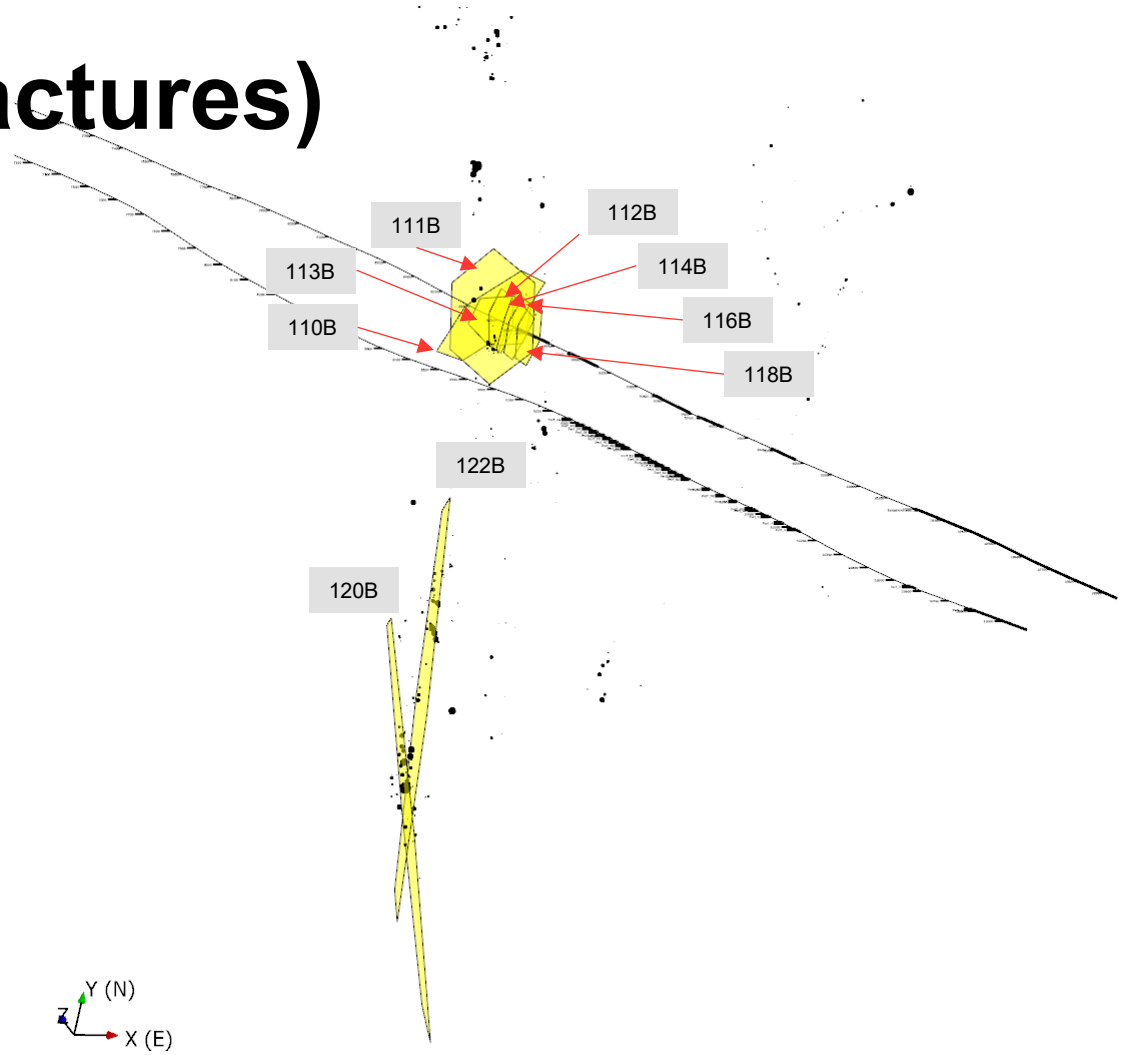
Stage 9 (20 fractures Cases A, B, and S)



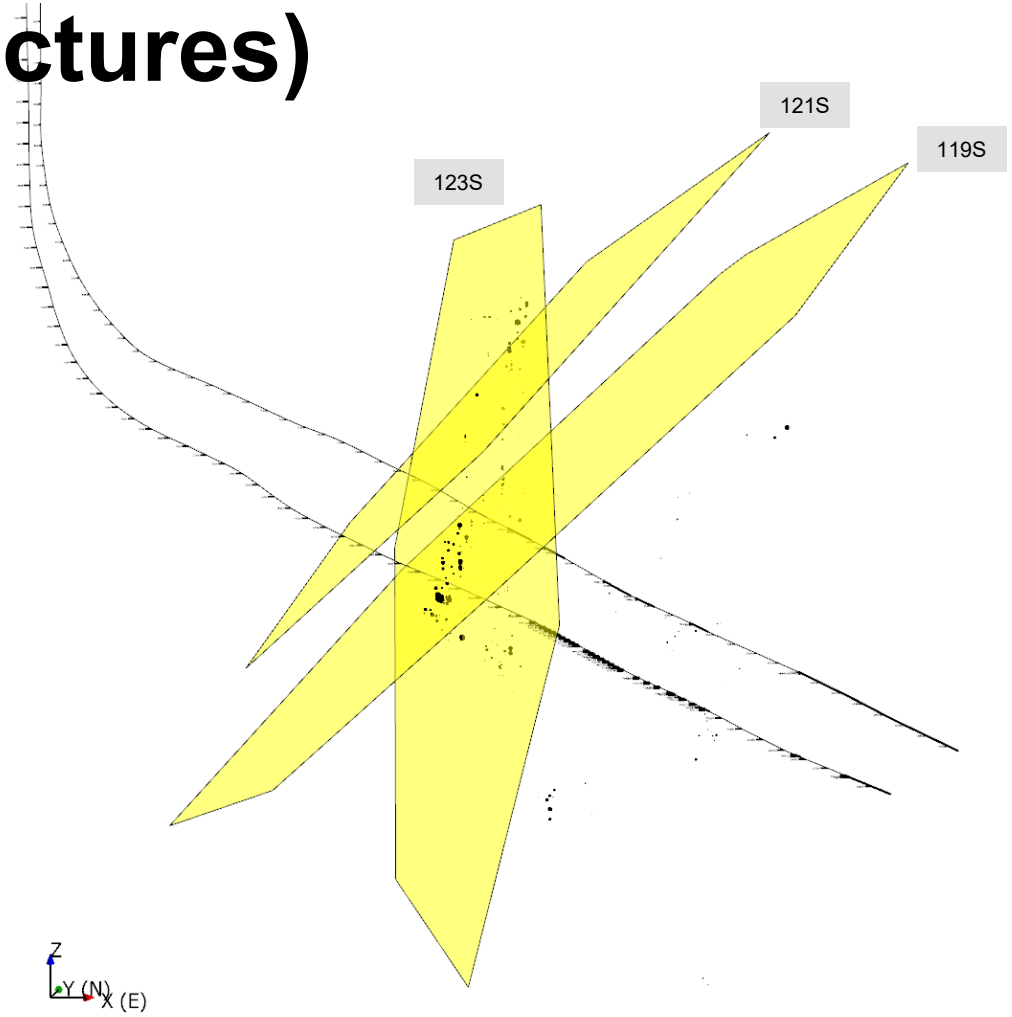
Stage 9 Case A (8 fractures)



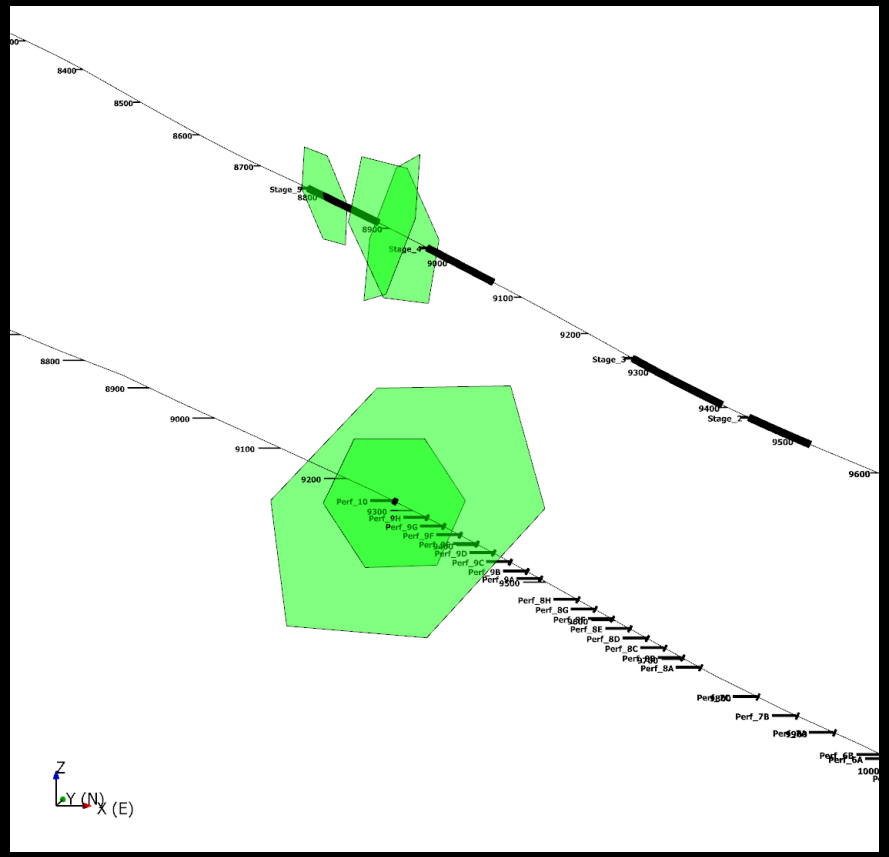
Stage 9 Case B (9 fractures)



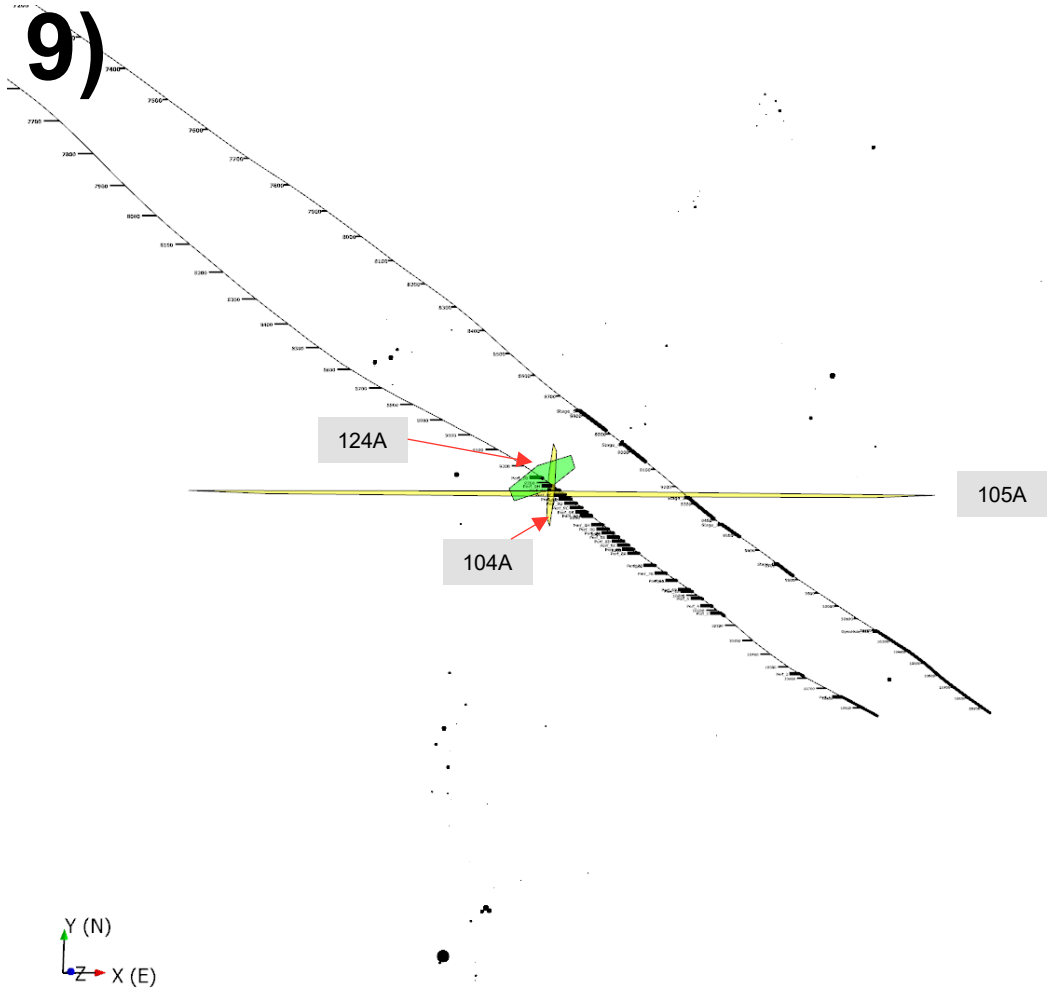
Stage 9 Case S (3 fractures)



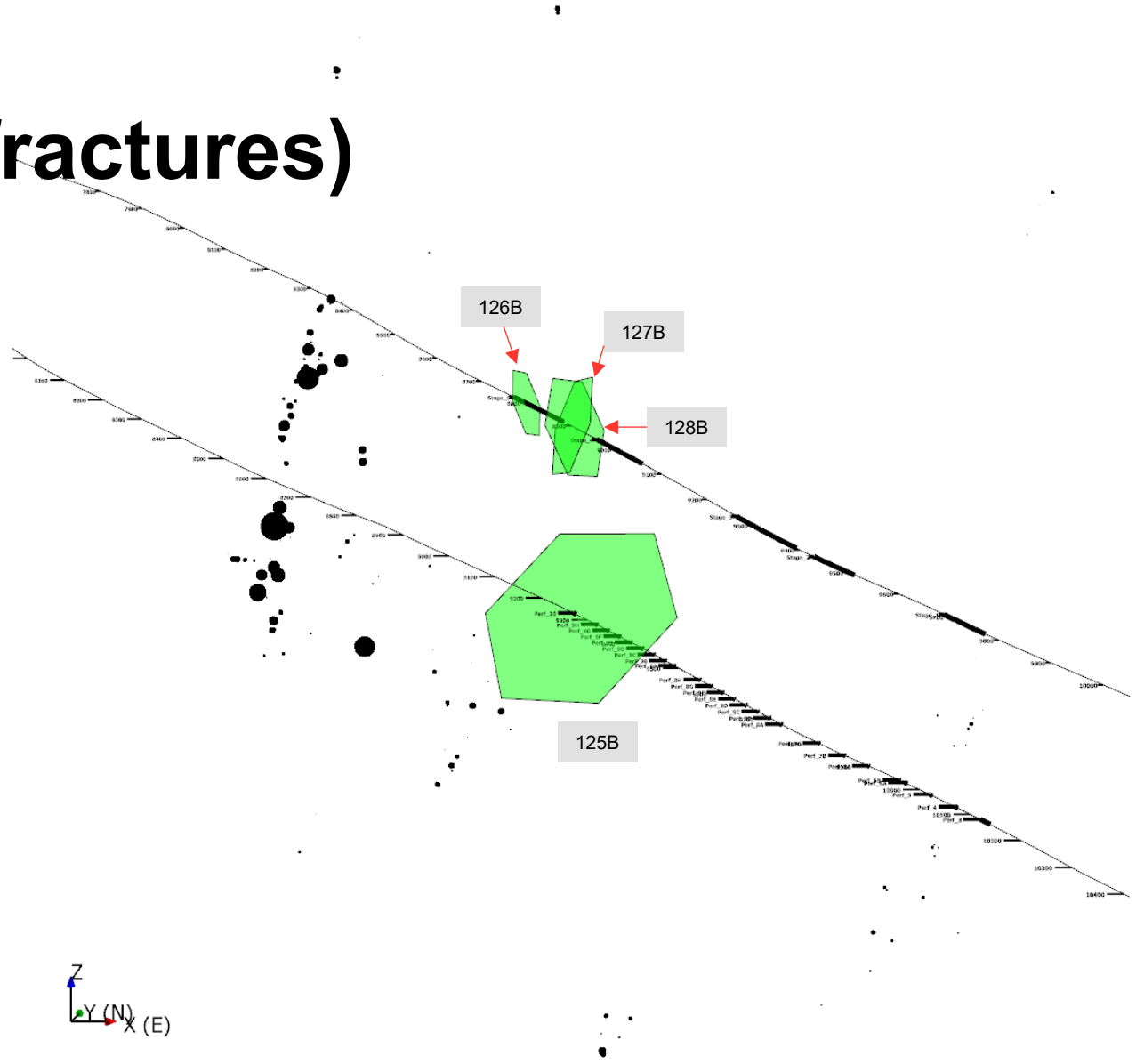
Stage 10 (5 fractures Cases A and B)



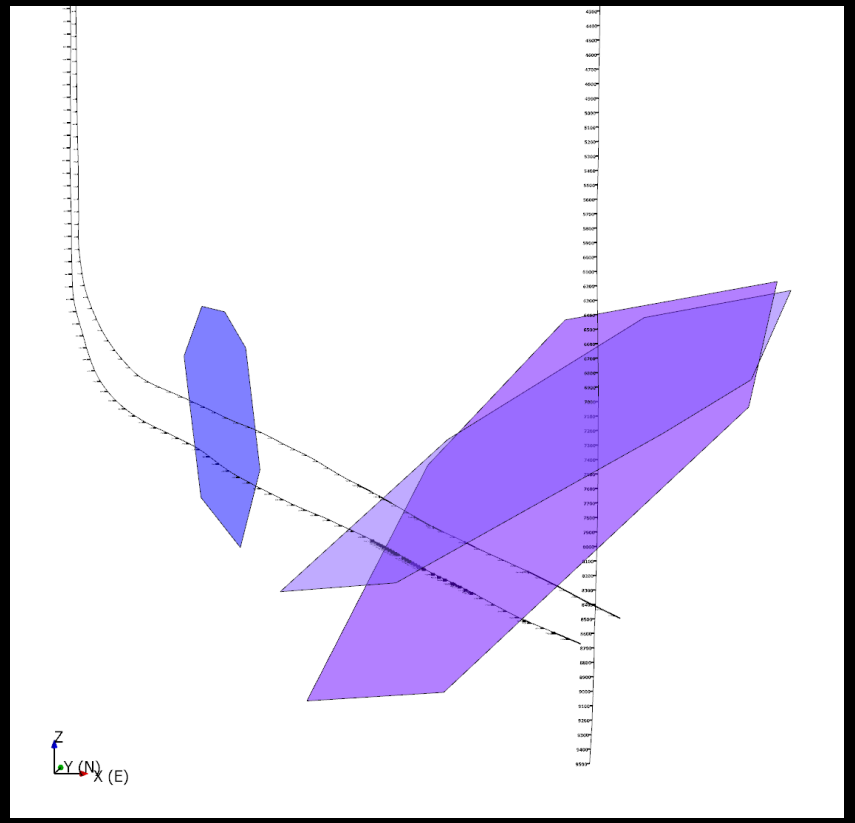
Stage 10 Case A (1 fracture – connects with two fractures in Stage 9)



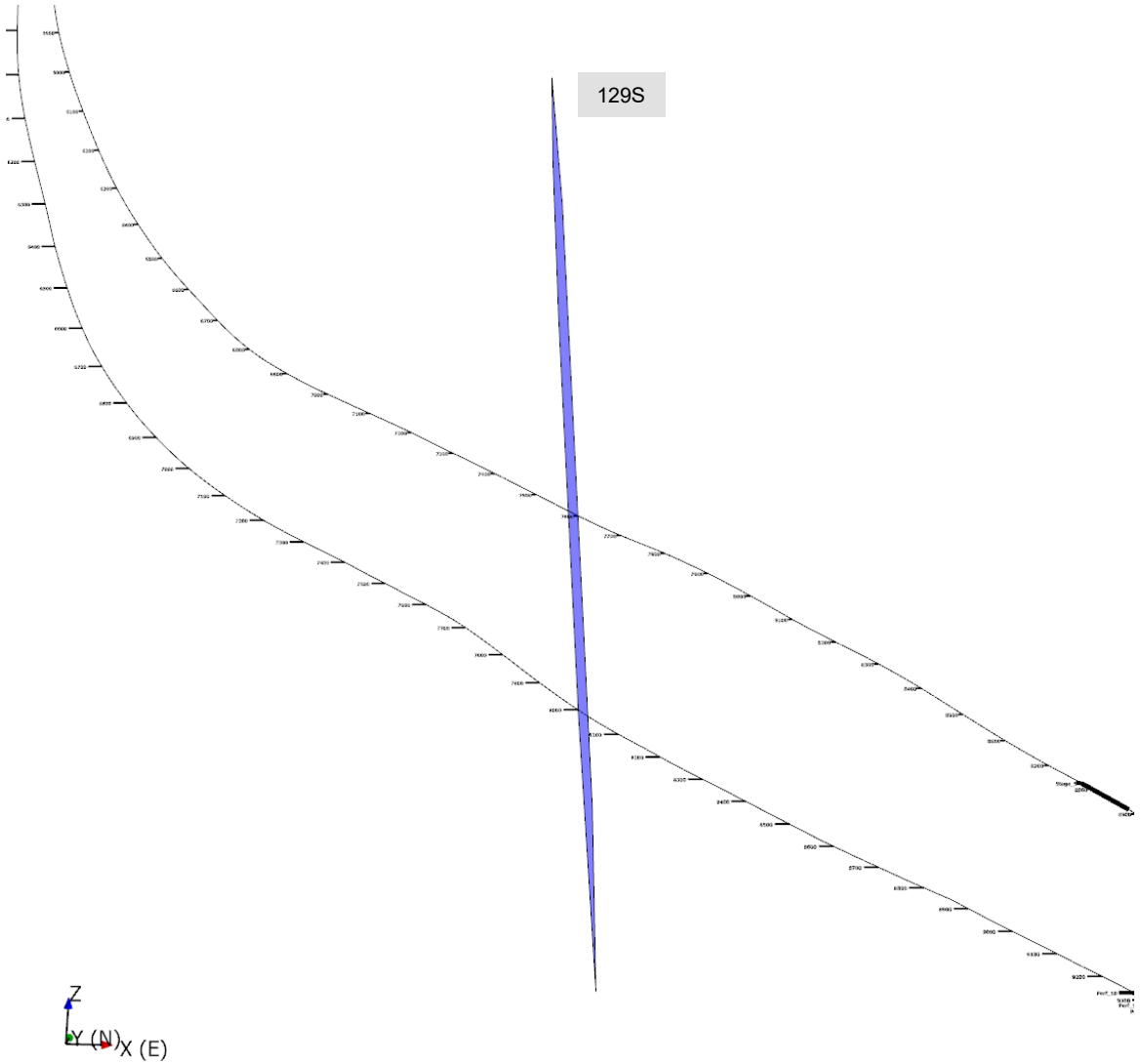
Stage 10 Case B (4 fractures)



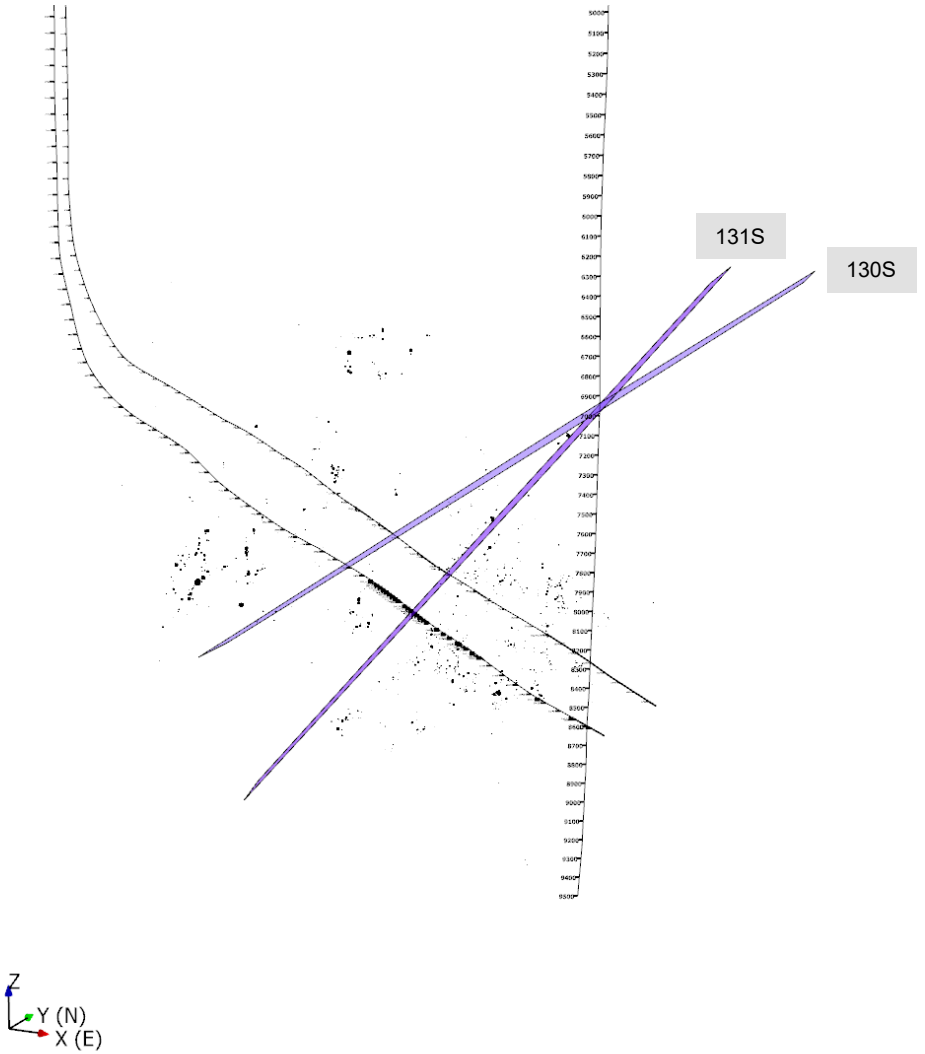
Other Structural Fractures (3 fractures Case S)



F1



78B-32



Acknowledgements

Funding for this work was provided by U.S. Department of Energy under grant DE-EE0007080 “Enhanced Geothermal System Concept Testing and Development at the Milford City, Utah FORGE Site”.