# Examination of subsurface fault architecture from three dimensional seismic data

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## Introduction

Outcrop observations of faults are generally limited spatially and so therefore is the understanding of overall fault architecture and growth that can be gained from them. Seismic data provides a solution to that issue, but resolution based limitations remain(Walsh et al., 2003). Data sets with fine resolution allow for a greater degree of interpretation with clearer insights into fault segmentation and growth; this project employs the Kym dataset from the Timor Sea (Giba et al., 2012; Gartrell et al., 2006). The results of this type of interpretation are of interest to academics who study these systems. Their impacts on subsurface fluid flow is of particular interest to members of various industries, such as the oil and gas industry.

## Methods

- TrapTester6.1 analytical software
- Mapping subset of 3D seismic dataset in a sequence of normal faults.
- Interpret geometry and growth history of structures in three dimensions using a common horizon as a point of reference.

## Aims

- Provide insight into the variation in interpretation of fault architectures based on scale of interpretation and resolution of data.
- Understand the impact of interpretation on subsurface fluid flow.
- Determine growth history of fault sequence and the resulting geometry present in subset of seismic data analyzed.

## Results

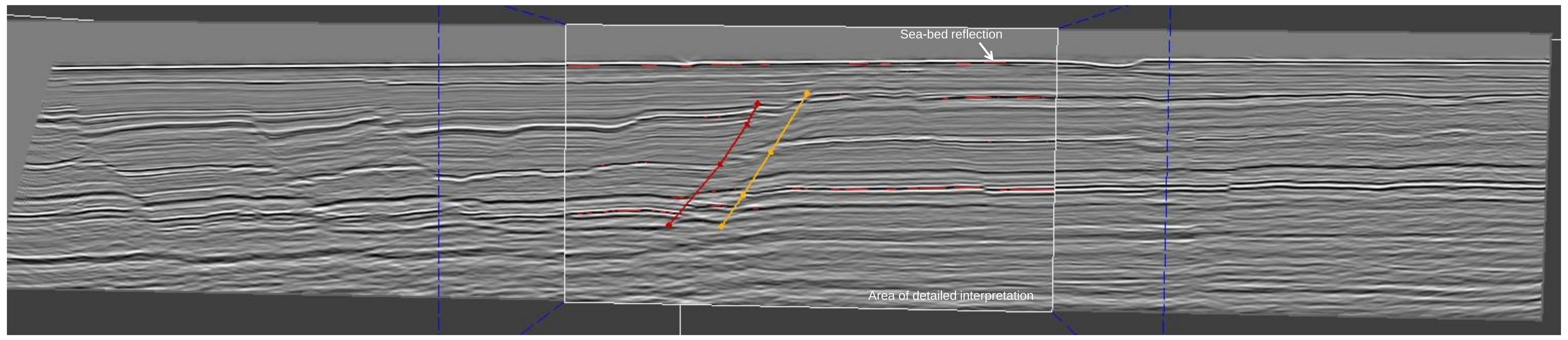



**Figure 1.** Seismic section (10km long by ~ 3 km high) showing the area of detailed interpretation.

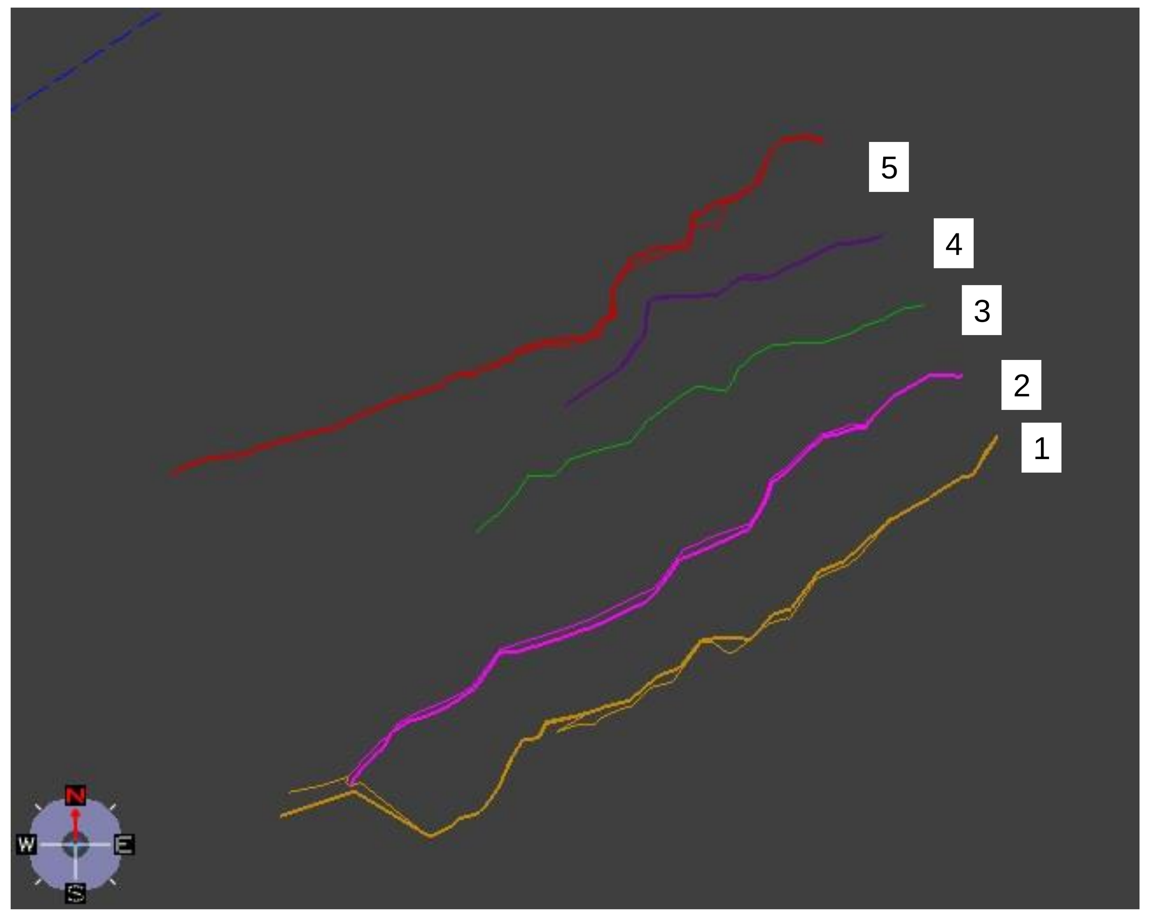



**Figure 2.** Map view of fault traces along the horizon shown in Fig. 3. Faults 1 and 2branch in the southwest portion of the map. The proximity of faults 4 and 5 near their centres suggests a possible linkage below data resolution. Fault colours are the same in all figures. Faults 1 and 2 are ~70 m apart, faults 1 and 5 are ~290 m apart.

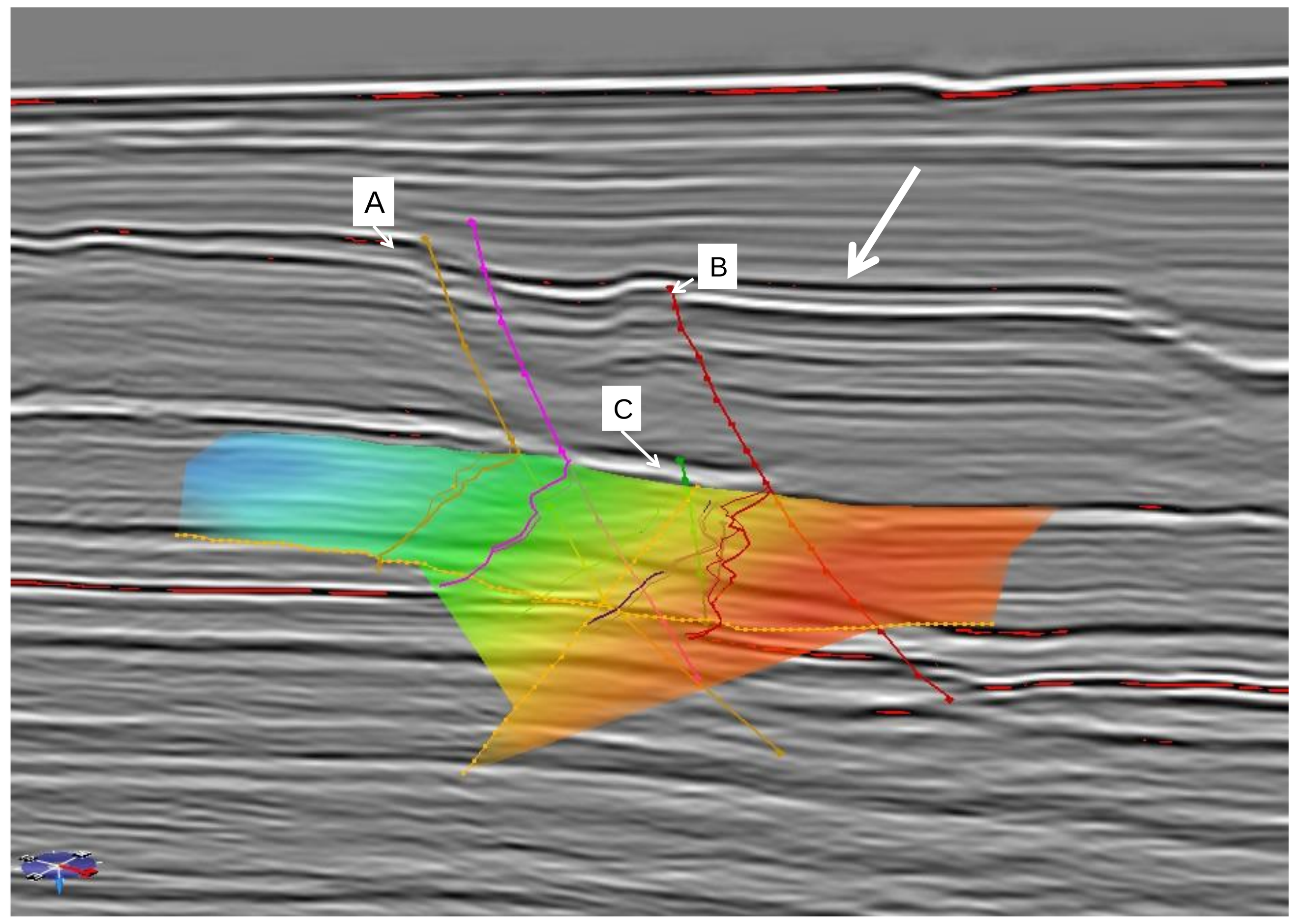
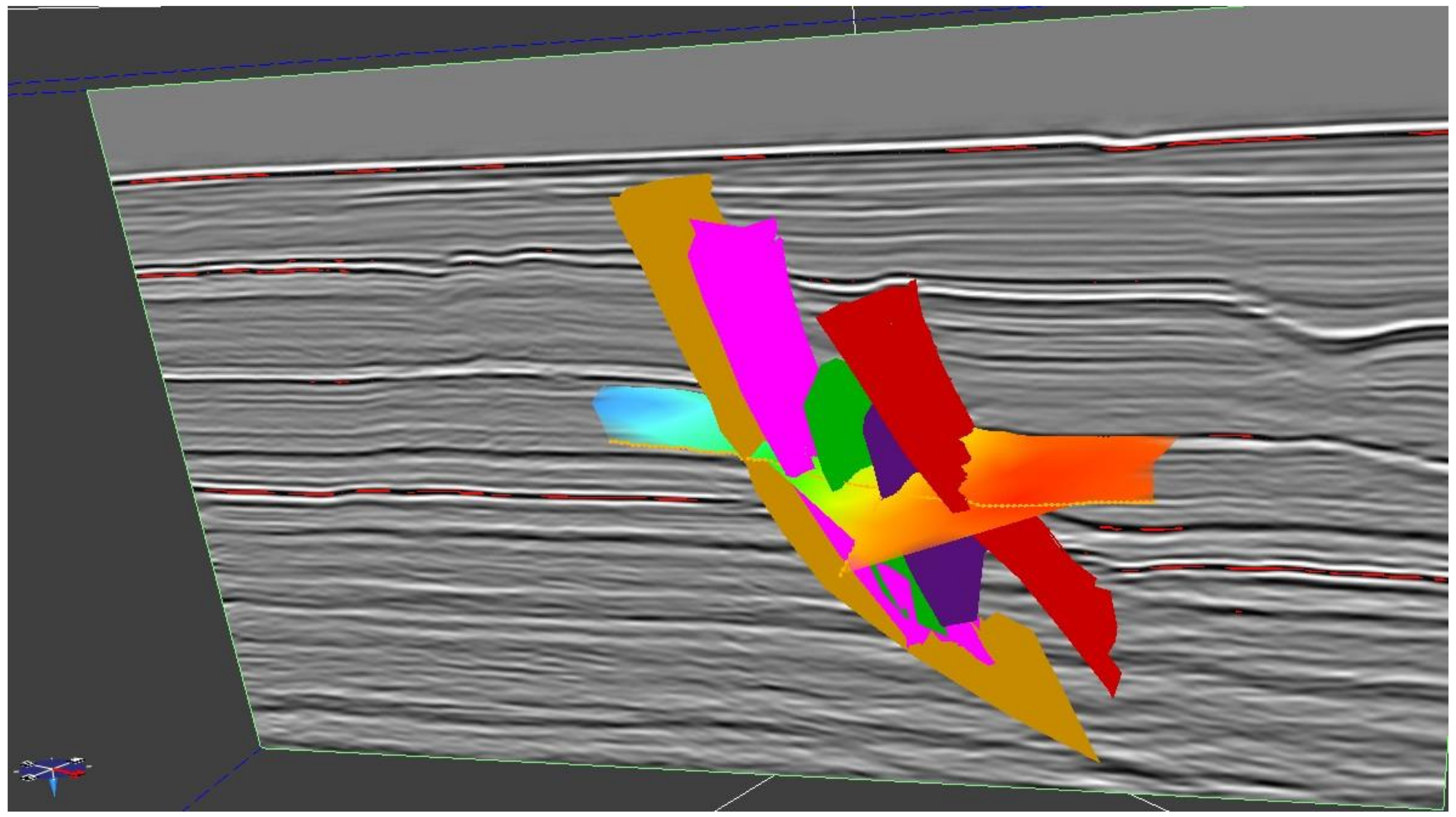



**Figure 3.** (A) Faults 1 and 2 breaching horizon dated at 6 million years old (arrowed). However, they ceased activity prior to deposition of the most recent strata. (B) Fault 5 growth halted below 6 million year old horizon. (C) Faults 4 and 5 accumulate no displacement above earlier deposited horizon that is colour contoured for depth below sea-level (550 m – 750 m).

**Figure 4.** The below image displays all of the fault surfaces mapped in 3-D intersecting a common horizon. The complex 3-D geometry of the fault surfaces and their intersections with horizons of different ages record progressive back stepping of fault activity towards the SE (left of image) during deformation.



## Discussion

- From a smaller scale, analogous to a higher resolution, a greater quantity of faults are observed (Fig. 1, 2).
- Compared to a simple interpretation, more faults imply more potential pathways for fluid flow. Depending on the lithology of the offset strata this implication can change; if these faults were fracturing limestones they could act as channels along which fluids would migrate. Conversely, these faults might impede flow within highly porous rocks, e.g. sandstones, by placing them against a less permeable rock type.
- The faults vertical extent and the strata they cross indicate the relative ages of their activities. The thickness of sediments on either side of a fracture indicates its relation to sedimentation (Fig. 3, 4). The package of sediments bounded by the arrowed horizon and the colored horizon is thicker on the North side than on the South side of the package (Fig. 3). From this we can tell that active faulting occurred during the time this package was deposited.

## Conclusions

- Detailed interpretation leads to a greater number of faults being resolved from seismic data (Fig. 1, 2).
- Greater number of faults implies a greater number of flow pathways for fluids in the system.
- Splaying of one or two faults resulted in the five faults observed here (Fig. 3, 4).
- Back-stepping of displacement through time from fault 4 to fault 1 resulted in the current orientation. Fault 4 dies out in the oldest strata. Fault 1 outlives the other faults dying out in the most recent strata (Fig. 3, 4) .

## References

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