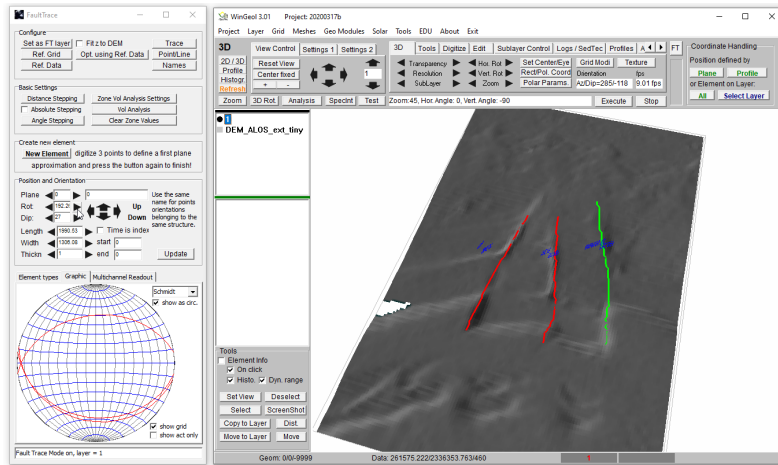
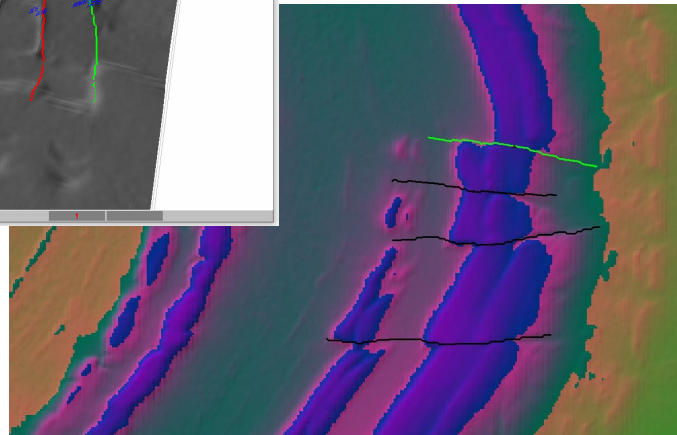


TerraMath FaultTrace

Robert Faber & Gisela Domej



Computer assisted 3D mapping
using digital elevation data
and satellite images



A tool to assist the creation of 3D models



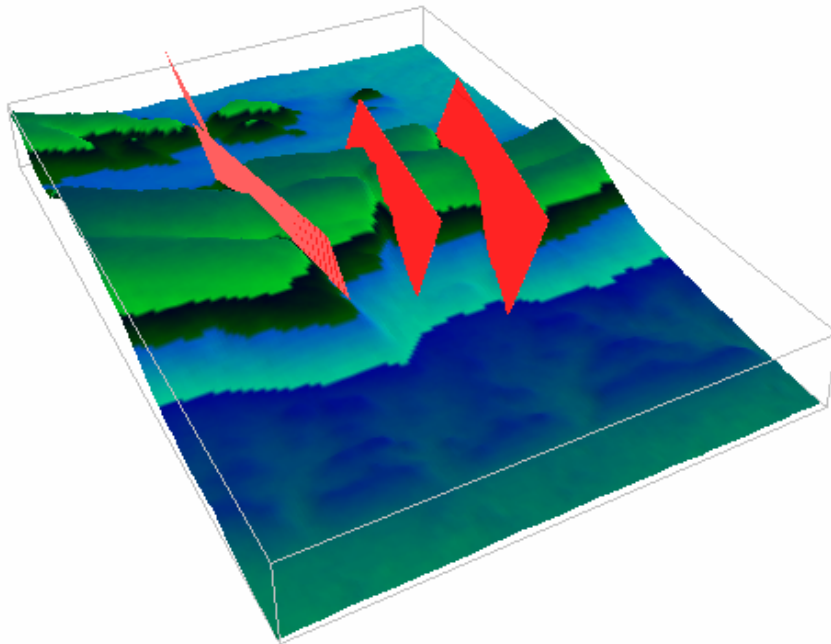
More detailed information is available on:
<http://terramath.com/egu2020/TerraMath%20FaultTrace%202020.pdf>

Basics

FaultTrace is a module of TerraMath WinGeol software. It is used to map geological structures in 3D from digital elevation models (DEM) and optional satellite images, geological maps or aerial photographs which are draped on the DEM.

The basic idea is that **tangential planes of geological features** like faults or bedding planes are cut with a digital elevation model to create a **trace or cut line**.

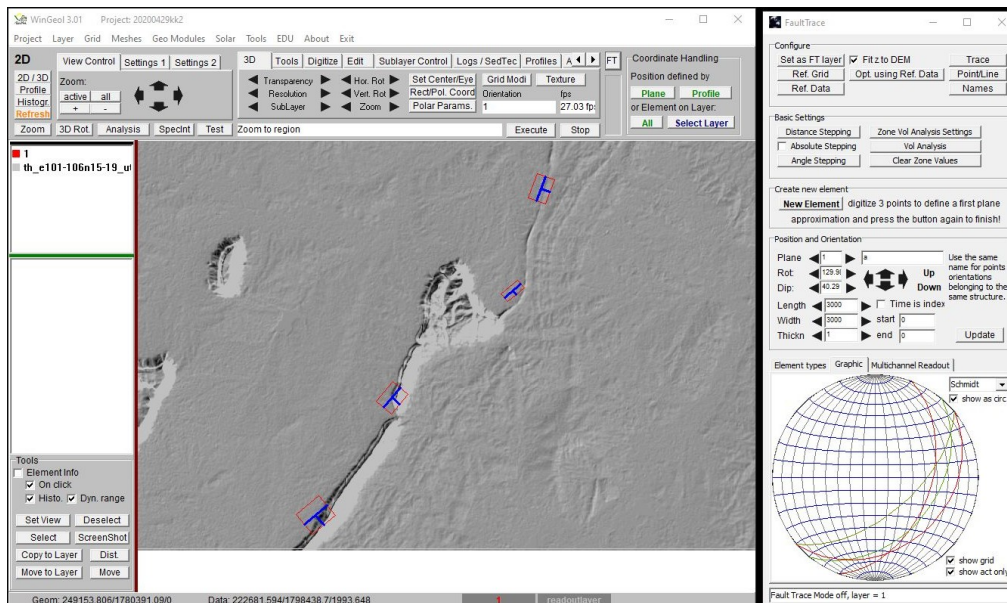
This line is compared with structures visible on the DEM or on overlying satellite images, if a fit is found, the orientation of the plane is known.



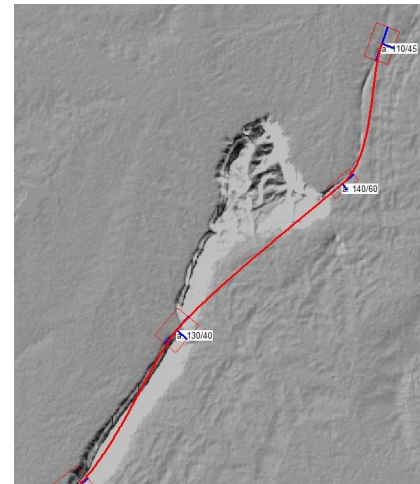
What was missing: Topology

- Measurements are grouped by an identifier to form a composite element
- Based on there position and orientation FaultTrace estimates how they connect and
- Interpolation (hermite spline based) creates in between values (suggestions – the user is still in command - to help to see where input is missing)

Having these suggestions we can see how the composite elements most likely will look like in a later 3D model. We see it before further time consuming steps are made!



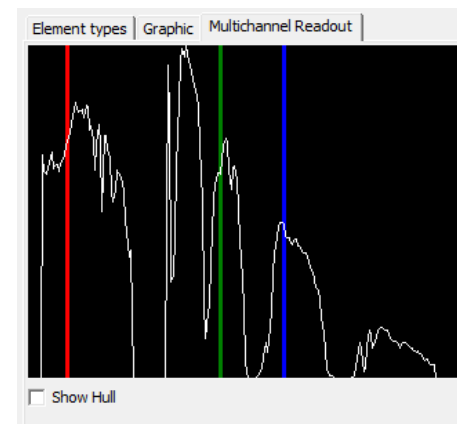
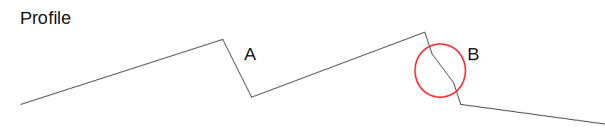
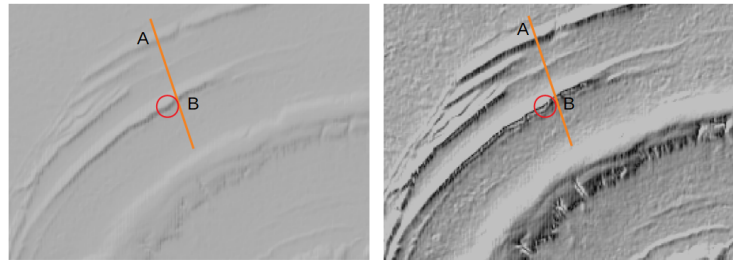
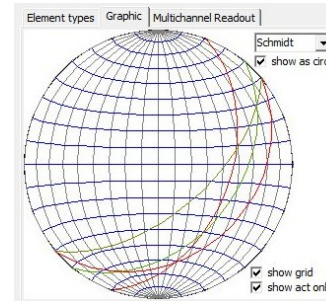
This how the algorithm sees the structure:



... and we see what is ok or not!

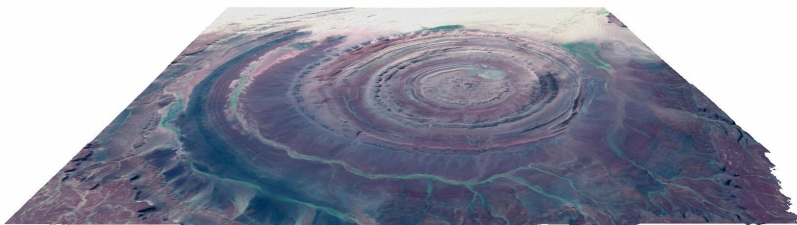
Added tools for mapping

- Stereonet display: single elements (colored by distance) or all elements, colored by element id
- Improved shaded relief: increases the dynamic range in low contrast = better identification of units
- Multichannel readout for utilization of multichannel or hyperspectral satellite data = we see now more than data from 3 color bands!

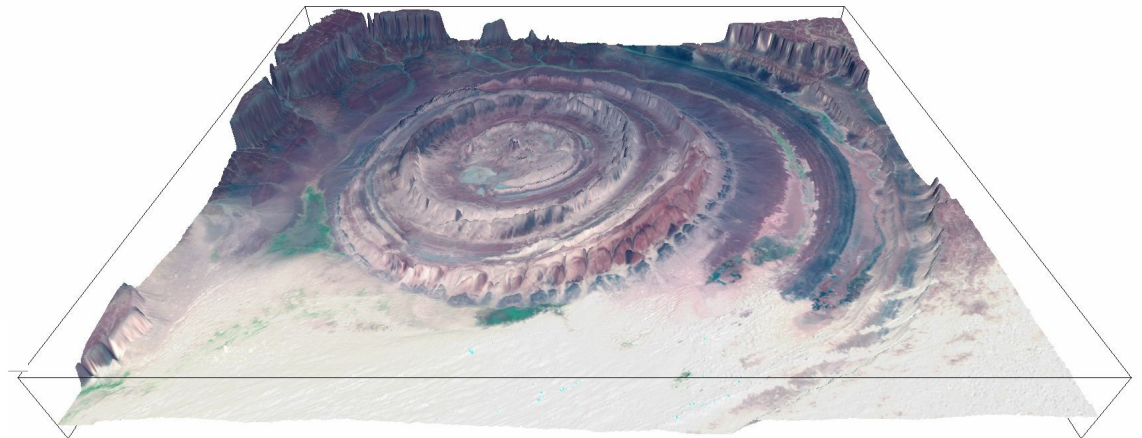


To demonstrate the functions of the software the Richat structure in NW Africa was selected – because of the very little difference between lowest and highest elevation (approx. 100m the diameter is some 40km) an especially demanding area!

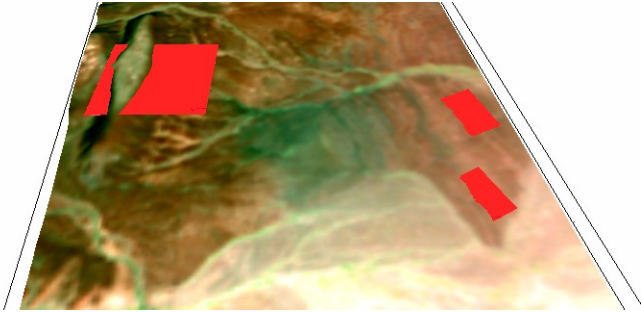
The task is to reproduce field observations and measurements (published data) and if possible to add additional insights ...



The original very flat



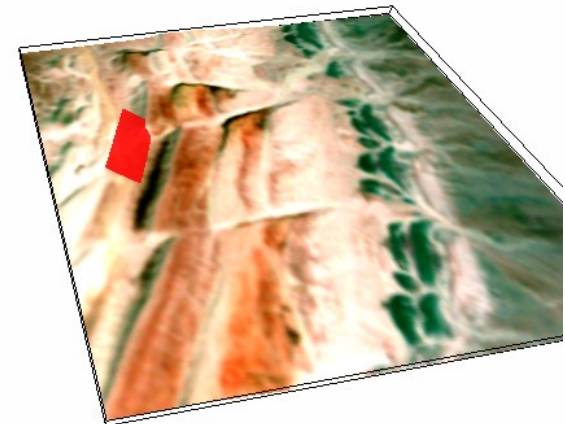
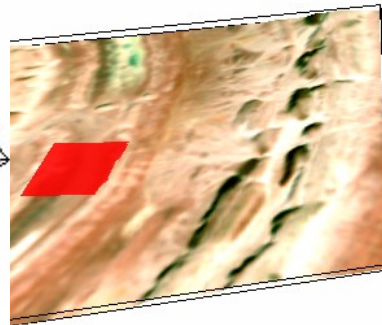
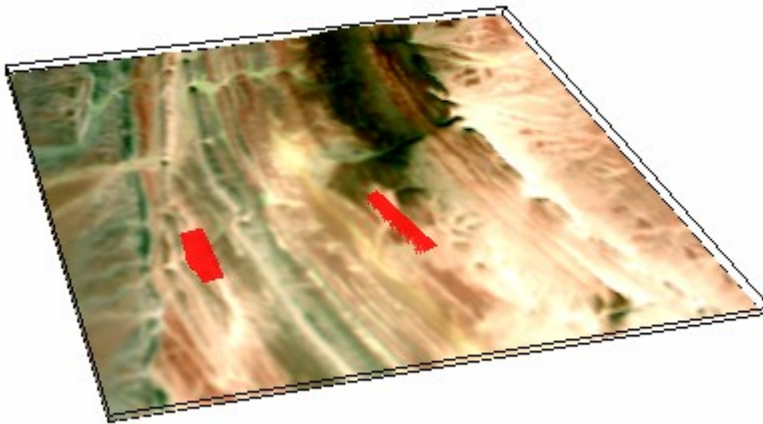
... and elevations multiplied by factor 15



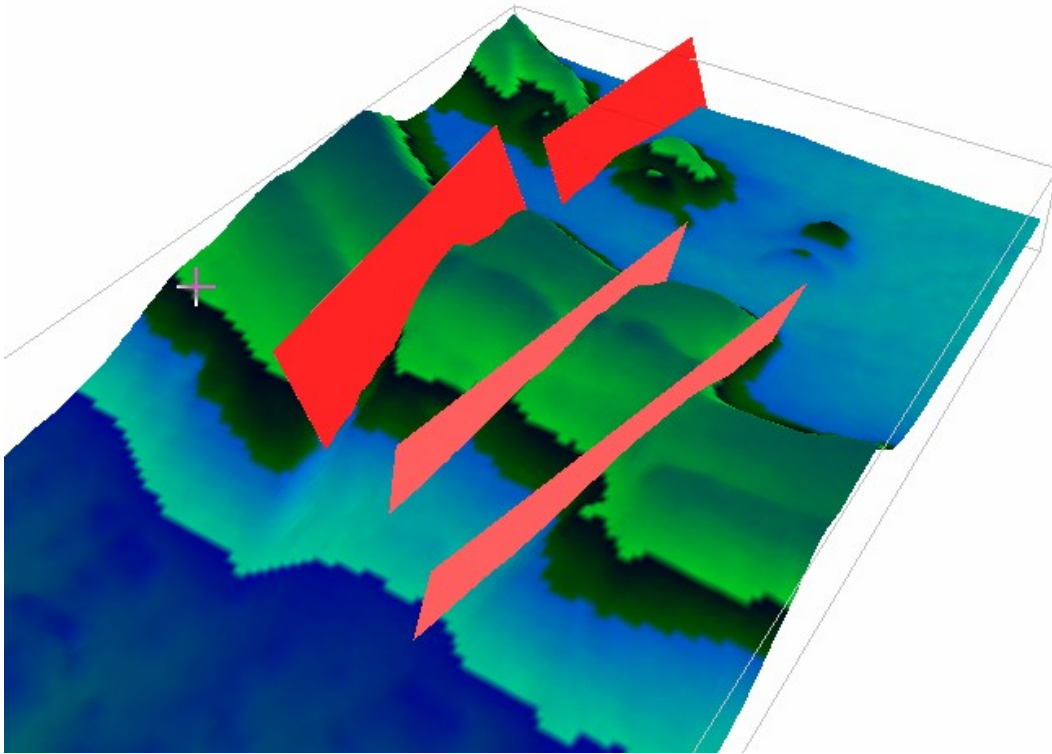
West of Richat the bedding is more or less horizontal (090/03), 5km more east we measure 270/04 ...

Closer to the center dipping is up to 12 degree but in the center dipping is smaller with 0-6 degree.

The eastern section chose values of dip 20 degree east ...



All in all observations fit to the values published.



Faults

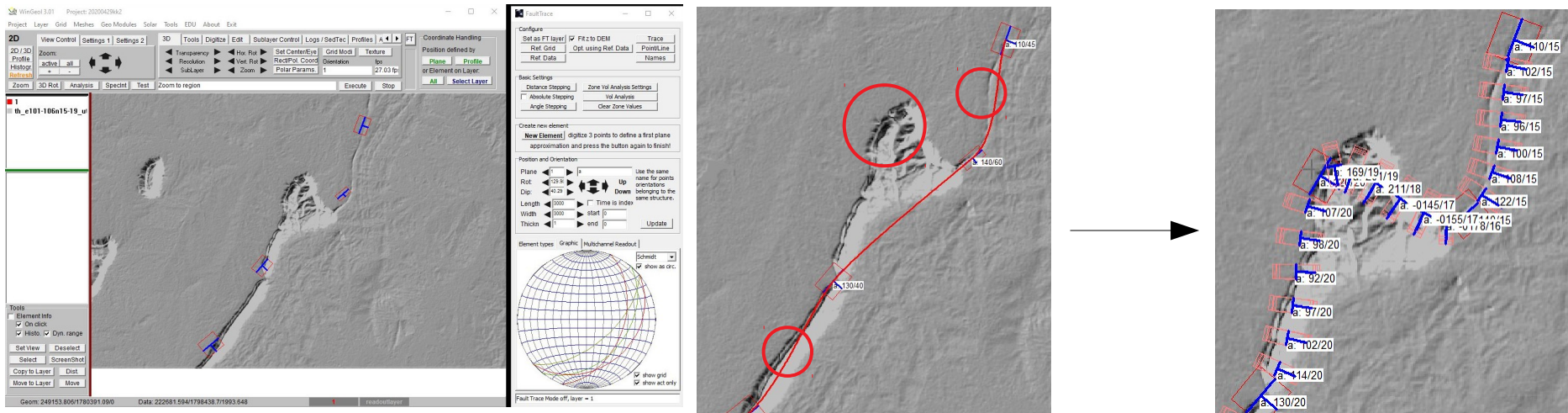
As we can observe the dipping better, it is possible to identify conjugated faults forming structures (like positive flower structures). The fault geometry has to be mapped as composite elements as orientation is not constant.

All in all faults are less vertical as expected ...
... and there is some more work to do to build up a detailed 3D model

All in all Richat is a very demanding showcase and not all locations seem to allow reasonable measurements (can be caused by a not perfect geocoding satellite image – elevation model and a DEM is of course not 100% accurate).

Please, find in the linked document more info how to use it and what frequent mistakes are ...

A last example – NE Thailand - using a composite element (consists of several plane elements) and how the build in interpolation model might help to identify areas with too few data points



4 measurements along a ridge



where the prediction tells us that something is missing (we made it easy to spot)

Allows to add data where it is really needed (here the effect of just one additional data point)

Important for 3D modeling

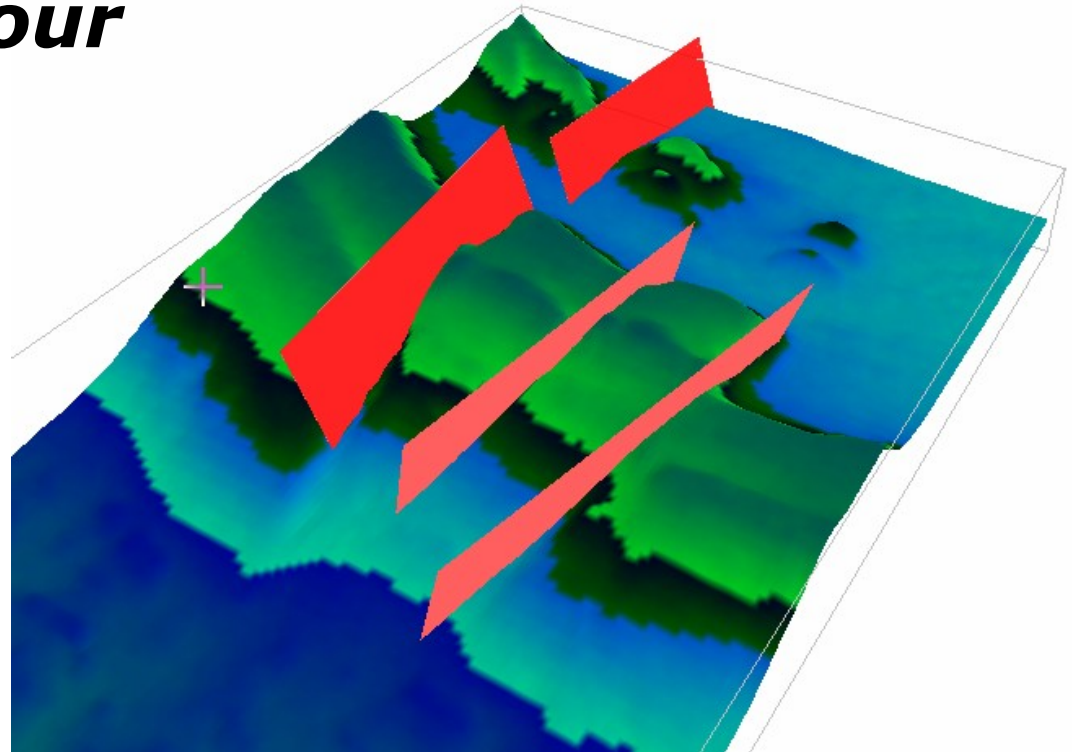
Data can be optimized before too many time consuming steps are made!

***Thank you for your
interest***

All the best

Robert & Gisela

robert.faber@terramath.com



More detailed information is available on:

<http://terramath.com/egu2020/TerraMath%20FaultTrace%202020.pdf>