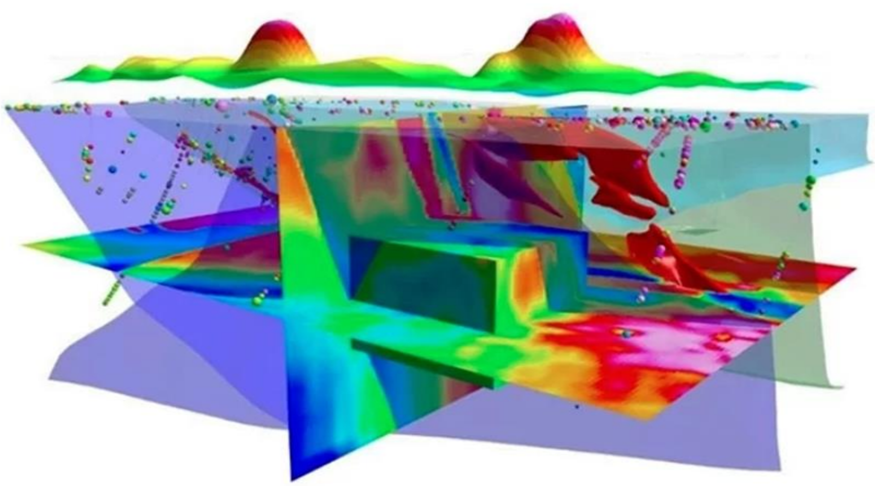
ARISTOTLE UNIVERSITY OF THESSALONIKI
SCHOOL OF GEOLOGY
DEPARTMENT OF GEOLOGY

MELINA DOROTHEA GKARI

PROCESSING AND INTERPRETATION OF SEISMIC PROFILES WITH THE USE OF PARADIGM SOFTWARE

BACHELOR THESIS



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[λευκή σελίδα]

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PROCESSING AND INTERPRETATION OF SEISMIC PROFILES WITH THE USE OF PARADIGM SOFTWARE

Υποβλήθηκε στο Τμήμα Γεωλογίας, Τομέας Κοιτασματολογίας

Επιβλέπων: Σακελλάρης Γρηγόριος Άαρνε

Επεξεργασία και ερμηνεία σεισμικών τομών με τη χρήση του λογισμικού Paradigm– Διπλωματική Εργασία

Processing and Interpretation of Seismic Profiles with the Use of Paradigm Software – Bachelor Thesis

Cover Figure: GOCAD Mining Suite release - Mira Geoscience

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ABBREVIATIONS:

2D=two-way-time and depth ECB=Eratosthenes Continental Block EEZ=Exclusive Economic Zone HB=Herodotus Basin MSC=Messinian Salinity Crisis TCF=trillion cubic feet bcfd=billion cubic feet per day

Abstract

Petroleum systems are typically associated with sedimentary basins that have undergone an evaporitic intrusive phase and tectonic deformation i.e. folding and faulting. Since the discovery of numerous natural gas fields in the Eastern Mediterranean region, especially within the basins of Herodotus and Levantine south of Cyprus, this area has been the target for intense hydrocarbon exploration in the recent years.

For this thesis 180 km of regional 2D seismic reflection profiles conducted by PGS (Petroleum Geo-Services) in the Cyprus Exclusive Economic Zone have been processed and interpreted using the PARADIGM software.

The research work included digitalization and interpretation of the seismic reflection profiles within the first 3.5 km below sea level. Based on the seismic reflectors, our study area is separated into four seismic stratigraphic Units. These distinct stratigraphic layers correlate well to the stratigraphic units of the upper Plio-Quaternary clastic sequence and the underlain Messinian Salinity Crisis sequence, which is bounded at the top and bottom by strong and distinctive reflections.

Based on the stratigraphy of the sequence and the deformational structures we identified potential traps for hydrocarbon reservoirs including low angle anticlines, faults that transect different lithological units, as well as, graben structures.

Considering that the deeper parts of this sedimentary sequence is represented by the Messinian evaporites we conclude that the area of this study has high potential for discovering hydrocarbon and natural gas deposits and the profils point highly prospective areas.

KEYWORDS: LEVANTINE BASIN, HERODOTUS BASIN, ERATOSTHENES CONTINENTAL BLOCK, MESSINIAN SALINITY CRISIS, GAS FIELDS, ZOHR, PARADIGM SOFTWARE, SEISMIC INTERPRETATION

Chapter 1.

1.1 GEOLOGIGAL SETTING

The Eastern Mediterranean basin is a remain of the Mesozoic Neotethys Ocean. Its present-day geological setting is the result of plate tectonic movements of the African, Arabian and Eurasian plates during the. Permo-Triassic period. The tectonic evolution of the Neotethys is divided in two distinct phases. The first phase which took place from the Triassic to the mid-Jurassic was a period of rifting and was followed by a spreading period from the Upper Jurassic to the Lower Cretaceous. The second phase was characterized intense tectonic deformation by the development of NNW-SSE striking transform faults. (Walley, 1998). The Eratosthenes Continental Block (ECB) was formed during the first period as a result of the separation of a piece of the continental crust from the Arabian plate (Robertson 1998; Van Hinsbergen et al., 2019). The whole Tethyan area endured a period of N-S directed compression from the upper Cretaceous to the Eocene. The Hellenic and Cyprus arcs were created as a result of this compressive phase (Robertson and Dixon, 1984). In the Upper Eocene and Early Oligocene, a significant tectonic event took place that caused the Suez rift to broaden, separating Arabia from the African continent (Garfunkel, 2004). Significant amounts of clastic sediments deposited towards the Eastern Mediterranean basin. This event had a huge impact on the structural and sedimentary setting of the area. West of the ECB, a NW-SE strike-slip faulting that took place during the Oligocene-Miocene period (Montadert et al., 2014). As the Eastern Mediterranean margins eroded during the Messinian Salinity Crisis, clastic sediments from the Nile entered the region (Macgregor, 2012). According to Said 1981, the river Nile alone has deposited in the sea basin west of the ECB, approx. m70,000 cubic kilometers of sediments in less than 3 Ma (three million years) period of time. The deposition of these clastic materials took place in front of low stand deltas.

The main structural units within that have been recognized and analyzed in this study are the:

a. Levantine Basin
b. Herodotus Basin
c. Eratosthenes Continental Block

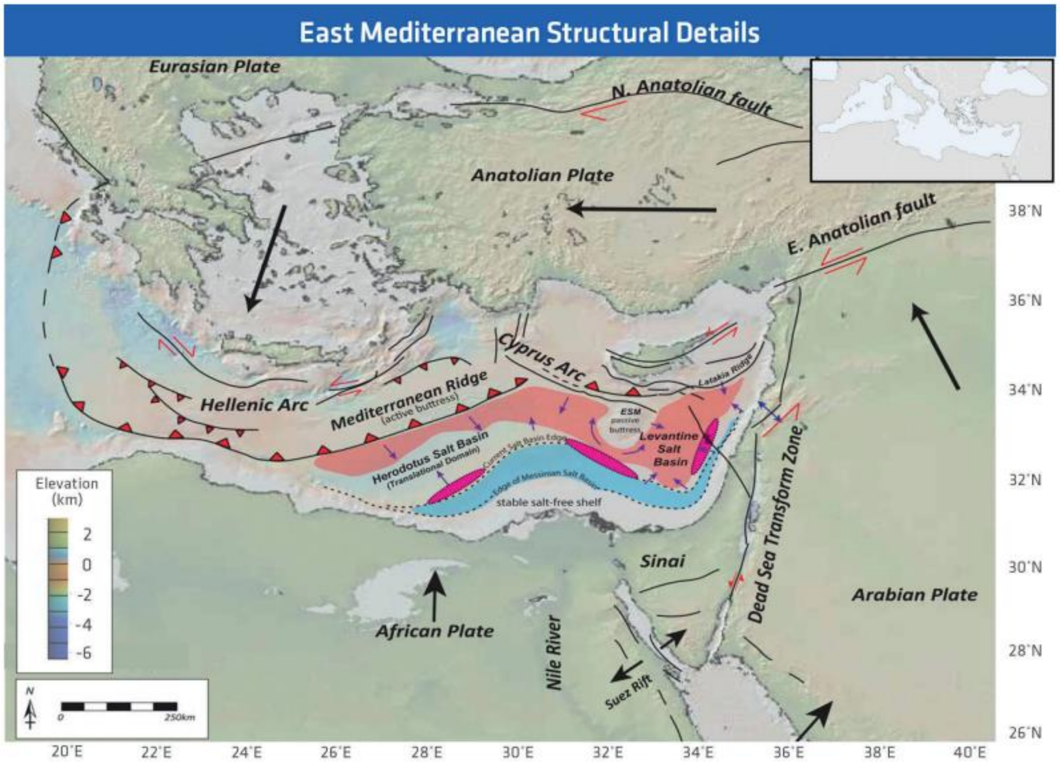


Figure 1. Structural map of the East Mediterranean area showing the plate movement tectonics (Kumar et al., 2018).

1.2 LEVANTINE BASIN

The Levantine basin is located offshore Palestine, Israel, and Lebanon in the eastern Mediterranean Sea. The water depth in that area averages at 1600 meters. This basin has a thick sediment infill (approximately 12 km) and a basement that is formed of thinned continental crust shaped via lithospheric stretching during the Early Triassic-Late Cretaceous (Granot, 2016; Hawie et al., 2013; Montadert et al., 2014). It forms a NE-trending depression about 1.5-2.0 km deep. The bedrock is of Triassic age and has proved to be of highly attenuated continental crust origin (Ben-Avraham et al., 2002). The Levant Basin contains more than 14 km of Mesozoic-Cenozoic successions, including an up to 2 km of Messinian salt (Ben-Avraham et al., 2002; Netzeband et al., 2006).

1.3 ERATOSTHENES CONTINENTAL BLOCK (ECB)

The Eratosthenes Continental Block (ECB) is a fragment of continental crust located in the eastern Mediterranean Sea between Cyprus and the estuary of the Nile (Robertson, 1998). It separates the Herodotus basin and the Levantine basin and forms the easternmost limit of the Herodotus Basin. During the Mesozoic and Tertiary periods, the ECB was most likely an isolated island surrounded by a shallow sea platform with local reef formation. After the end of the rifting phase, a carbonate platform was developed, isolated from any clastic input or salt precipitation. The ESB is covered by Cretaceous-Neogene shallow water carbonate (according to the data from the Ocean Drilling Program (ODP) scientific wells and seismic data) and is interpreted to be controlled by SW-NE trending normal faults related to the syn-rift stage.

1.4 HERODOTUS BASIN (HB)

The Herodotus basin is a NE-trending, 3 km deep depression and represents a slab of the Early Mesozoic Neotethys Ocean. The basin is bounded to the north by the Mediterranean Ridge, to the northeast by the west portion of the Cyprus Arc, and to the south by the Nile Delta. The HB has a 12-15 km thick basement of oceanic crust and a thick sedimentary cover. The basin itself contains an up to 7 km of Mesozoic-Cenozoic sediment unit overlain by an approx. 3 km Messinian salt unit. These are topped by Pliocene to Quaternary, Nile derived clastic accumulations with thickness that reach in places 4 km (Aal et al., 2000; Garfunkel, 1998; Loncke et al., 2006; Macgregor, 2012).

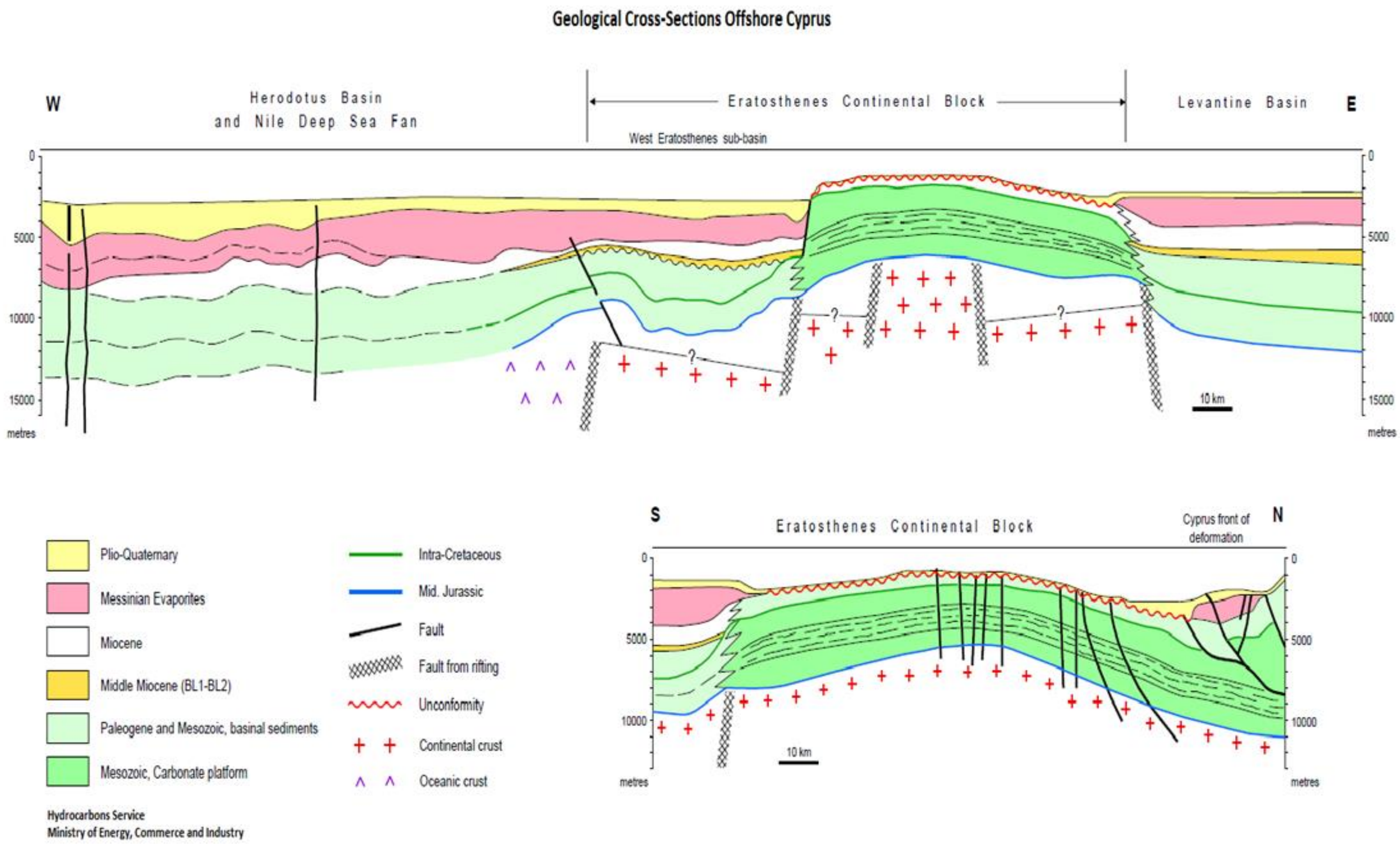


Figure 2. W-E and N-S cross-sections offshore, south of Cyprus showing the stratigraphy of the Eastern Mediterranean (https://hydrocarbons.gov.cy/en/geological-data/area-description-geology)

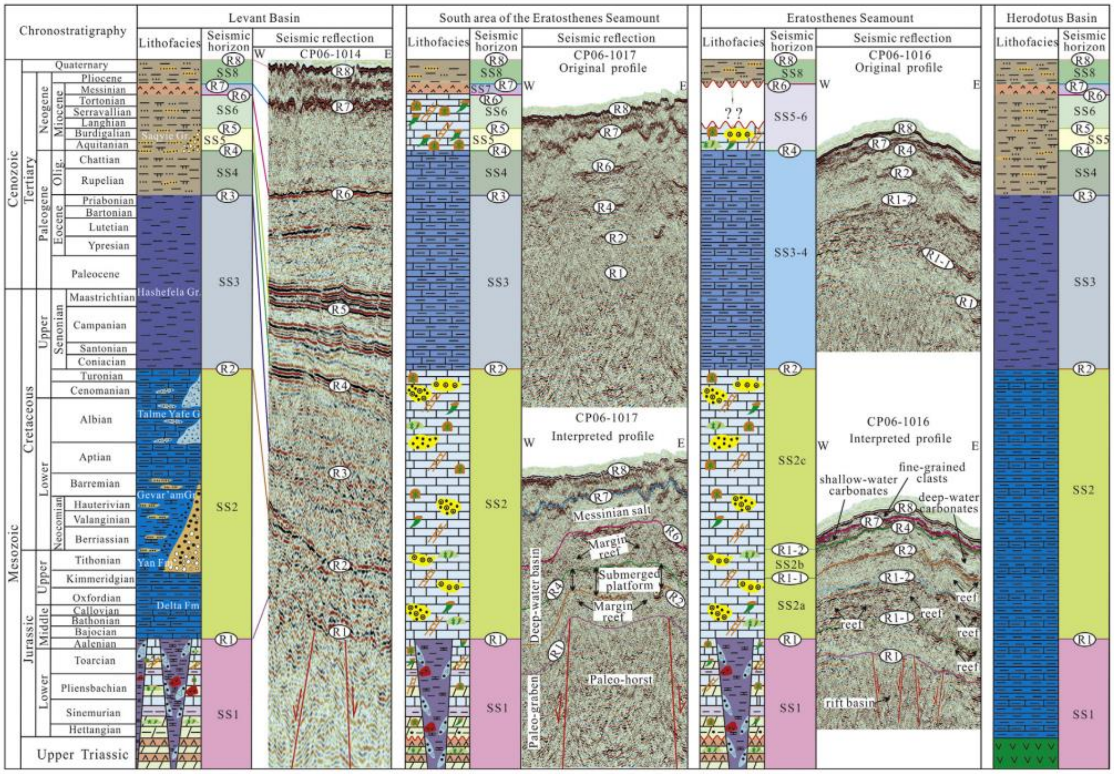


Figure 3. Chronostratigraphic columns showing the lithofacies, seismic sequences and reflections of the Levant basin, the Herodotus basin, the broader area of the Eratosthenes Seamount (Gao et al. 2020).

MESSINIAN DEPOSITION

The Mediterranean Sea is a basin that progressively closes as the African tectonic plate shifts to the north that will lead to shrinking and extinction. The Atlantic Ocean is connected to the Mediterranean Sea by a little channel, the Gibraltar Strait. The Messinian Salinity Crisis (MSC), also known as the Gibraltar Straits Limitation -an event that occurred 5.97 Ma ago that turned the Mediterranean Sea into a semi-closed evaporitic basin (HSU et al., 1973 and 1977; Manzi et al., 2013). The evaporite deposition ended 5.33 Ma ago when Gibraltar's straits abruptly reopened (Garcia-Castellanos et al., 2009). There are several models from researchers on the place, time, and circumstances of the evaporite deposition in that area.

1.5.1 THE FORMATION AND LITHOSTRATIGRAPHY OF THE MESSINIAN SALINITY CRISIS SEQUENCE

According to Mousouliotis (2021), the stratigraphy (and in order of deposition phases-steps) starts from bottom to top with:

- *Anhydrites and anoxic deep basins (5.97–5.6 Ma; step.1):*
  Recent studies show that during this period the lower evaporites were deposited due to the limited seawater inflow from Atlantic Ocean.

- *Intense halite precipitation coeval to desiccation and erosion (5.6–5.55 Ma; step 2):*
  This period is characterized by reduced inflow from Atlantic Ocean and the absence of other gateways. Consequently, the Gibraltar Strait was the only entry for seawater in the Mediterranean, whereas all the major rivers (Nile, Rhone and Ebro) flowing into the basin brought enormous volumes of clastic sediments in the basin.

- *Lago Mare deposition (5.55–5.33 Ma; step 3)*
  The flow of clastic sediments from the drainage systems of the continental edges, along with the huge amounts of halite precipitation, filled the basin's deepest portions (Kartveit et al., 2019). This process led to the formation of a shallow basin system together with a drop of the sea level. Inside those shallow basins, a different sequence of sediments was deposited forming the Lago Mare sequence. This sequence comprises of alternations of dolomite, gypsum, anhydride a.o., that reveal a saline environment (Hsü et al., 1973; Marzocchi et al., 2016; Popescu et al., 2015).

- *End of the MSC (ca. 5.33 Ma; step 4)*
  The "widening" of the Gibraltar Strait was the Zanclean reflooding (Garcia-Castellanos et al., 2009). This event was followed by the deposition of marine sediments giving an end to the evaporitic sedimentation (Ryan, 2008).

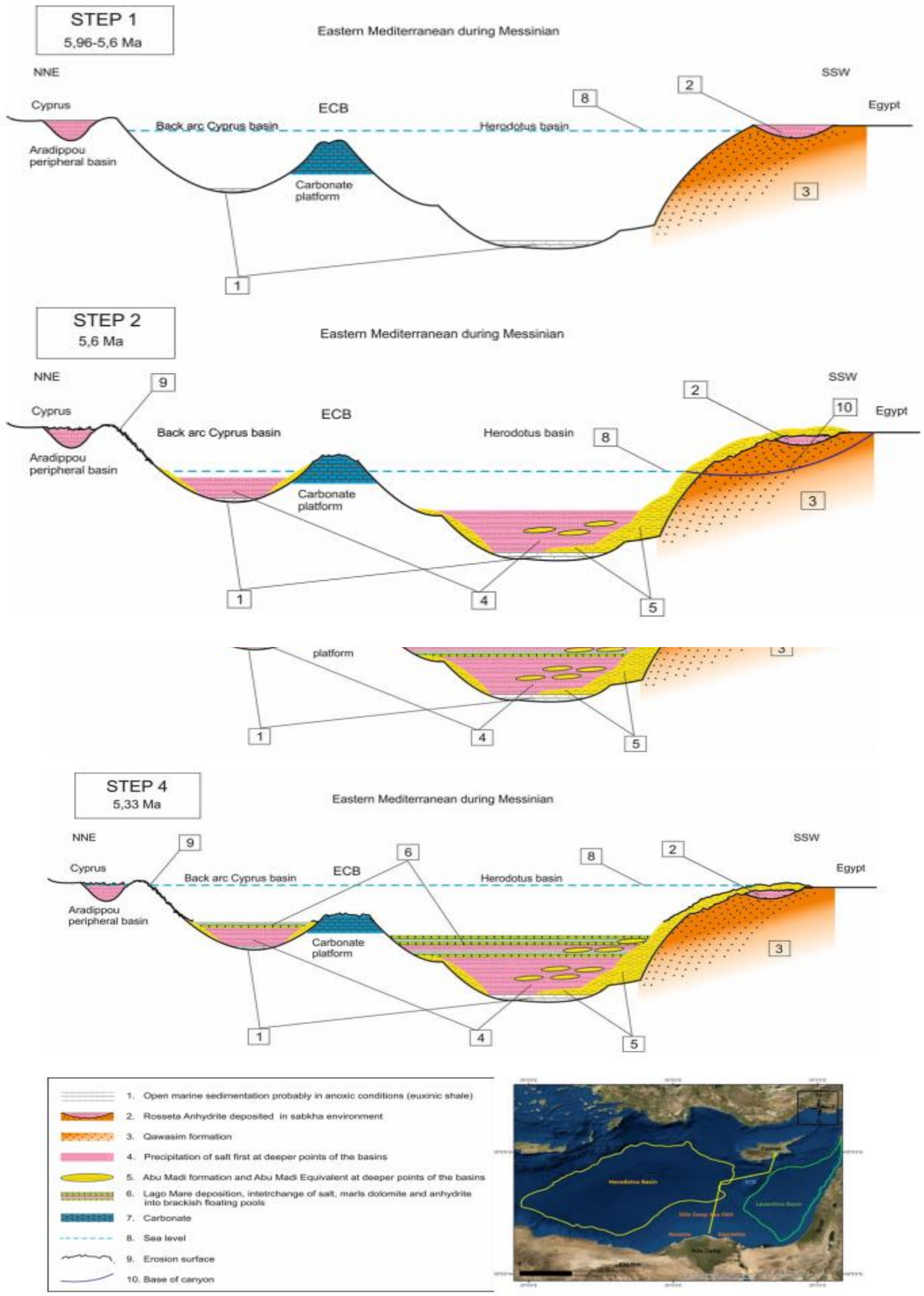


Figure 4. NNE-SSW **c**ross-section of East Mediterranean showing theoretical depositional model of salt during MSC (Mousouliotis, 2021).

Chapter 2.

2.1 GAS FIELDS IN THE EASTERN MEDITERRANEAN REGION

After the discovery of giant gas fields in the Eastern Mediterranean region during the first decade of 2000, this area has become an emerging exploration area for hydrocarbons and gas. Especially the Levantine Basin where the Cyprus' Exclusive Economic Zone (EEZ) is located, as well as, the areas offshore of Israel, Lebanon and Egypt have been target for intense exploration drilling by many Oil Companies.

Follows a list of the most important gas-fields of the Eastern Mediterranean region and their characteristics.

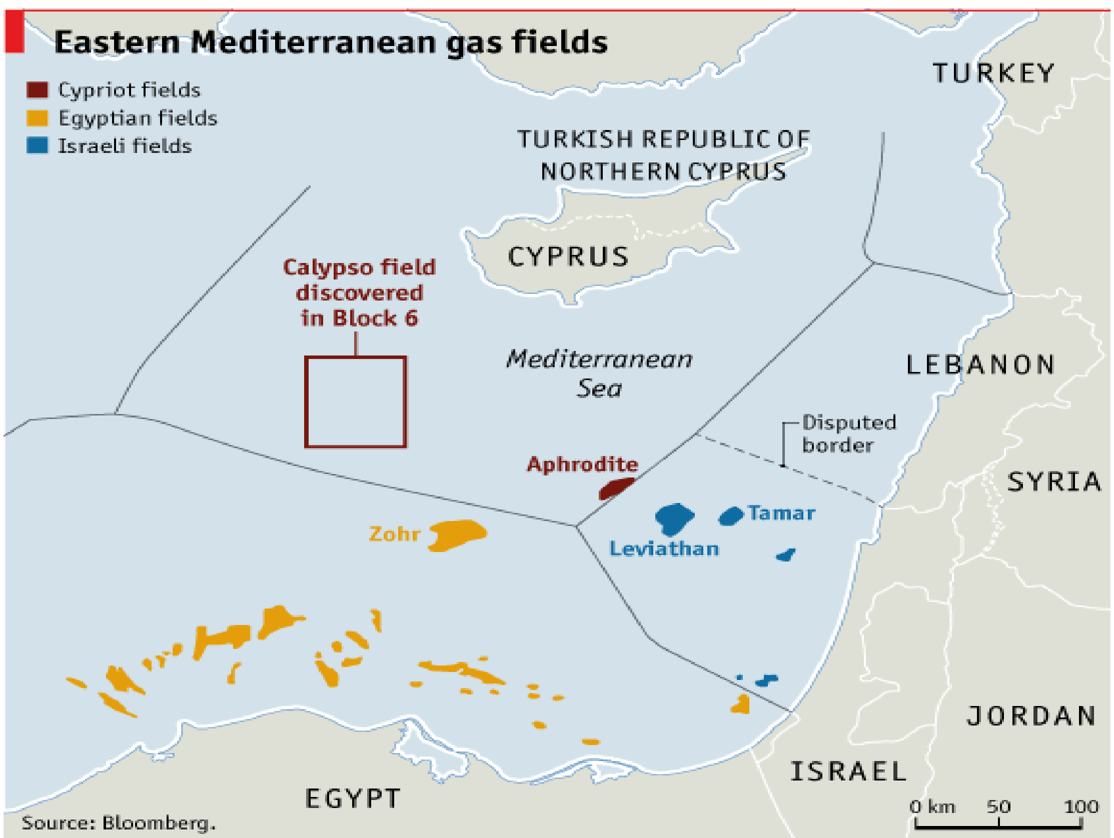


Figure 5. Easter Mediterranean gas fields of Israel, Egypt and Cyprus' EEZ (google).

2.1.1. ISRAEL

Offshore of Israel two large gas fields have been discovered and are currently in Production. Both have biogenic gas source.

2.1.1.1 LEVIATHAN

Coordinates: 33°10′04″N 33°37′02″E.

Leviathan was discovered in 2010 by Noble Energy and started production of gas on 31 December 2019. It covers an area of 83,000 Km^2 and has 33 trillion cubic feet of natural gas with the 20 -22 of them recoverable.

2.1.1.2 TAMAR

Coordinates: 33°04′42″N 33°57′05″E.

Tamar is a 97 km^2 natural the gas field has proven reserves of 200 billion cubic meters or 7.1-8.5 TCF of natural gas. Discovered by Noble Energy in 2009 while the exploitation started in 2013.

2.1.2 EGYPT

The Zohr gas field is the largest discovery ever made in Egypt and in the Mediterranean Sea in August 2015.

2.1.2.1 ZOHR

Coordinates: 33.00°N 32.50°E.

The offshore location of the field is within the Shorouk Block. In the Block 9, Eni holds a 50% stake, Rosneft 30%, BP 10% and Mubadala Petroleum 10% of the Contractor's Share. The Reservoir is located within the Miocene carbonates (reef) which are similar to the reef carbonates onshore of Cyprus in Cape Greco and Paphos. The gas field extends for about 100 km^2 and discovered Volumes estimated at 30 TCF of GOIP. The Zohr gas field has 4-6 km distance from block 11 of Cyprus and 40 km distance from Aphrodite gas field.

2.1.3 CYPRUS

South of the Republic of Cyprus, the hydrocarbons exploration area is located in the country's Exclusive Economic Zone (EEZ). That area covers around 51.000 km^2, the water depth ranges between 300 m (on the Cyprus Arc) and more than 3.000 m close to the island of Cyprus, in the deeper part of Herodotus Basin.

Following recent activities in the Eastern Mediterranean, with Egypt and Israel being already producers of hydrocarbons, Cyprus starts granting hydrocarbon exploration licenses per block in accordance with the Ministry of Energy and Environment of the Republic of Cyprus.

Some of the blocks are listed below:

Block 2, 3 and 9
Granted in January 2013.
Eni Cyprus Limited (60%), KOGAS Cyprus Limited (20%), Total Energies EP Cyprus B.V. (20%)

Block 5
Granted in December 2021.
ExxonMobil Exploration and Production Cyprus (Offshore) Limited (60%), Qatar Energy International E&P LLC (40%)

Block 6
Granted in April 2017.
Eni Cyprus Limited (50%), Total Energies EP Cyprus B.V. (50%)

Block 7
Granted in September 2019
Total Energies EP Cyprus B.V. (50%), Eni Cyprus Limited (50%)

Block 8
Granted in April 2017.
Eni Cyprus Limited (60%), Total Energies EP Cyprus B.V. (40%)

Block 10
Granted in April 2017.
ExxonMobil Exploration and Production Cyprus (Offshore) Limited (60%), Qatar Energy International E&P LLC (40%)

Block 11
Granted in February 2013.
Total Energies EP Cyprus B.V. (50%), Eni Cyprus Limited (50%)

Exploitation Licenses
Block 12 (Aphrodite)
Granted in November 2019
Chevron Cyprus Limited (35%), New Med Energy Limited Partnership (30%), BG Cyprus Limited (35%).

2.1.3.1 APHRODITE

Coordinates: 33°5′40″N 32°59′0″E.

Aphrodite is a 120 km^2 offshore gas field off the southern coast of Cyprus located at the exploratory drilling Block 12 in the country's maritime Exclusive Economic Zone. The discovery of the gas field came in September 2011 due drilling. The estimate natural gas reserves are about 4.5 TCF (trillion cubic feet).

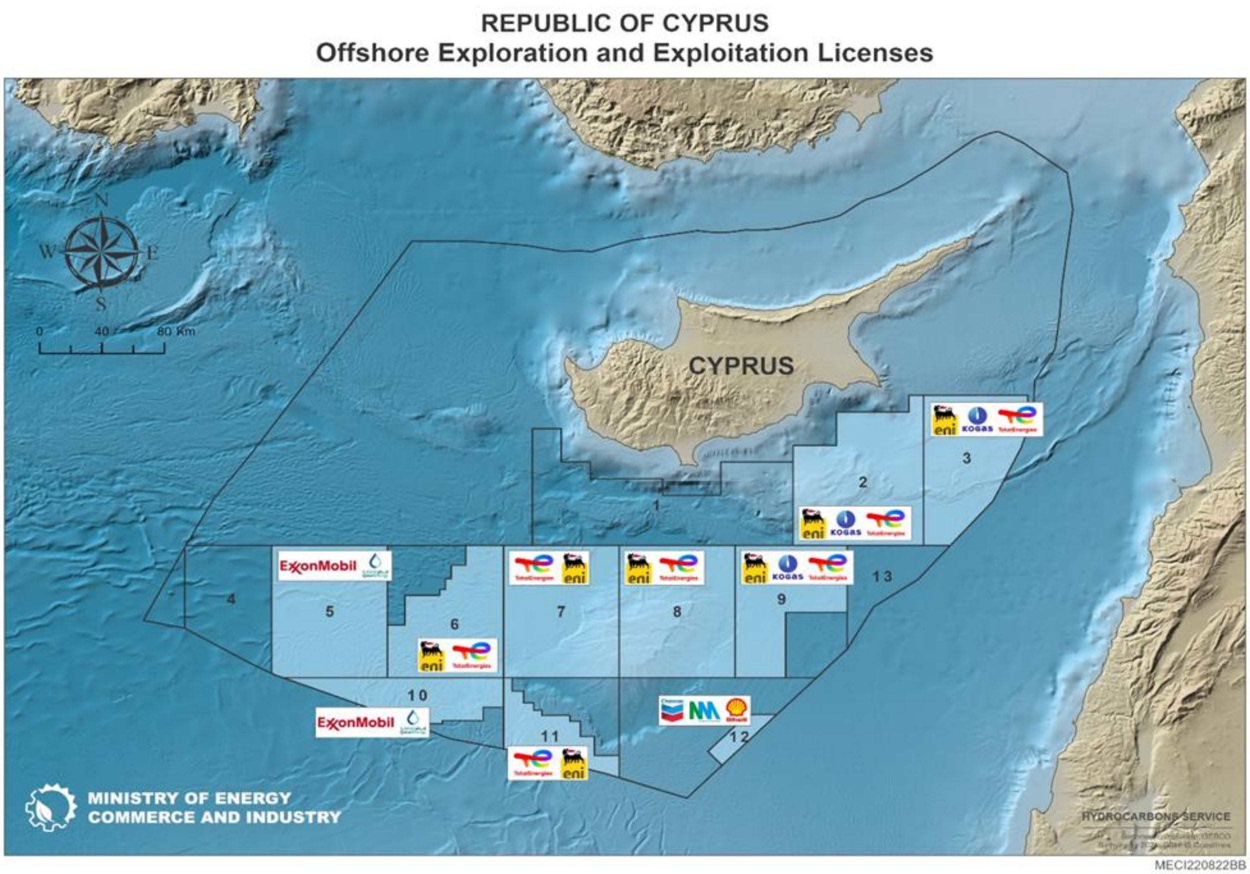


Figure 6. Exploration and exploitation licenses in Cypriot EEZ (https://hydrocarbons.gov.cy/en/licensing/granted-licences).

Chapter 3.

3.1 SEISMIC DATA AND METHODS

Three 2D-seismic reflection profiles (two-way-time and depth) were used for the process and interpretation of the seismic data in the area south of Cyprus using the Paradigm (SKUA-GoCad) software.

These 3 profiles have a total length of approx. 180 km and belong to the exploration survey campaign held in 2006 and 2008 by Petroleum Geo-Services (MC2D-CYP2006 and MC2D-CYP2008 programs). The seismic data were in form of SEG-Y files (Society of Exploration Geophysicists) file format.

The seismic dataset covers the Block 10, in the western part of the Eratosthenes Continental Block (ECB) close to the Herodotus Basin in the Exclusive Economic Zone of Cyprus.

Technology used was a dual sensor GeoStreamer®. The geophysical surveys used one streamer 8100 meters long and with a length of recording 9.216 s. The first reflector has a negative amplitude, is blue in color, and has a vertical-horizontal resolution of 4 ms and 12.5 m, respectively.

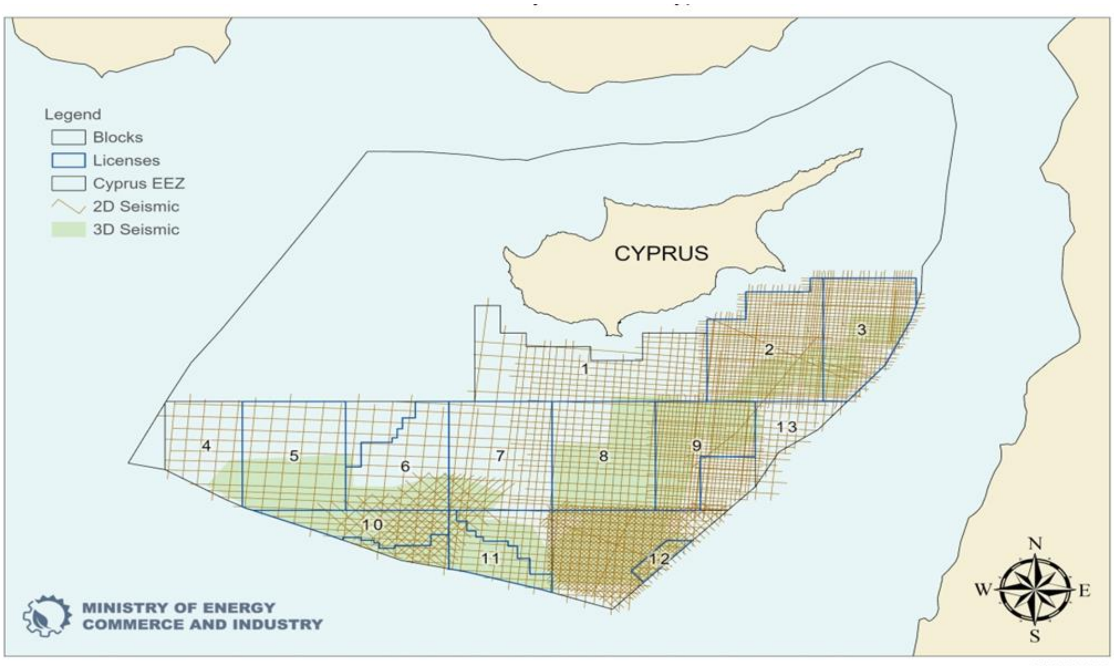


Figure 7. Seismic Surveys offshore Cyprus (https://hydrocarbons.gov.cy/en/geological-data/available-data).

3.2 METHODS

SKUA-GOCAD™ - High-Definition Earth Modeling

The Paradigm SKUA-GOCAD software is a pioneer in the engineering and petroleum industries by providing a strong and all-inclusive solution for data administration, interpretation, reservoir characterization, geo-modeling, and other geoscientific tasks. The suite of tools enables geologists, engineers, and other geo-experts to build intricate simulations and models to comprehend the subsurface.

The Paradigm SKUA-GOCAD program aids users in a variety of seismic, reservoir engineering, analysis, mapping, and other domains. It has the capacity to import data from seismic surveys, well logs, ground and subsurface maps, and other sources. Additionally, it provides the ability to attribute subsurface properties for reservoir simulations and volumetric assessment. It allows to include in the model sophisticated model structures, multi-z surfaces, and faults with unusual geometry, such as salt dome, overthrust, and reversal faults.

For this work, the GoCad three-dimensional environment of Paradigm was used for the visualization of the seismic lines, the digitization of the stratigraphic units and structures (i.e. faults) and their interpretation.

Chapter 4.

4.1 WORKFLOW

The processes for seismic interpretation as well as the interpretive structural and geological modeling included:

a. Opening a project.
b. Input of data file types SEG-Y in the 3D environment.
c. Recognition of the different stratigraphic units and structural elements.
d. Modeling (digitization) the horizons and fault networks.
e. Building the geologic grid.
f. Interpretation.

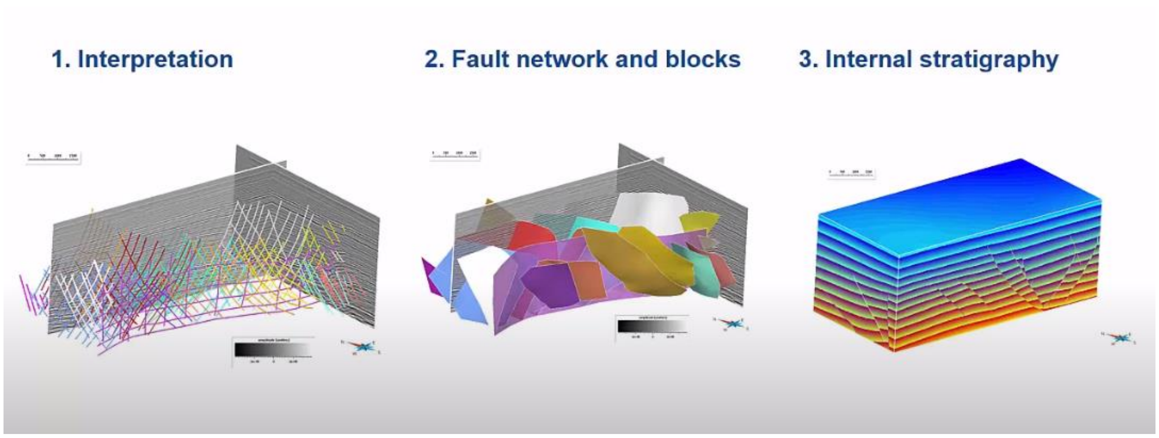
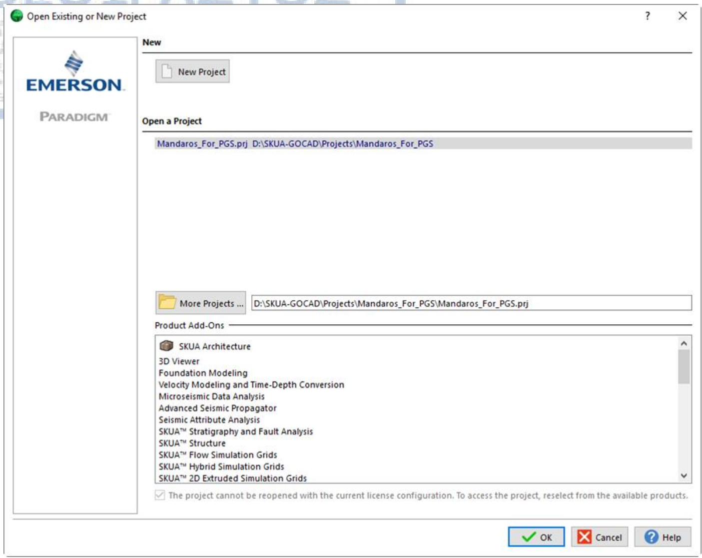


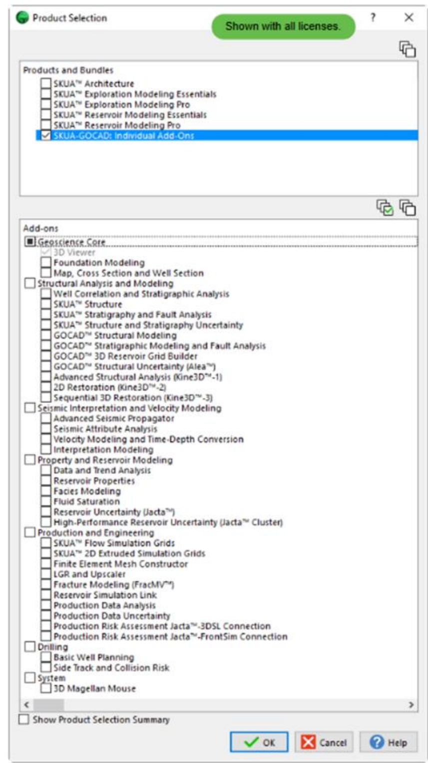
Figure 6. Process followed for this work.

4.1.1 CREATING A NEW PROJECT

To create the new project, in the Open Existing or New Project dialog box, proceed as follows:

1.Click New Project.
2.Specify the full path and file name.
3.Click Save.
Next, choose the add-ons for the new project.



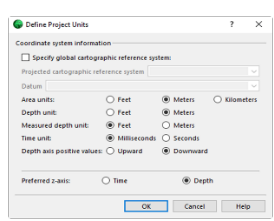


4.2.2 CHOOSING ADD-ONS FOR A PROJECT

From the Product Selection dialog box select which add-ons to load with the project. Add-ons are plug-in products that include specialized functionality for work in specific disciplines. Choose add-ons based on the types of modeling, analysis, and planning activities you want to do.

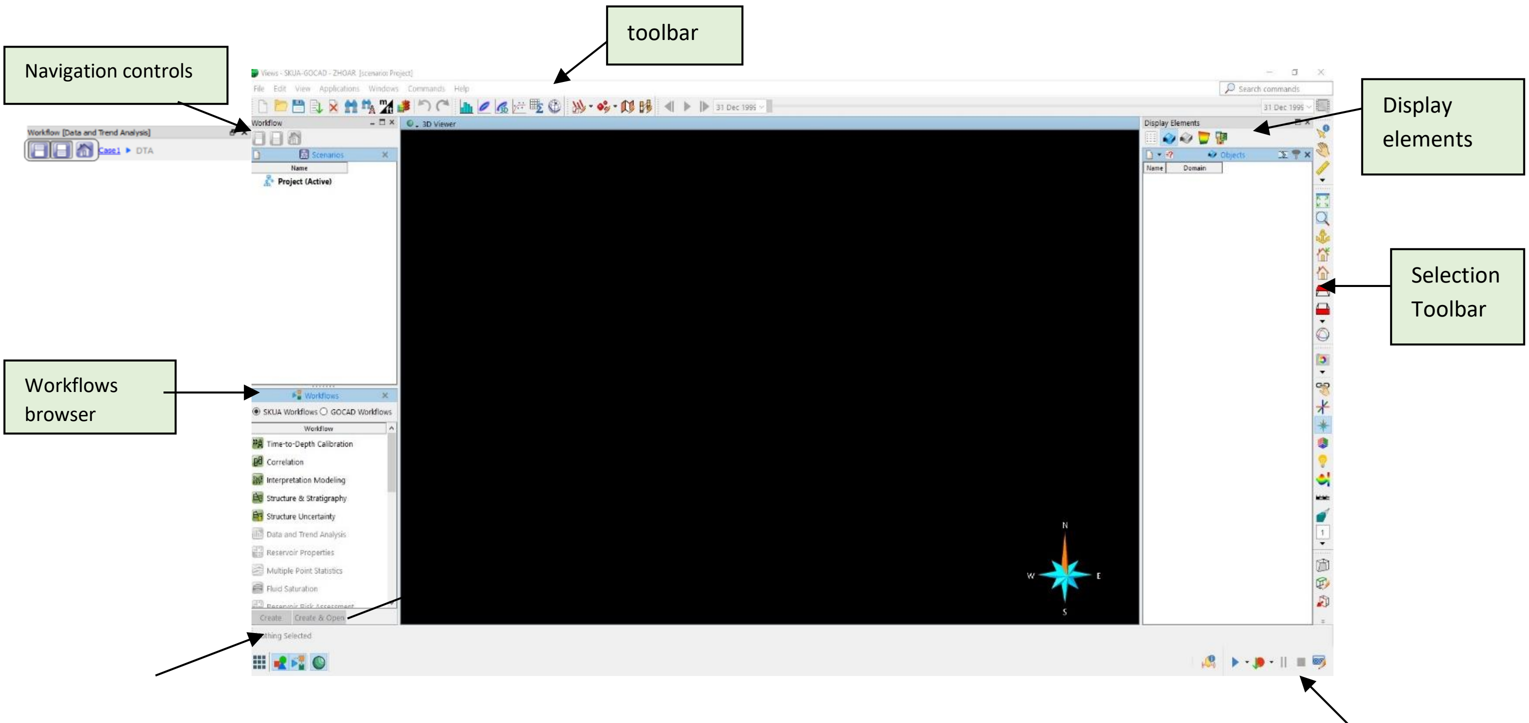
4.2.3 SET THE UNITS FOR A PROJECT

Define the units of measure and the orientation for depth values and the domain (time or depth). Save the project.



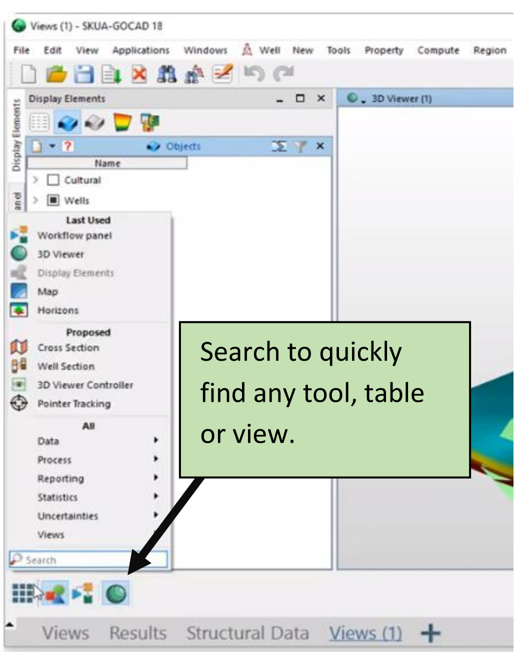
4.2.4 INTERFACE – APPLICATION WINDOW

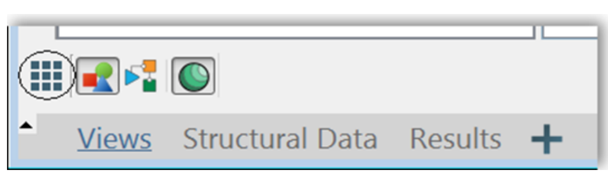
Basic commands and the additional functionality associated with any add-ons loaded with the project:



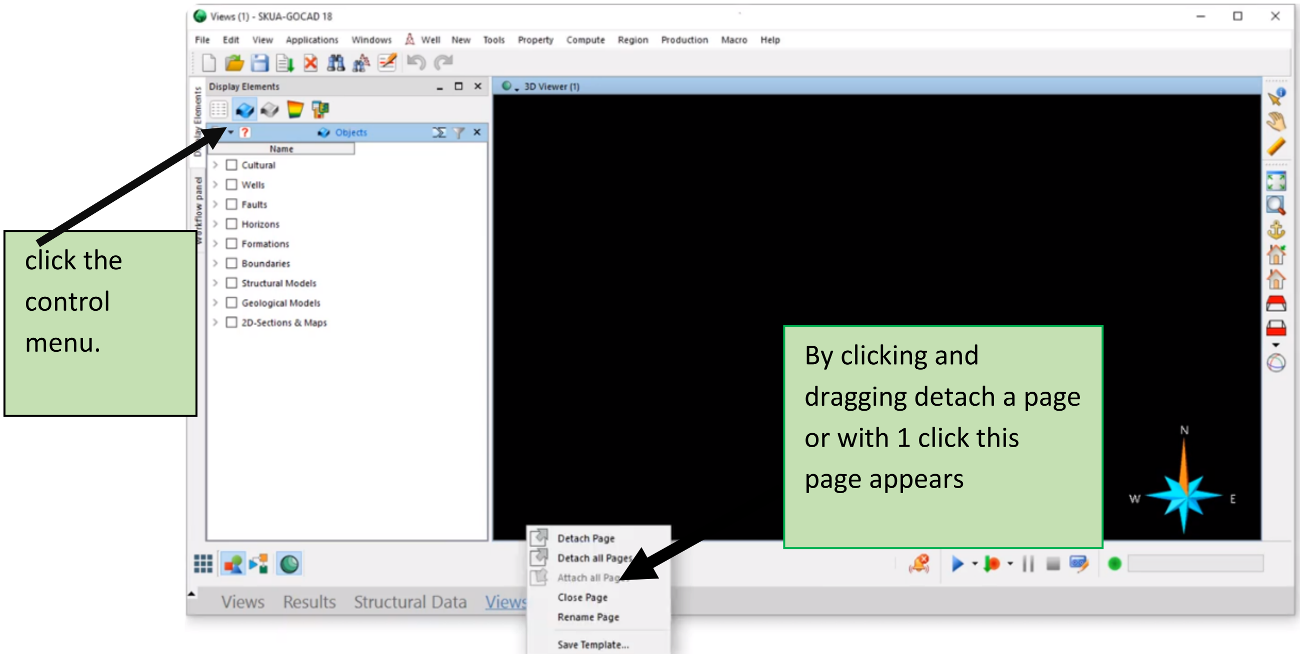
4.2.5 CONTROL MENU

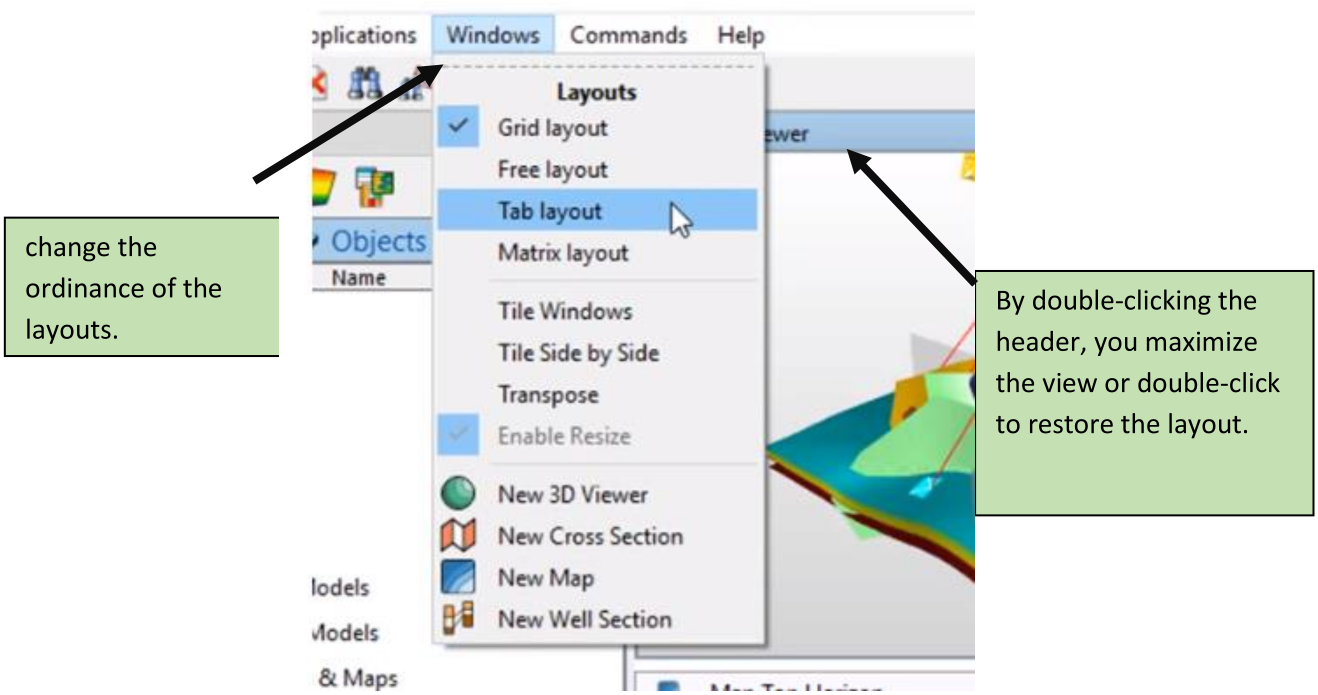
Control menu to add views and utilities.



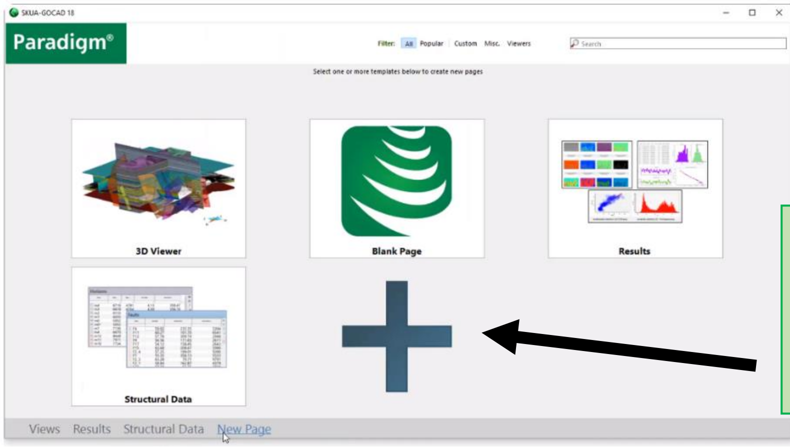


4.2.6 CUSTOMIZING PAGE

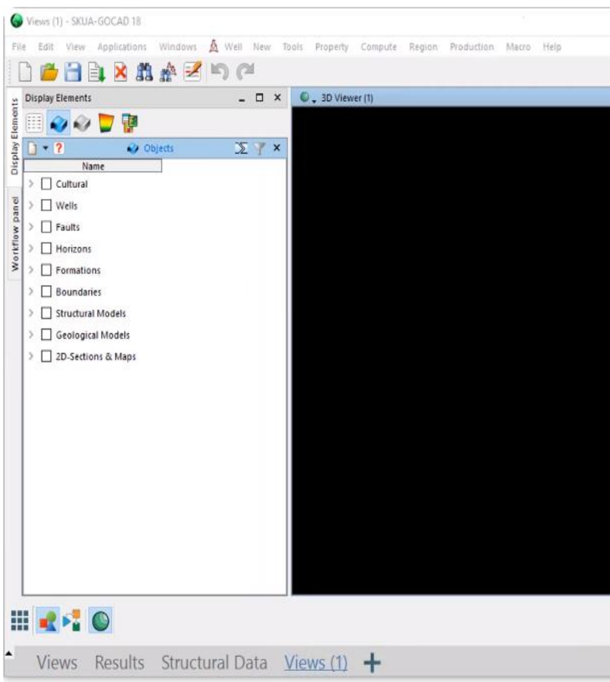




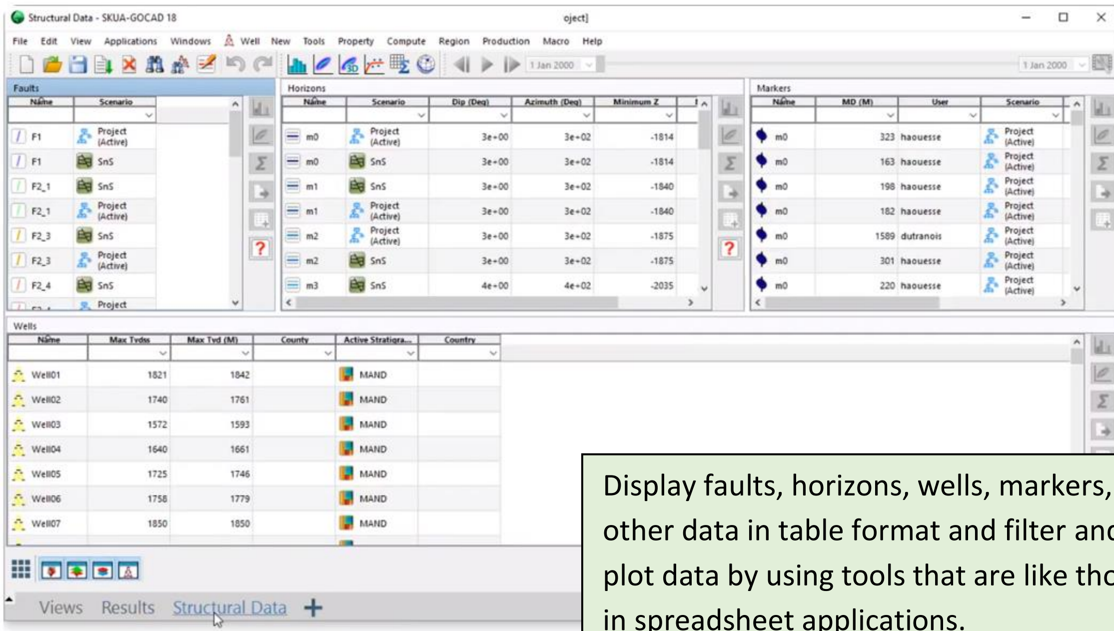
4.2.7 PREDEFINED PAGES



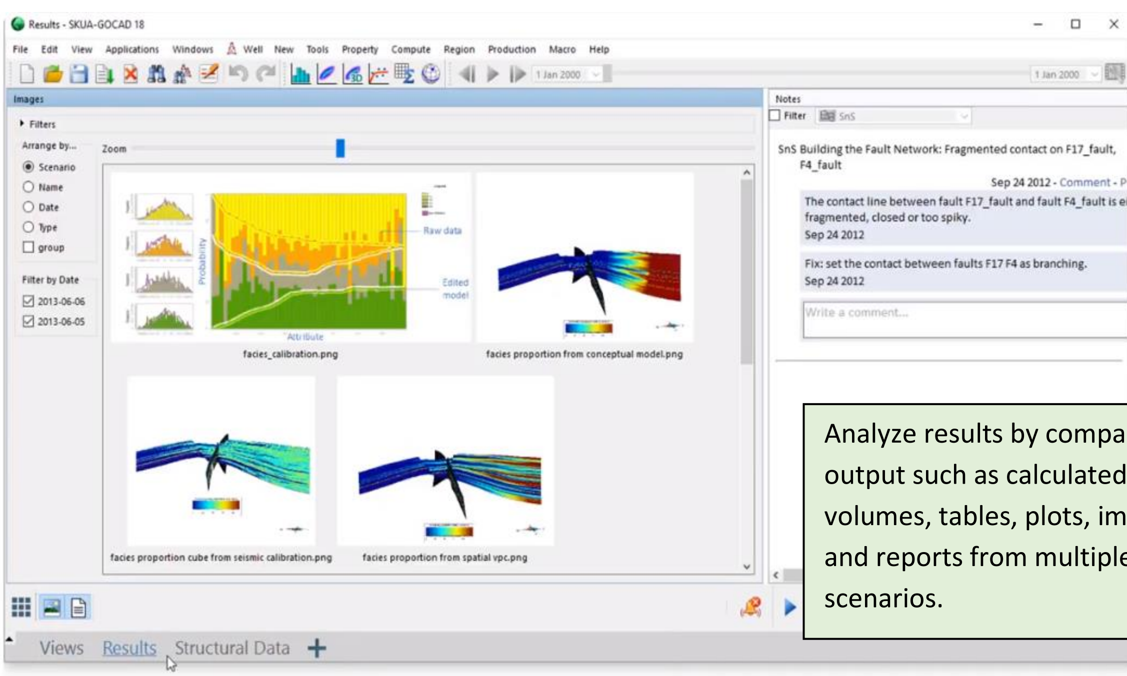
Create a new page or load a saved template.



- Browse all objects, data, and resources in your project.
- Open views to visually examine and manipulate your data models in 2D and 3D views.
- Change the appearance of displayed data and views with style settings.
- Import, create, and edit data.
- Get information about data objects and resources.
- Organize data in lists and folders.
- Assign geologic feature and property classifications to modeling objects and properties.
- Visually validate modeled objects and properties.
- Work with resource data to model, classify, analyze, or check the quality of your geometric objects.



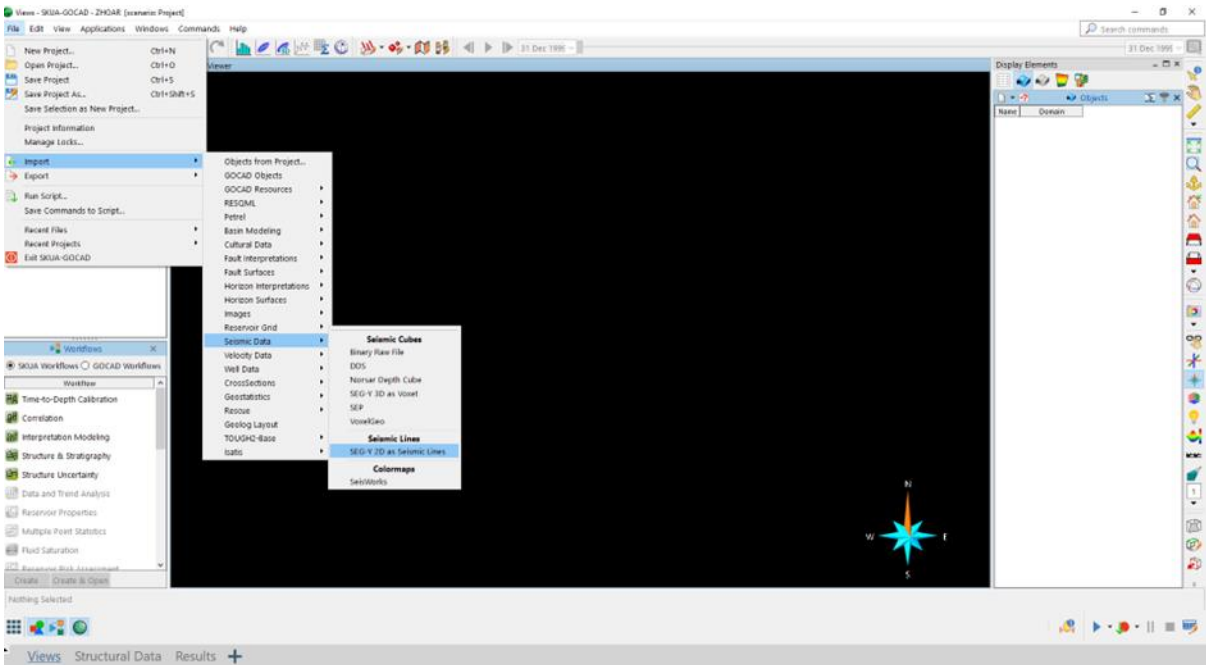
Display faults, horizons, wells, markers, and other data in table format and filter and plot data by using tools that are like those in spreadsheet applications.

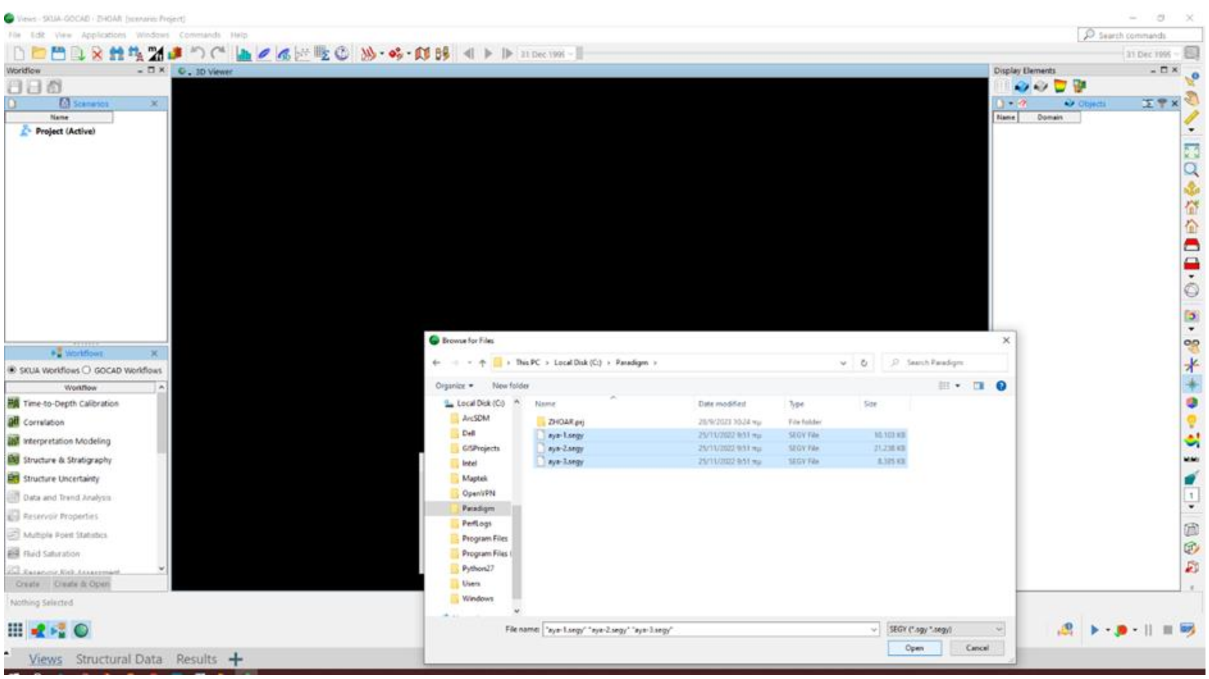


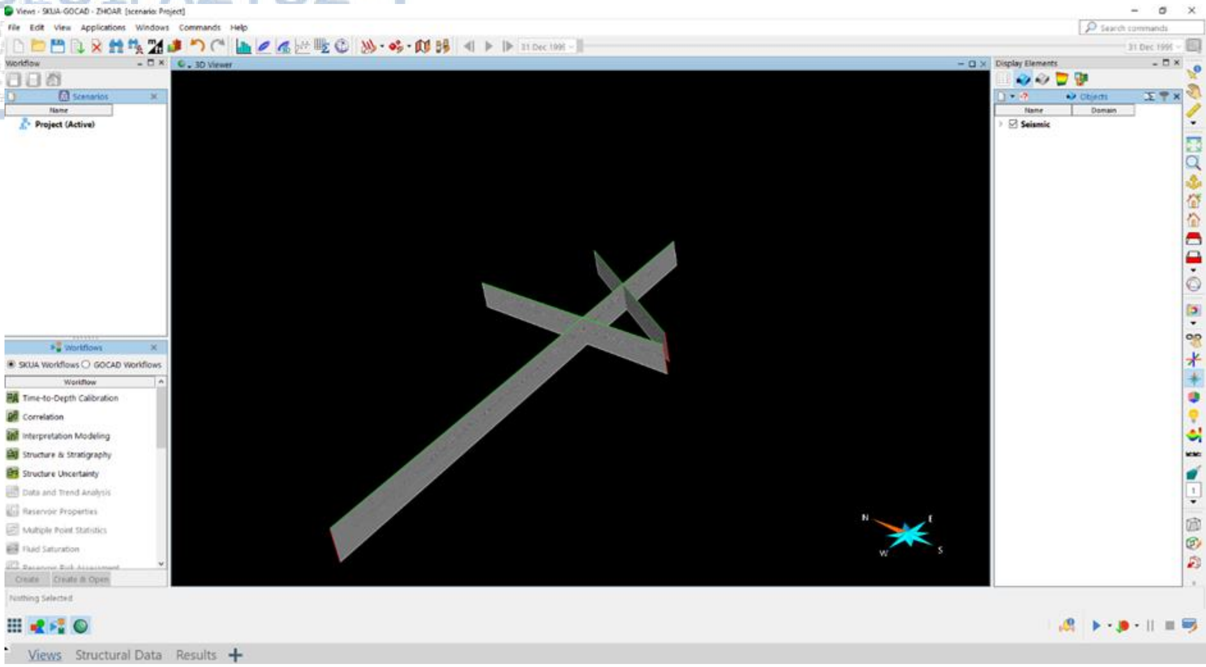
Analyze results by comparing output such as calculated volumes, tables, plots, images, and reports from multiple scenarios.

4.2.8 IMPORTING DATA

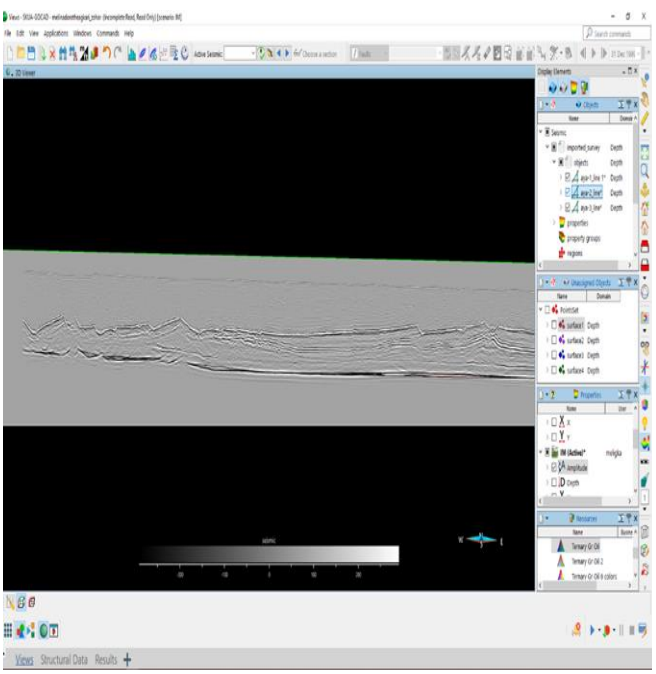
File ->import->seismic data->seg-y as seismic lines

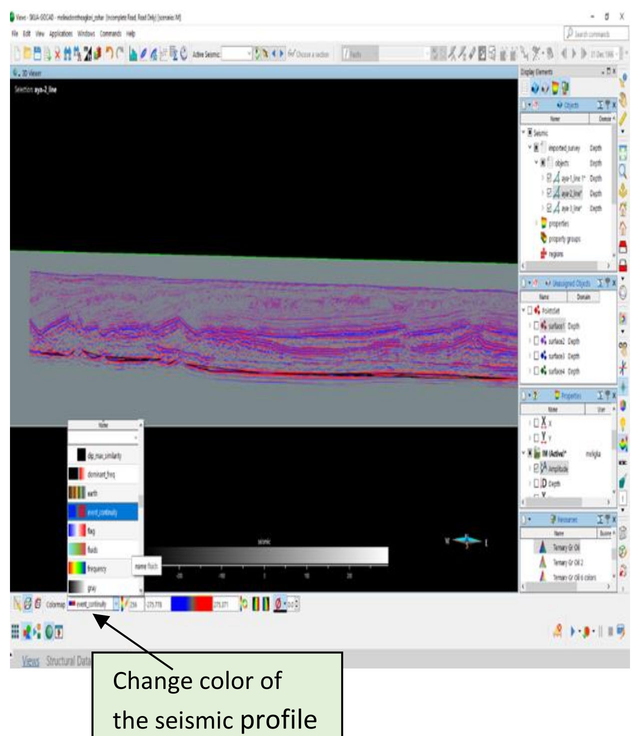






SEISMIC LINES: an object collection of seismic traces along one seismic line (shot lines).



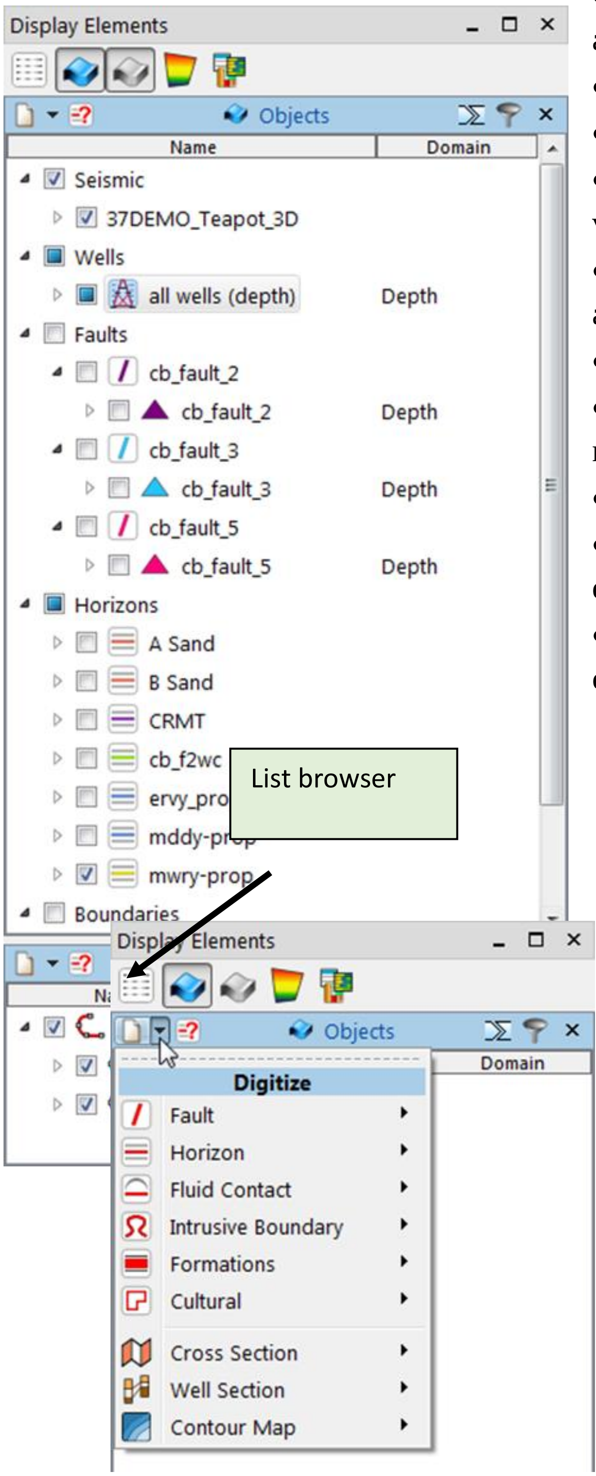


Change of color of the seismic profile to make it easier to identify the stratigraphy and tectonics (faults, grabens)

4.2.9 DISPLAY ELEMENTS

Browse through the digitized data (Objects and Unassigned Objects Browsers)

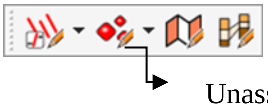
From the **Objects** browser and the **Unassigned Objects** browser:



- Browse through all objects to display in the active view.
- Create objects.
- Edit information about objects.
- Display objects and properties in the active view.
- Access commands and settings for objects and views.
- Perform drag-and-drop editing operations.
- Access commands to construct and manipulate your models.
- Create and edit geologic features.
- Reorder and rearrange the organization of data in the browser.
- Filter of data to search for features and objects.

4.2.10 DIGITIZATION

To ensure the toolbar is visible, select View -> Toolbars -> Digitization/Editing toolbar.

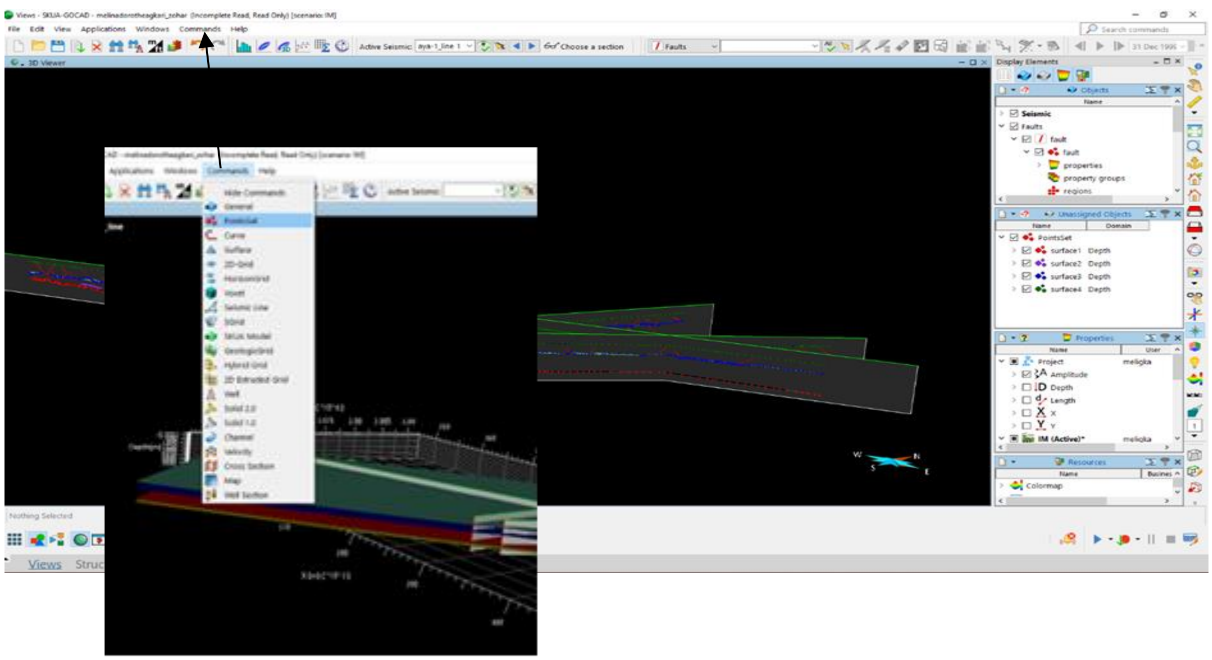


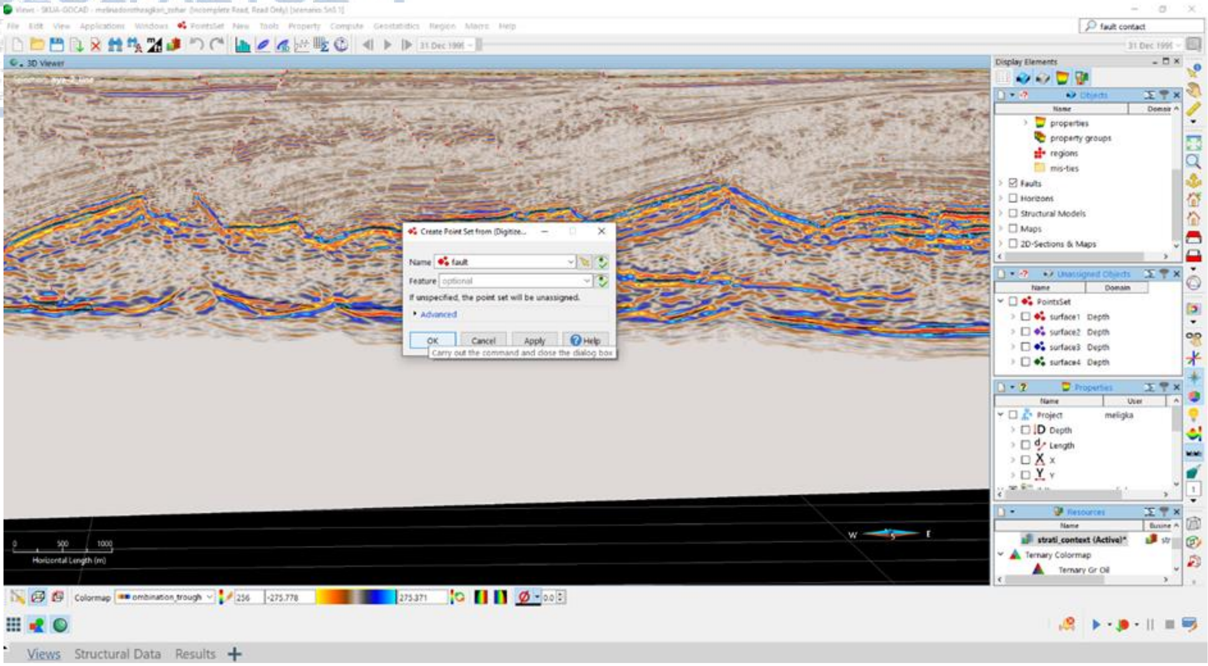
Unassigned objects

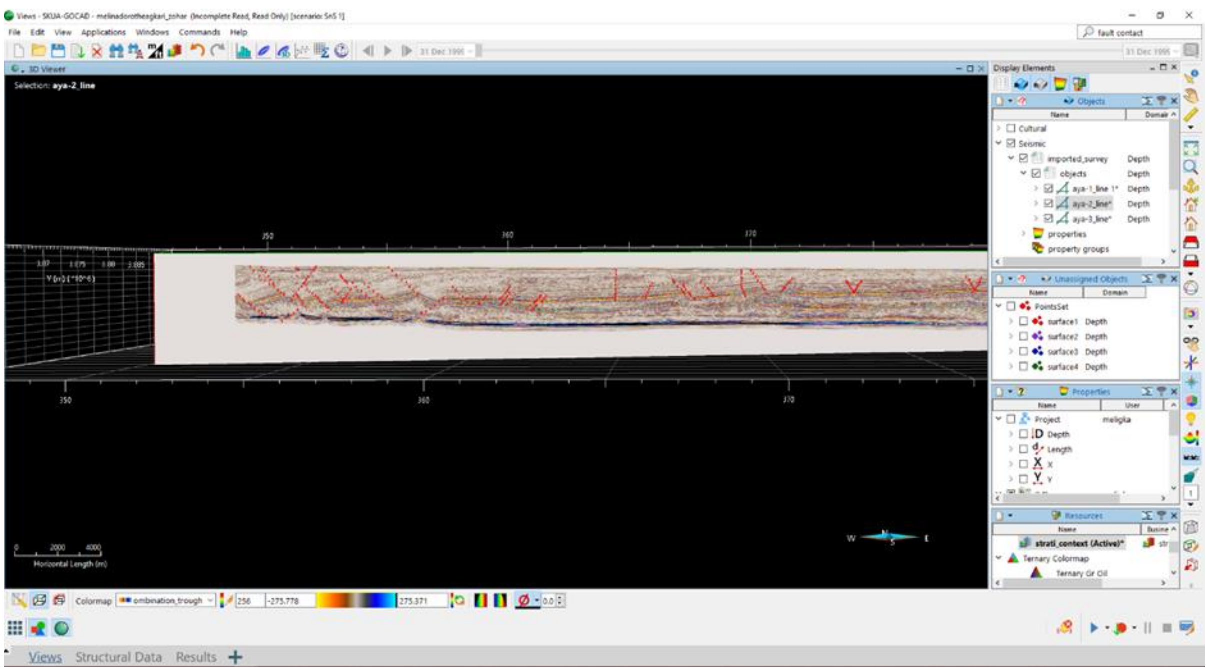
4.2.10.1 CREATING POINT SETS

A Point Set is an object that contains discrete data points with no connection between the points - for example, points from seismic interpretations.

To create: In the Unassigned Objects browser, on the title bar, select  Create Unassigned Objects menu -> Points.
To remove: Select PointsSet commands ->Tools -> Part -> Delete Selection.



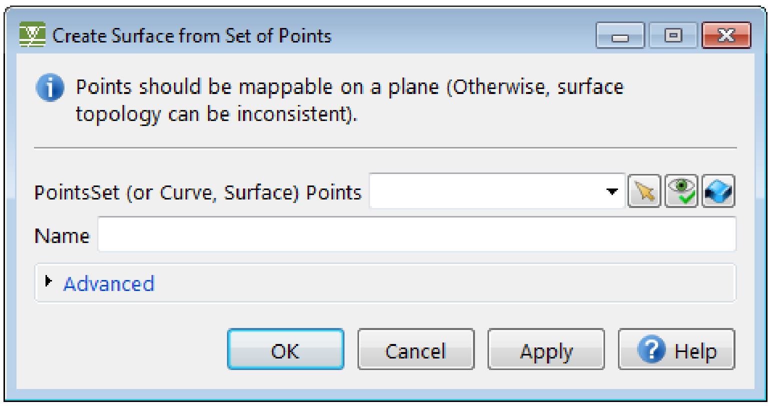




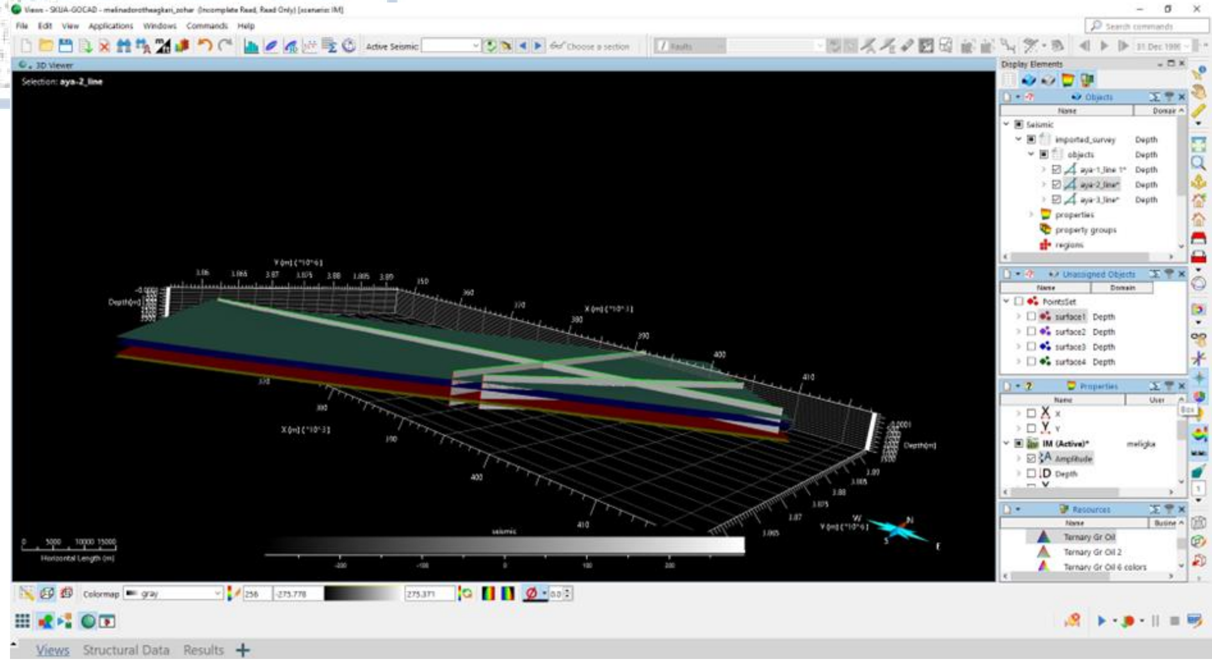
4.2.10.2 CREATING SURFACES FROM POINT SET

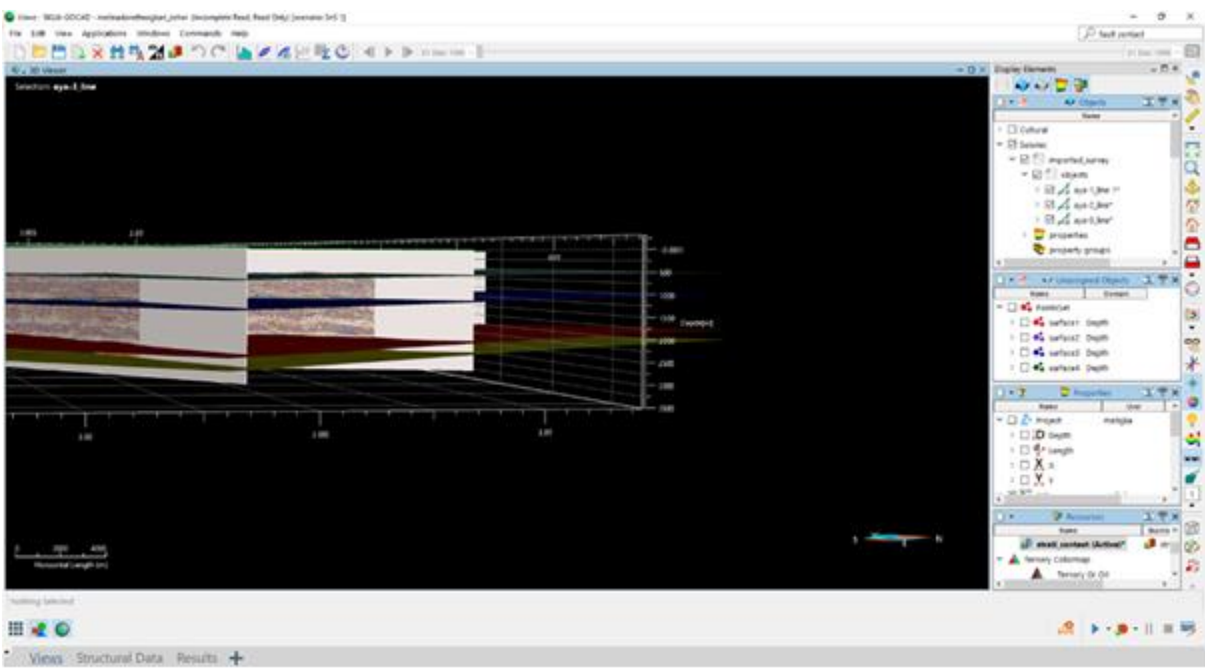
A Surface is an object that contains points connected by triangles. Surfaces can also consist of multiple disconnected parts.

- Display the point set in the 3D Viewer.
- Select Surface commands -> New -> From PointsSets -> PointsSet.

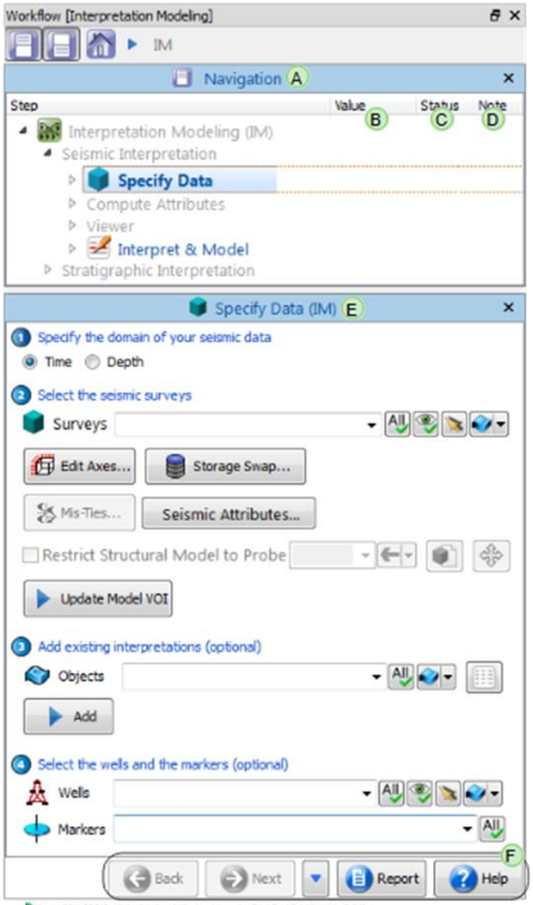


- Specify the source object and settings for creating the surface.
- *Points Set:* The source object (point set, curve, or surface) providing points to use to create the triangulated surface mesh.
- <u>Name</u>: The name for the new surface.
- To learn about adding the surface to an existing surface, see Surface name.
- For greater control over creation of the surface, in the Advanced area, specify settings as necessary.
- See Advanced Settings for Creating Surfaces.
- Click OK or Apply.

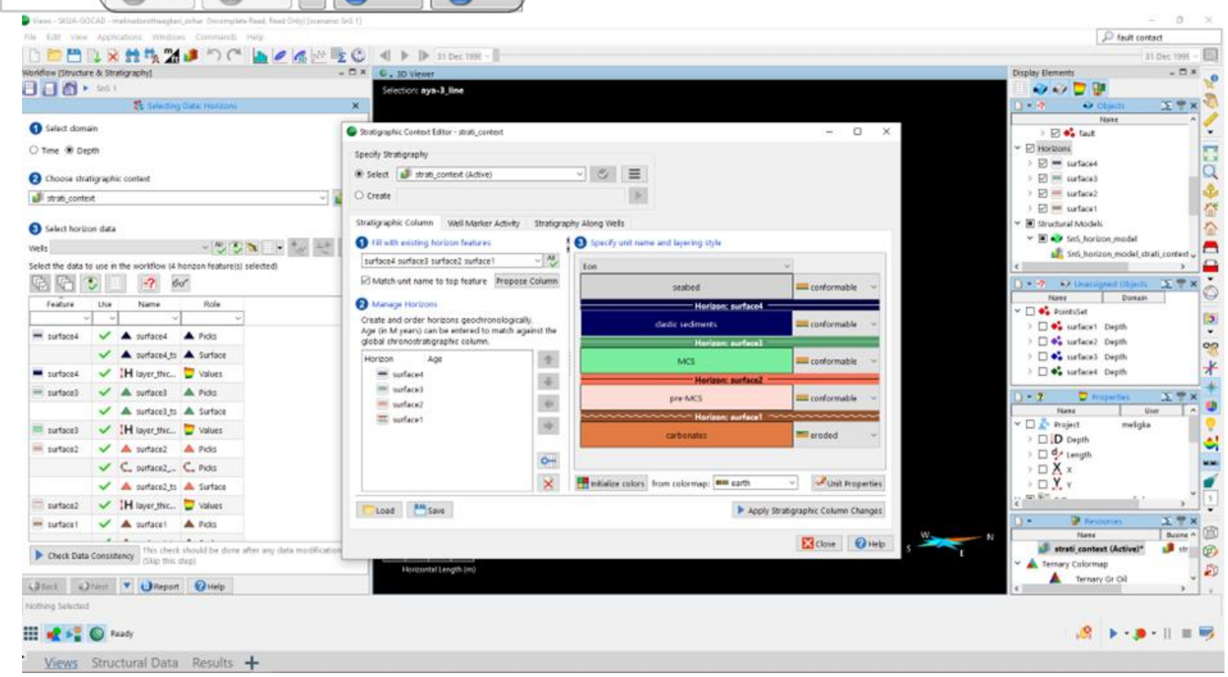

3D Viewer
Selection: aya-2_line
Display Elements
Views
Structural Data
Results

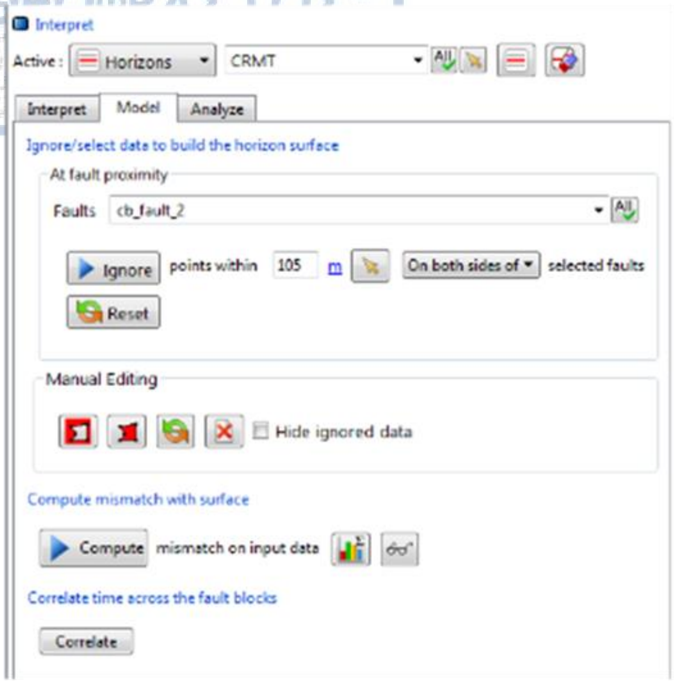


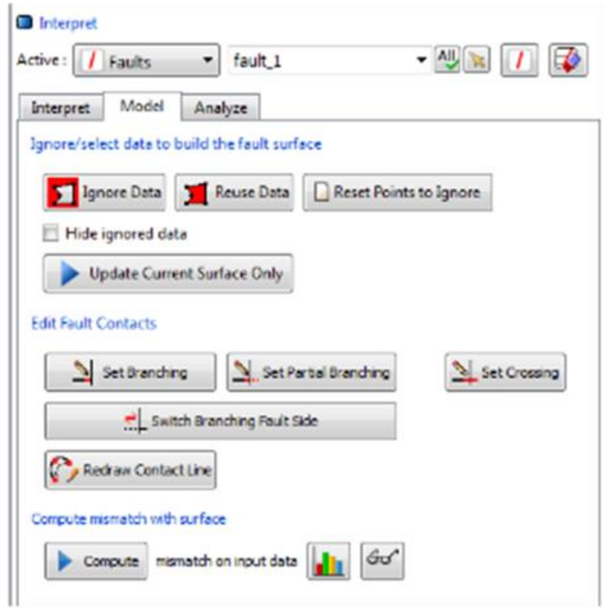
4.2.11 INTERPRETATION MODELING



a. Navigation pane
b. Value column
c. Progress column
d. Notes column
e. Workflow task panel
F. Workflow buttons







After the model creation the Interpret & Model tasks included:
(from **Model** tab)

- Edit data used to build horizon and fault surfaces in the SKUA model.
- Edit fault contacts.
- Compute mismatch between computed surfaces and input data.
- Correlate time across fault blocks.

Chapter 5.

5.1 RESULTS

5.1.1 SEISMIC STRATIGRAPHY

In the study area, four distinct seismic units were identified based on the analyzed seismic reflections and amplitude (acoustic character) and stratigraphic continuity and deformational complexity of the units. From bottom to top these include:

Unit 1 (-3500 to -3000 meters depth). Thickness >500 m. This unit shows a highly continuous and flat upper surface showing low-medium amplitude. The unit shows wavy sedimentation with low to medium sedimentary deformation, with faulting space averaging at approx. 1000 meters.

Unit 2 (-3000 to -1500 meters depth). Thickness 1500 m. This unit is highly deformed presenting sets of normal faulting that form numerous graben structures. The normal faults repeat every 200 meters. The upper boundary of this unit is characterized by uplifts and depressions showing over 100 meters vertical movements.

Unit 3 (-1500 to -300 meters depth). Thickness 1000 m. This unit, in comparison to the underlying unit 2, is moderately deformed presenting normal and reverse faults that crosscut in places only half the unit. The upper boundary is relatively flat. Some thin subunits present ‘slump structures” implying seismic activity and/or turbiditic movements.

Unit 4 (-300 to water surface). Thickness 300 m. This unit in continuous and flat with flat upper surface obviously representing the upper clastic seabed sedimentary sequence.

5.1.1 TECTONIC STRUCTURES

Several distinct tectonic structures have been identified and mapped crosscutting the stratigraphic units observed.

a. Horst and graben structures mostly in Unit 2 with deep depressions filled by flat-lying sediments.

b. Multiple sets of mostly normal and reverse faults. We identified Neogene high angle faults that crosscut all above lithological units. Smaller set of faults are restricted in specific units or subunits.
c. Seismites (or slump structures).
d. Erosion structures.

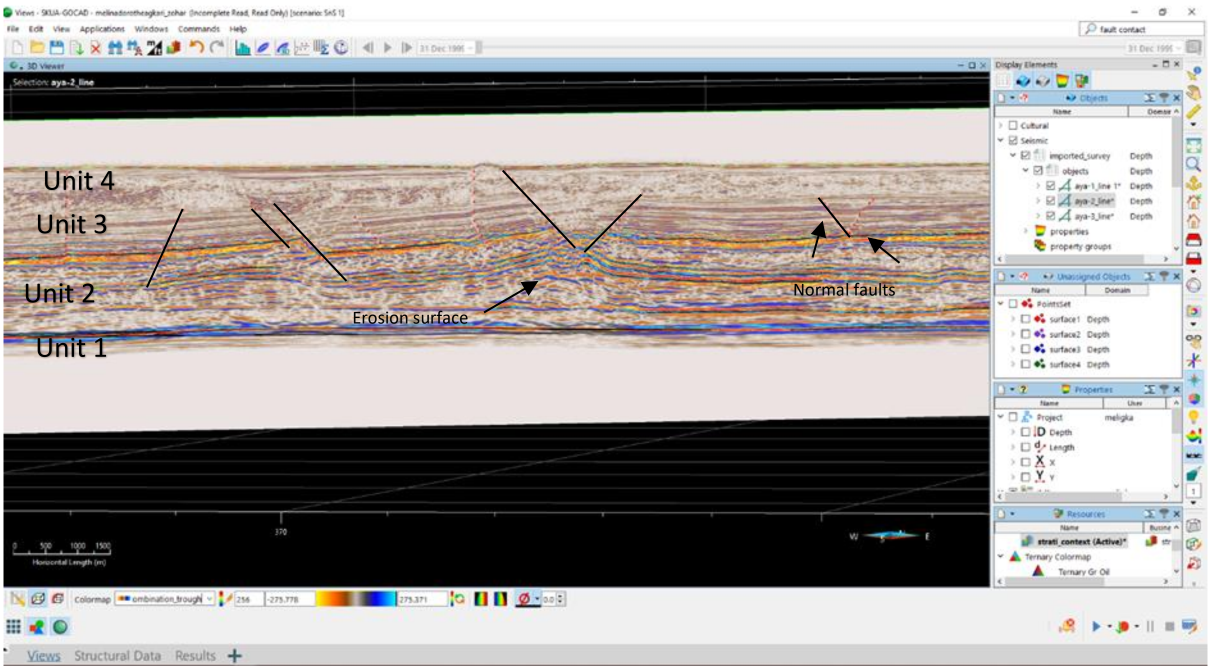


Figure 9. Screenshot of part of the Seismic line SEG-Y 3 showing the identified Unit layers and interpreted faults and erosion surfaces.

Chapter 6.

6.1 DISCUSSION AND CONCLUSIONS

Petroleum systems are typically strongly associated with basins that have undergone an evaporitic phase or tectonic deformation i.e. anticlines or faults (Warren 2006). Because of its evaporitic sedimentation and tectonic history, the Eastern Mediterranean is a very promising exploration area for hydrocarbons and gas resources.

The southern part of Cyprus is regarded as an appealing exploration location with untapped potential. The Zohr Gas field has only a 4-6 km distance from Block 11 of Cyprus and 40 km distance from the identified Aphrodite gas field. Within the Cyprus EEZ, similar Zohr-like potential to discover is very high.

According to Mousouliotis et al., 2020 the gas traps south of Cyprus are salt tectonic deformation patterns of the Messinian Salinity Crisis (MSC) sequence in the eastern section of the Herodotus Basin in the Eastern Mediterranean. In the study area presented here the digitalization and interpretation of the seismic reflection profiles within the first 3.5 km below sea level using PARADIGM software, showed a highly prospective area for hydrocarbon traps.

Based on the seismic reflectors, our study area is separated into four seismic stratigraphic Units (Unit 1, 2, 3, and 4). These identified stratigraphic layers and according to the published works for that area correlate well to the stratigraphic Units of the Plio-Quaternary clastic sequence for the Unit 4, whereas the Units 1-3 correspond to the MSC sequence, which is bounded at the top and bottom by strong and distinctive reflections.

Based on the seismic stratigraphy of the sequence we identified potential traps for hydrocarbon reservoirs including low angle anticlines, faults that transect different lithological units, as well as, graben structures.
Taking into account that the deeper parts of this stratigraphic column is represented by the Messinian evaporites we conclude that the area of this study has high potential for discovering hydrocarbon or gas deposits.

Chapter 7.

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