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## Contribution of Remote Sensing for Geological Study of the South – East of Constantine Basin, North of the Algeria

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# Contribution of Remote Sensing for Geological Study of the South – East of Constantine Basin, North of the Algeria

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**Abstract.** The main objectives of this work are to map and characterize network of likely fractures to develop major deposits carbonated in the region. It is a contribution to a better knowledge of the geometry of existing surface fractures networks and their extension in subsurface. For this it appeals to the tool of remote sensing and seismic. Using remote sensing data, our study enabled us to draw up a card lineament, along with tectonic analysis, where we could list 409 lineaments divided into 9 classes according to their directions, among which: the main directions of the NW/SE fracturing are: H (N1300-N1500), G (N1100-N1300) and F (N900-N1100). These three classes are in agreement with the major flaws of the region, which are: the fault of Biskra-Outaya, Ouinet-Morsott-Tébessa and the dextrose form. Of after the deferential work carried out on the South East Constantine area, and the results obtained by the seismic reflection, as well as the well data, summarizes our reservoirs are characterized by a mainly low to medium porosity and low permeability, these tanks are carbonated, and are affected by the majority of vulnerabilities detected on the surface, but these do not contribute to the improvement of the Petrophysical characteristics This can be reported to the clogging of the cracks.

## 1. Introduction

The South East Constantine basin, is located in the eastern part of northern Algeria (Figure 1). It includes a Northern domain (area), strongly structured and deformed, and a southern area, constituting the last Atlasic reliefs before the Saharan platform, characterized by the Miocene and Eocene outcrops (Figure 2). The main objectives of this work are to map and characterize the fractures' network which are likely to develop major carbonated deposits in the region, with the help of remote sensing and of the seismic.

The main structural features of the latter are:

- The orientation accident of the East-West, known as the South Atlasic accident.
- The orientation accidents of the North-west/South-east by Guiraud [1], Aissaoui [2].
- Accident north-east / south-west [3], the folds described by Addoum [4] and overlap and the diapirs.
- The main stratigraphic terms range from the Triassic to the current (Figure 3).
- Triassic in the Melrhir chott is argilo-sandstone and discordant on the Paleozoic, furthermore in the North it doesn't flush (outcrop) except in (as) diapiric extrusions, at the heart of the Ejective and at the crosses of the accidents, Villa [5].



## 2. Acquisition and Satellite Processing Data

The highlight of the geological formations lays under the analysis of three basic criterias of the photo-interpretation: the spectral signature tone, the color, the morphology and the texture and structure [6].

### 2.1. Geological overview on the study area

The main geological formations that outcrop in the region are essentially of a Miocene and an Eocene age in the South and of an upper and Middle Cretaceous age in the North, we also notice the presence of the Triassic in the North of the study area in the form of diapiric point (Figure 5).

### 2.2. Structural style

Depending on the Cup, we notice a stable area in the South, a bit deformed, affected by normal faults at low rejects, structuring is accentuated by the replay of the South Atlasic accident. Towards the North, a lift of the substratum is caused by the halocine and the diapers installation (Figure 6).

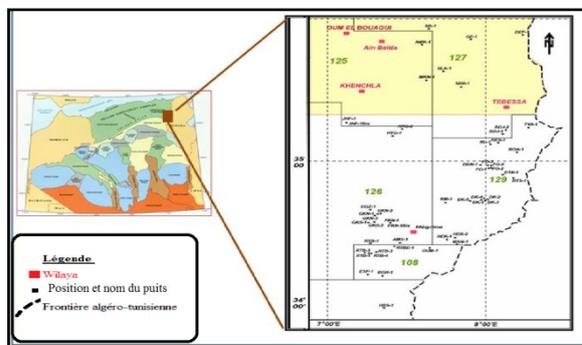


Figure 1. Geographical Location of the South -East Constantine Basin

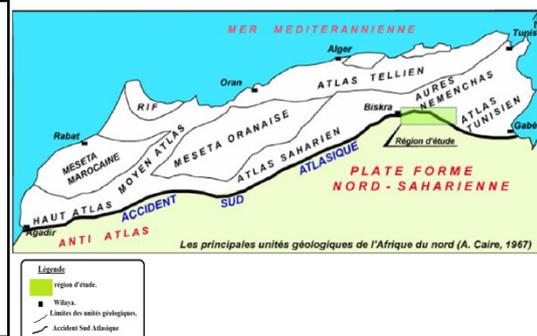


Figure 2. The main units of the North African

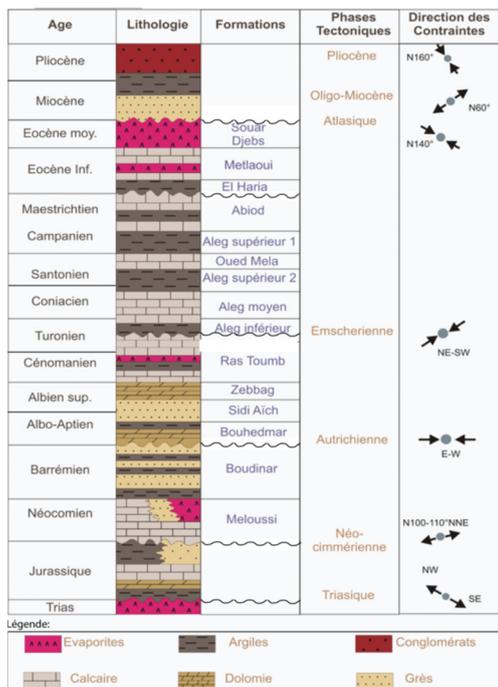


Figure 3. Stratigraphic column of the area study [4]

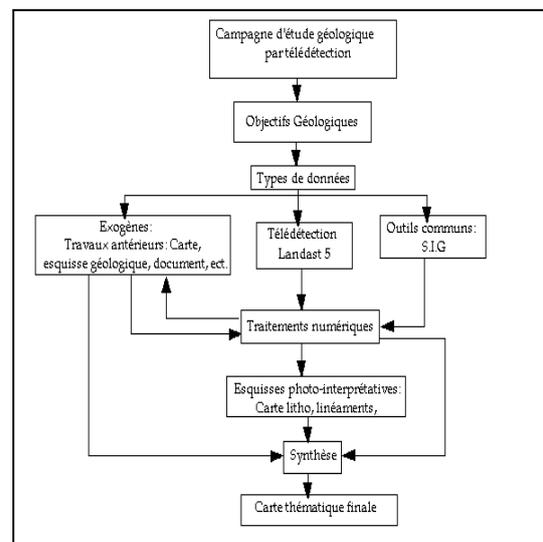
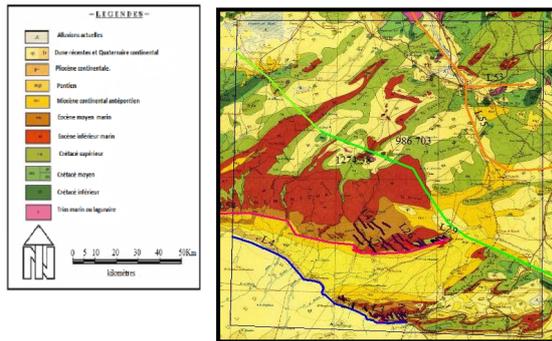
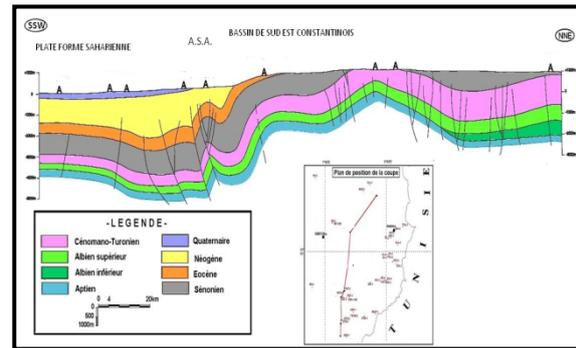


Figure 4. Step of a companion of remote sensing



**Figure 5.** Geological map of the area study from the geological map 1/500000.



**Figure 6.** Regional geological cross-section SSW - NNE in the South -East Constantine Basin.

It can be characterized 4 major flaws: L4, L54, L52, L53, and L55 [1, 3, 7, 8] (Figure 5).

### 3. Methodology

The methodological approach is based on all the geological works and on the Thematic Mapper of Landsat 5 data contribution.

#### 3.1. Used Documents

- Satellite raw scenes of Landsat5 (TM, 192/35, 36/192 and 193/35 and 193/36), where we extracted an image of a size 5400 by 5624 pixels.
- Geological maps of the study area on the scale 1/200.000 and 1/500,000.

#### 3.2. Spreading dynamics

It consists of the redistributing of the shades of grey values, beforehand chosen among the two raw threshold of histogram on the 256 levels (0 et 255).

#### 3.3 Colorful composition

R.V.B (red, green, and blue) of the region is established from the channels T.M.7, 4.1. We notice that in these three colors, the soft tectonic geological structures are well highlighted. The brittle tectonic is well materialized.

#### 3.4 Transformation R.V.B in I.T.S

This type of treatment consists in transforming the system R.V.B, T.M.7, T.M.4, T.M.1 into an intensity system, hue and saturation. The hue channel has enabled us to complete the lineaments network of the region on its two aspects (materialization of the network or under its radiometric shape).

#### 3.5. Structural analysis of the fracturing (Figure 7)

Basing on the Thematic Mapper of Landsat 5 images, a structural analysis has been done on 409 lineaments. For a good and objective interpretation, we have chosen a directional step (gap) of twenty (20 °) degrees. Different directions of lineaments have been highlighted (proven), Figure 8, Table.1.



**Figure 7.** Characterization of fracturing from different appropriate treatment system

**Figure 8.** Lineament Map showing the different class

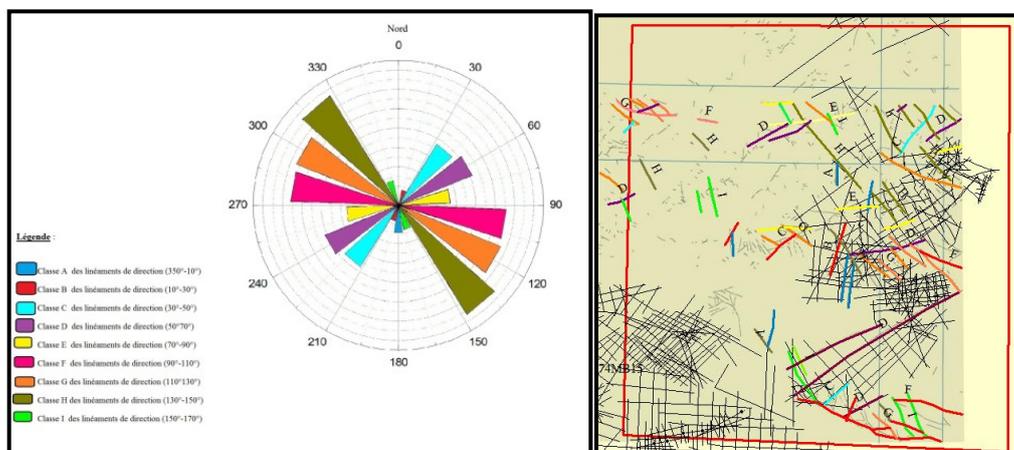
**Table 1.** Direction recapitulate of Lineaments encased in in the study area (with a 20° step)

Direction of the Class	Number of lineaments by average direction	Percentage %
A- 350°-10°	28	06.85
B- 10°-30°	23	05.62
C-30°-50°	47	11.49
D-50°70°	50	12.22
E-70°-90°	38	09.29
F-90°-110°	62	15.16
G-110°130°	63	15.40
H-130°-150°	71	17.39
I-150°-170°	27	06.60
Total	409	100%

## 4. Results

### 4.1. Rosette

Lineament statistical analysis revealed that the main direction is that of class H (N1300-N1500) of a direction NW/SE, this class is the most important, it represents 17.35%, and to a lesser degree those of a class F (N900-N1100), which represents 15.16% (Figure9).



**Figure 9:** Rosette of directional distribution of lineament cashed in the study area

**Figure 10:** Position of the lineaments on seismic plan

#### 4.2. The seismic

It is used to study fractures detected at the surface and their continuity in subsurface, where they can affect the tanks of our region. The used profiles are chosen in a way that the different classes of fractures detected by satellite can be observed (Figure 10). It was chosen 11 profiles, as they cross the majority of the distinct classes (Figure 11).

#### 4.3. Profile 1

It is located in the South East of Djebel Foua, oriented SW /NE , this profile shows the G class flaws that affect the 2 tanks (Figure 12). According the seismic study, we have been able to check the continuity of the fractures detected at the surface by satellite images in subsurface. Profiles 1, 2, 3, 4, 5, 6, 7, 8 and 9 have shown faults detected by the satellite images of the classes. A, C, D, E, F, G, H and I, which extend in depth to until affecting the 2 tanks.

#### 4.4. Oil results

The main deposits of hydrocarbons discovered in the area are:

- The gas fields of Djebel Foua in the Coniacienne series, with a maximum throughput of 147.000 m<sup>3</sup>/day to FO - 2,
- the oil deposit of Djebel Onk in the same series, the Cenomano-Turonian oil field (horizon Ras Toub) and the oil deposit of Guerguit El KILHAL in the Cenomano-Turonian limestones.

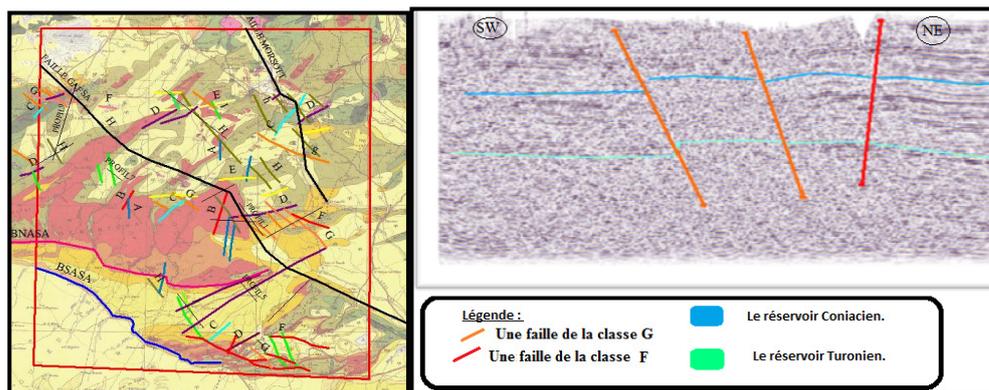


Figure 11. Position of the seismic profiles.

Figure 12. Profile 4 showing the Class G and F.

#### 5. Conclusions

In our frame of work on the South East Constantine area, the remote sensing and Landsat 5 images in particular, have been proved to be very effective to the geological recognition.

Thanks to the remote sensing data, we have been able to draw up a lineaments map, accompanied with tectonic analysis, where we have been able to list 409 lineaments divided into 9 classes depending on (in function of) their directions, among which:

The main directions of the fracturing NW/SE are: -H (N1300-N1500). -G (N1100-N1300). -F (N900-N1100).

These three classes are in agreement with the major flaws of the region, which are: the fault of Biskra-Outaya, of Ouinet-Morsott-Tébessa and the Dexter blackouts, which have played an important role in the structuring of the basin. Some other secondary directions, less frequent than the first ones, of orientation NE/SW - C (N30 - N50) -, D (N50 - N60 0), - E (N 60 - N70).

These fractures correspond to the important longitudinal flaws and to accidents from the base. According to the different works achieved and to the results obtained by seismic reflection, as well as the Well data, we concluded that our tanks are characterized by a mainly low to medium porosity and low permeability, these tanks are carbonated, and are affected by the majority of the detected flaws on

the surface, but these latter do not contribute to the Petrophysical characteristics improvement, this may be due to the clogging of the cracks.

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