GEOLOGY POSTER 14

METHODOLOGY IN SURFACE EVALUATION OF THE FOLD AND THRUST BELT REGION

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INTRODUCTION

Folded-belt is a distinctively challenging area for all type of E&P activities. Majority of folded-belts on earth are known non- working petroleum system. However some folded-belts are distinctively proven prolific hydrocarbon zone and active E&P area, for example in the Middle East. In areas where accessibility is a challenge, be it geographically or politically, a new method of geological evaluation is needed. There are also times where subsurface data is acquired but due to its low sampling and poor quality this could be a challenge to interpret therefore, a different method is required to assess the area of interest. Moreover, present-day challenging global E&P environment, forced us to look beyond our comfort zone and identify exploration opportunity in areas where we are limited in capability.

This presentation will discuss briefly on workflow and methodology used in evaluation and hydrocarbon prospecting of a folded belt surface evaluation.

WORKFLOW & METHODOLOGY

Prior to the start of any evaluation, a regional study is needed to identify important tectonic events, it's elements and dynamics, structural style and basin evolution which among others include, sediment fill and rock rheology's influence on deformation pattern and regional field excursion is needed to calibrate with desktop evaluation and to confine structural styles.

The satellite based mapping was done by interpreting data from Landsat-7 ETM+ and SRTM (LDCM, 2006). The in house Landsat data has a 30m (Band 1-7) and 15m (Band 8) resolution. SRTM or Shuttle Radar Topography Mission records digital elevation models near global scale from 56 deg S to 60 deg N. The database resolution is 90 m. Google Earth was used as referenced because direct structural interpretation cannot be done on it hence it was used to visualize terrains in 3D. In areas where vegetation is low, lithostratigraphy changes can be easily recognized. However, dipping beds might be a challenge to observe due to dip smearing that occurs in Google Earth images.

Structure pattern identification is done by outlining structural crest using SRTM data (Figure 2). This exercise is done with a lot of iterations as it is not always a straightforward identification process of a fold hinge due to the nature of thrust folds and box folds. The elevation highs on SRTM may also indicate resistive limbs of eroded anticline cores. This process requires iteration mapping using Landsat and Google Earth.

In areas where there is low or no vegetation, lithostratigraphy correlation (Figure.3) is easily carried out using Landsat but it also requires ground truthing as the colours may not indicate lithofacies. This method can be used in areas where lithostratigraphic units are widespread. Lithostratigrahic interpretation will then be used to better define or confirmed the structure interpretation for example in distinguishing between an antiform or synform

PROSPECTIVE CORNERS IDENTIFICATION

Structure and Stratigraphy mapping consists of a set of iterative process as shown in the figure below (Figure.4). It is essential to correlate with other data and information that is available to increase confidence on the satellite interpretation. Ground truthing is a critical process used to prove and identify anticlines and structure styles of the first and second order. The image's resolution does not easily resolve complex structure styles. It is also an essential tool used in calibrating, especially for stratigraphy mapping. In low accessibility areas, where proper field work can't be carried out, geological maps (national geological survey, academia and published maps) and published cross sections can be used. Subsurface information is used to calibrate the type section and thickness of each rock units. The nature of geology and geography of study area controls our confidence in correlation and mapping.

Once completed, the structural and stratigraphy mapping are integrated to produce cross sections of the area. The cross sections are then used to identify structural geometry and trap configuration on the subsurface. The structure model is meant to support the petroleum system concept in the subsurface and define prospective corners for exploration activities.

The main challenge in this method of evaluation is excessive vegetation and information accuracy due to satellite

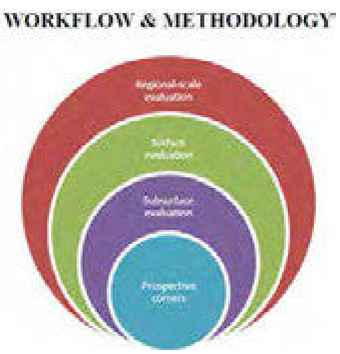

Figure 1: General workflow of folded belt surface evaluation.

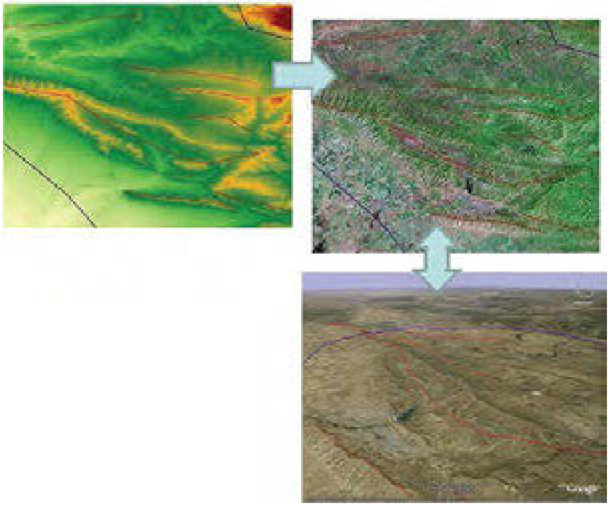

Figure 2: Structural crest identification, (Clockwise : SRTM data, Landsat data & Google Earth image)

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Figure 3: Lithostrastigraphy mapping (L-R: Fieldwork picture, Landsat data, Google Earth Image)

image resolution, poorly georeferenced images, maps and cross sections, confidentiality issues with host government to release subsurface information and oversimplified map sources from publication.

In interpreting structures, where there is an eroded anticline cores, structural crest may not always be the fold axes and this may lead to inaccurate interpretation. Thrust faults are also hard to map as the faults thrust and displacement are not easily observable. In the foreland area, it is a challenge to map due to diminishing observable topography. In stratigraphy mapping, we are mapping lithostratigraphy while in basin evaluation, chronostratigraphy mapping is required to tie to basin evolution and petroleum system study. It is a huge challenge to understand the chronology of basin evolution from lithostratigraphy mapping alone. Various version of interpretation, mainly in stratigraphic terminology across political borders and tectonic models, may complicate accurate identification.

CONCLUSION

Regional satellite mapping proves to be useful in clarifying areas with potential trap. The workflow and methodology is easily applicable in high terrain, less vegetated onshore area where regional scale geological evaluation is needed. The work platform only requires basic Windows OS, ArcGIS and an Internet connection which is easily available and accessible. This allows abundance of time to be spent on evaluation and interpretation of findings and it also allows documentation in digital and reworkable formats. It has to be noted though, that

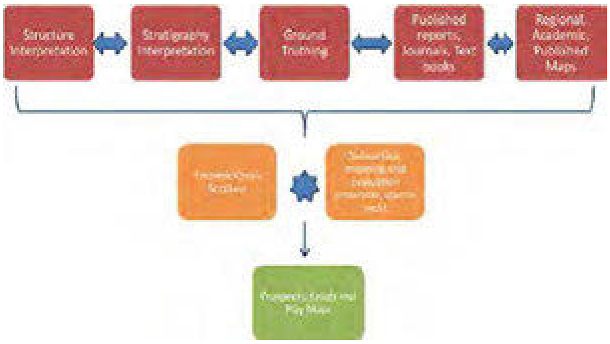

Figure 4: Satellite based evaluation workflow that leads to prospective corner identification.

satellite mapping alone is not adequate for prospect evaluation maturation and should be used as part of regional or semi regional scale petroleum system analysis.

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