

Selection and Utilization of Satellite Imagery for Environmental Assessment in Arid Regions - in the Kuche Area, Tarim Basin, China

Yu Wuyi , Dong Wentong, Guo Jianjun, Qi Xiaoping (China)

[yuwy@petrochina.com.cn](mailto:yuw@petrochina.com.cn)

Dirk Werle, Grant Bruce, Tom Boivin (Canada)

dwerle@ca.inter.net

Abstract.

The arid regions of western China are currently the focus of extensive exploration and development. This paper reports on recent experience gained by Chinese and Canadian project team members in the use of a variety of Earth observation satellite imagery for oil exploration and environmental assessment exercises in the Kuche area of Xinjiang. Through careful archival data selection and more recent data acquisition schemes, we have established several time series of MODIS, Landsat and Radarsat imagery in order to obtain a better understanding for daily, seasonal as well as decadal changes of the natural environment as well as man-made environmental features.

Key Words: Remote Sensing, Environmental, Radarsat

1. INTRODUCTION

This project examined the potential applications of Earth observation satellite data in support of specific oil and gas exploration activities, as well as for environmental health and safety, and impact assessment. It is the result of an international partnership that has brought together experts from the Remote Sensing Geology Department of PetroChina's Research Institute of Petroleum Exploration and Development (RIPED) and a consortium of Canadian companies led by Hatfield Consultants Ltd. and Aede Environmental Research. The Canadian Space Agency (CSA) and its Earth Observation Applications Development Program (EOADP) provided funding support for the team members to bring this 'Western China Oil and Gas Project' to a successful conclusion.

2. Comparative analysis in environmental application of multi-source remote sensing

2.1. The hierarchical and multi-dimensional approach

The EOADP project relied primarily on high resolution RADARSAT and Landsat image archives and MODIS data banks in North America, although SPOT and ERS archives in Europe also contained valuable high-quality earth observation data. An often overlooked source of information is the growing archive of astronaut photography reaching back to the early days of manned space flight in the 1960s. The recent addition of high quality photography from the International Space Station has added even greater value to the archive. The record of available Landsat imagery for the Kuche area goes back three decades. The recent release of American spy satellite data collected during the Cold War period.

The satellite data selection strategy for the EOADP project was threefold:

- to obtain good spatial coverage, both in terms of spatial detail (high resolution) and wide-area landform and

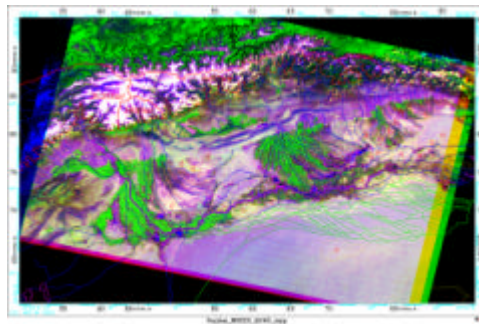
terrain analysis;

- to obtain a wide range of spectral coverage, in terms of both visible and infra-red bands for land cover, hydrology and geology analyses and radar for cloud-penetration and special terrain identification; and
- to obtain good temporal coverage, in terms of both long-term (decadal) and short term (seasonal) change detection in the landscape, for land cover and for land use.

2.2. Interpretation and analysis of remote sensing images for environment impact of water resources in Tarim basin

The MODIS remote sensing data used in Fig.1 has a spectral interval from visible light to near infrared band (M1–M7) with a pixel resolution of 250 m and 500 m as received on 18th, Aug. 2002. It revealed primarily the relative position of water system distribution in summer and vegetation & areas with saline-alkali anomaly in Kuqa area. The basement structures were analyzed based on topographic configuration and the potential oil/gas bearing was discussed in light of spectral anomaly. The interpretation of linear structures has been described in other section already, therefore, we have only present some anomaly areas in terms of discussion of oil/gas bearing potential based on spectral anomaly (a, b, c, d etc.).

Fig. 1 Interpretation map of Arksu –Kuqa area based on MODIS remote sensing data



2.3. Land change monitor

Compared with the normal farmland, the saline-alkali soil has strong response in the spectrum of visible light and near infrared band. The higher the soil salinization is, the stronger the spectral response is. In red and green light bands, the surface vegetation has influence upon the spectral response of the saline-alkali soil. Since the remote sensing image has a sensitive response to the salinization degree of the soil, the soil with high saline-alkali degree has higher reflectance with a light color tone or grayish white. It can be seen clearly from the remote sensing images with different time phase: the salinized soil with high salt content is distributed primarily at the outer peripheral of the margins of piedmont alluvial fans, presenting a color tone from white to light blue.

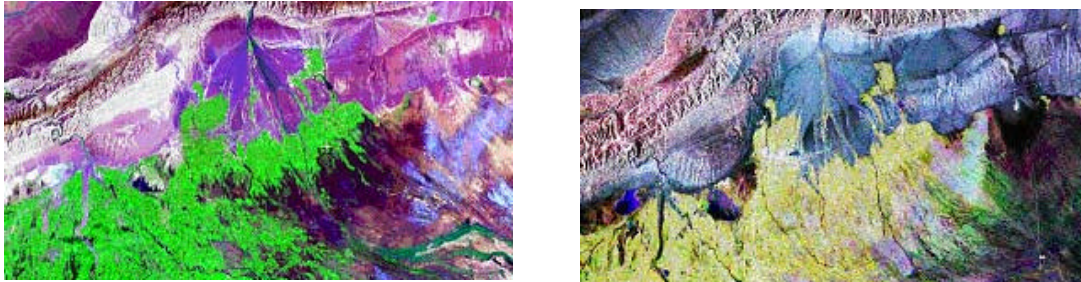
Fig. 2. ETM B432 (1st, Aug. 2001 in left), MSS421 (14th, Oct. 1976, in middle), Corona (29th, Aug. 1963, in right),



2.4. Pick up and comparison of surface information

Kuqa area features a developed agriculture and is densely populated. It is an oasis agriculture, depending mainly on water introduction for irrigation. Therefore, it can be seen from the images taken in Aug. and Sept. that the vegetation in the area is well developed, see Fig. 3.

**Fig.3 ETM 741(1st, Aug. 2001 in left)and
RADARSAT S7(13th, Aug. 1999, green for 14th, Sept. 2002 and blue for 2nd, Feb. 2002 in right)**



Conclusion:

1. Apply multiple remote sensing data to conduct an extensive environment study on water resources with the interpretation and precision for water system distribution up to mapping criterion at various scales in order to provide common mathematic basis and latest geographical information for special mapping and establishment of database;
2. Interpret the water system distribution and topographic setting, specially to pick-up the river flow direction, abnormal deposition or those called as spectral anomaly of EM field associated with the geological tectonic movement (faulting) in order to provide basis of remote sensing for the division of favorable zone for oil and gas exploration;
3. RADARSAT has a working mode of all weather, around clock, various visual angle scan ranges and wide imaging amplitude and can satisfy the essential requirements for petroleum geological study on complex surface structure and formation in combination with TM images;
4. MODIS data is a very effective data for investigation of geological structures and environment regionally;
5. The multi-source and multi-time phase remote sensing data can be used for dynamic environment monitor and environmental investigation.

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