

The role of the remote sensing in resource exploration

Application to Oil Exploration

Resource Exploration Process Flow



Preliminary Survey
Assessment of exploration target areas
● Remote-sensing offers geology and geological structure information over a wide area, which is crucial for selection of mining areas.



High-level/Detailed Survey
Geological and geophysical surveys for the selected area
● Remote-sensing provides high-level geological information and detailed topographic data for survey planning (e. g. selection of specific survey locations).



Pilot Drilling/Reserves evaluation
Pilot drilling and reserve estimation of the target area
● Providing topography, vegetation and land use information, remote-sensing is useful for site selection of test and evaluation wells and equipment transport logistics planning.



Development/Production
Plant construction and production roll-out
● Remote-sensing data is used for evaluation of the production site, pipeline routing and monitoring of environmental impact.

Remote-sensing data

Resource exploration primarily uses data from optical (multispectral, hyperspectral) sensors and synthetic aperture radar.

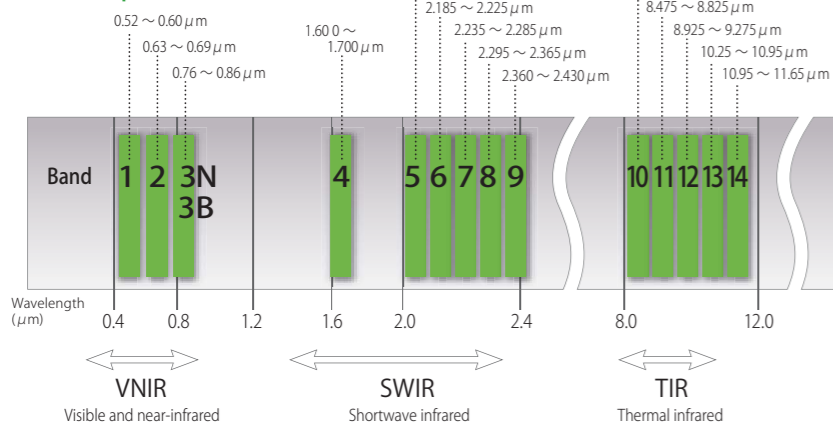
ASTER

ASTER data from its visible, near-, shortwave and thermal infrared sensors are useful for topographical/geological analyses and mineral mapping.

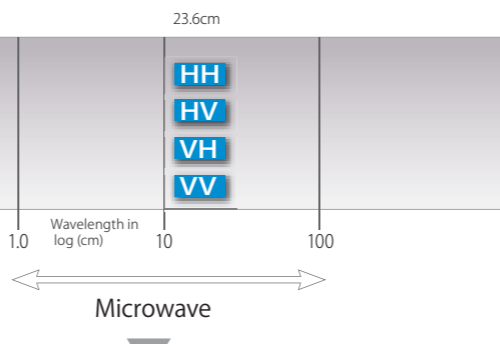
PALSAR

PALSAR's microwave scattering intensity data is useful for topographical analyses and studies of mineral distribution and geological structures. Ground deformation assessment uses PALSAR's microwave radar phase data.

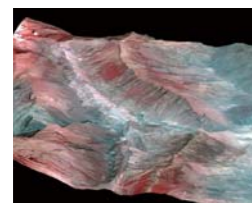
ASTER spectral bands



PALSAR spectral region (L-band)

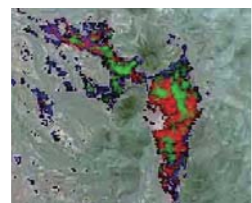


False-color and 3D visualization of topographic and geological information



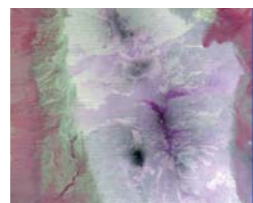
For geological faults, lineaments, local and regional geology, and geo-morphological analysis

Clay mineral classification by spectral analysis



Mineral mapping

Igneous rock classification by silicate mineral content analysis



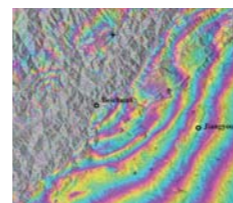
Igneous rock mapping

Topographic feature interpretation based on backscatter intensity distribution
The folding structure in a tropical rain forest



Geological structure of tropical rain forests

Ground deformation analysis using phase data
Ground deformation attributable to a large earthquake



Ground deformation

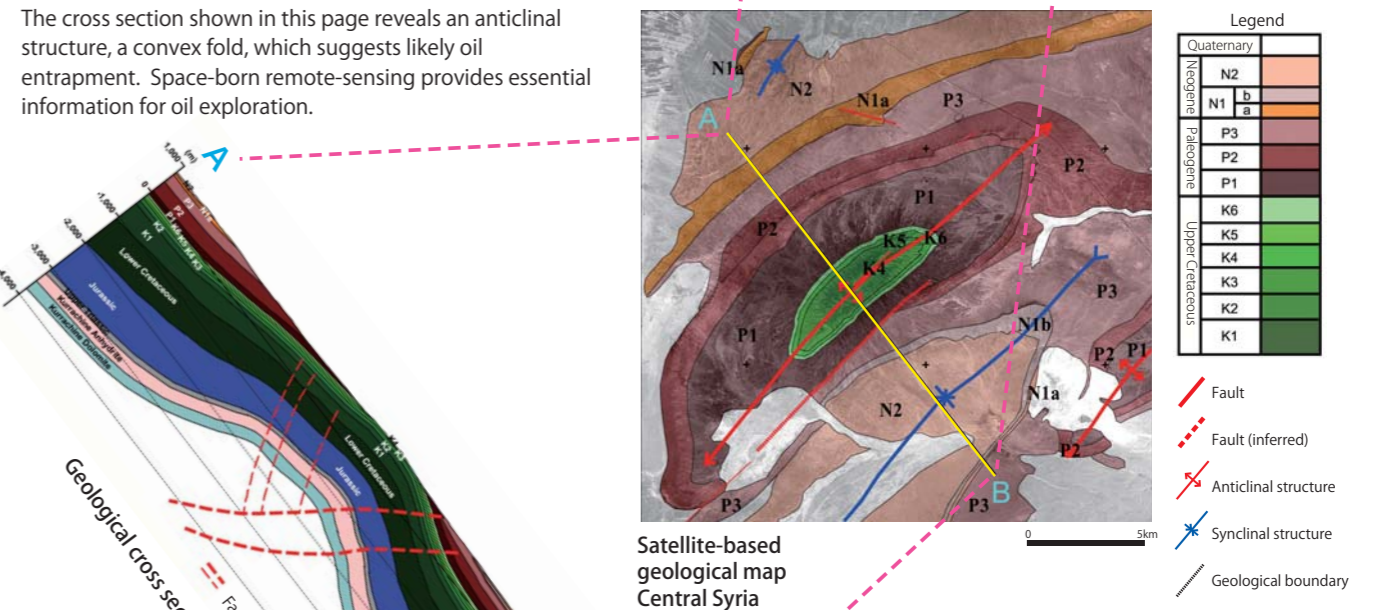
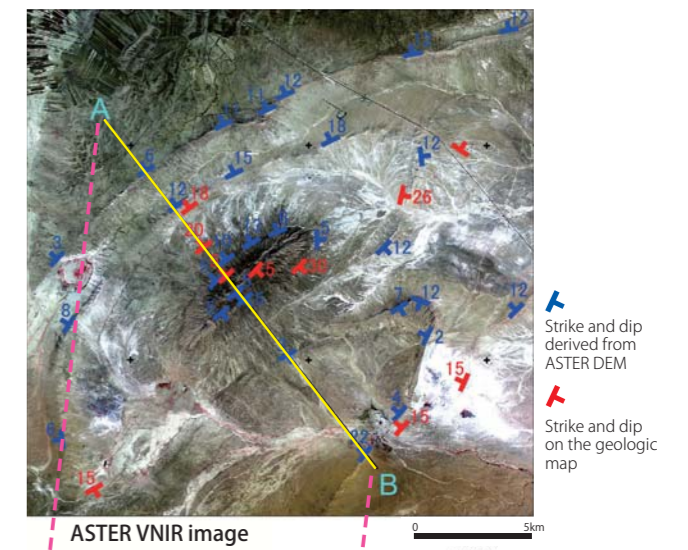
Remote-sensing for Oil Exploration

- Geology** Source rock: Formation containing elements of oil sources.
Reservoir rock: Porous strata for oil deposits.
- Geological structure** Cap rock: Formations preventing oil displacement.
Anticline/fault structure: Structures for oil deposits.
Strata continuity: Oil migration/accumulation paths.
- Oil slick** Oil seepage points from the ocean floor: Identification of oil fields.

Application to Onshore Exploration

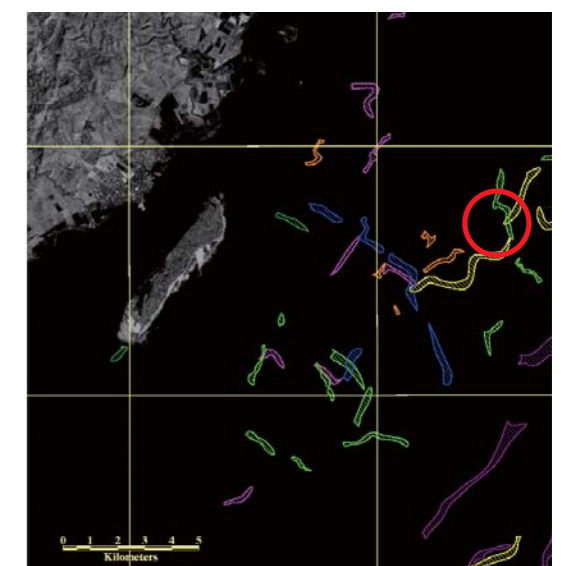
ASTER VNIR images are powerful data sources for photo-geological analyses. In addition to the interpretation of geological structures to identify folds and faults, ASTER provides with data for estimating the geological composition (e. g. source rock, reservoir rock, cap rock) and for satellite-based mineral mapping. ASTER Digital Elevation Model is used to produce geologic cross sections.

The cross section shown in this page reveals an anticlinal structure, a convex fold, which suggests likely oil entrapment. Space-borne remote-sensing provides essential information for oil exploration.



Application to Offshore Exploration

Multi-temporal SAR images are used to pin-point the origin of the surface oil film ("oil slick"). It can be assumed that the oil seeped from the ocean floor within an area where multiple origins of oil slicks are concentrated (the circle in the image indicates an estimated leakage point). Oil samples are collected from the oil slicks to determine if they are indeed seepage from an oil field under the sea floor. As shown in this example, oil slicks were detected using PALSAR data to estimate the existence of an oil field. ASTER-provided land geological data and geophysical exploration information are used for comprehensive analyses of sea and land areas.



Offshore of Refugio Island, Negros, Philippines