

Geological Mapping in Iraq using Terra ASTER and ALOS PALSAR images and Application to Petroleum Exploration

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Abstract: Iraq has vast hydrocarbon potential and has been attracting the petroleum exploration attention from international oil companies. Particularly Zagros Mountains and the foreland basin are widely known as major productive zone of hydrocarbons in Iraq. The study focuses on geological mapping of Zagros fold and thrust belt and the northwestern desert using satellite images of Terra ASTER and ALOS PALSAR. Result of structural interpretation was combined with published geologic and geophysical data in order to model types of hydrocarbon exploration play in the region. The study area is characterized by dry climate and hence sparse vegetation cover, which makes the spectral analysis using shortwave infrared (SWIR) and thermal infrared (TIR) data acquired by Terra ASTER applicable to geological mapping.

The study area can be divided into three structural provinces, namely High folded zone, Low folded zone and Khleisia high. High folded zone is a NW-SE trending structural belt with 40-50km width bounded by High Zagros Fault to the north and Mountain Front Fault (MFF) to the south. High folded zone is characterized by many NW-SE trending folds, typically more than 50km in length and 5-10 km in width, and few surface faults. Terra ASTER false color images composed of visible-near infrared (VNIR) bands and SWIR bands can beautifully delineate these folding structures by highlighting several key beds such as limestone layers. The use of TIR bands could help highlight the distribution of Pliocene to Pleistocene quartz-rich conglomerate and coarse sandstone layers. Low folded zone locates to the south of MFF and extends in NW-SE direction more than 400 km with about 150 km in width. Low folded zone is characterized by right-stepping en echelon geometry of folds with length of 10-20km and width less than 5km, indicating strong influence of right lateral wrench system. In

Low folded zone Calcite and Clay indices images were produced from Terra ASTER SWIR bands, aiming to locate abnormal concentration of calcite and clay minerals which might suggest the influence of hydrocarbon seepage. Several localities were extracted as having anomalous concentration of calcite and clays, when cross-checked with background geological context. Some of them locate along lineaments truncating crest of anticlines, which may suggest a hydrocarbon seepage path. Khleisia high occupies a broad area of the desert in northwestern part of Iraq, and is characterized by low relief topography. In Khleisia high ALOS PALSAR data has helped delineate ENE-WSW trending folds which are thought to be related with the graben system by emphasizing the difference of subtle surface relief among exposed rocks.

Schematic geological cross sections for selected areas that are interpreted as representing geological features in each structural province were drawn, by combining satellite image interpretation with known geologic and geophysical information. Based on the assumption of short hydrocarbon migration distance in horizontal sense, typical hydrocarbon play types for each province were modeled on these cross sections.

Keyword : Zagros Mountains, Terra ASTER, ALOS PALSAR.