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Primary Interpretation on Shorelines of Vanished Lop Nur Lake Using Multi-Source SAR Data

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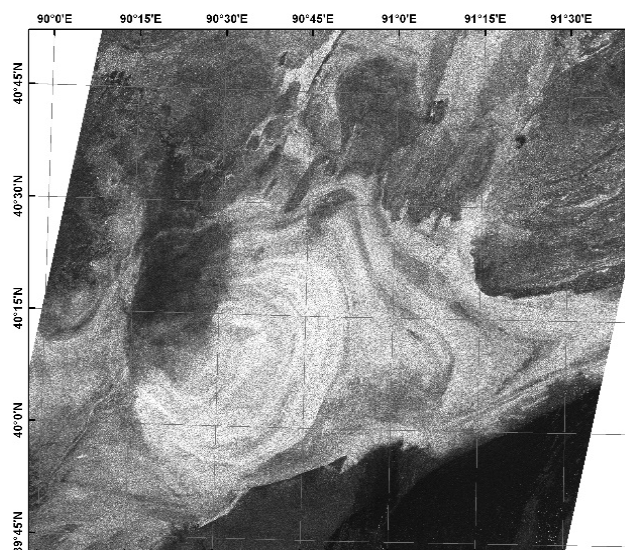
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Lop Nur is a huge vanished lake located at the east end of Tarim Basin, northwest of China and finally dried up before 70s. In history, Lop Nur was a large lake, rich production, beautiful scenery, and there were numerous civilizations including Loulan, Milan and Xiaohe. Lop Nur catchment was an important section of the ancient “Silk Road” as the prosperous and famous communication channel of Eastern and Western culture. It has been called the “Drought Pole” and “Sea of Death” because of its extremely dry condition and poor accessibility. Lop Nur is the most arid region of Eurasia, and due to its special geographical position in Tarim Basin, mineral salts accumulated and resulted in high salt concentration in this area, especially with very rich potassium deposits (Xia, 2007). The shorelines of Lop Nur Lake shown on SAR images left important traces for environment change and evolution study. The increasing worldwide concerns on global warming remind us that it is important to take into account the climate change history in Lop Nur region over a period of millennia (Shao et al., 2003; Elachi et al., 1983; Farr et al., 1986).

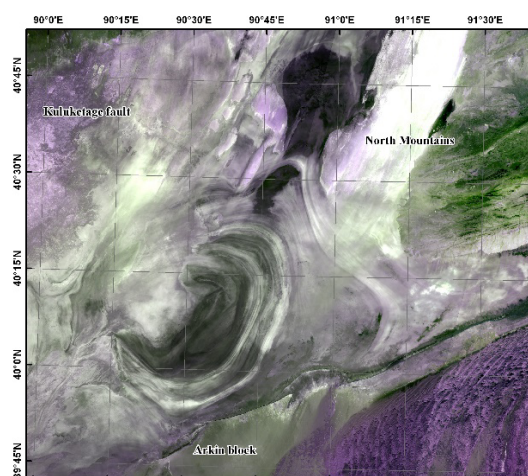
With the advantage of penetration capability and sensitivity to moist saline materials, SAR revealed the subsurface lacustrine deposits, delineated the partially buried shorelines and depicted a complete picture of Lop Nur Lake. Based on five field investigations, sample analysis, Ground Penetration Radar validation and scattering mechanism interpretation of polarimetric and multiple frequency SAR data three important scientific findings were achieved in this study (Shao et al., 2011).

A) The relatively younger West Lop Nur Lake is superposed on the top of the lacustrine deposits of East Lop Nur Lake presented by dash line in Figure so the original western part of shoreline loops of the East Lop Nur Lake were partly cut and covered by lacustrine deposits of West Lake and not visible on optical remote sensing images, which made the well known “Ear” feature

of Lop Nur. Comparing to the shorelines exposure to surface or only buried by aeolian deposits this part of shorelines have relatively low backscattering intensity but still clearly show on SAR images. Therefore the East Lop



(a) RADARSAT-1 Image (1999)



(b) TM Image (two image mosaic in 1999 and 1997, band combination: R (4):G(3):B(2))

Fig. 1. RADARSAT-1 image and TM image in Lop Nur.

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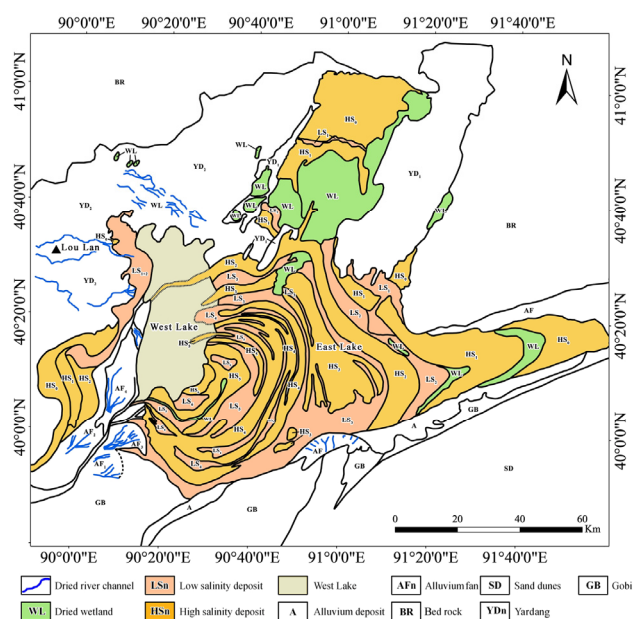


Fig. 2. Interpretation map of Lop Nur Paleo-Lake based on SAR images.

Nur Lake actually has nearly circular, closed shorelines as shown on SAR images and the interpretation map.

B) The ground truth validation has confirmed the existences of the northern part and western part of the shorelines which were not visible on optical images. Consequently, it is found the total area of the vanished Lop Nur Lake is more than 10,000 km² which is much larger than 5350 km² as reported based on the primary interpretation of optical image.

C) The drying-up process of East Lop Nur Lake went through six major phases according to the shoreline loops

interpreted from multi-source SAR images. The shrinking phases of Lop Nur Lake indicate the climate changes between dry and wet environment conditions. Each major phase is showed as a pair of bright region and dark region on SAR images. The bright region is lacustrine deposits with high salinity presented in yellow, representing a rapid process of lake area shrinkage and salt crystallization at dry environment conditions. The dark region is lacustrine deposits with relatively lower salinity presented in brown in Figure 4, representing a relatively weak process of lake area shrinkage with recharge from rivers and melting snow of mountains at relatively wet environment condition.

Key words: SAR, Lop Nur, remote sensing, environmental evolution

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