STUDY OF MODERN VICISSITUDES OF THE JIANGHAN LAKE GROUPS BY USING REMOTE SENSING TECHNIQUES

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The Jianghan lake groups which spread all over the Jianghan plain like stars in the sky were a scene of a region that abundant in rivers and lakes in the past. But, man has been competing with water for land for several hundred years, which is called "reclaiming land from a lake", result in the sharp decrease in the number and area of the Jianghan lake groups. The laudatory title "Province of a thousand lakes" has been irrevocably lost. Even though lakes exist there, they all suffer heavy threats by swamping.

The action of reclamation and natural siltation of lakes which result in the vicissitudes of lakes from water to land and the tendency of swamping are reflected clearly in the satellite remote sensing image. So we can make the historical process of vicissitudes of the lakes reappear to some degree and forecast its future evolution tendency.

1 VISUALLY INTERPRETING THE MSS IMAGE AND MAKING THE JIANGHAN LAKE GROUPS IN HISTORY (ABBREVIATED PALAELAKES) REAPPEAR

Through comparably analysing again and again, we select two pieces of image from many pieces of multi-temporal MSS image, one of Shashi in May 30, 1979 and one of Wuhan in June 16, 1979. From which we can correctly interprete the distribution area of lakes that existed before 60's. The foundation of image interpretion of the palaelakes are:

1.1 The integral spectrums of lake facies sediment and a shallow layer of water in palaelakes have specific image properties.

In the places of palaelakes, the sticky and blue-grey lake facies sediment (gley horizon) is deposited. Because of lower relief and difficulties for draining waterlogging, the watertable about 0.5 meter in general and lower soil productivity. Consequently the places of palaelakes are mostly single-cropping paddy fields, which is a common phenomenon in the Jianghan plain. So the key of interpreting palaelakes with image is to identify the distribution of single-cropping paddy fields. During the imaging of the two pieces of image above, there have shallow layer of water in the fields. Since seedling were not or just planted, the fields were generally in a "water field" state. The integral spectrums of "water" and the lake facies sediment under the water were abtained by the sensor which differ sharply from the spectrums of other water or crops (Fig. 1). These integral spectrums haven't the features of vegetation, i.e. haven't the reflective peak in infrared (MSS 6.7 band) and the reflective valley in red (MSS 5 band). They also differ from the spectrums of typical water. In the image on June 16, distinct blue-green color was

shown in the single-cropping paddy fields compared with the blue of river or black (or black-blue) of lakes. It also differ from the white with faint blue of cotton fields (generally representing the bare soil), the double cropping of paddy (high cover degree of crop), the rose or red of wild rice and reed, and the white with faint yellow of other dry crops.

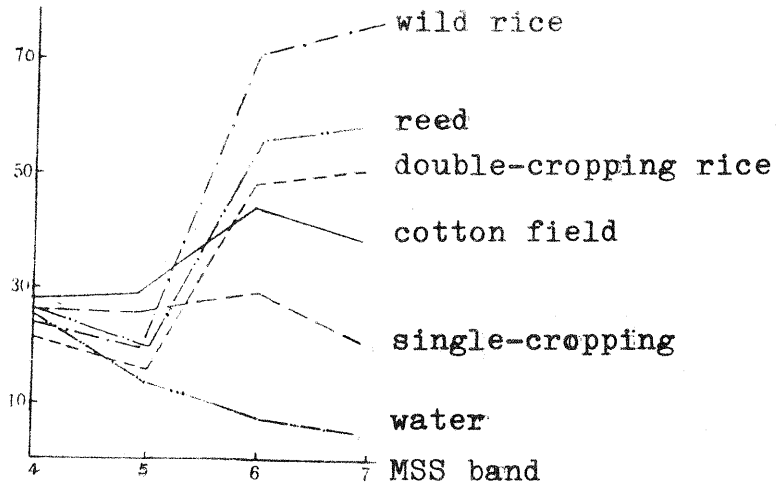

Fig. 1 The curve of spectral respond of varieties of cover (According to the CCT tape of June 28, 1980)

1.2 Wild rice and reed of vanguard plants are the important signs of lake transformation into marsh.

The vanguard plants in swamping of lakes and even transformation of lakes into land are usually wild rice and reed. So the association of wild rice and reed is an important mark (Fig. 1) to locate the palaelakes and the bank belt of shallow lakes, which image features are dense grain, villose structure, and red or rose color, differing from farm crops. Such lakes as Dashahu lake, Datonghu lake, Wuhu lake and Bailuhu lake all have vast stretches of wild rice and reed, which shows the plane figure of palaelakes.

1.3 The image feature of embankments encircling low paddy fields are the evidence of the splitting and dismembering of palaelakes.

The fact that the Jianghan lake groups were originally inland lakes abundant in water is verified by the drolling data (Cai Shuming, 1982) and historical maps. For natural and artificial reasons, they were split and dismembered later and shown the broken appearance. The natural reason is continuously depositing of sediment and course's changing, resulting in the changes of lake from large to small and breaking up the whole into parts. And the artificial reason is embanking and reclamation. So the developing process of the embankments is the process of silting up and dismembering of the Jianghan lake groups. Inversely, by making the distribution of the embankments in the past reappear,

we can retrieve the appearance of the palaelakes.

The typical structure of embankments is shown in Fig. 2. The structure of three color belt in the image represents the embankments or irrigation and drainage canal in the past, blue images encircled by the embankments are the low-lying paddy field. When the embankments are breaked, the field are accumulated by the water and changed into lakes again. Therefore, the palaelakes the past. Also, the existing lakes might be the fields in the past.

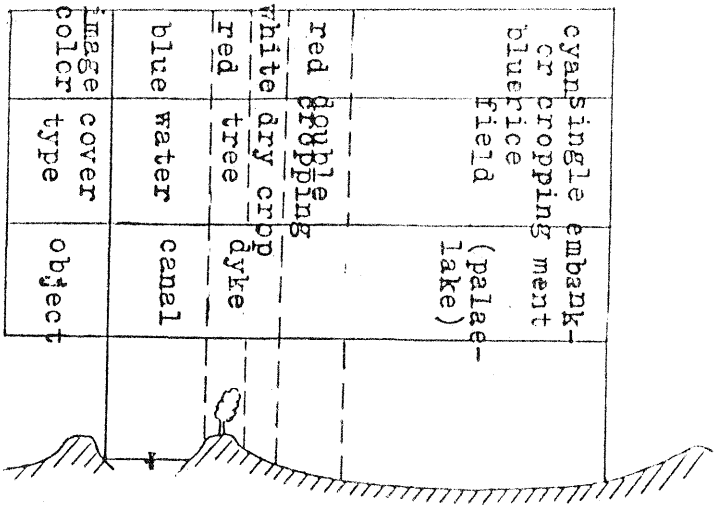

Fig. 2 The embankments structure of Jianghan plain

2 USING THE METHOD OF COMPOSING DIGITAL IMAGES OF TWO PERIODS TO RESEARCH THE VICISSITUDES OF LAKES

We use two period of images of Shashi on Oct. 17, 1978 and on May 6, 1975 to compose a digital image. Thus, the composite image includes the information of objects during two period. The surface of lakes in May, 1975 (included the existing lakes and palaelakes filled with water -- single-cropping paddy fields) is larger than that in Oct. 1978 (only included existing lakes on the image). The difference of two areas is shown sharply on the composite image in yellow-red color compared with the bright red of the lakes (Fig. 3).

3 FORECASTING THE FUTURE CHANGE TENDENCY OF THE JIANGHAN LAKES GROUPS WITH REMOTE SENSING TECHNIQUES

The degree and velocity of the swamping in the Jianghan lake groups primarily depends on the amount of aquatic plants. The more aquatic plants is the quicker the process. So we can interprete the swamping process with the study aquatic plants in remote sensing methods.

The research shows that the color of water in the image correlate the growth of aquatic plants, as followings:

Dark color of water in the image (black or blue-black) corresponds to the less suspended grains in the water, higher transparency —

higher transmissivity of light and stronger photosynthesis--lush growth of aquatic plants -- difficult to affect the bottom mud ; constraining the growth of planktons -- high transparency in the water, and vice verse.

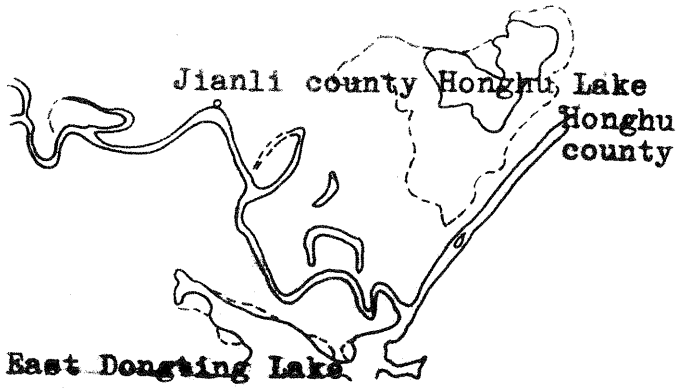

Fig. 3 The interpreted map of MSS digital image of double period composite.
——— The bound of "water" shown in Oct. 1978 image
- - - - - The bound of "water" shown in May 1975 image

So, the conclusion is: Dark color of water in the image--lush growth of aquatic plants, and vice verse.

Fig. 4 is an evidence of above analysis. In the image, exterior Tangsunhu lake shows dark color (black) and its spectral response reflects obviously the feature of vegetation, which is verified by the fact of the investigation in the field: The growth of aquatic plants is luch there. And somewhere, it is difficult to sail, its water is green and clear with the transparency of 1.9 or so. Whereas, the spectral response of the interior Tangsunhu lake completely has no the feature of vegatation, but the feature of "water". It's reflectence in band 4 and band 5 is obviously higher than those of normal water. The reason is that the interior lake is an artificial breeding farm with only a few aquatic plants and more planktons. In order to fully reveal the distribution of aquatic plants in the Jianghan lake groups, we have done a variety of processing work for digital image in the ARIES--II system, such as K -- L transformation, ratio transformation, contrast enhance and auto-classifying.

Through above analysises, we can forecast that the process of swamping in lakes such as the Changhu lake, Honghu lake, Wuhu lake and exterior Tangsunhu lake will be quicker, but that in the lakes such as the Liangzihu lake, Futouhu lake, Donghu lake and interior Tangsunhu lake will be slower.

4 VERIFYING THE RESULT OF REMOTE SENSING ANALYSIS

4.1 The interpretation of photomontage

On the photomontage (1966-1977; 1:100,000) there is difference

between lakes and palaelakes. The existing lake show black and their boundory are clear. But the palaelakes show dark-grey and their boundory are not clear. The position and the area of the lakes and the palaelakes almost coincide each other on the image and the photomontage (Fig. 5).

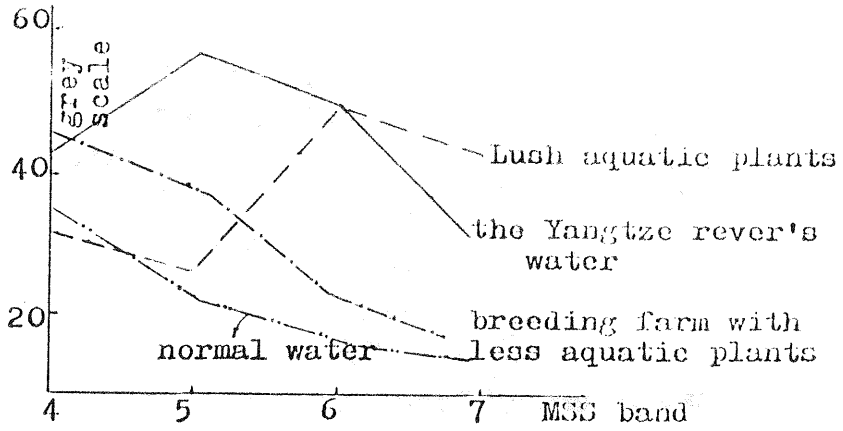

Fig. 4 The curve of spectral respond of varieties of water.
(According to the CCT tape of June 28, 1980)

4.2 The analysis of soil map

The gley-like rice soil and the bog type rice soil can represent the soil that develop on the mother material of lake facies sediment. Therefore, the distribution regions of both the soil are the places of the palaelakes, it's corresponding places on the satellite image have image feature of the palaelake (Fig. 5).

4.3 The analysis of the topographic maps in three period

We analyse the topographic maps in three period (1965, 1971, 1980) and comparing the interpreted map of image with the analysed result. We can see the distribution of the palaelakes on the image and the topographic maps is almostly coincident. Therefore, the age of the palaelake distribution by the image interpreting is about 40's or 50's (not age of formation), because the poto-montage used in compiling topographic maps was taken in 1955.

4.4 The overlap of a variety of maps

We use sampling method, selected the sampling of about 700 KM^2 in the north-east of Jianli county on a variety of maps that has more palaelakes. In the samples, we overlap these palaelake boundary lines of these maps and transfer them to a map at the same scale (Fig. 5). Result show that the distribution of palaelakes on four maps is almostly coincided. It is verified that the correct rate of the interpretation is high.

4.5 Investigation in field and verifying by sampling

The field work is divided into two stages: the first stage is establishing the key interpreting of the image in the field. The second stage is synchronously (with early June) verifying by

sampling in the field for the interpreted result of the image. It is verified that the correct rate with remote sensing interpretation at home is high.

Fig. 5 The interpretation map of palaelakes of MSS image in the Jianli county

——— The palaelakes boundary interpreting on the MSS image

—·—·— The coundary of the gley-like rice soil and the bog type rice soil

–·–·–·– The palaelake boundary interpreting on the photomontage

– – –~– The boundary of lake presented in the topographic maps

5 CONCLUSION

5.1 The results of the study express that since 50's, the area and the number of the Jianghan lake groups have greatly decreased, and also the existing lakes are facing the threat of swamping and even disappearing. As analysed, in the middle and late fifties, there are 609 lakes with area of more then 0.5 km^2, but in the early eighties, only remain 309 and decreasing percentage is 4?% (Zhang Rongxing, 1984). The alarm has been sounded: Save the Jianghan lakes!

5.2 Using the remote sensing analysing methods to research the vicissitudes of lakes shows excellent functions. The palaelakes which are sometimes difficultly discovered in the field investigation and aren't shown in the historical maps can be clearly shown in the image of remote sensing.

5.3 The processing techniques for digital image of remote sensing are of good functions, high speed and efficience, are fit for multiple purposes.

5.4 It's important that select the optimum temporal image according to different objects of the research for study.

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