

THE DEVELOPMENT OF CHINESE CHART IN THE 20TH CENTURY AND THE PROSPECTS FOR THE 21ST CENTURY

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Abstract

Chinese charts have developed rapidly in the 20th century. Four generation of nautical charts ,including a large amount of thematic charts and atlas have been compiled and published. Four developing features have been showed such as higher international standard, more sorts and quantity of charts, higher digital levels, and new chart making techniques. Charts will be developed throughout and widely in the 21st century, in which the following developing tendency will be appeared: sorts and quantity of charts to be increased; chart making to be automation ,intellectualized and integration; OGIS to be in wide use; construction of the chart database to be perfected ; chart to be influenced by Digital Earth.

Keywords

Chart Digital Chart Electronic Chart International Chart Digital Earth

1 The statement and features of the development of Chinese Charts in the 20th Century

1.1 The statement of the development of Chinese Charts in 20th Century

In the first half of the 20th Century, there were many wars in china, which led to the low level of the chart's production and even a stop of chart development. In the period of the KMT (Kuo Mintang), the publication of the charts depended on the foreign countries because of the shortage of the ability of KMT. There were only about 100 river charts and ocean charts published by the Hydrographic Office during the years from 1922 to 1949 and even a good of parts were compiled from the foreign hydrographical data and charts.

After the People's Republic of China was founded, there were a lot of progresses in the field of chart. In 1950s, the first generation of the chart in China was published. The data of these charts were compiled from the foreign data as basic data and the other new data as complemented data. And they were printed in two or three colors. In the late 1950s, some special type of charts such as shooting charts of navigation, arc charts and bearing and distance charts were published.

The second generation of the chart appeared in 1960s and 1970s. It was a symbol of

the developing period of charting in china. It meant that the Beijing coordinate system 1954, the theoretical depth datum, Mercator's projection, Gauss' projection and 4-color printing were used. *Symbols, abbreviations and terms used on Chinese charts* and *Specifications for Chinese nautical charts* were also been framed. The charts made in military use and in civil use were separated. Even the plot accuracy and the chart contents were better than that of the first generation. Drafting was replaced by Scribing. The kinds of chart were increased. A lot of charts, various atlases for special use appeared. And they were issued and sold to 66 countries. The cartographic area was expanded from Chinese coasts to the oceans all over the world.

The third generation of the chart was published in 1980s. In order to adapt the economical and military needs, there were some reforms in charts by naval hydrographic department. The specialty was emphasized. Charts in military use and in civil use were combined again. The type and quantity were increased. And both *Symbols, abbreviations and terms used on Chinese charts* and *Specifications for Chinese nautical charts* were established. In mid-1980s, the polyester film compilation began to be popularized. Then computer aid cartography (CAC) was introduced and the first generation of the electric nautical chart was made successfully.

The forth generation of the chart was published in 1990s. Because of the differences between Chinese chart symbols and international chart symbols, two-time changes were made in *Symbols, abbreviations and terms used on Chinese charts* and *Specifications for Chinese nautical charts* in the early and late 1990s. Since then, chart production began to be internationalized, normalized, standardized and scientized. The use of the Electric Publish System made the production ability of the chart volume and the navigation data increased. The development of Digital Charts and Electronic Charts have been from theory to application. The research in Chart Data Base and OGIS have got developed.

1.2 The features of the development of Chinese Charts in 20th Century

The development of Chinese charts was successful and there had been many splendid achievements during about 50 years. The summary of it is given below.

1.2.1 The standard of the internationalization became higher and higher

It made the chart be an international map that the area showed in chart was continuing and the needs of navigation was special. So IHO always works for the internationalization of Charts. In 1982, *Specifications for international nautical charts* was passed at the 12th meeting of IHO. It was published in 1984. And *Symbols, abbreviations and terms used on international charts* were also passed in the 13th meeting of IHO in 1987. The unified international standard led to the cooperation of the members of IHO and other countries along the coast. China is a member of IHO and it has done many works for the internalization of charts. In 1982, Chinese navy revised some symbols in the nautical charts for foreign ships consulting that of American, Japan and so on. In 1990, navy published *Symbols, abbreviations and terms used on Chinese charts* and *Specifications for Chinese*

nautical charts according to that of the international. And in 1998, navy re-edited them so that the system became more perfect. The order was more legitimate and the symbol system had been a big change. Differential GPS symbols were added and Loran-A Wireless Position System was deleted. English explanatory was added either. It made the connection between Chinese charts and international charts. For this, Chinese government was praised highly many times by IHO.

1.2.2 The sort and quantity were more and more

Getting the data became easier and quicker for the development of the depth-sounder from imitative echo sounder, digital sounder to multi-beam bathymetric system. Further more, the producing means became advanced which supplied the sufficient data and skill basis for the chart. The classification of chart became plentiful which met the needs of various walks of life. According to the navigation measures, there are paper chart, digital chart and electronic chart; According to the different user's demands, we produced charts in military use, charts in civil use and charts for foreign use in large, middle and small scale. According to using modes, we published table chart, wall chart, screen chart, etc. Thought about the chart contents and purposes, there were some navigation charts (general chart of the sea, sailing chart, harbor chart), general chart (topography chart, situation chart, etc), thematic chart (ocean hydrological chart, marine meteorological chart, submarine structure chart, marine communication chart, ocean aquaculture chart, navigation history map, ocean military thematic map, etc); In addition, many atlases were published, mainly were navigation atlas, thematic navigation atlas, such as harbor and anchorage atlas, coast route atlas, supported reference material atlas, ocean hydrologic investigation atlas, ocean meteorological reference atlas, military subject atlas, etc). The quantity of charts had been from about 10 sheets every year to nearly 200 sheets of general charts and about 200 sheets of digital charts a year.

1.2.3 The level of digitalization has greatly improved

The development of the computer technique and data base technique had given an impetus to the change from paper chart to digital chart. So electronic chart, digital chart and some related papers appeared.

Electronic chart is a kind of digital chart used in ECDIS. It is a navigation system highly integrated with data of chart, navigation information, equipment, software and hardware of computer. In 1980s, some organization began to make a study of these systems in China. HDI—101 electronic charting system on the basis of raster data is the first production of these system. Later, some other organization such as China Shipping Industry Company, the Ministry of Communications and some universities gave out several new productions, for example, the H—HDT—001 electronic chart system on the basis of vector data made by Dalian Naval Academy. These systems had become better and better. They were close up to the standard of ECGIS.

Digital chart is an order class of the space data showed in digital type that mainly

described ocean geographic information and navigation information. It was the main form of expression of ocean digital information. It brought a technological revolution in mapping because it had changed the production and application mode of chart. Digital chart is equal to electronic chart and paper chart when it was used in navigation. In 1990s, the relative standard, production system and quality control of chart became perfect because the hardware and software construction had a great deal of progresses after the introduction of some foreign drafting system by China Navigation Press such as ARC/INFO and INTERGRAPH. With the research and construction of chart data base, the development of the chart became quicker and quicker. And there was a given quantity in digital chart production of about 200 sheets a year. In addition, the types tuned various. Application mode was the same state, such as graph-showing, data searching and indexing, plotting operation, making hard-copy and creating new type of chart.

Chart data base supported the production of the chart. We have built two types of chart database by the effort of the researchers and the workers. One is charting database used in CAC. It's the data source for different charts and one sort of data and one scale of chart were corresponding. It has the capacity of adding, deleting, updating, correcting, outputting and expressing the data. The other is ECDB which is the data resource being used to produce, update and correct the electric chart.

The standard papers of digital charts include the regulations, norms and criterions to repress the digital chart production and the found of chart database. The technical specification used to meet the needs of international charts was included either. In 1995, we published The GB technical specification of the electric chart and worked out The data dictionary of Chinese nautical chart in 1999. These specifications unified other ones in this field and built up the relations with the international.

1.2.4 The producing methods became advance and advancer

The development of the science and the material of charting made the production methods of chart improved. In 1960s, drafting skill was used in three orders of compilation, fair drawing and publishing. In the late 1970s, scribing began to replace drafting. Firstly, scribe the chart elements in the etching film. Then, use the scribing tools to apply negative image scribing, rip the film and clip and paste lettering in positive image. It decreased the mapping steps and shorted the circle time. It is a progress that scribing replaced drawing. In the late 1980s, CAC became the main technique of charting and after it appeared, scribing was eliminated gradually. Nowadays, we use polyester film complication, then to digitalize and do interactive editing, do plate making and printing with the film last. Because the computer has done a great deal of work, the quantity of charting developed by leaps and bounds and the speed was accelerated, even the cycle was shortened.

2. The prospects in the 21st century

It was the 21st century is the ocean's century that scientists said. With the

developments of the space and aerial technique and the information technique, there is a good chance for the charting. So as the carriers and transmission tool of ocean geographic information, the charting must be made a might advance. These prospects are:

2.1 The classification and quantity will be increased by a wide margin.

China government will pay more attention to tourist nautical chart, yacht chart and fishing chart besides the rise in the quantity and quality of the nautical chart.

Thematic chart will have a lot of improvements because the ocean estate department and the ocean exploitation have increased. Firstly, do the charts showed the key element of the ocean geographic phenomenon and seawater's characteristics such as submarine structural chart, submarine geomorphic chart, submarine deposit chart, marine gravity anomaly chart, marine magnetic chart, tidal chart, current chart and salt chart. Secondly, do the series of the thematic chart with the same scale, for example, chart of boundary. In addition, the thematic marine atlas will be in good use for its convenience in querying, comparing and analyzing.

The bathymetric chart will become the basic type of the chart. Bathymetric chart is the stretch of the topography chart in ocean. With the development and the utilization of the coast belt, continental shelf and submarine bottom the bathymetric chart must to be the basic one of chart family.

2.2 The production of the chart tends to automatic, intellectual and organic.

Base on the demand of the user, paper chart and digital chart will coexist for a long time in 21st century. No matter paper chart or digital chart, the automation of the production would be higher and higher until completely automation. However because of the influence of the automatic charting integration, the current automation is not enough. First, in the step of edition, polyester film edition is manual and then the chart is digitized. The most serious thing is enhancing the automation of the integration of the chart element and do best to heighten the automation of edition. Second, the efficiency of checking by hand is lower and it wastes charting material such as paper and extends the cycle time. Hence the automatic estimate and check system of the digital chart should be developed. If the two problems above are resolved the automation of whole production of charting will be achieved mainly. And on the base the system of the digital chart's organic unity is accomplished. The system called digital chart production system can manage, inquire, compile and produce digital chart by introducing the database technique, especially the intelligent raster/vector data conversion technique. It consists of these technique, Intelligent Input, Image Database, Raster-based Digital chart, Vector-based Digital chart. Among them, the first is very important which is composed of the form tracing, node recognition, depth's symbols recognition, graph compilation technique and so on and the former three techniques are the pith of intelligent input.

2.3 OGIS will be put in use extensively

OGIS is the GIS used in ocean surveying and mapping. It is the synthesise system to

collect, storage, inquire, analyze and output the space information of the oceans by using the computer technique, remote sensing and information technique. It is composed of data collecting, database and database management system, data analyzing and applying system, displaying and outputting system, etc. It is necessary to build these system because the information increases rapidly and the methods to get the information have changed with the developments of ocean surveying and mapping technique and even the space and aerial technique. For researching the system lately, we haven't completely grasped this technique. Especially, it falls behind the Land GIS. So the research and exploitation in this field should be strengthened. The emphasis is the integration of "3s"(GIS, GPS, RS). Consulting these system, such as ocean thematic information system, ocean region information system and ocean information analyzing system, different OGIS should be built up, for example, Web-OGIS, Open-OGIS and Multimedia-OGIS.

2.4 Database construction of chart tends to be more perfect

To meet the needs of information indexing, inquiring and analyzing in ocean, chart database used by OGIS should be built. DEM database is necessary for the visualization of the sea floor. The coastline database and the nautical database are also demanded. The database will bring talent into full play if more types of chart database are built, for example, the relational chart database, the object-oriented chart database, the deduced chart database, the distributed chart database and the multimedia chart database.

2.5 "Digital Earth" will effect the production of the chart

"Digital Earth" means a digitalized and informational earth. It is a complete information model of the earth that digitally reappears and further understands the real earth and its phenomenon. The core idea is to deal with the natural and social activities by the digital measures. It uses the data arranged by their geographic coordinate to make up a global information model with the relational information of the earth in order to get maximum information and make use of the sources. The feature of "Digital Earth" is the virtual earth that can apply particular description of the earth with various resolutions and three-D technique. Because the 80 percent of the information human beings contacted is connected with their geography position and space distribution and the oceans occupy 71 percent of the earth area, the value that "Digital Earth" uses in chart is great. Using "Digital Earth", we can get digital chart and apply the internationalization of chart because it includes the earth satellite image in high resolution, digital chart and a lot of economic and social information. So the chart in 21st century is connected with the "Digital earth".

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