

Report of Current Activities of China for 1998-2000

Prepared by Dongchen E
Chinese Antarctic Center of Surveying and Mapping
Chinese representative to SCAR WG-GGI

Chinese Antarctic Center of Surveying and Mapping have developed programmes to conduct research or operational work in the Antarctic in the field of Geodesy, Bathymetry, Geographic Information, Cartography.

I. Scientific Expedition Activities in 1998-2000

1.1 GPS observation campaigns were carried out in the international framework of SCAR 99 and SCAR 2000 Epoch Campaigns.

With the aim of practice of the international cooperative research project Geodetic Infrastructure in Antarctica (GIANT) hosted by SCAR, both Chinese Great Wall Station and Zhong Shan Station have successfully participated SCAR Epoch 99 GPS Campaign during Jan.20-Feb. 10, 1999 and SCAR Epoch 2000 GPS Campaign during Jan.20-Feb. 10, 2000 in accordance with WG-GGI's instructions. The GPS receivers employed in campaigns were *Turbo Rogue SNR-8000* in Great Wall Station and *Geotracer 3220* in Zhong Shan Station. We have sent both observation data and documentation to the project chief Prof. Reinhard Dietrich in Germany. We are also processing the data.

1.2 Participate in Zhong Shan- Dome-A Inland Ice Sheet Traverse

As a component of ITASE (international Trans-Antarctic Scientific Expedition) project (see Fig. 1), China has carried out her three Antarctic inland ice sheet traverses since 1996.

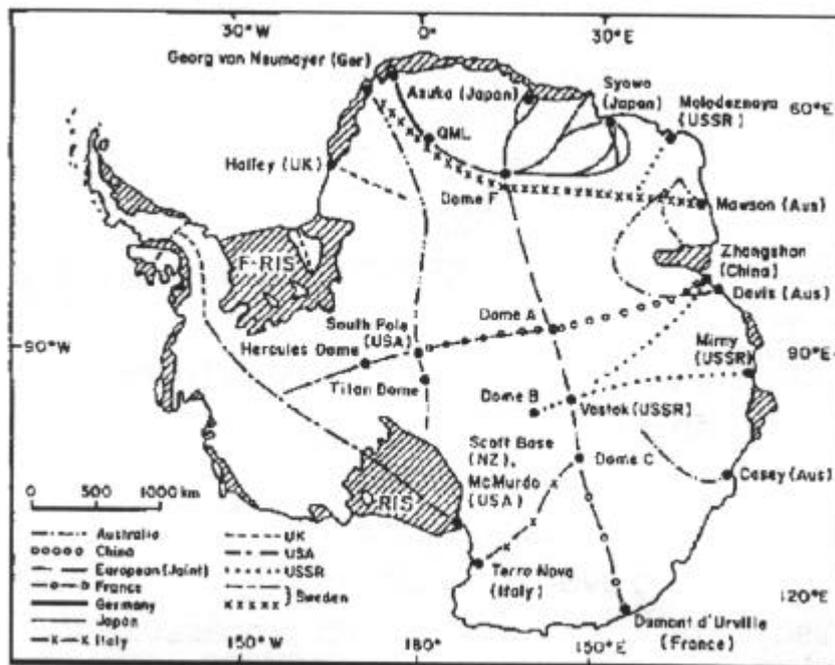


Fig. 1: the expedition routes of ITASE project

Every time, the traverse team departs from Zhong Shan Station and extends 300 kilometers, 500 kilometers and 1,100 kilometers towards Dome A (82° S, 75° E) respectively. As a member of the traverse team, surveyor is in charge of explanation satellite images, navigation and precise GPS positioning.

The first traverse was carried out from Jan. 18, 1997 to Feb. 1, 1997. The coordinate of the end point of this traverse is $71^{\circ} 54'$ S $77^{\circ} 59'$ E, where is 300 kilometers far away from Zhong Shan Station. On Feb. 3, 1998, China's second inland ice sheet traverse team departed from Zhong Shan Station, extended 500 kilometers towards Dome A to the point ($73^{\circ} 22'$ S, $77^{\circ} 00'$ E) and back to our base on Feb. 19, 1998. On the basis of former traverses, the third traverse team pushed forward successfully to Dome A area on Jan. 8, 1999. The farthest point is ($79^{\circ} 16'$ S $77^{\circ} 00'$ E), the elevation of which is 3,900 meters.

According to the route designed, surveyor navigated in the first tractor during advancing on ice sheet. Along the route, there was a mark rod every 2 kilometers for navigation and ice mass balance observation. On every camp point, a dual-frequency GPS receiver was employed to collect observation data simultaneously with fixed point at Zhong Shan Station. We could monitor ice mass balance and glacier drift with this differential GPS technique. The mark for high precise positioning was a glass fibre pole, which was 1 meter long, 3 cm in diameter. On top of the pole there was a clear mark for centering.

1.3 Surveying and Mapping in Grove Mountains

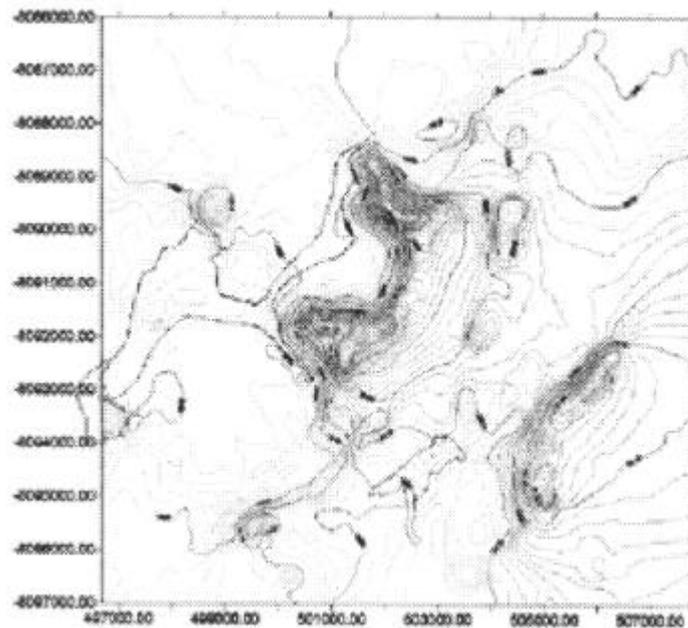
During the 15th CHINARE, except for a traverse team extending to Dome A, there was another traverse team composed of 4 Chinese expeditioners including a surveyor extended to Grove Mountains, which is 400-500 kilos south of Zhong Shan station. It is said that it's the first time getting to Grove Mountains by ground and on foot for mankind. The task of this traverse team was to do geological research work in Grove Mountains. The surveyor was in charge of navigation, GPS positioning, surveying and mapping in Grove Mountains. Trimble 4000SST GPS receiver was employed to positioning. Some control points were observed.

During the 16th CHINARE, China carried out the second expedition to Grove Mountains. The traverse team is composed of ten Chinese expeditioners including two surveyors, whose task is to survey the map of the core region of Grove Mountains at the scale of 1:50 000. The area of its core region (from $72^{\circ} 50' 54''$ to $72^{\circ} 56' 20''$ S, $74^{\circ} 54' 07''$ to $75^{\circ} 14' 09''$ E) is 110 square kilometers. A Geotracer 3220 dual-frequency GPS receiver, a Trimble-PROXR GPS receiver, and a SET-3B total-station and a theodolite T2 were employed in this project,

The main method of working is post-processing DGPS. Two base stations were set at the two encampments, MG-8 and MG-9. We got most of the field scattered points using DGPS and the other points (for example, the place that man could not access or climb) using total-station intercrossing. We got more than 14,000 GPS points and over 200 intercrossing points in all.

We have finished the office work of data processing and mapping. The data from the two base stations was co-processed with those from the Permanent GPS Tracking Site at Zhong Shan Station.

Here is the map mentioned above:



2. Research of Antarctic Geographic Information System.

Information industry has made progress with the development of network technology in recent years. At the same time, the development of theories of Digital Earth and GIS Visualization advances the mapping technology, including the Antarctica surveying. In order to satisfy with the rapid need to Antarctic data on internet, we are developing the Internet GIS of Antarctica on the platform of Geo-Star software.

In this System, you can obtain the coordinate systems of Great Wall Station, Zhong Shan Station and etc. You can browse the Vector data of maps and the corresponding attribute data by the popular browser such as Microsoft Internet Explorer, Netscape Navigator. You can acquire the information of scientific research and Antarctic surveying of China. In other words, you can acquire, publish and share Antarctic data on Internet by this system.

2.1 The features of Antarctica geographic information

Distributed Geographic Information (DGI): It indicates the geographic information including map, image, data muster, analysis operation, reporter and etc which is published in distributed ways on Internet by means of networking technology. The geographic information of Antarctica has also the distributive characteristics, which contains perpendicular distribution and horizontal distribution.

Perpendicular distribution: The same region may have the different thematic geographic information which is based on the same scale. King George Island region contains many layers information, such as coastline map, hydrologic map, contour map, place names map, topographic map, plants distribution map and etc.

Moreover, different layers may be collected and maintained by different departments in different ways. Coast linemap, contour map and etc may be collected by surveyors-distribution map of plants may be collected by biologist. Placename map may be collected by means of GPS technology; hydrologic map may be collected by means of RS technology. How to organize the above data efficiently, which concerned the organization the geographic data of Antarctica in horizontal distribution. The following map is the demonstration of the many layers.

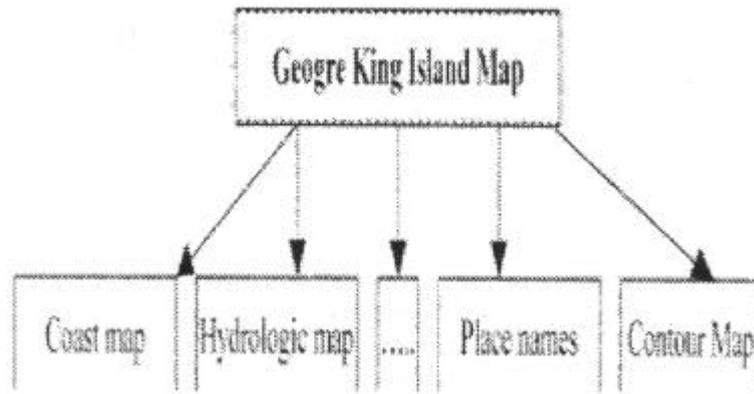


Fig. 2 The Layers of Geogre King Island Map

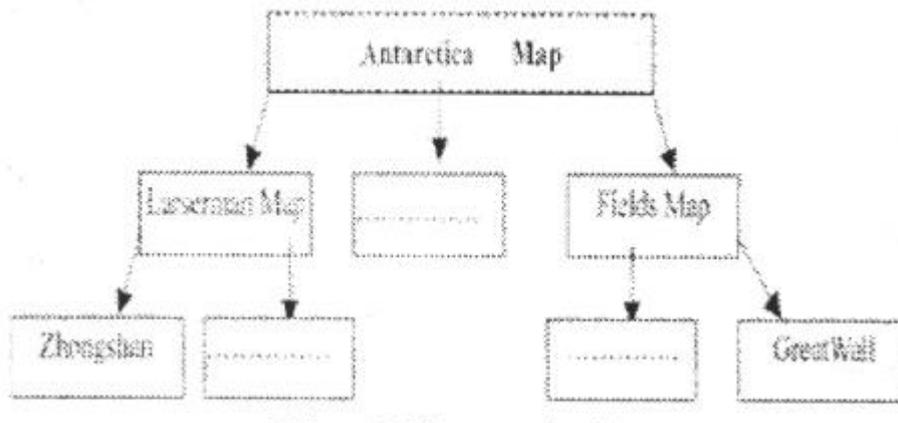


Fig. 3 The multi hyper maps

Horizontal distribution: A whole Antarctica map contains surface elevation, lakes, ice shelf, stations information and etc. In according to the conception of hyperlink, we can take the Antarctica map as home page (or main map) and takes each island as the keyword of hyperlink which links to each home page of stations by means of the related network address. User can query any information from Antarctica map to Laser map and from Laser map to Zhong Shan station map by clicking the hyper link, so that we can realize the multi-scales query.

Different scales and different map projections: Another feature of geographic information of Antarctica is different scales and different map projections. From the following table you can see that Antarctic map adopts the Oblique Azimuthal Equi-distant projection, Larserman and Fields maps adopt the Gauss-Kruger projection and Zhong shan and GreatWall adopt the Cylindrical Equirectangular projection and their scales are different from each other.

Map Name	Pro.jection	Scale	Format
Antarctica	Oblique Azimuthal Equi-distant	1:17250000	Arc/Info
Larserman	Gauss-Kruger	1:10000	MapInfo
Fields	Gauss-Kruger	1:10000	MapInfo
Zhongshan	Cylindrical Equirectangular	1:2000	GeoStar
GreatWall	Cylindrical Equirectajigular	11:2000	-GeoStar

Table 1-1: The comparison of maps

Another characteristic of Antarctic geographic information is heterogeneous data source. From the above table, we can see that Antarctic map adopts the Arc/Info data format, Laserman and Fields maps adopt the MapInfo data format and Zhongshan and GreatWall station adopt the GeoStar data format.

3. Establishment of Permanent GPS Tracking Site and Tide Gauging station at Zhong Shan Station.

3.1 Establishment of Permanent GPS Tracking Site at Zhong Shan station.

After two years preparation, China established a permanent GPS tracking site at Zhong Shan Station during 1998/1999 Antarctic summer season. The intention to establish this site is to develop the research of Antarctic dynamic and related problem. The content of research is as follows:

- 1) Link of the permanent GPS tracking site to the ITRF;
- 2) Accurate research on GPS satellite orbit in Antarctic area;
- 3) Providing foundation data for Antarctic plate movement;
- 4) Research on upper ionosphere and meteorology;
- 5) Research on crustal vertical motion.

This site, established according to international IGS standard, will be included into Antarctic permanent GPS tracking sites network.

A dual-frequency Geotracer 3220 GPS receiver sponsored by Spectra Precision AB was employed to perform continuous operation at this site. This kind of receiver has a superior performance. It can even work well under the condition of -30°C . It is controlled under the GPS-Base software, which ensure it work continuously all the day and store data automatically into computer.

The receiver was set up at the point where we previously participated in SCAR Epoch GPS Campaigns at Zhong Shan Station. Since this site was just established, there is problem of not being able to transport data in time, which is hopeful to be solved soon. Before it is solved, we use compact disc storage to store and transport data.

Since the second traverse team to Dome A set off in Dec. 15, 1998, the site began the co-surveying with them till Jan. 20th 1999. During the period of the second traverse team to Grove Mountains, We also carried out the co-surveying work.

3.1 Establishment of Permanent Tide Gauging Station at Zhong Shan station.

During the 16th CHINARE, with the help of Australia (Mr. Henk, Mapping Officer of Australian Antarctic Division), we established the Tide Gauging station at Zhong Shan station. Researchers from Australian Law Base (Spot engineer - Roger Handsworth) and Zhong Shan station cooperated in the establishment. The approximate position of the site is $69^{\circ} 22.998'$ S, $76^{\circ} 22.803'$ E.

The work of establishment was completed at the end of February. This site has begun its continuous and automatic observation.

4. Prospect of Antarctic Surveying and Mapping research of China.

- (a) Continue to participate in SCAR Epoch GPS Campaigns in future and process the data obtained from SCAR GPS Campaigns;
- (b) Perfect the establishment of permanent GPS Tracking Site at Zhongshan Station and real-time GPS data output;
- (c) Perfect the data-collecting system of the Tide Gauging station cooperated between China and Australia at Zhongshan Station, and cooperate with Australia to carry out the research of sea level change in East Antarctica;
- (d) Plan to establish DGPS station at Zhongshan Station region to improve GPS positioning precision for field expedition.