Chapter 1
Introduction

Location and Physiography

This report describes the geology of north Lantau Island and Ma Wan, and is covered by parts of the Hong Kong Geological Survey 1:20 000 Map Sheet 10 (Silver Mine Bay). The six 1:5 000 map sheets cover an area of some 6 750 ha (Figure 1), including the offshore area, stretching from Tai Ho Wan in the southwest through the Tsing Chau Tsai peninsula to Ma Wan in the northeast. In this report, the mapped area is referred to as 'the district'. The district occupies a region of rugged topography dominated by a central range of hills forming the backbone of Lantau Island. The highest peak in the southwest is Lo Fu Tau (465 m) and in the northwest, the highest peak is Fa Peng Teng (273 m). On Ma Wan, the highest point is Tai Leng Tau (69 m) in the southeast of the island. Deep embayments along the north Lantau coast form Chok Ko Wan (Penny's Bay) and Tai Pak Wan (Discovery Bay) in the east and Yam O Wan and Tai Ho Wan in the west. The Kap Shui Mun channel separates Ma Wan from north Lantau Island. Three small offshore islands (Tang Lung Chau, Cheung Sok Tsui, and Tsz Kan Chau) are included in the map area along with several offshore reefs.

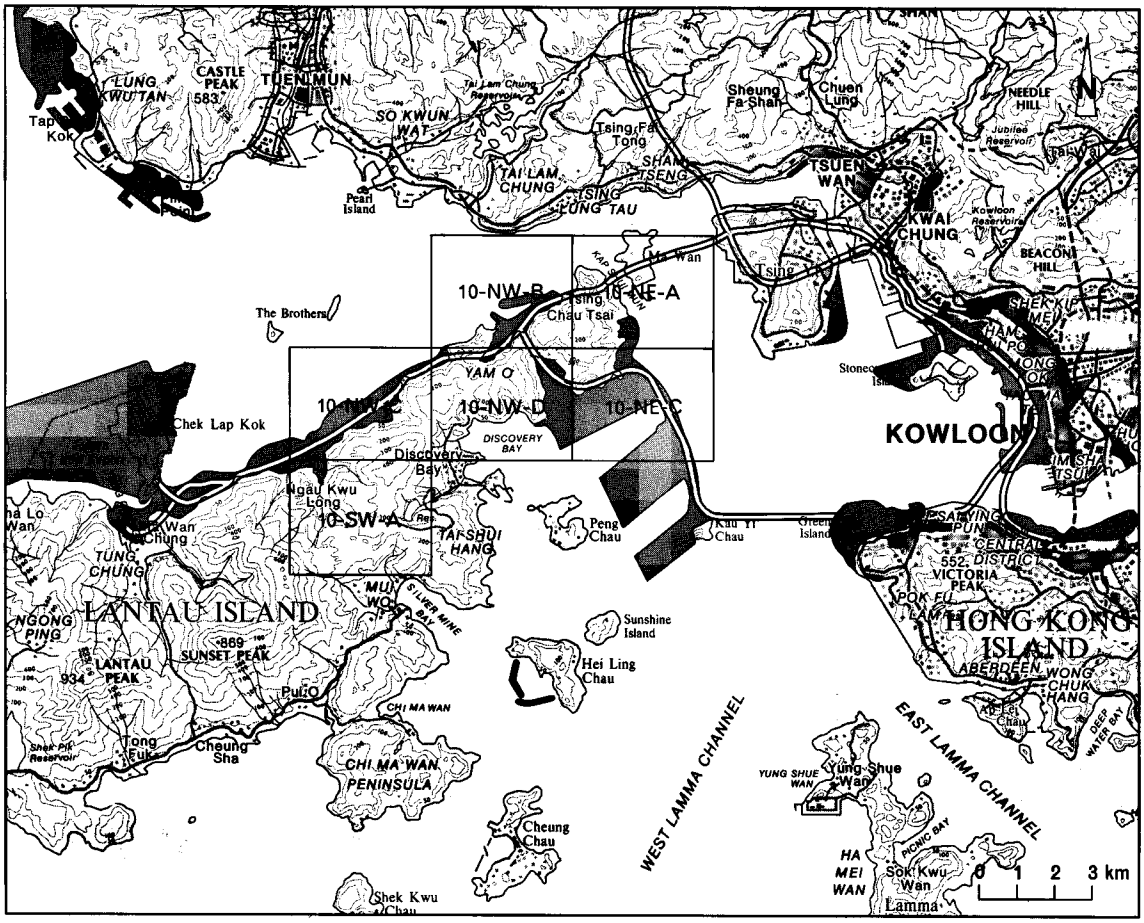

Figure 1 - Location Map of Major Infrastructure Developments Undertaken and Proposed for North Lantau Island and Ma Wan

Much of the area is agricultural, though now largely abandoned, with fish farming predominating on Ma Wan. Numerous small village settlements occupy the low-lying areas in the district with the highest populations at Kung Tsai Wan on Ma Wan and at Tai Ho Wan. Part of the district includes the private residential development of Discovery Bay which has a population of more than 10 000. New roads, buildings and a tunnel are planned or under construction and land development is likely to expand rapidly once the new airport is completed.

Previous Work

The first geological investigations in Hong Kong were undertaken by Brock, Uglow, Schofield & Williams between 1923 and 1927 under an agreement between the Colonial Office and the University of British Columbia. A geological map of Hong Kong was published at a scale of 1:84 480 by Brock *et al* (1936), and several papers relating to this work were published by Brock & Schofield (1926), Uglow (1926), Williams (1943) and Williams *et al* (1945). The first memoir, based largely on this work, was produced by Davis (1952), followed later by a detailed description of the geology of the Territory by Ruxton (1960).

Allen & Stephens (1971) published the first comprehensive geological map at a 1:50 000 scale together with a descriptive report. This survey remained the definitive work on the geology of the Territory until 1982 when the Hong Kong Geological Survey commenced the 1:20 000 mapping programme (Figure 2). Bennett (1984a; 1984b; 1984c) reviewed the stratigraphy and tectonics of the Territory, and the first 1:20 000 geological map covering the north Lantau Island district was published by Langford *et al*, (1991) (Sheet 10). The terrain characteristics, superficial deposits and engineering geology aspects were described in the Geotechnical Areas Studies Programme Report No. IV, North West New Territories (GCO, 1988a). The first geological memoir to describe the district has been prepared by Langford *et al*, (in press).

The New Port and Airport Projects

This report is the second in a series of geological reports and associated 1:5 000 scale map sheets covering the development areas of Lantau Island.

The new airport at Chek Lap Kok and new port facilities planned for north Lantau Island are enormous projects which require the construction of extensive infrastructure, including road and rail links, and establishment of new town communities at Tai Ho and Tung Chung. In the past, some of the problems encountered in such major infrastructure developments in Hong Kong have been attributed to insufficient geotechnical and geological knowledge. A previous regional geotechnical area study of north Lantau Island (GCO, 1988b) indicated that much of the area is influenced by high to extreme geotechnical constraints to development.

In view of the size and scope of the port and airport developments proposed for north Lantau Island and Ma Wan, it was decided by the Geotechnical Engineering Office (GEO), previously the Geotechnical Control Office, that detailed geological mapping of north Lantau Island and Ma Wan should be undertaken and this commenced in October 1990.

This report covers the area of the proposed airport support community at Tai Ho Wan, the infrastructure development at Siu Ho Wan, the proposed Port Peninsula Development, the North Lantau Expressway and Lantau Fixed Crossing in the most northeasterly part of Lantau Island. The main purpose of this study was to carry out detailed geological mapping to provide information on rock structure, texture and composition for use by engineers involved with the infrastructure development. An additional aim was to supplement existing published geological data with more detailed information for understanding broader issues of the geology of Hong Kong.

Data Sources

A large volume of north Lantau Island and Ma Wan borehole data exists from previous ground investigations carried out during the 1970s and early 1980s and more recently from the new airport project (Figure 3). This large data set was compiled onto a computerised database to allow easy retrieval, evaluation and interpretation. The report text is based on a review of site investigation data up to December 1992. However, the computerised database is regularly updated as new information is received and should therefore be of continuing interest to all those involved with geotechnical appraisals or design in the district.

The nature and distribution of offshore superficial sediments has been mapped using shallow seismic profiles, borehole logs, and CPT traces from several surveys. These surveys were originally carried out in preparation for the Lantau Fixed Crossing, Port and Airport Development Strategy (PADS), offshore sand resource exploration and site investigations for reclamations. The seismic data were shot using a 100 Joule 'boomer' source. This provided good resolution in the superficial sediments but at the expense of identifying bedrock structure. A total length of 330 km of seismic profiles were examined (Figure 4).

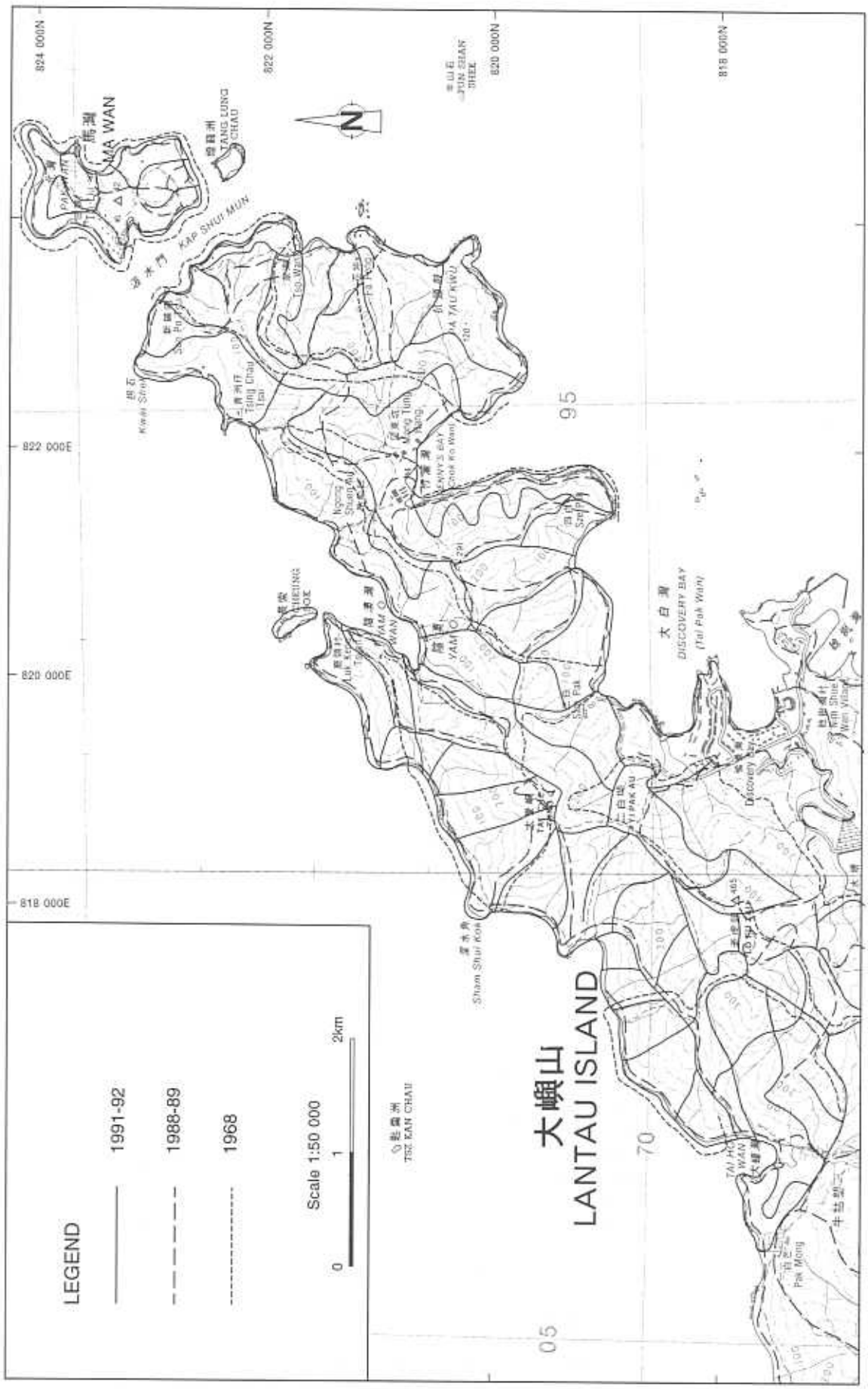

Figure 2 - Traverses Undertaken during 1968, 1988-89, and 1991-92 Field Surveys

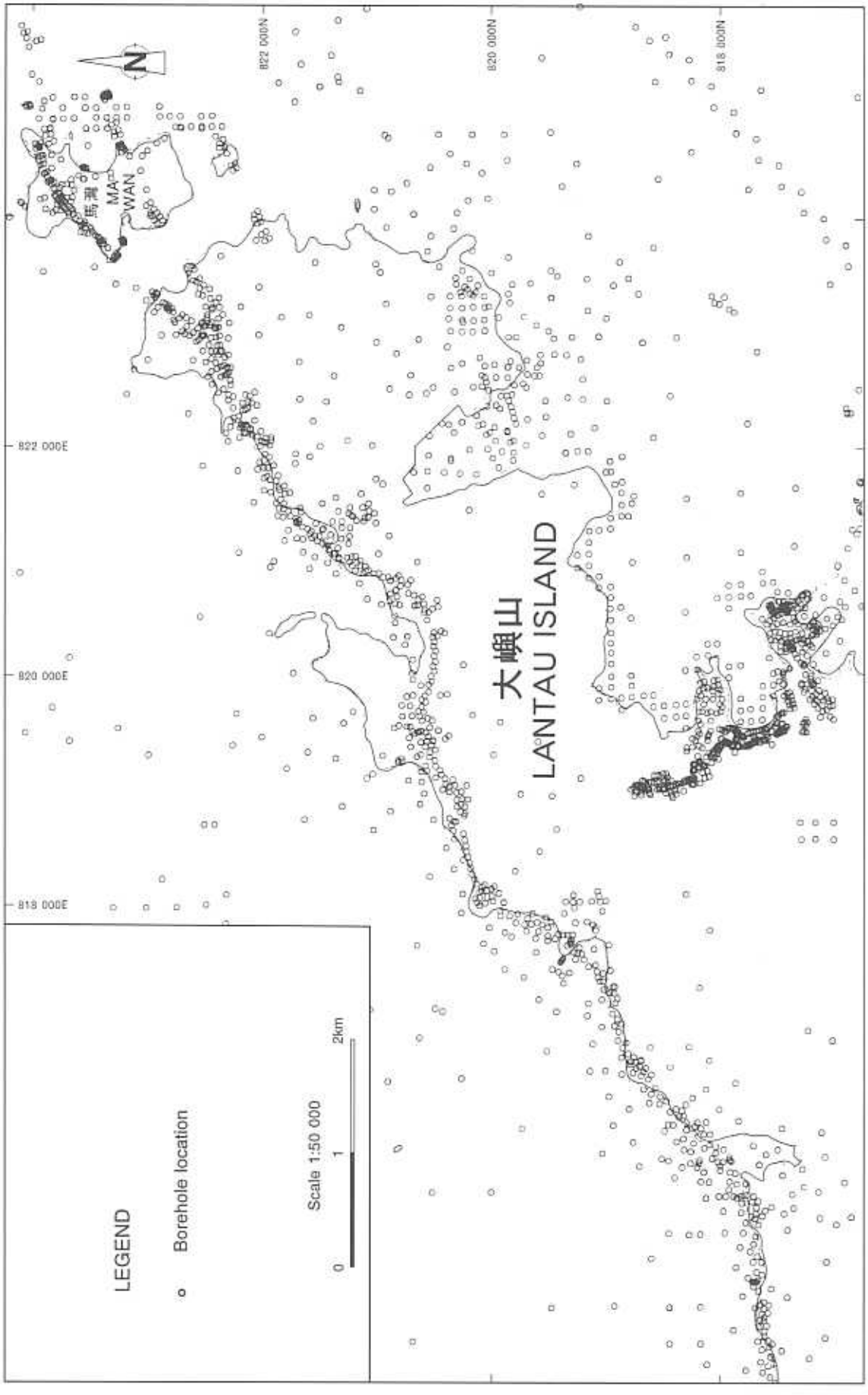

Figure 3 - Locations of Boreholes Drilled for North Lantau Island and Ma Wan Infrastructure Developments

A total of 182 new rock samples were collected during the present mapping. Among them, some 169 specimens were thin-sectioned; 95 samples were sent to the University of Nottingham for whole-rock major- and trace-element geochemical analysis, and 13 samples were sent for Rare Earth Element analysis at Royal Holloway and Bedford New College, London. Two samples have been collected from the district for Rb-Sr age determinations at the NERC Isotope Geosciences Laboratory, Keyworth, U.K.

Aerial photographs, particularly those taken in 1963, were invaluable in the mapping of onshore superficial deposits. A Landsat TM-image of the Pearl River Estuary, although at a small scale, gave an excellent overview of the district and supplied further evidence of structural trends determined from field mapping.

The 1:5 000 geological maps which accompany this report are based on the Hong Kong Geological Survey field surveys, now published as a map at a scale of 1:20 000. The present project not only supplements this work but also provides a detailed interpretation of the sub-surface geology based largely on new information, mostly from boreholes and offshore seismic traverses, obtained since these initial surveys. Each 1:5 000 sheet area is represented by one geological map showing the solid and superficial geology.

All the records from this project, including rock samples, thin sections, manuscript maps and analytical data, are held in the archives of the Hong Kong Geological Survey, Geotechnical Engineering Office. The powders used in geochemical analysis are also retained in the Hong Kong Geological Survey archives, and a sub-sample is kept at the British Geological Survey, Keyworth, U.K.

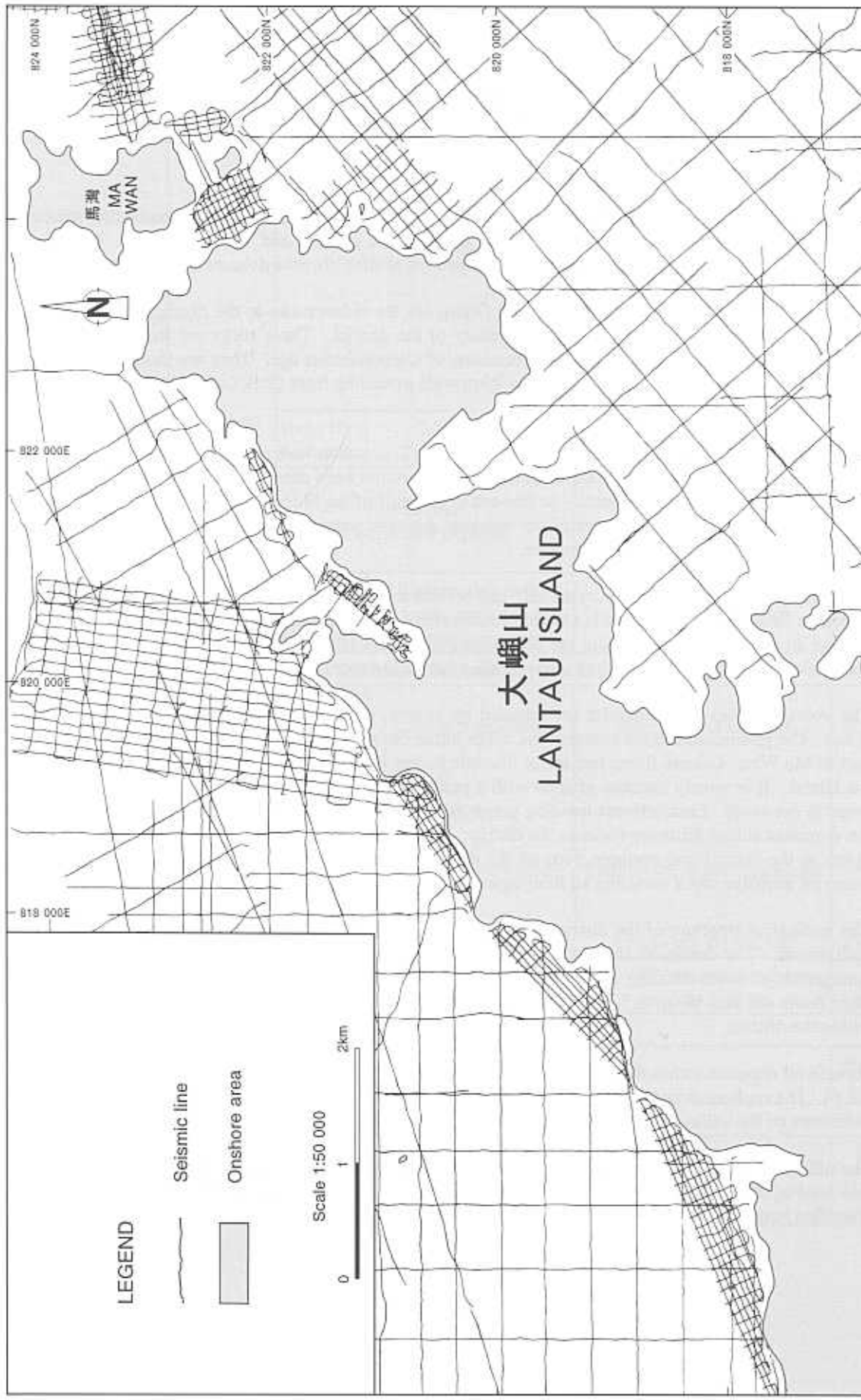

Figure 4 - Locations of Seismic Lines around North Lantau Island and Ma Wan