Chinese Journal of Polar Science, Vol. 9, No. 2, 125 - 132, December 1998

Late Palaeogene palynoflora from Point Hennequin of the Admiralty Bay, King George Island, Antarctica with reference to its stratigraphical significance

Duan Weiwu (段威武)
Guangzhou Marine Geological Survey, MGMR, Guangzhou 510075, China

Cao Liu (曹　流)
Nanjing Institute of Geology and Palaeontology, CAS, Nanjing 210008, China

Received June 23,1998

Abstract The present paper is to discuss the geological age and sedimentary environment based mainly on the characteristics of the palynological assemblage in the intercalated tuffaceous sand-mudstones of the Upper Point Hennequin Group in the Admirelty Bay, King George Island, Antarctica. More than 40 species, mainly the Late Paleogene plant community in Gondwana and belonging to Weddellian biogeographic Province, were encountered within the volcano-sedimentary rocks of the Upper Point Hennequin Group. The index member is the genus *Nothofagidites*. The occurrence of *N.* cf. *saraensis* and *N.* cf. *flemingii* and the absence of *Proteacidites* spp. indicates that the sporopollen-bearing rocks is of Oligocene age, which were deposited in a limnetic zone near medium-lower mountains environment with warm and humid climate.

Key words palynoflora, Point Hennequin Group, Palaeogene, Antarctica.

1 Introduction

The King George Island, located at 61°50′ - 62°15′S and 57°30′ - 59°00′E, is the largest one among the South Shetland Islands. It consists essentially of the Cenozoic island-arc volcanic sequence (Birkenmajer 1981). But more than 90% of the King George Island is covered by ice-caps and glaciers (Birkenmajer 1989). Rocks are exposed mainly in the coast of bay on the south of island facing the opening of the Bransfield Strait, particularly in the Maxwell Bay and the Admiralty Bay. The Tertiary biostratigraphy of the Island is little known, so is the palyniferous biostratigraphy. During the 7th Chinese National Antarctic Research Expedition (1990/1991), the Geological Group of Research vessel "Haiyang Ⅳ" conducted field work on the Point Hennequin of the Admiralty Bay and collected a number of rock samples. Among them, Number H5-5(6)-S contains many sporopollen fossils (Fig. 1). Although poorly preserved, they are the first to be discovered and are of significance to the determination of stratigraphical age.

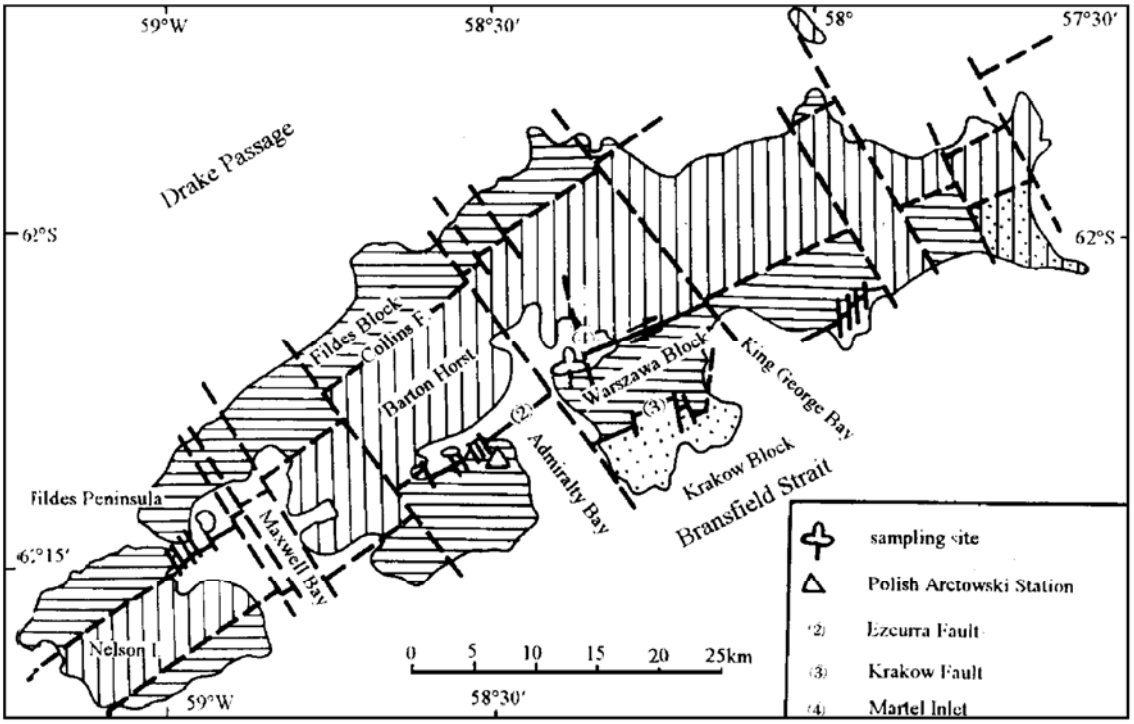

Fig. 1. Structure scheme of the King George Island and sampling sites (after Birkenmajer 1989).

2 Sample description

The exposed rocks are poorly scattered in the Point Hennequin of the Admiralty Bay and its northern coast. The rocks mainly consist of interbedded lava and tuffaceous breccia with intercalations of thin-bedded sedimentary clastic rocks. The visual thickness of the sequence is about 500 m (Berkenmajer 1981) without seeing the top and bottom boundaries. Hawkes (1961) named the volcano-sedimentary sequences the Point Hennequin Group, including those along the southeast coast of Martel Inlet and some other sites of Point Hennequin. Barton (1965) redefined the group and restricted its distribution to the area along the southeast coast of Martel Inlet only, i. e. Point Hennequin and its northern coastal zone. Based on the lithology, Birkenmajer (1981) subdivided the group into two formations, the Vieville Formation and the Mount Wawel Formation in ascending order, with the age of Miocene, which was redetermined to be Eocene-Oligocene (1987). Ruan Honghong *et al.* * measured the section at Seal Beach of the Point Hennequuin and its northern coast, and they divided the Point Hennequin Group into three parts:

------uncompleted by denudation------

Upper member: thick-bedded basaltic lava in multilayers, forming steep slope.

Middle member: variegated tuffaceous breccia with intercalated tuffaceous sandstone and mudstone (more tuffaceous breccia at Seal Beach); more intercalations of sedimentary clastic rocks in the northern coast, bearing plants and palynological fossils.

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* Ruan HH, Guo KY, Xing GF *et al.* (1995): The evolution of Mesozoic-Cenozoic volcanic Magma in the South Shetland Islands, Antarctica and its metallogenesis (in Chinese, unpublished).

Lower member: consisting of 4 thick-bedded basalt with intercalations of tuffaceous breccia and agglomerate (224 m, actual measurement).
------unknown------

There are no obvious lacuna or unconformity discovered within the members. The outcroppings along the northern coast are undeveloped, mainly consisting of the thick-bedded basalt (lower part) and variegated sedimentary clastic rock (upper part). The sample bearing sporopollen fossils was of intercalation of the tuffaceous muddy siltstone collected from the middle member. It is dark in colour and rich in plant fragments (Fig. 2). By lithological comparison, the rocks bearing palynological fossils could be equivalent to the Mount Wawel Formation designated by Birkenmajer (1981), or corresponding to his "Dragon Glacier Plant Beds".

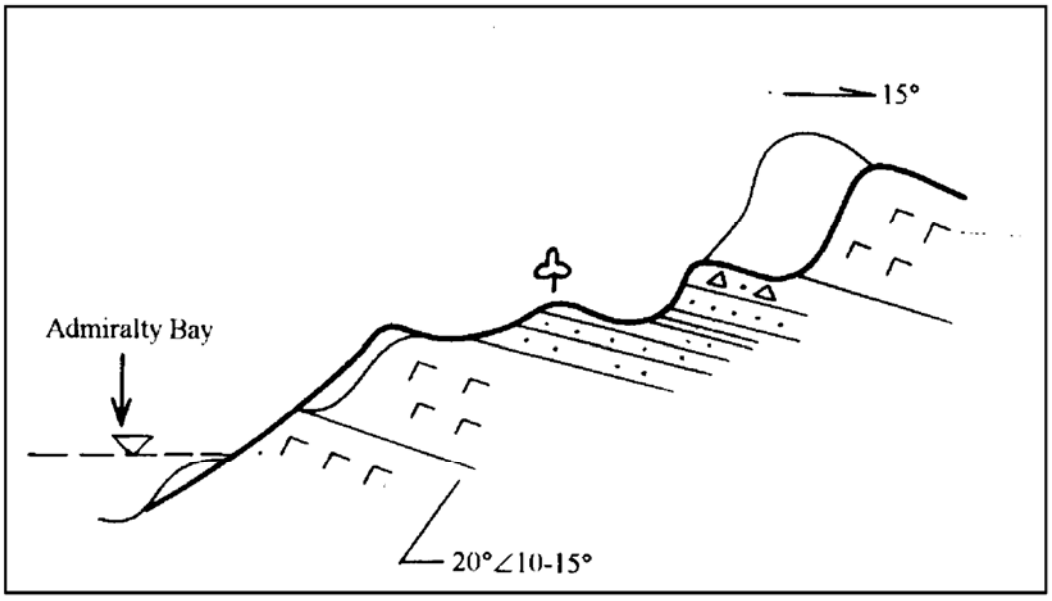

Fig. 2. Lithological profile of northern Point Henneguin of the Adimiralty Bay and the sampling stratohorizon.

3 Palynoflora feature

More than 40 species of palynological fossils have been initially examined in the sample H5-5(6)-S collected from the Point Hennequin of the Admirality Bay, King George Island, Antarctica. They constitute a palynilogical assemblage characterized by the following components (Plate I):

(1) Fungal spores are more than 10 species, mostly the Eumycophyta spores *Fractispronites* sp., *Asterina* sp., *Multicellaesporites* sp., *Diporites*? sp. and *Trihyphaecites* sp., occupying 8% of the total number of the assemblages.

(2) Pteridophyte spores are about 15 species, dominantly *Cyathidites minor* Couper, *Gleicheniidites* sp., *Leiotriletes* sp., *Foveasporis* cf. *areapunctatis* Stuchlik, *Retitriletes* cf. *austroclavatidites* (Cookson) Doring *et al.*, *Extrapunctatosporis* sp., *Lophozonotriletes* sp., *Polypodiisporites favus* (Pot.) Potonie and *Laevigatosporites* sp., etc., occupying 45% of the total number of the assemblage and being the major composition of the assemblage.

Plate I

Explanation of Plate I

(All the specimens were collected from the Upper Point Hennequin Group in the Admiralty Bay, King George Island, Antarctica, and are deposited in Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences. All figures are ×1000)

1. *Multicellaesporites* sp., No. 001-8
2. *Asterina* sp., No. 001-1
3. *Retitriletes* cf. *austroclavatidites* (Cookson) Doring *et al.*, No. 001-8
4. *Foveasporis* cf. *areapunctatis* Stuchlik, No. 001-3
5. *Cyathidites minor* Couper, No. 001-3
6. *Gleicheniidites* sp., No. 001-2
7. *Lophozonotriletes* sp., No. 001-3
8. *Extrapunctatosporis* sp., No. 001-8
9. *Polypodiisporites favus* (Pot.) Potonie, No. 001-1
10. *Laevigatosporites* sp., No. 001-7
11. *Phyllocladidites* sp., No. 001-3
12. *Podocarpidites marwickii* Couper, No. 001-7
13. *Trisaccites microsaccatum* (Couper) Couper, No. 001-3
14. *Dacrycarpites australiensis* Cookson et Pike, No. 001-8
15. *Nothofagidites* cf. *saraensis* Menendez et Caccavari, No. 001-1
16. *Nothofagidites* sp. 1, No. 001-7
17. *Nothofagidites* sp. 2, No. 001-7
18. *Nothofagidites* cf. *flemingii* (Couper) Potonie, No. 001-7

(3) Gymnospern pollen presents 8 species, chiefly *Trisaccites microsaccatum* (Couper) Couper, *Dacrycarpites australiensis* Cookson et Pike, *Podocarpidites marwickii* Couper, *Phyllocladidites mawsonii* Cookson et Couper, *Phyllocladidites* sp. and *Microachrydites antarcticus* Cookson, amounting to 42% of the total number and being the dominant composition of the assemblage.

(4) Angiosperm pollen includes 5 species, essentially *Nothofagidites* cf. *flemingii* (Couper) Potonie, *Nothofagidites* cf. *saraensis* Menendez et Caccavari and *Nothofagidites* spp., accounting for 5% of the total number.

4 Results and discussion

4.1 Age and environment

The principal components of the palynoflora from the upper part of the Point Hennequin Group demonstrate the Late Palaeogene terrestrial population in Gondwana continent, belonging to Weddellian Province and represented by the index genus *Nothofagidites*. It is necessary to point out that in the assemblage occurs the spores *Gleicheniidites* genus, which is widely distributed in the Cretaceous strata, particularly in the Cretaceous of both the north and south higher latitude zones. Only a few species of the genus could last to the Tertiary. Generally, the sedimentary rock bearing *Gleicheniidites* spp. is inclined to be of older age (Cao 1990). Furthermore, the absence of pollen herbaceous vegetation in the present assemblage suggests that its geological age could not be the Neogene. It is worth notice that the angiosperm pollen of the assemblage is dominated by *Nothofagidites* spp., the most developing in

the Oligocene. Among the genus, *Nothofagidites* cf. *saraensis* originally found from the Oligocene stage in Argentina; *N.* cf. *flemingii* from the Mid-Late Eocene in the New Zealand. The latter is still popular in the Oligocene. To sum up, the age of volcanic sediments bearing sporopollen fossils at the Point Hennequin of the Admiralty Bay is very likely the Oligocene in age, not determined as the Middle Miocene (Birkenmajer 1981) or the Late Oligocene (Zastawniak *et al.* 1985; Birkenmajer 1987, 1989; Shen 1994). The Late Palaeogene palynoflora from the Point Hennequin reflected a mixed forest of coniferous and broadleaf (including coniferales and *Nothofagus*, etc.) in the medium or lower-altitude mountain areas or nearby rivers and lakes. Under the mixed forest, the vegetation mainly consists of ferns, such as family Gleicheniaceae, Cyatheaceae, Adiantaceae, Lygodiaceae and Polypodiaceae, etc.. The paleoclimate grew warm and humid, supported evidently by the occurrence of the numerous fungal spores suitable for the warm and humid climate within the assemblage. Neither marine microfauna nor littoral microflora have been encountered, and on the contrary, terrestrial sporopollen, particularly a great number of fern spores have been commonly discovered from the rocks in the Point Hennequin area, it is most likely that they were deposited in situ or transported from a shorter distance and belong to continental facies environment.

4. 2 Correlation and discussion

The known localities where occurs Palaeogene sporopollen in the King George Island include Fossil Hill and oil reservoir nearby Bellingshausen Station of previous Soviet Union in the Fildes Peninsula, Polish Arctowski Station on the west side of the Admiralty Bay and the Point Hennequin. The last two lie on the Warszawa Block, separated from the first by Barton horst (Fig. 1).

According to the Shen' studies (1990, 1992, 1994), the sporopollen fossils were found from the Fossil Hill Formation in the Fossil Hill and near the Soveit's oil reservoir, besides the plant leaves, stems and bird footprints. Especially, in the latter place, i. e. Rocky Cove section, it is abundant in well-preserved palynological fossils (Shen 1994). Cao (1992) suggests that the age of Fossil Hill Formation is of Eocene with warm-humid and rainy climate based on the palynological result, showing a common view with Profs. Li and Shen (1990), who got the knowledge based on the flora study obtained from the same place.

Stuchlik (1981) from the Poland first reported the study on palynological fossils nearby the Polish Arctowski Station on the western side of the Admiralty Bay. The samples were collected from the Petrified Forest Member of Arctowski Cove Formation in the lower part of Ezucurra Inlet Group. The palynoferous rocks are chiefly the thin-bedded shale and then mudflow agglomerate in lenticular shape (30 – 50 m total thick). The palynological fossils are characterized by *Nothofagus*-Phteridophyta assemblage. According to the correlation of the present fossils with those from Australia and Ross Sea of Antarctica, Stuchlik thought the strata bearing "the Admiralty Bay flora" should not be older than late Eocene-early Oligocene, but are certainly older than the Point Hennequin Group". Birkenmajer (1988) reassigned the age of Petrified Forest Member with palyniferous fossils to the Late Eocene-Early

Oligocene. More recently, Song (1997) assigns the Petrified Forest Member to the Eocene age based on the palynological research.

The sporopollen assemblage from the Point Hennequin Group described here differs from those in the marine Cretaceous of the James Ross Island, in the Palaeocene of Seymour Island, Antarctic Peninsula and in the Late Cretaceous of the Fildes Peninsula. So far as the analysis result is concerned, some palynological elements from the Point Hennequin Group are quite the same as those from Ezcurra Inlet Group or Fossil Hill Formation, but there is still a marked difference in composition among them. The chief distinction in the assemblage of the Point Hennequin Group is by lack of pollen, such as *Proteacidites* spp. and other angiosperm pollen. *Proteacidites* exists in Ezcurra Inlet Group and Fossil Hill Formation, and it is one of the key members found from Late Cretaceous-Eocene strata in Southern Hemisphere and Antarctica. Moreover, the Mount Wawel Formation, i. e. the upper part of Point Hennequin Group, still yields plant fossils, represented by *Nothofagus*-Podocarpaceae assemblage. The fossil plants are characterized by small-medium sized and non-entire-marginal leaves, which show a monotonous type and occupy over 95% of the total number of the assemblage. Comparing with the flora assemblage from Petrified Forest member of the upper Ezcurra Inlet Group, the present flora assemblage has a certain difference in the features (Shen 1994). The authors primarily assign the Mount Wawel Formation of the Upper Point Hennequin Group to Oligocene, representing a new horizon bearing palynological fossils in King George Island.

Acknowledgements We are grateful to Prof. Zhou Tongshun from Beijing Institute of Geology, CAGS for providing the samples, also to Associate Prof. Ruan Honghong and Associate Prof. Guo Kunyi from Nanjing Institute of Geology and Mineral Resources, CAGS for providing the field profile data. Thanks are also due to Mr. Qian Zeshu from the Jiangsu Institute of Petroleum Exploration and Developing for analyses of the sporopollen fossils. The authors also wish to thank Prof. Shen Yanbin from Nanjing Institute of Geology and Palaeontology, CAS for his advice and useful publications.

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