北ベトナム・Bac Bo 平野及び周辺地域における先史以前の古植生の復元

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1.はじめに及び目的

Bac Bo 平野はベトナム地域において，古くから文化の中心地である．地形学・地質学・考古学など，多くの研究が行われている．これらの研究により，本地域は海水準変動の強い影響下にあり，完新世においていくつかの気候変動ステージにわけられることが明らかとなっている．しかし，花粉学的研究はほとんど行われておらず，Bac Bo 平野の植生史の知見は少ない．

そこで本研究では，Bac Bo 平野及び周辺地域における有史以前の古植生を復元すると共に，人間活動と植生との関係を評価することを目的とする．

2.方法

考古学遺跡において，7 地点のボーリング調査を行った．Bai Tu・Go Chien Vay・Chua Gio・Phu Luong・Van Dien の 5 箇所は縄文海進の終りに形成され，現在は河川作用が卓越する地域である．Dong Son・Nga Van の 2 箇所はデルタ南側に発達している海岸平野に位置し，潮汐作用が卓越する地域である．

花粉分析用に全 116 サンプルをボーリングコアから採取した．全サンプルに対し，第四紀堆積物の標準的な処理法に従って化学処理を行った．また，花粉分析に加え，考古学的証拠を用いて，先史以前の植生と人間活動との関係を考察した．

3.結果及び考察

花粉分析により，全 76 種/属・50 科が確認された．これらは生態学的に，熱帯性樹種・亜熱帯性樹種・温帯性樹種・草本種・シダ植物・マングローブ及びバックマングローブ種，の 6 つに分類することができた(Table 1)．花粉分析及びコアの年代測定の結果より，4 つのステージに区分することができた．

-ステージ 1(6,000～5,000yrBP)：Nga Van コア（深さ 80cm～140cm）・Dong Son コア（深さ 88cm～200cm）では，*Rhizophora ap.*，*Bruguira sp.* がマングローブ花粉のほとんどを占めていた．このことから，ステージ 1 の期間においては，海水準が安定的に現在よりも高かったことが考えられる．また，シダ植物では *Lygodium sp.*, *Polypodium sp.*, *Cyathea* sp.，木本種の花粉は，*Castanea sp.*，*Castanopsis sp.*，*Lithocarpus sp.*，*Pinus sp.*，*Myrtus sp.* が，草本種は主にイネ科であった．Bai tu コアでは，シダ植物と草本が優占し，木本種はほとんど出現しなかった．

-ステージ 2(5,000～4,000yrBP)：Nga Van・Dong Son コアの両方でマングローブ花粉が減少した．Bai Tu，Dong Son，Chua Gio コアではシダ胞子がほとんどないが，Nga Van・Van Dien コアでは増加した．木本種花粉はほとんどなく，草本種花粉はキク科・イネ科で構成されていた．

-ステージ 3(4,000～3,000yrBP)：すべてのコアにおいて，花粉/胞子が非常に少なかった．Nga Van，Dong Son でマングローブ花粉が出現しなくなり，海退が起こったことが示唆される．

Tropical arboreal plant	Subtropical arboreal plant	Temperature arboreal plant	Herb	Fern spore	Mangrove and back mangrove
Acacia sp. (Leguminosae)	Lithocarpus sp. (Fagaceae)	Ulmus sp. (Ulmaceae)	Orchidaceae	Angiopteris sp. (Pteridophyta)	Acrostichum sp. (Pteridaceae)
Aralia sp. (Araliaceae)	Castanopsis sp. (Fagaceae)	Ilex sp. (Aquifoliaceae)	Oryza sativa (Poaceae)	Ceratopteris sp. (Pteridophyta)	Avicennia sp. (Avicenniaceae)
Carya sp. (Juglandaceae)	Liquidambar sp. (Hamamelidaceae)	Quercus sp. (Fagaceae)	Compositeae	Coniogramme sp.(Pteridophyta)	Bruguiera sp. (Rhizophoraceae)
Cycas sp. (Cycadaceae)	Fagaceae	Juglands sp. (Juglandaceae)	Poaceae	Cyathea sp. (Cyatheaceae)	Ceriops sp. (Rhizophoraceae)
Engelhardtia sp. (Juglandaceae)		Myrica sp. (Myricaceae)	Malvaceae	Dicksonia sp. (Dicksoniaceae)	Cyperus sp. (Cyperaceae)
Ericaceae		Alnus sp. (Betulaceae)	Liliaceae	Gleichenia sp. (Gleicheniaceae)	Rhizophora sp.(Rhizophoraceae)
Euphorbia sp. (Euphorbiaceae)		Taxodium sp.Taxodiaceae)	Lilium sp. (Liliaceae)	Hymenophyllum sp.(Hymenophyllaceae)	Sonneratia sp. (Sonneratiaceae)
Euphorbiaceae		Castanea sp (Fagaceae)	Labiatae	Lycopodium sp. (Lycopodiaceae)	Nypa sp. (Arecaceae)
Glyptotrochus sp.		Abies sp. (Pinaceae)	Leguminosae (Fabaceae)	Lygodium sp. (Pteridophyta)	
Jatropha sp. (Euphorbiaceae)		Pinus sp. (Pinaceae)	Pterocarya sp. (Chenopodiaceae)	Microlepia sp. (Pteridophyta)	
Magnolia sp. (Magnoliaceae)		Metasequoia sp. Taxodiaceae	Chenopodium sp.(Chenopodiaceae)	Plagiogyria sp. (Pteridophyta)	
Michelia sp. (Lecythidaceae)			Polygonum sp. (Polygonaceae)	Polypodiaceae	
Morus sp.(Moraceae)				Polypodium sp. (Polypodiaceae)	
Myrtus sp. (Myrtaceae)				Pteris sp. (Pteridaceae)	
Nyssa sp. (Cornaceae)				Selaginella sp. (Selaginellaceae)	
Palmae				Stenochlaena sp. (Pteridophyta)	
Platycarya sp. (Juglandaceae)				Osmunda sp. (Osmundaceae)	
Podocarpus sp.(Podocarpaceae)					
Rhus sp. (Anacardiaceae)					
Rubiaceae					
Sterculia sp. (Sterculiaceae)					
Tilia sp. (Tiliaceae)					

表 1. 全確認種の分類表

－ステージ 4(3,000～2,000yrBP)：ウラボシ科，*Stenochlaena sp*，*Microlepia sp*，L*ygodium sp*，*Cyathea sp* といったシダ胞子が優占していた．草本種はキク科，*Oryza sativa* などのイネ科，木本種は *Magnolia sp*，*Michelia sp*，*Castanea sp*，*Castanopsis sp*，ヤシ科であった．イネ科花粉，*Oryza sztiva* 花粉は，この時期に Bac BO 平野において，農業が活発になったことを示している．加えて，石器から青銅器に変わり，Dong Son 時代(1,000 B.C.年頃)には鋤の頭が青銅で作られていることが考古学的に明らかになっていることからも，本地域で農業活動が活発化したと考えられる．

4.まとめ

本研究の結果から，Bac Bo 平野における先史の古植生は草地・潅木林・自然林がモザイク上に点在していたと推察される．花粉分析の結果は，先史における人間活動の影響を反映したものと言える．3,000yrBP と考えられる層から，大量のイネ科花粉が見つかり，これらは水稲種であると考えられる．本研究の成果は，今後の調査・研究への貢献ができたと言える．

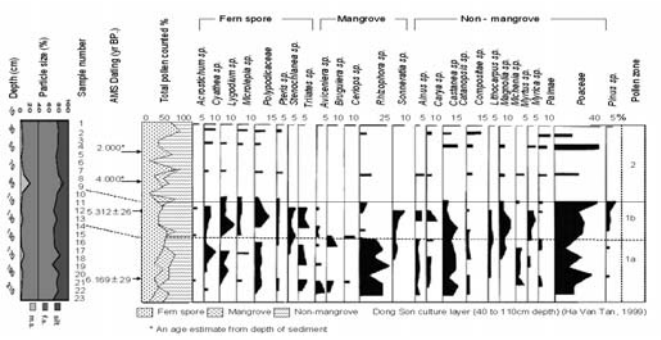

図 1.Don Son コアの花粉ダイアグラム

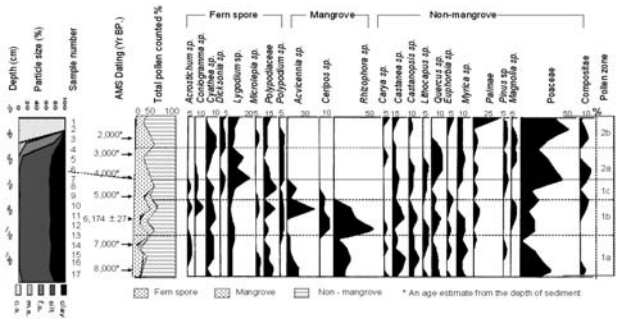

図 2.Nga Van コアの花粉ダイアグラム

Pre-historical Vegetation in the Bac Bo Plain and adjacent area, Northern Vietnam

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Key words: Pollen analysis, pre-historical vegetation, Bac Bo plain, Vietnam

1. Introduction and study objectives

Bac Bo plain is one of the most important regions which has a long history in Northern Vietnam. Studies concentrated on geology, geomorphology and archaeology show that the evolution of Bac Bo plain is closely related to the sea-level and climatic phase changes during the Holocene. There are few palynology researches undertaken in the Bac Bo plain, therefore vegetation history in Bac Bo plain is poorly understood and an interaction between human and vegetation has not discussed yet. This study aims to construct the pre-historical vegetation in Bac Bo Plain, and evaluate an interaction between vegetation and human in pre-historical time.

2. Material - Methodology

In total, seven coring sites (archaeological sites) are taken for this study: Five cores of them are located at fluvial dominated system which is formed at the end of the Flandrian transgression and affected by river activities. They are Bai Tu, Go Chien Vay, Chua Gio, Phu Luong and Van Dien core. Two other cores are located at wave dominated systems that are well developed along the southern parts of the delta coastal plain and mainly affected by wave and sand ridges. They are Dong Son and Nga Van cores.

The total 116 samples are extracted from seven cores to process pollen analysis. All samples are treated chemically according to the standard procedure of Quaternary sediment. The combination between pollen analysis results and archaeological evidences is carried out to evaluate human impact on pre-historical vegetation.

3. Results and discussion

All 76 species/genus belonging to 50 families have been found in soil samples. To understand the vegetation and ecological significance of the taxa from the sediments, six groups are classified according to the analytical results as follows: tropical, sub-tropical, temperate, herb, fern and mangrove-back mangrove (Table 1). Based on the pollen analysis result and dating of these cores, four stages are divided:

- Stage 1 (≧6,000 to 5,000yr BP.): Mangrove pollens are dominated by *Rhizophora sp., Bruguira sp.* at Nga Van core (from 80 to 140cm depth) and at Dong son (from 88 to 200cm depth). This indicates that sea level was stable in high level in that period. Besides, fern spore is composed by *Lygodium sp., Polypodium sp. Cyathea sp.*, pollen of trees include *Castanea sp., Castanopsis sp., Lithocarpus sp., Pinus sp., and Myrtus sp.* and herb exists mainly of Poaceae - At Bai Tu core, fern spore and herb pollen are dominant but tree pollen are very few.

- Stage 2 (5,000 to 4,000yr BP.): mangrove pollen gradually reduces in both Nga Van and Dong Son core. Fern spore are rare in Bai Tu, Dong Son and Chua Gio core but increases in Nga Van and Van Dien core. Pollen of tree is very few in this stage, included *Castanea sp., Lithocarpus sp*., herb pollen composed of Compositae and Poaceae.

- Stage 3 (4,000 to 3,000yr BP.): This stage shows components of non mangrove pollen and spore are shown the same with last stage but in low concentration of pollen and spore in all cores. Mangrove pollen is disappeared in both Nga Van and Dong Son core. It suggests that sea level had been regressed far from seaward.

- Stage 4 (3,000 to 2,000yr BP): this stage is dominated by fern spore such as Polypodiaceae, *Stenochlaena sp., Microlepia sp., Lygodium sp., Cyathea sp.*; herb pollen are characterized by Composiatae, especially Poaceae included

Tropical arboreal plant	Subtropical arboreal plant	Temperature arboreal plant	Herb	Fern spore	Mangrove and back mangrove
Acacia sp. (Leguminosae)	Lithocarpus sp. (Fagaceae)	Ulmus sp. (Ulmaceae)	Orchidaceae	Angiopteris sp. (Pteridophyta)	Acrostichum sp. (Pteridaceae)
Aralia sp. (Araliaceae)	Castanopsis sp. (Fagaceae)	Ilex sp. (Aquifoliaceae)	Oryza sativa (Poaceae)	Ceratopteris sp. (Pteridophyta)	Avicennia sp. (Avicenniaceae)
Carya sp. (Juglandaceae)	Liquidambar sp. (Hamamelidaceae)	Quercus sp. (Fagaceae)	Compositeae	Coniogramme sp.(Pteridophyta)	Bruguiera sp (Rhizophoraceae)
Cycas sp. (Cycadaceae)	Fagaceae	Juglands sp. (Juglandaceae)	Poaceae	Cyathea sp. (Cyatheaceae)	Ceriops sp. (Rhizophoraceae)
Engelhardia sp. (Juglandaceae)		Myrica sp. (Myricaceae)	Malvaceae	Dicksonia sp. (Dicksoniaceae)	Cyperus sp. (Cyperaceae)
Ericaceae		Alnus sp. (Betulaceae)	Liliaceae	Gleichenia sp. (Gleicheniaceae)	Rhizophora sp.(Rhizophoraceae)
Euphorbia sp. (Euphorbiaceae)		Taxodium sp.Taxodiaceae)	Lilium sp. (Liliaceae)	Hymenophyllum sp.(Hymenophyllaceae)	Sonneratia sp. (Sonneratiaceae)
Euphorbiaceae		Castanea sp (Fagaceae)	Labiatae	Lycopodium sp. (Lycopodiaceae)	Nypa sp. (Arecaceae)
Glyptotrobus sp.		Abies sp. (Pinaceae)	Leguminosae (Fabaceae)	Lygodium sp. (Pteridophyta)	
Jatropha sp. (Euphorbiaceae)		Pinus sp. (Pinaceae)	Pterocarya sp. (Chenopodiaceae)	Microlepia sp. (Pteridophyta)	
Magnolia sp. (Magnoliaceae)		Metasequoia sp. Taxodiaceae	Chenopodium sp.(Chenopodiaceae)	Plagiogyria sp. (Pteridophyta)	
Michelia sp. (Lecythidaceae)			Polygonum sp. (Polygonaceae)	Polypodiaceae	
Morus sp.(Moraceae)				Polypodium sp. (Polypodiaceae)	
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Nyssa sp. (Cornaceae)				Selaginella sp. (Selaginellaceae)	
Palmae				Stenochlaena sp. (Pteridophyta)	
Platycarya sp. (Juglandaceae)				Osmunda sp. (Osmundaceae)	
Podocarpus sp.(Podocarpaceae)					
Rhus sp. (Anacardiaceae)					
Rubiaceae					
Sterculia sp. (Sterculiaceae)					
Tilia sp. (Tiliaceae)					

Table 1: List of all taxa are found from seven cores

Oryza sativa, tree pollen is composed by *Magnolia sp.*, *Michelia sp.*, *Castanea sp.*, *Castanopsis sp.* and Palmae. Pollen of Poaceae and *Oryza sativa* found in the samples demonstrates that agricultural activities had been well developed in Bac Bo plain in this period. In addition, evidence of archaeology are also shown the human activities by stone hand tools like hoes, axes gradually replace by bronze tools. In Dong Son period archaeologists found ploughshare made from bronze. It indicates that at that time agriculture activities strongly develop in this area.

4. Conclusion

Based on the analytical results, it can be suggested that pre-historical vegetation of Bac Bo Plain possibly as mosaic of grassland, shrub tree and native forest. Pollen analysis results also reflect human impact on pre-historical vegetation in this area. When large quantities of Poaceae taxa appear in the record which intensified around 3,000 yr BP. (Dong Son culture) it is possibly included wet rice species. Discussion and interim synthesis of the data can serve to highlight areas of progress in our knowledge as well as outline for future research.

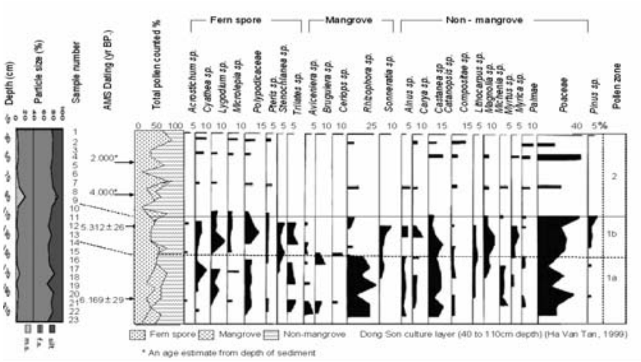

Fig 1: Pollen diagram of selected taxa of Dong Son core

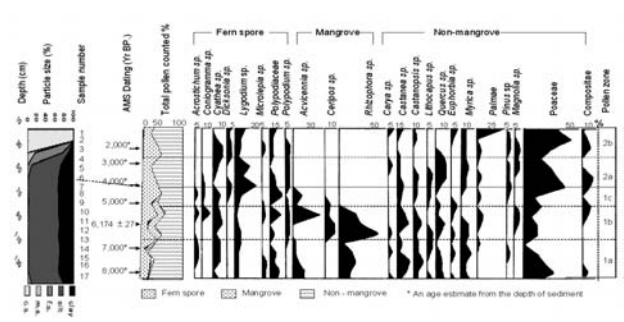

Fig 2: Pollen diagram of selected taxa of Nga Van core