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PHYTOLITHS IN FERNS II : IN SOME MORE THELYPTEROID FERNS

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ABSTRACT

Opal phytoliths were found in the fertile leaf segments of six species of Thelypteridaceae. Common forms of phytoliths are nearly cylindrical, triangular, square or rectangular and also amorphous. Some phytoliths are plate like and they are distinct in each species.

Key words : Opal phytolith, Fern, Thelypteridaceae.

Introduction

Phytoliths (Greek, *phyto*= plant, *lithos*= stones) or Plant stones are amorphous form of Silicon dioxide (known as 'opal') deposition found in many plants. Phytoliths provide valuable information about vegetation in Archaeology and Paleoecology, crop processing (Harvey and Fuller, 2005), radiometric dating (Wilding, 1967) and monitoring vegetation and climate change (Kelly *et al.*, 1991). Particular plant taxon or plant part can be identified by phytolith characters (Pearsall et al., 1995; Zhao *et al*., 1998).

Occurrence and characterization of pteridophytic phytoliths have been done in very few taxa like *Equisetum* and *Metteuccia* (Bozarth, 1993), *Trichomanes*, *Adiantum* and *Selaginella* (Piperno, 1988).

Recently, Mazumdar and Mukhopadhyay (2009a) reported the occurrence of opal phytoliths in three thelypteroid ferns viz., *Christella dentata* (Forssk.) Brownsey and Jermy, *Ampelopteris prolifera* (Retz.) Copel. and *Cyclosorus interruptus* (Willd.) H. Itô. Chauhan *et al*. (2009) reported biogenic silica deposition in different parts like leaf epidermis, hair base, stem cortex, spore wall, tracheid, parenchyma cell, etc of some ferns and fern allies and also discussed its ecological and evolutionary significance. Mazumdar and Mukhopadhyay (2009b) reported occurrence of opal phytoliths in fertile aerial branches of some *Selaginella* and *Lycopodium* species and sporophylls of *Isoetes coromondelina*. Characteristic plate like phytoliths were found in *Huperzia selago*, *Lycopodium clavatum*, *Palhinhaea cernua*, *Selaginella pentagona*, *S. bryopteris*, *S. inaequalifolia*, *S. tenera* and *Isöetes coromandelina*. Much work is required for proper characterization for phytoliths in Pteridophytes (Mazumdar and Mukhopadhyay, 2009a).

The aim of the present study was to find occurrence and morphology of phytoliths of some ferns of Family- Thelypteridaceae.

Material and Methods

Phytolith extraction method by Piperno (2006) was followed with some modifications of steps (Mazumdar and Mukhopadhyay,

2009a). Fertile leaf segments were selected as the cell wall deposits of silica often replicate the morphology of the living cells, while those forming in the lumen do not (Parr and Sullivan, 2005). Fertile pinnules of *Ampelopteris prolifera* (Retz.) Copel. and *Christella dentata* (Forssk.) Brownsey and Jermy were collected in fresh condition from Golapbag locality, Burdwan. Fertile pinnules of *Cyclosorus interruptus* (Willd.) H. Itô and *Pronephrium nudatum* (Roxb. ex Griff.) Holtt. were obtained from herbarium sheets of Pteridology Research laboratory, Botany Department, University of Burdwan. Fertile pinnules of *Pseudocyclosorus tylodes* (Kunze) Ching and *Pseudophegopteris pyrrhorhachis* var. *glabrata* (Clarke) Holtt. were obtained from personal collections of Dr. Gautam Ganguly in the areas of southern Sikkim. All materials were washed thoroughly several times with tap water and then with distilled water. About 0.2 gm of each of these plant materials were taken in test tubes and digested with concentrated Nitric Acid in water bath. Digested materials were washed with distilled water at 1700 rpm for 10 minutes and then boiled in 10 % Hydrochloric acid in water bath to remove calcium, then, washed with distilled water many times to remove the acid. The processed materials were then centrifuged with Acetone at 1700 rpm for 10 minutes each time and dried with Acetone. Dried materials were mounted in 10 % glycerin on the glass slide. Photographs were taken with Q Win (machine QG2-32, version V 3.2.0) in Leica microscope. Ten observations of each sample were recorded.

Observations and Discussion

Crystalline biogenic silica deposition or Opal phytoliths were found in all six species. Morphology and range of size of phytoliths have been shown in Fig.1, Fig.2 and Table 1. Phytoliths, which were possible to extract during the present study, show nearly cylindrical (Fig.1C,I,O, Fig.2B,I,N), nearly triangular (Fig.1D,J,M,Fig.2C,H,L), nearly square or rectangular (Fig.1D,H,N,Fig.2E,F,O), plate or sheet (Fig.1A,B,G,K,L,Fig2A,G,K) or amorphous (Fig.1F,P,Fig.2D,J,M) in shape.

TABLE – 1. SIZE RANGE OF EXTRACTED PHYTOLITHS

Plant material	Length (μm)	Width (μm)
Ampelopteris prolifera	17.5-140	6.25-60
Christella dentata	11.25-200	8.75-105
Cyclosorus interruptus	23.75-115	8.75-97.5
Pronephrium nudatum	21.25-112.5	10-113.75
Pseudocyclosorus tylodes	15-150	3.75-66.25
Pseudophegopteris pyrrhorhachis var. *glabrata*	27.5-130	16.25-85

Plate or sheets like phytoliths often show prominent features. In *Ampelopteris prolifera*, plates are hyaline with smooth surface and wavy margins resembling epidermal cells (Fig.1A,B). In *Christella dentata*, plates are nearly circular or rectangular with highly folded and granular surface (Fig.1G). In *Cyclosorus interruptus* plates are highly silicified with folded and rough surface (Fig.1K) or smooth hyaline with variable shapes (Fig.1L). In *Pronephrium nudatum*, plates are opaque granular with sinuous margins resembling epidermal cells (Fig.2A). In *Pseudocyclosorus tylodes* plates are highly silicified with granular and ridges (Fig.2G). In *Pseudophegopteris pyrrhorhachis* var. *glabrata* plates are opaque with wavy margins and unevenly silicified surface resembling epidermal cells (Fig.2K).

So, this study of phytoliths shows that it can provide valuable information about

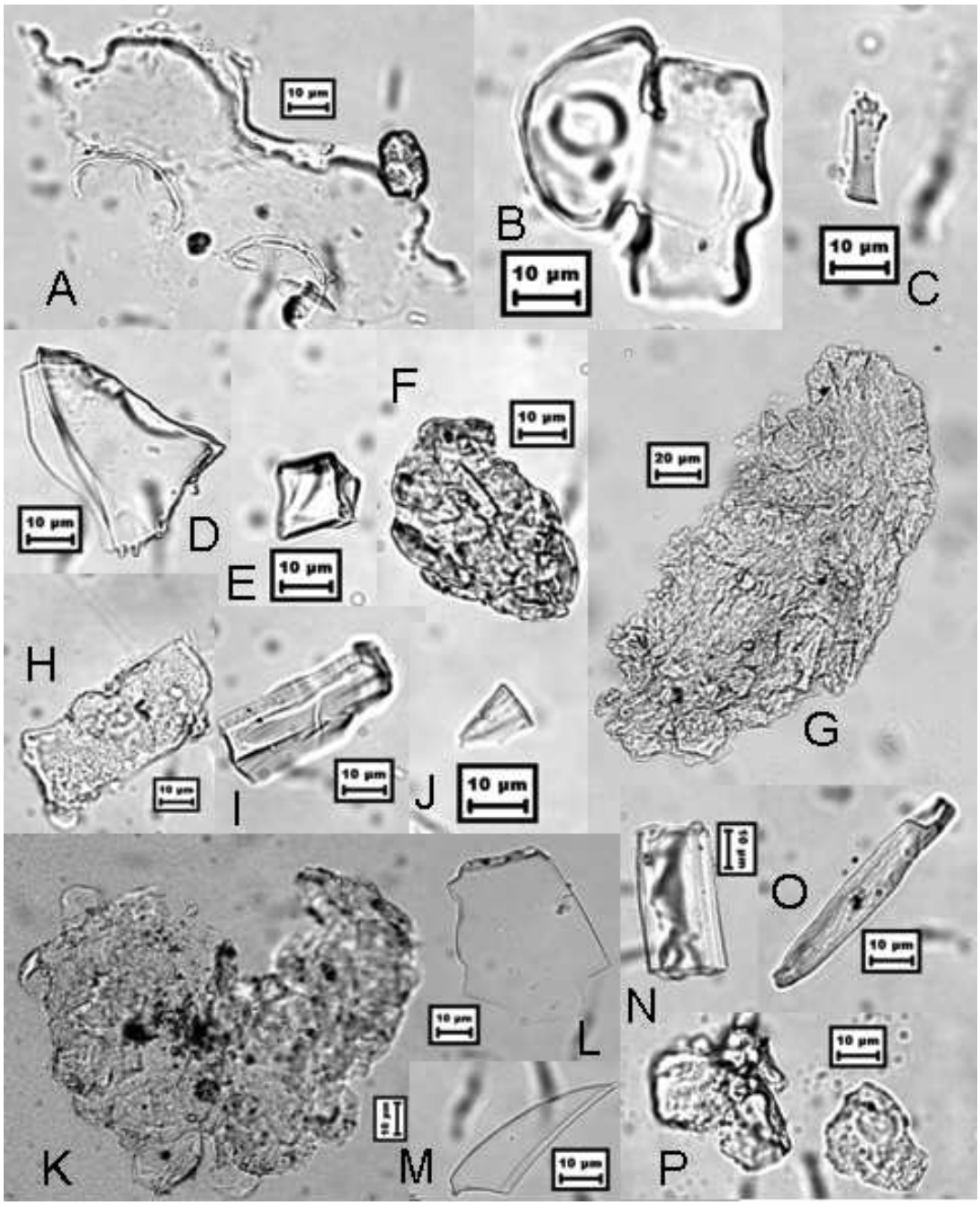

Fig. 1. Phytoliths of *Ampelopteris prolifera* (A - F), *Christella dentata* (G - J), *Cyclosorus interruptus* (K - P). (Bar = 10 µm , in G bar = 20 µm)

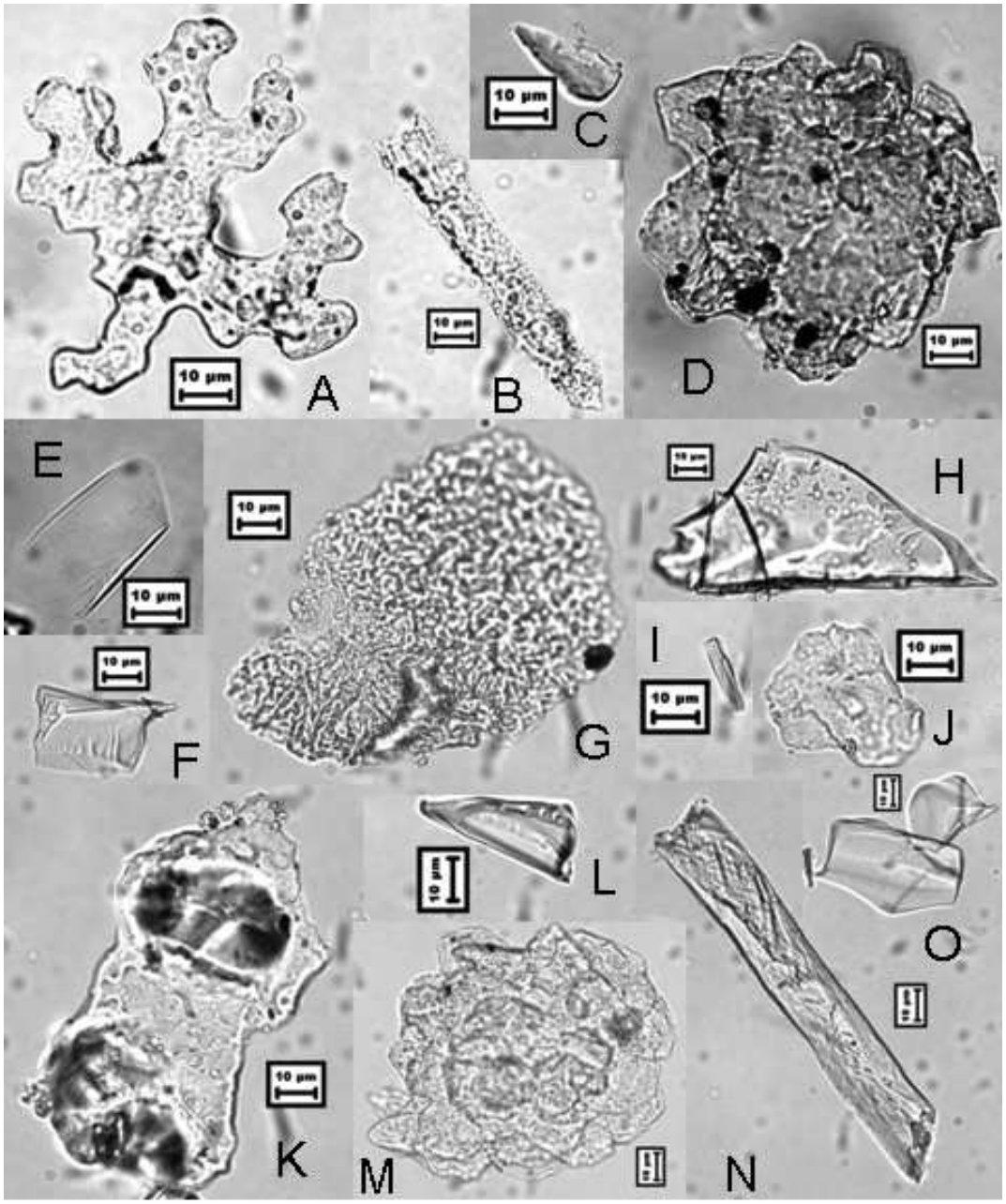

Fig. 2. Phytoliths of *Pronephrium nudatum* (A - E), *Pseudocyclosorus tylodes* (F - J), *Pseudophegopteris pyrrhorhachis var. glabrata* (K - O). (Bar = 10 µm)

identification of thelypteroid ferns as some phytoliths have distinct features. Further thorough investigation is required in more species and genera to find out 'diagnostic' phytoliths, if any, in the family Thelypteridaceae which can help in delineating the members.

Insufficient data are available on pteridophytes to draw any conclusions about phytolith production patterns; research is needed in this area (Pearsall, 2000).

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