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PRELIMINARY RESULTS OF PALYNOLOGICAL INVESTIGATIONS
OF TRIASSIC STRATA IN NORTH VIETNAM

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Assemblages of miospores and pollen grains found in the upper part of the Suoi Bang Formation in North Vietnam comprise 43 taxa, including two new combinations: *Deltoidospora concava* (Bolkovítina) comb. nov. and *Polypodites polymicroforatus* (Orłowska-Zwolińska) comb. nov. The assemblages from Vietnam largely resemble those from Europe, Iran and Afghanistan; this analogy permitted dating the upper part of the Suoi Bang Formation at the Rhaetian-Lias.

Key words: Miospores, pollen, Upper Triassic, north-west Vietnam.

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This paper is the first study of miospore-pollen assemblages from the Upper Triassic of Vietnam.

The studied material comes from the upper part of the Suoi Bang Formation, from three sections situated in the north-western part of Vietnam: Na Sang section in the Dien Bien region and Huoi La and Quynh Nhai sections in the Lai Chau region (figs. 1, 2). The samples have been collected by the author in the years 1975—1980. The collection is stored in the Institute of Geology and Mineral Resources in Hanoi (IG MR).

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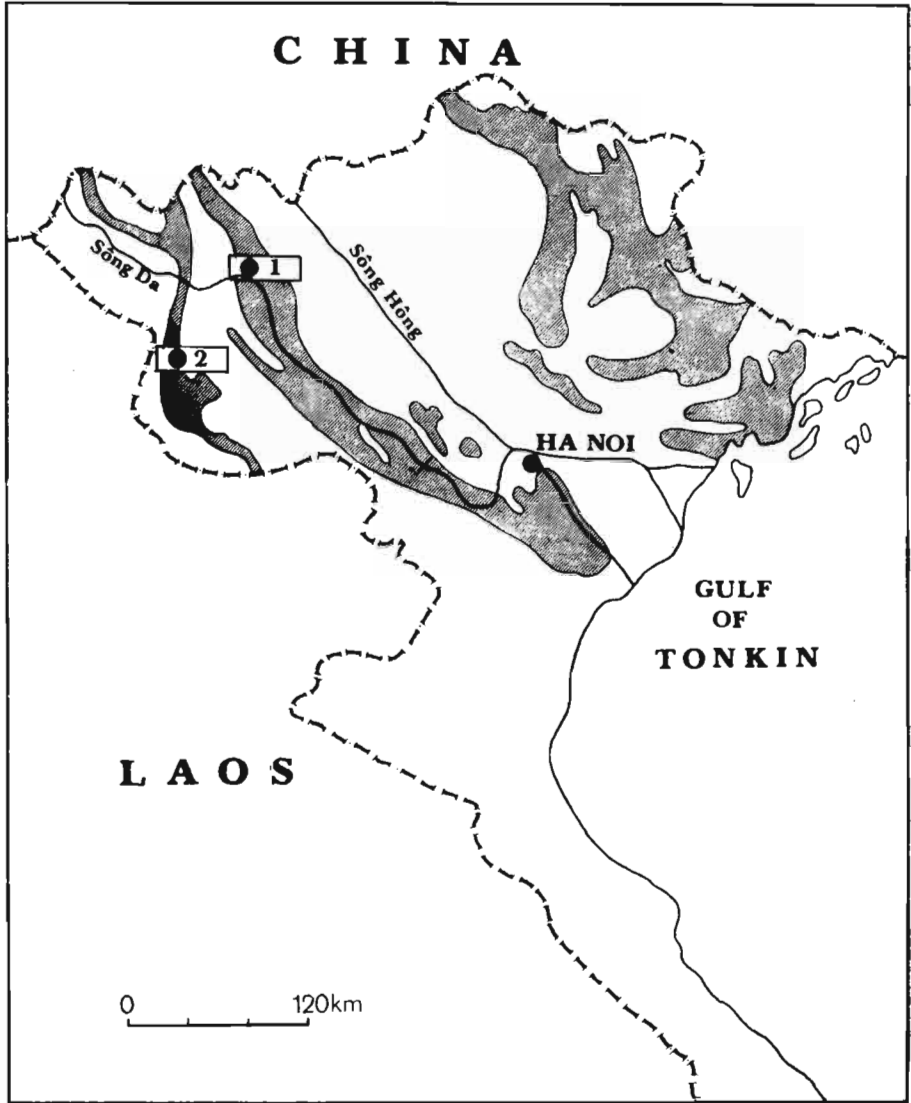


Fig. 1. Distribution of Triassic deposits in North Vietnam and location of spore and pollen sampling places: 1 Huoi La and Quynh Nhai sections in the Lai Chau region, 2 Na Sang section in the Dien Bien region.

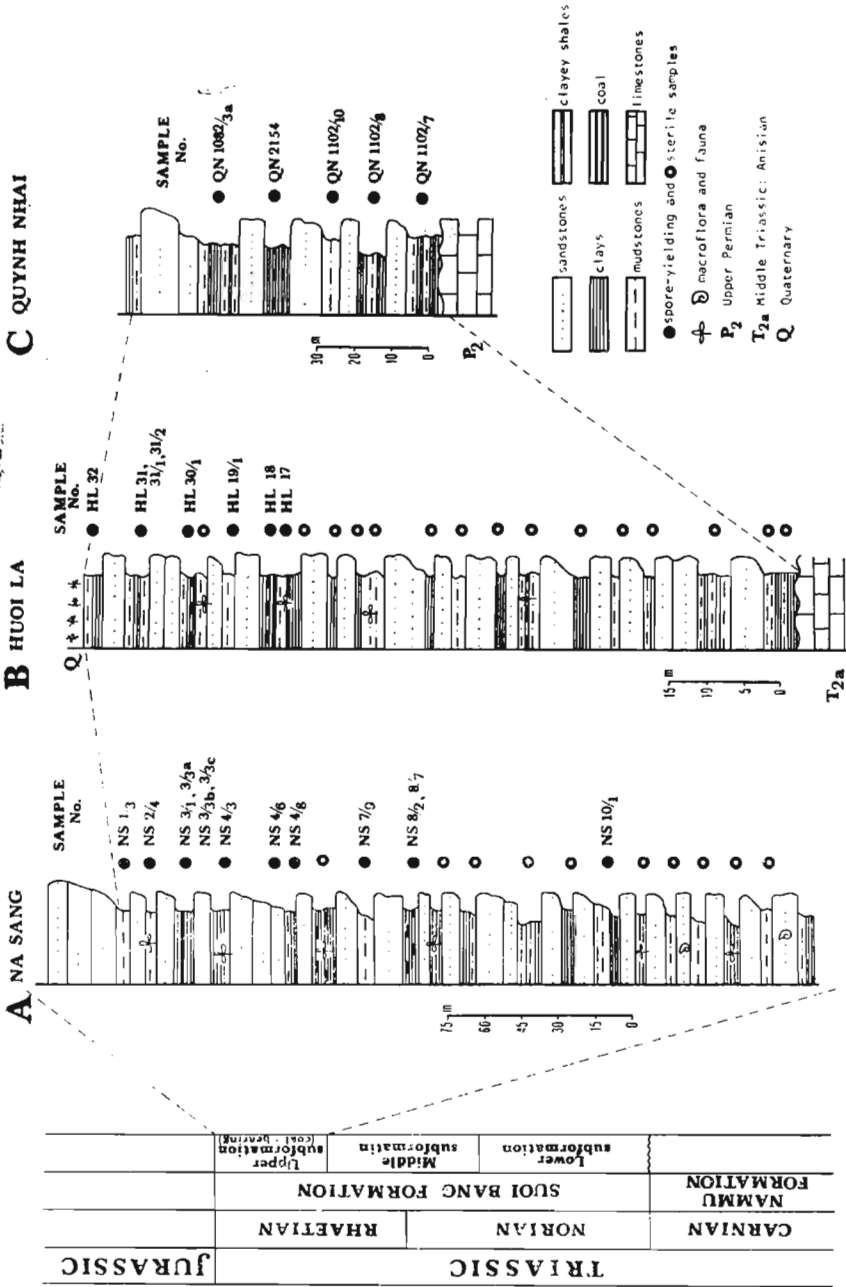


Fig. 2. Location of samples in the studied sections.

SPECIES SPECTRUM OF THE SPOROMORPH ASSEMBLAGES

The analysis of samples revealed that spores and pollen grains are numerous in all three sections (tables 1—3) in which 43 taxa have been determined (table 4, plates 23—28). The state of preservation of specimens is poor.

Table 1

Miospores and pollen grains in the Quynh Nhai section

taxa	samples				
	ON 1102-7	ON 1102-8	ON 1102-10	ON 2154	ON 1082-3a
<i>Deltoidospora australis</i>	•	•	•	•	•
<i>D. minor</i>	•	•	•	•	•
<i>Concavosporites divisorius</i>	•	•	•	•	•
<i>C. intrastriatus</i>	•	•	•	•	•
<i>C. jurienensis</i>	•	•	•	•	•
<i>C. kaiseri</i>	•	•	•	•	•
<i>C. kermanense</i>	•	•	•	•	•
<i>C. persicus</i>	•	•	•	•	•
<i>C. unbonatus</i>	•	•	•	•	•
<i>C. cf. toralis</i>	•	•	•	•	•
<i>Dictyophyllidites harrisii</i>	•	•	•	•	•
<i>Camarozonosporites hudiis</i>		•			
<i>Kyrtomisporeis laevigatus</i>				•	•
<i>Convèrucosisporites cameroni</i>				•	•
<i>Lophotriletes novicus</i>		•	•	•	•
<i>Acanthotriletes varius</i>	•	•	•	•	•
<i>Osmundacidites cf. senectus</i>				•	•
<i>Trachysporites fuscus</i>		•	•	•	•
<i>Annulispora microannulata</i>	•	•			
<i>Rogalskaiisporites cicatricosus</i>			•	•	•
<i>Densosporites fissus</i>			•	•	•
<i>D. irregularis</i>		•		•	•
<i>Polypodiites polymicroforatus</i>	•	•	•	•	•
<i>Monocolpopollenites magnus</i>	•	•	•	•	•
<i>Monosulcites minimus</i>			•	•	•
<i>M. subgranulosus</i>				•	•
<i>Minisulcites sp.</i>			•	•	•
<i>Alisporites parvus</i>				•	•
<i>Alisporites sp.</i>				•	•
<i>Chordasporites australiensis</i>	•	•			
<i>Cuneatisporites sp.</i>			•	•	•
<i>Sahnisporites grandior</i>			•	•	•
<i>Vitreisporites reductus</i>		•	•	•	•
<i>Voltsiacaesporites heteromorpha</i>			•	•	•
<i>Chasmatosporites magnolioides</i>			•	•	•
<i>Ricciisporites unbonatus</i>				•	•
<i>R. tuberculatus</i>				•	c

The following sporomorph groups can be distinguished:

1. Long-ranging species, known from the Permian through Cretaceous (even to Recent): *Deltoidospora australis*, *D. minor*, *Dictyophyllidites harrisii*.

2. Species known from the Permian through Middle Triassic: *Lophotriletes novicus*.

3. Species known since the Lower Triassic: *Vitreisporites reductus* (to Upper Triassic), *Voltziaceasporites heteromorpha* (to Middle Triassic), *Platysaccus queenslandii* (to Lias), *Sahnisporites grandior* (to Dogger).

4. Species known since the Middle Triassic: *Brachysaccus eskensis* (to Upper Triassic), *Converrucosisporites cameroni* (to Lias).

Table 2

Miospores and pollen grains in the Huoi La section

taxa	samples						
	HL 17	HL 18	HL 19	HL30-1	HL 31	HL31-2	HL 32
<i>Deltoidospora minor</i>	•	•	•	•	•	•	•
<i>D. concava</i>	•	•	•	•	•	•	•
<i>D. australis</i>	•	•	•	•	•	•	•
<i>Concavisporites divisiatus</i>	•	•	•	•	•	•	•
<i>C. intrastratus</i>	•	•	•	•	•	•	•
<i>C. jurienensis</i>			•	•	•	•	•
<i>C. cf. toralis</i>		•	•	•	•	•	•
<i>Dictyophyllidites harrisii</i>		•	•	•	•	•	•
<i>Camarozonosporites rudis</i>		•	•	•	•	•	•
<i>Kyrtomispors laevigatus</i>			•	•	•	•	•
<i>Converrucosisporites cameroni</i>	•		•	•	•	•	•
<i>Lophotriletes novicus</i>	•		•	•	•	•	•
<i>Acanthotriletes varius</i>		•	•	•	•	•	•
<i>Osmundacidites cf. senectus</i>	•	•	•	•	•	•	•
<i>Trachysporites fuscus</i>	•		•	•	•	•	•
<i>Annulispora microannulata</i>				•	•	•	•
<i>Foveosporites visscheri</i>				•	•	•	•
<i>Lycopodiacidites rugulatus</i>		•	•	•	•	•	•
<i>Rogalskiasporites cicatricosus</i>				•	•	•	•
<i>Cingulizonates rhaeticus</i>		•	•	•	•	•	•
<i>Densosporites fissus</i>	•	•	•	•	•	•	•
<i>Polypodiites polymicroforatus</i>		•	•	•	•	•	•
<i>Monocolpopollenites magnus</i>	•	•	•	•	•	•	•
<i>Densosporites irregularis</i>		•	•	•	•	•	•
<i>Monosulcites minimus</i>		•	•	•	•	•	•
<i>M. subgranulosus</i>				•	•	•	•
<i>Monosulcites sp.</i>				•	•	•	•
<i>Chordasporites australiensis</i>				•	•	•	•
<i>Platysaccus queenslandii</i>		•				•	
<i>Sahnisporites grandior</i>	•	•					
<i>Alisporites parvus</i>					•	•	•
<i>Alisporites sp.</i>	•	•					•
<i>Voltziaceasporites heteromorpha</i>				•	•	•	
<i>Ricciisporites tuberculatus</i>		•	•	•	•	•	•

5. Species known from the Triassic through Cretaceous: *Concavisporites umbonatus*, *Deltoidospora concava* (since Rhaetian), *Rogalskiasporites cicatricosus*.

6. Species known from the Triassic to Dogger only: *Concavisporites intrastratus* (since Rhaetian), *Lycopodiacidites regulatus* (since Keuper), *Chasmatosporites magnolioides* (since Rhaetian), *Concavisporites jurienensis* (since Rhaetian).

Table 3

Miospores and pollen grains in the Na Sang section

taxa	samples												
	NS 10/1	NS 8/7	NS 8/2	NS 7/9	NS 4/8	NS 4/6	NS 3/3c	NS 3/3b	NS 3/3a	NS 3/1	NS 2/4	NS 1/3	
<i>Deltoidospora concava</i>	•	•	•	•	•		•	•		•		•	
<i>D. minor</i>	•	•	•	•	•		•	•		•		•	
<i>Concavisporites dividorus</i>	•	•	•	•	•		•	•		•	•	•	
<i>C. umbonatus</i>	•	•	•	•	•		•	•		•	•	•	
<i>Concavisporites cf. toralis</i>	•	•	•	•	•		•	•		•	•	•	
<i>Dictyophyllidites harrisii</i>	•	•	•	•	•	•	•	•		•	•	•	
<i>Convruccosisporites cameroni</i>	•	•	•	•	•		•	•		•	•	•	
<i>Lophotriletes novicus</i>	•	•	•	•	•		•	•		•	•	•	
<i>Acanthotriletes varius</i>	•	•	•	•	•		•	•		•	•	•	
<i>Osmundacidites cf. senectus</i>			•	•	•		•	•		•	•	•	
<i>Trachysporites fuscus</i>				•	•		•	•		•	•	•	
<i>Polypodiites polymicroforatu</i>				•	•		•	•		•	•	•	
<i>Monocolpopollenites magnus</i>					•		•	•		•	•	•	
<i>Monosulcites minimus</i>						•	•	•		•	•	•	
<i>Monosulcites subgranulosus</i>						•	•	•		•	•	•	
<i>Monosulcites sp.</i>							•	•		•	•	•	
<i>Alisporites sp.</i>	•		•	•	•			•			•	•	
<i>Chordasporites australiensis</i>			•	•	•			•		•	•	•	
<i>Sahniasporites grandior</i>			•	•	•			•		•	•	•	

7. Species limited in range, known from the Upper Triassic through Lias: *Kyrtomisporites laevigatus* (Upper Triassic-Lias), *Annulispora microannulata* (Keuper-Lias), *Camarozonosporites rudis* (Carnian-Lias), *Chordasporites australiensis* (Norian-Lias), *Concavisporites kaiseri* (Norian-Lias), *C. persicus* (Norian-Lias), *C. kermanense* (Rhaetian-Lias), *Ricisporites tuberculatus* (Rhaetian-Lias), *Polypodiites polymicroforatus* (Rhaetian-Lias), *Cingulizonates rhaeticus* (Rhaetian-Lias), *Monocolpopollenites magnus* (Rhaetian-Lias), *Trachysporites fuscus* (Rhaetian-Lias), *Acanthotriletes varius* (Rhaetian-Lias), *Alisporites parvus* (Rhaetian-Lias).

8. Species known from the Rhaetian only: *Densosporites fissus*.

9. Species limited to the Lias: *Monosulcites subgranulosus*, *Foveosporites visscheri*, *Concavisporites dividorus*.

10. Species known from the Lias through Cretaceous: *Monosulcites minimus*.

The review presented above shows a Rhaetian-Liassic species domination in the microflore assemblages. In two sections they include pollen grains *Voltziaceasporites heteromorpha*, known only from the Lower and Middle Triassic. Typical Rhaetian species, such as *Rhaetipollis germanicus*, *Ovalipollis ovalis* or *Limbosporites lundbladii* are lacking as well as index Liassic forms, e.g. *Heliosporites reissingeri*.

DISCUSSION

Spore and pollen assemblages from the Suoi Bang Formation (table 5) have been correlated with assemblages from Poland (Orłowska-Zwolińska 1979, 1983), Germany (Brenner 1986), Danmark (Lund 1977), Sweden

Table 4

List of the miospores and pollen grains occurring in the considered sections

1. <i>Deltoidospora australis</i> (Couper, 1953) Pocock, 1970	Pl. 23: 18—20
2. <i>D. concava</i> (Bolkhovitina) comb. nov.	Pl. 23: 2
3. <i>D. minor</i> (Couper, 1953) Pocock, 1970	Pl. 23: 1
4. <i>Concavisporites divisorius</i> Kedves et Simoncsis, 1964	Pl. 23: 3—5
5. <i>C. intrastriatus</i> (Nilsson, 1958)	Pl. 23: 12
6. <i>C. jurienensis</i> Balme, 1957	Pl. 23: 6, 7
7. <i>C. kaiseri</i> Arjang, 1975	Pl. 23: 8, 9
8. <i>C. kermanense</i> Arjang, 1975	Pl. 23: 17
9. <i>C. persicus</i> Arjang, 1975	Pl. 23: 10, 11
10. <i>C. (Gleichenia) umbonatus</i> (Bolkhovitina, 1953) Arjang, 1975	Pl. 23: 14—16
11. <i>C. cf. toralis</i> (Leschik) Nilsson, 1958	Pl. 23: 13
12. <i>Dictyophyllidites harrisii</i> Couper, 1958	Pl. 23: 21—25
13. <i>Camaronosporites rudis</i> (Leschik, 1955) Klaus, 1960	Pl. 24: 13
14. <i>Kyrtomispores laevigatus</i> Mädlar, 1964	Pl. 24: 15
15. <i>Convruccosporites cameroni</i> (de Jersey, 1962) Playford et Dettmann 1965	Pl. 24: 7
16. <i>Lophotriletes novicus</i> Sing, 1964	Pl. 24: 1, 2
17. <i>Acanthotriletes varius</i> Nilsson, 1958	Pl. 24: 3, 6
18. <i>Osmundacidites cf. senectus</i> Balme, 1963	Pl. 24: 4, 5
19. <i>Trachysporites fuscus</i> Nilsson, 1958	Pl. 24: 12, 14
20. <i>Annulispora microannulata</i> de Jersey, 1962	Pl. 24: 11
21. <i>Foveosporites visscheri</i> Van Erve, 1977	Pl. 25: 5
22. <i>Lycopodiacidites rugulatus</i> (Couper, 1958) Schulz, 1967	Pl. 25: 12, 13
23. <i>Rogalskiasporites cicatricosus</i> (Rogalska, 1954) Danze-Corsin et Lavein, 1963	Pl. 24: 9, 10
24. <i>Cingulizonates rhaeticus</i> (Reinhardt, 1962) Schulz, 1967	Pl. 25: 9, 10
25. <i>Densosporites irregularis</i> Hacquebard et Barss, 1957	Pl. 25: 1—4
26. <i>D. fissus</i> Reinhardt, 1963	Pl. 25: 6, 7
27. <i>Polypodiites polymicroforatus</i> (Orłowska-Zwolińska) comb. nov.	Pl. 24: 8
28. <i>Brachysaccus eskensis</i> de Jersey, 1962	Pl. 27: 3
29. <i>Chasmatosporites magnolioides</i> (Erdtman, 1948) Nilsson, 1958	Pl. 28: 7
30. <i>Monocolpopollenites magnus</i> Nilsson, 1958	Pl. 27: 1, 2
31. <i>Monosulcites minimus</i> Cookson, 1947	Pl. 25: 8
32. <i>M. subgranulosus</i> Couper, 1958	Pl. 27: 4
33. <i>Monosulcites</i> sp.	Pl. 25: 4
34. <i>Alisporites parvus</i> de Jersey, 1962	Pl. 26: 4
35. <i>Alisporites</i> sp.	Pl. 26: 6, 7, 9
36. <i>Chordasporites australiensis</i> de Jersey, 1962	Pl. 27: 5, 6
37. <i>Cuneatisporites</i> sp.	Pl. 26: 5, 8
38. <i>Platysaccus queenslandi</i> de Jersey, 1962	Pl. 28: 1
39. <i>Sahnisporites (Succinctisporites) grandior</i> (Leschik, 1955)	Pl. 27: 8, 9
40. <i>Vitreisporites reductus</i> (Mädlar, 1964) Jaroshenko, 1978	Pl. 28: 2
41. <i>Voltziaceasporites heteromorpha</i> Klaus, 1964	Pl. 26: 1—3
42. <i>Ricciisporites tuberculatus</i> Lundblad, 1954	Pl. 28: 5
43. <i>R. umbonatus</i> et Burbridge, 1977	Pl. 27: 7

(Nilsson 1958), England (Orbel 1973; Morbey 1975), Iran and Afghanistan (Arjang 1975; Achilles *et al.* 1984).

The microflora corresponds best with the microfioral assemblages of the *Concavisporites* zone (Rhaetian/Lias) in Iran (Arjang 1975; Achilles *et al.* 1984). There are most species in common with the assemblage of the subzone *Concavisporites kaiseri*, *C. persicus*, *C. intrastriatus*, *C. divisorius*, *Cyathidites minor*, *Deltoidospora australis*, *Monosulcites minimus*, *Alisporites parvus*, *Lycopodiacidites regulatus*. There are only two species

Table 5

taxa	VIETNAM			CHINA	IRAN	AFGHANISTAN	AUSTRALIA	POLAND	GERMANY	BRITISH ISLANDS	AUSTRIA	FRANCE	SWEDEN	CANADA	USSR	ITALIA	DENMARK
	NA SAN section	HUOI LA section	QUYNH NHAI section														
<i>Cingulizonates rhaeticus</i> (Reinhardt) Schulz, 1967		•		•	•	•		•		•	•	•	•	•	•		•
<i>Ricciisporites tuberculatus</i> Lundblad, 1954		•		•	•					•	•		•				
<i>Kyrtomisporis laevigatus</i> Mädler, 1964		•		•	•		•			•	•						
<i>Polypodites polymicroforatus</i> (Orłowska-Zwolińska) comb. nov.	•	•	•			•		•		•							
<i>Monocopollenites magnus</i> Nilsson, 1958		•	•										•				
<i>Alisporites parvus</i> de Jersey, 1962		•	•	•	•		•										
<i>Trachysporites fuscus</i> Nilsson, 1958	•	•	•					•					•				
<i>Acanthotriletes varius</i> Nilsson, 1958		•	•					•			•		•				
<i>Monosulcites subgranulosus</i> Couper, 1958		•	•					•		•	•		•				
<i>Foveosporites vissheri</i> Van Erve, 1977		•	•														
<i>Concavisporites divisorius</i> Kedves Simoncsis, 1964	•	•	•		•											•	
<i>C. kaiseri</i> Arjang, 1975		•	•		•												
<i>C. kermanense</i> Arjang, 1975		•	•		•	•											
<i>C. persicus</i> Arjang, 1975		•	•		•												
<i>Chordasporites australiensis</i> de Jersey 1962	•	•	•	•			•									•	
<i>Annulispora microannulata</i> de Jersey, 1962		•	•				•										
<i>Camarozonosporites rudis</i> (Leschik) Klaus, 1960		•	•				•	•		•				•			
<i>Densosporites fissus</i> Reinhardt, 1963		•	•					•		•	•	•					•

Geographical distribution of pollen grains and miospores known from Vietnam

common with the assemblage of the subzone *Concavisporites kermanense*, the taxonomical diversity of the assemblage being poor.

This microflora is also close to the European, and the assemblages studied are similar to those from Poland. On the basis of the above comparisons the age of the upper part of the Suoi Formation from Vietnam may be determined as the Rhaetian-Liassic.

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BUI DUC THANG

WSTĘPNE WYNIKI BADAŃ PALINOLOGICZNYCH TRIASU Z WIETNAMU
PÓŁNOCNEGO

Streszczenie

W górnej części formacji Suoi Bang w północnym Wietnamie (fig. 1, 2) znaleziono zespół miospor i ziarn pyłku, z którego oznaczono 43 taksony (tabela 1—4, pl. 23—28), w tym dwie nowe kombinacje: *Deltoidospora concava* (Bolkhovitina) comb.

nov. i *Polypodiites polymicroforatus* (Orłowska-Zwolińska) comb. nov. Istnieje duży stopień podobieństwa zespołów miospor i ziarn pyłku z Wietnamu z zespołami Europy, Iranu i Afganistanu (tabela 5), co pozwoliło określić wiek górnej części formacji Suoi Bang jako retyko-lias.

Zbadane materiały są przechowywane w Zakładzie Paleontologii Instytutu Geologii i Surowców Mineralnych Thanh Xuan w Hanoi.

EXPLANATION TO PLATES 23—28

All photographs $\times 630$; numbers accompanying the specimens refer to the preparations from respective sections

Plate 23

1. *Deltoidospora minor* (Couper, 1953) Pocock: HL31-2.
2. *D. concava* (Bolkhovitina) comb. nov.: HL31-2.
- 3—5. *Concavisporites divisorius* Kedves et Simoncsics: 3 QN2154-1, 4 QN2154-4, 5 QN2154-4.
- 6—7. *Concavisporites juriensis* Balme: 6 HL31-2, 7 QN2154-4.
- 8—9. *C. kaiseri* Arjang: 8 QN2154-3, 9 QN1082-3a-3.
- 10—11. *C. persicus* Arjang: 10 QN1082-3a-3, 11 QN2154-2.
12. *C. intrastriatus* Arjang: HL31-2-1.
13. *C. cf. toralis* Nilsson: QN2154-1.
- 14—16. *C. (Gleichenia) umbonatus* Arjang: 14 QN1082-3a-4, 15 QN1082-3a-1, 16 QN2154-3.
17. *C. kermanense* Arjang: QN2154-3.
- 18—20. *Deltoidospora australis* (Couper) Pocock: 18 HL31-2, 19 HL31-2, 20 QN2154-3.
- 21—25. *Dictyophyllidites harrisii* (Couper) Dettmann: 21 QN1082-3a-3, 22 QN1102-7-1, 23 QN2154-2, 24 HL30-1-3, 25 QN1082-3a-4.

Plate 24

- 1—2. *Lophotriletes novicus* Singh: 1 HL17-1, 2 HL17-1.
- 3, 6. *Acanthotriletes varius* Nilsson: 3 HL17-1, 6 QN1102-7-1.
- 4—5. *Osmundacidites cf. senectus* Balme: 4 QN2154-4, 5 HL30-1-3.
7. *Converrucosisporites cameroni* (de Jersey) Playford et Dettmann: HL17-1.
8. *Polypodiites polymicroforatus* (Orłowska-Zwolińska) comb. nov.: HL31-4.
- 9—10. *Rogalskaisporites cicatricosus* (Rogalska) Danze-Corsin et Lavein: 9 QN2154-3, 10 HL30-1-4.
- 12, 14. *Trachysporites fuscus* Nilsson: 12 QN154-3, 14 QN154-1.
13. *Camarozonosporites rudis* (Leschik) Klaus: QN1082-3a-4.
15. *Kyrtomispores laevigatus* Mädler: QN2154-1.

Plate 25

- 1—4. *Densosporites irregularis* Hacquebard et Barss: 1 QN2154-1, 2 QN2154-3, 3 QN2154-4, 4 QN2154-2.
5. *Foveosporites visscheri* Van Erve: HL31-4.
- 6—7. *Densosporites fissus* Reinhardt: 6 QN2154-2, 7 QN2154-3.
8. *Monosulcites minimus* Cookson: QN1082-3a-3.
- 9—10. *Cingulizonates rhaeticus* (Reinhardt) Schulz: 9 HL30-1-3, 10 HL30-1-3.
11. *Monosulcites* sp.: QN2154-3.
- 12—13. *Lycopodiacidites rugulatus* (Couper): 12 HL30-1-3, 13 HL30-1-3.

Plate 26

- 1—3. *Voltziaceasporites heteromorpha* Klaus: 1 QN1102-7-3, 2 QN1082-3a-1, 3 QN1102-7-3.
4. *Alisporites parvus* de Jersey: QN2154-3.
- 5, 8. *Cuneatisporites* sp.: 5 QN1082-3a-3, 8 QN1082-3a-4.
- 6, 7, 9. *Alisporites* sp.: 6 QN2154-4, 7 QN1082-3a-4, 9 QN2154-3.

Plate 27

- 1—2. *Monocolpopollenites magnus* Nilsson: 1 QN1082-3a-3, 2 QN1082-3a-3.
3. *Brachysaccus eskensis* de Jersey: HL30-1-3.
4. *Monosulcites subgranulosus* Couper: QN1082-3a-4.
- 5—6. *Chordasporites australiensis* de Jersey: 5 QN1102-7-3, 6 QN1102-7-3.
7. *Ricciisporites umbonatus* Felix et Burbridge: QN1082-3a-3.
- 8—9. *Sahnisporites (Succinctisporites) grandior* (Leschik) Achilles et al.: 8 QN2154-3, 9 QN1082-3a-3.

Plate 28

1. *Platysaccus queenslandi* de Jersey: HL31-2.
2. *Vitreisporites reductus* (Madler) Jaroshenko: QN2154-2.
3. Undetermined pollen grain: QN2154-1.
4. *Sahnisporites (Succinctisporites) grandior* (Leschnik) Achilles et al.: QN1082-3a-4.
5. *Ricciisporites tuberculatus* Lundblad: QN1082-3a-3.
6. Undetermined sporomorph: HL30-1.
7. *Chasmatosporites magnolioides* (Erdtmann) Nicholsson: QN2154.

