ORDOVICIAN - SILURIAN AND LOWER DEVONIAN GRAPTOLITE BEARING BEDS FROM VIETNAM

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INTRODUCTION

Ordovician and Silurian graptolite bearing beds from Vietnam were firstly described by Giraud J. (1918) and Patt E. (1927), but the Lower Devonian graptolite bearing beds were discovered by Nguyen Van Phuc only in 1994. These strata were then briefly described from 1965 to 1989. Detailed work on graptolite bearing beds was carried out by Nguyen Van Phuc, when he measured the sections in Northern and Central Vietnam, during 1978 to 1995 (Fig. 1 and Fig. 2).

The present paper gives an account of the important Ordovician - Silurian and Lower Devonian graptolite zones and horizons of the newly discovered graptolite fauna.

Based on these species and forms, a primitive Ordovician - Silurtian and Lower Devonian graptolite sequence in Vietnam is configured. It allows the author to review the recently established stratigraphical units.

STRATIGRAPHY

Lower Palaeozoic and Lower Devonian rocks from Central Vietnam are characterized by the deeper water clastics with typical black graptolite bituminous shales, but in the weathering they are variably coloured. However, shallow water deposits including carbonate and shallow water clastics are dominant both in Northern and Central Vietnam. Since the andesites and lydites which intruded in the Caradocian and Ashgilian graptolite bearing beds in Central Vietnam, it is possible that Ordovician ophiolites could exist and thus would indicate an Ordovician suture zone in Central Vietnam. Thus, two blocks, the south margin of the Cathaysian massif (Northern Vietnam) and north margin of the Indosinian massif (Southern Vietnam) were separated by the Central Vietnam suture zone during Ordovician, Silurian and Lower Devonian.

I. Central Vietnam

1. Que Tan - Dai Quang area. The studied sections belong to the A Vuong Formation. It was described by Nguyen Xuan Bao (1979) and named after the A Vuong River and may indicate as an age of Late Cambrian - Early Ordovician, but it is unfossiliferous. Therefore the age of the formation is further discussed.

The unit is localated in the south of the Bach Ma Mountain. The sections are composed of variegated coloured mudstones, carbonate mudstones, shales, sandstones, quartzites, and conglomerates, at the base intercalated with andesites and limestone lenses

with a total thickness of about 1500 m. Early Ordovician graptolites were collected by Nguyen Van Phuc from the middle part of the formation.

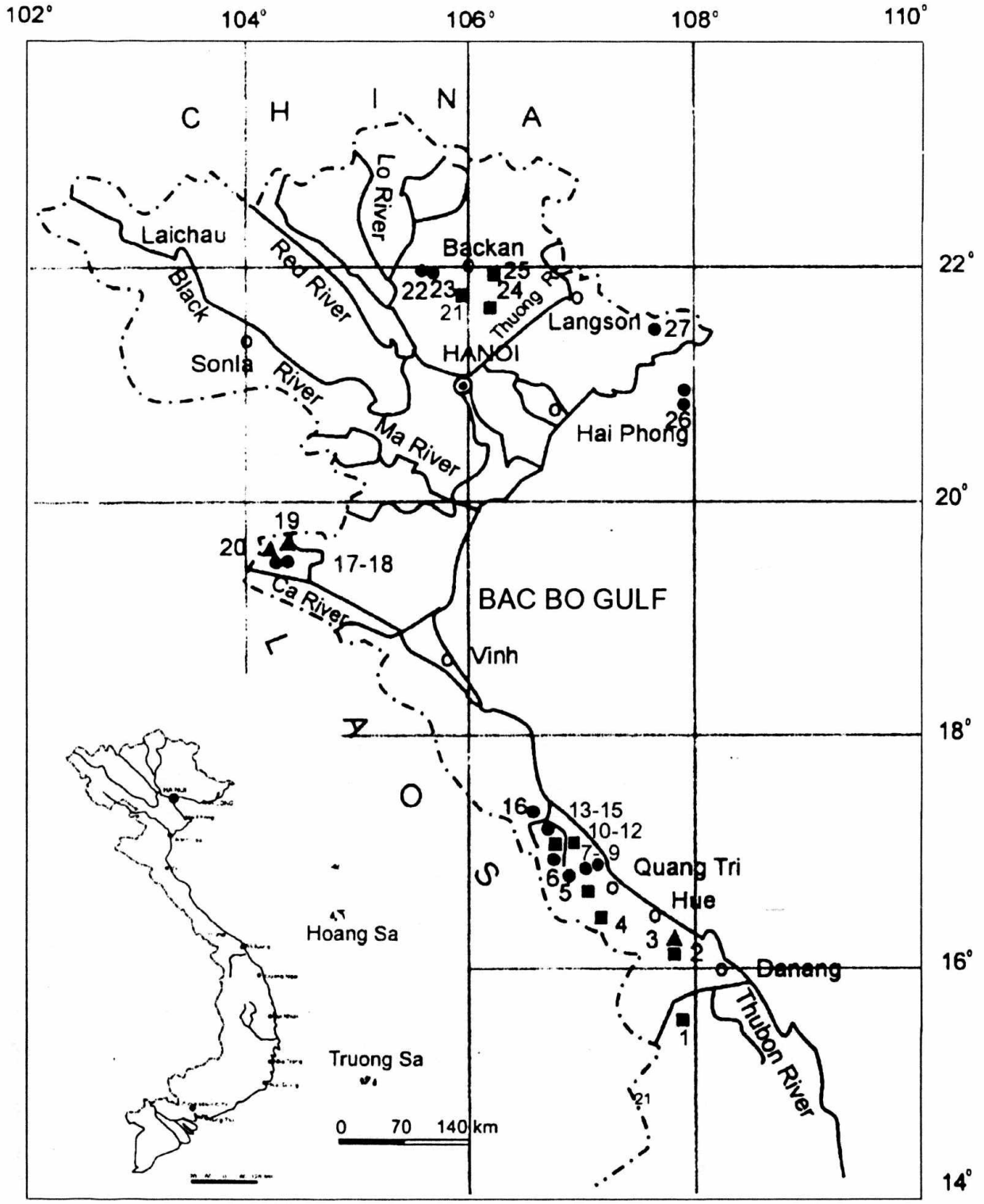

Fig. 1. Lacality map of the Ordovician - Silurian and Early Devonian graptolites in Northern and Central Vietnam. ■ Solid rectangle: Localities of Ordovician graptolites. ● Solid circle: Localities of Silurian graptolites. ▲ Solid triangle: Localities of Early Devonian graptolites. The Studied sections: 1. Daiquang - Que Tan sections, 2. Khesoc - Tatrach sections, 3. Namdong pass section, 4. Huongdien - Dong Ngo sections, 5-6-7-8-9. DongHa sections, 10-11-12-13-14-15. Longdai sections, 16. Leky section, 17-20. Northern Muong Xen sections, 21. Phugu section, 22-23. Chodon sections, 24. Namo section, 25. Nazam section, 26. Coto sections, 27. Tanmai section.

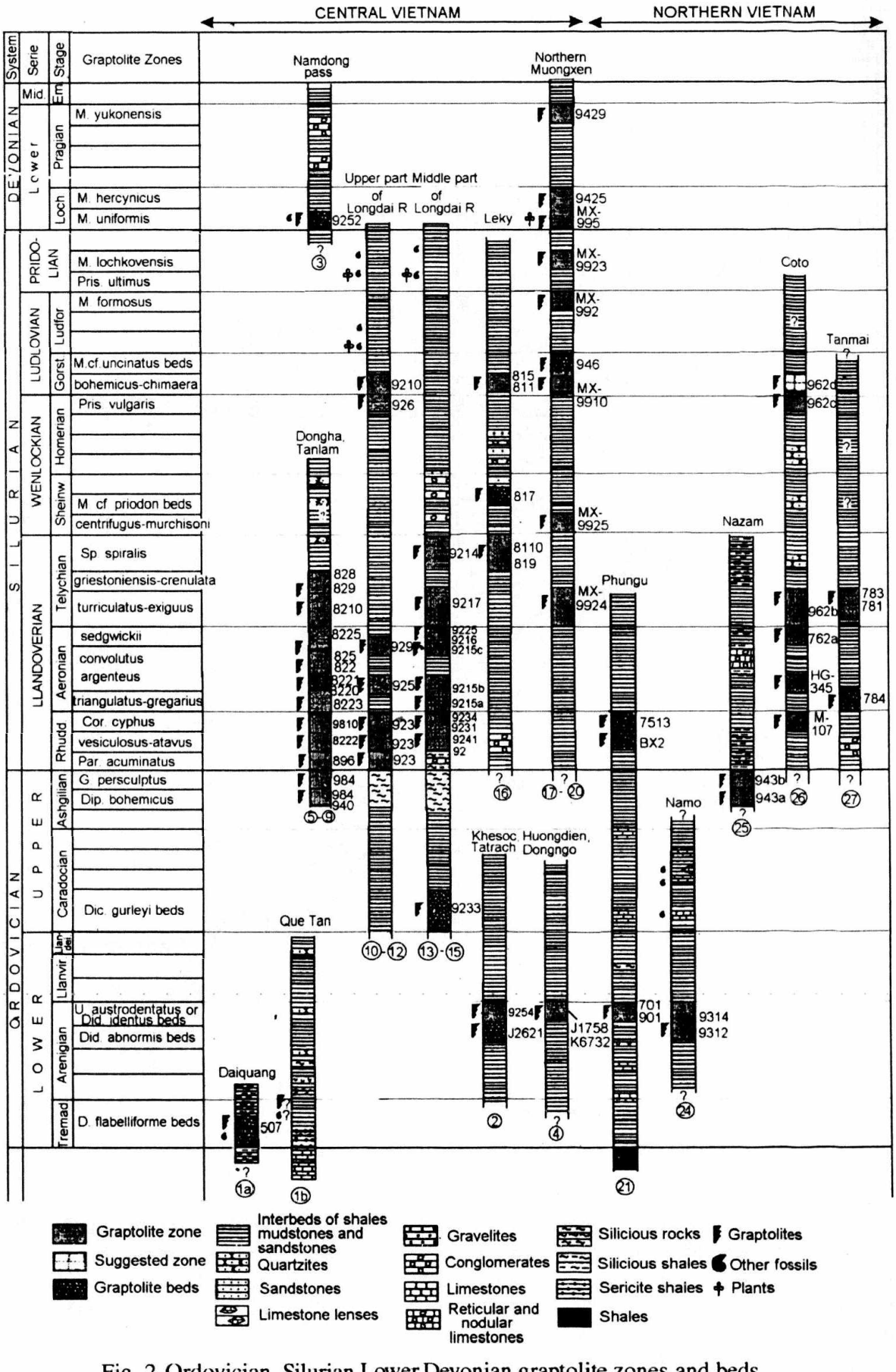

Fig. 2. Ordovician, Silurian, Lower Devonian graptolite zones and beds in Northern and Central Vietnam.

From the Dai Quang section (section 1a, Dai Loc District, Quang Nam - Da Nang Province):

***D. flabelliforme graptolithinum* beds (Lower Tremadocian).** Loc. HQ 507: *D. flabelliforme graptolithinum* Kjrulf, *A. sinensis Hsu, P. plumosus* Hall.

From the lower part of Que Tan section (section 1b, Que Son District), which is localated in the south from Dai Quang section, were found questionable graptolites.

2. Nam Dong area (Thua Thien Hue Province). The measured sections belong to the same A Vuong Formation.

From Khe Soc - Ta Trach section (section 2), Nam Dong District:

***Did. Abnormis* beds (Upper part of Arenigian,** from *Az. Suecicus* to *Ex. Clavus* zones of China). Loc.J 2621: *Did. Abnormis* (Hsu), *Ph. Anna* Hall. In the Jiangshan-Changshan-Yushan area of China *Ph. Anna* Hall occurs from the base of *Az. Suecicus* zone to the top of *Ex. Clavus* zone. *Did. Abnormis* (Hsu) is presented in the same level, but extended through the lower part of the *U. austrodentatus* zone. Under these graptolite bearing beds are exposed the metamorphosed carbonate mudstones and shales with the intercalated pyrite bearing lenses of limestones.

***U. austrodentatus* zone (Upper part of Llanvirnian).** Loc. 9254: *U. sinodentatus* (Mu et Lee), *U. ex gr. Formosus* (Mu et Lee), *Climacograptus* sp..

In the Nam Dong area the rocks of all stratigraphycal units are exposed: andesites, rhyolites, carbonate mudstones and shales, deeper water and shallow water directed fault system. Therefore we can not know which stratigraphycal unit is developed because no graptolites and any fossils were found as yet, and stratigraphycal relation of the andesites, rhyolites are too.

From the red beds of the section (section 3) near the Nam Dong Pass (at Km No 8 to Quang Nam - Da Nang Province), there are exposed with Lower Devonian age:

***Monograptus* beds** (may be **Lower part of Lochkovian**): Loc. 9252: *Monograptus* sp., similar to *M. aequabilis* group with pelecypods, gastropods, and brachiopods.

3. Huong Dien and Dong Ngo area. The Huong Dien section is localated in the west of Hue city, from which were collected:

***Did. identus* beds (*U. austrodentatus* zone, upper part of Llanvirnian).** Loc. J. 1758: *Did. identus* (Hall).

From the Dong Ngo section (in the left bank of Ba Long River near the Ba Long Village, Ba Long District, Quang Tri Province). Loc. K. 7642: *Did. nanus* Lapw..

4. Dong Ha area. In 1982, 1990-1992 and during the present year, the author measured 5 sections (sections 5-9) along the Road No 9 from Km No 3 to Km No 24 near the Dau Mau Bridge. As a new unit the Dong Ha Formation is proposed here which is composed of sandstones, mudstones, black bituminous variously and coloured shales in weathered state with a thickness of 900 m.

From these sections graptolites were collected by the author, in ascending order as follows:

***Dip. Bohemicus* zone (Ashgilian, Ordovician).** Loc. DH. 940, DH. 984: *Dip. bohemicus* (Marek), *Am. madernii* (Koren et Mikh.).

***G. persculptus* zone (uppermost zone of Ashgilian, Ordovician).** Loc. DH. 9810: *G. persculptus* (Salter), *G. gracilis Ge, Cl. angustus* (Perner).

***Par. acuminatus* zone (Rhuddanian, Llandovery).** Loc. DH. 986: *Par. acuminatus* (Nicholson).

***At. atavus* zone (Rhuddanian, Llandovery).** Loc. 8222, Loc. DH 984: *At. atavus* (Jones), *Pr. incommodus* (Tornq.), *Dip. modestus* Lapw..

***Cor. gregarius* zone or *Dem. triangulatus* (Aeronian, Llandovery).** Loc. 8217: *Cor. gregarius* (Lapw.), *N. scalaris* (Hising.), Loc. 8223, Loc. DH. 982: *N. scalaris* (Hising.), *Ps. hughesi* (Nichol.), *G. tamariscus* (Nichol.), *L. poschovae* Chal., *Dem. triangulatus* (Hark.), *Cam. curtus* Obut et Sob., *Rastrites* sp..

***M. sedgwickii* zone (Aeronian, Llandovery).** Loc. 8220: *M. sedgwickii* (Port.), *Cam. communis* (Lapw.), *Ps. hughesi* (Nichol.), *Pet. palmeus* (Bar.), *Pet. minor* Elles, *Pet. praecursor* Boucek et Pribyl.

***Str. exiguus* zone (Telychian, Llandovery).** Loc. 8210, Loc. 829: *Str. exiguus* (Nichol.), *M. parapriodon* Boucek.

***Mon. griestoniensis* zone (Telychian, Llandovery).** Loc. 827, Loc. 828: *Mon. griestoniensis* (Nichol.), *M. priodon* (Bronn), *M. acus* Elles et Wood.

The uppermost black beds of the *Str. spiralis* zone (Telychian, Llandovery) in the Dong Ha area were not yet found until now.

5. Long Dai area. The author and his colleagues have carried out field work in the Long Dai River Valley in 1991-1992. In this area 6 sections were measured (sections 10-15)

From these sections we discovered 39 localities of graptolites and 6 localities of trilobites, brachiopods, crinoids and nautiloids.

From the middle part of the section located along the Long Dai River at Km. No 28: .

***Dic. gurleyi* beds (Lower Caradocian).** Loc. 9223: *Dic. gurleyi* Lapw., *Dic.* cf. *sextans exilis* (Elles et Wood), *G. euglyphus* (Lapw.), *Climacograptus* sp.. *Dic. Gurleyi* Lapw., *Dic. sextans exilis* (E. et W.) indicate the *Nem. gracilis* and *Cl. peltifer* zones.

From the Ban Ho, Ban Mit sections and section at Km. No 28:

***Par. acuminatus* zone (Rhuddanian, Llandovery).** Loc. 923: *Dip. angustidens* Ge, *G. tamariscus linearis* Perner, *N. normalis* (Lapw.). Loc. 92 (collected from the pebbles of the shales along the right bank of Long Dai River at Km. No 28): *N.* cf. *Normalis* (Lapw.), *N. nanjingensis linearis* (Park.). Loc. 9241: *N. normalis* (Lapw.), *N. angustus* (Perner), *Par. acuminatus* (Nichol.), *Par. sinitzini* (Chalet.).

***Cys. vesiculosus* zone (Rhuddanian, Llandovery).** Loc. 923: *Cys. vesiculosus* (Nichol.), *Ps. hughesi* (Nichol.). Loc. 92: *Dim. extenuatus* E. et W., *Dip. secundus* Obut et Sob., *Met. jinyangensis* (Ye). Loc. 9231: *Cys. vesiculosus* (Nichol.), *N. rectangularis* (M'Coy), *G. sinuatus* Nichol.. Loc. 9234: *N. nanjingensis linearis* (Park.), *Dip. tcherskyi* Obut et Sob., *Met. Jinyangensis* (Ye).

***Cor. cyphus* zone (Rhuddanian, Llandovery).** Loc. 9215: *Cor. cyphus* (Lapw.), *Cor. acinaces* (Tornq.), *Pr. sandersoni* (Lapw.).

***Dem. convolutus* zone (Aeronian, Llandovery).** Loc. 929: *Dem. pulcherrimus* Manck.

From the section along the way No 10 from Km. No 21 to Km. No 18:

***M. sedgwiskii* zone (Aeronian, Llandovery).** Loc. 9216: *M. sedgwickii* (Portl.), *Pet. tenuis* (Bar.). Loc. 9225: *M. sedgwickii* (Portl.), *M. circularis* E. et W., *Pet. palmeus* (Bar.), *Pet. praecursor* Boucek et Prib., *Monograptus* sp..

In the section from Km. No 21 to Km. No 18:

***Sp. turriculatus* zone (Telychian, Llandovery).** Loc. 9222: *Sp. turriculatus* (Bar.), *Sp. minor* (Boucek), *Str. filiformis* Chen, *Pet. tenuis* (Bar.). Loc. 9227: *Sp. turriculatus* (Bar.), *Pet. tenuis* (Bar.), *Monograptus* sp..

In the section from Km. No 18 to Km. No 16:

***Str. exiguus* zone (Telychian, Llandovery).** Loc. 9217: *Str. exiguus* (Nichol.). Loc. 9221: *Str. exiguus* (Nichol.).

In the section at the Km. No 28:

***M. spiralis* zone (Telychian, Llandovery).** Loc. 9214: *M. spiralis* (Geinit.), *M. planus* (Bar.), *Mon. crenulata* (Tornq.), *Mon. griestoniensis* (Nichol.).

From the Ban Ho-Ban Mit and Xa Khia sections:

***Pris. vulgaris* zone (Homerian, Wenlockian).** Loc. 926: *Pris. vulgaris* (Wood). Loc. 9245: *Pris. vulgaris* (Wood), *M. comis* Wood. Loc. 9210: *Pris. vulgaris* (Wood), *M. comis* Wood.

***B. bohemicus - S. chimaera* zone (Gorstian, Ludlow).** Loc. 9246: *B. bohemicus* (Boucek), *S. chimaera* (Bar.), *Neo.* ex gr. *nilssoni* (Bar.).

From the Ban Mit-Xa Khia section and in the section from Km. No 21 to Km. No 18:

***M. formosus-Pris. Ultimus* zone (the base of the Pridolian).** Loc. 9249: *Pris. ultimus* (Wood), *Bohemograptus* sp.. Loc. 9223: *M. formosus* Boucek.

6. Le Ky area. The Silurian rocks are well exposed in this area. But they were described by geologists as Eifelian (Dovjikov A.E. et al., 1965) and Early Devonian (Tran Van Tri et al., 1977). After the Geological Division No 207, Nguyen Van Phuc was the author who discovered Silurian graptolites in the sequence of the Da Mao-Le Ky section. The section proposed here is based on a type section along a small stream in the NW Da Mao Mountains to the Le Ky railway station (section 16). It consists of sandstone, mudstones and grey-green shales intercalations with about 1900 m thickness. Sericitic schist and conglomerate lenses occur in the lower part of the section and gravelites, conglomerates and coarse-grained rocks in the middle. The variegated coloured shales are presented in the upper part. Silurian graptolites are listed in ascending order as follows:

***Sp. spiralis* zone (Telychian, Llandovery).** Loc. 8110: *Sp. spiralis* (Gein.), *Retiolites* sp., *Monograptus* sp.. Loc. 819: *Monograptus* sp..

From the middle part of the section:

***M.* cf. *Priodon* beds Wenlock).** Loc. 817: M. cf. *priodon* (Bronn).

***B. bohemicus - S. chimaera* zone (base zone of Ludlow).** Loc. 811, Loc. 812, Loc. 813, Loc. 814, Loc. 815: *S. chimaera* (Bar.), *S. salveyi* (Hopk.), *B. bohemicus* (Bar.), *C. colonus* (Bar.), *Pristiograptus* sp..

7. Muong Xen area. The studied sediments belong to the Ca River Formation (Middle Paleozoic, Dovjikov A.E. et al., 1965) and Huoi Nhi Formation (Upper Silurian-Lower De-

vonian, Nguyen Van Hoanh et al. 1978, 1996) with a thickness of 2500 m. The sections of the both formations were strongly offset and separated by variously directed fault systems. In 1994 the author and his colleagues described 8 partial sections in this area (Ky Son District) and up to now have not found Ordovician graptolites as yet.

From the Huoi Thang and Vang Phan sections:

***Sp. turriculatus - Str. exiguus* zone (Telychian, Llandovery).** Loc. MX. 9924 (Huoi Thang section): *Sp. Turriculatus* (Bar.), *Str. exiguus* (Nichol.), *Monograptus* sp.. Loc. 9438 (Vang Phan section): *Gl.* cf. *crispus* (Lapw.).

From the Keo Lac section:

***Cyr. centrifugus - murchisoni* (Sheiwoodian, Wenlockian).** Loc. MX. 9925: *M. cultellus* Tornq., M. cf. *retroflexus* Tullberg.

From the Huoi Poc section:

***B. bohemicus - S. chimaera* zone (Gorstian, Ludlovian).** Loc. MX. 9910, MX. 9911, MX. 9912: *B. bohemicus* (Boucek), *Neo. nilssoni* (Bar.), *Pristiograptus* sp..

***M.* cf. *Uncinatus* beds (*M. scanicus* zone, Gorstian, Ludlow).** Loc. 946: *M.* cf. *uncinatus* Tullber.

From the Huoi Thang section:

***M. formosus* zone (Ludfordian, Ludlovian).** Loc. MX. 992: *M. formosus* Boucek.

From the Huoi Mu section:

***M. lochkovensis* zone (Pridolian).** Loc. MX. 9923: *M. pridoliensis* Pribyl.

***M. uniformis* zone (Lochkovian, Lower Devonian).** Loc. MX. 995, MX. 9921: *M. uniformis* (Pribyl).

From the Tham Hoc section:

***M. hercynicus* zone (Lochkovian, Lower Devonian).** Loc. 9425: *M. hercynicus* Perner, *M. praehercynicus* Jaeger, assembled with *Nowakia* cf. *acuaria* (Rich.), *Now.* ex gr. *acuaria* (Rich.), *Styliolina* sp..

***M. yukonensis* zone (Upper part of Pragian).** Loc. 9429: *M. yukonensis fangensis* Jaeger et Stein, *M. yukonensis langgunensis* Jones, assembled with *Styliolina* sp., plants *Psilophyton* sp.

From the Keo Mieng section *M. yukonensis yukonensis* Jack. et Lenz, *M. aequabilis notoaequabilis* Jaeger et Stein were collected too with plants *Psilophyton* cf. *bellum* (Tscher.).

II. Northern Vietnam

1. Cho Moi area. The Ordovician (Upper) graptolite bearing beds were firstly described by Pham Dinh Long (1970) from the type locality of Phu Ngu Village, in the Cho Moi District, Bac Kan Province. It consists of flyschoid clastics, including shales, siliceous shales, tuffaceous sandstones, siliceous green or green-grey schists with some carbonate intercalations. The total thickness is measured with more than 2000 m. During the field work in 1970, 1990, 1991 Nguyen Van Phuc discovered Llanvirnian graptolites from the section (section 21) near Phu Ngu Village. But from the Cho Don sections (sections 22-23)

Llandovery graptolites were found. However the range of the whole Phu Ngu Formation still remains uncertain.

From the Phu Ngu section:

***U. austrodentatus* zone (Base zone of Llanvirnian).** Loc. 701 (= Loc. 901): *U. austrodentatus* (Har. et K.).

From the Khuoi Vang section Cho Don District (section 22):

***Pristiograptus* beds (Llandovery).** Loc. 7513: *Pristiograptus* sp..

From the Khuoi Toc section Cho Don District (section 23):

***Glyptograptus* beds (Llandovery).** Loc. BX.2: *Glyptograptus* sp., may be *G. tamariscus* (Nichol.).

2. Na Mo area. The section (section 24) consists of fine grained sandstones, mudstones and verious coloured shales with lenses of limestones. These sediments belong to the Na Mo Formation established by Patte E. (1927) and described firstly by Dovjikov A. E. et al. (1965). The total thickness is about 1200 m. Lower Ordovician brachiopods and trilobites have been recorded by the previous authors. The Llanvirnian-Llandeilian graptolites in this unit ware firstly collected by Nguyen Van Phuc in 1993. But the formation was separated by various fault systems. Therefore they are only partial sections and there is a great difficulty to know the exact stratigraphical position of the beds.

***U. austrodentatus* zone (Base zone of Llanvirnian).** Loc. 9312 and Loc. 9314: *U. austrodentatus* (Har. et K.), *Dendrograptus* sp.. Loc. 9315: *U. austrodentatus* (Har. et K.), *E. ferrugineus* (Suess).

3. Na Zam area. The studied section (section 25) is located at the Na Zam small Village and was established by Giraud J. (1918) and then described by Patte E. (1927). Based on this section Giraud J. reported that the graptolites in this unit are *Dictyonema* sp., and *Cl. scalaris* His., and aged as Early Silurian (Llandovery and Wenlockian). But Patte E. revised the climacograptids as *Cl. latus* El. et Wood and dated the formation as Late Ordovician. The formation is composed of yellowish (at the bottom) and black shales (at the top) with a thickness of about 10 m. This graptolite shales occurs between the Upper Cambrian and Lower Devonian outcrops. But according to present author the Lower Devonian sediments are need ageds as Llandoverian.

Nguyen Van Phuc found exactly two different assemblages of graptolites in 1993 from the boundary beds with a thickness of 60-70 centimeters. They are listed as follows:

***Dip. bohemicus* zone (Uppermost zone of Ashgilian).** Loc. 934A: *Dip. bohemicus* (Marek), *Dip. ojsuensis* Koren et Mikh., *G. daedatus* Mu et Ni, *G. elegantulus* Mu et Ni, *N. bicaudatus* Chen et Lin.

***G. persculptus* zone (Base zone of Rhuddanian, Llandovery, now considered as uppermost zone of Ashgilian, Ordovician).** Loc. 934B: *G. persculptus* (Salter), *G. gracilis* Ge, *G. elegantulus* Mu et Ni, *N. madernii* (Koren et Mikh.), *D.* cf. *compactum* Mu et Lin, *Thallograptus* sp..

From the graptolites mentioned above, *Dip. bohemicus* (Marek) only occurs in the Late Ashgilian strata from Bohemia (Kosov beds) and from the Yangtze, China (Wufeng Formation). The *G. persculptus* (Salter) and *G. gracilis* Ge only occurs at the base of the

Rhuddanian (now uppermost zone of Ashgilian) beds of all countries. This *G. persculptus* zone may indicate the boundary between Ordovician and Silurian in Vietnam.

4. Co To area. The studied sections in the Co To archipelago (Bac Bo Gulf) belong to the Co To Formation. This was established by Dovjikov A.E. et al. (1965) and dated as Neogene. In 1972, Tran Van Tri and Nguyen Huy Mac found Silurian graptolites from the type locality of this unit. More detailed work was then carried out by Nguyen Van Phuc from the type section (section 26) and is presented in this paper. The formation is characterized by intercalated green-grey, black flyschoid sandstones, siltstones and shales with a thickness of 1500-1600 m. The graptolite fauna is listed as follows (in ascending order):

***Cor. cyphus* zone (Rhuddanian, Llandovery).** Loc. Con Ngua (horse) Island: *Cor. cyphus* (Lapw.).

From the section in Nui Ngon and Thanh Lan Islands:

***Cor. gregarius* zone (Aeronian, Llandovery).** Loc. 989: *Cor. cyphus* (Lapw.), *N. rectangularis* (Mcoy), Loc. HG. 345: *Dem. triangulatus* (Hark.), *Cam. communis* (Lapw.), *Ras. longispinus* (Perner).

From the Thanh Lan section:

***M. halli* beds (M. sedgwickii zone ?, Aeronian, Llandovery).** Loc. 762A: *M. halli* (Bar.)

***Sp. turriculatus* (or Sp. minor) zone (Telychian, Llandovery).** Loc. 762B: *Sp. minor* (Boucek).

***Str. exiguus* zone (Telychian, Llandovery).** Loc. 762C: *Str. exiguus* (Nichol.).

***Pris. vulgaris* zone (uppermost zone of Homerian, Wenlock).** Loc. 762D: *Pris. dubius* (Suess).

***Saetograptus* beds (baseal zone of Gorstian, Ludlow).** Loc. 762E: *Saetograptus* sp.

5. Tan Mai area. The described section was established by Dovjikov A.E. et al. (1965) and is based on the type section (section 27) at Than Phun Village (near the border between Vietnam and China) along a road from Than Phun Village through Tan Mai Village. The unit consists of highly metamorphosed terrigeneous, flyschoid clastics with a total thickness of 1650 m. The lower boundary of the section is not exposed due to a fault between Tan Mai Formation and Late Triassic red beds. Jurassic continental red conglomerates unconformable overlie the formation. During the fieldwork in 1978, 1979 Llandovery graptolites were found by Nguyen Van Phuc from the middle and upper parts of the section.

From the member of red shales:

***Pseudoclimacograptus* beds (May be Aeronian, Llandovery).** Loc. 784: *Psedoclimacograptus* sp., may be *Ps. hughesi* (Nichol.).

***Str. exiguus* zone (Telychian, Llandovery).** Loc. 781: *Str. exiguus* (Nichol.), *Monograptus* sp..

As the above mentioned Ordovician - Silurian and Lower Devonian graptolite sequence is more complete in all studied areas of Central and Northern Vietnam, it is espected that the Ordovician - Silurian and Lower Devonian graptolite zonation of Vietnam

will be finalized later based on more detailed work in these areas, and will be a correlation standard in Vietnam, where the Ordovician - Silurian and Lower Devonian are mainly developed graptolite bearing facies. We hope that in the near future the Vietnamese Graptolite Standard Zones as well as the Ordovician - Silurian - Devonian boundaries will be clearly defined and established in Vietnam.

Acknowledgments

Financial support was granted by National Geographic Society, USA; Ministry of Education and Training of Vietnam; National Basic Research Program in Natural Sciences of Vietnam (Ministry of Sciences, Technology and Environment of Vietnam); Natural Science Council of Vietnam; Vietnam National University, Hanoi.

The author is indebted to Dr. Chen Xu (Nanjing Institute of Geology and Paleontology); Prof. Adam Urbanek; Prof. Lech Teller (Institute of Paleobiology, Polish Academy of Sciences) and Prof. Bernd-D. Erdtmann (TU Berlin) for their valued advice concerning identifications of the graptolites during the author's visits to their respective institutions.

Abbreviation of graptolite genera used in the text.

A. Acanthograptus, Acr. Acrograptus, Am. Amplexograptus, At. Atavograptus, Az. Azygograptus, B. Bohemograptus, Cam. Campograptus, Cl. Climacograptus, Clo. Clonograptus, C. Colonograptus, Cor. Coronograptus, Corym.Corymbograptus,Cyr. Cyrtograptus, Cys. Cystograptus, Dem. Demirastrites, Dic. Dicellograptus, Dicr. Dicranograptus, D. Dictyonema, Did. Didymograptus, Dim. Dimorphograptus, Dip. Diplograptus, Ex. Exigraptus, E. Expansograptus, Gl. Globosograptus, G. Glyptograptus, Iso. Isograptus, , L. Limpidograptus, Met. Metaclimacograptus, Mon. Monoclimacis, M. Monograptus, Nem. Nemagraptus, Neo. Neodiversograptus, Nic. Nicholsonograptus, N. Normalograptus. Onc. Oncograptus, Orth. Orthograptus, Par. Parakidograptus, Paraor. Paraorthograptus, Pen. Pendeograptus, Pet. Petalolithus, Ph. Phyllograptus, Pleur. Pleurograptus, Pr. Pribylograptus, Pris. Pristiograptus, Ps. Pseudoclimacograptus, Pt. Pterograptus, P. Ptilograptus, Ras. Rastrites, R. Retiolites, S. Saetograptus, Sp. Spirograptus, St. Starograptus, Str. Streptograptus, Tan. Tangyagraptus, Tetr. Tetragraptus, Un. Undulograptus. Km. Kilometre code.

System	Serie	Stage	Standard Graptolite Zones 1	China 2	Australia 3	Thailand 4	Malaya 5	Vietnam
DEVONIAN	Mid.	Em	M. pacificus	fangensis-atopus				
	Lower	Pragian	M. yukonensis	M. yukonensis	M. yukonensis	M. yukonensis	M. yukonensis *	M. yukonensis
			craigensis & thomasi	M. thomasi	M. thomasi			
			M. fanicus				M. fanicus *	M. fanicus *
			M. falcarius	M. falcarius				
		Loch.	M. hercynicus	M. hercynicus		M. hercynicus	M. hercynicus	M. hercynicus
			M. uniformis	M. uniformis	M. aequabilis		M. uniformis *	M. uniformis
SILURIAN	PRIDOLIAN		bouceki-transgrediens	No sediments	bouceki-transgrediens			
			M. lochkovensis					M. lochkovensis
			Pris. ultimus		M. formosus			Pris. ultimus
	LUDLOVIAN	Ludfor	M. formosus	No sediments	B. bohemicus-posthumus			M. formosus
			boh.tenuis-kozlowskii					
			leintwardiensis	M. tumescen				
		Gorst	M. scanicus	M. scanicus	S. chimaera			M.cf.uncinatus beds
			Neo. nilssoni	Neo. nilssoni				bohemicus-chimaera
	WENLOCKIAN	Homerian	ludensis		ludensis ?			Pris. vulgaris
			praeduebeli-duebeli		M. testis			
			parvus-nassa					
			lundgreni	lundgreni			M. flexilis	
		Sheinw	rigidus-perneri	rigidus				
			riccartonensis-belophorus	M. riccartonensis				M. cf. priodon beds
			centrifugus-murchisoni	Cyr. murchisoni	insectus			centrifugus-murchisoni
	LLANDOVERIAN	Telychian	lapworthi-insectus	Cyr. centrifugus	Sp. spiralis		Sp. spiralis-grandis	Sp. spiralis
			Sp. spiralis	Sp. spiralis	griestoniensis		Sp.spiralis-Mon.griest.	griestoniensis-crenulata
			griestoniensis-crenulata	Mon. griestoniensis	Gl. crispus		Gl. crispus	
			turriculatus-crispus	Gl. crispus	Sp. turriculatus		Sp.minor-Ras.linnaei	turriculatus-exiguus
			guerichi	Sp. turriculatus				
		Aeronian	M. sedgwickii	M. sedgwickii	M. sedgwickii		M. sedgwickii	M. sedgwickii
			Dem. convolutus	Dem. convolutus	Dem. convolutus		Dem. convolutus	Dem. convolutus
			argenteus	Dem. triangulatus				
			triangulatus-pectinatus		Cor. gregarius		Cor. gregarius	triangulatus-gregarius
		Rhuod.	Cor. cyphus	Cor. cyphus	Cor. cyphus	Cor. cyphus	Cor. cyphus	Cor. cyphus
			vesiculosus	vesiculosus			vesiculosus	vesiculosus-atavus
			Par. acuminatus	Par. acuminatus	Akidograptus		Par. acuminatus	Par. acuminatus
ORDOVICIAN	UPPER	Ashgillian	G. persculptus	G. persculptus			Climacograptus & Diplograptus shale	G. persculptus
			Dip. bohemicus	Dip. bohemicus	Dic. complanat	Dicranograptus shale		Dip. bohemicus
			pleur. linearis	Paraor. uniformis	Pleurograptus			
		Caradocian	Dicr. clingani	Orth. quadrimucronatus	Dic. hians	No graptolites		
			Cl. wilsoni	Tan. typicus	Cl. baragwanathi			
			Cl. peltifer	Dic. szechuanensis	Cl. peltifer			
			Nem. gracilis	Pleur. lui	Nem. gracilis			Dic. gurleyi beds
	LOWER	Llandei.	G. teretiusculus	Did. jiangxiensis	G. teretiusculus		No graptolites	
				Pt. elegans				
		Llanvir.	Did. murchisoni	Nic. fasiculatus	Did. nodosus			
			Did. bifidus	Acr.ellesae-Un.austrod.	G. intersitus			
					Un. austrodentatus			
		Arenigian	E. hirundo	Ex. clavus	Cardiograptus-Oncog.			Un.austrodentatus or Did.identus beds
			Isog. gibberulus	Onc. magnus	Isog. caduceus			Did. abnormis beds
			E. nitidus	Iso. vic. victoriae	Did.balticus-protobifidus			
			Corym. deflexus	Az. suecicus	Pen. fruticosus			
			Tetr. approximatus	Corym. deflexus	Tetr. approximatus			
				Pen. fruticosus				
		Tremadoc	Bryograptus	Adelograptus-Clonograptus	Bryograptus			D. flabelliforme beds
			Adelograptus	Clo. tenellus-St. dichotomus	Staurograptus & Dictyonema			
			D. flabelliforme	D. flabelliforme				

* Conjectural Zones

Fig. 3. Comparison and correlation of Ordovician-Silurian-Lower Devonian graptolite zones and b of Vietnam and other countries in the vicinity.Cited papers of the authors: 1- Standard Silu graptolite zones, after: Koren T.N., Lenz A.C., Loydell D.K., Melchin M.J., Storch P., Teller L., 19 British Standard Ordovician graptolite zones, after: Skevington D., 1976, 2- Lin Bao yu et al., 1982 and Jiao, 1983; Mu and Lin Yao-Kun, 1984; Mu, 1984; Chen Xu and Quan Qiu-Qi, 1992; Chen 1995, 3- Shrrard, 1953; Thomas, 1960; Jaeger H, 1966, 1967; Jaeger and Stein, 1969; Skevington 1976, 4- Kobayashi T., Igo H., 1965; Burton C.K., 1967, 5- Burton C.K., 1967; Jones C., 1973.

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TẠP CHÍ KHOA HỌC ĐHQGHN, KHTN & CN, t.XVIII, n^{0}1 - 2002

CÁC LỚP ĐÁ TRẦM TÍCH CHỨA BÚT THẠCH TUỔI ORDOVIC - SILUR VÀ ĐEVON SỚM Ở VIỆT NAM

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Các lớp đá chứa bút thạch đã được phát hiện trong 26 mặt cắt phân bố từ Đại Lộc tỉnh Qung Nam - Đà Nẵng đến Tấn Mài tỉnh Qung Ninh.

Trong các trầm tích Ordovic đã xác lập được 3 tầng và 4 đới chứa bút thạch (từ dưới lên trên): tầng chứa *D. flabelliforme* (bậc Tremađoc), và *Did. abnormis*, đới *U. austrodentatus* (bậc Arenic), tầng chứa *Dic. gurleyi* (bậc Carađoc), các đới *Dip. bohemicus, G. persculptus* (bậc Ashgili).

Trong các trầm tích Silur có mặt 14 đới và 2 tầng chứa bút thạch (từ dưới lên trên): các đới *Par. acuminatus, Cys. vesiculosus (=At. atavus), Cor. cyphus* (bậc Rhuđani, Llanđovery), *Dem. triangulatus- Cor. gregarius), Dem. convolutus, M. sedgwickii* (bậc Aeroni, Llanđovery), *Sp. turriculatus-Str. exiguus, Mon. griestoniensis- Mon. crenulata, Sp. spiralis* (bậc Telychi, Llanđovery), *Cyr. centrifugus- Cyr. murchisoni*, tầng chứa *M.* cf. *priodon* (bậc Sheivuđi, Venlock), các đới *Pris. vulgaris* (bậc Homeri, Venlock), *B. bohemicus-S. chimaera*, tầng chứa *M.* cf. *uncinatus* (bậc Gorsti, Luđlov), các đới *M. formosus* (bậc Luđforđi, Luđlov), *M. lochkovensis* (Priđoli).

Các trầm tích Đevon dưới gồm có (từ dưới lên trên): các đới bút thạch: *M. uniformis, M. hercynicus* (bậc Lochkov), *M. yukonensis* (bậc Praga).