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内蒙古西拉木伦河北部蛇绿岩带中二叠纪放射虫的发现及其地质意义*

王玉净
(中国科学院南京地质古生物研究所,南京 210008)

樊志勇
(内蒙古自治区第十地质矿产勘查开发院,赤峰 024005,内蒙古)

提要 内蒙古西拉木伦河北部杏树洼蛇绿岩带硅质岩中首次发现放射虫11属9种1相似种4未定种及伴生的1个台型牙形类 *Mesogondolella* sp.,这些化石常见于日本西南部,北美西部Oregon、Nevada等地区,菲律宾巴拉望,泰国东南部,中国广西钦州地区和云南西部孟连地区中二叠世Guadalupian期地层中,它们属于 *Follicucullus scholasticus*-*Fo. ventricosus* 带,*Fo. bipartitus*-*Fo. Charveti* 带或 *Neoalbaillella optima*-*Neo. ornithoformis* 带中的重要分子。这个动物群的时代最有可能是Guadalupian中、晚期的,这个时间也可能是蛇绿岩带形成和蒙古洋最后封闭形成缝合线的时间。该蛇绿岩带应属于海西期板块构造活动的产物。西拉木伦河断裂是中朝板块与西伯利亚板块碰撞的缝合线,其北部蛇绿岩带不是属于中朝板块北缘,而是属于西伯利亚板块南缘造山带的一部分。

关键词 放射虫 二叠纪 硅质岩 蛇绿岩带 内蒙古西拉木伦河断裂

西拉木伦河位于内蒙古东南部赤峰市北约120km,沿着这条河存在着一条相当规模的深大断裂,在河的北部杏树洼、柯单山、五道石门、黄梁岗、二八地、天山、九井子一带发育一条北东东向断续延伸180km的蛇绿岩带(插图1)。一些地质学家,如黄汲清等(1980)、王鸿祯(1982)、李春昱、王荃(1983),根据断裂两边晚古生代地层的明显差异和区域地层的发育状况把西拉木伦河视作中朝板块与西伯利亚板块相碰撞的缝合线,特别是李春昱等(1983)把西拉木伦河与其西的二连浩特、索伦山北侧、蒙古南缘至东准噶尔的克拉美丽山一线认作是一条晚古生代晚期的板块缝合线,并把甘肃北山南缘和内蒙古西拉木伦河一带二叠纪洋壳残块作为华夏古陆和安加拉古陆碰撞以及其间古海洋盆地最后封闭的遗迹,还把这次碰撞当作形成现今亚洲大陆构造轮廓的基础。对于西拉木伦河及其蛇绿岩带这样一种重要的认识,由于近年来在蛇绿岩带硅质岩中不断发现一些微体化石而引起了对这套蛇绿岩带形成时代和对西拉木伦河深大断裂地质意义的争议。何国琦、邵济安(1983)根据西拉木伦河北部蛇绿岩带硅质岩中发现的某些微体化石,如,柯单山硅质岩中的介形类 *Ecfoprimitia*

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sp.,五道石门硅质岩中的有孔虫 *Ammodiscus* sp., 小腕足类 Acrotretidae 科,放射虫 Sphaerellari 类,林西二八地硅质岩中的牙形类 *Panderodus* sp. 等认为蛇绿岩形成的时代是早古生代,为加里东期板块构造活动的产物;同时还认为海西阶段的蒙古洋和海西末期蒙古洋封闭而形成的缝合线应位于艾力更庙一锡林浩特中间地块以北。值得提出的是,被鉴定的这些化石多数未定种级,有的仅是科级,甚至只有类级,同时,都没有提供化石图影。因此,无法去验证其时代价值。1987 年,李锦轶也在西拉木伦河北部蛇绿岩带林西二八地硅质岩中发现放射虫 *Chancelloria*(?) sp., *Variocymatiosphaera* sp.1. *V*. sp.2, *Pygacapsa bilaminata*;在柯单山和五道石门硅质岩中找到藻类 *Gregalosphaera* cf. *textilopylora*, *Asteropylorus cruciporus*, *Pylosphaera* sp.,他根据这些图示的化石与温都尔庙蛇绿岩带硅质岩及南方牛蹄塘组中化石群面貌相近而提出西拉木伦河北侧蛇绿岩带的形成时代为早古生代早期,很可能不晚于奥陶纪,而且可能在早古生代末期构造侵位于中朝板块北缘。由此得出结论,西拉木伦河一带不存在中朝板块和西伯利亚板块之间的最后缝合线,其缝合线则位于该蛇绿岩带以北与贺根山蛇绿岩带之间。但文中所图示的放射虫和藻类化石可能都不是真正的生物化石,而可能是属于一类非生物成因的、与火山活动有关的宇宙尘埃或火山灰颗粒。这类物质,笔者曾在我国许多地区,如,内蒙古的温都尔庙、吉林大阳岔、河北卢龙县武山、江苏句容等地古生代地层中发现。最近,Lipps (1992)在评述彭立红(1984)采自内蒙古温都尔庙群 6 个科的放射虫时也指出,这些化石可能是火山物质的碎片。因此,根据这些非生物的"化石"来确定的蛇绿岩带形成时代是很难令人信服的。1991 年,日本人 Yao 发表的"内蒙古东部古生代放射虫产地"一文中(见 Ishii、刘效良等主编的"中国内蒙古前侏罗系地质学"一书)曾图示过西拉木伦河北部五道石门硅质岩中 3 个存疑的放射虫化石,由于标本保存很差,作者没有鉴定出属种名称和提供时代意见。但十分重要的是,其中的图版 2 图 2 标本,外壳具有较明显的乳突状构造,与我们在杏树洼发现的 *Hegleria mammilla* (Sheng et Wang)十分相似。笔者还怀疑,何国琦等(1983)文中所列与 Yao(1991)的文章中产于同一地点的放射虫 Sphaerellari(球虫类)也有可能是这个属。在与 Yao(1991)的文章同一本书中,Liang Rixuan 发表了"内蒙古东部和中部蛇绿岩序列和它的岩石组合特征"一文,他赞同何国琦等(1983)、李锦轶(1987)所论述的关于西拉木伦河北部蛇绿岩带的形成时代意见,他还补充了冶金工业部天津地质学院 Chen Senhuang (1987)提供的这个地区辉长岩 Rb-Sr 法同位素年龄值为 570—600Ma 的口头报告,使他更深信,这个地区蛇绿岩的形成时间是早古生代早期。但我们这次在西拉木伦河北部双井下场乡杏树洼蛇绿岩带硅质岩中首次发现的放射虫动物群,虽然丰度和分异度都比较低,但化石保存尚好,特征明显。这些化石包括 11 属 9 种 1 相似种 4 未定种,与其伴生的还有一个

图 1　西拉木伦河北部蛇绿岩分布示意图

Sketeh map of the Ophiolite Belt at the northern Side of Xar Moron River

台型牙形类碎片，王志浩鉴定为 *Mesogondolella* sp.，他认为这是属于中二叠世的分子。在这个动物群中，以 Ormistonellidae 科的属种和 Spongentactiniini 族的 *Hegleria mammilla* 比较普通，Entactiniidae 科的种类次之，Pseudoalbaillellidae 科仅见个别分子，名单如下：*Ormistonella robusta* De Wever et Caridroit，*Pseudotormentus kamigoriensis* De Wever et Caridroit，*Ishigaum trifistis* De Wever et Caridroit，*Nazarovella gracilis* De Wever et Caridroit，*N. scalae* Caridroit et De Wever，*Latentifistula similicutis* Caridroit et De Wever，*Entactinosphaera crassispinosa* Sashida et Tonishi，*Entactinia itsukaishiensis* Sashida et Tonishi，*E.* sp.，*Astroentactnia* sp.，*Hegleria mammilla* (Sheng et Wang)，*Pseudoalbaillella* cf. *longtanensis* Sheng et Wang，其中的前6种首见于日本西南部上二叠统 Maizuru 群 Tatsuno 组，最近相继在我国广西钦州地区中二叠统(Wang and Li，1994；Wang，Cheng and Yang，1994)、北美西部 Oregon(Blome and Reed，1992)、菲律宾 Guadlupian 统硅质岩相沉积中发现。后2种最早也在日本中部 Itsukaichi 地区 Guadalupian 统硅质岩相地层中发现，*E. itsukaichiensis* 还在北美西部 Oregon，Nevada，中国云南西部和内蒙古见有报道。*Hegleria mammilla* 常见于我国苏皖地区的孤峰组、广东曲江-仁布地区的“当冲组”、云南西部孟连地区的拉巴群、广西柳州一带的“孤峰组”和钦州地区二叠纪硅质岩中，在北美西部 Texas 和 Oregon，西西里岛，泰国东南部 Guadalupian 统硅质岩中也有发现。*Pseudoalbaillella longtanensis* 首见于我国南京龙潭孤峰组(Sheng and Wang，1985)，此后在苏皖地区孤峰组中较为常见，并成为该组下部带化石的一个组成分子(Wang and Qi，1995)，此种在日本西南部 Guadalupian 期地层中也较为普通。Ishiga(1990)曾提出以 *Ps. longtanensis* 带代替他的 *Ps.* sp. C 带，代表中二叠世 Leonardian 晚期的一个带化石，但由于 *Ps. longtanensis* 和 *Ps.* sp. C 不是相同的种，笔者等(Wang，Cheng ang Yang，1994)曾建议用 *Ps. ishigai* 带代替 *Ps.* sp. C 带，置于 Leonardian 阶，而 *Ps. longtanensis*-*Ps. fusiformis* 带，代表孤峰组下部的一个带化石的组成分子，置于 Guadalupian 阶。Guadalupian 期的放射虫最早被 Ishiga(1986，1990)分成中二叠世 Akasakan 期的 *Pseudoalbaillella globosa* 带、*Follicucullus monacanthus* 带、*Fo. scholasticus* 带(部分)和晚二叠世 Kuman 期的 *Fo. bipartitus*-*Fo. charveti* 带、*Neoalbaillella optima* 带、Mitaian 期的 *Neo. ornithoformis* 带；其后，Blome 和 Reed (1992)在研究北美西部 Oregon 地区二叠纪放射虫时，遵循 Ishiga 的分带方案，也把 Oregon 地区 Guadalupian 期放射虫分成 *Ps. globosa* 带、*Fo. monacanthus* 带、*Fo. Scholasticus* 带、*Neo. optima* 带和存疑为 Djulfian 期的 *Neo. ornithoformis* 带；最近，Wang，Cheng 和 Yang (1994)在总结“中国华南二叠纪放射虫生物地层学和系统分类”时提出中二叠世茅口期(=Guadalupian 期)放射虫分成 *Ps. globosa* 带、*Fo. monacanthus* 带、*Fo. scholasticus*-*Fo. ventricosus* 带、*Fo. bipartitus*-*Fo. charveti* 带和 *Neo. optima*-*Neo. ornithoformis* 带，还指出，后二个带是同时异相的产物。上述的分带，基本内容相似，仅在某些带的时代认识上略有不同。我们的认识与 Blome 和 Reed(1992)的基本一致，与 Ishiga 的差异较大，他把 *Neo. optima* 带与我国的吴家坪阶相比，把 *Neo. ornithoformis* 带与我国长兴阶比较。但日本学者以 类 *Lepidolina kumaensis* 带为特征所确定的晚二叠世 Kuman 阶由于这一 类动物群在我国华南地区常见于茅口组上部 *Yabeina*-*Metadoliolina* (= *Neomisellina*) 带，因此，日本的 Kuman 阶实际上与我国华南茅口组上部相当，也应归属于中二叠统 Guadalupian 阶。虽

然，我们这次发现的放射虫动物群没有上述各带中的带种化石，但都是属于 *Fo. scholasticus-Fo. ventricosus* 带、*Fo. bipartitus-Fo. charveti* 带或 *Neo. optima-Neo. ornithoformis* 带中的重要分子。因此，这个放射虫动物群的时代最有可能是中二叠世 Guadalupian 中、晚期的，这个时间也可能是西拉木伦河北部蛇绿岩带形成的时间。由此，我们取得如下 3 点认识：(1)西拉木伦河北部(包括杏树洼、五道石门等地)蛇绿岩带，根据放射虫化石和与其伴生的牙形类 *Mesogondolella* sp.，确定其形成时代为中二叠世，以中晚期可能性最大，这个时间也是古生代时蒙古洋最后封闭形成缝合线的时间，这条蛇绿岩带应属于海西期板块构造活动的产物。(2)保存在一个大陆地壳中的蛇绿岩代表着古老洋壳的残片，最年轻的蛇绿岩所占据的地区一般被认为是两个古老板块之间碰撞带的位置。我们赞同黄汲清等(1980)、王鸿祯(1982)、李春昱、王荃(1983)的意见，把西拉木伦河视作中朝板块与西伯利亚板块碰撞的缝合线。西拉木伦河北部蛇绿岩带不是属于中朝板块北缘，而是属于西伯利亚板块南缘造山带的一部分。其北的贺根山蛇绿岩带，根据我们的资料，由于在其硅质岩中发现属于晚泥盆世的放射虫化石 *Entactinia* sp.，*Entactinosphaera* sp. 等，自北向南，蛇绿岩带形成时间有逐渐变新的趋势，由此推测，其板块活动也可能由北向南推进的。(3)杏树洼蛇绿岩带硅质岩中放射虫和牙形类化石所提供的时代意见及其大地构造意义，显然与上述有些学者根据其它一些微体化石和同位素年龄值所得出的时间和认识相距甚远，孰是？孰非？有待今后对这条蛇绿岩带其它地区、以及内蒙古另外 3 条(索伦敖包、贺根山和温都尔庙)蛇绿岩带的硅质岩进行系统采集和深入研究予以解决。

DISCOVERY OF PERMIAN RADIOLARIANS IN OPHIOLITE BELT ON NORTHERN SIDE OF XAR MORON RIVER, NEI MONGGOL AND ITS GEOLOGICAL SIGNIFICANCE

Wang Yu-jing
(*Nanjing Institute of Geology and Palaeontology, Academia Sinica, Nanjing* 210008)
Fan Zhi-yong
(*Tenth Geological Institute of Mineral Exploration and Development, Nei Monggol, Chifeng* 024005, *Nei Monggol*)

Summary

Radiolarians are found in the cherts of the Xingshuwa Ophiolite Belt on the northern side of Xar Moron River, Nei Monggol, comprising 14 species (including 1 conformis and 4 unnamed species) representing 11 genera, together with a plate-like conodont *Mesogondonella* sp. These fossils are commonly discovered in the Middle Permian (Guadalupian) strata of Southwest Japan, Oregon and Nevada of western North America, the Philippines, Southeast Thailand, Guangxi and western Yunnan of China, and are regarded as some important members in the *Follicucullus scholasticus-Fo. ventricosus* Zone, the *Fo. bipartitus-Fo. charveti* Zone or the *Neoalbaillella optima-Neo. ornithoformis* Zone. This fauna is interpreted as middle and late Guadalupian in age which also may be the forming time of the Ophiolite Belt and the final closing time of the Mongolian ocean to form the collisional suture between the Sino-Korean and the Siberian plates. We consider this Ophiolite Belt as the Product of the Hercynian plate tectonic movement, the Xar Moron River Fault as the collisional suture between the Sino-Korean and the Siberian plates; and the northern Ophiolite Belt of this River as the southern marginal orogen of the Siberian plate, instead of part of the northern marginal orogen of the Sino-Korean plate.

Key words: Radiolaria, Permian, Cherts, Ophiolite Belt, Xar Moron River fault, Nei Monggol

Xar Moron River is situated about 120 km on the northern side of Chifeng City, along which exists a deep fault. In the northern part of this river (including Xingshuwa, Kedanshan, Wudaoshimen, Huanglianggang, Erbadi, Tianshan and Jiujingzi) is distributed an Ophiolite Belt extending uncontinuously in NEE trend for over 180 km in distance (see Text-fig. 1). Some geologists (Huang J. Q. *et al*., 1980; Wang H. Z., 1982; Li C. Y. and Wang Q., 1983), consider the Xar Moron River Fault as the collisional suture between the Sino-Korean and Siberian plates based on an obvious difference in the Late Paleozoic strata on both sides of this fault and a comparison of regional stratigraphy; especially, Li C. Y. and Wang Q. (1983), consider the line from Xar Moron River westwards to Erenhot, North Soronshan, South Mongolia through North Gansu to Karameili of East Junggar as a collisional suture of the plates at the end of Late Paleozoic age, and the Permian paleooceanic crust fragments of the area from South Beishan of Gansu to Xar Moron River of Nei Monggol as a mark indicating the collision between the Cathaysia and Angara old lands and the final closing of the ancient Asian Ocean Basin, and this collision as the base of structural configuration to form the present Asiatic landmass. This important conclusion concerning the Xar Moron River Fault and its northern Ophiolite Belt causes an argument as to the forming age of the Ophiolite Belt and the geological significance of the Xar Moron River deep Fault, owing to recent discoveries of some microfossils in the cherts of the Ophiolite Belt. He and Shao (1983) consider the Ophiolite Belt as Early Paleozoic in forming age and as a product of the Caledonian plate tectonic movement, based on some microfossils discovered in the cherts of the Ophiolite Belt on the northern side of Xar Moron River, such as the ostracod *Ecfoprimitia* sp. in the Kedanshan cherts, the foraminifera *Ammodiscus* sp., small brachiopod family Acrotretidae, the radiolarian Sphaerellari in the Wudaoshimen cherts, the conodont *Panderodus* sp. in the Erbadi cherts, etc. They also consider that the Mongolian Ocean of the Hercynian stage and the collisional suture which caused the final closing of the relic oceanic basin at the end of the Hercynian should be situated to the north of the Ailigeng Sum-Silinhot Mesomassif. It must be pointed out that these microfossils are mostly identified as unnamed species at family and even higher level, with no fossil figures published. Therefore, we can not determine their age values. Then, Li J. Y. (1987) proposed that the forming age of this Ophiolite Belt is early Early Paleozoic, very likely no later than Ordovician, and the time when the structure intruded into the northern margins of the Sino-Korean plate is probably at the end of Early Paleozoic based on the radiolarians *Chancelloria* (?) sp., *Variocymatiosphaera* sp. 1, *V.* sp. 2, *Pygacapsa bilaminata* in the Erbadi cherts and the microphytoplanktons *Gregalosphaera* cf. *textilophlora*, *Asteropylorus cruciporus*, *Pylosphaera* sp. found in the Kedanshan and Wudaoshimen cherts in the Ophiolite Belt on the northern side of Xar Moron River which are similar in biotic appearance to those in the cherts of the Ondor Sum Ophiolite Belt, Nei Monggol and the Niutitang Formation, Guizhou Province. For the reasons mentioned above, he draws a conclusion that the final suture line between the Sino-Korean and Siberian plates is not situated to Xar Moron River, but to the area between the northern side of this Ophiolite Belt and the Hegenshan Ophiolite Belt. However, the radiolarians and microphytoplanktons figured in his paper are not interpreted as real organic fossils, but probably as inorganic granules of volcanic ashes related with the volcanic activity; this kind of materials have been found in Paleozoic strata of many areas by the first author, such as, Ondor Sum of Nei Monggol, Dayangcha of Jilin, Wushan of Hebei and Jurong of Jiangsu. Recently, Lipps (1992) pointed out that these fossils may be most likely volcanic shards after he has reviewed the list and figures of six radiolarian families yielded in the cherts of the Ondor Sum Group, Nei Monggol (Peng, 1984). Thus, the forming age of the Ophiolite Belt identified from these inorganic pseudofossils has not been convincing. Three doubtful radiolarian fossils found in the Wudaoshimen cherts on the northern side of Xar Moron River are figured by Yao (1991, see Ishii, K. I., Liu X. *et al.*, (eds.) "Pre-Jurassic Geology of Inner Mongolia, China") who did not determine the names of genera and species and provide their age value. But it is very important that a sample (pl. 2, fig. 2) with obvious "mammae" structure on the outer shell is similar to *Hegleria mammilla* (Sheng et Wang) found in the Xingshuwa cherts in this paper. We also doubt that the radiolarian Sphaerellari listed by He and Shao (1983) and yielded in the cherts of the same location in Yao's paper are also interpreted as this genus. In the same book with Yao's paper, Liang R. published a entitled "The characteristics of the Ophiolite Sequence and Its Rock Associations in Central and Eastern Nei Monggol", he agrees with He and Shao's (1983) and Li's (1987) opinions concerning the forming age of the Ophiolite Belt on the northern side of Xar Moron River, and he also added to his paper an oral report provided by Chen Sen-huang (1987) from Tianjin Institute of Metallurgical Geology, Ministry of Metallurgical Industry, in which the gabbro in this region has a Rb-Sr isochron age of 570—600 Ma. Thus, he believes that the ophiolites in this region were formed in the early stage of Early Paleozoic. Although the radiolarian fauna found for the first time in the cherts of the Xingshuwa Ophiolite Belt on the northern side of Xar Moron River is lower in abundance and diversity, these fossils with distinct characters are well preserved. They consist of 14 species (including 1 conformis and 4 unnamed species) representing 11 genera and even associated with a plate-like conodont fragment which is identified by Prof. Wang Z. H. as *Mesogondollella* sp. of Middle Permian Guadalupian age. In this fauna, some genera and species of the Family Ormistonellidae and *Hegleria mammilla* of the tribe Spongentactiniini are relatively common; several forms of the Family Entactiniidae are less abundant, with one species of the Genus *Pseudoalbaillella* only individually seen. The radiolarians are identified as *Ormistonella robusta* De Wever et Caridroit, *Pseudotormentus kamigoriensis* De Wever et Caridroit, *Ishigaum trifistis* De Wever et Caridroit, *Nazarovella gracilis* De Wever et Caridroit, *N. scalae* Caridroit et De Wever, *Latentifistula similicutis* Caridroit et De Wever, *Entactinosphaera crassispinosa* Sashida et Tonishi, *Entactinia itsukaishiensis* Sashida et Tonishi, *E.* sp., *Astroentactinia* sp., *Hegleria mammilla* (Sheng et Wang) and *Pseudoalbaillella* cf. *longtanensis* Sheng et Wang. The former six species are first known in the Upper Permian Tatsuno Formation (Maizuru Group), SW Japan, and later discovered in the Middle Permian Guadalpuian cherts of Qinzhou area in Guangxi, China, Oregon of western North America, and the Philippines. The latter two species are also found in the Guadalupian cherts of the Itsukaichi area, Central Japan for the first time. *E. itsukaichiensis* is even reported from Oregon and Nevada of western North America, and western Yunnan, China. *Hegleria mammilla* is often found from the Kuhfeng Formation of Jiangsu and Anhui provinces, the "Dangchong Formation" of Renbu-Qujiang area in Guangdong, the Laba Group of Menglian area in western Yunnan, the "Kuhfeng Formation" of Liuzhou area and Permian cherts of Qinzhou area in Guangxi; it also discovered from Texas of western North America, Sicily and SE Thailand. *Pseudoalbaillella longtanensis* is first found from the Kuhfeng Formation in Longtan area of Nanjing City, and later from Jiangsu and Anhui provinces and the Guadalupian strata of SW Japan; this species has been regarded as a constituent element of the lower radiolarian zone in the Kuhfeng Formation. Ishiga (1990) renamed his *P.* sp. C. Zone *P. longtanensis* Sheng et Wang (1985) which is considered as belonging to Late Leonardian of Middle Permian. However, we do not treat *P. longtanensis* as a synonym with *P.* sp. C. Wang, Cheng and Yang (1994) suggested to replace Ishiga's *P. Longtanensis* with the *P. ishigai* (= *P.* sp. C, Leonardian Stage) Zone, while the *P. longtanensis*-*P. fusiformis* Zone was considered as a constituent element of the lower radiolarian zone of the Kuhfeng Formation (Guadalupian stage). Ishiga (1986, 1990) divides the Guadalupian radiolarians into the *Pseudoalbaillella globosa*, *Follicucullus monacanthus*, and *Fo. scholasticus* (partly) Zones of the Middle Permian Akasakan, the *Fo. bipartitus*-*Fo. charveti*, and *Neoalbaillella optima* Zones of the Kuman, and the *Neo. ornithoformis* Zone of the Late Permian Mitaian. Then, Blome and Reed (1992), following Ishiga's footsteps, separated the Guadalupian radiolarians of the Oregon area, western North America into the *Ps. globosa*, *Fo. monacanthus*, *Fo. scholasticus* and *Neo. optima* Zones and the *Neo. ornithoformis* Zone which is doubtfully attributed to the Djulfian age. Recently, Wang, Cheng and Yang (1994) also divide the Maokouan (=Guadalupian) radiolarians of South China into the *Ps. globosa*, *Fo. monacanthus*, *Fo. scholasticus*-*Fo. ventricosus*, *Fo. bipartitus*-*Fo.*

charveti and *Neo*. *optima*-*Neo*. *ornithoformis* Zones, among which the latter two zones are considered as contemporary products with different facies. The radiolarian zones mentioned above with the same contents have little difference in understandings about the age of some zones. Our idea is more consistent with Blome and Reed's (1992), but somewhat different from Ishiga's. Ishiga correlates the *Neo*. *optima* Zone to the Wuchiaping stage and the *Neo*. *ornithoformis* Zone to the Changhsing stage of South China. Japanese geologists commonly regard the Kuman stage which is characterized by the fusulinid *Lepidolina kumanensis* Zone as the Upper Permian Series. But, this fusulinid fauna is commonly found in the *Yabeina*-*Metadoeliolina* (= *Neomisellina*) Zone in the upper part of the Maokou Formation in South China; thus, the Japanese Kuman stage may correspond to the upper part of the Maokou Formation and should be regarded as the Guadalupian stage of Middle Permian Series. Although we have not discovered any zonal species in the radiolarian zones mentioned above, these fossils are interpreted as important members in the *Fo*. *scholasticus*-*Fo*. *ventricosus* Zone and the *Fo*. *bipartitus*-*Fo*. *charveti* Zone or *Neo*. *optima*-*Neo*. *Ornithoformis* Zone. Therefore this radiolarian fauna may be of the middle and late Guadalupian age which also may be regarded as the forming age of the Ophiolite Belt on the northern side of Xar Moron River. From this, we draw three conclusions as follows:

1. Based on the radiolarian fauna and conodont *Mesogondolella* sp., the Ophiolite Belt on the northern side of Xar Moron River was formed in the middle and late Guadalupian age which is also considered as the final closing time of the Mongolia Ocean and the forming time of the suture line. This Ophiolite Belt should be considered as the product of the Hercynian plate tectonic movement.

2. As a general rule, the ophiolite preserved in continental crust represents some segments of old oceanic lithosphere, and the area occupied by the youngest ophiolite is considered as the position of the collisional zone between two ancient plates. We agree to Huang *et al*. (1980), Wang (1982) and Li *et al*. (1983) who consider the Xar Moron River deep Fault as the collisional suture between the Sino-Korean and Siberian plates. The Ophiolite Belt on the northern side of the Xar Moron River does not belong to part of the northern marginal orogen of the Sino-Korean plate, but to the southern marginal orogen of the Siberian plate. Judging from such radiolarians as *Entactinosphaera* sp., *Entactinia* sp. found in the cherts of the Hegenshan Ophiolite Belt, the forming age of this Ophiolite Belt is interpreted as Late Devonian. Thus, the forming age of the Ophiolite Belts from North to South is gradually changed from older to younger. For the reason given above, we consider that the plate movement was probably from north to south.

3. The forming age and geotectonical significance suggested by the radiolarian fauna and conodont fossils found in the cherts of the Xingshuwa Ophiolite Belt are obviously different from those achievements of some researchers mentioned above based on other microfossils and isochron ages. We do not known whether they are right or wrong. To solve this problem, we hope to make systematic collections and scientific researches on the cherts of other areas in this

Ophiolite Belt and another three Ophiolite Belts (Solon Obo, Hegenshan and Ondor Sum), Nei Monggol in the near future.

Pseudoalbaillella cf. *longtanensis* Sheng et Wang

(Pl. I, figs. 5, 6)

Pseudoalbaillella longtanensis Sheng et Wang, 1985, pl. 2, figs. 3, 4; Wang, 1993b, pl. 1, figs. 3—5; Wang, Cheng and Yang, 1994, pl. 2, figs. 3, 4; Wang and Qi, 1995, pl. 1, figs. 2—5.

Ps. sp. aff. *Ps. longtanensis*; Nishimura and Ishiga. 1987, pl. 3, figs. 8—12.

Ps. sp. cf. *Ps. longtanensis*; Ishiga. Choi and Sato, 1990, pl. 1, fig. 1.

Ps. sp. aff. *Ps. elegans*; Miyamoto and Tanimoto, 1993, pl. 2, figs. 16—19.

Remarks: The shell with four pseudoabdomens is identified as a conformmis species because of the poorly preserved samples and partly broken outer shell. *Ps* sp. aff. *Ps. elegans* found in the Late Permian Olistostrome Kamoshishigawa Formation of the Chichibu Belt, SW Japan is regarded as a synonym of this species based on having four pseudoabdomens on the shell.

Range and Occurrence: Middle Permian (Early Guadalupian), Nei Monggol and South China, SW Japan.

Latentifistula similicutis Caridroit et De Wever

(Pl. I, fig. 4)

Latentifistula similicutis Caridroit et De Wever, 1986, pl. 4, figs. 4—6; Tumanda, Sato and Sashida, 1990, pl. 1, fig. 23; Wang, Cheng and Yang, 1994, pl. 3, figs. 24, 25.

L. sp. cf. *L. similicutis*; Cheng, 1989, pl. 1, figs. 13, 14, 16.

Triplanospongos sp. A; Wang and Li, 1994, pl. 3, figs. 6, 10, 11, 14.

Range and Occurrence: Middle Permian (Guadalupian), SW Japan, The Philippines, Guangxi and Nei Monggol, China.

Hegleria mammilla (Sheng et Wang)

(Pl. I, figs. 1—3)

Phaenicosphaera mammilla Sheng et Wang, 1985, pl. 3, figs. 1—8; Kozur and Krahl, 1987, fig. 7a.

Hegleria mammifera Nazarov et Ormiston, 1985, pl. 6, figs. 3—5; Noble and Renne, 1990, pl. 1, figs. 9, 10; Wang, 1991, pl. 3, figs. 5—7.

Heglerla mammilla; Blome and Reed, 1992, pl. 11, figs. 10, 12, 13; 1995, pl. 1, figs. 27, 28; Wang and Li, 1994, pl. 1, figs. 23, 24; Wang, Cheng and Yang, 1994, pl. 2, figs. 17, 18; Wang and Qi, 1995, pl. 5, figs. 1—12.

Phaenicosphaera mammifera; Catalano, Stefano and Kozur, 1989, fig. 61; 1991, pl. 6, fig. 6; 1992, fig. 6j; Kozur, 1993, pl. 2, fig. 1.

Hegleria? sp.; Sashida *et al.*, 1993, pl. 1, fig. 14.

Range and Occurrence: Middle Permian (Guadalupian); Nei Monggol and South China, Texas, Oregon, California and Nevada of westen North America, Sicily, SE Thailand.

Entactinia itsukaichiensis Sashida et Tonishi

(Pl. I, fig. 25)

Entactinia itsukaichiensis Sashida et Tonishi, 1985, pl. 1, figs. 1—10; Blome and Reed, 1992, pl. 11, figs. 2—5; 1995, pl. 1, figs. 25, 26; Feng and Liu, 1993, pl. 5, figs. 10, 11.

Range and Occurrence:: Middle Permian (Guadalupian), Central Japan, Oregon and Nevada of western North America, Nei Monggol and western Yunnan, China.

Entactinia sp.

(Pl. I, fig. 28)

Range and Occurrence: Middle Permian (Guadalupian); Nei Monggol, China.

Entactinosphaera crassispinosa Sashida et Tonishi

(Pl. I, fig. 24)

Entactinosphaera crassispinosa Sashida et Tonishi, 1985, pl. 3, figs. 6—12.

Range and Occurrence: Middle Permian (Guadalupian); Central Japan, Nei Monggol, China.

Astroentactinia? sp.

(Pl. I, figs. 26, 27)

Remarks: This unnamed species is characterized by having over 8 roddish main spines similar in shape and length. Due to the unclear internal structures of the shell, it is doubtfully classified in this genus.

Range and Occurrence: Middle Permian (Guadalupian), Nei Monggol, China.

Nazarovella scalae Caridroit et De Wever

(Pl. I, figs. 21—23)

Nazarovella scalae Caridroit et De Wever, 1986, pl. 5, figs. 3—6; Tumanda, Sato and Sashida, 1990, pl. 1, figs. 18, 19; Wang, Cheng and Yang, 1994, pl. 3, figs. 20, 21; pl. 4, fig. 18.

N. sp. cf. *N. scalae*; Cheng, 1989, pl. 4, fig. 3.

Range and Occurrence: Middle Permian (Guadalupian); SW Japan, the Philippines, Nei Monggol and Guangxi, China.

Nazarovella gracilis De Wever et Caridroit

(Pl. I, figs. 16, 17)

Nazarovella gracilis De Wever et Caridroit, 1984, pl. 1, figs. 14, 15, 17; Ishiga, 1985, pl. 2, figs. 22, 23; Caridroit and De Wever, 1986, pl. 4, figs. 9—15; Blome and Reed, 1992, pl. 13, figs. 9, 10; Miyamoto and Tonimoto, 1993, pl. 2, figs. 10—12; Feng and Liu, 1993, pl. 6, fig. 14.

N. sp. cf. *N. gracilis*; Cheng, 1989, pl. 4, fig. 4; Wang and Li, 1994, pl. 2, figs. 4, 5, 7, 8; Blome and Reed, 1995, pl. 1, fig. 12.

Range and Occurrence: Middle Permian (Guadalupian); Central and SW Japan, the Philippines, Oregon and Nevada of western North America, Nei Monggol, Guangxi and western Yunnan, China.

Ormistonella robusta De Wever et Caridroit

(Pl. I, figs. 7—9)

Ormistonella robusta De Wever et Caridroit, 1984, pl. 2, figs. 8, 9; Caridroit and De Wever, 1986, pl. 4, figs. 7, 8; Wang, Cheng and Yang, 1994, pl. 3, fig. 17; pl. 4, fig. 19.

O. sp. cf. *O. robusta*; Cheng, 1989, pl. 1, fig. 1; Wang and Li, 1994, pl. 1, figs. 19—21.

Range and Occurrence: Middle Permian (Guadalupian); SW Japan, the Philippines, Nei Monggol and Guangxi, China.

Ishigaum trifistis De Wever et Caridroit

(Pl. I, figs. 10—13)

Ishigaum trifistis De Wever et Caridroit, 1984, pl. 1, figs. 10—13, 16; Caridroit and De Wever, 1986, pl. 3, figs. 3—5; Ishiga, 1985, pl. 2, fig. 24; Blome and Reed, 1992, pl. 12, fig. 12; Miyamoto and Tanimoto, 1993, pl. 2, figs. 4, 5; Wang and Li, 1994, pl. 3, figs. 7, 15; Wang, Cheng and Yang, 1994, pl. 3, fig. 18; pl. 4, figs. 21—23.

I. sp. cf. *I. trifistis*; Sashida and Tonishi, 1986, pl. 2, figs. 4—6; Cheng, 1989, pl. 1, figs. 4, 15; pl. 3, fig. 3; pl. 4, figs. 1, 2, 5; Tumanda, Sato and Sashida, 1990, pl. 1, fig. 17.

Paronaella (?) sp. A, Takemura and Nakaseke, 1981, pl. 34, fig. 12.

Range and Occurrence: Middle Permian (Guadalupian); SW Japan, Oregon of western North America, the Philippines, Nei Monggol and Guangxi, China.

Pseudotormentus kamigoriensis De Wever et Caridroit

(Pl. I, figs. 18—20)

Pseudotormentus kamigoriensis De Wever et Caridroit, 1984, pl. 2, figs. 1—7; Garidroit and De Wever, 1986, pl. 5, figs. 7—11; Ishiga, 1985, pl. 2, figs. 20, 21; Blome and Reed, 1992, pl. 12, figs. 13—18, 21; Miyamoto and Tanimoto, 1993, pl. 2, figs. 8, 9; Feng and Liu, 1993, pl. 6, fig. 9; Wang and Li, 1994, pl. 2, figs. 13—16; Wang, Cheng and Yang, 1994, pl. 3, fig. 22.

P. cf. *P. kamigoriensis*: Tumanda, Sato and Sashida, 1990, pl. 1, fig. 5.

Range and Occurrence: Middle Permian (Guadalupian); SW Japan, Oregon of western North America, the Philippines, Nei Monggol, Guangxi and western Yunnan, China.

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图 版 I 说 明

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1—3. *Hegleria mammilla* (Sheng et Wang)　1.X120;2.X100;3.X107.

4. *Latentifistula similicutis* Caridroit et De Wever　4.X120.

5,6. *Pseudoalbaillella* cf. *longtanensis* Sheng et Wang　5,6.X134.

7—9. *Ormistonella robusta* De Wever et Caridroit　7,9.X154;8.X180.

10—13. *Ishigaum trifistis* De Wever et Caridroit　10.X167;11.X154;12.X134;13.X147.

14. *Ishigaum* sp.　14.X234.

15. *Quadriremis* sp.　15.X147.

16,17. *Nazarovella gracilis* De Wever et Caridroit　16.X234;17.X167.

18—20. *Pseudotormentus kamigoriensis* De Wever et Caridroit　18.X154;19.X147;20.X120.

21—23. *Nazarovella scalae* Caridroit et De Wever　21.X167;22.X147;23.X100.

24. *Entactinosphaera crassispinosa* Sashida et Tonishi　24.X167.

25. *Entactinia itsukaichiensis* Sashida et Tonishi　25.X147.

26,27. *Astroentactinia*? sp.　26.X154;27.X200.

28. *Entactinia* sp.　28.X167.