安徽巢湖平顶山下三叠统牙形石生物地层序列

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摘要：简要介绍安徽巢湖平顶山下三叠统牙形石生物地层研究的最新成果. 对平顶山西坡剖面 112.8 m 厚的下三叠统地层所采集的 286 件牙形石样品，经处理后获得 2 870 余枚牙形石样本，经鉴定共有 11 属 51 种. 这些属分别是 *Hindeodus*，*Isarcicella*（?），*Neogondolella*，*Neospathodus*，*Platyvillosus*，*Cratognathodus*，*Parachirognathus*，*Pachycladina*，*Ellisonia*，*Aduncodina* 和 *Cornudina*. 牙形石生物地层从老到新可划分为 9 个牙形石带：(1) *Hindeodus typicalis*—*Neogondolella planata* 带；(2) *Neogondolella krystyni* 带；(3) *Neospathodus kummeli* 带；(4) *Neospathodus dieneri* 带；(5) *Neospathodus* n. sp. C—*Neospathodus* n. sp. D 带；(6) *Neospathodus waageni* 带；(7) *Neospathodus* n. sp. M 带；(8) *Neospathodus eotriangularis* 带；(9) *Neospathodus abruptus*—*Neospathodus homeri* 带. 牙形石的组合面貌基本可与国内外其他地区牙形石带相对比. 但其中牙形石(2)，(3)，(5)，(7)，(8)带为巢湖地区首次建立. 在下三叠统菊石带控制下所建立的连续的牙形石分带对全球的三叠系阶的对比具有十分重要的意义.

关键词：牙形石；牙形石生物地层；下三叠统；安徽巢湖.
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0 引言

继全球二叠系—三叠系界线层型剖面和点(GSSP)确定在中国浙江长兴煤山后[1]，三叠系各阶界线的确定是三叠纪地层研究工作中的紧迫任务. 针对国际早三叠世建阶存在的问题，发挥我国早三叠世地质记录和二叠系—三叠系界线工作取得的优势，课题组调研了中国南方几条经典的早三叠世地层剖面后，选定安徽巢湖为重点区域，按照国际层型剖面和点的基本要求，开展了以牙形石和菊石生物地层为基础的多学科综合地层学研究. 本文旨在简单阐述巢湖地区通过下三叠统菊石带控制下而建立的连续的牙形石生物地层序列. 新的牙形石带较早期研究[2]有重要改进，文章中出现的牙形石新种和亚种及详细剖面描述将另文报道.

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1 地质背景

巢湖地区完整出露的海相三叠系剖面主要见于平顶山—马家山向斜的两翼及核部等地. 由于印支运动，扬子板块和华北板块发生碰撞成为一体. 在古地理位置上，巢湖位于下扬子地台北部边缘的较深的残留盆地，由于其特殊的古地理位置和重要的地质意义，不少学者对其进行了研究. 巢湖剖面在 1970 年由安徽区域地质调查队首次研究，确立了基本的地层格架. 郭佩霞和徐家聪[3]、丁梅华[2]分别在马家山剖面建立了 6 个菊石带及 6 个牙形石带；Ding 等[4]、童金南[5]分别从生态地层学、综合地层学讨论了马家山剖面早三叠世层序地层；Zhao 等[6]，Tong 等[7]分别从生物地层角度、同位素地层角度，讨论了巢湖地区印度阶、奥伦尼克阶界线等问题.

平顶山西坡剖面位于巢湖市西北约 5 km，南距马家山剖面约 2 km，交通方便[6]. 剖面露头为巢湖水泥厂矿山修路所掘，出露下三叠统厚度为112.8 m，露头完整，地层连续，层序清楚，化石相当丰富. 2000

年,笔者在巢湖地区实测了下三叠统 4 条剖面[6],系统密集地采集了菊石、双壳类及牙形石样,并在随后几年间多次补充采集化石标本和样品. 经室内研究,在殷坑组、和龙山组和南陵湖组中发现极其丰富的牙形石,尤其在殷坑组中部首次发现有重要地层意义的牙形石 *Neospathodus waageni*(以往发表的文章记载均在和龙山组及南陵湖组下部).

2　样品采集处理

平顶山西坡剖面牙形石样分多批次采集,第一批样品平均间距在 0.5 m 左右,以了解本剖面牙形石序列的基本情况. 第二批采集在第一批的基础上采用内插加密采样,除第 30～36 层 19.6 m 的泥岩夹少量透镜状灰岩外,平均采样间距在 20～30 cm 之间. 但对印度阶与奥伦尼克界线附近,即第 24 层和第 25 层,平均间距在 3～6 cm 之间. 样品质量在印度阶与奥伦尼克阶附近为 5 kg,其他平均样重为 2～3 kg. 286 件样品中有 172 件产丰富的牙形石,共获牙形石 2 870 余枚. 经鉴定共计 11 属 51 种. 这些属分别是 *Hindeodus*, *Isarcicella*(?), *Neogondolella*, *Neospathodus*, *Platyvillosus*, *Cratognathodus*, *Parachirognathus*, *Pachycladina*, *Ellisonia*, *Aduncodina* 和 *Cornudina*. 经研究将其划分为 9 个牙形石带,从而基本上建立完善了这一剖面的下三叠统牙形石动物群序列.

3　化石带及对比

根据巢湖平顶山剖面牙形石逐层产出情况,将下三叠统牙形石分为如下牙形石带及亚带:1. *Hindeodus typicalis*－*Neogondolella planata* 带;2. *Neogondolella krystyni* 带;3. *Neospathodus kummeli* 带;4. *Neospathodus dieneri* 带;5. *Neospathodus* n. sp. C*－*Ns.* n. sp. D* 带;6. *Neospathodus waageni* 带;7. *Neospathodus* n. sp. M* 带(*为本次研究所识别之新种,由于时间关系,暂未命名);8. *Neospathodus eotriangularis* 带(为本次研究所建立的新种);9. *Neospathodus abruptus*－*Neospathodus homeri* 带. 其中 *Neospathodus dieneri* 带又分为 3 个亚带,由下往上分别是 *Neospathodus dieneri* Type 1 亚带,*Neospathodus dieneri* Type 2 亚带和 *Neospathodus dieneri* Type 3 亚带. *Neospathodus dieneri* 三种类型的区别主要根据主齿和其相邻的牙齿的长度. 从剖面上化石分布来看,*Neospathodus dieneri* 三种类型是连续的,且都上延到 *Neospathodus waageni* 带. 目前,*Neospathodus dieneri* 三种类型在世界其他地区亦能分离出来.

第 6 化石带 *Neospathodus waageni* 带,亦能分为 3 个亚带,由下而上分别为 *Neospathodus waageni eowaageni* 亚带,*Neospathodus waageni elongata* 亚带及 *Neospathodus waageni waageni* 亚带(*Neospathodus waageni waageni* 为 Sweet(1970)所描述的正型标本,*Neospathodus waageni eowaageni*, *Neospathodus waageni elongata* 为本次研究所建立的新亚种).

根据巢湖剖面所产的牙形石化石的组合特点和它们共生的菊石化石,巢湖平顶山剖面所建立的牙形石带可与国内外下三叠统的牙形石带很好地对比(表 1). *Hindeodus typicalis*－*Neogondolella planata* 带,相当于巴基斯坦盐岭地区及印度 Spiti 地区 *H. parvus* 带及 *I. staeschei* 带下部[9]. *Ng. krystyni* 带对应于 *I. staeschei* 带上部和 *H. postparvus* 带[9]. *Neospathodus kummeli* 带和 *Neospathodus dieneri* 带能与 Sweet(1970)在巴基斯坦所建的同名化石带相对比[8];*Ns.* n. sp. C－*Ns.* n. sp. D 带大体对应于印度卡什米亚古鲁尔谷剖面 *Neospathodus cristagalli* 带;*Neospathodus waageni* 带大致对应于北美 *Neospathodus waageni* 带中的 D、E、F 亚带[10](表 1);*Ns.* n. sp. M 带对应于北美 *Ng. milleri* 带[11]; *Neospathodus eotriangularis* 带及 *Neospathodus abruptus*—*Neospathodus homeri* 带相当于阿曼或加拿大西部盆地 *Ng.* aff. *sweeti* 带或 *Neospathodus crassatus* 带和 *Icriospathodus collinsoni* 带的一部分[12]. 牙形石 *Neogondolella krystyni* 带;*Neospathodus kummeli* 带;*Neospathodus* n. sp. C—*Neospathodus* n. sp. D 带;*Neospathodus* n. sp. M 带和 *Neospathodus eotriangularis* 带为巢湖地区首次建立. 该剖面在下三叠统菊石带控制下所建立的连续的牙形石分带对全球标准的三叠系阶的对比具有十分重要的意义.

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表1 几条全球下三叠统剖面菊石和牙形石带或牙形石动物群对比

Table 1 Correlation of Lower Triassic biochronostratigraphy showing intercalibration of ammoniod and conodont zones and faunas over the world

series	stage	substage	Ammonioid Zones: Arctic and western Canada [12~15]	Ammonioid Zones: Idaho [13,16]	Ammonioid Zones: South China	Ammonioid Zones: This paper	Tethyan Realm Conodont Zones: Pakistan [8,17]	Tethyan Realm Conodont Zones: Kashmir Guryul Ravine [18]	Tethyan Realm Conodont Zones: Spiti Lalung [19]	Tethyan Realm Conodont Zones: Nepal Thakkhola [20]	Tethyan Realm Conodont Zones: Nepal Central Polpo [21]	Tethyan Realm Conodont Zones: USA [11,22]	Boreal Realm Conodont Zones: Canada [14]	Tethyan Realm Conodont Zones: Nyalam, Tibet [23,24]	Tethyan Realm Conodont Zones: Eastern Yunnan, western Guizhou and northern Guangxi [25~27] basinal facies	Tethyan Realm Conodont Zones: Eastern Yunnan, western Guizhou and northern Guangxi [25~27] platform facies	Tethyan Realm Conodont Zones: Eastern Yunnan, western Guizhou and northern Guangxi [25~27] platform margin facies	Tethyan Realm Conodont Zones: Upper Yangtze region [28]	This Paper
Lower Triassic	Olenekian	Spathian	*Subrobustus*	*Prohungarites mckelvei*	*Subcolumbites*		*Jubata* 12	*Homeri/ spathi*	*Elongata*	*Jubata*	Fauna 9	*Jubata*	*Symmetricus* / *Regale*	*Jubata*	*Jubata*	*Jubata*	*Homeri-*	*Homeri-*	
			Pilaticus	*Columbites parisianus*	*Columbites/ Tirolites*								*Triangularis* / aff. *Taimyrensis*						
				Tirolites harti			*Jubata* 11	*Jubata*				*Collinsoni*	*Collinsoni* / *Elongata*		*Collinsoni*	*Collinsoni*	*Triangularis*	*Triangularis*	*Abruptus/ Homeri*
							10					H / I	*Crassatus* / aff. *Sweeti*	*Triangularis*	*Homeri-Triangularis*	*Homeri-Triangularis*			*Eostrianglaris*
		Smithian	*Tardus*	*Anasibirites*	*Anasibirites Owenites*	*Anasibirites*	9	*Waageni*	*Waageni*	*Milleri*	Fauna 8 / Fauna7	*Waageni* G	*Waageni* / *Milleri*	*Milleri*	*Milleri*	*Delicatulus-Waageni-Pachycladina*	*Waageni*	*Parachirognathus-Pachycladina-Waageni*	*Ns*.n.sp.M
			Romunduri	*Meekoceras*	*Flemingites*	*Euflemingites /Flemingites*	8				Fauna 6	F	*Meeki*	*Waageni*	*Waageni*				R
				gracilitatis			7				Fauna 5	E			*Conservativus*				
			Hedenstroemi				*Pakis-tanensis* 6		*Pakistanensis /Nepalensis*		Fauna 4	D	*Nepalensis* / *Pakistanensis*	*Pakistanensis*	*Pakistanensis*		cf. *Pakistanensis*		Q
																			P
	Induan	Dienerian	*Sverdrupi*	*Kymatites* /	*Prionolobus/*	*Prionolobus/*	*Cristagalli*5	*Cristagalli*	*Cristagalli*	*Kummeli-Cristagalli*	Fauna 3	*Dieneri*	*Dieneri*	*Cristagalli*	*Cristagalli*	*Pakistanensis-Costatus-Cristagalli*	*Cristagalli*	*P. costatus*	*Ns*.n.sp.C/ *Ns*.n.sp.D
											Fauna 2								
			Candidus	*Xenodiscoides*	*Gyronites*	*Gyronites*	*Dieneri* 4	*Dieneri*	*Dieneri*					*Dieneri*	*Kummeli-Dieneri*	*Erromera-Dieneri*	*Dieneri*	*Dieneri*	*Dieneri* O / L / K
							Kummeli 3	*Kummeli*	*Kummeli*		Fauna 1	*Kummeli*	*Kummeli*	*Kummeli*					*Kummeli*
		Griesbachian	*Strigatus*		*Ophiceras/*	*Ophiceras/*	*Carinata* 2	*Carinata*	*Discreta*	*Carinata*		*Typicalis* C	*Peculiaris* / *Discreta*	*Carinata*	*Carinata*	*Carinata*		*Carinata Planata*	*Krystyni*
			Commune	*Ophiceras*	*Lytophiceras*	*Lytophiceras*		*Isarcica*	*Krystyni*	*Typicalis*			*Carinata* / *Krystyni*	*Isarcica*	*Isarcica*	*Isarcica*		*Isarcica*	
			Boreal				*Typicalis* 1	*Parvus*	*Meishanensis*			B	*Taylorae-Parvus* / *Meishanensis*	*Parvus*	*Parvus*	*Parvus*	*Parvus*	*Parvus*	*Typicalis/ Planata*
			Concavum																

7. Parachirognathodus-Furnishius; 8. Conservativus; 9. Milleri; 10. Platyvillosus; 11. Neospathodus n. sp. G; 12. Jubata; Subzone B. Isarcica; Subzone C. Carinata; SubzoneD. Triserratus; Subzone E. meeki; Subzone F. Ethingtoni; Subzone G. Milleri; H. Triangularis; Subzone I. Triangularis; Subzone J. Platyvillosus; Subzone K. Dieneri Type 1; Subzone L. Dieneri Type 2; Subzone O. Dieneri Type 3; Subzone P. Waageni eowaageni; Subzone Q. *Waageni elongata; Subzone R. Waageni waageni*

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Lower Triassic Conodont Biostratigraphical Sequence at West Pingdingshan Section, Chaohu, Anhui Province, China

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Abstract: The authors provide a brief introduction on the Lower Triassic conodont zonation at West Pingdingshan Section, Chaohu, Anhui Province, China. Rich conodont fossils have been extracted from 172 productive samples in 286 analyzed samples, from the Lower Triassic Yinkeng, Helongshan, and the lower part of Nanlinghu Formation exposed at the section of 112.8 m thick. The extracted 2 187 conodont elements include 51 stratigraphically significant species referable to 11 genera: *Hindeodus*, *Isarcicella*(?), *Neogondolella*, *Neospathodus*, *Platyvillosus*, *Cratognathodus*, *Parachirognathus*, *Pachycladina*, *Ellisonia*, *Aduncodina and Cornudina*. Nine conodont zones are recognized in ascending order as follows: (1) *Hindeodus typicalis-Neogondolella planata* Zone; (2) *Neogondolella krystyni* Zone; (3) *Neospathodus kummeli* Zone; (4) *Neospathodus dieneri* Zone; (5) *Neospathodus* n. sp. C-*Neospathodus* n. sp. D Zone; (6) *Neospathodus waageni* Zone; (7) *Neospathodus* n. sp. M Zone; (8) *Neospathodus eotriangularis* Zone; (9) *Neospathodus abruptus-Neospathodus homeri* Zone. Zones (2), (3), (5), (7) and (8) are first established and also *Neospathodus waageni* is reported for the first time from the Yinkeng Formation. Associated with conodonts also occur macrofossils such as ammonoids and bivalves, which confirm the conodont biochronostratigraphy to a certain degree.

Key words: conodont; conodont biostratigraphy; Lower Triassic; Chaohu, Anhui Province.