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## COMPETITIVE CANDIDATE SECTIONS FOR THE MIDDLE-UPPER CAMBRIAN BOUNDARY STRATOTYPE IN EASTERN LIAONING, NORTH CHINA

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Cambrian trilobites and biostratigraphy of the Dalian region, east Liaoning have been studied by Kobayashi (1933), Endo (1937, 1944), Wang and Lu (1954), Zhu (1959), Chang (1980), Nan and Chang (1982), Zhang and Jell (1987), Guo, Zan and Luo (1996), etc.

The Lashushan, Nahaituo, and Muopanshan (Muopan Hill) sections are well exposed. Muopan hill is the type locality of Endo's Mapan Formation. Unfortunately, the upper part of Muopan hill is broken by north- to northeast-trending and northwest-trending faults. Also, rocks containing *Damesella brevicaudata* are covered by fault mud. The Muopan hill section lacks the upper part of the Taitzu Formation and the lower part of the Kushan Formation (i.e., trilobites of the upper part of the *Damesella* Zone and the *Drepanura* Zone are missing).

The Lashushan section, located on the seacoast about 50 km south of Muopan hill, is well exposed and continuous for all Cambrian strata. The Mapan Formation is about 40 m thick, the Taitzu Formation is about 160 m thick, the Kushan Formation is about 60 m thick, and the Changshan Formation is about 40 m thick (Table 1).

There are many polymeroid and agnostoid trilobites in the Lashushan section. The agnostoid trilobites are well preserved and easy to find in the middle Middle Cambrian upper Tangshih Formation (Hsuehuangian Stage) and in the upper Cambrian. Most of the agnostoid trilobites occur together with polymeroid trilobites. The agnostoid stratigraphic sequence is clear and can be correlated in detail with the polymeroid trilobite zones of North China and with some agnostoid trilobite zones in South China and other slope facies sequences.

The Nahaituo section, located about 20 km northeast of Mapanshan, is richly fossiliferous, easily accessible, excellently exposed, and continuous. The rocks contain abundant polymeroids and agnostoids. The thickness of this section is the same as that of the Lashushan section (Table 1).

We made a systematic study of the Cambrian trilobite faunas (including both polymeroid

and agnostoid assemblages) and stratigraphic sequences in the Lashushan and Nahaituo sections in eastern Liaoning (eastern edge of the North China platform). Discussed in the present paper are the upper Middle and lower Upper Cambrian sequence, agnostoid biostratigraphy, and the Middle-Upper Cambrian boundary. We also correlate the upper Middle and lower Upper Cambrian trilobite zones in eastern Liaoning with zones in other regions of China as well as with zones in Australia, southern Kazakhstan, Sweden, and North American.

The Lashushan and Nahaituo sections in east Liaoning are richly fossiliferous, with both polymeroid and agnostoid trilobites, are easily accessible, moderate thick, structurally simple, and well and continuously exposed. For these reasons, we regard the Lashushan and Nahaituo

**Table 1. Correlation of the upper Middle and lower Upper Cambrian trilobite zones and agnostoid trilobite biostratigraphic position in East Liaoning.**

Series	NORTHEAST CHINA PROVINCE			
	Stage	Fm.	Polymeroid Trilobite Zone	Agnostoid Trilobite Biostratigraphic Position
Upper Cambrian	Changshanian	Paishan	<i>Chuanguia</i>	<i>Ps. (Ps.) chinensis</i>
Middle Cambrian.	Kushanian	Kushan	<i>Drepanura</i>	<i>Proagnostus bulbosus</i>
			<i>Blackwelderia</i>	<i>Formosagnostus formosus</i>
	Changshanian	Taitzu	<i>Damesella paronai</i> <i>Damesella brevicaudata-Yabeia</i>	<i>Kormagnostus seclusus</i> <i>Ammagnostus nanhaitoensis</i>
			<i>Liopeshania</i> <i>Redlichaspis</i> <i>Taitzuia-Poshania</i> <i>Amphoton</i>  <i>Crepicephalina</i>	<i>Tomagnostella sulcifera interger</i> <i>Peronopsis shandongensis</i> <i>Iniospheniscrus nodai</i>  <i>Peronopsis ozakii</i>
Mapan		<i>Eosoptychoparia-Manchuriella</i>	<i>Ptychagnostus sinicus</i> <i>Baltagnostus rakuroensis</i>	

sections as the most competitive candidate sections for the Middle-Upper Cambrian Boundary Stratotype.

The present Cambrian Subdivision International Tie-Points for Cambrian series and stages, proposed by the Cambrian Subdivision Working Group, are based mainly on agnostoid trilobites, which occur mainly in slope facies or in deep-water deposits. But the Cambrian System also contains extensive shallow-water platform facies. Therefore, when we search for Global Boundary Stratotype Sections and Points for stages and series, we must pay attention to shallow-water platform sequences. We should choose trilobites or other fossils that are present not only in slope facies or deep-water deposits, but also in shallow-water deposits.

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