62. Ordovician Cephalopods in Hwangho Basin, Eastern Asia

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In geology of Eastern Asia the Tsinling-Seoul (Keijo) line is the biogeographic boundary of prime importance. In the Ordovician period the northern fauna was intimately related to the Arcto-American fauna, while the southern fauna reveals close affinity to the European-Australian one, as pointed out in 1930. The northern area covering North China, South Manchuria and North Korea was called "Hwangho basin" (1943).

In the Taitzuho region, South Manchuria, three stages of cephalopod evolution in the Ordovician period were distinguished, namely the Wanwanian ellesmeroceroid age, the Wolungian piloceroid (better to say, manchuroceroid) age and the Toufangian actinoceroid age (1931a). Recently a larger part of the Wanwanian cephalopods (1933) was found late Upper Cambrian age (Chen and Teichert, 1983). While the siphuncular bulb is well developed among the Cambrian ellesmeroceroids, it is absent in the basal Ordovician ones. *Ectenolites* is a survivor in the Yehli formation at Luan-hsien, Hobei (Obata, 1940). The Yehli fauna is now amplified with eight genera including three new genera. Among *Anguloceras*, *Cumberloceras*, *Dakeoceras*, *Woosteroceras* and *Barnesoceras* from the Taihang Mountains, last four genera warrant the Gasconadian age of this fauna (Chen *et al.*, 1980). These genera belong to either the Ellesmeroceratidae or the Bassleroceratidae in the Ellesmeroceratida except for *Proterocameroceratina* of the Proterocameroceratidae in the Endoceratida.

The occurrence of "*Ellesmeroceras*" cf. *elongatum* together with *Archaeoscyphia chihliensis* at Sangok-myeon near Kowoon, North Korea indicates the transition from Wanwanian to Wolungian (1931b). The typical Wolungian cephalopods of the Hwangho basin are *Manchuroceras*, *Coreanoceras*, *Chihlioceras* and *Parapiloceras* whose siphuncle is highly complicated by organic deposits, usually thick on the ventral side. A unique phragmacone of *Coreanoceras kemipoense*'s conch (pl. 8, fig. 1, 1931b) shows that septal distance is very short; camerate portion occupies about a half of shell diameter and contains no deposit. Hence the part is easily destructive. *Hardmanoceras* is an important associate for interprovincial correlation. The fauna is approximately correlated to the middle-late Canadian (Chen *et al.*, 1980).

Various actinoceroids constitute the dominant group of the Middle Ordovician Toufangian fauna in which subgroups can be distinguished. *Polydesmia* and *Ordosoceras* of the Polydesmiidae are two keys to the Maruyaman fauna which corresponds to the Whiteriverian one (1940, 1977). Remarkably enough, their siphuncles reveal double structure of outer nummuli and inner sheathes. They are accompanied by *Wutinoceras* which is an armenoceroid appeared slightly earlier at the transition from Wolungian to Toufangian. Another associate is *Stereoplasmoceras* which appeared simultaneously or even a little earlier and survived through the Toufangian age.

The Maruyaman fauna was succeeded by the so-called Machiakou fauna by

Grabau (1922) in which different species of *Armenoceras* and *Ormoceras* have appeared and disappeared one after another. *Discoactinoceras* and *Tofangoceras* are common in the later stage. *Gonioceras* is one of the latests whose age is Trentonian.

Thus actinoceroids constitute the main group of the Tofangian cephalopods. Their conchs are mostly orthocones and *Cyrtactinoceras* is an exception. The siphuncle varies in size. It is narrow and subcentral in *Ormoceras*. In eury-siphonate ones the siphuncle is submarginal on the ventral side. *Armenoceras* is the leading member whose siphuncle is large. Not only nummuli but also intracamerall deposits are well developed.

Judging from the shell structure manchuroceroids as well as eury-siphonate actinoceroids are quite unsuitable for quick motion and presumably incapable of swimming. In view of their heavy shells, the former was a vagile benthos and the latter a sluggish vagile benthos. In other words they were brought to birth by benthonic adaptation.

Manchuroceras, *Parapiloceras* and *Hardmanoceras* occur at Daiyangsha and *Armenoceras*, *Ormoceras* and *Tofangoceras* at Wangou, both in Hunjiang region, Jilin (Liang, 1981), and *Armenoceras* at Shuo-hsien (1941) and *Ectenoceras*, *Coreanoceras* and *Discoactinoceras* in three horizons at Qingshueihe near Shansihe, Inner Mongolian border (Zou, 1981). These occurrences define the eastern and western limits of the Hwango basin. Gypsum deposits are found in the Tofangian formation around Taiyuan, Central Shansi are considered evaporites in shallow lagoon or embayment in the western margin of the Hwangho basin (Obata, 1940). Thus "Ordos" land or island is assumable out of the facts.

In Zuoxi Mountain (Chaotzushan), West Ordos are distinguished in six zones, namely *Pseudowutinoceras* (1), *Parakogenoceras* (2), *Polydesmia* (3), *Ordosoceras* (4), *Pomphoceras-Dideroceras* (5) and *Eurasiaticoceras-Sheshanoceras* (6) zones among which the 3 and 4 zones are Maruyaman and the 6 assemblage is upper Trentonian. The *Liulinoceras-Kotoceras* and *Teichertoceras-Westonoceras* assemblages are known from Yaoxian district, Shaanxi, where the former is correlated to the Chikunsan fauna of South Korea and the latter is upper Trentonian in age (Chen and Zou, 1984).

In the Kilianshan to the west four horizons containing (1) *Manchuroceras* and *Wutinoceras*, (2) *Wutinoceras*, *Armenoceras* etc., (3) *Wutinoceras*, *Linormoceras* etc. and (4) *Discoceras verbeeki* are reported (Chang, 1965). *Sigmorthoceras*, *Wutinoceras*, *Discoceras* and *Rhynchorthoceras* are found in the Mt. Altun area on the Qinghai and Xijiang border (Lai and Wang, 1986). In further west in Tianshan the *Sinoceras rudum* limestone and the *S. chinense* limestone were found in the Saergan series of Kelpin (Chang *et al.*, 1959). Now various Ordovician cephalopods are reported from different horizons in Xijiang among which the oldest is *Ellesmeroceras holmi*. *Dideroceras*, *Chisiloceras*, *Michelinoceras* and *Steroplasmoceras* belong to the second group and *Trocholites*, *Discoceras*, *Sinoceras chinense* and so forth are in the third group. These cephalopods of the trans-Ordos and Xijiang regions show as a whole the mixing of the Hwangho and Yangtze faunas and become stronger in the latter region.

Finally it is noted that *Discoceras*, *Nybyoceras* and *Troedssonoceras* occur in Upper Ordovician rocks in Kazakstan (Barskov, 1972), although little as yet known of Palaeozoic cephalopods of Mongolia. Upper Ordovician ones were found there recently but undescribed (Zhuravleva, 1978).

References

- Barskov, I. S. (1972): Late Ordovician and Silurian cephalopod molluscs of Kazakstan and Middle Asia. 94 pp., 12 pls.
- Chang Jih-tung (1962): Some cephalopods from the Middle Ordovician from Huanhsien in Kansu. *Acta Paleont. Sinica*, **10**(4), 514-517, 1 pl.
- (1965): On some Lower Ordovician nautiloids from Qilianshan, Northwestern China. *ibid.*, **13**(2), 343-362, 2 pls.
- Chen Junyuan (1967): Advances in the Ordovician stratigraphy of North China with a brief description of nautiloid fossils. *ibid.*, **15**(1), 55-74, 3 pls.
- Chen Junyuan and Zou Xiping (1984): Ordovician cephalopods from the Ordos Area, China. *Mem. Nanjing Inst. Geol. Palaeont., Acad. Sinica*, no. 20, pp. 33-84, 6 pls.
- Chen Junyuan *et al.* (1980): Ordovician sediments and faunas in the Taihang Mountains, North China. *ibid.*, no. 16, pp. 111-152, 6 pls.
- Gau Yueying, Lai Caigen, and Wen Yuling (1982): Nautiloidea, pp. 187-208. *Palaeontological Atlas of Northwest China, Shaanxi-Gansu-Ningxia Volume, Part 1. Precambrian and early Paleozoic*. 480 pp., 106 pls., 4 tables.
- Grabau, A. W. (1922): Ordovician fossils from North China. *Palaeontol. Sinica*, ser. B, **1**, Fasc. 1, 127 pp., 9 pls.
- Kobayashi, T. (1930): Cambrian and Ordovician faunas of South Korea and the bearing of the Tsinling-Keijo Line on Ordovician palaeogeography. *Proc. Imp. Acad.*, **6**, 423-426.
- (1931a): Studies on the stratigraphy and palaeontology of the Cambro-Ordovician Formation of Huo-lien-chai and Niu-hsin-tai, South Manchuria. *Japan. J. Geol. Geogr.*, **8**, 131-189, pls. 16-23.
- (1931b): Studies on the stratigraphy and paleontology of North Korea with notes on the Ordovician fossils of Shantung and Liaoning. *Bull. Geol. Surv. Chosen (Korea)*, **11**, no. 1, 60 pp., 9 pls.
- (1933): Faunal study of the Wanwanian (Basal Ordovician) Series with special notes on the Ribeiridae and the Ellesmeroceroids. *J. Fac. Sci. Imp. Univ. Tokyo*, sec. 2, **3**(2), 249-328, 10 pls.
- (1936): *Coreanoceras*, one of the most specialized Piloceroids and its benthonic adaptation. *Japan. J. Geol. Geogr.*, **13**, 185-195, pls. 22-23.
- (1940): *Polydesmia*, an Ordovician Actinoceroid of Eastern Asia. *ibid.*, **17** (1-2), 27-44, pls. 3-5.
- (1941): On some Ordovician nautiloids from Shuo-hsien in the Chinpei region, Menchiang (Sino-Mongolian Borderland). *ibid.*, **18**, 457-460, pl. 10.
- (1977): An occurrence of *Ordosoceras* in Jehol, Northeast China and a note on the Polydesmiidae. *Trans. Proc. Paleont. Soc. Japan*, N.S. no. 107, pp. 125-134, pls. 17-16.
- (1978): *Discoactinoceras* and the Discoactinoceratidae, *Fam. Nov.* *ibid.*, no. 109, pp. 223-234, pls. 31-32.
- Kobayashi, T., and Matsumoto, T. (1942): Three new Toufangian nautiloids from Eastern Jehol. *Japan. J. Geol. Geogr.*, **18**(4), 313-317, pls. 30-31.
- Lai Caigen and Wang Mingqian (1986): Ordovician cephalopods from Mt. Altun Area, N.W. China. *Acta Pal. Sinica*, **25**(3), 248-258, 2 pls.
- Liang Zhonfa (1976): Nautiloidea, pp. 325-331. *Palaeontological Atlas of North China, Fasc. Inner Mongolia. Paleozoic.*, 502 pp., pls.
- (1981): Ordovician cephalopods from Hunjiang region of Jilin and Northern Neimongol. *Acta Pal. Sinica*, **20**(5), 393-399, 2 pls.
- Obata, T. (1939): *Parapiloceras*, a new Asiatic Piloceroid from North China. *Jubilee Publ. Prof. H. Yabe's 60th Birthday*, pp. 255-260, pl. 18.
- (1939-1940): Studies on the Ordovician Limestone in North China, 1-4. *J. Shan-hai Sci. Inst.*, sec. 2, **9**, 89-110, 273-286, 293-302, 303-318, pls. 7-10, 34-40.

- Obata, T. (1956): Ordovician cephalopod zones in North China. Sci. Rep. Aichi Gakugei Univ., **5**, 50-56.
- Wang Mingqing (1981): Cephalopoda, pp.115-134. Palaeontological Atlas of Northwest China. Xijiang Weiwuer Autonomic Province. Fasc. 1, 332 pp., 92 pls.
- Zhuravleva, F. A. (1978): Some Mongolian early and middle Paleozoic cephalopods. Paleont. Zhur., 1978, no. 4, pp. 67-76; Trans., **12**, no. 4, 484-492.
- Zou Xiping (1981): Early Ordovician nautiloids from Qingshuihe, Nei Mongol (Inner Mongolia) and Pianguan, Shaanxi Province. Acta Pal. Sinica, **20**, no. 4, 353-362, 2 pls.