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The Middle Ordovician Micro Crinoids Stem Fossils from Phyongnam Flexure of Korea

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Abstract We reported the Middle Ordovician Micro Crinoids Stem Fossils from Phyongnam flexure, of Korea. In addition, we reported the extraction method of microcrinoids stems fossils and have determined geological age of the research stratum by the conodont with Microcrinoids Stem Fossils. These fossils are very significant in the determination of the process evolution of crinoids and geological age of limestone, Ordovician biofacies.

Key words Middle Ordovician, crinoids, microfossil, limestone, Mandal formation

Introduction

Among many fossils of paleontology, the crinoids are the fossils that are known a lot in the marine strata from the Paleozoic era to the present age, but the studying data are less than other fossils of paleontological branch.

Until now, in our country, except to be studied fragmentally on the upper Ordovician, Silurian and Devonian crinoids stem fossils at the defined areas, the study on the Paleozoic crinoids stem fossils are not almost studied.

There are data that are described the literatures about some crinoids stem fossils of Carboniferous period, but there are not data that described contents in detail.

Micro crinoids samples were collected from Unhak member of Mandal Formation in Sungho area.

1. Study on the Middle Ordovician Strata of Pyongnam Flexure.

The stratigraphical and paleontological study of Paleozoic era in Phyongnam flexure areas of our country have been progressed for a long time by many researchers [2, 3].

In 1919, a researcher studied the lower Paleozoic strata of several areas such Phyongnam south coal field of our country and named the Middle Ordovician strata of Mt. Mandal area “Mandal Formation”.

After that, by several researchers the Middle Ordovician strata of Mt. Mandal area were divided into some strata.

They were divided the Middle Ordovician strata with Kwangjong member, Mandal member, Unhak member and Namchang member from the bottom to the top.

In our country, after liberation, under the wise leadership of the great leader and our Party, the geological exploration of scale 1∶50 000 and scale 1∶200 000 were progressed generally.

As the studying results, the mass of Kwangjong member, Mandal member and Unhak member that consisted of mainly limestone named "lower limestone strata", and Namchang member that was layered at the top and consisted of mainly dolomite named "upper dolomite strata".

In addition, 30 species including Cephalopods, Gastropods, Brachiopods and Bryozoans fossils were found in the section of Mandal Formation of Unhak valley in Gwangjong-ri.

In 1960s, *Neuropteris gigantea* and *Lepidodendron* sp. were found at the black argillite that was placed in lower horizon of Namchang dolomite strata at the Hwanggyong valley in Sungho County.

And in 1970s, *Fusulina* fossils were newly known at the limestone lens of up and down of the black clay slate.

So the opinion that was going to illustrate differently the age of this strata, but researchers considered it structurally from the strike extension of strata that fossils were known and the character of paleontological fossils clusters [3].

Like this, the studying history of Mandal Formation is older than other, but the boundary problem is not yet resolved completely.

In "Geological composition of Korea"(2) that was published in 1990, authors described about the Middle Ordovician strata of researching area as follows [3, 4].

Mandal Formation that is called the Middle Ordovician strata of researching area is distributed in small square measure relatively at the south and north wings of Sungho-Samdung region.

Mandal Formation is divided into the lower limestone strata and upper dolomite strata by the fossil data and section character in the studying area.

You can see the standard section of the Middle Ordovician at Sungho County Kwangjong-ri.

Here, Mandal Formation is placed conformity on the marlite bed, upper part of Singok Formation, and is covered unconformity by clay slate bed of the red bean color.

The upper section of the lower limestone strata of the Unhak valley at Sungho County Kwangjong-ri is from down to up as follows.

Grey limestone (20m)

There are Cephalopods and Gastropods fossils.

Grey dololimestone (20m)

There are Cephalopods and Gastropods fossils.

Black-grey marlstone (10m)

There are Brachiopods, Gastropods and Bryozoans fossils.

Black-grey limestone of including much calcite (20～30m)

There are remains of fossils.

stained and massive limestone (10～20m)

The thickness of this section is about 90～110 meters.

There are known about 30 species of fossils in these strata.

Exception this, the rocks of Mandal Formation are distributed in Kwangjong-ri, Mt. Mandal, Hwachon-dong.

In the world, the study on the stem fossils of crinoids has already been begun from long before such as other fossils, but the studying data on it can appraise to poor comparatively.

But the studying data on the anther fossils(*calyx*) of crinoids are rich comparatively.

In our country, the study on the stem fossils of crinoids was advanced fragmentally about the macro stem fossils at the upper Ordovician-Devonian.

The crinoids stem fossils of the upper Ordovician-Silurian period which had already been studied already are as follows.

Pentagonocyclicus borealis Yelt., *P. monocostatus* Stuk., *Pentagonopentagononalis kokajgyrensis* Stuk., *P. probus* Stuk., *Compositocrinus compositus*(Yelt.), *Bystrowicrinus quinquelobatus* (Yelt.), *B. angustilobatus* (Yelt.), *Obuticrinus bullosus* Yelt. et Stuk., *O. bilobatus* (Yelt.), *Ramosocrinus ramosus* (Yelt. et Stuk.), *Dentiferocrinus dividuus* (Yelt.), *D. tenuis* (Yelt.), *Cyclocyclicus* sp., *Crotalocrinites* sp., *Kstutocrinus primus* Yelt., *Gliptocrinus elegans* Yelt [2].

And the Devonian crinoids stem fossils that are presented at the reference are as follows.

Pentagonocyclicus levidensis Duba., *P. glaber* Yelt., *P. jucundus, P. paucus, P. imatschensis, P. mundus, Hexacrinites dentadus, Anthinocrinus* aff. *Floreus, Trigonotrigonalis* sp., *Tetragonotetragonalris* sp., *Tetragonocyclius* sp..

The fossils which are known on the reference as the Carboniferous crinoids stem fossils of Phyongnam flexure are *Sinocrinus* sp., *Pentagonocyclicus* sp., and so on, the crinoids fossils of Duman group *Cyclocyclicus dispariens* Duba. et Shao, *Cyclocyclicus* cf. *dentatus* Li, *Cyclocyclicus* sp., *Pentagonocyclicus* sp., *Tetragonocyclius* sp., *Cycloellipticus* sp., *Ellipsollipticus* sp. and so on [3].

Like this, among the crinoids stem fossils which are known in our country, there are no microfossils, and the described species scientifically on scientific books are less than 10 species among the macro crinoids stem fossils of the upper Ordovician-Carboniferous period.

In the areas adjoining to our country, the crinoids stem fossils were studied a little than other fossils.

2. The Extraction Method of Microcrinoids Stems Fossils

Normally microfossils were used as the very fine index fossils than macrofossils in deciding the geological age of strata, dividing and comparing strata.

That's why the study has been widely progressed worldwide and many extraction methods of microfossils were developed and used.

But the extraction method of the micro crinoids stem fossils in any scientific books hasn't been known yet.

In the course of finding conodonts fossils on the Ordovician limestone, we can newly establish the method that finds the micro crinoids stem fossils.

The method is as follows.

First, throughout the investigation on the field section we extract the limestone sample of almost 200g that is fresh than the other and wash it with clear water to dry.

Secondly, we break the sample with walnut size and put it in the plastic beaker, and pour into acetic acid of which temperature is nearly 15～25℃ and density is 10～15 percent in degree that sample can be soaked enough.

In this time, the limestone sample is resolved slowly with the chemical reaction as follows.

$$CaCO_3+2CH_3COOH=Ca(C_2H_3O_2)_2+H_2O+CO_2$$

When we repeated the course with changing the acetic acid solution, the sample in the beaker is resolved completely and only resolving remains exist.

Be careful not to throw out when acetic acid solution replaced, it could be thrown out with solution.

When reaction is all finished and only remains exist, we wash them with clear water several times.

This time, acid is removed completely and light clay material is all removed.

In the remains of washed, there are only mineral particles of which density is large than the other and organic materials (including the microfossils).

Among them, in order to remove some organic remains we pour out the hydrochloric acid solution of 3～5% in the beaker and stir up well in degree of 10～20s, then and pour out the clear water in it and remove. Then we put the remains on the plate to shallowly spread out and dry in the cool place.

After that the dry remains are observed at the microscope and microfossils found there such as the micro crinoids stem fossils.

Sometimes, conodonts are known, too.

Finding numbers of the microfossils in condition of several densities of acetic acid solution is different.

Table. A number of micro crinoids stem fossils in the different condition

Sample	Density of solution/%			
	10	12	15	20
Sample 1(200g)	18	30	37	12
Sample 2(150g)	14	23	33	9
Sample 3(150g)	11	28	32	5

As seen in this table, the typical density is 10～15%.

On the basis of the extraction method like this, we have got many micro crinoids stem fossils at the limestone of Mandal Formation around Kwangjong-ri in Sungho County and have considered their distribution state as the sections [1].

3. Characters of the Middle Ordovician Micro Crinoids Stem Fossils.

Micro crinoids stem fossils that we found from the research area consists of all 20 species of 7 genuses (Fig. 1).

The schematic geological map of the research area is as Fig. 2.

The distribution characters of the microcrinoids stem fossils which are known in the research area are as follows.

First, the micro crinoids stem fossils are appeared in same rate almost at any limestone of Unhak member of Mandal Formation.

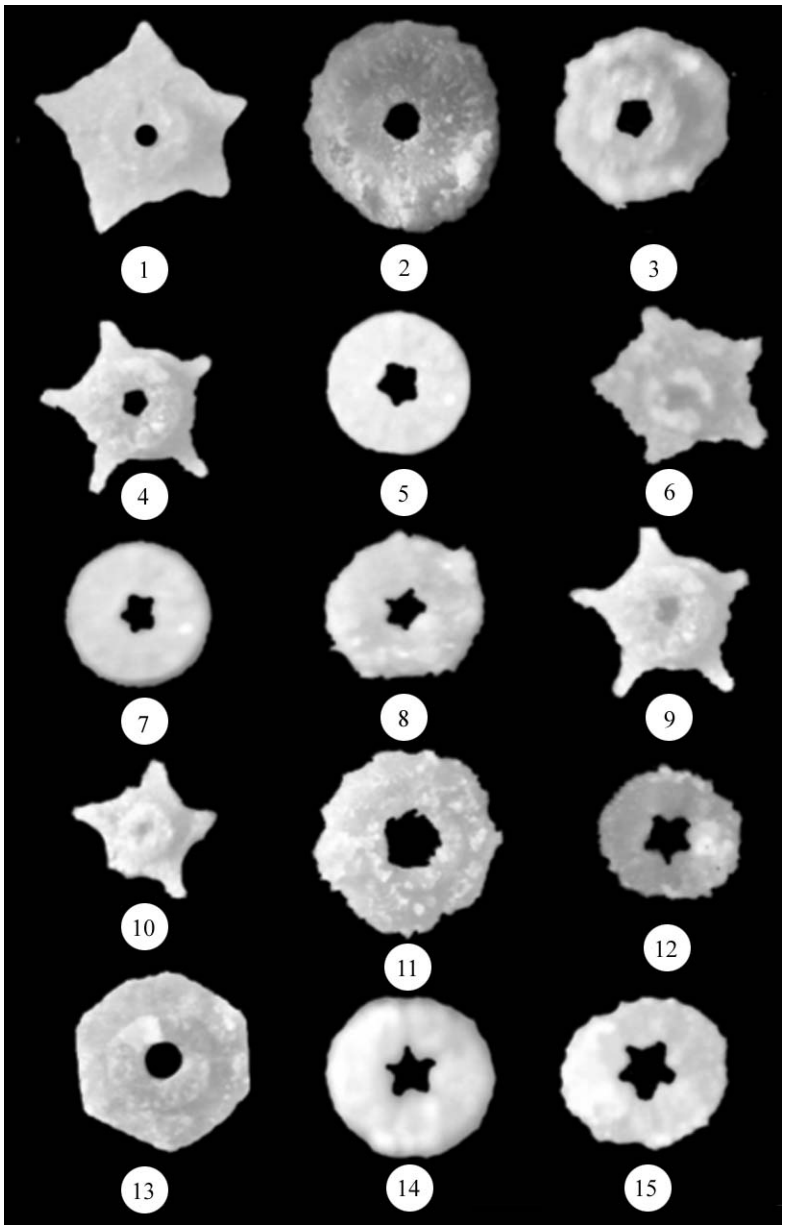

Fig. 1. Explanation of plates

1－*Asterocrinus munsteri* Eich., ×72, No. 08－ㅅ－39, 2－*Pentagonocyclicus biplex* Yelt., ×82, No. 08－ㅅ－40, 3, 11－*Pentagonocyclicus monile* (Eich.), ×84, No. 08－ㅅ－15, 4, 9－*Schizocrinus vainikensis* Hynda et Saladzhius, ×86, No. 08－ㅅ－30, 5, 7－*Grammocrinus lineatus* Eich., ×76, No. 08－ㅅ－7, 7－1, 6－*Asterocrinus munsteri* Eich., ×75, No. 08－ㅅ－16, 8, 12－ *Pentagonocyclicus pentaporus* (Eich.), ×84, No. 08－ㅅ－3, 10－*Schizocrinus kukersiensis* Yelt., ×82, No. 08－ㅅ－22, 13－*Pentagonocyclicus bifidus* Yelt., ×84, No. 08－ㅅ－12, 14, 15－*Pentagonocyclicus pentaporus* (Eich.), ×84, No. 08－ㅅ－3

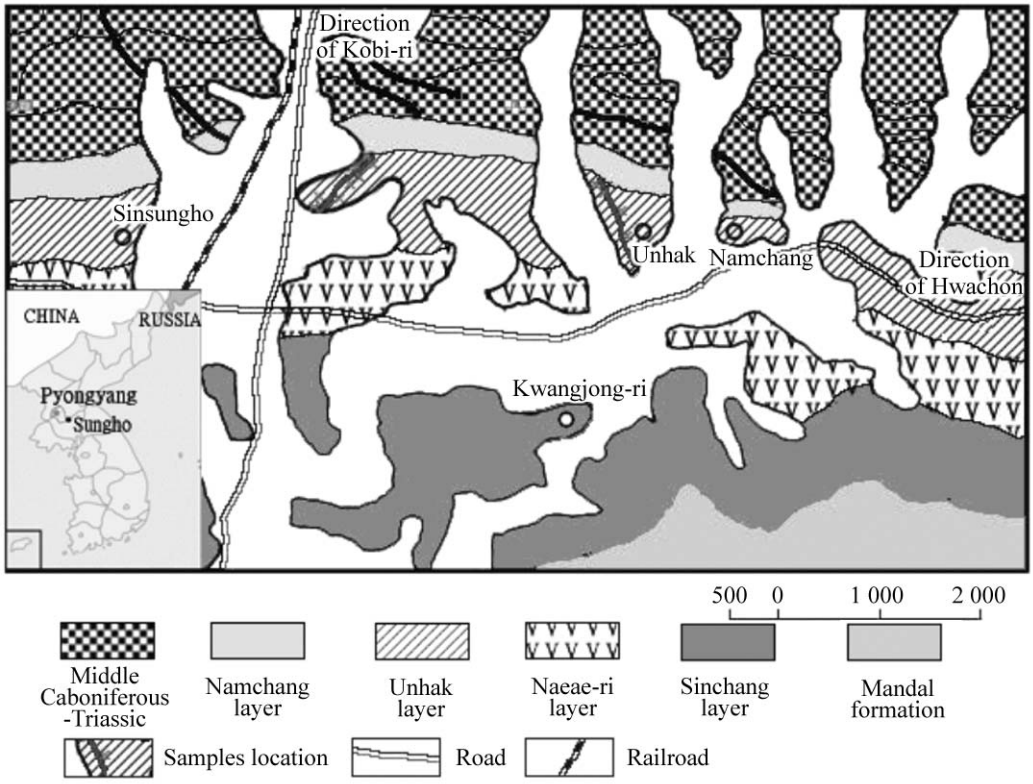

Fig. 2. The schematic geological map of the research area

And the genus and species composition of the micro crinoids stem fossils which are known in the research area is very various.

The found fossils are very similar to others which were found in other areas including our country, but different in size.

The samples size, very small micro size, is usually 0.3～0.7mm in diameter but other materials are very large.

The fossils are *Pentagonocyclicus concentricus* Yelt., *Pentagonocyclicus bifidus* Yelt., *Pentagonocyclicus* sp.1, *Pentagonocyclicus* sp.2, *Schizocrinus* cf. *vainikensis* Hynda et Saladzhius, *Pentagonopentagonalis mirabilis* Yelt., *Pentagonopentagonalis* sp.1, *Pentagonopentagonalis* sp.2, *Pentagonocyclicus biplex* (Eich.), *Pentagonocyclicus pentaporus* (Eich.), *Schizocrinus vainikensis* Hynda et Saladzhius, *Schizocrinus kukersiensis* Hynda et Saladzhius, *Asterocrinus munsteri* Eich., *Pentagonocyclicus monile* (Eich.), *Pentagonopentagonalis collariformis* Yelt., *Cyclocyclicus ungulatus* Yelt., *Cyclocyclicus* sp.1, *Cyclocyclicus* sp.3, *Cyclocyclicus* sp.2, *Mimocystites* ? *izyrakensis* Duba., *Mimocystites* ? *longiugatus* Duba., *Mimocystites* ? *diversiformis* Duba., *Grammocrinus lineatus* Eich.

Next, these fossils exist with Bivalvia, Gastropods, Brachiopods and Conodonts..

This means that the ecological environment of micro crinoids with Bivalvia, Gastropods, Brachiopods and Conodonts were same at that time.

But the micro crinoids stem fossils is a little in the limestone that include a lot of conodonts.

We have also found conodonts (*Aurilobodus aurilobus* An) of indicating the Middle Ordovician period at the remains of resolved the limestone.

This conodonts is an index fossil which is well known in the Middle Ordovician strata of Tangshan, Laiwu and Pingchuan of north China and Sungho region and Okchon flexure of our country, and is one of the representive conodonts fossils of the Middle Ordovician period of setting to the fossil zone in the regions that this fossil is known not only in China but also in our country [5, 6].

Therefore, the geological age of Unhak member of Mandal Formation in research area is the Middle Ordovician period such as last by the conodonts data.

Conclusion

The micro crinoids stem fossils, which are first found in Sungho area, Korea, are very important in dividing and comparing Middle Ordovician strata.

In the future the study of these microfossils would solve many problems in the process evolution of crinoids and Ordovician biofacies.

These fossils are very significant in the determination of the geological age of limestone of which microfossils such as conodonts are not known.

References

[1] 원철국; 고동물학, **김일성**종합대학출판사, 219～221, 주체96(2007).

[2] 백유성 등; 조선지질구성 2, 공업종합출판사, 159～327, 1990.

[3] 박명화 등; 조선지질총서 2, 공업종합출판사, 119～237, 주체97(2008).

[4] 로수원 등; 조선의 지질, 과학백과사전출판사, 55～71, 1987.

[5] P. M. Kier; J. Paleont., 39, 3, 439, 1965.

[6] 范方显; 古生物学教程, 中国石油大学出版社, 243～244, 2006.