



Sinuiju Biota of the Mesozoic in Korea



The palaeontology research group of the Resources Science Faculty of Kim Il Sung University and an editorial team of the Foreign Languages Publishing House are pleased to publish the picture album Sinuiju Biota of the Mesozoic in Korea with the collection of research findings of palaeontological fossils in the Sinuiju Formation distributed in Paektho-dong and Ryonsang-dong of Sinuiju in the Democratic People's Republic of Korea.

Illustrated with various fossils of the Sinuiju Biota, the book shows the history of the evolution and development of terrestrial organisms of the Mesozoic in Korea.

The book introduces the Archaeopteryx of Korea and the Ancestral Frog which were named by President Kim Il Sung, the Paekthodong Fossil Reserve in the Sinuiju Biota designated by Chairman Kim Jong Il and fossils of the Paektho Bird named by the respected Comrade Kim Jong Un.

It also introduces the geological background, composition and typical fossils of the Sinuiju Biota, new species unearthed in the biota, scientific papers on the biota, Paekthodong Fossil Reserve, study of fossils from the Sinuiju Biota and academic exchanges with regard to it.

We have tried to give intuitive and vivid explanations of the Sinuiju Biota of the Mesozoic in Korea with the illustration of photographs of various fossils. We hope that palaeontologists and fossil hobbyists at home and abroad will enjoy this book.

Won Chol Guk,

Merited Scientist, Professor
and Doctor, and section
chief of the Resources
Science Faculty of
Kim Il Sung University

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Sinuiju Biota of the Mesozoic in Korea

About three kilometres east of Sinuiju, North Phyongan Province in the northwestern part of Korea, are Paektho-dong, Ryonsang-dong, Phungso-dong and Thosong-ri. And the Sinuiju Formation is distributed in these areas which embrace the Sinuiju Biota of the Early Cretaceous in the Mesozoic of Korea. The area that exposes the formation is designated as Paekthodong Fossil Reserve, a natural monument, and is under good preservation.

During the study of the Mesozoic fossils that has been conducted in the Paektho-dong area of Sinuiju since the 1960s, typical EEL fauna of the Early Cretaceous in the Mesozoic was confirmed and the Sinuiju Biota was established.

Between late 1980s and early 1990s the fossils of bird, frog and pterosaur were found there.

President Kim Il Sung saw the bird and frog fossils and named them the Archaeopteryx of Korea and Ancestral Frog.

Chairman Kim Jong Il had the Paektho-dong area where the fossils of the Archaeopteryx of Korea were discovered designated as the Paekthodong Fossil Reserve.

Until then, only fragmentary plant fossils were revealed there, so many scientists were engrossed in the study of animal fossils.

It was in 2014 when the palaeontological research team of Kim Il Sung University buckled down to the all-round excavation and investigation of the fossils from the Sinuiju Formation in the Mesozoic

distributed in the areas of Paektho-dong and neighbouring Ryonsang-dong and Phungso-dong.

Accordingly, several thousand pieces of animal and plant fossils, including primordial mammals and dinosaur's tooth, were newly unearthed.

The respected Comrade Kim Jong Un named the fossils of bird with well-preserved quills discovered in the Paektho-dong area the Paektho Bird.

In 2021 palaeontologists gave scientific explanations of the Paektho-dong area of Sinuiju as the birthplace of all groups of vertebrates in the Mesozoic in Korea, and, based on them, established the Sinuiju Biota where a wide variety of animal and plant fossils in the Early Cretaceous are deposited.

The Sinuiju Biota contains the fossils of such vertebrates as fishes, amphibians, reptiles, birds and mammals, the fossils of such invertebrates as insects, conchostracans, bivalves, and gastropods, and several plant fossils.

As there are well-preserved fossils of various insects and the fossils of the Paektho Bird were unearthed and verified recently, the biota has aroused deeper interest at home and abroad.

When the study of the Sinuiju Biota is intensified in the future, it will make a greater stride in the research on the biota of the Early Cretaceous in the Mesozoic of Korea as well as the study of other Mesozoic biota in Northeast Asia.

Fossils of Archaeopteryx of Korea and Ancestral Frog



Archaeopteryx of Korea

The fossils of a bird discovered in the Paektho-dong area of Sinuiju, North Phyongan Province, was named the *Archaeopteryx of Korea* on September 27, 1993.



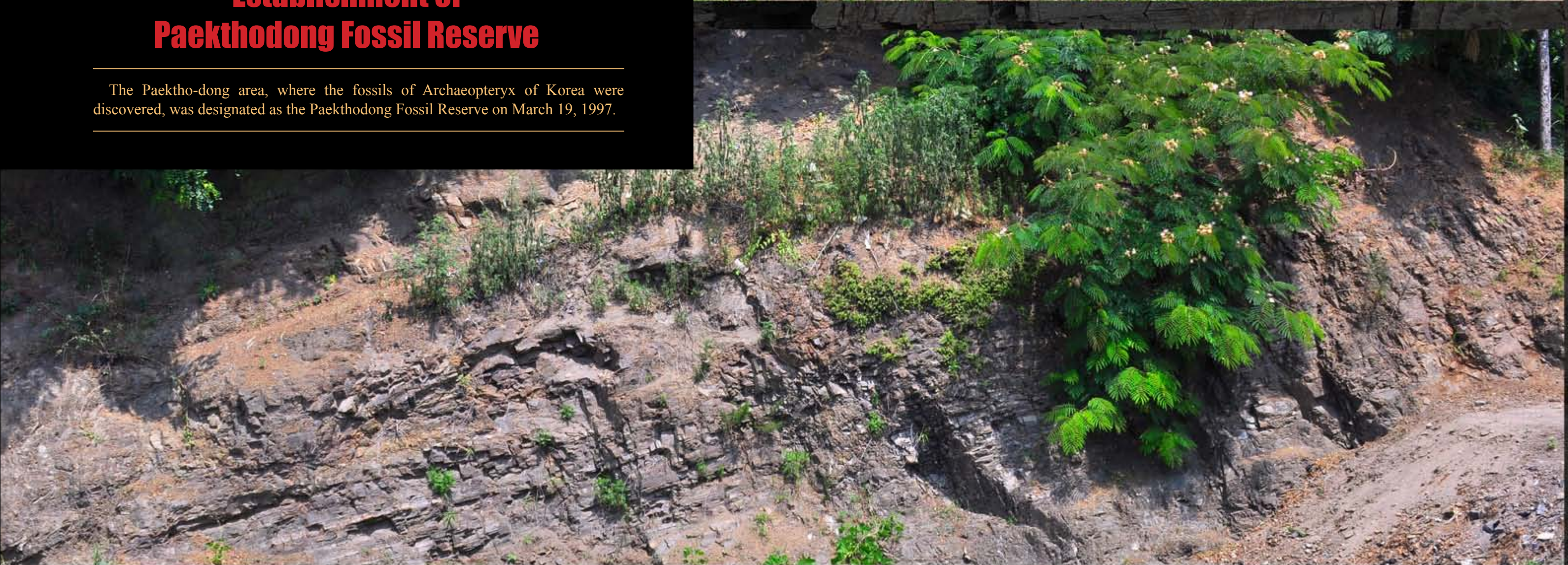
Ancestral Frog

The frog fossil unearthed in the Paektho-dong area of Sinuiju, North Phyongan Province, was named the *Ancestral Frog* on April 7, 1994.



Establishment of Paekthodong Fossil Reserve

The Paektho-dong area, where the fossils of Archaeopteryx of Korea were discovered, was designated as the Paekthodong Fossil Reserve on March 19, 1997.



Fossils of Paektho Bird



0 2 4cm



0 2 4cm



0 2 4cm

Fossils of Paektho Bird

The fossils of a bird with well-preserved quills unearthed in the Paektho-dong area was named the Paektho Bird on February 13, 2021.

Geological Background of Sinuiju Biota

The Sinuiju Formation dating to the Mesozoic in Korea is exposed in the areas of Paektho-dong, Ryonsang-dong, Phungso-dong and Thosong-ri in Sinuiju, North Phyongan Province. The formation, mainly distributed in the Sinuiju Basin and structurally located above the older strata (the Lower Proterozoic) along the southwest-northeast direction, is 50km long and 15km wide. It is divided into eight members from bottom to top.

The first member consisting of purple-brown siltstone and well-graded sandstone and mudstone containing invertebrate and plant fossils is deposited unconformably on the Precambrian basement.

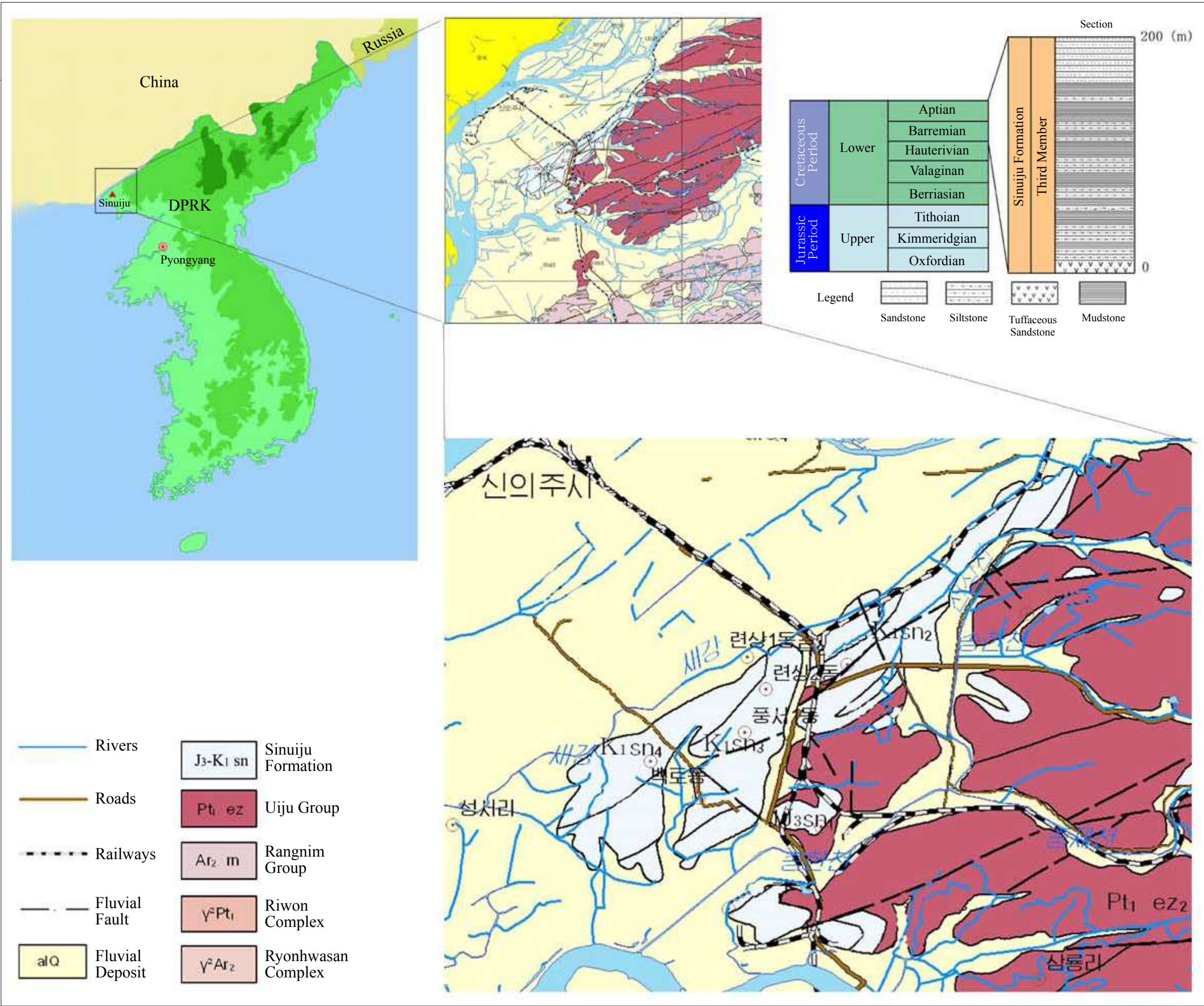
The second member consists of andesite and tuffaceous siltstone, where sedimentary layers are interbedded and conformable to the lower member.

The third member is visibly exposed in Paektho-dong, Ryonsang-dong and Phungso-dong and Thosong-ri. And its greyish-green sandstone, grey and black mudstone and siltstone contain a large number of fossils of vertebrates, conchostracans, insects, bivalves, gastropods, ostracods and terrestrial plants. This member is 200-300m thick and rests conformably on the second member, though its thickness varies according to the locations of individual fossils.

The lower part of the fourth member distributed in Paektho-dong consists of sandstone, siltstone, mudstone and slate. Its upper part and the fifth to eighth member consist of andesite, tuffaceous siltstone and sandstone. In the Sinuiju Basin, these strata are not exposed to the surface.

Geologists had previously regarded the geological age of the Sinuiju Formation dating to the Upper Jurassic-Lower Cretaceous.

However, on the basis of insect and bivalve fossils, the age of the third member of the formation was recently reconfirmed as the Lower Cretaceous.



Representative Fossils of Sinuiju Biota

Most of the fossils in the Sinuiju Biota are found in the third member of the Sinuiju Formation of the Lower Cretaceous and are comprised of invertebrate, vertebrate and plant fossils.

Invertebrate fossils include shellfish, mud snail, Conchostraca, and insects, and vertebrate fossils fish, amphibians (Ancestral Frog), reptiles (tooth of dinosaur and pterosaur), birds (Archaeopteryx of Korea and Paektho Bird), and mammals (primordial animals). And plant fossils contain pteridophytes, *Pteridospermopsida*, horsetails, *Cycadopsida*, and Ginkgoaceae.

Of the fossils produced by the Sinuiju Biota are those of insects, including Odonata, Neuroptera, Orthoptera, Coleoptera, Homoptera, Blattulidae, Hymenoptera, and Hemiptera.



Reconstruction map of the natural environment of the Sinuiju Biota



Representative Fossils of Sinuiju Biota

Gastropods

Gastropods are found generally together with bivalves in the either greyish-black siltstone or greyish-black silty mudstone. They are limited in terms of genus and species and badly preserved as compared to other fossils so far unearthed in the Sinuiju Biota.



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Representative Fossils of Sinuiju Biota

Bivalves

Bivalves are found both in the second and third members of the Sinuiju Formation, and in fairly concentrated way in certain horizons of the third member.

Such bivalves as *Sphaerium anderssoni*, *Arguniella lingyuanensis*, *Arguniella yanshanensis*, and *Ferganoconcha dapingshanensis* have been discovered in the grey siltstone and greyish-black silty mudstone of the formation, and they preserve their shell forms and structures in a vivid way.



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Representative Fossils of Sinuiju Biota

Conchostracans

The Sinuiju Biota contains conchostracans generally in the layers of the third member of the Sinuiju Formation, and in many cases they occur with insects and plants.

The Paektho-dong and Ryonsang-dong areas produced various species of conchostracans, including *Yanjiestheria yanjiensis*, *Yanjiestheria dalaziensis*, *Eosestheria middendorffii*, *Eosestheria ovata*, and *Longjiangestheria cericula*, most of them belonging to *Yanjiestheria* and *Eosestheria*.

They are found in the yellowish-brown and grey mudstone, and a rich assemblage of well-preserved fossils in several layers.



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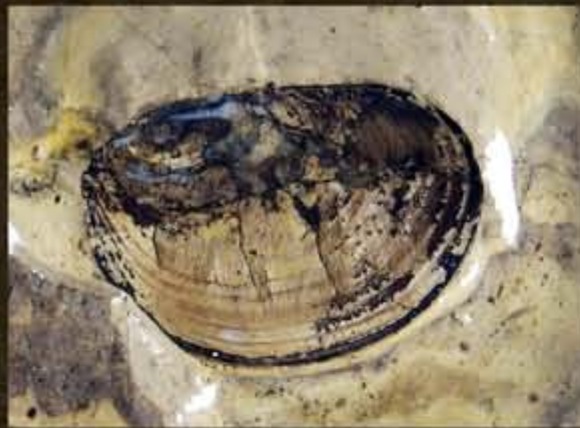
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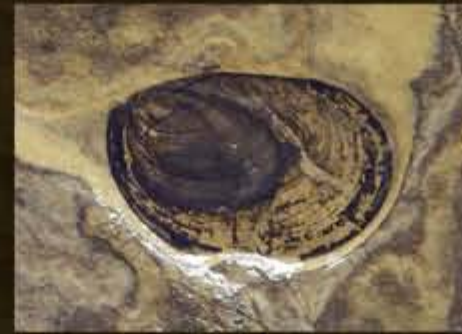
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Representative Fossils of Sinuiju Biota

Insects

Insects are the most diversified invertebrate group of the Sinuiju Biota.

Their fossils are rich in the greyish-green and grey mudstone and silty mudstone in the third member of the Sinuiju Formation.

Here *Ephemeropsis trisetalis* Eichwald, 1864 (Ephemeroptera), is found in all areas of the third member of the Sinuiju Formation, and they are well preserved and abundant.

The Sinuiju Biota also contains such insects as Odonata, Neuroptera, Orthoptera, Coleoptera, Homoptera, Blattulidae, Hymenoptera, and Hemiptera.

Among the new species are *Angarosphex baektoensis* Jon et al., 2019, *Sinuijuhelorus baektoensis* Jon et al., 2019, *Sinuijus baektoensis* Fang et al., 2019, *Habroblattula sinuijunensis* Fang et al., 2019, *Sinuijularis baektoensis* Jon et al., 2019, *Karataus ryonsangensis* So et Won, 2021, *Khasurtella ryonsangi* So et Won, 2021, *Pompilopterus ryonsangensis* So et Won, 2021, *Pompilopterus ryonsangensis* So et Won., 2021, *Stenophlebia ryonsangensis* Won et al., 2021, *Stellularis sinuijuensis* Jon et al., 2020, *Sinuijumantispa ryonsangia* Won et So, 2021, *Sinuijupodagrion ryonsangae* So et Won, 2021, *Aenigmoilus ryonsangensis* So et Won, 2020, and *Stellularis ryonsangensis* So et Won, 2021.

Insect fossils are found simultaneously with conchostracan and plant fossils.

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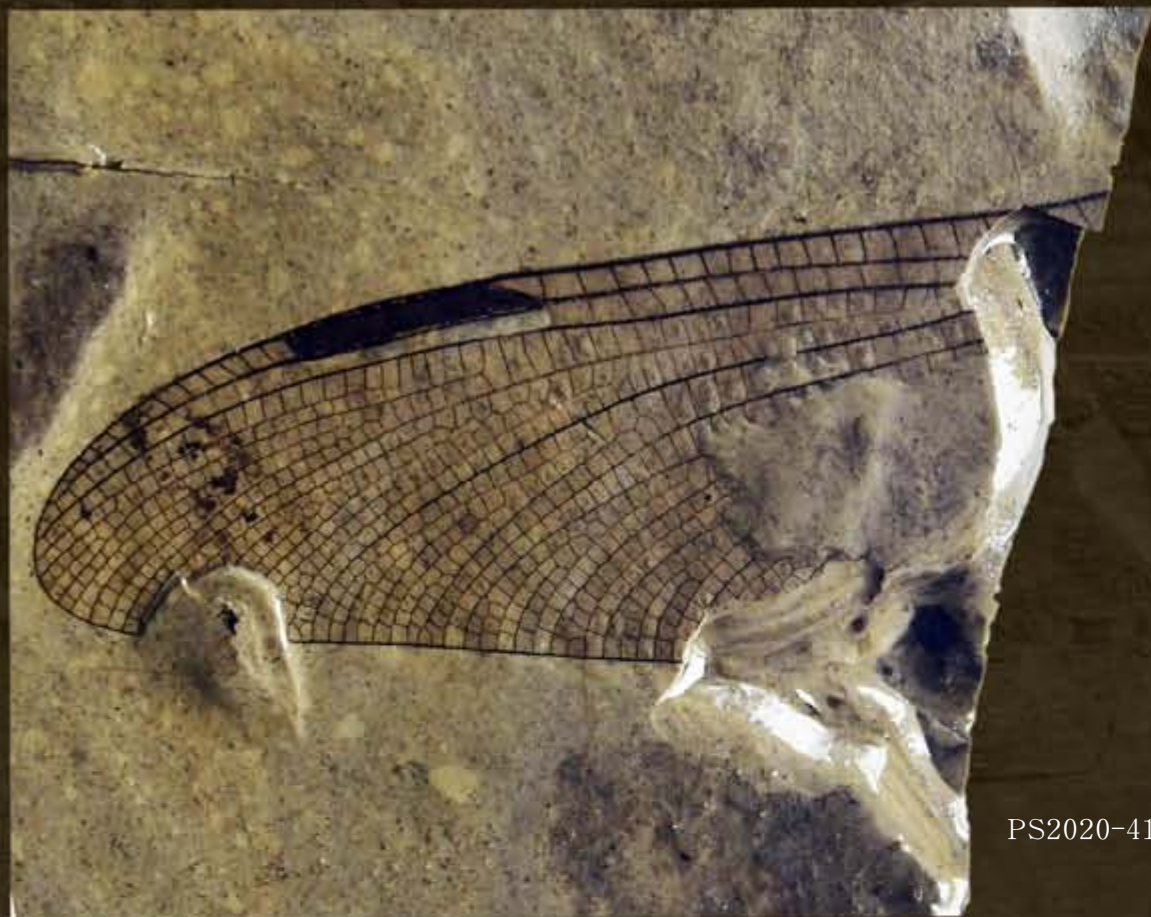
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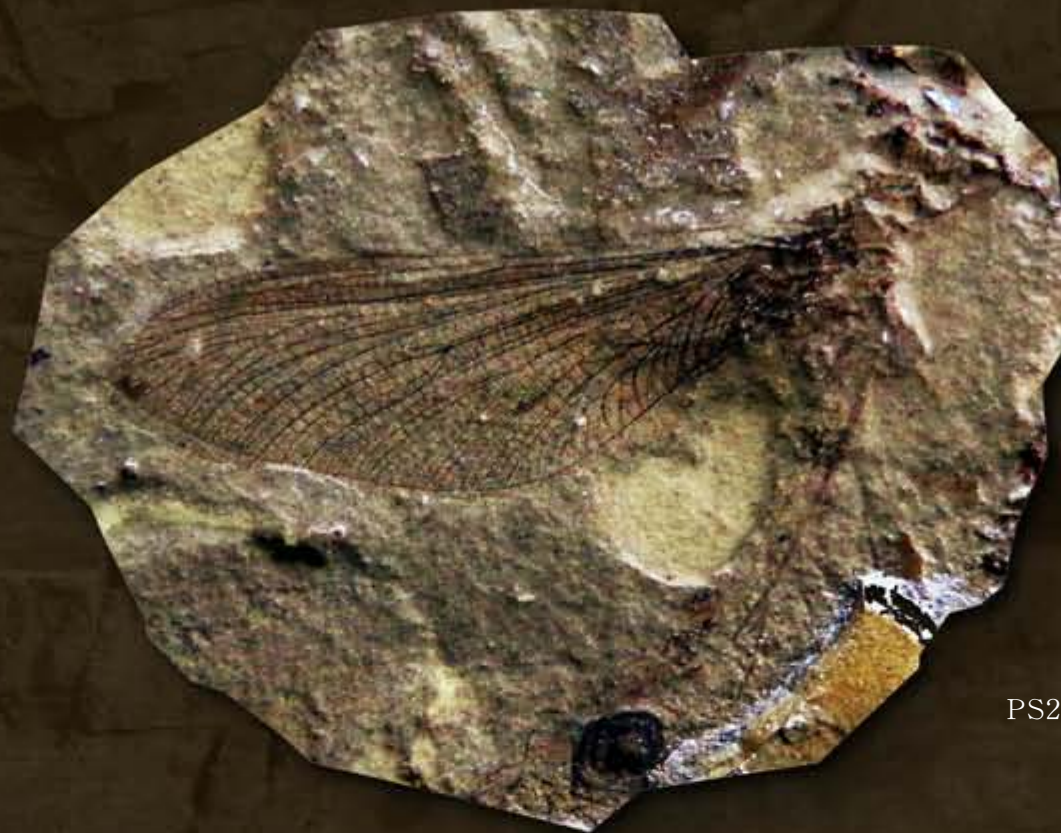
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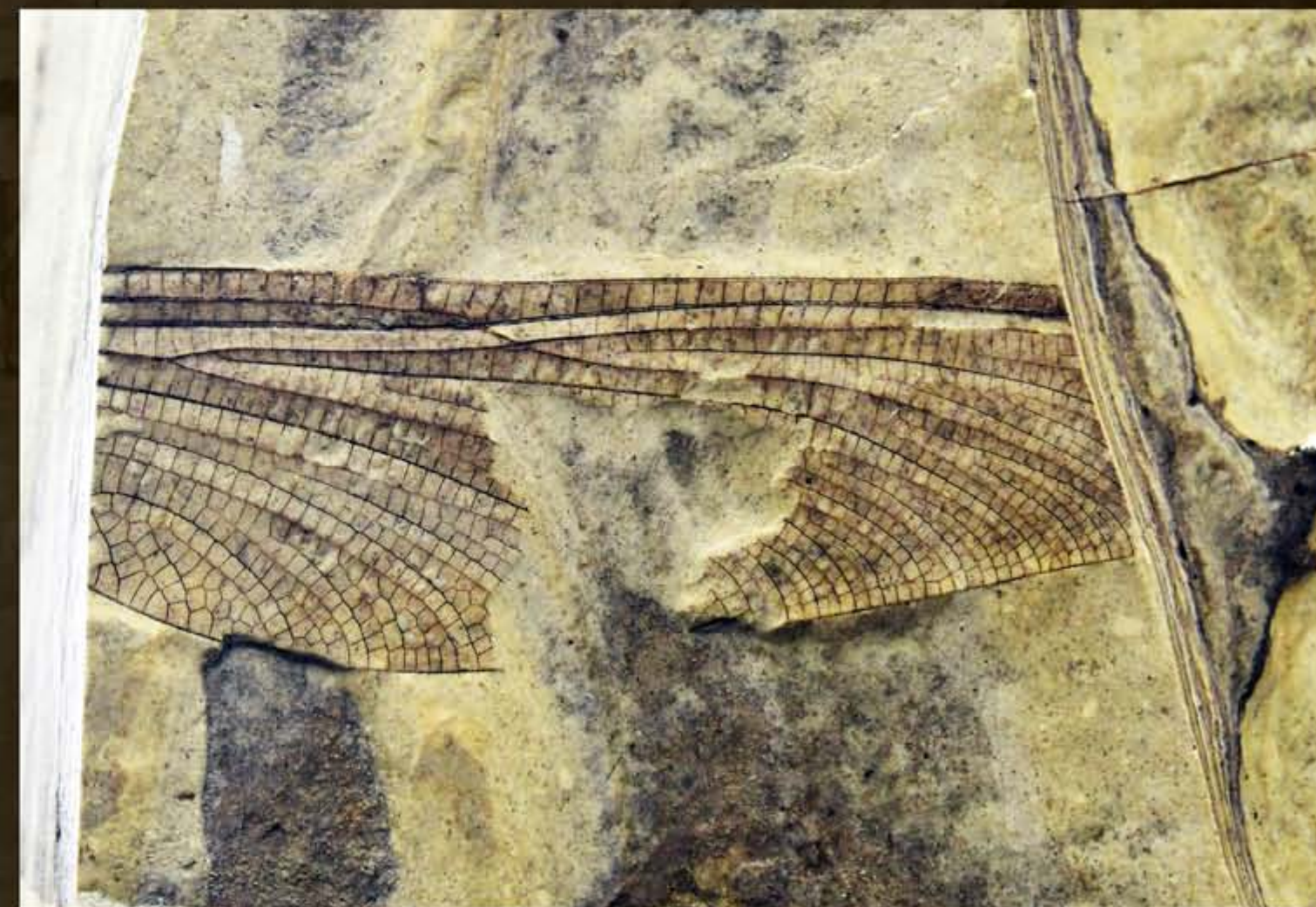


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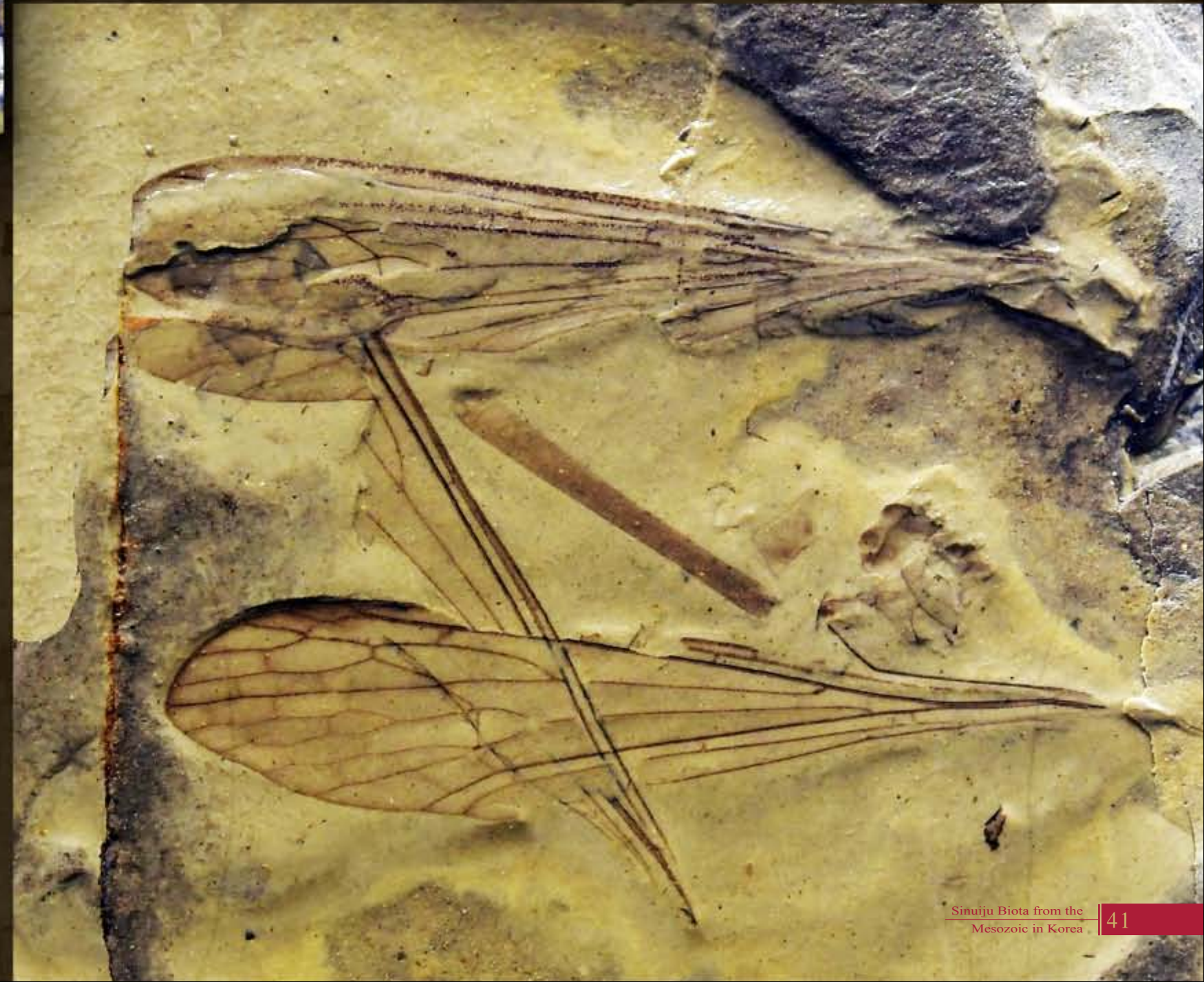


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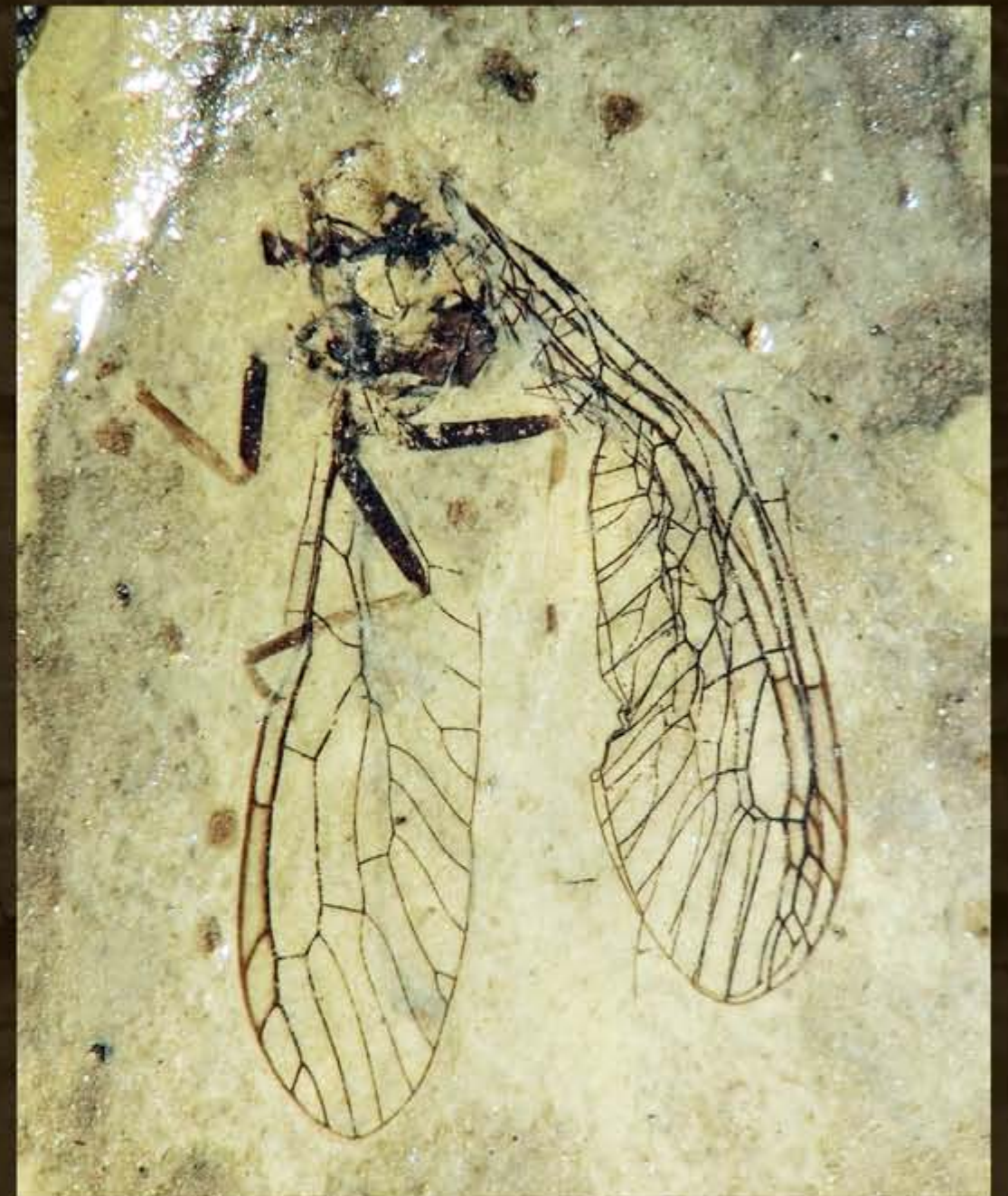




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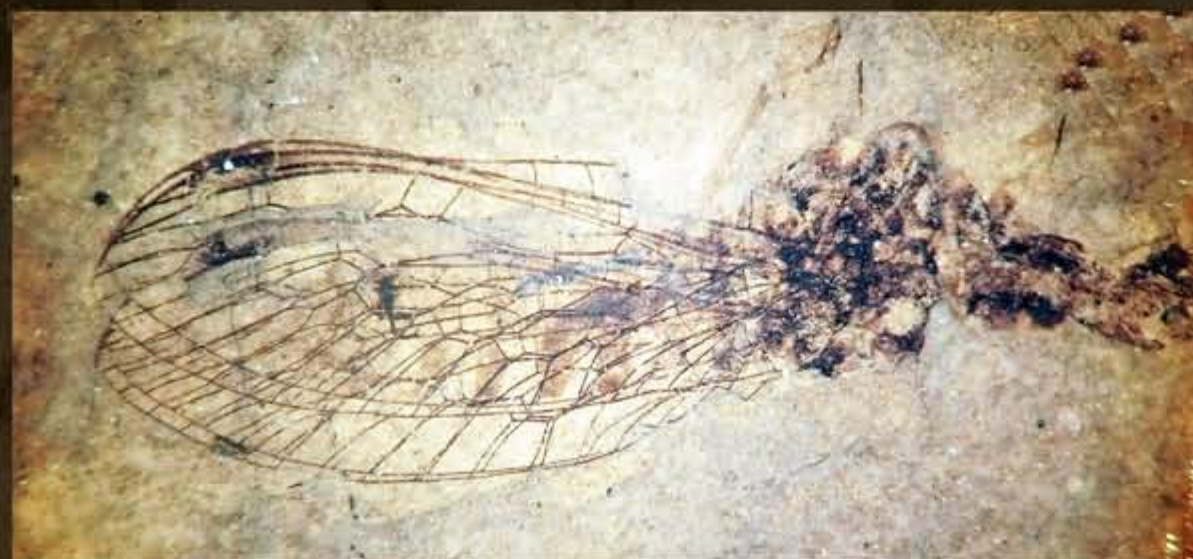
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PS2018-32



PS2018-16

PS2020-53



PS2015-60



PS2015-05



PS2020-68

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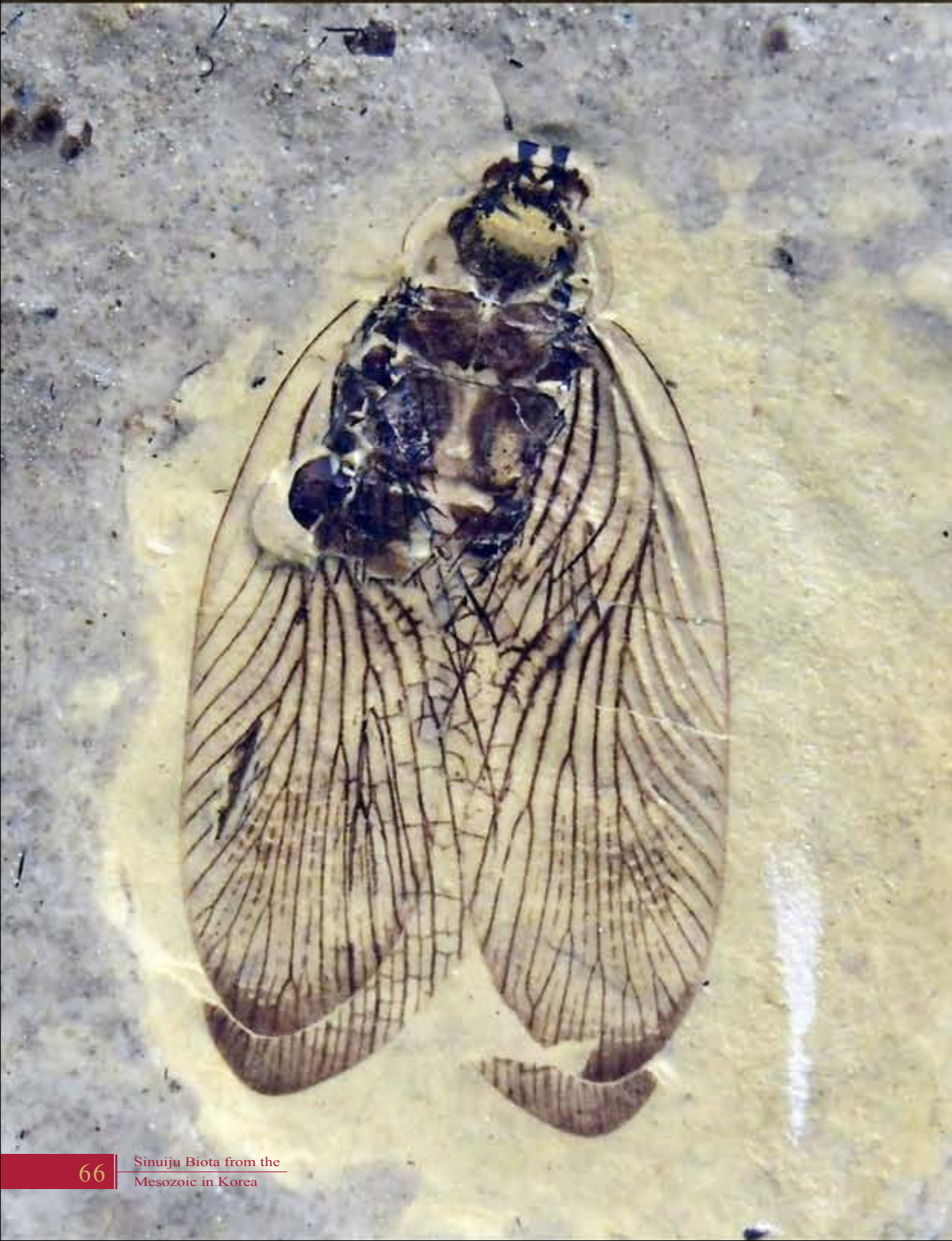
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PS2018-49

Representative Fossils of Sinuiju Biota

Fish

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Fishes are often discovered in the greyish-black silty mudstone of the third member of the Sinuiju Formation, and rarely in the greyish-green mudstone.

Lycopera davidii, *Lycopera muroii* and

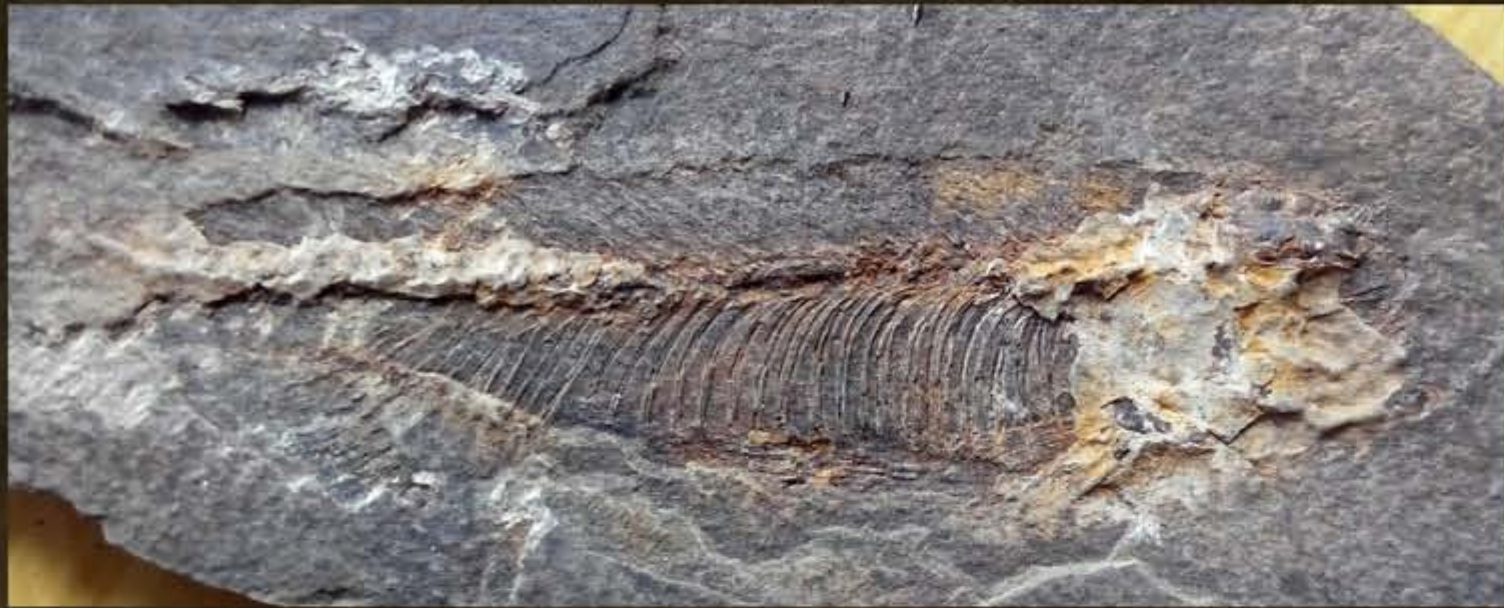
Peipiaosteus sp. 1, *Peipiaosteus* sp. 2 are included in the fossils from the Sinuiju Biota.

Lycopera are the most common species in the Sinuiju Biota, and they preserve shapes and

structures fairly well.

In the lower layer of the member containing fish fossils are also produced remains of bivalves, gastropods and plants, while in the upper layer insects, conchocratans and plants.





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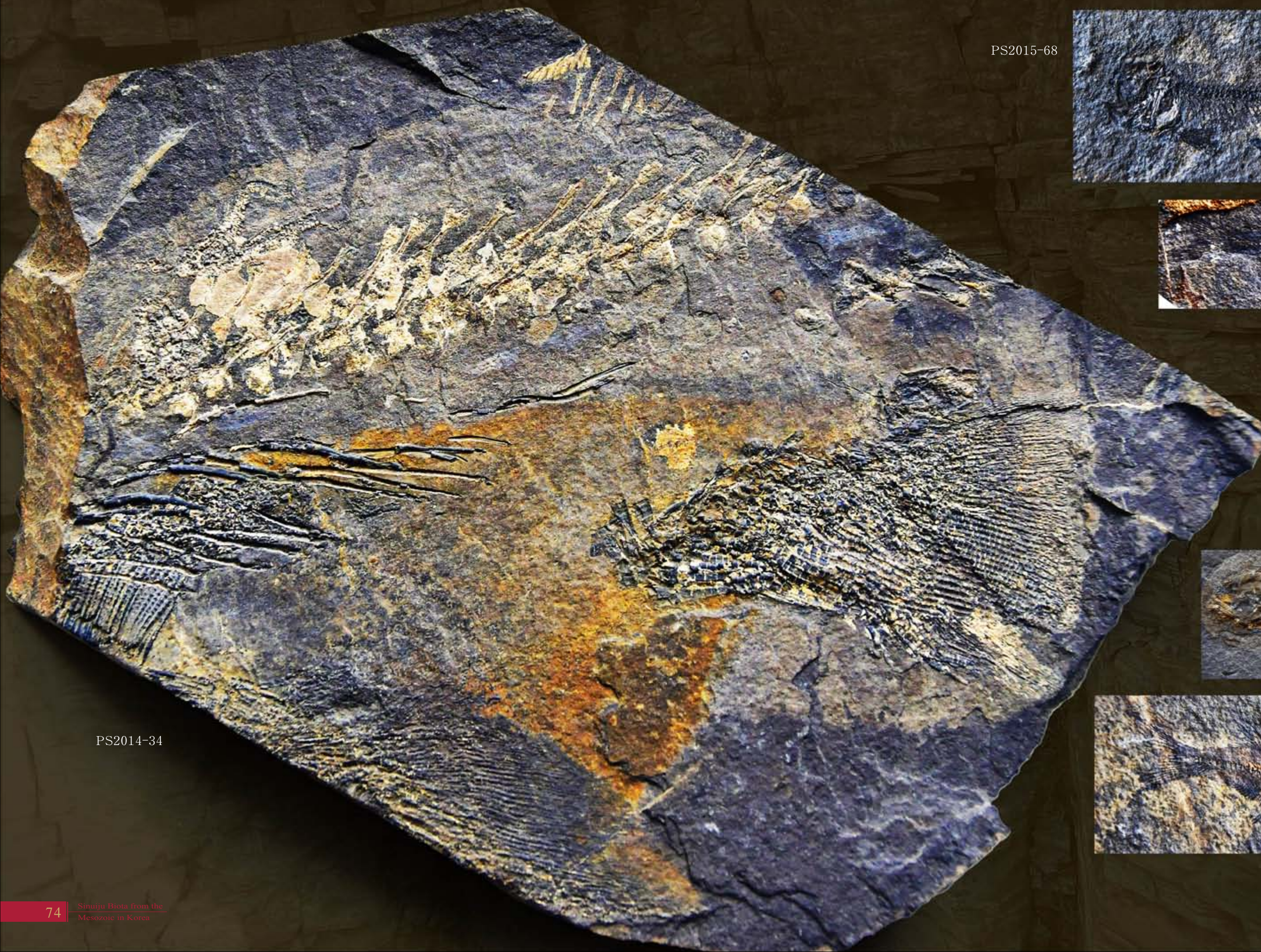


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PS2014-07



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PS2016-03



PS2019-33

Representative Fossils of Sinuiju Biota

Frog

In the early 1990s a frog fossil was discovered in the Sinuiju Biota. Found in the greyish-green silty mudstone of the third member of the Sinuiju Formation distributed in Paektho-dong, the fossil has most of its skeletons, except its head, that are relatively well-preserved. It has similar morphological features with *Liaobatrachus grabaui* Ji and Ji, 1998. The fossil is named the Ancestral Frog of Korea.



PS200121

Representative Fossils of Sinuiju Biota

Pterosaurs

It is known that the Sinuiju Biota contains two pterosaur categories, all unearthed in the third member of the Sinuiju Formation.

The fossils prove that pterosaurs existed in the Paektho-dong area in the Early Cretaceous in the Mesozoic.

The fossil of the pterosaur (PS198922) is thought to belong *Jeholopterus ningchengensis* Wang et al., 2002.



PS199921



PS198922

Representative Fossils of Sinuiju Biota

Dinosaur's Tooth

The fossilized dinosaur's tooth was found in the third member of the Sinuiju Formation distributed in Paektho-dong in 2016.

The tooth, smooth-surfaced and a little crooked backward, has close sawtoothed denticles along the anterior and posterior margins.



PS201643

Representative Fossils of Sinuiju Biota

Birds

A bird fossil that was first unearthed in the early 1990s in the grey silty mudstone layer of the third member of the Sinuiju Formation preserves some parts of the skull and toe bones. The fossilized bird is named the Archaeopteryx of Korea.

And another fossil unearthed in the Paektho-dong area of the Sinuiju Biota in 2020 has well-preserved skull, toe bones and eleven primary feathers of a bird, which is named the Paektho Bird.

Both bird fossils are registered as the DPRK’s natural monuments.



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Representative Fossils of Sinuiju Biota

Mammal

The mammalian fossil has been recently discovered in the Sinuiju Biota. Though it has no skull and forelimbs, the fossil preserves relatively clear structures of hindlimbs and chest. Judging from the characteristics of its well-preserved toe bones, it belongs to the Cretaceous mammal.



PS201641

Representative Fossils of Sinuiju Biota
Plants

Plants are found alike in the second, third and fourth members of the Sinuiju Formation, but most of them are in the third member.

Especially, fossils of Pteridophytes, *Pteridospermopsida*, *Cycadopsida*, Ginkgoaceae, Sphenophytes, and Conifers produced in the areas of Ryonsang-dong and Paektho-dong are in rather good preservation, but they are not so varied in terms of species and genus.

Most common plants recently unearthed in the third member of the Sinuiju Formation include *Coniopteris ermolaevii*, *Coniopteris vachrameevii*, *Equisetum* sp., *Czekanowskia rigida*, and *Baiera borealis*.



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PS2015-82



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PS2020-81



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PS2021-62



PS2016-07



PS2015-74



PS2016-100



PS2015-83



PS2014-08



PS2016-101



PS2021-63



PS2021-64



PS2020-82



PS2014-39



PS2016-102



PS2016-80



PS2021-64



PS2016-81



PS2016-103



PS2014-40



PS2014-42



PS2021-65

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The fossils from the Sinuiju Biota contain a variety of invertebrates of the Early Cretaceous in the Mesozoic, including bivalves, gastropods, conchostracans, and insects, and major five groups of vertebrates—fishes, amphibians, reptiles, birds and mammals.

The palaeontological circle of the DPRK named the biota the Sinuiju Biota, which contains a wide variety of fossils of lake-dwelling animals and plants of the Early Cretaceous.

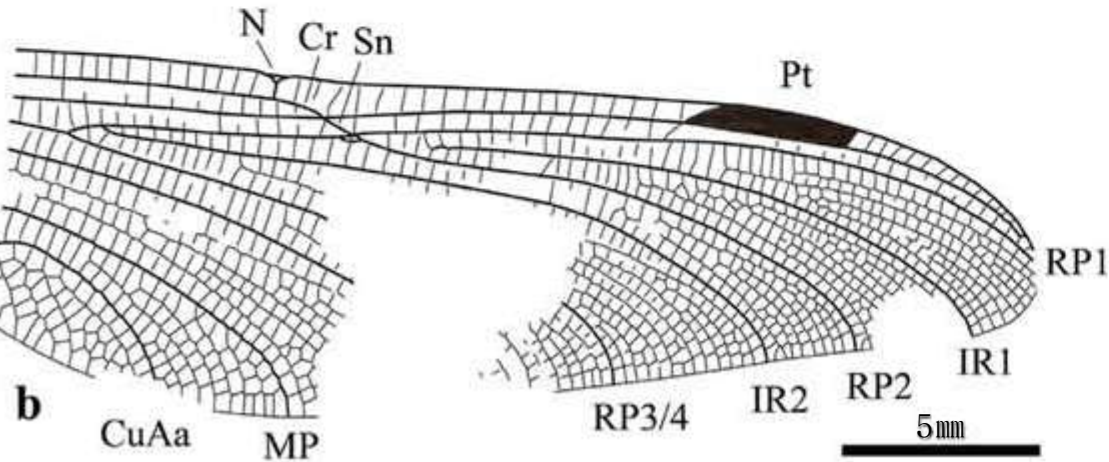
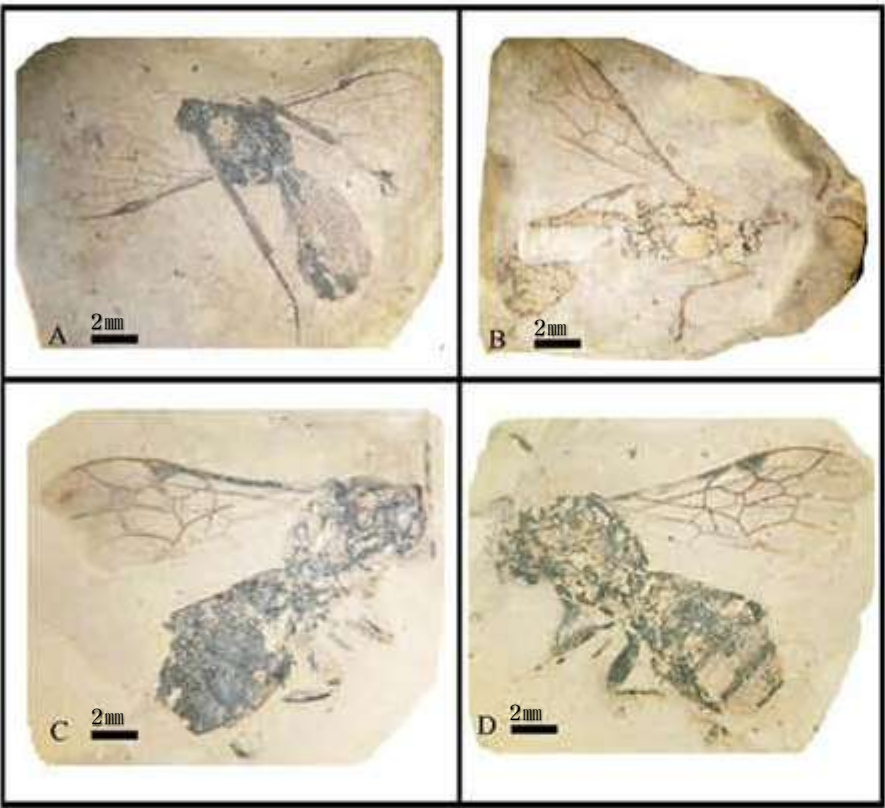
The establishment of the Sinuiju Biota is of great academic significance in explaining the evolution and development of terrestrial ecosystem and living creatures in the Mesozoic of Korea.

New Species Discovered in Sinuiju Biota

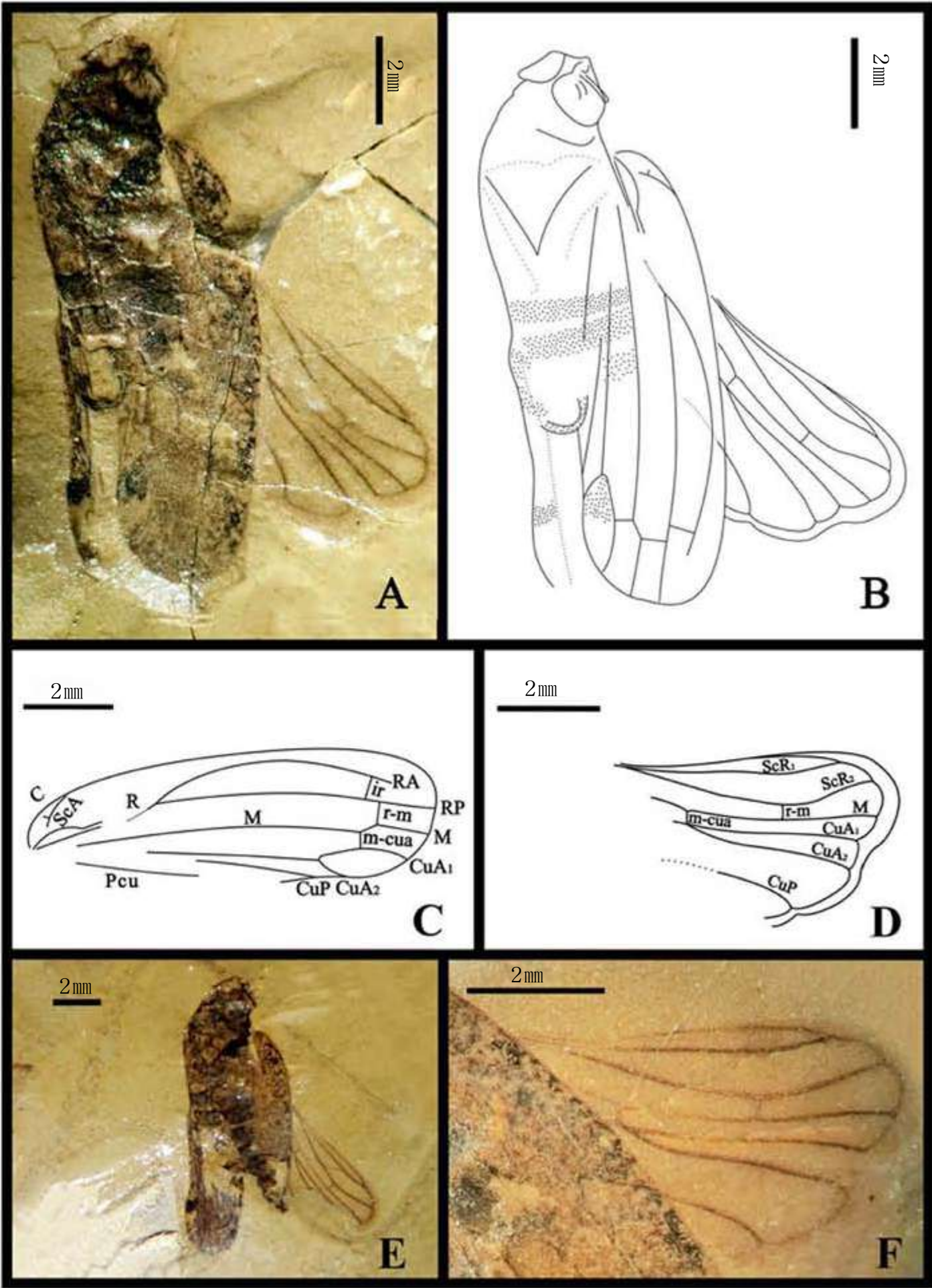
Palaeontologists of the DPRK newly discovered and verified many insect fossils through their study of the Sinuiju Biota.

Below are illustrated insect fossils of new species.

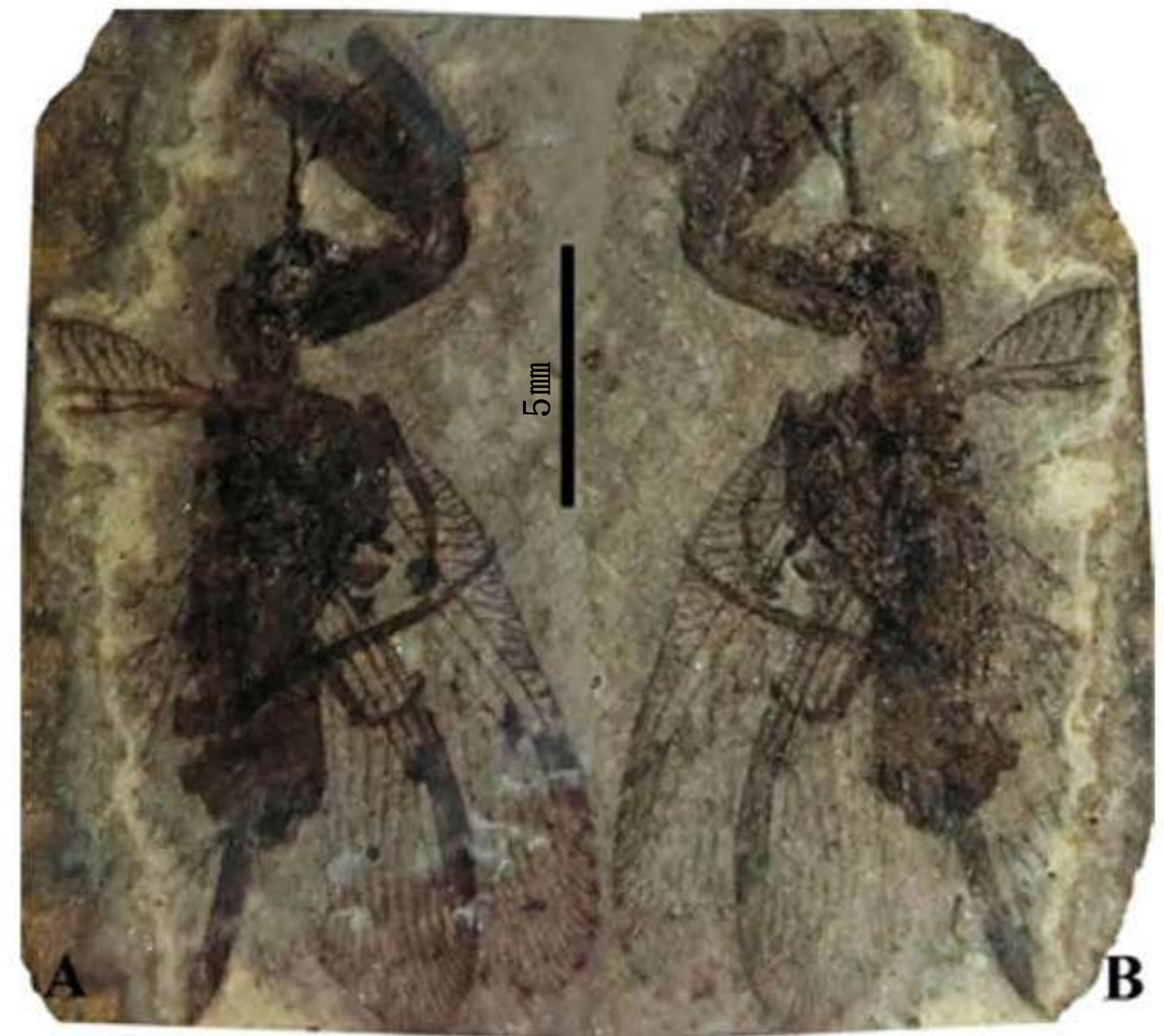
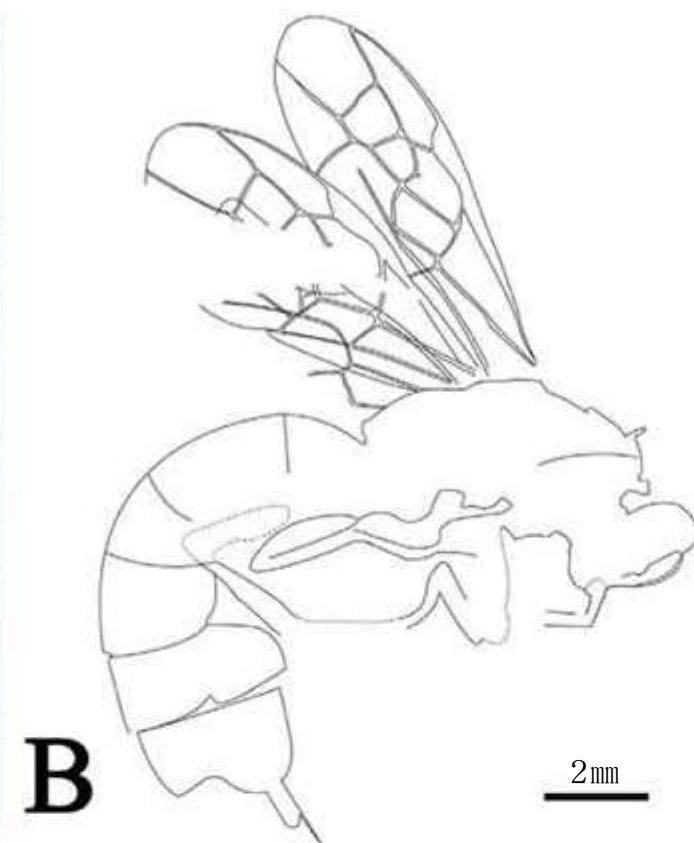
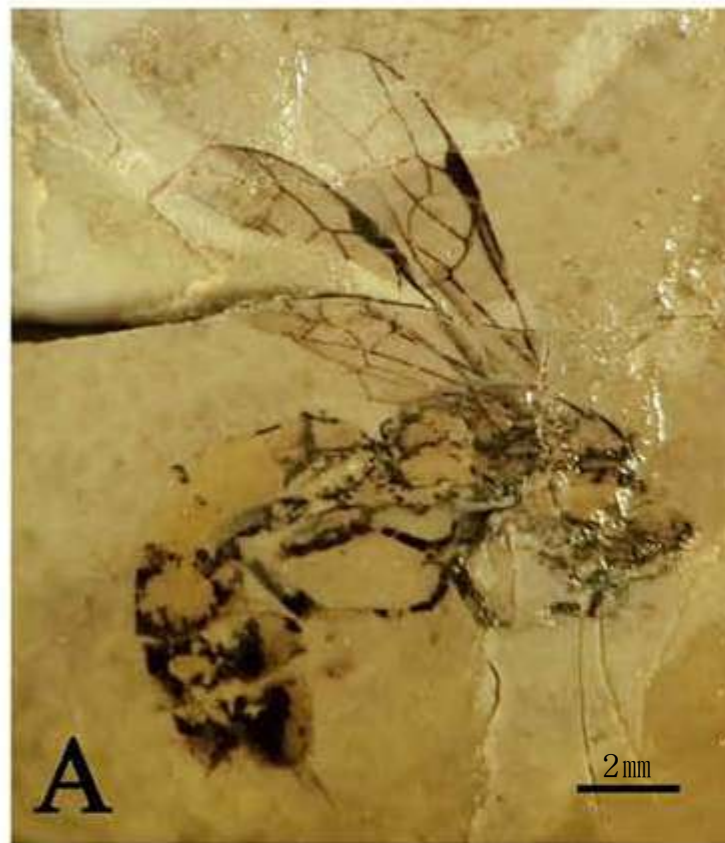
- A-*Karataus ryonsangensis* Won et al., 2021
- B-*Khasurtella ryonsangi* Won et al., 2021
- C-*Pompilopterus ryonsangensis* Won et al., 2021
- D-*Pompilopterus ryonsangensis* Won et al., 2021



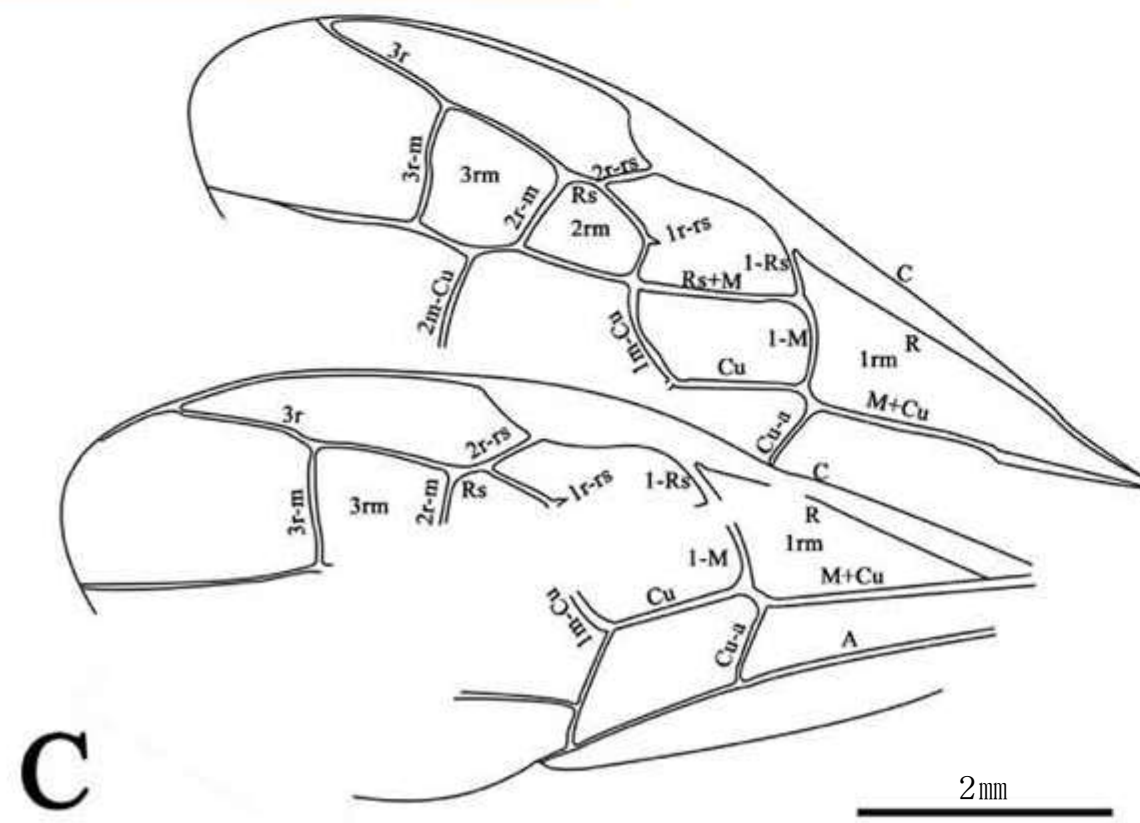
Stenophlebia ryonsangensis Won et al., 2021



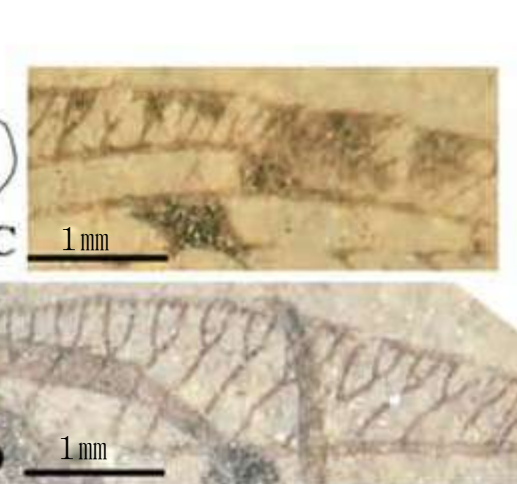
Stellularis sinuijuensis Jon et al., 2020



Sinuijumantispa ryonsangia Won et So, 2021



Angarosphex baektoensus Jon et al., 2019



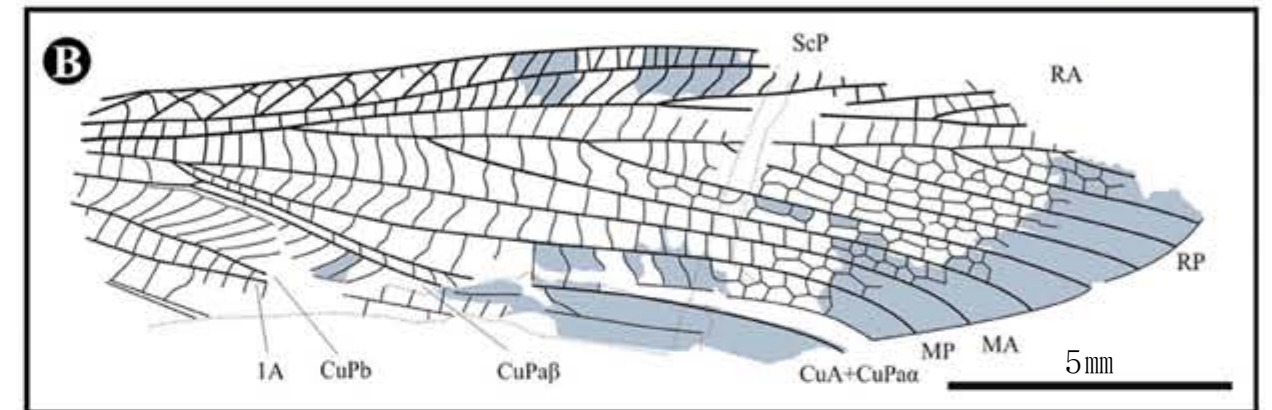
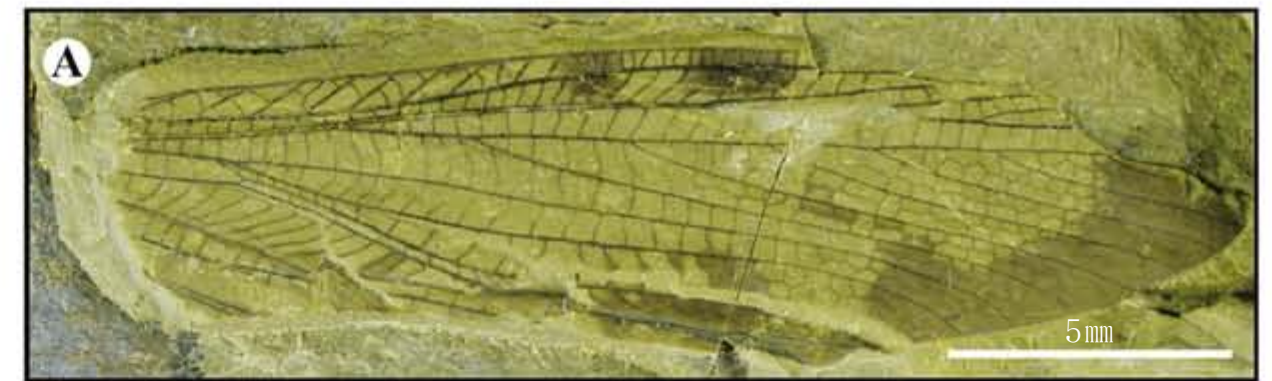
Sinuijupodagrion ryonsangae Won et So, 2021



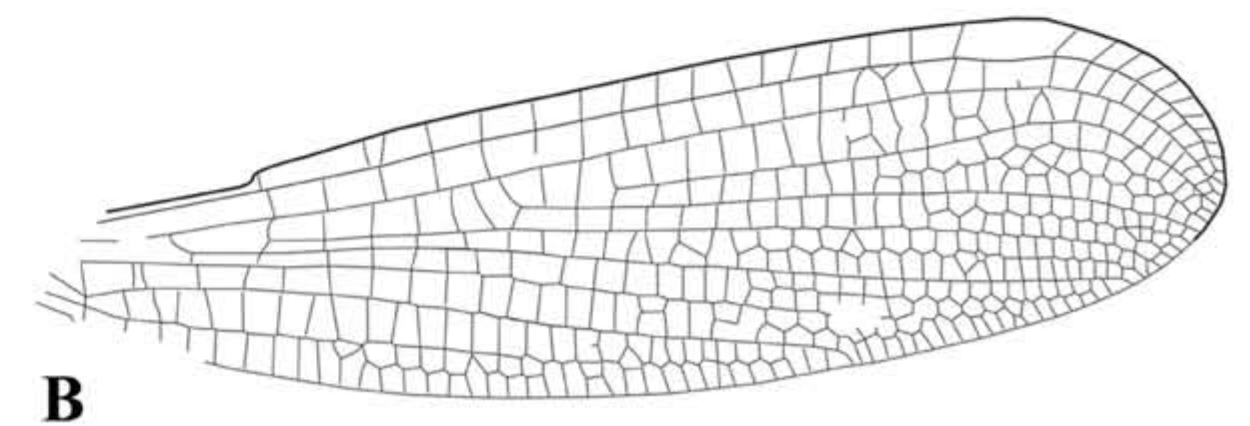
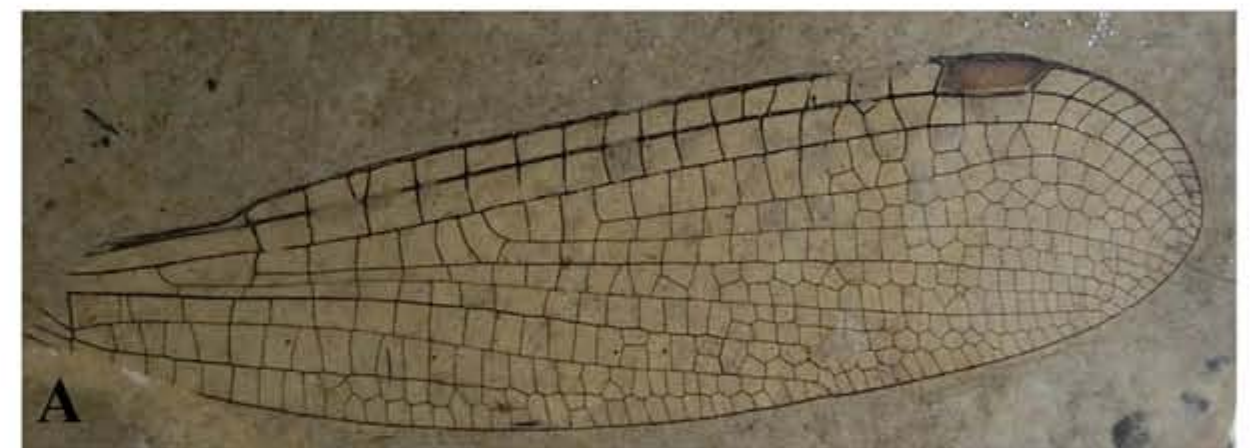
Aenigmoilus ryonsangensis So et Won, 2020



Stellularis ryonsangensis So et Won, 2021



Sinuijus baektoensis Fang et So, 2020



Sinuijupodagrion ryonsangae So et Won, 2021



Paekthodong

Fossil Reserve



The Paektho-dong area that contains various animal and plant fossils of the Early Cretaceous has been designated as the Paekthodong Fossil Reserve, a natural monument, in 1997.

The reserve is distributed in four separate sections.

The reserve has fair-arranged geological cross sections and well-preserved fossils in various kinds, so it is of importance in the study of the Sinuiju Biota of the Lower Cretaceous in the Mesozoic.

Section 1

Major fossils produced in Section 1 include fishes, bivalves, gastropods, conifers and pteridophytes deposited in the greyish-black silty shale and greyish-green silty mudstone.

Fish fossils were discovered in abundance there.

Section 2

The fossils of the Paektho Bird was unearthed here, together with a large number of insect and conchostracan fossils and some plant fossils. The most representative insect fossil is *Ephemeropsis trisetalis* Eichwald, 1864. The layer is composed of greyish-green silty mudstone, yellowish-brown siltstone and greyish-green sandstone.

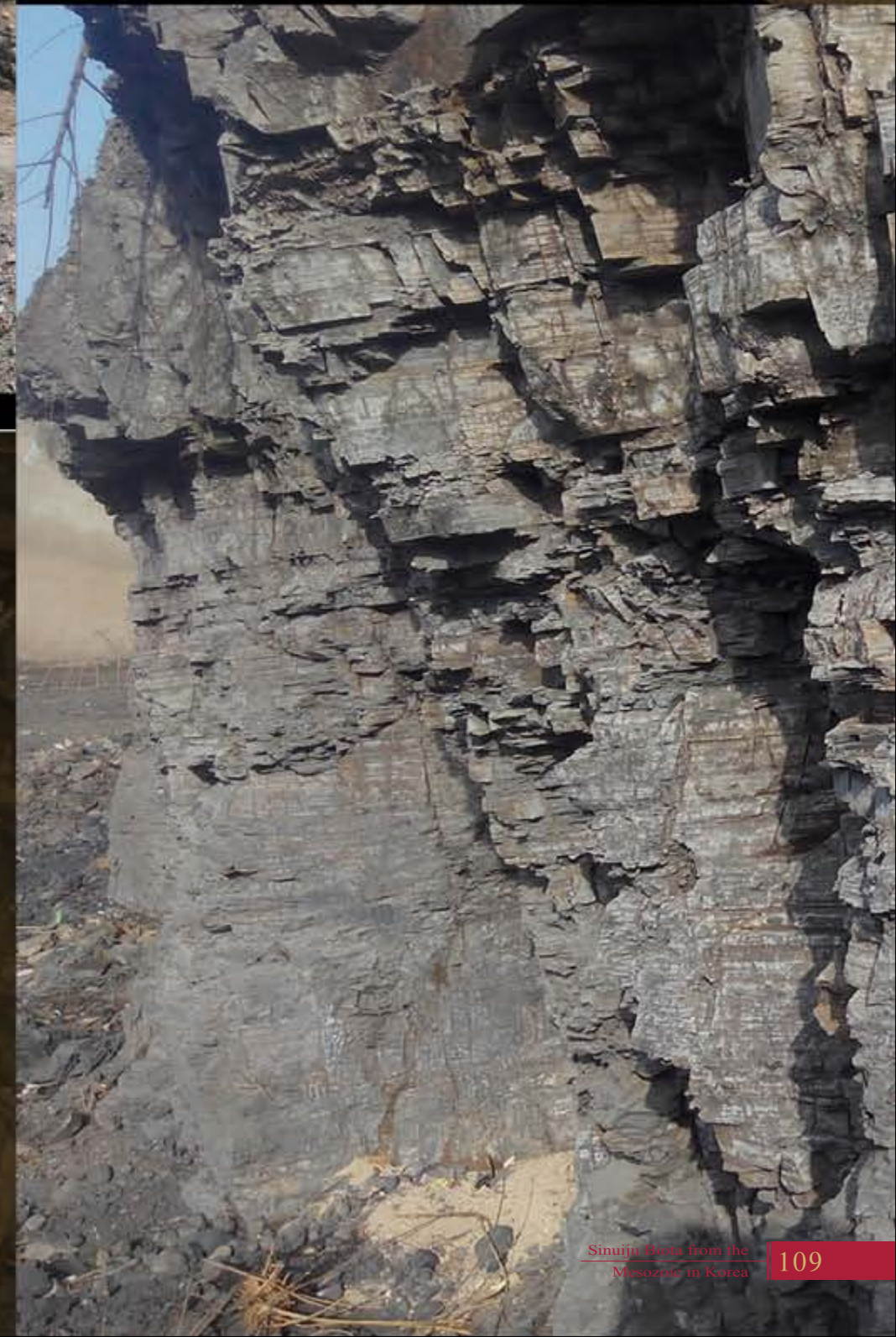




Section 3

Section 3 produces mainly insect, conchostracan, bivalve and gastropod fossils, and consists of greyish-green silty mudstone, greyish-green sandstone and yellowish-brown sandstone.





Section 4

The fossils of the Archaeopteryx of Korea, pterosaur, fishes, bivalves, gastropods, pteridophytes, and Ginkgoaceae were discovered in the section. The section consists of greyish-black sandstone, siltstone and silty mudstone.



Study of Fossils and Academic Exchange

Excavation and Study of Fossils from Sinuiju Biota in Paektho-dong and Ryonsang-dong



The DPRK's palaeontologists intensified the study of fossils from the Sinuiju Formation since 2014, and unearthed and verified a lot of fauna and flora fossils in Paektho-dong and Ryonsang-dong of Sinuiju.

Study of Fossils and Academic Exchange

Academic Discussions with Chinese palaeontologists

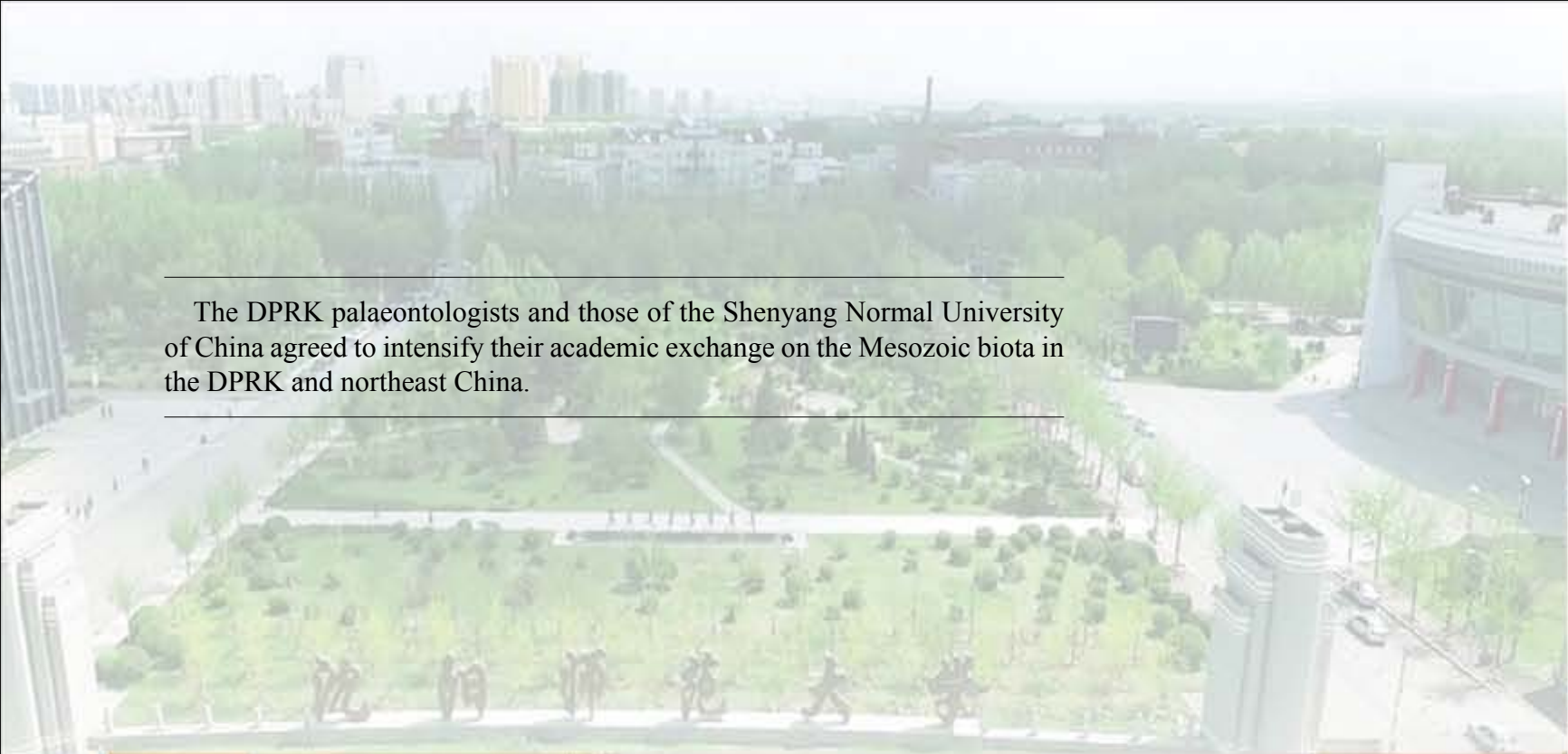
Fossil samples from the Sinuiju Biota of the Mesozoic are exhibited in the palaeontological hall of the Natural History Museum built at the foot of Mt Taesong, DPRK.

Professor Sun Ge, director of the Paleontological Institute of the Shenyang Normal University and also head of the Paleontological Museum of Liaoning in China, and other Chinese palaeontologists visited the Natural History Museum and looked round its palaeontological hall.

Palaeontologists of the DPRK and China exchanged their scientific opinions on the evolution and development of the Mesozoic organisms.

Academic discussion with the palaeontologists of the Shenyang Normal University of China at the palaeontological hall of the Natural History Museum





The DPRK palaeontologists and those of the Shenyang Normal University of China agreed to intensify their academic exchange on the Mesozoic biota in the DPRK and northeast China.



Academic discussion with the palaeontologists of the Shenyang Normal University of China



Joint research and academic seminar with the Nanjing Institute of Geology and Palaeontology of Chinese Academy of Sciences

The DPRK palaeontologists met with Prof. Zhan Renbin, director of the Nanjing Institute of Geology and Palaeontology of Chinese Academy of Sciences, and Prof. Wang Bo. They discussed the orientation of their joint research and collaborated in the research and compilation of scientific papers on insect fossils.





Study of Fossils and Academic Exchange

Academic Exchange with Palaeontologists from Mongolian Academy of Sciences

Mongolian palaeontologists headed by Prof. Khishigjav Tsogtbaatar, director of the Institute of Palaeontology and Geology of the Mongolian Academy of Sciences, visited Kim Il Sung University and agreed to conduct joint study and academic exchange with the DPRK counterparts.



Mongolian palaeontologists visiting the DPRK



Study of Fossils and Academic Exchange

International Seminars

The DPRK palaeontologists participated in several international meetings, including the International Symposium on Cretaceous Biota and K-Pg Boundary in Jiayin of Heilongjiang and Jiayin Forum on Fossil Protection, China, the Fourth International Symposium on Geosciences in Northeastern Asia, and the Fourth Council of the International Centre of Geosciences Research and Education in Northeastern Asia. The meetings discussed the issues on the joint study of the palaeontological evolution and development in the Mesozoic of Korea, and scientific papers were read.



International Symposium on Cretaceous Biota and K-Pg Boundary in Jiayin of Heilongjiang, China





Many DPRK and foreign scientists are paying great attention to the Sinuiju Biota of the Mesozoic in Korea.
The Sinuiju Biota will further produce new and valuable fossils in larger numbers and thus accelerate the related academic exchanges.



Fourth International Symposium on Geosciences in Northeast Asia

Fourth Council of the International Centre of Geosciences Research and Education in Northeast Asia



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Photo: Pyon Chan U, Song Tae Hyok, Yun Hyok

Sinuiju Biota of the Mesozoic in Korea

Published by the Foreign Languages Publishing House
Printed at the Printing Plant of the Foreign Languages
Publishing House
Issued in December Juche 111 (2022)





Foreign Languages Publishing House, DPRK
Juche 111 (2022)