

ГЕОГРАФИЯ

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BASIS FOR THE AGE OF THE BAYANTUMEN FORMATION SEDIMENTS DISTRIBUTED ALONG THE BORDER OF MONGOLIA (CHOIBALSAN SUM AREA OF EASTERN PROVINCE)

M. Bat-Erdene

© **Myatav Bat-Erdene**

Ph.D student.,

Geological Center for Research and Analysis,

P. O. Box 437, Songinokhairkhan District,

Ulaanbaatar 18080, Mongolia

bmlgeotour@mail.com

Abstract. Bayantumen Formation sediments occupy 18.2 per cent of the area of the Ovoot Tolgoi-50 project, which covers the Choibalsan, Chuluun Kohot, and Gurvanzagal districts of Dornod Province, or 523.8 km². This sediment is widely distributed in the Eastern Mongolia region.

The Ovoot Tolgoi-50 project area borders with China in the southeast. Previous researchers mapped the sediments of the Lower Cretaceous Bayantumen Formation along the border of Mongolia, and Jurassic volcanogenic and volcanic sedimentary rocks adjacent to it in Chinese territory.

As part of the research work of the Ovoot Tolgoi-50 project, we have taken absolute age samples from the volcanics of the lower member of the Bayantumen Formation and determined by the uranium-lead method. The age was determined to be 141 ± 1.7 million years, corresponding to the Valanginian-Gotian period (K₁).

Lower Cretaceous Valanginian-Gotian shells were found in the acid metasands of the lower member of the Bayantumen Formation, which confirmed the basis for the age of the sediments.

Keywords: Bayantumen Formation, animal and plant remains, absolute age, Eastern Mongolia.

Acknowledgments

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Introduction

The “Ovoot Tolgoi-50 project spans an area of 2878.05 km², covering the Choibalsan, Chuluunkhoroot, and Gurvanzagal districts of Dornod Province, as delineated by M-50-88-A, B, G; M-50-89-B, G-a, c; and M-50-100-B on a 1:50,000 scale map. Geological mapping and general exploration were conducted on planes M-50-101-A, B-a, B-b, c. According to the tectonic classification by O.Tumartogoo (2017), the majority of the research area falls within the Ereen Davaa tectonic region, with a smaller portion belonging to the riftogenic zone (block) of Doch River (Fig. 1).

Origin of the Name

Volcanogenic sequences that are widespread in Choibalsan City and Gurvanzagal Sum area of Dornod Province were first identified by T. Binderya (1993) and P. Hosbayar (1995) and named Bayantumen after the old name of Choibalsan city.

Previous Study

The Bayantumen Formation sediments which are distributed around Sum Lake in Gurvanzagal Sum, Dornod Province and conformably cover the sediments of the Lower Cretaceous Ochirkhuret Formation and the Church Lake Formation sediments (Fig. 2). The thickness of the sequence is 500–2000 m. Following fauna have been found in the sequence — *Limnocyrena elongata* Marts, *L. subplana* (Reis), *Campolema conica* Marts., *Arguniella* sp, conchostrac — *Bairdestheria huzitai* Kob. et Kus., molluscs such as *B. sinensis* (Chi), *Brachugraptia sibirica* (Kras.), *Lycoptera fralis*, and fish fossils such as *Terrindusia reisi* Suk found in the sequence. The Bayantumen Formation consists of volcanic rocks of various compositions including trachyrhyolite, rhyolite, rhyodacite, trachybasalt, ignimbrite, felsite, pearlite, andesibasalt, andesite, their tuff, tuff sandstone, tuff conglomerate, siltstone, and clay shale.

In Russia, the Lower Cretaceous sediments are divided into the Turgin Suite and divided into 3 sub-suites. The volcanogenic-terrigenous sediments of the Turgin Suite consists of sandstone, siltstone, and mudstone layers, and contain several lava flows of 50–100 m thick trachyandesibasalt. This sedimentary layer contains Lower Cretaceous ostracods, conchurstrs, molluscs, fishes, and plant remains. The age of basalt is 119–129 Ma /apt-barren/ by the K-Ar method, and 134.8 Ma /valanginian/ by the U-Pb method.

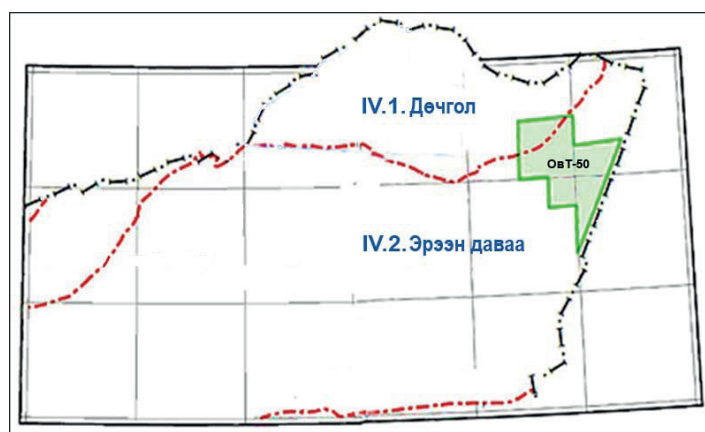


Fig. 1. Tectonic zones, location of the study area [Tumartogoo, 2017]

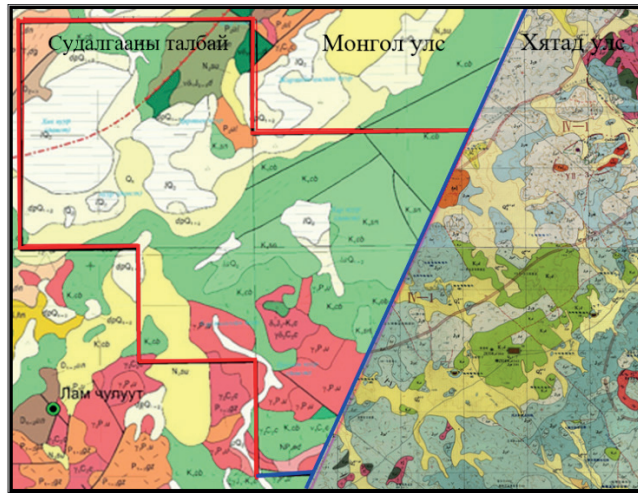


Fig. 2. Geological map of Mongolia and China

The sediments of the Yixian and Jiufotan Formations, which contain a complex fauna and flora of the Jehol Group distributed throughout the Argun Block of Liaoning Province, China, indicate Barremian-Aptian-Albian stages (Fig. 2) [Jung Gou, De-Yu Sun et al., 2019].

Distribution and Outcropping

Bayantumen Formation sediments (Fig. 5) are poorly exposed and are mostly eluvial. in scale, it is rarely found on the top of the hill, forming a ridge (alkaline and acid volcanic as residual cover) (Fig. 3).



Fig. 3. Sediments of Bayantumen Formation and their state of discovery

Interpretation of aerial and satellite images. The study area has low surface fragmentation, consists thick soil, and intensively developed vegetation cover, low undulating hills, as such the interpretation of aerial and satellite images is poor. The sediments of the Bayantumen Formation are dark brown, brownish brown, and brown-grey in the Sentinel image, and light green, greenish grey, brownish brown, pinkish, and light grey in the Aster image with moderate contrast (see Figure no. 4). and aerial photographs show a fuzzy map of light grey.

Lithological composition: Bayantumen Formation consists of dark, brown-grey, dark-blue, almond-shaped, porous and massive basalt, andesibasalt, trachyandesite, encrusted

andesite, beige, light grey, monolithic rhyolite, tuffels, tuff conglomerate, beige, It consists of light-grey, fine to medium-grained, weakly cohesive conglomerate, gravelite, sand, siltstone, and rarely dark argillite which altered by iron oxide and limonitized.

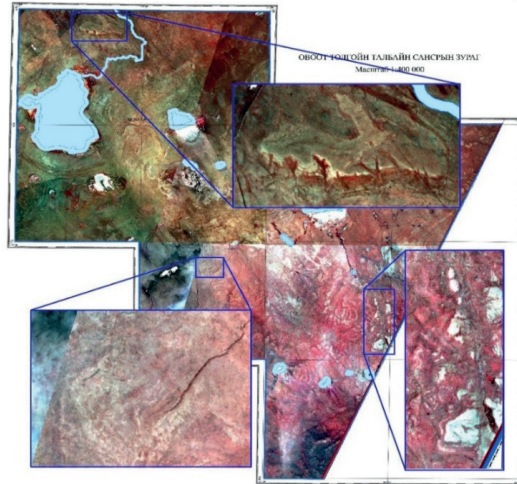


Fig. 4. Bayantumen Formation sediments are visualized in satellite images

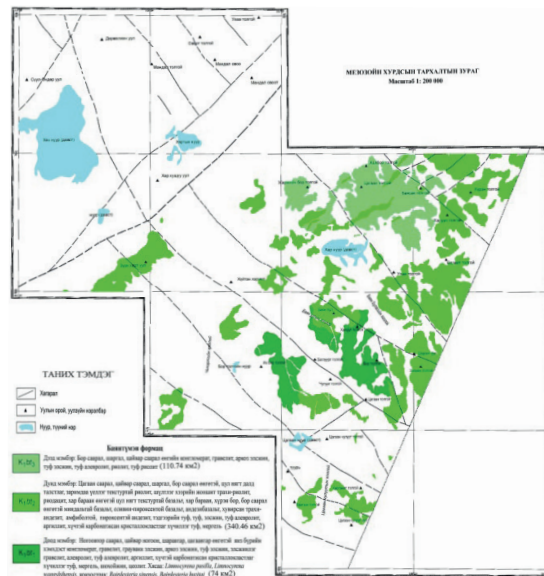


Fig. 5. Distribution scheme of Bayantumen Formation sediments

Research methods

The identification of paleontological samples was carried out by Dr. L. Gereltseg of the Institute of Paleontology of MAS. The absolute age determination was carried out using zircon U-Pb method using LA-ICPMS (Laser Ablation — Inductively Coupled Plasma-Mass Spectrometry) in the laboratory of the Department of Geological Sciences of Taiwan State University. Temorastd $207\text{Pb}/235\text{U}=1061.8\pm 2.1$ ratio normalized

91 500 and MTstandart was used Petrographic and petrochemical analysis were carried out on selected samples. Samples were prepared by crushing and separating the magnetic fraction and binocularly separating zircon grains from the heavy fraction with a heavy solution of 2.85 g/ml. To ensure the reliability of the measurement results of the separated zircon grains and to increase the accuracy of the measurement, fraction of 100–200 µm was selected and prepared for measurement, and mechanical and chemical polishing was performed. Seperated zircon grains were studied by cathodoluminescence image analysis, and the internal structure was determined, and finally, zircon grains were selected for age determination.

Results

Petrochemical characteristics

We took 17 silicate samples from the volcanogenic rocks of the Bayantumen Formation and utilized samples of similar rocks from the research materials of the Chuluun Khoroot — 50 projects to compare the results. The results are shown in the table below (Table 2).

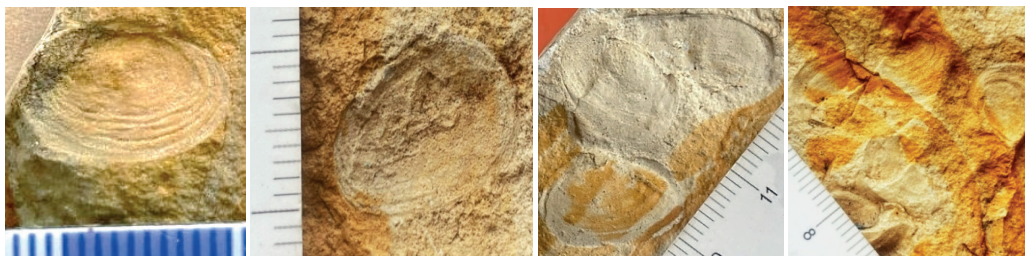
Paleontological results: In the lower member of the Bayantumen Formation, poorly preserved plant stems, shells, and imprints are observed in felsic tuff, tuff sand, and tuff siltstone. Lower Cretaceous Valangian-Goterivian clams *Limnocyrena wangshihensis*, *Limnocyrena pusilla*, conchostracs *Bairdesteria sinensis*, *Bairdesteria huzitai* were newly discovered were found in the felsic tuff, tuff sandstone, and tuff siltstone /observation point — 180, 5030 (Fig. 6, 7).



Limnocyrenawangshihensis

Limnocyrena pusilla

Fig. 6. Contained in the sediments of the lower member of the Bayantumen Formation are (op-180) animal remains — fauna (photographed under a microscope, magnification 8 times)



Bairdesteriasinensis (A_q – 5030 - 2)

Bairdesteria huzitai (a_q – 5030 - 4)

Fig. 7. Contained in the sediments of the lower member of the Bayantumen Formation are (op – 5030 — 2, 5030 — 4) animal remains — fauna

Table 2

Chemical composition and petrochemical parameters of volcanic rocks of Bayantumen Formation taken from Ovoot Tolg field

Дээж №	3270	8091	186	1118	26	8062	8072	8077	8061	1097	8074	8092	150-2	178	159	676	8075
SiO ₂		59,29	55,32	54,54	57,17	62,75	53,53	60,22	74,0			61,15	61,99	59,47	67,82	55,23	74,99
TiO ₂	1,01	2,234	1,491	1,753	1,351	1,423	1,375	1,314	0,2	0,013	0,035	0,718	0,748	1,156	0,397	1,863	0,132
Al ₂ O ₃	0,40	15,77	16,91	16,11	16,74	17,83	15,94	16,79	13,8	0,20	0,84	17,47	16,94	15,42	15,31	16,76	13,27
Fe ₂ O ₃	1,29	8,11	7,93	8,84	6,68	3,52	6,71	6,04	2,1	2,16	0,71	5,10	4,78	6,64	3,67	7,65	1,45
FeO	1,28	1,14	3,48	1,31	0,57	0,72	1,73	1,36	1,4	1,92	0,25	2,00	1,17	3,55	2,45	3,17	1,37
CaO	0,10	2,66	6,34	5,86	3,60	4,24	4,52	3,79	0,7	0,27		4,14	4,21	5,05	2,10	6,78	0,54
MgO	0,01	0,61	2,97	2,49	2,57	0,61	3,29	1,30	0,2	0,02		2,35	1,57	3,06	0,98	3,24	0,21
Na ₂ O	0,01	4,35	4,40	3,91	4,84	4,88	6,53	4,30	5,1	0,01	0,01	5,17	4,89	3,93	4,06	4,15	3,03
K ₂ O	0,05	3,94	2,60	3,08	4,56	3,07	3,37	3,97	3,9	0,04	0,15	2,32	3,07	3,26	4,30	2,48	5,33
P ₂ O ₅	0,07	1,152	0,672	0,768	0,581	0,533	0,707	0,606	0,0	0,261	0,016	0,211	0,265	0,360	0,154	0,784	0,009
MnO	0,01	0,080	0,112	0,091	0,067	0,052	0,096	0,080	0,1	0,019	0,052	0,097	0,041	0,095	0,058	0,126	0,046
SO ₃	0,10	0,10	0,10	0,10	0,1	0,10	0,10	0,10	0,2	0,10	0,1	0,22	0,22	0,17	0,39	0,10	0,10
nnn	0,02	1,93	0,95	2,17	1,59	0,95	3,87	1,60	0,1	0,32		1,41	1,28	1,30	1,07	1,04	1,05
H ₂ O	0,05		1,08	1,30	2,15					0,15			1,33	0,71	0,55		
CO ₂	0,40	0,40	0,44	1,20	0,4	0,40	1,55	0,40	0,4	0,40	11,60	0,4	0,40	0,40	0,40	0,46	0,40
Дүн	100,4	100,2	99,8	99,7	99,9	100,0	100,0	100,1	100,2	100,4	100,2	100,4	100,0	99,9	100,3	100,2	100,1

Table 3

Modal composition of Bayantumen Formation sandstone (%)

no	Sample no	Rock name	Age	Q	PL	Ksf	Bt/musk	Lt %	Total Counted Granules
				%				Acidic effusive	
1.	1055	Tuff-sand	K ₁ bt ₁	39,2	30,2	11,3	3,1	16,2	600
2.	5083	Sandstone	D ₂₋₃ su	43,3	29,8	26,2	0,7		600



Fig. 12. FQL diagram for classification of sand feed provinces [Dickinson, 1985]

Conclusion

As a result of the research work, the age of volcanogenic-sedimentary sediments distributed along the border of Mongolia was confirmed by paleontological and absolute age determination.

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ОБОСНОВАНИЕ ВОЗРАСТА БАЯНТУМЕНСКИХ ОТЛОЖЕНИЙ,
РАСПРОСТРАНЕННЫХ ВДОЛЬ ГРАНИЦЫ МОНГОЛИИ
(РАЙОН ЧОЙБАЛСАН-СУМ ВОСТОЧНОЙ ПРОВИНЦИИ)

М. Бат-Эрдэнэ

Мятав Бат-Эрдэнэ

аспирант,
Геологический центр исследований и анализа,
Монголия, 18080, г. Улан-Батор,
Сонгинохайрханский район, а/я 437
bmlgeotour@mail.com

Аннотация. Баянтуменские отложения занимают 18,2% площади комплекса Овоот Толгой-50, охватывающего Чойбалсанский, Чулуун-Кохотский и Гурванзагалский районы провинции Дорнод, или 523,8 км². Этот осадок широко распространен в регионе Восточной Монголии.

Территория комплекса Овоот Толгой-50 граничит с Китаем на юго-востоке. Предыдущие исследователи картировали отложения нижнемелового Баянтуменского образования вдоль границы Монголии, а также прилегающие к ней юрские вулканогенные и вулканогенно-осадочные породы на территории Китая.

В рамках научно-исследовательских работ проекта Овоот Толгой-50 из вулканитов нижней пачки баянтуменского образования были отобраны образцы абсолютного возраста и определены уран-свинцовым методом. Возраст был определен как $141 \pm 1,7$ млн лет, что соответствует валанжинско-готскому периоду (K_1). В кислых метапесчаниках нижней пачки баянтуменского образования обнаружены нижнемеловые валанжинско-готерийские раковины и подтвержден возраст отложений.

Ключевые слова: баянтуменское образование, остатки животных и растений, абсолютный возраст, Восточная Монголия.

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