

SPECIFICATION OF AGE AND STRATIGRAPHIC POSITION OF COAL DEPOSITS OF THE RUDNYI ALTAI RUSSIAN PART

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At detailed studying of coal continental deposit of the Rudnyi Altai Russian part the collection of fossils was collected. On the basis of studying the age interval of deposits from top early up to late Carboniferous was increased, three separate stratigraphic divisions, which are offered to be considered in the future in a rank of series, are established.

Introduction

On the territory of Rudnyi Altai the coal deposits are developed on small sites isolated from each other, composing imposed synclinal folds and troughs [1]. The given deposits are characterized by sufficiently homogeneous lithologic composition of rocks presented by rhythmical layer interstratifications of coal, argillite and frequently carbonaceous aleurolites, sandstones with lenses and interlayers of gritstone, conglomerates and rarely limestones. All these deposits were referred to the Maloulbinskaya series [2]. The age of the Maloulbinskaya series was defined by the remains of the mineral plants which were found in its rocks. Study of the vegetative remains from the Maloulbinskaya series deposits was carried out from 1939 to 1962 by paleobotanists: E.F. Chirkova, M.F. Neyburg, M.I. Radchenko, S.G. Gorelova. But though leading paleontologists were studying flora of this area, one cannot say that it is studied fully enough. It was caused by small number of paleontologic material – coal deposits in Rudnyi Altai are nearly completely overlapped by Cenozoic cover. Research of flora by paleontologists in the 60, 70's of the last century has allowed for comparison of the Maloulbinskaya series with average Carboniferous. Geologists have used this age dating till now in their reports as well as in composition of State Geological Map of the Russian Federation [2].

As a result of the search-exploration works which were done from 1994 to 2004 on the territory of the Rudnyi Altai Russian Part it was possible to complete essentially the flora collection with coal deposits. The huge paleontologic material (vegetative remains, myriophytes, brachiopods and single finds of columnal) was collected. Its analysis permitted for specification of the conclusions obtained earlier on the age and stratigraphic position of series, for supplement of its paleontologic characteristic and reconstruction of paleogeographical condition of the Rudnyi Altai during the coal period.

As a result of coal deposit studying the collection of mineral material (4500 samples) from deposits of three areas was selected: Novo-Aleksandrovskaya, Lugovskaya, Uspensko-Razdolninskaya (Fig. 1). On the basis of paleontologic and lithologic material, taking into account the data of Open Society «Rudno-Altayskaya Expeditsiya» geologists (Zmeinogorsk), the author made composite sections of each area (Fig. 2).



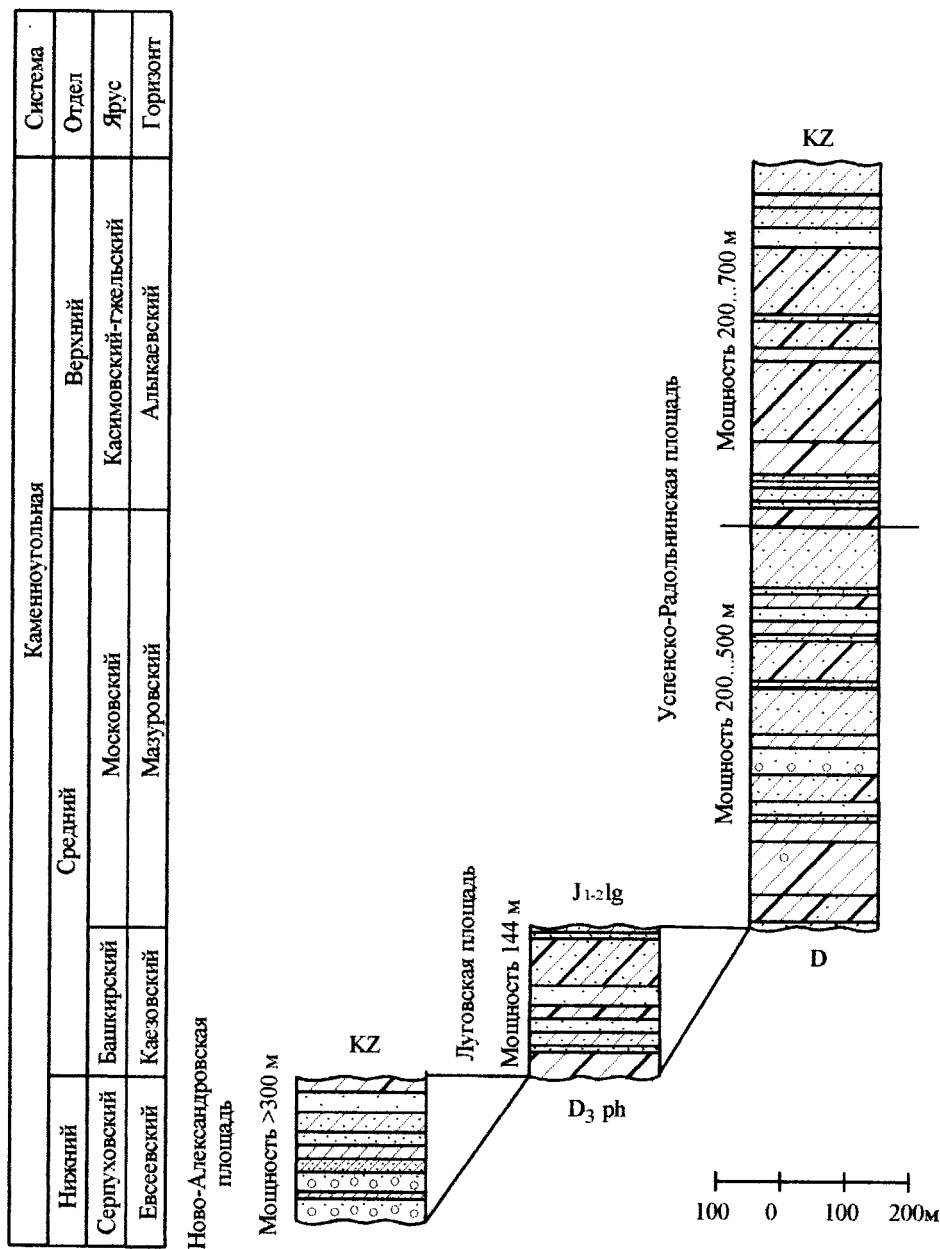
Fig. 1. The plan of the prospecting areas location. Scale 1:1000000

Explanation to Fig. 1:

Рубцовск – Rubtsovsk
 Ново-Александровская площадь – Novo-Aleksandrovskaya area
 Новониколаевка – Novonikolaevka
 Новоалександровка – Novoaleksandrovka
 Октябрьский – Oktyabrskiy
 Веселый Яр – Veselyi yar Локоть – Lokot
 Георгиевка – Georgievka
 Луговская площадь – Lugovskaya area
 Ремовский – Removskiy Горняк – Gorniyak
 Успенка – Uspenka; Самарка – Samarka; Золотуха – Zolotuha
 Успенско-Раздольнинская площадь, участки –
 Uspensko-Razdolninskaya ploskad, sites
 1. Северо-Восточный – Severo-Vostochniy
 2. Северный – Severniy 3. Южный – Uzhniy

The Novo-Aleksandrovskaya area

The Novo-Aleksandrovskaya area is dated to syncline of the sublatitudinal course located in 6...8 km to the South of Rubtsovsk city. Its deposits were opened by 6 search wells. From core of all wells 557 samples with numerous prints of lycopsids, arthropytes, ferns, holoseeds of uncertain systematic position and 2 samples



Условные обозначения:

- | | | |
|-----------|--------------------------------|---|
| Уголь | Слабоуглистая порода Алевролит | Тонкое переслаивание алевролитов и песчаников |
| Песчаники | Слабоуглистая порода Аргиллит | Гравелиты |

Fig. 2. Composite sections of coal deposits of the Rudnyi Altay Russian part

Explanation to Fig. 2: Каменноугольная – Coal; Система – System; Нижний – Bottom; средний – Medium; Верхний – Top; Отдел – Formation; Серпуховский – Serpuhovskiy; Башкирский – Bashkirskiy; Московский – Moskovskiy; Касимовский-Гжельский – Kasimovskiy-Gzhelskiy; Ярус – Stage; Евсеевский – Evseevskiy; Казовский – Kazovskiy; Мазуровский – Mazurovskiy; Алыкаевский – Alykaevskiy; Горизонт – Horizon; Ново-Александровская площадь – Novo-Aleksandrovskaya area; Мощность – Capacity; Луговская площадь – Lugovskaya area; Успенско-Радольнинская площадь – Uspensko-Radolninskaya area

Условные обозначения – Symbols

Уголь – Coal; Песчаники – Sandstones; Слабоуглистая порода Алевролит – Poorly carbonaceous rock Aleurolite; Слабоуглистая порода Аргиллит – Poorly carbonaceous rock Argillite; Тонкое переслаивание алевролитов и песчаников – Thin interstratifications of aleurolites and sandstones; Гравелиты – Gritstone

with myriarians and brachiopods were selected. Deposits are presented by argillites, aleurolites, sandstones and conglomerates. Their distinctive feature is the presence of big amount of coarse-grained fragmental material – sandstones and conglomerates which form rather powerful layers. Layers of coal in the given section are rare, low-power and are not sustained on course.

The remains of plants *Tomiodendron* were found in deposit of the given pack by the author *sp.*, *Abacaniidium sp.*, *A. abaeatum* (Zal.) Radez., *Paracalamites sp.* and *Dichophyllites cf. karagandensis* Bors. and numerous *Chacassopteris concinna* Radez. were found by the author in the deposits of the given pack. Finds of myriarians and brachiopods *Lingula sp.* were noted [3]. Thus, on the basis of the above listed features it is possible to draw a conclusion that section of the Novo-Aleksandrovskaya area is presented by lagoon and deltoid deposits [4]. They were formed in the transgressive stage of depositogenesis. The capacity of coal deposits in territory of the Novo-Aleksandrovskaya area according to drilling data exceeds 300 m. The parity with underlying rocks is not established, as the sole of the pack is not opened by search wells. The top border is sharp; the pack is blocked by Cenozoic deposits. Based on systematic composition of flora, which was found in given deposits, the age of rocks was determined to be the Serpukhov century of the early Carboniferous.

The Lugovskaya area

The Lugovskaya area is dated to syncline (the Lugovskaya trough) of the sublatitudinal course located 20 km to the north of the Gorniak city. Its deposits are studied by drilling of 28 search wells. Coal rocks are opened in the Lugovskiy site, in the Western part of the Lugovskaya trough. The paleontologic remains are found in the core of 10 wells. As a result of their level-by-level examination only 640 samples with remains of plants are found, they are presented by lycopsids, arthropytes, single ferns, holoseeds of the uncertain systematic position and 4 samples with fresh-water myriarians.

Coal deposits of the Lugovskaya area are characterized by monotonous composition of rocks – rhythmic interstratification of sandstones, aleurolites and argillites. Very often within the limits of one layer thin stratification of inequigranular rocks is observed. Layers of coal are of very unrestrained character and complex structure. The paleontologic remains are presented by mineral plants *Koretrophyllites vulgaris* Radez., *Abacaniidium sp.*, *A. abaeatum* (Zal.) Radez., *A. cf. chacassicum* Radez., *Rhodea javorskyi* Radez. and *Aphlebia ostrogiana* Gorel., single *Cardioneura cf. sibirica* Zal., *Angaropteridium cardiopteroides* (Schmalh.) Zal., *Samaropsis cf. severnoensis* Such. Among spineless only single finds of fresh-water myriarian shells are found by the author, the sea fauna is absent. Such features of deposits characterize continental lake-alluvial facies [5–7] which were formed during the regressive stage of depositogenesis. Coal rocks lie unconformably on the Devonian deposits of the Pihtovskaya series and are unconformably overlapped by the Jurassic deposits of the Lugovskaya series.

Their capacity according to drilling data is about 144 m. The discovered complex of mineral flora allows dating the given deposit to the Bashkirskiy century of the average Carboniferous.

The Uspensko-Razdolninskaya area

The Uspensko-Razdolninskaya area is located the North-west of Gorniak village and Orlovka village. It is dated to syncline of the south-east course. Coal deposits of the syncline are drilled by 58 wells. Fossils are found only in the core of 39 wells. They occur extremely non-uniformly in sections of the wells, even within the limits of one structure. In total 3180 samples with vegetative remains and about five dozens of unbroken shells and fragments of brachiopod, myriarians were selected. Coal deposits are presented by interstratifications of argillites, aleurolites, sandstones, conglomerates and gritstones, the presence of coal thick layers is noted. Some distinctions are observed between the bottom and the top parts of the section. The bottom part of the section is characterized by more coarse-grained composition of composing it rocks – layers with sandstones and aleurolites with interlayers of sandstones prevail. Coal layers are low-thick, not sustained on course. Paleontologically, the bottom part of the section is characterized by sea fauna (brachiopods ♂) and vegetative remains in small quantity and they are often in bad condition. The vegetative remains are presented by *Paracalamites sp.*, *Koretrophyllites sp.*, *Koretrophyllites vulgaris* Radez., *Abacaniidium sp.*, *Angaropteridium sp.*, *A. cardiopteroides* (Schmalh.) Zal., *Angaridium sp.*, *A. potaninii* (Schm.) Zal., *Angaridium (?) tenuis* Gorel., cordaites (are found only in the section of the Northern site) *Cordaites sp.*, *Rufloia sp.*, *R. ex gr. archaica* (Gluch.), *R. ex gr. theodorii* (Tschirk. et Zal.) S. Meyen, *R. ex gr. subangusta* (Zal.) S. Meyen, seeds *Gluchoviella siberiana* (Zal.) Sivtch., *Angarocarpus sp.*, *Cardiocarpus krapivinoensis* Such., the remains of spineless are presented by: *Lingula sp.*, *Balakhonia sp.*, *Cleothyridina sp.*, *Productidae*, fragments of columnal, valves of sea folding mollusks. These coastal-sea, deltoid deposits reflect the transgressive stage of depositogenesis.

The top part of the section is characterized by increase in biodiversity which is shown in the form of new taxons occurrence and increase in quantitative composition of vegetative remains, which presented by *Paracalamites sp.*, *Autophyllites sp.*, *Phyllothea sp.*, *Ph. tomensis* Chachlov, *Koretrophyllites mungaticus* Radez., *Baracaria obrutschevii* Neub., single *Annularia asteriscus* Zal., *Angaropteridium sp.*, *A. cardiopteroides* (Schmalh.) Zal., *A. buconicum* Tschirk., *Neuropteris izylensis* (Tschirk.) Neub., *Angaridium sp.*, *A. potaninii* (Schm.) Zal., *A. submongolicum* Neub., *Paragondwanidium petiolatum* (Neub.) S. Meyen, *P. odontopteroides* (Zal.) S. Meyen, *Sphenopteris sp.*, *Sphenopteris izylensis* Zal., *Prynadaeopteris sp.*, *Ginkgophyllum vsevolodii* Zal., *Cordaites sp.*, *C. odontophyllum* Gluch., *C. neuburgae* Gluch., *Rufloia sp.*, *R. ex gr. archaica* (Gluch.), *R. ex gr. theodorii* (Tschirk. et Zal.) S. Meyen, *R. ex gr. subangusta* (Zal.) S. Meyen, *Rufloia sp. 1*, *Entsovia rara* Gluch., *Elatocladus kassagatschica* (Tschirk)

Krysh., *Gaussia cristata* Neub., *Krylovia* (?) sp., *Samaropsis rectialata* Neub., *S. patula* Zal., *S. cf. severnoensis* Such., *S. auriculata* Neub., *S. euryptera* Such., *Angarocarpus ungenis* (Zal.) Radcz., *Rasskazoviella angarica* (Rassk.) Sivtch., *Gluchoviella siberiana* (Zal.) Sivtch., *Cardiocarpus* sp., *Cardiocarpus krapivinoensis* Such.

In lithological way, the top part of the section is characterized by more fine-grained rocks which are presented in general by interstratification of fine-grained sandstone with aleurolites and argillites, aleurolites, argillites and coals. Upwards on the section granularity of rocks increases, more thick layers of sandstones appear. Simultaneously, the elements of sea fauna appear (brachiopods). Such features of lithologic and paleontologic composition of deposits (replacement of lake-marsh and alluvial deposits by coastal-sea, increase in regular and quantitative composition of the floristic complex, occurrence of sea fauna) indicate the regressive-transgressive stage of depositogenesis [8] during which the top part of the coal deposit section of the Uspensko-Razdolninskaya area was formed.

Coal deposits of the Uspensko-Razdolninskaya area diconformly lie on the Devonian and are overlapped by the Cenozoic. The capacity of these deposits fluctuates from 200 up to 1200 m. The age of deposits, taking into account the found vegetative and animal remains, is ascertained as Moscovskiy (the bottom part of the section) and Kasimovsko-Gzhelskiy (the top part of the section) centuries of the coal period.

Conclusion

Formation of coal deposits of the Rudnyi Altai Russian part took place against the background of the oro-

genesis process of the Sudet phase of the Hercynian epoch tectogenesis within the limits of local stretching zones (in intermountain deflections) [9, 10]. These processes led to replacement of sea deposits of the Buhtarminskaya series by coastal-continental of the Maloulbinskaya series, which reflects the transgressive-regressive stage of depositogenesis. In deposits of the Maloulbinskaya series one can point out the separate pieces of finer order responsible for the transgressive-regressive cycle. The section of the Novo-aleksandrovskaya area represents the transgressive stage of depositogenesis, the section of the Lugovskaya area – the regressive stage. The bottom part of the section of the Uspensko-Razdolninskaya area characterizes the transgressive stage, and the top part of the section – the regressive stage of deposition with small ingressions. The given character of depositogenesis in the territory of the Rudnyi Altai nearly coincides with eustatic events of Siberia Carboniferous [11]. That once again confirms legitimacy of establishment of separate stratigraphic divisions in composition of coal deposits.

Results of detailed study in the Rudnyi Altai Russian part coal deposits have questioned the common fact that Carboniferous in the given territory is presented only by deposits of the Maloulbinskaya series of the Middle-coal age. Three fragments of coal deposits described above were formed at various times dated to different structure-facies zones and are different in lithologic paleontologic features. It gives the basis for reference of these fragments to three uneven-age series in the future. Such detailed partition of coal deposits will undoubtedly render greater help at correlation of coal layers at detection and research of new sites of coal deposits on the territory of the Rudnyi Altai Russian part.

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