Systematic composition of the middle Jurassic flora and its stratigraphic distribution (Ustyurt region, Uzbekistan)

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Abstract. The article presents the systematic composition and stratigraphic distribution of the Middle Jurassic flora of Ustyurt (Uzbekistan). In the Middle Jurassic sediments, three plant complexes of different ages are distinguished, corresponding to aalen, bayos and bath, differing from each other by the unequal species composition of Coniopteris ferns and Nilssonia cicadas. The change of complexes during the Middle Jurassic occurred gradually. The vegetation reached its greatest dawn in the Bajocian and Bath centuries.

1 Introduction

Determining the age and correlation of the Jurassic continental sediments of the Ustyurt region is the most difficult and controversial issue, due to such specific features of these strata as facies incontinence, lack of guiding fauna [1]. In such a situation, the main tool for stratigraphy of these strata can be the remains of plants, which until recently were practically not used for these purposes due to their poor knowledge [1-5]. The stratigraphy of the Jurassic deposits of Ustyurt is covered in many publications by Akramkhodjaev et al., 1962, 1967, 1970; Aykhodjaeva et al., 1968; Alimova, Kuzichkina, 1966; Alimova, Khachieva, 1973; Garetsky et al., 1964; Grinberg, Sukhinin, 1966; Rodvilsky, 1971; Shebuev et al., 1969; Radyushkina et al., 1966; Khachieva, 1977; Beneson et al., 1969; Abdullayeva et al., 2003; et al. Biostratigraphic studies of sections of the Jurassic strata of the Ustyurt region, which began in the 60s of the last century, have significantly weakened after the 70s. By the 80s, paleontological research stopped altogether, which was largely due to the fact that since the 80s of the XX century, the pace of prospecting and exploration began to decline, which in turn led to a reduction in scientific research [6-10]. The dismemberment of the rocks exposed by drilling was carried out according to logging diagrams using age dating of previous years.
2 Methods and materials

From 2007 to the present, more than 30 exploratory and exploration wells have been drilled, 4566.3 m of core material has been raised. Research work on the complex study of core material is carried out in JSC “IGIR-NIGM”. These studies provide good prospects for studying the lithological and facies features of Jurassic rocks, solving a number of issues on the stratigraphy of the Jurassic, in particular, one of the most important tasks is the biostratigraphic dismemberment of Jurassic sediments [10-15].

This paper presents the floristic characteristics (summary lists) of Jurassic sediments, determination and clarification of their age, taking into account the facies type of sediments, comparison with complexes of neighboring areas [16-20]. When describing the section, attention was paid to all plant residues without exception: definable and indefinable, good and poor preservation, single and occurring in mass quantities, as well as the occurrence of certain plant residues to precipitation of one or another facies type [21-25].

3 Results and discussion

As a result of the conducted research, new data on Jurassic flora were obtained (Table 1).

Monographically selected macrostates of plants from the Middle Jurassic sediments have been studied in layers. As a result, the taxonomic composition of the Middle Jurassic flora of Ustyurt has been clarified:
- the stages of development of the Jurassic paleoflora have been age-dated. Thus, phytogorizons and layers with flora isolated in the Jurassic thick-ness of the Ustyurt basin received a clear stratigraphic reference.
- it has been established that the distribution of flora is related to the physical and geographical conditions of the environment, which determines the great importance of this group for the reconstruction of the conditions of sedimentation of the paleobasin.

![Fig 1. a) Coniopteris embensis Print., prints of single feathers (VostuAytuz square, sq.1, int.2965-2966 m). Middle Jurassic (Aalenian tier).](image)

![Fig 2. b-v). Anomozamites minor (Brongn.) Nath. The imprint of an elongated ribbon-shaped segmented leaf area of Gel, sq.2, int.2382-2383 m (Aalenian tier)](image)
Fig 3. g-d) The imprint of Cladophlebis whitiensis Brongniart.; the shape of the feathers and venation are clearly visible, uv.x6 times. Kartpai pl., sq.1, int.2950-2968m (Bayos tier)

Fig 4. e-j) Fern Coniopteris vialovae Turutanova-Ketova, triangular shape with a sharp, elongated tip; c,d) in.x2 times. Western Aral square, sq.1, int.2450-2468m (Batsky tier)

Some representatives of the Middle Jurassic deposits of a single sequence of the development of the Ustyurt flora complexes with the same age associations of the Bukhara-Khiva region, the Southwestern spurs of the Hissar ridge, Ukraine, Russia, Europe, and the Caucasus is determined and the important correlative role of floral complexes in clarifying the dissection of different facies sections is shown.

In the Middle Jurassic sediments, three plant complexes of different ages are distinguished, corresponding to Alain, Bayos and batu, differing from each other by the unequal species composition of Coniopteris ferns and Nilssonia cicadas.

The change of complexes during the Middle Jurassic occurred gradually. 

Fig.5. Composition of the flora of the Aalen tier The deposits of alain are lithologically represented by coarse-grained unsorted, obliquely layered, porous sandstones, turning in places into mudstones of dark gray, black color, with...
a microhorizontal layered texture, with numerous carboniferous, pyriticized remains of plants, rare inclusions of coals are observed. We have identified the following species as part of the Aalen flora: Neocalamites hoerensis (Schimper) Halle, Sphenobaiera cf. czekanowskiana (Heer) Florin, Nilssonia vittaeformis Pryn, N. inonyeri Yok, Coniopteris cf. spectabilis Bri., Cladophlebis cf. lobifolia (Phill.) Brongn., Eborasia lobifolia (Phill.) Thomas, Nilssonia sp., Phoenicopsis ex.gr. angustifolia Heer, Pityophyllum cf. angustifolium, Pterophyllum cf. anarcanum Schimp., Czekanowskia cf. rigida Heer, Carpolithes heere-Ketova (see fig.1).

Fig.6. Composition of the flora of the Bayos tier

The sediments of the bayos above are represented by mudstones dark gray to black, in the upper part of the section more clayey, with charred plant remains, in the lower part thin layered, crumbly, with interlayers of gray fine-grained, thin-plate sandstone, sliding mirrors are also observed. Rather large carboniferous remains of plant stems and leaves are observed in the rocks (see Fig. 1.): Neocalamites hoerensis (Schimper), Equisetites sp., Equisetites beanii (Bunbury) Seward, Equisetites laterialis (Phill.) Phill., Coniopteris embensis Pryn, Coniopteris cf. maakina (Heer) Pryn, Coniopteris simplex (Lindl. et Hutt.) Harris, Coniopteris spectabilis Brick, Coniopteris whitbiensis Brong., Cladophlebis lobifolia (Phillips) Brong., Klukia cf. exilis (Phill.)

Fig.7. Composition of the Bath flora

The Bath formations are composed of gray fine-grained, polymictic siltstones alternating with dark gray clay formations with a micro-layered texture due to the abundant inclusion of carbonized plant detritus, which occurs both in the form of large prints and finely dispersed.
organic matter in the bulk. The Bath plant complex (see Fig. 7) is represented by such species as Neocalamites hoerensis Halle, Neocalamites pinitoides (Chachl.) Chachl, Equisetites sp., Prun. Coniopteris burejensis (Za1.) Seward Coniopteris simplex (Lindl. et Hutt.) Harris, Cladophlebis denticulata (Brongn.) Cladophlebis haiburnensis (L. et H.) Seward, Podozamites lanceolatus (L. et H.) Schimper, Nilssonia polymorpha Sch., Phoenicopsis ex.gr. angustifolia Heer, Phoenicopsis cf. angustifolia Heer, Phoenicopsis speciosa Heer.

4 Conclusion

From the above brief overview of the Jurassic vegetation of Ustyurt, it can be seen that the Jurassic flora can be divided into the following complexes: Early Jurassic, Aalen, Bayos, Batsky and Kelloveysky. The vegetation reached its greatest dawn in the Middle Jurassic era, namely in the Bajocian and Bata centuries. Thus, a monographic study of the fossil flora, collected strictly in layers and in all cases precisely linked to the geological section, leads to a paleobotanical substantiation of the stratigraphy of the Jurassic deposits of Ustyurt. This makes it possible to substantiate and detail to some extent the stratigraphic scheme of the Jurassic deposits of this region, which can be used during geological exploration, to correlate and determine the age of individual sections of the section opened by deep wells of new areas of the studied region and in adjacent territories.

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