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THE RHYTHMIC BUILD OF SEDIMENTARY FORMATIONS AS A MIRROR OF THE WASHOUT AREAS PALEOTECTONICS

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В статье на основе анализа литературных источников и собственных наблюдений автора сделан вывод об ошибочности существующих представлений о волновых движениях бассейна осадконакопления как первопричине ритмического сложения осадочных толщ. В качестве такой причины рассматривается прерывистый характер воздымания областей сноса осадочного материала. Ритмичность сложения осадочных толщ, в частности угленосных, рассматривается как ключ к реконструкции палеотектонических движений в областях сноса.

В статті на основі аналізу літературних джерел та власних спостережень автора зроблено висновок про помилковість існуючих уявлень про хвилясті рухи земної кори як причину ритмічного складу осадкових товщ. В якості такої причини розглядається перериваний характер підйому областей зносу террігенного матеріалу. Ритмічне зложення осадкових товщ розглядається як ключ до реконструкції палеотектонічних рухів в областях зносу.

Many coal-bearing formations have rhythmic stratified structure. The origin of rhythmic build of granulometric composition of sedimentary sequences, including coal-bearing ones, was a subject of lively discussions in the course of many years. For explanation of this phenomenon, some researchers (G. A. Ivanov [1] et al.) suggested a special mechanism of short-periodic oscillatory movements of the sed-

imentation basin bottom on the background of its total sinking (the wave theory), which seemed to be especially attractive, considering a possibility of its mathematical presentation with factorization into harmonic components, though satisfactory explanation for the nature of such mechanism was not suggested. It is proper to note that besides of the mentioned other variants were offered as well, for example a mechanism of the rhythmic sedimentation suggested by P. Pruvost and consisting in pulsating, i.e. interrupted character of the basin's bottom sinking, but his hypothesis that received name "the hypothesis of Pruvost" was not supported by scientific community, while the wave theory acquired for long years status of an irrefutable dogma.

The most widespread error of nearly all researchers in the sphere of lithology lies in aspiration to reduce all diversity of factors having influence on the character of a terrigenous sediment to two main ones – depth of the sedimentation basin and remoteness from shoreline. This is an extremely simplified scheme based on sufficiently primitive notions about differentiation of sediments in the aquatic environment. The accepted by G. A. Ivanov model of distribution of the zones of sedimentation does really exist, but, as it was shown long ago by F. P. Shepard [13] and affirmed by recent researches of G. G. Matishov [14] and others, it can be attributed only to very narrow coastal stripe along the abrasion shores and can not follow the advancing or retreating shoreline, as it was shown at the notorious schemes of Ivanov, without considerable perturbations due to inevitable washout of previously deposited sediments in course of transgressions and regressions.

In most cases the mistake lies in an aspiration to explain practically all peculiarities of the sediment by paleogeographical and paleotectonic conditions exclusively of the basin or territory of sedimentation, while in reality in formation of the lithological profile of sedimentary cross-section, besides of climatic conditions, take part, as a minimum, three relatively independent paleotectonic factors – tectonic regime of sedimentation area, tectonic regime of areas of the clastic (including organic) material washout, and also eustatic oscillations of sea level, by all evidence, also caused by tectonic movements of the ocean floor, but in more distant areas (tectonoeustatic). In this connection, it is necessary to recognize that the lithology of the sediment,

and, first of all, its granulometric composition, is in the greatest degree influenced not by depth of the sedimentary basin and remoteness from the shore, but by processes taking place in areas of washout, caused by rate of lifting of the continental blocks and energy of water flows, that are practically ignored by authors of facies theories. Indeed, be it any depth of the water reservoir, if from the washout area comes only pelitic material, the composition of formed sediment by all means can not be psammitic or psephitic, and opposite. This seemingly obvious circumstance was noted at different times by such researchers as L. B. Rukhin and V. S. Popov [3, 4], but their conclusions remained unnoticed by community of lithologists-facialists.

In shallow water reservoirs, the wave processes, reaching bottom, lead to certain form of areal differentiation of the sediment, and as a result, on the banks, spits and shallows, the most fine-grained part is carried out from total mass of sediment, and these areas of bottom are always characterized by the most coarse-grained sediment. But at all events, in the composition of the isochronous layer will prevail the material which is predominant in the hard run-off.

The logical mistake made by G. A. Ivanov and his followers [5, 6] is that, though a carefully developed by him hypothetic scheme of rhythmic sedimentation with migration of shoreline was intended only as a probable explanation for the mechanism of formation of granulometric rhythms, later on, the very existence of these rhythms began to be perceived as a proof of the hypothesis itself, in spite of existence in the proposed scheme of unexplained by any means controversies. In reality, coal and limestone, that according to the hypothesis of Ivanov are full antagonists, in the granulometric profile of coal-bearing sequence of Donbas occupy the same position, and not infrequently are neighbors in the cross-section, in full accordance with the law of Golovkinsky-Walter, what proves their close genetic relationship. Though, according the same hypothesis, coals, unlike limestones, must occupy place among the most coarse-grained part of the sequence. The zigzag occurrence of the rhythmically built sequences in accordance to the schemes of Ivanov, not only has never been discovered, it is impossible even theoretically, because of inevitable fluvial and marine abrasion of already deposited sediments in course of shoreline migration, and these are only two of many erroneous state-

ments. It is proved long ago [7, 8], that coal beds, so as other elements of sedimentary rhythms, are isochronous formations, i.e. are formed simultaneously throughout whole territory of their spreading.

Nevertheless, during many decades the scheme of Ivanov, acquiring status of a theory, together with inseparable from it theory of autochtonous peat-coal accumulation, thoroughly occupied minds of several generations of coal geologists. There exists great number of known facts testifying that fossil coal represents an usual clastic sedimentary rock of organic composition that is formed in the aquatic sedimentary basins on account of the peatbogs subject to denudation and disintegration in the areas of washout, i.e. coal is an allochtonous formation, so as nearly all other members of coal-bearing sequences [9, 10, 15].

The inclination of the facies theories into the side of explanation of the rhythmical character of sedimentation by wavelike movements of the bottom of sedimentation basin as the main or single factor, is caused, first of all, by the fact that washout areas of ancient sedimentation basins most often are beyond scope of researchers and in many cases are at all unknown, while the accumulated sediments, as a rule, are partly or in full preserved and accessible for study.

The process of accumulation of thick sedimentary sequences of rhythmic built can be presented as follows [9, 10].

For the formation of thick sedimentary (including coal-bearing) sequence, the necessary condition is existence of two more or less close neighbouring areas of the Earth surface, one of which experiencing steady sagging (area of sedimentation) and other, simultaneously, steady rise relatively to the basis of erosion (area of washout). As it has been shown by L. B. Rukhin [3], V. S. Popov [4] and others, ascending and descending orogenic movements taking part in the sedimentation processes are uniformly directed but not oscillatory as it has been proclaimed by the wave theory.

The sedimentation at the area of sagging to be rhythmic, the rise of the washout area must occur in pulsing (interrupted) mode, when after the phase of relatively quick rise, at which the energy of water flows is maximal and into the basin of sedimentation comes the most coarse-grained material, follows the phase of relative rest, duration of which is enough for leveling of the relief and accumulation in the sed-

imentation basin of more or less thick layer of phytomass (by favorable climatic conditions for vegetation and closed character of the sedimentation basin) or, by other sedimentation conditions, organogenous, and also chemogenic or evaporate mineral deposits, most frequently limestones. Infringements of the basin's closed character may be caused by eustatic changes of sea level.

In the washout area, when energy of water flows is low, peatbogs of different types – lowland, watershed and intermediate, are washed off together with the mineral substrate and fresh plants, but mineral components along with undecomposed large plant fragments are subject to a short-distance transfer, while the peat mass disintegrated by water flow, owing to its low specific weight, reaches the final basin of sedimentation and forms a deposit of disintegrated organics, being an initial material of a coal bed. At the periods of high flow energy, amount of organic matter in the hard run-off is so small in comparison with a mass of mineral components, that it can form only dispersed organic matter in resulting sedimentary rocks.

Resuming of upward movements in the washout area is accompanied by drift-over of more and more coarse grained sediments, burial of deposed already organics which consequently form a coal bed, i.e. the complete rhythm is formed. Local conditions of the sedimentation basin have minor effect on the composition of the sediment, being reflected mainly in its supplementary features, such as communities of fossil fauna, ripple marks etc.

The interrupted character of upward orogenic movements can be judged about by areas of modern upward movements in regions of spreading of thick dislocated carbonate sequences prone to the action of tidal oscillations of the sea level, where every pause in upward movements is fixed by development of horizontal karst – system of caves formed in the elevation interval between maximal and minimal tidal sea level, and also of abrasion niches on the surface of coastal cliffs.

So, at the sea coast of the Northern Vietnam in the dislocated carbonate massif of Devonian-Carboniferous-Permian age experiencing present-day uplift, there are noticed several levels of horizontal caves at the altitudes of 5-6 m above sea level (the youngest), 15-18 m (second level) and higher, up to marks of several hundred meters. At

first glance it may seem that in other areas experiencing uplift, where coincidence of soluble rocks and sea tides is absent, such reliable indicators of the interrupted uplift character are not present and single evidence of this phenomenon can be found only in sediments stored in the accumulation area. Nevertheless, if the question is about areas of modern uplift, the interrupted character of the process is fixed by the multistory structure of river terraces, each of them corresponding to the position of the base level of erosion formed during one of the pauses in the process of uplift [11, 12].

The cause of interrupted character of the orogenic movements can be found in the same natural mechanism that controls earthquakes and volcanic eruptions – steady accumulation of tectonic stresses with their periodical discharge when they reach critical level. On this background, the sedimentation process is affected by minor short-term changes of water level, caused by the eustatic ingressions and emersions that can explain many of peculiarities in structure of sedimentary cycles.

There is no ground for the opinion that during former geological epochs the character of ascending movements of the Earth's crust blocks was different from the present-day one. Thus we may rightfully use the rhythmic build of sedimentary formations for deciphering the paleotectonic history of the washout areas, even if their exact location is not determined.

All aforesaid is related to the simplest case where in the process there are involved only one basin of sedimentation and single area of washout. And if to take into consideration that one basin of sedimentation may have not one, but two or more washout areas, and the rhythms themselves may be incomplete, it becomes clear what prospects (but also difficulties) are opened in study of the paleogeography and paleotectonics of the coal accumulation epochs.

The genetic schemes not based on facts lead to untrue notions about the paleotectonics of coal basins and their surrounding, incorrect paleogeographic constructions, and, at the same time, there is missed the opportunity to make up the notion about paleotectonic regime of ancient washout areas, i.e. to open unknown pages of geological history of the planet.

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