

Amber deposits and finds in Belarus

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While studying the regularities of the dissemination of fossil resins on Earth it is not difficult to notice that different kinds of fossil resins are linked to areas, which have retained certain features of their geological history. The resiniferous deposits of Belarus occupy a special position among the potentially productive complexes of amber of the western part of the East European platform. The terrain of south-western Belarus is situated between the floor spaces with documented amber deposits on the Sambian Peninsula and the north-western declines of the Ukrainian shield. Many common traits are found in the constitution, composition and conditions of the formation of the Paleogene deposits in those regions, which along with direct discoveries of fossil resins within the Polesye region of Belarus underscores the prospect of finding significant resin amounts there. The vast majority of the fossil resins found in the marine Paleogene deposits of Belarus is dated for the deposits of the Kharkov Fm. (=horizon), which in considerable terrain are widely found within all structure-facies zones (BURLAK 2005). In the most comprehensive profiles of the Kharkov Fm., the changeover of sediments reflecting the transgressive and regressive development cycles of a sea basin is observed.

The sediments of the bottom part of the Kharkov Fm. (Late Eocene) on the Polesye saddle and in the Podlasye-Brest depression are represented by arenaceous, glauconitic-quartz, micaceous, non-carbonated silts, with fields transforming into sands (glaucous, rarer green-grey, close-grained, frequently alevrite to various extent, clayed, glauconite-quartz, micaceous, non-carbonated). The sediments of the bottom part of the Kharkov Fm. are normally underlain by the formations of the Kiev Fm. and in the peripheral parts of the paleobasin in the south of the Polesye saddle and the Podlasye-Brest depression by the blurred formations of the Upper Cretaceous. Here, in the base surface of the profile, conglomerates of rubble and concretions of dark grey, very strongly phosphoritic sandstone are observed. The layer of the Upper Eocene sediments in the Podlasye-Brest depression is 10 to 12 meters and on the Polesye saddle it is 5 to 7 meters thick.

The deposits at the top of the Kharkov Fm. (Early Oligocene) in the south of the Polesye saddle and in the Podlasye-Brest depression are represented by the uniform stratum of glaucous, occasionally green-grey, close-grained, well sorted glauconite-quartz, frequently micaceous sands with occasional large and medium-sized well rounded quartz grains. The layer of the deposits at the top of the Kharkov Fm. considerably varies in thickness from 6 to 15 meters. Over the greater part of the Podlasye-Brest depression, the Kharkov Fm. is covered with the continental deposits of the Upper Oligocene – Neogene, while the rest of the area – with the Quaternary formations. The mineralogical composition of the formations of the Kharkov Fm. is dominated by quartz and glauconite, with a subordinate place occupied by muscovite, feldspars, phosphates, spalls of effusive and metamorphic rocks. The quantity of heavy mineral content is insignificant.

The age of the sediments of the Kharkov Fm. is determined on the basis of the studies of spores and pollen, algal flora, mollusks, spicules of sponges and confirmed by the data of the radioactive geochronology (BURLAK 2005). There are two palynocomplexes in these deposits, which are described quite well by S.S. MANYKIN (1973) and A.F. BURLAK (1992). The first is characteristic for the horizon's bottom, its taxonomic composition is close to the Kiev suite (Middle Oligocene) and it displays considerable similarity with the spore-pollen complex of the Obuhov suite of the Kiev Pridneprovye territory (Upper Eocene). The second palynocomplex – in the upper portion of the deposits of the Kharkov Fm. – in its systematic composition of pollen of the coated and gymnosperms is close to the palynocomplex of the

Mezhigor suite (with amber) of northern Ukraine (Early Oligocene). Palaeontological data makes it possible to designate the age of the deposits of the Kharkov Fm. as Late Eocene – Early Oligocene (Priabonian – Rupelian). The Late Eocene age of its bottom is also confirmed by the results of the K-Ar analysis of the autogenic glauconite: by three definitions it is dated 37.0; 37.5 and 38.0 ± 2 million years (MURASHKO 1994).

By now, the fact of the amber-bearing sediments of the Kharkov Fm. on the territory of Belarus has been established by a large number of borehole profiles. However, due to the non-representative character of the sampling works, the obtained results do not provide enough reliable data on the scale of the ore fields. The resins in core samples typically have the form of thin scraps of grains with dimensions of no more than 1.0 cm. Quite possibly they were fragmented during the boring. From the point of view of the prospects of amber-bearing, the Polesye saddle is of the greatest interest and it is characterized by the accumulation of shallow-water deposits, in relation to the sineclizes situated to the east and to the west. The shallow (epicontinental) character of the water of the Eocene–Oligocene sea is confirmed by the differences in the Upper Oligocene spore-pollen complexes of the southwest and southeast regions of Belarus. Thus, the composition and interrelation of the found forms of the spore-pollen complexes of the western regions are closer to the even-aged complexes of the Baltic and Western Europe than to the complexes from the deposits of the southeast of the republic (BURLAK 2005).

Despite certain rearrangement at the tectonic stage of development, the Middle-Upper Paleogene sediments on the Polesye saddle (especially in its southern and eastern parts) are situated higher – in relation to the current hypsometric position of the base surface of the Kiev Fm. – in comparison with the adjoining floor spaces of the adjacent sineclizes. The amplitude of this difference is about 20 m and is especially accurately traced on isohypses +60 and +80 m. In the southern part of the terrain of the Polesye saddle, in the immediate vicinity of the floor spaces with the expressed recurrence of sedimentations, profiles which are completely filled with non-sorted sands are sometimes found. The formation of such profiles may have had a polygenetic nature but is more likely due to the perturbing influence of running paleorivers. The picture is completed by the accumulation of the gentle graded sands dissecting the deposit region of the carbonate rocks of the Kiev Fm. (Bartonian) and wedging in the field of argillaceous silts both of the Kiev and the Kharkov Fm. In the light of the above-mentioned criteria, the areas with such profiles have a potential of resin accumulation.

Single finds of fine resin grains are known in the Neogene deposits forming the so-called "lignite" formation in the southern regions of Belarus. Fossil resins are found in the closed-grained silica sands containing fine vegetative detritus and separate weathered glauconite grains. It seems that, due to denudation, they come from Paleogene resiniferous sediments which underlie the carboniferous strata. Considerable clumps of resins in the Neogene deposits of Belarus should not be expected.

The indirect testimony of the more amber-bearing deposits of the Kharkov Fm. are also the finds of individual chunks and the whole clumps of the redeposited fossil resin in Quaternary deposits in which they have been entered during the spreading of Paleogene formations. In the Quaternary deposits of Belarus, the finds of fossil resins are predominantly known in the south-west regions, in sandres and limnetic-alluvial plains of the Brest Polesye and in the alluvial plains of Pripyat Polesye. The distribution of the resin finds in the profile allows us to allocate them to fluvial-glacial and limnetic-alluvial facies. So far, about 50 sites of fossil resin finds have been recorded in the Quaternary deposits of the southwest of Belarus (AZHGIREVICH *et al.* 2000; BOGDASAROV 2001).

The forming of amber placers in the Quaternary sediments took place at the expense of the material from Paleogene deposits and the subsequent differentiation of this material in fluvial-glacial streams. This statement is a criterion for local forecasts and amber prospecting in areas which have not been researched yet (AZHGIREVICH *et al.* 2000; BOGDASAROV 2001).

The prospective evaluation of the amber-bearing and extraction possibilities of the Quaternary deposits of Belarus can be executed only for the southwest of its terrain. The Republic's Southeast is not promising in this regard.

The secondary amber placer accumulations revealed up until the present are not industrially viable. The fossil resin prospecting operations in the Quaternary deposits are carried out in a rather restricted terrain – only within a paludous massive of the Gatcha-Osovo occupying less of 10% of the total area of all perspective zones. The practical lack of prospecting activity in other areas provides statistical odds for finding more productive amber deposits here. On the other hand, the formation of successive deposits of resin dissipation in the Quaternary sediments points to the essential shattering of the resin's secondary deposits and the necessity to make a good note of this factor at a potential assessment of Paleogene deposits.

The largest and best studied deposit of fossil resins is Gatcha-Osovo, located in the interfluvium of the left-hand inflows of the river Muhavets – the rivers Osipovka and Trostjanitsa, approximately 12 km to the South-West from Kobrin. Its geological constitution is typical of the majority of some considerable resin clumps in the Quaternary sediments of Belarus. Analyzing the composition of the deposit components and the peculiarities of fossil resins distribution, it is possible to conclude that the main productive sediments are: sandy-gravel admixtures of the roof of the Dnepr glacial complex of the Pripyat horizon, lying down on Dnepr moraine and coated by Belarus-Lakeland limnetic-alluvial deposits, and Holocene deposits of various genesis.

Today the amber productivity of the individual horizons of Cenozoic deposits of Belarus is confirmed by a number of excavation sites and does not invoke any doubts. The available research allows us to expect that these deposits can actually be extracted. As results of the explorations, stratigraphic correlations and reasons for the formation of accumulations in Paleogene deposits have been detailed. It has been determined that the discovery of the buried amber placer accumulations was most probable in the deposits of top Kharkov, Stradub and Krupej horizons.

The criteria for the location of amber-bearing placer accumulations in fluvial-glacial sediments over the Dnepr moraine and in younger Quaternary sandy deposits have been revealed. We need to emphasise the significance of prospective areas when acquiring fossil resin fields, taking into account their frequency, the location of the amber-bearing sediments, as well as the presence of amber in drill core samples.

Having recognised the expertise of the prospecting and evaluation operations in the Gatcha-Osovo area, it is necessary to emphasize that the assessed potential of the Quaternary deposits calls for certain restraint. It is necessary to assume that both in placer accumulation formations and in other types of deposits, certain processes may cancel all the other favourable formation factors (PETROV 2005). Water pulsation and the velocity of fluvial-glacial streams could have become such unfavourable circumstances. Instead of creating accumulation-prone sites, they may have caused the distribution and dispersion of amber over vast areas.

The finds of fossil resins are rather rare and peculiar, which influences largely the character of geological prerequisites for fossil resin prospecting and evaluation. Due to the fact that resin accumulation is determined by the joint action of tectonic, geomorphological, stratigraphic, litological and mineralogical factors, the basic criteria for deposits prospecting are considered analogous. It is well-known that several kinds of resins can be found in one area. Contemporary methods of investigation make it possible to identify amber (succinite), as well as other fossil resins, which are in no way inferior to amber both in quality and in price. Consequently, the most important prerequisites for the classification of fossil resin deposits must be not only the reconstruction of the conditions of formation of the rocks which contain them, performed on the basis of a complex of special geological investigations, but the actual mineralogical determination of fossil resins.

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