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SUBFOSSIL POLLEN SPECTRA OF FLOOD-PLAIN FOREST OF *PTEROCARYA PTEROCARPA* IN THE ALAZANI VALLEY (EAST GEORGIA)

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ABSTRACT. The study of the flood-plain forest of the Alazani valley with its predominance of *Pterocarya pterocarpa*, and comparison of the pollen spectra composition with similar spectra from Colchis and Lagodekhi, clearly demonstrated some features peculiar to the Alazani spectra. One is the underestimation of the role of *Pterocarya* pollen, although the, the Alazani spectra, as a whole, adequately depict the dominants of all three layers of the arboreal vegetation. There is a predominance of *Alnus, Pterocarya* and *Juglans* from layers a1 and a2 as well as an abundance of *Hedera, Corylus* and *Crataegus* pollen from layer b.

KEY WORDS: flood-plain forest, Tertiary relict, actuopalynology, Georgia

INTRODUCTION

At present *Pterocarya pterocarpa* has no area of continuous distribution in the Caucasus. It is recorded as isolated communities in Colchis, Lagodekhi, Alazani and Tal'ish (Fig. 1). Outside the Caucasus it grows in Turkey and Iran.

Over a geological timescale *Pterocarya pterocarpa* has been growing in the region under study since the Miocene. The earliest discoveries of macrofossils date from the Sarmatian (Catalogue of plant fossils of the Caucasus 1973). The maximum development of *Pterocarya* forest occured in the climatic optima of the Upper Pleistocene and especially of the Holocene (Shatilova & Ramishvili 1990, Kvavadze 1994). In East Georgia (Iori plateau) this species has been known since the Akchagyl period (Dolidze, 1981). By the end of the Holocene the forest area of this unique tertiary relict began to decline throughout the whole of Georgia both in its western and eastern regions (Gogichaishvili 1988). To conserve *Pterocarya pterocarpa* in its extant sites reserves such as those at Colchis, Miussera and Lagodekhi (Fig. 2) were created where we have already carried out investigations into the present-day composition of *Pterocarya* forest and compared it with pollen spectra (Stuchlik & Kvavadze 1987, Kvavadze & Stuchlik 1990, Kvavadze & Stuchlik 1997). In addition to the specific reserves mentioned above the entire area of *Pterocarya pterocarpa* forest found in the Alazani valley is being conserved (Fig. 2). It is precisely this region which was the subject of our investigations, the results of which are given in this paper.

BRIEF PHYSICO-GEOGRAPHICAL DESCRIPTION OF THE REGION

The Alazani valley lies in the extreme north-east of Georgia between the Gombori Ridge and south spurs of the Greater Caucasus Range. This valley is a continental geosyncline filled with thick quaternary alluvial sediments (Atlas of Gruzinskoi SSR 1964). Due to the closed relief the climate here is similar to that of kettles and is very mild. In winter there are almost no negative temperatures (mean January temperature is up to 1.5–2°) and the mean annual temperature is 13.3° *. For comparison it should be mentioned that in Tbilisi situated 100 km to the south-west of Alazani the annual temperature does not ex-

* Hereinafter all climatic indices are given according to the Guide to the climate of the Georgian SSR 1971, 1973).

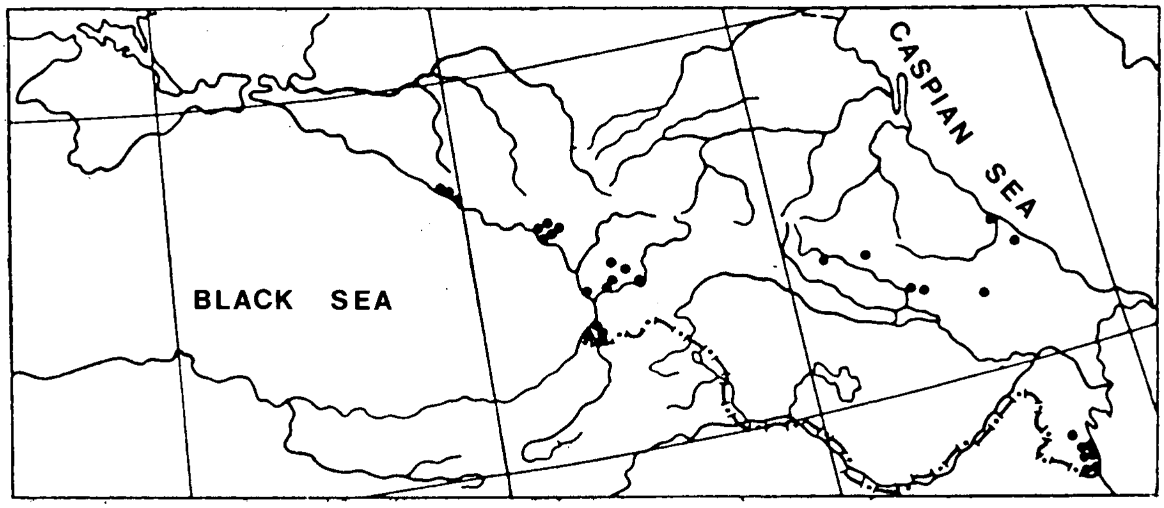

Fig. 1. The *Pterocarya pterocarpa* area in the Caucasus

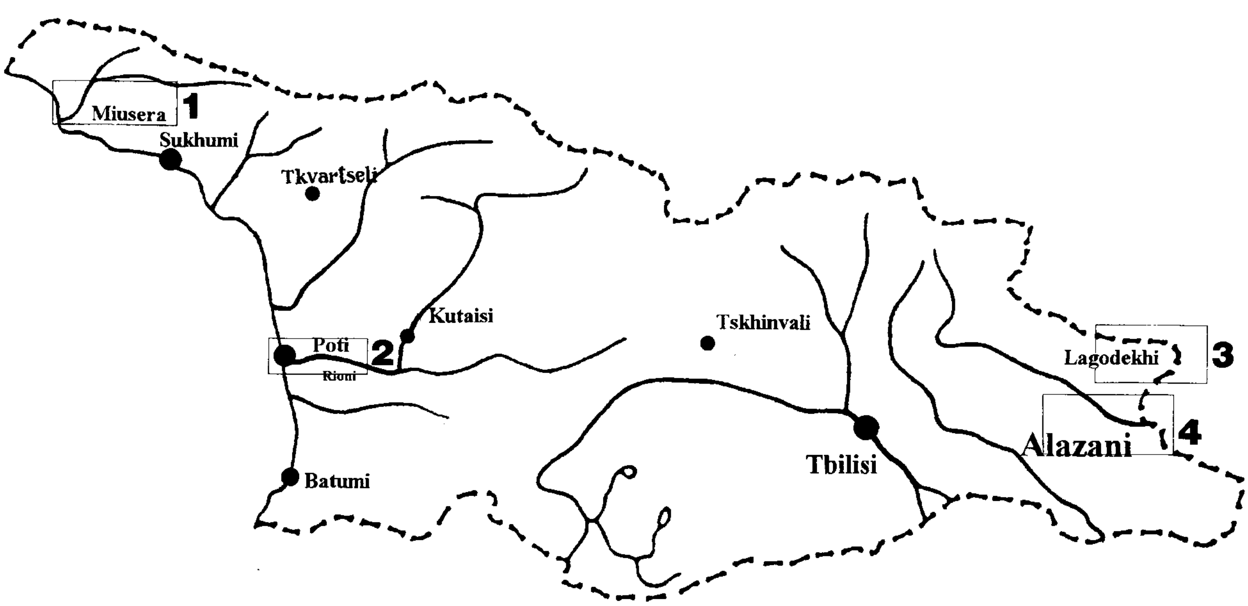

Fig. 2. Schematic map of Georgia and location of the plots under investigation: **1** – Miussera, **2** – Colchis reserve, **3** – Lagodekhi, **4** – Alazani

ceed 11.5–11.9° (Climate of Tbilisi 1992). The total annual rainfall is also high in the Alazani valley and reaches 650–700 mm (Fig. 3). Under such favourable conditions the vegetation of the area differs significantly from that of the region as a whole. Here the forest can grow not only in the flood-plain of the rivers, but also further afield (Maruashvili 1970). However, for the most part, the Alazani valley presents a cultivated landscape.

MATERIALS AND METHODS

The botanical description of vegetation on sample plot N22 and a selection of soil samples were made during fieldwork by carried out the joint Polish-Georgian expedition in

June 1989. A detailed description of plants was made according to Braun-Blanquet (1951). The material for spore-pollen analysis was first treated by the alkaline method and then by acetolysis. Percentage rating and construction of the pollen diagram was carried out using E. Grimm computer programs Tilia-2 and Tilia-Grapf.

The studied preparations are kept in the Palynotheca of the Institute of Palaeobiology of the Georgian Academy of Sciences.

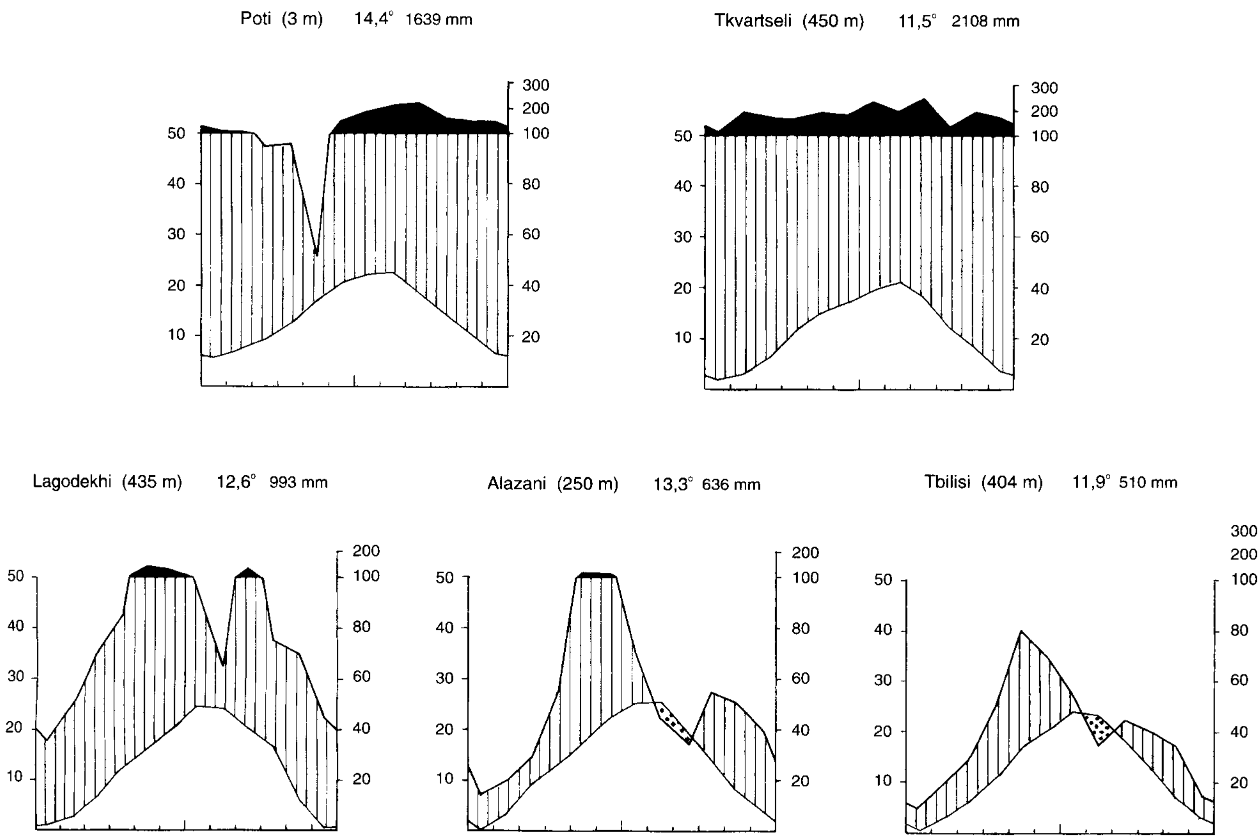

Fig. 3. Climate diagrams of Poti, Tkvartseli, Lagodekhi, Alazani and Tbilisi

RESULTS AND DISCUSSION

On the left bank of the middle part of the Alazani river at an altitude of 250 m plot N22 was studied. Here the flood-plain relief is flat. The forest is of uneven age, dense, with a well-developed undergrowth of shrubs and climbers. The first layer consists of two sublayers. *Populus hybrida* trees grow to height of 40 m, and attain a diameter of up to 150 cm. The dominant of the first layer is *Pterocarya pterocarpa* and the subdominant – *Alnus barbata* and *Populus hybrida*. Of lesser importance are *Juglans regia*, *Acer campestre* and *Gleditsia triacanthos*.

In the shrub layer *Pterocarya*, *Cerasus avium* and *Rubus saxatilis* are prevalent. Of climbers *Hedera helix* and *Periploca graeca* are abundant. *Calystegia sepium, Smilax excelsa, Clematis vitalba, Humulus lupulus* and *Apocynum* sp. are recorded.

The herbaceous layer is also well-developed. There are great amounts of *Commelina, Salvia, Festuca, Galium,* etc.

Below we present a detailed description of the plot according to the Braun-Blanquet principle (1951).

D a t e 10.06.1989; altitude: 250 m, height of trees 40 m; their diameter 150 cm, covering of tree layer (a) – 8%, that of shrub layer (b) – 90%, that of herb layer (c) – 70%.

T r e e s. *Populus hybrida* **a_1**-3.3; *Alnus barbata* a_1-3.3; a_2-1.1; b+; *Pterocarya pterocarpa* a_1-4.4; a_2-2.2; b-4.4; *Juglans regia* a_1-1.1; a_2-1.1; *Acer campestre* a_1+; *Populus tremula* a_2+; *Gleditsia triacanthos* a_2+;.

S h r u b s. *Cerasus avium 3.3; Frangula alnus* 1.1; *Rubus saxatilis* 2.2; *Viburnum opulus* 1.1; *Ulmus foliacea* 1.1; *Sambucus nigra* 1.1*; Crataegus* sp.1.1; *Euonymus verrucosa* 1.1*;Cotinus coggygria +;Ulmus* sp. +; *Diospyros lotus+; Rosa canina+; Carpinus caucasica+; Morus alba+;Corylus avellana+; Pyrus communis+; Calystegia sepium* 1.1; *Hedera helix* 3.3*; Periploca graeca* 2.2*; Smilax excelsa* 1.1*; Clematis vitalba* 1.1*; Humulus lupulus+; Apocynum* sp. +.

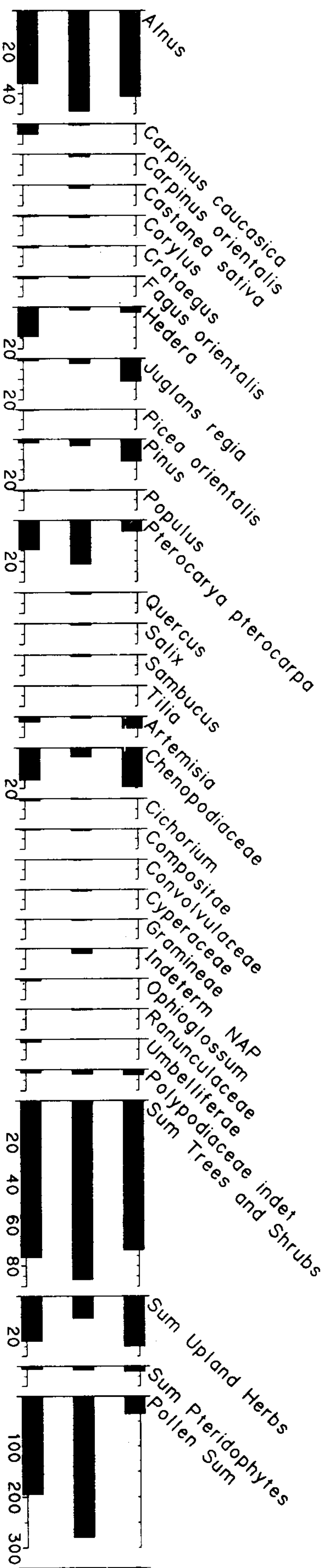

Fig. 4. Spore-pollen diagram of soil samples from plot N22 (Alazani)

H e r b s. *Galium odoratum* 2.3; *Asarum europaeum* 1.1, *Festuca gigantea* 3.3; *Sanicula europaea* 1.1; *Geum urbanum*+; *Commelina* sp.4.4; *Viola* sp.+; *Stachys sylvatica* 1.1; *Hedera helix* 3.3; *Carex sylvatica* 1.1; *Circaea lutetiana* 1.1; *Equisetum telmateia*+; *Galeobdolon luteum* 1.1; *Euphorbia macroceros* 1.1; *Salvia sylvestris* 3.3; *Arctium lappa*+; *Cynanchum scandens*+; *Mentha cf. aquatica*+.

As is seen from the above list, many plants accompanying *Pterocarya pterocarpa* are Tertiary relicts and need protection.

Soil samples NN62–66 were taken from plot N22 for spore-pollen analysis. Samples 65 and 66 which were composed of sandy alluvial soils showed a very low quantities of pollen. Samples 63 and 64 (Fig. 4) contained the greatest quantities of pollen and spores.

For the pollen spectra the predominance of arboreal and shrub pollen is characteristic (Fig. 4). The dominants of the spectrum among arboreal species are *Alnus* and *Pterocarya*, with the subdominants of *Juglans, Pinus* and *Hedera* pollen. Poplar is very poorly represented in the spectra. Its pollen content is a several times underestimate compared with its real frequency in the forest. *Acer* pollen is completely absent and *Gleditsia* pollen only occasionally recorded. However, the content of *Alnus barbata* which is known to produce large amounts of pollen is overestimated. The frequency of the dominant climbers and shrubs is adequately reflected in the pollen spectra. This is particularly true of *Hedera helix*, which dominates both in the spectrum and the vegetation (Fig. 4). In addition to local elements, the pollen of regional vegetation is revealed in the spectra such as that of *Castanea, Tilia, Quercus*, etc. which might have been introduced from Lagodekhi forest. The same situation is observed among herbs where both local and introduced pollen are present. The proximity of the Shiraki and Eldari steppes to the south is shown by the presence of Chenopodiaceae and *Artemisia* pollen which are spectrum dominants in the herbaceous pollen group.

In the spore-pollen spectra, besides primary pollen, redeposited pollen belonging to archaic Gymnosperms and undetermined Tricolporate is revealed. The old remains of Dinoflagellata are also present. Secondary pollen is well-distinguished from more recent deposits by its more intensive colour. We also recorded the

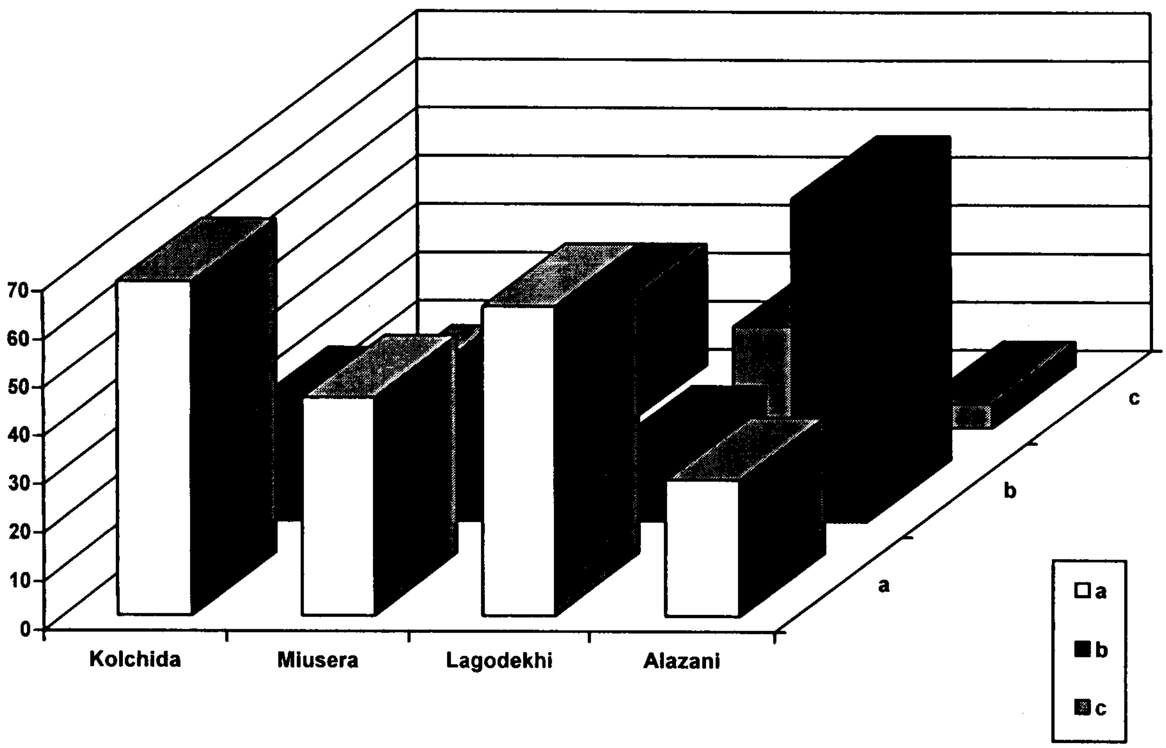

Fig. 5. Bar-chart of the content of pollen spectrum dominants (a – *Pterocarya*, b – *Alnus*, c – *Carpinus*) in Colchis, Miussera, Lagodekhi and Alazani (in percentage terms)

presence of redeposited forms in the spectra of *Pterocarya* flood-plain forest from the Colchis reserve (Stuchlik & Kvavadze, 1987). Both the Colchis and Alazani plots are fully inundated by water during floods which is the source of redeposited pollen.

As for the main (primary) spectrum elements, comparison of the pollen complexes of Alazani, Lagodekhi, Colchis and Miussera (Fig. 5) showed the following irregularities. For the Colchis and Lagodekhi forests the first dominant in the pollen spectrum is *Pterocarya* accounting for 50 to 70% of the total amount of arboreal pollen. However, in the spectra under the *Pterocarya* forest canopy in Alazani this index is much lower and does not exceed 25–30%, i.e. *Pterocarya* pollen is subdominant in the spectra (Fig. 5). Here *Alnus* is the first dominant. Another feature of the Alazani spectra is that they have a very low amount of Pteridophyta spores, no more than 2–3%. In the pollen spectra of the Lagodekhi *Pterocarya* forest the content of Pteridophyta spores amounts to 8–10% (Kvavadze & Stuchlik 1997) and, in Colchis, up to 15–18% (Stuchlik & Kvavadze 1987). These peculiarities might be explained by climatic conditions and particularly by humidity. In Colchis, where the amount of precipitation is nearly three times as high as in Alazani (Fig. 3), the pollen content of hygrophytes in the spectra is greater. Under these favourable conditions hygrophilous plants might produce much more pollen. The direct connection between the amount of *Pterocarya* pollen in the spectra and the rainfall is clearly seen in the diagram on Fig. 5. Climatic diagrams for Poti, Lagodekhi and Alazani are given in Fig. 3.

CONCLUSION

The investigation of the Alazani flood-plain forest with its predominance of *Pterocarya pterocarpa*, and the comparison of the pollen spectra with those of Colchis and Lagodekhi has demonstrated a feature peculiar to the Alazani spectra. This is the predominance of *Alnus* pollen. The *Pterocarya* content is of subordinate importance despite the fact that in the forest stand *Pterocarya pterocarpa* prevails. The reduced presence of *Pterocarya* in the pollen spectra can be explained by its low pollen production in the Alazani valley. Another reason may also be the fact that in Colchis where the air humidity is high compared with that of Alazani, pollen is seldom transferred over long distances and is deposited locally. However, in the dry air of the lowland part of East Georgia the pollen of many arboreal species is dispersed over longer distances than in Colchis. For example, we have found *Pterocarya* pollen in recent sediments both in the highlands of Lagodekhi (Kvavadze & Stuchlik 1997) and in the Iori plateau (Kvavadze & Todria 1992).

It should also be mentioned that the amount of introduced pollen in the Alazani valley here is fairly significant. Therefore, in interpreting the Alazani fossil pollen spectra the revealed irregularities must be taken into account.

Nevertheless, as a whole, the pollen spectra of the Alazani valley adequately depict the dominants of all three layers of arboreal plants. These are *Alnus, Pterocarya* and *Juglans* from layers a_1 and a_2, predominance of *Hedera, Corylus* and *Crataegus* from layer b. The vegetation of neighbouring regions is also adequately represented.

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