



***In situ* pollen grains from the Middle Miocene Satovcha Graben (SW Bulgaria)**

***In situ* полен от късномиоценски седименти от Сатовчанския грабен (ЮЗ България)**

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Keywords: *in situ* pollen, fossil flowers, Miocene, Bulgaria.

Introduction

Well-preserved plant macrofossils including leaves, flowers and seeds as well as dispersed spores and pollen microfossils provide an excellent record useful for interpretation of the paleovegetation and paleoclimate. Pollen grains are an important component of Neogene palynological assemblages in Bulgaria. Morphological information about fossil pollen grains in Bulgaria Neogene floras has been described by Ivanov (1994, 2001). However, *Castanea* and *Sparganium* type have not previously been isolated *in situ* in Neogene sediments in Bulgaria. Only one palaeobotanical study of Middle Miocene leaf remains and spores *in situ* from Satovcha Graben was known (Bozukov, Ivanov, 1995). Satovcha Graben is one of the richest Miocene fossil sites and has been the subject of many palaeobotanical investigations from taxonomic and phytocenotic point of view (Palamarev et al., 1991; Palamarev, Bozukov, 1992; Bozukov, 1999, 2000). The fossil records demonstrate that hygromesophyte to mesophyte plant associations were more diversified in macroflora existed in this region during the Miocene. Within these assemblages, the presence of species from genera *Castanea* and *Sparganium* is well documented.

Results

Family Sparganiaceae Rudolphi
Genus *Sparganium* L.
Sparganium sp.

In situ pollen grains. Pollen class: monoporate. Outline: mainly elliptic or circular. Apertures: ectoaperture porus, more or less circular in outline; margins distinct or indistinct; porus membrane beset with sexine elements. Endoaperture – porus, outline following that of the ectoap-

erture and therefore more or less congruent with it. Size range: diameter about 20.0–22.5 μm ; diameter of pore up to 3.0 μm . Exine: 1.5–1.7 μm thick. Ornamentation: reticulate under LM. *Remarks:* The comprehensive studies of recent *Sparganium* pollen morphology by Erdtman (1966), Punt (1975), Nilsson et al. (1977) and Halbritter (2015) with profuse LM and SEM illustrations, indicate that pollen grains are similar in size and morphology to the pollen grains under this study.

Family Fagaceae Dumortier
Genus *Castanea* Mill.

Castanea sativa

In situ pollen grains. Pollen class: tricolporate. Outline: elliptic in equatorial view, rounded in polar view. Apertures: ectoapertures colpi, long; endoapertures pores, equatorial situated; diameter of pores 0.5–2.5 μm . Size range: polar axis 20.0–25.5 μm , equatorial diameter 8.0–12.5 μm . Shape: prolate. Exine: 0.9–1.25 μm thick. Ornamentation: psilate under LM. *Remarks:* The pollen morphology of *Castanea* pollen has been thoroughly documented by Erdtman (1966) with size range varied between 12 and 18.5 μm (width \times length). Our results are in accordance with these values. The morphological features of the isolated *in situ* pollen no differ from the pollen grains of the recent species *Castanea sativa* M. (Kedves, 1982). The latter is also known by Van Benthem et al. (1984), where pollen grains are larger in equatorial diameter 10–13 μm than those measured in this study. The pollen morphology (LM and SEM) and ultrastructure (SEM) of *Castaneoideae* pollen has been thoroughly documented by Grimsson et al. (2016). *Castanea*-type pollen appears to be generally smaller (polar axis 13–15 μm) and narrower than our investigated fossil pollen grains.

Conclusion

The present study uses a combined palaeobotanical investigation to document the diversity of Middle Miocene flora of Southwest Bulgaria. *In situ* pollen grains described here provide new information about *Sparganium* and *Castanea sativa*. During this period species from these genera have wider distribution in plant palaeocommunities in Satovcha fossil flora. The combination of pollen and macrofossils will allow to be established the palaeoecology, vegetation, and climate in this part of Bulgaria during the Middle Miocene.

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