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ABSTRACTS VOLUME

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Fluids related to remobilization of Mesozoic sulfide mineralization in the Eptadendro-Rachi region in Eastern Rhodope, Thrace, Greece

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The copper sulfide mineralization in the Eptadendro and Rachi areas is hosted in the Upper Tectonic Unit of eastern Rhodope in Thrace. The orebodies are found along the contacts between granitoid intrusions and meta-ultrabasic-basic rocks, as well as within meta-ultrabasic-basic rocks. Two stages of mineralization have been identified: an initial stratabound stage which is considered to be of submarine volcanosedimentary origin and a later vein-type stage formed during a hydrothermal episode, related to the intrusion of the granitoids (trodhjemites and pegmatites), during Upper Cretaceous-Early Tertiary. It consists of pyrite, chalcopyrite, sphalerite, galena, hessite, bismuthinite, emplectite, tetradymite, aikinite, wittichenite, siegenite, millerite, bornite, pyrrhotite, covellite, magnetite, hematite and goethite, with chlorite, quartz, calcite and sericite being the main syn-ore gangue minerals. The mineralization has been affected at least by a greenschist facies metamorphic episode during Eocene-Oligocene. Although the sulfide mineralization is partly deformed and shows recrystallization textures, the data obtained from fluid inclusions demonstrate well the physical and chemical parameters of ore-forming environment during the latest hydrothermal event, caused by intrusion of the granitoids. Microthermometric studies showed three groups of fluid inclusions, corresponding to the distinct fluids involved in the mineral deposition and the pegmatite formation. The first group of fluid inclusions hosted in syn-ore quartz is characterized by relatively high homogenization temperatures (300° to 380° C, with a peak at 330° C) and low salinities (1.6 to 7.2 wt% NaCl equiv) and corresponds to the fluids of the main ore stage. The second group is distinguished by a drop in T_h (210° to 260°C) corresponding to the late ore stage associated with calcite formation, and salinities (3.2 to 6.3 wt% NaCl equiv) similar to the first group. The third group of fluid inclusions in the pegmatite is characterized by temperatures ranging from 300° to 390°C, and variable salinities (6.9 to 8.9 wt% NaCl equiv and 34.7 to 58.5 wt% NaCl equiv) suggesting a magmatic origin. The composition of these fluids is dominated by NaCl+KCl. Most probably these fluids were not related to the ore mineralization process.

Palaeoavian remains from the Late Miocene localities of Pikermi, Chomateri and Kerassiá; palaeoecological implications

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The Late Miocene avian record of Greece is rather poor. Three Late Miocene Greek localities have yielded palaeoavian remains until now: Pikermi, Samos and Perivolaki. In the present paper we describe some additional specimens from Pikermi (Attica), as well as some from the Late Miocene localities of Chomateri (Attica) and Kerassiá-4 (Euboea).

Among the aforementioned localities, the classical Pikermi locality is the most diverse taxonomically and has yielded the greatest number of specimens. However, the precise systematic position of some Pikermi avian taxa needs to be further explored. For example, Mlíkovský in 1996 reported seven different genera, while in 2002 he recognized five species belonging to five genera. Boev and Koufos recognized six species distributed in five genera. *Struthio karatheodoris* and *Ciconia gaudryi* are generally accepted to be present in Pikermi, even if the Pikermi struthioniform is sometimes assigned to the oospecies *Struthio* *chersonensis*. *Grus pentelici* is also an accepted name for the Pikermi gruiform, even though it is sometimes referred to the poorly defined *Pliogrus*. Most problems concern the taxonomic status of the galliforms. Gaudry (1862-67) recognized two size groups of galliforms, and referred the smaller specimens to *Gallus aesculapii* and the larger to *Phasianus* ? *archiaci*. *Gallus aesculapii* was included to *Pavo* by Jánossy and was followed by Boev and Boev and Koufos. Mlíkovský combined *G. aesculapii* and *Phasianus archiaci*, introducing the name *Pavo archiaci* adopted also by Boev and Koufos. The latter, also reported the presence of *Pavo bravardi* in Pikermi. Finally, Mlíkovský and Boev and Koufos also reported *Phoenicopterus* sp. in Pikermi.

The new specimens described herein are tentatively assigned to five species. The species recognized in Pikermi include *Struthio karatheodoris* (lateral tarsometatarsal trochlea), *Grus pentelici* (proximal humerus, two distal ulnae), *Pavo archiaci* (proximal femur, distal tibiotarsus), *Pavo* sp. (distal humerus), and *Gyps* sp. (distal ulna). Within the Pikermi findings, *Pavo* sp. is much larger than *P. archiaci*, approaching the size of *P. bravardi*. The recognized Chomateri palaeoavian remains are assigned to *Pavo archiaci* (proximal humerus, distal humerus). Finally Kerassiá-4 has yielded a tibiotarsus assigned to *Pavo archiaci*.

Extant representatives of *Struthio* are adapted to open environments and a similar ecological adaptation can be inferred for *Struthio karatheodoris*. The presence of *Gyps* sp. in Pikermi is important, as scavenging bird finds are relatively rare. Paleoecologically, an open environment is further supported since vultures depend on a large supply of carcasses, a condition met primarily in such environments. *Grus pentelici*, being a wading bird, requires the presence of bodies of water. Extant *Pavo* species live in open forests, often along watercourses, conditions that would have been preferred by the *Pavo* species found in Pikermi, Chomateri and Kerassiá-4.

Deformation phases and ophiolites emplacement in the Hellenides

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The terms ophiolites, ophiolite nappes and ophiolite bearing sedimentary formations in Greece, refer to outcrops of mainly peridotites, but also of basaltic rocks with eventual sedimentary formations. Based on the present-day scientific knowledge, the ophiolites as a whole are characterized by high variability regarding: a) their petrological signature, from their petrography, their mineral chemistry up to their alterations, b) their deformation pattern ranging from plastic to brittle, including both compression and extension phases, c) their emplacement characteristics, involving extensive nappes, lithostratigraphic alternations and melanges. Detailed analysis of a large number of ophiolite outcrops demonstrated their occurrence in different geotectonic conditions (tectonic windows, nappes and clastic sedimentary complexes), in variable geometric forms (isolated bodies, lenses and interlayers), in various composition and deformation configurations (harzburgites, lherzolites, meta-gabbros and amphibolites, basalts and sedimentary formations). The ophiolites experienced a continuous deformation from the Late Jurrasic phase (EoHellenic) up to the Eocene-Oligocene alpine orogeny (HoHellenic). Their evolution involved different emplacement mechanisms, producing a significant thickening in the oceanic and the surrounding environments and an extensive thinning in the continental margin environment.

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Palaeoavian Remains from the Late Miocene of Pikermi, Chomateri and Kerassiá Palaeoecological Implications

Dimitris MICHAILIDIS, Socrates ROUSSIAKIS and George THEODOROU

Introduction

Late Miocene avian remains from Greece are rare and reported so far from three localities: Pikermi (Attica), Samos Island, and Perivolaki (Thessaly). The Samos avifauna includes *Struthio karatheodoris* FORSYTH MAJOR, 1888 and *Amphipelargus majori* LYDEKKER, 1891, and the Perivolaki one *Branta thessaliensis* BOEV & KOUFOS, 2006 and Perdicinae *indet.* These localities have yielded but few avian remains as compared to Pikermi, which is the richest in number of specimens and most diverse in number of taxa. Originally, Gaudry (1862-1867) reported the following taxa in Pikermi: ? *Ciconia* sp., *Phasianus archiaci*, *Gallus aesculapi*, *Grus pentelici* and Aves *indet.* ("ossements d'oiseaux indéterminés"). Later, Bachmayer & Zapfe (1862) added to the Pikermi palaeoavifauna *Struthio karatheodoris*. This avifaunal list has been taxonomically altered over the years by several researchers; thus the exact systematic identity of some Pikermian avian taxa is rather ambiguous and is in need of further clarification. In the present paper we describe some specimens from Pikermi (Attica), as well as some from the Late Miocene localities of Chomateri (Attica) and Kerassiá-4 (Euboea).

Table 1. Pikermi palaeoavian fauna

Gaudry (1862-67)	Mlíkovský (2002)	Boev & Koufos (2006)	Present report
	Struthio chersonensis [1]	*Struthio chersonensis*	*Struthio karatheodoris*
? *Ciconia* sp.	*Ciconia gaudryi*	*Ciconia gaudryi*	*Ciconia gaudryi*
	Phoenicopterus sp.[2]	*Phoenicopterus* sp.	?
			Gyps sp.
Phasianus ? *archiaci*	*Pavo archiaci*	*Pavo archiaci*	*Pavo archiaci* [3]
Gallus aesculapi			
"Ossements d'oiseaux indéterminés"		*Pavo bravardi*	*Pavo* sp.
Grus pentelici [4]	*Grus pentelici*	*Grus pentelici*	*Grus pentelici*

1: Firstly reported in Pikermi by Bachmayer & Zapfe (1962), as *Struthio* cf. *karatheodoris*, species based on osteological remains from Samos. *Struthio chersonensis* is an oospecies and should be avoided for osteological samples.
2: According to Mlíkovský (2002), part of the material referred by Gaudry (1862-1867) to *G. pentelici*.
3: Referred provisionally to *Pavo*, however, with similarities to *Phasianus*.
4: Referred to *Pliogrus* by Cracraft (1973) and others.

Systematics

The new specimens from Pikermi (Figs 1, 2, 3c, 4a-b, 5-6) are tentatively assigned to five species: *Struthio karatheodoris* (3rd trochlea of tarsometatarsus), *Grus pentelici* (distal tarsometatarsus, distal ulna), *Pavo archiaci* (proximal femur, distal tibiotarsus), *Pavo* sp. (distal humerus), and *Gyps* sp. (distal ulna). Within the Pikermi findings, *Pavo* sp. is much larger than *P. archiaci* approaching the size of *P. bravardi*. The recognized Chomateri palaeoavian remains (Fig. 3a-b) are assigned to *Pavo archiaci* (proximal humerus, distal humerus). Finally Kerassiá-4 has yielded a tibiotarsus (Fig. 4c) assigned to *Pavo archiaci*.

Struthio karatheodoris is a generally accepted species name for the struthionid Pikermi specimens and is based on osteological finds from Samos Island. The name *Struthio chersonensis* (BRANDT, 1873) has also been used, but as it is based on eggshell fragments its use for skeletal remains should be avoided.

The presence of *Gyps* sp. in Pikermi is recorded for the first time by a distal ulna. Its condylus dorsalis is proximally extended much more than in *Haliaaetus* spp., resembling more to *Gyps spp.*

Grus pentelici is a generally accepted name for the Pikermi gruiform, even though it is sometimes referred to *Pliogrus* LAMBRECHT, 1933 (e.g. Cracraft, 1973). The new finds do not differ from the Pikermi material deposited in the MNHN of Paris, on which Gaudry (1862) based the description of this species.

Most problems concern the taxonomic status of the galliforms. The new Pikermi galliform finds can be grouped into three size groups. The largest in size is clearly different from the other galliform specimens and is here tentatively referred to as *Pavo* sp. Further studies shall focus on its affinities to the similarly sized *Pavo bravardi* (GERVAIS, 1849). The other size groups were firstly recognized by Gaudry (1862-67) who referred the smaller Pikermi specimens to *Gallus aesculapii* and the larger to *Phasianus* ? *archiaci*. *Gallus aesculapii* was included to *Pavo* by Jánossy (1991) and was followed by Boev (2002) and Boev and Koufos (2000). Mlíkovský (2002) combined *G. aesculapii* and *Phasianus archiaci*, introducing the name *Pavo archiaci* (GAUDRY, 1862) adopted also by Boev and Koufos (2006).

Figure 1. *Struthio caratheodoris* FORSYTH MAJOR, 1888. Left tarsometatarsus,3rd trochlea in dorsal (a) and (b) lateral view. Pikermi.

Figure 2. *Gyps* sp. Left ulna, distal part in ventral view. Pikermi.

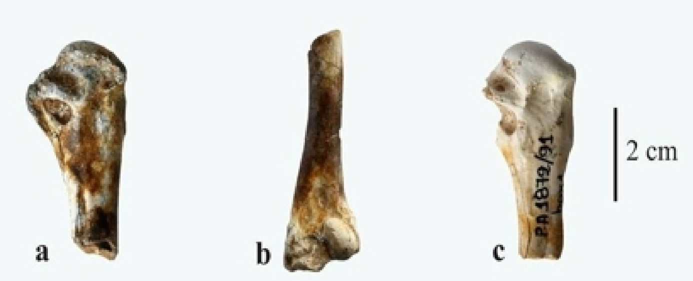

Figure 3. *Pavo archiaci* (GAUDRY, 1862). a) Right humerus, proximal part, caudal view. Chomateri. b) Left humerus, distal part, cranial view. Chomateri. c) Right humerus, proximal part, caudal view. Pikermi.

Figure 4. *Pavo archiaci* (GAUDRY, 1862). a) Right femur, proximal part, cranial view. Pikermi. b) Left tibiotarsus, distal part, cranial view. Pikermi. c) Left tibiotarsus, distal part, caudal view. Kerassiá-4.

Figure 5. *Pavo* sp. Right humerus, distal part, cranial view. Pikermi.

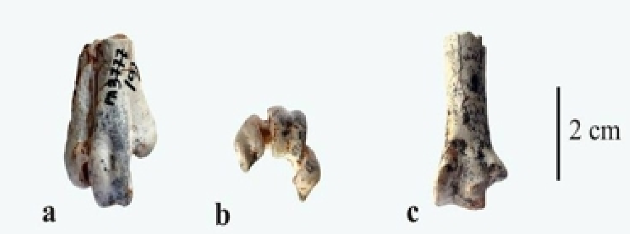

Figure 6. *Grus pentelici* (GAUDRY, 1862), Pikermi. a-b) Right tarsometatarsus, distal part in dorsal (a) and distal (b) view. c) Left ulna, distal part, ventral view.

Considering the large intraspecific size variation and the significant sexual dimorphism of most extant Phasianidae, the combination of *Gallus aesculapii* and *Phasianus archiaci* to the same taxon is supported. Provisionally, and following Mlíkovský (2002), we refer these specimens to *Pavo archiaci*. The same applies for the galliform specimens from Chomateri and Kerassiá-4. However, their assignement to *Pavo* rather than *Phasianus* or *Miophasianus* LAMBRECHT, 1933 is not clearly supported by osteological criteria, and this hypothesis should be further tested.

Palaeoecology

The analysis of different elements of a palaeofauna can provide supplementary information concerning the palaeoecology and zoogeography of a fossil site. In particular, the Pikermi fossil avian remains- being fairly numerous- can be of use in reconstructing the local Miocene palaeoenvironment. Walker & Dyke (2006) suggest that avian fossils are especially valuable for the reconstruction of the palaeoenvironment, because osteological differences between Miocene birds and their nearest recent relatives are often minimal, thus allowing for an accurate use of modern ecological data. Furthermore, many avian species have specialized ecological adaptations for specific habitats, thus facilitating precise palaeoecological reconstructions.

In the current study the five taxa reported for Pikermi (*Struthio karatheodoris*, *Pavo archiaci*, *Pavo* sp., *Grus pentelici* and *Gyps* sp.), Provide supplementary data for a palaeoecological reconstruction. Extant representatives of *Struthio* are adapted to open environments and a similar ecological adaptation can be inferred for *Struthio karatheodoris*. Extant *Struthio* grazes on green grass and browses on shrubs and seeds, while occasionally eat insects such as locusts (Hutchins *et al*., 2002). The presence of *Gyps* sp. in Pikermi is important, as scavenging bird finds are relatively rare. Palaeoecologically, an open environment is further supported since vultures depend on a large supply of carcasses, a condition met primarily in such environments. Moreover, as extant *Gyps* are found in the warmer regions of the Old World, similar conditions could be inferred for the Pikermi Miocene. Extant *Pavo* species live in open forests, often along watercourses, conditions that would have been preferred by the *Pavo* species found in Pikermi. Even if some of the specimens referred to *Pavo* were to be assigned to *Phasianus,* there would be limited modifications in terms of palaeoecological interpretations as extant *Phasianus* and *Pavo* favour similar habitats. Both are omnivorous, feeding on most plant parts (leaves, fruit and seeds), insects and small vertebrates (reptiles, amphibians, small birds and rodents) (Hutchins *et al*., 2002). Trees are important to both taxa, as they roost for protection at night in trees. Extant *Grus* breeds in wetlands of Northern Europe and Asia and winters in Africa, Southern Europe and Southern Asia, in freshwater wetlands or saltwater coastal marshes (Hutchins *et al*., 2002). It is omnivorous, subsisting on leaves, roots, berries as well as insects and small vertebrates. In conclusion, the palaeoenvironment inferred from the Pikermi taxa indicates open grassland with wooded areas and bodies of open water. The *Pavo archiaci* remains from the Late Miocene of Chomateri (Attica) and Kerassiá-4 (Euboea) point to open forests with some freshwater sources.

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