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Mineralogy and geochemistry of diatomite associated with lignite seams in the Komnina Lignite Basin, Ptolemais, Northern Greece

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Abstract

Diatomite with variable chemical and mineralogical composition occurs in the Komnina Lignite Basin. The diatomite layers, which overly lignite seams of Upper Miocene age, are rich in silica or calcium. These layers correspond respectively to quartz-rich and calcite-rich layers. The diatomite mainly consists of opal-A, while other minerals are quartz, feldspars, calcite, smectite, illite, kaolinite, chlorite, cristobalite, and muscovite. The well-preserved nature of the diatom species indicates a weak silica diagenesis. This is also indicated by the mineralogical composition of diatomite, especially the absence of opal-CT. The organic material present in the lake acted as coating and prevented diatom dissolution. The shallow lake, where the diatoms were deposited, did not allow diagenesis of diatomite. Diatoms were deposited in the Komnina Lake as a result of the acidic pH, the warm-humid conditions, and the silica-rich environment that occurred due to volcanic activity in the nearby area (Aridea). Remains of volcanic ash have been identified in the lignite deposits of the wider Ptolemais area. The association of diatomite with lignite was brought about by tectonic movements that occurred in the wider area of Monastir–Florina–Ptolemais–Kozani–Elassona–Sarantaporo in the Upper Miocene, resulting to the development of individual small shallow lakes. The paleoenvironment changed to acidic from the previous alkaline pH, the vegetation died off, the silica produced from the volcanic activity and the calm water conditions allowed the deposition of diatoms.

Keywords: Diatomite; Lignite; Komnina; Ptolemais; Mineralogy; Geochemistry

1. Introduction

Diatoms are single-celled organisms, related to algae, with a soft body enclosed by an opaline exoskeleton. The exoskeleton or frustule is composed of two halves, the smaller half fitting inside the larger half. Frustules are either circular (centric) or elliptical (pennate) in form, and are ornamented with sieve-like perforations (punctae) and intricate rib structures (costae). Diatoms create their food by combining carbon, obtained from photosynthesis of carbon dioxide, with nutrients extracted from seawater. Diatoms are adapted to a wide range of aquatic environments, including marine, brackish, and fresh waters. The organisms require suitable environmental conditions if they are to flourish, including appropriate temperature and photic conditions, a narrow salinity and acidity range, and a stable supply of nutrients including silica, nitrogen, phosphorous, iron, oxygen, and carbon dioxide. Diatoms inhabit the photic zone at

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depths down to 200 m, and thrive in the cold waters of sub-polar and temperate regions. The presence of diatoms in sedimentary rocks can provide valuable information about the environment of deposition of those rocks. Benthic diatoms may indicate inner continental shelf, coastal and estuarine environments, whereas planktonic forms are found in shelf and deeper water deposits (Sancetta, 1983).

Diatoms first appeared in the geological record about 100 Ma during the Late Cretaceous, but most economic deposits are of Miocene–Pleistocene age. Diatomite deposits are frequently associated with volcanic activity,

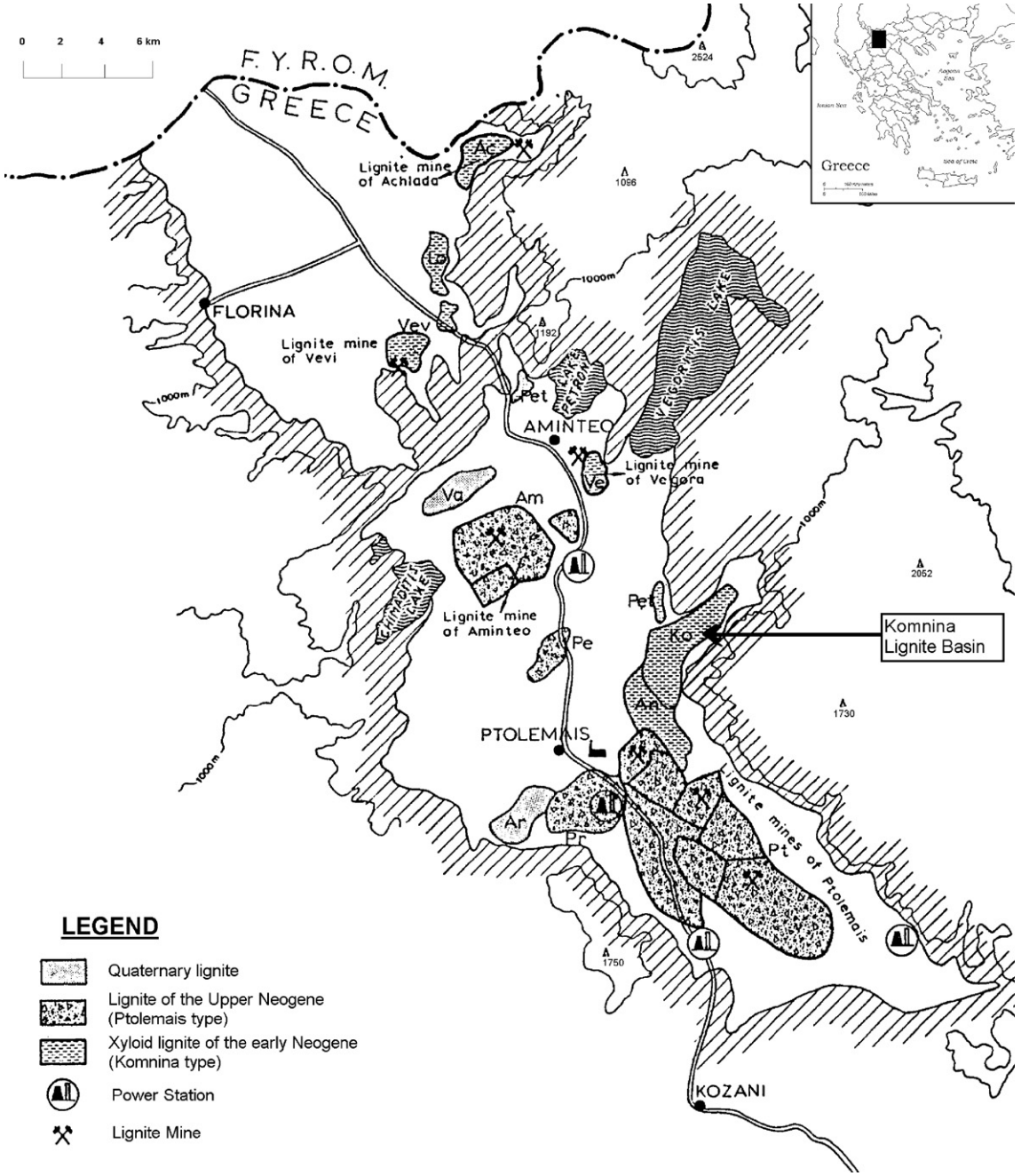

Fig. 1. Location of Komnina Lignite Basin (Ko = Komnina) and the lignite deposits of Ptolemais and Florina sedimentary basins (Pt = Ptolemais, Pr = Proastio, Ar = Ardassa, An = Anatoliko, Pel = Pelargos, Pe = Perdikas, Am = Amynteo, Va = Valtonera, Ve = Vegora, Pet = Petres, Vev = Vevi, Lo = Lofi, Ac = Achlada).