Planktonic foraminiferal biostratigraphy and palaeoenvironmental implications of a Middle Miocene transgressive sequence in the Ionia zone of Levkas Island, Ionian Sea, Greece

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Asprogerakata section, located in the northeast part of Levkas Island, Ionian Sea, consists of well-bedded grey-brown calcareous sandstones and silty to sandy marls and represents part of the Miocene transgressive cover of the Ionian zone. Biostratigraphic data and palaeoenvironmental conditions are inferred based upon the planktonic foraminifera. A rich, highly to moderately diverse and well preserved planktonic foraminiferal association enabled biostratigraphic zonation of the Lower-Middle Miocene deposits. On the basis of the composition of the foraminiferal assemblages, palaeoecological and palaeoclimatic interpretations have been made. Quantitative and qualitative analyses provide a detailed distribution of the identified taxa and defined a number of bioevents for the Middle Miocene. The recognition of the first Acme End (AaE) of *Paragloborotalia siakensis* proved that the Neogene deposits in Levkas Island have an age of 15.435 Ma and belong to the MMi4 planktonic foraminiferal zone. The MMi4c-MMi4d boundary has been defined by the presence of *Praeorbulina glomerosa circularis* dated at 14.89 Ma. Planktonic foraminiferal assemblages identify a significant change in variability of climate system at around 15.2 Ma, probably corresponding to the global cooling events superimposed to the Middle Miocene Climatic Optimum. In particular, faunal composition suggests a warm phase in the lower part of the section followed by a cooling phase.

Structure of the Eastern Hellenides and emplacement of ophiolites. Field evidences

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Our recent research in most areas of Eastern Hellenides has given following results:

In Vourinos and Vermion, the ophiolites are in normal, not tectonic contact with their supporting layers (marbles of mostly upper Triassic age). This contact shows a typical thermal transformation with layers of hornstein, amphibolites and granatites. The directly underlying series shows progressive and clear evolution from a carbonate platform into a submarine environment with increasing volcanic influences, including pillow lava flows.

In northern Pindos, at the ophiolitic overthrusted masses, outcrops of limestones are observed. Detailed analysis of these limestones showed that they are remainings of transgressions, their age determined by the microfauna as upper Campanian – early Maastrichtian. The limestone series ends upwards in a karstic surface supporting doleritic lava flows with essential thickness. In the locations of Tragopetra and Tzina we can observe that these lavas clearly intrude in the caves of the paleokarst. At the same section, over this lava formation can be found the basic conglomerate (Auversian) of the "mesohellenic trench" sediments. An important outcome of this is that there is no ocean floor before the overthrust but that land, with karstification of the limestones, was already emerged instead.

In central Pindos, near Artotina, we observe ophiolite outcrops in the Pindos flysch, with a transgression enclosing microfauna of the same age.

In Euboea, a "subpelagonian" ophiolitic unit, with his underlying limestones, is overthrusted over a paleozoïc and mesozoïc continuous sedimentary succession (Eretria unit), but the contact is violently folded and characterized by a thick mylonite. This Eretria unit is the equivalent in South Euboea of the Styra unit and is overthrusted over a continental platform carbonate unit (Almyropotamos unit).

In Argolide, we observe the same situation: an ophiolite unit, overthrusted over limestones and flysch with a mylonitic contact, with insertions of klippes of a continental slope unit (Pindos). Localy, the limestones are karstificated before the overthrust.

As a conclusion of these observations we can state that we should respect the principle of actualism (James Hutton, Charles Lyell). Now, in present world, the geographic zones are large, extended: so was also in the past. The distinction of a (paleo) geographical zone must be based on the trend through geological times, not on local variations of sedimentation. Today, we observe a breaking up of geological units, due to more successive tectonic phases, not to a primary differentiation. Like this, already in Middle Cretaceous or even earlier, Tethys's floor (ophiolites with effusive emplacement) was deformed and at least folded, and emerged. This emersion possibly characterizes also certain parts of African shelf. Immediately afterwards, ophiolites overthrust on the African shelf in an enormous movement, which drifted, fragmented and disintegrated the continental slope (Pindos unit, Eretria unit). This movement is accompanied also by proportional movement of the European-Asian mass. It is deformed in the scale of planet. It is obvious that this major movement was immediately followed by a phase of strongly, isoclinal folding, trending from SSW to NNE. The most obvious today (because latest) deformation during Late Eocene and Oligocene is the one which caused the actually observed main structural lines of the Hellenides.

Gold-base metal deposits in Greece: Genetic types and economic perspectives

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Greece's geology favours a potent and dynamic use of mineral resources, which became a major incentive of the country's mining business, and economic and social growth. Among the Non-Energy Metallic Minerals commodities, base and precious metals, in particular zinc, lead, copper, gold, and silver are becoming an increasingly important and rapidly growing target of the mining industry. In NE Greece, where most of the potential resources and feasible deposits are hosted, gold-base metal mineralizations occur in a wide range of genetic types comprising magmatic, hypothermal/mesothermal, epithermal, and supergene mineralization types. The magmatic porphyry copper type deposits and mineralizations show economic gold grades (e.g. Skouries, Fisoka, and Pontokerasia), the hypothermal/ mesothermal manto-type base metal sulphides form high-grade gold ores (e.g. Olympias, Mavres Petres, Piavitsa, Thermes, Pangeon, Farasino) and the epithermal gold systems lead to potential high-sulphidation mineralizations (e.g. Konos, Perama, Kirki, Pefka). Proven reserves amount to porphyry gold and copper of 3.9 Moz and 0.8 Mt, respectively, manto-type gold of 3.6 Moz, lead + zinc of 1.6 Mt and silver of 66 Moz, as well as more than 2.0 Moz epithermal gold. The genetic link between porphyry coppers and large base metal manto style sulphide deposits can be incorporated into regional exploration strategies in a complex metamorphic terrain of schists, gneisses and marbles, whereas the epithermal type deposits were emplaced within a broad volcanic belt, which developed first in Bulgaria and then moved south through northern Greece to the region of Thrace. The epithermal gold mineralization occurs in hydrothermal breccia zones, related to volcanic rocks of andesitic, dacitic or shoshonitic composition as well as hosted by sedimentary rocks. All previous types of sulphide minerals (particularly those hosted by Rhodope and Serbo-Macedonian marbles) were overimposed by post-Pliocene co-active supergene oxidation and karstification