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REVIEW

by Professor Mariana Vladimirova Filipova-Marinova,

Doctor of Biological Sciences

Natural History Museum – Varna (retired)

Member of the Scientific Jury appointed by Order No. 300/26.09.2025 of the Director of the Institute of Oceanology at the Bulgarian Academy of Sciences – Varna for conducting a competition for the academic position of "**ASSOCIATE PROFESSOR**" in the scientific specialty "**Geology of the Oceans and Seas**"; Scientific field: "Paleoclimate and Geoecology of the Black Sea", Professional field: 4.4. Earth Sciences, Field of higher education: 4. Natural Sciences, Mathematics and Informatics, announced in **State Gazette No. 63/01.08.2025** for the needs of the "Marine Geology and Archaeology" section at the Institute of Oceanology at the Bulgarian Academy of Sciences.

In the announced competition for the academic position of "**ASSOCIATE PROFESSOR**" in the scientific specialty "**Geology of Oceans and Seas**", the only candidate is **Senior Assistant Professor Dr. Krasimira Ruseva Slavova** from the "Marine Geology and Archaeology" section at the Institute of Oceanology at the Bulgarian Academy of Sciences.

1. General information about the candidate's career and thematic development

Senior Assistant Krasimira Ruseva Slavova graduated in 1997 from the N.Y. Vaptsarov Naval Academy in Varna with a Master's degree in Ecology and Environmental Protection. In 1999, she enrolled as a doctoral student at the Institute of Oceanology at the Bulgarian Academy of Sciences in Varna and subsequently obtained a PhD in Oceanology in 2004 after defending her dissertation on "*Climatic and Geocatastrophic Events in the Black Sea 7,500 Calendar Years Ago*" under the supervision of the renowned world-famous marine geologist and geoarchaeologist Prof. Dr. Petko Dimitrov. Since 2004, Dr. Krasimira Slavova has been working in the Marine Geology and Archaeology Section of the Institute of Oceanology at the Bulgarian Academy of Sciences, successively holding the positions of ecologist (until 2005), first degree research associate in oceanology (2005–2011) and senior assistant in oceanology (since 2011). She has participated in joint Black Sea expeditions with prominent scientists (e.g. Prof. Dr. William Ryan, Columbia University at New York, USA), during which she mastered classical and innovative biostratigraphic and palaeoceanographic methods of marine geology and geoarchaeology, which she subsequently successfully applied in her scientific research.

2. Opinion on the presence or absence of plagiarism in the publications submitted for evaluation

Upon review of the materials submitted for this competition, **no evidence of plagiarism was found.**

3. Main areas of the candidate's research work and most important scientific contributions in each of them

The submitted self-assessment of scientific contributions is considered **sufficiently detailed, excellently structured and reliable**. The research activity of Senior Assistant Professor Dr. Krasimira Slavova is distinguished by a notable interest in **interdisciplinary approaches** and **diverse research methods**, and an ability to work on issues of practical importance **that are relevant to global geological science**. The candidate studies coastal and deep-water Black Sea sediments in order to establish correlations between climate change and the paleoecological conditions of the basin, fluctuations in the Black Sea level, and the dynamics of Late Pleistocene and Holocene sedimentation. Based on these correlations, palaeoclimatic reconstructions of the evolution of the Black Sea basin and corresponding palaeoceanographic interpretations for the last 26000 years have been carried out. Her geocological studies on the pollution of Black Sea sediments and waters with radionuclides, heavy metals and floating waste, which are directly related to contemporary climate change and anthropogenic pressure, are particularly valuable.

The candidate's main and most significant **scientific contributions** are:

Original scientific contributions:

- ✓ As a result of a detailed lithological description of three sediment cores from deep-water Black Sea boreholes, white laminations were found, all at the base of the sapropel. The petrographic analysis performed established that all the laminations studied are composed mainly of aragonite, in the form of rice-like crystals and spheroidal aggregates. Whole preserved aragonite crystals and aggregates fragmented into smaller particles were observed, some of which have a fan-shaped form. The genesis of aragonite was studied as a key geochemical indicator associated with a dry climate, shallow water conditions and a transitional hydrological regime, which shows that it was initially formed by direct precipitation from seawater in shallow conditions on part of the modern shelf during the early Holocene regression to ~100 m bsl. No coccolithophores were found in the studied materials of the white laminations from the three sediment cores, confirming its inorganic origin. A mechanism for the redeposition of aragonite at the base of the sapropel is proposed. A relationship has been established between the deepening of the basin and the decrease in the size and number of rice-like aragonite crystals.
- ✓ New data on climate change and ecosystem responses in the western Black Sea region over the last 26000 years have been obtained from three marine cores. A total of six local pollen assemblage zones have been identified, which are chronostratigraphically related to the palaeoclimatic changes

reflected in regional pollen assemblage zones (RPAZ). The following have been distinguished: RPAZ IV (25,903–15,612 cal. yrs BP), RPAZ V (15,612–11,788 cal. yrs BP), RPAZ VI (11,788–8,004 cal. yrs BP), RPAZ VII (8,004–5,483 cal. yrs BP), RPAZ VIII (5,483–2,837 cal. yrs BP), RPAZ IX (2837 cal. yrs BP – to the pre-industrial time). For better differentiation and interpretation, the RPAZ V zone is divided into 4 regional pollen complex subzones RPASZ Va (15612–14295 cal. yrs BP), RPASZ Vb (14295 – 14036 cal. yrs BP), RPASZ Vc (14036 – 12965 cal. yrs BP), RPASZ Vd (12965 – 11788 cal. yr BP).

✓ A time interval with a change in the palaeoecological conditions in the Black Sea basin during the early Holocene has been established by distinguishing two main regional dinoflagellate assemblage zones (RDAZ). The first (RDAZ 1) is dominated by stenohaline freshwater to brackish species and is attributed to the interval 25903 – 7668 cal. yrs BP. The second (RDAZ 2) is dominated by euryhaline marine species and is divided into two subzones: subzone 2a (RDASZ 2a), assigned to the interval 7668–2837 cal. BP, and subzone 2b (LDASZ 2b), assigned to the interval 2837 cal. BP – to the pre-industrial time. For the first time in microfossil records from dinoflagellate cysts in Black Sea sediments (core Akad 11-17), the climatic fluctuation associated with the sharp short-term cooling in the period between 8.5 and 8.3 ka BP, established throughout Europe as the "8.2 ka cold event", has been established.

✓ The palaeoclimatic, paleoecological and geological conditions of the Black Sea basin over the last 20000 years have been traced using an integrated and comprehensive approach that includes multiple analyses and methods, as well as interpretations of existing hypotheses for paleoexchange of water masses between the Mediterranean and Black Seas. Sea surface salinity (SSS), water temperature and water level in the Black Sea basin have been compared and a curve of the average surface salinity for the Black Sea basin over the last 20000 years has been derived.

✓ New ^{14}C ages of fossilised specimens of *Ostrea edulis* from the base of the reef at Perla Beach have been obtained and the palaeoecological conditions of the basin at the time of its initial settlement in the Black Sea, as well as its adaptive potential for survival and the reasons for its disappearance, have been studied. Using the curve of the average surface salinity for the Black Sea basin and new ^{14}C dating, it is concluded that the settlement of *Ostrea edulis* in the Black Sea occurred at a surface salinity of 16 psu about 5,000 ^{14}C yrs BP.

✓ The degree of pollution of coastal sediments in the Bulgarian Black Sea coastal zone (22 stations from the monitoring network) was assessed by calculating various pollution indices: geoaccumulation index (Igeo), enrichment factor (EF), contamination factor (CF), modified contamination degree (mCd) and pollutant load index (PLI). It was found that most areas range from unpolluted to moderately polluted, with one exception of significant pollution (Pb and Zn). The northern part of the

Bulgarian coastal zone, influenced by the Danube River, is classified as slightly polluted with Zn and Pb according to the applied indices.

✓ An in-depth assessment of plastic pollution in the Black Sea waters was carried out. Its composition, density and distribution were studied through visual observations within a total of 288 transects covering a study area of 7.52 km², as well as the identification of accumulation zones of floating marine debris. The new data obtained allowed for the classification of 1,320 waste items, 90% of which were identified as plastic materials. The presence of floating waste has been recorded in the coastal, shelf and open waters of the Bulgarian Black Sea area, with an average density of 170 items/km⁻².

Confirmatory scientific contributions:

✓ The existence of an ancient Black Sea coastline located at ~120 m bsl has been confirmed. In the Black Sea shelf aquatory, the Paleoproviadiyska River, Emine and Koketrais polygons have been studied in detail. The echo sounder and acoustic studies carried out on the ancient accumulative formations (bars and dunes) of the old coastline and the three-dimensional maps of the studied areas depict the submerged coastal bars and dunes during the early Holocene, located obliquely to parallel to the modern coastline. The presence of an erosion surface at a depth of up to ~120 m bsl indicates significant regression preceding the invasion of Mediterranean waters.

✓ Using a multidisciplinary approach and methods (lithological description, biostratigraphic analysis, isotopic analyses of ¹⁶O/¹⁸O, ⁸⁶Sr/⁸⁷Sr and ¹⁴C dating of fossil molluscs), samples from a total of 41 boreholes from the shelf, the continental slope and the deep-water zone of the Black Sea, suggesting a rapid early Holocene Mediterranean flood rather than a slow inundation of the drained old coastlines of the Black Sea basin.

✓ A new interpretation of the paleoexchange of water masses between the Aegean, Marmara and Black Seas is proposed, rejecting the constant paleodepth of the Bosphorus threshold for the period 20000 - 7000 cal. BP and the acceptance of two models for the depth of the Bosphorus threshold – a deep-threshold and a shallow-threshold model, during different stages of the period under consideration. A new explanation is proposed for the formation of the lower sapropel layer in the Marmara Sea.

✓ The relationship between the established cycles of solar luminosity (showing no clear links to orbital variations) recorded after the last glacial period in a speleothem proxy record of solar insolation from the Duhlata Cave and the palaeoclimatic data obtained from various analyses of sedimentary material show a causal relationship. Solar luminosity cycles have been recorded with conclusive evidence in the changes in the paleoclimate and ecosystem of the Black Sea region and the Late Pleistocene and Holocene fluctuations in water level in the Black Sea basin. Conventional ¹⁴C years with which the various palaeoclimate data from the Black Sea region are dated have been

corrected and then converted into calendar years in order to correlate them correctly with the solar luminosity cycles measured by the U/Th dating method.

✓ A chronostratigraphic scheme has been proposed for the correlation of lithostratigraphic units from the shelf and deep-water zone of the Black Sea, corresponding to the established boundaries between the Holocene horizons (in calendar years) and the difference in the time range between the established Pleistocene/Holocene climatic boundary, proven by spore-pollen analysis, and the boundary of salinity change in the basin, established by analysis of dinoflagellate cysts.

✓ For the second time in Black Sea sediments (core Akad 11-17) high-resolution spore-pollen analysis has confirmed the cooling in the period 8.5–8.3 ka BP, which is considered a palaeoclimatic change in vegetation cover in connection with the "8.2 ka cold event" established throughout Europe.

✓ Local changes in the incoming terrigenous material of the main fractions (sand, silt, clay) and the dynamics of their deposition in two drill cores of Late Pleistocene and Holocene age were traced. A general trend in particle size (fine and medium-grained fraction) has been established. The new data obtained on the sharp increase in the values of the medium-grained fraction, combined with a sharp decrease in the fine fraction and a decrease in carbonate values, just before the start of sapropel deposition, indicate a sea level drop during the early Holocene evolution of the Black Sea and are indicative of the last stage of the regressive phase in the evolution of the Black Sea basin, i.e. its most active phase.

✓ The changing radiocarbon ^{14}C reservoir ages during the late Pleistocene and Holocene for the Black Sea basin have been determined. ^{14}C reservoir ages were obtained by comparing the $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values of molluscs (from all available shelf boreholes) with the corresponding $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ measurements in nearby stalactites, dated using the uranium-thorium (U/Th) method, from the Sofular cave. The reservoir ages were also used to correct the radiocarbon years before their conversion into calendar years. A lower value of the reservoir age of the Black Sea basin was calculated compared to previous studies.

✓ An approach is proposed for obtaining data on carbon captured by marine sediments, following analysis of new evidence of accelerated sedimentation and increased rates of organic and inorganic carbon accumulation over the last 100 years from sediment records from a borehole in the western Black Sea and two boreholes in the southern part of the Adriatic Sea. The results of radionuclide dating with ^{210}Pb and $^{137}\text{Cs}/^{241}\text{Am}$, measurement of organic and inorganic C, granulometric and mineral composition of the samples show that the long-term and widespread increase in the rates of accumulation of organic and inorganic C in sediments correlates with the increase in atmospheric CO_2 concentrations. This highlights the important role of coastal sediments in capturing atmospheric C and thus in regulating the Earth's climate. The results confirm that the use of radionuclide dating in combination with organic and inorganic carbon analysis of coastal sediment core samples could be a

useful approach for obtaining data on carbon captured by marine sediments, which could improve models and make predictions about the global carbon cycle more accurate.

✓ New data have been obtained on the accumulation of the technogenic radionuclide ^{137}Cs and the natural radionuclides of the ^{238}U and ^{232}Th series, as well as ^{40}K in sediments from two boreholes in front of cape Galata, at depths of -24.5 m and -22 m, and a sediment sample from a depth of -18 m in the Varna Bay. Comparative analysis with data from previous studies shows that the values for ^{137}Cs , ^{238}U , ^{226}Ra and ^{232}Th from previous studies are significantly higher than those measured in the study conducted by the candidate.

✓ New data were obtained for technogenic ^{137}Cs and natural radionuclides ^{232}Th , ^{234}Th , ^{226}Ra and ^{40}K from two sediment samples collected from depths of -14 and -20 m in the area of Perla Beach (Primorsko). The data show that the measured values are low and close to background levels. All values are comparable to those obtained in previous studies of sediments collected from the same area in Primorsko. The exception is the higher concentrations measured for ^{40}K compared to the results obtained in previous studies.

Scientifically applied contributions:

✓ A new palaeoceanographic approach has been evaluated and applied – aragonite laminations deposited at the base of sapropel muds are used as markers for a better understanding of the palaeoclimatic, paleoecological and sedimentological conditions during the transition from the regressive to the transgressive phase of the Black Sea basin during the early Holocene. This is based on the proven temporal and spatial unity of the genesis of sapropel muds and the strictly fixed deposition of laminations at the base of the sapropel.

✓ A synchronised and harmonised protocol for sampling and sample preparation of sedimentary material for analysis using nuclear analytical techniques by 12 laboratories and research institutes has been developed and applied in two international expeditions.

✓ A database has been created from an inventory of measured concentrations of radionuclides (technogenic and natural) and toxic elements (Mn, Ni, Zn, Cu, Pb, As, Cr, Cd and Co) and new data obtained for sediments from the Black Sea basin. The local database has been integrated into the database of the Marine Radioactivity Information System.

4. Significance of the results obtained

The analysis of the scientometric data from the scientific output submitted for review is **fully compliant** with the *Regulations on the conditions and procedures for acquiring educational and scientific degrees and occupying academic positions at the Institute of Oceanology of the Bulgarian Academy of Sciences*.

I fully accept the evidences presented by Senior Assistant Professor Dr. Krasimira Ruseva Slavova as meeting the national minimum requirements for the academic position of Associate Professor. A review of the information submitted by the participant in the competition to meet the national minimum requirements and the requirements of the Regulations of the Institute of Oceanology at the Bulgarian Academy of Sciences for holding the academic position of "associate professor" in scientific field 4. "Natural Sciences, Mathematics and Informatics", Professional field: 4.4. Earth Sciences, shows **that the minimum required points have been exceeded**, as follows:

- Group of indicators "A" – 50 points (50 points required);
- Group of indicators "B" – 115 points (100 points required);
- Group of indicators "G" – 262 points (220 points required);
- Group of indicators "E" – 487 points (60 points required).

The candidate has submitted a list of 41 titles (40 of which are scientific publications), grouped according to the required indicators. Seven of these are related to the acquisition of a doctoral degree (1 dissertation and 6 scientific publications), and they are not subject for review in this competition, but are taken into account in the overall assessment of the candidate. For this competition, 34 publications are presented, which are distributed according to the reference for compliance with the minimum national requirements and those of the IO-BAS (Indicators B4 and G7). Regarding indicator B4, Six publications are scientific publications in journals that are referenced and indexed in world-renowned scientific information databases (Web of Science and Scopus). Two of them are in Q1 quartile journals, one is in a Q2 quartile journal, and three are in Q3 quartile journals. Indicator G7. Scientific publications in journals that are referenced and indexed in world-renowned scientific information databases (Web of Science and Scopus), outside the habilitation thesis, includes 28 publications presented, of which 20 are scientific publications in peer-reviewed journals, and 8 are distributed by quartiles as follows: Q1 – 2, Q2 – 1, Q3 – 4, Q4 – 1. Most of the publications presented in the competition are in author teams, a significant part of which have international participation, an indicator of good scientific cooperation, which is extremely important when conducting multidisciplinary research. Dr Slavova is the lead author in nineteen of the publications submitted for the competition (in twelve – first or sole author and in seven – second author).

The author's list of citations in scientific publications contains 115 citing sources, 81 of which are referenced and indexed in world-renowned scientific information databases (Web of Science and Scopus), with 16 cited publications. The relatively high number of citations is an indicator of the relevance of her research and the quality of her scientific output.

5. Most significant scientifically applied achievements

The candidate's geocological studies on the pollution of Black Sea sediments and waters with radionuclides, heavy metals and floating waste in direct connection with contemporary climate change and anthropogenic pressure are of particular value.

6. Demonstrated skills or aptitude for leading scientific research

Dr Slavova has participated in a large number of international (15) and national (8) research projects (coordinator of six of the projects), which proves her intensive scientific, organisational and expert activity and teamwork skills. Her participation in 17 national and international scientific forums contributes to the active dissemination of the results of the research conducted.

7. Profile of scientific research work

Dr. Krasimira Slavova's main research profile is in the field of paleoclimate and geocology of the Black Sea. The results of her research have been published in 14 articles in specialised and renowned international scientific journals, referenced and indexed in Web of Science/Scopus, such as Marine Geology, Journal of Soils and Sediments, Marine Pollution Bulletin, Grana, Nature Conservation and others.

The research work of Senior Assistant Professor Dr. Krasimira Ruseva Slavova reflects **contemporary scientific and scientifically applied achievements** with original and confirmatory contributions, **skilful use** of interdisciplinary research methods and comparative approaches, and convincingly presents her as: an established **specialist with a clearly defined profile** in the field of ocean and sea geology; **a key expert** – marine geologist and **creator** – **a professional with recognised authority** at institutional, national and international level.

8. The candidate's teaching and educational activities and role in the training of young scientific staff

Senior Assistant Professor Dr. Krasimira Ruseva Slavova successfully coordinates a series of educational projects of the Institute of Oceanology at the Bulgarian Academy of Sciences for the European Researchers' Night. Together with her fluency in classical and innovative geological methods, this provides a solid foundation for the future habilitated specialist's leading role in **training new personnel** for the establishment and development of marine geology and geoarchaeology as an important scientific field at the Institute of Oceanology of the Bulgarian Academy of Sciences.

9. Critical comments and recommendations

Essentially, **I have no** critical comments on the candidate's scientific output. I find the presentation of the documents submitted for the competition to be **excellent**, combining **precision and high scientific style**. I recommend Dr. Slavova to continue her future research with geochemical studies on Black Sea sediments, as these are of great value to the contemporary geoecological science in assessing anthropogenic pressure on the Black Sea ecosystem.

10. Conclusion

Senior Assistant Professor Dr. Krasimira Ruseva Slavova is participating in the competition for the academic position of "ASSOCIATE PROFESSOR" with **sufficient volume and quality of scientific output**, defining the profile of her scientific field – Paleoclimate and Geoecology of the Black Sea. The materials submitted for review contain **diverse and detailed information** on the candidate's research interests, results and achievements, as well as on her academic, expert and teaching activities and the professional biography of the candidate, in full compliance (**even exceeding**) with the conditions and national minimum criteria for holding the academic position of "ASSOCIATE PROFESSOR", formulated in the Law on the Development of Academic Staff in the Republic of Bulgaria, the Ordinance for the implementation of the Law and the internal academic regulations and criteria adopted by the Scientific Council of the Institute of Oceanology at the Bulgarian Academy of Sciences in Varna.

The above gives me a reason to strongly recommend to the honourable members of the Scientific Jury for this competition and the esteemed members of the Scientific Council of the Institute of Oceanology at BAS - Varna to vote "YES" for the selection of Senior Assistant Professor Dr. Krasimira Ruseva Slavova in the competition for the academic position of "ASSOCIATE PROFESSOR" in the scientific field of "Geology of the Oceans and Seas".

November 12, 2025
Varna

Reviewer:
(Prof. DSc Mariana Filipova-Marinova)