The peculiarities of the influence of nanochimical, geomechanical, and biocolloidal factors on the formation of deep-sea sediments

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INTRODUCTION / OBJECTIVES / AIMS / METHODS

According to the **task**, the viability of microorganisms within biocolloid composition of iron oxide-hydroxides, carbonates, and clayey iron-aluminosilicates (IASs) was investigated. The **aim** was to understand the behavior of such compositions in natural deep-sea (2-6 km and 6-11 km) pelitic sediments, considering the influence of nanochemical, geomechanical, colloid-chemical, and rheological factors.

Methods. Chemical, X-ray diffraction, electron microscopic, derivative, adsorption, and medical-biological methods were employed for the research.

RESULTS

A comprehensive analysis of the conditions governing the displacement of oceanic-marine pelito-turbidite disperse sediments, accompanied by the reformation of geocoenoses on slopes and deep-sea (up to 6 km) abyssal plains with dimensions up to 6000 km, as well as the behavior of complex compositions in troughs and trenches at depths of 6-11 km, has been conducted [1-3]. For the first time, it has been demonstrated that microbiological processes are accompanied by parallel inorganic reactions leading to the formation of various IASs within the micropores of silicate particles. This significantly increases (by 1.5-2 times) the sorption surface of sediments, enhancing their capacity to absorb pollutants, including those of technogenic origin, from marine waters.

Peloids (pelitic structures)

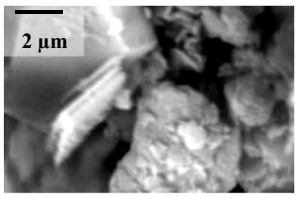

Fig. 1. **macrostructures**

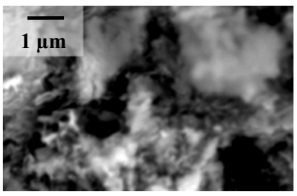

Fig. 2. **microstructures**

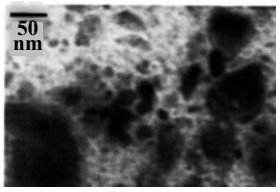

Fig. 3. **nanostructures**

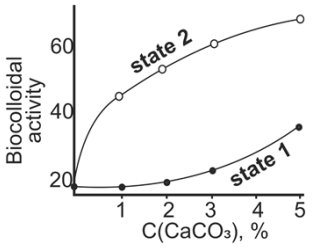

Fig. 4. Increase in biocolloidal activity as a function of carbonate content (Effect of State 2 and State 1)

Mechanochemical dispersion in turbulent mode during pelite transformation (State 2)

$$\underset{\text{microstructured phase}}{Ca(Al,Fe)CO_3} + \underset{\text{(marine water)}}{2NaCl} \rightleftharpoons \underset{\text{nanostructured phase}}{[Na_2(Al,Fe)CO_3]_n} + CaCl_2$$

At depths of 0-0.2 km (shelf)

$$\underset{\text{nanostructured phase}}{[Na_2(Al,Fe)CO_3]_n} + H_2SiO_3 \rightleftarrows \underset{\text{nanostructure}}{[Na_2(Al,Fe)SiO_3]_n} + CO_2$$

At depths of 0,2-11 km

Nanochemical recondensation in the laminar regime of transformation on the shelf (State 1)

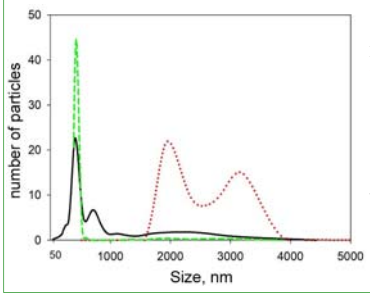

Figure 5. Distribution of fine fraction sediment particles by size:
····· Azov Sea mud, sample 1; —— Black Sea mud, sample 2; ----- Black Sea mud, sample 3

Figure 5 confirms that deep-sea sediments (at 2200 m depth) contain significantly more nano and colloidal particles, which have the largest sorption surface. The Azov Sea mud was taken from a depth of 10 m, while the Black Sea mud samples are as follows: sample 2 from 1800 m depth, and sample 3 from 2200 m depth.

CONCLUSIONS

The obtained results are significantly important for advancing modern fundamental understanding of mechanisms causing disturbances in the ecological balance of marine environments [4]. According to preliminary data, the impact of marine environments exceeds that of terrestrial land by orders of magnitude, making it highly relevant for the future life on Earth.

CITATIONS

1. Kovzun, I. G., Prokopenko, V. A., Panko, A. V., et al. (2020). Nanochemical, Nanostructural and Biocolloidal Aspects of Transformations in Dispersions of Iron-Aluminosilicate Minerals. Kyiv: PH "Akademperiodyka". 187 p. https://doi.org/10.15407/akademperiodyka.416.188
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3. Horne, R. A. (Ed.). (1969). Marine Chemistry. New York: Wiley Interscience.
4. Sobek, A. (2023, April 28). We found long-banned pollutants in the very deepest part of the ocean. The Conversation (online journal). Retrieved from https://theconversation.com/we-found-long-banned-pollutants-in-the-very-deepest-part-of-the-ocean-204447

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