Geomechanics and Nanochemistry of Bottom Sediment Formation from Dispersed Polymineral Iron-Aluminosilicates in Seas and Oceans

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INTRODUCTION / OBJECTIVES / AIMS / METHODS

According to the **task**, experimental and model-theoretical studies were conducted with the **aim** to establish the peculiarities of the influence of geomechanical, physical, colloid-chemical, and nanochemical factors on the nanostructural contact formation and rheological behavior of clayey iron-aluminosilicate marine and oceanic bottom sediments (IASs) depending on their layered deposition at depths ranging from 0.2 to 11 km.

Methods. Chemical, rheological, X-ray diffraction, derivatographic, electron microscopic, and adsorption methods were used.

RESULTS

The study examines the peculiarities of the influence of rheological phenomena and physicochemical geomechanics during nanostructural layered transformations of ironaluminosilicates (IASs). For the first time, it has been demonstrated that under dynamic conditions the formation of various IASs depends on the physicochemical nanotransformation of iron compounds, silicate and carbonate conversions, leading to the prior rapid obtaining [1, 2] of compositions with well-developed mesoporous structure and increased sorption activity in 1.5-2 times. It is also shown for the first time that the decrease in the moisture content of IAS dispersions leads to decreasing of their flow, while the speed of micro- and macrostructural formation increases in conditions of sliding of marine sediments, which additionally consolidate in deep trenches as layered deposits. These findings have significant implications for understanding the formation of IASs and the development of highly active compositions with advanced mesoporous structure, especially under various environmental conditions, thus opening new opportunities for applications in diverse fields [2, 3].

1. Theoretical concepts [1, 3]

Nanochemical recondensation in a laminar regime or in a quiescent state (state 1)

$$\frac{dS}{dt} : \ r\frac{dr}{dt} = \frac{2\sigma C_0 D V^2}{lRT} = const$$

Mechanochemical nanodispersion in a turbulent regime (state 2).

$A \cdot l + B \cdot l^2 = t;$

$A = r \cdot R \cdot T / D \cdot C_0 \cdot P \cdot V$

$B = 12\eta / r^2 \cdot P$

$(S - S_0)^2 = k \cdot t$

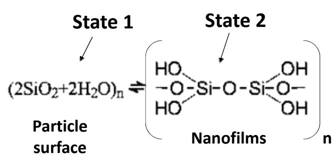
where A, B, k, R are constants;

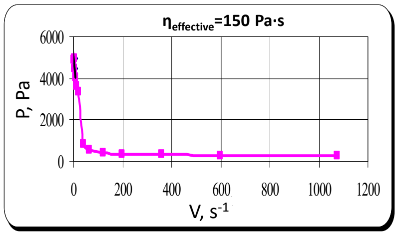
- D and l are the diffusion coefficient and penetration depth;
- r is the particle radius;
- V is the volume;
- P is the pressure;
- S is the surface.

2. Experimental testing [1-3]

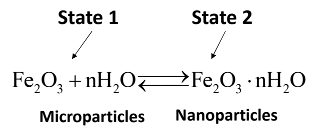
Iron-aluminosilicate suspension (rheological data)

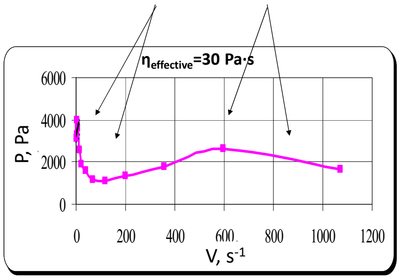
Purified from Fe_2O_3 and CaO)





Natural
(0,9% Fe_2O_3; 0,14% CaO)





CONCLUSIONS

These studies contribute to the exploration of new perspectives in understanding the fundamental mechanisms of formation of marine and oceanic bottom sediments based on disperse clayey polyminearal iron-aluminosilicates. These findings have the potential to enhance our knowledge and improve the ecological state of marine and oceanic environments.

The obtained results are crucial for advancing modern understanding of the mechanisms of ecological balance in marine and oceanic environments [1, 2, 4], as well as for developing innovative technological solutions to prevent negative phenomena on ocean slopes and maintain ecological equilibrium in deep marine sediments (up to 6-11 km) using the methods of physicochemical geomechanics [1-3].

CITATIONS

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