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COSEDIMENTATION OF KAOLINITE-MONTMORILLONITE SUSPENSIONS

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ABSTRACT

The sedimentation of kaolinite and quartz prepared from flecked kaolin was investigated in a suspension made from the montmorillonite fraction as a medium. The concentration of the suspension the pH and the quantities of certain electrolytes (NaCl and $CaCl_2$) were varied, and it was found that the character of the complex sedimentation and the structures of the sediments are influenced to a great extent by these parameters. The (aggregated) cosedimentation of montmorillonite and kaolinite could be achieved when a kaolinite suspension coagulated to some extent was added to a stable montmorillonite suspension of appropriate concentration.

The flecked kaolin from Mád-Rátka is a mixture of montmorillonite, kaolinite, quartz and feldspar. The kaolinite and the quartz appear in the form of "flecks" in the montmorillonite base material.

Since the conditions of develcpment of montmorillonite and kaolinite are very different, this is probably a reworked formation. Sedimentation of the kaolinite and quartz fractions of flecked kaolin, previously disaggregated (peptized) and fractionated, was investigated in a suspension medium prepared from the montmorillonite fraction. This served to model the geological conditions of the reworking process considered possible.

In the course of the separation of flecked kaolin, 29% pure montmorillonite, 56% kaolinite and 15% of a fraction containing chiefly quartz were obtained. In our experiments the fractions were mixed in the above ratio, and either the concentration of the suspension or the ratio of the components was changed.

As regards the conditions of formation it is well-known that kaolinite crystallizes at $pH < 7$ and montmorillonite at $pH > 7$. Consequently, in the model of the formation of flecked kaolin (presumably formed by reworking) — the pH of the kaolinite suspension was set to lower than 7. The pH of the montmorillonite suspension was about 8.2.

In parallel with this examination the influence of the ion milieu was also investigated. The experimental parameters are listed in Table 1.

The measurements were carried out at room temperature in 20 ml sedimentation tubes. Kaolinite suspensions of different concentrations and pH values to which different electrolytes and the appropriate rough quartz in calculated amount was added were layered onto montmorillonite suspensions of different concentrations. The sedimentation of suspensions made by systematic variation of the experimental parameters, and the structures of the resulting sediments, were observed through one month. It was found that in practice these systems can be divided into 3 main groups:

1. Suspensions which settle slowly and diffusely, resulting in sediments of measurable volume. This is the situation when a 1, 2 or 5% kaolinite suspension of

TABLE 1

Experimental conditions of complex sedimentation of montmorillonite and kaolinite

	Kaolinite suspension	Montmorillonite suspension
Concentration of suspension, g/100 ml	1, 2, 5	0.47, 0.95, 2.2
Suspension pH	7.5, 6, 5	8.2
NaCl-concentration, mole/dm³	0,01, 0.05, 0.1	0.05
$CaCl_2$-concentration, mole/dm³	0.01, 0.05, 0.1	

pH 7.5, containing rough quartz, is layered onto a montmorillonite suspension of relatively low concentration *(Fig. 1/a)*.

If the pH of the kaolinite suspension is set to 6, the whole suspension visibly coagulates a little, but with hardly any change in the character of the sedimentation. The kaolinite settles into the montmorillonite suspension, but coagulation initiating sedimentation with a sharp interface cannot be observed. The slight coagulation of the kaolinite suspension is not accompanied by that of the montmorillonite; this remains essentially in a peptized condition and does not settle.

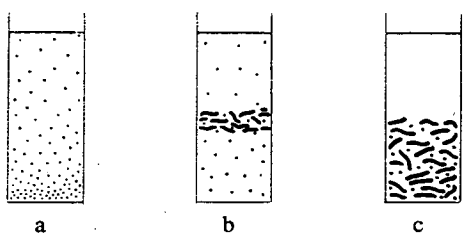

Fig. 1. a) Diffuse sedimentation, measurable volume of sediment
b) Kaolinite-quartz sediment ring on montmorillonite suspension
c) Cosedimented, coagulated montmorillonite-kaolinite-quartz suspension.

2. This group shows how large a role the concentration of the suspension may have: when the concentration of the montmorillonite suspension is 1.5% or higher, a ring-like sediment of the over-layered kaolinite suspension is formed on the surface of the montmorillonite. This ring of sediment becomes broader only when the kaolinite suspension contains quartz. The sedimentation character did not change even when the pH of the kaolinite suspension was changed or electrolytes with different concentrations, were added.

The same sedimentation character may occur with montmorillonite suspensions of lower (e. g. about 1%) concentration, if they are treated with 0.05 M calcium chloride (i. e. coagulated) before the over-layering of the kaolinite suspension *(Fig. 1/b)*.

3. This group comprises the suspensions which coagulate after being superposed on each other: they settle together at different rates, with a relatively sharp interface: their dispersion media become clear *(Fig. 1/c)*.

The kaolinite suspension coagulated in laminated layers settles relatively quickly into a montmorillonite suspension with lower than 1% concentration, and causes it to coagulate more or less: the montmorillonite, kaolinite and quartz then settle together at a lower rate. This process can also be induced by setting the kaolinite suspension to pH 5—6, but the resulting suspension settles to only a very small degree. The above phenomenon can be observed most characteristically in a system where a 2% kaolinite suspension (pH 6, containing 0.05 M calcium chloride) is layered over a 0.47% montmorillonite suspension.

It was found that cosedimentation of montmorillonite and kaolinite can be achieved when a kaolinite suspension coagulated to some extent is added to a stable montmorillonite suspension of appropriate concentration.

To summarize it can be stated that the character of the complex sedimentation of montmorillonite and kaolinite, and the structures of the sediments, are influenced by the concentration of the suspension (primarily that of montmorillonite), their pH conditions, and the quantity and nature of the electrolytes added. Some of the systems we investigated are especially noteworthy: however, further systematic and exact investigations are necessary in order to model the geological conditions more precisely.

REFERENCES

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