Although the absence of the "o" in "the" was no more likely to be noticed than the absence of any other "o", it is nevertheless more likely to be missed than other terminal pronounced "e's" ($P < 0.02$). This finding would suggest that "the" has properties which tend to override acoustic factors to result in a disproportionately high probability of not noticing its absent "e".

The effect of position within a word is in the opposite direction to that of the previous study. It would appear that the end of a word is poorly scanned for existing letters, but scanned carefully for missing letters.

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SOIL SCIENCE

Silicic Acid and the Reaction of Zinc with Clays

DURING studies on the reactions between heavy metal cations at low concentrations and montmorillonite in 0.05 molar calcium chloride, it was noted that the amount of zinc sorbed increased when silicic acid was added. The work of Caillière, Hélin and associates¹ has shown that layer lattice silicates of magnesium, nickel, cobalt, ferrous and ferric iron, zinc and manganese can be synthesized under laboratory conditions at atmospheric pressure and temperatures near 100° C. Of these, zinc is reported to form silicates quite readily and the detailed study of Esquevin² has described such syntheses in detail.

In my experiments, the increase in the sorption of zinc caused by the presence of silicic acid, designated ΔZ_{nsi} , occurred under conditions which did not result in the precipitation of zinc compounds from pure solutions in the absence of clay. In the presence of montmorillonite the interaction of zinc and silicic acid was studied over a range of pH values from 5 to 6.5 for concentrations of zinc labelled with zinc-65 varying from 5×10^{-6} to 10^{-3} molar, and for silicic acid solutions varying from 2×10^{-4} to 1.8×10^{-3} molar with respect to silicon. The influence of pH and varying zinc concentration on the sorption of zinc in 0.05 molar calcium chloride and in the presence of added silicic acid is shown in Fig. 1 in the form of adsorption isotherms at 20° C. The experiments were carried out using 20 mg clay in 12 ml. suspension. These results indicate that ΔZ_{nsi} increased with pH for any level of zinc in solution but was virtually independent of zinc concentration above about 2×10^{-5} molar for constant levels of silicic acid and pH in solution. More zinc would be hydrolysed and more silicic acid adsorbed at higher pH values. Extension of similar isotherms to higher levels of zinc in solution and at increased pH show that precipitation of zinc compounds as indicated by strong inflexions in the curves also occurs much more readily when silicic acid is added. Thus sorption and precipitation of zinc in clay suspensions to which silicic acid has not been added may be caused in part by silicic acid associated naturally with clays.

Table 1 shows the effect of varying the initial concentration of silicic acid on the magnitude of ΔZ_{nsi} for an

Fig. 1. The effect of pH, zinc concentration and added silicic acid ($1.88 \mu\text{moles/ml.}$) on the sorption of zinc by montmorillonite in 0.05 molar calcium chloride. No added silicic acid: $\circ$, pH 4.5; Δ , pH 5.0; $\square$, pH 6.0. Silicic acid added: $\bullet$, pH 4.5; $\blacktriangle$, pH 5.0; $\blacksquare$, pH 6.0.

equilibrium concentration of 6×10^{-5} molar zinc at pH 6; ΔZ_{nsi} increased with increasing silicic acid in solution, at least up to an initial level of 1.6×10^{-3} molar in the example given. The adsorption of silicic acid by montmorillonite cannot be measured readily because of the irreversible release of silicon by the solid, but tests showed that the adsorption of silicic acid increased with pH and silicic acid concentration over the limited range of conditions in these studies: the precipitation of amorphous silica is unlikely at the concentrations of silicic acid used. The results suggest that the increased sorption of zinc is related to the amount of silicic acid adsorbed.

The evidence indicates that over a wide range of pH and zinc concentration there is an interaction between zinc and silicic acid which is probably restricted to an adsorbed layer rather than in a separate zinc silicate phase. Furthermore, in the presence of clay and at higher pH values and/or increased zinc concentrations precipitation of a separate phase which contains zinc, and probably silicon, is favoured by the addition of silicic acid. This precipitation is observed to take place under conditions different from those in the absence of clay presumably because of the higher concentrations of reactants at the clay surface which may in turn provide a template for layer silicate formation.

Other aspects of this problem, including the mechanism by which adsorbed silicic acid increases the sorption of heavy metal cations, the application to other surfaces and cations are being investigated and will be presented fully later. Preliminary results show that this reaction also applies to cobalt.

These results have implications in the synthesis of silicates in weathering environments containing low concentrations of reactants in solution and assist in understanding the reactions by which heavy metal micro-nutrients become less available to plants.

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¹ Caillière, S., and Hélin, M. S., *Colloq. Intern. Centre Nat. Rech. Sci.*, No. 105, 31 (1961).

² Esquevin, J., *Ann. Agron.*, 11, 497 (1960).

Table 1. EFFECT OF VARIATION IN THE INITIAL CONCENTRATION OF SILICIC ACID ON THE AMOUNT OF ZINC SORBED BY MONTMORILLONITE

Silicic acid (molar)	Zinc sorbed ($\mu\text{moles/g}$)	ΔZ_{nsi} ($\mu\text{moles/g}$)
0	2.11	0
0.2×10^{-3}	2.48	0.37
0.4×10^{-3}	2.68	0.57
0.8×10^{-3}	2.77	0.66
1.2×10^{-3}	3.03	0.92
1.6×10^{-3}	3.09	0.98