The Influence of Aluminum on Iron Oxides. VI. The Formation of Fe(II)-Al (III) Hydroxy-Chlorides, -Sulfates, and -Carbonates as New Members of the Pyroaurite Group and Their Significance in Soils

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Abstract: In the absence of oxygen, Fe(II) chloride, sulfate, and carbonate solutions react at pH 6.5 to 7 with aluminum hydroxide suspensions to form new Fe(II)-Al(III) hydroxy anion compounds of the pyroaurite group. The Fe(II)-Al(III) hydroxy-chloride and -sulfate compounds are isostructural with Fe(II)- Fe(III) " green rust " compounds with Al essentially substituting for Fe(III). Where CO_3^{2-} is the only anion in the system, an Fe(II)-Al(III) compound isostructural with hydrotalcite is formed. Either in the dried or wet state, these compounds are unstable in air due to oxidation of Fe(II). Oxidation of the dried sample in air yields akaganeite or aluminous ferrihydrite, whereas, if the sample is maintained in a moist condition and oxidized by air under water, lepidocrocite or aluminous goethite is produced along with small amounts of ferrihydrite. On X-ray powder diffraction, the lepidocrocite so formed commonly shows no diagnostic (020) basal reflection, or one with a markedly reduced intensity. The products of oxidation, and the rapidity of their formation, appear to be dependent on the composition of the initial double hydroxy compound and the conditions under which the oxidation is carried out.

The green colored compounds commonly observed in gleyed soils also rapidly become yellow brown on exposure to air, and difficulty arises in the identification of the Fe oxide phases assumed to be present. Similar conditions and reactants to those involved in the formation of the compounds described above are expected in these soils, and it is suggested that Fe(II)-Al(III) members of the pyroaurite group may form in such an environment.

Key Words: Fe-Al hydroxycarbonate • Fe-Al hydroxychloride • Fe-Al hydroxysulfate • Green rust • Iron oxide • Pyroaurite

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