
Reactivity of Clay Minerals with Acids and Alkalies*

Dorothy Carroll[†] and Harry C. Starkey

U.S. Geological Survey, Menlo Park, Calif. 94025 and Denver, Colo. 80225

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[†] Deceased, January 30, 1970.

Abstract: One-g samples of a montmorillonite, a metabentonite, an illite, two kaolinites, and three halloysites were treated with 50 ml of hydrochloric acid (6·45 N, 1 : 1), acetic acid (4·5 N, 1 : 3), sodium hydroxide (2·8N), sodium chloride solution (pH 6·10; Na = 35‰; Cl = 21·5‰), and natural sea water (pH 7·85; Na = 35·5‰; Cl = 21·5‰) for a 10-day period in stoppered plastic vials. The supernatant solutions were removed from the clay minerals and analyzed for SiO₂, Al₂O₃, CaO, MgO, Na₂O, and K₂O. All the solutions removed some SiO₂, Al₂O₃, and Fe₂O₃ from the samples, but the quantities were small. Sodium hydroxide attacked the kaolin group minerals more strongly than it did montmorillonite, metabentonite, or illite. Halloysite was more strongly attacked by hydrochloric acid than was any of the other experimental minerals. Hydrochloric acid removed iron oxide coatings from soil clay minerals, but acetic acid did not remove them completely. The samples most strongly attacked by HCl and NaOH were examined by X-ray diffraction. Acid treatment did not destroy the structure of the clays, but the halloysite structure was partially destroyed. Sodium hydroxide attacked the halloysite structure, as shown by chemical analysis and X-ray diffraction. These experiments show that treatment in dilute acids has no harmful effect in the preparation of clays for X-ray diffraction. Acetic acid is preferred to hydrochloric acid for this purpose. Hydrochloric acid cleans clay minerals by removing free iron oxide from the surface; acetic acid is less effective.

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