Extraction of Iron Oxides from Sediments Using Reductive Dissolution by Titanium(III)

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Abstract: A new iron oxide dissolution method designed to measure the abundance of " free " Fe oxide phases and associated elements in soils and sediments has been tested. The method employs a ternary complex of Ti(III), citrate, and ethylenediaminetetraacetate (EDTA) as a reductant and bicarbonate as a proton acceptor. The Ti(III)-citrate-EDTA-HCO_3 method dissolved more synthetic amorphous ferric oxide and goethite, but less synthetic hematite, than the dithionite-citrate-HCO_3 method of Mehra and Jackson. The production of acidity by the dissolution indicated that Ti(IV) is hydrolyzed to TiO_2 during the extractions. The heated dithionite method dissolved 3 – 6 times more Al from kaolinite and nontronite standard clays than room temperature dithionite, and 4 – 6 times more Al than the Ti(III)-citrate-EDTA-HCO_3 method. Furthermore, the release of Fe from the clay mineral samples consistently and rapidly reached a plateau during multiple extractions by the Ti(III)-citrate-EDTA-HCO_3 method, indicating that a well-defined Fe oxide fraction was removed. Fe released by the dithionite method continued to increase with each extraction, suggesting that some release of structural Fe occurred. Tests on two natural sediments and one heavy mineral fraction from the Miocene Cohansey Sand in the New Jersey Coastal Plain suggested that the Ti(III)-citrate-EDTA-HCO_3 method removed Fe oxides more effectively and more selectively than the dithionite method. The selectivity of the Ti(III)-citrate-EDTA-HCO_3 method is enhanced by rapid extractions at room temperature and low free ligand concentrations.

Key Words: Dissolution • Dithionite • Extraction • Goethite • Hematite • Reduction • Titanium(III)

Clays and Clay Minerals; October 1991 v. 39; no. 5; p. 509-518; DOI: 10.1346/CCMN.1991.0390506

Clay Minerals Society (www.clays.org)