
Mössbauer Spectroscopic Evidence for Citrate-Bicarbonate-Dithionite Extraction of Maghemite from Soils

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Abstract: In a previous paper, we used powder X-ray diffraction and changes in magnetic susceptibility to argue the importance of pedogenic maghemite to soils and the efficacy of the chemical extractant citrate-bicarbonate-dithionite (CBD) to preferentially remove pedogenic maghemite from soil samples while not removing coarse-grained magnetite. Although X-ray diffraction provides strong support for this contention, Mössbauer spectroscopy is the method of choice for determining the oxidation state of iron in minerals and for inferring mineralogy of the iron oxide phases. Our objective in this work was to seek confirming evidence of the importance of maghemite as a pedogenic mineral and the usefulness of the CBD procedure in separating pedogenic maghemite from lithogenic magnetite. We present Mössbauer data on magnetic fractions from pre- and post-CBD treated soil samples. Six of the 10 samples had only maghemite as the sextet component and after CBD treatment, four lost between 96 and 100% of the magnetic susceptibility. Two samples were interpreted as highly oxidized magnetite or a mixture of magnetite and maghemite. We cannot distinguish between these with Mössbauer spectroscopy. In the remaining two samples, iron existed as hematite, ilmenite, magnetite and minor (<10%) amounts of maghemite. Our results provide additional support for pedogenic maghemite in soils and for the preferential removal of maghemite by the CBD procedure.

Key Words: Mössbauer spectroscopy • Soil genesis

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