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Mössbauer, X-ray diffraction and Magnetic characteristics of burned soil profiles

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The rare occurrence of magnetic soil in Denmark is normally explained by the hypothesis that the site has been burned. However, at some sites formation by means of biological processes has been suggested (1, 2). It is of considerable interest to determine the characteristics of profiles of burned soil, both in order to recognise these sites, and in order to understand the mineralogical alterations associated and formation of magnetic iron oxides. To document this, we have performed detailed studies of properties of burned sites using Mössbauer spectroscopy to determine the Fe(III) mineralogy, X-ray diffraction to determine lattice parameters and crystallite sizes together with magnetic methods. These have been applied on experimentally burned soil and a historic site where soil burning has taken place. In the case of the experimentally burned soil, it was possible to monitor the temperature as a function of depth during the burn, and these data can be used to extract the temperature dependent mineralogical changes.

In the experimentally burned profile, four clearly distinct layers where found containing almost pure iron oxides, from top: (A) mixture of maghemite and well crystalline hematite (B) maghemite, showing gradient in crystallinity (C) hematite and (D) original goethite. At the historic sites, the results are slightly different, but some of the characteristics and/or layering of the experimentally burned profile can be identified. The results give us the opportunity to determine whether a site has been subjected to soil burning, or whether other processes (chemical or biological) may be involved in the formation of magnetic iron oxides.

References:

(1) H. P. Gunnlaugsson *et al.*, 2002, *Hyp. Int.* **144/145**, 365.
(2) P. Nørnberg *et al.*, 2004, *Clay minerals* **39**, 85.