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Mineralogical effects of an experimental forest fire on a goethite/ferrihydrite soil – an attempt to solve the presence of hematite and maghemite in topsoils in a temperate region

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Isolated soil spots, a few square metres in size, as red as Munsell colour 10R ¾ are found in Denmark. These spots are well known as places that have been exposed to fire. However, a long-standing unresolved puzzle is the presence of extended areas with high iron content (8-40 %) where goethite and ferrihydrite are present in the topsoil along with hematite and maghemite. Hematite and particularly maghemite would normally not be expected to occur under the temperate humid Danish climate, but be interpreted as the result of high temperature as found in tropical areas or after forest fires. However, a body of evidence argues against these sites having been exposed to fire. In an attempt to get closer to an explanation of this iron mineralogy, an experimental forest fire was produced. The results showed a clear mineralogical zonation down to 10 cm depth. This was not observed at the natural sites, which contained a uniform mixture of goethite/ferrihydrite, hematite and maghemite down to 20 cm depth. The experimental forest fire furthermore left charcoal and ashes at the topsoil, produced high pH and decreased organic matter content, all of which is in contrast to the natural sites. Physical and chemical date as well as XRD, Mössbauer spectroscopic data and TEM micrographs from the sites will be presented. The conclusion from this work is that the mineralogy of these sites is not consistent with exposure to fire, but may rather result from long term transformation within a reducing environment, possibly involving microorganisms.

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