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# Magnetic enhancement of wildfire-affected soils and vegetation ashes

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Wildfires pose one of the most serious hazardous treats worldwide and cause severe physical and chemical changes to the soil. Wildfires were further considered as one of the possible mechanisms of soil magnetic enhancement through heating-induced mineral transformations in soil minerals which lead to production of new strongly magnetic iron oxides. In this study, magnetic properties of a collection of depth profiles of wildfire affected soils from 18 locations from Bulgaria and vegetation ashes from several sites are investigated. The major aim of the work is to reveal the factors responsible for the varying degree of fire-induced magnetic enhancement observed in different environmental settings. Dense soil sampling at half centimeter interval along the near-topsoil depth provides detailed information about the variations of magnetic characteristics. Magnetic susceptibility in fire affected soils exhibits strongly expressed maximum in the uppermost 1-cm depth and sharply decreases in depth usually down to 3-5 cm. The absolute magnetic enhancement estimated for the various soil profiles included in the study varies from 5 to 321 x10E-8 m3/kg. Taking into account that sampling locations include different soil types, relative magnetic enhancement is calculated as 100*(Xsurface-Xsubsurface)/Xsubsurface. This relative magnetic enhancement reaches a maximum of 2660 in a site affected by extremely severe fire and generally varies between 100 and 300. The same parameter, calculated for respective soil profiles which are not affected by fire, shows much lower values varying between -35 (e.g. magnetic susceptibility increases in depth) and 60 (natural topsoil pedogenic enhancement). Considering the vegetation character in each locality, wildfires in pine forests seem to produce the highest magnetic topsoil enhancement, while grass fires cause significantly weaker effects on soil magnetism. Magnetic characteristics of different burnt vegetation and ashes (wood chips, pine needles, pine bark, grass) suggest strongly varying concentration of magnetic phases. Black-colored burnt wood chips are most often diamagnetic, black- and dark grey ashes are weakly ferrimagnetic or paramagnetic, while white ashes show strong magnetic enhancement. Thus, an important issue to be resolved in further studies is whether the magnetic enhancement of fire affected soils arises because of mineral transformations in soil minerals, or through additions of vegetation ashes, or a combination of both. This study is supported by the project DFNI K02/13 funded by the Bulgarian National Science Fund.