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Magnetic and Geochemical Discrimination of Wildfire Affected Soils

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A b s t r a c t

Magnetic enrichment of fire-affected soils is a long – known phenomenon, observed at the birth of environmental magnetism and it was suggested that fire may be responsible for the soil magnetic enhancement of well aerated soils (Tite and Mullins 1971). Since then, several rock magnetic parameters have been proposed for discrimination between natural magnetic enhancement and burnt soils' enhancement, based on the observation that fire-affected soils show systematically higher concentration of fine grained superparamagnetic magnetite particles (Oldfield and Crowther 2007, Roman *et al.* 2013). The aim of the present contribution is to examine the effect of complex variations in fire severity, type of vegetation, time since fire and natural soils' properties on the observed magnetic and geochemical signature of burnt soils from Bulgaria. For that purpose, nine couplets of burnt-natural forest soils under pine forest; four couplets under mixed/broadleaf forest and three soil couplets with grass/bush vegetation have been studied. The wildfire events happened at different times before sampling, encompassing the period 2000–2017. In all profiles sampled, clear distinction of the burnt layer was possible based on the presence of abundant ashes and charcoal. Systematic magnetic enhancement is observed in all fire-affected soil levels, which is expressed not only in increased SP-content, but also enhanced concentration of stable SD particles. It is suggested by the experimental data, that the relative contribution of the two fractions depends on the fire severity in terms of both maximum firing temperature reached in the surface soil and the duration of fire event. Maximum fire-induced magnetic enhancement of susceptibility is obtained for soils developed under pine forest, suffered by strong wildfires. Less intense fire events and mixed or broadleaf vegetation cover induced weaker magnetic enhancement. Along with the enrichment with strongly magnetic iron oxides of the burnt layers, significant increase in the content of total concentration of elements – micronutrients such as Mn, Cu, Zn, P is observed, in line with other studies (Certini 2005, Pereira *et al*. 2012). Much better log-linear correlation is obtained between total carbon content (Ctot) and anhysteretic remanence (ARM) for burnt soil levels (R^2 of 0.85) as compared to non-burnt and Ctot – magnetic susceptibility relationships.

These findings suggest that wildfire affected soils' magnetic signature is dominated by magnetic signal of vegetation ashes.

Keywords: burnt soils, magnetism, fire severity, mineralogy.

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