Geophysical Research Abstracts
Vol. 13, EGU2011-1589, 2011
EGU General Assembly 2011

Charcoal and stable soil organic matter indicate fire frequency, past vegetation and climate in volcanic soils (Mt. Etna, Sicily)

Markus Egli (1), Giovanni Mastrolonardo (2), Ruedi Seiler (1), Giacomo Certini (2), Salvatore Raimondi (3), Filippo Favilli (1), and Paolo Cherubini (4)

(1) Department of Geography, University of Zürich, Zürich, Switzerland (markus.egli@geo.uzh.ch), (2) Dipartimento di Scienze delle Produzioni Vegetali, del Suolo e dell'Ambiente Agroforestale (DIPSA), Università degli Studi di Firenze, Firenze, Italy, (3) Dipartimento di Agronomia Ambientale e Territoriale, University of Palermo, Palermo, Italy, (4) Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland

A powerful tool to reconstruct past environments and climate is the extraction, identification and radiocarbon dating of charcoal fragments buried in soils. Charcoal fragments are particularly useful to reconstruct past vegetation because the level of preservation is often good enough to determine the tree genus (and in some cases the species) level. All forest ecosystems have the potential to burn as a result of climate or human-induced fires. Forest fires are ultimately coupled to climate and are a not negligible factor of pedogenesis in the Mediterranean areas, where they occur frequently. Furthermore, soil organic matter (SOM) is prone to changes due to forest fires, both in terms of quantity and quality. A soil sequence along an elevational gradient ranging from Mediterranean to subalpine climate zones on slopes of the Etna region (Sicily, southern Italy) was investigated in respect of soil organic C and charcoal. The amount of charcoal and the identification of charred species give an indication about fire frequency and vegetation changes that have occurred in the past. Furthermore, the distribution into labile and stable organic fraction provide insight into the stabilisation and turn-over mechanisms of SOM. The stable organic matter fraction is intended here as the residue of a treatment of the soil material using H_2O_2. The soils along the altitudinal sequence were variations of Vitric Andosols that developed on a trachy-basaltic (alkali mugearite) lava flow having an age of about 10-15 ky. Two main vegetation systems dominate the studied sites: at the lower sites it is mainly maquis vegetation and at the higher elevated sites pine forest. Charcoals were older at higher elevation with ages of up to 1500 y calBP. The vegetation type did not change much over the last $>$ 1000 years, as all charcoal pieces were identified as *Pinus nigra*. Charred material at the lower sites could be identified as particles of deciduous shrubs, *Quercus, Castanea sativa*, *Lonicera implexa* and *Cytisus sp.* with mostly a modern ^{14}C age up to about 300 y calBP. A similar finding is obtained for the stable SOM. In fact, very high ages were found at the highest elevations, where the stable organic matter fraction had an age of up to 8.2 ky – an age that is quite close to the start of soil formation. At the lower sites, frequent bush fires more often destroyed a part of the stable fraction. In the subsoil of these sites, the stable SOM fraction had an age ranging from a few decades to max. 1 ky. Furthermore, SOM stocks and the amount of labile organic matter increased with decreasing altitude. The soils consequently have recorded the signal of fire frequency and climatic effects: with decreasing altitude and therefore with a warmer climate, fire frequency, SOM abundance and the amount of labile SOM increased. At the lower sites, charcoal particles predominantly reflect the more recent vegetation probably because the repeated fires hindered here their preservation. Fire appears to also negatively affect the stable SOM fraction at lower altitudes. Our findings suggest that the high fire frequency is a powerful rejuvenating factor for soil organic matter, removing part of the SOM and promoting plant recolonisation. The fire frequency and intensity is, however, still moderate enough as the organic matter pool even at the lowest is still high and consequently not depleted.