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Total organic carbon and humus fractions in restored soils from limestone quarries in semiarid climate, SE Spain

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Mining activities generate erosion and loss of plant cover and soil organic matter (SOM), especially in arid and semiarid Mediterranean regions. A precondition for ecosystem restoration in such highly disturbed areas is the development of functional soils with sufficient organic matter. But the SOM quality is also important to long-term C stabilization. The resistance to biodegradation of recalcitrant organic matter fractions has been reported to depend on some intrinsic structural factors of humic acid substances and formation of amorphous organo-mineral recalcitrant complexes. In an experimental soil restoration in limestone quarries in the Sierra de Gádor (Almería), SE Spain, several combinations of organic amendments (sewage sludge and compost from domestic organic waste) and mulches (gravel and woodchip) were added in experimental plots using a factorial design. In each plot, 75 native plants (Anthyllis cytisoides, A. terniflora and Macrochloa tenacissima) were planted and five years after the start of the experiment total organic carbon (TOC), physico-chemical soil properties and organic C fractions (particulate organic matter, H3PO4-fulvic fraction, fulvic acids (FA), humic acids (HA) and humin) were analyzed. We observed significant differences between treatments related to the TOC content and the HA/FA ratio. Compost amendments increased the TOC, HA content and HA/FA ratio, even higher than in natural undisturbed soils, indicating an effective clay humus-complex pointing to progressively increasing organic matter quality. Soils with sewage sludge showed the lowest TOC and HA/FA ratio and accumulated a lower HA proportion indicating poorer organic matter quality and comparatively lower resilience than in natural soils and soils amended with compost.