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Pedogenetic processes and carbon budgets in soils of Queretaro, Mexico

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Pedogenetic processes have been investigated in two different physiographic regions of the state of Querétaro in order to assess the carbon budget of soils, looking into the gains and losses of organic and inorganic carbon: In the mountain region of the natural reserve Sierra Gorda (SG) with soils developed on cretaceous argillites and shales under sub-humid temperate to semi-arid conditions, and in the Transmexican Volcanic Belt (TMVB) with soils developed on acid and intermediate igneous rocks under humid temperate climate in the highlands and semi-arid and subhumid subtropical conditions in the lowlands. The analyses of soil organic carbon (SOC) and soil inorganic carbon (SIC) of the SG region, including additional physical, chemical and mineralogical investigations were based on 103 topsoils in an area of 170 km2. The analyses in the TMVB region were based on the profiles of a soil toposequence from high mountainous positions down to the plains of the lowlands. The results show a SOC accumulation from temperate to semi-arid forest environments, based on processes of humification and clay formation including the influence of exchangeable Ca and the quantity and quality of clay minerals. The turnover rates of SOC and SIC depended largely on the rock parent materials, especially the presence of carbonate rocks. Moreover, we found that the SOC content and distribution was clearly depending on land use, decreasing from forests to agricultural land, such as pasture and cropping areas and were lowest under mining sites. The highest SIC pools were found in accumulation horizons of soils under semi-arid conditions. On all investigated sites SOC decreased the mobility of cations and especially that of heavy metals, such as As, Hg, Sb, Pb, and Cd.