EGU2020-20965
https://doi.org/10.5194/egusphere-egu2020-20965
EGU General Assembly 2020

Assessment of the potential for long-term soil carbon sequestration and stabilization in contrasting soils after native forest conversion to planted forests.

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Soil organic carbon accretion through reforestation has been proposed as one of the most economically feasible and effective alternatives for carbon sequestration. A substantial fraction of these reforestation efforts are expected to occur through intensively managed exotic plantations. Management intensification and forest type conversion into productive plantations can significantly alter SOC inputs and dynamics, reducing the potential positive effect on long-term soil carbon sequestration. To understand how this forest cover change modifies the magnitude and distributions of C as well as the stability of these C pools, we selected five soils of contrasting origin and mineralogy (crystalline to amorphous clays) under both remnants of secondary temperate oak forests and pine plantations in south-central Chile. In each of these sites, two adjacent permanent plots were established, where soils were sampled at 5 points to a depth 2.4m. The sites included volcanic soils formed from recent volcanic ash (Arenosol), young ash deposits (Andosol) and old ash deposits (Ferralsol), and two residuals soils formed from granite (Luvisol) and slate (Lixisol). The recent ash-derived soils displayed clay mineralogy dominated by amorphous minerals, the young-ash by short-range order minerals and meta-halloysite; the old-ash soils have mineralogy dominated by halloysite and goethite; while residuals soils had micaceous clays, kaolinite, gibbsite, and iron oxy-hydroxides clays. Soil types had a strong influence on the C, N, and P pools. The arenosol has the smallest total C pools followed by the Andosol and Ferralsol (e.g., 45 to 56 Mg C/ha), while the largest C pool sizes were found in the residual lixisol (e.g., 387 to 243 MgC /m2). For most sites, plantation forests have lower total C and N pools and higher P pools, except for the ferrosol. Respiration rates vary significantly between sites and forest types. Total soil respiration rates tend to be higher in the native forest soils than in planted soils. Respired FM $^{14}CO_2$ was significantly correlated to bulk soil ^{14}C FM ($p<0.01$, R^2 = 0.7). Surface organic carbon mostly incorporated post-bomb testing ^{14}C, which tends to become much depleted at deeper horizons. This depth-dependent trend was similar for plantations and native forest soils, but plantation displayed more depleted $\Delta^{14}C$ than native soils at all depths in most soil types. In most soil types, surface layers respired $^{14}CO_2$ was more enriched in the native forests than in plantations, but this relation flipped at depths intervals deeper than 80 cm. The age of the respired carbon was highly dependent on soil type. Soil respiration rates and $^{14}CO_2$ signatures in soils with more active clay

mineralogy (2:1 and pseudo crystalline clays) seemed to be less affected by forest conversion than in soils with low stabilization capacity. The arenosol showed modern bulk and respired carbon at all depths as a result of its low carbon retention capacity (sandy textures). Our preliminary results highlight the relevance of the mineralogical control on SOC dynamics and stabilization processes and they also emphasized the need to further asses the effectiveness of planted forests for long-term soil carbon sequestration. Acknowledgments: CONICYT–PCI MPG190022, FONDECYT-Iniciacion 1160372