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Comparison of topsoil and subsoil organic matter quality under mixed eucalypt and old-growth rainforests in Tasmania

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Mixed eucalypt forests and old growth rainforests represent two prevalent and interchangeable forest types covering large areas in Tasmania, Australia. Thereby, former consists of a eucalypt (fire tolerant) overstory undergrown by a developing (fire intolerant) rainforest understory. Pure rainforest is thus seen as the rare end of the natural succession evolving due to the absence of wildfires, which eucalypt trees need for germination. Recently, both forest types received attention in their role as an appreciable carbon (C) sink. Regarding their above-ground biomass, the mixed eucalypt forest stored more than twice as much C (378 $\pm$ 173 Mg C ha-1) compared to the old growth rainforest (171 $\pm$ 71 Mg C ha-1). Current studies on below ground soil C stocks, however, revealed no significant differences.

Based on the sparse research available on soils in these unique ecosystems, this study focuses on topsoil and subsoil organic matter (OM) quality. Therefore, 14 study sites across Tasmania were grouped in soil pairs of geographic proximity and opposing forest types such that seven different parent materials (one for each soil pair) are covered ranging from Precambrian silt stone to Quaternary aeolian sediments. All sites were sampled according to their identified horizons to a depth of 100 cm. Laboratory analysis included pH, total soil organic carbon (SOC) and nitrogen as well as iron (oxalate and dithionite extractable) for each horizon. In order to determine the distribution and chemical composition of differently stabilized SOM fractions, the soils were fractionated into free, occluded and mineral-associated OM. Selected samples were analysed with 13C-CPMAS-NMR spectroscopy.

At certain sites, relatively high amounts of SOC were detected in the subsoil for both forest types. This is in line with low bulk densities observed by previous studies in respective areas, pointing towards an important stabilization mechanism in such environments: through wildfires and subsequent erosion events, subsoil OM is rendered stable through burial with topsoil at foot slopes. Presumably due to regular occurrence of such incidents in the past, a less pronounced SOC-decrease with depth is observed compared to forests experiencing less or no wildfires.
In the topsoils, mainly mixed eucalypt forests and partly old-growth rainforests show high amounts of black C representing another artefact from preceding wildfires as well as another rather stable SOM pool. This was supported by 13C-CPMAS-NMR spectroscopy demonstrating high amounts of aromatic C especially in the light particulate fractions.

Apart from outlined findings, we will demonstrate differences with respect to distribution and composition of particulate vs. organo-mineral associated OM fractions in top- and subsoils as determined by the different parent materials.