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Activity and abundance of methane-oxidizing bacteria in secondary forest and manioc plantations of Amazonian Dark Earth and adjacent soils

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The oxidation of atmospheric CH_4 in upland soils is mostly mediated by uncultivated groups of microorganisms that have been identified solely by molecular markers, such as the sequence of the *pmoA* gene encoding the β-subunit of the particulate methane monooxygenase enzyme. The objective of this work was to compare the activity and diversity of methanotrophs in Amazonian Dark Earth (ADE) and their adjacent soil. Secondly, the effect of recent land use in the form of manioc cultivation was examined by comparing secondary forest and plantation soil. CH_4 oxidation potentials were measured and the structure of the methanotroph communities was assessed by qPCR and amplicon pyrosequencing of the *pmoA* gene. The CH_4 oxidation potentials were relatively high in all the secondary forest sites of both ADE and adjacent soils. CH_4 oxidation in one of the ADE soils that was only recently (5 years) converted to a manioc plantation was also relatively high. In contrast, both the adjacent soils used for manioc cultivation and the ADE soil with a longer history of agriculture displayed minimal CH_4 uptake. Amplicon pyrosequencing of *pmoA* genes indicated that USCα, *Methylocystis* and the tropical upland soil cluster (TUSC) were the dominant groups depending on the soil type. USCα, which are believed to mediate atmospheric methane oxidation, were more abundant in all ADE soils than forested adjacent soils, and were below the qPCR detection limit in manioc plantations of adjacent soil. In contrast, *Methylocystis pmoA* genes in ADE soils were approximately 2-orders of magnitude lower than USCα and their abundance was not significantly different between ADE and adjacent soils, or between forest and plantations. The results indicate that ADE soils harbor high abundances of atmospheric CH_4 oxidizers and are potential sinks for atmospheric CH_4, but as in other upland soils this activity can be inhibited by the conversion of forest to agricultural plantations.

Keywords: Methanotrophs, Amazonian Dark Earth, Forest soils