

Initial carbon storage in new tephra layers of Mt. Talang in Sumatra as affected by pioneer plants

ABSTRACT

To date, no global data on carbon sequestration at the initial weathering phase of tephra deposits are available. To study carbon storage in the new volcanic deposit, tephra layers were reconstructed for a period of 46 months. The tephra samples were collected immediately after eruption of Mount (Mt.) Talang on 12 April 2005, over portions of the Solok District in West Sumatra, Indonesia. Pot experiments were filled with and without soil materials and covered with the collected tephra. The pot experiments were conducted in a wired house. The tephra was applied in 0, 2.5 and 5 cm depths to simulate natural tephra deposition. Every day 250 ml of filtered water was added and allowed to percolate. Solid fraction from the tephra layer was collected and analyzed at regular intervals and primary plant succession was observed over a period of 4 years. After 2 months, blue-green algae (cyanobacteria) started to colonize the bare surface tephra layer to form an algae mat. After 16 months, the surface was transformed into a green biofilm of lichen. Vascular plants (grasses and shrubs) started to be established after 2 years. Total carbon (TC) content of the tephra layer was increased significantly from 0.19 to 1.75% or eight times higher after 46 months of incubation. Higher TC storage was found in the 2.5 cm compared to that of the 5.0 cm tephra layer, which was reconstructed above the soil, with values of 1.75 and 0.89%, respectively. On the contrary, lesser amount of TC was accumulated in the single tephra layer (without soil underneath). Between 71 and 90% of TC was considered as total organic carbon (TOC). The labile organic carbon (LOC) content in the 2.5 cm and 5.0 cm of tephra layer was found to be 0.22 and 0.77%, respectively, at the end of incubation. This experiment confirmed the potential of tephra to capture carbon from the atmosphere with the help of nonvascular plants and then by vascular plants and finally sink them in the tephra layer.

Keyword: Carbon storage; Cyanobacteria; Lichens; Moss; Plant succession; Tephra