Weathering of Volcanic Ash and the Fate of Organic Carbon on the Continental Margin of New Zealand

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The effects of carbon sequestration on climate change have become a hot button topic in both academic and media discussions, and volcanic eruptions have the potential to play a more significant role in this process than previously expected. Volcanic eruptions produce a fairly immediate effect on climate with the production of sulfuric gases and fine ash particles decreasing in solar radiation. However, there is now evidence that the volcanic ash may continue to have an effect on climate long after it is deposited.

Mineral surface area has been identified as a key control on carbon burial (Keil, et al 1994; Hedges, et al, 1998). Smectite in particular, a clay product of the weathering of volcanic ash, is thought to be a key player in carbon burial, with its surface area around 800 m^2/g (Kennedy et al, 2002; Curry, et al., 2007). Does the weathering of volcanic ash deposited in both terrestrial and marine environments lead to enhanced carbon sequestration and burial on the continental margin of New Zealand, site of the highly active Taupo Volcanic Zone?

Terrestrial and marine core samples were obtained from New Zealand in 2006 and 2007, and kept frozen until analysis. A SEM was used to observe smectite growing on the surfaces of volcanic ash. This was done by examining individual grains and collecting EDS data on the altered and unaltered surfaces, then comparing the compositions of each. Sonication was used to distinguish growing clays from those simply stuck on surfaces. FTIR and XRD were used on the clay fractions of each sample to better understand what types of clays were being observed, and to compare against SEM results. $\delta 13C$ and $\Delta 14C$ studies were used to quantify the amount of carbon associated with smectite over other clay minerals.

Volcanic ash deposited on land and transported to the marine environment was shown to have the highest surface area, and the most clays growing on them. These clays were shown to be mostly smectites, and showed a higher amount of associated carbon using $\delta 13C$ and $\Delta 14C$. Ash from tephra layers deposited directly into the marine environment showed significantly less weathering to smectites, a smaller surface area, and a lower amount of associated carbon. These findings may be combined with future studies in other locations around the globe to determine the impact of weathering of volcanic ash on climate change.