REDOX ZONATION AFFECTING GROUNDWATER NITRATE CONCENTRATIONS IN THE TUTAEUAUA CATCHMENT, LAKE TAUPO

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Should denitrification occur below the root zone of the pasture, the nitrate load entering Lake Taupo would be smaller than calculated from leaching estimates valid for the bottom of the root zone. However, due to the commonly presumed scarcity of organic matter in the young volcanic materials and their high porosity, the extent of denitrification has previously been considered negligible.

Heterotrophic denitrification occurs under mildly reducing conditions, when aerobic decomposition of organic matter has ceased due to lack of oxygen. Once the NO_3^- has also been consumed, microbes use Mn^{4+}, Fe^{3+}, and SO_4^{2-} as alternate electron acceptors. Redox conditions and N and C species in shallow groundwater were analysed up to 7 times on a maximum of 27 wells that were grouped into 10 multi-level well (MLW) clusters (2-5 wells each) and 2 single well sites.

Reducing conditions and correspondingly low nitrate concentrations were found in approx. 40% of the wells. 90% of all samples with dissolved oxygen < 2 mg/L, or dissolved Fe > 0.2 mg/L, or dissolved Mn > 0.25 mg/L had NO_3-N < 1 mg/L. Approx. 30% of these samples had concentrations below the detection limit (0.002 mg/L NO_3-N).

Wells screened near the water table drew typically oxidised, nitrate bearing water (predominantly 1 - 6 mg/L NO_3-N). A strong redox zonation with reduced, nitrate depleted groundwater underlying an oxidised upper groundwater zone was found at 6 MLW sites, demonstrating that denitrification had reduced nitrate concentrations along the groundwater flow path.

Circumstantial evidence suggests that organic debris from the vegetation buried by the 186 AD Taupo eruption is the electron donor inducing the reducing conditions. Where oxidised groundwater prevailed, this organic debris was either missing or found above the water table, where gas exchange with the atmosphere appears to be high enough to prevent reducing conditions from developing.