Nitrate assimilation capacity of shallow groundwater underlying dairy farms in the Reporoa Basin, NZ

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Monitoring data indicated that a sizeable fraction of wells in the Reporoa Basin draw groundwater with reduced redox status, which indicates conditions suitable for denitrification to occur. This suggested that the basin may have a substantial assimilative capacity for nitrate lost from the root zone.
To investigate the spatial and temporal variation of the shallow groundwater system's hydrochemistry, we installed 8 monitoring wells on 4 neighbouring dairy farms along a west-east transect through the basin. This allowed us to investigate in close proximity the groundwater hydrochemistry underlying a range of soils with drainage classes ranging from well-drained to very poorly drained. The mean depth to the water table ranged from less than 0.1 m at the very poorly drained peat site to approx. 2.6 m at a site with well-drained pumice soil. Using inflatable packers enabled depth-specific sampling of 3 to 5 depths per site so that vertical profiles of the hydrochemistry in the uppermost groundwater zone could be established.
Fully oxic groundwater throughout the investigated depth range was only found at the free-draining site with the greatest depth to the water table. Vertical redox gradients were observed at a few sites, while fully anoxic conditions occurred at most sites. Correspondingly, nitrate nitrogen concentrations ranged from up to 11 mg L-1 in the fully oxic groundwater to concentrations < 0.1 mg L-1 in the prevailing anoxic groundwater. The vertical redox gradients observed in winter or spring had disappeared by autumn, when consistently reduced conditions prevailed.
Understanding the spatial distribution of reduced vs. oxic groundwater at the farm or catchment scale may allow the land use intensity to be matched in the future to the assimilative capacity of the underlying groundwater system.