

# Phosphorus cycling in the North Pacific Subtropical Gyre using cosmogenic 32P and 33P

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ABSTRACT: The North Pacific Subtropical Gyre (NPSG) has been hypothesized to be in transition from a nitrogen (N)-limited system to one predominantly limited by phosphorus (P) as a result of a two-decade-long selection for $N_2$-fixing organisms. In this study, the naturally occurring cosmogenic radioisotopes, $^{32}P$ (half-life = 14.3 d) and $^{33}P$ (halflife = 25.3 d), were measured and $^{33}P/^{32}P$ activity ratios were used to estimate radioactive P residence times at Sta. ALOHA (22° 45'N, 158° 00'W) in the NPSG from February 1999 to July 2000. The $^{33}P/^{32}P$ activity ratio in the total dissolved P pool varied considerably but systematically; high ratios correlated with periods of enhanced primary production ($^{14}C$ incorporation). Marine particulate $33P/^{32}P$ activity ratios were similar to those found in the source (i.e., rain). Smaller size classes had longer apparent residence times. The observation that the activity ratio of $^{33}P/^{32}P$ closely follows primary production suggests that atmospherically derived $^{32}P$ and $^{33}P$ atoms track the most □□bioavailable□□ pool of P within the NPSG ecosystem. These preferred substrates were removed from the dissolved phase via plankton uptake during periods of high productivity. Our results suggest that the soluble nonreactive P pool, which is substantially larger than the soluble reactive P pool, is a potentially important source of P to organisms and that its utilization can vary significantly on scales of weeks to months.