

## Phosphorus in groundwater discharge to the ocean –A potential source for coral reef degradation

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Phosphorus, the main ingredient of fertilizer, is a limiting factor for sustainable primary production and is recognized as a major source for eutrophication of lakes, estuaries, and watersheds. Phosphorus in the water environment exists in various forms, and its transport form have been remained in many regions. Many sequential extraction methods have been proposed for morphological fractionation of phosphate in soil, but there are problems such as not being usable for morphological classification of polyphosphate and organic phosphorus. However, in recent years, One-dimensional (1D) solution <sup>31</sup>P nuclear magnetic resonance spectroscopy (NMR) is currently the tool of choice for molecular-level characterization of organic P in soils <sup>31</sup>P nuclear magnetic resonance spectroscopy (<sup>31</sup>P-NMR) as a morphological separation method of phosphorus in soil in fields such as soil fertilizer has been conducted. In this method, it is possible to classify phosphate in a form which was difficult to classify by the continuous extraction method.

In the present study, <sup>31</sup>P-NMR and Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) are used to understand a characteristic of the transport form of phosphate in soil and groundwater. In addition, we estimated the phosphorus load through groundwater to the coral reefs sea region of Okinawa through field measurement and numerical simulations, and investigated the effect of phosphate on in vivo skeleton formation of primary polyp for hard coral *Acropora digitifera*.

Keywords: Phosphorus, <sup>31</sup>P nuclear magnetic resonance spectroscopy, groundwater, coral reefs