Isotopes of dissolved nitrate trace the location, variability and source properties of the California Undercurrent

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Introduction

- Climate variability in the North Pacific influences the major water masses in the CalCOFI region
- As the main source of upwelling in the southern CCE, the properties of the California Undercurrent (CUC) are of particular interest
- Denitrification in the eastern tropical N. Pacific (ETNP) decreases the concentration and increases $\delta^{15}N$ of nitrate in Pacific Equatorial Water (PEW), thus nitrate isotopes are a sensitive indicator of the CUC
- Here we compared nitrate isotope measurements to results from a more traditional water mass analysis from Bograd et al., 2019

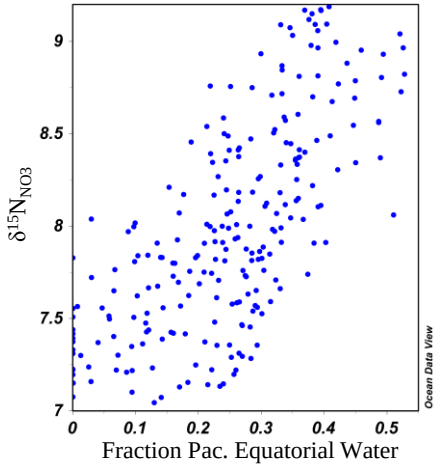

Figure 1. Higher $\delta^{15}N_{NO3}$ corresponds with greater PEW influence along line 80.

Results

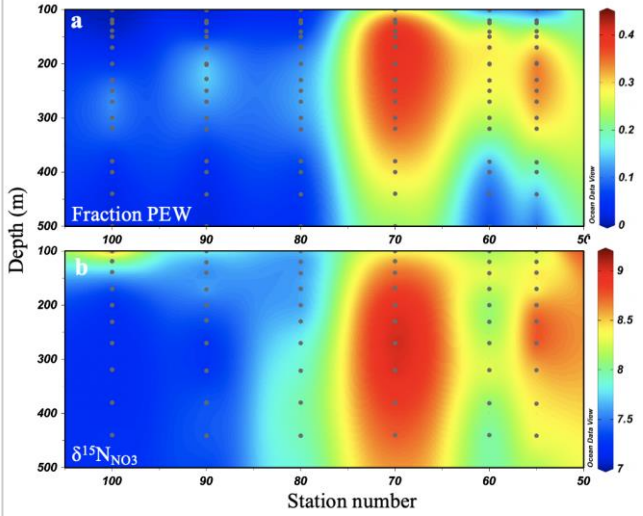

Figure 2. Fraction PEW (**a**) and isotopes of nitrate (**b**) at line 80 during fall 2010.

- Nitrate isotopes at 100-500 m reflect PEW influence (Figure 1, 2)
- Some differences are apparent, e.g. isotopes suggest a deeper undercurrent at many stations than is reflected in fraction PEW (Figures 2, 3)
- Isotopic enrichment did not always co-occur with increased % PEW to the same extent (Figure 1)
- This could be due to trends in the source isotopes, for example changes in denitrification in the ETNP

Methods

- Nitrate isotope samples were collected from lines 80 and 93 of the CalCOFI grid on 14 cruises from 2010-2016 and analyzed using the denitrifier method (Sigman et al. 2001)
- Nitrogen isotopes of nitrate ($\delta^{15}N_{NO3}$) were compared with water mass percentages calculated using an optimum multiparameter (OMP) analysis based on temperature, salinity, oxygen, and nutrient concentrations (Bograd et al., 2019) to examine the spatiotemporal variability of source water contributions to the CCE

Conclusion

- Nitrate isotopes largely confirm OMP estimates of PEW influence, though isotopes may suggest a deeper CUC
- Differences in nitrate isotopes may reflect changes in source water characteristics as well as in source water contributions

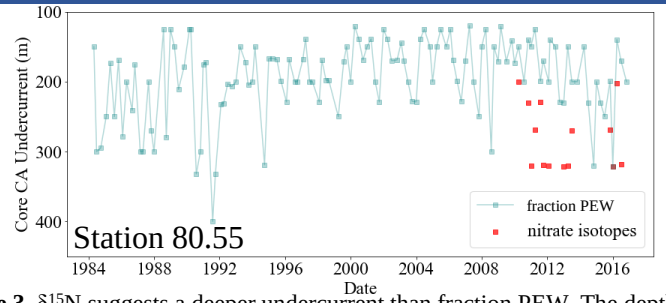

Figure 3. $\delta^{15}N$ suggests a deeper undercurrent than fraction PEW. The depth of max fraction PEW is shown along with depth of max $\delta^{15}N$ for station 80.55.

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References

- Bograd, S. J., I. D. Schroeder, and M. G. Jacox. 2019. A water mass history of the Southern California current system. Geophys. Res. Lett. 46.
- Sigman, D. M., K. L. Casciotti, M. Andreani, C. Barford, M. Galanter, and J. K. Böhlke. 2001. A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Anal. Chem. 73: 4145–4153.