

# Spatial Trends in Nutrient Concentration at the Surface and Chlorophyll Maximum with Relation to Geographic Location around the Galapagos Archipelago

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**PROJECT SUMMARY:**

My objective is to further study the relationship between the depth of the chlorophyll and the chlorophyll concentration in relation to areas of high and low nutrients. I will use a CTD to profile the water column and will sample water at the surface and the chlorophyll maximum. The water will then be analyzed with standard lab procedures for concentrations of chlorophyll, dissolved oxygen, nitrate, phosphate and silica. I wish to see if areas of similar levels of nutrient concentration yield similar chlorophyll maximum characteristics. I also wish to see how different those characteristics differ from surface measurements, which are what the satellites that gather most chlorophyll data pick up.

## INTRODUCTION

The Galapagos is a unique ecosystem affected by several different subsurface and surface level currents. The Equatorial Undercurrent approaches the archipelago from the west and upwells off the western coast of Islas Fernandina and Isabella. The South Equatorial Current comes up from South America to the Galapagos running southeast to northwest. It is not clear what the exact path of the current is but a general trend of running from the southeast, up above San Cristobal, and between San Salvador and Genovesa (Steger 1998).

Previous CTD work in the archipelago on chlorophyll levels in the vertical water column (Martin et al. 1994) has shown a noticeably higher chlorophyll concentration at various depths in the water column than at the surface. This would give support to the idea that the chlorophyll maximum is not always on the surface and would then be depend on some factor other than just incoming sunlight. Since the Ecuadorian government limits the amount of research cruises to the Galapagos, most chlorophyll and primary production data is accumulated from satellite photo images (such as those in Feldman 1986). These photo images are of the sea surface, so it maybe possible that chlorophyll concentration data obtained by this way are inaccurate to some degree.

I wish to test nutrients at the chlorophyll maximum and at the surface and see how they compare. I hypothesis that there will be similarities between stations in areas of high productivity and similarities between the stations in areas of low productivity. I also hope to also see a similarity between the station of San Cristobal and the station between San Salvador and Genovesa. It is important to make a comparison between levels of chlorophyll maximum and surface levels so we can get a better estimate on how inaccurate satellite photos are of chlorophyll concentration and primary production in the Galapagos archipelago.

**PROPOSED RESEARCH:**

CRUISE PLAN:

Day 1: No stations

Day 2:

TD3	NTR/1.5 hrs on station	1	08.00	S	91	28.50	W
	Arr1127/Dep1257						
TS1/TD4*	NTR/1.5 hrs on station	0	32.00	S	91	47.00	W
	Arr1615/Dep1745						

Day 3: No stations

Day 4:

TS4/TD2*	NTR/1.5 hrs on stn	0	01.00	S	91	08.00	W
AJ4	Arr2206						

Day 5: No stations

Day 6:

TS5/TD6	NTR/1.5 hrs	0	32.00	S	90	47.00	W
	Arr0200/Dep0330						
NW8/TD5*	Nav Waypoint/ 1hr in trans	0	9.00	N	90	52.00	W
	Arr1739						

Day 7: No Stations

Day 8:

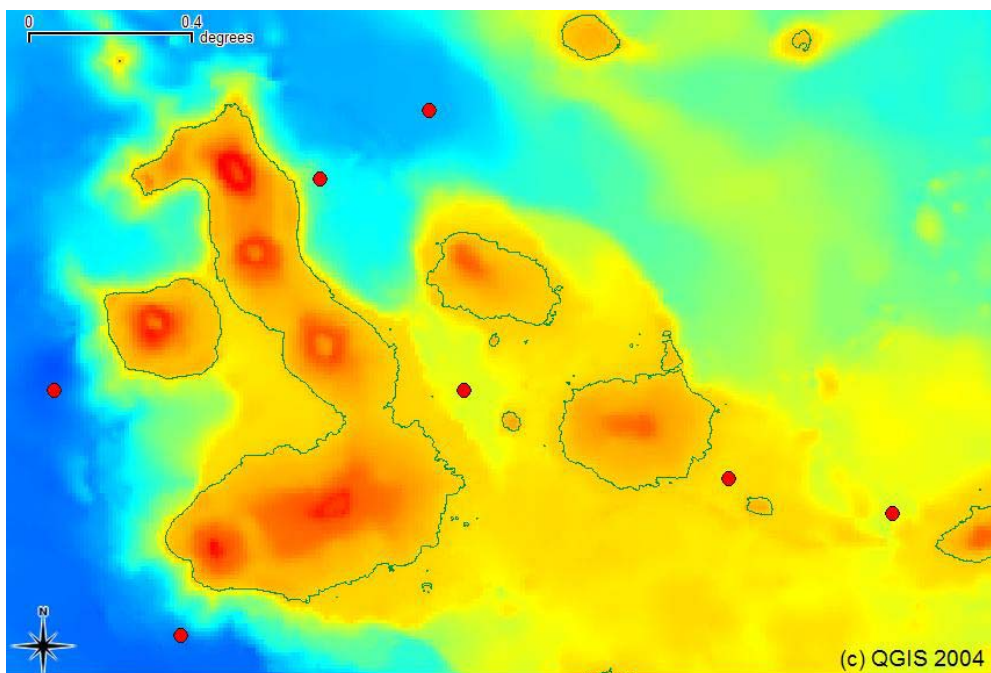
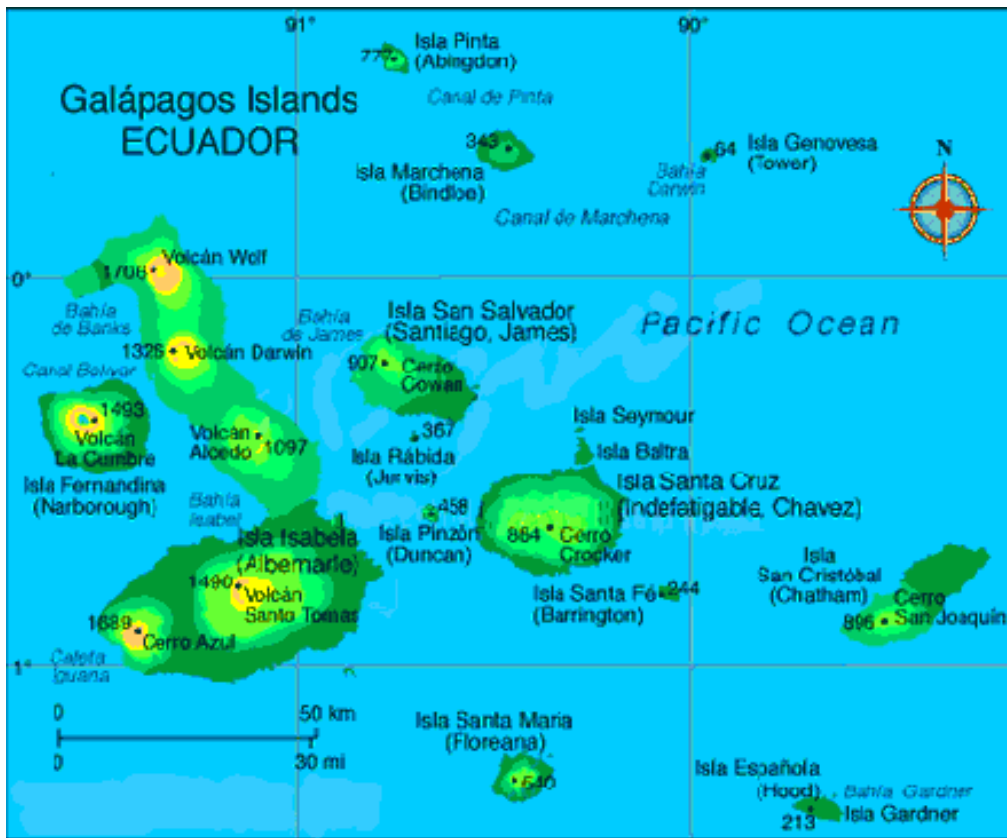
TD7	NTR/1.5 hr	0	50.00	S	89	44.00	W
	Arr2053/Dep2223						

Day 9:

TD1	NTR/1.5 hr	0	45.00	S	90	08.00	W
	Arr2423/Dep0153						

\* denotes stations with lab analysis for chlorophyll and dissolved oxygen

CHARTLETS:



## METHODS AND ANALYSIS:

I first will run a CTD rosette down through the water column and look at live feed results to determine where the chlorophyll maximum is in the water column. The CTD has onboard sensors that measure temperature, salinity, chlorophyll concentration, dissolved oxygen and PAR in the water column. Once the depth of the chlorophyll maximum has been determined, I will sample at the chlorophyll maximum and the surface. Water samples will be taken with the Niskin bottles at all seven stations to analyze for nitrate, phosphate (Grasshoff 1983) and silica (Strickland 1968) in the water. At three stations, water will also be collected to test chlorophyll and dissolved oxygen levels in order to calibrate data with the CTD sensors using standard methods for chlorophyll (Holm-Hansen and Riemann 1978, EPA 1997) and dissolved oxygen (Carpenter 1965b). Ideally, these samples will be at stations that are not already being tested by other students for oxygen and chlorophyll levels. I do need several hours after the last station to analyze samples. Since I have replicates of each sample and three nutrient samples at each station at two depths, I will have 84 nutrient samples in total. I am only doing dissolved oxygen and chlorophyll concentration lab analysis at three stations so I will have 36 samples each for oxygen and chlorophyll.

A similar approach by Sakamoto et al. (1998) showed definite relationships between salinity and dissolved nitrates. I would like to see if such a relationship exists here as well as a trend between chlorophyll concentration and dissolved oxygen concentration. I expect to see similarities between the stations of high nutrients as well as similarities between those of low nutrients. I also am interested to see if there are trends between the station off San Cristobal and the one between of San Salvador and Genovesa because of the way the South Equatorial Current comes up from the southwest (Steger 1998).

**PROPOSED BUDGET:**

EQUIPMENT	COST	DAYS	TOTAL
Filter Rack & Vacuum Pump	\$ 6.00/DAY	5	\$30.00
Centrifuge	\$ 6.00/DAY	5	\$30.00
Lab Fluorometer	\$ 15.00/DAY	5	\$75.00
Dosimat Titrater	\$ 15.00/DAY	5	\$75.00
CTD (Seabird SBE-9)	\$ 135.00/DAY	5	\$675.00
R/V Thompson	\$10,000.00/DAY	9	\$90,000.00
Nutrient Bottles (per case)	\$ 3.00/DAY	5	\$15.00
Spectrophotometer 100	\$ 6.00/DAY	5	\$30.00
Oxygen Bottles (Case, 24 bottles)	\$ 6.00/DAY	5	<u>\$30.00</u>
			\$90,960

CHEM ANALYSIS*	COST	DEPTH	RPLCTS	STATIONS	TOTAL
Chlorophyll	\$3/sample x 2	x 2	x	3	\$36.00
Nitrate	\$5/sample x 2	x 2	x	7	\$140.00
Phosphate	\$5/sample x 2	x 2	x	7	\$140.00
Silica	\$5/sample x 2	x 2	x	7	\$140.00
Oxygen	\$6/sample x 2	x 2	x	3	<u>\$72.00</u>
					\$528

$$\$90,960 \text{ (EQUIPMENT)} + \$528 \text{ (ANALYSIS)} = \$91,488 \text{ (TOTAL)}$$

\*Note: Other students may also be getting samples at my station in which case we are doing analysis together on the same sample and sharing the cost.

**DONATED EQUIPMENT**

- GF/F filters for chlorophyll
- Ice
- Freezer
- Tinfoil
- Tweezers
- Glasswear
- Glass marker
- Stir bar for Dosimat titrater

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- UW Pooled Equipment Website