



Effect of stream proximity on  
percent-organic and inorganic  
carbon in a  
Southwestern Arizona wetland

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# Overview

- Ciénegas, or desert wetlands, provide crucial ecosystem services such as:
  - Help maintain perennial stream flow
  - Foraging opportunities
  - Crucial aquatic habitats
- Contain only 2% of the land area but harbor 19% of species of concern for conservation



# Definition

- Ciénegas
  - Desert wetlands in the American Southwest between 1000 m and 2000 m in elevation.
  - Characterized by hydrosols (permanently saturated, highly organic, reducing soils)
  - Dominated by Swamp Willow, *Mimulus* and sedges understory, and Gooding Willow and Cottonwood in less saturated soils along the margins.

# Purpose

- How do percent organic carbon and inorganic carbon change in regard to stream proximity?
- Can changes in organic and inorganic carbon explain the developmental history of ciénegas and possible historical stream position within the ciénegas?

# Hypothesis

- $H_0$ : The stream channel migrates
- $H_1$ : Once the ciénega develops the stream becomes fixed
  - Tested through organic composition of series of cores
- $H_0$ : Inorganic carbon is covariant with organic carbon
- $H_1$ : Inorganic carbon reflects hydrologic flow
  - Tested through comparison of organic and inorganic carbon

# Background

- Ciénegas were degraded over the past 100 years through over-grazing, groundwater withdrawal.
- Areas of high conservation concern.
- Experience transitions between steady states of gravel-bed/grassland and wetland.



# Site Description I

- Canelo Hills Ciénega
  - Purchased by Nature Conservancy in 1969
  - Small ciénega which is relatively undisturbed
- Located in Southeastern Arizona at  $31^{\circ} 33' N$  and  $110^{\circ} 31' W$



# Site Description II

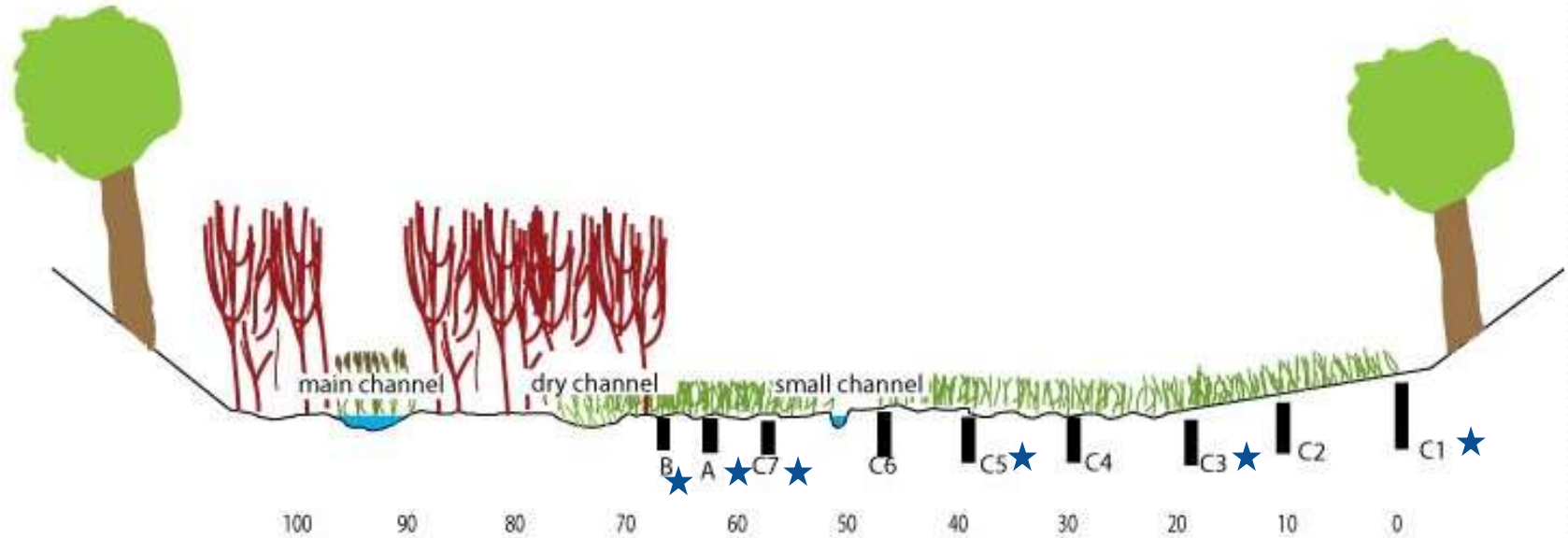
- Ciénega surface is approximately 100m wide and 1500 m long.
- At the head waters of Turkey Creek
- Vegetation characterized by:
  - Swamp Willow, *Mimulus* and sedges and grasses
  - Gooding Willow and Cottonwood on margins
  - Oak Juniper woodlands/ grassland in the uplands



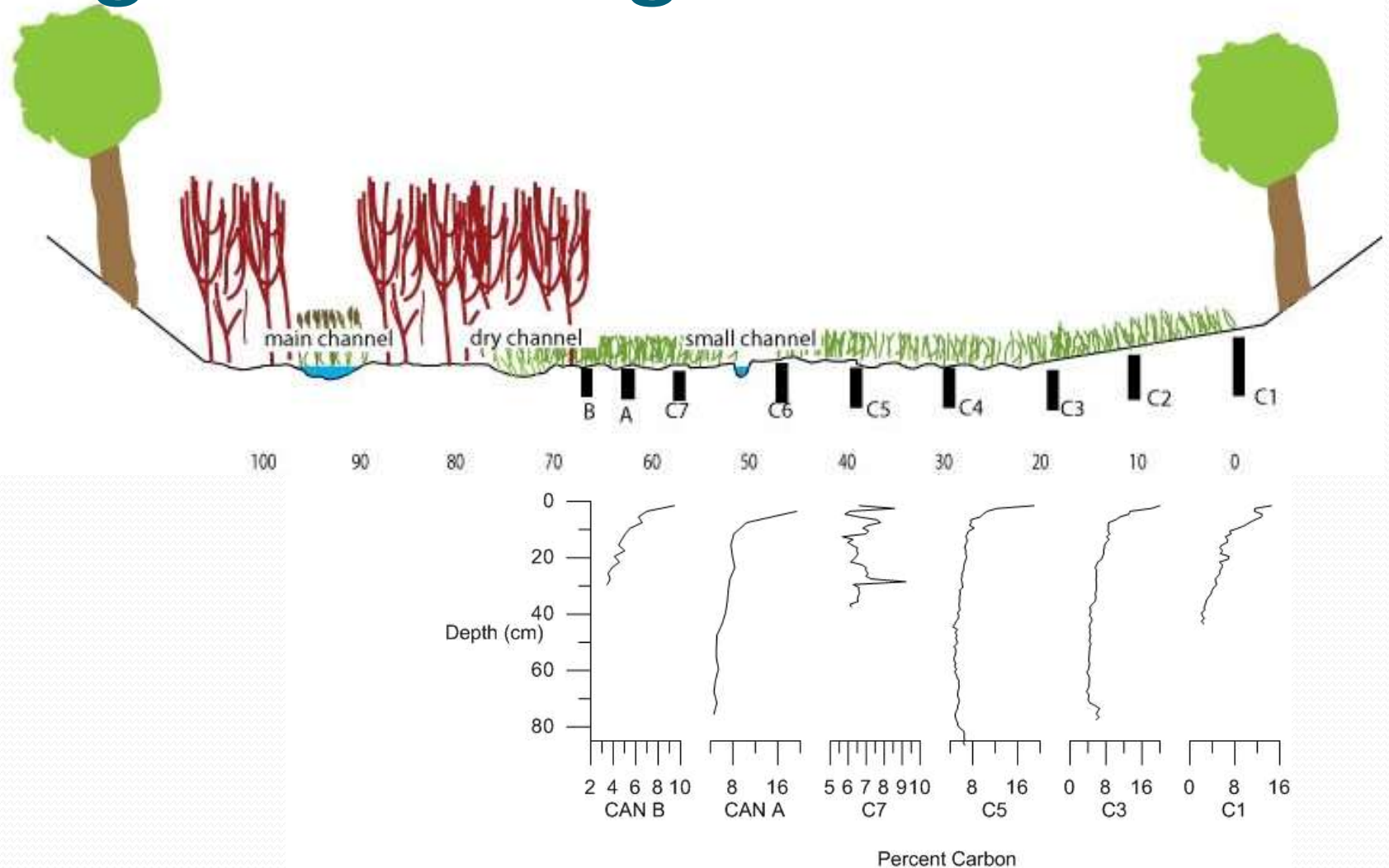
# Methods

- Cores were collected at 10 m intervals in a transect
- Each core was sampled contiguously for Loss on Ignition
  - Loss on ignition was used to estimate:
    - Percent organic carbon
    - Percent inorganic carbon
- Pairwise comparison between each core
  - T-test used to determine significant difference

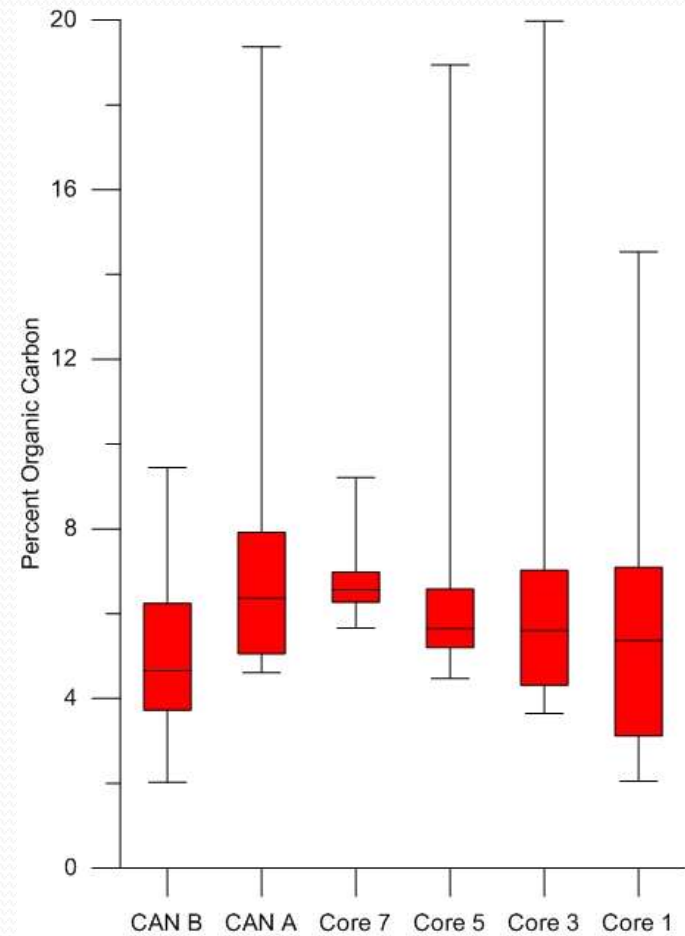
# Transect



# Organic C along transect



# Organic C Results



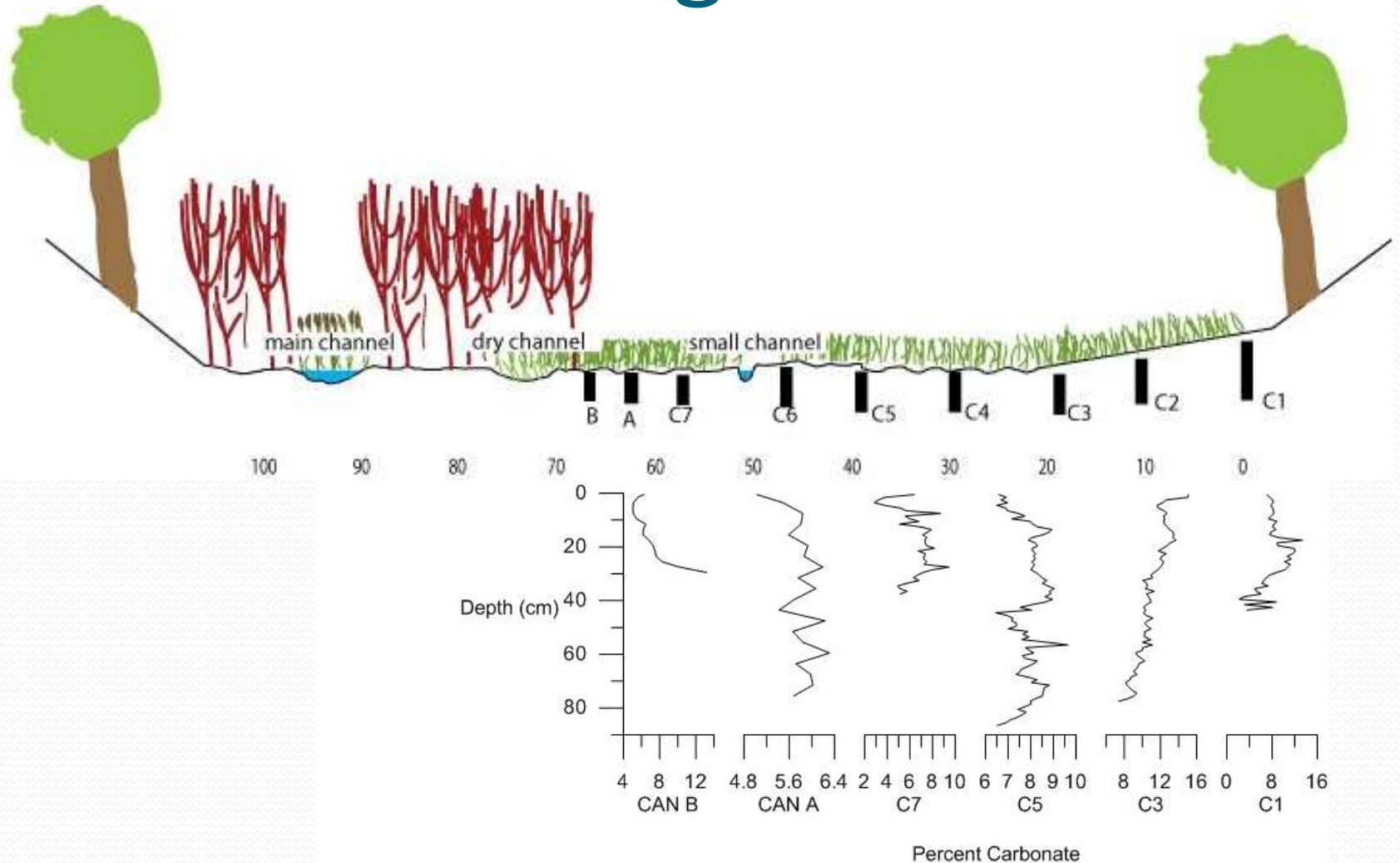
# Results

Percent Organics (students t-test)

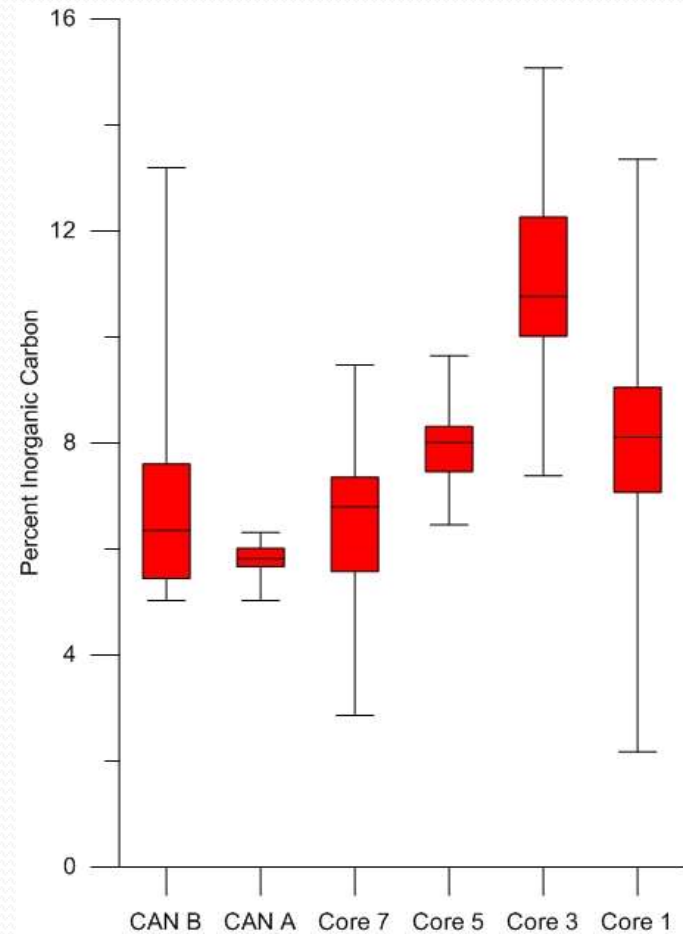
organics	C1	C3	C5	C7	A	B
C1		0.752324	0.118881	0.169602	0.228145	0.125264
C3			0.114289	0.139333	0.274867	0.03242
C5				0.027323	0.25121	0.019001
C7					0.617872	0.00124
A						0.019159
B						

legend	p<0.05
	p<0.001

# Carbonate along transect



# Results



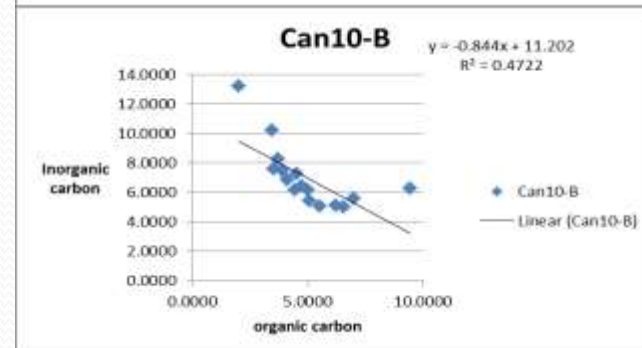
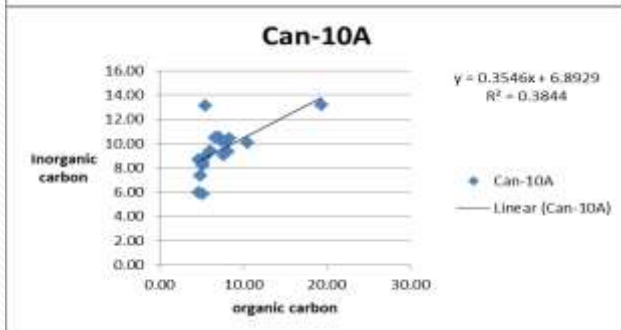
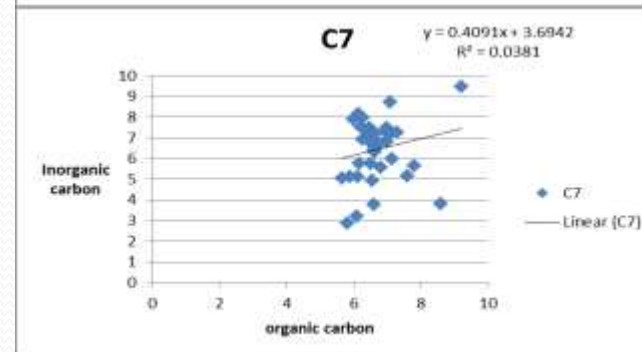
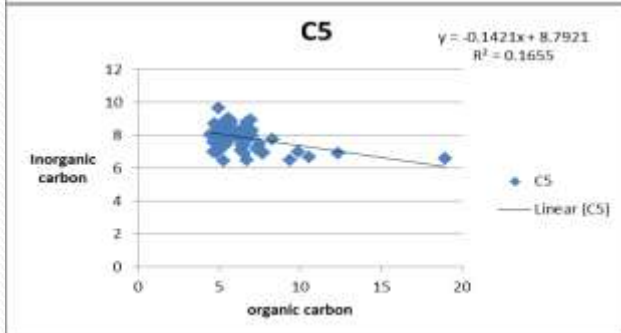
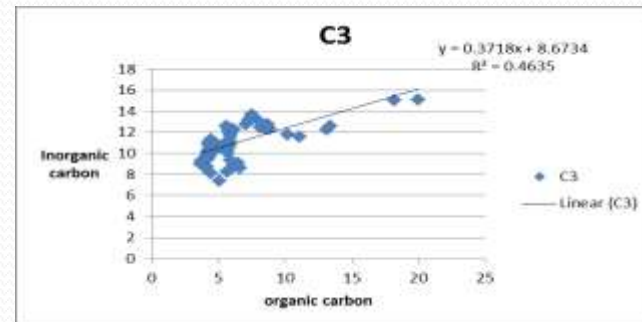
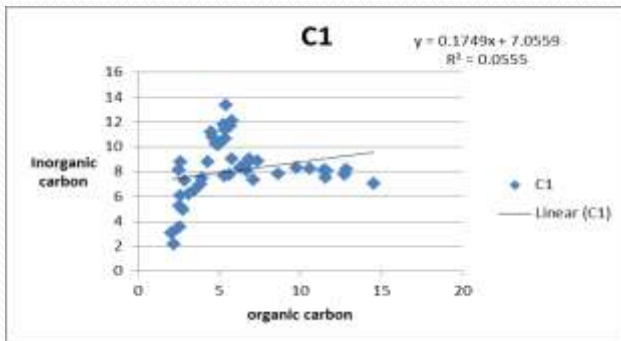
# Results

## Percent Inorganics (Student T-test)

Inorganics	C1	C3	C5	C7	A	B
C1		1.95531E-09	0.613948921	0.000311029	0.024548181	0.103171929
C3			6.12012E-29	6.91611E-25	0.002031662	1.28971E-06
C5				5.09079E-07	0.002289096	0.115061246
C7					7.9638E-07	0.338172134
A						0.001422068
B						

Legend	p<0.05
	p<0.001

# Organic Carbon compared to Inorganic Carbon



# Discussion

- Question 1: How do percent organic carbon and inorganic carbon change in regard to stream proximity?
  - Organic carbon is consistent across transect.
  - Percent inorganic carbon varied significantly across transect with an increasing trend across the middle of the ciénegas.
- Hypothesis accepted that stream channel fixes with cienega development

# Discussion

- Question 2: Can these changes in organic and inorganic carbon help explain the developmental history of ciénegas and possible historical stream position within the ciénegas?
  - Percent organic carbon suggests ciénegas undergo a uniform change in vegetation structure.
  - However, differences in inorganic carbon are due to evaporation and indicate that this is a hydrologic flow/flux proxy and is not related to growth.

# Conclusion

- The hydrology through system (inorganic carbon) is separate from growth (organic carbon) of system
- The different evaporative potentials across the surface cause variation in the inorganic carbon

# Acknowledgements

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- The EPSCoR Program
- The Southwest Center for Environmental Research and Policy



# Results

