Effect of Lake Shinji periphyton upon phosphorus sorption by concrete

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Background, hypotheses, and questions:

Periphyton (attached algae and bacteria) removes phosphorus from water (Craggs 2001, Dodds 2003)

Concrete materials sorb phosphorus from water (Sato et al. 2004, Park and Tai 2004, Takio et al. 2007)

Periphyton may have a preference for recycled concrete material (RCM) type

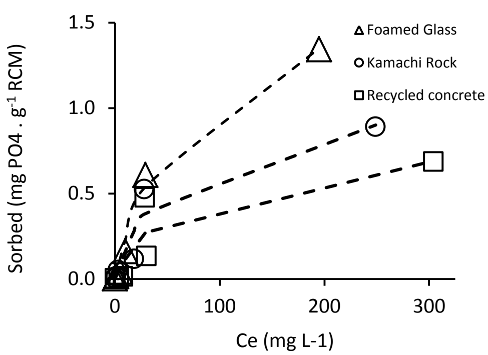
Periphyton-covered RCM may differ in phosphorus sorption behavior

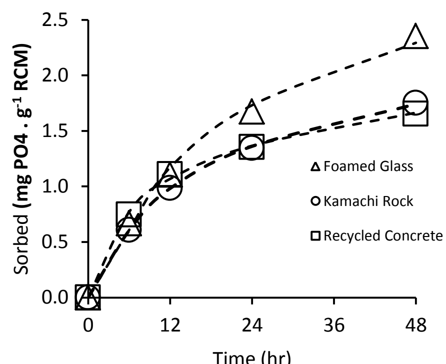
RCM may be engineered to optimize most favorable periphyton condition (Future Research)

1) What is the phosphorus affinity of RCM?
2) What is the effect of RCM upon periphyton growth in Lake Shinji?
3) What is periphyton effect upon phosphorus sorption by RCM?
4) Is phosphorus sorbed to RCM available to periphyton?

1)

RCM test cylinder (50mm x 50 mm)						
Material	Size	Density	Portland	Aggregate	Unit Weight	Max P Sorption
	(mm)	(g cm^{-3})	(%)	(%)	(kg m^{-3})	(mg g^{-1})
Glass RCM	3 - 8	1.32	23	77	1186	2.88
Kimachi RCM	3 - 8	1.68	19	81	1432	2.34
Concrete RCM	7 - 15	1.67	16	84	1440	2.14

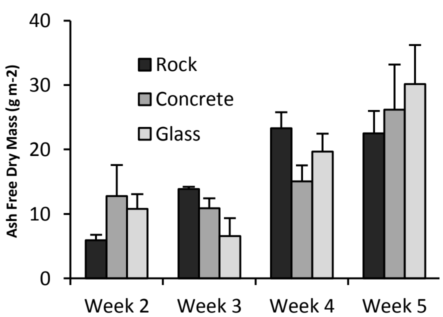


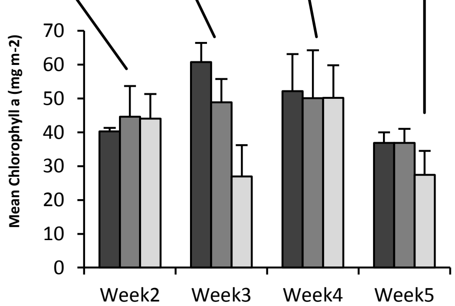


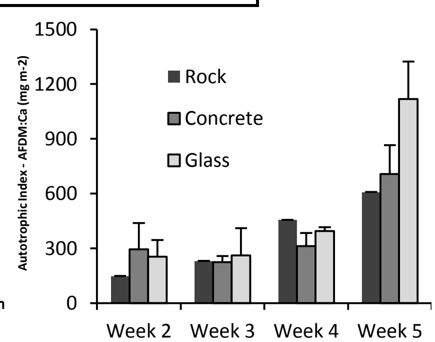
2)

Lake Shinji conditions at research site near Izumo (35° 27' 04.38" N 132° 57' 36.32" E)

		Date					
Variable	Units	7/2/2009	7/15/2009	7/22/2009	7/29/2009	8/5/2009	8/18/2009
Weather	Visual	Rain	Clear	Cloudy	Rain	Cloudy	Sunny
Depth	(m)	0.56	0.51	**1.15**	0.53	0.46	0.47
pH	(n/a)	6.42	7.00	7.35	7.55	7.80	7.64
Conductivity	(sec m$^{-1)}$	0.38	1.10	0.83	0.12	0.20	0.24
Turbidity	(NTU)	35	4	80	37	45	14
Dissolved O_2	mg L^{-1}	9.3	6.7	6.8	6.7	7.6	6.2
Temperature	(°C)	24.5	25.8	26.0	24.5	24.9	29.3
Salinity	(%)	0.2	0.6	0.5	0.1	0.1	0.1
Dissolved Solids	(g L^{-1})	2.5	7.0	5.3	0.8	1.3	1.6



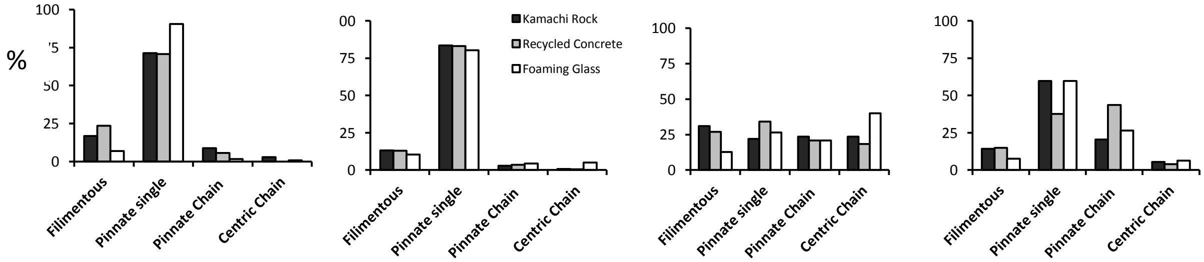




2)

Periphyton common to Lake Shinji (ID courtesy of OHTANI, Shiro –Shimane U. Faculty of Education)

Green filamentous algae	Diatoms	Functional groups
Cladophora sp.	*Melosira virans*	Green filamentous
Rhizoclonium sp.	*Pleurosira laevis*	Single pinnate diatom
Enteromorpha sp.	*Cymbella* spp.	Chain pinnate diatom
	Navicula spp.	Chain centric diatom
	Nitzschia spp.	



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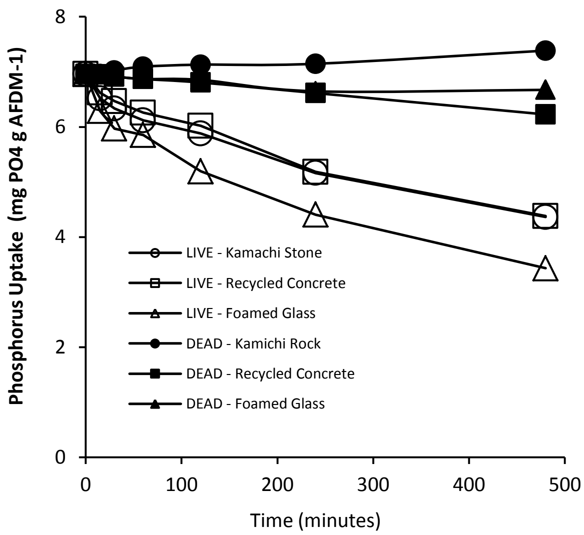

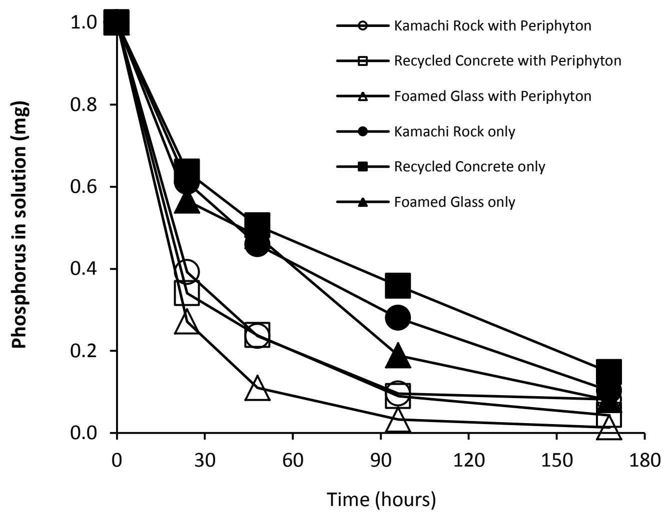

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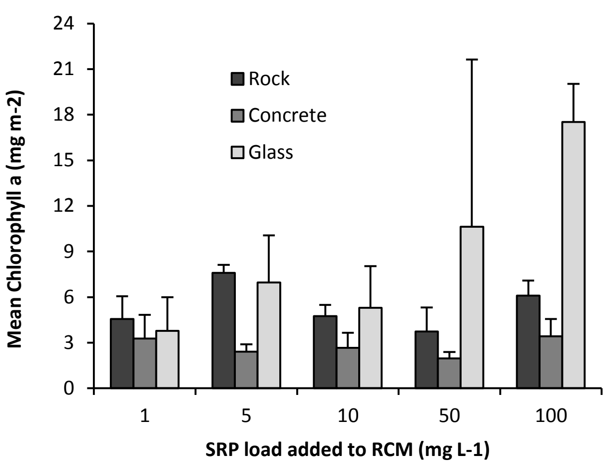

Summary:

1) RCM exhibited different P sorption capacities based on composition
2) Lake Shinji periphyton rapidly colonized all RCM with no preference
3) Periphyton biofilms negatively affected dissolved P sorption by RCM
4) Increasing amounts of P sorbed to RCM exhibited both null (rock, concrete) and positive (foamed glass) effects upon periphyton biomass accumulation

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