Joe Bartlett

1/28/09

Critical review of Corbett et al.

This article described a paleolimnological study of climate histories contained in sediment cores from two lakes in Utah. The study is significant because the lakes are very similar in elevation, location, and surrounding vegetation, but sediment cores produced notably different climate reconstructions. Differences in the hydrogeomorphic setting for each lake were identified as the potential cause of these discrepancies in the climate record. Hydrogeomorphic setting is not always considered when selecting sites for paleolimnological research and this could potentially produce climate records that lack or underemphasize potentially important climatic events.

The paper is well written and presents the project and results in a clear and relatively concise manner. The data and analysis show an important need for considering hydrogeomorphic setting when taking and interpreting sediment cores. The interpretations of the data are clear and reasonable and the methods are well cited. The literature review is strong and the author did a great job of conveying a breadth of knowledge in a concise manner. The writing and figures are clear; however the figures could be presented in a manner better suited for comparison.

This article should be accepted with minor revisions. The abstract is the only area that needs moderate work. The introduction contains an excellent and concise literature review and could benefit from some minor reorganization. The methods and results and clearly presented. A visual representation of the 2 cores may be helpful in conveying the climate data. For example: A drawing of 2 cores normalized to a time scale with the macrofossils and major changes in LOI, C/N, etc, marked in their approximate locations. Specific recommendations for revision are as follows:

- P2 L3 This sentence is very important and does not draw the reader in to the article. Consider starting with a summary statement such as: This study examined the differing post-glacial climate records present in sediment cores taken from two physically and biologically similar lakes in the Uinta Mountains of Utah. Then draw the reader in by discussing the unexpected differences that were detected and how hydrogeomorphology is important to paleolimnology.
- P2 L8 – P2 L17 This section is probably too much detail for the abstract and can be condensed to one sentence
- P3 L20 This paragraph is choppy and could be fixed by moving the sentence about hydrologic settings either earlier or later and breaking the long descriptive sentence into 2 sentences.
- P4 L23 This section on water resources could be moved to the discussion where most of it is reiterated. It's a small enough piece that it could forego mentioning in the introduction.
- P5 L3 A revised figure 2 could better display the 2 lakes. Most of figure 2 is the surrounding topography and there is little detail of the actual lakes. If bathymetry is available that would be a good addition
- P5 L30 The submission guidelines specify that all latin names (ephippia) need to be italicized

- P8 L5 Figures 3 and 4 could be presented as separate series on the same graph, especially if color graphics are allowed. As is its somewhat difficult to visually compare the 2 figures.

The paper is very well written and is very close to being publication ready. The authors did a good job of describing a meaningful study and presenting the results in a clear and effective manner. The guidelines for submission were fulfilled.

INVESTIGATING THE INFLUENCE OF HYDROGEOMORPHIC SETTING ON THE RESPONSE OF LAKE SEDIMENTATION TO CLIMATIC CHANGES

REVIEW by Christina Syrrakou
01/28/09

In this paper the writers present the different response of two adjacent lakes, Reader Lake and Elbow Lake, located in the Uinta Mountains of Utah, to post-glacial climatic changes. A main point in this paper is that although these two lakes are located in close proximity and they have quite similar environment they could present different data and therefore be misleading in the characterization of the specific site. The writers concluded that possible reasons for the different response of the two lakes to the analytical methods used (LOI, BSi, C/N and grain size distribution) are differences in the hydrogeomorphology and lake bathymetry.

The manuscript presented is well-written and there is a significant amount of literature references included. The interpretations of the results are logical although there is an obvious uncertainty (indicated by the words: may have, likely etc.) which is understandable due to the fact that when referring to geologic phenomena occurring so many years ago there is a possibility of error in the assumption one makes. Generally, while reading the paper I got the impression that the writers tried not to include details in the content of the paper and just to point out the major points and emphasize on the discussion part. I have to admit though, that probably due to my lack of geologic background I would prefer a little more detail in some cases like the sample analysis. However, the content of the manuscript was well presented and I believe that this paper should be accepted with minor revisions.

- Firstly, at the abstract while reading it I was a bit confused on which part was your original data and which part was the results. Maybe, an indicating phrase could solve that issue.
- In the introduction it is mentioned that a single core cannot represent well an area. Maybe an example where a single core was used and erroneous data derived could help.
- Also, at the results part I believe that just for a better visual comparison a table could be added.
- At the methods I think that the writers could provide a little more detailed information on the cores. For example, how many cores were taken? Could the coring location inside a lake affect the results? For example, would the results be different if the core was taken at the edges or at a bigger depth inside the same lake?
- Figures 1 and 2 could be better presented.

Investigating the influence of hydrogeomorphic settings on the response of lake sedimentation to climatic changes

By: Lee Corbett

Review by: Will

Lee,

This is a well-written and very interesting manuscript. I think it flows well overall from the background through to getting your points across in the end. Grammatically it's pretty much fine. I noted a couple of minor changes in text that are more a matter of preference than anything. In addition, I do have a few questions and suggestions for improvement:

Study Site- I like the way you go general leading into specifics about the lakes in question. Figure 1 would be more effective I think if you had another inset showing that region of the US (scale-wise). Figure 2 is limited by its lack of color I think, or just the limited range of elevation in the area as shown by the DEM. Perhaps change it to a contour map or limit the color/shade ramp on the DEM to make the view of the surrounding area better.

Methods- The methods are very descriptive and possibly excessively detailed at points (ie;, packhorses, Middlebury College). That being said, those are stylisitic to a point, and given the specificity of lab sites discussed in the later sentences it is consistent. I like the sample analysis section better I think, as it gives concise, clear explanation.

Results- Again we come down to the issue of "to separate or not to separate (from discussion…)". I think overall I like it better the way you have it structured right now in terms of flow. This way I can read a concise list of results for each making early comparison in my head, before moving into discussion to really delve into the similarities and differences between the two records. I see what

you mean about it feeling dumb to describe what you can more easily see in the figure, but I think it's a necessary evil and lets you have numbers in your head.

Discussion- You might consider making some kind of summary graphic- something like a column for each variable showing direct comparison of observation and interpretation. I don't know, might be more trouble than it's worth. In paleoclimate and geomorph I had a question on lines 7-9. Wouldn't the presence of the inflow channel make it more prone to washing anything going on in the meadow into the lake though? Ie; if it's a wet meadow shouldn't you see record of whatever is going on over there?

Also, at lines 14-17, same page, is there any evidence of ephemeral inflow at all? Or at least an abandoned ephemeral inflow?

Finally, on page 10, lines7-14. It seems that significant droughting would be able to severely reduce if not halt inflow fromk the stream, so despite the lack of wetland fringe shouldn't you be able to see something going on as a result of the lack of/decreased direct input?

I think that's it. This is good stuff and everything I pointed out seems pretty minor, so do with it what you will. Well done,

Will

AHolland Review of Corbett manuscript

Summary

This study is a comparison of historical records from two lakes that are in close proximity and had similar climate and vegetative conditions. Environmental proxies measured in the lake sediments provided different pictures of the paleoclimatic records that may be explained by their differences in hydrogeomorphic characteristics. The concluding remark was cautionary, that care should to be taken in identifying the study site in paleoclimatic studies (characteristics of site e.g. hydrogeomorphic) and how that site may influence the interpretation of the results.

Evaluation:

Overall the manuscript is well written and clearly provides scenario descriptions of the phases in the limnological record. Right from the start in the introduction it lays out the types of information that could be extracted in this type of research and with the last sentence of the first paragraph we are able to tell where you are going with this study (good primer there for what's to come).

The methods section provides great detail in the individual analyses and purpose for measuring each environmental variable. However, I did not see a tie later in the results or discussion section for the information provided in the second paragraph of the methods detailing the organic macrofossils found. Could this information regarding the organic materials at the different depths be brought into the discussion section as further evidence? If not, is this type of information necessary to include in paper? I am not familiar with what information is common reporting in paleolimnology to discern if this data has a place in the methods even if it is not brought in later to help support the story.

The section 'paleoclimate and geomorphology' does an excellent job of fully interpreting what was found in the data. It provides the interpretation that is important for later being able to bring together why this sequence of information is relevant and guides the argument that the overall interpretation of this data depends on the information used to create it.

The figures pertaining to the study sites provide useful background information however, the main image in Figure 2 of the elevation profile provides less detail due to lack of contrast in elevation than it does in emphasizing the proximity of the sites. Is there a way to exaggerate the elevation layer to provide more contrast in the image or perhaps show a different background layer to simply emphasize the proximity, as the elevations are similar? In regards to your concerns on captions for figures 3 and 4, I do not consider it necessary to have a results narrative in the figure caption and prefer the text to walk through time sequence and trends in data. This point however is one that can vary with each discipline and would recommend looking at published articles deciding on this text.

Status of paper & recommendations:

I recommend that this manuscript be accepted as a research paper submission to the Journal of Paleolimnology. It provides a necessary reminder for field researchers that the context of the research site itself can strongly impact the conclusion made especially if extrapolating to regional scales.

- To address your thought on combining the results and discussion section, both sections are fine in the present state, but could be combined, as the information is repetitive in its content. If you do consider combining these sections, the first paragraph/first subsection of the discussion could be expanded with some of the detail and text from the results section.
- For a better flow near the end of the discussion section, I would recommend removing the second paragraph in the 'mid-Holocene drought' subsection. Although interesting, it seems more like an aside. This paragraph's position right before the future implications distracts from the main message and conclusions of your paper regarding context of study site information and impacts it could have on regional conclusions.

Edits for compliance with Journal of Paleolimnology
The author has done a great job adhering to the requests of the journal in formatting his manuscript. The following is a format correction that should be addressed before submission:

- Remove punctuation in figure captions and bold figure and number, e.g. **Figure 1**. [Instructions from journal, "The format of the caption should be as follows: Fig. and number in bold. There should be no end punctuation after the caption number or at the end of the caption itself."]

January 28, 2009

UVM internal review of:

Investigating the influence of hydrogeomorphic setting on the response of lake sediment to climatic changes

Authors: Lee B. Corbett; Jeffrey S. Munroe

This paper investigates the paleolimnologic history of two lakes located in the Uinta Mountains in north eastern Utah. The geographic proximity and similar geologic features lends strong support to the assumption that climatic changes for each lake would be nearly identical. Despite being in the same climate marine sediment cores taken from both lakes show distinctly different limnological records based on multiproxy analysis of the recovered sediment cores. After careful consideration of hydrological and bathymetric differences between the two lakes the author interprets the data collected to reconstruct the hydrologic and geomorphic history of both study sites using sound logic. The author notes that had samples not been collected from both lakes analysis of the proxies could lead to several differences in the reconstruction of the hydrogeomorphic history of the region. It is then concluded that if accurate hydrogeomorphic representation of a region is to be made by sediment analysis close attention must be paid to the hydrologic and bathymetric properties of each sampling location.

The overall content of this paper is quite good. The data presented both in the body of the report and the figures allow the reader to understand where the critical changes in levels of the proxies were measured. That said the illustrations used to show the samples sites needs some touch up. The logic used by the author is firmly supported by the detailed observations of the study sites and the collected data. Writing quality in this report is top notch with minimal grammatical errors although some sentences may need rephrasing.

Having limited knowledge of either limnology or paleoclimatology I was delighted with the way the author presented this paper; making it easily understandable for the lay person. Without prior knowledge of the subject I cannot comment on the originality of this study. However the conclusions reached by the author are significant and applicable to studies that make use of paleolimnological testing. Due to the significance of this paper, the use of clear explanations, and content organization this paper should be accepted with only minor revisions.

- The majority of figures provide good illustrations of the sample locations and data collected. The scale used in figure two is particularly good at showing the proximity of the two lakes to one another. However since the location of the two lakes had already been pointed out in figure one a larger scale image in combination with a different elevation gradient than that used in figure one may be nice to show the geography of the mountain ridge.
- Being somewhat of a layperson to this field I had a difficult time in determining what each of the proxies used tracked. I could not fully understand the meaning of the fluctuations until after

reading through the discussion section of the report at which point I then went back to the results section to reach my own conclusion. I am not familiar with the readership of this particular journal but feel a brief explanation as to what information may be gleaned from the proxy data is in order. This would ideally be placed prior to the results section. The introduction may be expanded to encompass this either by directly stating the proxy's purpose or by referencing another paper that does.

- The implications section makes excellent suggestions as to which type of lake should be considered for sampling to obtain information on drought and large precipitation events. It would be nice in this section if further insight into the hydrogeomorphic history of the site may be gained though taking strategically place samples in a single lake. It seems that this may be possible if the bathymetry of the lake is well known. If both steep and shallow banks exits would it be possible to detect both monsoon and drought events, or would seasonal mixing of the water body allow homogenization of the proxies.
- The methods section is well laid out explaining the sampling and analysis methods sufficiently. However the method of transport does not seem necessary. If however it still seems necessary it would be nice to know how the samples were also transported from UT to VT. Additionally this is the first section to mention details about the sample size, but does not address the exact extent of the samples. Later in the paper the initial sedimentation dates are noted for each lake and that organisms are found at the maximum extent of the sample. It should probably be noted as to why the samples are the length collected. Were they trimmed in the field to this length and how was that determined or did the sampler simply hit bedrock blocking the collection of a longer sample. If this is the case how was it determined that the stopping point was bed rock and not a piece of large aggregate.

After closely looking at the instructions to authors for this journal everything seems to comply with the accepted manuscript form. Over all this paper was a pleasure to read and provides seemingly significant conclusions applicable to paleoclimatic reconstructions using sediments.

Jaron

January 25, 2009
Response to Corbett and Munroe
Investigating the influence of hydrogeomorphic setting on the response of lake sedimentation to climatic changes

Physical setting of lakes can affect the interpretation of proxies used in paleolimnological research. Not accounting for these effects may lead to miss-interpretation of past climates, or the omission of important climatic events such as droughts or changes in precipitation.

Overall this study is a valuable contribution to the field of paleolimnology. The strength of this study is in its simplicity. The authors simply explain the potential error in traditional methods used in paleolimnology. Though the simplicity of this paper limits the inferences the authors are able to make, the study will still make a significant contribution to the field of paleolimnology. As I am unfamiliar with this field, if similar work has not already been completed, this paper will be very useful in future paleolinological research.

- Good introduction, very succinct and to the point. As I am not too familiar with this journal, the following comment may not be necessary. The topic you have chosen is very interesting, and it seems like you have a very simple study that illustrates a potentially serious flaw in many previous studies -- that's really exciting. For this reason, I wonder if several additional paragraphs reviewing the extant literature on paleolimnology, and pointing out places where the lack of inclusion of the sensitivities of proxies to physical settings may have affected results. Has anyone every suggested the significance of physical setting on proxy interpretation before? Are there relative ties to dendrochronology, or other paleoclimatic sciences that tie in proxies that may be affected by physical setting? If this material does exist it would be helpful to include it, especially if this issue has already come up in other fields of paleoclimatology, and your work is the first to address it in paleolimnology.

- In the introduction, be careful of the excessive use of therefore, however, etc…often times eliminating them can help elucidate the point you are trying to get across.

- The site description is great, and sets up the physical and environmental criteria that you will be investigating in your research. One suggestion is to be careful of the use of the passive voice. Instead of using "has" to describe something, you can be more succinct and authoritative using a more active voice by using "is". These are simple changes that have a really big impact on how the paper reads.

- The methodology section reads very smoothly, and offers an excellent overview (especially of lab procedures). The results section also flowed smoothly, and even

though you asked us to focus on the intermingling of results and discussion, I don't feel that it was a problem here. The discussion section does an excellent job of tying in the results sections and making inferences and interpretations of why these differences exist. As I am unfamiliar with the field, I am not sure if statistical analyses to test for differences between samples are the norm, but if they are, several basic statistical comparisons would allow you to make more conclusive inferences in your discussion (though if you are restricted to one core, this may be difficult). Without these statistical comparisons be careful, as you are throughout the discussion, to include the caveat that you are making inferences based on a small sample size. This is not to say that your findings are at all less significant, as this is the ideal paper to start a more in depth investigation of the subject matter.

- More specifically, it might be helpful to back up some of your more broad inferences with the precise findings that allowed you to make the inference, as on page 9 line 12 and 13. Another note, the section on the Mid-Holocene drought is well written and provides a good overview of this period in geologic history. However, it might be helpful to more directly link this to the 2 lakes studied in this region and how this event would have effected how proxies are interpreted at these sites (or possibly omit this section). In this section the focus starts to drift away from the central point of the effect of physical setting on proxy interpretation.

- One final note, the last section of the discussion section might fight better under the conclusions section, as in this section you make excellent conclusions from the study, and very eloquently describe the importance of the findings from your research.

Paper Title: **Investigating the influence of hydrogemorphical setting on the response of lake sedimentation to climatic changes**
Paper Authors: L.B. Corbett and J.S. Monroe

Reviewer: **Lance E. Besaw**
Date: 1/28/09

Summary
The authors compare two Utah lakes and look to determine how their responses to climatic, geomorphic, and hydrologic stressors have differed since the retreat of the last glaciers. To do so they analyzed lacustrine sediment cores of the two lakes. They use lacustrine sediment cores taken from the lakes to investigate the paleoclimate change of the lakes. The authors' main finding appears to be that it would be helpful to retrive cores from several different lakes and use the multiple sources of information to piece together a robust understanding of paleoclimate history. Or if multiple lake cores are not accessible, at least consider the hydrogeomorphic setting of the available core(s).

Evaluation
The authors' contribution is noteworthy in that they clearly reveal the need for lacustrine sediment cores from multiple lakes to put together a defensible interpretation of a region's paleoclimatic history. However, I feel the authors need to rewrite portions of the abstract, introduction, discussion and conclusions to more clearly state this important discovery. I feel like the authors undersell their findings.

Regarding the data quality. The data collection and analysis methods appear scientifically correct. However, I am not an expert in the field and can not provide further comment on the data quality.

As someone not familiar with the field of study, I found the "Sample analysis" section to be very read- and understandable. Very well written.

The figures provide a lot of information to the reader. I would like to see Figures 3 and 4 merged together. It might also be advantageous for the authors to present some demarcations for the major paleoclimatic eras. These two changes would allow readers to compare the two cores in a more straightforward way.

Recommendation
Overall, I think the manuscript is extremely well written and it contribution is significant. I recommend the manuscript be accepted with major revisions. Those revisions being the rewriting of the sections outlined above to more clearly state the significance of this research. The manuscript clearly reveals the need for considering using cores from multiple lakes or hydrogeomorphic setting to devise a region's paleoclimatic history.

Specific Comments
I feel like the abstract provides a lot of background (maybe too much) and raises many questions. However, the main findings of the paper are not presented, as is typically done

in abstracts. The use of the words "may" and "likely" present the reader with more hypotheses than scientific findings.

The introduction provides lots of material that may be better suited for a background section. Typically, I find information in the introduction that frames the importance/significance of the work. As a non-paleoenvironmentalist (or as an engineer), I would like to see the introduction present why this work is important. What is it advancing our about our general understanding of lake sediments and lake-hydrogeomorphic responses? Is this paper/research further evidence that a watershed's hydrogeomorphologic setting drives its paleoclimate response? Can the goal of the paper (last sentence on page 3) be phrased as a hypothesis?

Could some of the information presented in the first paragraph on page 5 be better summarized in a table? Likewise, can some of the information presented in the "Results" section be summarized in a table?

The "discussion" section does not read like a typical discussion. The use of the phrases "may be", "would be" and "likely" makes the paper read like the authors are not taking a defensible position in the paper. I understand that the results could be debatable, but I feel like the author should take a firmer stance with their arguments.

Luke Reusser
GEOL 371
Jan 29th, 2009

Review of:
Corbett, Lee, Munroe, Jeffrey, **Investigating the influence of hydrogeomorphic setting on the response of lake sedimentation to climatic changes.**

Planned submission to:
Journal of Paleolimnology.

In this manuscript, the authors present their findings from a study of two high altitude lakes in the Uinta Mountains of NE Utah. The researches analyzed single cores from each lake for LOI, BSi content, C/N ratios, and mean grain size at 1 cm increments, and established age control with 6 radiocarbon dates from each core. While the lakes are in close proximity to one another and experienced similar post-glacial climate, reconstructions based on core analysis suggest notably different histories of sedimentation and climate from one lake to the other. The authors posit that these discrepancies can be attributed to differences in the hydrogeomorphology between the basins. Further, they warn of the dangers of inferring past-climate trends based on core analysis without a thorough understanding of the hydrologic and geomorphic setting of the watershed in question, and how these landscape elements influence sedimentation patterns in lakes. In addition, they stress the value of mindfully selecting the lake to be cored based upon the ability of different hydrogeomorphic settings to most effectively address the research questions at hand (i.e. drought history vs. monsoonal strength).

By and large, this manuscript is well written, clearly and effectively organized, and was a pleasure to read. The study the authors' present is simple and quite elegant, and is of definite relevance and importance to the study of paleoclimatology through paleolimnology. This manuscript should be accepted with minor revision. I found the level of detail to be sufficient for me as a reader to understand and believe their interpretations while not overwhelming me with jargon.

One key implication of their findings, which isn't clearly stated, is, at least to me, this study brings many other climate reconstructions based on lake cores into question. They have demonstrated that lakes that we previously believed "should" tell the same story do not. If they had not looked at both, then we would be left to believe one or the other climate reconstruction depending upon which lake was cored. So why then should we believe other reconstructions based on single cores when we at present do not fully understand the effects of hydrogeomorphology on sedimentation patterns. I know this may sound cynical, but it is a very real implication of this study.

Below, I have listed my key suggestions to the authors. Refer to the manuscript for smaller ticket items of grammar, sentence structure and the like.

1. While there are a variety of hydrogeomorphic considerations (slope, basin shape, bathymetry etc.), what seems to be the most influential element to me (at least between these two lakes) is the presence of an inflow channel to one and not the other. The lakes have fundamentally different delivery mechanisms for sediment

and organic material. While lake surface areas are greatly influenced by shoreline slopes, the delivery of material to lakes via streams vs. surface flow alone seems to be the most influential difference between the two. As such, this factor should perhaps be pushed more directly in the last paragraph of the introduction.

2. Along these same lines, while I was reading the paper, I found myself asking what type of lakes are usually cored? Do they usually have inflows? Do they usually not? Is it a mix? Do other researching conducting similar studies usually report and discuss the presence or absence of surface streams or delivery regimes in general to the lakes that they core? This doesn't have to be a section or integral part of the paper, but I think it is important to know the answer to these questions when considering climate reconstructions from other studies in relation to your findings here.
3. One thing I wanted to see in figs 3 and 4 was sedimentation rate. While the lakes are close by and were subjected to the same climate, both the size of the lakes and the size of the watersheds are quite different. I found myself curious about the sedimentation rate in each. I realize that you have a limited number of radiocarbon dates, and as such would be providing a very averaged account of rate, but it could be useful.
4. Again along these lines, and this is what originally got me thinking about sedimentation rate, the core from the smaller Reader lake, which has a smaller drainage basin and no inflow channel is longer that the one from Elbow lake. I would have expected the opposite. What determined the length of each core? Was it depth to bedrock? Just how far in you could drive the core in each? May be worth including this in methods section.
5. Regarding the collection of the cores themselves, it would be beneficial to include several sentences in the Methods section regarding how you selected the site of each. Was it based on the deepest part of the lakes? For Elbow Lake, how close are you to the river delta? How close to the shore are you for both? I'm wondering if there is any conceivable way to differentiate between materials sourced from the river vs. material washed into the lake from surface wash.
6. On the top of page 11, in the section on Mid-Holocene drought, you end with several sentences on water supply and growing demand in the southwest. I see where you are going, but this just kind of pops up here and then you never go anywhere with it. If it is something you want to include as part of the paper, I think you should push it as a motivation for the study in the introduction, with specifics to your study area in the last paragraph on page 4. Then follow up in the discussion with a section on what your study tells us about drought threats and implications for water demand etc. Maybe have a whole separate section after the discussion including the implications for future paleolimnological studies and present day water demand. Should also include it in the conclusions. Alternatively, you could remove these sentences. This paper has plenty to stand on already.
7. In the implications for future paleolimnological studies section, maybe you should include a clause about replicating this type of study both in your study area as well as in other environments. You've demonstrated that you get totally different signals in two lakes with different hydrogeomorpology, but we don't know if that

is the rule, or just a fluke. It's obviously outside of the scope of this study, but I think it is important to know the answer to this. If you conducted another paired study in the unitas with an inflow and non-inflow set of lakes, do you see the same discrepancies, do you see no discrepancies, or do you see something completely different. You've raised an excellent issue with study of paleolimnology…that being not all lake tells the same story. The next question is how do you know how to anticipate what lakes will tell you based upon their hydrogeomorphology.

Figures: Refer to the actual manuscript for detailed suggestions for figures.

Lee, nice job on this paper and all the work you did. It is really interesting stuff, and am sure you will get this published.

Cheers, Luke

Review of: 'Investigating the influence of hydrogeomorphic setting on the response of lake sedimentation to climatic changes'

Lee B. Corbet et al.

This paper states that regionally paired lakes can have drastically different climatic reconstructions: the paper does a great job of proving this idea with sedimentary core analysis from two paired lakes in Utah. The introduction states how the two regionally similar lakes have different paleoclimatic core data that could be due to the hydrogeomorphic differences in the two lakes. The intro also states that multiproxy analysis was used to study the lakes. The geologic setting and history of Reader and Elbow Lakes are described in detail. The important differences that make them hydrogeomorphicly unlike are introduced. The methods of transporting the cores and analyzing the proxies are described. The results section concisely overviews how the different proxies changed temporally in each lake. The discussion then links the paleoclimate and the geomorphic setting with the results. The bathymetry and opposing hydrogeomorphology are linked to differences that exist between the two lakes. Overall I am impressed with the conclusions that are drawn from the data, such as attributing the diminishing diatom population to the diminishing open water due to the increase in LOI and C/N (the progression from the end of page 9 to the beginning of page 10).

The data is well summarized in the graphs and the results section, but some descriptive statistics might be useful to help quantify things like variability. Have you done any statistics with the data? Descriptive statistics might be useful to see things like the mean (maybe median), standard deviation, and variance of the data. That analysis should be straightforward and might be helpful in the conclusions section. Inferential statistics might be more difficult because your data is not independent, but it might be worthwhile to do a simple regression analysis (what kind of Pearson's correlations or R^2 values exist between the different proxies?). I thought it might be helpful to show that proxies between lakes are significantly different (ie. p-value=0.05) at specific times, but this might not be feasible with data that is dependent like yours.

The figures in the paper are good but they can still be improved. Figure 1 can be laid out in a more optimal format that does not have as much white space, and the caption can be more descriptive. In Figure 2 the background is not very clear, and a description of what type of map it is might be useful. In the captions of figures 3 and 4 you could include the equivalent amount of years for each cm.

The paper has a lot of good data and interpretations, and I think that reconsidering some of the order will help the paper flow better. The body of the paper (results and discussion) seems to be well organized.

- Starting with the Title; inserting something geographic might be more telling
- The intro starts with multiproxy analysis (which is the methodology), I feel like that should be later in the intro. The intro should start with something about differing hydrogeomorpholgy affecting climatic data (like the last paragraph of the intro).
- At the end of the discussion (pages 10-11) there is a reference to droughts affecting human civilizations, and this is the first time that humans are mentioned in the paper. I think this

portion could move into the concluding remarks, or you could append this portion into the future implications section (page 11).

- I was going to suggest adding more discussion to your conclusion, but I think it is also nice as frank as it is. So, if you do not have any discussion in the Conclusion I think you should combine the discussion about drought with the discussion about future work.

I think that your paper is worthy of being published after minor revisions. I am not an expert in geomorphology, but I think the content of your paper is very strong.

Good luck,

Martin

Meredith Clayton
28 January, 2009

Review #2: Investigating the Influence of Hydrogeomorphic Setting on the Response of Lake Sedimentation to Climactic Changes

This paper presents a study conducted on Reader Lake and Elbow Lake, located in Uinta Mountains of Utah. The two lakes share many characteristics, including proximity, elevation, and identical vegetation communities. Due to their close proximity it is assumed in this study that both lakes were subject to the same climatic forcing. Climate reconstruction from sediment cores collected from each lake suggest that the two lakes responded distinctly different to post-glacial climate changes despite their many similarities. Loss on ignition (LOI), biogenic silica (BSi), carbon to nitrogen ratios (C/N), and grain size distribution were the primary indicators used to evaluate differences between the cores taken at each lake. While both lakes display high variance of LOI and mean grain size, only Reader Lake displayed variance in biogenic silica, while only Elbow Lake displayed variance in C/N ratios. It is also noted that the variance of the proxies measured occurs on vastly different time scales between the two lakes. The study assumes that differences in the two sediment cores are reflections of the differences in watershed hydrogeomorphology and lake bathymetry. In general, Reader Lake is shallow and lacks an inflowing stream suggesting a likely sensitivity to drought. Conversely, Elbow Lake is deep, with a large through flow, which suggests a possible sensitivity to changes in terrestrial inwash. Given these geomorphologic differences, it is assumed that past changes in precipitation amount and intensity within the watershed may have impacted the two lakes in different ways, subsequently highlighting the need to consider hydrogeomorphic setting when considering suitability of a potential research site for a paleolimnological study.

As written, I believe this paper is approaching preparedness for submission following a few minor revisions. The illustrations and data presented in the paper clearly support the conclusions drawn from the study and appear to be of good quality. The logic of the interpretations of these data are expressed clearly and are presented in a succinct fashion. The paper also appears to be fully compliant with the instructions to authors provided by the journal. Minor revisions to this paper should include consideration for the placement of transitional phrases in sentence structure. Throughout the paper, the use of words such as *therefore* interrupts the otherwise smooth flow of the paragraphs. By placing such words in the middle of sentences, it reduces the potential power of the sentence and displaces some of the emphasis from the intended object. More specifically, it is not the use of these words, but their placement that detracts from the overall flow of the paper. Additional suggestions include revision of the abstract. The syntax and diction could also be refined to match that of the following text. The abstract successfully summarizes the paper; however, the use of detail such as the presentation of data is unnecessary in this section. The abstract should clearly summarize the purpose, methods, results, and conclusions of the paper. While this piece should serve as a stand-alone description of the paper, it should contain minimal details to provide a focus.

- Revise abstract to contain effective summary in more concise form working to use more elevated diction as in the remaining portions of the paper

- Revise use of transitions. Avoid mid-sentence placement.
- Consider revising use of literary citations. It is grammatically sound to begin the sentence with credit to an individual; however, it places emphasis on the credited author while drawing attention away from the critical information you are attempting to present. This is not always possible but where it is an option, I recommend using a more traditional in-text citation approach.
- Revise a few places noted in the text where diction is too casual.
- Don't change much more than a few details. Overall, this is a great paper.

Mark Isselhardt

Critical Writing (Geology 371)

1/21/09

Corbett, L. B., Munroe, J. S, 2009 **Investigating the influence of hydrogeomorphic setting on the response of lake sediment to climate changes** for submission to the Journal of Paleolimnology

Physical and chemical analysis of lake sediment core constituents is an established technique for paleoclimate reconstruction. The author's used the values of four such constituents to investigate sediment cores taken from two hydrogeomorphically dissimilar lake basins within close proximity of each other. The results of the sediment core analysis for each lake were then compared. There was a general lack of agreement in the climate reconstructions for the two cores. The apparent variability of selected climate proxies between sites calls into question how coring sites are choosen. This paper suggests that the underlying hydrogeomorphology of a given drainage could potentially influence the reconstructed prehistoric climate of that area. The discussion outlines possible confounding influences on the strength of a given climate reconstruction. The conclusion clearly raises issues of how a given sample areas physical setting could generate biased results.

This paper is well written and provides enough background information so that at the end of the introduction the reader is left with a solid idea of what is being proposed. A great deal of time was spent on a careful description of the regional geology and climate. Although the detail is informative it might benefit from some trimming given the tight focus of the field work. Perhaps a citation of work related to the past climate of the Whiterocks Basin or a similar area in the southeastern Uinta Mountains could provide some historical context for the study area. The next section describes the two lakes in the study. How were these lakes chosen? Was it purely based on their proximity? Are there other examples of such a paired study? The present day surface area and associated watershed of the two lakes is different. Were the differences determined to be minor? How was the coring site chosen? It appears that only a single core was taken at each lake. Is this a common practice? A citation of previous work would strengthen the decision to use this method. The methods section clearly explains how each sample is analyzed and provides citations for each proxy's analytical method. The discussion is in depth and covers all the results in detail. The conclusion makes a succinct wrap up of the results but could be strengthened with the inclusion of

Figure 1 locates the greater region within which the study area falls. A smaller simplified map of Utah, with a larger illustration of the Whiterocks Basin/Reader and Elbow Lakes might set the scene with more spatial context. As it is the DEM is of a scale that is hard to interpret.

Figure 2 combines what appear to be digital orthophotos and a DEM of Reader and Elbow Lake. The small amount of contrast of the DEM makes it hard to read. It might be more effective to show a simplified contour of the area (a line could be drawn to show the mean elevation of the lakes). This

could allow the reader to see major hydro- and geomorphic features directly, without having to rely on the DEM, photo and caption. It was very helpful to see where the cores were taken.

Figure 3 and 4 display the results of the sediment core analysis. Since the essence of this paper is comparing the two lakes, could the figures be combined into one figure? Perhaps two line styles (one for each coring site). This might make for easier viewing. The units are given as Age (ka BP) but the scale interval is 1000 already. The gain size values for Elbow Lake from 9000 BP on show what appears to be a minimum value around 6 um. Is this the detection limit for the instrument? Can this be discussed? The discussion section picks out a few important events or periods recorded in the cores. Could a larger figure include an arrow or similar highlight to connect the figure to the text?

This paper deserves to be published in the Journal of Paleolimnology if some of the larger issues are addressed. The largest issue could have more to do with the reviewer's ignorance of accecpted paleolimnologic experimental methods. If single cores are commonly used then the issue of potentially erroneous samples would likely go away. It seems however that if the variability of a given lakes sediment record is not known how can comparisons to another site (with its own unknown variability) be made?

1. It is customary to state the whole meaning when it is first used and abbreviate after that.
2. Are you saying any variation in the proxies or significant variation? Is there an accepted standard for what constitutes significant variation? Does each variable have equal weight or are some weighted more given their overall variability?
3. This seems like a place for a supporting citation. Has anyone else found that lakes in close proximity had similar core samples?
4. Was there just one core taken at each site? Could you include a citation for similar sample collection and design?
5. Could the different lake basins (and associated hydrogeomorphology) supported biological communities. Communities different enough to have impacted the climate proxy values? Would a lake like Elbow presumably have a more complex ecosystem? Could this affect the LOI, C/N and BSi values?

INVESTIGATING THE INFLUENCE OF HYDROGEOMORPHIC SETTING ON THE RESPONSE OF LAKE SEDIMENTATION TO CLIMATIC CHANGES

Lee B. Corbett, Jeffrey S. Munroe, Department of Geology, Middlebury College, Middlebury, VT 05753.

Review by Andrea Pearce
1/28/09

Corbett and Munroe document sediment core sampling from two high elevation lakes in Utah's Unita Mountains, Reader Lake and Elbow Lake. The cores were dated and analyzed for loss on ignition, biogenic silica, carbon to nitrogen rations and grain size distribution. They present the results of the analyses for the two cores graphically. Despite the close proximity of the two lakes, the similar geologic setting and same climate history there is a considerable difference in the composition of the sediment record. The cores reveal periods of increased precipitation intensity and frequency and periods of drought. The patterns of measured parameters in the two cores corroborate known climatic shifts, but because of dissimilarity of the hydrologic setting and sediment characteristics could have suggested different patterns of climate. The authors conclude by suggesting that using cores from multiple hydrologic settings are more valuable than single cores in reconstructing past climate patterns, because some climate shifts may not be reflected in some sediments, while they are in others, depending on hydrology.

This manuscript is well written and edited. The writing is clear, concise, and thoughtful. The construction of the sampling design and analytical methods appear to be sound and generally well documented. There could be more explicit details given to the documentation of the actual data collection and reporting. For the most part the study dataset is used qualitatively, and the addition of some basic statistical measures would make the story behind these two lakes much more convincing. This research presents sound evidence to support the use of multiple samples for climate reconstruction and intuitive idea.

This manuscript fits within the guidelines as a 'research paper' for this publication, and the research methods and findings are of an appropriate topic. I recommend that this manuscript be published with minor revisions as described below.

- Results section - What you mean by variability in measured parameters? Does this describe noise in the data or a trend/shift over time? Providing calculated means and standard deviations from the different cores would allow the reader to see the differences for themselves (since there really is no datum for 'variability', there should be a comparison). In the first paragraph of the discussion you suggest three different phases for Elbow Lake over time. Perhaps you could also report the means and standard deviations of the various parameters during these phases. This could all be could be concisely reported in a table to accompany the text.
- Methods - Please clarify what type of grain size measurement is collected reported. The methods section does not fully explain the reported data. Figures three and

four show single measurements representing grain size. Is this a single measure describing the shape of the grain size distribution? On page 6 of the methods you describe a 'grain size distribution' measurement, but on page 9 of the discussion, you refer to 'mean grain size' for the first time. Is this the same measurement? If so, the wording is unclear, if not, please explain how each is used. The wording of the methods should be consistent with the reported data in the results and discussions.

- Results section – Did the two similar length cores represent the same time scale? Were the sedimentation rates constant throughout the core record?
- First paragraph of Discussion, "Comparison between records" – Based on the contents of the results section and the style of the remaining discussion, this paragraph seems to fit better in your results section.
- First paragraph on page 9, mid-way – You mention possible errors in the depth-age model, but do not define (I'm assuming a depth-age model is the interpolation of the date vs. depth relationship along the length of the cores between the vertical locations of the dated organic fragments.). You may want to describe what type of depth-age model you used and the sort of errors that may exist in your dataset as a result and the significance.
- Figures 3 and 4 – The scale should read 0 -14 ka BP or 0 – 14000 BP. Your scale implies to me it extends to 14,000,000 years before present
- Check the journal requirements for text formatting and punctuation of figure captions.

Good job, and good luck with the real review process!

Eric Portenga
Writing Seminar
January 28, 2009

Corbett and Munroe Review

This paper is an important look into the disparities of paleoclimate interpretations derived from sediment cores between two seemingly similar lakes in the post-glacial Uinta Mountains, Utah. The study also explains the implications resulting from oversights in simply extending climate data from a small lake to a larger region, when, depending on the local hydrogeomorphology of lake, interpretations may be biased. For these reasons, this paper is an excellent candidate for publication in *Paleolimnology* with some minor improvements.

I thought this paper read well and was organized in a manner that makes sense to the reader. The Abstract sums up the paper without going into unnecessary detail and the rest of the paper follows the same style of nixing superfluous wording and detail, only providing the pertinent information. The sections of the paper are organized and each one segues into the next without abruptness.

Again, I think this study will be useful in that it provides a better understanding of the implications of extracting data from a single point and using it to generalize a larger region in that two lakes so similar and proximal to each other provided such different results. Future studies will be able to use the ideas presented here to better their own work by understanding this key concept.

There were, however, a few things that if fixed would make the paper even smoother:

- Consistency in the order information is presented. In the Abstract the list of proxies reads LOI, BSi, C/N, and Grain Size. In the Sample Analysis section, the

order changes. I think the paper would read better if things were referenced in the same order. For instance the two lakes are referred to always Reader Lake *then* Elbow Lake and it helps from getting things mixed up. The order of the graphs in the Figures could also match the same order for better congruency with the rest of the paper.

- I wasn't sure if including BP after every age given was necessary. From my understanding, ka or Ma assumes thousands or millions of years before present, so BP is not needed. Sometimes BP *isn't* used which makes the reader wonder why in some cases it is used and in others it isn't.
- The way in which ranges of ages or depths in the cores is not consistent throughout the paper and I think it would read better if it did.
- Finally, along the congruency theme, whenever 1-cm is written, a hyphen is included, but in other measurements of length there is no hyphen between the value and the unit.
- In some places there seems to be an extra space between a number and its unit, such as on page 7, lines 14, 23, and 26.
- The DEMs in Figures 1 and 2 appear washed out. Maybe there could be more contrast for better viewing?

In terms of matching the journal's instructions, the Figure captions did not meet the preferred style. The word "Figure" should be emboldened and reduced to "**Fig. 1**" with no period after the caption number. Also, periods should not be at the end of the description. Other than that, I didn't notice any blaring mismatches.

January 27th Review for the Journal of Paleolimnology

Title: Investigating the Influence of Hydrogeomorphic Setting on the Response of Lake Sedimentation to Climate Change

Authors: Lee Corbett and Jeffrey Munroe

Summary:

This paper examines the possible reasons for extreme differences observed in the climate proxy records taken from two lake sediment cores in lakes only 2km apart. With lakes this close, we expect them to be subject to similar climatic conditions, so when climate proxies between them are so different, other factors need to be investigated to determine what could cause such a large amount of disagreement. Differences in the shape of the lakes themselves as well as drainage patterns appear to have contributed to the different patterns of sedimentation in the lakes. One lake was wide and shallow without an inflowing stream, while the other was smaller and deeper with an inflowing stream. These differences in shape and water source can explain the differences between the proxy records for each lake.

Although this a very technical paper and clearly aimed at people familiar with hydrogeomorphic or limnologic concepts and terminology, the main point from the paper was very clear and reinforced. It is clear that the lakes are very close together, and that they are exhibiting very different sedimentation patterns in response to presumably the same climate. The reasons for this pattern are also clear, that 1) The shape and depth profile of the lakes differ causing them to react differently to changes in climate, and 2) The way in which water is fed into each lake differs since one has an inflowing stream while the other does not, causing different aspects of climate to effect each lake. You also make the case well that the hydrogeomorphic setting of a study should be taken into account when using sediment data to make conclusions about past climate.

I thought that the introduction of the paper, particularly the first paragraph, was a good introduction to proxy records and sediment cores. However, as someone who has no real experience with the terminology of this discipline, I got hung up on LOI in the introduction. All the other proxies made sense at least on some level, but “loss-on-ignition” meant nothing to me. You explain what it is in the sample analysis section, but by then it’s been used a half-dozen times. The only other real question I had in the introduction was whether there are other factors (other than hydrogeomorphology) that have been identified and can affect how a lake responds to climate. Is there kind of a geologic checklist that you go through so you can know ahead of time what information gathered at a given site is going to be able to tell you? Just as an example from a different field, if you want to use tree rings to identify changes in precipitation, you’re not going to use trees found in wet areas. I’m not sure that makes sense in geology, but I think it’s what I’m going for. Also, have other studies found similar things when they use a deep lake or a shallow lake?

I thought your study site was well described and it gave a good idea of the region, not only in terms of the physical and hydrological characteristics of the site, but its importance to the region overall. As a botanist, I’m not familiar with how much rain would equal 1.8km3 of runoff, so the only thing I might consider adding to this section is

the current annual rainfall and perhaps the seasonality of that rain. In other words, is there a clear wet and dry season or is the precipitation less episodic and fairly consistent over the course of a year?

The methods section in general cleared up a lot of questions I held from the Introduction, particularly in terms of the importance of the proxy records used and what they told us about climate. Most of this information was in the sample analysis subsection of the methods. I did find the last sentence of the first paragraph (lines 23 page 5) confusing though. I felt that before that I could picture what was being done to the core, but that lost me a little bit. While the information on the radiocarbon dating was clear and easy to follow, I did not find any mention of the results from the radiocarbon dated material later on. Were the needles and Daphnia used in any further analyses? What did they tell us that the sediments themselves could not?

In terms of results, I found this section well laid out and the major trends were highlighted well. I would have benefited from a little more explanation along the way however. For instance, in the sentence beginning on line 10 of page 7, after explaining what the graph shows, I think I would have benefited from having the results translated for me into what the environment was like at the time. So if the mean grain size is becoming finer and the BSi is decreasing rapidly, tell me that means influx of water is decreasing along with aquatic productivity. I don't think that's too much analysis of trends even if you also have a separate discussion section.

The discussion section pulled it all together for me and made the graphs make a lot more sense. To help out a little bit, you might want to think about putting dashed horizontal lines or something similar in the figures to mark the important times as well. I thought the explanations of the trends and the reasons for the differences observed in the figures was well thought out, and the importance of taking hydrogeomorphology into consideration as very clear. My only confusion here was how the extent of the wetlands impacted these systems. I could see them changing water flow rates and grain size, but beyond that I really didn't have an intuitive sense of why they matter. Again, it would probably not be difficult for a limnologist to see this, so it is probably my lack of knowledge in this area that is contributing to this particular confusion.

Overall, I think it this paper carries an important message; that any study has to be aware of its limitations and take the bigger picture into consideration.

Carrie Pucko

Review of

INVESTIGATING THE INFLUENCE OF HYDROGEOMORPHIC SETTING ON THE RESPONSE OF LAKE SEDIMENTATION TO CLIMATIC CHANGES

The paper looks at two lakes, Reader Lake and Elbow Lake in the Uinta Mountains of Utah. Both of these lakes have had a core drilled in them for use in Paleoclimate research. While the lakes are very close to each other, they seem to react differently to changes in climate. This paper focuses on why these lakes act differently in changing climate. The conclusion is that one lake is shallow and has no streams flowing into it, so that it effect much more by drought then the other one which is deeper and has an inflowing stream.

The paper presents quality research that is backed up by many references. The data is presented clearly and logically so that it is easy to understand how to interpret it. The interpretations themselves make sense and are very easy to follow. The writing is clear, I believe at some points it becomes to technical and it uses abbreviations to much. The illustrations for the most part are very good. Figure 1, 3 and 4 are easy to understand and good images all around, figure 2 on the other hand in think needs to contain a more detailed map.

I believe the paper should be accepted with minor revisions. The paper is clearly important to the paleoclimate community so it should be published on those merits. As a whole, the paper is well done and has no major flaws. I think it only needs

1. Fewer abbreviations. eg. Put in the full name of LOI at the beginning of each section you use it in.
2. More explaination of the technical aspects. eg. What does Loss-on-ignition mean and why is it important?

3. Figure 2 needs to have a more detailed map.

From what I can tell, it follows the instructions to authors.

Paper: 'Investigating the influence of hydrogeomorphic setting on the response of lake sedimentation to climatic changes' by Lee B. Corbett and Jeffrey S. Munroe

In this paper, the authors investigate the influence of hydrogeomorphic setting on two cases in Uinta Mountains. In order to describe the response of each lake's sedimentation to climatic changes, four parameters were analyzed and the results proved the theory that the consideration of hydrogeomorphic setting is very needful when evaluating the suitability of a specific lake for a paleolimnological study. In this particular project, even though that Reader Lake and Elbow Lake are located at similar elevations and very close to each other, they have responded totally different to past climate changes. The paper is well-written and it offers a clear overview of the methods used. In general, the paper can be accepted with minor revisions.

The readers of the JOPL can identify the paper's purpose and goal from the first paragraph. The introduction is very well organized but I think it would be better if in the second paragraph where you explain how important is the use of the LOI parameter to add why you used the other parameters also. The part where a general description of the area is given provides the reader with a solid background to be able to understand the general morphology of the area. At the end of this section a reference should be cited.

The methods are described in adequate detail and the quality of data is high. I am thinking that you could add some photos from the whole process (samples, analysis devises) to help the readers to fully evaluate the analysis procedure. Also, you can include a figure with the points where you collect your samples. Because I am not familiar with the subject I do not know if there are any other ways to analyze the samples for these four environmental proxies? If there are, you could mention although you have a lot of references included already.

While reading the results I have to admit that I found it detailed as well as valuable. Although the figures help the readers to understand the results, I think it would be better to present your results in a table because the comparison will be easier. As for the discussion, maybe you can combine the two parts (the role of geomorphology and the next one) under one section header. The rest part of the discussion is well written. Finally I want to point out that if the figures 1 and 2 are colored there is no problem but I recommend finding more clear and useful figures. This manuscript is well suited to the goals of the JOPL and is worthy of publication at this journal with minor revisions.

Reviewer: Nikos Fytilis