The recitation for this class is meant to help you dissect scientific papers in a little more organized way. To do this there are 5 prompts that will hopefully help you organize your thoughts and give you things to think about when reading/digesting a paper. Each of these sections will be populated for each paper we read. There only needs to be 3-5 sentences for each section and a soft limit of 500 words for the whole summary. I have attached three examples of how this would be approached for three different papers. The papers will be in the modules section in canvas under "*recitation*" if you would like to glance at the papers with the example recitations.

Addressed Questions: What are the main questions that this paper is trying to answer? Think about what sort of knowledge gaps they have identified and are trying to fill.

Conclusions: The biggest takeaways and discoveries from the study. Sometimes this can be found in the results/discussion section and referenced in the conclusions.

Supporting Evidence: This section should focus on figures and tables. Referencing which figures are key to their conclusions and clear statements made in the results/discussion section.

Data Support: Were there clear trends in the data they presented and were the figures easy to understand? Do you think if you were to look at their figures alone you could have gotten a complete picture?

Quality of Evidence: Were their observations statistically significant? Was their study design sufficient (think about groupings of data)? Was there any thing they could have added to strengthen their study experimentally or in the design? Were proper techniques used?

Radium Sorption to Iron (Hydr)oxides, Pyrite, and Montmorillonite: Implications for Mobility

Michael A. Chen and Benjamin D. Kocar

Addressed Questions: Radium is a radioactive element found in soils and waters, that can threaten water resources and human health. Ra isotope ratios are used to decipher groundwater movement, estimate submarine discharge flux, and fingerprint contamination associated with hydraulic fracturing operations. The extent of Ra sorption to other minerals and under variable environmental conditions (e.g., pH and salinity) is limited, so this paper addresses this by utilizing surface complexation modeling with different minerals and varying pH/cations.

Conclusions: Radium retention is typically highest within soils, aquifer materials, and subterranean groundwater discharge (SGD) sediments rich in Fe and Mn (hydr)oxides. Under sustained reducing conditions, metal sulfides and other reduced or mixed-valence iron (hydr)oxides form within sediments that are relevant to Ra contamination and SGD. Sodium montmorillonite shows large changes in Ra retention in the presence of different competing cations and it is less observed with the other tested minerals. sorption decreased 80% when using a higher saline solution when compared to 10 mM NaCl. High ionic strength solutions imparted less effect on Ra adsorption to iron (hydr)oxides.

Supporting Evidence: results mirror these observations, as goethite and ferrihydrite sorb appreciable quantities of Ra around circumneutral pH (Figure 1)**.** Examined Ra sorption to pyrite was found to sorb most extensively compared to other minerals when normalized to surface area. The influence of background cation controls on Ra sorption can be observed in Figure 2. The observed effect of ionic strength on Ra can be observed in Figure 3. Goethite and ferrihydrite in ASW only decreased 8 and 54% in saline solution when compared to 10 mM NaCl.

Data Support: There are clear trends in the conditions they tested for Ra and they discuss the importance of these observation to natural and anthropogenic produced conditions. All three of the figures are presented nicely and emphasize their results. They knew the limitation of the data that they generated and when speculating they either discuss relevant chemistry or literature background to support their claims.

Quality of Evidence: From the supplemental material they prepared 47 different reactions. For each media that was generated thorough identification and classification was performed to ensure specific mineral or conditions were accurate or functional. This classification was performed with standard and robust analytical methods.

Thermodynamically controlled preservation of organic carbon in floodplains

Kristin Boye, Vincent Noël , Malak M. Tfaily , Sharon E. Bone , Kenneth H. Williams , John R. Bargar and Scott Fendorf

Addressed Questions: In anoxic environments microbial respiration is thought to depend on the energetics of available electron acceptors and couple the reduction of these species to oxidize organic carbon. But just organic carbon itself can determine whether it can be decomposed by microbes. So, the study observed water-soluble organic carbon to compare the chemical composition and average nominal oxidation state of carbon.

Conclusions: There are distinct minimum values in the average nominal oxidation state of water-soluble carbon in an anaerobic environment. Thermodynamic constraints play a role in the decomposition of organic matter in anerobic conditions. In anoxic and sulfate terminal electron accepting environments the nominal oxidation state of carbon tends to lower. In oxic and oxygen electron accepting environments the nominal oxidation state of carbon tends to be higher. Organic carbon in the soluble fraction of sulfidic sediments remains due to thermodynamic constraints and would be metabolized if exposed in an aerobic environment.

Supporting Evidence: the concentration and relative fraction of total water-soluble organic C with a NOSC below the thermodynamic threshold for sulfate reduction (NOSC<−0.3) were higher in the sulfidic (51.6 mg kg−1 soil or 65%) than non-sulfidic sediments (27.3 mg kg−1 soil or 45%). The thermodynamic limit for sulfate reduction occurs when NOSC<−0.3 at current conditions within the sulfidic samples, or when NOSC<-0.6 assuming standard state conditions which are used as the thermodynamic thresholds in figure 2 for each field site. FT-ICR-MS-identified molecules based on their O/C and H/C elemental ratios which classed each compound and then an average NOSC was calculated for each group which can be seen in figure 3

Data Support: The first figure gives a nice overview of the process being explored and gives context to the rest of the material. There was a nice presentation of lab data and field soil profiles. Other observations from samples were mentioned but directed the reader to supplemental material. The speculation in the paper was minimal, but they would try to relate it back to the theoretical frame work that was laid out in the beginning and make logical inferences saying that their findings are only a piece of the puzzle.

Quality of Evidence: Each sample core from the field sites were taken to target anoxic zones and 1m long cores were taken. Each core was transported in N_2 purged plastic sleeves. For the sub samples they also made sure that they were purged and stored in ice before being taken back to lab. Statistical analysis that was performed compared parameters that were n>11. Advance and modern techniques were used to couple their theoretical thermodynamic analysis as well.

Redox and pH Microenvironments within *Shewanella oneidensis* MR-1 Biofilms Reveal an Electron Transfer Mechanism

Jerome T. Babauta, Hung Duc Nguyen, and Haluk Beyenal

Addressed Questions: Industry all over the world has been creating waste that is deposited in sediments and aquatic environments. With the standards set by the government, remediation sites need novel ways to stabilize or remove potentially detrimental environmental or human contaminants. Biofilms are a method that has increasingly been researched as this application leverages microbes to breakdown contaminants. This research was to quantify the variations in redox potential and pH in *Shewanella oneidensis* MR-1 biofilms respiring on electrodes.

Conclusions: The redox potential decreased from the top of the biofilm to the bottom which confirms reducing activity. The biofilm electrode is polarized to a higher potential, the biofilm electrode removes electrons from the solution, thus oxidizing and increasing the redox potential of the solution. Using a ferri-/ferrocyanide control system to directly compare the results between a fully redox-controlled system and the biofilm system. soluble redox mediators play a significant role in electron transfer, this indicates redox potential should increase because of electrode polarization. Removal of the soluble redox mediators had no observable effect on the shape of the redox potential profiles. For the *Shewanella oneidensis* MR-1 biofilms the proton transfer is limited by buffer strength and the decreasing redox potential in the biofilm is not due to pH changes.

Supporting Evidence: The decreasing redox potential change shown in Figure 3 indicates that there was an increased concentration of reduced species near the biofilm electrode. When the electrode was polarized to +400 mVAg/AgCl, redox potential variation was generated as ferrocyanide was oxidized to ferricyanide. Figure 4 demonstrates the changes of redox potential for the ferri-/ferrocyanide system. The effect caused by the removal of soluble redox moderators can be observed in figure 5. The Ph profiles of the electrode are observed in figure 6 and indicate the redox potential profiles were not caused by pH.

Data Support: Each figure that was included had important implications to their conclusions. Each figure showed clear trends and there was little to no ambiguity in the reported figures. Methods and more data is located in the supplemental material that allows the reader to go further conceptually and provide better insight on how to reproduce the experiment. Speculation was minimal, but when there was literature and thermodynamics was used to support their claims.

Quality of Evidence: For each measured system redox potential and pH were measured at least 3 times in multiple locations. A control system of ferri-/ferrocyanide was used to help support their conclusions and appropriate methods and instrumentation was used. They also mention that some measured results were close to the detection limits.