Working Title: *High channel mobility sequesters coarse sediment in floodplain deposits*

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Goals:

* To connect changing hydrological cycling during the PETM to increased channel mobility in the Piceance Basin, and thereby to sedimentary record.
* To propose a model for how increased channel mobility can lead to sand enrichment in floodplain deposits, whereas low channel mobility promotes segregation of fine material to the floodplain, and preferential bypass of sand.
* To connect these observations to other studies, suggesting that this process could be responsible for changes in carbon cycling in floodplains (recent paper, Lyons et al 2019) and responsible for relative enrichment in mud on continental margins.

1. Introduction
   1. The PETM altered hydrological cycling
   2. PETM is connected to sedimentological changes on a global scale
      1. Enrichment in mud on continental margins
      2. Coarsening of fluvial deposits
      3. Changes in fluvial sedimentation style
   3. Fluvial systems responded to accommodate altered hydrological cycling, but the mechanisms invoked for this response are ambiguous. Generally, previous studies invoke increased discharges and transient increases in sediment flux. The source for this sediment is thought generally to be excess sediment stored in hillslopes.
   4. However, it is not well understood whether increased fluxes of sediment are required to enrich the floodplain in sand. Rather, channel mobility alone could be the culprit.
   5. Turn to a site which experienced a fluvial response to altered hydrological cycling, and evaluate specific changes in paleohydrology to develop a model for how changes in hydrology can alter sedimentology.
   6. Will address the following hypotheses:
      1. River channel geometries and kinematics respond to altered hydrology during the PETM via deepening and greater mobility.
      2. Higher channel mobility drives sand enrichment in floodplain deposits, and depletes the floodplain of mud, which is exported to downstream basins.
2. Study Site and Methods
   1. Brief summary of Piceance Basin stratigraphy
   2. It’s a good site for our study because it experienced:
      1. No documented changes in subsidence history during this interval
      2. No changes in sediment provenance
      3. No evidence for tectonically-driven increases in sediment flux
      4. Paleoshoreline at a great distance (1000s of kilometers)
   3. Paleohydraulic estimates
      1. Bar clinoform thicknesses
      2. Grain size
   4. Reworking index
      1. Ratio of partially preserved barforms to fully preserved barforms
      2. Indicates higher relative revisitation rate of channels
   5. Model for sand enrichment via lateral migration\*
      1. Box model approach, where sand fraction in reservoirs is a function of channel kinematics.
      2. Will likely include feedbacks where enrichment in sand depends on sand fraction.
3. Results and Interpretation
   1. No change in paleogeometries
      1. Partially a function of poor resolution
      2. Indicate that channel geometries likely did not change by more than a factor of 10
      3. This implies that rivers did not necessarily carry a higher discharge or sediment flux
   2. More floodplain reworking during PETM interval
      1. Shown through increased cross-cutting of bar deposits
      2. Also through changes in avulsion style (hope to add this if we bring in Liz)
      3. Probably due to flashier hydrograph
      4. Implies faster lateral migration rates and avulsion rates.
      5. This process could explain coarsening of deposits without invoking higher fluxes.
   3. Increased sand fraction of fluvial deposits during PETM
      1. Related to avulsion and lateral migration “combing” or “distilling” of the floodplain, excavating fine material, re-exposing it transport, and distributing sand parcels across the floodplain.
      2. An individual parcel of floodplain material therefore had a higher likelihood of being reworked, which likely increased the exposure frequency of floodplain organic matter to oxidation
      3. The converse of this assertion is sand is preferentially bypassed during Atwell and Shire time, likely due to stable channels that act as conduits for
4. Conclusions
   1. Higher paleodischarges and sediment fluxes have been invoked to explain sedimentological differences in the Piceance and other basin, but we do not find this to be supported by paleohydraulics.
   2. Instead, the same effect can be achieved by varying only the lateral migration rate of the channel, and partitioning more channel sediment to deposits.
   3. Before the PETM, the initial hydrological regime favored meandering channels that seldom avulsed and laterally migrated through bar accretion.
   4. As a result of the PETM, an altered hydrograph increased channel activity, driving more channel sediment to be deposited in floodplains. This could be because of:
      1. Destabilized banks (less vegetation)
      2. Increased frequency of avulsion triggers
   5. Therefore, the sedimentological signature of the PETM can be generated with a simple increase in channel mobility.
   6. Implications for carbon cycling
   7. Implications for basin analysis and reservoir connectivity.
   8. Implications for future environmental change

\*Still working on this model. It should be fairly simple, and it’s something I’m working on with Mark.