Comparison of Intrabasinal and Extrabasinal Turbidites in Glacial Lake Systems

Pacific Lutheran University Department of Geoscience

Orion Schomber and Dr. Alex Lechler

Abstract

Turbidites are distinctive fining upward sedimentary sequences caused by density flows in water-based environments (Shanmugam, 1997). While most geologists learn of intrabasinal turbidites, which are caused by seismic and mass wasting events (Shanmugam, 1997), many do not know that similar features can be created from flooding events and are referred to as extrabasinal turbidites (Zavala, 2016). I analyzed two previous study sites that were impacted by the Cordilleran Ice Sheet: Flathead Lake, MT (Hofmann et al., 2010), and Garden Gulch, MT (Smith 2016), to see if the determined turbidite conclusions matched the criteria established in Zavala et al. (2016). From Zavala et al. (2016), intrabasinal turbidites contain asymmetric ripples, coarse grains, and are geographically isolated, while extrabasinal turbidites have climbing ripples, fine grains, lamination, and are geographically un-isolated. Flathead lake was shown to have asymmetric ripples, the grain lamination, and geographically un-isolated, while Garden Gulch had climbing ripples, a mixture of grain sizes, and fine lamination. Thus, I conclude that both Flathead lake and Garden gulch have extrabasinal turbidites, which agrees with Hofmann et al. (2010), but disagrees with Smith (2017).

Introduction- Turbidites

- Turbidites are sedimentary sequences created by turbidity flows (Zavala et al., 2016)
  - Associated with mass wasting and seismic
  - Transports sediment as suspended load (Shanmugam, 1997)
- Sedimentary sequences
  - Bouma sequences, fining upward pattern with five distinctive phases (Shanmugam, 1997) (Figure 1)
  - Referred to as Intrabasinal turbidites
- Hyperpycnites form from hyperpycnal flows, density differentiations between plume and water (Mulder et al., 1998)
  - Result of outburst or river floods from terrestrial to marine (Zavala et al., 2016) (Figure 2)
  - Referred to as Extrabasinal turbidites

Discussion

Flathead Lake

- Fining upward small grains (Sections B and C) indicative of extrabasinal suspended load or lofing stage at the plume tail
- Asymmetric ripples (A) suggests intrabasinal flow according to Zavala et. al (2016)
- Geographical location (A) suggests extrabasinal flow from ice sheet to lake (Hofmann et al. 2010)
- Finer grain lamination = long periods of traction time -> indicating long, hyperpycnal flow event

Garden Gulch

- Climbing ripples -> suggests extrabasinal suspended load; disagrees with Smith (2017) conclusion
- Climbing ripples and fine grained sediments combined -> longer residence time to develop structures -> suggests long formation event -> extrabasinal flow

Conclusion

- The criteria set in Zavala et al. (2016) is extremely helpful, but extrabasinal glacial turbidites have some major differences like ripple type and drop stoncs
- Flathead lake most likely experiences extrabasinal flows, like Hofmann et al. (2010) suggests
- Garden Gulch probably show extrabasinal turbidites, which disagrees with Smith (2017)
- Future research -> focus more on distinguishing between the types in order to properly understand the geological history of an area

References/ Acknowledgements

Thank you to the PLU Geoscience department, Dr. Alex Lechler, and Dr. Claire Todd for their help and guidance through this project.