IRGF Final Report

Daniels - #103317

Paleogeographic Reconstruction of Southern Alberta During the Early Cretaceous Epoch: Implications for Subsurface Reservoir Characterization

1.1 Project Summary

This project focused on subsurface characterization of Early Cretaceous sedimentary rock units in the Lethbridge-Taber area of Southern Alberta. Subsurface characterization efforts involved description and interpretation of rock cores and petrophysical data sets, as well as analysis of subsurface cross-sections that were constructed using data from the aforementioned data sets. Project results were used to constrain Early Cretaceous landscape development in the region, as well as evaluate the link between paleolandscape evolution and subsurface reservoir development in nearby time-equivalent units.

1.2 Project Outcomes and Impacts

Project Outcomes: Results and interpretations from research efforts were formally summarized in a variety of deliverables that were associated with two separate independent student research projects (i.e., GEOL 5201 projects) carried out at Mount Royal University during the Fall 2023 term. The students that completed these projects (Marilyn Becerra de Rosales and Max Werner-Fisher) wrote manuscripts based on the aforementioned results and interpretations, and delivered presentations based on their manuscripts to an audience of Department of Earth and Environmental Sciences faculty members and other undergraduate student colleagues at the conclusion of the term. Project results will be shared with the broad Canadian geoscience community via two separate poster presentations at two different geoscientific meetings during the Spring 2024 term (i.e., the 2024 GAC-MAC-PEG meeting in Brandon, Manitoba; the 2024 GeoConvention meeting in Calgary, Alberta). After these presentations have taken place, the students and I will work together to produce a focused scientific manuscript based on all of the work completed that will be submitted to a peer-reviewed journal in late 2024. Project Impacts: Comprehensive interpretations of the paleogeography of ancient landscapes using sedimentary units are crucial for constraining the effects of key events in Earth's history over millions of years, including the growth of mountain belts, as well as sea-level variations. Detailed analysis of Cretaceous units of Alberta provides a key perspective into the role of these external stimuli in the instigation of paleogeographic changes in sedimentary basins. The project results provide a template on which to assess the timing of paleogeographic changes in relation to the aforementioned stimuli, which will be the focus of later research efforts. Moreover, the project results have also offered new insight into subsurface resource distribution in the Lethbridge-Taber area, which will be used for targeted resource exploration efforts in the region going forward.

2.1 Use of Awards Funds

Most of the money that I was awarded to carry out this project was used to cover the salary of a Research Assistant (Aatish Mann, MRU ID: 201725523) that I employed during a work term that took place between June 5, 2023 and July 28, 2023 (actual number of working days: 40). During the work term, the Research Assistant was paid at a rate of $17.50 per hour for 6 hours of work per day. According to an email that I received from the Office of Research, Scholarship and Community Engagement on August 16, 2023, total personnel costs associated with employing this Research Assistant during the aforementioned work term came to $4,808. Since the award that I received was for $5,000, this means that there was $192 remaining in the account following the conclusion of the work term. Since I did not attempt to spend the remaining money on research-related initiatives (and I did not request an extension for this particular research grant), I suspect that the remaining money has already been returned to the Internal Research Grant Fund.

2.2 Additional Outcomes/Research Issues

All key project outcomes have been summarized in Section A of this report. I did not encounter any notable issues while performing research associated with this project; as a result, I do not have any information to share on research issues in this case. I will use this part to the report to point out that the Research Assistant that I hired did not complete an independent research project (i.e., a GEOL 5201 project) during the Fall 2023 term. This is because the Research Assistant was about to begin the third year of their degree, and GEOL 5201 research projects are normally carried out by students that are entering the final year of their degree (Marilyn Becerra de Rosales and Max Werner-Fisher were both about to start the final year of their degree when they contacted me about conducting an independent research project, so it made sense to have them assess the results of the work carried out by the Research Assistant as a part of their GEOL 5201 projects). The Research Assistant has indicated to me that they are interested in completing a formal independent research project under my supervision in the future, and I look forward to having the opportunity to supervise them should they decide to proceed.

2.3 Dissemination of Project

Results associated with this project were (or are going to be) disseminated to academic and student audiences in a variety of ways. Specific manuscripts, presentations, and publications associated with project results are listed in the sections below: Final Research Manuscripts for GEOL 5201 (Independent Research Projects I): Becerra de Rosales, M., 2023. Sedimentology and stratigraphy of the Albian Glauconitic Sandstone Member, Taber County, Southeastern Alberta. GEOL 5201 Final Research Manuscript, 34 pp. Werner-Fisher, M., 2023. Evaluating relative sediment source contributions to Early Cretaceous River Systems in Southern Alberta using stratigraphic mapping and U-Pb detrital zircon data mixture modelling. GEOL 5201 Final Research Manuscript, 25 pp. Department of Earth and Environmental Sciences Seminar Presentations: Becerra de Rosales, M., 2023. Sedimentology and stratigraphy of the Albian Glauconitic Sandstone Member, Taber County, Southeastern Alberta. GEOL 5201 Final Presentation, Department of Earth and Environmental Sciences Seminar, December 8, 2023. Werner-Fisher, M., 2023. Evaluating relative sediment source contributions to Early Cretaceous River Systems in

Southern Alberta using stratigraphic mapping and U-Pb detrital zircon data mixture modelling. GEOL 5201 Final Presentation, Department of Earth and Environmental Sciences Seminar, December 8, 2023. Upcoming Conference Presentations (Spring 2024): Becerra de Rosales, M., Sinjar, M., Mann, A., Daniels, B.G., 2024. The influence of inherited paleotopography on the evolution of early to middle Albian sediment-routing systems in southeastern Alberta. 2024 GeoConvention Meeting (Calgary, Alberta). Poster Presentation. Werner-Fisher, M., Mann, A., Sinjar, M., Daniels, B.G., 2024. Characterization of sediment source contributions to Early Cretaceous sediment-routing systems in the central and southern sectors of the Alberta Basin. 2024 GAC-MAC-PEG Meeting (Brandon, Manitoba). Poster Presentation. Anticipated Scientific Manuscripts (Fall 2024): Becerra de Rosales, M., Werner-Fisher, M., Mann, A., Sinjar, M., Daniels, B.G., in preparation, Paleogeographic reconstruction of Southern Alberta during the Early Cretaceous Epoch: implications for subsurface reservoir characterization. Bulletin of Canadian Energy Geoscience (anticipated venue).

2.4 Future Research Plans

Future work on initiatives linked to this project is closely aligned with my long-term research program at Mount Royal University, which is strongly focused on Cretaceous rocks in Alberta. Going forward, I plan on using the insights gleaned from this project to take a closer look at the specific controls on Cretaceous rock unit arrangement in the Western Canada Sedimentary Basin. I am particularly interested in examining the role of tectonic processes in mountain belts and global sea-level changes in the instigation of paleogeographic changes in sedimentary basins, as these stimuli have been shown to significantly influence landscape evolution in other ancient and modern sedimentary basins worldwide. Since the fill of the Western Canada Sedimentary Basin records numerous tectonic events and sea-level changes during the Cretaceous, a key opportunity exists to examine how these specific processes may have impacted Cretaceous landscape evolution. Results from this project will be used as a starting point for that research.