Example of the interplay of Tectonics, Eustasy and Surface Processes on the North Slope of Alaska Since the Jurassic

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The North Slope of Alaska has experienced a complex tectonic and geodynamic history. Although regional paleogeographic reconstructions for the North Slope of Alaska have been interpreted from the geological record, a process-based understanding of the source-to-sink system accounting for both the landscape and sedimentary basin evolution of the region has not been undertaken. Additionally, the interaction of the complex tectonic and climatic forces and their influence on the development of sedimentary basins is not well understood.

We investigate the influence of tectonics (including deep mantle flow), eustasy and isostasy (including flexure) on the source to sink system on the North Slope to better understand its evolution since the Jurassic.

We use a quantitative forward modelling approach with the open-source surface evolution code Badlands \textsuperscript{(*)} which incorporate time-dependent dynamic topography estimates from mantle convection models linking plate motions and mantle flow. We present a new method to implement 3D tectonic displacements (including dynamic topography) in landscape evolution models.

The models capture the North Slope's complex tectonic history and reproduce the sediment depositional trends as observed from the sedimentological record. The spatial variation in dynamic topography through time results in tilting of the basin which influenced sediment routing directions. Sea-level fluctuations significantly slow the depositional system, trapping more sediment in the proximal basin. Cross-sections of the modelled deposition are used to more closely analyse the shelf margin evolution. They reveal that the models reproduce the large-scale stratal geometries observed from the seismic record, as well as the shelf margin trajectory shifts since the Jurassic. This study demonstrates the importance of linking deep Earth processes to landscape evolution models to gain a better understanding of the long-term evolution of sedimentary basins.