The depositional model of the Festningen Member of the Barremian Helvetiafjellet Formation is that fluvial to inner deltaic plain conditions were established as deltas that built southeastward into the Barents Sea basin from an unknown source northeast of present-day Svalbard. Currently, models of Arctic drainage plains are nascent to non-existent. Here, evidence for a large arctic drainage basin into the Cretaceous Barents Sea is suggested by using established scaling relationships and the Fulcrum method in the Festningen Sandstone. Data from several locations in Svalbard: Kongsdalen, Reventse, Cricorasaksla, and Hanaskogdalen. The Festningen Member sandstone sections were all initially photographed by drone in order to determine channel body dimensions and architecture in the sandstone as well as to record data for 3D photogrammetric construction of virtual outcrop models. Paleohydraulic estimates based on the Fulcrum method use bankfull channel dimensions, specifically the height and width, and the D16, D50, D84, and D90 grain sizes to develop basin-process models and infer past catchment constraints. Festningen Member sandstone sections were logged and found to represent braided fluvial systems with mid-channel bars up to 3 m thick and channel-fill up to 4 m thick. Representative bedload samples were taken from approximately 10 cm above the base of channel scours for analysis and model input. The coarse grainize and large clasts, frequently 3-4 cm and up to 15 cm in diameter, in the Festningen Member sandstone samples show that this was a large river capable of moving a coarse bedload. Scaling relationships equivalent to 4 m channels and coarse-grained D-values are found on the order of the modern Colorado River that flow through the southwestern United States. The Bjarmeland Platform and Fingerdupet Subbasin in the western Barents Sea have a potential petroleum play in the Lower Cretaceous strata, which are, in part, considered to have been fed by the same Festningen fluvial system that is represented in cliff sections on Svalbard. Seismic profiles show clinoforms that may suggest deltaic facies, but remains unknown due to lack of well data. Seismic data shows that the Cretaceous Festningen fluvial system was able to deliver enough sediments onto the Bjarmeland Platform area to build clinoforms. The size of the source area sufficient to form a trunk river on this scale remains unconstrained, but an area of 100,000 km² is necessary to produce the river found in the rock record, if the Fulcrum method is applied. Existing Arctic tectonic reconstructions do not consistently show a land area of sufficient size to accommodate this magnitude of drainage area, but results from this study may provide further input to the discussion on timing and land-mass configuration in the present day arctic during the Early Cretaceous.

The deposition model of the Festningen Member is a potential oil and gas target in the Barents Sea. Little is known about the play except that clinoforms are seen in the seismic data that seem to resemble a prograding delta. With a ~20km gap in the deltaic clinoforms and the preserved fluvial system, the quality of the reservoir is still highly speculative.

Collecting data on the fluvial system that fed the delta proves useful in defining the size and character of the river that fed the system. Rock sample analysis and 3D modeling of the Festningen Sandstone are used to place constraints on the maximum and minimum size of the fluvial system thereby giving an estimate on the amount of discharge one would expect into the delta.

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