

# NEW INSIGHTS OF THE CRETACEOUS DEPOSITS (CENOMANIAN) IN THE MESABI IRON RANGE DISTRICT OF NORTHERN MINNESOTA

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## ABSTRACT

The Cenomanian aged Cretaceous deposits of Northern Minnesota have been mentioned in Minnesota Geological Survey reports and in differing degrees in other papers since 1899. These deposits, in varying thickness, are primarily reported from the Mesabi Iron Range District as extending approximately 114 kilometers from Coleraine, Minnesota eastward to the Enterprise Mine near Virginia, Minnesota, with isolated outliers south in the Cuyuna Range. In the past 116 years no serious study has been undertaken to correlate this data with recent core samples and other evidence from new mining operations in this area. Nearly all of the Cretaceous deposits mentioned in earlier reports have been "mined out" and are long since lost to stratigraphic investigation. The most famous and useful site at the Hill-Annex Mine in Calumet, Minnesota contains an extensive in-situ section of the Cretaceous which will be under water within five years due to the rising water table in the mine pit. With new mining opportunities as well as access to data from most of the previous 400 mining localities along the Mesabi, a useful stratigraphic record can now be made of the Coleraine Formation in and around the Mesabi District.

## INTRODUCTION

The Mesabi Iron Range District of northern Minnesota has been sparsely documented since the discovery of Cretaceous sediments in Minnesota (Hall, 1869). Cretaceous foraminifers were noted from clay and shale collected from the Big Fork and Little Fork rivers (Winchell, 1887) and invertebrates from subsequent test pits dug for iron ore near the Arctus Mine (Grant, 1899). Efforts by C.H. Stauffer and R.E. Gile in 1928 (Bergquist, 1938, 1944) to record the stratigraphic record of a great many mines along the Mesabi are now among the only documentation that exists since the deposits have been "mined-out" or are underwater in abandoned pits (FIG 1). Other investigations (Burgess, 1955; Sloan, 1964, 2005) produced new information from the Enterprise Mine near Virginia, Minnesota which contains the greatest thickness of Cretaceous strata of any other mine on the Mesabi Range with 18 distinct lithological units (Burgess, 1955). A similar though less extensive deposit occurs within the Bennett Mine near Keewatin, Minnesota and while not the subject of this investigation suggests that an embayment was present between these localities during the Cretaceous (FIG 2).

In 2006 the authors re-surveyed the Hill-Annex Mine in Calumet, Minnesota for fossils in the spoil piles and to collect geological data (Hanks, et.al., 2011). Using the notes of Stauffer and Gile and working in co-operation with the staff at the Hill-Annex Mine State Park a project was undertaken to document the stratigraphy of the Coleraine Formation within the Park. The Hill-Annex Mine was chosen because it was the only accessible mine with in-situ Coleraine Formation deposits. By using the Hill-Annex Mine stratigraphic data as a baseline for the other mines along the Mesabi combined with old mining records and drill cores a more comprehensive record of these deposits can be made. During the field surveys several unreported layers were found within the original published stratigraphic records.

## GEOLOGY

The predominately marine Coleraine Formation overlies the Bibwabik Iron Formation and is exposed to varying degrees along the Mesabi for 114 km from Coleraine eastward to Virginia, Minnesota. These sediments are found north in Koochiching County and in Itkin and Crow Wing Counties to the south and numerous outcrops and well cores. While heavily buried by glacial drift, the Coleraine Formation most certainly extends westward to the Red River Valley in western Minnesota (Winchell, 1899; Sloan 2005). Data from well cores and mining operations show the Cretaceous in the area of Coleraine and Bovey was over 30 meters (100 ft) decreasing in thickness eastward near Hibbing where it again increases to 30+ meters in thickness and gradually feathers out to non-marine deposits in the area of Virginia (FIG 2). This suggests marine shelf deposition to the west trending to an estuarine deposition eastward grading into terrestrial sediments.

The Coleraine Formation generally consists of a conglomerate of paint rock, taconite, iron ore, fine grit and sand. Bergquist (1938) reported bluish-green shale in the upper layers at the Hill-Annex Mine and occurring in wide areas in the Canesto/Walker and Arctus mines in Coleraine and Bovey. These shales are interpreted to be stream channels draining northeast into the Cretaceous Seaway. It has been possible to document these sections and discover additional unreported sediments (FIG.3), seen in-situ in the northeastern face of the Hill-Annex Mine and to some extent the southern face in late winter and early spring before being overgrown with vegetation. Using the 1928 data it has been possible to reconstruct the original notes of Stauffer and Gile by identifying the loose rock in the spoil dumps and to develop a more detailed and defined stratigraphic record of these deposits.

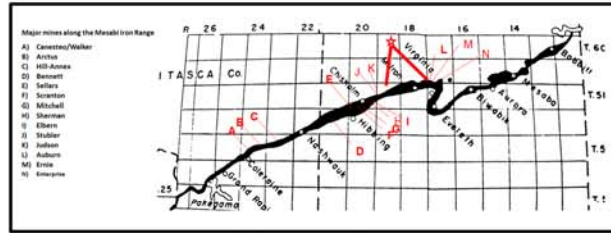


Fig 1. Major mines along the Mesabi Iron Range (Modified from Burgess, 1955)

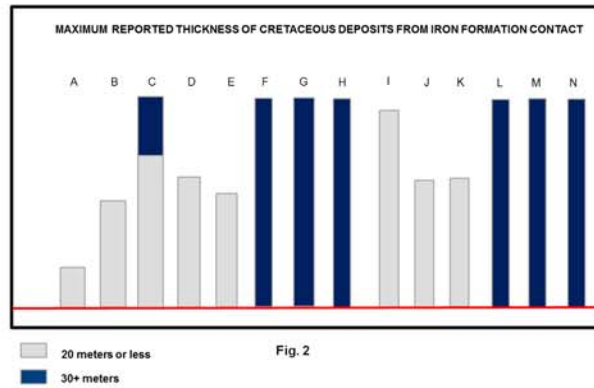


Fig. 2

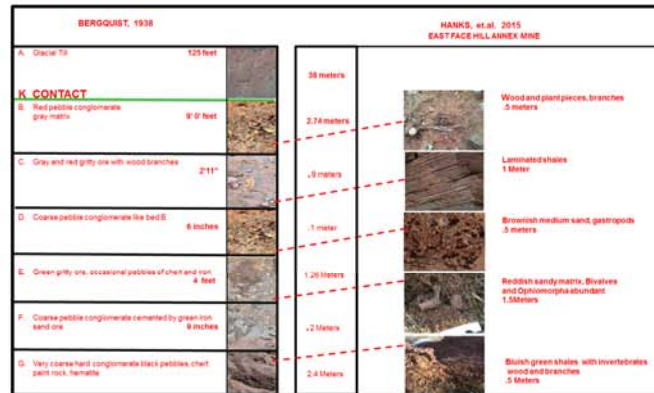


Fig. 3



Fig 4. Hill-Annex 2009



Fig 5. Hill-Annex 2012



Fig 7. Hill-Annex 2015



Fig 6. Hill-Annex 2013



Fig 8. Hill-Annex 2015



Fig 9. Hill-Annex 2015



Fig. 10 From Crofteau, 2013

## CONCLUSIONS

With nearly all of the Cretaceous deposits in the major mines along the Mesabi Iron Range having long since been removed the only locality that contains any useful in-situ stratigraphy is the Hill-Annex Mine in Calumet, Minnesota. This locality however will be underwater due to the rising water table within three to five years (FIGS. 4-10). After these deposits are covered no useful localities will remain. By documenting the Hill-Annex Cretaceous sediments in-situ before they are no longer accessible and comparing these findings to the other mine spoil dumps along the Mesabi Range it will be possible to establish a more in-depth stratigraphic record of these localities. New opportunities have occurred to study over 200 cores from several localities near the Hill-Annex Mine area and will add to the further understanding of the Cretaceous of Minnesota.

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