

SURFICIAL GEOLOGY OF THE FERTILE NE 7.5' QUADRANGLE, WORTH COUNTY, IOWA

> Iowa Geological and Water Survey **Open File Map OFM-11-05**

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Introduction to the Surficial Geology of the Fertile NE, 7.5' Quadrangle The Fertile NE Quadrangle is located in Worth County in north-central Iowa. The mapping area encompasses

the eastern margin of the Late Wisconsin-age Des Moines Lobe Landform (DML), the most recently glaciated region of the state (Prior and Kohrt, 2006). In the map area, the DML consists of a complex suite of depositional landforms and sediment sequences related to supraglacial, subglacial and, proglacial sedimentation. The Des Moines Lobe is characterized by hummocky terrain that forms arcuate belts of moraine complexes and undulating plains with thick increments of supraglacial sediment (>3 m). In the map area, the Bemis Moraine (terminal end moraine) as well as the younger Altamont Moraine Complex (AMC) dominate the landscape. The entire western portion of the map consists of the Altamont (AMC). The moraine is mapped as a complex this far north on the DML. The mapping reveals that younger advances of ice readvanced over previous positions; the Altamont I and II moraines recognized in central Iowa are not discernable in this area. Also, no till plain is mapped as the Altamont (AMC) advanced over the stagnating Bemis Moraine ice. The Bemis and Altamont ice advances are well dated with an approximate 1,000 year time span between the two advances (Bettis et al., 1996). Further evidence of readvance, is the presence of a benched-type surface on the Bemis Moraine. This surface appears to be cut to an elevation of approximately 1,250 feet. However, there is relief on this landscape and it is mantled with DML supraglacial deposits rather than proglacial deposits. It is possible that the Bernis ice was still stagnating at this position when exposed to some sort of Altamont (AMC) meltwater release (subglacial or proglacial). In turn, there is a second bench cut below this benched surface on the Bemis This surface is cut at an elevation of 1,220 feet and is mantled with slackwater sediments overlying sand and gravel. This surface was likely cut by the drainage of the youngest DML moraine recognized in Iowa, the Algona Moraine. Similar slackwater deposits are mapped in areas along the Des Moines River valley which also drained the Algona Moraine. Supraglacial and proglacial sediments (coarse-grained glaciofluvial, ice-contact sediments associated with hummocky terrain, outwash fans, slackwater, and channel deposits) encompass a large area of the eastern flank of the DML and are extensively mapped at the former ice margin, the Shell Rock and Elk Creek valleys. It would appear that the map area has a complex history related to the drainage of the DML.

Williams (1899) described and mapped the Quaternary and Paleozoic bedrock geology of the county and discussed the stratigraphy of Devonian strata that were exposed at the land surface. He also noted the extreme thinness of the "drift" along the the Winnebago River and nearby Shell Rock River and the remarkable difference in surface features between the eastern and western portions of Worth County. State wide bedrock geologic maps by Hershey (1969), and most recently by Witzke, Anderson, and Pope (2010), depict the increased understanding of the complex distribution of geologic units at the bedrock surface across this region, including Worth County. The only regional surficial map of the area consists of the Des Moines 4 ° x 6 ° Quadrangle at a scale of 1:1,000,000 (Hallberg et al, 1991).

The map area has a rich and complex geologic history punctuated by at least seven periods of glaciation between 2.2 million to 500,000 years ago. (Boellstorff, 1978a,b; Hallberg, 1980, 1986). In this area, Pre-Illinoian Episode glacial deposits and associated buried soils are overlain by much younger Wisconsin-age glacial deposits. During earlier and mid Wisconsin-age, glacial mataerials associated with ice advances dating from approximately 40,000 to 26,000 years before present were deposited throughout the map area. In Iowa, this glacial deposit is formally recognized as the Sheldon Creek Formation (Bettis et al, 1996, Bettis, 1997) and in earlier literature is referred to as the "Tazewell till" (Ruhe, 1950). A period of intense cold occurred during the Wisconsin full glacial episode from 21,000 to 16,500 years ago (Bettis, 1989). This cold episode and ensuing upland erosion led to the development of the distinctive landform recognized as the Iowan Erosion Surface (IES) (Prior, 1976). A periglacial environment prevailed during this period with intensive freeze-thaw action, solifluction, strong winds and a host of other periglacial processes (Walters, 1996). The result was that surface soils were removed from the IES and the Sheldon Creek and Pre-Illinoian till surface were significantly eroded resulting in the development of a region-wide colluvial lag deposit referred to as a "stone line". Shortly, following the IES formation the southern edge of the Laurentide Ice Sheet split into several lobes that each flowed down regional topographic lows. The Des Moines Lobe extended from central Canada through the Dakotas and Minnesota into Iowa, terminating at what is now the City of Des Moines. The Des Moines Lobe was active in Iowa between about 15,000 and 12,000 RCY BP, about 5,000 to 8,000 years later than glacial lobes to the east made their southernmost maximum advance (Johnson, 1986; Fullerton, 1986). The Lobe advance occurred during a period of regional warming and was thus climatically out of equilibrium (Kemmis et al., 1994). Ice thickness reconstructions indicate that the bbe was probably thin and gently sloping (Mathews, 1974; Clark, 1992; Brevik, 2000; Hooyer and Iverson, 2002). Clark (1992) reconstructed the Lobe's thickness near Ames, Iowa, at ~80 m. More recently, ice reconstructions by Hooyer and Iverson (2000) were based on a model assuming the Be mis Moraine was ice-cored, which yie kled ice thickness estimates of ~ 250 m. Despite these variations, all agree that the Des Moines Lobe ice sheet was extremely thin and gently sloping. This ice advance was rapid and episodic and was most likely fueled by basal lubrication; in other words, a warm-based, non-deforming bed glacier. These assumptions are backed up by evidence of numerous plants (Baker et al., 1986) and trees (Bettis et al., 1996) found near the base of the DML package. Furthermore, the complex landform sediment assemblages found on the DML in Iow a seem more indicative of regional

Surficial deposits of the map are a are composed of seven formations: DeForest, Dows, Noah Creek, Peoria, Sheldon Creek, Wolf Creek, and Albumett formations. Hudson age deposits associated with fine-grained alluvial, organic and colluvial sediments include the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek, Gunder, Corrington, Flack, and Woden members. The Dows Formation consists of upland glacial deposits and is subdivided into the Alden, Lake Mills, Morgan, and Pilot Knob members. The Noah Creek Formation includes coarse sand and gravel associated with outwash from the Des Moines Lobe. Areas of Peoria Formation eolian materials are present along the Elk Creek valley and east along the Shell Rock River valley as well as stringers on the IES surface. Eolian materials may also be intermittently present mantling most other mapping units and are more abundant near stream valleys. Sheldon Creek Formation glacial deposits are undifferentiated and occur in northwest and north-central Iowa. The full extent of these deposits is still not fully understood. Pre-Illinoian glacial deposits in Iowa consist of two formations: the younger Wolf Creek Formation and the Alburnett Formation. The Wolf Creek is divided into the Winthrop, Aurora, and Hickory Hills members (oldest to youngest). The Albumett Formation consists

stagnation, by a surging-type glacier, not rapid recession.

of several "undifferentiated" members.

The youngest bedrock unit within the quad is the Windrow Formation of the Cretaceous. The Devonian rocks are dominated by carbonates varying between limestone and dolomite, accompanying with minor shale. Based on lithologic features and fossils, uppermost bedrock of Devonian in the mapping area can be subdivided into, in descending order, the Shell Rock, Lithograph City, and Coralville formations (Witzke et al., 2010).

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> Base map from USGS Fertile NE 7.5' Digital Raster Graphic (IGS GIS file DRGB28.TIF) which was scanned from the Fertile NE 7.5' Topographic Quadrangle map, published by US Geological Survey in 1972 Topographic contours and land features based on 1971 aerial photography, field checked in 1972 Land elevation contours (10' interval). Iowa Geological and Water Survey digital cartographic file FertileNE_SurficialGeology.mxd, version 9/28/11 (ArcGIS 10.0) Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15, datum NAD83.

The map and cross section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site specific studies.

