



## **DIGITAL GEOLOGIC MAP OF IOWA** PHASE 1: NORTHWEST IOWA

Prepared by Brian J. Witzke Greg A. Ludvigson Raymond R. Anderson Bill J. Bunker Maureen K. Slaughter James D. Giglierano John P. Pope T. Michael Whitsett Michael J. Bounk

Energy and Geological Resources Division Geological Survey Bureau

August 1997

Produced under the STATEMAP program, in cooperation with the U.S. Geological Survey, Department of Interior, supported by assistance Award No. 1434-HQ-96-AG-01486.



Iowa Department of Natural Resources Larry J. Wilson, Director

ACKNOWLEDGMENTS

Recognized for direct contributions to the map's production: Donald L. Koch, Robert M. McKay, Mary R. Howes, Bernard E. Hoyer, John A. Schmidt, Stephen L. Benoist, Jackson L. Gilmore, and Robert D. Pyle of the Iowa DNR, Geological Survey Bureau.

> LEGEND Description of Map Units

Km

Kmc

Mg

CRETACEOUS "MANSON GROUP," Manson Impact Structure; rocks of the Crater Moat and Terrace Terrane (Megablock Zone); Upper Cretaceous, late Campanian; may reach thicknesses up to 10,000 ft (3000 m) in Crater Moat. The dashed line identifies the approximate location of the boundary between the Crater Moat and Terrace Terranes. Primary Lithologies (at bedrock surface): Phanerozoic Clast Breccia gray calcareous silty-sandy clay matrix entraining clasts and blocks of Cretaceous shale and varied Paleozoic lithologies; minor clasts of Proterozoic crystalline basement lithologies, Proterozoic "red clastics" (mudstone, siltstone, sandstone), grains of devitrified melt rock (thickness 460-675 ft, 140-205 m, above Overturned Ejecta Flap). Secondary Lithologies: Overturned Ejecta Flap (Terrace Terrane only, locally forms bedrock surface) - breccias of Paleozoic lithologies and Proterozoic "red clastics" preserved in general inverted stratigraphic order (thicknesses approximate 1000 ft, 300 m). Down-dropped blocks (structurally-preserved in Terrace Terrane only, locally forms bedrock surface) - normal stratigraphic succession of Cretaceous and Paleozoic units, locally includes Cretaceous strata up to 650 ft (200 m). "MANSON GROUP," Manson Impact Structure; rocks of the Central Peak; Upper Cretaceous, late Campanian; maximum thickness for breccia interval above crystalline-rock megabreccia approximates 640 ft (195 m). Primary Lithologies (at bedrock surface): dominated by Phanerozoic Clast Breccia (see above; thickness 0-200 ft, 60 m). Secondary Lithologies: Crystalline-Rock Megabreccia (locally forms bedrock surface), fractured and brecciated Proterozoic basement lithologies, dominantly gneiss (but including granite and other igneous-

metamorphic rocks). Suevite and Impact-Melt Breccias (locally forms bedrock surface), clasts of Proterozoic crystalline basement rocks,

melt-rock, and minor Proterozoic "red clastics" in a matrix of melt-rich material and/or sandy-silty debris (thicknesses to 380 ft, 115 m). Keweenawan Shale-Clast Breccia (locally forms bedrock surface), dominated by gray and black shale clasts derived from the lower "red clastic" sequence, common melt-rock clasts, minor basement and Phanerozoic clasts, in a silty-sandy shaly matrix or melt-rich matrix (thicknesses to 250 ft, 75 m). NIOBRARA FORMATION (upper Colorado Group); Upper Cretaceous, lower Campanian; estimated maximum thickness 50 ft (15 m). Primary Lithologies: shale, gray, silty, calcareous to marly. FORT BENTON GROUP (lower Colorado Group); includes "Graneros" Shale, Greenhorn Formation, Carlile Shale; Upper Cretaceous, upper Cenomanian-Turonian; maximum thickness 265 ft (80 m). Primary Lithologies: shale, gray, calcareous, variably silty. Secondary Lithologies: limestone, argillaceous, chalky (marl), with inoceramite packstones (Greenhorn Fm.). Minor: siltstone; calcite concretions; siderite.

Kd DAKOTA FORMATION; Cretaceous, upper Albian-upper Cenomanian; maximum thickness 500 ft (150 m). Nishnabotna Member (lower sandstone-dominated interval), not present in eastern map area; Woodbury Member (upper shale/mudstone-dominated interval); eastern facies (probable coarse-grained equivalent of Woodbury Member) in Kossuth, Calhoun, Webster, Humboldt, eastern Emmet, eastern Palo Alto, eastern Pocahontas counties. *Primary Lithologies:* shale/mudstone, gray, noncalcareous, variably silty-sandy; sandstone, very fine to medium grained. *Secondary Lithologies:* sandstone, medium to very course, pebbly; siltstone; shale/mudstone, red, pink, yellow-brown, black (carbonaceous); gravel, quartzose, chert-rich. Minor: lignite; siderite (sphaerosiderite pellets, cemented siltstones). JURASSIC

Jfd FORT DODGE FORMATION; lower gypsum bed, upper "Soldier Creek beds"; Jurassic, possibly Oxfordian-Kimmeridgian; maximum thickness 75 ft (23 m). Webster County only Primer Viel 1 thickness 75 ft (23 m). Webster County only. Primary Lithologies: gypsum; shale/mudstone, red, gray, green, calcareous; sandstone, fine to medium, includes limestone grains, calcareous. Minor: sandstone/conglomerate, limestone pebbles.

PENNSYLVANIAN

MISS ISSIPPIAN

PC CHEROKEE GROUP; Middle Pennsylvanian, Atokan-Desmoinesian; maximum thicknesses 200 to 300 ft (30-60 m). Primary Lithologies: shale and mudstone, gray to black, variably silty, variably pyritic; sandstone, very fine to medium. Secondary Lithologies: sandstone, medium to very course; siltstone; mudstone, red to pink. Minor: coal; limestone; siderite.

"ST. LOUIS" AND PELLA FORMATIONS; Middle Mississippian, Meramecian (of Iowa usage); maximum thickness total interval 135 ft (41 m); maximum thickness Pella Formation 75 ft (23 m); maximum thickness "St. Louis" Formation 65 ft (20 m). Primary Lithologies: "St. Louis - dolomite, variably silty to sandy, part cherty; Pella - shale, gray, red, green-gray, calcareous. Secondary Lithologies: "St. Louis" - sandstone, fine to medium; Pella - limestone, argillaceous. Minor: "St. Louis" - shale, gray, calcareous; Pella - siltstone, sandstone. Ma AUGUSTA GROUP; includes northern facies equivalents of "Keokuk" and "Warsaw" formations; Middle Mississippian, Osagean; maximum thickness 105 ft (32 m). *Primary Lithologies:* dolomite, argillaceous, cherty to very cherty, part glauconitic, part silty. *Secondary Lithologies:* limestones include fossiliferous packstones (part glauconitic), oolite (middle unit), sublithographic mudstones, dolomitic limestones. Minor: quartz druse, chalcedony. GILMORE CITY FORMATION; includes strata previously assigned to the Humboldt and Iowa Falls members; Mississippian, uppermost Kinderhookian-lower Osagean; maximum thickness 160 ft (49 m). Primary Lithologies: limestone, packstone-grainstone, skeletal to oolitic, part intraclastic. Secondary Lithologies: limestone, dense, sublithographic mudstone. Minor: dolomite, calcitic; limestone-dolomite breccia (top of formation); shale, gray, calcareous. MAYNES CREEK AND PROSPECT HILL FORMATIONS; lower strata locally includes Chapin Formation; Lower Mississippian, Kinderhookian; maximum thickness total interval 175 ft (53 m); basal Prospect Hill-Chapin interval 15-50 ft (4.5-15 m). *Primary Lithologies*: Maynes Creek – dolomite, variably cherty; Prospect Hill – siltstone, calcareous. *Secondary Lithologies*: Maynes Creek – upper limestone, dense, sublithographic, locally stromatolitic, middle limestone, oolitic; Chapin - limestone and dolomite, skeletal to

DEVONIAN

FAMENNIAN INTERVAL; Upper Devonian Famennian strata variably assigned to the Sheffield, Aplington, and "Maple Mill" (unnamed shale) formations; maximum thickness 15-55 ft (4.5-17 m). *Primary Lithologies*: shale, gray, silty. *Secondary Lithologies*: dolomite, argillaceous, part cherty. DI LIME CREEK FORMATION; Upper Devonian, upper Frasnian; maximum thickness 210-250 ft (63-75 m); . Primary Lithologies: dolomite, variably argillaceous. Secondary Lithologies: limestone, sublithographic mudstones. ORDOVICIAN

Om MAQUOKETA FORMATION; Upper Ordovician, Richmondian; maximum thickness 75 ft (23 m). *Primary Lithologies*: dolomite, cherty to very cherty. *Secondary Lithologies*: limestone, cherty to very cherty, dolomitic in part. GALENA GROUP AND PLATTEVILLE FORMATION; Galena Group includes (ascending) Decorah, Dunleith, Wise Lake, Dubuque Og formations; Platteville not represented at bedrock surface in map area; Middle-Upper Ordovician; Blackriveran, Chatfieldian, Edenian, Maysvillian; maximum thickness 290 ft (88 m). Primary Lithologies: dolomite, fossil-moldic. Secondary Lithologies: dolomite, cherty; dolomite, argillaceous; limestone, dolomitic. Minor: shale, green-gray, calcareous. **Os** ST. PETER SANDSTONE; Middle Ordovician, upper Chazyan-lower Blackriveran; maximum thickness 90 ft (27 m). *Primary Lithologies*: sandstone, very fine to medium, part pyritic. *Minor:* shale, brown, green. PRECAMBRIAN

SIOUX QUARTZITE; Lower Proterozoic; estimated thickness < 500 ft (150 m). Primary Lithologies: quartzite, hard, fine to course, nink red number Minor: conclourse algorithm and an estimated thickness < 500 ft (150 m). pink, red, purple. Minor: conglomerate; claystone/argillite, red.

Description of Map Symbols

GEOLOGIC UNIT CONTACT U FAULT TRACE ..... MANSON CRATER MOAT/TERRACE BOUNDARY

# BEDROCK WELL DATA POINT

COUNTY BOUNDARY OR COUNTY SEAT — MAJOR HIGHWAY , Interstate Route / US Route O State Route - TOWNSHIP BOUNDARY C LAKE ── RIVER OR STREAM