THE SUBSURFACE DEVONIAN LITHOSTRATIGRAPHY OF SOUTHEASTERN IOWA

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INTRODUCTION

This is the first of a two-part report dealing primarily with the Devonian strata in the subsurface of extreme southeastern Iowa. In this portion, the lithostratigraphic relationships between three cores from Des Moines and Lee Counties are discussed (see fig. 1). The second part of this report will be concerned primarily with the biostratigraphic aspects of the examined cores.

Over 1050 feet of core were examined and described for this study. The three cores studied are:

(1) H-27; NW 1/4, NE 1/4, NW 1/4, sec. 21, T.68N., R.3W., Lee County, Iowa.

(2) H-28; SE 1/4, SE 1/4, sec. 22, T.65N., R.5W., Lee County, Iowa.

(3) H-33; SW 1/4, NW 1/4, NE 1/4, sec. 15, T.71N., R.2W., Des Moines County, Iowa.

The bulk of this report will deal with the general lithologic similarities between the three cores as well as with those of comparable strata as examined in outcrop and as reported in the literature. The various lithologic units will be discussed in ascending stratigraphic order. In addition, a detailed description of each of the cores is given as an appendix to this report.

STRATIGRAPHY

Ordovician

In each of the examined cores, Devonian-aged strata disconformably overlie strata of Ordovician age. In the H-33 core, the Devonian is underlain by the Maquoketa Shale which is, in turn, underlain by dolostones of the Galena Group. In the H-27 and H-28 cores, however, the Maquoketa is missing and the Devonian directly overlies strata of the Galena Group.

Devonian

Wapsipinicon Formation

The Wapsipinicon Formation is the oldest of the Devonian strata to be recognized in each of the three cores. The lower part of the Wapsipinicon Formation, however, is missing from each of these cores. The lowest member of the Wapsipinicon encountered is the Kenwood Member which occurs in both the H-33 and H-27 cores. The lithology of the Kenwood is somewhat variable between the two cores but can generally be described as an argillaceous dolostone to a dolomitic to calcitic shale. The unit is also somewhat silty in both cores and shows some degree of brecciation. Kenwood strata are absent from the H-28 core. In this core, the undifferentiated Davenport and Spring Grove Members of the Wapsipinicon Formation unconformably overlie the dolostones of the Galena Group. The Davenport-Spring Grove also occurs in the H-27 and H-33 cores, and unconformably overlies the Kenwood Member. This unit is dominantly a limestone in the H-27 and H-28 cores but is more dolomitic to the north in the H-33 core. In all cases it is laminated and brecciated in part with abundant stylolites throughout. The lowest parts of the unit commonly exhibit a petroliferous odor when broken or crushed. This unit is also somewhat porous, in part apparently due to dissolution of gypsum(?) crystals. In the northern part of the study area, (H-33 and H-27 cores) the Spring Grove-Davenport is at nearly the same thickness being approximately 37 to 38 feet thick. In the southernmost core, (H-28), this unit decreases markedly in thickness to about 23 feet.

Cedar Valley Limestone

Solon-Rapid Members

The Cedar Valley Limestone in the three cores is dominated by limestones and argillaceous limestones. It may also be dolomitic in part. Stylolites are common, especially in the southernmost core (H-28). The Solon and Rapid Members were not readily distinguishable in the cores. A possible contact between the two members was picked at the 575 foot depth level in the H-28 core. This contact was based on a color change from light-to medium-gray above the contact to a more grayish-brown below the contact. In addition, strata above the contact tend to be more dolomitic and argillaceous than below. No attempt was made to separate the two units in the H-27 core. Lithologies characteristic of both the typical Solon and Rapid Members are found throughout the interval at this locality. In the H-33 core, however, the lithologies encountered were most typical of the Rapid Member only and the Solon Member was not recognized.

The H-28 core was cherty in parts of the interval identified as probably belonging to the Solon. The chert occasionally showed "liesegang" rings similar to the so-called oncolites described by Anderson and Wiig (1974) from the lower Rapid Member of the Cedar Valley Limestone in Black Hawk County, Iowa. Some glauconite was also found near the base of the Cedar Valley in this core. Some sphalerite was found, occasionally replacing pelmatozoan debris, in the

H-27 core. Fossils are abundant and diverse throughout the Solon-Rapid Members in the examined cores and are dominated by articulate brachiopods, pelmatozoans, bryozoans and corals. The combined thickness for the Solon-Rapid Members in the three cores increases from a minimum of 58 feet in the north (H-33 core) to a maximum of about 74 feet in the south (H-28 core). Of that 74 feet in the H-28 core, approximately 56 feet would be placed in the Solon Member. In both the H-33 and H-27 cores, a discontinuity surface occurs within the Solon-Rapid interval. Whether this discontinuity represents a synchronous period of nondeposition or not is uncertain. No such features were recognized in the corresponding interval of the H-28 core. In all cases, the contact between the Cedar Valley strata and the underlying Wapsipinicon Formation was a readily observable disconformity.

Coralville Member

Unlike the Solon and Rapid Members, the Coralville Member of the Cedar Valley Limestone was more easily recognized in the three cores. It is characteristically a yellowish-gray to brownish-gray calcarenite as opposed to the generally light-to medium-gray calcilutites characteristic of the Rapid lithology. In addition, in each of the three cores, the contact between the Solon-Rapid and Coralville Members was sharply defined. In the cases of the H-33 core, the contact was chosen at a discontinuity surface. In the H-28 core a more obvious disconformity marked the contact. No obvious unconformity was recognized in the H-27 core. The contact in this core was picked at the sharp contact between a medium yellowish-gray calcarenite above and a medium- to light-gray, argillaceous calcilutite below. The base of the Coralville Member, in this case, is characterized by the presence of abundant corals which are coated with stromatoporoids. This association is also typical of the contact between the two members as can be seen at the Mehaffey Bridge section in Johnson County, Iowa. In both the H-33 and H-27 cores, the limestones composing the Coralville Member are more argillaceous than is typical of this member as it occurs in its type area in Johnson County. Some brecciation was also noted in this interval, particularly in the H-27 core. In no case were the pelletal calcilutites, typical of the upper Coralville in Johnson County, recognized. The Coralville Member was the highest stratigraphic unit recovered in the H-33 core. Fifteen feet of limestone assignable to the Coralville were recorded from this core. In the H-27 and H-28 cores, 40 feet and 29 feet respectively of the Coralville Member were noted.

Lime Creek Formation

In the H-27 core, 30 feet of generally olive-gray calcitic claystones, and argillaceous limestones and dolostones overlie the Cedar Valley Limestone. The contact between these two units is a sharp hard ground along which truncated fossils can be found. This overlying unit is tentatively placed in the Lime Creek (or Sweetland Creek) Formation. This unit agrees fairly well, in terms of lithology and thickness, with the Lime Creek (Sweetland Creek) as reported by Dorheim et al., (1969). The placement of this interval into the above unit is considered tentative because of the apparently discontinuous nature of the interval. No similar lithologic unit was recognized in the H-28

core save for the presence of some possibly dolomitic and calcitic shales in the lowest 10 feet or so of that section. At the type Sweetland Creek section in Muscatine County, Iowa, this basal calcitic-dolomitic interval is approximately 8 feet thick. In both the Sweetland Creek outcrop and in the H-27 core, the carbonate intervals are interbedded with shales not greatly dissimilar to the overlying non-calcitic shales. Although the contact between the calcitic and non-calcitic intervals in the H-27 core is fairly sharp, the apparently discontinuous and interbedded nature of this interval suggests that it would be better treated as a member of the overlying interval, rather than as a separate formation.

Sheffield Formation - Maple Mill Shale

Dorheim, et al. (1969), recognized two formations, the Sheffield and the overlying Maple Mill Shale between the Lime Creek and the English River Formation. These two shale sequences, along with the English River Formation were placed into the Upper Devonian, Yellow Spring Group. They reported that, in southeastern Iowa, the Maple Mill Shale lies in sharp contact with the underlying Sheffield Formation. According to Dorheim, et al. (1969), the contact between the two formations can be recognized by a change from an interlaminated greenish-gray and olive-gray shale above to a dark olive-gray to dusky yellowish-brown, very hard shale below. The bulk of the Sheffield Formation is a uniform, very light olive-gray colored shale and becomes interlaminated olive-gray and dark olive-gray in the lower 21 feet. They reported spore carps throuhout most of the shale sequence, but noted that they are especially abundant and crushed at the contact between the two formations. Shale sequences of 221 feet and 194 feet occur in the H-27 and H-28 cores respectively.

In the H-28 core, lithlogies similar to those attributed to the Maple Mill Shale from Des Moines County, Iowa by Dorheim, et al. (1969), are found from a depth of 343'8" to 389'8". This interval lies in sharp contact with dark olive-gray to olive-black shales which may mark the top of the Sheffield Formation. Even in the intervals with olive-black shale some interlayering with greenish-gray shale occurs. This dark olive-gray to olive-black interval is approximately 30 feet thick. Below this darker interval, for about the next 109 feet, medium-gray to olive-gray shales predominate. The remaining 22 feet vary from olive-black to greenish-gray. Although the thicknesses of the intervals in the H-28 core vary somewhat from those described by Dorheim, Koch, and Parker in their 1969 paper, the lithologies involved correspond fairly closely.

In the H-27 core, however, the contact between the Sheffield and Maple Mill is not as readily determined. A thin, olive-black shale occurs in this core at a depth of about 208 feet. Greenish-gray shales are still very common below this level. An olive-gray to dark olive-gray shale occurs at a depth of 355 feet and continues down to the contact with the Lime Creek at about 371 feet. If the Sheffield-Maple Mill contact is chosen at the top of the upper olive-black shale, the thickness of the upper olive-black shale is about 3 feet. The middle Sheffield about 150 feet and the lower darker shales about 16 feet. This compares to 16, 95 and 21 feet for each of the three above-mentioned intervals reported from Des Moines Co., respectively. The total thickness of

the shales above the upper dark shales cannot be determined as the recovered core begins in this interval. Lack of a sharp contact, similarity of lithologies on either side of the proposed contact, and discrepancies in thicknesses of the shale intervals between the H-27 core and those reported from Des Moines County make placement of the Sheffield-Maple Mill contact in the core rather questionable.

English River Formation

As mentioned in the previous section, the H-28 core is the only core to include strata higher than the Sheffield-Maple Mill. This unit is approximately 18 feet thick and is composed of light olive-gray to bluish-gray siltstone. Some fossils occur in this interval, including the characteristic brachiopod Chonopectus. The contact between this unit and the underlying shale is gradational and silt-sized grains can be found in the shales as far as 40 feet below the proposed contact. This unit marks the upper boundary of the Yellow Spring Group.

Mississippian

McCraney Limestone

This represents the highest unit in the H-28 core, as well as the highest unit examined in this study. It consists primarily of light-gray to light olive-gray limestones more or less alternating, in part, with more brownish layers. The lower part of this unit may be slightly silty. The contact with the underlying unit is fairly sharp and may be unconformable.

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APPENDIX

Core Descriptions

H-27 Core
NW 1/4, NE 1/4, NW 1/4, sec 21, T.68N., R.3W.
Lee County, Iowa
El. 522'; T.D. 583'

Depth	Maple Mill Formation
150'-155'	Shale, medium greenish gray, mottled in part, due to bioturbation, somewhat dense, friable to fissile; megaspores very common; inarticulate brachiopod at 150'2"; narrow, pyrite-lined burrows at 154'7"; contact with underlying interval gradational.
155'-160'	Shale, medium greenish gray to olive gray, mottled in part due to bioturbation; moderately dense, friable to fissile; megaspores very common; inarticulate brachiopod at 156'4"; fish tooth at 157'3"; contact with underlying interval gradational.
160'-165'	Shale , medium light gray to medium greenish gray; somewhat dense, friable; some megaspores; contact with underlying interval gradational.
165'-170'	Shale, medium light gray to medium greenish gray, somewhat dense, friable to fissile; inarticulate brachiopods at 167'8", 168'9", 169'4" and 169'8"; contact with underlying interval gradational.
170'-175'	Shale, medium greenish gray to olive gray to medium light gray, mottled in part, moderately dense, fissile to friable; scattered pyrite at 173'10"; dolomitic? at 173'9"; horizontal burrows at 174'3"; megaspores very common; inarticulate brachiopods common; conodonts at 174'7"; contact with underlying interval gradational.
175'-180'	Shale, olive gray to medium gray, mottled in part, moderately dense, fissile to friable; pyrite on bedding plane at 178'8"; pyrite nodules at 177'4"; megaspores very common; inarticulate brachiopod at 175'4"; contact with underlying interval gradational.
180'-190'	Shale, medium greenish gray to medium olive gray, commonly mottled, moderately dense, fissile to friable; megaspores very common; fish tooth at 184'5"; inarticulate brachiopod at 184'4" and 181'8"; contact with underlying interval gradational.
190'-195'	Shale, medium greenish gray to medium olive gray, commonly mottled, moderately dense, fissile; pyrite nodules throughout;

megaspores very common; conodonts at 193'10"; contact with underlying interval gradational.

195'-200' Shale, medium greenish gray to olive gray, somewhat mottled, moderately dense, very fissile; pyrite nodules throughout; megaspores very common; contact with underlying interval gradational.

200'-205' Shale, interbedded medium bluish gray to medium greenish gray to olive gray, commonly mottled, moderately dense, very fissile; some pyrite framboids at 202'; some possible bioturbation; megaspores very common; contact with underlying interval gradational.

205'-210' Shale, interbedded medium bluish gray to medium greenish gray to olive black, commonly mottled, moderately dense, very fissile; scattered pyrite from 207'-208'1"; megaspores common; contact with underlying interval gradational.

210'-220' Shale, interbedded medium bluish gray to medium greenish gray to olive gray, commonly mottled, moderately dense, very fissile; scattered pyrite at 210'11"; megaspores common; scolecodonts at 211'3"; conodonts at 211'10"; contact with underlying interval gradational.

220'-231' Shale, interbedded medium gray to olive gray, medium dark gray and medium greenish gray, moderately dense, fissile; scattered pyrite at 229'9" and 238'8"; pyrite nodules from 229'3" to 230'6", pyrite layers at 228' and 229'2"; some horizontal burrows at 221'2"; megaspores abundant; conodonts (including Palmatolepis) at 231'; scolecodonts at 231'; abundant, unidentified black reticulated objects from 229'1" to 230'8".

231'-235' Shale, medium dark gray to olive gray, moderately dense, fissile, scattered pyrite from 231'-234'11"; pyrite nodules from 231'5"-234'10"; conodonts including Palmatolepis at 231'6"; contact with underlying interval gradational.

235'-242'5" Shale, olive gray, moderately dense, moderately fissile; scattered pyrite nodules from 235'7"-241'8"; ctenostome bryozoans at 239'7" and 241'5"; scolecodonts at 239'11"; inarticulate brachiopods at 239'2", conodonts at 235'3", 237' and 238'11", interval clayey from 238'-238'4"; contact with underlying interval sharp.

242'5"-244'8" Shale, olive gray to light olive gray, moderately dense, moderately fissile; pyrite nodules at 243'11"; some whitish calcitic laminae at 243'5"; horizontal pyrite-lined burrows from 243'2"-244'; megaspores very common; ctenostome bryozoans at 243'3", 243'9" and 243'10"; conodonts at 243'6" and 243'9"; contact with underlying interval sharp.

244'8"-252'3" Shale, light bluish gray to greenish gray, moderately dense, moderately to slightly fissile; whitish calcitic lamina at

250'9"; calcite-filled vertical fracture from about 250'6"-251'; pyrite nodules from 244'10"-251'5"; "sole" markings common; horizontal burrows common; pyrite-lined narrow horizontal burrows from 244'9"-247'10"; some pyrite-lined, calcite filled, vertical burrows at 245'1"; conodonts, including Palmatolepis, at 250'11" and 252'3"; pyritized sponge? spicules at 251'10"; megaspores common; contact with underlying interval fairly sharp.

252'3"-255' Shale, olive gray, moderately dense, fissile; pyrite nodules 253'9"; horizontal burrows common; megaspores very common; inarticulate brachiopods from 252'6"-253'10"; articulate brachiopods at 252'9"; conodonts at 252'4"; contact with underlying interval gradational.

255'-260' Shale; olive gray; greenish gray from 257'10"-258'7" and 259'2"-259'8", moderately dense, moderately fissile; pyrite nodules from 255'5"-259'8"; narrow, pyrite-lined, horizontal burrows at 257', 258'3" and 259'3"; megaspores very common; small articulate brachiopods at 258'-258'3" and 259'3"; scolecodonts at 258'5"; inarticulate brachiopods at 255'2"-256'1"; conodonts, including Palmatolepis at 256'11", 259'8", and 260'; contact with underlying interval gradational.

260'-265' Shale, olive gray, mottled with greenish gray, greenish gray from 262'1"-263'4", moderately dense, moderately fissile; pyrite nodules from 260'1"-264'9"; some horizontal burrows; megaspores very common; inarticulate brachiopods at 263' and 264'9"; conodonts, including Polygnathus at 263'2" and Palmatolepis at 260'3", 260'11" and 262'1"; contact with underlying interval gradational.

265'-270' Shale, interbedded light bluish gray, greenish gray and olive gray, moderately dense; pyrite nodules at 268'10" and 269'6", scattered pyrite crystals at 266'9"; some pyrite-lined horizontal burrows; megaspores abundant; inarticulate brachiopods at 269'8"; articulate brachiopods including Leiorhynchus? at 266'11" and 269'3" shells not preserved; fossils oriented parallel to bedding; productids at 267'6"; contact with underlying interval fairly deep.

270'-270'6" Shale, light bluish gray to greenish gray, moderately dense; pyrite nodules at 270'6"; some bioturbation; megaspores common; contact with underlying interval fairly sharp.

270'6"-271'6" Shale, olive gray to medium gray, moderately dense; some pyrite nodules at 270'8" and 270'11"; megaspores abundant; horizontal burrows common; fish fragments at 270'7"; conodonts including Palmatolepis at 270'9"; contact with underlying interval fairly sharp.

271'6"-272'11" Shale, light bluish gray to greenish gray, moderately dense; horizontal pyrite-lined burrows common; megaspores common;

pyritized pectinid bivalve? at 272'8"; contact with underlying interval sharp.

272'11"-275' Shale, medium gray to medium light gray, moderately dense; some pyrite "framboids" from 273'2"-275'; layers with pyrite nodules from 273'2"-274'8"; megaspores very common; contact with underlying interval gradational.

275'-280' Shale, medium light gray to medium gray to olive gray, moderately dense; scattered pyrite nodules from 276'3"-280'; scattered pyrite crystals on bedding planes from 277'1"-279'4"; pyrite "framboids" at 276'9" and 277'6"; some megaspores; some fish fragments at 276'1".

280'-285' Shale, medium gray to medium light gray, moderately dense, fissile; scattered pyrite nodules from 280'10"-285'; pyrite "framboids" from 280'9"-284'7"; megaspores common; contact with underlying interval gradational.

285'-290' Shale, medium gray to medium light gray, moderately dense, fissile; coarsely crystalline pyrite nodules from 285'8"-289'9"; surface covered with pyrite "framboids" at 287'5"; and 289'4"' some scattered pyrite at 287'5"; megaspores very common; some conodonts at 287'2"; contact with underlying interval gradational.

290'-295' Shale, medium gray to medium olive gray, some mottling with greenish gray, moderately dense, moderately fissile; calcite nodules (up to .25") at 293'9" and 295'; coarsely crystalline pyrite nodules at 292'4" and 294'6"; narrow pyrite streaks (burrow fillings?) at 292'10"; pyrite "framboids" at 291'; some bioturbation; megaspores very common to abundant; scoleodonts at 292'1"; contact with underlying interval gradational.

295'-300' Shale, medium gray to olive gray, some mottling with greenish gray, moderately dense, moderately fissile; pyrite nodules around 299'10"; calcite nodules (to .25") at 299'; minor slickensides at 296'8"; some bioturbation; megaspores very common; some scoleodonts at 298'5"; inarticulate brachiopods at 295'6" and 297'; contact with underlying interval gradational.

300'-305' Shale, medium gray, becomes medium olive gray to greenish gray from 300'9"-301'1", moderately dense, moderately fissile; some short pyrite streaks (burrow fillings?) at about 304'1" and 304'9"; pyrite nodules at 301'2"; megaspores common to abundant; inarticulate brachiopods at 302', 303'3" and 304'?; contact with underlying interval gradational.

305'-310' Shale, medium gray to medium light gray, moderately dense, moderately fissile; pyrite nodules at 305'9", 307'3" and 309'11"; pyrite-rich lamina at about 309'8"; some bioturbation?; megaspores common to abundant; contact with underlying interval gradational.

310'-315' Shale, medium olive gray to medium gray, moderately dense, moderately fissile; small calcite nodules at 314'9"; calcitic lamina at 310'8"; bedding plane covered with small pyrite nodules at 312'8"; pyrite-rich lamina at 311'1"; some pyrite-filled burrows?; megaspores common; fish? fragments and pyritized ostracodes? at 313'6"; contact with underlying interval gradational.

315'-320' Shale, medium gray to greenish gray, moderately dense, moderately fissile; calcite nodules at 315'2"; some narrow, pyrite-lined, horizational burrows? at about 315'9"; megaspores abundant near base, becoming less so toward top; spiriferids at 315'1" preserved as pyrite-lined molds, oriented parallel to bedding; contact with underlying interval gradational.

320'-325' Shale, greenish gray to olive gray to medium gray, moderately dense, moderately fissile to friable; calcitic nodules from 320'-321'; bioturbation abundant near base; megaspores abundant; conodonts at 321'3"; contact with underlying interval gradational.

325'-330' Shale, medium light gray, moderately dense, moderately fissile; some megaspores, becoming abundant around 326'; some bioturbation; inarticulate brachiopods at 329'11"; some scolecodonts; some bivalves; some conodonts around 328'6" and 328', including Palmatolepis; coaly? material at 325'7"; contact with underlying interval gradational.

330'-340' Shale, medium light gray, moderately dense, moderately fissile becoming more friable near top; some bioturbation; megaspores very common; some scoleocodonts and conodonts including Palmatolepis at 333'7"; some fish fragments; some bivalves; inarticulate brachiopods at 334'7"; contact with underlying interval gradational.

340'-345' Shale, medium gray to medium light gray to light bluish gray, moderately dense, moderately fissile; some pyrite laminae; megaspores very common; some scolecodonts, contact with underlying interval gradational.

345'-350' Shale, medium light gray, to light bluish gray, moderately dense, moderately fissile; small scattered pyrite nodules; some pyritic laminae, megaspores very common; some scolecodonts; inarticulate brachiopods around 345'2"; contact with underlying interval gradational.

350'-355' Shale, medium light gray, moderately dense, friable; scattered pyrite nodules (to .25"); megaspores very common; contact with underying interval gradational.

355'-360' Shale, medium gray to olive gray, becoming greenish gray toward top, moderately dense, moderately fissile, becoming more friable in upper 2'; some silt; some pyrite nodules (under .25") around 359'6"; megaspores abundant; some conodonts including

Palmatolepis at 358'4"; contact with underlying interval gradational.

360'-365'1" Shale, dark olive gray to greenish gray with some medium greenish gray laminae, dense, moderately fissile, also a 4" light bluish gray to greenish gray friable interval about 5" above the base; somewhat silty at 361'8"; pyrite nodules (.25") at 363'3" and 363'7"; some whitish calcitic and pyritic laminae; megaspores common; conodonts, including Palmatolepis at 362'3"; inarticulate brachiopods at 361'8"; contact with underlying interval gradational.

365'-371'1" Shale, dark olive gray to greenish gray near top, dense, fissile to friable; some small pyrite nodules; some whitish calcitic and pyritic laminae; some megaspores; contact with underlying interval sharp.

371'1"-375' Shale, dolomitic?, greenish gray, fairly dense, weakly fissile to friable especially at top; slightly calcitic, sandy layer at 373'1"; discontinuity surfaces? at 372'8" and 372'10"; pyrite abundant; some horizontal burrows; fish fragments abundant; brachiopods, including productids, abundant, generally disarticulated, preserved as internal and external molds lined with fine pyrite and generally oriented parallel to bedding; some conodonts.

375'-379'5" Shale, dolomitic, dark yellowish brown at base to greenish gray, moderately porous, moderately fissile; scattered pyrite crystals; some inarticulate brachiopods; fish fragments common; contact with underlying interval gradational.

379'5"-380'5" Dolostone, argillaceous, mottled light olive gray to medium gray, medium grained, moderately porous (intragranular); small scattered pyrite nodules near base; some circular vugs (to .25") filled with calcite; contact with underlying interval gradational.

380'5"-382'11" Claystone, dolomitic, greenish gray, somewhat porous; some scattered pyrite crystals; some horizontal burrows; fish fragments at 382'3"; contact with underlying interval sharp (discontinuity).

382'11"-388'8" Dolostone, argillaceous, very argillaceous from 387'9" to 388', mottled yellowish gray to medium gray, fairly fine-grained, generally dense but with some moldic porosity in part; discontinuity surfaces at 385'3"; and 388'4" some .25" calcite-filled vugs near top; pyrite abundant; pelmatozoan debris abundant; brachiopods common; contact with underlying interval sharp.

388'8"-389'9" Limestone, argillaceous, mottled light olive gray to medium gray, medium-grained, fairly dense; wavy shaly laminae abundant; pyrite common; articulate brachiopods abundant, commonly articulated, shells preserved, generally oriented parallel to

bedding; pelmatozoan debris abundant; contact with underlying interval fairly sharp.

389'9"-390' Claystone, calcitic, light olive gray to medium gray, fairly dense, weakly fissile; articulate brachiopods abundant, usually disarticulated; pelmatozoan debris abundant, shells preserved, generally oriented parallel to bedding; contact with underlying interval sharp (discontinuity surface).

390'-394'7" Limestone, argillaceous, light olive gray to dark yellowish gray, fine-to medium-grained, dense, very argillaceous from 391'6"-392'; conglomeratic around 392'; intraclasts at base; some pyrite; pelmatozoan debris abundant; articulate brachiopods abundant; brachiopods generally disarticulated, shells preserved, no obvious orientation.

394'7"-401'10" Claystone, calcitic, medium light gray to light olive gray, dense; some pyrite, abundant medium gray (pyritic?) burrows; pelmatozoan debris and articulate brachiopods at base, shells preserved; scolecodonts common; some fish fragments; contact with underlying unit sharp (hardground with truncated fossils).

Cedar Valley Formation
Coralville Member

401'10"-405' Limestone, argillaceous, dark yellowish gray to medium gray, medium-grained (calcarenite), brecciated, clasts commonly with a medium gray coating; some calcite-filled vugs (less than .5"); some small stylolites; some pyrite; some wavy shaly laminae; discontinuity surface at 404'6"; articulate brachiopods abundant, pelmatozoan debris abundant, shells preserved, may be concentrated between clasts; contact with underlying interval gradational.

405'-410' Limestone, somewhat argillaceous, pinkish gray to medium yellowish gray, medium-grained (calcarenite) but coarser than above unit, dense; wavy shaly laminae abundant; some intraclasts; some pyrite; articulate brachiopods (including Atrypa) abundant, some articulated, generally oriented parallel to bedding; pelmatozoan debris abundant, some fossils partially replaced with pyrite; contact with underlying interval gradational.

410'-415' Limestone, argillaceous, dolomitic?, light gray to medium olive gray, meduim-grained (calcarenite), dense; some intraclasts; some shaly, wavy laminae near top; some calcite-filled vugs (.5"); articulate brachiopods (including Atrypa) abundant, commonly articulated; pelmatozoan debris abundant; Tentaculites abundant near 412'; fossils generally oriented parallel to bedding, shells preserved; contact with underlying interval gradational.

415'-420' Limestone, argillaceous, light gray to light olive gray, fine- to medium-grained (calcilutite to calcarenite), dense; some intraclasts; some small stylolites; pelmatozoan debris; bryozoans and articulate brachiopods abundant; brachiopods both articulated and disarticulated, shells preserved; contact with underlying interval gradational.

420'-425' Limestone, argillaceous, medium yellowish gray medium-grained (calcarenite), dense; wavy shaly laminae abundant; intraclasts abundant; pyrite common; articulate brachiopods including Orthospirifer and cranenids abundant, shells generally disarticulated; bryozoans including Sulcoretepora and fenestellids abundant; pelmatozoan debris abundant; Cladopora very common; fossils generally oriented parallel to bedding, shells may be partially replaced with pyrite; contact with underlying interval gradational.

425'-430' Limestone, argillaceous, medium yellowish gray, medium-grained (calcarenite), dense; wavy shaly laminae abundant; some intraclasts; stylolites abundant; pelmatozoan debris abundant; rugose corals abundant, oriented both vertically and horizontally; bryozoans abundant; articulate brachiopods, including strophomenids, Atrypa and Orthospirifer, very common, shells preserved, generally disarticulated; some gastropods; Sulcoretepora common; contact with underlying interval gradational.

430'-435' Limestone, argillaceous, medium yellowish gray, medium-grained (calcarenite), dense; stylolites and wavy shaly laminations abundant; some calcite-filled vugs; pelmatozoan debris abundant; articulate brachiopods; including Atrypa, very common; some bryozoans; corals, including Cladopora abundant, shells preserved, rugose corals commonly on sides; contact with underlying interval gradational.

435'-441' Limestone, medium yellowish gray; medium-grained (calcarenite), dense; some stylolites; some clasts of underlying lithology at base; some pyrite; corals abundant especially around 446'6" including Hexagonaria and solitary rugose corals, corals commonly on sides, those around 446'6" generally coated with stromatoporoids; pelmatozoan debris abundant; articulate brachiopods very common including Atrypa and cranenids; stromatoporoids common near base; orientation of fossils variable; contact with underlying unit sharp.

Rapid Member

441'-445' Limestone, argillaceous, medium gray to light gray, fine-grained (calcilutite), dense; wavy shaly laminae abundant; scattered pyrite; some short, darker gray streaks; some sphalerite; horizontal burrows abundant; Tentaculites abundant;

pelmatozoan debris abundant; some bryozoans; articulate brachiopods abundant; shells preserved, generally disarticulated, generally oriented parallel to bedding.

445'-450' Limestone, argillaceous, medium light gray to light gray, mottled, in part, with short, darker gray streaks, fine- to medium-grained (calcilutite-calcarenite), dense; wavy, shaly laminae abundant; some pyrite; some vertical and horizontal burrows; pelmatozoan debris abundant; Tentaculites common; some bryozoans; digitate stromatoporoids abundant near top; articulate brachiopods, including productids (near base) and strophomenids, abundant, shells preserved, generally disarticulated and oriented parallel to bedding; contact with underlying interval gradational.

450'-445' Limestone, argillaceous, medium- to light-gray, fine- to medium-grained (calciutite-calcarenite), dense; shaly laminae abundant; scattered pyrite; pelmatozoan debris abundant; bryozoans including Sulcoretepora and fenestellids very common; some solitary rugose corals; some gastropods; articulate brachiopods including Athyris abundant, generally disarticulated, generally oriented parallel to bedding, shells preserved; contact with underlying interval gradational.

455'-460' Limestone, argillaceous, olive gray to medium gray, medium- to fine-grained (calcarenite-calcilutite), dense; wavy shaly laminations or partings abundant; some scattered pyrite, bryozoans, including fenestellids and Sulcoretepora abundant; pelmatozoan debris abundant; occasionally replaced with sphalerite; articulate brachopods abundant, shells preserved, generally oriented parallel to bedding, generally disarticulated; contact with underlying interval gradational.

460'-465' Limestone, argillaceous, light gray to light olive gray, fine- to medium-grained (calcilutite-calcarenite), dense; wavy, shaly partings abundant; some horizontal burrows; bryozoans, including fenestellids and Sulcoretepora abundant; pelmatozoan debris abundant; some Cladopora; articulate brachiopods very common, shells preserved, generally parallel to bedding; contact with underlying interval gradational.

465'-470' Limestone, argillaceous, light gray to light olive gray, mottled with short, darker gray streaks, fine- to medium-grained (calcilutite-calcarenite), dense; shaly partings abundant; some pyrite; discontiuty surface at 466'5"; diagonal burrows filled with calcarenite at about 466'9"; pelmatozoan debris abundant; bryozoans, including fenestellids and Sulcoretepora abundant; articulate brachiopods abundant, shells preserved, generally oriented parallel to bedding; contact with underlying interval gradational.

470'-475' Limestone, argillaceous, light olive gray to light gray, mottled with short, darker gray streaks, fine-grained (calcilutite), dense; thin shaly partings abundant; some pyrite;

pelmatozoan debris abundant; digitate stromatoporoids very common; articulate brachiopods abundant, shells preserved, generally oriented parallel to bedding; contact with underlying interval gradational.

475'-480' Limestone, argillaceous, light olive gray to light gray, mottled with short, darker gray streaks, fine-grained (calcilutite), dense; thin shaly partings abundant; pelmatozoan debris abundant; bryozoans including fenestellids and Sulcoretepora abundant; articulate brachiopods very common; contact with underlying interval gradational.

480'-485' Limestone, argillaceous, light bluish gray to light olive gray, mottled with short, darker gray streaks, fine-grained (calcilutite), dense; some scattered pyrite; some vertical, calcite-filled, narrow fractures; wavy, shaly partings very common; some small, horizontal burrows; pelmatozoan debris abundant; some rugose corals; some bryozoans, including fenestellids; articulate brachiopods, including productids, abundant; contact with underlying interval gradational.

485'-490' Limestone, argillaceous, mottled light gray, light bluish gray and light olive gray, fine-grained (calcilutite), dense; wavy, shaly partings abundant, some pyrite; Tentaculites abundant; bryozoans abundant, including fenestellids and Sulcoretepora?, some coral; pelmatozoan debris abundant; digitate stromatoporoids abundant; articulate brachiopods abundant, shells preserved, generally oriented parallel to bedding; contact with underlying interval gradational.

490'-495' Limestone, argillaceous, light gray, fairly fine-grained (calcilutite), dense; wavy shaly partings abundant; some pyrite; fenestellid bryozoans abundant; pelmatozoan debris abundant; digitate stromatoporoids abundant; some coral; some inarticulate brachiopods; articulate brachiopods, shells preserved, fossils generally fragmentary, oriented approximately parallel to bedding, commonly grayish to white in color; contact with underlying interval gradational.

495'-500' Limestone, argillaceous, light gray but olive black horizon around 495'7", medium-grained (calcarenite), fairly dense; some pyrite, wavy shaly laminae abundant; stylolites common; pelmatozoan debris abundant fenestellid bryozoans abundant; some conularid fragments; coral common; digitate stromatoporoids abundant; articulate brachiopods, including Atrypa, abundant, fossils commonly dark colored, some replaced with pyrite, generally oriented parallel to bedding; contact with underlying interval sharp.

500'-503'6" Limestone, slightly argillaceous, light olive gray to olive gray, medium-grained (calcarenite), fairly dense; some scattered pyrite crystals; corals, including Hexagonaria, abundant, especially around 500'6"; pelmatozoan debris abundant; articulate brachiopods, including Atrypa, abundant, shells preserved

but generally poorly, oriented approximately parallel to bedding; contact with underlying interval sharp unconformity.

Wapsipinicon Formation
Davenport-Spring Grove Members

503'6"-505' Limestone, light olive gray to light gray, very fine-grained (calcilutite) some open "birdseye" porosity but otherwise dense; brecciated, spaces between clasts filled with sandy material; some 1" pyrite nodules; abundant low relief stylolites; contact with underlying interval gradationa.

505'-510' Limestone, yellowish gray to light gray to medium olive gray, very fine-grained (calcilutite), some open "birdseye" porosity but otherwise dense; some vertical, calcite-filled fractures; stylolites, with up to 1" relief, abundant; gypsum? crystals at 509'6"; some medium bluish gray to light bluish gray shaly partings; scattered pyrite crystals throughout and larger pyrite nodules near top; contact with underlying interval gradational.

510'-515' Limestone, medium olive gray to dark olive brown to light olive gray, very fine-grained (calcilutite), some "birdseye" porosity but otherwise fairly dense; somewhat laminated; some brecciation; some stylolites with up to .5" relief; some calcite-filled fractures; medium bluish gray shale parting at 512'; contact with underlying interval gradational.

515'-520' Limestone, medium olive gray to dark olive brown, very fine-grained (calcilutite), dense; somewhat laminated; calcite-filled "birdseye" porosity; some calcite-filled vertical fractures; some scattered pyrite; some stylolites; minute pores near top; contact with underlying interval gradational.

520'-525' Limestone; medium olive gray to dark olive brown, fine-grained (calcilutite), dense, somewhat laminated; stylolitic, some with over 2" relief; contact with underlying interval gradational.

525'-530' Limestone, pinkish gray to light yellowish gray to medium olive gray, very fine-grained (calcilutite), dense; fine-intraclastic in part; stylolites abundant, some with up to 1" relief; contact with underlying interval gradational.

530'-534' Limestone, medium olive gray to light yellowish gray, very fine-grained (calcilutite), vuggy porosity with vugs up to 2"; vugs lined with calcite crystals and some with very fine pyrite; stylolites with low relief abundant; quartz nodule? at base; contact with underlying unit sharp.

534'-535'9" Dolostone, slightly calcitic, light bluish gray to medium light gray, mottled in part, fine-grained, fairly dense except for

unfilled fractures between clasts; thin medium bluish gray, silty to sandy, argillaceous dolostone at base; some calcite-filled fractures; laminated and brecciated in part; contact with underlying unit sharp.

Kenwood Member

535'9"-540' Claystone, slightly calcitic to dolomitic to argillaceous dolostone, silty; very light gray to light bluish gray, fairly dense; some medium dark gray, rounded spots of uncertain origin at about 539'; brecciated near 536'; contact with underlying interval gradational.

540'-545' Claystone, slightly calcitic to dolomitic, sandy to silty in part, swirled light bluish gray to very light gray to light olive gray, fairly dense; some small intraclasts; some scattered pyrite; crinkly laminae near top; contact with underlying interval gradational.

545'-550' Claystone, very sandy, slightly calcitic to dolomitic, swirled light bluish gray to greenish gray to very light gray, fairly dense; some small intraclasts; some scattered pyrite crystals; contact with underlying interval gradational.

550'-555' Siltstone to claystone, dolomitic, somewhat swirled, light bluish gray to pale greenish gray, moderately dense; intraclastic near top; some pyrite; slightly calcitic and sandy near top; contact with underlying interval gradational.

555'-558'3" Siltstone, dolomitic?, somewhat swirled light bluish gray to greenish gray, moderately porous; intraclastic at top; fractures near top filled with calcite, some pyrite-lined burrows; thin intraclastic interval at base; contact with underlying unit fairly sharp.

Galena Group?

558'3"-565' Dolostone, medium light gray to light gray, fine- to medium-grained, moderately porous (intragranular, fossil moldic and vuggy with vugs up to .5"), stylolites with over 1" relief very common; nearly vertical fractures filed with dolomite?; some pyrite in vugs; calcite partially fills some vugs; gastropods very common; brachiopods very common.

565'-570' Dolostone, yellowish gray to light olive gray to medium gray, medium- to fine-grained, porous to dense, porosity includes intragranular, fossil moldic and vuggy (over 1"); stylolites with over 1" relief very common; brownish gray horizontal burrows abundant; gastropods abundant; pelmatozoan debris

abundant; articulate brachiopods including strophomenids very common; fossils preserved as internal and external molds.

570'-575' Dolostone, yellowish gray to light olive gray to light gray, medium-grained, porous, including intragranular, fossil moldic and vuggy (over 1"); some stylolites with up to .5" relief; some open fractures; brownish-gray horizontal burrows abundant; Hormotoma-like gastropods abundant; articulate brachiopods abundant; fossils preserved as internal and external molds, no obvious orientation; some pyrite in burrows and fossil molds.

575'-583' Dolostone, yellowish gray to light olive gray, medium-grained, porous, including intragranular, fossil moldic and vuggy (to 1"); some stylolites; Hormotoma-like gastropods abundant; articulate brachiopods abundant; brownish gray burrows very common; fossils preserved as internal and external molds; no obvious orientation; stylolites with over 1.5" relief; some patches of pyrite.

H-28 Core
SE 1/4, SE 1/4, Sec. 22, T. 65N., R. 5W.
Lee County, Iowa
El. 576'; T.D. 697'

McCraney Formation

-315' Limestone, light olive gray alternating with more dolomitic medium brownish gray layers; very light gray near top, very fine- to medium-grained, dense, petroliferous odor when broken; alternating layers have irregular, wavy contacts some vertical, calcite-filled fractures and voids; megaspores abundant; articulate brachiopods, including spiriferids and chonetids, abundant; pelmatozoan debris very common.

315'-320' Limestone, more or less alternating layers of medium brownish gray, light olive gray and yellowish gray, very fine-grained, dense; somewhat laminated; some calcite-filled fractures, megaspores abundant; spiriferid brachiopods very common; some pelmatozoan debris; fossil debris may occur in irregular zones; contact with underlying interval gradational.

320'-326' Limestone, silty?, light gray to olive gray, very fine- to medium-grained, dense, some medium olive gray, shaly intervals which may have abundant megaspores and chonetid brachiopods with relatively long, curved spines on the hinge; limestone appears laminated from about 320'-323'; some vertical fractures filled with fluorite? at about 321', which may terminate abruptly against slickenside?; some pelmatozoan debris, brachiopods, including rhynchonellids, very common, shells preserved and oriented parallel to bedding; contact with underlying unit fairly sharp and possibly unconformable.

English River Siltstone

326'-330' Siltstone, slightly calcitic to dolomitic, light olive gray to medium greenish gray fairly dense; bioturbated, some megaspores; contact with underlying interval gradational.

330'-335' Siltstone, slightly calcitic to dolomitic, medium greenish gray to olive gray to light olive gray, short, darker-colored streaks of uncertain origin common, fairly dense; somewhat bioturbated; contact with underlying interval gradational.

335'-340' Siltstone, calcitic, medium bluish gray to medium greenish gray, with short, darker-colored streaks as in overlying interval, fairly dense; horizontal, pyrite-filled burrows common; contact with underlying interval gradational.

340'-343'8" Siltstone, may be dolomitic and becomes calcitic toward the top of the interval, medium bluish gray to medium greenish gray; pyrite-filled burrows very common; some fenestellid bryozoans; bactritid at 340'7"; some articulate brachiopods, including Chonopectus at about 341'3"; fossils generally preserved as internal and external molds, but some brachiopods shells may be replaced with pyrite; contact with underlying unit gradational.

Maple Mill Formation

343'8"-345' Shale, somewhat sandy, medium bluish gray to medium greenish gray; pyrite-filled, horizontal burrows abundant; contact with underlying interval gradational.

345'-355' Shale, some sand, medium bluish gray to medium greenish gray; pyrite-filled horizontal burrows abundant; some megaspores; some fragmentary inarticulate brachiopods in upper part.

355'-360' Shale, medium bluish gray to medium greenish gray; pyrite-filled horizontal burrows abundant; some fish-teeth; contact with underlying interval gradational.

360'-370' Shale, somewhat sandy, medium bluish gray to medium greenish gray; some calcitic horizons at about 365' showing cone-in-cone structure; abundant pyrite-filled, horizontal burrows; some lingulid brachiopods in lower part.

370'-380' Shale, somewhat sandy, medium bluish gray; to medium greenish gray; scattered pyrite especially in calcitic sandy laminae in upper part; pyrite-filled horizontal burrows very common; some vertical burrows in upper part; some conodonts; some articulate brachiopods; contact with underlying interval gradational.

380'-385' Shale, sandy and calcitic near top; medium to dark bluish gray to medium greenish gray; pyrite-lined, horizontal burrows very common; some megaspores; contact with underlying interval gradational.

385'-389'8" Shale, sandy, medium to dark bluish gray; abundant pyrite-lined horizontal burrows; contact with underlying interval sharp.

389'8"-395' Shale, dark olive gray becoming medium gray to medium olive gray towards top, some medium greenish gray layers up to 2" thick; some slightly calcitic lenses and whitish calcitic laminae; some fine, scattered pyrite; some slickensides; megaspores very common; conodonts, including Palmatolepis, common; some carbonaceous (plant?) matter.

395'-400' Shale, olive black to brownish black, alternating with medium greenish gray shales (up to 10" thick), some whitish calcitic laminae and lenses associated with greenish gray shales; some

pyritic laminae; scattered pyrite nodules; megaspores abundant; some carbonaceous (plant?) material; some conodonts; fish tooth at 397'4"; contact with underlying interval gradational.

400'-406' Shale, olive black to brownish black to medium dark gray, some greenish gray shale layers (up to 2.5" thick), reddish laminae may separate greenish gray shales and darker shales; pyrite nodules common; some whitish calcitic and pyritic laminae; some pyrite-filled burrows; megaspores abundant; conodonts, including Palmatolepis, common; some carbonaceous (plant?) material; fish? fragment at about 401'6"; contact with underlying interval sharp.

406'-415' Shale, medium gray to medium dark gray to olive gray; some whitish calcitic and pyritic laminae in upper part; some reddish, sideritic, slightly calcitic in upper part; scattered pyrite; megaspores abundant; conodonts throughout but abundant at about 414'4"; some lingulids; contact with underlying interval gradational.

415'-420' Shale, medium olive gray, to medium gray to olive black near top; some whitish calcitic and pyritic laminae; some reddish, sideritic, slightly calcitic laminae; scattered pyrite; some pyrite-filled horizontal burrows; some conodonts including Palmatolepis; some linguilids; ctenostome bryozoan at about 418'5"; contact with underlying interval gradational.

Note-interval around 420' apparently out of place and probably belongs around 422'9".

420'-430' Shale, medium gray to olive gray; some whitish calcitic laminae in lower part; some reddish, sideritic, calcitic and pyritic laminae in upper part; scattered pyrite; some slickensides coated with calcite in lower part; some horizontal burrows; megaspores abundant; some conodonts including Palmatolepis and Ancyrodella; some lingulid brachiopods; contact with underlying interval sharp.

430'-435' Shale, medium greenish gray to medium olive gray; some reddish, sideritic, calcitic laminae; some pyrite; some horizontal burrows; megaspores common; some conodonts, including Palmatolepis; some scolecodonts.

435'-440' Shale, medium gray to medium dark gray to greenish gray; scattered pyrite; some narrow, pyrite-filled, horizontal burrows; megaspores common; some conodonts; contact with underlying interval gradational.

440'-445' Shale, medium light gray to medium gray to medium greenish gray; some reddish, sideritic, calcitic laminae; some whitish calcitic laminae; scattered pyrite; some horizontal burrows; some megaspores; some conodonts; contact with underlying interval gradational.

445'-450' Shale, medium light gray to medium gray to medium olive gray; some whitish calcitic laminae; scattered pyrite; megaspores abundant; scattered conodonts, including Plamatolepis; contact with underlying interval gradational.

450'-455' Shale, medium greenish gray; some calcitic laminae; scattered pyrite; some burrows; abundant megaspores; contact with underlying interval sharp.

455'-460' Shale, medium light gray to medium gray interbedded with greenish gray shale; some reddish, sideritic, calcitic laminae; scattered pyrite; burrows in darker shales filled with greenish gray shale; megaspores abundant; conodonts abundant, including Palmatolepis at about 458'; contact with underlying interval gradational.

460'-465' Shale, medium gray; some reddish, sideritic calcitic laminae; scattered pyrite; megaspores abundant; contact with underlying interval gradational.

465'-470' Shale, medium gray to olive gray; some reddish sideritic, calcitic laminae; scattered pyrite; megaspores abundant; contact with underlying interval gradational.

470'-486'11" Shale, mottled olive gray and greenish gray, medium gray in upper part; some reddish, sideritic, calcitic laminae; scattered pyrite; megaspores abundant in lower part becoming scattered in upper part; inarticulate brachiopods in upper part; conodonts including Palmatolepis around 476', 478' and in upper medium gray shale; some scolecodonts in upper part.

486'11"-490' Shale, medium gray to olive gray; some reddish, sideritic, calcitic laminae; scattered pyrite; scattered megaspores.

490'-510' Shale, medium gray; some reddish, sideritic, calcitic laminae; scattered pyrite; some calcitic laminae are diagonal to other laminae (e.g. at 497'); scattered megaspores; some scolecodonts near top of interval.

510'-515' Shale, olive gray to medium gray toward top, some light bluish gray laminae; some calcitic laminae generally with a reddish color due to siderite; scattered pyrite; scattered megaspores.

515'-525' Shale, olive black, greenish gray in part; some calcitic laminae, commonly with a reddish color due to the presence of siderite; scattered pyrite; scattered megaspores; some inarticulate brachiopods; conodonts including Palmatolepis at about 524'4"; conodont cluster at 519'; contact with underlying interval gradational.

525'-528'3" Shale, olive gray, greenish gray from 526'1" to 526'5", calcitic at base; scattered pyrite; scattered coaly material; scattered megaspores; conodonts, including Palmatolepis at about 527'2"; contact with underlying interval fairly sharp but somewhat interbedded.

528'3"-537'5" Shale, dolomitic?, greenish gray; scattered pyrite crystals and nodules; horizontal burrows common to abundant and may be pyrite-filled in the upper part; scattered megaspores; contact with underlying interval sharp and irregular.

Cedar Valley Formation
Coralville Member

537'5"-545' Limestone, light brownish gray; medium-grained, dense; some intraclasts of finer-grained, less dense, light grayish brown limestone around 542'; wavy laminations common; some pyrite; some vertical fractures filled with calcite; some stylolites; some large, calcite-filled vugs; discontinuity surface at 540'6"; pelmatozoans common to abundant; some fish fragments; some stromatoporoids; some articulate brachiopods, including Atrypa?, may be articulated or disarticulated, generally oriented parallel to bedding; contact with underlying interval gradational.

545'-550' Limestone, dolomitic?, light brownish gray, medium-grained, fairly dense; wavy laminations common; chertified in parts; some narrow, vertical, calcite-filled fractures; some pyrite; some calcite-filled vugs (up to 1.5"); articulate brachiopods, including spiriferids, at about 559'3", generally disarticulated and oriented parallel to bedding; pelmatozoan debris in parts; some fish-fragments; contact with underlying interval gradational.

550'-556'7.5" Limestone, dolomitic, light brownish gray, medium-grained, fairly dense; some chertified areas; some calcite-filled vugs associated with cherty areas; wavy laminations abundant; some fractures filled with calcite; pelmatozoan debris abundant in parts; contact with underlying unit sharp, unconformable.

Rapid Member

556'7.5"-560' Limestone, slightly argillaceous, very light- to light-gray, fine- to medium-grained; some weakly developed stylolites; some pyrite; pelmatozoan debris abundant; Tentaculites abundant; some thin bryozoans; some articulate brachiopods, including Cupularostrum?, generally disarticulated and oriented parallel to bedding; contact with underlying unit gradational.

560'-565' Limestone, argillaceous, dolomitic, very light- to medium-gray, fine- to medium-grained (largely calcilutite to skeletal calcarenite); somewhat laminated; minor amounts of glauconite; weakly developed stylolites; some pyrite; articulate brachiopods, including chonetids, small spiriferids and Orthospirifer, abundant, generally disarticulated and with variable

orientation; burrows common; blade-like bryozoans abundant; some fish fragments; some pelmatozoan debris; Tentaculites common; some coral, including a small tabulate in life position, near top, contact with underlying interval gradational.

565'-570' Limestone, dolomitic, slightly argillaceous, light- to medium-gray, fine-grained (calcilutite) to medium-grained (calcarenitic) in part, dense; somewhat laminated; some pyrite; vertical burrows common; ostracodes abundant, commonly filling burrows and occurring in small horizontal lenses, pelmatozoan debris common; some cylindrical bryozoans oriented horizontally; articulate brachiopods common to abundant, including Chonetes coquinas near 565'6", generally disarticulated and oriented parallel to bedding.

570'-575' Limestone, light- to medium-gray, somewhat mottled with darker gray, fine-grained (calcilutite) to medium-grained (calcarenite) in part, dense; some weakly developed stylolites; some inclined fractures; some pyrite; some vertical burrows; Tentaculites very common; some bryozoans, including Sulcoretepora; articulate brachiopods common, including Strophodonta?, and Orthospirifer?, disarticulated, oriented parallel to bedding; inarticulate brachiopods including orbiculoids, present.

Solon? Member

575'-585' Limestone, light- to medium-brownish gray, fine- to medium-grained, dense; some vertical fractures; some pyrite; weakly developed stylolites; some slickensides in lower part; some dark gray mottling near base; pelmatozoan debris abundant; bryozoans, including fenestellids and Sulcoretepora common; some cystiphyllid corals oriented horizontally; Tentaculites abundant; some ostracodes; articulate brachiopods, including Strophodonta?, productids, and Schizophoria, very common, disarticulated, and generaly oriented parallel to bedding.

585'-596' Limestone, light- to medium-brownish gray, somewhat mottled from 590'-596' due to silicification, fine- to medium-grained, dense; weakly developed stylolites; some calcite-filled fractures in upper part; some vugs filled with quartz crystals in upper part; liesegang? structures in upper part; some pyrite throughout; pelmatozoan debris abundant; bryozoans, including fenestellids, and Sulcoretepora, very common; sponge spicules in silicified portions in upper part; corals, including Cladopora common, generally oriented horizontally; contact with underlying interval gradational.

596'-601'11" Limestone, light- to medium-brownish gray, fine- to medium-grained, dense; some stylolites; some silicification; some

small horizontal burrows; pelmatozoan debris common; bryozoans, including Selcoretepora?, fenestellids and some small stick-like forms common; some scolecodonts; some corals, including cystiphyllids and Cladopora, in lower part, not in life position; some gastropods near base; articulate brachiopods, including Atrypa and productids, very common, generally oriented parallel to bedding; contact with underlying interval gradational.

601'11"-603'1" Dolostone, light- to medium-brownish gray, fine- to medium-grained, fairly dense; some pyrite; articulate brachiopods abundant, generally not articulated and oriented parallel to bedding; nature of contact with underlying interval unknown.

603'1"-607' Limestone, light- to medium-brownish gray, fine- to medium-grained, dense, somewhat mottled due to irregular silicified patches, some liesegang? rings in parts of silicified patches; some pyrite; stylolites; some scolecodonts; bryozoans, including fenestellids, Sulcoretepora?, and stick-like forms common; pelmatozoan debris common; some corals (on sides); articulate brachiopods abundant, including productids, Strophodonta, Orthospirifer and other spiriferids, commonly articulated and parallel to bedding.

607'-615' Limestone, argillaceous, medium brownish gray, medium- to coarse-grained (calcarenite), dense; stylolites common; some pyrite and limonite; corals, including cystiphyllids and other rugosans; stromatoporoids common; pelmatozoans common; bryozoans, including Sulcoretopora, common; articulate brachiopods, including productids and spiriferids, very common, commonly articulated; contact with underlying interval gradational.

615'-621'3" Limestone, argillaceous, medium brownish gray, medium- to coarse-grained (calcarenite), dense; stylolites common; some horizontal burrows; pelmatozoan debris abundant; corals, including cystiphyllids?, common, not in life position; articulate brachiopods, including Atrypa, abundant, generally disarticulated and oriented parallel to bedding.

621'3"-627'6" Limestone, argillaceous, medium gray, fine- to medium-grained, dense; some glauconite; some wavy laminations in part; stylolites common throughout; pelmatozoan debris common; bryozoans, including Sulcoretepora? abundant; articulate brachiopods common, often articulated; most fossils apparently abraded.

627'6"-630'6" Limestone, slightly argillaceous, light- to medium gray, medium- to fine-grained, dense; wavy laminations in part; some calcite-filled vugs; minor areas of brecciation; some slickensides; some burrows; pelmatozoan debris abundant; megaspores common; some inarticulate brachiopods; articulate brachiopods, including Atrypa and Strophodonta? abundant, generally disarticulated.

Wapsipinicon Formation
Davenport-Spring Grove Members

630'6"-652' Limestone, pale yellowish brown, very fine-grained (calcilutite), dense; stylolitic; some calcite-filled fractures, brecciated from 646'-648' and 649'-649'6".

652'-653'6" Limestone, dark yellowish brown, very fine-grained (calcilutite), fairly dense; some darker laminae, petroliferous odor when broken.

Ordovician
Galena Group

653'6"-697' Dolostone, light yellowish brown mottled with light gray, coarse- to medium-grained, porous (vuggy, fossil moldic), fossiliferous, sandy material in fractures at top.

H-33 Core
SW 1/4, NW 1/4, NE 1/4, Sec. 15, T. 71N., R. 2W.
Des Moines County, Iowa
El. 732'; T.D. 759'

Cedar Valley Formation
Coralville Member

241'6"-245' Limestone, yellowish gray, somewhat mottled, medium-grained, dense; some argillaceous partings; some stylolites; some near vertical fractures filled with calcite; some burrows; pelmatozoan debris abundant; bryozoan fragments abundant; some corals; some stromatoporoids; articulate brachiopods, including Orthospirifer?, some articulated; fossils generally oriented parallel to bedding.

245'-250' Limestone, argillaceous, yellowish gray to pale yellowish brown, medium-grained (calcarenite), dense; some stylolites; some bioturbation; pelmatozoan debris abundant; bryozoans very common including Sulcoretepora and encrusting forms; corals, including Cladopora and Hexagonaria, common; Tentaculites common; some domal stromatoporoids; articulate brachiopods very common, generally disarticulated, and parallel to bedding; fossils generally whitish to light-gray, shells preserved.

250'-255' Limestone, argillaceous, medium yellowish brown to dark yellowish brown to medium grayish orange, medium-grained (calcarenite), dense; stylolites abundant; some argillaceous partings; some voids (up to .75") and some calcite-filled vugs (up to 1"); some fractures; coral, including Hexagonaria and Favosites, common; pelmatozoan debris abundant; articulate brachiopods abundant, shells preserved, generally oriented parallel to bedding.

255'-256'6" Limestone, very pale orange to yellowish gray to dark yellowish brown, medium-grained (calcarenite), dense; some horizontal burrows; pelmatozoan debris abundant; some stick-like stromatoporoids;; some corals, including Favosites; contact with underlying interval sharp discontinuity surface.

Rapid Member

256'6"-260' Limestone, argillaceous, light olive gray, dense; stylolites abundant; some pyrite; horizontal burrows abundant, articulate brachiopods, including chonetids?, abundant, generally disarticulated and oriented parallel to bedding, shells preserved, contact with underlying interval gradational.

260'-265' Limestone, argillaceous, light olive gray to light gray, fine-grained (calcilutite), dense; some pyrite; horizontal burrows very common; bryozoans, including Sulcoretepora and encrusting forms abundant; pelmatozoan debris abundant; Tentaculites at 261'8"; articulate brachopods, including Atrypa Chonetes and Cyrtina, abundant; generally disarticulated and oriented parallel to bedding; shells generally white and gray in color; brachiopod "coquina" at 263'6"-264'8"; contact with underlying interval gradational.

265'-270' Limestone, argillaceous, light gray to light bluish gray, fine-grained (calcilutite), dense; scattered pyrite cubes; horizontal and vertical burrows abundant, some lined with pyrite; some coral, including rugose forms; bryozoans, including Sulcoretepora, abundant; pelmatozoan debris common; articulate brachiopods, including Cyrtina, very common, generally oriented parallel to bedding and disarticulated; contact with underlying interval gradational.

270'-275' Limestone, argillaceous, pinkish gray to yellowish gray to light gray, fine-grained (calcilutite), dense; somewhat laminated around 271'2"; scattered pyrite throughout; pyrite-lined narrow, horizontal burrows abundant; pelmatozoan debris abundant; bryozoans including fenestellids, Sulcoretepora, and domal? forms, abundant; some trilobites; some articulate brachiopods, generally oriented parallel to bedding fossil shells preserved; contact with underlying interval gradational.

275'-280' Limestone, argillaceous, light olive gray to light gray, mottled with medium gray, fine-grained (calcilutite), dense; scattered pyrite cubes around 275'6"-277'2"; burrows abundant; pyritized sponge spicules common; pelmatozoan debris abundant; Tentaculites common; fenestellid bryozoans at 277'7"; articulate brachiopods abundant, including productid coquina at 277'1", shells preserved and generally oriented parallel to bedding; contact with underlying interval gradational.

280'-285' Limestone, argillaceous, light olive gray to light gray, mottled with medium gray, fine-grained (calcilutite), dense; argillaceous partings abundant; scattered pyrite; horizontal and vertical burrows abundant; pelmatozoan debris abundant; bryozoans, including Sulcoretepora and fenestellids, abundant; articulate brachiopods, including Spinatrypa?, abundant, shells preserved and generally oriented parallel to bedding; contact with underlying interval gradational.

285'-290' Limestone, argillaceous, light gray to pinkish gray to yellowish gray, fine-grained (calcilutite), dense; wavy argillaceous partings abundant; scattered pyrite; some small stylolites; pelmatozoan debris abundant; bryozoans, including Sulcoretepora and fenestellids, abundant; Cladopora at 287'2"; digitate stromatoporoids? common near base; articulate brachiopods abundant, shells preserved or may be partially replaced with pyrite, generally oriented parallel to bedding; contact with underlying interval gradational.

290'-295' Limestone, argillaceous, light gray to yellowish gray, fine-grained (calcilutite), dense; wavy argillaceous partings abundant; scattered pyrite, commonly in cubes and commonly associated with fossils; small discontinuity surface at 294'; pelmatozoan debris abundant; bryozoans, including Sulcoretepora and fenestellids, abundant; digitate stromatoporoids abundant; small corals, not in life position, around 294'; articulate brachiopods, including Cranenea?, abundant, shells preserved, generally oriented parallel to bedding; contact with underlying interval gradational.

295'-300' Limestone, argillaceous, yellowish gray to light olive gray, fine-grained (calcilutite) to medium-grained (calcarenite?), dense; wavy shaly partings abundant; some scattered pyrite; pelmatozoan debris abundant; stromatoporoids? common; bryozoans, including Sulcoretepora and fenestellids, very abundant; Aulopora common; articulate brachiopods abundant, may or may not be disarticulated, shells preserved, generally oriented parallel to bedding; contact with underlying interval gradational.

300'-305' Limestone, argillaceous, light gray to light olive gray, fine-grained (calcilutite), dense; wavy, argillaceous partings abundant; slickensides common; calcite-filled, near vertical fracture near base; some pyrite-lined burrows? at 303'9"; pelmatozoan debris abundant; small rugose corals common; bryozoans, including Sulcoretepora and fenestellids, very common; massive stromatoporoid at 302'2"; pyritized sponge? spicules at 303'9"; articulate brachiopods abundant, generally disarticulated, shells preserved, some may be partially pyritized, generally oriented parallel to bedding; contact with underlying interval gradational.

305'-310' Limestone, argillaceous, becoming dolomitic around 306', light gray to light olive gray, fine-grained (calcilutite) to medium-grained (calcarenite?), dense; nearly vertical, calcite-filled fractures abundant; wavy shaly partings abundant; scattered pyrite; some stylolites with up to .25" relief; fenestellids bryozoans abundant; pelmatozoan debris very common; fish fragments around 309'5"; rugose coral, on side, at base; articulate brachiopods common, shells preserved, generally oriented parallel to bedding; contact with underlying interval fairly sharp (stylolitic).

310'-314'5" Limestone, argillaceous, light gray to light olive gray to dark yellowish brown, medium-grained (calcarenite), dense; vertical, calcite-filled, hairline fractures abundant; wavy shaly partings abundant; low amplitude stylolites very common; 1" calcite-filled vug at 813'3"; favositid and cystiphyllid corals abundant, not in living position; pelmatozoan debris abundant; sheet-like stromatoporoids very common; articulate brachiopods very common, shells preserved, generally oriented parallel to bedding; contact with underlying unit sharp unconformity.

Wapsipinicon Formation
Davenport-Spring Grove Members

314'5"-318'8" Dolostone, medium yellowish-brown to light olive-gray, fine-grained, laminated, "pinhole" porosity in upper part tending to follow laminae, porosity may, in part, be due to gypsum molds, becomes very porous and brecciated at 316'; brecciated chert from 318'4"-318'8"; vertical, calcite-filled fracture crosses contact with overlying unit; lithology like that of overlying unit fills fracture at 314'9"; some pyrite, generally around fractures; calcite-filled vugs, approximately 1" at 316'2"; quartz sand? filled vug at 316'10"; 1.5" stylolites at about 318'; contact with underlying interval sharp (stylolitic).

318'8"-320' Limestone, slightly dolomitic? near top, medium yellowish brown, somewhat mottled, very fine-grained (calcilutite), dense; stylolites (up to 1") abundant; some brecciation with fractures filled with calcite, some fractures filled with light olive gray limestone; some pyrite along stylolite at 320'; several vugs (up to 1") at about 320' filled with geopetal "crystal silt" and blocky calcite; contact with underlying interval unknown.

320'-323'2" Limestone, yellowish gray to olive gray, very fine-grained (calcilutite), dense; somewhat brecciated; stylolites (up to .5") abundant; some vertical calcite-filled fractures; oolitic from 322'5"-323'2"; contact with underlying interval sharp (stylolitic).

323'2"-325'8" Dolostone, mottled pale yellowish brown to light grayish orange pink, fine-grained, fairly dense; brecciated; stylolites abundant; calcite-filled fractures very common; contact with underlying interval irregular (stylolitic in part).

325'8"-326'8" Limestone, medium-light gray to light olive gray, fine-grained (calcilutite), dense; stylolites (up to .5") very common.

326'8"-328'10" Dolostone, becoming more calcitic around 327'4"; pinkish gray to olive gray, fine-grained, dense; some large, nearly vertical, calcite-filled fractures; stylolites (less than .5") abundant; some dessication? cracks around 327'10"; somewhat laminated; some pyrite along laminae.

328'10"-335' Dolostone, moderate to dark yellowish brown in alternating laminae, pale yellowish brown below 330', fine- to medium-grained, porous, fine (intragranular) near top becoming more porous (gypsum? moldic) below 330'; some vertical calcite-filled fractures; calcitic in part; contact with underlying interval gradational.

335'-343'5" Dolostone, light olive gray and dark yellowish brown; fine- to medium-grained, gypsum? moldic and intragranular porosity; scattered fine-grained pyrite at 335'2"; some vuggy porosity from 335'3"-336'3", some pores filled with pyrite or calcite; lamniated in part; some nearly vertical fractures.

343'5"-352'1" Dolostone, laminated, some laminae calcitic, moderate- to dark-yellowish brown to grayish orange, fine- to medium-grained, fine vuggy porosity; strong petroliferous odor when broken; 2" zone of breccia with light gray matrix and medium gray clasts, both of dolostone, at top, contact between breccia and underlying dolostone sharp and wavy, clasts in breccia less than .5"; contact with underlying unit sharp unconformity.

Kenwood Member

352'1"-358'7" Dolostone, argillaceous, sandy, mottled light olive gray and greenish gray with medium dark gray streaks at top, becoming yellowish gray ahd slightly calcitic just below top; brecciated around 353'3"; possible discontinuity with pyrite nodules at 353'7"; scattered pyrite throughout; some subangular chert clasts (up to 1.25") at 355'8"; brecciated around 358'; contact with underlying interval unconformable.

Ordovician

Maquoketa Formation

358'7"-365' Siltstone, argillaceous, dolomitic?, light brownish gray to greenish gray, fine grained, fairly dense; pyrite scattered throughout; scattered phosphatic grains (nonskeletal?) around 361'10" to 365'; contact with underlying interval gradational.

365'- Siltstone, argillaceous, dolomitic?, light olive gray, fine-grained, fairly dense; nonskeletal? phosphatic grains very common; some horizontal burrows around 365'3" and 366'10"; inarticulate brachiopod fragment at 366'2".

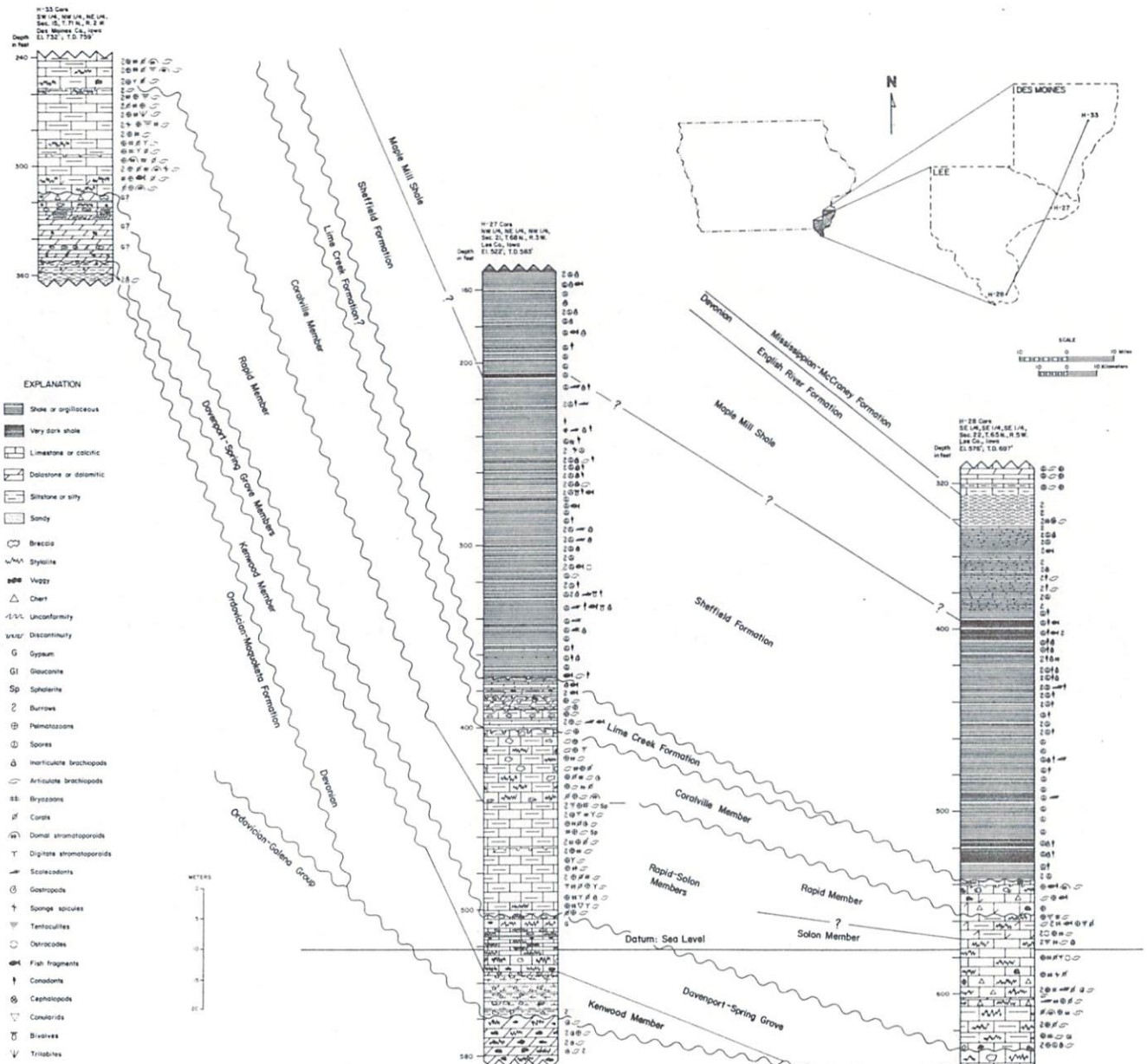

Figure 1. Lithostratigraphic relationships of three cores in Lee and Des Moines Counties, Iowa.