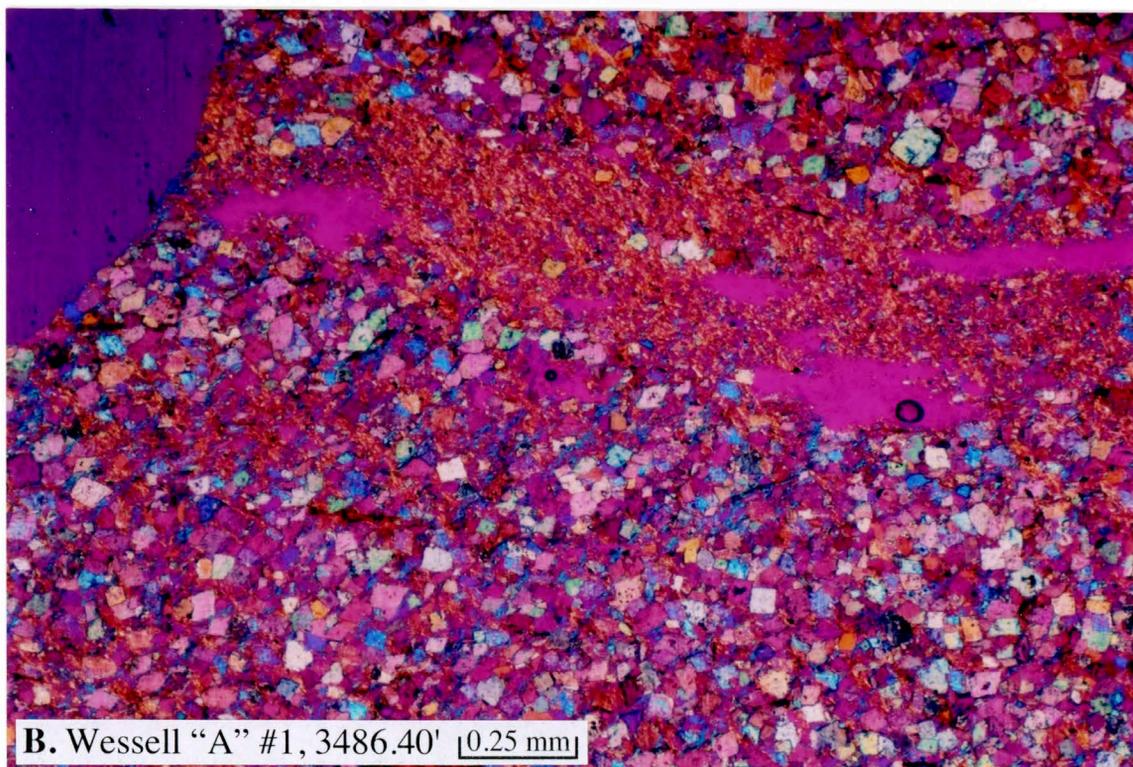
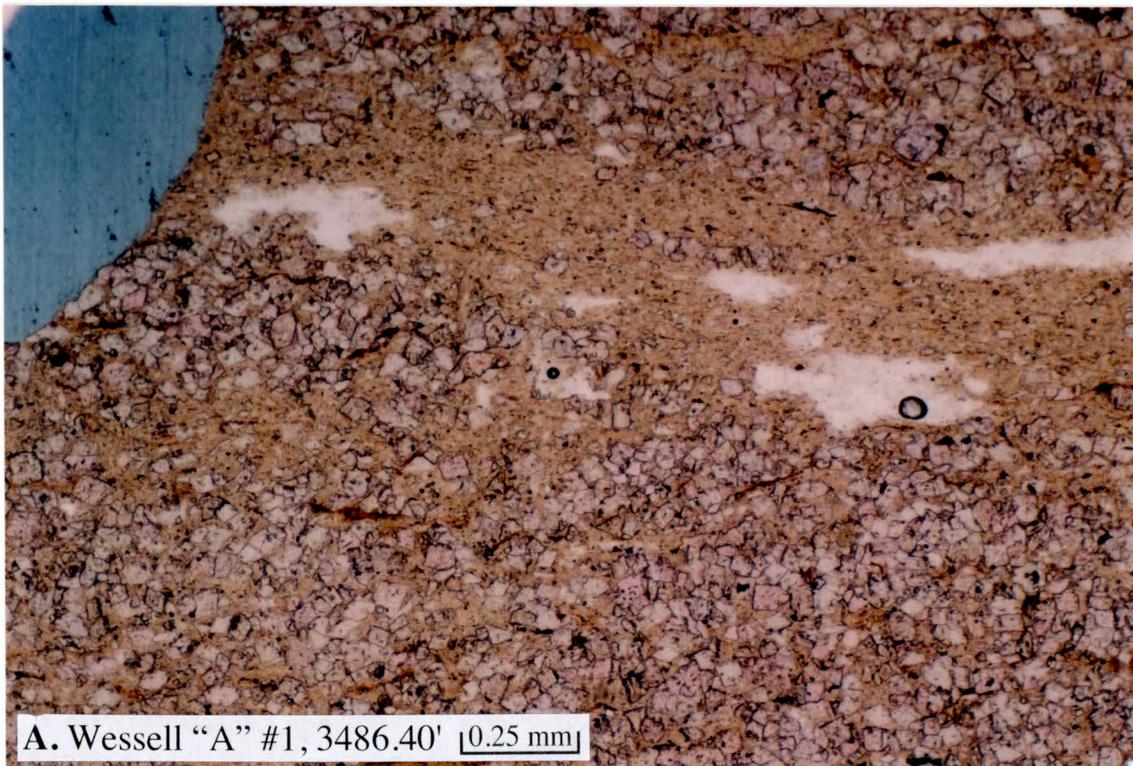
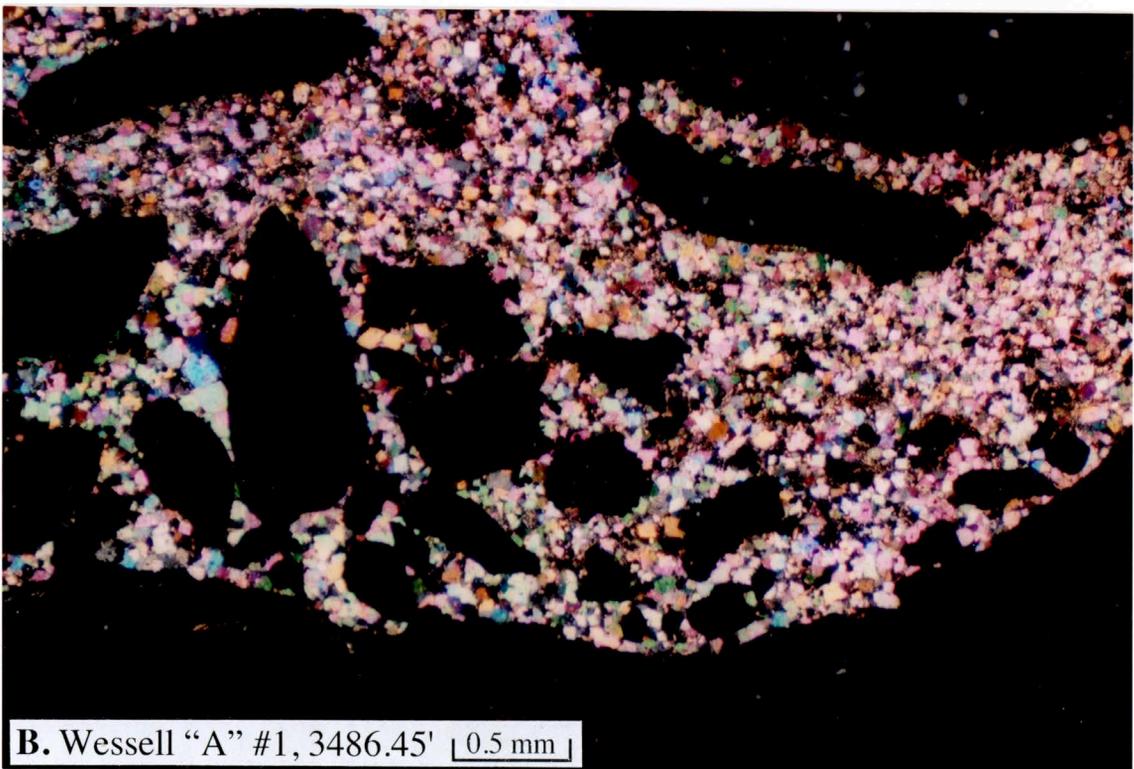
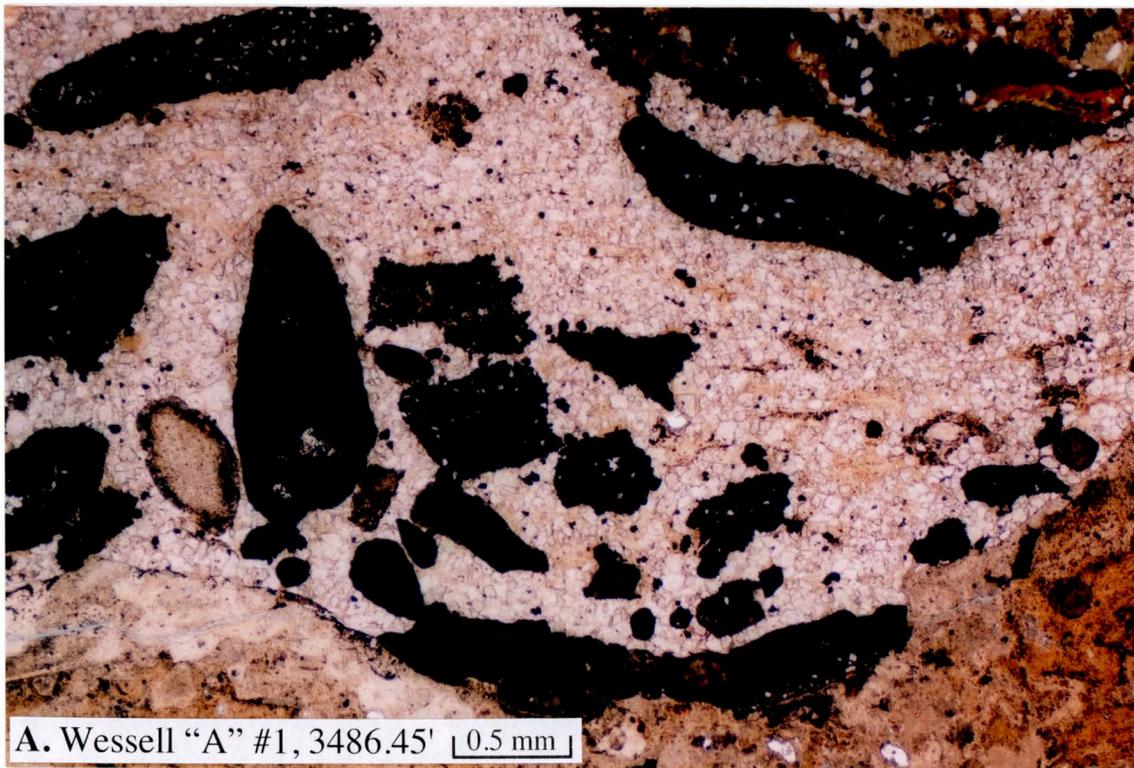


**Plate 1. Wessell "A" #1, 3486.40 ft: Contact of Maquoketa on Viola Formation
"Up" Notch in Basal Maquoketa Illitic and Dolomitic "Shale"**



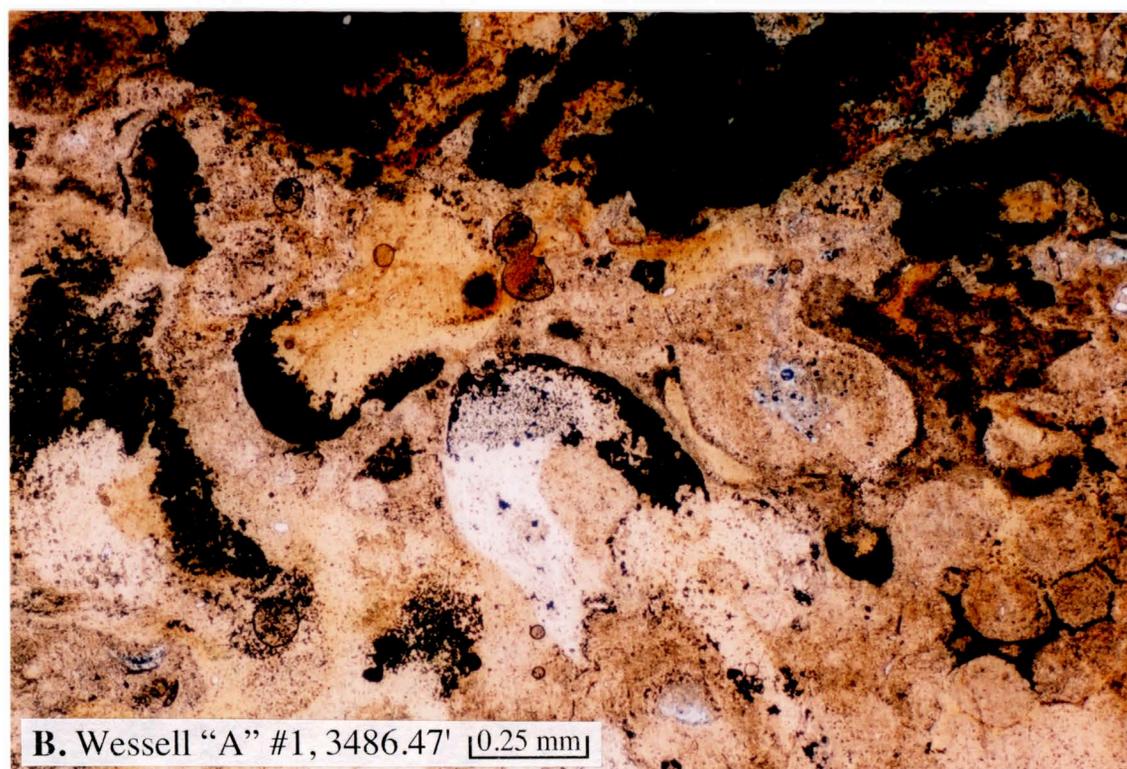
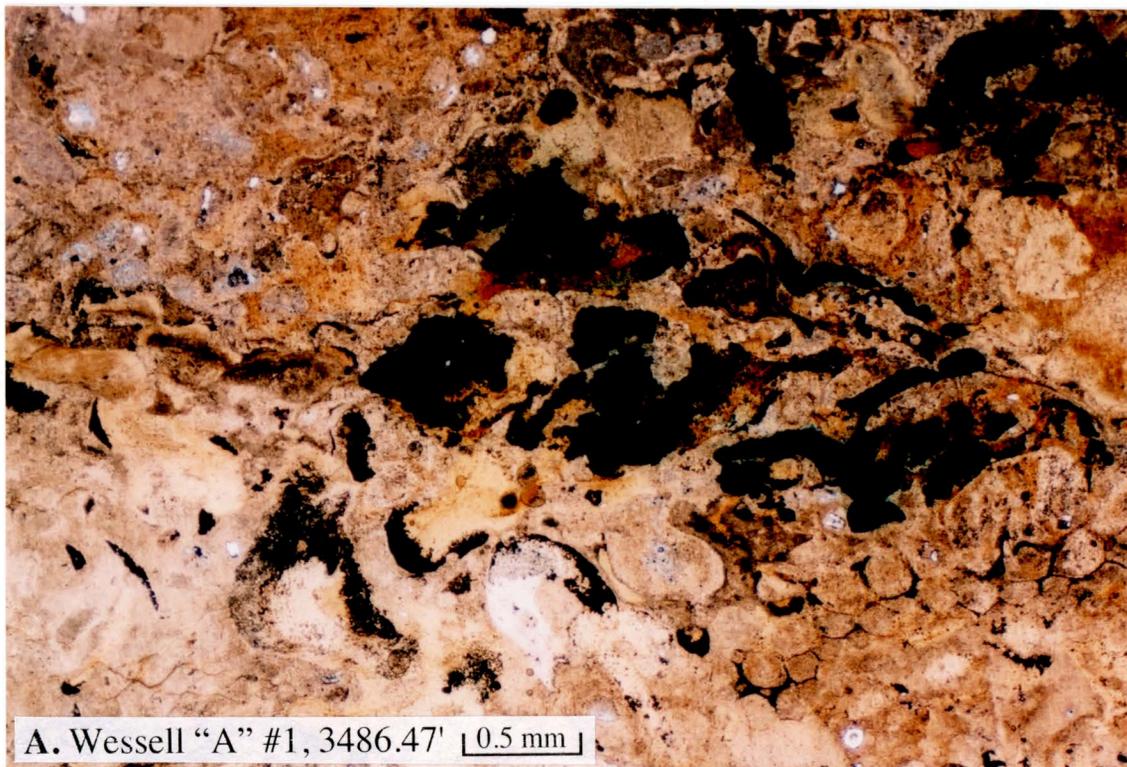
This well was drilled by Cities Service in 1983 in Sec. 24, T4S, R13E (Nemaha County, KS) to 3810 ft and completed as a dry hole with oil shows in the Simpson and Viola. The well was cored from 3476 to 3533 ft and again from 3685 to 3715 ft. The shallower core contains the contact of the Maquoketa Shale and dolomitized upper Viola that DST'd 2728 ft of salt water. These photomicrographs show the basal Maquoketa to be a shaly (illitic) dolomite mudstone with some plucking of the clays (white areas in Photo A). Two samples of this "shale" at 3480.5 and 3484.1 ft had just 0.56% and 0.5% TOC indicating poor source potential.

**Plate 2. Wessell "A" #1, 3486.45 ft: Contact of Maquoketa on Viola Formation
Pyritic Black Clasts in Very Finely Crystalline Dolomite on Phosphate Bed**



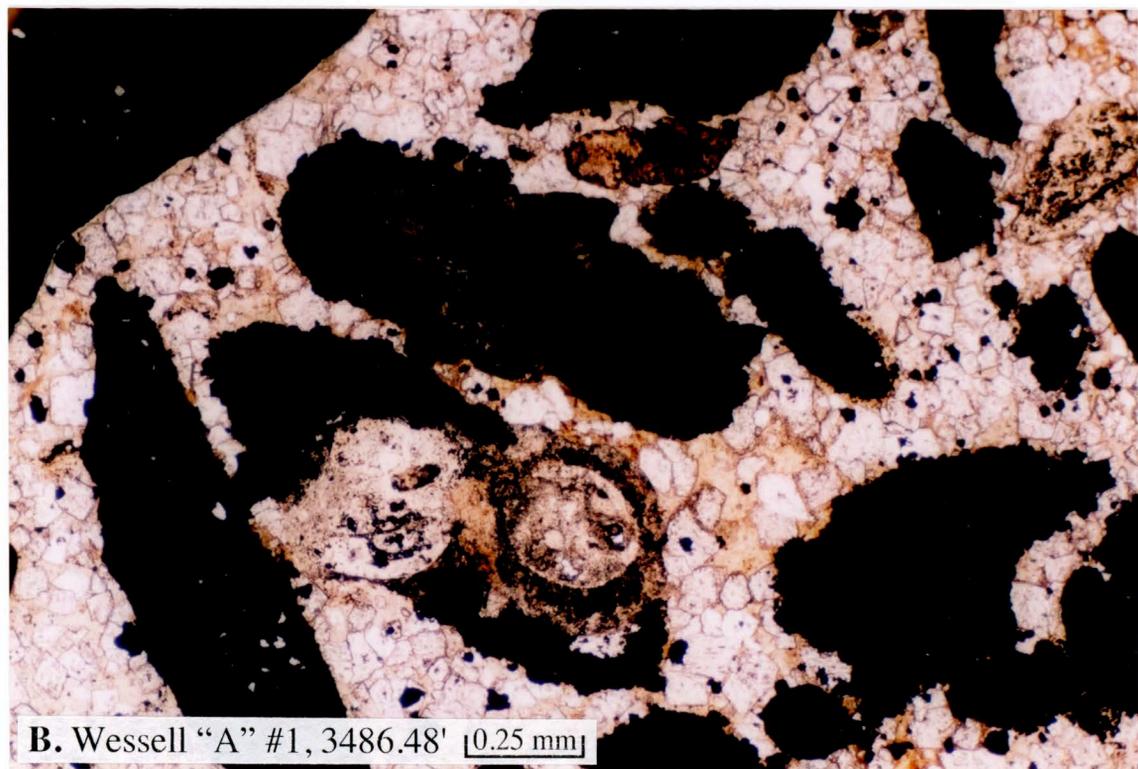
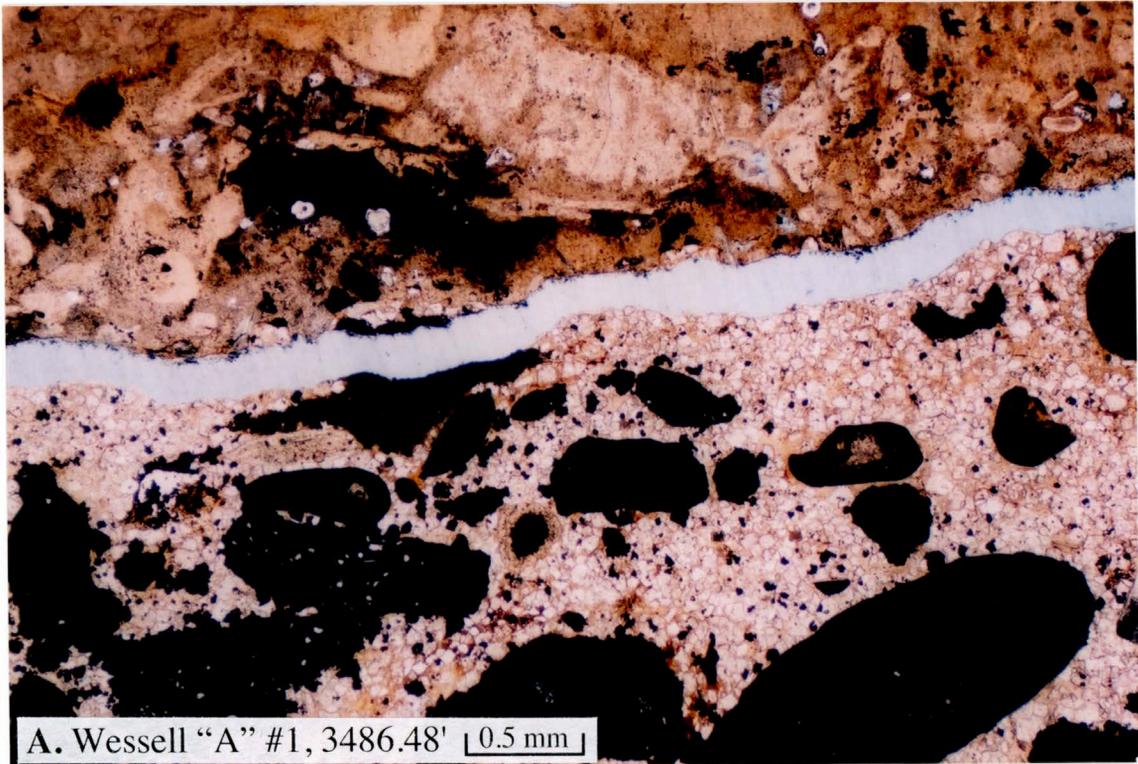
These photomicrographs show more of the basal Maquoketa just below the part of the sample seen in Plate 1. Here the rock consists of black clasts now composed of pyrite in a finely crystalline dolomite matrix with crystals identical to those shown in Plate 1. At the base of both photos is a phosphatic hardground (tan in Photo A; black (isotropic) in Photo B taken with crossed polarized light). A few of the clasts appear to be ripped up phosphatic debris, but most appear to have been derived from another lithology. This contact is a subtle angular unconformity representing perhaps several million years.

**Plate 3. Wessell "A" #1, 3486.47 ft: Phosphatic Cap on Viola Formation
Bed of Phosphatized Fossil Debris with Common Pyrite Replacement**



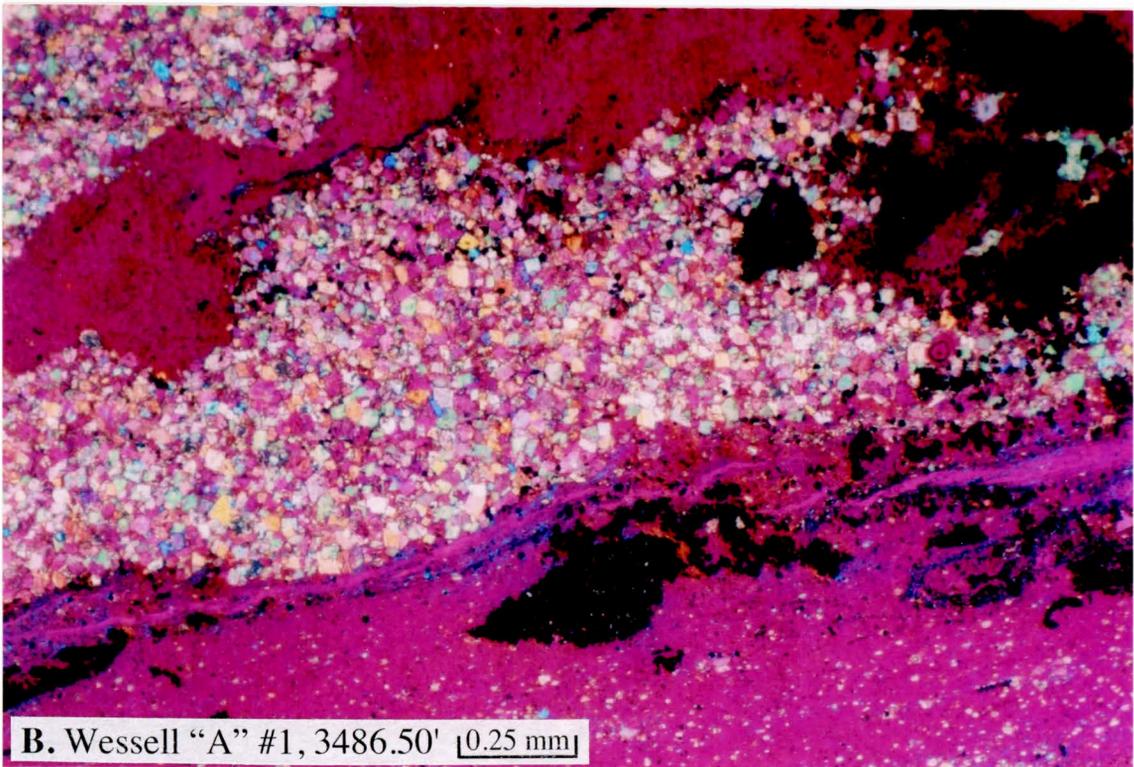
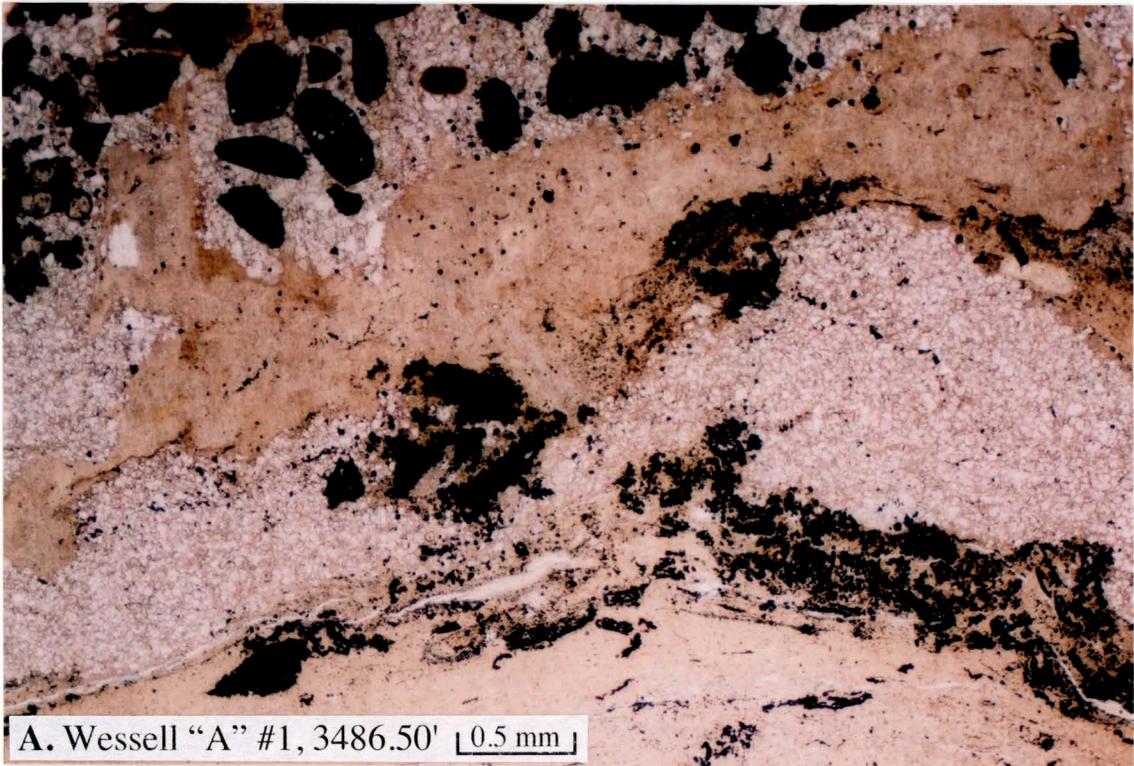
These photomicrographs show what I interpret as a phosphatic cap on the top of the Viola Formation. The phosphate has replaced assorted fossil fragments, mainly echinoderms, in a former wackestone to packstone. Pyrite (black) has also replaced some grains and phosphatic material. No quartz is present here. The phosphatic bed is interpreted as a submarine hardground deposited under sediment-starved conditions.

**Plate 4. Wessell "A" #1, 3486.48 ft: Uppermost Viola Formation
Contact Between a Phosphatic Bed (Top) and Pyritic Clasts in Fine Dolomite**



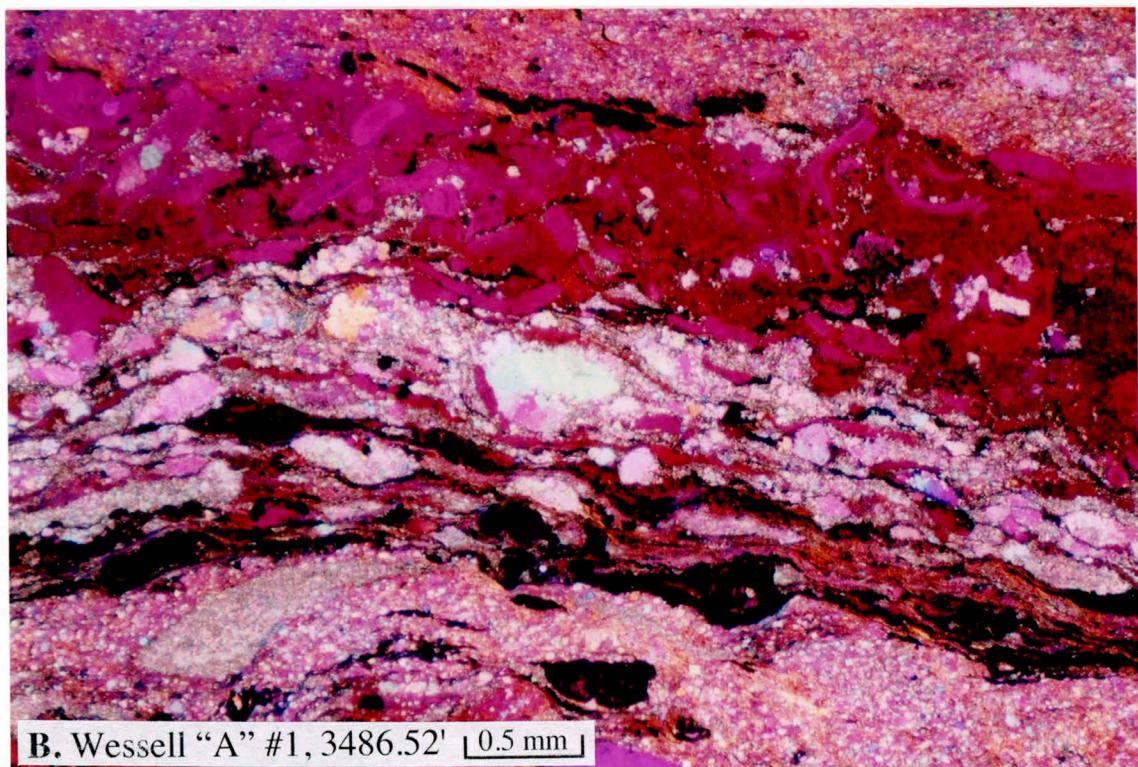
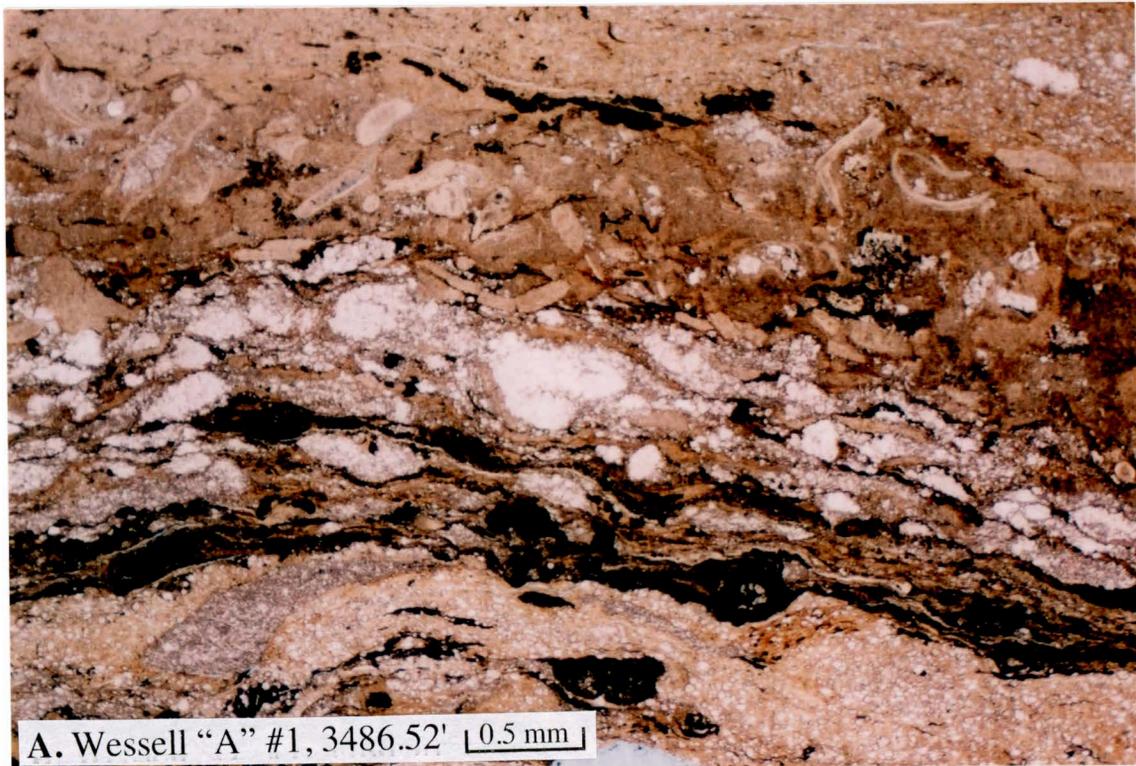
Here less than 10 mm below the phosphatic bed seen in Plate 3 things get weird. The lower half of Photo A and Photo B show pyritic black clasts in finely crystalline dolomite in a bed virtually identical to that in Plate 2 interpreted as basal Maquoketa. In other words, this appears to be more basal Maquoketa below the phosphatic bed (top, Photo A) interpreted as the cap on the Viola. Perhaps conditions at the unconformity were alternating between sediment starved (phosphatic) and Maquoketa-like dolomite deposition. An artificial fracture separates the phosphatic bed from the dolomitic bed.

**Plate 5. Wessell "A" #1, 3486.5 ft: Phosphatic Cap on Viola Formation
Pyritic Clasts in Dolomite on Phosphatic Bed on Shaly Dolomite on More Phosphate**



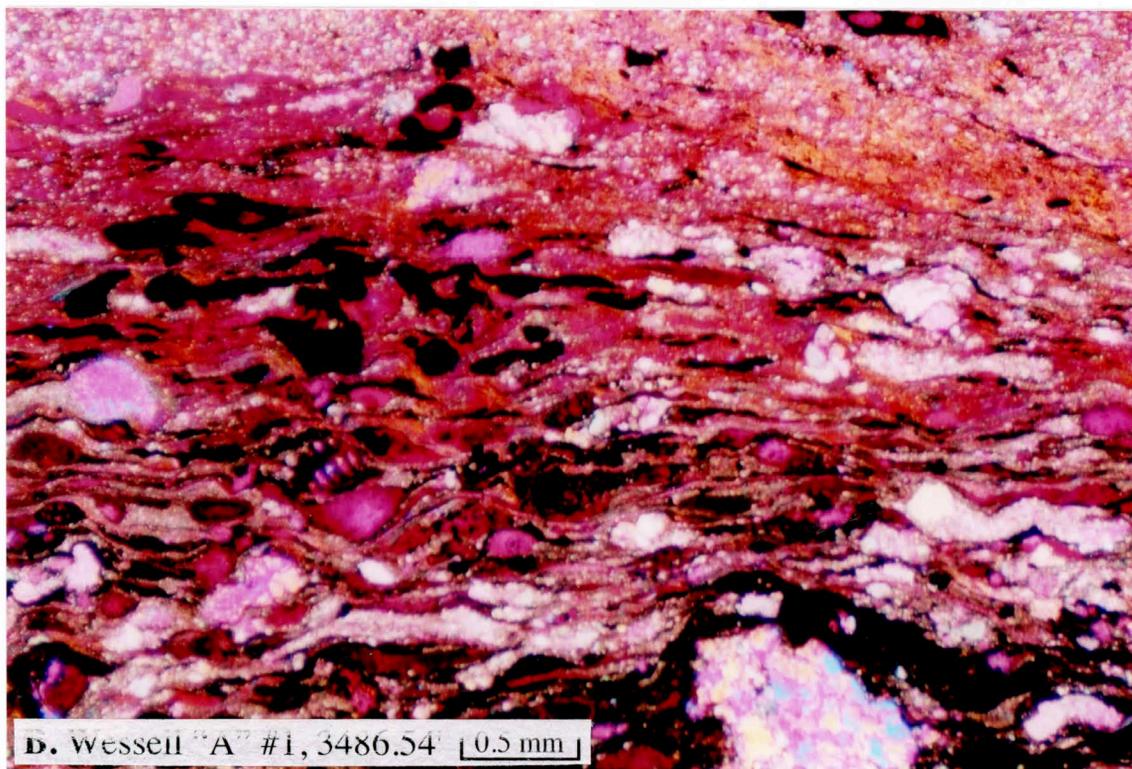
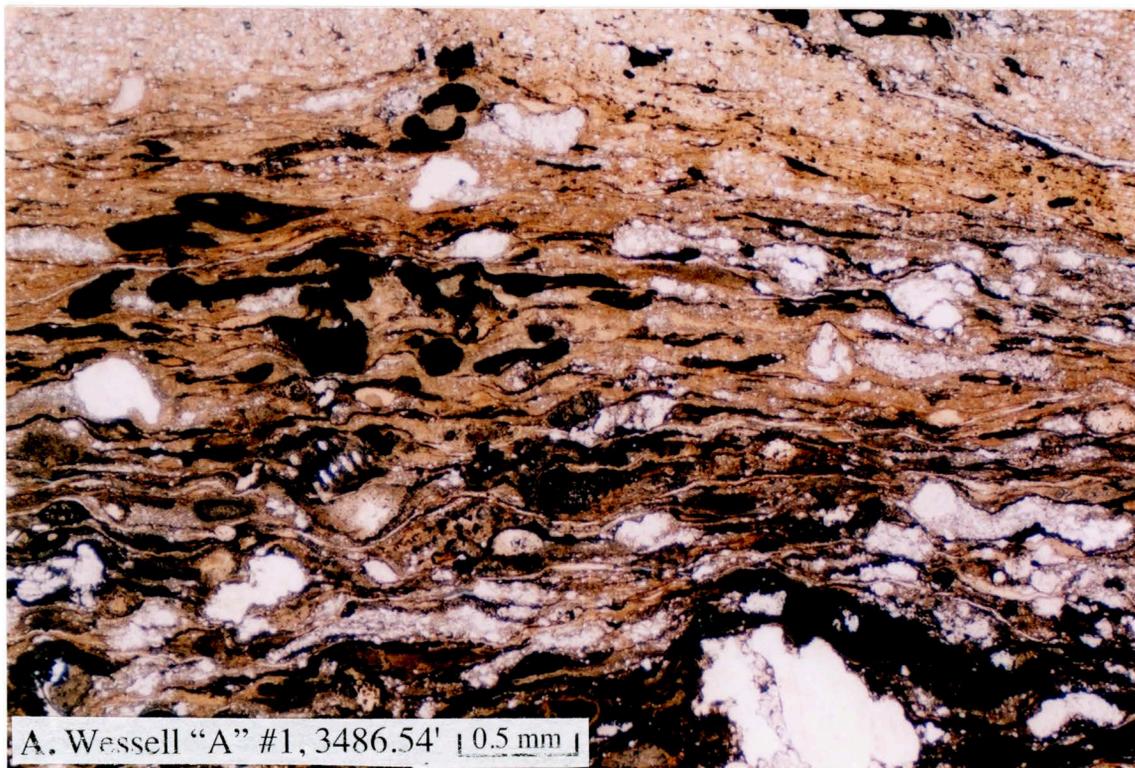
Four distinct lithologies are represented in Photo A. From top (upper left) to bottom, these are: 1) pyritic black clasts in finely crystalline dolomite (basal Maquoketa lithology as seen in Plate 2); 2) finely crystalline homogenous phosphate bed (tan); 3) pyritic finely crystalline dolomite (better seen in the center of Photo B taken with crossed polarizers and a gypsum filter); and 4) more pyritic phosphate with scattered dolomite crystals. All this variation happens in about 4 mm of section. Conditions were clearly fluctuating dramatically.

**Plate 6. Wessell "A" #1, 3486.52 ft: Viola Formation Dolomite
Alternating Phosphatic and Dolomitic Beds with Rip-Up Clasts**



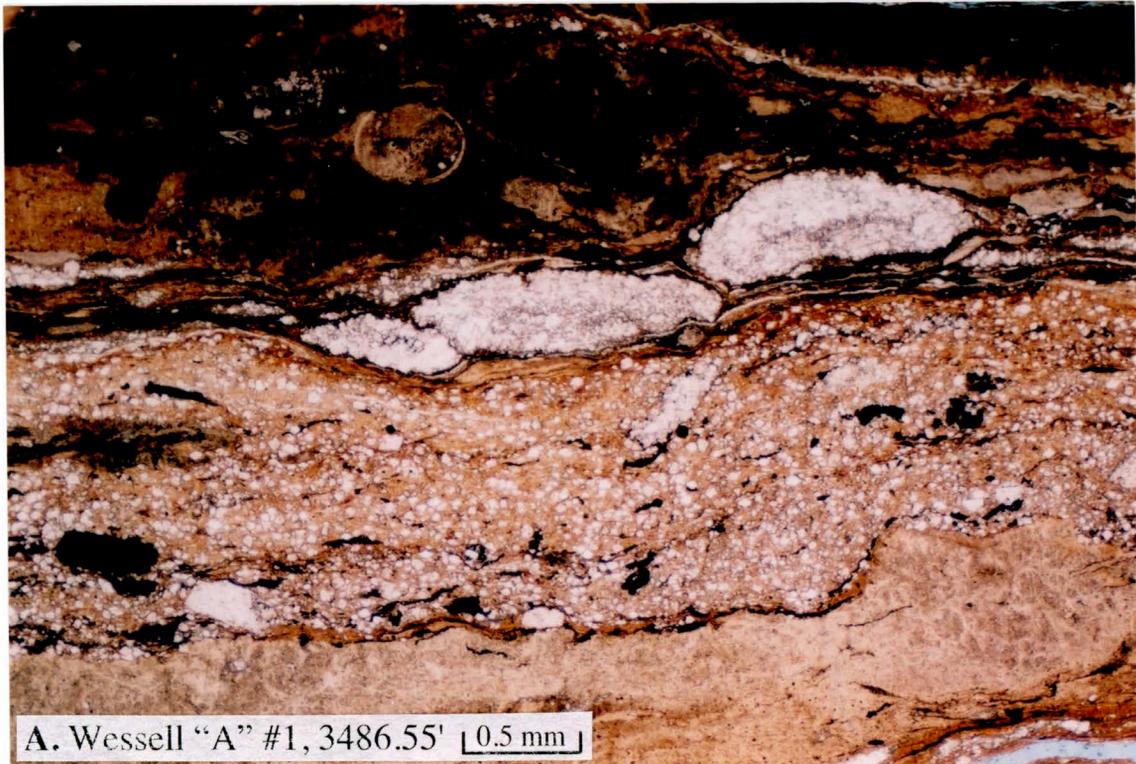
These photos show more of the layered lithologies at the Viola/Maquoketa unconformity just a couple millimeters below those shown in Plate 5. A dolomitic bed is barely visible at the top of both photos resting in sharp contact on a phosphatic bed about 1 mm thick (tan in Photo A; magenta in Photo B taken with crossed polarizers and a gypsum filter); and then a bed of dolomitic and phosphatic rip-up clasts with some pyrite on another bed of dolomite contains more clasts. Again, conditions were clearly fluctuating dramatically.

**Plate 7. Wessell "A" #1, 3486.54 ft: Uppermost Viola Formation (?)
Fossil and Rip-Up Clasts in Laminated Dolomite, Shale, and Phosphate**



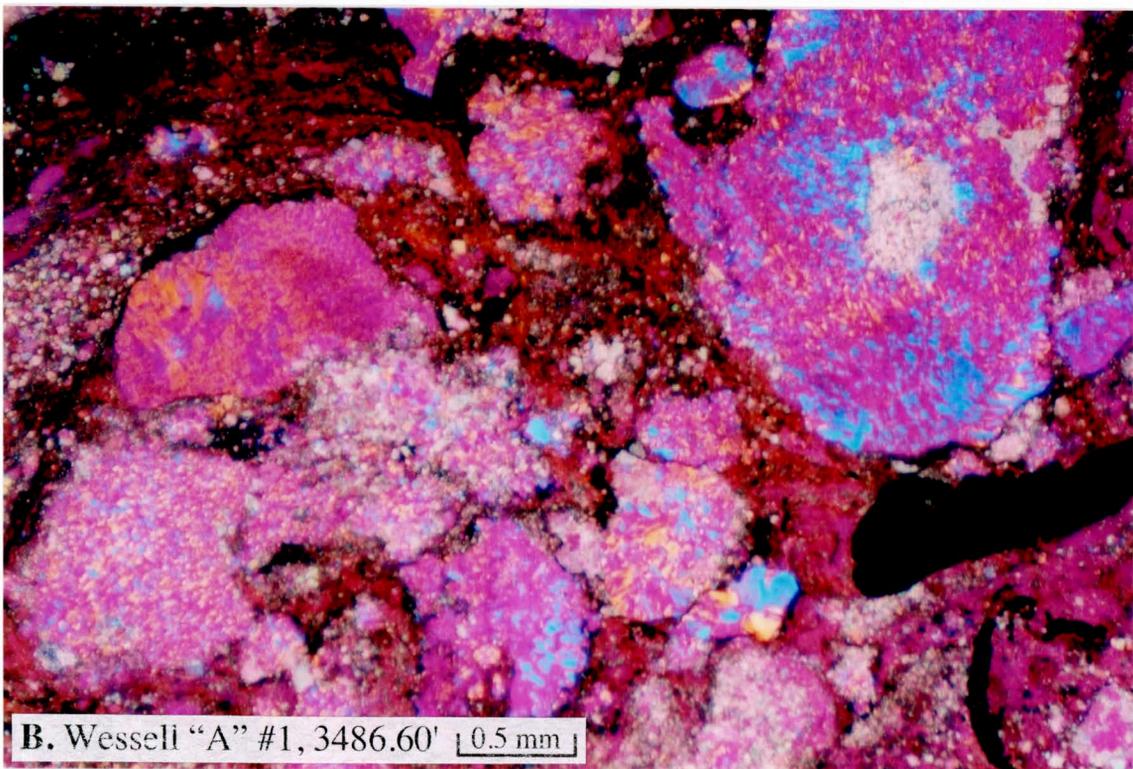
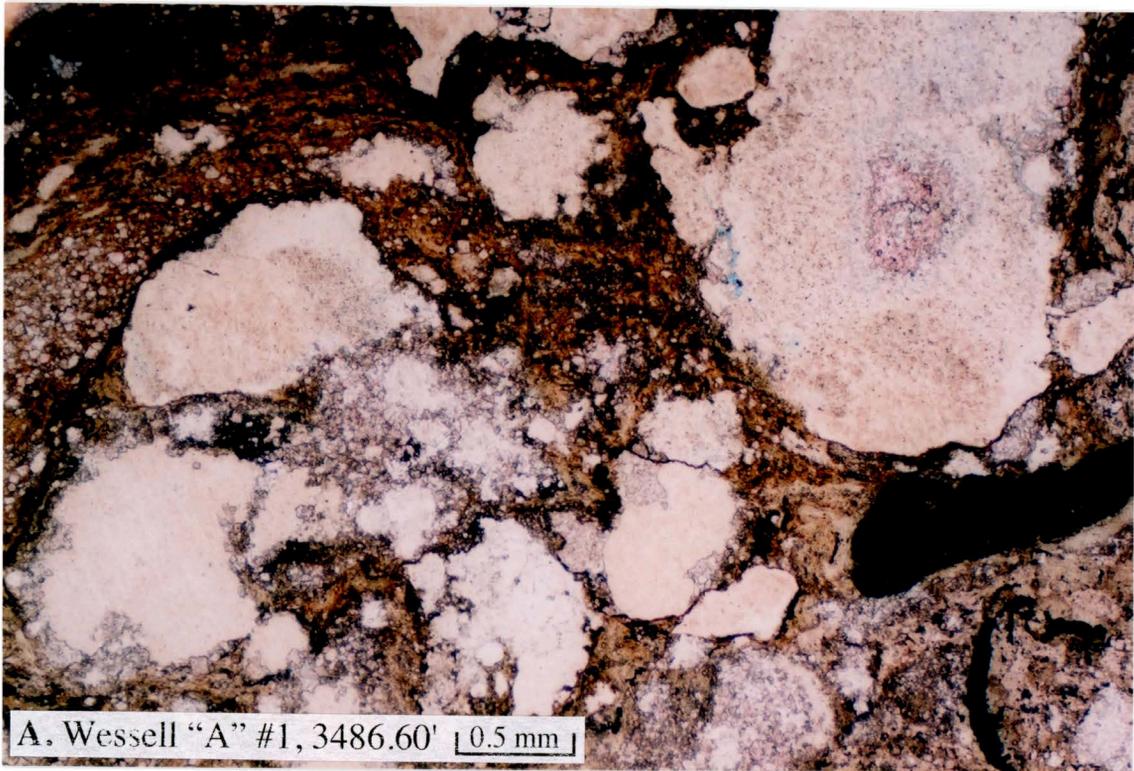
Again dropping down just a few millimeters through the complex lithologies at the Viola/Maquoketa contact, this sample shows laminated shale, dolomite, and phosphate with fossil debris (mainly echinoderms) and rip-up clasts, some of which have been replaced with chalcidony. I interpret this to be part of the uppermost Viola, but it probably deserves a separate stratigraphic term because it represents the deposits at the unconformity.

**Plate 8. Wessell "A" #1, 3486.55 ft: Uppermost Viola Formation (?)
Phosphatized Fossils & Dolomite Clasts in Laminated Dolomite, Shale, & Phosphate**



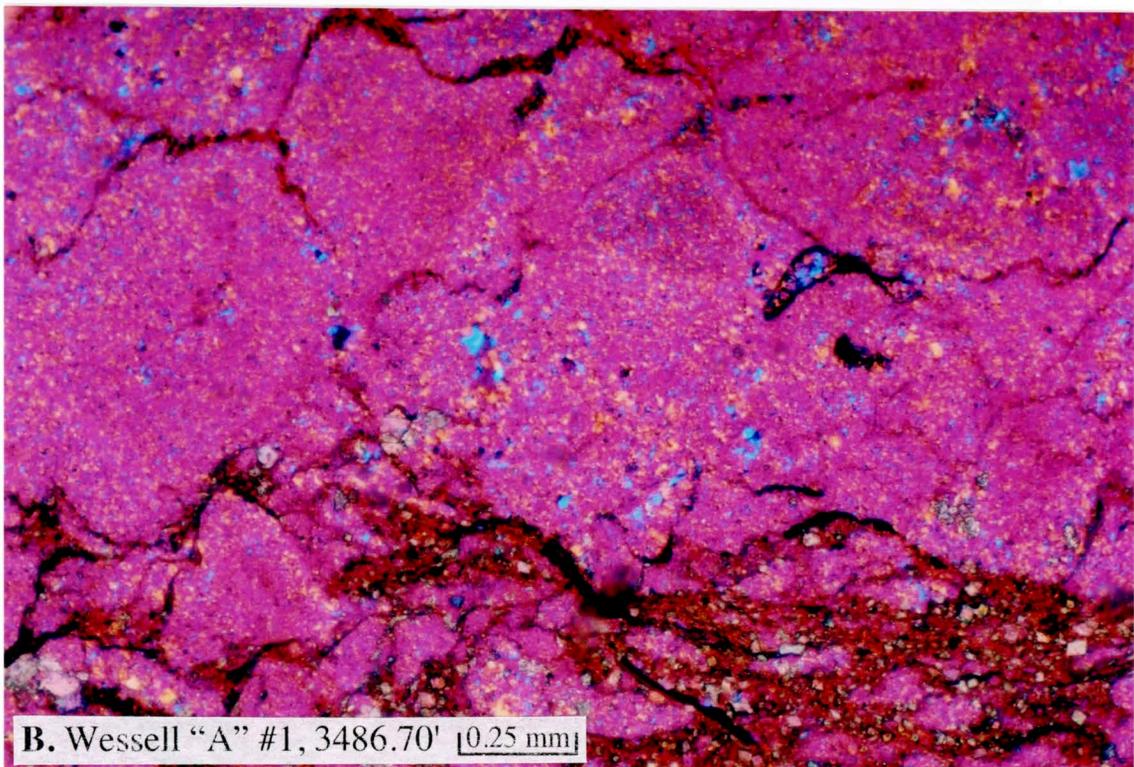
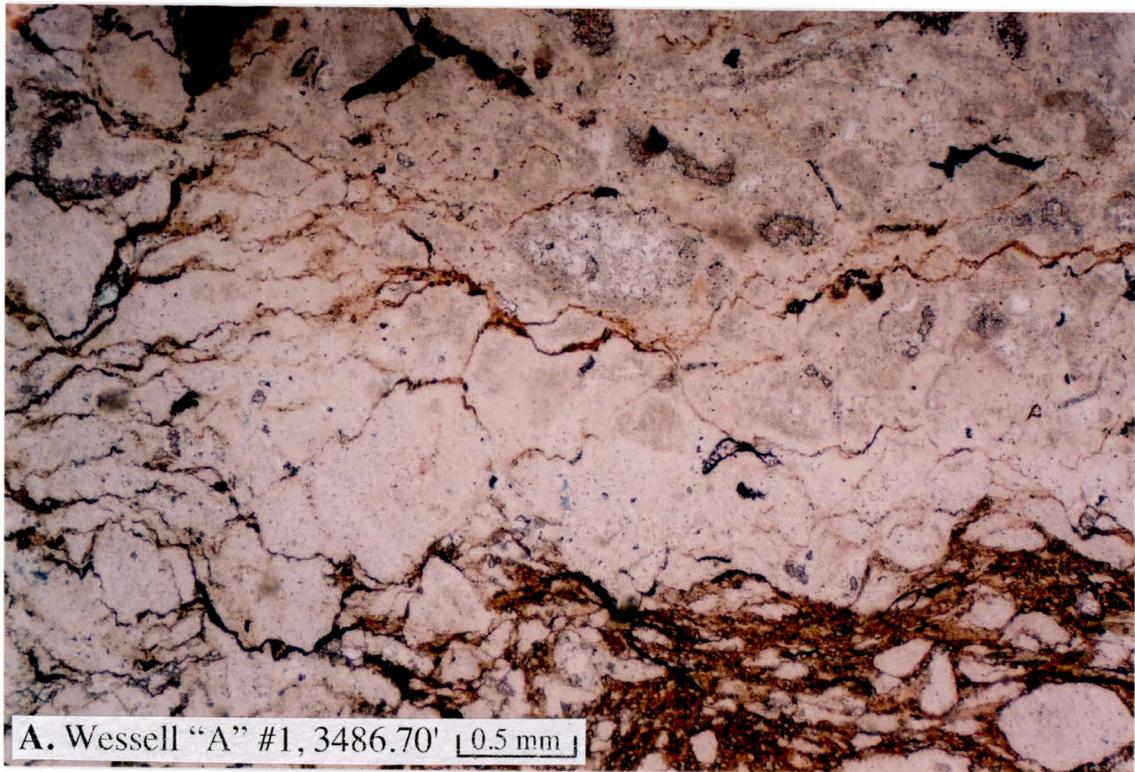
Again this photo shows multiple lithologies in thin beds just a millimeter or two thick. From top to bottom is a phosphate bed with phosphatized fossil fragments, a set of three elongate dolomite clasts (top center), a bed of dolomitic shale with some pyrite), and another bed of phosphate (bottom of photo behind label). I interpret this to be part of the uppermost Viola, but it probably deserves a separate stratigraphic term because it represents the deposits at the unconformity.

**Plate 9. Wessell "A" #1, 3486.6 ft: Uppermost Viola Formation (?)
Silicified Fossils & Chalcedony Nodules under Phosphatic Bed**



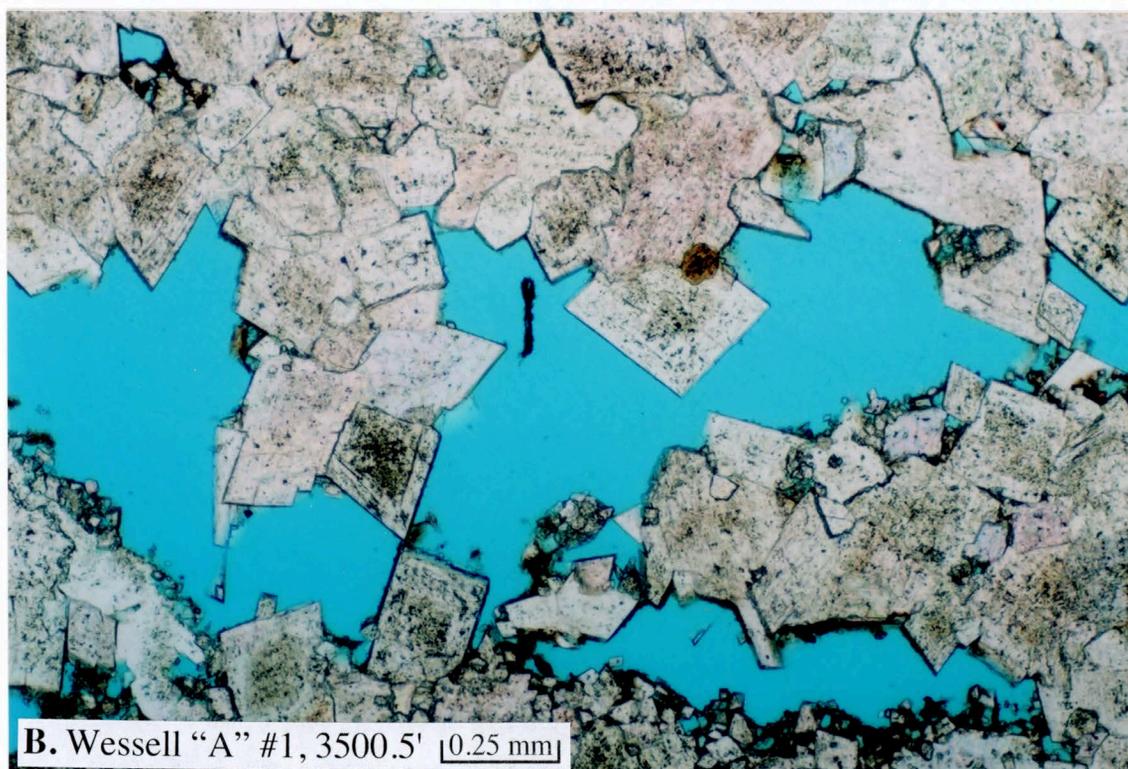
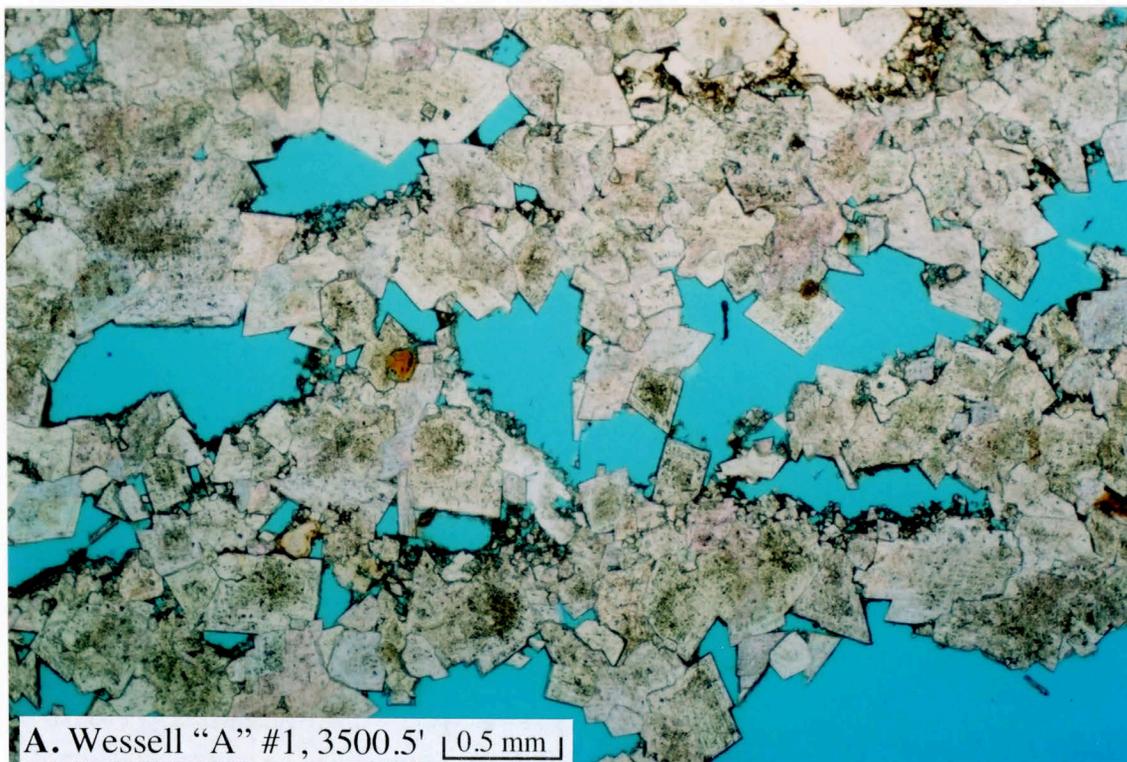
The bed of phosphate at the top of these photos is the same as the bed at the base of the photo in Plate 8. Below this bed is an interval of chalcedony nodules and silicified fossil fragments in a shaly and partly dolomitic matrix. Some pyrite (black) is also present. Again this photo shows the complex lithologies associated with the Viola/Maquoketa contact. No visible porosity is present.

**Plate 10. Wessell "A" #1, 3486.70 ft: Uppermost Viola Formation (?)
Chert Nodules and Chalcedony Replacing Fossils on Shaly Bed**



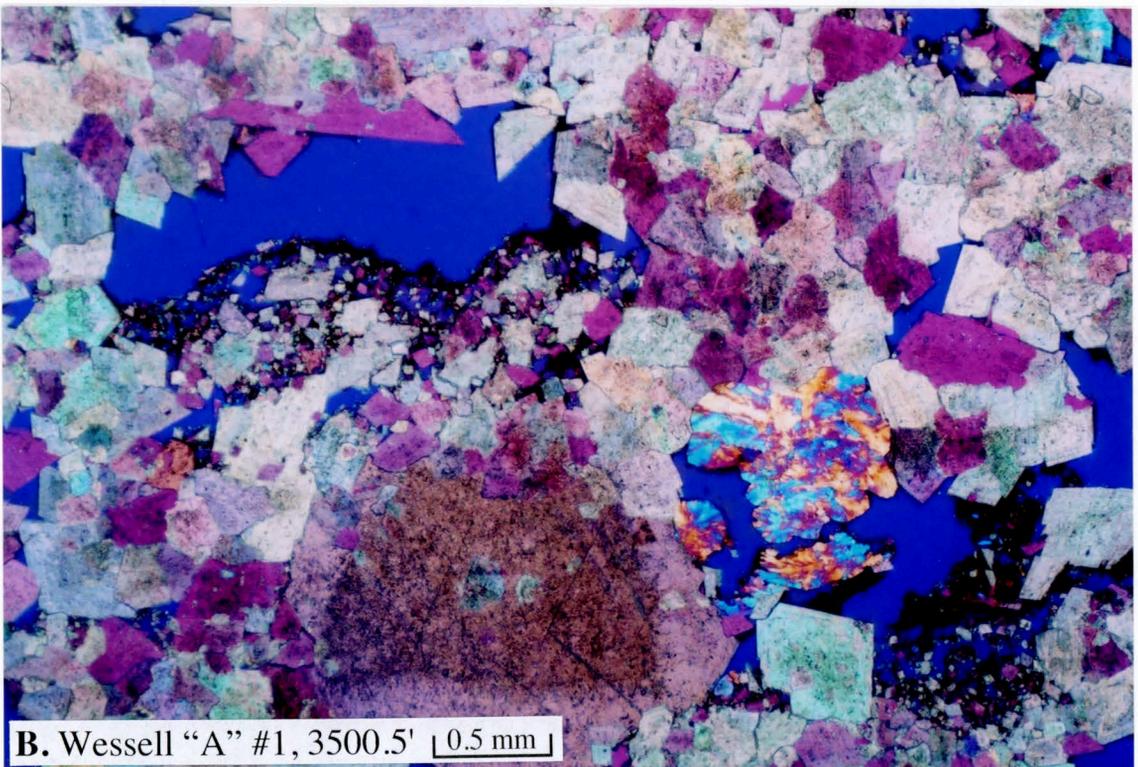
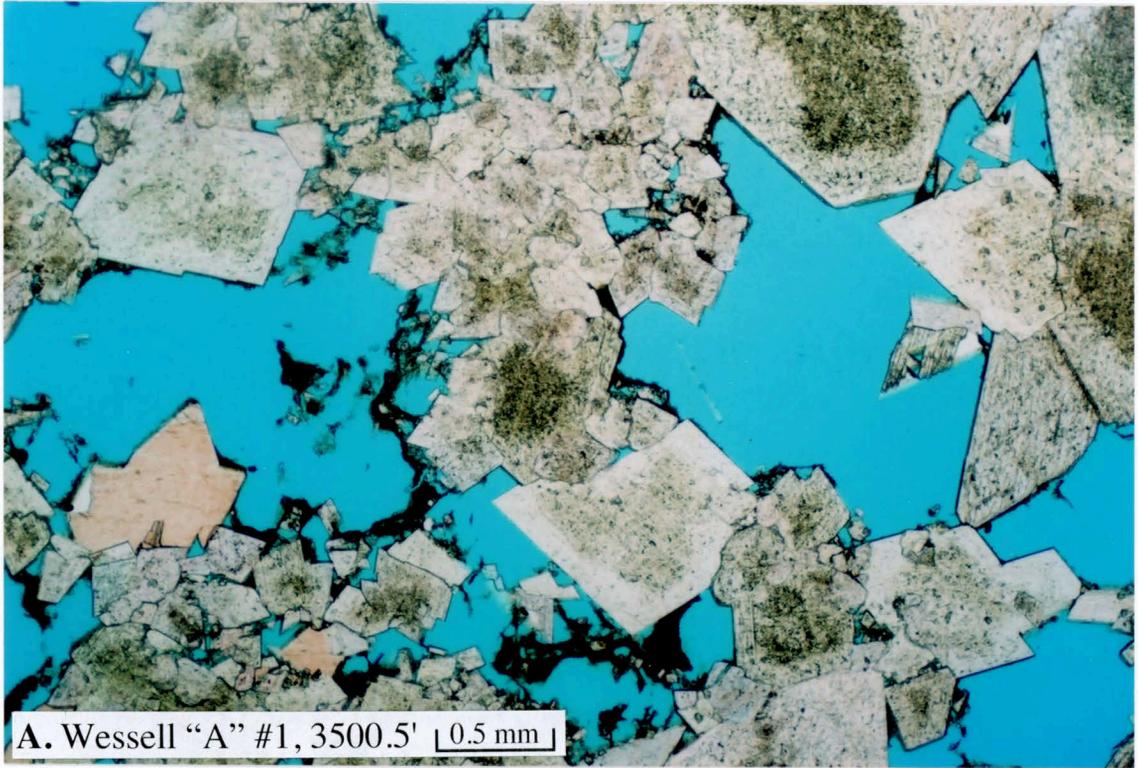
These photomicrographs show the base of the oversized thin section cut at the Viola/Maquoketa contact. Here chert nodules rest in gradational contact on a shaly bed (base of both photos). Some silicified fossil fragments are also present. This lithology is certainly atypical for the Viola Formation and probably represents a distinct and separate stratigraphic unit deposited at the angular unconformity separating the Viola from the overlying Maquoketa dolomitic shale.

**Plate 1. Wessell "A" #1, 3500.5 ft: Viola Formation Dolomite
Intercrystalline and Vuggy Pores in Medium- to Coarse-Crystalline Dolomite**



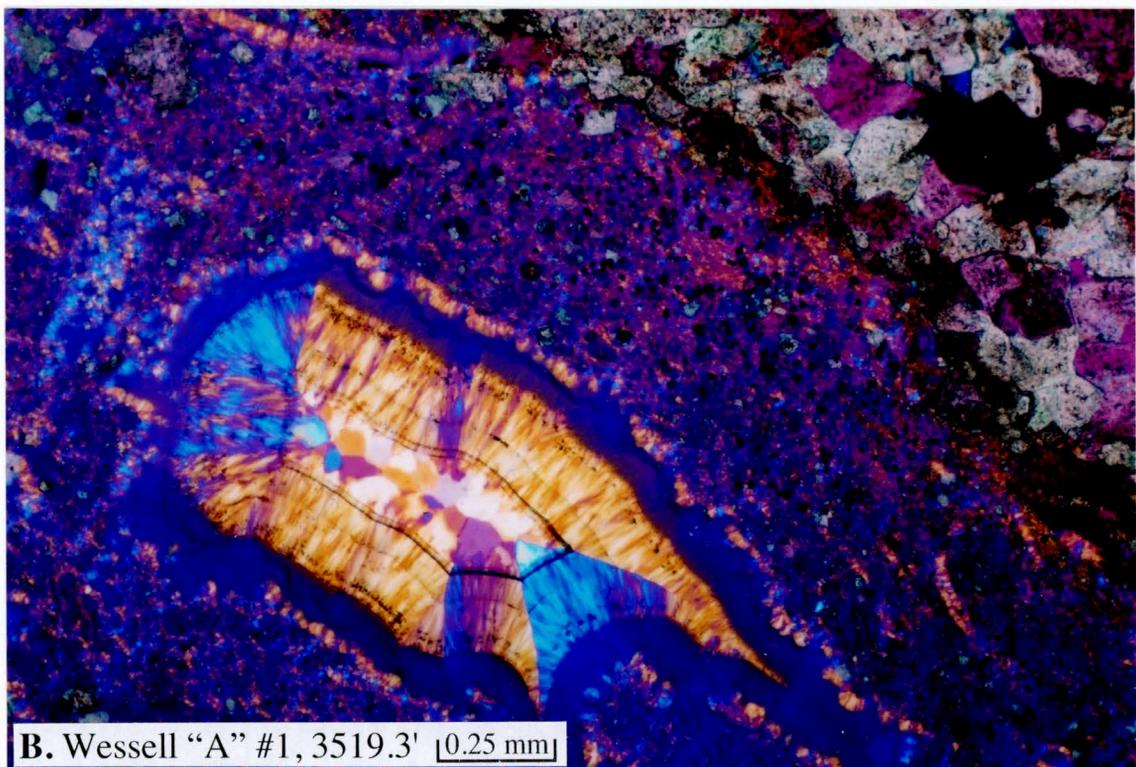
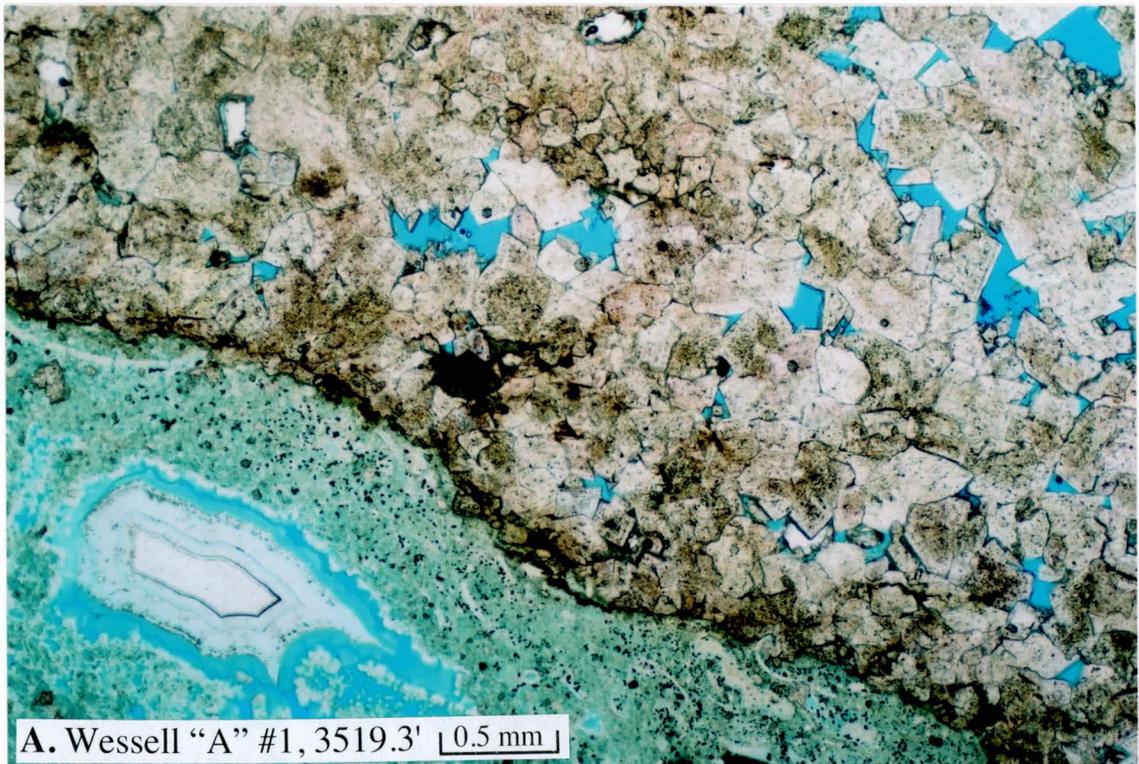
This well was drilled by Cities Service in 1983 in Sec. 24, T4S, R13E (Nemaha County, KS) to 3810 ft and completed as a dry hole with oil shows in the Simpson and Viola. The well was cored from 3476 to 3533 ft (Plates 1-3) and again from 3685 to 3715 ft (Plates 4-6). The shallower core contains the contact of the Maquoketa Shale and dolomitized cap on the Viola Formation. A promising reservoir zone, shown in Plates 1 and 2, consists of medium- to coarse crystalline dolomite with up to 25% vuggy and intercrystalline porosity. The dolomite crystals are mostly euhedral with no undulose extinction. Minor geopetal sediment is present.

**Plate 2. Wessell "A" #1, 3500.5 ft: Viola Formation Dolomite
Euhedral Dolomite Crystals Growing into Vugs with Geopetal Sediment**



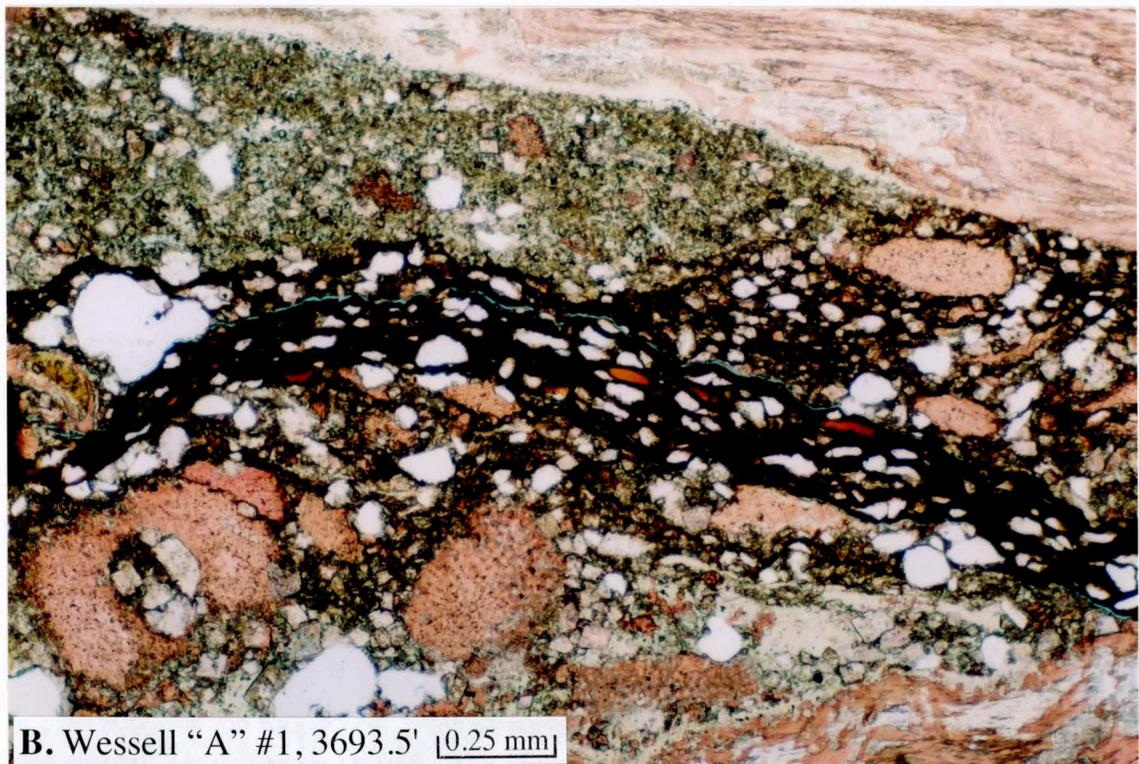
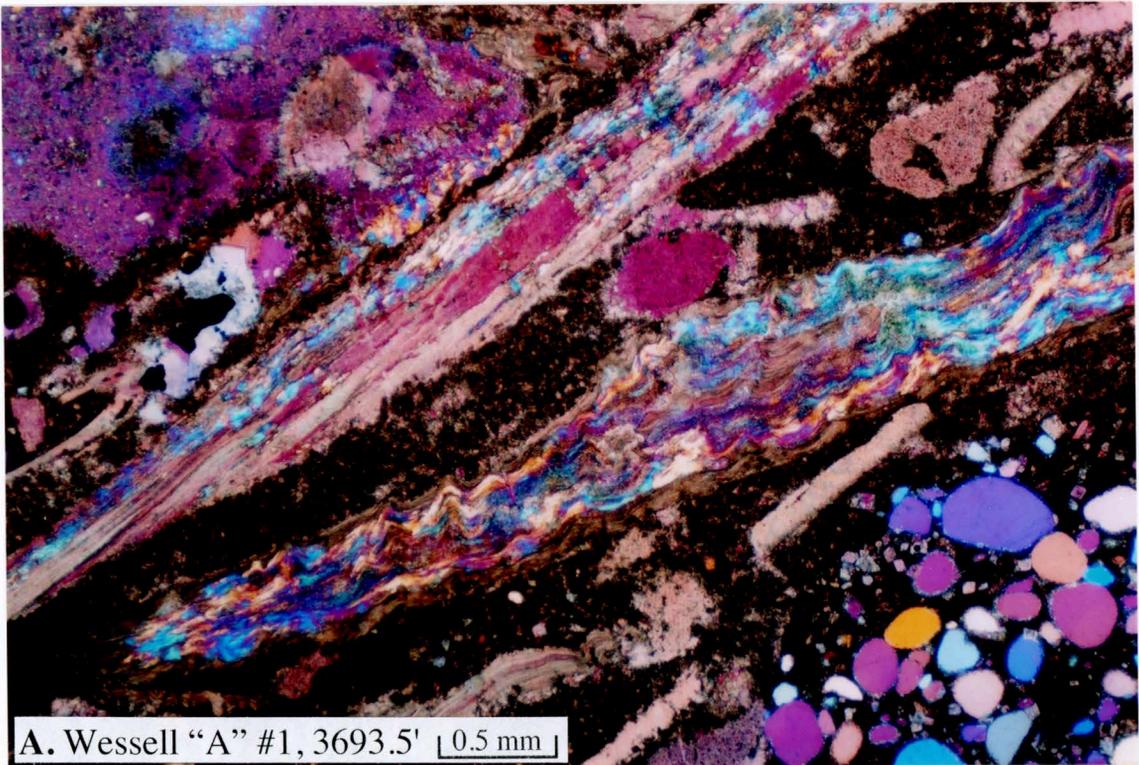
These photomicrographs show more of the same sample seen in Plate 1. This is more of the medium- to coarse-crystalline dolomite with large vugs containing some beautiful euhedral crystals mostly ~0.5 mm in size. The largest dolomite crystals have echinoderm fragments as nuclei (e.g., the cloudy part of the large crystals at top right in Photo A and bottom center of Photo B). The crystal faces of the dolomites are straight with no hint of undulose extinction. This part of the core had a some oil stain, but only traces of oil are visible in these photomicrographs. A patch of chalcedony (yellow and blue) is visible in Photo B taken with a gypsum filter.

**Plate 3. Wessell "A" #1, 3519.3 ft: Viola Formation Dolomite
Chert Nodule with Length-Fast Chaledony in Medium-Crystalline Dolomite**



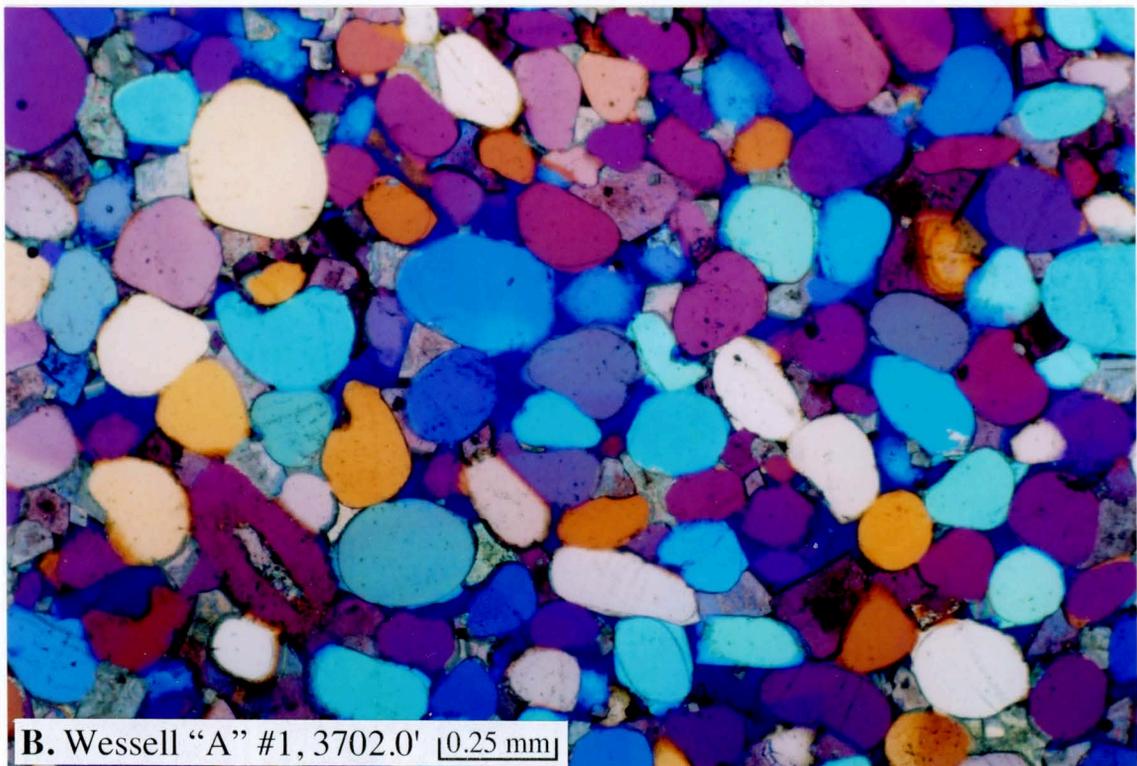
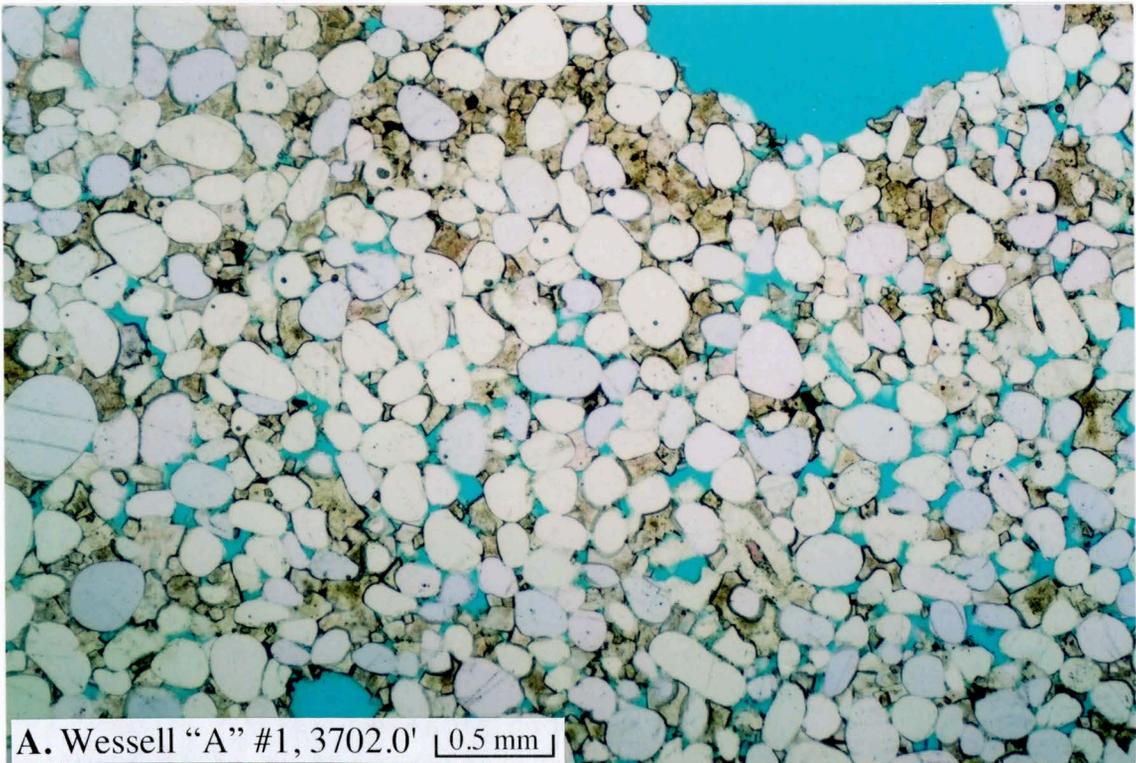
This sample from 14 ft below that shown in Plates 1 and 2 in the lower part of the porous dolomite contained white chert nodules, one of which is visible at lower right in Photo A. The chert contains vugs filled with radial-fibrous length-fast chaledony (Photo B taken with crossed polarized light and a gypsum filter). The dolomite itself is medium-crystalline with an estimated 10% intercrystalline and vuggy porosity. No residual bitumen is present in this dolomite, suggesting it lies below the oil/water contact.

**Plate 4. Wessell "A" #1, 3693.5 ft: Simpson Group Sandy Limestone
Partly Silicified Brachiopods and Shaly Stylolite in Skeletal Wackestone**



These photomicrographs show a skeletal-rich wackestone to packstone from about 8 ft below the top of Core #2 in the Simpson Group. Photo A, taken with crossed polarized light and a gypsum filter, shows partly silicified brachiopod shells and echinoderm fragments along with well-rounded quartz sand in a burrow at lower right. Photo B shows a possible thin kerogenite bed with partly dissolved quartz grains between more of the crinoidal and brachiopod-rich skeletal wackestone to packstone. No porosity is visible in either photo.

**Plate 5. Wessell "A" #1, 3702.0 ft: Simpson Sandstone
Interparticle Porosity and Dolomite Cement in Fine-Grained Quartz Sandstone**



This sample from about 17 ft below the top of Core #2 reveals a porous fine- to medium-grained quartz sandstone with superbly rounded grains that are partly cemented with dolomite. A hollow oval-shaped grain of phosphatic fossil debris is visible at lower left in Photo B (taken with crossed polarized light and a gypsum filter). The notch cut in the thinsection stub to indicate "up" is visible at top right in Photo A. Total visible porosity is estimated at 12%, all in intergranular pores. This sandstone is about 5 ft below an interval that tested 8 BOPD, but a second test across the same interval yielded 110 BOPD so this interval was plugged off.

**Plate 6. Wessell "A" #1, 3713.6 ft: Simpson Group Limestone
Trilobite and Brachiopod Fragments in Dolomitic Skeletal Wackestone**



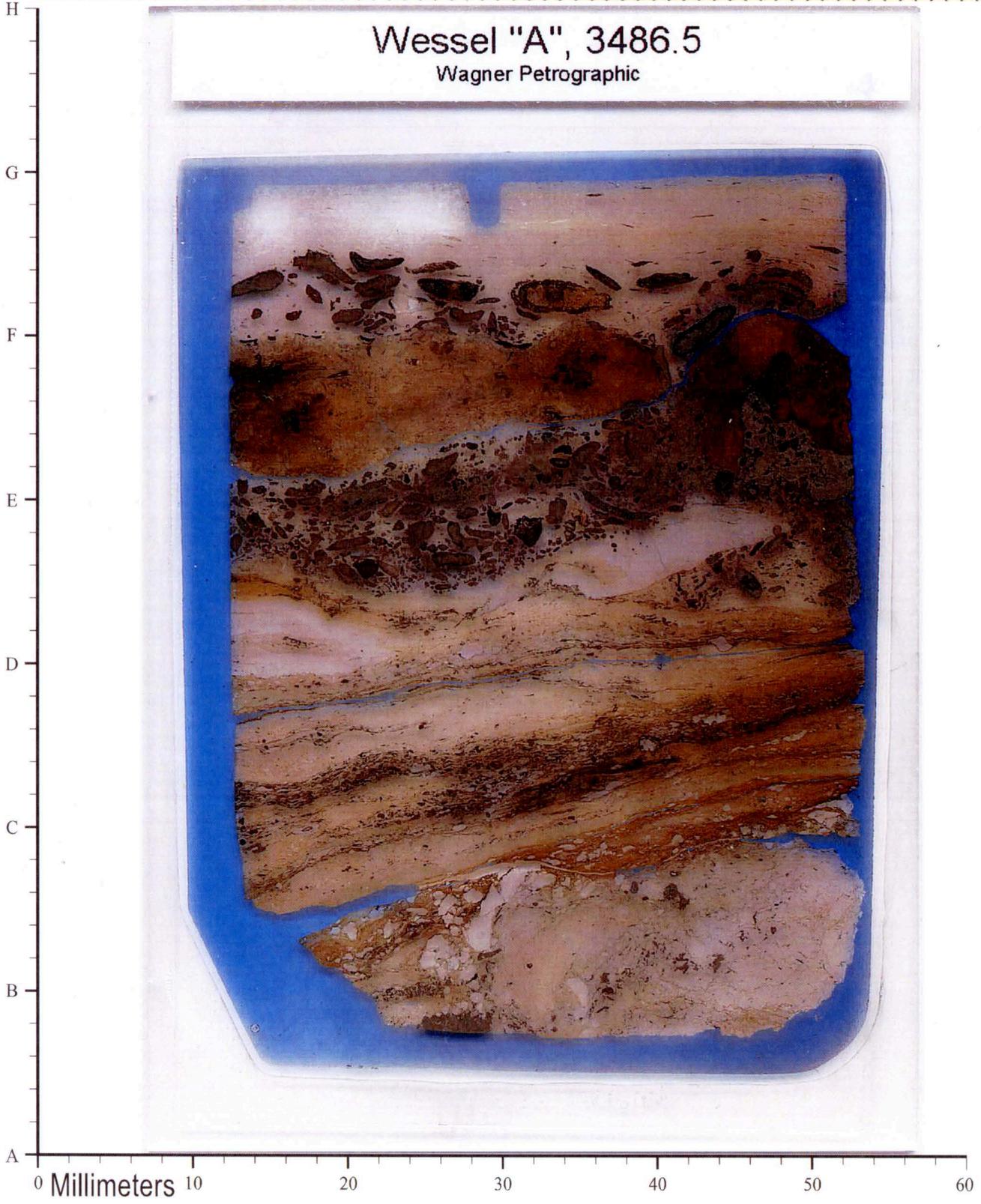
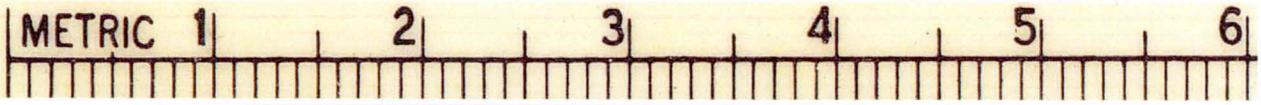
This sample was selected for petrographic study because it contained a contact between mottled dolomite and tight limestone. Shown in Photo A is part of the skeletal wackestone with a crook-shaped trilobite fragment. At top right in Photo A is a wispy stylolite separating a dolomitic limestone from the wackestone. Photo B shows a "Y"-shaped fragment of a brachiopod shell in a dolomitic wackestone. This thinsection had no visible porosity. Photos taken with plain light.

Wessel "A" #1, 3486.5 ft

PLATE 1

Contact of Maquoketa "Shale" on Viola Formation

Basal Maquoketa Illitic and Dolomitic "Shale" on Intraclast-Rich Beds

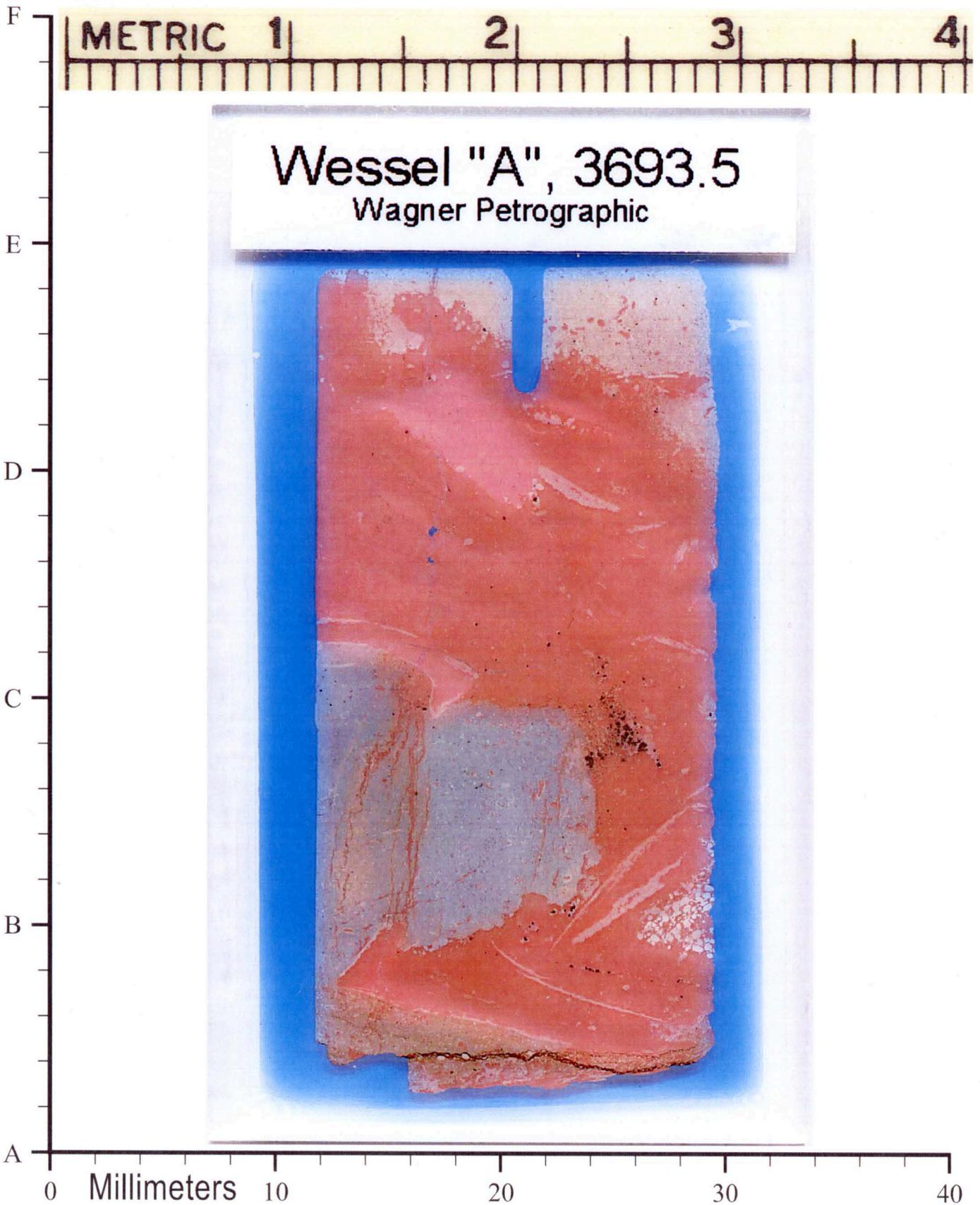


Wessel "A" #1, 3693.5 ft

PLATE 2

Interval: Simpson Group Sandy Limestone

Partly Silicified Brachiopods and Shaly Stylolite in Skeletal Wackestone

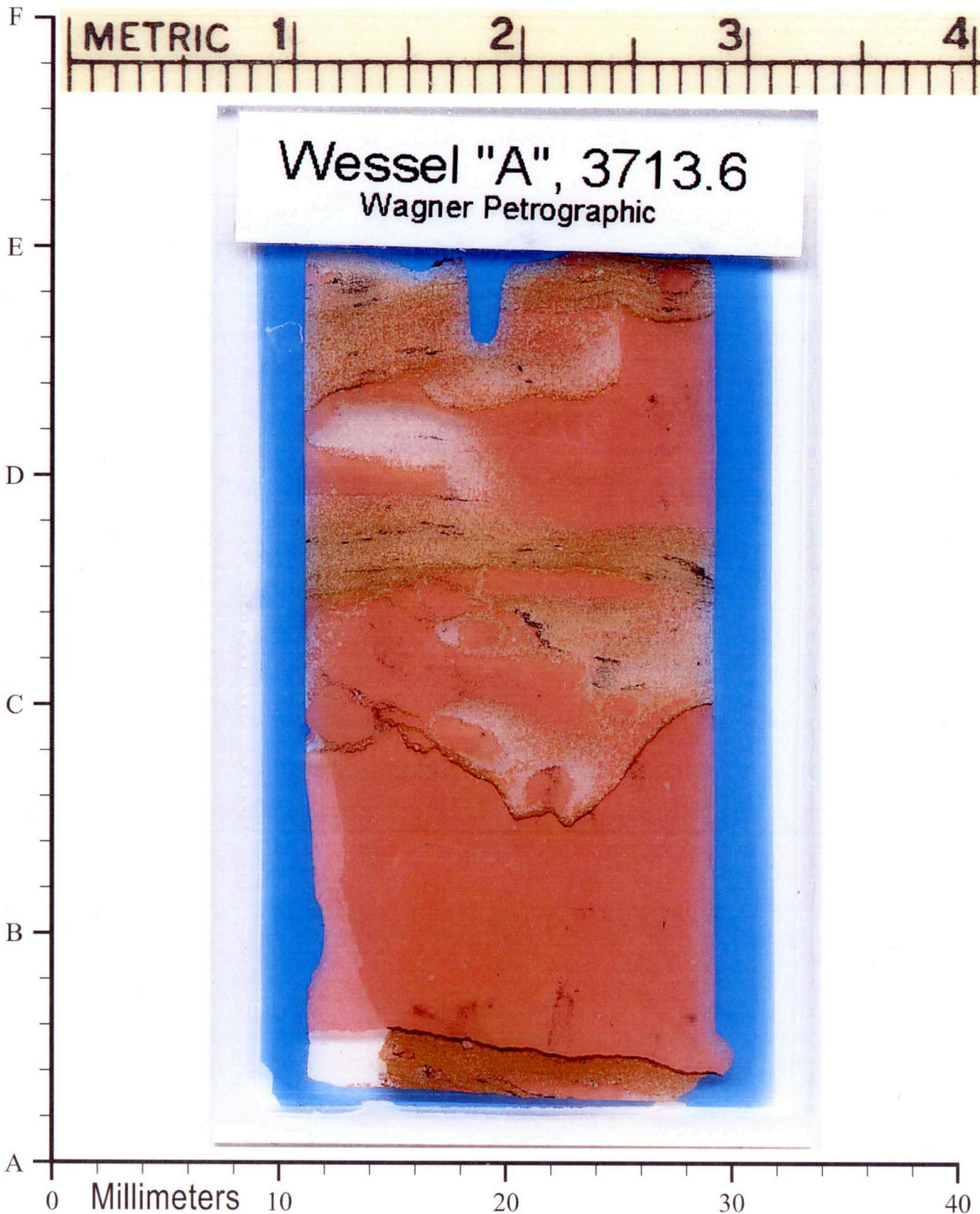


Wessel "A" #1, 3713.6 ft

PLATE 3

Interval: Simpson Group Limestone

Skeletal Fragments in Dolomitic and Shaly Skeletal Wackestone





TOTAL ORGANIC CARBON and ROCK-EVAL PYROLYSIS

Company: QEP

Project #: 14EG0285

Well Name	Lab ID	Sample Type	Depth	Prep	TOC Wt. %	S1 mg/g	S2 mg/g	S3 mg/g	Tmax	HI	OI	S1/TOC	PI	Formation	Description
WESSEL "A" #1	QEEG000121	CORE	3480.5 FT	NOPR	0.56	0.09	1.27	0.32	437	226	57	16	0.07	Maquoketa Sh.	Maquoketa Sh.
WESSEL "A" #1	QEEG000122	CORE	3484.1 FT	NOPR	0.50	0.14	1.13	0.31	438	226	62	28	0.11	Maquoketa Sh.	Maquoketa Sh.
WESSEL "A" #1	QEEG000118	CORE	3685.5 FT	NOPR	1.05	0.16	3.96	0.41	442	377	39	15	0.04	Black Simpson Shale	Black Simpson Sh.
WESSEL "A" #1	QEEG000119	CORE	3690.0 FT	NOPR	0.41	0.05	0.88	0.30	436	214	73	12	0.05	Fissile Gray Simpson Sh.	Simpson Gray Shale
WESSEL "A" #1	QEEG000120	CORE	3713.6 FT	NOPR	0.26	0.10	0.39	0.29	437	152	113	39	0.20	Gray Simpson Sh in LS	Simpson Gray Shale
MCCLAIN#1	QEEG000123	CORE	3561.2 FT	NOPR	0.22	0.08	0.45	0.35	437	209	163	37	0.15	VIOLA GY SHALE	VIOLA GY SHALE
MCCLAIN#1	QEEG000124	CORE	3568.9 FT	NOPR	0.23	0.09	0.52	0.33	436	228	145	39	0.15	VIOLA GY SHALE	VIOLA GY SHALE
MCCLAIN#1	QEEG000125	CORE	3573.5 FT	NOPR	0.42	0.18	1.51	0.20	436	361	48	43	0.11	VIOLA GY SHALE	VIOLA GY SHALE
SCOBY 83-2	QEEG000126	CORE	4005.9 FT	NOPR	9.80	1.96	61.22	0.29	447	625	3	20	0.03	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000127	CORE	4027.1 FT	NOPR	7.55	2.92	55.12	0.19	446	730	3	39	0.05	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000128	CORE	4029.8 FT	NOPR	5.45	1.30	39.34	0.15	447	722	3	24	0.03	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000129	CORE	4033.0 FT	NOPR	6.50	1.37	47.36	0.22	448	729	3	21	0.03	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000130	CORE	4044.9 FT	NOPR	0.87	0.10	0.38	0.36	439	44	42	12	0.21	Simpson Shale	BELOW IRONSTONE



TOTAL ORGANIC CARBON, TOTAL CARBON

Company: QEP Project #: 14EG0285

Well Name	Lab ID	Sample Type	Depth	Prep	TOC Wt. %	Carbon Wt. %	Carbonate%	Formation	Description
WESSEL "A"#1	QEEG000121	CORE	3480.5 FT	NOPR	0.56	3.25	22.40	Maquoketa Gray Sh.	MAQUOKETA SH.
WESSEL "A"#1	QEEG000122	CORE	3484.1 FT	NOPR	0.50	4.25	31.26	Maquoketa Gray Sh.	MAQUOKETA SH.
WESSEL "A"#1	QEEG000118	CORE	3685.5 FT	NOPR	1.05	2.97	16.00	Black Simpson Sh.	SIMPSON SHALE
WESSEL "A"#1	QEEG000119	CORE	3690.0 FT	NOPR	0.41	0.70	2.41	Simpson Gray Sh.	SIMPSON SHALE
WESSEL "A"#1	QEEG000120	CORE	3713.6 FT	NOPR	0.26	10.30	83.70	Simpson Gray Sh.	SIMPSON SHALE
MCCLAIN#1	QEEG000123	CORE	3561.2 FT	NOPR	0.22	12.10	99.04	VIOLA GY SHALE	VIOLA GY SHALE
MCCLAIN#1	QEEG000124	CORE	3568.9 FT	NOPR	0.23	11.00	89.77	VIOLA GY SHALE	VIOLA GY SHALE
MCCLAIN#1	QEEG000125	CORE	3573.5 FT	NOPR	0.42	9.87	78.77	VIOLA GY SHALE	VIOLA GY SHALE
SCOBY 83-2	QEEG000126	CORE	4005.9 FT	NOPR	9.80	10.30	4.17	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000127	CORE	4027.1 FT	NOPR	7.55	7.62	0.58	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000128	CORE	4029.8 FT	NOPR	5.45	5.62	1.42	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000129	CORE	4033.0 FT	NOPR	6.50	6.85	2.92	SIMPSON KEROG.	SIMPSON KEROG.
SCOBY 83-2	QEEG000130	CORE	4044.9 FT	NOPR	0.87	1.31	3.71	Simpson Shale	BELOW IRONSTONE