

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

THERMAL MATURATION VALUES (CONODONT COLOR ALTERATION INDICES) FOR  
PALEOZOIC AND TRIASSIC ROCKS, CHANDLER LAKE, DE LONG MOUNTAINS,  
HOWARD PASS, KILLIK RIVER, MISHEGUK MOUNTAIN,  
AND POINT HOPE QUADRANGLES,  
NORTHWEST ALASKA, AND SUBSURFACE NPRA

By

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been reviewed for conformity with U.S.  
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## INTRODUCTION

Conodonts are apatitic marine microfossils that can be relatively easily and rapidly recovered from carbonate and metacarbonate rocks of Cambrian through Triassic age. They are valuable biochronologic indices throughout most of their geologic range and, since 1977, have also become important indices of organic metamorphism (Epstein and others, 1977; Harris, 1979). Conodonts visibly change color between 50° and 500°C and are therefore useful thermal indices for assessing hydrocarbon and mineralization potential. Several papers describe the origin, calibration, and geologic applications of conodont color alteration, particularly as related to hydrocarbon exploration (Epstein and others, 1977; Harris and others, 1978; Harris, 1979; Harris and others, 1980; Harris and others, 1981). It is only necessary to repeat here that conodont color alteration is time and temperature dependent and results chiefly from either burial metamorphism or heat associated with intrusive igneous activity. Less commonly, conodont color alteration can also result from contact with warm saline solutions that can produce oxidation of organic materials and corrosion of minerals.

Color alteration index (CAI) values have been correlated with temperature via laboratory experiments, bore holes and other geothermometers. This correlation is given below; the temperature ranges represent heating durations of 500 million to 1 million years (lower temperature is the 500 m.y. value).

| CAI | Temperature range, °C |
|-----|-----------------------|
| 1   | 50-80                 |
| 1.5 | 50-90                 |
| 2   | 60-140                |
| 3   | 110-200               |
| 4   | 190-300               |
| 5   | 300-400               |
| 6   | 350-450               |
| 7   | 400-500               |
| 8   | 450-550               |

## PURPOSE

In the last several years, there has been increasing interest on the part of U.S. Geological Survey geologists mapping Paleozoic and Triassic terranes in Alaska to collect conodont samples for biostratigraphic control. Therefore, the conodont samples for which CAI values are given in this report were not collected specifically for organic maturation studies, but for biostratigraphic and structural interpretations. As a result, the distribution of CAI points is not related to any strategy for thermal maturation assessment.

We are releasing our CAI values for part of the northwest Brooks Range and the subsurface National Petroleum Reserve in Alaska, at this time, because this area is of current interest to hydrocarbon explorationists. As a result we have had inquiries

from industry concerning any available organic maturation data.

All samples were collected by U.S. Geological Survey geologists, mostly by S. Curtis, I.F. Ellersieck, C.F. Mayfield, and I.L. Tailleux in the course of field mapping related to exploration of the NPRA (Curtis and others, 1982; Ellersieck and others, 1982; Mayfield and others, 1982). A.G. Harris is solely responsible for the conodont age and thermal evaluations.

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## EXPLANATION OF TABLE NOTATIONS

(Samples are listed alphabetically by quadrangle name, then chronologically by decreasing geologic age, and lastly by increasing latitude.)

|                              |  |
|------------------------------|--|
| *                            | Subsurface sample  |
| Devonian (U)                 | Conodonts indicate a Late Devonian age   |
| Devonian (M-U)               | Conodonts indicate a Middle through Late Devonian age                                      |
| Devonian (M/U)               | Conodonts indicate a short interval across the Middle-Late Devonian boundary               |
| Devonian-Mississippian       | Conodonts merely indicate a Devonian through Mississippian age                             |
| Devonian-Mississippian (U-L) | Conodonts indicate a Late Devonian through Early Mississippian age                         |
| Devonian/Mississippian (U/L) | Conodonts indicate a short interval across the Late Devonian- Early Mississippian boundary |
| CAI                          | Conodont color alteration index  |

Table 1.--Conodont-based age and thermal maturation values for part of the northwest Brooks Range and the subsurface NPRA.

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM        | (SERIES) | CAI   | FIELD NO.   |
|---------------------------|--------------------|---------------|----------|-------|-------------|
| CHANDLER LAKE             | 68°00.1'/152°17.0' | Dev.-Miss.    | (M-L)    | 5.5   | 75ATR14-1   |
| "                         | 68°00.0'/152°49.7' | Mississippian | (L)      | 5     | 75ATR15.2   |
| "                         | 68°22.6'/152°50.8' | Mississippian | (L)      | 5.5-6 | ROMY01.1    |
| "                         | 68°18.0'/151°50.2' | Mississippian | (U)      | 2     | 75TR1.2     |
| "                         | 68°18.0'/151°53.8' | Mississippian | (U)      | 1.5   | ROMY10-7-10 |
| "                         | 68°18.2'/151°50.3' | Mississippian | (U)      | 1.5-2 | ROMY07c     |
| "                         | 68°22.3'/151°52.7' | Mississippian | (U)      | 2     | 75TR11:0-15 |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM        | (SERIES) | CAI   | FIELD NO. |
|---------------------------|--------------------|---------------|----------|-------|-----------|
| DE LONG MINS.             | 68°08.1'/163°41.5' | Devonian      | (M)      | 3     | 79MD171A  |
| "                         | 68°05.7'/163°36.3' | Devonian      | (U)      | 3     | 79MD86C   |
| "                         | 68°06.0'/163°36.3' | Devonian      | (U)      | 2.5-3 | 79MDR6B   |
| "                         | 68°10.6'/163°24.6' | Devonian      | (U)      | 3     | 79MDI15E  |
| "                         | 68°10.7'/163°24.4' | Devonian      | (U)      | 3     | 79MDI15F  |
| "                         | 68°18.9'/162°08.8' | Devonian      | (U)      | 3     | 79CX60A   |
| "                         | 68°08.7'/163°38.6' | Dev.-Miss.    | (M-L)    | 2.5-3 | 79CX127G  |
| "                         | 68°10.3'/163°26.2' | Dev.-Miss.    | (M-L)    | 3-4   | 79MDI16B  |
| "                         | 68°10.6'/163°34.5' | Dev.-Miss.    | (M-L)    | 3     | 79EK180C  |
| "                         | 68°20.3'/162°18.2' | Dev.-Miss.    | (M-L)    | 3     | 79MD47    |
| "                         | 68°08.2'/162°30.8' | Dev.-Miss.    | (U-L)    | 3     | 79EK274A  |
| "                         | 68°12.9'/163°04.7' | Dev.-Miss.    | (U-L)    | 2.5-3 | 79EK196F  |
| "                         | 68°07.8'/163°33.1' | Dev.-Miss.    | (U-U)    | 3-4   | 79CX227   |
| "                         | 68°08.8'/163°05.2' | Dev.-Miss.    | (U-U)    | 3-4   | 79EK166   |
| "                         | 68°06.1'/163°34.3' | Mississippian | (L)      | 3     | 79EK175C  |
| "                         | 68°07.8'/163°43.2' | Mississippian | (L)      | 2.5-3 | 79MD171D  |
| "                         | 68°08.3'/163°25.8' | Mississippian | (L)      | 2.5-3 | 79Tr144   |
| "                         | 68°14.5'/164°03.7' | Mississippian | (L)      | 2     | 63Tr243B  |
| "                         | 68°21.3'/162°02.4' | Mississippian | (L)      | 3     | 79MD44C   |
| "                         | 68°21.4'/162°56.5' | Mississippian | (L)      | 2.5-3 | 79EK184B  |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM           | (SERIES) | CAI   | FIELD NO.  |
|---------------------------|--------------------|------------------|----------|-------|------------|
| DE LONG MTS.              | 68°00.3'/163°16.3' | Mississippian    | (U)      | 2.5   | 79Tr142    |
| "                         | 68°03.5'/163°08.2' | Mississippian    | (U)      | 2.5-3 | 79EK15B2   |
| "                         | 68°18.3'/163°19.5' | Mississippian    | (U)      | 3     | 79MD146D   |
| "                         | 68°06.3'/164°06.3' | Mississippian    |          | 1.5-2 | 79MD180    |
| "                         | 68°21.6'/162°56.0' | Mississippian    |          | 2-3   | 79Tr74E    |
| "                         | 68°22.0'/163°22.3' | Mississippian    |          | 2.5-3 | 79EK189C   |
| "                         | 68°07.9'/163°38.7' | Pennsylvanian    | (L)      | 2.5-3 | 79CX125H1  |
| "                         | 68°18.0'/163°10.2' | Triassic         | (L)      | 2     | 79EK264B   |
| "                         | 68°24.4'/163°31.8' | Triassic         | (L)      | 2     | 79MD107C   |
| "                         | 68°08.8'/163°05.2' | Dev.-Permian     |          | 3-4   | 79CX119A   |
| "                         | 68°01.5'/162°45.0' | Silurian-Permian |          | 3     | 79CX198E   |
| "                         | 68°04.8'/163°04.8' | Silurian-Permian |          | 3.5   | 78W38782   |
| "                         | 68°06.0'/163°15.5' | Silurian-Permian |          | 3-4   | 79CX22E    |
| "                         | 68°07.5'/163°43.5' | Silurian-Permian |          | 2-3   | 79MD171E   |
| "                         | 68°07.7'/163°33.0' | Silurian-Permian |          | 3-4   | 79MD84D    |
| "                         | 68°08.5'/162°29.5' | Silurian-Permian |          | 3     | 79MD164-29 |
| "                         | 68°09.4'/162°48.0' | Silurian-Permian |          | 2.5-3 | 79EK163    |
| "                         | 68°10.8'/162°20.0' | Silurian-Permian |          | 3     | 79EK2B     |
| "                         | 68°12.5'/163°04'   | Silurian-Permian |          | 2.5   | 79EK196J   |
| "                         | 68°15.8'/163°09.8' | Silurian-Permian |          | 3     | 79CX214A   |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM           | (SERIES) | CAI   | FIELD NO.   |
|---------------------------|--------------------|------------------|----------|-------|-------------|
| DE LONG MTNS.             | 68°16.0'/163°07.2' | Silurian-Permian |          | 2-3   | 79EK262C    |
| "                         | 68°22.3'/163°22.0' | Silurian-Permian |          | 3     | 79EK189C    |
| "                         | 68°22.7'/162°28.7' | Silurian-Permian |          | 3     | 79MD181-62  |
| "                         | 68°12.2'/163°07.7' | Ord.-Permian     |          | 3     | 79MD110C    |
| "                         | 68°22.7'/162°28.7' | Ord.-Permian     |          | 2.5-3 | 79MD181-132 |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE  | SYSTEM        | (SERIES) | CAI   | FIELD NO. |
|---------------------------|---|---------------|----------|-------|-----------|
| *HARRISON BAY             | 70°25'29"/151°43'52.5"<br>(South Harrison Bay east<br>well, 10,613-26') | Pennsylvanian | (L-M)    | 2     |           |
| *                         | 70°49'56"/152°18'11"<br>(W.T. Foran east well<br>8,253-69')             | Pennsylvanian | (L-M)    | 1-1.5 |           |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM        | (SERIES) | CAI   | FIELD NO. |
|---------------------------|--------------------|---------------|----------|-------|-----------|
| HOWARD PASS               | 68°20.9'/158°15.8' | Silurian-Dev. |          | 1.5   | 78CX27A1  |
| "                         | 68°20.9'/158°15.7' | Devonian      | (U)      | 7     | 79ANS41C  |
| "                         | 68°24.2'/158°26.7' | Devonian      | (U)      | 2     | 79ANS25C  |
| "                         | 68°27.6'/156°34.6' | Devonian      | (U)      | 1-1.5 | 78Tr231   |
| "                         | 68°20.7'/158°16.5' | Dev.-Misc.    | (U-L)    | 3.5-4 | 78ANS205B |
| "                         | 68°19.4'/158°18.9' | Dev.-Triassic |          | 3     | 78AMH35D  |
| "                         | 68°19.3'/158°19.2' | Triassic      |          | 2     | 79ANS31B  |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE  | SYSTEM        | (SERIES) | CAT   | FIELD NO. |
|---------------------------|---|---------------|----------|-------|-----------|
| *KILLIK RIVER             | 68°29'05.5"/155°41'35.5"<br>(Liaburne test well,<br>16,302-09') | U. Dev.-Miss. |          | 3.5   |           |
| "                         | 68°26.8'/155°52.5'  | Mississippian |          | 1.5-2 | 79EK296B  |
| "                         | 68°28.6'/155°42.2'  | Mississippian |          | 1.5   | 79T1177P  |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE   | SYSTEM        | (SERIES) | CAL   | FIELD NO.  |
|---------------------------|----------------------|---------------|----------|-------|------------|
| MISHEGUK MTN.             | 68°26.2' / 160°57.3' | Devonian      | (M)      | 3     | 78MD160A   |
| "                         | 68°09.3' / 161°41.0' | Devonian      | (M-U)    | 3     | 78Tr161B-C |
| "                         | 68°12.1' / 160°10.7' | Devonian      | (M-U)    | 4     | 78Tr120A   |
| "                         | 68°09.2' / 161°44.1' | Devonian      | (U)      | 1.5-2 | 78Tr157    |
| "                         | 68°19.5' / 161°42.5' | Devonian      | (U)      | 2     | 78MD133    |
| "                         | 68°04.4' / 161°52.6' | Dev.-Miss.    | (U-L)    | 1.5   | 78Tr155A   |
| "                         | 68°14.4' / 159°51.9' | Dev.-Miss.    | (U/L)    | 3     | 78ND87     |
| "                         | 68°24.5' / 159°54.5' | Dev./Miss.    | (U/L)    | 3     | 78ND116A   |
| "                         | 68°10.2' / 161°44.0' | Dev.-Miss.    | (M-L)    | 1.5   | 78MD128C   |
| "                         | 68°15.3' / 161°33.8' | Dev.-Miss.    | (U-L)    | 2     | 78MD137R   |
| "                         | 68°34.1' / 159°26.2' | Dev.-Miss.    | (U-L)    | 3     | 78Tr32A    |
| "                         | 68°10.4' / 161°41.2' | U. Dev.-Miss. |          | 1.5-2 | 78MD129R   |
| "                         | 68°24.3' / 161°34.4' | Mississippian | (L)      | 2.5-3 | 78EK123C   |
| "                         | 68°36.6' / 159°13.0' | Mississippian | (U)      | 2     | 82Tr38     |
| "                         | 68°37.1' / 159°12.5' | Mississippian | (U)      | 2     | 82Tr4G     |
| "                         | 68°10.5' / 161°41.1' | Mississippian |          | 1.5-2 | 78MD129A   |
| "                         | 68°11.4' / 160°46.7' | Mississippian |          | 2.5-3 | 78EK116P   |
| "                         | 68°21.8' / 161°44.8' | Mississippian |          | 2-3   | 78MD130B   |
| "                         | 68°37.2' / 159°14.0' | Miss./Penn.   | (U/L)    | 2     | 82Tr2C-E   |
| "                         | 68°38.5' / 159°17.3' | Miss./Penn.   | (U/L)    | 1.5   | 82Tr1A     |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM           | (SERIES) | CAI   | FIELD NO. |
|---------------------------|--------------------|------------------|----------|-------|-----------|
| MISHEGUK MTN.             | 68°16.5'/161°58.8' | Miss.-Permian    | (U-L)    | 2-2.5 | 79Tr30D   |
| "                         | 68°28.1'/160°31.0' | U. Dev.-Permian  |          | 3     | 78EK73    |
| "                         | 68°30.8'/159°19.2' | Dev.-Permian     |          | 3     | 78EK16C   |
| "                         | 68°11.6'/160°12.6' | Silurian-Permian |          | 3     | 78TR121A  |
| "                         | 68°15.9'/161°28.8' | Silurian-Permian |          | 3     | 78MD186   |
| "                         | 68°20.3'/159°51.5' | Silurian-Permian |          | 3     | 78MD115E  |
| "                         | 68°27.0'/160°14.2' | M. Ord.-Permian  |          | 3     | 78EK79E   |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE | SYSTEM      | (SERIES) | CAI   | FIELD NO. |
|---------------------------|--------------------|-------------|----------|-------|-----------|
| POINT HOPE                | 68°33.9'/166°14.0' | Silurian    | (L)      | 5     | 82Tr83B   |
| "                         | 68°49.2'/166°12.2' | Dev.-Miss.  | (U-U)    | 1.5-2 | 82Tr108B  |
| "                         | 68°08.4'/165°57.9' | Miss.       | (U)      | 2.5   | 82Tr105   |
| "                         | 68°41.6'/166°11.7' | Miss.       | (U)      | 1.5-2 | 82Tr95    |
| "                         | 68°43.5'/166°11.9' | Miss.       | (U)      | 1-1.5 | 82Tr96    |
| "                         | 68°44.5'/165°49.8' | Miss.       | (U)      | 1.5-2 | 82AKr26a  |
| "                         | 68°45.1'/166°11.8' | Miss.       | (U)      | 1.5-2 | 82Tr98A   |
| "                         | 68°45.3'/166°11.9' | Miss.       | (U)      | 1.5-2 | 82Tr98B   |
| "                         | 68°45.7'/166°11.8' | Miss.       | (U)      | 1.5-2 | 82ARr30   |
| "                         | 68°47.1'/166°11.3' | Miss.       | (U)      | 1.5-2 | 82Tr99    |
| "                         | 68°48.8'/166°12.0' | Miss.       | (U)      | 2-3   | 82Tr108A  |
| "                         | 68°49.7'/166°12.0' | Miss.       | (U)      | 1.5-2 | 82Tr109   |
| "                         | 68°50.1'/166°11.8' | Miss.       | (U)      | 2-2.5 | 82Tr110   |
| "                         | 68°46.8'/166°11.2' | Miss.-Penn. |          | 1.5-2 | 82Tr100   |
| "                         | 68°44.4'/166°11.7' | Ord.-Tri.   |          | 1.5-2 | 82Tr97    |

| QUADRANGLE<br>(1:250,000) | LATITUDE/LONGITUDE  | SYSTEM        | (SERIES) | CAI   | FIELD NO. |
|---------------------------|---|---------------|----------|-------|-----------|
| *TESHEKPUK                | 70°00.3'/153°06'<br>(Inlgok east well,<br>16,185-98')<br>(14,037-54') | Mississippian | (U)      | 3.5-4 |           |
| *                         | 70°55.2'/153°08.3'<br>(J.W. Dalton east well,<br>8317-41')            | Pennsylvanian | (L-M)    | 1.5   |           |
| *                         | 70°57.2'/155°21.4'<br>(T.W. Simpson well,<br>6464')                   | Triassic      | (M)      | 1.5   |           |
| *                         | 70°27.3'/154°19.9'<br>(Ikipkuk east well,<br>11,718-33')              | Permian       | (L/U)    | 2     |           |