ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

REPORT OF INVESTIGATIONS 2016-4
Gregersen and Shellenbaum, 2016
SHEET 1 OF 1

TOP MESOZOIC UNCONFORMITY SUBCROP MAP, COOK INLET BASIN, ALASKA

by
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2015

SCALE 1:500 000

QUADRANGLE INDEX

MAP LOCATION

APPROXIMATE MINIMUM BEDROCK ELEVATIONS

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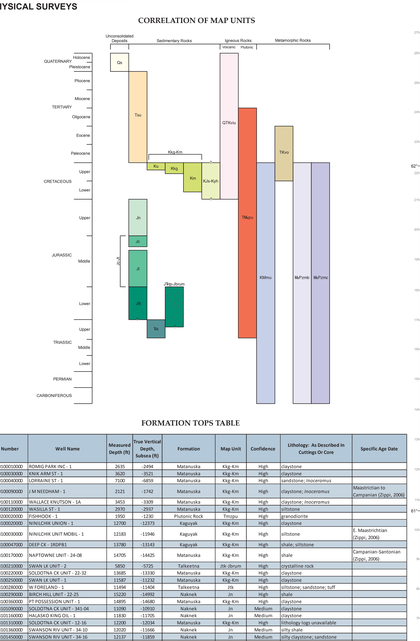
CORRELATION OF MAP UNITS



LIST OF MAP UNITS

Glaciers – Surface

Bedrock unknown – Surface

UNCONSOLIDATED DEPOSITS

Qs Surficial depositis, undivided (Quaternary) – Surface

SEDIMENTARY ROCKS

Sedimentary rocks, undivided (Quaternary–Tertiary) – Surface

Unnamed nonmarine sandstone at Saddle Mountain (Upper Cretaceous, Maastrichtian) – Surface

Kagayak Formation (Upper Cretaceous, Maastrichtian, and Campanian) – Subcrop and Surface

Matanuska Formation (Upper Cretaceous, Maastrichtian to upper Lower Cretaceous, Albian) – Subcrop and Surface

Turbidite sedimentary rocks of the Kahiltna flysch sequence and graywacke of Yentlo Hills, undivided (Cretaceous, Aptian, and Valanginian or younger, in Upper Jurassic?) – Surface

Naknek Formation, undivided (Upper Jurassic) – Subcrop and Surface

Chinitna Formation, undivided (Middle Jurassic; Callovian) – Subcrop and Surface

Tuxedni Group, undivided (Middle Jurassic; lower Bathonian to Aalenian) – Subcrop and Surface

Talkeetna Formation, undivided (Lower Jurassic) – Subcrop and Surface

Talkeetna Formation, Border Ranges Ultramafic and Mafic Complex, undivided (Lower Jurassic, Upper Triassic, Norian) – Subcrop and Surface

Kemishak Formation (Upper Triassic, Norian) – Surface

IGNEOUS ROCKS

VOLCANIC ROCKS

GTKnu Volcanic and shallow intrusive rocks, undivided (Quaternary, Tertiary, Cretaceous) – Surface

PLUTONIC ROCKS

TMzpi Plutonic rocks, undivided (Tertiary, Cretaceous, Jurassic, Upper Triassic) Volcanic and shallow intrusive rocks, undivided (Quaternary, Tertiary, Cretaceous) – Subcrop and Surface

METAMORPHIC ROCKS

TKvu Orca and Valdez Groups, undivided (Tertiary, Upper Cretaceous) – Surface

MzPzu McHugh and Uyak Complexes, undivided (Cretaceous to Mississippian) – Surface

MzPzmu Metamorphic rocks near the Border Ranges fault, undivided (Cretaceous to Mississippian) – Surface

MzPzmc Metamorphic rocks north of the Castle Mountain and Bruin Bay faults, undivided (Cretaceous to Mississippian) – Surface

Note: The location of the map unit is specified after the dash (–) in each description – unit appears only on the subcrop map
Surface – unit appears only on the surface geologic map
Subcrop and Surface – unit appears on both the subcrop map and surface geologic map

FORMATION TOPS TABLE

Map No.	API Number	Well Name	Measured Depth (ft)	True Vertical Depth, Subsea (ft)	Formation	Map Unit	Confidence	Lithology As Described In Cuttings Or Core	Specific Age Date
1	50009120010000	ROMIG PARK INC - 1	2635	-2494	Matanuska	Kkg-Km	High	claystone	
2	50009120030000	ROOSTER OIL - 1	3600	-3521	Matanuska	Kkg-Km	High	claystone	
3	50009120060000	LORRAINE ST - 1	7100	-6859	Matanuska	Kkg-Km	High	sandstone: micaceous	
4	50009120080000	EM NEECHAM - 1	2121	-1742	Matanuska	Kkg-Km	High	claystone; micaceous	
5	50009120100000	HAWK UNIT TYSON - 1A	10600	-10211	Matanuska	Kkg-Km	High	claystone; micaceous	
6	50009120120000	WASILLA ST - 1	2970	-2937	Matanuska	Kkg-Km	High	siltstone	
7	50009120160000	DEEP CREEK - 1	1050	-1249	Fishtrap Rock	Tmzpu	High	granodiorite	
8	50133100020000	NINILCHIK UNOCAL - 1	12700	-12373	Kaguyak	Kkg-Km	High	claystone	
9	50133100030000	NINILCHIK UNIT MOBIL - 1	12183	-11946	Kaguyak	Kkg-Km	High	siltstone	
10	50133100170000	DEEP CREEK - 1	1180	-1179	Kaguyak	Kkg-Km	High	shale; siltstone	E. Maastrichtian (Tappan, 2006)
11	50133100170000	NAPTOWNE UNIT - 24-08	14705	-14425	Matanuska	Kkg-Km	High	shale	Campanian-Santonian (Zippi, 2009)
12	50133100200000	JOHN U UNIT - 2	5850	-5725	Talkeetna	Jk-Jbrum	High	crystalline rock	
13	50133100250000	KENAI NATIVE ASSN 2-22-32	13665	-13100	Matanuska	Kkg-Km	High	claystone	
14	50133100290000	SWAN UE UNIT - 1	11587	-11232	Matanuska	Kkg-Km	High	claystone	
15	50133100300000	BIG LAKE FEDERAL - 1	11404	-11404	Talkeetna	Jk	High	claystone; sandstone; tuff	
16	50133100930000	BIRCH HILL UNIT - 22-21	15200	-14992	Naknek	Jn	High	shale	
17	50133100400000	PYRAMID RIV UNIT - 34-10	14895	-14680	Matanuska	Kkg-Km	High	silty shale	
18	50133100600000	SOLDOTNA CK UNIT - 341-04	10390	-10910	Naknek	Jn	Medium	claystone	
19	50133100610000	BALAKLAVA INC - 1	11930	-11779	Naknek	Jn	High	claystone	
20	50133100610000	SOLDOTNA CK UNIT - 32-10	12200	-12034	Matanuska	Kkg-Km	High	lithology logs unavailable	
21	50133100640000	SWANSON RIV UNIT - 34-10	12030	-11686	Naknek	Jn	Medium	silty shale	
22	50133100650000	SWANSON RIV UNIT - 14-10	15137	-11559	Naknek	Jn	Medium	silty claystone; sandstone	
23	50133100690000	MIDDLE RIV ST SHELL - 1	5250	-5124	Talkeetna	Jtk	High	volcanic rock	
24	50133100700000	MIDDLE RIV ST - 1	5000	-4875	Talkeetna	Jtk	High	basalt	
25	50133100810000	TWANSON UFS - 1	13040	-11801	Matanuska	Kkg-Km	High	claystone; micaceous	
26	50133100910000	BUSKATAN CWI-NON - 1	13100	-12838	Talkeetna	Jtk	High	sandstone	
27	50133100930000	HAPPY VALLEY - 31-22	11539	-12580	Kaguyak	Kkg-Km	High	sandstone; micaceous	
28	50133100930000	ANCHOR RIV - 1	6750	-5224	Metasedimentary Rock	MzPzmu	Medium	claystone; highly oxidized, chert	
29	50133100940000	N FORK UNIT - 41-35	11045	-10260	Kaguyak	Kkg-Km	Medium	sandstone	
30	50133100950000	ANCHOR RIV - 1	8970	-8719	Kaguyak	Kkg-Km	High	claystone	
31	50133100960000	PRITZ CK - 1	3580	-3425	Metasedimentary Rock	MzPzmu	High	sandstone; argillite; muscovite schist	
32	50133100960000	N FORK UNIT - 11-04	12130	-11007	Kaguyak	Kkg-Km	High	sandstone	
33	50133100970000	S CARIBOU HILL UNIT - 1	9964	-9647	Metasedimentary Rock	MzPzmu	High	shale	
34	50133100970000	TITDATNA CK - 1	7080	-6326	Plutonic Rock	Tmzpu	High	quartz diorite	
35	50133100980000	IVAN RIV UNIT - 44-01	13125	-11026	Matanuska	Kkg-Km	High	sandstone; tuff	Maastrichtian (Zippi, 2006)
36	50133100980000	TYONEK ST 17587 - 2	12260	-13154	Tuxedni	Jc-Jt	Medium/Low	claystone	
37	50133100990000	COTTONWOOD ST - 1	4140	-4061	Plutonic Rock	TMzpu	High	granite	155 my ±2 (Zippi, 2006)
38	50133101040000	CAMPBELL PT - 1	4315	-4252	Matanuska	Kkg-Km	High	tuff; claystone	
39	50133101050000	W TYONEK - 1	6620	-6195	Talkeetna	Jtk	High	welded tuff	
40	50133101060000	NICOLAI CK UNIT UNION - 5	8540	-8451	Talkeetna	Jtk	High	volcanic rock	
41	50133101070000	OLONAN S 8A-17 - 1	11640	-11411	Naknek	Jn	High	sandstone	
42	50133101130000	KALGIN FLST - 1	14101	-14056	Naknek	Jn	High	sandstone	
43	50133101140000	GRIT FKST 17 - 1	5010	-4951	Talkeetna	Jtk	High	claystone; siltstone	
44	50133101240000	REDOUBT SHOAL ST 22064 - 1	14239	-14208	Tuxedni	Jc-Jt	Medium/Low	claystone	
45	50133101300000	W FORELAND UNIT - 1	10912	-10812	Talkeetna	Jtk	High	claystone; tuff	
46	50133101300000	W FORELAND UNIT - 4	13270	-13141	Talkeetna	Jtk	High/Medium	sandstone	
47	50133101310000	STATE 18G - 1	11630	-11199	Naknek	Jn	High	shale; tuff	
48	50133101330000	MIDDLE RIV ST ARCO - 1	6954	-6873	Talkeetna	Jtk	High	claystone	
49	50133101350000	KUSTATAN UNOCAL - 1	11737	-11173	Naknek	Jn	High/Medium	claystone; tuff	
50	50133101350000	TRADING BAY - 7A	6010	-5981	Talkeetna	Jtk	High	claystone; tuff	
51	50133101370000	TRADING BAY ST - A-02	6605	-6291	Talkeetna	Jtk	High	tuff	
52	50133101390000	GRANITE PT - 1	11508	-11447	Tuxedni	Jc-Jt	Medium/Low	claystone; indurated	
53	50133101390000	MIDDLE GROUND SHOAL ST 18S - 1	6049	-6995	Naknek	Jn	High	claystone	
54	50133101390000	MIDDLE GROUND SHOAL - A43-11	9712	-9540	Naknek	Jn	High	claystone	
55	50133101400000	CORLAIS ST 18743 - 1	13016	-12001	Talkeetna	Jtk	High	claystone; volcanic	
56	50133101430000	W TRADING BAY ST - 1	6211	-6211	Talkeetna	Jtk	High	lithology logs unavailable	
57	50133101430000	TRADING BAY ST - A-12	7255	-6275	Talkeetna	Jtk	High	lithology logs unavailable	
58	50133101600000	W FORELAND UNIT - 5	8585	-8494	Talkeetna	Jtk	High	basalt	
59	50133101600000	BUCATNA RIV UNIT - A3-10	10840	-10662	Talkeetna	Jtk	High	sandstone	
60	50133101600000	TRADING BAY UNIT - G-07	11205	-10622	Talkeetna	Jtk	High/Medium	lithology logs unavailable	
61	50133101600000	N FORELAND UNIT - SPR-04	6985	-6587	Talkeetna	Jtk	High	lithology logs unavailable	
62	50133101800000	MIDDLE RIV ST UNIT - 2	8080	-7792	Talkeetna	Jtk	High	siltstone; conglomerate	
63	50133101800000	TRADING BAY UNIT - D-17	11630	-10746	Talkeetna	Jtk	High/Medium	volcanic fragments	
64	50133101730000	GRANITE PT ST 18741 - MLK-1	13365	-12041	Naknek	Jn	Medium	shale; sandstone	
65	50133101760000	TRADING BAY UNIT - G-18	12033	-10985	Talkeetna	Jtk	High	lithology logs unavailable	
66	50133101940000	TRADING BAY UNIT - G-31	12676	-10659	Talkeetna	Jtk	High/Medium	lithology logs unavailable	
67	50133101940000	TRADING BAY UNIT - G-32	11535	-10319	Talkeetna	Jtk	High/Medium	lithology logs unavailable	
68	50133101940000	TRADING BAY ST - A-31	7180	-6624	Talkeetna	Jtk	High	lithology logs unavailable	
69	50133101950000	W TRADING BAY - 1	12517	-11837	Talkeetna	Jtk	High/Medium	tuff	
70	50133101950000	W TRADING BAY - 1	8660	-8300	Talkeetna	Jtk	High	tuff; clay	
71	50133101950000	W TRADING BAY UNIT - 14	13930	-11149	Tuxedni	Jc-Jt	Medium/Low	claystone	
72	50133101960000	BEARD ST - 1-11	11246	-11126	Naknek	Jn	High	siltstone	
73	50133101960000	ST MICHEN - 1	6850	-6830	Talkeetna	Jtk	High	siltstone	
74	50133101970000	TRADING BAY UNIT - M-29	11335	-10811	Talkeetna	Jtk	High/Medium	tuff; claystone	
75	50133102020000	STARICHKOF ST - 3	8750	-8682	Kaguyak	Kkg-Km	High	sandstone	
76	50133102030000	COAL BAY ST - 1	3920	-3908	Metasedimentary Rock	MzPzmu	Medium	siltstone; clay; thin bed chert	
77	50133102030000	TYONEK ST 17586 - 1	13230	-13111	Naknek	Jn	Medium	sandstone; conglomerate	
78	50133102100000	W COOK INLET ST - 1	14020	-14020	Metasedimentary Rock	MzPzmu	High	shale	
79	50133102930000	TURNAGAIN ARM UNIT - 1	4213	-4163	Matanuska	Kkg-Km	High	sandstone	
80	50133102940000	N FORELAND ST - 1	5561	-5561	Matanuska	Kkg-Km	High	sandstone	
81	50133103010000	OCS 0168 COHO - 2	4052	-4003	Kaguyak	Kkg-Km	High	claystone; siltstone	
82	50133103010000	OCS COST LOWER COOK INLET - 1	2550	-2459	Kaguyak	Kkg-Km	High	siltstone; claystone	Maastrichtian - microfossils (Magoon, 1986)
83	50133103010000	OCS 0097 RAVEN - 1	2505	-2505	Kaguyak	Kkg-Km	High	siltstone; claystone	Campanian @ 5080 Foraams & nannofossils 3565'ft
84	50133103010000	OCS 0086 GUPPY - 1	5030	-4965	Kaguyak	Kkg-Km	High	siltstone; claystone	Campanian or older (Zippi, 2006)
85	50133103010000	OCS 0136 BEDE - 1	3505	-3427	Kaguyak	Kkg-Km	High	claystone	
86	50133103010000	OCS 0152 ROWHEAD - 1	3930	-3856	Kaguyak	Kkg-Km	High	claystone	
87	50133103010000	OCS 0124 ARCH - 1A	1350	-1271	Kaguyak	Kkg-Km	High	claystone; shale	
88	50133103010000	OCS 0151 BIRD - 1	670	-591	Kaguyak	Kkg-Km	High	sandstone	
89	50133103010000	OCS 0167 FALCON - 1	1965	-1884	Kaguyak	Kkg-Km	High	claystone; siltstone	Maastrichtian (8501'ft)
90	50133103110000	BILL G - 1	13300	-10951	Naknek	Jn	High	claystone	
91	50133103200000	ALBERT KALDA - 1	13510	-13258	Tuxedni	Jc-Jt	Medium/Low	claystone	
92	50133103110000	LEWIS RIV - 13-02	11179	-11026	Tuxedni	Jc-Jt	Medium/Low	claystone	
93	50133103130000	STATE 36A65 - 1	11640	-13505	Tuxedni	Jc-Jt	High	claystone	
94	50133103130000	BEA - 1	13015	-10779	Kaguyak	Kkg-Km	High	claystone; siltstone	
95	50133103140000	NORTH FORK UNIT - 32-35	11965	-11286	Kaguyak	Kkg-Km	High	claystone; siltstone	
96	50133103150000	NORTH FORK UNIT - 14-25	11445	-10068	Kaguyak	Kkg-Km	High	siltstone; claystone	
97	50133103150000	BELUGA RIVER UNIT - 212-35	16760	-14657	Matanuska	Kkg-Km	Medium	claystone	
98	50133103200000	INGSIN UNIT BEAL - 1	0	350	Tuxedni	Jc-Jt	High	claystone	
111	50133103200000	INGSIN UNIT UNOCAL - 1	0	330	Tuxedni	Jc-Jt	High	lithology logs unavailable at DNR	

*BSEE = Bureau of Safety and Environmental Enforcement

EXPLANATION

This map shows the subcrop pattern of the Mesozoic rock units present at the top Mesozoic unconformity (also commonly referred to as the Base Tertiary unconformity) in Cook Inlet basin, Alaska. The subcrop is projected onto the top Mesozoic unconformity depth surface as mapped by Shellenbaum and others (2010). Oil in Cook Inlet basin is primarily derived from organic-rich petroleum source rocks in the Middle-Jurassic Tuxedni Group (Magoon and Anders, 1992; Magoon, 1994). The subcrop trends of the Middle Jurassic oil source rocks and potential petroleum reservoir rocks of Mesozoic age are important consideration in oil exploration in the inlet.

Publicly available geological and geophysical data from multiple sources were collected, interpreted, and integrated into the subcrop map. Formation picks at the top Mesozoic unconformity were determined for 109 wells. Mesozoic horizons from two regional seismic, two-dimensional (2-D) seismic datasets (~3,300 miles) were interpreted. Seven map units were established for the Mesozoic subcrop map: Kaguyak–Matanuska Formations, undivided; Naknek Formation; Chinitna Formation–Tuxedni Group, undivided (Middle Jurassic); Talkeetna Formation (Lower Jurassic); and Talkeetna Formation–Border Ranges ultramafic and mafic complex (BRUMC), undivided (Lower Jurassic to Lower Triassic). The metamorphic rocks were Well formation picks, marine 2-D seismic interpretation, production from outcrop, and interpreted aeromagnetic data had the greatest influence on the subcrop map unit boundaries.

Each Mesozoic sedimentary map unit regionally trends northeast–southwest, with perturbations in the map pattern due to paleogeography and localized faulting and folding. The Mesozoic sedimentary rocks, in general, form a broad syncline in which Oligocene and younger rocks unconformably overlie progressively older units from west to the northeast on the eastern and western sides of the basin by Jurassic and older volcanic and sedimentary rocks (Fisher and Magoon, 1978; Jones and others, 1976; Detterman and others, 1982). The principal form of the basin is shown clearly on seismic line ALC-009, a migrated dip line in lower Cook Inlet cross section A–A'.

This map was projected by the Alaska Department of Natural Resources as part of a multi-year effort to provide the public with the most accurate information possible on the geologic framework of this economically important area.

Data Collection

Publicly available geological and geophysical data that inform subcrop map were collected and catalaged. These data include: wireline logs and lithology logs obtained from the Alaska Oil and Gas Conservation Commission (AOGCC), GABTAPE (Alaska Division of Geological & Geophysical Surveys petroleum-focused database), the Alaska Geologic Materials Center (GMC) paleology data (Zippi, 2006); other biostratigraphic data (Bureau of Safety and Environmental Enforcement [BSEE] library); Magnox, 1980; Detterman and others, 1982; Magoon and others, 1986). Well formation CI88 and CI89 picks: public 1975 Marathon seismic data (ALC prefix, donated to the U.S. Geological Survey [USGS] by Weatherford Laboratories, Houston, Texas, written onto tapes (R.W. Saltus, Jonathan; and Saltus, 2011); geologic maps of the Cook Inlet region (Magoon and others, 1976; Winkler, 1992; Bradley and others, 1999; Detterman and Reed, 1980; Wilson and others, 2012); previous subcrop map interpretations (Kirschner and Lyon, 1973; Magoon and others, 1980; Gregersen and Shellenbaum, 2010); published cross sections through the basin (Hess and others, 1976; Magoon and Claypool, 1981; Church and others, 1985; Fuchs and others, 1985; Laughlanm and others, 1985; Laughlanm and others, 1973; Seamount, 2005); and the top Mesozoic unconformity depth map for Cook Inlet basin (Shellenbaum and others, 2010).

Subcrop Map Structural Surface

The Mesozoic subcrop map is projected onto the top Mesozoic unconformity depth surface of Cook Inlet basin, Alaska, published by Shellenbaum and others (2010). This surface is the boundary between the Tertiary sedimentary rocks that comprise the basin fill and the older, lithified, pre-basin rocks. Mesozoic sedimentary rocks are the most likely basin source rocks of oil as well as potential petroleum reservoir rocks. The boundaries of the subcrop map are the same as for the map of Shellenbaum and others (2010).

Formation Picks

Formation picks at the top Mesozoic unconformity were determined for 109 wells in Cook Inlet basin (see formation tops table). The formation picks were primarily interpreted from drill cuttings and wireline logs, and, when available, core, biostratigraphic, paleontological, geochemical, and (or) petrophysical data were considered.

The easiest subcrop units to distinguish from cuttings and core chips at the top Mesozoic unconformity were the Upper Cretaceous to upper Lower Cretaceous Kaguyak–Matanuska Formations, undivided; Jurassic-age plutonic rocks, undivided, and the metamorphic rocks near the Border Ranges fault, undivided. The most challenging formations to clearly identify in cuttings at the top Mesozoic unconformity were the Upper Jurassic Naknek Formation, the Middle Jurassic Chinitna Formation–Tuxedni Group, undivided, and the Lower Jurassic Talkeetna Formation. The challenge stems from the fact that the Middle Jurassic Chinitna Formation–Tuxedni Group, undivided, contains lithic volcanic detritus (derived from the volcanic rocks of the Talkeetna Formation) and plutonic detritus (the primary component of the Naknek Formation). Age calls from palynology and biostratigraphy, seismic character, and proximity to mapped bedrock helped differentiate between the Jurassic rock units.

Geophysical Interpretation

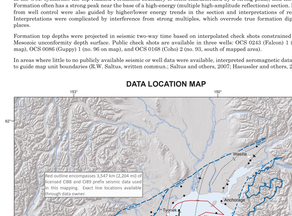
Two regional 2-D marine seismic data sets were used to interpret the Mesozoic horizons. Upper Jurassic Naknek, Middle Jurassic Tuxedni, and Lower Jurassic Talkeetna (data location map). The primary regional data were the same CI88 and CI89 multichannel data (~2,200 miles, now marketed by Spectrum Geo and Reflex, Inc) used in the construction of the top Mesozoic unconformity depth map. USGS seismic data from lower Cook Inlet were migrated and interpreted to provide additional control (~3,300 miles). 1975 vintage ALC data available from the USGS National Archive of Marine Seismic Surveys [NAMSS] website). The final interpretation was an internally consistent set of horizon picks that honored all of the well control. Between the wells, the interpretation was sometimes based on wavelet character, but in many areas depended on projections and dip interpretation rather than consistent character picks. The fact that the Talkeetna and Naknek Formations are truncated and locally transgressive, commonly angular, adds to potential dip interpretation and extrapolation away from well control. Naknek and Tuxedni/Talkeetna horizons are also often characterized by packages of high-amplitude reflections that provide broad indications of continuity where individual reflections do not. Wells with Mesozoic formation tops were used to constrain the horizon picks (Outer Continental Shelf [OCS] wells in lower Cook Inlet and the North Foreland–State #1 well in upper Cook Inlet).

In the middle and upper Cook Inlet, where Mesozoic well control was sparse, horizon picks were influenced by the formation picks at the top Mesozoic unconformity and the interpretation of the Mesozoic horizons in adjacent areas where tops were created when available, but due to low seismic frequencies and poor signal-to-noise in the deeper data, statistical or character tows were problematic. Insights from the synthetics were used to guide the picks away from well control. Reflections in the OCS synthetics the top Naknek Formation boundary is often characterized by a strong peak); and the Talkeetna Formation shows has a strong peak at the base of a high-amplitude reflection. Lower amplitude reflections in the Talkeetna Formation (as well control were also guided by higherlower energy trends in the section and interpretations of regional dip. Interpretations were also influenced by interference from strong multiples, which overprode true formation dips in many places.

Formation top depths were projected in seismic two-way time based on interpolated check shots constrained by the top Mesozoic unconformity depth surface. Public check shots are available in three wells: OCS 0243 (Falcon) 1 (no. 101 on map), OCS 0168 (Coho) 2 (no. 80), and OCS 0158 (Cohoe) 2 (no. 93, south of mapped area).

In areas where little to no publicly available seismic or well data were available, interpreted aeromagnetic data were used to guide map unit boundaries (R.W. Saltus, written commun.; Saltus and others, 2007; Hauessler and others, 2011).

DATA LOCATION MAP



DESCRIPTION OF SUBCROP MAP UNITS

Seven map units were established for the top Mesozoic subcrop map, based on well formation picks, 2-D seismic interpretation, interpreted aeromagnetic data, and surrounding bedrock geology. The sedimentary rock units include: Kaguyak–Matanuska Formations, undivided (Upper Cretaceous to upper Lower Cretaceous); Naknek Formation (Upper Jurassic); Chinitna Formation–Tuxedni Group, undivided (Middle Jurassic); Talkeetna Formation (Lower Jurassic); and Talkeetna Formation–Border Ranges ultramafic and mafic complex (BRUMC), undivided (Lower Jurassic to Lower Triassic). The metamorphic rocks are lumped into one unit. Plutonic rocks, undivided (Tertiary to Triassic).

A composite of 17 map units exist from the combined subcrop map in the subsurface and the surrounding bedrock geology from the USGS 2012 geologic map of the Cook Inlet region (Wilson and others, 2012) and the USGS 2015 geologic map of Alaska (Wilson and others, 2015). The list of map units specific which units appear only on the subcrop map, which map units appear only on the surface geologic map, and which units appear on both the subcrop and the surface geologic maps.

The following paragraphs provide rock descriptions for the seven subcrop map units as they are observed in outcrop, cuttings, and core.

KAGUYAK–MATANUSKA FORMATIONS, UNDIVIDED (**Kkg-Km**)—The Kaguyak–Matanuska Formations, undivided, are interpreted at the top Mesozoic unconformity in wells in central and east-central Cook Inlet basin. In the subsurface these two units are treated as correlative, with the formation name changing from Matanuska in upper Cook Inlet to Kaguyak south of Kalgin Island in lower Cook Inlet (Magoon, 1986). Outcrops of Matanuska Formation are present along trend to the northeast on the Matanuska Valley, and outcrops of the Kaguyak Formation are present along trend to the south on the upper Alaska Peninsula.

The Matanuska Formation is described in outcrop as dark-gray, marine shale, siltstone, sandstone, and conglomerate with fossiferous fragments and ammonites (Grantz, 1964; Trop, 2008). The Kaguyak Formation is described in outcrop as dark gray to pale brown, marine; fossiliferous, siltstone, sandstone, and shale (Detterman and Miller, 1985; Wartes and others, 2015a). Nonmarine sedimentary rocks correlative with the Kaguyak Formation have been documented in the CODT well (no. 94 on map) and in outcrop (Magoon, 1986; Magoon, and others, 1980; LePain and others, 2012). The cuttings interpreted as Kaguyak–Matanuska Formations, undivided, are described as dark gray shale, gray-green to gray-brown siltstone, and sandstones with *Inoceramus* prisms. Palynology data from these wells suggest a Late Cretaceous age (Zippi, 2006), which supports the Kaguyak–Matanuska Formation, undivided, interpretation.

Lower Cretaceous sedimentary rocks are present in the CODT well (no. 94) and are known from seismic data to be widespread in lower Cook Inlet, but they do not intersect the top Mesozoic unconformity nor do they crop out anywhere in the map area. In outcrops near Saddle Mountain on the west side of the basin, Upper Cretaceous nonmarine strata correlative with unit **Kkg-Km** unconformably overlie the Upper Jurassic Naknek Formation, and Lower Cretaceous rocks are not present due to erosion or nondeposition.

NAKNEK FORMATION (**Jn**)—The Naknek Formation is interpreted at the top Mesozoic unconformity in eight wells in the west-central portion of the basin, along strike of Naknek outcrops on the Iniskin Peninsula. The Naknek Formation is also interpreted at the top Mesozoic unconformity in six wells at Swanson River Field on the east side of the basin. Seismic data in lower Cook Inlet indicate a northeast–southwest subcrop trend for the Naknek on the east side of the basin. The 2-D data also suggest that there is a window of the Naknek Formation at the top Mesozoic unconformity, offshore, northwest of the Ninilchik Unocal 1 well (no. 8 on map).

The Naknek Formation is described in outcrop as light to dark gray, fossiliferous, marine arkosic sandstone, conglomerate, siltstone, and shale having a primarily pluvious provenance (Detterman and Hartsock, 1966; Detterman and others, 1996; Trop and others, 2005; Wartes and others, 2015b). Multiple wells in the west-central portion of the basin include strata that are assigned an age of Late Jurassic at the top Mesozoic unconformity: Bell Island 1, State SRS 1, MC State SRS 1, Kalgin Island State 1, and Oldman Bay State 1 (nos. 92, 59, 65, 54, and 53 on map) (Zippi, 2006; Boss and others, 1970). Cuttings in those wells at the top Mesozoic unconformity are described mostly as gray to gray-green claystone, siltstone with some sandstone, arkose, tuff, and argillite. In the subsurface, the westernmost portion of the Naknek Formation include gray to pale green siltstone, sandstone, claystone, mica, tuff, and glauconite.

CHINITNA FORMATION–TUXEDNI GROUP, UNDIVIDED (**Ja–Jt**)—The Chinitna Formation–Tuxedni Group, undivided, is interpreted at the top Mesozoic unconformity in six wells on the west side of Cook Inlet, along strike of the Chinitna Formation and Tuxedni Group outcrops on the Iniskin Peninsula. On the east side of the basin, seismic data in lower Cook Inlet indicate a northeast–southwest subcrop trend, but no wells are interpreted to have Chinitna Formation or Tuxedni Group at the top Mesozoic surface on the east side of the basin.

In outcrop, the Chinitna Formation and Tuxedni Group are described as light to dark gray and green, marine, fossiliferous, siltstone, sandstone, and shale with the Chinitna Formation having many limy concretions (Detterman and Hartsock, 1966; Detterman and Reed, 1980). Both the Chinitna Formation and the Tuxedni Group contain a mixture of plutonic and volcanic detritus and clasts presumed to be derived from erosion of the Talkeetna Formation and related plutonic rocks of the Early Jurassic magmatic arc (Detterman and Hartsock, 1966; Trop and others, 2005). Two wells, Iniskin Unit Bed (no. 110 on map) and Iniskin Unit Zappa (no. 111 on map), are drilled in surface outcrops of the Tuxedni Group. Green-gray and brown-gray siltstone, sandstone, conglomerate, and shale are documented in cuttings in these wells. A Middle-Jurassic age was assigned to the rocks at the top Mesozoic unconformity in the State 36465A 1 well (no. 105 on map) (Zippi, 2006). The cuttings in those wells at the top Mesozoic unconformity are described mostly as gray to green claystone, siltstone with some sandstone, arkose, tuff, and argillite. In the subsurface, the westernmost portion of the Tuxedni Group include gray to pale green siltstone, sandstone, claystone, mica, tuff, and glauconite.

TALKEETNA FORMATION AND TALKEETNA FORMATION–BORDER RANGES ULTRAMAFIC AND MAFIC COMPLEX, UNDIVIDED (**Jtk and Jtbr**)—The Talkeetna Formation is interpreted at the top Mesozoic unconformity in seven of the wells in the West Foreland–Trading Bay Unit area of the west side of Cook Inlet basin. Outcrops of the Talkeetna Formation are present to the west and south of Cook Inlet basin. The Talkeetna Formation is also interpreted at the top Mesozoic unconformity on the east side of the basin in one well, Swan Lake 2 (no. 12 on map). Outcrops of the Talkeetna Formation on the east side of the basin are found in the northeast Kenai Peninsula and in the Talkeetna Mountains. The Talkeetna Formation is described in outcrop as mafic and ultramafic plutonic rocks referred to as the Border Ranges ultramafic and mafic complex (BRUMC) (Burns, 1983; Winkler, 1992; Pavlis, 1982). Interpretations of nonmarine, lithic sandstone in the BRUMC and the Talkeetna Formation are present on the east side of Cook Inlet basin along the Border Ranges fault (Mankhemsbong and others, 2013; Burns and Winkler, 1976; Jones, 1963; Jones and others, 1976). Outcrops of volcaniclastic rocks, limestone, coal, and tuffaceous argillite interpreted to be correlative with the Talkeetna Formation are also present on the east side of Cook Inlet basin in the Chugach Mountains (Plafker and others, 1994; Clift and others, 2005). Detrital zircon data from Kelley (1983) named these outcrops the Paguloi Formation. Limestone, converted chert, and pyroxenite interpreted as the Port Graham Formation of Kelley (1983) are also found in outcrop in this area. Because no other well data or seismic data are available on the east side of the basin, and Tyonek, Beluga, and Sterling Formations are known to pinch out against the Paguloi Formation, or Port Graham Formation subcrops the top Mesozoic unconformity, we include the BRUMC, Paguloi Formation, and Port Graham Formation with the Talkeetna Formation on the east side of the basin and designate this as a separate map unit, Talkeetna–BRUMC undivided.

In outcrop, the Talkeetna Formation is described as dark green to black, red, and multicolored lava, agglomerate, breccia, and tuff with interbedded sandstone and shale (Detterman and Hartsock, 1966). The Talkeetna Formation is interpreted to be a product of extension and erosion of an Early Jurassic arc (Detterman and Reed, 1980; Trop and Plawman, 2006). The cuttings and core chips interpreted as Talkeetna Formation are described as gray-green-brown-black volcanics, basalt, and tuffs.

PLUTONIC ROCKS, UNDIVIDED (**TMzpi**)—Plutonic rocks are observed at the top Mesozoic unconformity in wells at three different locations. Two of these plutonic rocks are interpreted to the Bothem Creek Unit 7 (no. 34 on map) and the Cottonwood State 1 (no. 49 on map) wells, are in the northwestern corner of the subcrop map near outcrops of *Jurassic* quartz diorite, diorite, and granodiorite (Magoon and others, 1976). The third area, which corresponds to the Fishhook well (no. 7 on map), is in the northeastern cor