WYOMING STATE GEOLOGICAL SURVEY Thomas A. Drean **Director and State Geologist** Laramie, Wyoming

Interpreting the past, providing for the future

CORRELATION OF THE UPPER CRETACEOUS STRATA OF WYOMING



Open File Report 2017-3 Stratigraphic Chart **Upper Cretaceous** Wyoming



Bighorn Basin Western Hanna Laramie Denver Greater Green River Basin Wind River Basin **Powder River Basin** Wyoming Basin Basin Basin Y Α Μ Ν W Χ С D Е F G J Κ Ο Q R S Т В н L Ρ U V Age Period Epoch Polarity U.S. Western Interior U.S. Western Interior U.S. Western Interior North American Stage and Stage U.S. Western Interior Laramie Basin, Salt Creek Southern Lost Soldier Tully Rawlins Hanna Basin Eastern Southeastern Central Jackson Northwestern Southern Eastern Eastern Atlantic Rocky Point Separation Western Southern and Bighorn lorthwestern outhwestern Northwestern Denver Boundary Radiometric Ammonite Inoceramid Land Vertebrate Palynostratigraphic Chron Thrust Belt n Uplift Rock Springs Rock Springs Powder River Hole and Ranch Draw Wind River Central Wind | Wind River Basin Powder Powder Black Hills Black Hills Basin Washakie Rim Rim Age (Ma) Biozone Biozone (Ma) Biozone Age **River Basin** Hoback Basin Rock River Basin **River Basin River Basin** Basin Basin Basin (6, 10, 29, 30, 47, 53, 65, 66, 67, 72, 75, 76) (7, 56, 77) (8, 49, 54, 55, 56, 69, 72) (7, 23, 25, 56, 74) (7, 56, 74) (2, 33, 35, 77) (50) (1, 12, 30, 36, 58, 74) (1, 12, 30, 36, 58, 74) (5, 12, 15, 17, 20, 57, 74, 78) (7, 56, 74) (6, 11, 12, 22, 32, 37, 47, 67, 74) (12, 26, 30, 64, 72, 74) 12, 26, 30, 36, 63, 64, 72, 74) (12, 19, 20, 26, 29, 30, 36, 62, 63, 67, 74) 1, 12, 21, 30, 36, 58, 64, 74) (1, 12, 30, 36, 39, 58, (1, 12, 30, 36, 58, 74) (1, 12, 30, 36, 58, 64, (6, 12, 30, 36, 41, 58, 59, 60, 74) (1, 12, 30, 36, 58, 64, 59, 60, 74) (6, 12, 19, 20, 46, 74, 78) 12, 17, 24, 28, 40, 43, 52, 59, 74) (12, 16, 17, 18, 40, 44, 45, 46, 52, 59, 74) (4, 12, 42, 46, 52, 59, 61, 74) (12, 27, 31, 48, 70, 73, 74) (12, 13, 59, 74) (12, 13, 59, 74) (9, 12, 13, 14, 19, 59, (12, 40, 52, 59, 74) (3, 12, 17, 51, 59, 74) (12, 40, 52, 59, 68, 74) (4, 12, 52, 59, 61, 74) Lebo Member (part) main body (part) Torrejonian C28r P3 upper (part) China Butte Member (part) Fort Union Formation (part) lower member (part) lower member (part) lower member (part) Fort Union Formation (part) Fort Union Formation (part) No Record No Record _ _ _ _ _ _ _ Dani (pai C28r P2 C29n middle Tullock Member Tullock Member Tullock Member Tullock Member Tullock Member Puercan Pinyon Conglomerate P1 C29r _ _ _ _ _ _ — 66.02 ± 0.08 — _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ 660 + 05---lower Red Rim Red Rim Red Rim Red Rim Member Red Rim Red Rim Red Rim Unzoned Member Member Member (? Member (? Member Member (' ----C30r _ _ _ _ _ _ _ _ _ _ _ _ _ . Lance Formation Lance Formation Torringto Member *Wodehouseia spinata* Assemblage Biozone Lance Formation Lance Formation Hoploscaphites Lance Formation Lance Formation Lance Formation upper Unzoned Lancian Lance Formation nebrascensis Medicine Bow C30r lower member lower member lower member Medicine Bow Formation Formation lower member lower member lower member lower member Lance Formation Lance C31r Hoploscaphites nicolletii Fox Hills _ _ _ _ _ Lance Formation Bobcat Member Fox Hills Sandstone ----Fox Hills Sandstone Sandston _ _ _ _ _ Fox Hills Sandstone Hoploscaphites birkelundae Meeteetse Formation Fox Hills Ss differentia Fox Hills S 70-Fox Hills Ss _ _ _ _ _ _ _ _ _ - 70.08 ± 0.37 Fox Hills Sandstone "Inoceramus" balchii Fox Hills Ss Fox Hills Ss Fox Hills Ss upper part Dad Sandstone Mbr Unit C C31r Baculites clinolobatus upper pa Fox Hills Fox Hills Sandstone upper part upper par Lewis Shale arpaw Shal Sandstone 70.66 ± 0.66 Trochoceramus radiosus ad Sandsto Member Baculites grandis d Sandsto Member Unit B Membe Dad Ss Mbi Whetstone Falls Member upper shale member Lewis Shale Lewis Shale lower Lewis Shale Fox Hills Sandstone Hams Fork onglomerate Member "Inoceramus" incurvus *Mancicorpus striatus* Interval Biozone Meeteetse Formation Meeteetse Formation Lewis Shale Baculites baculus Unit A Endocostea typica Lewis Shale /leeteetse Formation lower part lower part lower part lower part 2.1 ± 0.2 Kara Bentonitic Member Kara Bentonitic Member Almond Formation shale Edmontonian Almond Baculites eliasi "Inoceramus" redbirdensis a Sand Mbr Lewis Shale C32n lower part Formation ichard Ss I Almond Formation Almond Formation Almond Formation Almond Formation Lewis Shale Almond Formation Baculites jenseni Almond shale shale shale "Inoceramus" oblongus ormation Bearpaw Shale Baculites reesidei ----73.41 ± 0.47 Pine Ridge Ss Pine Ridge S Pine Ridge Sa Pine Ridge Ss Pine Ridge Ss Pine Ridge Ss Teapot Ss Mbr Teapot Ss Mbr _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Pine Ridge Sa Teapot Ss Mbr Teapot Ss Mbr Teapot Ss Mbr Teapot Ss Mb Pine Ridge Ss lower mbr Baculites cuneatus -----_____ 74.05 ± 0.39 "Inoceramus" altus Baculites compressus upper C32r shale Didymoceras cheyennense Meeteetse Formation . _ _ _ _ _ _ _ _ _ _ _ _ _ Exiteloceras jenneyi - - - - - - - - - -Sphaeroceramus 74 85 + 0 43 75pertenuiformis Didymoceras stevensoni shale _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ shale _ _ _ _ _ _ _ _ shale shale shale Didymoceras nebrascense Rusty zone Aquilapollenites Rusty zon *quadrilobus* Interval Biozone shale member Baculites scotti Rock River middle ----Hygiene Allen Ridge Formation Allen Ridge Formation Allen Ridge Formation "Inoceramus" tenuilineatus Trail ormation member Mesaverde Formation Allen Ridge Formation Member Member Red Bird Silty Member Red Bird Silty Member Red Bird Silty Member Member Baculites reduncus Judithian Trail Parkman member Allen Ridge Formation Allen Ridge Formation Parkman Sandstone -----Sandstor Membe Baculites gregoryensis Parkman /lember

			middle	C33r =	$ 80.10 \pm 0.61 $ $ 80.62 \pm 0.40 $ $ 81.71 \pm 0.51 $ $ 81.84 \pm 0.22 $ $ 82.29 \pm 0.34 $	Baculites perplexus Baculites sp. (smooth) Baculites asperiformis Baculites mclearni Baculites obtusus Baculites sp. (weak flank ribs) Baculites sp. (smooth) Scaphites hippocrepis III Scaphites hippocrepis II	Cataceramus subcompressus "Inoceramus" azerbaydjanensis Cataceramus balticus	Aquilan	Aquilapolenites senonicus Interval Biozone Pseudoplicapolis newmanii	Adaville	Sohare Formation	Rock Springs Formation	Mesaverde Group Blair Fm Rock Springs Fm Rock	Brooks Tongue Blair Formation	Steele Shale	Hatfield Sandstone Member Seminoe Mbr O'Brien Spring Mbr Bolten Ranch Mbr Tapers Ranch Mbr	Hatfield Sandstone Member Steele Shale Deep Creek Ss Mbr	L Standstone shale shale shale shale shale shale shale shale Hatfield Ss Mbr Espy Tongue, Steele Shale Deep Creek Ss Mbr	Haystack Mountains Formation	lower member, Haystack Mountains Formation equivalent? Cody Shale	Cody Shale	Luger Hatfield Ss Member Work Work Member OBrien Spring Ss Mbr Iower Member Tapers Ranch Ss Mbr Steele	Steele Shale	middle member basal ss mbr	Conant Creek tongue," Cody Shale "Alkali Butte Mbr"	Failen SS Member Wallace Creek Fales Ss Member Shale sandstone State sandstone State	upper part Judith River Bentonite lower part	Claggett Member	Sandstone Member shale "Stray sandstone" shale Sandstone Member shale Shannon Ss Mbr shale "Fishtooth sandstone"	Shale Sussex Ss Mbr Shale Shanon Ss Mbr Shale Shanon Ss Mbr Shale	Mitten Member Sharon Springs Member ✓ ^{Ardmore} Bentonite	Mitten Member	Mitten Member	Mitten Black Shale Member Sharon Springs Member Gammon Ferruginous Mbr
	│ ^{Cretaceous (part)}	Upper	83.6 ± 0.3 upper middle lower 86.3 ± 0.5		$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Scaphites hippocrepis I Scaphites leei III Desmoscaphites bassleri Desmoscaphites erdmanni Clioscaphites choteauensis Clioscaphites vermiformis Clioscaphites saxitonianus	Sphenoceramus lundbreckensis Cordiceramus bueltenensis Cladoceramus undulatoplicatus	- 	Interval Biozone	Pormation		Airport Sandstone Member	Baxter Shale Airport Sandstone Member	Airport Sandstone Member Baxter Shale	Niobrara Formation	Shale Niobrara Formation	Niobrara Formation	Niobrara Formation	Niobrara Formation	Niobrara Formation	Niobrara Formation	Shale Niobrara Formation	Niobrara Formation	upper sandy member	upper sandy member, including "Sussex" and "Shannon" sandstones	member, including "Sussex" and "Shannon" sandstones	Cody Shale Shale Cody Shale	Beds Gammon Memory Beds	shale Shale Ood No	Niobrara Member	Niobrara Member	හ Niobrara Member	Niobrara Formation	Smoky Hill Chalk Member
	90		upper middle lower 89.8 ± 0.4 - upper		— 87.13 ± 0.19 — — 89.32 ± 0.34 — — 89.87 ± 0.18 —	Scaphites depressus Scaphites ventricosus Scaphites preventricosus Scaphites mariasensis – Prionocyclus hyatti (8 Biozones, detailed below)	Magadiceramus crenelatus Magadiceramus subquadratus Volviceramus koeneni Volviceramus involutus Cremnoceramus crassus inconstans/crassus Cremnoceramus deformis erectus/dobrogensis Cremnoceramus waltersdorfensis – Inoceramus perplexus (7 Biozones, detailed below)	Fencelakian		Hollow Mbr hollow Mbr	Bacon Ridge Sandstone Cody Shale marine sandstone member	Shale Dry Hollow/ Wall Creek Mbr	Shale Dry Hollow/ Wall Creek Mbr	Dry Hollow/ Wall Creek Mbr	Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	Sage Breaks Shale Wall Creek Member	"chalk kick" Wall Creek Member	"chalk kick" Wall Creek Member	lower shaly member "chalk kick" Wall Creek Member	Wall Creek Member equivalent?	Niobrara Member	Niobrara Member Wall Creek Member	Sage Breaks Member Wall Creek Mbr	Sage Breaks Mbr Turner Sandy Member	Sage Breaks Mbr Turner Sandy Member	Sage Breaks Mbr Turner Sandy Member	Fort Hays Ls Mbr Codell Sandstone Member
Detailed Below		F	middle lower 93.9 ± 0.2 - upper	C34n	91.24 ± 0.23 93.67 ± 0.31 93.79 ± 0.26 94.10 ± 0.27 94.20 ± 0.28 94.43 ± 0.29 94.43 ± 0.29 94.10 ± 0.27 94.10 ± 0.27 94.10 ± 0.29 94.10 ± 0.29 95.10	Collignoniceras praecox Collignoniceras voolgari Mammites nodosoides – Watinoceras devonense (4 Biozones, detailed below)	Inoceramus dimidius – Mytiloides subhercynicus (6 Biozones, detailed below) Mytiloides mytiloides – Mytiloides puebloensis (3 Biozones, detailed below) Mytiloides hattini –		<i>Nyssapolenites abertensis</i> Interval Biozone	Lourdier Poyster Ridge Sandstone Mbr Allen Hollow Coalville Mbr	nonmarine	Louine Conster Ridge/ Emigrant Gap Mbr	Emigrant Gap Mbr	Emigrant Gap Mbr Chalk Creek Member	Emigrant Gap Mbr Loundier Frontier	Londier Formation	Emigrant Gap Mbr	Emigrant Gap Mbr	Emigrant Gap Mbr		Frontier Formation	Frontiar Formation		Ernigrant Gap Mbr	Emigrant Gap Mbr	Frontier Formation Frontier Formation	Emigrant Gap Member equivalent?	Member Greenhorn Formation	sandstone sandstone	Emigrant Gap Member	Pool Creek Member upper part	Pool Creek Member Greenhorn Formation	Pool Creek Member euopseul Greenhorn Formation	Bridge Creek Limestone Member Heartland Shale Member
			middle		$\begin{array}{c} 95.32 \pm 0.61 \\ 95.53 \pm 0.25 \end{array}$ $\begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	(15 Biozones, detailed below) Unzoned Beattonoceras beattonense Ireniceras bahani Neogastroplites septimus Neogastroplites maclearni Neogastroplites americanus Neogastroplites muelleri Neogastroplites cornutus	(7 Biozones, detailed below) Unzoned	Mussentuchian		Chalk Creek Member	Mowry Shale	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member	Belle Fourche Member Clay Spur Bentonite (?) Mowry Shale	Belle Fourche Member	 Torchlight Ss Mbr" ✓ "Peay Ss Mbr" ✓ "Peay Ss Mbr" ✓ Belle Fourche Member equivalent ✓ Clay Spur Bentonite (?) Mowry Shale 	Belle Fourche Formation	Soap Creek Bentonite Bailey Flats (core) Bent sandstone and shale Clay Spur Bentonite Mowry Shale	Belle Fourche Member	Belle Fourche Formation	Belle Fourche Formation	Belle Fourche Formation	Lincoln Ls Mbr
	- - - - - - - - - - - - - - - - - - -	(part)			99.26 ± 0.70 99.46 ± 0.59	Neogastroplites haasi Unzoned	Posidonioceramus nahwisi Unzoned		<i>Plicatella unica</i> Interval Biozone	Quealy Fm Cokeville Fm Bear		Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Muddy Sandstone	Shell Creek Shale Muddy Sandstone	Shell Creek Shale Muddy Sandstone	Shell Creek Shale Muddy Sandstone	Shell Creek Shale Muddy Sandstone	Shell Creek Shale	Shell Creek Shale	Shell Creek Shale	Shell Creek Shale Muddy Sandstone	Shell Creek Shale Newcastle Sandstone	Shell Creek Shale Newcastle Sandstone	Muddy Sandstone/ "J sandstone"

	Lower		Gnesioceramus comancheanus	Fork Fm	n																							
		Eopachydiscus marcianus			Thermopolis Shale	Skull Creek Shale	Skull Creek Shale	Skull Creek Shale	Thermopolis Shale																			
105		Unzoned				Chaid	endie	Chaid	Chaic					endie	Charo				enale						Citaio	Chaid		

										CORRELATION CHART EXPLANATION	ACKNOWLEDGMENTS		REFERENCES	
Cenomanian, Turonian, and Coniacian Stages: Detailed										Certain age boundary Fm Formation Mbr Member Se Sandstone	Sincere thanks and appreciation to Kevin "Casey" McKinney for help with the U.S. Geological Survey's Denver Mesozoic Invertebrate Database. Reviews from Mark Kirschbaum, Robert Raynolds, Robert Scott, David Sawyer, James Fox, Anton Wroblewski, and Donald Boyd were invaluable.	 Bader, J.W., Gill, J.R., Cobban, W.A., and Law, B.E., 1983, Biostratigraphic correla- tion chart of some Upper Cretaceous rocks from the Lost Soldier area, Wyoming to west of Craig. Colorado: U.S. Geological Survey Miscellaneous Field Studies 	 Kauffman, E.G., 1977, Upper Cretaceous cyclothems, biotas, and environments, Rock Canyon anticline, Pueblo, Colorado: The Mountain Geologist, v. 14, nos. 3-4 p. 129–152 	 Nichols, D.J., and Brown, J.L., 1992, Palynostratigraphy of the Tullock Mem (lower Paleocene) of the Fort Union Formation in the Powder River Bas Montana and Wyoming: U.S. Geological Survey Bulletin 1917, F. 35 p. 10 p.
Age F (Ma)	eriod Epocl	h Stage Bo	es and Sounda (Ma)	Stage Polarity ry Chron	U.S. Western Interior Radiometric Age (Ma)	U.S. Western Interior Ammonite Biozone	U.S. Western Interior Inoceramid Biozone	North American Land Vertebrate Age	U.S. Western Interior Palynostratigraphic Biozone	Bentonite—Named when known Ls Limestone Maximum missing or condensed section Bent Bentonite ? Uncertain formation name Uncertain formation name	REQUEST FROM AUTHORS This publication is a work in progress that will be updated periodically. The authors request notice of any new or revised data that will enhance the accuracy of the interpretations presented in this chart.	 Cifelli, R.L., Eberle, J.J., Lofgren, D.L., Lillegraven, J.A., and Clemens, W.A., 2004, Mammalian biochronology of the latest Cretaceous, <i>in</i> Woodburne, M.W., ed., Late Cretaceous and Cenozoic mammals of North America: New York, Colum- bia University Press, p. 21–42. 	 Kirschbaum, M.A., Merewether, E.A., and Condon, S.M., 2009, Stratigraphy and age of the Frontier Formation and associated rocks, central and southern Bighorn Basin, Wyoming—Surface to subsurface correlation: The Mountain Geologist, v. 46, no. 4, p. 125–147. Kirschbaum, M.A., and Roberts, L.N.R., 2005a, Geologic assessment of undiscov- 	 Nichols, D.J., and Jacobson, S.R., 1982, Cretaceous biostratigraphy in the Wyom thrust belt: The Mountain Geologist, v. 19, no. 3, p. 73–78. Obradovich, J.D., 1993, A Cretaceous time scale, <i>in</i> Caldwell, W.G.E., and Kat man, E.G., eds., Evolution of the Western Interior Basin: Geological Associat of Canada Special Paper 39, p. 379–396.
86			(7, 56, 74)	(7, 56, 74)	(8, 49, 54, 55, 56, 69, 72)	(7, 23, 25, 56, 74)	(7, 56, 74)	(2, 33, 35, 77)	(50)	" " Unofficial formation or member name	DISCLAINERS Users of these cross sections and mans are cautioned against using the data at scales different from those at which	3. Cobban, W.A., 1990, Ammonites and some characteristic bivalves from the Upper Cretaceous Frontier Formation Nationa County Wyoming: U.S. Geological	ered oil and gas resources in the Mowry composite total petroleum system,	55. Obradovich, J.D., and Cobban, W.A., 1975, A time-scale for the Late Cretaceous
-		\square	— 86.3 ±	±0.5 —	——— 86.52 ± 0.33 ——	Clioscaphites saxitonianus (part)	Cladoceramus undulatoplicatus (part) Magadiceramus crenelatus			Terrestrial and transitional marine depositional environment (generalized) Nearshore to transitional marine depositional environments (generalized) Offshore depositional environment (generalized)	the data were compiled. Using these data at a larger scale will not provide greater accuracy and is a misuse of the data.The Wyoming State Geological Survey (WSGS) and the State of Wyoming make no representation or warranty, expressed or implied, regarding the use, accuracy, or completeness of the data presented herein, or of a map printed from these data. The act of distribution shall not constitute such a warranty. The WSGS does not guarantee the	 Cobban, W.A., and Larson, N.L., 1997, Marine Upper Cretaceous rocks and their ammonite record along the northern flank of the Black Hills Uplift, Montana, Wyoming, and South Dakota: University of Wyoming Contributions to Geology, v. 32, no. 1, p. 27–35. 	 Southwestern Wyoning Fronnec, Wyoning, Colorado, and Otan, enap. 5 of U.S. Geological Survey Southwest Wyoning Province Assessment Team, comp., Petroleum systems and geologic assessment of oil and gas in the southwestern Wyoning Province, Wyoning, Colorado, and Utah: U.S. Geological Survey Digital Data Series 69-D, 23 p. 30. Kirschbaum, M.A., and Roberts, L.N.R., 2005b, Stratigraphic framework of the Contraction Manual Shelp Evention and Diagram and Diagram turity and Diagram. 	 the Western Interior of North America: <i>in</i> Caldwell, W.G.E., ed., The Cretaced system in the Western Interior of North America: Geological Association Canada Special Paper 13, p. 31–54. 56. Ogg, J.G., and Hinnov, L.A., 2012, Cretaceous, <i>in</i> Gradstein, F.M., Ogg, J. Schmitz, M.D., and Ogg, G.M., eds., The geologic time scale 2012: Amsterda Elsevier B.V., p. 793–853.
-			upp	ber	87.13 ± 0.19	Scaphites depressus	Magadiceramus subquadratus		Proteacidites retusus Interval Biozone (part)	Approximate location of radiometric age sample ADDITIONAL INFORMATION	digital data or any print made from the data to be free of errors or inaccuracies. The WSGS and the State of Wyoming disclaim any responsibility or liability for interpretations made from these digital data or from any print made from these digital data, and for any decisions based on the digital data or printed publication. The WSGS and the State of Wyoming retain and do not waive sovereign immunity. The use of or reference to trademarks, trade names, or other product or company names in this publication is for	 Cobban, W.A., and Reeside, J.B., Jr., 1951, Frontier Formation near Sinclair, Carbon County, Wyoming: Wyoming Geological Association, 6th annual field confer- ence, Guidebook, p. 60–65. Cobban, W.A., and Reeside, J.B., Jr., 1952, Frontier Formation, Wyoming and adjacent areas: American Association of Petroleum Geologists Bulletin, v. 36, no. 10, p. 1,913–1,961. 	Wyoming Province, Wyoming, Colorado, and Utah, chap. 15 of U.S. Geological Survey Southwest Wyoming Province Assessment Team, comp., Petroleum systems and geologic assessment of oil and gas in the southwestern Wyoming Province, Wyoming, Colorado, and Utah: U.S. Geological Survey Digital Data Series 69-D, 31 p.	 Perman, R.C., 1988, Stratigraphy and sedimentology of the Lewis Shale and the F Hills Formation in south-central Wyoming: Berkeley, University of Californ Ph.D. dissertation, 256 p. Pyles, D.R., and Slatt, R.M., 2007, Stratigraphy of the Lewis Shale, Wyomi USA—Applications to understanding shelf-edge to base-of-slope changes stratigraphic architecture of prograding basin margins <i>in</i> Nilsen TH. Sh
		niacian	mid	dle		Scaphites ventricosus	Volviceramus koeneni Volviceramus involutus			The approximate location of each stratigraphic column is shown with the corresponding letter on the map. References used to determine formation ages for each column are listed as numbers below the gener-	descriptive or informational purposes only, or is pursuant to licensing agreements between the WSGS or State of Wyoming and software or hardware developers/vendors, and does not imply endorsement of those products by the WSGS or the State of Wyoming.	 Cobban, W.A., Walaszczyk, Ireneusz, Obradovich, J.D., and McKinney, K.C., 2006, A USGS zonal table for the Upper Cretaceous middle Cenomanian–Maastrich- tian of the Western Interior of the United States based on ammonites, inocera- mids, and radiometric ages: U.S. Geological Survey Open-File Report 	 Kiteley, L.W., 1976, Marine shales and sandstones in the Upper Cretaceous Pierre Shale at the Francis Ranch, Laramie County, Wyoming: The Mountain Geolo- gist, v. 13, no. 1, p. 1–19. Leier, A.L., and Steidtmann, J.R., 2009, The Bacon Ridge Sandstone of northwestern Wyoming and its place within the larger cools. Late Cretaceous depositional 	 R.D., Steffens, G.S., and Studlick, J.R.J., eds., Atlas of deepwater outcro American Association of Petroleum Geologists, Studies in Geology 56, ch 113, p. 485–489. 59. Reeside, J.B., and Cobban, W.A., 1960, Studies of the Mowry Shale (Cretaceo
-		Ŭ	low	ver	89.32 ± 0.34	Scaphites preventricosus	Cremnoceramus crassus inconstans Cremnoceramus crassus crassus Cremnoceramus deformis erectus			 alized column name and correspond to the numbered references. Wyoming's stratigraphic nomenclature can be inconsistent, especially near the borders with surrounding states. The nomenclature used in this chart is from Love and others (1993) in locations where multiple terminologies are used. 	NOTICE TO USERS OF INFORMATION FROM THE WYOMING STATE GEOLOGICAL SURVEY The WSGS encourages the fair use of its material. We request that credit be expressly given to the "Wyoming State Geological Survey" when citing information from this publication. Please contact the WSGS at 307-766-2286, ext. 224 or by email at wsgs-info@wyo.gov if you have questions about citing materials, preparing acknowledgments, or extensive use of this material. We appreciate your cooperation.	 2006-1250, 46 p., 1 pl. Clyde, W.C., Ramezani, Jahandar, Johnson, K.R., Bowring, S.A., and Jones, M.M., 2016, Direct high-precision U-Pb geochronology of the end-Cretaceous extinction and calibration of Paleocene astronomical timescales: Earth and Planetary Science Letters, v. 452, p. 272–280. Demar D.G., Ir. and Braitheunt P.H. 2006. The nonmampalian variables to prove the provided of th	 33. Lillegraven, J.A., and Ostresh, L.M., 1990, Late Cretaceous (earliest Campanian/Maastrichtian) evolution of western shorelines of the North American Western Interior Seaway in relation to known mammalian faunas, <i>in</i> Bown, T.M., and Rose, K.D., eds., Dawn of the age of mammals in the northern part of 	 and contemporary formations in the United States and Canada: U.S. Geolog Survey Professional Paper 355, 126 p., 58 pls. 60. Reynolds, M.W., 1976, Influence of recurrent Laramide structural growth sedimentation and petroleum accumulation, Lost Soldier area, Wyoming: An ican Association of Petroleum Geologists Bulletin, v. 60, no. 1, p. 12–33.
- 90 -			- 89.8 ±	±0.4 —	89.87 ± 0.18	Scaphites mariasensis Prionocyclus germari Scaphites nigricollensis	Cremno. deformis dobrogensis Cremno. walterdorfensis Mytiloides scupini Mytiloides incertus	Fencelakian (part)		Martin and others (2007) proposed raising the rank of the Pierre Shale from formational to group level and consequently raised its members to formational status. To maintain consistency with previously published literature on the Pierre Shale, this chart retains the former nomenclature following Love and others (1993).	Individuals with disabilities who require an alternative form of this publication should contact the WSGS. For the TTY relay operator, call 800-877-9975. For more information about the WSGS or to order publications and maps, go to www.wsgs.wyo.gov, call 307-766-2286, ext. 224, or email wsgs.sales@wyo.gov.	 beinar, D.G., J., and Brethlaupt, B.H., 2000, The holimatininatian vertebrate intero- fossil assemblages of the Mesaverde Formation (Upper Cretaceous, Campanian) of the Wind River and Bighorn basins, Wyoming, <i>in</i> Lucas, S.G., and Sullivan, R.M., eds., Late Cretaceous vertebrates from the Western Interior: New Mexico Museum of Natural History and Science Bulletin 35, p. 33–53. 10. Dorr, J.A., Jr., 1985, Newfound early Cretaceous dinosaurs and other fossils in 	 the Rocky Mountain Interior, North America: Geological Society of America Special Paper 243, p. 1–30. 34. Love, J.D., Christiansen, A.C., and Ver Ploeg, A.J., comps., 1993, Stratigraphic chart showing the Phanerozoic nomenclature for the state of Wyoming: Geological Survey of Wyoming [Wyoming State Geological Survey] Map Series 41. 25. Lucas, S.C., Sullivan, B.M., and Spielmann, I.A., 2012, Crotaceus watchnate 	 Robinson, C.S., Mapel, W.J., and Bergendahl, M.H., 1964, Stratigraphy and struct of the northern and western flanks of the Black Hills Uplift, Wyoming, Monta and South Dakota: U.S. Geological Survey Professional Paper 404, 134 p., 5 Roehler, H.W., 1978, Correlations of coal beds in the Fort Union, Almond, and Ro Springs formations in measured sections on the west flank of the Rock Spri Uplift, Sweetwater County, Wyoming: U.S. Geological Survey Open-I
				oer	91.24 ± 0.23	Scaphites whitfieldi Scaphites ferronensis Scaphites warreni Prionocyclus macombi Brionocyclus hyotti	Inoceramus dakotensis Inoceramus perplexus Inoceramus dimidius			45°N-	107°W 106°W 105°W 104°W S H E R I D A N Sheider	 southeastern Idaho and westernmost Wyoming: Contributions from the Museum of Paleontology, University of Michigan, v. 27, no. 3, p. 73–85. 11. Dorr, J.A., Jr., Spearing, D.R., and Steidtmann, J.R., 1977, Deformation and deposition between a foreland uplift and an impinging thrust belt—Hoback Basin, Wyoming: Geological Society of America Special Paper 177, 82 p. 12. Eicher, D.L., 1960, Stratigraphy and micropaleontology of the Thermopolis Shale: Yale University, Peabody Museum of Natural History Bulletin 15, 126 p., 6 pls. 	 Lucas, S.G., Suffivali, K.H., and Spielmann, J.A., 2012, Cretaceous Vertebrate biochronology, North American Western Interior: Journal of Stratigraphy, v. 36, no. 2, p. 436–461. Lynds, R.M., and Lichtner, D.T., 2016, Stratigraphy and hydrocarbon potential of the Fort Union and Lance Formations in the Great Divide and Washakie Basins, south-central Wyoming: Wyoming State Geological Survey Report of Investiga- tions 73, 70 p., 2 pls. Malone, David, 2017, Unpublished detrital zircon data 	 Report 78-395. 63. Roehler, H.W., 1983, Stratigraphy of Upper Cretaceous and lower Tertiary outer in the Rock Springs Uplift, Wyoming: U.S. Geological Survey Miscellane Investigations Series Map I-1500. 64. Roehler, H.W., 1990, Stratigraphy of the Mesaverde Group in the central and east Greater Green River Basin, Wyoming, Colorado, and Utah: U.S. Geolog Survey Professional Paper 1508, 52 p., 2 pls.
-	(t)	Turonian	mid	dle		Collignoniceras praecox Collignoniceras woolgari	Inoceramus newsin Inoceramus n. sp. Mytiloides hercynius		Nyssapolenites abertensis		R N C A M P B E L L Gillette Uplift	 Finn, I.M., 2007, Source rock potential of Opper Createcous marine shales in the Wind River Basin, Wyoming, chap. 8 of U.S. Geological Survey Wind River Basin Province Assessment Team, comp., Petroleum systems and geologic assessment of oil and gas in the Wind River Basin Province, Wyoming: U.S. Geological Survey Digital Data Series 69-J, 24 p. Finn, T.M., and Pawlewicz, M.J., 2013, Maps showing thermal maturity of Upper Cretaceous marine shales in the Wind River Basin, Wyoming: U.S. Geological Survey Scientific Investigations May 2266, 13 p. 1 pl. conta 1500,000 	 Martin, J.E., Bertog, J.L., and Parris, D.C., 2007, Revised lithostratigraphy of the lower Pierre Shale Group (Campanian) of central South Dakota, including newly designated members, <i>in</i> Martin, J.E., and Parris, D.C., eds., The geology and paleontology of the Late Cretaceous marine deposits of the Dakotas: Geological Society of America Special Paper 427, p. 9–22. Mellere, D.A., and Steele, R.J., 1995, Facies architecture and sequentiality of nearshore and 'shelf' sandbodies: Havstack Mountains Formation. Wyoming 	 Rubey, W.W., 1973, New Cretaceous formations in the western Wyoming thrust b U.S. Geological Survey Bulletin 1372-I, 135 p. Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1961, Age of the Evanston Formati western Wyoming: Wyoming Geological Association, 16th annual field con ence, Guidebook, p. 68–69. Rudolph, K.W., Devlin, W.J., and Crabaugh, J.P., 2015, Upper Cretaceous seque stratigraphy of the Rock Springs Uplift, Wyoming: The Mountain Geologist
	Cretaceous (par Upper (part)		low - 93.9 1	ver C34n (part)	$ \begin{array}{c} & 93.67 \pm 0.31 & \\ & 93.79 \pm 0.26 & \\ & 94.10 \pm 0.27 \end{array} $	Mammites nodosoides Vascoceras birchbyi Pseudaspidoceras flexuosum Watinoceras devonense Nigericeras scotti	Mytiloides subhercynius Mytiloides mytiloides Mytiloides kossmati Mytiloides puebloensis Mytiloides hattini			44°N- HOLE HOLE BIGHORN BASIN Worland Worl	POWDER RIVER BASIN + -44°N	 Gill, J.R., 1974, Stratigraphic sections of the Mesaverde Group, Lewis Shale, Fox Hills Formation, and Medicine Bow Formation, Carbon County, Wyoming: U.S. Geological Survey Open-File Report 74-1038, 4 sheets. Gill, J.R., and Cobban, W.A., 1966, Regional unconformity in Late Cretaceous, Wyoming: U.S. Geological Survey Professional Paper 550-B, p. B20–B27. Gill, J.R., and Cobban, W.A., 1973, Stratigraphy and geologic history of the Montana Group and equivalent rocks, Montana, Wyoming, and North and South Dakota: U.S. Geological Survey Professional Paper 776, 37 p. 	 Merewether, E.A., 1996, Stratigraphy and tectonic implications of Upper Cretaceous rocks in the Powder River Basin, northeastern Wyoming and southeastern Montana: U.S. Geological Survey Bulletin 1917-T, 92 p. Merewether, E.A., and Cobban, W.A., 1972, Unconformities within the Frontier Formation, northwestern Carbon County, Wyoming: U.S. Geological Survey Professional Paper 800-D, p. D57–D66. Merewether, E.A., and Cobban, W.A., 1973, Stratigraphic sections of the Upper Correct County, Eventian Paper 800-D, p. D57–D66. 	 52, no. 3, p. 13–157. Runge, J.S., Wicker, W.L., and Eckelberg, D.J., 1973, A subsurface type section the Teckla Sand Member of the Lewis Shale Formation: Wyoming Geolog Association Earth Science Bulletin, v. 6, no. 3, p. 3–18. Sageman, B.B., Singer, B.S., Meyers, S.R., Siewert, S.E., Walaszczyk, Irenet Condon, D.J., Jicha, B.R., Obradovich, J.D., and Sawyer, D.A., 2014, Integ ing 40Ar/39Ar, U-Pb, and astronomical clocks in the Cretaceous Niobh Formation, Western Interior Basin, USA: Geological Society of Amer Bulletin, v. 126, nos. 7–8, p. 956–973.
- - 95 - -			ubt	Der	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Neocardioceras juddii Burroceras clydense Euomph. septemseriatum Vascoceras diartianum Dunveganoceras conditum Dunveganoceras albertense Dunveg. problematicum	Inoceramus pictus Inoceramus ginterensis			43°N- + HOBACK BASIN + WIND RIVER BASIN # +		 Gill, J.R., Cobban, W.A., and Kier, P.M., 1966, The Red Bird section of Upper Cretaceous Pierre Shale in Wyoming: U.S. Geological Survey Professional Paper 393-A, 69 p., 12 pls. Gill, J.R., Merewether, E.A., and Cobban, W.A., 1970, Stratigraphy and nomencla- ture of some Upper Cretaceous and lower Tertiary rocks in south-central Wyoming: U.S. Geological Survey Professional Paper 667, 53 p. Gomez-Veroiza, C.A., and Steele, R.J., 2010, Iles clastic wedge development and sediment partitioning within a 300-km fluvial to marine Campanian transect (3 	 43. Merewether, E.A., and Cobban, W.A., 1986, Biostratigraphic units and tectonism in the mid-Cretaceous foreland of Wyoming, Colorado, and adjoining areas, <i>in</i> Peterson, J.A., ed., Paleotectonics and sedimentation in the Rocky Mountain region, United States: American Association of Petroleum Geologists Memoir 41, p. 443–468. 44. Merewether, E.A., Cobban, W.A., and Cavanaugh, E.T., 1979, Frontier Formation and equivalent rocks in eastern Wyoming: The Mountain Geologist v. 16, pp. 3. 	 Schlaikjer, E.M., 1935, Contributions to the stratigraphy and palaeontology of Goshen Hole area, Wyoming. II. The Torrington Member of the Lance Forr tion and a study of a new Triceratops: Harvard College, Museum of Comparat Zoology Bulletin, v. 76, p. 31–68. Schmitz, M.D., 2012, Radiometric ages used in GTS2012—Appendix 2, Gradstein, F.M., Ogg, J.G., Schmitz, M.D., and Ogg, G.M., eds., The geolo time scale: Amsterdam, Elsevier B.V., p. 1,045–1,082. Smith, J.H., 1965, A summary of stratigraphy and paleontology, upper Colorado a
-			mid	dle	95.53 ± 0.25 — 96.12 ± 0.31 —	Plesiacanth. wyomingense Acanthoceras amphibolum Acanthoceras bellense Acanthoceras muldoonense Acanthoceras granerosense Conlinoceras tarrantense	Inoceramus pretragilis Inoceramus rutherfordi Inoceramus arvanus Inoceramus eulessanus			S U B L E T	Converse N/10 B R A R A Casper Douglas	 m.y.), Western Interior Seaway, southwestern Wyoming and northern Colorado: American Association of Petroleum Geologists Bulletin, v. 94, no. 9, p. 1,349–1,377. 21. Hale, L.A., 1961, Late Cretaceous (Montanan) stratigraphy, eastern Washakie Basin, Carbon County, Wyoming: Wyoming Geological Association, 16th annual field conference, Guidebook, p. 129–137. 22. Harris, J.D., Johnson, K.R., Hicks, J., and Tauxe, L., 1996, Four-toed theropod 	 45. Merewether, E.A., Cobban, W.A., and Obradovich, J.D., 2007, Regional disconformities in Turonian and Coniacian (Upper Cretaceous) strata in Colorado, Wyoming, and adjoining states—Biochronological evidence: Rocky Mountain Geology, v. 42, no. 2, p. 95–122. 46. Merewether, E.A., Cobban, W.A., and Obradovich, J.D., 2011, Biostratigraphic data 	 Montanan Groups, southcentral Wyoming, Northeastern Utah, and northwest Colorado: Wyoming Geological Association, 19th annual field conferer Guidebook, p. 13–26, 4 pls. 73. Walaszczyk, Ireneusz, and Cobban, W.A., 2000, Inoceramid faunas and biostratig phy of the Upper Turonian–Lower Coniacian of the Western Interior of United States: Paleontological Association, Special Papers in Palaeontology, 64, 118 p., 32 pls.

Torrington

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DENVER

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