

Appendix 5. Numerical ages of Tethyan and Western Interior Ammonite and Inoceramid Zones.

Tethyan Ammonites	GTS2004	CRETCSDB.4 FO	Upper Cretaceous Stages/Substages		Stage Ages Ma GTS2012	Stage Ages Ma CRETCSDB.4	Western Interior Ammonite Taxon Range Zones	GTS2012 Age Ma	CRETCSDB.4 Ages Ma	Western Interior Inoceramid Interval Zones	CRETCSDB.4 Ages Ma	
<i>Anapachydiscus terminus</i>	66	66.96	MAASTRICHTIAN	Upper	66	65.5		NA				
<i>Anapachydiscus fresvillensis</i>	69.42	70.33					<i>Jeletzkytes nebrascensis</i>					
							<i>Hoploscaphites nicolletii</i>					
			MAASTRICHTIAN	Lower	72.1	72.6	<i>Hoploscaphites birkelundae</i>					
<i>Pachydiscus neubergicus</i>	71.29	72.58					<i>Baculites clinolobatus</i>	70.08 ± 0.37	69.67-69.28	" <i>Inoceramus</i> " <i>balchii</i> "	73.43-69.28	
							<i>Baculites grandis</i>	70.66 ± 0.66	70.55-69.95	<i>Trochoceramus radiosus</i>	NA	
			CAMPANIAN	European Substages: Upper	Upper		<i>Baculites baculus</i>	71.54-70.62		" <i>Inoceramus</i> " <i>incurvus</i>	70.87 - 69.48	
<i>Nostoceras hyatti</i>	72.71	74.56					<i>Baculites eliasi</i>	72.50 ± 0.31	72.20-71.31	" <i>Inoceramus</i> " <i>redbirdensis</i>	NA	
							<i>Baculites jenseni</i>	72.39-72.32		" <i>Inoceramus</i> " <i>oblongus</i>	NA	
<i>Didymoceras cheyennense</i>	75	74.61					<i>Baculites reesidei</i>	73.41 ± 0.47	73.46-72.45			
							<i>Baculites cuneatus</i>		74.25-74.20			
							<i>Baculites compressus</i>	74.05 ± 0.39	74.23-74.29	" <i>Inoceramus</i> " <i>altus</i>	NA	
				European Substages: Middle	Middle		<i>Didymoceras cheyennense</i>	74.61-74.08				
							<i>Exiteloceras jenneyi</i>	74.85 ± 0.43	74.63-74.26	<i>Sphaeroceramus pertenuiformis</i>	NA	
							<i>Didymoceras stevensoni</i>		74.98-74.65			
<i>Bostrychoceras polyplacum</i>	80.2	76.05					<i>Didymoceras nebrascense</i>		75.31-74.84			
							<i>Baculites scotti</i>	76.62 ± 0.51	75.97-75.41	" <i>Inoceramus</i> " <i>tenuilineatus</i> ± 0.26 Ma	75.84 76.51 - 75.83	
							<i>Baculites reduuncus</i>		NA			
							<i>Baculites gregoryensis</i>		76.78-76.11			
			European Substages: Lower	Lower		<i>Baculites perplexus</i> [upper part of C33r]	80.10 ± 0.61	79.33-76.84	<i>Cataceramus subcompressus</i>	79.17 - 76.22		
						<i>Baculites sp. (smooth)</i>		80.34				
						<i>Baculites asperiformis</i>		79.70-79.14				
						<i>Baculites maclearni</i>		80.29-79.30				
<i>Delawarella delawarensis</i>	81.6	82.53				<i>Baculites obtusus</i>	80.62 ± 0.40 / 81.30 ± 0.55	80.34-79.89	" <i>Inoceramus</i> " <i>azerbaydjanensis</i>	80.29 - 79.98		
						<i>Baculites sp. (weak flank ribs)</i>		80.99-79.49				
			SANTONIAN	Upper	83.6	83.55	<i>Baculites sp. (smooth)</i>		81.32			
<i>Placentoceras bidorsatum</i>	83.5	83.57					<i>Scaphites hippocrepis</i> III		LO - 81.05	<i>Cataceramus balticus</i>	85.39 - 70.14	
							<i>Scaphites hippocrepis</i> II	81.87 ± 0.25	NA			
							<i>Scaphites hippocrepis</i> I		FO - 83.80			
							<i>Scaphites leei</i> III		84.33-82.69			
							SANTONIAN	Middle	86.3	85.91	<i>Desmoscaphites bassleri</i>	84.33 ± 0.27 / 84.43 ± 0.15
<i>Placentoceras polyopsis</i>	85.8	84.46	<i>Clioscapites erdmanni</i>	84.57 ± 0.35	NA							
			<i>Clioscapites choteauensis</i>		85.69 - 85.66	<i>Cordiceramus bueltenensis</i>					NA	
			CONIACIAN	Upper	89.8	88.96	<i>Clioscapites vermiformis</i>	85.55 ± 0.25	85.71 - 85.69			
<i>Paratexanites serratomarginatus</i>	87	87.83					<i>Clioscapites saxtonianus</i>	85.59 ± 0.35	85.89 - 85.70	<i>Cladoceramus undulatopectatus</i>	85.91 - 84.88	
							<i>Scaphites depressus</i>	86.98 ± 0.24 / 87.11 ± 0.15	86.99-85.90	<i>Magadiceramus crenelatus</i>	86.29 - 86.00	
<i>Gauthiericeras margae</i>	88	NA		CONIACIAN	Middle	89.8	88.96			<i>Magadiceramus subquadratus</i>	86.99 - 85.56	
<i>Peroniceras tridorsatum</i>	88.5	88.43						<i>Scaphites ventricosus</i>		89.95	<i>Volviceramus involutus</i>	88.12 - 86.03
											<i>Volviceramus koeneni</i>	NA
				CONIACIAN	Lower	89.8	88.96	<i>Cremnoceramus crassus crassus</i>		88.03	<i>Cremnoceramus crassus inconstans</i>	NA
<i>Forresteria petrociensis</i>	89	88.96						<i>Cremnoceramus deformis dobrogensis</i>	89.30 ± 0.27 / 89.37 ± 0.15		<i>Cremnoceramus deformis erectus</i>	88.30 - 88.30 88.51 - 88.12
								<i>Scaphites mariasensis</i>			<i>Cremnoceramus waltersdorfensis</i>	88.53 - 88.30
			<i>Prionocyclus germari</i>							<i>Mytiloides scupini</i>	88.58 - 88.58	
<i>Subprionocyclus neptuni</i>	90.4	NA	<i>Scaphites nigricollensis</i>					89.86 ± 0.26		<i>Mytiloides incertus</i>	88.83 - 88.76	
			<i>Scaphites whitfieldi</i>		88.91-88.76	<i>Inoceramus dakotensis</i>	NA					
			<i>Scaphites ferronensis</i>		88.94-88.92	<i>Inoceramus perplexus</i>	88.93 - 88.53					
			<i>Scaphites warreni</i>		88.93-88.83	<i>Inoceramus dimidius</i>	89.80 - 88.91					

<i>Collignonicer</i> <i>woollgari</i>	92	92.35	TURONIAN	Middle			<i>Prionocyclus macombi</i>	91.07 ± 0.28 / 91.37 ± 0.16	89.91-88.99	<i>Inoceramus aff. dimidius</i>	NA
							<i>Prionocyclus hyatti</i>	91.15 ± 0.29	90.80-89.92	<i>Inoceramus howelli</i>	90.01 - 88.94
							<i>Collignonicer</i> <i>praecox</i>			<i>Inoceramus n.sp.</i>	
							<i>Collignonicer</i> <i>woollgari</i>		92.35-89.82	<i>Mytiloides hercynicus</i>	92.48 - 92.15
<i>Mammites nodosoides</i>	92.6	92.76	Lower				<i>Mammites nodosoides</i>	93.48 ± 0.58	FO - 92.76	<i>Mytiloides mytiloides</i>	92.91 - 92.19
<i>Watinoceras devonense</i>	93.5	92.99					<i>Vascoceras birchbyi</i>	93.67 ± 0.31 / 94.09 ± 0.19	93.02-92.90	<i>Mytiloides kossmati</i>	92.88 - 92.64
							<i>Pseudaspidoceras flexuosum</i>	93.79 ± 0.26 / 94.37 ± 0.14	FO - 92.99	<i>Mytiloides puebloensis</i>	92.99 - 92.64
							<i>Watinoceras devonense</i>				
<i>Neocardioceras juddii</i>	94.2	93.19	CENOMANIAN	Upper			<i>Nigericeras scotti</i>		92.95	<i>Mytiloides hattini</i>	93.14 - 92.77
							<i>Neocardioceras juddii</i>	94.01 ± 0.14 / 94.29 ± 0.17	93.19-93.00	<i>Inoceramus pictus</i>	93.4-90.40
<i>Calycoceras naviculare</i>	94.8	94.05					<i>Burroceras clydense</i>	94.20 ± 0.28 / 94.43 ± 0.29			
<i>Acanthoceras jukesbrownei</i>	95	95.14					<i>Euomphaloceras septemseriatum</i>		93.45-93.49		
			<i>Vascoceras diartianum</i>	95.25 ± 1.00	93.34						
			<i>Dunveganoceras conditum</i>			<i>Inoceramus ginterensis</i>	93.72 - 93.08				
			<i>Dunveganoceras albertense</i>								
			<i>Dunveganoceras problematicum</i>								
<i>Acanthoceras rhotomagense</i>	95.8	95.43 94.23	Middle				<i>Dunveganoceras pondi</i>	95.32 ± 0.61	93.52-93.44	<i>Inoceramus prefragilis</i>	
							<i>Plesiacanthoceras wyomingense</i>				93.09-91.58
<i>Cunningtoniceras inerme</i>	96.2	95.43 94.23					³ <i>Acanthoceras amphibolum</i> [X Bentonite]	95.53 ± 0.25 / 95.87 ± 0.14	94.78	<i>Inoceramus rutherfordi</i>	95.40 - 93.80
			³ <i>Acanthoceras bellense</i>		95.13	<i>Inoceramus arvanus</i>	95.40 - 95.00				
			³ <i>Acanthoceras muldoonense</i>		95.10-94.64	<i>Inoceramus macconnelli</i>	NA				
			³ <i>Acanthoceras granerosense</i>		95.1						
<i>Mantelliceras dixonii</i>	97.8	95.65	Lower		100.5	97.13	<i>Conlinoceras tarrantense</i> [Thatcher]	96.12 ± 0.31	95.40-95.22		
							¹² <i>Graysonites woolridgei</i> / <i>G. adkinsi</i>	99.70 ± 0.38	97.40-96.62		
							<i>Neogastropilites maclearni</i> [Clay Spur]	97.88 ± 0.69	97.11-96.98		
							<i>Neogastropilites americanus</i>		98.03-97.42		
							<i>Neogastropilites muelleri</i>		98.50-97.49		
<i>Mantelliceras mantelli</i>	99.6	97.07					<i>Neogastropilites cornutus</i> [Arrow Creek]	99.24 ± 0.41	98.58-98.51		
			<i>Neogastropilites haasi</i>	99.26 ± 0.70 / 99.46 ± 0.59	98.84-98.62						
<i>Stoliczkaia dispar</i>	100	98.14	ALBIAN	Upper							

¹Two-fold divisions of Campanian generally accepted in Europe

³*Texacanthoceras* of Cooper, 1998

⁴*Coloradoscaphites* of Cooper, 1994

⁵*Anascaphites* of Cooper, 1994

⁶*Cliosscaphites* of Cooper, 1994

⁷*Billcobboceras* of Cooper, 1994

⁹Hicks et al., 2002, K-T Boundary

¹⁰Izett, 1998

¹¹Baadsgaard, 1993, Ar₄₀₃₉ age on sanidine, corrected from 27.84 to 28.02 Ma

¹²Radiometric age for *Graysonites woolridgei*, from Hokkaido, Japan (Obradovich et al., 2002)

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