

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

Stages and Substages		Stage Boundaries Ma <sup>2</sup>	Western Interior Ammonite Taxon Range Zones	Age Ma	CRETCSDB1 Ages Ma	Western Interior Inoceramid Interval Zones	CRETCSDB1 Ages Ma
MAASTRICHTIAN	Upper	65.5 ± 0.30/65.5		65.51 ± 0.10	65.48 ± 0.02		
			<i>Jeletzkytes nebrascensis</i>				
			<i>Hoploscaphites nicolletii</i>				
	Lower		<i>Hoploscaphites birkelundae</i>				
			<i>Baculites clinolobatus</i>	69.59 ± 0.36	69.65-69.39	" <i>Inoceramus</i> " <i>balchii</i>	71.46 - 69.39
			<i>Baculites grandis</i>	70.00 ± 0.45	70.54-69.79	<i>Trochoceras</i> <i>radiosus</i>	
			<i>Baculites baculus</i>		72.20-70.74	" <i>Inoceramus</i> " <i>incurvus</i>	70.94 - 69.58
						<i>Endocostea typica</i>	71.93 - 70.98
CAMPANIAN	European Substage s Upper	70.6 ± 0.6/72.6	<i>Baculites eliasi</i>	71.98 ± 0.31	72.20-71.37	" <i>Inoceramus</i> " <i>redbirdensis</i>	
			<i>Baculites jenseni</i>		72.89-72.38		
			<i>Baculites reesidei</i>	1172.94 ± 0.45	72.91-72.45	" <i>Inoceramus</i> " <i>oblongus</i>	
			<i>Baculites cuneatus</i>		74.25-74.20		
			<i>Baculites compressus</i>	873.52 ± 0.39	74.29-74.2*	" <i>Inoceramus</i> " <i>altus</i>	
			<i>Didymoceras cheyennense</i>	74.67 ± 0.15	74.61-74.53		
			<i>Exteloceras jenneyi</i>	875.08 ± 0.11	74.72-74.65		
			<i>Didymoceras stevensoni</i>		75.00-75.00	<i>Sphaeroceras</i> <i>pertenuiformis</i>	
			<i>Didymoceras nebrascense</i>	75.19 ± 0.28	75.35-75.10		
			<i>Baculites scotti</i>	1075.56 ± 0.11			
				75.84 ± 0.26	75.96-75.56	" <i>Inoceramus</i> " <i>tenuilineatus</i>	
			Middle		<i>Baculites reduncus</i>		
	<i>Baculites gregoryensis</i>				76.83-76.09		76.46 - 75.81
	<i>Baculites perplexus</i>				79.30-7.93		
	<i>Baculites</i> sp. (smooth)					<i>Cataceramus subcompressus</i>	79.46 - 76.49
	<i>Baculites asperiformis</i>				80.04-79.92		
	<i>Baculites maclearni</i>				80.09-80.07		
	Lower		<i>Baculites obtusus</i>	880.58 ± 0.55	80.27-80.27	" <i>Inoceramus</i> " <i>azerbaydjanensis</i>	
			<i>Baculites</i> sp. (weak flank ribs)		80.99-79.49		80.29 - 79.98
			<i>Baculites</i> sp. (smooth)		81.32-80.36		
			<i>Scaphites hippocrepis</i> III		LO - 83.60	<i>Cataceramus balticus</i>	
			<i>Scaphites hippocrepis</i> II	81.86 ± 0.36			
			<i>Scaphites hippocrepis</i> I		FO - 83.96		85.92 - 70.14
				<i>Scaphites leei</i> III		85.25-82.69	
SANTONIAN	Upper	83.5 ± 0.7/83.5	<i>Desmoscaphites bassleri</i>	884.30 ± 0.34	85.74-84.90	<i>Sphenoceras</i> <i>lundbreckensis</i>	
			<i>Desmoscaphites erdmanni</i>				
	Middle		<i>Clioscapites choteauensis</i>		85.69 - 85.67		
			<i>Clioscapites vermiformis</i>		85.71 - 85.71	<i>Cordiceramus bueltenensis</i>	
Lower			<i>Clioscapites saxonianus</i>		85.89 - 85.72	<i>Cladoceras undulatoplicatus</i>	85.91 - 84.72
CONIACIAN	Upper	85.8 ± 0.7/85.9	<i>Scaphites depressus</i>	87.14 ± 0.39	86.43	<i>Magadiceramus crenelatus</i>	86.29 - 86.00
					86.54	<i>Magadiceramus subquadratus</i>	86.91 - 85.56
	Middle		<i>Scaphites ventricosus</i>		89.77	<i>Volviceras involutus</i>	86.94 - 86.29
						<i>Volviceras koeneni</i>	
	Lower		<i>Scaphites preventricosus</i>	88.55 ± 0.59		<i>Cremnoceras crassus crassus</i>	
						<i>Cremnoceras crassus inconstans</i>	88.51 - 88.30
				88.03	<i>Cremnoceras deformis dobrogensis</i>	88.30 - 88.30	
				88.03	<i>Cremnoceras deformis erectus</i>	88.51 - 88.12	
TURONIAN	Upper	88.6 ± 1.0/88.5	<i>Scaphites mariasensis</i>			<i>Cremnoceras waltersdorfensis</i>	88.52 - 88.30
			<i>Prionocyclus germari</i>			<i>Mytiloides scupini</i>	88.58 - 88.58
			<i>Scaphites nigricollensis</i>			<i>Mytiloides incertus</i>	88.83 - 88.76
			<i>Scaphites whitfieldi</i>		88.63	<i>Inoceramus dakotensis</i>	
	Middle		<i>Scaphites ferrenensis</i>		88.94-88.92	<i>Inoceramus dimidius</i>	89.72 - 88.96
			<i>Scaphites warreni</i>		88.96-88.76		
			<i>Prionocyclus macombi</i>	90.21 ± 0.54	89.91-88.99	<i>Inoceramus aff. dimidius</i>	
			<i>Prionocyclus hyatti</i>	92.46 ± 0.58	90.80-89.92	<i>Inoceramus howelli</i>	90.01 - 88.94
			<i>Collignoniceras praecox</i>			<i>Inoceramus n.sp.</i>	
			<i>Collignoniceras woollgari</i>			<i>Mytiloides hercynicus</i>	92.48 - 92.15
	Lower		<i>Mammites nodosoides</i>		92.42-90.62	<i>Mytiloides subhercynicus</i>	92.79 - 92.42
			<i>Vascoceras birchbyi</i>	93.48 ± 0.58	FO - 92.76	<i>Mytiloides mytiloides</i>	92.86 - 92.39
<i>Pseudaspidoceras flexuosum</i>			93.19 ± 0.42	93.02-93.02	<i>Mytiloides kossmati</i>	92.85 - 92.63	
<i>Watinceras devonense</i>				FO - 93.01	<i>Mytiloides puebloensis</i>	92.95 - 92.63	
CENOMANIAN	Upper	93.5 ± 0.3/93.0	<i>Nigericeras scotti</i>		92.95-92.95	<i>Mytiloides hattini</i>	93.10 - 92.75
			<i>Neocardioceras juddii</i>	93.32 ± 0.38			
			<i>Burroceras clydense</i>	93.82 ± 0.30	93.20-93.08	<i>Inoceramus pictus</i>	
			<i>Euomphaloceras septemseriatum</i>	93.68 ± 0.50	93.32-93.25		
			<i>Vascoceras diartianum</i>	93.99 ± 0.72	94.62		94.62 - 93.08
			<i>Dunveganoceras conditum</i>			<i>Inoceramus ginterensis</i>	
			<i>Dunveganoceras albertense</i>				
			<i>Dunveganoceras problematicum</i>				93.72 - 93.04
	Middle		<i>Dunveganoceras pondi</i>	94.71 ± 0.49	93.52-93.44	<i>Inoceramus prefragilis</i>	94.47 - 94.01
			<i>Plesiocanthoceras wyomingense</i>			<i>Inoceramus rutherfordi</i>	95.40 - 94.67
			<i>Acanthoceras amphibolium</i>	94.96 ± 0.50	94.92-94.77	<i>Inoceramus arvanus</i>	95.40 - 94.81
			<i>Acanthoceras bellense</i>		95.13-95.13		
			<i>Acanthoceras muldoonense</i>		95.26-94.91		
			<i>Acanthoceras granerosense</i>		95.26-95.10	<i>Inoceramus macconnelli</i>	
Lower			<i>Conlinoceras tarrantense</i>	95.73 ± 0.61			
				1299.33 ± 0.37			
						99.6 ± 0.9/97.1	

<sup>1</sup>Two-fold divisions of Campanian generally accepted in Europe

<sup>2</sup>Ogg et al., 2008/Scott 2009

<sup>3</sup>*Texacanthoceras* of Cooper, 1998

<sup>4</sup>*Coloradoscaphites* of Cooper, 1994

<sup>5</sup>*Anascaphites* of Cooper, 1994

<sup>6</sup>*Clioscapites* of Cooper, 1994

<sup>7</sup>*Billobanoceras* of Cooper, 1994

<sup>8</sup>Low in zone

<sup>9</sup>Hicks et al., 2002, K-T Boundary

<sup>10</sup>Izett, 1998

<sup>11</sup>Baadsgaard, 1993, Ar<sub>4039</sub> age on sanidine, corrected from 27.84 to 28.02 Ma

<sup>12</sup>Radiometric age for Graysonites woolridgei, from Hokkaido, Japan (Obradovich et al., 2002)

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