Appendix 2

Radioisotopic ages used in GTS2020

M.D. SCHMITZ

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
		Quaternary – not compiled										
		Neogene – not compiled										
			Pliocene									
			Miocene									
		Paleogene										
			Oligocene									
				Chattian								
Pg36					biotite-rich layer; PAC-B2	Pieve d'Accinelli section, northeastern Apennines, Italy	43°35′40.41″N, 12°29′34.16″E	Scaglia Cinerea Fm, 42.3 m above base of section	26.57	0.02	0.04	^{206}Pb/^{238}U
				Rupelian								
Pg35	**Pg20**				biotite-rich layer; MCA-145.8, equivalent to MCA/84-3	Monte Cagnero section (Chattian GSSP), northeastern Apennines, Italy	43°38′47.81″N, 12°28′03.83″E	Scaglia Cinerea Fm, 145.8 m above base of section	31.41	0.03	0.04	^{206}Pb/^{238}U
Pg34					biotite-rich layer; MCA-142.8	Monte Cagnero section (Chattian GSSP), northeastern Apennines, Italy	43°38′47.81″N, 12°28′03.83″E	Scaglia Cinerea Fm, 142.8 m above base of section	31.72	0.02	0.04	^{206}Pb/^{238}U
			Eocene									
				Priabonian								
Pg33	**Pg19**				biotite-rich layer; MASS-14.7, equivalent to MAS/86-14.7	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Cinerea Fm, 14.7 m above base of section	34.50	0.04	0.05	^{206}Pb/^{238}U
Pg32					biotite-rich layer; MASS-12.9	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Cinerea Fm, 12.9 m above base of section	34.68	0.04	0.06	^{206}Pb/^{238}U
Pg31	**Pg18**				biotite-rich layer; MASS-12.7, equivalent to MAS/86-12.7	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Cinerea Fm, 12.7 m above base of section	34.72	0.02	0.04	^{206}Pb/^{238}U
Pg30					biotite-rich layer; MASS-12.9	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Variegata Fm, 8.0 m above base of section	35.28	0.03	0.05	^{206}Pb/^{238}U
Pg29					biotite-rich layer; MASS-12.9	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Variegata Fm, 7.2 m above base of section	35.34	0.03	0.05	^{206}Pb/^{238}U
Pg28					biotite-rich layer; MASS-12.9	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Variegata Fm, 6.5 m above base of section	35.40	0.03	0.05	^{206}Pb/^{238}U
Pg27					biotite-rich layer; MASS-12.9	Massignano (Oligocene GSSP), near Ancona, northeastern Apennines, Italy	43.5328°N, 13.6011°E	Scaglia Variegata Fm, 5.8 m above base of section	35.47	0.03	0.05	^{206}Pb/^{238}U
				Bartonian								
				Lutetian								
Pg26	**Pg17**				Mission Valley ash, SDSNH Loc. 3428	La Mesa, California	~33°N, 117°W	terrestrial facies of Mission Valley Fm	43.35	± 0.50	± 0.50	^{40}Ar/^{39}Ar
Pg25	**Pg16**				DSDP Hole 516F	DSDP Hole 516F	30°16.59′S, 35°17.10′W		46.24	± 0.50	± 0.50	^{40}Ar/^{39}Ar
				Ypresian								
Pg24	**Pg15**				68-0-51, 3497; Blue Point Marker ash	Two-Ocean Plateau and Irish Rock locales, Absaroka volcanic province, western USA	~44°N, 109°W	overlies Aycross Fm	48.41	± 0.21	± 0.21	^{40}Ar/^{39}Ar
Pg23	**Pg14**				CP-1; Continental Peak tuff	Bridger Basin, western USA	42°16′06.2″N, 108°43′7.5″W	Bridger Fm	48.96	± 0.28	± 0.33	^{40}Ar/^{39}Ar

Primary radioisotopic age details	Zonal range assignment			Biostratigraphy	Reference
	clade	zonation	Zone		
Weighted mean age of 5 (of 8 with 2 older and 1 younger) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		upper Zone O5; lower NP25	upper Zone O5; lower NP25; magnetostratigraphic control at top of Chron C9n.2n	Sahy et al. (2017); Coccioni et al. (2008)
Weighted mean age of 6 (of 7 with 1 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		middle Zone O2; middle NP23	middle Zone O2; mid NP23; magnetostratigraphic control at upper Chron 12r	Sahy et al. (2017); Coccioni et al. (2008)
Weighted mean age of 4 (of 5 with 1 younger) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		middle Zone O2; middle NP23	middle Zone O2; mid NP23; magnetostratigraphic control at upper Chron 12r	Sahy et al. (2017); Coccioni et al. (2008)
Weighted mean age of 3 (of 7 with 4 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		lowermost NP21, lowermost CP16a	lowermost NP21, lowermost CP16a; magnetostratigraphic control in lower Chron 13r	Sahy et al. (2017); Odin et al. (1991)
Weighted mean age of 3 (of 3) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		uppermost NP19/20, uppermost CP15b	uppermost NP19/20, uppermost CP15b; magnetostratigraphic control near base of Chron 13r	Sahy et al. (2017); Odin et al. (1991)
Weighted mean age of 7 (of 10 with 3 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		uppermost NP19/20, uppermost CP15b	uppermost NP19/20, uppermost CP15b; magnetostratigraphic control near base of Chron 13r	Sahy et al. (2017); Odin et al. (1991)
Weighted mean age of 7 (of 12 with 5 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		lower NP19/20, lower CP15b	lower NP19/20, lower CP15b; magnetostratigraphic control in C15r	Sahy et al. (2017); Odin et al. (1991)
Weighted mean age of 5 (of 7 with 2 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		lower NP19/20, lower CP15b	lower NP19/20, lower CP15b; magnetostratigraphic control in C15r	Sahy et al. (2017); Odin et al. (1991)
Weighted mean age of 6 (of 10 with 4 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		lower NP19/20, lower CP15b	lower NP19/20, lower CP15b; magnetostratigraphic control in C16n.1n	Sahy et al. (2017); Odin et al. (1991)
Weighted mean age of 6 (of 9 with 3 older) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	Plank. foraminifera; calc. nannoplankton		lower NP19/20, lower CP15b	lower NP19/20, lower CP15b; magnetostratigraphic control in C16n.1n	Sahy et al. (2017); Odin et al. (1991)
Laser fusion single-crystal sanidine analyses, originally calibrated to TCs = 28.32 Ma; no analytical data published.	Plank. foraminifera; calc. nannoplankton		NP16, CP14a	coccoliths *Reticulofenestra umbilica* (Levin) and *Discoaster distinctus* Martini; magnetostratigraphic control	Obradovich, unpublished data cited in Walsh et al. (1996)
Laser fusion of biotite and sanidine separates, no analytical data published.	Plank. foraminifera; calc. nannoplankton		NP15, CP10	NP15, CP10; magnetostratigraphic control	Swisher and Montanari, in prep, cited in Berggren et al. (1995) (postscript)
Weighted mean of multi-grain feldspar (46.8% of gas) and multi-grain hornblende (98.7% of gas) incremental heating plateau ages, originally calibrated using FCs = 27.84 Ma.	magnetostratigraphy			magnetostratigraphic control	Hiza (1999); Flynn (1986)
Weighted mean age of 12 (of 16) laser fusion analyses on small multi-grain aliquots of sanidine, using FCs as fluence monitor.	magnetostratigraphy			magnetostratigraphic control	Smith et al. (2008); Clyde et al. (2001)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
Pg22	**Pg15**				GR-416; Sixth tuff	Green River Basin, western USA	41°32′31.1″N, 109°28′52.9″W	uppermost Wilkins Peak Member, Green River Fm	49.69	± 0.05	± 0.07	^{206}Pb/^{238}U
Pg21	**Pg3**				Upper Willwood ash; bed B	Bighorn Basin, western USA	42°16′06.2″N, 108°43′7.5″W	Willwood Fm	52.93	± 0.23	± 0.23	^{40}Ar/^{39}Ar
Pg20	**Pg12**				Ash-17	DSDP Site 550, north Atlantic	48°30.91′N, 13°26.37′W		55.48	± 0.12	± 0.12	^{40}Ar/^{39}Ar
Pg19	**Pg11**				SB01-01 bentonite	Longyearbyen section, Spitsbergen, Svalbard Archipeligo	~78°09′10″N, 15°01′38″E	10.9 m above base of the Gilsonryggen Member, Frysjaodden Fm, within the PETM carbon isotope excursion	55.785	± 0.034	± 0.075	^{206}Pb/^{238}U
			Paleocene									
				Thanetian								
				Selandian								
Pg18	**Pg10**				Belt Ash	Southeast Polecat Bench section, northern Bighorn Basin, Wyoming, USA	44°51.5′N, 108°45.1′W	Silver Coulee beds, Fort Union Fm	59.39	± 0.30	± 0.30	^{40}Ar/^{39}Ar
				Danian								
Pg17					volcanic tuff in Kiowa core, KJ08-17	Kiowa core, Elbert County Fairgrounds, Kiowa, Colorado	39.35242°N, 104.46642°W	174.52 m below top of core; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	64.52	± 0.03	± 0.08	^{206}Pb/^{238}U
Pg16					volcanic tuff in Kiowa core, KJ07-63	Kiowa core, Elbert County Fairgrounds, Kiowa, Colorado	39.35242°N, 104.46642°W	179.26 m below top of core; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	64.63	± 0.05	± 0.09	^{206}Pb/^{238}U
Pg15					U coal tephra	Biscuit Butte locality, Garfield County, eastern Montana	47°29′13.1″N, 107°4′7.6″W	base of Lebo Member of the Fort Union Formation	64.66	± 0.05	± 0.09	^{40}Ar/^{39}Ar
Pg14					V coal tephra	Biscuit Butte locality, Garfield County, eastern Montana	47°29′21.8″N, 107°4′23.8″W	above the Farrand Channel, upper Tulloch Member of the Fort Union Formation	64.84	± 0.05	± 0.09	^{40}Ar/^{39}Ar
Pg13					W coal tephra	Saddle Section locality, Garfield County, eastern Montana	47°30′34.8″N, 107°4′54.9″W	below the Farrand Channel, upper Tulloch Member of the Fort Union Formation	64.91	± 0.05	± 0.10	^{40}Ar/^{39}Ar
Pg12					X coal tephra	McGuire Creek locality, McCone County, eastern Montana	47°37′47.5″N, 106°10′12.4″W	capping the Garbani Channel, upper Tulloch Member of the Fort Union Formation	65.29	± 0.06	± 0.11	^{40}Ar/^{39}Ar
Pg11					Y coal tephra	Hell Hollow locality, Garfield County, eastern Montana	47.53472°N, 107.1687°W	base of the Garbani Channel, lower Tulloch Member of the Fort Union Formation	65.50	± 0.04	± 0.09	^{40}Ar/^{39}Ar
Pg10					volcanic tuff in Kiowa core, KJ08-53	Kiowa core, Elbert County Fairgrounds, Kiowa, Colorado	39.35242°N, 104.46642°W	267.74 m below top of core; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	65.80	± 0.04	± 0.09	^{206}Pb/^{238}U
Pg9					MCZ coal, Lerbekmo bentonite (upper)	Lerbekmo (Hell Creek Marina Road) locality, Garfield County, eastern Montana	47.51602°N, 106.9366°W	near base of Tulloch Member of the Fort Union Formation	65.80	± 0.07	± 0.11	^{40}Ar/^{39}Ar
Pg8					MCZ coal, McGuire Creek bentonite (lower)	Multiple localities (Lofgren, Z-line, Haxby Road, Lerbekmo, Thomas Ranch) in eastern Garfield and western McCone Counties, eastern Montana	47°31.593′N, 106°56.397′W	near base of Tulloch Member of the Fort Union Formation	65.82	± 0.03	± 0.09	^{40}Ar/^{39}Ar
Pg7					IrZ coal, Nirvana bentonite	Multiple localities (Hauso Flats, McKeever Ranch, Nirvana, Hell Hollow) in eastern Garfield and western McCone Counties, eastern Montana	47°31.732′N, 107°12.513′W	base of the Tulloch Member of the Fort Union Formation	65.85	± 0.02	± 0.09	^{40}Ar/^{39}Ar
Pg6					Haitian tektites	Beloc, Haiti	18°23′40″N, 72°38′06″W	between levels f and g, in lower part of the marine limestone Beloc Fm	65.83	± 0.06	± 0.10	^{40}Ar/^{39}Ar

Primary radioisotopic age details	Zonal range assignment			Biostratigraphy	Reference
	clade	zonation	Zone		
Weighted mean age of 6 single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	magnetostratigraphy			magnetostratigraphic control, maximum age for C22n-C22r transition	Machlus et al. (2015); Smith et al. (2004)
Weighted mean age of 16 laser-fusion and 4 five-step laser incremental heating analyses on 1–3 crystal aliquots of sanidine, using FCs as fluence monitor.	NALMA, magnetostratigraphy			Lystitean-Lostcabinian (Wa6–Wa7) North American land mammal age (NALMA) substage boundary; magnetostratigraphic control at base of Chron 24n.1	Smith et al. (2004); Wing et al. (1991); Clyde et al. (1994); Tauxe et al. (1994)
Weighted mean age of 38 laser fusion analyses on single and multi-grain aliquots of sanidine, originally calibrated to FCs = 28.02 Ma.	chemostratigraphy			above the PETM carbon isotope excursion	Storey et al. (2007)
Weighted mean age of five (of 13) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	chemostratigraphy			within the PETM carbon isotope excursion	Charles et al. (2011)
Weighted mean age of 23 laser fusion analyses on 20 grain aliquots of sanidine, originally calibrated to TCs = 28.34 Ma.	magnetostratigraphy			magnetostratigraphic control	Secord et al. (2006)
Weighted mean of 8 (of 12) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy			with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and “fern spike” at 302.93 m below top of core; with respect to base of C28n at 175.16 m below top of core	Clyde et al. (2016)
Weighted mean of 6 (of 8) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy			with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and “fern spike” at 302.93 m below top of core; with respect to base of C28n at 175.16 m below top of core	Clyde et al. (2016)
Weighted mean age of 173 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	NALMA, magnetostratigraphy		Torrejonian 1	magnetostratigraphic control at base of C28n	Sprain et al. (2015)
Weighted mean age of 175 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	NALMA, magnetostratigraphy		Torrejonian 1	magnetostratigraphic control in lower C28r	Sprain et al. (2015)
Weighted mean age of 68 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	NALMA, magnetostratigraphy		Torrejonian 1	magnetostratigraphic control in upper C29n	Sprain et al. (2015)
Weighted mean age of 87 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	NALMA, magnetostratigraphy		Puercan 3	magnetostratigraphic control in middle C29n	Sprain et al. (2015)
Weighted mean age of 137 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	NALMA, magnetostratigraphy		Puercan 2	magnetostratigraphic control in lower C29n	Sprain et al. (2018)
Weighted mean of 8 (of 11) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy		Puercan 1	with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and “fern spike” at 302.93 m below top of core; with respect to base of C29n at 268.47 m below top of core	Clyde et al. (2016)
Lerbekmo bentonite, correlated across multiple locations (Flag Butte, Z-line, Haxby Road, Lerbekmo) on the basis of Pb isotopes in feldspars.	NALMA, magnetostratigraphy		Puercan 1	magnetostratigraphic control in middle C29r	Renne et al. (2013); Ickert et al. (2015)
McGuire Creek bentonite, dated in multiple locations (Lofgren, LG11-1; Z-line, ZL12-2; Haxby Road, HX12-1; Lerbekmo, HC-2PR; Thomas Ranch, TR13-3), and correlated on the basis of Pb isotopes in feldspars.	NALMA, magnetostratigraphy		Puercan 1	magnetostratigraphic control in middle C29r	Sprain et al. (2018); Sprain et al. (2015); Ickert et al. (2015); Renne et al. (2013); Swisher et al. (1993)
Nirvana bentonite, dated in multiple locations (Hauso Flats, HF14-1, HF-1PR, HF15-1; McKeever Ranch, MK13-3; Nirvana, NV12-1; Hell Hollow, HH12-1), and correlated on the basis of Pb isotopes in feldspars.	NALMA, magnetostratigraphy		Puercan 1	magnetostratigraphic control in middle C29r	Sprain et al. (2018); Sprain et al. (2015); Ickert et al. (2015); Renne et al. (2013); Swisher et al. (1993)
Weighted mean age of 14 plateau ages on single tektites, originally calibrated to Renne et al. (2011) optimization.	K-Pg event stratigraphy			debris from KT impact event	Renne et al. (2013)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
Pg5	**Pg3**				Haitian tektites	Beloc, Haiti	18°23′40″N, 72°38′06″W	from 0.5-thick marl bed in lower part of the marine limestone Beloc Fm	65.92	± 0.14	± 0.18	^{40}Ar/^{39}Ar
Pg4	**Pg2**				Haitian tektites	Beloc, Haiti	18°23′40″N, 72°38′06″W	between levels f and g, in lower part of the marine limestone Beloc Fm	65.84	± 0.16	± 0.18	^{40}Ar/^{39}Ar
Pg3	**Pg1**				C1 glassy melt rock	Chicxulub crater	~20.5°N, 89.8°W	C1 glassy melt rock	65.81	± 0.10	± 0.14	^{40}Ar/^{39}Ar
Pg2					volcanic tuff, KJ04-70	"Bowring Pit", West Bijou Creek area, Elbert County, Colorado	39.57059°N, 104.30306°W	1.00 m above K-Pg boundary; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	65.89	± 0.03	± 0.08	^{206}Pb/^{238}U
Pg1					volcanic tuff in Kiowa core, KJ10-04	Kiowa core, Elbert County Fairgrounds, Kiowa, Colorado	39.35242°N, 104.46642°W	302.56 below top of core; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	66.02	± 0.02	± 0.08	^{206}Pb/^{238}U
		Cretaceous										
			Late									
				Maastrichtian								
K88					volcanic tuff, KJ08-157	"Bowring Pit", West Bijou Creek area, Elbert County, Colorado	39.57059°N, 104.30306°W	0.46 m below K-Pg boundary; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	66.08	± 0.02	± 0.08	^{206}Pb/^{238}U
K87					Null coal bentonite	Bug Creek site, Garfield County, eastern Montana	47°40′48.6″N, 106°12′49.6″W	upper Hell Creek Formation	66.08	± 0.10	± 0.13	^{40}Ar/^{39}Ar
K86					Null coal bentonite	Thomas Ranch site, Garfield County, eastern Montana	47.66675°N, 106.4258°W	upper Hell Creek Formation	66.14	± 0.30	± 0.32	^{40}Ar/^{39}Ar
K85					volcanic tuff in Kiowa core, KJ10-09	Kiowa core, Elbert County Fairgrounds, Kiowa, Colorado	39.35242°N, 104.46642°W	344.50 m below top of core; D1 sequence of fluvial/paludal sandstone, mudstone, and lignite beds	66.30	± 0.03	± 0.08	^{206}Pb/^{238}U
K84	**K71**				AK-476	Strawberry Creek, Alberta	53°17′N, 116°06′W	Kneehills Tuff, 18-cm bentonite, 1.8 m above the upper Kneehills Tuff zone	67.29	± 1.11	± 1.11	^{40}Ar/^{39}Ar
K83	**K70**				91-O-14	Red Bird section, Niobrara County, Wyoming (sec.14, T.38N, R.62W)	43.27°N, 104.27°W	30-cm bentonite bed from unit 112, Red Bird section (Gill and Cobban, 1966), sec. 14, T. 38 N, R. 62 W	70.08	± 0.37	± 0.37	^{40}Ar/^{39}Ar
K82	**K69**				92-O-32	Red Bird section, Niobrara County, Wyoming (sec.14, T.38N, R.62W)	43.27°N, 104.27°W	1.40-m bentonite bed from unit 97, Red Bird section (Gill and Cobban, 1966)	70.66	± 0.65	± 0.66	^{40}Ar/^{39}Ar
				Campanian								
K81	**K67**				Snakebite 1 bentonite	Cruikshank Coolee, north of Herbert, southwestern Saskatchewan	~50.7°N, 107.4°W	Snakebite Member of Bearpaw Fm	73.41	± 0.47	± 0.47	^{40}Ar/^{39}Ar
K80	**K66**				90-O-15, bentonite	Big Horn County, Montana (NE/NE, sec.14, T.1N, R.33E)	45.839°N, 107.573°W	Bearpaw Shale – 22-cm bentonite 1.5 m above base of ammonite zone	74.05	± 0.39	± 0.39	^{40}Ar/^{39}Ar
K79	**K65**				93-O-16, bentonite	Montrose County, Colorado (NE corner SE/SE, sec.17, T.48N, R.7W)	38.4153°N, 107.6522°W	Mancos Shale – Bentonite bed in upper part	74.85	± 0.43	± 0.43	^{40}Ar/^{39}Ar
K78	**K64**				86-O-05, bentonite	Foreman, Little River County, Arkansas	33.695°N, 94.415°W	Anonna Fm, Foreman Quarry	75.92	± 0.39	± 0.39	^{40}Ar/^{39}Ar
K77	**K63**				92-O-13, bentonite	Rio Arriba County, New Mexico (CW1/2, sec.11, T.23N, R.1W)	36.238°N, 106.916°W	Lewis Shale – 15-cm bentonite (possibly equivalent to the Huerfanito bentonite marker bed in the subsurface)	76.62	± 0.51	± 0.51	^{40}Ar/^{39}Ar
K76	**K62**				Judith River Bentonite	Elk Basin (northern Bighorn Basin), Wyoming	~45°N, 109°W	Judith River Bentonite; 22m below C33r/C33n polarity reversal	80.10	± 0.61	± 0.61	^{40}Ar/^{39}Ar
K75	**K61**				RB92-15, bentonite	Red Bird section, Niobrara County, Wyoming (sec.14, T.38N, R.62W)	43.27°N, 104.27°W	Ardmore bentonite bed in the base of the Pierre Shale at the Red Bird section	80.62	± 0.40	± 0.40	^{40}Ar/^{39}Ar
K74	**K60**				Ardmore bentonite	Elk Basin (northern Bighorn Basin), Wyoming	44.954°N, 108.856°W	Ardmore Bentonite; a 4.9 m thick bentonite near the base of the Claggett Shale	81.30	± 0.55	± 0.55	^{40}Ar/^{39}Ar

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean age of 52 laser fusions on single or several tektites, originally calibrated to FCs = 27.55 Ma.	K-Pg event stratigraphy			debris from KT impact event	Dalrymple et al. (1993); Izett et al. (1991)
Weighted mean age of 5 plateau ages on single tektites, originally calibrated to FCs = 27.84 Ma.	K-Pg event stratigraphy			debris from KT impact event	Swisher et al. (1992)
Weighted mean age of 5 plateau ages on glassy (andesitic) rock chips, originally calibrated to FCs = 27.84 Ma.	K-Pg event stratigraphy			debris from KT impact event	Swisher et al. (1992)
Weighted mean of 11 (of 14) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy		Puercan 1	with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and "fern spike"; within C29r	Clyde et al. (2016)
Weighted mean of 5 (of 9) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy		Puercan 1	with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and "fern spike" at 302.93 m below top of core; with respect to base of C29r at 363.89 m below top of core	Clyde et al. (2016)
Weighted mean of 12 (of 14) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy		Lancian	with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and "fern spike"; within C29r	Clyde et al. (2016)
Weighted mean age of 57 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	K-Pg event stratigraphy, magnetostratigraphy		Lancian	magnetostratigraphic control at base of C29r	Sprain et al. (2015)
Weighted mean age of 54 single crystal sanidine laser fusions, originally calibrated to Renne et al. (2011) optimization.	K-Pg event stratigraphy, magnetostratigraphy		Lancian	magnetostratigraphic control at base of C29r	Sprain et al. (2018)
Weighted mean of 6 (of 8) single zircon crystal analyses, utilizing CA-TIMS and the ET535 spike.	K-Pg event stratigraphy, magnetostratigraphy		Lancian	with respect to K-Pg boundary defined by iridium layer, disappearance of dinosaurs and plants, and "fern spike" at 302.93 m below top of core; with respect to base of C29r at 363.89 m below top of core	Clyde et al. (2016)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	dinosauria	North America	*Triceratops*	*Triceratops dinosaur zone*	Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites clinolobatus* ammonite zone (uppermost)	*Top of Baculites clinolobatus* ammonite zone	Hicks et al. (1999)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites grandis* ammonite zone.	*Baculites grandis* ammonite zone	Hicks et al. (1999)
Weighted mean age of 10 multi-grain sanidine laser fusion analyses, originally using FCs = 27.84 Ma as fluence monitor.	ammonite	North America	*Baculites reesidei* ammonite zone (uppermost)	top of *Baculites reesidei* ammonite zone	Baadsgaard et al. (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites compressus* ammonite zone	*Baculites compressus* ammonite zone	Hicks et al. (1999)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Exiteloceras jenneyi* ammonite zone	*Exiteloceras jenneyi* ammonite zone	Hicks et al. (1999)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	planktonic foraminifer	Tethyan	*Globotruncanita calcarata*	5m above lowest occurrence of foraminifer *Globotruncanita calcarata*	Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites scotti* ammonite zone	*Baculites scotti* ammonite zone	Hicks et al. (1999)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites obtusus* to *B. perplexus* ammonite zone	*Baculites obtusus* to *B. perplexus* ammonite zone	Hicks et al. (1995)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites obtusus* ammonite zone	*Baculites obtusus* ammonite zone	Hicks et al. (1999)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	North America	*Baculites obtusus* ammonite zone	*Baculites obtusus* ammonite zone	Hicks et al. (1995)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
K73	**K59**				PP-6, upper ash layer	Montagna della Maiella, Valle Tre Grotte, west of Pennapiedimonte, central Apennines, Italy	42°09′N, 14°11′E	Tre Grotte Fm	81.67	± 0.21	± 0.26	^{206}Pb/^{238}U
K72	**K58**				78-O-05, bentonite	Cat Creek Oil field, Petroleum County, Montana	46.880°N, 107.870°W	Eagle Sandstone, thin bentonite in lower part of Scaphites hippocrepis II ammonite zone.	81.84	± 0.11	± 0.22	^{40}Ar/^{39}Ar
				Santonian								
K71					S1019, bentonite	Songliao SK-1s core; Songliao Basin, NE China	45°34′14.42″N, 124°40′15.59″E	Bentonite at 1019 m depth in SK-1s borehole; in lower Nenjiang Fm "of deep-water lacustrine gray to black mudstone intercalated with thin marl, shelly limestone, and oil shales"	83.27	± 0.04	± 0.11	^{206}Pb/^{238}U
K70	**K57**				TOM001, volcanic tuff	Horosari Valley, Tomiuchi area, Hokkaido, Japan	42°45′27″N, 142°13′20″E	"Tomiuchibashi Tuff", Kashima Fm, Yazo Group	84.90	± 0.20	± 0.25	^{206}Pb/^{238}U
K69	**K56**				MT08-04; 97-O-04, bentonite	East bank of McDonald Creet, Petroleum County, Montana	47.0044°N, 108.3340°W	Telegraph Creek Fm, 10-cm bentonite	84.41	± 0.14	± 0.24	^{40}Ar/^{39}Ar
K68	**K55**				MT08-04, bentonite	East bank of McDonald Creet, Petroleum County, Montana	47.0044°N, 108.3340°W	Telegraph Creek Fm, 10-cm bentonite	84.43	± 0.09	± 0.15	^{206}Pb/^{238}U
K67	**K54**				70-O-06 (OB93-12), bentonite	bentonite mine, south of Aberdeen, Monroe County, Mississippi	33.775°N, 88.525°W	Bentonite in Tombigbee Sand Member of Eutaw Fm	84.70	± 0.41	± 0.41	^{40}Ar/^{39}Ar
K66	**K53**				91-O-09, bentonite	Head of ravine, 12.9 km west of Shelby, Montana	48.4923°N, 112.0303°W	3-cm-thick bentonite	84.55	± 0.24	± 0.37	^{40}Ar/^{39}Ar
K65	**K52**				MT09-07; 90-O-10, bentonite	Cut bank on east side of Bighorn River, 1.35 miles SE of Hardin, Montana	45.7216°N, 107.5788°W	4-inch-thick bentonite	85.66	± 0.09	± 0.19	^{40}Ar/^{39}Ar
K64	**K51**				92-O-14, bentonite	creek bottom, 1.1 km NW of Whitewright, eastern Grayson County, Texas	33.5200°N, 96.4034°W	Austin Chalk, 91-cm bentonite is immediately above a fossiliferous 0.3−0.6-m-thick hard massive chalk	86.08	± 0.24	± 0.37	^{40}Ar/^{39}Ar
				Coniacian								
K63	**K50**				MT08-1; 91-O-08, bentonite	S. side of Yellowstone river, just south of Billings, Montana	45.7407°N, 108.5119°W	Cody Shale, 30-cm bentonite, 30.5 m above top of Kevin bentonite group in Cody Shale	87.13	± 0.09	± 0.19	^{40}Ar/^{39}Ar
K62	**K49**				MT08-1, bentonite	S. side of Yellowstone river, just south of Billings, Montana	45.7407°N, 108.5119°W	Cody Shale, 30-cm bentonite, 30.5 m above top of Kevin bentonite group in Cody Shale	87.11	± 0.08	± 0.15	^{206}Pb/^{238}U
K61	**K48**				MT08-03; 91-O-13, bentonite	N. bank, Marias River, 0.5 km W of I-25; Toole County, Montana	48.4288°N, 111.8921°W	Marias River Shale, 15-cm bentonite	89.32	± 0.11	± 0.24	^{40}Ar/^{39}Ar
K60	**K47**				MT08-03, bentonite	N. bank, Marias River, 0.5 km W of I-25; Toole County, Montana	48.4288°N, 111.8921°W	Marias River Shale, 15-cm bentonite	89.37	± 0.07	± 0.15	^{206}Pb/^{238}U
				Turonian								
K59	**K46**				MT-09-09, bentonite	ca. 14 km east of main outcrops of Kewvin type section; Toole County, Montana	48.8177°N, 111.8156°W	Possibly marker bed #39 in Ferdig Member of Marias River Fm	89.87	± 0.10	± 0.18	^{40}Ar/^{39}Ar
K58	**K45**				SAN JUAN, bentonite	San Juan County, New Mexico	~36°N, 108°W	Mancos Shale, 40-cm-thick bentonite in Juana Lopez Member	91.24	± 0.09	± 0.23	^{40}Ar/^{39}Ar
K57	**K44**				UT-08-03, bentonite	Ferron sandstone section near Castle Dale, Utah	39.2226°N, 110.9486°W	Mancos Shale, thin bentonite in Juana Lopez Member	91.37	± 0.08	± 0.17	^{206}Pb/^{238}U
K56	**K43**				UT-08-05; 90-O-56, bentonite	Emery Point section, Mesa Butte quadrangle, Emery County, Utah	38.6°N, 111.2°W	Ferron Sandstone, bentonite between Clausen and Washboard members	91.15	± 0.13	± 0.26	^{40}Ar/^{39}Ar

Primary radioisotopic age details	Zonal range assignment			Biostratigraphy	Reference
	clade	zonation	Zone		
Weighted mean age of four small multi-grain zircon analyses, utilizing physical abrasion and in-house UNIGE spike (0.1% error in tracer calibration).	ammonite	North America	late Early Campanian (*Sca. hippocrepis III* to *Bac. obtusus* zone interval)	upper part of the *Aspidolithus parcus* (CC 18) calcareous nannoplankton zone; and middle of *Globotruncanita elevata* foraminifer zone	Bernoulli et al. (2004)
Weighted mean age of 43 (of 44) laser fusions on 1–3 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Scaphites hippocrepis II ammonite zone*	lower *Scaphites hippocrepis II* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Six (of 14) youngest single grain zircon analyses yield a weighted mean $^{206}\mathrm{Pb}/^{238}\mathrm{U}$ age, utilizing CA-TIMS and ET535 spike.	magnetostratigraphy and cyclostratigraphy		Just below base of Chron C33r	Cyclostratigraphy from tuning the interpreted 405kyr (long) eccentricity cycles in the natural-gamma log of the sedimentary record to the La2010a astronomical model. Chron C34n–C33r boundary is at 985.95 m depth in the Songliao SK-1s core.	Wang et al. (2016)
Four (of 5) multigrain chemically-abraded zircon fractions; ID-TIMS.	planktonic foraminifer	Tethyan	Late Santonian to earliest Campanian?	Local *Globotruncana arca* planktonic zone. Within lower *Inoceramus japonicus* zone, which Walaszczyk and Cobban (2006) cite as “Late Santonian evolutionary descendant of *Platyceramus ezoensis*”; although Quidelleur et al. (2011) show as earliest “Campanian”.	Quidelleur et al. (2011)
Weighted mean age of two samples, including 64 (of 70) laser fusions on 3–4 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Desmoscaphites bassleri* ammonite zone	*Desmoscaphites bassleri* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Four (of 17) youngest single grain zircon analyses yield a weighted mean $^{206}\mathrm{Pb}/^{238}\mathrm{U}$ age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	*Desmoscaphites bassleri* ammonite zone	*Desmoscaphites bassleri* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*Boehmoceras*	Just below *Boehmoceras* fauna of “Uppermost Santonian”	Obradovich (1993)
Weighted mean age of 30 (of 46) laser fusions on 5–7 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Clioscaphites erdmanni* ammonite zone (upper)	Upper part of *Clioscaphites erdmanni* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of two samples, including 45 (of 51) laser fusions on 7–10 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Clioscaphites vermiformis* ammonite zone (middle)	lower-Upper part of *Clioscaphites vermiformis* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of one sample, including 19 (of 25) laser fusions on 5 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	Top of *Clioscaphites saxitonianus* ammonite zone	Top of *Cladoceramus undulatoplicatus* inoceramus bivalve zone, equivalent to top of *Clioscaphites saxitonianus* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of four samples, including 101 (of 127) laser fusions on 4–5 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	middle of *Scaphites depressus* ammonite zone	*Protexanites bourgeoisianus (Scaphites depressus)* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Seven (of 11) single grain zircon analyses yield a weighted mean $^{206}\mathrm{Pb}/^{238}\mathrm{U}$ age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	middle of *Scaphites depressus* ammonite zone	*Protexanites bourgeoisianus (Scaphites depressus)* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of two samples, including 69 (of 84) laser fusions on 1–10 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Scaphites preventricosus* ammonite zone (upper-middle)	*Forresteria alluaudi–Scaphites preventricosus* ammonite zone (upper ash bed)	Sageman et al. (2014); Obradovich (1993)
Four (of 18) single grain zircon analyses yield a weighted mean $^{206}\mathrm{Pb}/^{238}\mathrm{U}$ age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	*Scaphites preventricosus* ammonite zone (lower-middle)	*Forresteria alluaudi–Scaphites preventricosus* ammonite zone (lower ash bed)	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of two samples, including 58 (of 63) laser fusions on 8->10 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Scaphites nigricollensis* ammonite zone	*Scaphites nigricollensis* ammonite zone	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of two samples, including 85 (of 93) laser fusions on single grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	Top of *Prionocyclus macombi* ammonite zone	Top of *Prionocyclus macombi* ammonite zone; 0.9 m above *P. macombi* and 6 m below *Scaphites warreni*	Sageman et al. (2014); Obradovich (1993)
Five (of 11) single grain zircon analyses yield a weighted mean $^{206}\mathrm{Pb}/^{238}\mathrm{U}$ age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	Top of *Prionocyclus macombi* ammonite zone	Within *Prionocyclus macombi* ammonite zone; most likely not same level as the San Juan Ar/Ar sample above.	Sageman et al. (2014); Obradovich (1993)
Weighted mean age of two samples, including 83 (of 103) laser fusions on 1–5 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Prionocyclus hyatti* ammonite zone	*Prionocyclus hyatti* ammonite zone	Siewert (2011); Obradovich (1993)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
K55	**K42**				90-O-34, bentonite	Laholi Point section, Blue Gap, Navajo Indian Reservation, Arizona	36.1849°N, 109.8836°W	Mancos Shale, bentonite BM-17, 0.16-m-thick in lower calcareous shale member, 25-m above base. Equated to bentonite PCB-20 at top of lower Bridge Creek Limestone Mbr, Pueblo, Colorado; and equivalent bentonite below Bed 97 in USGS #1 Portland core.	93.67	± 0.21	± 0.31	^{40}Ar/^{39}Ar
K54	**K41**				AZLP-08-05 (same bentonite as 90-O-34)	Laholi Point section, Blue Gap, Navajo Indian Reservation, Arizona	36.1849°N, 109.8836°W	Mancos Shale, bentonite BM-17, 0.16-m-thick in lower calcareous shale member, 25-m above base. Equated to bentonite PCB-20 at top of lower Bridge Creek Limestone Mbr, Pueblo, Colorado; and equivalent bentonite below Bed 97 in USGS #1 Portland core.	94.09	± 0.13	± 0.19	^{206}Pb/^{238}U
K53	**K40**				AZLP-08-04; K-07-01C; 90-O-33, bentonite	Laholi Point section, Blue Gap, Navajo Indian Reservation, Arizona; and two equivalent bentonites from other Bridge Creek limestone localities	36.1849°N, 109.8836°W; 38.2803°N, 104.7397°W	Mancos Shale, bentonite BM-15, 0.6-m-thick in lower calcareous shale member, 6.4-m above base. Equated to bentonite PCB-17 in lower Bridge Creek Limestone Mbr, Bed 87 in Turonian GSSP, Pueblo, Colorado; equivalent bentonite below limestone Bed 90 in USGS #1 Portland core.	93.79	± 0.12	± 0.26	^{40}Ar/^{39}Ar
K52	**K39**				AZLP-08-04	Laholi Point section, Blue Gap, Navajo Indian Reservation, Arizona; and two equivalent bentonites from other Bridge Creek limestone localities	36.1849°N, 109.8836°W; 38.2803°N, 104.7397°W	Mancos Shale, bentonite BM-15, 0.6-m-thick in lower calcareous shale member, 6.4-m above base. Equated to bentonite PCB-17 in lower Bridge Creek Limestone Mbr, Bed 87 in Turonian GSSP, Pueblo, Colorado; equivalent bentonite below limestone Bed 90 in USGS #1 Portland core.	94.37	± 0.04	± 0.14	^{206}Pb/^{238}U
K51	**K38**				HKt003	Hakkin river section, Hokkaido, Japan	43°02′44″N, 142°09′26″E	Base of Kakkin Muddy sandstone Member, Saku Fm, Yezo Group	94.30	± 0.30	± 0.35	^{206}Pb/^{238}U
				Cenomanian								
K50	**K37**				K-07-01B; NE-08-01; 90-O-19; 90-O-49	Little Blue River, Thayer County, Nebraska; Four Corners, San Juan County, New Mexico; and one other equivalent bentonite from a Bridge Creek limestone locality	40.1731°N, 97.4463°W; 38.2803°N, 104.7397°W	Greenhorn Limestone; HL-3 marker bed; and Turonian GSSP Bed 80	94.10	± 0.14	± 0.27	^{40}Ar/^{39}Ar
K49	**K36**				NE-08-01	Little Blue River, Thayer County, Nebraska	40.1731°N, 97.4463°W	Greenhorn Limestone; 15–20 cm bed above HL-37	94.01	± 0.04	± 0.14	^{206}Pb/^{238}U
K48	**K35**				Bighorn River Bentonite	Ram River below Ram Falls, Alberta	52° 5′44.00″N, 115°49′3.31″W	Vimy Member of Blackstone Fm; upper prominent 35-cm greenish-grey bentonite in lowest part of member.	94.29	± 0.13	± 0.17	^{206}Pb/^{238}U
K47	**K34**				AZLP-08-02; 90-O-31, bentonite	Lohali Point section, Blue Gap, Navajo Indian Reservation, Arizona; and one equivalent bentonite from other Bridge Creek limestone locality	36.1835°N, 109.8843°W	Mancos Shale; bentonite BM-6, 0.22 m thick in lower calcareous shale member, 6.8 m above base of Mancos Shale.	94.20	± 0.15	± 0.28	^{40}Ar/^{39}Ar
K46	**K33**				AZLP-08-01; 90-O-30, bentonite	Lohali Point section, Blue Gap, Navajo Indian Reservation, Arizona	36.1835°N, 109.8843°W	Mancos Shale, bentonite BM-5, 0.9-m-thick in lower calcareous shale member, 5.7-m above base of Mancos Shale.	94.43	± 0.17	± 0.29	^{40}Ar/^{39}Ar
K45	**K32**				AZLP-08-01, bentonite	Lohali Point section, Blue Gap, Navajo Indian Reservation, Arizona	36.1835°N, 109.8843°W	Mancos Shale, bentonite BM-5, 0.9-m-thick in lower calcareous shale member, 5.7-m above base of Mancos Shale.	94.28	± 0.08	± 0.15	^{206}Pb/^{238}U
K44	**K31**				LP22 biotite	Lohali Point section, Blue Gap, Navajo Indian Reservation, Arizona	36.1835°N, 109.8843°W	Bentonite BM-7; Mancos Shale	95.25	± 1.00	± 1.00	^{40}Ar/^{39}Ar
K43	**K30**				D2315 (OB93-23)	Carbon County, Wyoming	42.13°N, 106.20°W	Frontier Fm	95.39	± 0.18	± 0.37	^{40}Ar/^{39}Ar
K42	**K29**				WY-09-04; 90-O-50	Big Sulphur Draw quadrangle, Natrona County, Wyoming	43.31°N, 106.78°W	Frontier Fm, Soap Creek Bentonite marker	95.53	± 0.09	± 0.25	^{40}Ar/^{39}Ar

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean age including 33 (of 41) laser fusions on 5 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	Top of *Pseudaspidoceras flexuosum* ammonite zone	Top of *Pseudaspidoceras flexuosum* ammonite zone (zone below *V. birchbyi* Zone)	Meyers et al. (2012); Obradovich (1993)
Two youngest (of 11) single grain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and ET535 spike. [Not used in Late Cretaceous spline fit.]	ammonite	North America	Top of *Pseudaspidoceras flexuosum* ammonite zone	Top of *Pseudaspidoceras flexuosum* ammonite zone (zone below *V. birchbyi* Zone)	Meyers et al. (2012); Obradovich (1993)
Weighted mean age of three samples, including 93 (of 107) laser fusions on 5–7 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Watinoceras devonense* ammonite zone (upper half)	upper part of *Watinoceras devonense* ammonite zone	Meyers et al. (2012); Obradovich (1993)
Five youngest (of 7) single grain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	*Watinoceras devonense* ammonite zone (upper half)	upper part of *Watinoceras devonense* ammonite zone.	Meyers et al. (2012); Obradovich (1993)
Five (of 7) multi-grain chemically-abraded zircon fractions. ID-TIMS.	planktonic foraminifer	Tethyan	Cenomanian-Turonian boundary interval	Between LAD of *Rotalipora cushmani* and FAD of *Marginotruncana schneeganei;* therefore Cenomanian-Turonian boundary interval.	Quidelleur et al. (2011)
Weighted mean age of four samples, including 103 (of 116) laser fusions on 1–3 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Neocardioceras juddii–N. scotti* (lower-middle)	One-third up in undifferentiated *Neocardioceras juddii–Nigericeras scotti* ammonite zone [Meyers et al. (2012) figure]	Meyers et al. (2012), Obradovich (1993)
Six youngest (of 11) single grain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	*Neocardioceras juddii–N. scotti* (lower-middle)	One-third up in undifferentiated *Neocardioceras juddii–Nigericeras scotti* ammonite zone [Meyers et al. (2012) figure]	Meyers et al. (2012); Obradovich (1993)
Six single zircon grains yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike	ammonite	North America	*Neocardioceras juddii* ammonite zone	Correlated to "B" bentonite, or Bed 80 in Pueblo section; therefore same as other dated "*N. juddii*" bentonite horizon.	Barker et al. (2011)
Weighted mean age of two samples, including 74 (of 83) laser fusions on single grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	Middle of combined *Vascoceras diartianum-B. clydense* interval	*Euomphaloceras septemseriatum* ammonite zone [middle of undifferentiated *S. gracile* zone (including *B. clydense* ?); on Meyers et al. (2012) figure]	Meyers et al. (2012); Obradovich (1993)
Weighted mean age including 42 (of 46) laser fusions on 3–6 grain aliquots of sanidine, using fluence monitor FCs = 28.201 Ma.	ammonite	North America	Middle of combined *Vascoceras diartianum-B. clydense* interval	*Vascoceras diartianum* portion of *Sciponoceras gracile* ammonite zone [middle of undifferentiated *S. gracile* zone (including *B. clydense* ?); on Meyers et al. (2012) figure]	Meyers et al. (2012); Obradovich (1993)
Two youngest (of 5) single grain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and ET535 spike.	ammonite	North America	Middle of combined *Vascoceras diartianum-B. clydense* interval	*Vascoceras diartianum* portion of *Sciponoceras gracile* ammonite zone [middle of undifferentiated *S. gracile* zone [including *B. clydense* ?); on Meyers et al. (2012) figure]	Meyers et al. (2012); Obradovich (1993)
Plateau of biotite separate, originally using FCs = 28.02 Ma as fluence monitor.	ammonite	North America	Base of combined *Vascoceras diartianum-B. clydense* interval	Near base of undifferentiated *Sciponoceras gracile* ammonite zone (overlying *M. mosbyense* zone)	Quidelleur et al. (2011)
Weighted mean age including 25 (of 33) laser fusions on single sanidine crystals, using fluence monitor FCs = 28.201 Ma.	ammonite	North America	*Dunveganoceras pondi* ammonite zone	*Dunveganoceras pondi* ammonite zone	Ma et al. (2014); Obradovich (1993)
Weighted mean age of three samples, including 60 (of 69) laser fusions on 1->10 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Acanthoceras amphibolum* ammonite zone	*Acanthoceras amphibolum* ammonite zone	Siewert (2011); Obradovich (1993)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
K41	**K28**				X bentonite	Burnt Timber Creek, Alberta	51°32′55.91″N, 115°11′42.80″W	Sunkay Member of Blackstone Fm; 30-cm-thick brownish-gray bentonite enclosed by dark marine mudstone.	95.87	± 0.10	± 0.14	^{206}Pb/^{238}U
K40	**K27**				91-O-03; bentonite	Gulch south of Colo. Hwy 76, Pueblo County, Colorado	38.12°N, 104.86°W	Graneros Shale; 7.5-cm-thick bentonite, approximately 0.9 m below its Thatcher Limestone Member	96.12	± 0.19	± 0.31	^{40}Ar/^{39}Ar
K39	**K26**				Bailey Flats core (OB93-26); bentonite	Johnson County, Wyoming	43.6°N, 106.6°W	Basal 7.5 cm of 3-m-thick bentonite, 27 m below lowest occurrence of *C. gilberti* in Frontier Fm	96.56	± 0.45	± 0.45	^{40}Ar/^{39}Ar
K38	**K25**				68-O-09 (OB93-27); bentonite	12.9 km W of Casper, Wyoming; S. side Wyo Hwy 220	42°46′N, 106°26′W	Top of Mowry Shale; Clay Spur Bentonite	97.88	± 0.69	± 0.69	^{40}Ar/^{39}Ar
K37	**K24**				OB93-28; bentonite	N. bank Arrow Creek, Judith Basin County, Montana	47.314°N, 110.487°W	Arrow Creek Member, Colorado Shale; basal 15 cm of Arrow Creek bentonite	99.24	± 0.41	± 0.41	^{40}Ar/^{39}Ar
K36	**K23**				91-O-20 (OB93-29); bentonite	NE of Greybull, Big Horn County, Wyoming	44.56°N, 108.00°W	Thermopolis Shale, 30-cm-thick bentonite ca. 2 m above mudstone unit containing black Mn-nodules, upper part of Shell Creek Shale Member	99.26	± 0.70	± 0.70	^{40}Ar/^{39}Ar
K35	**K22**				91-O-12 (OB93-30); bentonite	Johnson County, Wyoming	43.67°N, 106.85°W	Thermopolis Shale, bentonite 12 m below top	99.46	± 0.59	± 0.59	^{40}Ar/^{39}Ar
K34	**K21**				TNGt006; crystal tuff	Tengunosaw valley, Hokkaido, Japan	43°10′36″N, 142°12′03″E	Hikagenosawa Fm; Yazo Group	97.00	± 0.40	± 0.40	^{206}Pb/^{238}U
K33	**K17**				TNGt005; crystal tuff	Tengunosaw valley, Hokkaido, Japan	43°10′38″N, 142°12′12″E	Hikagenosawa Fm; Yazo Group	99.70	± 1.30	± 1.30	^{206}Pb/^{238}U LA-ICPMS
K32	**K20**				R8072; crystal tuff	Hotei-zawa, Soeushinai area, Hokkaido, Japan	44°16′48″N, 142°04′56″E	Upper Bed My3; middle part of Yezo Group	99.70	± 0.38	± 0.38	^{40}Ar/^{39}Ar
K31	**K19**				SK069; crystal tuff	Hotei-zawa, Soeushinai area, Hokkaido, Japan	44°16′48″N, 142°04′56″E	Upper Bed My3; middle part of Yezo Group; equivalent to R8072 of Obradovich	99.70	± 0.30	± 0.30	^{206}Pb/^{238}U
K30	**K18**				R8943B; crystal tuff	Kyoei-Sakin-zawa, Soeushinai area, Hokkaido, Japan	44°16′N, 142°07′E	Lower Bed My3; middle part of Yezo Group	99.89	± 0.37	± 0.37	^{40}Ar/^{39}Ar
			Early									
				Albian								
K29					TNGt001-8	Tengunosaw valley, Hokkaido, Japan	43°10′45″N, 142°12′48″E	Hikagenosawa Fm; Yazo Group	102.10	± 2.70	± 2.70	^{206}Pb/^{238}U LA-ICPMS
K28	**K16**				75-O-06 (OB93-31); bentonite	Gully on N. bank of Peace River, short distance below the "Gates", British Columbia	56°06′30″N, 121°49′00″W	Hulcross Fm, bentonite in its upper 50 m.	107.89	± 0.30	± 0.30	^{40}Ar/^{39}Ar
K27	**K15**				Vohrum tuff	Vöhrum clay pit situated 30 km east of Hannover, 1.6 km SW of Vöhrum, NW Germany	52°19′49″N, 10°11′44″E	Schwicheldt Ton Member, Gault Fm. 2-cm-thick tuff horizon 65 cm above the (local usage) "Aptian/Albian boundary"	113.08	± 0.07	± 0.14	^{206}Pb/^{238}U
				Aptian								
K26	**K14**				OB93-32; bentonite	Otto gott clay pit, NE of Sarstedt, 21 km SE of Hannover, NW Germany	52°20′34″N, 9°57′28″E	Trachytic tuff, attributed to the Waddenzee volcanic center located off the Netherlands coast (Mutterlose and Böckel, 1998) within a succession of clays and marls.	114.84	± 1.30	± 1.30	^{40}Ar/^{39}Ar

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Six single zircon grains yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike	ammonite	North America	*Acanthoceras amphibolum* ammonite zone	Correlated to "X" bentonite of Frontier Fm in Wyoming; therefore coeval with sample 90-O-50 (*A. amphibolum* ammonite zone). Close to end of regressive phase, just prior to onset of the major transgression culminating in early Turonian most-extensive-flooding of Cretaceous Western Interior basin.	Barker et al. (2011)
Weighted mean age of 48 (of 58) laser fusions on 5 grain aliquots of sanidine, using FCs as fluence monitor.	ammonite	North America	*Conlinoceras tarrantense–C. gilberti* ammonite zone	*Conlinoceras tarrantense (=Conlinoceras gilberti)* ammonite zone	Siewert (2011); Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*N. cornutus*–base *C. gilberti* ammonite zone interval.	27 m below lowest occurrence of *C. gilberti* ammonite	Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*N. cornutus*–base *C. gilberti* ammonite zone interval.	Top of Mowry Shale	Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*Neogastroplites cornutus* ammonite zone	*Neogastroplites cornutus* ammonite zone	Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*Neogastroplites haasi–N. cornutus* ammonite zones	0.9–4.6 m above mudstone unit containing black Mn-nodules with *Neogastroplites haasi*	Obradovich (1993)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*Neogastroplites haasi* ammonite zone	Similarity in age to 91-O-20 suggests the *N. haasi* Zone.	Obradovich (1993)
Mean of four (of 9) multi-grain chemically abraded zircon fractions.	planktonic foraminifer	Tethyan	Early Cenomanian	"*Above FAD of Mantelliceras ammonite*" and within range of foraminifer *Thalmanninella globotruncanoides.";* however, there is a fault below the sampled horizon, therefore is not reliable for scaling relative to underlying strata (Ando, 2016).	Quidelleur et al. (2011)
Eleven spots on 12 zircon grains.	ammonite	Pacific	*Mantelliceras mantelli* ammonite zone (base of upper subzone)	Nearly coeval with local FAD of pelagic forminifer *Thalmanninella globotuncanoides* (primary marker of Albian-Cenomanian boundary).	Quidelleur et al. (2011)
Single or multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	Pacific	*Mantelliceras mantelli* ammonite zone (base of upper subzone)	*Mantelliceras saxbii* ammonite subzone (lower part) of *Mantelliceras mantelli* Zone.	Obradovich et al. (2002)
Five multigrain chemically abraded fractions from SK069 were analyzed by ID-IMS.	ammonite	Pacific	*Mantelliceras mantelli* ammonite zone (upper subzone)	Above occurrence of *Mantelliceras saxbii* ammonite	Quidelleur et al. (2011)
Single or multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor.	ammonite	Pacific	*Mantelliceras mantelli* ammonite zone (top of lower subzone)	Top of *Graysonites woodridgei* ammonite zone (equivalent to European subzone of *Neostlingoceras carcitanense*); upper part. local FAD (but single horizon) of pelagic forminifer *Thalmanninella globotuncanoides* (primary marker of Albian-Cenomanian boundary) is at this level (Ando 2016); thereby placing a minimum age on the base of Cenomanian.	Obradovich et al. (2002)
Seven spots on eleven zircon grains from TNGt001.8 were analyzed by LA-ICPMS.	planktonic foraminifer	Tethyan	*Ps. subticinensis* foraminifer zone	Above FAD of planktonic foraminifer *Pseudothalmanninella subticinensis.*	Quidelleur et al. (2011)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	North America	*Euhoplites loricatus* ammonite zone	*Pseudopulchellia pattoni* zone of North American Western Interior. Correlated to mid-Middle Albian, *Euhoplites loricatus* zone of Europe.	Obradovich (1993)
Weighted mean of five (of 7) single and 2–3 grain zircon fractions, utilizing CA-TIMS and the ET535 spike	ammonite	Western Europe	*Leymeriella tardefurcata* (lower subzone)	65 cm above the first occurrence of the ammonite *Leymeriella (Proleymeriella) schrammeni anterior*	Selby et al. (2009)
Multi-grain sanidine laser fusion analysis, originally using TCs = 28.32 Ma as fluence monitor; no analytical data published.	ammonite	Western Europe	lower *Acanthohoplites nolani* (or slightly above middle of original *Parahoplites nutfieldiensis*)	*Parahoplites nutfieldiensis* ammonite zone [but definition of this zone was not provided in this paper; but see Singer et al. (2015), below for re-analysis of same sample]	Obradovich (1993)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
					Re-analysis: OB93-32; bentonite	Otto gott clay pit, Sarstedt, 21 km SE of Hannover, Germany	52°20′34″N, 9°57′28″E	Trachytic tuff, attributed to the Waddenzee volcanic center located off the Netherlands coast (Mutterlose and Böckel, 1998) within a succession of clays and marls.	114.86		± 0.37	^{40}Ar/^{39}Ar
					Gott	Otto gott clay pit, Sarstedt, 21 km SE of Hannover, Germany	52°20′34″N, 9°57′28″E	Trachytic tuff, attributed to the Waddenzee volcanic center located off the Netherlands coast (Mutterlose and Böckel, 1998) within a succession of clays and marls.	114.80	± 0.12	± 1.10	^{40}Ar/^{39}Ar
K25	**K13**				PA-140, tuff layer	Bano Nuevo Volcanic Complex, near Cerro Mirador, central Patagonian Cordillera, Argentina	45°15′S 71°34′W	volcanics conformably overlie unconsolidated sands of the Apeleg Fm	120.90	± 1.10	± 1.10	^{206}Pb/^{238}U ion probe
K24	**K12**				MC-44, MC-84, MC-86-1; lavas	Bano Nuevo Volcanic Complex, near Cerro Mirador, central Patagonian Cordillera, Argentina	45°17′S 71°28′W	volcanics conformably overlie unconsolidated sands of the Apeleg Fm	122.20	± 1.50	± 1.50	^{40}Ar/^{39}Ar
K23					Yixian Basin	Mashenmiao-Zhuanchengzi (MZ) section, Yixian, Liaoning Province, northeast China	41°29′N, 121°03′E,	Basalt flows; terrestrial setting	122.01	± 0.5	± 0.52	^{40}Ar/^{39}Ar
K22	**K11**				144-878A-46M-1, 46M-2, 79R-3; hawaiites	ODP Site 878A (Leg 144), MIT Guyot, western Pacific	27°19.143′N, 151°53.028′E	Seamount basalts below transgressive carbonates	122.18	± 1.43	± 1.43	^{40}Ar/^{39}Ar
K21	**K10**				MC888; tuff	outcrops along McCarty Creek, 2 miles north of Paskenta, Tehama County, Great Valley, California, USA	39.9°N, 122.5°W	Great Valley Group, California, USA	124.07	± 0.16	± 0.24	^{206}Pb/^{238}U
K20	**K9**				40R-1, 41R-1, 42R-5, 45R-1; plagioclase phenocrysts from volcaniclastic rocks	ODP Site 1184 (Leg 192), eastern salient of Ontong Java Plateau, western equatorial Pacific	5°0.6653′S, 164°13.9771′E	Four samples from cores into subunit IIE in the lower part of the volcaniclastic succession.	124.32	± 1.80	± 1.80	^{40}Ar/^{39}Ar
K19	**K8**				SG7, SGB25, ML475, KF36, KF53; whole rock basalts	on-shore sections of Ontong Java Plateau basalts, central Malaita, Solomon Islands; equivalent to OJP basalts drilled in ODP Site 807	~9°S, 161°E	Malaita Volcanic Group	125.98	± 2.86	± 2.87	^{40}Ar/^{39}Ar
				Barremian								
K18					Svalbard DH	DH-3&7 borehole for U-Pb, DH-2 for C-13 and Magstrat; Svalbard	78°12.1′N, 15°48.9′E	Helvetiafjellet Fm; bentonite at 164.4 m depth in DH7 and coeval one in DH3	123.10	± 0.30	± 0.30	^{206}Pb/^{238}U
K17	**K7**				144-878A-89R-4, 91R-3; plagioclase from alkalic basalts	ODP Site 878 (Leg 144), MIT guyot, western Pacific	27°19.143′N, 151°53.028′E	Seamount basalts below transgressive carbonates.	125.45	± 0.41	± 0.43	^{40}Ar/^{39}Ar
				Hauterivian								
K16					sample EP 1711–1712	El Portón section, Neuquén Basin, Argentina	37°11′52′′S, 69°41′03″W	Interbedded between shales of the upper part of the upper member (Agua de la Mula) of the Agrio Fm	126.97	± 0.04	± 0.15	^{206}Pb/^{238}U
K15					Agrio del Medio	Neuquén Basin, Argentina	38°20′S, 69°57′W	Interbedded between shales of the upper part of the upper member (Agua de la Mula) of the Agrio Fm	127.42	± 0.03	± 0.15	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Laser fusions on 7–10 grain aliquots of sanidine, using FCs as fluence monitor. (Note: details given in GSA talk; but not published in detail.)	ammonite	W. Europe	lower *Acanthohoplites nolani* (or slightly above middle of original *Parahoplites nutfieldiensis*)	Zone is also called "Nolaniceras nolani". Base of Nolani (hence, top of *P. nutfieldiensis* Zone) is constrained in Germany by 114.86 ± 0.37 Ar/Ar, which verifies and enhances Obradovich's 114 ± 1.3 Ma.	Singer et al. (2015)
Gott K-feldspar sample displays highly reproducible step ages, with a high precision plateau age of 114.85 ± 0.12 Ma, when only analytical uncertainties are considered, using Fish Canyon Tuff age of 28.02 Ma as fluence monitor; not yet converted to new standard of 28.201 Ma (Kuiper et al., 2008)	ammonite	W. Europe	lower *Acanthohoplites nolani* (or slightly above middle of original *Parahoplites nutfieldiensis)*	Same level as the other Ar/Ar determinations; slightly above middle of original *Parahoplites nutfieldiensis*	
Weighted mean of 14 (of 17) spot analyses analyzed by SHRIMP II (ANU), using the TEMORA zircon standard.	ammonite	Argentina	*Deshayesites forbesi* through *E. martinoides* zones due to vague biostrat	upper beds of the Apeleg Formation have been dated as early Aptian based on the presence of the ammonite *Tropaeum* or *Australiceras* sp.	Suárez et al. (2010)
Weighted mean of three hornblende 40Ar/39Ar plateau or isochron ages, originally calculated with FCs = 28.02 Ma as the fluence monitor.	ammonite	Argentina	*Deshayesites forbesi* through *E. martinoides* zones due to vague biostrat	upper beds of the Apeleg Formation have been dated as early Aptian based on the presence of the ammonite *Tropaeum* or *Australiceras* sp.	Suárez et al. (2010)
Weighted mean of three whole rock plateau ages; originally calculated with TCs = 28.34 Ma as the fluence monitor.	magnetostratigraphy		Reversed polarity; unknown biostratigraphic age	No biostratigraphy in this terrestrial section that could be correlated to marine standards. Reversed-magnetization basalt flows (10 samples on transect; no boundaries found to normal polarity). Publication assigned it to be Chron M0r based on the reversed polarity.	He et al. (2008)
Weighted mean of three whole rock 40Ar/39Ar isochron ages, originally calculated with TCs = 27.92 Ma as the fluence monitor.	calcareous nannofossil	Tethyan	Within or older than NC6	MIT seamount normally magnetized (above reversed magnetized), upper hawaiite lavas. Platform carbonates 25 m above volcanic basement are assigned to the lower-Aptian *C. litterarius* nannofossil biozone (NC6). Implied to be older than mid-Early Aptian	Pringle and Duncan (1995)
Weighted mean of youngest five (of 7) 1–4 grain zircon fractions, utilizing CA-TIMS and in-house UNC spike (0.1% error in tracer calibration), with analytical error expanded in accommodate geologic scatter.	calcareous nannofossil	Tethyan	lower NC 6B nannofossil zone	*Chiastozygus litterarius* biozone (NC6) – Text says NC6A subzone, as supported by the first occurrence of *C. litterarius* and the last occurrence of *Conusphaera rothii* in MC887, a sample found below MC888. But, LAD of *C. rothii* = base subzone 6B, therefore sample is lower NC6B.	Shimokawa (2010)
Weighted mean of 6 (of 8) laser fusions on 4–5 grain aliquots of plagioclase, sampled from four core intervals, originally calibrated to FCs = 28.02 Ma.	planktonic foraminifer	Tethyan	upper *Leupoldina cabri* foraminifer zone	The oldest sediment overlying basement on the crest of the Ontong Java Plateau occurs within the upper part of the *Leupoldina cabri* planktonic foraminiferal zone.	Chambers et al. (2004)
Weighted mean of 5 whole rock incremental heating plateau ages, originally calculated with FCT-3 biotite = 27.55 Ma.	planktonic foraminifer	Tethyan	*upper Leupoldina cabri* foraminifer zone	The oldest sediment overlying basement on the crest of the Ontong Java Plateau (ODP sites) occurs within the upper part of the *Leupoldina cabri* planktonic foraminiferal zone; but there are no biostratigraphic constraints on these Malaita exposures.	Tejada et al. (2002)
Midtkandal et al. (2016) merged zircon sets from the same bentonite in two boreholes [DH-3 from Corfu et al. (2013)], and used the 10 youngest zircon grains (of 21).	magnetostratigraphy		upper Chron M1r	Indirect palyntology correlations. Lowest meters of overlying Carolinefjellet Formation has a negative then positive C-13 excursion which was interpreted as characteristic of earliest Aptian OAE1a. Position of the ash horizon in adjacent borehole magneostratigraphy indicate it is within mid-Chron M1r (Zhang et al., 2019)	Midtkandal et al. (2016)
Weighted average of plagioclase 40Ar/39Ar isochron ages, originally calculated with TCs = 27.92 Ma as the fluence monitor	magnetostratigraphy		Was interpreted as top of M0r; reinterpreted as top M3r	MIT seamount lower alkalic basalts at reversed-upward-to-normal polarity transition; overlain by normal-polarity basalts. Platform carbonates 25 m above volcanic basement are assigned to the lower-Aptian *C. litterarius* nannofossil biozone (NC6). Implied to be older than mid-Early Aptian. Was interpreted as top of Chron M0r; but re-interpretation might be top of M1r or top of M3r.	Pringle and Duncan (1995)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	ammonite	Argentina	*Sabaudiella riverorum*	Near base of the *Sabaudiella riverorum* regional ammonite zone	Aguirre-Urreta et al. (2019)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	ammonite	Argentina	upper *Pseudothurmannia ohmi* ammonite zone	Within upper part of regional ammonite zone of *Paraspiticeras groeberi*; which they project to be nearly at end of Hauterivian (uppermost *Pseudothurmannia ohmi* Zone of Tethyan Mediterranean).	Aguirre-Urreta et al. (2015)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
K14	**K6**				Caepe Malal; tuff layer	Neuquén Basin, Argentina	37°11′S, 70°23′W	Interbedded between shales of the lowermost part of the upper member (Agua de la Mula) of the Agrio Fm	129.09	± 0.04	± 0.14	^{206}Pb/^{238}U
K13					POT 3 tuff	El Portón section, Neuquén Basin, Argentina	37°11′52″S, 69°41′03″W	Pilmatué Member of the lower Agrio Fm	130.39	± 0.04	± 0.16	^{206}Pb/^{238}U
				Valanginian								
K12	**K5**				MC873A; tuff	outcrops along McCarty Creek, 2 miles north of Paskenta, Tehama County, Great Valley, California, USA	39°54′54″N, 122°32′34″W	Great Valley Group	133.51	± 0.22	± 0.29	^{206}Pb/^{238}U
K11	**K4**				XZ0506; rhyolite	Kadong section, south side of Yamzho Iyumco Lake, 28.75N, 90.70E, ca. 51km ESE of Nagarze, Tibet.	52°18′50.2″N, 9°58′05.5″E	Rhyolite is from unit 13 of the upper (volcanic and volcaniclastic) part of Sangxiu Fm	136.00	± 3.00	± 3.00	^{206}Pb/^{238}U ion probe
K10	**K3**				MC180.5; tuff	outcrops along Kelly Road, Paskenta, Tehama County, Great Valley, California, USA	39°55′N, 122°35′W	Great Valley Group	137.62	± 0.07	± 0.21	^{206}Pb/^{238}U
				Berriasian								
K9	**K2**				CA-6189; rhyolite ignimbrite	southern slope of Lago Norte, 3 km NNW of Lago Norte, Aisén Basin, Patagonia, Argentina	45.1°S, 71.9°W	12 m thick rhyolitic ignimbrite of the Lago Norte Vocanic Complex, overlying a 50 m thick fossiliferous marine succession of Toqui Fm intercalated in the Ibáñez Fm	137.30	± 1.20	± 1.20	^{206}Pb/^{238}U ion probe
K8	**K1**				GC-670; tuff	Outcrops on south side of Grindstone Creek, west of State Road 306, Glen County, Great Valley, California, USA	39°40′N, 122°35′W	Great Valley Group	138.46	± 0.21	± 0.29	^{206}Pb/^{238}U
K7					Lena-Neuquen LL3	Las Loicas; Neuquén Basin, Argentina	35°48′55″S, 70°09′21″W	Vaca Muerta Fm; ca. 54 m level in section	139.24	± 0.05	± 0.16	^{206}Pb/^{238}U
K6					Venari-Neuquen	Las Loicas; Neuquén Basin, Argentina	35°48′55″S, 70°09′21″W	Vaca Muerta Fm; ca.56m level in section	139.55	± 0.03	± 0.16	^{206}Pb/^{238}U
K5					Lena-Neuquen LL9	Las Loicas; Neuquén Basin, Argentina	35°48′55″S 70°09′21″W	Vaca Muerta Fm; ca. 41 m level in section	139.96	± 0.06	± 0.17	^{206}Pb/^{238}U
K4					Lena-Neuquen LL10	Las Loicas; Neuquén Basin, Argentina	35°48′55″S. 70°09′21″W	Vaca Muerta Fm; ca. 31 m level in section	140.34	± 0.06	± 0.18	^{206}Pb/^{238}U
K3					Lena-Neuquen MZT-81	Mazatepec, Puebla State; Sierra Madre, Mexico	∼20°N, 97°W	Lower Tamaulipas Fm of gray limestone (lower part); ca. 23 m level in section.	140.51	± 0.03	± 0.16	^{206}Pb/^{238}U
K2					Lena-Neuquen LL13	Las Loicas; northern Neuquén Basin, Argentina	35°48′55″S, 70°09′21″W	Vaca Muerta Fm; ca. 3 m level in section	142.04	± 0.06	± 0.17	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	ammonite	Argentina	*Subsaynella sayni* ammonite zone (lower)	within the *Spitidiscus riccardii* ammonite zone, correlated with the lower *Subsaynella sayni* zone of the Tethys	Aguirre-Urreta et al. (2015)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	ammonite	Argentina	*Crioceratites loryi* ammonite zone (lower)	Base of regional *Holcoptychites agrioensis* subzone, *Holcoptychites neuquensis* zone; and they suggest this is approximately coeval to base of *Crioiceratites loryi* zone of Tethyan Mediteranean. Same level as local highest-occurrence of *E. windii* nannofossil.	Aguirre-Urreta et al. (2017)
Weighted mean of youngest eight (of 10) 3–5 grain zircon fractions, utilizing CA-TIMS and in-house UNC spike (0.1% error in tracer calibration), with analytical error expanded in accommodate geologic scatter.	calcareous nannofossil	Tethyan	upper *C. oblongata* (lower NC3b) nannofossil zone (middle Valanginian)	Calcareous nannofossils of *P. fenestrata, R. nebulosus, C. angustiforatus, Cyclagelosphaera deflandrei, Eiffellithus windii, Metadoga mercurius, R. wisei*, and *Tubodiscus verenae* place this sample in the *C. oblongata* (NC3) biozone – lower *E. windii* (lower NC3b) subzone	Shimokawa (2010)
Weighted mean of fifteen spot analyses analyzed by SHRIMP II (Beijing), using the TEMORA zircon standard	calcareous nannofossil	Tethyan	*C. oblongata* (NC3) nannofossil zone	Sample is above a *Calcicalathina oblongata–Speetonia colligata* assemblage of calcareous nannofossils, but minimum age is unconstrained. Assigned here as Valanginian.	Wan et al. (2010)
Weighted mean of six oldest (of 8) 1–2 grain zircon fractions, utilizing CA-TIMS and in-house UNC spike (0.1% error in tracer calibration).	calcareous nannofossil	Tethyan	lowest *C. oblongata* (lower NC3a) nannofossil zone (uppermost Berriasian-lowermost Valanginian)	Calcareous nannofossil occurrences suggest correlation to the *C. angustiforatus* biozone – *P. fenestrata* subzone (NK-2B) at the oldest, but it is not possible to rule out a younger age with the current biostratigraphy; the sample is conservatively placed at the base of the Valanginian in the lower *Calcicalathina oblongata* biozone. [*C. oblongata* begins in lower *T. pertransiens* ammonite zone]	Shimokawa (2010)
Weighted mean of 14 (of 19) spot analyses analyzed by SHRIMP II (ANU), using the TEMORA zircon standard.	ammonite	Argentina	Late Berriasian or younger?	Ammonites (*Groebericeras* Leanza and *Blandfordiceras* Cossman) from the underlying Toqui Formation, the basal unit of the Coihaique Group, indicate early Berriasian and late Berriasian ages.	Suárez et al. (2009)
Weighted mean of five 2–4 grain zircon fractions, utilizing CA-TIMS and in-house UNC spike (0.1% error in tracer calibration), with analytical error expanded in accommodate geologic scatter.	calcareous nannofossil	Tethyan	*Cretarhabdus angustiforatus* biozone (NK-2)	Sample placed in the *Cretarhabdus angustiforatus* biozone (NK-2), supported by the occurrences of *C. angustiforatus* and *Assipetra infracretacea* 1 cm above the sample, and the appearances of *Micrantholithus hoschulzii* and *Rhagodiscus nebulosus* within a meter above the sample.	Shimokawa, 2010
Weighted mean of youngest four (of nine) single zircon grains, utilizing CA-TIMS and the ET2535 or ET535 spike	ammonite; calpionellid	Argentina	upper *A. noduliferum* Zone, *Calpionella* Zone; projected as uppermost Chron M17r	upper *Argentiniceras noduliferum* regional ammonite zone; within Calpionella Zone (calpionellids); therefore, upper Berriasian (Kietzmann et al., 2018).	Lena et al. (2019)
Weighted mean of five single zircon grains, utilizing CA-TIMS and the ET2535 spike	ammonite	Argentina	middle *A. noduliferum* Zone; projected as Chron M17r	middle of Argentiniceras noduliferum regional ammonite zone; therefore, upper Berriasian (Kietzmann et al., 2018).	Vennari et al. (2014)
Weighted mean of youngest four (of 11) single zircon grains, utilizing CA-TIMS and the ET2535 or ET535 spike	ammonite	Argentina	lower *A. noduliferum* Zone; projected as basal Chron M17r-uppermost M18n	lower *Argentiniceras noduliferum* regional ammonite zone; within lower Calpionella Zone (calpionellids); above FO nannofossil *Nannoconus steinmannii minor*; therefore, upper Berriasian (Kietzmann et al., 2018).	Lena et al. (2019)
Weighted mean of youngest four (of eight) single zircon grains, utilizing CA-TIMS and the ET2535 or ET535 spike	ammonite; calpionellid	Argentina	uppermost *B. koeneni* Zone, uppermost *Crassicollaria* Zone; projected as basal Chron M18n-uppermost M18r	uppermost *Substeueroceras koeneni* regional ammonite zone; uppermost Crassicollaria Zone (calpionellids); above FO nannofossil *Rhadodiscus* as per, below FO *Nannoconus wintereri;* therefore, middle Berriasian (Kietzmann et al., 2018).	Lena et al. (2019)
Weighted mean of youngest four (of eight) single zircon grains, utilizing CA-TIMS and the ET2535 or ET535 spike	calpionellid	Tethyan	lower *Calp. elliptica* Zone; projected as between base Chron M18n to lower half M17r.	lower Calpionella elliptica subzone; above FO *Nannoconus kamptneri minor,* below *N. steinmannii steinmanni* FO; therefore, middle Berriasian (Kietzmann et al., 2018).	Lena et al. (2019)
Weighted mean of three single zircon grains, utilizing CA-TIMS and the ET2535 or ET535 spike	ammonite	Argentina	middle(?) *B. koeneni* Zone, lower(?) *Crassicollaria* zone; projected as lower Chron M18r	middle (?) *Substeueroceras koeneni* regional ammonite zone (base not exposed); within lower (?) Crassicollaria Zone (calpionellids); below FO nannofossil *Umbria granulosa*; therefore, middle Berriasian (Kietzmann et al., 2018).	Lena et al. (2019)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
K1	**J19**				Shatsky Rise basalt sills	ODP Hole 1213B (Leg 198) on Shatsky Rise, northwest Pacific	31°34.6576′N, 157°17.8621′E	Lithologic Unit IV. Whole-rock = Core 28R-2 (1–6 cm) and 30R-3 (1–6 cm). Feldspars from Core 33R-3 (115–120 cm)	146.48	± 1.62	± 1.63	^{40}Ar/^{39}Ar
		Jurassic										
			Late									
				Tithonian								
J40					Lena-Neuquen LYS	Las Loicas; northern Neuquén Basin, Argentina	35°48′55″S, 70°09′21″W	Base of Vaca Muerta Fm overlying non-marine Tordillo Fm	147.11	± 0.08	± 0.18	^{206}Pb/^{238}U
				Kimmeridgian								
J39	**J18**				Staffin black shale	Flodigarry, Staffin Bay, Isle of Skye, U.K. = proposed GSSP for base-Oxfordian	57°39′40″N, 6°14′44″W	Bed 35, which is 1.30 ± 0.1 m below Concretion-rich marker Bed 36, and near the proposed GSSP level (1.25 m below Bed 36); Flodigarry Shale Member, Staffin Fm	154.10	± 2.10	± 2.20	Re-Os
				Oxfordian								
J38					AB4 Pellenard	Kaberlaba section, in the Altopiano di Asiago (Trentino Alto Adige and Veneto regions, Italy	45°50′27″N, 11°29′47″E	Top of middle unit (RAM) of Rosso Ammonitico	155.67	± 0.80	± 0.89	^{40}Ar/^{39}Ar
J37					felsic tuff, sample EP03-174-1 (z7850)	6.5 km southwest of Diagonal Mountain, central Bowser Basin, British Columbia	56°41′09″N, 127°22′15″W	upper Hazelton Group, 45 m below the base of the Bowser Lake Group	158.70	± 0.20	± 0.27	^{206}Pb/^{238}U
			Middle									
				Callovian								
J36	**J15**				Ash at Bathonian-Callovian boundary	Chacay Melehué, Neuquén Basin, western Argentina	37°15′S, 70°30′W	"Boundary tuff"; Los Molles Fm	164.64	± 0.20	± 0.27	^{206}Pb/^{238}U
				Bathonian								
				Bajocian								
J35	**J14**				Samples ODP 801C-30R-4 37-41 and 801C-31R-4 138-143	ODP Site 801, Pigafetta basin, western Pacific; marine magnetic anomaly M43r (or M42n.4r on revised deep-tow nomenclature)	18°38.538′N, 156°21.588′E	Tholeiitic basalts (ca. 750 mbsf; this unit extends from ca. 500 mbsf to base of hole at ca. 950 mbsf), oceanic thoeiitic basalt crystalline groundmass	168.72	± 1.71	± 1.73	^{40}Ar/^{39}Ar
J34	**J13**				GUN-F; bentonite	near top of Gunlock section, Washington County, Utah, USA	37.270°N, 113.791°W	Crystal Creek Member, Carmel Fm, Utah, USA	168.35	± 1.30	± 1.31	^{40}Ar/^{39}Ar
J33	**J12**				GUN-4; bentonite	near bottom of Gunlock section, Washington County, Utah, USA	37.270°N, 113.791°W	uppermost Temple Cap Fm, Utah, USA	171.48	± 1.20	± 1.22	^{40}Ar/^{39}Ar
				Aalenian								
J32	**J11**				Eskay Rhyolite	Eskay rhyolite east, Eskay Creek gold mine, Kitimat-Stikine A, Iskut River map area, NW British Columbia	56°39′13.6″N, 130°25′47.4″W	Salmon River Fm, Hazelton Group	174.10	± 0.68	± 0.72	^{206}Pb/^{238}U
			Early									
				Toarcian								

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of whole rock (middle sill), and plagioclase (lower sill) incremental heating plateau ages, originally calculated with FCT biotite = 28.03 Ma as the fluence monitor.	calcareous nannofossil	Tethyan	Younger than NK1 nanno zone of earliest Berriasian	Sills (reversely magnetized) were injected into sediments with Calcareous nannofossil zone NK1 and radiolarian zone *Pseudodictryomitra carpatica* of earliest Berriasian = > emplacement of Sills must be younger than earliest Berriasian; and perhaps during Chron M18r.	Mahoney et al. (2005)
Weighted mean of youngest four (of seven) single zircon grains, utilizing CA-TIMS and the ET2535 or ET535 spike	ammonite	Argentina	*V. andesensis* Zone (lowermost Tithonian)	In *Virgatosphinctes andesensis* (same as *Virg. mendozanus* in some scales) regional ammnonite zone (base of ammonite recovery at this level of facies change); therefore lowermost Tithonian (Kietzmann et al., 2018)	Lena et al. (2019)
Model 3 isochron age from 9 rock powder aliquots (+1 replicate) sampling a of 10 cm of section, dissolved via CrVI-H2SO4.	ammonite	Subboreal	*Epipeltoceras bimammatum* ammonite zone (middle part)	"subboreal Oxfordian-Kimmeridgian *(Pseudocordata/ Baylei* zones) boundary is placed between 1.65–1.47 m and 1.08 m below bed 36—the last occurrence of *Ringsteadia* and the first occurrence of *Pictonia,* respectively. Bed 35 is rich in *Pictonia densicostata.*	Selby (2007)
Plateau of 100% of gas released by step-heating of sanidine separate, originally calibrated to joint optimization scheme of Renne et al. (2011).	ammonite	Tethyan	*Gregoryceras transversarium* ammonite zone or younger	ammonites "chacteristic of the *Gregoryceras transversarium* Biozone, indicates a Middle Oxfordian age for the top of the RAM unit"; and overying upper Rosso Ammon.	Pellenard et al. (2013)
Seven multi-grain zircon fractions combined to yield a weighted mean ^{206}Pb/^{238}U age, utilizing air abrasion and an in-house tracer calibration	ammonite	Tethyan	*Quenstedtoceras lamberti* or *Q. mariae* zones	Upper Hazelton Group contains *Quenstedtoceras* or earliest *Cardioceras* of latest Callovian (*Quenstedtoceras lamberti* Zone) or earliest Oxfordian age (*Q. mariae* Zone), 45 m below the base of the Bowser Lake Group.	Evenchick et al. (2010)
Weighted mean of 6 (of 9) single zircon grains, utilizing CA-TIMS and the ET535 spike	ammonite	Tethyan	*Clydoniceras discus–R. anceps* ammonite zone interval?	Tuff between *L. steinmanni* and *vergarensis* regional ammonite zones. Top of local *Lilloettia steinmanni* ammonite assemblage zone. "A precise age cannot be established. . . . Only the overling *Hecticoceras proximum* Zone [which is above a local *Neuqueniceras bodenbenderi* assemblage zone] is chararacterised by an association of Tethyan Oppeliidae indicating the latest early Callovian (Riccardi et al., 1989)."	Kamo and Riccardi (2009)
Weighted mean of two laser incremental heating plateau ages (41%–57% of gas) on acid-leached crystalline groundmass, originally calibrated to FCT-3 biotite = 28.04 Ma.	magnetostratigraphy		Probably Bajocian or Aalenian	Probably the lower massive tholeiitic basalt is mid-Bajocian to early Bathonian [disputed, see Jurassic text; with a much older Early Bajocian or early Aalenian proposed by Bartolini and Larson (2001)]. Important constraint on Jurassic portion (Bajocian-Oxfordian) of M-sequence.	Koppers (2003)
Weighted mean of six single-grain sanidine laser fusion analyses, originally using FCs = 27.84 Ma as fluence monitor.	ammonite	Tethyan	*W. laeviuscula–G. garantiana* ammonite zone interval	Bivalve correlation of Carmel Formation to ammonite-bearing Twin Creek Formation indicates an age of late Early to early Late Bajocian	Kowallis et al. (2001)
Weighted mean of eight single-grain sanidine laser fusion analyses, originally using FCs = 27.84 Ma as fluence monitor.	ammonite	Tethyan	*W. laeviuscula–G. garantiana* ammonite zone interval	Bivalve correlation of Carmel Formation to ammonite-bearing Twin Creek Formation indicates an age of late Early to early Late Bajocian	Kowallis et al. (2001)
Weighted mean of 5 multi-grain zircon fractions, utilizing physical abrasion and in-house UBC spike (0.1% error in tracer calibration). Analytical error expanded in accommodate geologic scatter.	ammonite	Tethyan	uppermost Toarcian–mid-upper Aalenian (*D. pseudoradiosa–B. bradfordensis* zone interval)	Flow-banded rhyolite is overlain by Upper Aalenian strata, correlated to *Erycitoides* cf. *howelli* ammonite zone of western North America zonation) [therefore, could be Lower Aalenian or older?]	Childe (1996)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
J31					Bed 99	Palquilla section near Tacna in southern Peru.	70.000092°S, 17.616156°W	Pelado Formation	180.35	± 0.39	± 0.44	^{206}Pb/^{238}U
J30	**J10**				PCA-YR-1; volcanic ash	Yakoun River, Queen Charlotte Islands, British Columbia	~53.5°N, 132.2°W	Whiteaves Fm	181.40	± 0.73	± 0.78	^{206}Pb/^{238}U
J29	**J9**				AR08AS-29C; tuff	Serrucho Creek, west of Malargüe city, Mendoza prov., Neuquén Basin, Argentina	35°26′32″S, 69°54′12″W	Upper tuff bed within 19.5-m-thick organic-rich shale of lower Tres Esquinas Fm (21.9 mab in measured section).	180.59	± 0.40	± 0.48	^{206}Pb/^{238}U
J28	**J8**				AR08AS-16; tuff	Serrucho Creek, west of Malargüe city, Mendoza prov., Neuquén Basin, Argentina	35°26′32″S, 69°54′12″W	Lower tuff bed within 19.5-m-thick organic-rich shale of lower Tres Esquinas Fm (13.8 mab in measured section)	181.33	± 0.17	± 0.31	^{206}Pb/^{238}U
J27					Bed 28	Palquilla section near Tacna in southern Peru.	70.000092°S, 17.616156°W	Pelado Formation	182.13	± 0.081	± 0.22	^{206}Pb/^{238}U
J26					Bed 22	Palquilla section near Tacna in southern Peru.	70.000092°S, 17.616156°W	Pelado Formation	181.99	± 0.13	± 0.24	^{206}Pb/^{238}U
J25					Ash bed sample AR08-VT56	Chacay Melehue creek, Vega del Tero, Neuquén Basin, Argentina	37°15′9″S, 70°30′25″W	Chachil Limestone, basal Cuyo Group	182.30	± 0.40	± 0.48	^{206}Pb/^{238}U
J24					Multiple samples	Dormettingen Quarry, SW Germany.	48.245°N, 8.761°E	Posidonienschiefer; Multiple samples from sedimentary layers below and between the Unterer Stein, Oberer Stein, Inoceramus Bank, and Nagelkalk horizons.	183.00	± 2.00	± 2.20	Re-Os
J23	**J7**				EP-89-258; quartz monzonite pluton	Spatsizi River map area, Stikine region, NW British Columbia, Canada	~57°N, 129°W	McEwan Creek pluton	183.23	± 0.62	± 0.67	^{206}Pb/^{238}U
J22					Bed 2	Palquilla section near Tacna in southern Peru.	70.000092°S, 17.616156°W	Pelado Formation	183.22	± 0.25	± 0.32	^{206}Pb/^{238}U
J21					Ash bed SC1T	St. Clair section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Hyde Formation, Izee terrane, Blue Mountains tectonic province	184.02	± 0.05	± 0.21	^{206}Pb/^{238}U
				Pliensbachian								
J20					Ash bed WS13T	Sterrett section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Nicely Formation, Izee terrane, Blue Mountains tectonic province	184.36	± 0.07	± 0.21	^{206}Pb/^{238}U
J19					Ash bed SC11T	St. Clair section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Nicely Formation, Izee terrane, Blue Mountains tectonic province	184.55	± 0.04	± 0.21	^{206}Pb/^{238}U
J18					Ash bed SC19T	St. Clair section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Nicely Formation, Izee terrane, Blue Mountains tectonic province	185.18	± 0.07	± 0.21	^{206}Pb/^{238}U
J17					Ash bed SC28T	St. Clair section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Nicely Formation, Izee terrane, Blue Mountains tectonic province	185.47	± 0.04	± 0.21	^{206}Pb/^{238}U
J16	**J6**				IWE-95-111; rhyolite tuff	ridges west of Skinhead Lake near the town of Granisle, NW British Columbia, Canada (UTM 6085600N 675060E)	54.9°N, 126.5°W	Rhyolite tuff in Hazelton Group	184.75	± 0.60	± 0.63	^{206}Pb/^{238}U
J15	**J5**				GGAJ-92-127; lithic crystal lapilli tuff	South side of Copper Island, Atlin Lake, NW British Columbia, Canada	59.4°N, 133.8°W	Laberge Group	185.68	± 0.19	± 0.33	^{206}Pb/^{238}U
J14					bentonite, +2.35 m	East Tributary of Bighorn Creek, Alberta, Canada	51°43′49″N, 115°31′51″W	2.35 m above base of section, in Red Deer Member, Fernie Formation	185.49	± 0.25	± 0.32	^{206}Pb/^{238}U
J13					Ash bed SC_47T	St. Clair section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Nicely Formation, Izee terrane, Blue Mountains tectonic province	186.52	± 0.16	± 0.26	^{206}Pb/^{238}U
J12					Ash bed Rb_50	Rosebud section, 2 km W of Izee, E. Oregon	44°08′N, 119°19′W	Nicely Formation, Izee terrane, Blue Mountains tectonic province	186.71	± 0.06	± 0.21	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of youngest three (of six) single zircon grains, utilizing CA-TIMS and the ET535 spike	ammonite	Tethyan	*Gr. thouarsense* Zone	Above strata containing *Yakounia* ammonites, interpreted as equivalent to *Gr. thouarsense* Standard Zone	Sell et al. (2014); Al-Suwaidi et al. (2016)
Weighted mean of 6 single and multi-grain zircon fractions, utilizing physical abrasion and in-house GSC spike (0.1% error in tracer calibration).	ammonite	Tethyan	upper *Hild. bifrons* to lower *Haugia variabilis*	North American *Crassicosta* ammonite zone is interpreted to correlate to the upper *Hild. bifrons*—lower *Haugia variabilis* ammonite zones of NW Europe	Pálfy et al. (1997); Al-Suwaidi et al. (2016)
Weighted mean of 8 (of 9) multi-grain zircon fractions, utilizing either physical or chemical abrasion and in-house Oslo spike (0.1% error in tracer calibration).	ammonite	Tethyan	*Hild. bifrons* to *H. variabilis* Zone	Andean *Dact. hoelderi* Zone to *P. pacificum* Zone is interpreted to be equivalent to a range from the *Harp. serpentinum* to *Hild. bifrons* Standard Zones	Mazzini et al. (2010); Al-Suwaidi et al. (2016)
Weighted mean of 5 multi-grain zircon fractions, utilizing either physical or chemical abrasion and in-house Oslo spike (0.1% error in tracer calibration).	ammonite	Tethyan	*Hild. bifrons* to *H. variabilis* Zone	Andean *Dact. hoelderi* Zone to *P. pacificum* Zone is interpreted to be equivalent to a range from the *Harp. serpentinum* to *Hild. bifrons* Standard Zones	Mazzini et al. (2010); Al-Suwaidi et al. (2016)
Weighted mean of youngest six (of nine) single zircon grains, utilizing CA-TIMS and the ET535 spike	ammonite	Tethyan	*Hild. bifrons* Zone?	Within strata containing *Porpoceras* ammonites, interpreted as equivalent to *Hild. bifrons* Standard Zone	Sell et al. (2014); Al-Suwaidi et al. (2016)
Weighted mean of youngest three (of 10) single zircon grains, utilizing CA-TIMS and the ET535 spike	ammonite	Tethyan	*Hild. bifrons* Zone?	Within strata containing *Porpoceras* ammonites, interpreted as equivalent to *Hild. bifrons* Standard Zone	Sell et al. (2014); Al-Suwaidi et al. (2016)
Weighted mean of 5 (of 7) single or multi-grain zircon fractions, utilizing either physical or chemical abrasion and in-house Oslo spike (0.1% error in tracer calibration).	ammonite	Tethyan	*Harp. serpentinum*?	Tuff is in the upper Chachil Limestone, and below a level in lower Los Molles Formation with ammonites of *hoelderi* Zone, interpreted to be equivalent to the *Harp. serpentinum* Zone of NW Europe	Leanza et al. (2013); Al-Suwaidi et al. (2016)
The Dormettingen shale suite (n = 14) yields a model 3 isochron age (Excluding the most bioturbated samples 1-BGM, 3- SGS, and 4-AGM).	ammonite	Tethyan	*Dact. tenuicostatum* to *Hild. bifrons* zones	Shale samples included in isochron include horizons spanning the *Dact. tenuicostatum* to *Hild. bifrons* zones	van Acken et al. (2019)
Weighted mean of one zircon and two titanite multi-grain fractions, utilizing physical abrasion and in-house GSC spike (0.1% error in tracer calibration). Analytical error expanded to accommodate geologic scatter.	ammonite	Tethyan	*Dact. tenuicostatum*—*Hild. bifrons* ammonite zone interval?	Intrudes volcanics with intercalated sediments of Early Toarcian age; pluton is perhaps co-magmatic with volcanism.	Evenchick and McNicoll (1993)
Weighted mean of youngest four (of five) single zircon grains, utilizing CA-TIMS and the ET535 spike	ammonite	Tethyan	*Dact. tenuicostatum* Zone/ *Harp. serpentinum* Zone boundary	Lies above *Dactylioceras kanense* and below *Hildaites striatus*	Sell et al. (2014); Al-Suwaidi et al. (2016)
Weighted mean of 7 single grain analyses, excluding 3 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	Tethyan	*Dact. tenuicostatum*?	Occurs above highest Plienbachian ammonites in section and possibly equivalent to the NW European *tenuicostatum* Zone (Toarcian)	De Lena et al. (2019)
Weighted mean of 4 single grain analyses, excluding 2 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*carlottense* Zone	Interpreted to be equivalent to *spinatum* Zone of NW Europe	De Lena et al. (2019)
Weighted mean of 5 single grain analyses, excluding 4 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*carlottense* Zone	Interpreted to be equivalent to *spinatum* Zone of NW Europe	De Lena et al. (2019)
Weighted mean of 5 single grain analyses, excluding 4 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*carlottense* Zone/*kunae* Zone boundary	Interpreted to be equivalent to *spinatum* Zone *margaritatus* Zone boundary of NW Europe	De Lena et al. (2019)
Weighted mean of 4 single grain analyses, excluding 5 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus* Zone (*gibbosus* Subzone?) of NW Europe	De Lena et al. (2019)
Weighted mean of 4 multi-grain zircon fractions, utilizing physical abrasion and in-house GSC spike (0.1% error in tracer calibration). Analytical error expanded to accommodate geologic scatter.	ammonite	North America	*Fuc. lavinianum* (lower half)—*Emac. emaciatum* (upper half) zones = *kunae* zone	Interpreted to be equivalent to *margaritatus Zone* of NW Europe	Pálfy et al. (2000)
Weighted mean of 4 multi-grain zircon fractions, utilizing physical abrasion and in-house GSC spike (0.1% error in tracer calibration).	ammonite	North America	*Fuc. lavinianum* (lower half)–*Emac. emaciatum* (upper half) zones=*kunae* Zone	Interpreted to be equivalent to *margaritatus Zone* of NW Europe	Johannson and McNicoll (1997)
Three of five single zircon grain analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus Zone* of NW Europe	Them et al. (2017)
Weighted mean of 6 single grain analyses, excluding 2 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus* Zone (*subnodosus/gibbosus* subzones boundary?) of NW Europe	De Lena et al. (2019)
Weighted mean of 3 single grain analyses, excluding 3 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus* Zone (*subnodosus/gibbosus* subzone boundary?) of NW Europe	De Lena et al. (2019)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
J11					Ash bed SC57T	St. Clair section, 2 km W of Izee, E. Oregon	44°04′N, 119°24′W	Suplee Formation, Izee terrane, Blue Mountains tectonic province	186.82	± 0.04	± 0.21	^{206}Pb/^{238}U
J10					Ash bed Rb_22	Rosebud, 2 km W of Izee, E. Oregon	44°08′N, 119°19′W	Suplee Formation, Izee terrane, Blue Mountains tectonic province	186.96	± 0.07	± 0.22	^{206}Pb/^{238}U
J9					bentonite, −1.9 m	East Tributary of Bighorn Creek, Alberta, Canada	51°43′44″N, 115°31′51″W	1.9 m below base of section, in Red Deer Member, Fernie Formation	188.58	± 0.25	± 0.32	^{206}Pb/^{238}U
J8					Ash bed sample AR08-VT14	Chacay Melehue creek, Vega del Tero, Neuquén Basin, Argentina	37°15′9″S, 70°30′25″W	Chachil Limestone, basal Cuyo Group	185.70	± 0.40	± 0.48	^{206}Pb/^{238}U
J7					Ash bed samples C-09-1 and C-09-2	Mirador del Chachil, Neuquén Basin, Argentina	39°1317″S, 70°33′37″W	Chachil Limestone, basal Cuyo Group	186.00	± 0.40	± 0.48	^{206}Pb/^{238}U
				Sinemurian								
J6	**J4**				93JP48; rhyolite flow	southern Telkwa Range, Smithers map area, British Columbia (UTM 6025080N, 622200E)	~56°N, 127°W	Telkwa Fm, Hazelton Group	191.16	± 0.72	± 0.74	^{206}Pb/^{238}U
J5	**J3**				LM4-19B; tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed L-19 at ca. 130 m in their section of Aramachay Fm of Pucara Group	199.53	± 0.22	± 0.30	^{206}Pb/^{238}U
				Hettangian								
J4					LM4-155/182; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 100 m in their section of Aramachay Fm of Pucara Group	200.35	± 0.13	± 0.22	^{206}Pb/^{238}U
J3					LM4-117/118; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 77 m in their section of Aramachay Fm of Pucara Group	200.67	± 0.21	± 0.30	^{206}Pb/^{238}U
J2	**J2**				LM4-100/101; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 68 m in their section, approximately 5 1/2 m above sample LM4-90, in Aramachay Fm of Pucara Group	201.32	± 0.13	± 0.22	^{206}Pb/^{238}U
J1	**J1**				NYC-N10; volcanic tuff	New York Canyon, Nevada, USA	38.5°N, 118.1°W	New York Canyon section [stratigraphy, ammonites, carbon-isotopes in Guex et al. (2004)]; which was candidate for base-Triassic GSSP.	201.33	± 0.17	± 0.27	^{206}Pb/^{238}U
		Triassic										
			Late									
				Rhaetian								
T39	**T24**				LM4-90; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed 90 at ca. 65 m in their section of Aramachay Fm of Pucara Group.	201.39	± 0.14	± 0.25	^{206}Pb/^{238}U
T38	**T23**				LM4-86; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed 86 at ca. 59 m level in their section of Aramachay Fm of Pucara Group.	201.51	± 0.15	± 0.24	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 5 single grain analyses, excluding 5 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus* Zone *(subnodosus/gibbosus* subzones boundary?) of NW Europe	De Lena et al. (2019)
Weighted mean of 4 single grain analyses, excluding 4 older grains; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus* Zone *(subnodosus/gibbosus* subzones boundary?) of NW Europe	De Lena et al. (2019)
Three of five single zircon grain analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	ammonite	North America	*kunae Zone*	Interpreted to be equivalent to *margaritatus Zone* of NW Europe	Them et al. (2017)
Weighted mean of 2 (of 11) single multi-grain zircon fractions, utilizing either physical or chemical abrasion and in-house Oslo spike (0.1% error in tracer calibration).	ammonite	Andean	*Austromorphites behrendseni*	lower Chachil Limestone contains *Austromorphites behrendseni* Assemblage Zone (interpreted as equivalent to Tethyan *Prodactylioceras davoei* Standard Zone)	Leanza et al. (2013)
Weighted mean of 5 (of 14) single grain analyses, utilizing chemical abrasion and in-house Oslo spike (0.1% error in tracer calibration).	ammonite	Andean	*Austromorphites behrendseni*	lower Chachil Limestone contains *Austromorphites behrendseni* Assemblage Zone (interpreted as equivalent to Tethyan *Prodactylioceras davoei* Standard Zone)	Leanza et al. (2013)
Weighted mean of 3 multi-grain zircon fractions, utilizing physical abrasion and in-house GSC spike (0.1% error in tracer calibration). Analytical error expanded to accommodate geologic scatter.	ammonite	North America	late Sinemurian (*O. oxynotum*−*E. raricostatum* zone interval?)	Sample from 100 m of epiclastic and pyroclastic strata above sediments with ammonite assemblages characteristic of Late Sinemurian *Plesechioceras? harbledownense* ammonite zone of western North America	Pálfy et al. (2000)
Six (of 9) single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration).	ammonite	Peruvian	*Badouxia canadensis* ammonite zone	Within *Badouxia canadensis* ammonite beds, with a level with *Angulaticeras* genus about 8 m below and the lowest *Vermiceras densicostatum* and *Metophioceras* occurrence about 12 m above.	Schaltegger et al. (2008), Guex et al. (2012)
Eight single zircon grains analyzed with CA-TIMS and ET2535 spike illustrate excess scatter attributed to a range of growth histories prior to eruption; the authors estimate the eruption age from youngest robust grain analysis.	ammonite	Peruvian	*Kammerkarites* ammonite zone	In upper part of local occurrence of ammonite *Kammerkarites* (middle Hettangian); equivalent to *Saxoceras* zone in NW Europe scale.	Guex et al. (2012)
Seven single zircon grains analyzed with CA-TIMS and ET2535 spike illustrate excess scatter attributed to a range of growth histories prior to eruption; the authors estimate the eruption age from youngest robust grain analysis.	ammonite	Peruvian	*Psiloceras tilmanni* ammonite zone	At the local lowest occurrence of ammonite *Psiloceras tilmanni* (early Hettangian)	Guex et al. (2012)
Fourteen single zircon grains analyzed with CA-TIMS and ET2535 spike illustrate excess scatter attributed to a range of growth histories prior to eruption; originally published as 201.29 ± 0.19/0.28; then revised in Wotzlaw et al. (2014b) as 201.32 ± 0.13 Ma.	ammonite	Peruvian	*Psiloceras spelae ammonite zone (lower half)*	ca. 2.5 m above lowest occurrence of Hettangian genus *Psiloceras (Psiloceras spelae);* which is presumed to be equivalent to the base-Jurassic GSSP level in Austria.	Schoene et al. (2010); Wotzlaw et al. (2014b)
Seventeen single zircon grains analyzed with CA-TIMS and ET2535 spike. Estimate of eruption age from youngest robust grain at 201.33 ± 0.19 Ma; weighted mean of 9 youngest robust grains is statistically equivalent at 201.45 ± 0.12 Ma.	ammonite	Peruvian	*Psiloceras spelae ammonite zone (lower half)*	1.5 m above the lowest occurrence of Hettangian genus *Psiloceras (Psiloceras spelae);* which is presumed to be equivalent to the base-Jurassic GSSP level in Austria.	Schoene et al. (2010); Wotzlaw et al. (2014b)
Fourteen single zircon grains analyzed with CA-TIMS and ET2535 spike include Proterozoic xenocrysts, a cluster of 9 equivalent grains and one young analysis attributed to Pb-loss; the authors estimate the eruption age from most precise, young, robust grain, although a weighted mean of nine grains is statistically equivalent.	ammonite	Tethyan	Top-Triassic ammonite zone gap	Mid-way between highest local occurrence of the topmost Triassic ammonite genus *Choristoceras* (*Choristo. crickmayi*, 3 m below) and lowest occurrence of Hettangian genus *Psiloceras (Psiloceras spelae,* about 3 m higher) => middle of "extinction interval" of end-Triassic. Tri/Jur boundary projected as about the 64 m level in section (FAD of *Psiloceras spelae*).	Schoene et al. (2010); Wotzlaw et al. (2014b)
Fourteen single zircon grains analyzed with CA-TIMS and ET2535 spike illustrate excess scatter; the authors estimate the eruption age from youngest robust grain, although a weighted mean of youngest three robust grains is statistically equivalent.	ammonite	Tethyan	Top-Triassic ammonite zone gap	One meter above the highest local occurrence of the topmost Triassic ammonite genus *Choristoceras (Choristo. crickmayi*, in Bed 84b, 59.5 m level), and 5 m below the Hettangian genus *Psiloceras (Psiloceras spelae,* in bed 93b, 64.5 m level) and about 18 m below *Psiloceras tilmanni* (Bed 114-129, lowest at 77.5 m level).	Schoene et al. (2010); Wotzlaw et al. (2014b)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
T37					LM4-76/77; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 51 m level in their section of Aramachay Fm of Pucara Group.	201.87	± 0.17	± 0.25	$^{206}\text{Pb}/^{238}\text{U}$
T36					LM4-58/59; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 35 m level in their section of Aramachay Fm of Pucara Group.	202.16	± 0.27	± 0.30	$^{206}\text{Pb}/^{238}\text{U}$
T35					LM4-50/51; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 29 m level in their section of Aramachay Fm of Pucara Group.	202.38	± 0.16	± 0.25	$^{206}\text{Pb}/^{238}\text{U}$
T34					LM4-23B; volcanic tuff	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca. 9 m level in their section of Aramachay Fm of Pucara Group.	203.71	± 0.11	± 0.24	$^{206}\text{Pb}/^{238}\text{U}$
				Norian								
T33					LP2010-1d	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca.—32 m level in their section of Aramachay Fm of Pucara Group.	205.35	± 0.19	± 0.30	$^{206}\text{Pb}/^{238}\text{U}$
T32					LP2010-1b	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca.—32 m level in their section of Aramachay Fm of Pucara Group.	205.39	± 0.09	± 0.24	$^{206}\text{Pb}/^{238}\text{U}$
T31					LP2010-3a	Utcubamba valley, northern Peru; on fresh road section from Levanto to Maino.	6°18′26.8″S, 77°53′7.1″W	Ash bed at ca.—39 m level in their section of Aramachay Fm of Pucara Group.	205.70	± 0.15	± 0.27	$^{206}\text{Pb}/^{238}\text{U}$
				Carnian								
T30	**T22**				Aglianico tuff bed	Pignola, southern Apennines, southern Italy	40.5°N, 15.8°E	“A 5-cm-thick volcanic ash bed (here named Aglianico) occurs within the hemipelagic to pelagic Calcari con Selce Fm (i.e., cherty limestones) of the Pignola 2 section”. Unusual clay-bed (no carbonate) 3 m below is “Carnian pluvial event” that coincides with demise of rimmed carbonate platforms in the Tethys.	230.91	± 0.13	± 0.28	$^{206}\text{Pb}/^{238}\text{U}$
			Middle									
				Ladinian								
T29	**T21**				Alpe di Siusi ash bed	Rio Nigra section, Alpe di Siusi/ Seiser Alm area, Dolomites, northern Italy	45°31.0′N, 11°35.0′E	Frommer Member, Fernazza Fm	237.85	± 0.05	± 0.14	$^{206}\text{Pb}/^{238}\text{U}$
T28	**T20**				FP2; volcaniclastic sandstone	Flexenpass, eastern Vorarlberg, westernmost Northern Calcareous Alps, Austria	47°08′35″N, 10°10′01″E	Graded volcaniclastic layer in the upper part (44.3 m level in section) of the Reifling Fm	239.34	± 0.28	± 0.38	$^{206}\text{Pb}/^{238}\text{U}$
T27	**T19**				Litér, volcanic ash matrix of neptunian dyke	Litér dolomite quarry, Balaton Highlands, Hungary	47°05.9′N, 18°0.4′E	Neptunian dyke into Tagyon Dolomite	238.58	± 0.65	± 0.70	$^{206}\text{Pb}/^{238}\text{U}$

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Originally published as 201.78 ± 0.16 in Guex et al. (2012); then revised by them in Wotzlaw et al. (2014b) as 201.87 ± 0.17 Ma.	ammonite	Tethyan	*Vandaites saximontanum* to *Choristoceras crickmayi*	Between *Vandaites saximontanum* (mid-Rhaetian) and *Choristoceras crickmayi* (late Rhaetian)	Guex et al. (2012); Wotzlaw et al. (2014b)
Utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Originally published as 202.10 ± 0.27 in Guex et al. (2012); then revised by them in Wotzlaw et al. (2014b) as 202.16 ± 0.27 Ma	ammonite	Tethyan	*Vandaites saximontanum* to *Choristoceras crickmayi*	Between *Vandaites saximontanum* (mid-Rhaetian) and *Choristoceras crickmayi* (late Rhaetian)	Guex et al. (2012); Wotzlaw et al. (2014b)
Utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Originally published as 202.32 ± 0.16 in Guex et al. (2012); then revised by them in Wotzlaw et al. (2014b) as 202.38 ± 0.16 Ma.	ammonite	Tethyan	*Vandaites saximontanum* to *Choristoceras crickmayi*	Between *Vandaites saximontanum* (mid-Rhaetian) and *Choristoceras crickmayi* (late Rhaetian)	Guex et al. (2012); Wotzlaw et al. (2014b)
Utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Originally published as 203.62 ± 0.10 in Guex et al. (2012); then revised by them in Wotzlaw et al. (2014b) as 203.71 ± 0.11 Ma.	Ammonite	Tethyan	*Vandaites saximontanum* ammonoid zone	Ca. 5 m above occurrence of *Vandaites saximontanum* (mid-Rhaetian)	Guex et al. (2012); Wotzlaw et al. (2014b)
Youngest six (of 14) single zircon grains, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration).	bivalve	Tethyan	Norian-Rhaetian transition interval	5 m above sample 3a. Occurs "an abundant fauna of *Otapiria*, which are closely related to *Otapiria norica* known from the late Norian *G. cordilleranus* ammonoid zone of northeastern British Columbia (Meyers et al., 2011)." (Wotzlaw et al., 2014b)	Guex et al. (2012); Wotzlaw et al. (2014b)
Date of the youngest zircon (n = 14) consistent with respect to its stratigraphic position relative the other two ash bed samples, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration).	bivalve	Tethyan	Norian-Rhaetian transition interval	5 m above sample 3a. There is "an abundant fauna of *Otapiria*, which are closely related to *Otapiria norica* known from the late Norian *G. cordilleranus* ammonoid zone of northeastern British Columbia (McRoberts, 2011)." (Wotzlaw et al., 2014b)	Guex et al. (2012); Wotzlaw et al. (2014b)
Youngest 8 (of 15) single zircons, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration).	bivalve	Tethyan	Top of *Monotis subcircularis* bivalve zone	Occurs with bivalve *Oxytoma* cf. *O. inaequivalvis*. About 5 m above highest occurrence of "large monotid bivalves, identified as *Monotis subcircularis* . . . which occur in hard gray and massive silty limestones at the base of the section. *M. subcircularis* and other large monotid bivalves underwent nearly complete extinction at the top of the Norian, correlative with the top of the *Sagenites quinquepunctatus* ammonoid zone in the Tethys and the top of the *Gnomohalorites cordilleranus* ammonoid zone in the Americas.	Guex et al. (2012); Wotzlaw et al. (2014b)
Eight single zircon grains yield a weighted mean ^{206}Pb/^{238}U age utilizing CA-TIMS and in-house MIT spike.	conodont	Tethyan	Assigned in text to either *P. carpathicus* or *E. nodosa* zone of Channell et al. (2003) or to lower and middle part of the *M. nodusus* zone of Orchard (1991).	Just below FAD of conodont *P. carpathicus* and within total range of conodont *M. nodosus*, but they indicate FAD of this taxa varies among sections and workers. Mid-Upper Carnian is suggested by "Lower Carnian conodonts (*Glad.* spp., *N. postkockeli, P. inclinata, P. tadpole*) abruptly disappear 3 m below the ash bed at a level corresponding to the Carnian pluvial event" and "Carnian-Norian boundary can be placed 6 m above the ash bed with the first occurrence of *M. communisti*."	Furin et al. (2006)
Seven single zircon grains pre-treated by the chemical abrasion (CA-TIMS)	ammonite	Tethyan	*Protrachyceras neumayri* Zone	"close to the *neumayri/regoledanus* subzones"	Mietto et al. (2012)
Nine single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house BGC spike (0.1% error in tracer calibration)	ammonite	Tethyan	*Protrachyceras longobardium* Zone	About 2 m below level with bivalve *Daonella tyrolensis*, and about 16 m above level with *Daonella* cf. *longobardica*. The presence of *Protrachyceras steinmanni* at a similar stratigraphic level in the correlative Bagolino section suggests that this age corresponds to the *P. longobardicum* zone.	Brühwiler et al. (2007); Mietto et al. (2012)
Two (of 5) multi-grain zircon analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing mechanical	ammonite	Tethyan	*Protrachyceras gredleri* to *P. archelaus* zone	Redeposited tuff in neptunian dyke that contains ammonite assemblage assigned to upper *Protrachyceras gredleri* ammonite zone. Pálfy et al. (2003) schematically	Pálfy et al. (2003)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
T26					SEC-G	Seceda, NW Dolomites, N. Italy	45°35.9′N, 11°43.5′E	Base of upper Pietra Verde interval of Buchenstein Fm	239.04	± 0.04	± 0.25	^{206}Pb/^{238}U
T25					SEC-E	Seceda, NW Dolomites, N. Italy	45°35.9′N, 11°43.5′E	Prominent lapilli layer in Pietra Verde interval of Buchenstein Fm	240.29	± 0.04	± 0.25	^{206}Pb/^{238}U
T24					FEO-12	Passo Feudo, Dolomites, N. Italy	46°20′27.0″N, 11°33′32.2″E	Ash layer from "upper part of the Knollenkalke interval suspected to correlate with the middle Pietra Verde interval" at Seceda	240.43	± 0.05	± 0.26	^{206}Pb/^{238}U
T23					SEC-D	Seceda, NW Dolomites, N. Italy	45°35.9′N, 11°43.5′E	Lowest prominent ash layer of the middle Pietra Verdi interval, directly overlying the cyclic Knollenkalke interval of Buchenstein Fm	240.58	± 0.04	± 0.25	^{206}Pb/^{238}U
T22				***Anisian***								
T21					SEC-B	Seceda, NW Dolomites, N. Italy	45°35.9′N, 11°43.5′E	Tc tuff from basal Knollenkalke interval of Buchenstein Fm	241.71	± 0.05	± 0.29	^{206}Pb/^{238}U
T20					FEO-2	Passo Feudo, Dolomites, N. Italy	46°20′27.0″N, 11°33′32.2″E	Ash layer from "basal Plattenkalke interval close to the base of the Buchenstein Fm"	242.01	± 0.05	± 0.26	^{206}Pb/^{238}U
T19	**T18**				MSG.09; volcanic ash	Miniera Val Porina, 820 m elevation, Monte San Giorgio, Lake Lugano, Switzerland	45°54.2′N, 8°57.1′E	Tuff in bituminous shales (Grenzbitumen horizon), Bed 71	242.14	± 0.45	± 0.52	^{206}Pb/^{238}U
T18	**T15**				LAT31; tuff	Cimon Latemar, Dolomites, N. Italy.	46°35′N, 11°22′E	Lower Cyclic Facies (lower-middle)	242.65	± 0.76	± 0.80	^{206}Pb/^{238}U
T17	**T14**				LAT30; tuff	Cimon Latemar, Dolomites, N. Italy.	46°35′N, 11°22′E	Middle Tepee Facies (middle)	242.80	± 0.34	± 0.42	^{206}Pb/^{238}U
T16	**T12**				CHIN-34; volcanic ash	Jinya section, Nanpanjiang Basin, NW Guangxi, south China	24°35′22.0″N, 106°53′13.6″E	Baifeng Fm (shaly base of Fm)	244.60	± 0.43	± 0.50	^{206}Pb/^{238}U
T15	**T11**				CHIN-29; volcanic ash	Jinya section, Nanpanjiang Basin, NW Guangxi, south China	24°35′25.8″N, 106°52′09.7″E	Uppermost part of "Transitional beds" between Luolou and Baifeng Fms	246.80	± 0.39	± 0.47	^{206}Pb/^{238}U
T14	**T10**				GDGB-0; 7-m thick tuffaceous siliciclastic mudstone	Upper Guandao section, Great Bank of Guizhou, Nanpanjiang Basin, South China	25°39′17″N, 106°51′13″E	Luolou Fm, 17.0-m above base of section; 7.0 m above the FOD of *Chiosella timorensis* at 10.0-m	246.30	± 0.14	± 0.29	^{206}Pb/^{238}U
T13	**T9**				GDGB Tuff-110	Lower Guandao section, Great Bank of Guizhou, Nanpanjiang Basin, South China	25°39′17″N, 106°51′13″E	Luolou Fm, 260.25-m above base of section; 17.25 m above the FOD of *Chiosella timorensis* at 243.0-m	246.50	± 0.11	± 0.30	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
abrasion and in-house NIGL spike (0.1% error in tracer calibration).				show biostratigraphic uncertainty as spanning upper-quarter of *P. gredleri* Zone through lower-quarter of *P. archelaus* Zone.	
Weighted mean of younger cluster (six of 10 analyzed) single-grain zircon analyses using CA-ID-TIMS method.	ammonite	Tethyan	ca. base of *P. archelaus* Zone	"upper part of the Buchenstein succession the correlation is corroborated by the sequential occurrence of three different species or groups of *Daonella* (*D. pichleri, D. tyrolensis, D. lommeli* group)"	Wotzlaw et al. (2018)
Weighted mean of eight single-grain zircon analyses using CA-ID-TIMS method.	ammonite	Tethyan	ca. middle *P. gredleri* zone	"In the middle Pietra Verde interval representatives of the ammonoid genus *Arpadites* occur in a small interval straddling the accretionary lapilli-bearing horizon"	Wotzlaw et al. (2018)
Weighted mean of younger cluster (three of 8 analyzed) single-grain zircon analyses using CA-ID-TIMS method.	ammonite	Tethyan	ca. middle *P. gredleri* Zone	"In the middle Pietra Verde interval representatives of the ammonoid genus *Arpadites* occur in a small interval straddling the accretionary lapilli-bearing horizon"	Wotzlaw et al. (2018)
Weighted mean of six (of 7) single-grain zircon analyses using CA-ID-TIMS method.	ammonite	Tethyan	ca. base *P. gredleri* Zone	"In the middle Pietra Verde interval representatives of the ammonoid genus *Arpadites* occur in a small interval straddling the accretionary lapilli-bearing horizon"	Wotzlaw et al. (2018)
Weighted mean of younger cluster (five of 10 analyzed) single-grain zircon analyses using CA-ID-TIMS method.	ammonite	Tethyan	ca. lower *N. secedensis* Zone	"characteristic packages of pelagic beds defined at Seceda are still recognizable at Bagolino and Monte Corona (Fig. 5). Moreover, it allows the GSSP equivalent level to be precisely located at Seceda. Based on this bed-by-bed correlation, we place the boundary level between beds D01 and D02", which is ca. 7 m above this dated sample SEC-B.	Wotzlaw et al. (2018)
Weighted mean of six single-grain zircon analyses using CA-ID-TIMS method.	ammonite	Tethyan	middle *R. reitzi* Zone	middle *Reitzi* Zone	Wotzlaw et al. (2018)
Six (of 8) single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house BGC spike (0.1% error in tracer calibration)	ammonite	Tethyan	ca. lower *N. secedensis* Zone	*Daonella* bivalve species are 150 cm below lowest dated sample. Assigned to lowermost *Nevadites secendensis* ammonoid zone by Brack et al. (1996)	Mundil et al. (2010)
Six (of 9) single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing HF-leaching and in-house BGC spike (0.1% error in tracer calibration).	ammonite	Tethyan	lower N. secedensis Zone [uppermost zone of Anisian]	About 40 m above base of Lower Cyclic Facies, which overlies *Latemarites* ammonites, a genera with range assigned by them to upper *Reitzi* Zone; therefore, sampled level might correspond to lowermost part of *Nevadites secedensis* ammonoid zone.	Mundil et al. (2003)
Ten single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house BGC spike (0.1% error in tracer calibration).	ammonite	Tethyan	upper *R. reitzi* ammonoid zone	uppermost *Reitzi* Zone	Mundil et al. (2003); Brack et al. (2007)
Four (of 7) single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Uncertainties recalculated in Galfetti et al. (2007).	ammonite	South China	*Balatonites shoshonensis* ammonoid zone	Bracketed by layers containing an ammonoid assemblage diagnostic of the low-palolatitudinal *Balatonites shoshonensis* Zone.	Ovtcharova et al. (2006)
Six (of 8) single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Uncertainties recalculated in Galfetti et al. (2007).	ammonite	South China	*Acrochordiceras hyatti ammonoid zone*	Poorly preserved *Platycuccoceras*-dominated ammonoid assemblage, indicates *Acrochordiceras hyatti* ammonite zone	Ovtcharova et al. (2006)
Thirteen (of 40) single zircon grain analyses yielded a weighted mean ^{206}Pb/^{238}U age, utilizing both physical abrasion and CA-TIMS, and in-house MIT spike.	conodont	South China	*Chiosella timorensis*	"a short distance above the Olenekian boundary". Nearly at base of "Bith-N" polarity zone (in nomenclature of Ogg et al. (2008)]. FAD of conodont *Chiosella timorensis* (working definition of base-Anisian) is about 3 m below this ash layer, and *Ni. germanica* FAD is at about this level.	Ramezani et al. (2007a, b), Lehrmann et al. (2007)
Two of nine single zircon grain analyses (excluding seven older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	South China	*Chiosella timorensis*	Just above LADs of conodonts *Neogondolella regalis* and *Chiosella timorensis*, middle of range of *Neospathodus germanica*, and just above FAD of conodont *Nicoraella kockeli*. Assigned by authors to lowest part of Pelsonian Substage.	Lehrmann et al. (2015)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
T12	**T8**				PGD Tuff-3	Lower Guandao section, Great Bank of Guizhou, Nanpanjiang Basin, South China	25°34′42″N, 106°37′08″E	Luolou Fm, 247.9-m above the base of section; 4.9 m above the FOD of Chiosella timorensis at 243.0-m	247.08	± 0.11	± 0.31	$^{206}\text{Pb}/^{238}\text{U}$
			Early									
				Olenekian								
T11	**T7**				PGD Tuff-2	Lower Guandao section, Great Bank of Guizhou, Nanpanjiang Basin, South China	25°34′42″N, 106°37′08″E	Luolou Fm, 239.3-m above base of section; 3.7-m below the FOD of *Chiosella timorensis* at 243.0-m	247.32	± 0.08	± 0.30	$^{206}\text{Pb}/^{238}\text{U}$
T10	**T6**				PGD Tuff-1	Lower Guandao section, Great Bank of Guizhou, Nanpanjiang Basin, South China	25°34′42″N, 106°37′08″E	Luolou Fm, 238.8-m above base of section; 4.2-m below the FOD of *Chiosella timorensis* at 243.0-m	247.46	± 0.05	± 0.29	$^{206}\text{Pb}/^{238}\text{U}$
T9	**T5**				CHIN-23; volcanic ash	Jinya section, Nanpanjiang Basin, NW Guangxi, South China	24°36′48.9″N, 106°52′34.0″E	Luolou Fm (upper carbonate unit)	248.12	± 0.37	± 0.45	$^{206}\text{Pb}/^{238}\text{U}$
				Induan								
T7	**T4**				CHIN-10; volcanic ash	Jinya section, Nanpanjiang Basin, NW Guangxi, South China	24°36′26.2″N, 106°52′39.6″E	Luolou Fm (upper carbonate unit)	250.55	± 0.47	± 0.54	$^{206}\text{Pb}/^{238}\text{U}$
T6	**T3**				CHIN-40; volcanic ash	Jinya section, Nanpanjiang Basin, NW Guangxi, South China	24°35′23.5″ 106°52′49.6″E	Luolou Fm (lower unit of "thin-bedded, dark, laminated, suboxic limestones alternating with dark, organic-rich shales")	251.22	± 0.20	± 0.42	$^{206}\text{Pb}/^{238}\text{U}$
T5					Bed 34 bentonite; sample MSB34-2	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 34, Yinkeng Fm	251.50	± 0.06	± 0.29	$^{206}\text{Pb}/^{238}\text{U}$
T4					Bed 33 bentonite; sample MD99-3u	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 33, Yinkeng Fm	251.58	± 0.09	± 0.29	$^{206}\text{Pb}/^{238}\text{U}$
T3					bentonite; sample PEN-22	Penglaitan section, Laibin area, Guangxi Province, S. China	23°41′8.4″N, 109°18′21″E	lower Ziyun Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	251.91	± 0.03	± 0.28	$^{206}\text{Pb}/^{238}\text{U}$
T2					bentonite; sample DGP-21	Dongpan section, southwestern Guangxi Province, S. China	22°16′11.8″N, 107°41′31.3″E	lower Ziyun Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	251.95	± 0.04	± 0.28	$^{206}\text{Pb}/^{238}\text{U}$
T1	**T2**				Bed 28 bentonite; sample MBE0205	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 28, Yinkeng Fm	251.88	± 0.03	± 0.28	$^{206}\text{Pb}/^{238}\text{U}$
		Permian										
			Lopingian									
				Changhsingian								
P37	**P17**				Bed 25 bentonite; sample MBE0205	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	The base of Bed 25 is the Fmal boundary between the Changhsing Fm and Yinkeng Fm	251.94	± 0.03	± 0.28	$^{206}\text{Pb}/^{238}\text{U}$
P36					Bed 22 bentonite; sample MZ96(-4.3)	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 22, Changhsing Fm	252.10	± 0.06	± 0.28	$^{206}\text{Pb}/^{238}\text{U}$

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Four of six single zircon grain analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	South China	*Chiosella timorensis*	Just above LAD of conodont *Neospathodus symmetricus*, in uppermost part of range of *Neospathodus homeri*, in lowermost part of range of *Chiosella timorensis*, and base of range of *Neogondolella regalis.* Assigned by them as about one-third up in Aegean subzone (they assign base-Aegean, hence base-Anisian, to be the FAD of *Chiosella timorensis* at 267.3-m at the Guandao section).	Lehrmann et al. (2015)
Weighted mean of 11 (of 29) single zircon grain analyses, utilizing both physical abrasion and CA-TIMS, and in-house MIT spike.	conodont	South China	*Neospathodus homeri*	Just above PGD Tuff-1; uppermost part of range of conodont *Neospathodus triangularis*, and in upper part of range of *Neospathodus homeri* (uppermost Spathian).	Lehrmann et al. (2006)
Six of six single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	South China	*Neospathodus homeri*	Just below PGD Tuff-2; uppermost part of range of conodont *Neospathodus triangularis*, and in upper part of range of *Neospathodus homeri* (uppermost Spathian).	Lehrmann et al. (2015)
Weighted mean of 6 (of 10) single zircon grain analyses, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Uncertainties recalculated in Galfetti et al. (2007).	ammonite	Tethyan	*Neopopanoceras haugi*	Low-paleolatitude *Neopopanoceras haugi* zone ammonite fauna (second ammonite zone down from top of Spathian) is correlated with the high-paleolatitude *Keyserlingites subrobustus* zone.	Ovtcharova et al. (2006)
Weighted mean of 6 (of 8) single zircon grain analyses, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration). Uncertainties recalculated in Galfetti et al. (2007).	ammonite	Tethyan	*Tirolites/Columbites*	*Tirolites/Columbites* ammonite assemblage (second ammonite zone from base of Spathian)	Ovtcharova et al. (2006)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and in-house UNIGE spike (0.1% error in tracer calibration).	ammonite	Tethyan	*Kashmirites densistriatus*	"within the "*Kashmirites densistriatus* beds" of early Smithian", which overlie beds with *Hedenstroemia hedenstroemi* ammonites that are assigned to basal-Smithian (basal Olenekian)	Galfetti et al. (2007)
Eleven of fourteen single zircon grain analyses (excluding three older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina planata* Zone (*Neoclarkina krystyni-Nc. discreta*)	Bed 34, ca. 7 m above the base of the GSSP Bed 27c at Meishan D section	Burgess et al. (2014)
Nine of nine single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	upper *Isarcicela isarcica* Zone?	The base of Bed 33, a 2-cm volcanic clay, is 175-cm above the base of the GSSP Bed 27c at Meishan D section.	Burgess et al. (2014)
Eight of eleven single zircon grain analyses (excluding one younger and two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Hindeotus parvus Zone*	The bentonite is 0.5-m above the lithologic formation boundary (PTB), and 0.2-m above the FOD of *H. parvus*.	Baresel et al. (2017)
Eight of fourteen single zircon grain analyses (excluding six older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Hindeotus parvus Zone*	The bentonite is 0.3-m above the lithologic formation boundary (PTB) between bed 12 with diverse Permian fauna and Bed 13 with abundant Griesbachian bivalves and ammonoids.	Baresel et al. (2017)
Thirteen of thirteen single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Hindeotus parvus* Zone	The base of Bed 28, a 4-cm volcanic clay, is 8-cm above the base of the GSSP Bed 27c at Meishan D section, corresponding to the first appearance of conodont *Hindeodus parvus*.	Burgess et al. (2014)
Sixteen of sixteen single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina meishanensis* Zone	Bed 25, a 5-cm volcanic clay, is the approximate culmination of the late-Permian mass extinction. The base of this former "boundary clay" level is 19-cm below the base of the GSSP Bed 27c at Meishan D section, corresponding to first appearance of conodont *Hindeodus parvus.*	Burgess et al. (2014)
Twelve of twelve single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite in Bed 22 is 4.3-m below the base of the GSSP Bed 27c at Meishan D section.	Burgess et al. (2014)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
P35					bentonite; sample PEN-28	Penglaitan section, Laibin area, Guangxi Province, S. China	23°41′8.4″N, 109°18′21″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	252.06	± 0.04	± 0.28	^{206}Pb/^{238}U
P34					bentonite; sample PEN-70	Penglaitan section, Laibin area, Guangxi Province, S. China	23°41′8.4″N, 109°18′21″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	252.13	± 0.07	± 0.29	^{206}Pb/^{238}U
P33					bentonite; sample PEN-6	Penglaitan section, Laibin area, Guangxi Province, S. China	23°41′8.4″N, 109°18′21″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	252.14	± 0.08	± 0.29	^{206}Pb/^{238}U
P32					bentonite; sample DGP-17	Dongpan section, southwestern Guangxi Province, S. China	22°16′11.8″N, 107°41′31.3″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	251.96	± 0.03	± 0.28	^{206}Pb/^{238}U
P31					bentonite; sample DGP-16	Dongpan section, southwestern Guangxi Province, S. China	22°16′11.8″N, 107°41′31.3″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	251.98	± 0.04	± 0.28	^{206}Pb/^{238}U
P30					bentonite; sample DGP-13	Dongpan section, southwestern Guangxi Province, S. China	22°16′11.8″N, 107°41′31.3″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	252.10	± 0.04	± 0.28	^{206}Pb/^{238}U
P29					bentonite; sample DGP-12	Dongpan section, southwestern Guangxi Province, S. China	22°16′11.8″N, 107°41′31.3″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	252.12	± 0.04	± 0.28	^{206}Pb/^{238}U
P28					bentonite; sample DGP-10	Dongpan section, southwestern Guangxi Province, S. China	22°16′11.8″N, 107°41′31.3″E	upper Dalong Fm; PTB is placed at the Fmal boundary between the Permian Dalong Fm and the Triassic Ziyun Fm	252.17	± 0.06	± 0.28	^{206}Pb/^{238}U
P27					Bed 15 bentonite; sample MD99-15(-17.3)	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 15, Changshing Fm	252.85	± 0.11	± 0.29	^{206}Pb/^{238}U
P26					Bed 7 bentonite; sample MD-7b-96(-36.8)	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 7, Changshing Fm	253.45	± 0.08	± 0.29	^{206}Pb/^{238}U
P25					Bed 6 bentonite; sample MZ96(-38.0)	Meishan section D, the GSSP of the base of the Triassic; Changhsing, Zhejiang Province, S. China	31°07′14″N, 119°42′14″E	Bed 6, Changshing Fm	253.49	± 0.07	± 0.28	^{206}Pb/^{238}U
P24	**P14**				SH27(23); bentonite	Shangsi section, north Sichuan Province, central China	32°20′N, 105°28′E	Bed 23, upper Dalong Fm	253.24	± 0.36	± 0.45	^{206}Pb/^{238}U
P23	**P13**				Bed 18 bentonite; sample S03-22 (−12.8 m)	Shangsi section, north Sichuan Province, central China	32°20′N, 105°28′E	Bed 18, upper-middle of Dalong Fm	253.60	± 0.08	± 0.29	^{206}Pb/^{238}U
				Wuchiapingian								
P22	**P12**				Bed 15 bentonite; sample S03-05 (−27.5 m)	Shangsi section, north Sichuan Province, central China	32°20′N, 105°28′E	Bed 15, lower-middle of Dalong Fm	257.79	± 0.14	± 0.31	^{206}Pb/^{238}U
P21					silicified dacitic tuff; sample 13VD82	Druzhba Creek, northeastern periphery of the Okhotsk Massif, Verkhoyansk, Siberia	60.913257°N, 146.817396°E,	middle Druzhba Fm	258.14	± 0.20	± 0.36	^{206}Pb/^{238}U
P20					silicified dacitic tuff; sample 13VD78	Druzhba Creek, northeastern periphery of the Okhotsk Massif, Verkhoyansk, Siberia	60.910240°N, 146.821460°E	lower Druzhba Fm	260.16	± 0.39	± 0.50	^{206}Pb/^{238}U
P19	**P11**				SH03(8); bentonite	Shangsi section, north Sichuan Province, central China	32°20′N, 105°28′E	Bed 8, lower-middle of Wuchiaping Fm	260.74	± 0.86	± 0.90	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Seven of thirteen single zircon grain analyses (excluding six older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite is 0.3-m below the lithologic formation boundary (PTB), and 0.6-m below the FOD of *H. parvus*.	Baresel et al. (2017)
Seven of eighteen single zircon grain analyses (excluding eleven older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite is 0.6-m below the lithologic formation boundary (PTB), and 0.9-m below the FOD of *H. parvus*.	Baresel et al. (2017)
Three of fifteen single zircon grain analyses (excluding twelve older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite is 1.1-m below the lithologic formation boundary (PTB), and 1.4-m below the FOD of *H. parvus*.	Baresel et al. (2017)
Eleven of twelve single zircon grain analyses (excluding one older grain) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Neogondolella yini* (UAZ1)	The bentonite is 2.7-m below the lithologic formation boundary (PTB) between bed 12 with diverse Permian fauna and Bed 13 with abundant Griesbachian bivalves and ammonoids.	Baresel et al. (2017)
Nine of ten single zircon grain analyses (excluding one younger grain) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Neogondolella yini* (UAZ1)	The bentonite is 3.2-m below the lithologic formation boundary (PTB) between bed 12 with diverse Permian fauna and Bed 13 with abundant Griesbachian bivalves and ammonoids.	Baresel et al. (2017)
Seven of seven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite is 6.4-m below the lithologic formation boundary (PTB) between bed 12 with diverse Permian fauna and Bed 13 with abundant Griesbachian bivalves and ammonoids.	Baresel et al. (2017)
Eight of eight single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite is 7.3-m below the lithologic formation boundary (PTB) between bed 12 with diverse Permian fauna and Bed 13 with abundant Griesbachian bivalves and ammonoids.	Baresel et al. (2017)
Seven of ten single zircon grain analyses (excluding three older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	South China	*Clarkina changxingensis* Zone	The bentonite is 9.7-m below the lithologic formation boundary (PTB) between bed 12 with diverse Permian fauna and Bed 13 with abundant Griesbachian bivalves and ammonoids.	Baresel et al. (2017)
Seven of seven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the in-house MIT 535 spike.	conodont	South China	*Clarkina changxingensis* (middle)	The bentonite in Bed 15 is 17.3-m below the base of the GSSP Bed 27c at Meishan D section.	Shen et al. (2011)
Seven of eight single zircon grain analyses (excluding one younger grain) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the in-house MIT 535 spike.	conodont	South China	*Clarkina wangi* (middle)	The bentonite in Bed 7 is 36.8-m below the base of the GSSP Bed 27c at Meishan D section.	Shen et al. (2011)
Seven of seven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the in-house MIT 535 spike.	conodont	South China	*Clarkina wangi* (middle)	The bentonite in Bed 6 is 38.0-m below the base of the GSSP Bed 27c at Meishan D section.	Shen et al. (2011)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and in-house BGC spike (0.1% error in tracer calibration)	conodont	South China	*Clarkina yini*	The bentonite in Bed 23 is 3.0-m below the extinction horizon at the base of bed 28, and 7.6-m below the FOD of *H. parvus* in bed 30.	Mundil et al. (2004)
Six of seven single zircon grain analyses (excluding one younger grain) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the in-house MIT 535 spike.	conodont	South China	*Clarkina wangi* (middle)	The bentonite in Bed 18 is 12.8-m below the extinction horizon at the base of bed 28.	Shen et al. (2011)
Six of six single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the in-house MIT 535 spike.	conodont	South China	*Clarkina transcaucasica*	The bentonite in Bed 15 is 27.5-m below the extinction horizon at the base of bed 28.	Shen et al. (2011)
Two of ten single zircon grain analyses (excluding eight older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	bivalve	NE Asian	*Maitaia tenkensis* Zone, lower Wuchiapingian	Regional correlation of the host Druzhba Formation and the nearby Titan Formation suggest a position within the regional *Maitaia tenkensis* bivalve zone, which is correlated to the lower Wuchiapingian Stage.	Davydov et al. (2018a)
Four of six single zircon grain analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	bivalve	NE Asian	*Maitaia tenkensis* Zone, lower Wuchiapingian	Regional correlation of the host Druzhba Formation and the nearby Titan Formation suggest a position within the regional *Maitaia tenkensis* bivalve zone, which is correlated to the lower Wuchiapingian Stage.	Davydov et al. (2018a)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and in-house BGC spike (0.1% error in tracer calibration)	conodont	South China		The bentonite in Bed 8 is 64.0-m below the extinction horizon at the base of bed 28.	Mundil et al. (2004)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
P18	**P10**				SH01(7); bentonite	Shangsi section, north Sichuan Province, central China	32°20′N, 105°28′E	Bed 7, lower-middle of Wuchiaping Fm	259.10	± 1.01	± 1.05	^{206}Pb/^{238}U
			Guadalupian									
				Capitanian								
P17					bentonite; sample 10VD-2	Trapper Creek, Cassia County, SE Idaho, USA	42°6.943′N, 114°7.060′W	upper phosphatic Meade Peak Member of the Phosphoria Fm	260.57	± 0.07	± 0.31	^{206}Pb/^{238}U
P16					bentonite; sample 12VD-105	Natalkin–Glukharynyi Creek, Ayan-Yuryakh basin, Magadan Province, NE Russia	61°38.566′N, 147°48.506′E	middle Atkan Fm	262.45	± 0.21	± 0.37	^{206}Pb/^{238}U
P15					bentonite; sample GM-20	Patterson Hills, Guadalupe Mountains, Texas, USA	31°49′28.4″N, 104°52′32.1″W	20 m above the base of the Rader Limestone	262.58	± 0.45	± 0.53	^{206}Pb/^{238}U
				Wordian								
P14	**P9**				Nipple Hill bentonite	Nipple Hill, Guadalupe Mountains National Park, Texas, USA	31.909°N, 104.789°W	The ash occurs within the undifferentiated lower unit of the Bell Canyon Fm, below the Pinery Limestone Member, and approximately 2 m above the top of the Manzanita Limestone Member of the underlying Cherry Canyon Fm.	265.46	± 0.27	± 0.39	^{206}Pb/^{238}U
P13					bentonite; sample GM–29	Monolith Canyon, Guadalupe Mountains, Texas, USA	31°54.740′N, 104°46.943′W	near the base of the South Wells Limestone Fm	266.50	± 0.24	± 0.37	^{206}Pb/^{238}U
				Roadian								
P12					bentonite; Ash bed “C”, sample PDSE D003	Pingdingshan East Section, Chaohu, Anhui Province, South China	31°38.048′N, 117°49.828′E	the lower part of the Kuhfeng Fm; 1-m above Ash bed “A”	271.04	± 0.10	± 0.33	^{206}Pb/^{238}U
P11					bentonite; Ash bed “A”, sample PDSE D001	Pingdingshan East Section, Chaohu, Anhui Province, South China	31°38.048′N, 117°49.828′E	base of the Kuhfeng Fm	272.95	± 0.11	± 0.34	^{206}Pb/^{238}U
P10					bentonite; sample 13VD83	Druzhba Creek, northeastern periphery of the Okhotsk Massif, Verkhoyansk, Siberia	60.873580°N, 146.867660°E	upper Khuren Fm	273.12	± 0.13	± 0.34	^{206}Pb/^{238}U
P9					bentonite; sample 64/2AB-91	Plastovyi Creek, eastern periphery of the Okhotsk Massif, Verkhoyansk, Siberia	60.774157°N, 147.657132°E	middle Khuren Fm	274.00	± 0.12	± 0.34	^{206}Pb/^{238}U
			Cisuralian									
				Kungurian								
				Artinskian								
P8	**P8**				01DES-403; bentonite	Usolka, Dal’ny Tulkas roadcut section, Southern Urals, Russia	53.883829°N, 56.537216°E	12.5 mab of section (base of Bed 9), in Tulkas Fm	288.21	± 0.15	± 0.34	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and in-house BGC spike (0.1% error in tracer calibration)	conodont	South China		The bentonite in Bed 7 is 76.0-m below the extinction horizon at the base of bed 28.	Mundil et al. (2004)
Five of fifteen single zircon grain analyses (excluding ten older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	West Texas	upper Capitanian Stage	*Jinogondolella aserrata, Mesogondolella phosphoriensis, M. rosenkrantzi, M. bitteri and M. siciliensis* are reported from the Meade Peak of the Phosphoria and lower-middle Gerster Fm of the Park City Formation in Idaho, Wyoming, Utah and Nevada. *M. siciliensis* is described from Oman in the beds with ammonoid *Timorites* and conodont *M. bitteri* immediately below Wuchiapingian beds (Baud et al., 2012). In the Delaware Basin, *Timorites* ranges from the upper Wordian to the top of the Capitanian.	Davydov et al. (2018b)
Four of eight single zircon grain analyses (excluding four older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	bivalve/ ammonoid	NE Asian	lower Capitanian Stage	The Atkan Formation is assigned to the *Maitaia bella* bivalve zone that corresponds to the lower Gizhigian regional stage of northeastern Russia. The latter correlates with the Capitanian of the International Time Scale through the occurrence of the ammonoid *Timorites*, together with Gizhigian bivalves and brachiopods in the Transbaikal region.	Davydov et al. (2016)
Four of six single zircon grain analyses (excluding two younger grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	West Texas	*Jinogondolella postserrata* Zone	Bentonite is found in strata containing *Polydiexodina*, and is correlated to the lower *J. postserrata* Zone	Nicklen (2011)
Seven of seven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	West Texas	upper *Jinogondolella aserrata* Zone	The horizon is 37.2 m below the base of the *Jinogondolella postserrata* conodont zone that defines the base of the Capitanian Stage of the Guadalupian Series.	Ramezani and Bowring (2017)
Eight of thirteen single zircon grain analyses (excluding one younger and four older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	West Texas	lower *Jinogondolella aserrata* Zone	Lower *Jinogondolella aserrata* Zone	Nicklen (2011)
Eight of ten single zircon grain analyses (excluding two younger grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	West Texas	middle *Jinogondolella nankingensis* Zone	Bentonite is found 1.3-m below strata containing *Jinogondolella nankingensis* and *J. aserrata*	Wu et al. (2017)
Seven of thirteen single zircon grain analyses (excluding one younger and five older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	West Texas	middle *Jinogondolella nankingensis* Zone	Bentonite is found 2.3-m below strata containing *Jinogondolella nankingensis* and *J. aserrata*	Wu et al. (2017)
Five of seven single zircon grain analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	ammonoid/ conodont	Canadian Arctic/ West Texas	middle *Jinogondolella nankingensis* Zone	The tuff bed occurs within the NE Asian *Kolymia plicata* bivalve zone, which is younger than the Kolymia multiformis bivalve zone, whose type species is co-occurs with the pectinids *"Heteropecten" cf. girtyi* Newell and *"H." cf. gryphus* Newell known from the Word Formation of Texas.	Davydov et al. (2018a)
Three of eight single zircon grain analyses (excluding five older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	ammonoid/ conodont	Canadian Arctic/ West Texas	middle *Jinogondolella nankingensis* Zone	The tuff bed occurs within the upper part of the NE Asian *Kolymia inoceramiformis* bivalve zone, while the ammonoid *Sverdrupites harkeri* occurs immediately below the dated tuff bed. This provides direct correlation to the Roadian Stage in the Canadian Arctic, where the conodont index species of the Roadian Stage *Jinogondolella nankingensis gracilis* and *Sverdrupites harkeri* and other Roadian ammonoids are documented from the Assistant Formation.	Davydov et al. (2018a)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Sweetognathodus "whitei"* Zone	12.3 m above FAD of *Sweetognathus "whitei"*; Burtsevian Substage (Russian Platform) of Artinskian Stage	Schmitz and Davydov (2012)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
P7	**P7**				DTR905; bentonite	Usolka, Dal'ny Tulkas roadcut section, Southern Urals, Russia	53.883829°N, 56.537216°E	10.5 mab of section (upper Bed 7), in Tulkas Fm	288.36	± 0.17	± 0.35	^{206}Pb/^{238}U
				Sakmarian								
P6	**P6**				07DTRBed2; bentonite	Usolka, Dal'ny Tulkas roadcut section, Southern Urals, Russia	53.883829°N, 56.537216°E	4.0 mbb of section (upper Bed 2), in Tulkas Fm	290.81	± 0.17	± 0.35	^{206}Pb/^{238}U
P5	**P5**				97USO-91.0; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	91.0 mab of section, in Tulkas Fm	290.50	± 0.17	± 0.35	^{206}Pb/^{238}U
P4	**P4**				97USO-66.2; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	66.2 mab of section (upper Bed 28), in Tulkas Fm	291.10	± 0.18	± 0.36	^{206}Pb/^{238}U
				Asselian								
P3	**P3**				01DES-212; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	41.25 mab of section (upper Bed 18), in Kurkin Fm	296.69	± 0.16	± 0.37	^{206}Pb/^{238}U
P2	**P2**				01DES-202; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	36.0 mab of section (upper Bed 16), in Kurkin Fm	298.05	± 0.46	± 0.56	^{206}Pb/^{238}U
P1	**P1**				01DES-194; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	32.4 mab of section (middle Bed 16), in Kurkin Fm	298.49	± 0.20	± 0.37	^{206}Pb/^{238}U
		Carboniferous										
			Pennsylvanian (*sub-period*)									
				Ghzelian								
Cb47	**Cb35**				01DES-144; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	30.8 mab of section (lower Bed 16), in Kurkin Fm	299.22	± 0.20	± 0.37	^{206}Pb/^{238}U
Cb46	**Cb34**				97USO-23.3; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	23.3 mab of section (lower Bed 14), in Kurkin Fm	300.22	± 0.16	± 0.35	^{206}Pb/^{238}U
Cb45	**Cb33**				01DES-121; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	21.45 mab of section (upper Bed 12), in Kurkin Fm	301.29	± 0.16	± 0.36	^{206}Pb/^{238}U
Cb44	**Cb32**				01DES-112; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	18.2 mab of section (middle Bed 12), in Kurkin Fm	301.82	± 0.17	± 0.36	^{206}Pb/^{238}U
Cb43	**Cb31**				01DES-63; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	12.0 mab of section, in Kurkin Fm	303.10	± 0.16	± 0.36	^{206}Pb/^{238}U
				Kasimovian								
Cb42	**Cb30**				97USO-2.7; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	11.4 mab of section, in Kurkin Fm	303.54	± 0.18	± 0.39	^{206}Pb/^{238}U
Cb41	**Cb29**				97USO-1.2 & 01DES-63; bentonites	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	10.65 mab of section, in Kurkin Fm	304.49	± 0.16	± 0.36	^{206}Pb/^{238}U
Cb40	**Cb28**				02VD-5 & 01DES-42; bentonites	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	9.85 mab of section, in Kurkin Fm	304.83	± 0.16	± 0.36	^{206}Pb/^{238}U
Cb39	**Cb27**				01DES-31 & 08USO-8.4; bentonites	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	7.8 mab of section, in Kurkin Fm	305.49	± 0.16	± 0.36	^{206}Pb/^{238}U
Cb38	**Cb26**				01DES-371; bentonite	Dal'ny Tulkas quarry section, Southern Urals, Russia	53.884546°N, 56.544646°E	20.15 mab of section, in Kurkin Fm	305.51	± 0.18	± 0.37	^{206}Pb/^{238}U
Cb37	**Cb25**				08USO-7.09; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	6.5 mab of section, in Kurkin Fm	305.95	± 0.17	± 0.37	^{206}Pb/^{238}U
Cb36	**Cb24**				01DES-363; bentonite	Dal'ny Tulkas quarry section, Southern Urals, Russia	53.884546°N, 56.544646°E	19.7 mab of section, in Kurkin Fm	305.96	± 0.17	± 0.36	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 7 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Sweetognathodus “whitei”* Zone	10.3 m above FAD of *Sweetognathus “whitei”;* Burtsevian Substage (Russian Platform) of Artinskian Stage	Schmitz and Davydov (2012)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Sweetognathodus anceps* Zone	4.2 m below FAD of *Sweetognathus “whitei”;* Sterlitamakian Substage (Russian Platform) of Sakmarian Stage	Schmitz and Davydov (2012)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Sweetognathodus anceps* Zone	Sterlitamakian Substage (Russian Platform) of Sakmarian Stage	Schmitz and Davydov (2012)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Sweetognathodus anceps* Zone	Sterlitamakian Substage (Russian Platform) of Sakmarian Stage	Schmitz and Davydov (2012)
Weighted mean of 9 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus fusus* Zone	Uskalikian Substage (Russian Platform) of Asselian Stage	Schmitz and Davydov (2012)
Weighted mean of 9 single zircon grain analyses, utilizing both physical abrasion and CA-TIMS and the MIT-1L spike calibrated against the EARTHTIME gravimetric standards.	conodont	Boreal	*Streptognathodus cristellaris–St. sigmoidalis* Zone	4.55 m above FAD of *Streptognathodus isolatus*; Surenian Substage (Russian Platform) of Asselian Stage	Ramezani et al. (2007a, b)
Weighted mean of 14 single zircon grain analyses, utilizing both physical abrasion and CA-TIMS and the MIT-1L spike calibrated against the EARTHTIME gravimetric standards.	conodont	Boreal	*Streptognathodus isolatus* Zone	0.95 m above FAD of *Streptognathodus isolatus;* Surenian Substage (Russian Platform) of Asselian Stage	Ramezani et al. (2007a, b)
Weighted mean of 19 single zircon grain analyses, utilizing both physical abrasion and CA-TIMS and the MIT-1L spike calibrated against the EARTHTIME gravimetric standards.	conodont	Boreal	*Streptognathodus waubaunsensis* Zone	0.65 m below FAD of *Streptognathodus isolatus;* Noginian Substage (Russian Platform) of Gzhelian Stage	Ramezani et al. (2007a, b)
Weighted mean of 7 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus simplex–St. bellus* Zone	Noginian Substage (Russian Platform) of Gzhelian Stage	Schmitz and Davydov (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus virgilicus* Zone	Pavlovoposadian Substage (Russian Platform) of Gzhelian Stage	Schmitz and Davydov (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus virgilicus* Zone	Pavlovoposadian Substage (Russian Platform) of Gzhelian Stage	Schmitz and Davydov (2012)
Weighted mean of 4 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus simulator* Zone	Rusavkian Substage (Russian Platform) of Gzhelian Stage	Schmitz and Davydov (2012)
					Schmitz and Davydov (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus firmus* Zone	Rusavkian Substage (Russian Platform) of Gzhelian Stage	Schmitz and Davydov (2012)
Two samples of same ash bed yielded identical weighted mean ages of 304.49 ± 0.16 Ma (six single grains) and 304.42 ± 0.16 Ma (five single grains), utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Idiognathodus toretzianus* Zone	Dorogomilovian Substage (Russian Platform) of Kasimovian Stage	Schmitz and Davydov (2012)
Two samples of same ash bed yielded identical weighted mean ages of 304.83 ± 0.16 Ma (four single grains) and 304.82 ± 0.17 Ma (three single grains), utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Idiognathodus sagittalis* Zone	Khamovnikian Substage (Russian Platform) of Kasimovian Stage	Schmitz and Davydov (2012)
Two samples of same ash bed yielded identical weighted mean ages of 305.49 ± 0.16 Ma (six single grains) and 305.52 ± 0.19 Ma (six single grains), utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Idiognathodus sagittalis* Zone	Khamovnikian Substage (Russian Platform) of Kasimovian Stage	Schmitz and Davydov (2012)
Weighted mean of 4 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Idiognathodus sagittalis* Zone	Khamovnikian Substage (Russian Platform) of Kasimovian Stage	Schmitz and Davydov (2012)
Weighted mean of 3 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus subexcelsus* Zone	Krevyakian Substage (Russian Platform) of Kasimovian Stage	Schmitz and Davydov (2012)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus subexcelsus* Zone	Krevyakian Substage (Russian Platform) of Kasimovian Stage	Schmitz and Davydov (2012)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
				Moscovian								
Cb35	**Cb23**				01DES-362; bentonite	Dal'ny Tulkas quarry section, Southern Urals, Russia	53.884546°N, 56.544646°E	17.4 mab of section, in Kurkin Fm	307.66	± 0.17	± 0.37	^{206}Pb/^{238}U
Cb34	**Cb22**				06USO-2.0; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	1.4 mab of section, in Zilim Fm	308.00	± 0.18	± 0.37	^{206}Pb/^{238}U
Cb33	**Cb21**				01DES-481; bentonite	Usolka (Krasnousolsky) section, Southern Urals, Russia	53.923777°N, 56.532353°E	1.25 mab of section, in Zilim Fm	308.36	± 0.20	± 0.38	^{206}Pb/^{238}U
Cb32	**Cb20**				01DES-351; bentonite	Dal'ny Tulkas quarry section, Southern Urals, Russia	53.884546°N, 56.544646°E	12.4 mab of section, in Zilim Fm	308.50	± 0.16	± 0.36	^{206}Pb/^{238}U
Cb31	**Cb19**				n1 coal; tonstein	Butovskaya Shaft, Donets Basin	48.0677°N, 37.7918°E	Isaevskaya Fm, C31(N) lithostratigraphic index	307.26	± 0.19	± 0.38	^{206}Pb/^{238}U
Cb30	**Cb18**				m3 coal; tonstein	Zasyadko Shaft, Donets Basin	48.0517°N, 37.7939°E	Lisitchanskaya Fm, C27(M) lithostratigraphic index	310.55	± 0.19	± 0.38	^{206}Pb/^{238}U
Cb29	**Cb17**				l3 coal; tonstein	Krasnolimanskaya Shaft, Donets Basin	48.3594°N, 37.2430°E	Almaznaya Fm, C26(L) lithostratigraphic index	312.01	± 0.17	± 0.37	^{206}Pb/^{238}U
Cb28	**Cb16**				l1 coal; tonstein	Kirov Shaft, Donets Basin	48.1320°N, 38.3548°E	Almaznaya Fm, C26(L) lithostratigraphic index	312.23	± 0.18	± 0.37	^{206}Pb/^{238}U
Cb27	**Cb15**				k7 coal; tonstein	Pereval'skaya Shaft, Donets Basin	48.4460°N, 38.80°E	Kamenskaya Fm, C25(K) lithostratigraphic index	313.16	± 0.17	± 0.37	^{206}Pb/^{238}U
Cb26					tonstein; sample Z1	Furst Leopold Coal Mine, Dorsten, Ruhr Basin, Germany	51°40′23″N, 6°58′57″E	10 to 12-m beneath the Aegiranum Marine Band	313.78	± 0.08	± 0.38	^{206}Pb/^{238}U
Cb25					Sub-High Main tonstein; sample EH28155	Holme Pierrepont Borehole, Nottinghamshire, England; 181.8-m depth	52°56′47″N, 1°04′13″W	14-m above the Aegiranum Marine Band	314.37	± 0.25	± 0.53	^{206}Pb/^{238}U
Cb24	**Cb14**				k3 coal; tonstein	Pereval'skaya Shaft, Donets Basin	48.4460°N, 38.80°E	Kamenskaya Fm, C25(K) lithostratigraphic index	314.40	± 0.17	± 0.37	^{206}Pb/^{238}U
				Bashkirian								
Cb23	**Cb13**				Bed 32; bentonite	Kljuch section, 5 km W of Kamensk-Ural'sky city, Sverdlov Province, Southern Urals, Russia	56.42414°N, 61.80709°E	Scherbakov Fm, Bed 32	317.54	± 0.17	± 0.38	^{206}Pb/^{238}U
Cb22					tonstein; sample T75	Zwartberg Coal Mine, Campine Basin, Belgium	51°01′17″N, 5°31′30″E	between the Wasserfall and Quaregnon marine bands	317.63	± 0.12	± 0.39	^{206}Pb/^{238}U
Cb21	**Cb12**				Bed 9; bentonite	Kljuch section, 5 km W of Kamensk-Ural'sky city, Sverdlov Province, Southern Urals, Russia	56.42414°N, 61.80709°E	Scherbakov Fm, Bed 9	318.63	± 0.22	± 0.40	^{206}Pb/^{238}U
Cb20	**Cb11**				Bed 2; bentonite	Kljuch section, 5 km W of Kamensk-Ural'sky city, Sverdlov Province, Southern Urals, Russia	56.42414°N, 61.80709°E	Scherbakov Fm, Bed 2	319.09	± 0.18	± 0.38	^{206}Pb/^{238}U
			Mississippian (*sub-period*)									
				Serpukhovian								
Cb19					tonstein; sample B9	Oakenclough Brook, Staffordshire, Pennine Basin, England	53°10′10″N, 1°54′54″W	between the Wasserfall and Quaregnon marine bands	324.54	± 0.26	± 0.46	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 7 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Neognathodus roundyi–Streptognathodus cancellosus* Zone	Peskovian Substage (Russian Platform) of Moscovian Stage	Schmitz and Davydov (2012)
Weighted mean of 4 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Neognathodus roundyi–Streptognathodus cancellosus* Zone	Myachkovian Substage (Russian Platform) of Moscovian Stage	Schmitz and Davydov (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Neognathodus roundyi–Streptognathodus cancellosus* Zone	Myachkovian Substage (Russian Platform) of Moscovian Stage	Schmitz and Davydov (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Neognathodus roundyi–Streptognathodus cancellosus* Zone	Myachkovian Substage (Russian Platform) of Moscovian Stage	Schmitz and Davydov (2012)
Weighted mean of 9 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Neognathodus roundyi–Streptognathodus cancellosus* Zone	base C_3a biostratigraphic zone of Donets Basin;	Davydov et al. (2010)
Weighted mean of 10 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Idiognathodus podolskiensis* Zone	base C_2^mc biostratigraphic zone of Donets Basin;	Davydov et al. (2010)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus dissectus* Zone	base C_2^mb biostratigraphic zone of Donets Basin;	Davydov et al. (2010)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Streptognathodus dissectus* Zone	base C_2^mb biostratigraphic zone of Donets Basin;	Davydov et al. (2010)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Neognathodus uralicus* Zone	base C_2^ma biostratigraphic zone of Donets Basin;	Davydov et al. (2010)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET2535 spike.	ammonoid	NW Europe		Tonstein coal occurs 10–12-m beneath the Aegiranum Marine Band, which defines the base of the Bolsovian (Westphalian C) substage and is thus in the upper Duckmantian (Westphalian B) Substage	Pointon et al. (2012)
Four of nine single zircon grain analyses (excluding two younger and three older grains) have a weighted mean $^{206}Pb/^{238}U$ age; utilizing CA-TIMS and the ET535 spike.	ammonoid	NW Europe		Tonstein coal occurs 14-m above the Aegiranum Marine Band, which defines the base of the Bolsovian (Westphalian C) Substage	Waters and Condon (2012)
Weighted mean of 7 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Declinognathodus donetzianus* Zone	Tonstein occurs in the base C2ma biostratigraphic zone of Donets Basin, which correlates to the lower Bolvovian Substage of the Westphalian Stage of Western Europe	Davydov et al. (2010)
Weighted mean of 4 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe		Foraminifera correlate to upper Bashkirian Tashastian Horizon of Urals, and to just below H_6 Limestone of Donets Basin; Cheremshanian Substage (Russian Platform) of Bashkirian Stage	Schmitz and Davydov (2012)
Five of ten single zircon grain analyses (excluding two younger and three older grains) have a weighted mean $^{206}Pb/^{238}U$ age; utilizing CA-TIMS and the ET2535 spike.	ammonoid	NW Europe		Tonstein coal occurs between the Wasserfall and Quaregnon marine bands and thus is in Langsettian (Westphalian A) Substage	Pointon et al. (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe		Foraminifera correlate to middle Bashkirian Ashyabashian Horizon of Urals, and between G_1 and G_1^2 Limestones of Donets Basin; Prikamian Substage (Russian Platform) of Bashkirian Stage	Schmitz and Davydov (2012)
Weighted mean of 4 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe		Foraminifera correlate to middle Bashkirian Ashyabashian Horizon of Urals, and between F_1 and F_1^1 Limestones of Donets Basin; Prikamian substage (Russian Platform) of Bashkirian Stage	Schmitz and Davydov (2012)
Four of nine single zircon grain analyses (excluding five older grains) have a weighted mean $^{206}Pb/^{238}U$ age; utilizing CA-TIMS and the ET2535 spike.	ammonoid	NW Europe		Tuff occurs in the lower Namurian Stage (Arnsbergian substage), E2b2 ammonoid subzone (cycle E2b2ii).	Pointon et al. (2012)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
Cb18					tonstein; Gabriela coal (seam 365)	Julius Fučík Mine, Petřvald, Moravia-Silesia Region, Czech Republic	49°49.166′N, 18°22.691′E	Jaklovec Member, Ostrava Fm	325.64	± 0.13	± 0.40	^{206}Pb/^{238}U
Cb17					tonstein; Eleonara coal (seam 335)	Julius Fučík Mine, Petřvald, Moravia-Silesia Region, Czech Republic	49°49.166′N, 18°22.691′E	Jaklovec Member, Ostrava Fm	325.58	± 0.26	± 0.46	^{206}Pb/^{238}U
Cb16	**Cb10**				tonstein; Ruzeny coal (seam 103)	Upper Silesian Basin, Ostrava, Czech Republic (ton. 106-B2 Karel, 146.92–146.94 m, Staric2 borehole)	~49.8°N, 18.3°E	Lower Hrusov Member, Ostrava Fm	327.58	± 0.17	± 0.39	^{206}Pb/^{238}U
Cb15					Main Ostrava Whetstone	Paskov mine, Upper Silesian Basin, Ostrava, Czech Republic	~49.8°N, 18.3°E	boundary between Petrkovice Member and Lower Hrusov Member, Ostrava Fm	327.35	± 0.15	± 0.49	^{206}Pb/^{238}U
Cb14	**Cb9**				tonstein; c11 coal	Yuzhno-Donbasskaya, Shaft No 3, Ugledar; Donets Basin	47.7839°N, 37.2474°E	Samarskaya Fm, C13(C) lithostratigraphic index, D13lower (= C4) limestone	328.14	± 0.20	± 0.40	^{206}Pb/^{238}U
Cb13					Bentonite B6; sample BLL1976	BGS Harewood Borehole, 12 km NNE of Leeds, West Yorkshire, England; 304.10-m depth	53°54′N, 1°31′W	upper part of eumorphoceras yatesae (E2a3) Marine Band, Arnsbergian Substage	328.34	± 0.30	± 0.55	^{206}Pb/^{238}U
Cb12	**Cb8**				tonstein; Ludmila coal (043)	Upper Silesian Basin, Ostrava, Czech Republic	~49.8°N, 18.3°E	Petrkovice Member, Ostrava Fm	328.48	± 0.19	± 0.41	^{206}Pb/^{238}U
				Visean								
Cb11					bentonite; sample W13	Anhée Sud locality, disused Watrisse Quarry, Namur-Dinant Basin, Belgium	50°16.5′N, 4°54.7′E	Lower Member, Anhee Fm	332.50	± 0.07	± 0.40	^{206}Pb/^{238}U
Cb10	**Cb7**				bentonite; Bed 8	Verkhnyaya Kardailovka section, Southern Urals, Russia	52.28630°N, 58.92426°E	Gusikhin Fm, Bed 21-8	333.87	± 0.18	± 0.39	^{206}Pb/^{238}U
Cb9					bentonite; sample W8	Yvoir or Anhée Nord locality, abandon quarry to the north of the village of Anhée, Namur-Dinant Basin, Belgium	50°19.8′N, 4°53.5′E	Poilvache Member, Bonne River Fm	335.59	± 0.19	± 0.44	^{206}Pb/^{238}U
Cb8					bentonite; sample W1	Yvoir or Anhée Nord locality, abandon quarry to the north of the village of Anhée, Namur-Dinant Basin, Belgium	50°19.8′N, 4°53.5′E	Seiles/Maizeret Member, Grands Malades Fm	336.22	± 0.06	± 0.40	^{206}Pb/^{238}U
Cb7					Krásné Louèky tuffite	Krásné Louèky–Kobylí quarry, Krnov, Moravo-Silesian Basin, Czech Republic	50°7′13.08″N, 17°37′40.30″E	Brantice Member of the Horní Beneöov Fm near the transition to the Moravice Fm	340.05	± 0.10	± 0.41	^{206}Pb/^{238}U
Cb6	**Cb6**				bentonite; C1ve2	Sukhaya Volnovakha, Dokuchaevsk, Tsentral′nyi rudnik, east; Donets Basin	47.73°N, 37.6503°E	lower Styl′skaya Fm, C1A9 lithostratigraphic index	342.01	± 0.19	± 0.41	^{206}Pb/^{238}U
Cb5	**Cb5**				bentonite; C1vc	Sukhaya Volnovakha, Dokuchaevsk, Tsentral′nyi rudnik, east; Donets Basin	47.72°N, 37.6502°E	Skelevatskaya Fm, C1A8 lithostratigraphic index	345.00	± 0.18	± 0.41	^{206}Pb/^{238}U
Cb4	**Cb4**				bentonite; 3/2002	Sukhaya Volnovakha, Dokuchaevsk, Tsentral′nyi rudnik, east; Donets Basin	47.73°N, 37.6503°E	Skelevatskaya Fm, C1A8 lithostratigraphic index	345.17	± 0.18	± 0.41	^{206}Pb/^{238}U
				Tournaisian								
Cb3	**Cb3**				bentonite; 5/2002	Volnovakha River, right bank, near Businova Ravine, Donets Basin, Ukraine	47.6398°N, 37.8926°E	Upper member, Karakubskaya Fm, C1A4 lithostratigraphic index	357.26	± 0.19	± 0.42	^{206}Pb/^{238}U
Cb2	**Cb2**				bentonite (a2); sample DT-13	Apricke section, Ruhr Basin, Nordrhein-Westfalen, Germany.	~50°N, 8°E	Bed 15, Hangenberg Limestone, equivalent to Bed 70 in Hasselbachtal section	358.43	± 0.19	± 0.42	^{206}Pb/^{238}U

Primary radioisotopic age details	Zonal range assignment			Biostratigraphy	Reference
	clade	zonation	Zone		
Five of eight single zircon grain analyses (excluding one older and two younger grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	ammonoid	NW Europe	*Eumorphoceras bisulcatum* Zone	Jaklovec and Poruba Members of the Ostrava Formation assigned to the goniatite E2 (Eumorphoceras bisulcatum) Zone, Arnsbergian Substage of the Namurian Stage of Western Europe.	Jirásek et al. (2018)
Four of seven single zircon grain analyses (excluding three younger grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	ammonoid	NW Europe	*Eumorphoceras bisulcatum* Zone	Jaklovec and Poruba Members of the Ostrava Formation assigned to the goniatite E2 (Eumorphoceras bisulcatum) Zone, Arnsbergian Substage of the Namurian Stage of Western Europe.	Jirásek et al. (2018)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Lochriea ziegleri* Zone	Tonstein occurs in the Pendleian Substage of the Namurian Stage of Western Europe.	Jirásek et al. (2013)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET2535 spike.	conodont	Boreal	*Lochriea ziegleri* Zone	Tonstein occurs in the Pendleian Substage of the Namurian Stage of Western Europe.	Jirásek et al. (2013)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	conodont	Boreal	*Lochriea ziegleri* Zone	middle C1vg2 biostratigraphic zone of Donets Basin; correlative with the Lochriea ziegleri zone of Urals, the Tarussian and lower Steshevian Horizons of the Russian Platform, and the *Eumorphoceras* ammonoid zone (Pendleian and Arnsbergian substages) of the Namurian of Western Europe.	Davydov et al. (2010)
Eleven of seventeen single zircon grain analyses (excluding two older and four younger grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	ammonoid	NW Europe	*Eumorphoceras yatesae* Zone	Tuff occurs within the upper part of the *Eumorphoceras yatesae* (E2a3) Marine Band of early Arnsbergian age.	Waters and Condon (2012)
Weighted mean of 5 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	ammonoid	NW Europe	*Eumorphoceras yatesae* Zone	Pendleian Substage of lower Namurian A (lower Serpukhovian).	Gastaldo et al. (2009)
Five of six single zircon grain analyses (excluding one older grain) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	fusulinid	NW Europe	MFZ14 foraminiferal Zone	near the middle of the MFZ14 foraminiferal zone, in the upper Asbian Substage of northwestern Europe and the upper Lower Warnantian Substage of Belgium	Pointon et al. (2014)
Weighted mean of 4 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike. Twelve other single zircons yielded older ages indicative of reworking of the original pyroclastic deposit.	conodont	Boreal	*Lochriea mononodosa* Zone	1.48 m below the FOD of *Lochriea ziegleri*, in the middle part of the *Lochriea mononodosa* zone, and *Hypergoniatites-Ferganoceras* ammonoid genozone of the Urals.	Schmitz and Davydov (2012)
Three of nine single zircon grain analyses (excluding six older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	fusulinid	NW Europe	MFZ13 foraminiferal zone	near the base of the MFZ13 foraminiferal zone, in the lower Asbian Substage of northwestern Europe and the lowermost Warnantian Substage of Belgium	Pointon et al. (2014)
Seven of eight single zircon grain analyses (excluding one older grain) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	fusulinid	NW Europe	top of the *Eostafella porikensis–Archaediscus gigas* Zone	near the top of the MFZ12 foraminiferal zone, at the top of the Holkerian Substage of NW Europe and the Livian Substage of Belgium	Pointon et al. (2014)
Five of seven single zircon grain analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	fusulinid	NW Europe	*Eostafella porikensis–Archaediscus gigas* Zone	Fossils from the Kobyli Quarry include *Globoendothyra* sp., *Eostaffella* sp., *Archaediscus krestovnikovi* Rauser, *Archaediscus* sp., *Endothyra* sp., *Palaeotextulariidae* indet.	Jirásek et al. (2014)
Weighted mean of 7 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe	base of the *Eostafella porikensis–Archaediscus gigas* Zone	base C1ve2 biostratigraphic zone of Donets Basin; correlative with the MFZ12 foraminiferal zone, at the base of the Holkerian Substage of NW Europe and the Livian Substage of Belgium	Davydov et al. (2010)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe	*Uralodiscus rotundus* Zone	upper C1vc biostratigraphic zone of Donets Basin; correlative with the base of the MFZ10 foraminiferal zone of Western Europe	Davydov et al. (2010)
Weighted mean of 6 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe	*Uralodiscus rotundus* Zone	middle C1vc biostratigraphic zone of Donets Basin; correlative with the base of the MFZ10 foraminiferal zone of Western Europe	Davydov et al. (2010)
Weighted mean of 8 single zircon grain analyses, utilizing CA-TIMS and the ET535 spike.	fusulinid	NW Europe	*Prochernyshinella disputabilis–Tournayellina beata* Zone	base of C1tb2 biostratigraphic zone of Donets Basin; equivalent to lower Cherepetian Horizon of the eastern Russian Platform, and the MFZ3 foraminiferal zone of Western Europe	Davydov et al. (2010)
Weighted mean of 18 single zircon grain analyses, utilizing CA-TIMS and the ET535 and 2535 spikes.	conodont	Boreal	Lower *Siphonodella duplicata* Zone	Lower part of *S. duplicata* conodont zone, lower Tournaisian	Davydov et al. (2011)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
Cb1	**Cb1**				bentonite (a2); Bed 79	Hasselbachtal section, Ruhr Basin, Nordrhein-Westfalen, Germany.	~50.3°N, 8.3°E	Bed 79, Hangenberg Limestone	358.71	± 0.19	± 0.42	^{206}Pb/^{238}U
		Devonian										
			Late									
				Famennian								
D27					bentonite; sample A2KQ-2	Kowala Quarry, Holy Cross Mountains, 10 km southwest of Kielce, Poland	50°47′49.1′′N, 20°33′55.9′′E	Hangenberg Limestone, 30 cm above top of the Hangenberg Black Shale	358.89	± 0.20	± 0.48	^{206}Pb/^{238}U
D26					bentonite; sample A2KQ-1	Kowala Quarry, Holy Cross Mountains, 10 km southwest of Kielce, Poland	50°47′49.1′′N, 20°33′55.9′′E	Wocklum Limestone. 20 cm below the base of the Hangenberg Black Shale	358.97	± 0.11	± 0.43	^{206}Pb/^{238}U
D25	**D18**				bentonite (w3); sample DT-12	Apricke section, Ruhr Basin, Nordrhein-Westfalen, Germany.	~50°N, 8°E	Wocklum Limestone, equivalent to Bed 87 in Hasselbachtal section	359.25	± 0.18	± 0.42	^{206}Pb/^{238}U
D24	**D17**				black shale	Jura Creek, Exshaw, Alberta, Canada	51°04′N, 115°10′W	Exshaw Fm	361.30	± 2.10	± 2.40	Re-Os
D23	**D14**				pumice tuff	Caldera complex, southern New Brunswick, Canada	~46°N, 66°W	Bailey Rock Rhyolite, which intrudes and overlies the Carrow Fm	362.87	± 0.88	± 0.96	^{206}Pb/^{238}U
D22	**D13**				pumice tuff	Caldera complex, southern New Brunswick, Canada	~46°N, 66°W	Carrow Fm pumiceous tuff, Piskahegan Group	364.08	± 2.22	± 2.25	^{206}Pb/^{238}U
D21	**D12**				WVC754; black shale (0.4%–4% TOC)	Cattaraugus County, western New York, USA	~42°N, 79°W	Dunkirk Fm, ~6.4 m above F-F boundary	367.70	± 2.50	± 2.80	Re-Os
				Frasnian								
D20	**D11**				WVC785; black shale (0.4%–4% TOC)	Cattaraugus County, western New York, USA	~42°N, 79°W	Hanover Fm, ~2.9 m below F-F boundary	374.20	± 4.00	± 4.20	Re-Os
D19	**D10**				bentonite; Bed 36	Steinbruch Schmidt quarry, Kellerwald, Germany	~51°N, 9°E?	Kellwasser Horizons	372.36	± 0.05	± 0.41	^{206}Pb/^{238}U
D18					bentonite; "Tephra 7.67" (EMC-7.67 m)	Eighteenmile Creek, Erie County, NY, USA; 7.67 m above base of the Rhinestreet Shale	43.3°N, 78.7°W	Rhinestreet Fm, West Falls Group	375.14	± 0.12	± 0.45	^{206}Pb/^{238}U
D17					bentonite; "Tephra 06" (LWG Ash-6)	Little War Gap, East Tennessee, USA	36.5°N, 83.0°W	Belpre Tephra Suite, Lower Dowelltown Member, Chattanooga Shale Fm	375.25	± 0.13	± 0.45	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 9 single zircon grain analyses, utilizing CA-TIMS and the ET2535 spike.	conodont	Boreal	Upper *Siphonodella sulcata* Zone	Upper part of *S. (Eos.) sulcata* conodont zone, basal Tournaisian	Davydov et al. (2011)
Five of six single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	NW Europe	middle/upper *costatus-kockeli Interregnum* conodont zone	Above the Hangenberg Black Shale, ~2 m below the Devonian-Carboniferous boundary. Had been assigned as *kockeli* Zone (=new name for Upper *praesulcata* Zone) at Kowala; re-assigned as middle/upper *costatus-kockeli* Interregnum (Becker et al., 2020, this volume)	Myrow et al. (2014)
Six of seven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	NW Europe	Upper *Siphonodella praesulcata* Zone	Below the Hangenberg Black Shale, ~3.5 m below the Devonian-Carboniferous boundary. “Unfortunately, the D/C conodont stratigraphy of Kowala has not yet been fully investigated. Both lower ash beds fall in the upper part of revised *S. (Eos.) praesulcata* Zone, and in the higher *Wocklumeria sphaeroides* Zone (UD VI-D) of the ammonoid zonation.” (Becker et al., 2020, this volume)	Myrow et al. (2014)
Weighted mean of 13 single zircon grain analyses, utilizing CA-TIMS and the ET535 and 2535 spikes.	conodont	NW Europe	Upper *Siphonodella praesulcata* Zone	. . .“. . .“. . . . . .”	Davydov et al. (2011)
Isochron age for six samples collected over a 4 m thick interval spanning the Devonian-Carboniferous boundary, processed with CrO3-H2SO4 dissolution	conodont	North America	centered at lower part of revised *S. praesulcata*	Interval between the middle *Palmatolepis expansa* through upper *Siphonodella duplicata* zones. “the Re-Os date comes from an interval stretching from the higher *Bi. costatus* Subzone to the basal *costatus-kockeli-Interregnum* (ckl) sensu Kaiser et al. (2009) (below the Hangenberg Regression).” (Becker et al., 2020, this volume)	Selby and Creaser (2005)
Five multigrain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age (sample above or crosscutting spore-bearing bed)	conodont	North America	uppermost *Palmatolepis marginifera* to upper *Palmatolepis expansa* zones	Spore-bearing horizon between the Bailey Rock rhyolite and Carrow Fm pumiceous tuff falls within the *pusillites-lepidophyta* spore zone (FA2d), equivalent to the uppermost *Palmatolepis marginifera* to upper *Palmatolepis expansa* conodont zones (Streel, 2000) [assigned as middle/upper *Bi. costatus* conodont subzone in revised zonal scheme]	Tucker et al. (1998)
Four multigrain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age (95% conf. int. including geologic scatter; sample below spore-bearing bed)	conodont	North America	uppermost *Palmatolepis marginifera* to upper *Palmatolepis expansa* zones	. . .“. . .. . .”. . .. . .”	Tucker et al. (1998)
Isochron age for nine samples collected from drillcore, processed with CrO3-H2SO4 dissolution	conodont	North America	*Palmatolepis triangularis* Zone	*Palmatolepis triangularis conodont* zone, ~6.4 m above F-F boundary. Equivalent to *“the Pa. delicatula platys Zone, which replaced terminologically the former Middle subzone of Pa. triangularis Zone” (*Becker et al., 2020, this volume*)*	Turgeon et al. (2007)
Isochron age for eight samples collected from drillcore, processed with CrO_3-H_2SO_4 dissolution.	conodont	North America	*Palmatolepis linguiformus Zone (MN 13b)*	*Palmatolepis linguiformus* conodont biozone, upper Frasnian Stage; ~2.9 m below F-F boundary. *“A position of D20 within the lower part of the Pa. linguiformis Zone (MN Zone 13b) is accepted with some reservation” (*Becker et al., 2020, this volume*)*	Turgeon et al. (2007)
Eight of eleven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET2535 spike.	conodont	NW Europe	middle *Palmatolepis bogartensis* Zone (MN 13a)	Bed 36 bentonite occurs in the middle part of the late *Palmatolepis rhenana* conodont Zone, Upper Frasnian; 2.5 m below the F-F boundary. “middle part of the *Pa. bogartensis* Zone or MN Zone 13a (middle part of the *Upper rhenana* Zone sensu Ziegler and Sandberg 1990).” (Becker et al., 2020, this volume)	Percival et al. (2018)
Six of six single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	North America	*upper “Ozarkodina” nonaginta Zone (upper MN 7)*	Occurrence of *“Ozarkodina” nonaginta* indicates the base of FZ 7 at or near the base of the Rhinestreet Formation, where it occurs in association with *Ag. ancyrogna thoideus* and *Ag.* primus, which do not range above FZ 7 (= lowermost subzone of *Palmatolepis hassi* conodont zone)	Lanik et al. (2016)
Six of nine single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	North America	*Palmatolepis housei* Zone *[MN 8]*	Enclosing strata contain *Ad. nodosa* and *Pa. punctata*, which range from FZ 5 through FZ 9 in the lowermost Dowelltown Member; overlying strata contain *Ag. barba* and *Pa. housei* that are restricted to FZ 8 (= second subzone of *Palmatolepis hassi* conodont zone)	Lanik et al. (2016)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
D16	**D9**				bentonite; "Tephra 01" (LWG Ash-1)	Little War Gap, East Tennessee, USA	36.5°N, 83.0°W	Belpre Tephra Suite, Lower Dowelltown Member, Chattanooga Shale Fm	375.55	± 0.10	± 0.44	^{206}Pb/^{238}U
			Middle									
				Givetian								
				Eifelian								
D15					Tioga Ash Bed F	Seneca Stone Quarry, Seneca Falls, New York, USA	42°51.3′N, 76°47.2′W	Near base of the Union Springs Fm of the Marcellus Subgroup	390.14	± 0.14	± 0.47	^{206}Pb/^{238}U
D14					Tioga Ash Bed B	Seneca Stone Quarry, Seneca Falls, New York, USA	42°51.3′N, 76°47.2′W	Contact between Moorehouse and Seneca Members of the Onendaga Fm	390.82	± 0.18	± 0.48	^{206}Pb/^{238}U
			Early									
				Emsian								
D13	**D6**				Hercules I K-bentonite, sample 12VD-80	Wetteldorf section, Schönecken, Germany	50°10′N, 6°27′E	Heisdorf Fm	394.29	± 0.10	± 0.47	^{206}Pb/^{238}U
D12	**D5**				Volcanic layer	Hans-Platte layer, Eschenbach quarry, Bundenbach (Hunsrück), Germany		Lower Hunsrück Slate	407.75	± 1.08	± 1.16	^{206}Pb/^{238}U
				Pragian								
D11	**D3**				volcaniclastic sandstone, sample 94843525	Cheshire Creek, Limekilns District, Hill End Trough, Eastern Lachlan Orogen, eastern Australia	33°15′20″S, 149°41′54″E	Merrions Fm	411.70	± 0.90	± 1.20	^{206}Pb/^{238}U
D10					Milton of Noth Andesite	Rhynie Outlier, NE Scotland	57°20′38″N, 02°49′31″W	Tillybrachty Sandstone and Dryden Flags Fms	411.50	± 1.10	± 1.30	^{206}Pb/^{238}U
				Lochkovian								
D9	**D2**				crystal rich volcaniclastic sandstone, sample 94843520	Hill End Trough, Eastern Lachlan Orogen, eastern Australia	33°03′50″S, 149°37′43″E	Turondale Fm	415.60	± 0.50	± 0.80	^{206}Pb/^{238}U
D8					felsic volcanic, sample 93844562B	Cowra Trough, Eastern Lachlan Orogen, eastern Australia	33°04′09″S, 149°36′06″E	Bulls Camp Volcanics	417.70	± 0.50	± 0.80	^{206}Pb/^{238}U
D7					K-bentonite, sample H5-1	Smoke Hole section, eastern West Virginia, USA; 84.9 mab	38.82257°N, 79.28615°W	lower Corriganville Limestone Fm of the Helderberg Group	417.22	± 0.21	± 0.50	^{206}Pb/^{238}U
D6	**D1**				Kalkberg' K-bentonite (KKB), sample CV-2; also referenced as Judds Falls Bentonite Bed	US Highway 20, W of Judds Falls, northeast of Cherry Valley, eastern NY, USA; 2.40–2.45 mab	42°49′19″N, 74°43′43″W	Historically described as the Kalkberg Fm, but now interpreted as the New Scotland Fm of the Helderberg Group	417.61	± 0.12	± 0.50	^{206}Pb/^{238}U
D5	**D1**				Kalkberg' K-bentonite (KKB), sample H1-1	US Highway 20, northeast of Cherry Valley, eastern NY, USA; 44.1 mab	42°49′N, 74°44′W	Historically described as the Kalkberg Fm, but now interpreted as the New Scotland Fm of the Helderberg Group	417.68	± 0.21	± 0.52	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Seven of fifteen single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age; utilizing CA-TIMS and the ET535 spike.	conodont	North America	*Palmatolepis housei* Zone *[MN 8]*	Enclosing strata contain *Ad. nodosa* and *Pa. punctata*, which range from FZ 5 through FZ 9 in the lowermost Dowelltown Member, and are overlain by strata containing *Ag. barba* and *Pa. housei* that are restricted to FZ 8 (= second subzone of *Palmatolepis hassi* zone)	Lanik et al. (2016)
Eight of ten single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 and 2535 spikes.	conodont	North America	*Polygnathus costatus* Zone	All Tioga ashes are between conodont bearing strata of the *Polygnathus costatus* zone, middle Eifelian.	Harrigan et al. (in review)
Seven of eleven single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 and 2535 spikes.	conodont	North America	*Polygnathus costatus* Zone	All Tioga ashes are between conodont bearing strata of the *Polygnathus costatus* zone, middle Eifelian.	Harrigan et al. (in review)
Nine single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 and 2535 spikes.	conodont	NW Europe	uppermost *Polygnathus patulus* Zone	Uppermost part of the *Polygnathus patulus* conodont zone, uppermost Emsian. The "Hercules I" K-bentonite is situated 13 m below the formal boundary of the Lower and Middle Devonian (GSSP section).	Harrigan et al. (in review)
Ten single zircon analyses include five results, which form a tightly grouped cluster and weighted mean ^{206}Pb/^{238}U age.	conodont	NW Europe	lower *Eol. gronbergi* Zone	Tentaculites (dacryoconarids) allow a biostratigraphic assignment to the upper part of the *Nowakia zlíchovensis* dacryoconarid zone.	Kaufmann et al. (2005)
Four of six single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and an in-house spike.	dacryo-canarid	Australasian	*Nowakia acuaria* Zone	Devoid of fossils; but the Pragian dacryoconarid index, *Nowakia acuaria,* and the brachiopod *Nadiastropha* (sensu stricto) appear in the overlying Limekilns Fm [*N. acuaria* spans ca. base-Pragian through *kitabicus* conodont zone].	Bodorkos et al. (2017); Jagodzinski and Black (1999)
Four air- or chemically abraded zircon fractions yield and equivalent data combined into a weighted mean ^{206}Pb/^{238}U age; in-house EARTHTIME-calibrated spike.	palyno-morph	NW Europe	*polygonalis*—*emsiensis* Spore Assemblage Biozone = *profunda* through *excavatus* s.str. conodont zones	Spore assemblages indicate an early (but not earliest) Pragian to earliest Emsian zonal assignment. This biostratigraphical age range is potentially further constrained by the presence of *Dictyotriletes subgranifer* (Wellman 2006), indicating a latest Pragian to (?) earliest Emsian age.	Parry et al. (2011)
Six of six single zircon grain analyses combined to procude a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and an in-house spike.	conodont	Australasian	*eurekaensis* *(=postwoschmidti)* through lower *delta (=* through *transitans*) zones	Faunal assemblage assigned to the early Lochkovian *Boucotia australis* brachiopod zone (Garratt and Wright, 1989), itself correlated with the *eurekaensis* conodont zone by Mawson et al. (1989).	Bodorkos et al. (2017); Jagodzinski and Black (1999)
Three of five single zircon grain analyses combined to procude a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and an in-house spike.	conodont	Australasian	*woschmidti (= hesperius)* through *eurekaensis (= postwoschmidti)* Zone	Bulls Camp Volcanics conformably overlie shales containing FOD of Late Silurian *Monograptus* cf *uniformis*, and "overlain by latitic volcanic rocks devoid of fossils (but which elsewhere overlie conodont-bearing limestones of the *woschmidti* to *eurekaensis* zones) . . . indicate a *woschmidti* to *eurekaensis* Zone age for the Bulls Camp Volcanics."	Bodorkos et al. (2017); Jagodzinski and Black (1999)
Youngest precise analysis of eight single grain zircon analyses, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	above the LOD of *O. elegans detortus* and the FOD of *I. woschmidti woschmidti*, and immediately above the Klonk CIE, indicating a position in the late Middle Lochkovian.	Husson et al. (2016)
Six of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	Conodonts *Wurmiella excavata* and *Ozarkodina planilingua* at 1.75—1.85 mab, *Ancyrodelloides sp.* at 2.35—2.40 mab, and *Pseudooneotodus sp.* at 2.45—2.55 mab indicate a position no lower than the base of the *Caudicriodus postwoschmidti Zone* and no higher than the upper part of the *Ancyrodelloides trigonicus Zone.*	McAdams et al. (2017)
Youngest precise analysis of eight single grain zircon analyses, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	Correlation to regional sections indicate a position a position no lower than the base of the *Caudicriodus postwoschmidti* Zone and no higher than the upper part of the *Ancyrodelloides trigonicus* Zone.	Husson et al. (2016)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
D4					K-bentonite, sample H2-4	Cobleskill, eastern NY, USA; 18.4 mab	~42.5°N, 72.5°W	Historically described as the Kalkberg Fm, but now interpreted as the New Scotland Fm of the Helderberg Group	417.56	± 0.20	± 0.51	^{206}Pb/^{238}U
D3					K-bentonite, sample H2-3	Cobleskill, eastern NY, USA; 15.1 mab	~42.5°N, 72.5°W	Historically described as the Kalkberg Fm, but now interpreted as the New Scotland Fm of the Helderberg Group	417.73	± 0.22	± 0.53	^{206}Pb/^{238}U
D2					K-bentonite, sample H2-2	Cobleskill, eastern NY, USA; 12.5 mab	~42.5°N, 72.5°W	Historically described as the Kalkberg Fm, but now interpreted as the New Scotland Fm of the Helderberg Group	417.85	± 0.23	± 0.54	^{206}Pb/^{238}U
D1					K-bentonite, sample H2-1	Cobleskill, eastern NY, USA; 9.0 mab	~42.5°N, 72.5°W	Historically described as the Kalkberg Fm, but now interpreted as the New Scotland Fm of the Helderberg Group	418.42	± 0.21	± 0.53	^{206}Pb/^{238}U
		Silurian										
			Pridoli									
			Ludlow									
				Ludfordian								
S8					C6 bentonite	Ataky 117 section, Khotyn, Podolia, southwestern Ukraine	48°32.5′N, 26°28.8′E	top of the Pryhorodok Fm	422.91	± 0.07	± 0.49	^{206}Pb/^{238}U
S7					M12 bentonite	Malynivtsi 150 section, E. of Khotyn, Podolia, southwestern Ukraine	48°29.8′N, 26°36.1′E	upper Hrynchuk Fm	424.08	± 0.20	± 0.53	^{206}Pb/^{238}U
				Gorstian								
			Wenlock									
				Homerian								
S6	**S8**				WNH15 bentonite	Lion's Mouth Cavern, Wren's Nest Hill, Dudley, England	52.52227°N, 2.09668°W	Upper Quarried Limestone Mbr., Much Wenlock Limestone	427.77	± 0.50	± 0.68	^{206}Pb/^{238}U
S5	**S7**				lower of two bentonites separated by 16 cm; Djupvik bentonite	Djupvik 1 Locality, W. Gotland, Sweden	57°18.9′N, 18°10.1′E	Djupvik Member, Halla Fm	428.06	± 0.48	± 0.68	^{206}Pb/^{238}U
S4	**S6**				upper part of the 30-cm-thick Grötlingbo bentonite	Hörsne 3 Locality, central Gotland, Sweden	57.5°N, 18.5°E	Mulde Brickclay Mbr., Halla Fm	428.47	± 0.54	± 0.72	^{206}Pb/^{238}U
				Sheinwoodian								
S3	**S4**				Ireviken bentonite	Ireviken 1 Locality, Gotland, Sweden	57.8°N, 18.4°E	Lower Visby Fm	431.80	± 0.53	± 0.71	^{206}Pb/^{238}U
			Llandovery									
				Telychian								
S2	**S3**				K-bentonite	Osmundsberg North Quarry, Siljan, Dalarna, south-central Sweden	61°01′03″N, 15°12′04″E	Kallholn Shale	438.74	± 1.11	± 1.20	^{206}Pb/^{238}U
				Aeronian								
				Rhuddanian								
S1	**S2**				Ash	Dob's Linn, Moffat, Scotland, UK	55.44°N, 3.27°W	Birkhill Shales	439.57	± 1.24	± 1.33	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Youngest precise analysis of eight single grain zircon analyses, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	Correlation to regional sections indicate a position a position no lower than the base of the *Caudicriodus postwoschmidti* Zone and no higher than the upper part of the *Ancyrodelloides trigonicus* Zone.	Husson et al. (2016)
Youngest precise analysis of eight single grain zircon analyses, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	Correlation to regional sections indicate a position a position no lower than the base of the *Caudicriodus postwoschmidti* Zone and no higher than the upper part of the *Ancyrodelloides trigonicus* Zone.	Husson et al. (2016)
Youngest precise analysis of eight single grain zircon analyses, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	Correlation to regional sections indicate a position a position no lower than the base of the *Caudicriodus postwoschmidti* Zone and no higher than the upper part of the *Ancyrodelloides trigonicus* Zone.	Husson et al. (2016)
Youngest precise analysis of eight single grain zircon analyses, utilizing CA-TIMS and the ET535 spike.	conodont	North America	*L. omoalpha* through *A. trigonicus* zones	Correlation to regional sections indicate a position a position no lower than the base of the *Caudicriodus postwoschmidti* Zone and no higher than the upper part of the *Ancyrodelloides trigonicus* Zone.	Husson et al. (2016)
Eight of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite/ conodont		Upper *Uncinatograpus spineus–Pseudomonoclimacis latilobus* Zone; upper *Ozarkodina crispa* Zone	Middle *Ozarkodina remscheidensis baccata/Ozarkodina snajdri parasnajdri* Polodian conodont zone places interval in the upper global *Ozarkodina crispa* conodont zone and upper Baltic *Uncinatograpus spineus–Pseudomonoclimacis latilobus* graptolite zone.	Cramer et al. (2015)
Seven out of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite/ conodont		Upper *Saetograptus leintwardinensis* Zone and upper *Polygnathoides siluricus* Zone	Middle *Ozarkodina crispa* Polodian conodont zone places interval in the upper global *Polygnathoides siluricus* conodont zone and upper Baltic *Saetograptus leintwardinensis* graptolite zone	Cramer et al. (2015)
Six out of eleven single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite/ conodont		Uppermost *Colonograptus ludensis* Zone	From detailed regional correlation this bentonite is likely only cm's below the base Ludlow GSSP. Therefore, a correlation with the uppermost part of the *Colonograptus ludensis* zone is assigned.	Cramer et al. (2012)
Six out of nine single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite/ conodont		Upper part of *Colonograptus praedeubeli* to lower part of *C. ludensis* zones	Within the *Kockelella ortus absidata* conodont zone, correlated to a position somewhere from high in the *Colonograptus praedeubeli/deubeli* to low in the C. ludensis graptolite zones	Cramer et al. (2012)
Five out of nine single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite/ conodont		*Pristiograptus dubius parvus/Gothograptus nassa* Zone	Within the *Ozarkodina bohemica* longa conodont zone and the *Pristiograptus dubius parvus/Gothograptus nassa* graptolite zone.	Cramer et al. (2012)
11 out of 15 single grain zircon analyses from the Ireviken Bentonite yield a weighted mean ^{206}Pb/^{238}U age (including analytical error, tracer error, and decay constant error), utilizing CA-TIMS and the ET535 spike.	graptolite		Middle to upper part of the *Cyrtograptus murchisoni* Zone	14 cm above Ireviken Event Datum 2 (base of the Upper *Pseudooneotodus bicornis* conodont zone), which is within cm's of the base Wenlock GSSP.	Cramer et al. (2012)
Four single grain zircon analyses yield a weighted mean ^{206}Pb/^{238}U age [including 0.1% tracer uncertainty, Mundil et al. (2004)]	graptolite		*Spirograptus turriculatus* Zone	*Spirograptus turriculatus* Zone, Telychian Stage of the Llandovery Series	Bergstrom et al. (2008)
Six multigrain zircon fractions yield a weighted mean ^{206}Pb/^{238}U age.	graptolite		*Coronogr. cyphus* Zone	Exact level uncertain, *Coronogr. cyphus* Zone assigned by Ross et al. (1982) and accepted here.	Tucker et al. (1990), Ross et al. (1982), Toghill (1968)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
		Ordovician										
			Late									
				Hirnantian								
O42					K-bentonite, sample YC0601	Hirnantian GSSP at Wangjiawan North Section, Yichang, Hubei	30.9841°N, 111.4197°E	039 below base of the Kuanyinchiao Bed	443.20	± 1.60	± 2.73	^{206}Pb/^{238}U ion probe
				Katian								
O41	**O16**				Ash	Dobbs Linn (Linn Branch), Scotland	55.44°N, 3.27°W	Hartfell Shales	444.88	± 1.07	± 1.17	^{206}Pb/^{238}U
O40					Manheim K-bentonite, sample W1204_12.8	Nowadaga Creek, New York, USA	42°59.205′N, 74°48.401′W	Indian Castle Fm, Trenton Group	450.68	± 0.12	± 0.53	^{206}Pb/^{238}U
O39					Reedville Calmar K-bentonite	Reedsville, Pennsylvania, USA	52°18′50.2″N, 9°58′05.5″E	Antes Shale	451.20	± 0.13	± 0.50	^{206}Pb/^{238}U
O38					Manheim Falls K-bentonite	North Creek, New York, USA	43°5.330′N, 74°55.943′W	Dolgeville Fm, Trenton Group	451.26	± 0.10	± 0.53	^{206}Pb/^{238}U
O37					Manheim K-bentonite, sample F1302_1.8	Nowadaga Creek, New York, USA	42°59.724′N, 74°47.286′W	Dolgeville Fm, Trenton Group	451.42	± 0.10	± 0.53	^{206}Pb/^{238}U
O36					Chuctanunda K-bentonite	Chuctanunda Creek, New York, USA	42°54.869′N, 74°13.792′W	Flat Creek Fm, Trenton Group	451.71	± 0.13	± 0.53	^{206}Pb/^{238}U
O35					Sherman Falls K-bentonite	Flat Creek, New York, USA	42°52.069′N, 74°32.266′W	Flat Creek Fm, Trenton Group	452.82	± 0.08	± 0.53	^{206}Pb/^{238}U
				Sandbian								
O34					Shakertown Millbrig K-bentonite	Outcrop on U.S. Highway 68, 1.6 km southwest of intersection with State Route 33, at entrance to Shakertown, Mercer County, KY, USA	37°49′N, 84°45′W	Tyrone Fm	452.86	± 0.29	± 0.59	^{206}Pb/^{238}U
O33					K-bentonite, sample Upper Womble	Black Knob Ridge, Atoka, Oklahoma; Katian Global Stratotype Section and Point (GSSP)	34°25′39.08″N, 96°04′3.78″W	Upper Womble Shale	453.16	± 0.24	± 0.57	^{206}Pb/^{238}U
O32					K-bentonite, sample LOQ-B	L'Orignal Quarry, Ontario, Canada	45°31′N, 74°22′W	top of the L'Orignal Fm	453.36	± 0.38	± 0.65	^{206}Pb/^{238}U
O31					K-bentonite, sample Lower Womble	Black Knob Ridge, Atoka, Oklahoma; Katian Global Stratotype Section and Point (GSSP)	34°25′39.08″N, 96°04′3.78″W	Upper Womble Shale	453.98	± 0.33	± 0.62	^{206}Pb/^{238}U
O30					Shakertown Deicke K-bentonite	Outcrop on U.S. Highway 68, 1.6 km southwest of intersection with State Route 33, at entrance to Shakertown, Mercer County, KY, USA	37°48.985′N, 84°45.432′W	Tyrone Fm	453.74	± 0.20	± 0.56	^{206}Pb/^{238}U
O29					K-bentonite, sample C-10-11 upper Grimstorp bentonite	Linlandveien road section, Vollen, Oslo, Norway; 7 m above base	59°48.19′ N, 10°29.21′E	Arnestad Fm	453.91	± 0.37	± 0.61	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Weighted mean of 18 (of 20) zircon spots using SHRIMP II (Beijing), calibrated to standard TEM.	graptolite	South China	top of *Metabolograptus extraordinarius Zone*	uppermost *Metabolograptus extraordinarius* Zone	Hu et al. (2008)
Four multigrain zircon fractions yield a weighted mean ^{206}Pb/^{238}U age of 444.88 ± 1.17 Ma	graptolite	Britain	*Paraorthograptus pacificus* Zone	Approximately 4.5 m below Ordov/Sil GSSP, *Paraorthograptus pacificus* Zone	Tucker et al. (1990)
Six of six single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite	North America	top of *Diplacanthograptus spiniferus* Zone	top of *Diplacanthograptus spiniferus* Zone	Macdonald et al. (2017)
Eight of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite	North America	lowermost *Diplacanthograptus spiniferus* Zone	Bentonite just above base of the *Diplacanthograptus spiniferus* Zone	Taylor et al. (2015)
Seven of nine single grain zircon analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite	Australian	lowermost *Diplacanthograptus spiniferus* Zone	Dlgevilel Fm contains graptolites of the *Orthograptus rudemanni* zone. Manheim bentonite correlated through apatite chemistry to the Calmar K-bentonite (Sell et al., 2015). N.Amer. *O. rudemanni* Zone considered coeval with lower *D. spiniferous* Zone of Australia.	Macdonald et al. (2017)
Six of nine single grain zircon analyses (excluding three older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite	Australian	lowermost *Diplacanthograptus spiniferus* Zone	Dlgevilel Fm contains graptolites of the *Orthograptus rudemanni* zone. Manheim bentonite correlated through apatite chemistry to the Calmar K-bentonite (Sell et al., 2015). N.Amer. *O. rudemanni* Zone considered coeval with lower *D. spiniferous* Zone of Australia.	Macdonald et al. (2017)
Eight of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite	Australian	*Diplacanthograptus lanceolatus*	Contains graptolites of the *Corynoides americanus* biozone. *C. americanus* considered coeval with the Australian *Diplacanthograptus lanceolatus* Zone.	Macdonald et al. (2017)
Five of eight single grain zircon analyses (excluding three older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite	Australian	*Diplacanthograptus lanceolatus*	Contains graptolites of the *Corynoides americanus* biozone. *C. americanus* considered coeval with the Australian *Diplacanthograptus lanceolatus* Zone.	Macdonald et al. (2017)
Three of five single grain zircon analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite/ conodont	N. Atlantic/ N. Amer. Midcont.	Upper *Climacograptus bicornis* Zone	*Climacograptus bicornis* Zone/*Phragmodus undatus* Zone	Sell et al. (2013)
Ten of twelve single grain zircon analyses (excluding two younger grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite/ conodont	N. Atlantic/ N. Amer. Midcont.	*Climacograptus bicornis* Zone/*Phragmodus undatus* Zone	Diagnostic graptolites include *C. bicornis, C. bicornis tridentatus, Orthograptus whitfieldi, O. calcaratus ssp., Archiclimacograptus modestus, Dicranograptus spinifer, D. contortus, D. arkansasensis, Normalograptus brevis*, and *Nemagraptus gracilis*; the co-occurrence of *I. cf. I. superba* and *A. tvaerensis* indicates the *B. alobatus* Subzone of the *A. tvaerensis* Zone.	Sell et al. (2013)
Six of six single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite/ conodont	N. Atlantic/ N. Amer. Midcont.	*Climacograptus bicornis* Zone	No biostrat included; but considered to be equivalent to the Millbrig bentonite' which would be near base of *Plectodina tenuis* conodont zone (Fig. 13 in their paper)	Oruche et al. (2018)
Six of eight single grain zircon analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite/ conodont	N. Atlantic/ N. Amer. Midcont.	*Climacograptus bicornis* Zone/*Phragmodus undatus* Zone	Diagnostic graptolites include *C. bicornis, C. bicornis tridentatus, Orthograptus whitfieldi, O. calcaratus ssp., Archiclimacograptus modestus, Dicranograptus spinifer, D. contortus, D. arkansasensis, Normalograptus brevis*, and *Nemagraptus gracilis*; the co-occurrence of *I. cf. I. superba* and *A. tvaerensis* indicates the *B. alobatus* Subzone of the *A. tvaerensis* Zone.	Sell et al. (2013)
Four of five single grain zircon analyses (excluding one older grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite/ conodont	N. Atlantic/ N. Amer. Midcont.	Upper *Climacograptus bicornis* Zone	*Climacograptus bicornis* Zone/*Phragmodus undatus* Zone	Sell et al. (2013)
Thirteen of sixteen single grain zircon analyses (excluding one younger and two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house spike intercalibrated to ET100 solution.	conodont	North Atlantic	*Amorphognathus tvaerensis* Zone	*Amorphognathus tvaerensis* Zone	Svensen et al. (2015)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
O28					Vasagard Kinnekulle K-bentonite	Vasagard section along Læsa brook, Bornholm, Denmark; 0.5–2 m above base	54°52′N, 14°55′W	Skagen Fm	454.41	± 0.17	± 0.53	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O27					Ristikula bed 46 K-bentonite	Ristikula core, Pärnu County, SW Estonia	~58.2°N, 24.8°W	bed 46	454.65	± 0.56	± 0.75	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O26					Arnestad Kinnekulle K-bentonite, sample C-10-9 Arnestad tephra (tuff B)	Linlandveien road section, Vollen, Oslo, Norway; −1 to 0 m below base	59°48.19′N, 10°29.21′E	Arnestad Fm	454.52	± 0.50	± 0.70	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O25					K-bentonite, sample EB16-S-28.63	Sinsen railway cut, Oslo, Norway; 28.63-m above base	59°56.138′N, 10°46.983′E	Arnestad Fm	456.84	± 0.48	± 0.69	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O24					K-bentonite, sample EB16-S-0	Sinsen railway cut, Oslo, Norway; 0-m above base	59°56.138′N, 10°46.983′E	Arnestad Fm	457.66	± 0.65	± 0.83	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O23					K-bentonite	East River Mountain Tunnel, I-77, Mercer County, West Virginia, USA	37°17.0′N, 18°07.5′E	Elway Fm	458.76	± 0.26	± 0.56	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
			Middle									
				Darriwilian								
O22	**O8**				Gritty calcareous ash	Llandindrod, central Wales	~52.2°N, 3.4°W	Llanvirn Series	458.76	± 2.19	± 2.24	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O21	**O6**				Indurated bentonite	Abereiddy Bay, Wales	~51.9°N, 5.2°W	Lower rhyolitic tuff, Llanrian Volc Fm	462.90	± 1.23	± 1.32	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O20	**O5**				Ash flow	Arenig Fawr, Wales	~52.9°N, 3.7°W	Serv Fm	465.61	± 1.69	± 1.76	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O19					K-bentonite, sample F1456	Red slate quarry, Giddings Brook Thrust Sheet, eastern New York, USA	43°28.960′N, 73°19.098′W	upper Indian River Fm	464.20	± 0.13	± 0.55	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O18					K-bentonite, sample Mainland 41 m	Mainland Section, Port au Port Peninsula, western Newfoundland, Canada; 41 m above base	~48.5°N, 49.0°W	Cape Cormorant Fm	464.50	± 0.40	± 0.64	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O17					K-bentonite, sample D	West Bay Centre quarry section, Port au Port Peninsula, western Newfoundland, Canada	~48.5°N, 49.0°W	Table Head Group	464.57	± 0.95	± 1.07	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
L16					Likhall Bed zircons recovered from limestone	Thorsberg Quarry, Kinnekulle, Sweden	58°34′45′′N, 13°25′46′′E	Likhall Bed, Taljsten Interval	467.50	± 0.28	± 0.62	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O15	**O7**				ARG-1 K-bentonite	Cerro Viejo, near Jáchal, San Juan Province, Argentina	30°11′05″S, 68°35′05″W	Lower Member of the Los Azules Fm	465.46	± 3.49	± 3.53	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$
O14					K-bentonite, sample KB-1	Cerro La Chilca section, San Juan Province, Argentina	30°36′16.9′′S, 69°47′41.0′′W	Upper San Juan Fm	469.53	± 0.26	± 0.62	$^{206}\mathrm{Pb}/^{238}\mathrm{U}$

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Eight of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite/ conodont	Britain	Upper *Diplograptus foliaceus* Zone; *S. cervicornis* Zone	Upper *Diplograptus foliaceus* Zone; *S. cervicornis* Zone	Sell et al. (2013)
Five of five single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	chitinozoan		*S. cervicornis* Zone	*S. cervicornis* Zone	Sell et al. (2013)
Eleven of fourteen single grain zircon analyses (excluding one younger and two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house spike intercalibrated to ET100 solution.	conodont	North Atlantic	*Amorphognathus tvaerensis* Zone	*Amorphognathus tvaerensis* Zone	Svensen et al. (2015)
Four of six single grain zircon analyses (excluding one younger and one older grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house spike intercalibrated to ET100 solution.	graptolite/ conodont	Baltic	*Climacograptus bicornis* graptolite zone *or Amorphognathus tvaerensis* conodont zone	Based on the stratigraphic relationship to the Kinnekulle bentonite suite, these beds are Mid- Late Sandbian in age—*Climacograptus bicornis* graptolite Zone or *Amorphognathus tvaerensis* conodont Zone.	Ballo et al. (2019)
Two of four single grain zircon analyses (excluding one younger and one older grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and in-house spike intercalibrated to ET100 solution.	graptolite/ conodont	Baltic	Upper *Nemagraptus gracilis* Zone?	Based on the stratigraphic relationship to the Kinnekulle bentonite suite, these beds are Mid Sandbian in age—*Nemagraptus gracilis* graptolite Zone (might be below base of *B. cornis*) or *Amorphognathus tvaerensis* conodont Zone.	Ballo et al. (2019)
Five of five single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	condont	N. Atlantic/N. Amer. Midcont.	Upper *Cahabagnathus sweeti* Zone?	Conodont fauna in the Elway Fm immediately below the ERM K-b consists of *Plectodina aculeata?, Pteracontiodus sp., Phragmodus sp. cf. Phragmodus flexuous, Panderodus sp., and Erismodus sp*. conodont fauna in Elway Fm immediately above the ERM K-b consists of *Pl. aculeata, Ph. flexuosus, Pa. sp., Er. sp., Curtognathus sp., . . . and Appalachignathus delicatulus*.	Leslie et al. (2012)
Five multigrain zircon fractions yield a weighted mean ^{206}Pb/^{238}U age of 458.76 ± 2.24 Ma (95% conf. int. including geologic scatter).	graptolite	Britain	*Didymograptus murchisoni* Zone	*Didymograptus murchisoni* immediately below sampled ash *"considered by Elles to be close to base G. teretiusculus Zone"*	Tucker and McKerrow (1995)
Three multigrain zircon fractions yield a weighted mean ^{206}Pb/^{238}U age and corroborating weighted mean ^{207}Pb/^{206}Pb age [recalculated using the U decay constant ratio of Mattinson (2010)]	graptolite	Britain	*Didymograptus murchisoni* Zone	Immediately overlying Cyffredin Shale is of *Didymograptus murchisoni* zone age (Tucker and McKerrow 1995).	Tucker et al. (1990)
Two multigrain zircon fractions yield a weighted mean ^{206}Pb/^{238}U age.	graptolite	Britain	*Didymograptus artus* Zone	Underlying mudstone contains *Didymograptus artus* Zone graptolites	Tucker et al. (1990)
Six of six single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	none		?	No fossils have been identified within the Indian River Formation. Sharply overlain by Mount Merino Fm that contains *N. gracilis* graptolite zone in upper part (early Sandbian). Their Fig. 11 suggests that the dated Indian River ashes might be lower Darriwilian.	Macdonald et al. (2017)
Five of five single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	graptolite	N. America	*Pterograptus elegans Zone*	*Pterograptus elegans* Zone	Sell et al. (2011)
Three of three single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	conodont	N. America	*upper Holmograptus holodentata Zone*	*Holmograptus spinosus* graptolite zone (regional zone equivalent to upper *Holm. lentus* Zone according to Maletz (2009), [D. Goldman 29 Apr 2019 "New conodont information indicates upper *Histiodella holodentata* conodont zone."]	Sell et al. (2011)
Eight of sixteen single grain zircon analyses (excluding six older grains and two younger grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.	conodont	Argentina	base of *Y. crassus* Zone	The base of the 'Likhall' bed coincides with the boundary between the globally recognized *Lenodus variabilis* and *Yangtzeplacognathus crassus* conodont zones.	Lindskog et al. (2017)
Three multigrain zircon fractions (14 grains total) yield a weighted mean ^{206}Pb/^{238}U age of 465.46 ± 3.53 Ma (95% conf. int. including geologic scatter).	graptolite	Austral-asian	*U. sinicus Subzone* of the *U. austrodentatus Zone*	10 graptolite species listed by Mitchell et al. (1998); the *U. sinicus Subzone* of the *U. austrodentatus* Zone. Based on Ortega et al. (2007) this is Da2—L. dentatus graptolite zone.	Huff et al. (1997)
Six of nine single grain zircon analyses (excluding three older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	North Atlantic	*L. variabilis?*	All three dated beds are in the upper San Juan Formation. Conodont range information is not yet available but estimated to be lowermost Darriwilian (*L. variabilis* or *L. antivariabilis*).	Thompson et al. (2012)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
O13					K-bentonite, sample KBT-10	Talacasto section, San Juan Province, Argentina	31°00′35.5″S, 68°46′12.0″W	Upper San Juan Fm	469.63	± 0.21	± 0.60	^{206}Pb/^{238}U
O12					K-bentonite, sample KBT-7	Talacasto section, San Juan Province, Argentina	31°00′35.5″S, 68°46′12.0″W	Upper San Juan Fm	469.86	± 0.33	± 0.65	^{206}Pb/^{238}U
				Dapingian								
			Early									
				Floian								
O11					K-bentonite, sample 221598	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1165.44–1165.45 m below top of core	18°15′00.8″S, 122°37′10.9″E	Willara Fm	470.18	± 0.13	± 0.55	^{206}Pb/^{238}U
O10					K-bentonite, sample KGC2	Knock Airport section, Charlestown Inlier, County Mayo, Ireland; 13-m above base of section	53.914677°N, 8.8075466°W	upper Horan Fm	472.01	± 0.19	± 0.55	^{206}Pb/^{238}U
O9					K-bentonite, sample 221599	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1239.27–1239.30 m below top of core	18°15′00.8″S, 122°37′10.9″E	Upper Member, Nambeet Fm	471.32	± 0.11	± 0.55	^{206}Pb/^{238}U
O8					K-bentonite, sample 221600	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1249.31–1249.33 m below top of core	18°15′00.8″S, 122°37′10.9″E	Upper Member, Nambeet Fm	471.78	± 0.13	± 0.56	^{206}Pb/^{238}U
O7					K-bentonite, sample 221474	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1264.61–1264.62 m below top of core	18°15′00.8″S, 122°37′10.9″E	Upper Member, Nambeet Fm	472.82	± 0.13	± 0.56	^{206}Pb/^{238}U
O6					K-bentonite, sample KBT-3N	Talacasto section, San Juan Province, Argentina	31°00′35.5″S, 68°46′12.0″W	Upper San Juan Fm	473.45	± 0.40	± 0.70	^{206}Pb/^{238}U
O5					K-bentonite, sample 221477	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1335.03–1335.04 m below top of core	18°15′00.8″S, 122°37′10.9″E	Upper Member, Nambeet Fm	477.07	± 0.21	± 0.59	^{206}Pb/^{238}U
O4					K-bentonite, sample 221478	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1339.56–1339.57 m below top of core	18°15′00.8″S, 122°37′10.9″E	Upper Member, Nambeet Fm	477.03	± 0.16	± 0.57	^{206}Pb/^{238}U
				Tremodocian								
O3					K-bentonite, sample 221480	Olympic 1 well, Broome Platform, Canning Basin, Western Australia; 1383.27–1383.28 m below top of core	18°15′00.8″S, 122°37′10.9″E	Upper Member, Nambeet Fm	479.37	± 0.16	± 0.57	^{206}Pb/^{238}U
O2	**O2**				Volcanic sandstone	section McL-6, 4 km downstream of the ford where Bourinot Road crosses McLeod Brook, Cape Breton Island	~46.0°N, 60.5°W	Chelsey Drive Group	481.13	± 1.12	± 2.76	^{207}Pb/^{206}Pb
O1	**O1**				Crystal-rich volcanic sandstone	Bryn-llin-fawr, Harlech Dome, N. Wales	52°51′35.9″N, 3°47′53.0″W	sequence boundary between Dolgellau and Dol-cyn-afon Fm, Mawddach Group	486.78	± 0.53	± 2.57	^{207}Pb/^{206}Pb
		Cambrian										
			Furongian									
				Age 10								
C16	**C11**				Crystal-rich volcanic sandstone	Ogof-ddu, Criccieth, N. Wales	52°55.138′N, 4°12.803′W	lower Dolgellau Fm, Mawddach Group	488.71	± 1.17	± 2.78	^{207}Pb/^{206}Pb

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Five of seven single grain zircon analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	North Atlantic	*L. variabilis?*	*L. antivariabilis* to *L. variabilis* conodont zones, assumed that this same-dated horizon in this section is similar in age to the nearby section for O15 (See comment on O13)	Thompson et al. (2012)
Four of six single grain zircon analyses (excluding two older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	North Atlantic	*L. variabilis?*	*L. antivariabilis* to *L. variabilis* conodont zones, assumed that this same-dated horizon in this section is similar in age to the nearby section for O15 (See comment on O13)	Thompson et al. (2012)
Eight of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Austral-asian	*Jumudontus gananda* Zone	Condonts of the *J. gananda* Zone	Normore et al. (2018)
Four of six single grain zircon analyses (excluding one older and one younger grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	graptolite	Austral-asian	*C. morsus* Zone	Graptolites sampled at 10-m above base in the section (and 2 m below this dated horizon) include *Pseudisograptus sp.* of the *manubriatus* group, and *Exigraptus uniformis* and *Skiagraptus gnomonicus*, indicating a latest Dapingian (i.e. Yapeenian Ya 2/late Arenig) age.	Herrington et al. (2018)
Seven of seven single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Austral-asian	*O. communis* Zone	Condonts of the *Oepikodus communis* Zone, for which correlation with graptolite biostratigraphy should be *P. fruticosus* graptolite zone.	Normore et al. (2018)
Seven of seven single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Austral-asian	*O. communis* Zone	Condonts of the *Oepikodus communis* Zone, for which correlation with graptolite biostratigraphy should be *P. fruticosus* graptolite zone.	Normore et al. (2018)
Six of six single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Austral-asian	*O. communis* Zone	Condonts of the *Oepikodus communis* Zone, for which correlation with graptolite biostratigraphy should be *P. fruticosus* graptolite zone.	Normore et al. (2018)
Four of four single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Precordiilleran	Uncertain; maybe *base O. evae* Zone	The biostratigraphy is currently questionable; upper Floian; base *Oepikodus evae* conodont zone?	Thompson et al. (2012)
Two of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Austral-asian	*P. oepiki -S. bilobatus* Zone	Conodonts of the *P. oepiki–S. bilobatus* Zone	Normore et al. (2018)
Six of eight single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Austral-asian	*P. oepiki -S. bilobatus Zone*	Conodonts of the *P. oepiki -S. bilobatus* Zone	Normore et al. (2018)
Seven of seven single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	conodont	Gond-wanan	*P. proteus Zone*	Conodonts of the *P. proteus* Zone	Normore et al. (2018)
Six multigrain zircon fractions yield a weighted mean ^{207}Pb/^{206}Pb age of 481.13 ± 2.76 Ma [recalculated using the U decay constant ratio of Mattinson (2010)].	trilobite	Avalonian	Late Tremadocian (Hunnebergian), Late La2 Zone	Trilobite *Peltocare rotundiformis, Hunnegr. cf. copiosus, Adelograptus* of *quasimodo* type	Landing et al. (1997)
Fourteen single zircon grains yield a weighted mean ^{207}Pb/^{206}Pb age of 486.78 ± 2.57 Ma [recalculated using the U decay constant ratio of Mattinson (2010)]	graptollite	Avalonian	Base, *R. praeparabola* Zone, base Ordovician	Close to top *Acercare* Zone. Dated ash is 4 m below appearance of *Rhabdinopora*, and 5 m below *R.f. parabola*. It is therefore very close to C/O boundary	Landing et al. (2000)
Nine multigrain zircon fractions to yield a weighted mean ^{207}Pb/^{206}Pb age of 488.71 ± 1.17 (analytical) or ± 2.78 Ma (total) [as recalculated using the U decay constant ratio of Mattinson (2010)]	trilobite	Avalonian	Lower *Peltura scarabaeoides* Zone	*Peltura scarabaeoides scarabaeoides* below and *P.s. westergardi* above "indicate the third subzone (*Parabolina lobata* Subzone) of the *Peltura scarabaeoides* Zone in Norway.	Davidek et al. (1998)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
				Jiangshanian								
				Paibian								
			Maiolingian									
				Guzhangian								
C15	**C10**				Volcanic ash bed	Taylor Nunatak, Shackleton Glacier, Antarctica	87°19.114′S, 149°26.079′W	Taylor Fm	502.10	± 2.40	± 3.50	^{207}Pb/^{206}Pb
				Drumian								
C14					Trieb-1 volcanic ash bed	~650 m southwest of Triebenreuth village; 1.0 m above the base of the lower division of the Triebenreuth Formation, Germany	50°10.658′N, 11°32.965′E	lower Triebenreuth Fm	503.14	± 0.13	± 0.59	^{206}Pb/^{238}U
				Wuliuan								
C13	**C9**				Comley ub volcanic ash bed	200 m south of Comley Quarry, Comley village, Shropshire, England	52°33.670′N, 2°45.756′W	basal Quarry Ridge Grits, basalt Upper Comley Sandstone Fm	509.10	± 0.33	± 0.62	^{206}Pb/^{238}U
			Epoch 2									
				Age 4								
C12	**C8**				SoS-56.1 volcanic ash bed	Somerset Street, Saint John, New Brunswick, Canada	45°16.765′N, 66°3.852′W	9.5 m above the base of the Hanford Brook Fm, middle Somerset St Mbr	508.05	± 1.13	± 2.75	^{207}Pb/^{206}Pb
				Age 3								
C11	**C7**				Section Le-XI volcanic ash bed	Section Le-XI, south of Taliwine n′ Aït-Al Mimoun in the upper Lemdad valley, Anti-Atlas, southern Morocco	30°47.822′N, 8°10.480′W	Upper Lemdad Fm	515.56	± 1.03	± 1.16	^{206}Pb/^{238}U
C10	**C6**				Comley lb volcanic ash bed	200 m south of Comley Quarry, Comley village, Shropshire, England	52°33.670′N, 2°45.756′W	Several centimeters below the top of the Green Callavia Sandstone, uppermost Lower Comley Sandstone Fm	514.45	± 0.43	± 0.69	^{206}Pb/^{238}U
C9					Purley Shale Formation bentonite	NW corner of Woodlands Quarry, 200 m NNW of Hartshill Green (5 km NW of Nuneaton), Warwickshire, England	52°33.009′N, 1°31.401′W	Seven meters above the base of the Purley Shale Fm, Charnwood Block, Avalon Composite Terrane	517.22	± 0.40	± 0.66	^{206}Pb/^{238}U
C8					Mudstone, sample 14CJ-3	Xiaolantian section, Chengjiang County, eastern Yunnan, South China	24°40′53″N, 102°58′50″E	Maotianshan Shale, Yu′anshan Member, Chiungshussuan Fm, South China Block	≤518.03	± 0.69	± 0.71	^{206}Pb/^{238}U
C7	**C5**				Cwm Bach 1 volcanic ash bed	Cwm Bach, near Newgale, Pembrokeshire, south Wales	51°51.822′N, 5°8.225′W	closely above only known fossiliferous horizon, Caerfai Bay Shales Fm	519.30	± 0.34	± 0.64	^{206}Pb/^{238}U
			Terreneuvian									
				Age 2								
C6					M236 volcanic ash bed	Oud Sdas section, Anti-Atlas, Morocco	30°23.600′N, 8°38.700′W	upper Lie de Vin Fm	520.93	± 0.21	± 0.57	^{206}Pb/^{238}U
C5					M234 volcanic ash bed	Oud Sdas section, Anti-Atlas, Morocco	30°23.486′N, 8°38.115′W	lower Lie de Vin Fm	523.17	± 0.22	± 0.57	^{206}Pb/^{238}U
C4					M231 volcanic ash bed	Oud Sdas section, Anti-Atlas, Morocco	30°22.229′N, 8°37.676′W	Tifnout Member, upper Adoudou Fm	524.84	± 0.18	± 0.56	^{206}Pb/^{238}U

Primary radioisotopic age details	Zonal range assignment			Biostratigraphy	Reference
	clade	zonation	Zone		
Sample TAY-F, two multigrain zircon fractions yield a weighted mean ^{207}Pb/^{206}Pb age of 502.1 ± 3.5 Ma [recalculated using the U decay constant ratio of Mattinson (2010)]	trilobite	Gond-wanan	Undillan Stage	Trilobites in carbonate bed, 1 km from dated samples. *Amphoton* cf. *oatesi*, *Nelsonia* cf. *schesis*, taken to indicate an Undillan, possibly late Floran, age.	Encarnación et al. (1999)
Five single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age utilizing CA-TIMS and the ET535 spike.	trilobite	Gond-wanan	Drumian Stage	Poorly preserved but relatively diverse, trilobite-dominated assemblage of eodiscinids, corynexochids and ptychopariids suggesting a traditional middle Middle Cambrian (middle Celtiberian Series) age are found roughly 40 m above the Triebenreuth volcaniclastic rocks.	Landing et al. (2014)
Seven single zircon grain analyses yield a weighted mean ^{206}Pb/^{238}U age of 509.07 ± 0.33 Ma, utilizing CA-TIMS and the ET535 spike.	trilobite	Avalonian	*P. harlani* Zone, upper Stage 4, Series 2	*Paradoxides harlani* and other trilobites in immediately overlying beds indicate the *P. harlani* Biozone of Newfoundland	Harvey et al. (2011)
Eight single zircon grains or small multigrain fractions yield a weighted mean 207Pb/206Pb age of 508.05 ± 2.75 Ma [recalculated using the U decay constant ratio of (Mattinson (2010)]	trilobite	Avalonian	*Protolenus howleyi* Zone Late Branchian, Stage 4, Series 2	*Protolenus* cf. *elegans* Matthew, *Ellipsocephalus* cf. *galeatus* Matthew associated in same bed. Suggests an age for the base of Series 3 and Stage 5 of ~507 Ma.	Landing et al. (1998)
Five single zircon grains yield a weighted mean ^{206}Pb/^{238}U age of 515.56 ± 1.16 Ma.	trilobite	Avalonian	*Antatlasia guttapluviae* Zone, Banian Stage; Stage 3	*A. guttapluviae* Zone, based on detailed correlation to section Le-I, 8 km away. The trilobite, *Berabichia vertumnia*, a guide to the *A. guttapluviae* Zone, is 21 m higher in sequence. Lower Botomian.	Landing et al. (1998)
Two single zircon grain analyses yield a weighted mean ^{206}Pb/^{238}U age of 514.38 ± 0.43 Ma, utilizing CA-TIMS and the ET535 spike.	trilobite	Avalonian	*Callavia* Zone of upper Stage 3 of Series 2	Dated ash lies in the *Callavia* Zone of upper Stage 3 of Series 2	Harvey et al. (2011)
Five of nine single zircon grains (excluding four older grains) yield a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	trilobite	Avalonian	*Fallotaspis* or *Callavia* Zone of Stage 3 of Series 2	Fossils of the underlying Home Farm Member (Hartshill Sandstone Formation) correlated to faunas of Siberian Tommotian-Atdabanian boundary, and with the *Camenella baltica* Biozone of Cape Breton Island and Newfoundland; fauna some 66 m above the base of the Purley Shale Formation includes *Serrodiscus bellimarginatus* and *Strenuella sabulosa*, correlated with the *sabulosa* Biozone at the base of Stage 4	Wiliams et al. (2013)
Maximum depositional age from youngest single grain analyzed by CA-TIMS with the ET535 spike.	trilobite	South China	*Eoredlichia*–*Wutingaspis* Zone, Nangaoan Stage (Stage 3)	Mudstone lies below the Chengjiang biota, and above the first occurrence of trilobites of the *Parabadiella* Zone	Yang et al. (2018)
Six single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	trilobite	Avalonian	*Fallotaspis* Zone of lower Stage 3 of Series 2	Dated ash lies in the *Fallotaspis* Zone of lower Stage 3 of Series 2	Harvey et al. (2011)
Six single grain zircon analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	carbon isotopes	Morocco	below the Adtabanian–Tommotian boundary	Dated ash lies below the peak of a major positive δ^{13}C excursion that is correlated with CIE IV of Siberia at the Adtabanian–Tommotian boundary; below the first occurrence of *Fallotaspis* Zone trilobites	Maloof et al. (2010)
Ten of eleven single grain zircon analyses (excluding one older grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	carbon isotopes	Morocco	lower Tommotian	Dated ash lies below the peak of a major positive δ^{13}C excursion that is correlated with CIE II of Siberia	Maloof et al. (2010)
Eight single zircon grains (five air-abraded and three chemically abraded) yield a weighted mean ^{206}Pb/^{238}U age utilizing the EARTHTIME-calibrated ET535 and MIT-1L spikes.	carbon isotopes	Morocco	Tommotian/Nemakit-Daldynian boundary; late Cordubian	Dated ash lies at the zero-crossing on the descending limb of a major positive δ^{13}C excursion, and is thus correlated to the Tommotian–Nemakit-Daldynian boundary	Maloof et al. (2010)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
C3	**C4**				M223 volcanic ash bed	Oud Sdas section, Anti-Atlas, Morocco	30°22.117′N, 8°36.907′W	Tifnout Member, upper Adoudou Fm	525.34	± 0.18	± 0.56	^{206}Pb/^{238}U
				Fortunian								
C2	**C3**				Volcanic ash bed	Somerset Street, Saint John, New Brunswick, Canada	45°16.765′N, 66°3.852′W	24.3 m above the base of the Chapel Island Formation of the Ratcliffe Brook Group	530.02	± 1.07	± 1.20	^{206}Pb/^{238}U
C1					17SWART7 ash 6 volcanic ash bed	Swartkloofberg section, Witputs Subbasin, Nama Basin, southern Namibia	27°26′38.6″S, 16°33′31.4″E	Nomtsas Fm, Nama Group	538.58	± 0.19	± 0.63	^{206}Pb/^{238}U
		Ediacaran										
E26					15UNA20 ash 5 volcanic ash bed	Swartpunt section, Witputs Subbasin, Nama Basin, southern Namibia	27°28′27.4″S, 16°41′35.9″E	Urusis Fm, Upper Spitskopf Member, Schwarzrand Subgroup, Nama Group	538.99	± 0.21	± 0.63	^{206}Pb/^{238}U
E25					15UNA18 ash 3 volcanic ash bed	Swartpunt section, Witputs Subbasin, Nama Basin, southern Namibia	27°28′27.1″S, 16°41′34.8″E	Urusis Fm, Upper Spitskopf Member, Schwarzrand Subgroup, Nama Group	539.52	± 0.14	± 0.61	^{206}Pb/^{238}U
E24					15UNA22 ash 1 volcanic ash bed	Swartpunt section, Witputs Subbasin, Nama Basin, southern Namibia	27°28′22.9″S, 16°41′39.9″E	Urusis Fm, Upper Spitskopf Member, Schwarzrand Subgroup, Nama Group	540.10	± 0.10	± 0.60	^{206}Pb/^{238}U
E23	**C1**				BB5 volcanic ash bed	Oman (3045 m depth, Birba-5 well)	18°09′57.7″N, 55°14′32.7″E	Ara Group, 1 m above base of A4 carbonate unit	541.00	± 0.29	± 0.63	^{206}Pb/^{238}U
E22					sample 1.04 volcanic ash bed	Corcal, Corumbá—State of Mato Grosso do Sul, Brazil	19°01.067′S, 57°40.941′W	top of Tamengo Formation, Corumba Group, southern Paraguay Belt	541.85	± 0.77	± 0.97	^{206}Pb/^{238}U
E21					sample 1.08 volcanic ash bed	Corcal, Corumbá—State of Mato Grosso do Sul, Brazil	19°01.067′S, 57°40.941′W	top of Tamengo Formation, Corumba Group, southern Paraguay Belt	542.37	± 0.32	± 0.68	^{206}Pb/^{238}U
E20	**E17**				Mkz-11b volcanic ash bed	Oman (2194.4 m depth, Mukhaizna-11 well)	19°22′16.2″N, 56°26′13.1″E	Ara Group, 9 m below top of A3 carbonate unit	542.37	± 0.28	± 0.63	^{206}Pb/^{238}U
E19	**E15**				Minha-1A volcanic ash bed	Oman (3988.3 m depth, Minha-1 well)	18°19′12.0″N, 55°06′19.9″E	Ara Group, 3 m above base of A3 carbonate unit	542.90	± 0.29	± 0.63	^{206}Pb/^{238}U
E18	**E13**				Asala-1 core 21 volcanic ash bed	Oman (3847 m depth, Asala-1 well)	17°54′17.9″N, 54°27′40.8″E	Ara Group, middle of A0 carbonate unit	546.72	± 0.34	± 0.66	^{206}Pb/^{238}U
E17	**E12**				94-N-10B volcanic ash bed	Hauchabfontein, Namibia	24°33′21.3″S, 16°06′57.9″E	Lower Hoogland Member, 270 m above the base of the Kuibis Subgroup, Nama Group	547.32	± 0.31	± 0.65	^{206}Pb/^{238}U
E16	**E11**				JIN04-2 volcanic ash bed	Jijiawan (Jiuqunao) section, 17 km west of Maoping in Yangtze Gorges area, western Hubei Province, South China	30°48′13″N, 111°3′20″E	top of Miaohe member black shale, uppermost Doushantuo Fm	551.09	± 0.84	± 1.02	^{206}Pb/^{238}U
E15	**E10**				Volcanic ash bed	between Medvezhiy and Yeloviy creeks, Zimnie Gory section, White Sea region, Russia	65°28′04.3″N, 39°42′34.2″E	15-m-thick claystone unit in the lower part of sequence B, uppermost Ust-Pineg Fm	552.85	± 0.77	± 2.62	^{207}Pb/^{206}Pb
E14					Porto Morrinhos tuff	Porto Morrinhos—State of Mato Grosso do Sul, Brazil	19°30′24.6″S, 57°25′53.4″W	Bocaina Formation, Corumba Group, southern Paraguay Belt	555.18	± 0.34	± 0.70	^{206}Pb/^{238}U

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Twelve single zircon grains (six air-abraded and six chemically abraded) yield a weighted mean ^{206}Pb/^{238}U age utilizing the EARTHTIME-calibrated ET535 and MIT-1L spikes.	carbon isotopes	Morocco	Tommotian/Nemakit-Daldynian transition; late Cordubian	Dated ash lies at the peak of a major positive δ^{13}C excursion that is correlated with a global excursion below the Tommotian–Nemakit-Daldynian boundary	Maloof et al. (2010)
Three multigrain fractions yield a weighted mean ^{206}Pb/^{238}U age using physical abrasion and in-house MIT spike.	ichnofossil		Placentian Series, Fortunian Stage	Middle part of trace fossil zone *Rusophycus avalonensis*, Placentian Series	Isachsen et al. (1994)
Three of nine single grain zircon analyses (excluding six older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	ichnofossil		basal Cambrian	Above first occurrence of Cambrian advanced bilaterian-sourced trace fossils, represented by *Streptichnus narbonnei* and *Treptichnus c.f. pedum*.	Linnemann et al. (2019)
Three of eleven single grain zircon analyses (excluding eight older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	Below occurrences of Ediacaran rangeomorph/ erniettomorph biota, including *Swartpuntia germsi* and *Pteridinium simplex*, Nama Assemblage	Linnemann et al. (2019)
Five of eight single grain zircon analyses (excluding three older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	Below occurrences of Ediacaran rangeomorph/ erniettomorph biota, including *Swartpuntia germsi* and *Pteridinium simplex*, Nama Assemblage	Linnemann et al. (2019)
Five of six single grain zircon analyses (excluding one older grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	Below occurrences of Ediacaran rangeomorph/ erniettomorph biota, including *Swartpuntia germsi* and *Pteridinium simplex*, Nama Assemblage	Linnemann et al. (2019)
Eight single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	Simultaneous occurrence of an extinction of Precambrian *Namacalathus* and *Cloudina* (Nama Assemblage) and a negative excursion in carbon isotopes taken as coincident with Cambrian/Ediacaran boundary.	Bowring et al. (2007)
Five of eleven single zircon grain analyses (excluding six older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	The sedimentary succession has yielded macroscopic body fossils including the scyphozoan-like *Corumbella werneri* and *Paraconularia*, along with *Cloudina lucianoi*, in the upper Tamengo Formation, Nama Assemblage	Parry et al. (2017)
Four of eight single zircon grain analyses (excluding 1 older and 3 younger grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	The sedimentary succession has yielded macrofossils including the scyphozoan-like *Corumbella werneri* and *Paraconularia*, along with *Cloudina lucianoi*, in the upper Tamengo Formation, Nama Assemblage	Parry et al. (2017)
Sample Mkz-11b just below the Precambrian–Cambrian boundary, yields ten single zircon grain analyses with a weighted mean ^{206}Pb/^{238}U age of 542.37 ± 0.63 Ma, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Nama Assemblage	Associated with the highest calcified Ediacaran macrofssils (*Cloudina* and possibly *Namacalathus*), Nama Assemblage	Bowring et al. (2007)
Sample Minha-1A yields eight single zircon grain analyses with a weighted mean ^{206}Pb/^{238}U age of 542.90 ± 0.63 Ma, utilizing CA-TIMS and the ET535 spike.	carbon isotopes		Nama Assemblage	Simultaneous occurrence of an extinction of Precambrian *Namacalathus* and *Cloudina* and a negative excursion in carbon isotope, Nama Assemblage	Bowring et al. (2007)
Sample Asala-1 core 21 yields eight single zircon grain analyses with a weighted mean ^{206}Pb/^{238}U age of 546.72 ± 0.66 Ma, utilizing CA-TIMS and an EARTHTIME-calibrated spike.	carbon isotopes		Nama Assemblage	Minimum age constraint on +4 per mil carbon isotope peak following the Shuram Excursion, Nama Assemblage	Bowring et al. (2007)
Sample 94-N-10B yields eight single zircon grain analyses with a weighted mean ^{206}Pb/^{238}U age of 547.36 ± 0.65 Ma, utilizing CA-TIMS and an EARTHTIME-calibrated spike.	carbon isotopes		Nama Assemblage	Middle of Kuibis Subgroup positive C-isotope excursion. Nama Assemblage Ediacaran macrofossils and Cloudina, Nama Assemblage	Bowring et al. (2007)
Sample JIN04-02 yields two (of ten total) single zircon grain analyses with a weighted mean ^{206}Pb/^{238}U age of 551.09 ± 1.02 Ma. A corroborating weighted mean 207Pb/206Pb age of 548.09 ± 2.61 Ma is obtained from all ten zircons [recalculated using the U decay constant ratio of Mattinson (2010)]	Ediacaran fauna		White Sea Assemblage	Ash bed occurs at the top of late acanthomorphic acritarch assemblage and Miaohe biota, and is therefore a minimum age for Doushantuo embryos and small bilaterians, White Sea Assemblage	Condon et al. (2005)
Nineteen single grain and small multigrain zircon fractions yield a weighted mean ^{207}Pb/^{206}Pb age of 552.85 ± 2.62 Ma [recalculated using the U decay constant ratio of Mattinson, (2010)]	Ediacaran fauna		White Sea Assemblage	Midpoint of the White Sea occurrence of Ediacaran macrofossils, including *Kimberella*, and *Dickinsonia*, White Sea Assemblage	Martin et al. (2000)
Eight single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna			Stromatolitic dolostones and phosphorites underlying Nama Assemblage macrofossils	Parry et al. (2017)

GTS 2020 ID	GTS 2012 ID	Period	Epoch	Age	Sample	Locality	Lat-Long	Lithostratigraphy	Age (Ma)	± 2s analytical	± 2s total	Age Type
E13					Park Breccia, monomagmatic volcaniclastic turbidite, sample JNC 912	cutting on the A50 road [same locality as sample CH$_2$ of Compston et al. (2002)], Charnwood Forest, Leicestershire, England	52°41′38.6″N, 001°16′56.4″W	Park Breccia Member, basal Bradgate Formation, Maplewell Group, Charnian Supergroup	561.85	± 0.66	± 0.89	$^{206}\text{Pb}/^{238}\text{U}$
E12					vitric tuff, sample JNC 907	southern part of Bardon Hill Quarry, Charnwood Forest, Leicestershire, England	52°42′42.3″N, 001°19′28.9″W	middle Beacon Hill Formation, Maplewell Group, Charnian Supergroup	565.22	± 0.65	± 0.89	$^{206}\text{Pb}/^{238}\text{U}$
E11					Benscliffe Breccia (pyroclastic flow), sample JNC918	Benscliffe Breccia Member at the "Pillar Rock" type 126 locality in Benscliffe Wood, Charnwood Forest, Leicestershire, England	52°42′26.5″N, 001°14′23.3″W	Benscliffe Breccia Member, basal Beacon Hill Formation, Maplewell Group, Charnian Supergroup	569.08	± 0.73	± 0.94	$^{206}\text{Pb}/^{238}\text{U}$
E10					volcanic ash bed, sample MPMP33.56	Mistaken Point, eastern Trepassey Bay, Newfoundland	46°37′32.46″N, 53° 9′45.88″W	33.56 m above the base of the Mistaken Point Formation, Conception Group	566.25	± 0.48	± 0.77	$^{206}\text{Pb}/^{238}\text{U}$
E9					volcanic ash bed, sample Drook-2	Pigeon Cove, eastern Trepassey Bay, Newfoundland	46°41′6.94″N, 53°15′38.03″W	Drook Formation, Conception Group	570.94	± 0.46	± 0.77	$^{206}\text{Pb}/^{238}\text{U}$
E8					volcanic ash bed, sample OBJP-01	Old Bonaventure, Bonavista Peninsula, Newfoundland	48°17′2.57″N, 53°24′58.26″W	post-glacial strata; Rocky Harbour Formation, Musgravetown Group	579.24	± 0.30	± 0.69	$^{206}\text{Pb}/^{238}\text{U}$
E7					tuffaceous diamictite, sample OBJP-03	Old Bonaventure, Bonavista Peninsula, Newfoundland	48°17′3.84″N, 53°25′4.08″W	syn-glacial strata; Trinity Diamictite, Rocky Harbour Formation, Musgravetown Group	579.35	± 0.42	± 0.75	$^{206}\text{Pb}/^{238}\text{U}$
E6					volcanic ash bed, sample B1552-42.2	Old Bonaventure, Bonavista Peninsula, Newfoundland	48°17′3.34″N, 53°25′5.16″W	pre-glacial strata; Rocky Harbour Formation, Musgravetown Group	579.63	± 0.29	± 0.68	$^{206}\text{Pb}/^{238}\text{U}$
E5					volcanic ash bed, sample NoP-0.9	North Point, St. Mary's Bay, Avalon Peninsula, Newfoundland	46°56′17.87″N, 53°34′30.39″W	post-glacial strata; basal Drook Formation, 0.9 m above the Gaskiers Formation; Conception Group	579.88	± 0.52	± 0.81	$^{206}\text{Pb}/^{238}\text{U}$
E4					volcanic ash bed, sample GCI-neg6.55	Great Colinet Island, St. Mary's Bay, Avalon Peninsula, Newfoundland	46°57′33.14″N, 53°43′7.82″W	pre-glacial strata; upper Mall Bay Formation, 6.55 m below the base of the Gaskiers Formation; Conception Group	580.90	± 0.53	± 0.82	$^{206}\text{Pb}/^{238}\text{U}$
E3					volcanic ash bed, sample GCI-neg7.75	Great Colinet Island, St. Mary's Bay, Avalon Peninsula, Newfoundland	46°57′32.69″N, 53°43′8.79″W	pre-glacial strata; upper Mall Bay Formation, 7.75 m below the base of the Gaskiers Formation; Conception Group	580.34	± 0.62	± 0.88	$^{206}\text{Pb}/^{238}\text{U}$
E2	**E2**				YG04-2 volcanic ash bed	Jijiawan (Jiuqunao) section, 17 km west of Maoping in Yangtze Gorges area, western Hubei Province, South China	30°48′13″N, 111°03′20″E	9.5 m above base of Doushantuo Fm, 5 m above top of Lower Dolomite Member (Nantuo Cap Carbonate)	632.48	± 0.84	± 1.02	$^{206}\text{Pb}/^{238}\text{U}$
E1	**E1**				YG04-15 volcanic ash bed	Wuhe-Gaojiaxi section, south of Sandouping in Yangtze Gorges area, western Hubei Province, South China	30°48′49″N, 111°01′26″E	2.3 m above base of Doushantuo Fm, within the Lower Dolomite Member (cap carbonate)	635.26	± 0.84	± 1.07	$^{206}\text{Pb}/^{238}\text{U}$
		Cryogenian										
Cr4					ES-1 gray tuffaceous mudstone	Eshan section, eastern Yunnan Province, South China	24°12′15.66′′N, 102°28′31.33′′E	~20 cm gray tuffaceous mudstone at the top of the Nantuo Fm	634.57	± 0.90	± 1.10	$^{206}\text{Pb}/^{238}\text{U}$
Cr3	**Cr1**				NAV.00.2B volcanic ash bed	Navachab section, Damara Belt, Karibib, Namibia	21.98727°S, 15.72989°E	Kachab dropstone interval, ~30 m below the base of the Keilberg cap carbonate, Ghaub Fm, Swakop Group	635.21	± 0.61	± 0.92	$^{206}\text{Pb}/^{238}\text{U}$
Cr2					dolomitic, fine-grained sandstone; sample R008187	southeast coast of King Island, 100 km northwest of Tasmania	39°59′11.14″S, 144°07′33.34″E	0.7-m-thick transitional bed between the diamictite and lonestone-bearing sandstone and siltstone Cottons Breccia, and the overlying Cumberland Creek Dolostone, Grassy Group	≤636.41	± 0.45	± 0.83	$^{206}\text{Pb}/^{238}\text{U}$
Cr1					DW-1 volcanic ash bed	Duurwater section along Fransfontein Ridge, Namibia	20.20940°S, 15.14693°E	~15 m below the base of the Keilberg cap carbonate, with in the glaciomarine Ghaub Fm, Tsumeb Subgroup, Otavi Group	639.29	± 0.31	± 0.75	$^{206}\text{Pb}/^{238}\text{U}$

Primary radioisotopic age details	**Zonal range assignment**			**Biostratigraphy**	**Reference**
	clade	**zonation**	**Zone**		
Eleven single zircon grains have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Avalon Assemblage	Mercian assemblage of rangiomorphs including *Charnia masoni* and *Bradgatia linfordensis*, Avalon Assemblage	Noble et al. (2015)
Two of five single zircon grain analyses (excluding 3 older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Avalon Assemblage	Lowest occurrence of the Mercian assemblage represented by a single specimen of *Aspidella*, Avalon Assemblage	Noble et al. (2015)
Two of twelve single zircon grain analyses (excluding 1 younger and 9 older grains) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Avalon Assemblage	Avalon Assemblage	Noble et al. (2015)
Five single zircon grains have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Avalon Assemblage	Bedding plane exposed at the base of this volcanic ash contains numerous large Ediacaran fossils including characteristic “pizza disc” ivesheadiomorphs, Avalon Assemblage	Pu et al. (2016)
Five single zircon grains have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.	Ediacaran fauna		Avalon Assemblage	Bedding plane exposed at the base of this volcanic ash contains numerous large ivesheadiomorphs and spindle-shaped Ediacaran fossils, Avalon Assemblage	Pu et al. (2016)
Nine of ten single zircon grains (excluding one older analysis) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Minimum age constraint on Gaskiers glaciation	Pu et al. (2016)
Four of six single zircon grains (excluding two older analyses) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Synglacial age constraint	Pu et al. (2016)
Five single zircon grains have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Maximum age constraint on Gaskiers glaciation	Pu et al. (2016)
Five single zircon grains have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Minimum age constraint on Gaskiers glaciation	Pu et al. (2016)
Nine single zircon grains have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Maximum age constraint on Gaskiers glaciation	Pu et al. (2016)
Eight of ten single zircon grains (excluding one younger and one older) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Maximum age constraint on Gaskiers glaciation	Pu et al. (2016)
Three (of nine total) single zircon grain analyses yield a weighted mean ^{206}Pb/^{238}U age using physical abrasion and the in-house MIT spike.				Minimum age constraint on top of the Nantuo diamictite (Marinoan glaciation); direct constraint on basal Ediacaran cap carbonate	Condon et al. (2005)
Three (of 18 total) single zircon grain analyses have a weighted mean ^{206}Pb/^{238}U age using physical abrasion and the in-house MIT spike.				Minimum age constraint on top of the Nantuo diamictite (Marinoan glaciation); direct constraint on basal Ediacaran cap carbonate (Marinoan deglaciation)	Condon et al. (2005)
Four of seven single zircon grain analyses (excluding two younger and one older grain) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				Direct depositional age constraint on the top of the Nantuo diamictite (Marinoan glaciation)	Zhou et al. (2019)
An aliquot of the sample NAV.00.2B analyzed by Prave et al. (2016) yields a weighted mean ^{206}Pb/^{238}U age based upon the five youngest single zircon grain analyses, utilizing CA-TIMS and the ET2535 spike.				direct depositional age of the glaciogenic Ghaub Formation and Marinoan glaciation on Congo craton	Hoffmann et al. (2004); Prave et al. (2016)
Seven of eight single zircon grains (excluding one older analysis) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET535 spike.				maximum depositional age of the upper most glaciogenic Cottons Breccia, and Marinoan deglaciation in Tasmania	Calver et al. (2013)
Nine of ten single zircon grains (excluding one younger analysis) have a weighted mean ^{206}Pb/^{238}U age, utilizing CA-TIMS and the ET2535 spike.				direct depositional age of the glaciogenic Ghaub Formation and Marinoan glaciation on Congo craton; minimum age for the initiation of Marinoan glaciation	Prave et al. (2016)

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