Table DR1. Ages and related references for geologic context for carbonates analyzed in this study.

Stratigraphic unit and location	Age (Ga)	Reference for age estimates
Dresser Fm., Warrawoona Group, Western Australia	ca. 3.500	Van Kranendonk et al., 2006
Steep Rock Group, Ontario, Canada	2.801-2.757	Stone 2010
Tumbiana Fm., Fortescue Group, Western Austrailia	2.729-2.719	Blake et al., 2004
Cheshire Fm., Ngezi Group, Zimbabwe	2.650-2.552	Bolhar et al., 2002
Wittenoom Fm., Hamersley Group, Western Australia	2.59-2.54	Krapež et al., 2003; Rasmussen et al., 2005
Campbellrand Subgroup, South Africa	2.563-2.541	Barton et al., 1994
Tongwane Fm., Chunniespoort Group, South Africa	2.486-2.368	Bekker et al., 2001
Duitschland Fm., Pretoria Group, South Africa	2.486-2.368	Bekker et al., 2001
Espanola Fm., Huronian Supergroup, Ontario Canada	2.475-2.32	Bekker et al., 2005; Rasmussen et al., 2013
Carbonates of the Turee Creek Group, Western Australia	2.450-2.400	Bekker et al., 2002; Krapež , 1996; Takehara et al., 2010
Cercadinho Fm., Minas Supergroup, Brazil	ca. 2.22	Bekker et al., 2003b; Babinski et al., 1995
Gandarela Fm., Minas Supergroup, Brazil	ca. 2.42	Bekker et al., 2003b; Babinski et al., 1995
Gordon Lake Fm., Huronian Supergroup, Ontario, Canada	2.32	Bekker et al., 2006; Rasmussen et al., 2013
Bad River Dolomite, Chocolay Group, Lake Superior, USA	2.32-2.22	Bekker et al., 2006
Saunders Fm., Chocolay Group, Lake Superior, USA	2.32-2.22	Bekker et al., 2006
Lucknow Fm., Olifantshoek Group, South Africa	2.15	Schröder et al., 2008
Mcheka Fm., Lomagundi Group, Zimbabwe	2.15	Master and Hofmann, 2010
Lower Albanel Fm., Mistassini Group, Quebec, Canada	2.10	Mirota and Veizer, 1994
Nash Fork Fm., Snowy Pass Supergroup, Wyoming, USA	2.15-2.10	Bekker et al., 2003a
Aquas Claras Fm., Serra Pelada Sequence, Brazil	ca. 2.1	Mougeot et al., 1996
Aluminium River Fm., Amer Group, Nunavut, Canada	1.95-1.91	Rainbird et al., 2010

Table DR2. Iodine to calcium plus magnesium ratios measured in this study.

Geologic Unit	Sample	I/(Mg+Ca)
Aluminum River Formation, Amer Group	AB-49	0.00
Aluminum River Formation, Amer Group	AB57	0.00
Aluminum River Formation, Amer Group	AB-48	0.00
Aluminum River Formation, Amer Group	AB-47	0.00
Aquas Claras Fm., Serra Pelada Sequence	F67 300.10	0.54
Aquas Clara Fm., Serra Pelada Sequence	FD-67 314.53	0.28
Aquas Clara Fm., Serra Pelada Sequence	FD-67 303.85	0.51
Aquas Clara Fm., Serra Pelada Sequence	FD-214 142.75	0.39
Aquas Claras Fm., Serra Pelada Sequence	SL-1246 325.95	0.00
Aquas Claras Fm., Serra Pelada Sequence	SL-2286 328.28	0.00
Aquas Claras Fm., Serra Pelada Sequence	SL-1246 305.29	0.00
Aquas Claras Fm., Serra Pelada Sequence	SL-1246 328.37	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-2	0.05
Nash Fork Fm., Snowy Pass Supergroup	BM-17	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-4 AB110	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-7 AB123	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-3 AB107	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-14	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM10 AB 11	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-18	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-9 AB105	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-13	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-12 AB-116	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-6 AB-112	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-1 AB113	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-11 AB106	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-5 AB117	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM15	0.00
Nash Fork Fm., Snowy Pass Supergroup	BM-16	0.00
Nash Fork Fm., Snowy Pass Supergroup	2000_9/1	0.00
Nash Fork Fm., Snowy Pass Supergroup	97-9-2	0.00
Lower Albanel Fm., Mistassini Group	LAF-F3	2.79
Lower Albanel Fm., Mistassini Group	UAF-2	0.28
Lower Albanel Fm., Mistassini Group	UAF-1	1.16
Lower Albanel Fm., Mistassini Group	LA-E4	0.36
Lower Albanel Fm., Mistassini Group	LA-D5	0.47
Lower Albanel Fm., Mistassini Group	LAF-D2	0.29

Lower Albanel Fm., Mistassini Group	LAF-C1	1.74
Lower Albanel Fm., Mistassini Group	MI-H-66 AB7	0.00
Lower Albanel Fm., Mistassini Group	MI-13-1 AB4	0.01
Lower Albanel Fm., Mistassini Group	MI-16-2 AB9	0.00
Mcheka Fm., Lomagundi Group	ZA-1	0.33
Mcheka Fm., Lomagundi Group	ZA-4	0.78
Mcheka Fm., Lomagundi Group	ZA-6	0.46
Mcheka Fm., Lomagundi Group	ZA-7	0.29
Mcheka Fm., Lomagundi Group	ZA-8	0.61
Mcheka Fm., Lomagundi Group	ZA-9	0.27
Mcheka Fm., Lomagundi Group	ZA-10	0.13
Mcheka Fm., Lomagundi Group	ZA-11	0.32
Mcheka Fm., Lomagundi Group	ZA-12	0.00
Mcheka Fm., Lomagundi Group	ZA-13	1.65
Mcheka Fm., Lomagundi Group	ZA-16	0.30
Mcheka Fm., Lomagundi Group	ZA-18	0.00
Mcheka Fm., Lomagundi Group	ZA-19	0.63
Mcheka Fm., Lomagundi Group	ZA-20	0.04
Mcheka Fm., Lomagundi Group	ZA-22	0.09
Mcheka Fm., Lomagundi Group	ZA-26	0.53
Mcheka Fm., Lomagundi Group	ZA-27	0.06
Mcheka Fm., Lomagundi Group	ZA 29	0.41
Mcheka Fm., Lomagundi Group	ZA-30	0.00
Mcheka Fm., Lomagundi Group	ZA-31	0.49
Mcheka Fm., Lomagundi Group	ZA 32	0.35
Mcheka Fm., Lomagundi Group	ZA-33	0.28
Mcheka Fm., Lomagundi Group	ZA-35	0.58
Mcheka Fm., Lomagundi Group	ZA-35	0.89
Mcheka Fm., Lomagundi Group	ZA-37	0.74
Mcheka Fm., Lomagundi Group	Z-2	0.82
Mcheka Fm., Lomagundi Group	Z-3	1.25
Mcheka Fm., Lomagundi Group	Z8	1.57
Mcheka Fm., Lomagundi Group	Z-11	0.78
Mcheka Fm., Lomagundi Group	Z-13	0.60
Mcheka Fm., Lomagundi Group	Z-15	0.85
Mcheka Fm., Lomagundi Group	Z-16	0.58
Mcheka Fm., Lomagundi Group	Z19	1.16
Mcheka Fm., Lomagundi Group	Z-20	0.53
Mcheka Fm., Lomagundi Group	Z-21	0.68
Mcheka Fm., Lomagundi Group	Z-25	0.34
Mcheka Fm., Lomagundi Group	Z-26	0.39
Lucknow Fm., Olifantshoek Group	LK-9 AB38	1.02
Lucknow Fm., Olifantshoek Group	LK-1	0.09

Lucknow Fm., Olifantshoek Group	LK-4	0.47
Lucknow Fm., Olifantshoek Group	AB-41, LK-2	1.79
Lucknow Fm., Olifantshoek Group	LO-3	0.00
Gordon Lake Fm., Huronian Supergroup	PL-4	0.00
Gordon Lake Fm., Huronian Supergroup	PL-5	0.00
Gordon Lake Fm., Huronian Supergroup	JT-98-2	0.00
Gordon Lake Fm., Huronian Supergroup	JT-98-3	0.00
Gordon Lake Fm., Huronian Supergroup	FE-3	0.00
Gordon Lake Fm., Huronian Supergroup	PL-3	0.00
Gordon Lake Fm., Huronian Supergroup	JT-98-1-2	0.00
Gordon Lake Fm., Huronian Supergroup	PL-2	0.00
Gordon Lake Fm., Huronian Supergroup	PL-6	0.00
Bad River Dolomite, Chocolay Group	BD-96-3	0.00
Bad River Dolomite, Chocolay Group	AB147	0.00
Saunders Fm., Chocolay Group	AB158	0.00
Gandarela Fm., Minas Supergroup	GA20/1	0.00
Gandarela Fm., Minas Supergroup	GA-5	0.00
Gandarela Fm., Minas Supergroup	GQ-2	0.00
Cercadinho Fm., Minas Supergroup	CE-20-1	0.00
Cercadinho Fm., Minas Supergroup	CE-20-2	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	DC-00-1	0.89
Carbonates of the Turee Creek Group, Duck Creek Syncline	DC-00-2	0.36
Carbonates of the Turee Creek Group, Duck Creek Syncline	DC-00-4	0.05
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC -4/+16 AB 171	0.46
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC-4/+20 AB 164	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC-3 AB172	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC-9	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC 3	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC 4-4	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	TC 6	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-2 AB-169	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-7 AB 170	1.66
Carbonates of the Turee Creek Group, Hardey Syncline	HS-9 AB-167	0.61
Carbonates of the Turee Creek Group,	TC-2	0.00

Hardey Syncline		
Carbonates of the Turee Creek Group, Hardey Syncline	HS-1	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-1	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-10	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-5	0.00
Carbonates of the Turee Creek Group, Duck Creek Syncline	DC-00-3	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-6	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-8	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-11	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-4	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-4	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-8	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	TC-7	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-3	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-10	0.00
Carbonates of the Turee Creek Group, Hardey Syncline	HS-5	0.00
Duitschland Fm., Pretoria Group	BH2-8.2	0.00
Duitschland Fm., Pretoria Group	BH2-9.5	0.00
Tongwane Fm., Chunniespoort Group	TON-3	0.00
Tongwane Fm., Chunniespoort Group	TON-2	0.00
Tongwane Fm., Chunniespoort Group	TON-6	0.00
Tongwane Fm., Chunniespoort Group	AB-123	0.00
Tongwane Fm., Chunniespoort Group	AB-126 TON-5	0.51
Espanola Formation, Huronian Supergroup	El-2	0.00
Espanola Formation, Huronian Supergroup	El-4	0.00
Espanola Formation, Huronian Supergroup	EL35A	0.00
Espanola Formation, Huronian Supergroup	EL-56	0.00
Espanola Formation, Huronian Supergroup	EL-1	0.00
Espanola Formation, Huronian Supergroup	EL-13	0.00
Espanola Formation, Huronian Supergroup	EL-18	0.00
Espanola Formation, Huronian Supergroup	AB31	0.00
Wittenoom Fm., Hamersley Group	abdp-9 330.29	0.00

Wittenoom Fm., Hamersley Group	abdp-9 331.98	0.00
Wittenoom Fm., Hamersley Group	abdp-9 332.61	0.00
Wittenoom Fm., Hamersley Group	adbp-9 418.33	0.00
Wittenoom Fm., Hamersley Group	adbp-9 421.7	0.00
Wittenoom Fm., Hamersley Group	adbp-9 423.31	0.00
Wittenoom Fm., Hamersley Group	adbp-9 427.58	0.00
Wittenoom Fm., Hamersley Group	adbp-9 429.27	0.00
Wittenoom Fm., Hamersley Group	adbp-9 432.36	0.00
Wittenoom Fm., Hamersley Group	adbp-9 435.3	0.00
Wittenoom Fm., Hamersley Group	adbp-9 439.54	0.00
Wittenoom Fm., Hamersley Group	adbp-9 442.48	0.00
Wittenoom Fm., Hamersley Group	adbp-9 446.21	0.00
Wittenoom Fm., Hamersley Group	adbp-9 449.4	0.00
Wittenoom Fm., Hamersley Group	adbp-9 451.1	0.00
Wittenoom Fm., Hamersley Group	adbp-9 453.3	0.00
Campbellrand Subgroup	CR-1	0.00
Campbellrand Subgroup	CR-2	0.00
Campbellrand Subgroup	CR-3	0.00
Campbellrand Subgroup	CR-4	0.00
Campbellrand Subgroup	CR-5	0.00
Campbellrand Subgroup	CR-6	0.00
Cheshire Fm., Ngezi Group	CH-1	0.00
Cheshire Fm., Ngezi Group	CF-16	0.00
Cheshire Fm., Ngezi Group	Cheshire	0.00
Tumbiana Fm., Fortescue Group	P1 37.4	0.00
Tumbiana Fm., Fortescue Group	P1 44.5	0.00
Tumbiana Fm., Fortescue Group	P1 47.0A	0.00
Tumbiana Fm., Fortescue Group	P1 68	0.00
Tumbiana Fm., Fortescue Group	P1 69.2	0.00
Tumbiana Fm., Fortescue Group	P1 70.4C	0.00
Tumbiana Fm., Fortescue Group	P1 72.4	0.00
Tumbiana Fm., Fortescue Group	P1 73.5	0.00
Tumbiana Fm., Fortescue Group	P1 75.1	0.00
Tumbiana Fm., Fortescue Group	P1 77.1	0.00
Tumbiana Fm., Fortescue Group	P1 80.6A	0.00
Tumbiana Fm., Fortescue Group	P1 83.2B	0.00
Tumbiana Fm., Fortescue Group	P1 84.8	0.00
Tumbiana Fm., Fortescue Group	P1 85.7B	0.00
Tumbiana Fm., Fortescue Group	P1 87.5	0.00
Tumbiana Fm., Fortescue Group	P1 88.2	0.00
Tumbiana Fm., Fortescue Group	P1 89.5	0.00
Tumbiana Fm., Fortescue Group	P1 90.4	0.00
Steep Rock Group	SR S4-1	0.00

Steep Rock Group	SR-3	0.00
Steep Rock Group	SMALL STREAM SR7	0.00
Steep Rock Group	SMALL STREAM SR-4	0.00
Steep Rock Group	STEEP ROCK STOP 4	0.00
Steep Rock Group	SR-54	0.00
Steep Rock Group	STOP 1	0.00
Steep Rock Group	SR-56	0.00
Steep Rock Group	SR10-2	0.00
Steep Rock Group	SR10 SMALL STREAM	0.00
Steep Rock Group	Steep Rock	0.00
Steep Rock Group	SR 10-1	0.00
Steep Rock Group	SR 11	0.00
Steep Rock Group	SR 11-2	0.00
Dresser Fm., Warrawoona Group	P2c-92.9	0.00
Dresser Fm., Warrawoona Group	P2c-93.45	0.00
Dresser Fm., Warrawoona Group	P2c-93.5a BC	0.00
Dresser Fm., Warrawoona Group	P2c-94.1	0.00
Dresser Fm., Warrawoona Group	P2c-94.2	0.00
Dresser Fm., Warrawoona Group	P2c-95.5a ba	0.00
Dresser Fm., Warrawoona Group	P2b-84.6a	0.00
Dresser Fm., Warrawoona Group	P2b-87.39b	0.00

Sources for geologic context, age, and prior geochemical analysis performed on given samples are displayed in Table DR1. Samples from the Mcheka, Espanola, Lucknow, and Lower Albanel formations are described in Planavsky et al. (2012). Those from the Dresser and Tumbiana formations are from the Pilbara Drilling Project (PDP1; e.g. Thomazo et al., 2011). Samples from the Wittenoom Dolomite were taken from the ABDP-9 core from the Hamersley Province of Western Austrailia (e.g., Reinhard et al., 2009). Also included below are results from the Nash Fork Formation, which were not included in the compilation in the main text due to higher grade metamorphic alterations.

Turee Creek

The presence of high I/(Ca+Mg) ratios in carbonates of the Turee Creek Group in the Duck Creek Syncline presents an interesting and a special case where high iodine concentrations could be linked to post-depositional processes rather than to oxygen accumulation and IO_3^- formation in the water column during primary carbonate precipitation. The carbonate unit expressing significantly higher than blank

I/(Ca+Mg) ratios are directly below an uncomformity with a paleosol developed at 2.1-2.0 Ga. A combination of this stratigraphic position and carbonate carbon isotope values near -5 ‰ in the carbonate unit (Table DR3) point to the potential for subaerial exposure of the carbonate and caliche formation after the GOE and LE, when higher atmospheric oxygen concentrations during the period of subaerial exposure could have allowed for IO_3^- formation in meteoric fluids. This would permit IO_3^- incorporation into carbonate during meteoric alteration of carbonate leading to caliche development. The concentrations of total iodine in modern meteoric fluids are low (< 0.02 µmol; Truesdale and Jones, 1996) and approach the detection limit for I/(Ca+Mg) (see main text), but the slightly acidic pH values of meteoric fluids and groundwaters allow the possibility of I^- oxidation to IO_3^- mediated by Mn-oxides (Fox et al., 2009). Regardless of this uncertainty, stratigraphic position and carbon and oxygen isotope values from iodine-containing carbonates of the Turee Creek Group in the Hardey Syncline provide an additional support for an aerobic iodine cycle in the aftermath of the oldest Paleoproterozoic glaciation.

Table DR3. Carbon and oxygen isotope values for the Turee Creek Group carbonates that contain iodine.

Sample	Syncline	$\delta^{13}C_{carb}$	$\delta^{18}O_{carb}$
DC-00-1	Duck Creek	-5.16	-5.48
DC-00-2	Duck Creek	-5.62	-5.5
DC-00-3	Duck Creek	-5.1	-6.19
DC-00-4	Duck Creek	-5.9	-5.9
TC-4/+16	Duck Creek	1.8	-10.0
HS-2	Hardey	0.8	-15.6
HS-7	Hardey	0.1	-8.9
HS-9	Hardey	0.9	-7.6

Mcheka Formation

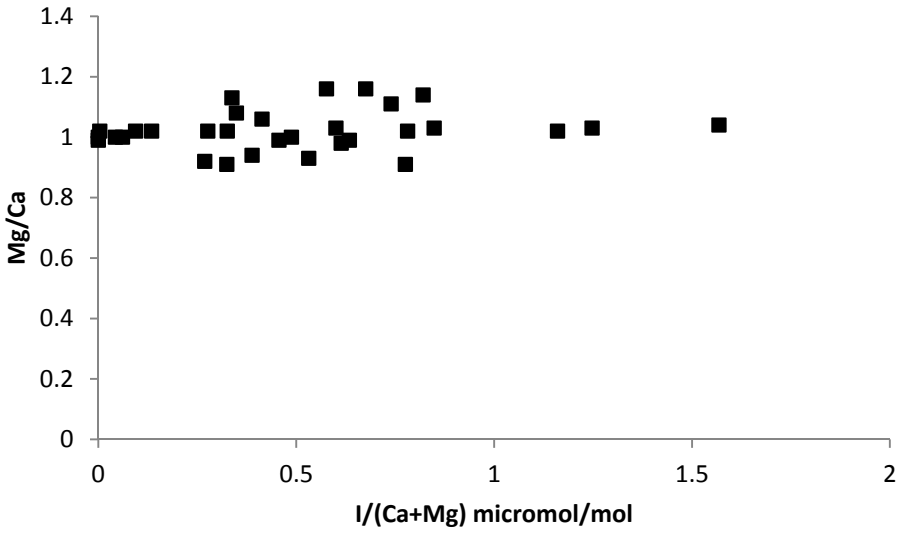

Figure DR1. Mg/Ca versus I/(Ca+Mg) ratios in the Mcheka Formation carbonate show little variation in the degree of dolomitization. From this we expect no significant partial shift in I/(Ca+Mg) ratios related to dolomitization.

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