Supplementary Material

Table S1 Field data and estimated long-term exposure rates for steels in various waters
Field data: columns (1)-(8). Estimated corrosion parameters columns (9)-(12).

Case	Vessel, structure / Location / Comments	Ref.	D (m)	t_{nom} (y)	t_{eff} (y)	Evidence of rust	Av. DIN (mg N/l)	T (°C)	c_T (mm)	r_{sT} (mm/y)	$c_{12.5}$ (mm)	$r_{12.5}$ (mm/y)
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Natural Seawaters:											
1	**British gunboat** (Meyer wreck) / St George's boatyard / Corrosion estimated from depth of graphitization for 5 cast iron ship parts.	[46]	3.5	104	104	Not reported		28.5	5, 7 ,7, 8	0.048-0.076		0.042 (ave)
2	**Steel mooring chain 76mm diam.** / Catherine Hill Bay, Pacific Ocean coast, Australia / multiple observations (20+)	[22]	0-10	100	100	Red-brown rusts		20		0.06		0.05
3	**Titanic** / N Atlantic / c_s, r_s estimated from 6 year field trial, observations for ship plates / much paint visible.	[47,48]	3800	84	34	Visible rusts		2	~1.37	0.04	1.72	0.05
4	**Queen Mary** / North Sea near Jutland.	[49,50]	50-57	85		Light rusts, some rusticles.						
5	**HMS Audacious** / 25 km from Malin Head, Donegal, Ireland / Spotty calcareous deposits.	[51–53]	55-66	98		Many rusted surfaces. Some rusticles.						
6	**Hood** (British battleship) / N. Atlantic, 600km south of Cork, IR.	[54]	~5000	61		On plates, at welds, at torn plate edges.						
7	**Bismarck** / N. Atlantic, 650 km west of Brest, F. / In 2001 in 'remarkably good condition'	[55,56]	4800	61		At welds, torn plate edges.						
8	**SS Central America** / Atlantic, 260km off coast, SC	[57,58]	2200	131		Red-brown rusts.						
9	**U-155** / Loch Ryan, Scotland.	[59,60]	73	76		Red-brown rusts, rusticles.						
10	**Ituna** / 40km off San Francisco coast.	[61,62]	60	95		Extensive deep rust layers.						
11	**USS Johnston** / Off Leyte Gulf, Samar Island, Philippines.	[63,64]	6220	77		Some rusts on some steel surfaces.						
12	**SS Republic** / 150 km off coast of Georgia, USA / some spotty calcareous deposition.	[65]	500	140	140	Red-brown rusts.		~4				
13	**SMS Markgraf** / Scapa Flow Scotland / Some calcareous deposition.	[66]	42			Rusted surfaces.						
	Natural seawaters with elevated DIN											
14	**Various WW2 wrecks / Chuuk Lagoon /** $FeCO_3$ in rusts. / Several estimates of c_T / 'Flash' fishing destroys calcareous layers and rusts. Implies no effective calcareous deposits. Fuel and oil spills from WW2 onwards.	[68]	5-40	60	60	Yes		30	6.5-6.8 (to 11.6)	0.11-0.14	4.3-5.6	0.073-0.093
15	**Immersion part of steel sheet piling** / Boston, MA	[11]	1-3	18	18	Yes	0.2	10		0.064		0.068
16	**Ditto** / Norfolk, VA	[11]	1-3	16	16	Yes	0.4	16		0.070		0.065
17	**Ditto** / Key West, FL	[11]	1-3	22	22	Yes	0.03	21		0.075		0.060
18	**Ditto** / Coco Solo PCZ	[11]	1-3	24	24	Yes	0.03	27		0.12		0.083
19	**Ditto** / San Diego, CA	[11]	1-3	18	18	Yes	0.2	17		0.10		0.086
20	**Ditto** / Alameda, CA]	[11]	1-3	21	21	Yes	0.07	16		0.075		0.068
21	**Invincible** / North Sea near Jutland.	[68,69]	50-60			Red-brown rusts.						
22	**Anona** / Viosca Knoll, GOM	[70–72]	1258	61		Extensive deep rust layers.						
	Natural seawaters with calcareous deposition											
23	**USS Monitor** / Atlantic, 23 km off Cape Hatteras, NC. / Chalky deposits	[73–75]	67-90	140	130	3-5 mm red, brown rusts.		~15	~2.2	0.017	2.1	~ 0.016
25	**Cast Iron cannons**, from HMS **Swan (pinnacle),** Isle if Mull, Scotland / Corrosion estimated from graphitized layer thickness	[12,77,79]	?	347	337	Not reported		~10	4.0	0.13	4.6	0.014
26	**SS Laurentic** / 25 km W of Malin Head, Ireland / Strong currents.	[80,81]	60	98		Some rusts visible						
27	**SS Empire Heritage** / 50km NW of Malin Head, Ireland / strong currents.	[80,81]	60	71		Some rusts visible						
28	**SS Justicia /** 100km NW of Malin Head, Ireland / Calcareous deposition upper surfaces, with stumpy rusticles.	[80,82,83]	60	98		Extensive red-brown rusts on vertical hull						

						surfaces.							
29	**SM U-89** / 40km North of Malin Head, Ireland / Near calcareous Donegal coast.	[84,95]	60	94		Not obvious in calcareous material.							
30	**U-352** / N. Atlantic 42km offshore Cape Lookout, NC	[86,87]	35	73		Corroded surfaces, flat rusticles.							
31	**9U-869** / 100km off New Jersey coast /	[88,89]	70			Extensive rusts, rusticles							
32	**Musashi** / Leyte Gulf, Sibuyan Sea, Philippines / Apparent thick calcareous layers.	[90]	>1000	68		Rusts amongst calcareous layers.							
33	**SS Yongala** / 90km SE of Townsville, Australia / Thick calcareous layers.	[91,92]	16-28	109		Rusts amongst calcareous layers.							
34	**Leopoldville** / 8km off Cherbourg, France /Thick calcareous layers.	[93,94]	~50	72		Rusts amongst calcareous layers.							
35	**U-711** / Kilbotn, south of Harstad, N / Some deposition material.	[95,96]	~50	~70		Red-brown rusts in some deposition.							
	***Natural seawater**s with calcareous deposition and elevated DIN*												
36	**Belgian Wrecks (10 in total) /** North Sea, off Belgian coast / various depths / Calcareous material within rusts, for some cases also external.	[9,97]	4-10	43-105		Yes	Elevated	12.5					0.016 (av. over 10 wrecks)
37	**USS Arizona** / Pearl Harbour, Hawaii / Corrosion losses from coupons cut from hull. Traces of $CaCO_3$ and $FeCO_3$ in rusts.	[98–100]	87	61	61	Not reported.	Elevated	25	1.8-2.5	0.03-0.041	1.3-1.8	0.21-0.03	
38	**Virginia** / Near outflow of Mississippi R., Gulf of Mexico. / Calcareous deposits: 10-15 mm, overlain with 5-10 mm layer slime. Potentially Gasoline pollution. Near mouth of Mississippi River.	[31,70,101]	143	62		Rusts 10-70 mm thick.	Elevated						
39	**Halo** /Near Mississippi R. outflow/Calcareous deposits: 5-15 mm, overlain with 2-5mm slime./Nutrients from sunken barrels of oil.	[31,70, 101–103]	554	62		Visible rusts. Rusticles ~5% of surface, 5-300 mm long.	Elevated						
40	**Gulfpenn** / Deep water Mississippi Canyon MI. / Calcareous deposits: 5-15mm over 60% of surface. Slime over about half. Coral accretions on 10-30% of vessel surface. Nutrients from sunken barrels of gasoline.	[70,101,104 105]	1450	62		Extensive rusts. Rusticles to 1500 mm long.	Elevated						
41	**U-166** / Mississippi Canyon area, GoM / Calcareous deposits: 1-5mm over 40% of surface, overlain with 2-5mm slime. Near mouth of Mississippi River.	[31,70,101, 105,106]	480	62		Extensive rusts. Rusticles over ~20% of surface.	Elevated						
42	**Robert E. Lee** / 72 km SE of Mississippi River, GOM / Near mouth of Mississippi River.	[31,70,107,108]	1965	62		Extensive rusts and rusticles up to 2 m long over ~20% of surfaces	Elevated						
43	**Alcoa Puritan** / 83 km SSE of entrance to Mississippi River, GOM / Calcareous deposits: 3-8mm over 65% of observable surface. Near mouth of Mississippi River.	[31,70,109]	40-45	62		Extensive rusts. Longer rusticles over ~35% surface.	Elevated						
44	**Momokawa Maru** / Chuuk Lagoon, Micronesia / Calcareous deposits in thick layers. Fuel and oil spills from WW2 wrecks.	[110]	64	76		Rusts amongst calcareous layers.	Elevated						
45	**Aikoku Maru** / Chuuk Lagoon, Micronesia / 64m / Calcareous deposits: Apparently thick layers. Fuel and oil spills from WW2 wrecks.	[111]	4-26	77		Rusts amongst calcareous layers.	Elevated.						
46	**Chrisoula K** / Shaab Abu Nuhas reef, Red Sea off Egypt / 5 other wrecks local and similar to Chrisoula / Calcareous deposits.	[112,113]	4-10	34		Extensive rusts.	Elevated						

D = depth (metres)
t = exposure time period (years)
t_{eff} = effective exposure time period (years) (allows for paint coating deterioration)
T = seawater mean temperature (˚C) at location
c_T = corrosion loss (average) at mean seawater temperature T (mm)
$c_{12.5}$ = corrosion loss (average) at mean seawater temperature of T = 12.5˚C (mm)
r_{sT} = estimated average long-term corrosion rate at mean seawater temperature T (mm/y)
$r_{s12.5}$ = estimated average long-term corrosion rate at mean seawater temperature T= 12.5˚C (mm/y)

Temperature Standardization for $r_{s12.5}$ - based on r_s values for DIN = 0 and mean water temperature T in [11].

Annual mean temperature ˚C	5	10	12.5	15	20	22.5	25	27.5
Long-term corrosion rate r_s	0.040	0.0470	0.050	0.054	0.062	0.066	0.07	0.072
Correction factor	0.80	0.94	1	1.08	1.24	1.32	1.4	1.44