

# Valid publication of the names of forty-two phyla of prokaryotes

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## Abstract

After the International Committee on Systematics of Prokaryotes (ICSP) had voted to include the rank of phylum in the rules of the International Code of Nomenclature of Prokaryotes (ICNP), and following publication of the decision in the IJSEM, we here present names and formal descriptions of 42 phyla to effect valid publication of their names, based on genera as the nomenclatural types.

The rules of the current version of the International Code of Nomenclature of Prokaryotes (ICNP) (2008 Revision) [1] do not include the rank of phylum. Following the publication of proposals to include the rank of phylum in the rules of the ICNP [2, 3], the members of the International Committee on Systematics of Prokaryotes (ICSP) have voted on these proposals in February 2021 [4]. The majority of the voting members were in favour of including the rank of phylum under the rules of the ICNP, using the ending *-ota* for phylum names that must be based on the name of a genus as its nomenclatural type. The Judicial Commission of the ICSP can make exceptions and conserve extensively used names of phyla formed in different ways [4]. To implement these votes, the Editorial Board of the ICNP prepared proposals for emendation of rules 5b, 8, 15, and 22, to be incorporated in the upcoming revision of the ICNP [5].

We here present a list of 42 names of phyla, all original or corrected names published earlier elsewhere, to effect valid publication, based on validly published and legitimate names of genera that serve as their nomenclatural types.

## ACIDOBACTERIOTA CORRIG. PHYL. NOV.

(A.ci.do.bac.te.ri.o'ta. N.L. neut. n. *Acidobacterium*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Acidobacteriota*, the *Acidobacterium* phylum)

The properties of the taxon are as described by Thrash and Coates, 2010 [6]. Correction of the effectively published homonym *Acidobacteria* Thrash and Coates 2010; it is a later synonym of *Acidobacteria* Cavalier-Smith 2002, which is on the list of rejected names.

Type genus: *Acidobacterium* Kishimoto *et al.* 1991.

## ACTINOMYCETOTA CORRIG. PHYL. NOV.

(Ac.ti.no.my.ce.to'ta. N.L. masc. n. *Actinomyces*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Actinomycetota*, the *Actinomyces* phylum)

The properties of the taxon are as described by Goodfellow 2012 [7]. Correction of the effectively published synonym: *Actinobacteria* (sic) Goodfellow 2012.

Type genus: *Actinomyces* Harz 1877 (Approved Lists 1980).

## AQUIFICOTA CORRIG. PHYL. NOV.

(A.qui.fi.co'ta. N.L. masc. n. *Aquifex*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Aquificota*, the *Aquifex* phylum)

The properties of the taxon are as described by Reysenbach 2001 [8]. Correction of the effectively published synonym: *Aquificae* (sic) Reysenbach 2002.

Type genus: *Aquifex* Huber and Stetter 1992.

## ARMATIMONADOTA CORRIG. PHYL. NOV.

(Ar.ma.ti.mo.na.do'ta. N.L. fem. n. *Armatimonas*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Armatimonadota*, the *Armatimonas* phylum)

The properties of the taxon are as described by Tamaki *et al.* 2011 [9]. Correction of the effectively published synonym: *Armatimonadetes* (sic) Tamaki *et al.* 2011.

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**Abbreviations:** ICNP, International Code of Nomenclature of Prokaryotes; ICSP, International Committee on Systematics of Prokaryotes.

Type genus: *Armatimonas* Tamaki *et al.* 2011.

### **ATRIBACTEROTA PHYL. NOV.**

(A.tri.bac.te.ro'ta. N.L. masc. n. *Atribacter*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Atribacterota*, the *Atribacter* phylum)

The properties of the taxon are as described by Katayama *et al.*, 2020 [10].

Type genus: *Atribacter* Katayama *et al.* 2021.

### **BACILLOTA CORRIG. PHYL. NOV.**

(Ba.cil.lo'ta. N.L. masc. n. *Bacillus*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Bacillota*, the *Bacillus* phylum)

The properties of the taxon are as described by Gibbons and Murray, 1978 [11]. Effectively published synonyms: *Firmacutes* Gibbons and Murray 1978; *Firmicutes* corrig. Murray 1984.

Type genus: *Bacillus* Cohn 1872 (Approved Lists 1980).

### **BACTEROIDOTA CORRIG. PHYL. NOV.**

(Bac.te.ro.i.do'ta. N.L. masc. n. *Bacteroides*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Bacteroidota*, the *Bacteroides* phylum)

The properties of the taxon are as described by Krieg *et al.*, 2010 [12]. Correction of the effectively published synonym: *Bacteroidetes* (sic) Krieg *et al.* 2010.

Type genus: *Bacteroides* Castellani and Chalmers 1919 (Approved Lists 1980).

### **BALNEOLOTA CORRIG. PHYL. NOV.**

(Bal.ne.o.lo'ta. N.L. fem. n. *Balneola*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Balneolota*, the *Balneola* phylum)

The properties of the taxon are as described by Hahnke *et al.*, 2016 [13]. Correction of the effectively published synonym: *Balneolaeota* (sic) Hahnke *et al.* 2016.

Type genus: *Balneola* Urios *et al.* 2006.

### **BDELLOVIBRIONOTA PHYL. NOV.**

(Bdel.lo.vi.bri.o.no'ta. N.L. masc. n. *Bdellovibrio*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Bdellovibrionota*, the *Bdellovibrio* phylum)

The properties of the taxon are as described by Waite *et al.*, 2020 [14].

Type genus: *Bdellovibrio* Stolp and Starr 1963 (Approved Lists 1980).

### **CALDISERICOTA CORRIG. PHYL. NOV.**

(Cal.di.se.ri.co'ta. N.L. neut. n. *Caldisericum*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Caldisericotota*, the *Caldisericum* phylum)

The properties of the taxon are as described by Mori *et al.*, 2009 [15]. Correction of the effectively published synonym: *Caldiserica* (sic) Mori *et al.* 2009.

Type genus: *Caldisericum* Mori *et al.* 2009.

### **CALDITRICHOTA CORRIG. PHYL. NOV.**

(Cal.di.tri.cho'ta. N.L. fem. n. *Caldithrix*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Calditrichota*, the *Caldithrix* phylum)

The properties of the taxon are as described by Kublanov *et al.*, 2017 [16]. Correction of the effectively published synonym: *Calditrichaeota* (sic) Kublanov *et al.* 2017.

Type genus: *Caldithrix* Miroshnichenko *et al.* 2003.

### **CAMPYLOBACTEROTA PHYL. NOV.**

(Cam.py.lo.bac.te.ro'ta. N.L. masc. n. *Campylobacter*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Campylobacterota*, the *Campylobacter* phylum)

The properties of the taxon are as described by Waite *et al.*, 2018 [17]. Replacement of the illegitimate name: *Epsilonbacteraeota* Waite *et al.*, 2017 [18], which is an earlier synonym for *Campylobacterota* Waite *et al.* 2018, but is illegitimate as it was based on the illegitimate class *Campylobacteria* Waite *et al.* 2017, which is a later homotypic synonym of *Epsilonproteobacteria* Garrity 2006.

Type genus: *Campylobacter* Sebald and Véron 1963 (Approved Lists 1980).

### **CHLAMYDIOTA CORRIG. PHYL. NOV.**

(Chla.my.di.o'ta. N.L. fem. n. *Chlamydia*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Chlamydiota*, the *Chlamydia* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [19]. Correction of the effectively published synonym: *Chlamydiae* (sic) Garrity and Holt 2001.

Type genus: *Chlamydia* Jones *et al.* 1945 (Approved Lists 1980).

### **CHLOROBOTA CORRIG. PHYL. NOV.**

(Chlo.ro.bi.o'ta. N.L. neut. n. *Chlorobium*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Chlorobiota*, the *Chlorobium* phylum)

The properties of the taxon are as described by Iino *et al.*, 2010 [20]. Correction of the effectively published synonym: *Chlorobi* (sic) Iino *et al.* 2010.

Type genus: *Chlorobium* Nadson 1906 (Approved Lists 1980).

### **CHLOROFLEXOTA CORRIG. PHYL. NOV.**

(Chlo.ro.fle.xo'ta. N.L. masc. n. *Chloroflexus*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Chloroflexota*, the *Chloroflexus* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [21]. Correction of the effectively published synonym: *Chloroflexi* (sic) Garrity and Holt 2001.

Type genus: *Chloroflexus* Pierson and Castenholz 1974 (Approved Lists 1980).

### **CHRYSIAGENOTA CORRIG. PHYL. NOV.**

(Chry.si.o.ge.no'ta. N.L. masc. n. *Chrysiogenes*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Chrysiogenota*, the *Chrysiogenes* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [22]. Correction of the effectively published synonym: *Chrysiogenetes* (sic) Garrity and Holt 2001.

Type genus: *Chrysiogenes* Macy *et al.* 1996.

### **COPROTHERMOBACTEROTA PHYL. NOV.**

(Co.pro.ther.mo.bac.te.ro'ta. N.L. masc. n. *Coprothermobacter*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Coprothermobacterota*, the *Coprothermobacter* phylum)

The properties of the taxon are as described by Pavan *et al.*, 2018 [23].

Type genus: *Coprothermobacter* Rainey and Stackebrandt 1993.

### **DEFERRIBACTEROTA CORRIG. PHYL. NOV.**

(De.fer.ri.bac.te.ro'ta. N.L. masc. n. *Deferribacter*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Deferribacterota*, the *Deferribacter* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [24]. Correction of the effectively published synonym: *Deferribacteres* (sic) Garrity and Holt 2001.

Type genus: *Deferribacter* Greene *et al.* 1997.

### **DEINOCOCCOTA CORRIG. PHYL. NOV.**

(Dei.no.coc.co'ta. N.L. masc. n. *Deinococcus*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Deinococcota*, the *Deinococcus* phylum)

The properties of the taxon are as described by Weisburg *et al.*, 1989 [25]. Correction of the effectively published synonym: *Deinococcus-Thermus* (sic) Weisburg *et al.*, 1989.

Type genus: *Deinococcus* Brooks and Murray 1981.

### **DICTYOGLOMOTA CORRIG. PHYL. NOV.**

(Dic.ty.o.glo.mo'ta. N.L. neut. n. *Dictyoglomus*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Dictyoglomota*, the *Dictyoglomus* phylum)

The properties of the taxon are as described by Patel, 2010 [26]. Correction of the effectively published synonym: *Dictyoglomi* (sic) Patel 2010.

Type genus: *Dictyoglomus* Saiki *et al.* 1985.

### **ELUSIMICROBIOTA CORRIG. PHYL. NOV.**

(E.lu.si.mi.cro.bi.o'ta. N.L. neut. n. *Elusimicrobium*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Elusimicrobiota*, the *Elusimicrobium* phylum)

The properties of the taxon are as described by Geissinger *et al.*, 2009 [27]. Correction of the effectively published synonym: *Elusimicrobia* Geissinger *et al.* 2009.

Type genus: *Elusimicrobium* Geissinger *et al.* 2010.

### **FIBROBACTEROTA CORRIG. PHYL. NOV.**

(Fi.bro.bac.te.ro'ta. N.L. masc. n. *Fibrobacter*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Fibrobacterota*, the *Fibrobacter* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [19]. Correction of the effectively published synonym: *Fibrobacteres* Garrity and Holt 2001.

Type genus: *Fibrobacter* Montgomery *et al.* 1988.

### **FUSOBACTERIOTA CORRIG. PHYL. NOV.**

(Fu.so.bac.te.ri.o'ta. N.L. neut. n. *Fusobacterium*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Fusobacteriota*, the *Fusobacterium* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [19]. Correction of the effectively published synonym: *Fusobacteria* (sic) Garrity and Holt, 2001.

Type genus: *Fusobacterium* Knorr 1922 (Approved Lists 1980).

### **GEMMATIMONADOTA CORRIG. PHYL. NOV.**

(Gem.ma.ti.mo.na.do'ta. N.L. fem. n. *Gemmatimonas*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Gemmatimonadota*, the *Gemmatimonas* phylum)

The properties of the taxon are as described by Zhang *et al.*, 2003 [28]. Correction of the effectively published synonym: *Gemmatimonadetes* (sic) Zhang *et al.* 2003.

Type genus: *Gemmatimonas* Zhang *et al.* 2003.

**IGNAVIBACTERIOTA CORRIG. PHYL. NOV.**

(Ig.na.vi.bac.te.ri.o'ta. N.L. neut. n. *Ignavibacterium*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Ignavibacteriota*, the *Ignavibacterium* phylum)

The properties of the taxon are as described by Podosokorskaya *et al.*, 2013 [29]. Correction of the effectively published synonym: *Ignavibacteriae* (sic) Podosokorskaya *et al.* 2013.

Type genus: *Ignavibacterium* Iino *et al.* 2010.

**KIRITIMATIELLOTA CORRIG. PHYL. NOV.**

(Ki.ri.ti.ma.ti.el.lo'ta. N.L. fem. n. *Kiritimatiella*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Kiritimatiellota*, the *Kiritimatiella* phylum)

The properties of the taxon are as described by Spring *et al.*, 2016 [30]. Correction of the effectively published synonym: *Kiritimatiellaeota* (sic) Spring *et al.* 2016.

Type genus: *Kiritimatiella* Spring *et al.* 2017.

**LENTISPHAEROTA CORRIG. PHYL. NOV.**

(Len.ti.sphae.ro'ta. N.L. fem. n. *Lentisphaera*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Lentisphaerota*, the *Lentisphaera* phylum)

The properties of the taxon are as described by Cho *et al.*, 2004 [31]. Correction of the effectively published synonym: *Lentisphaerae* (sic) Cho *et al.* 2004.

Type genus: *Lentisphaera* Cho *et al.* 2004.

**MYCOPLASMATOTA CORRIG. PHYL. NOV.**

(My.co.plas.ma.to'ta. N.L. neut. n. *Mycoplasma*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Mycoplasmata*, the *Mycoplasma* phylum)

The properties of the taxon are as described by Murray, 1984 [32]. Correction of the effectively published synonym: *Tenericutes* (sic) Murray 1984.

Type genus: *Mycoplasma* Nowak 1929 (Approved Lists 1980).

**MYXOCOCCOTA PHYL. NOV.**

(My.xo.coc.co'ta. N.L. masc. n. *Myxococcus*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Myxococcota*, the *Myxococcus* phylum)

The properties of the taxon are as described by Waite *et al.*, 2020 [14].

Type genus: *Myxococcus* Thaxter 1892 (Approved Lists 1980).

**NITROSOSPHAEROTA CORRIG. PHYL. NOV.**

(Ni.tro.so.sphae.ro'ta. N.L. fem. n. *Nitrososphaera*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Nitrososphaerota*, the *Nitrososphaera* phylum)

The properties of the taxon are as described by Brocher-Armanet *et al.*, 2008 [33]. Correction of the effectively published synonym: *Thaumarchaeota* (sic) Brochier-Armanet *et al.* 2008.

Type genus: *Nitrososphaera* Stieglmeier *et al.* 2014.

**NITROSPINOTA CORRIG. PHYL. NOV.**

(Ni.tro.spi.no'ta. N.L. fem. n. *Nitrospina*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Nitrospinota*, the *Nitrospina* phylum)

The properties of the taxon are as described by Lückner *et al.*, 2013 [34]. Correction of the effectively published synonym: *Nitrospinae* (sic) Lückner *et al.* 2013.

Type genus: *Nitrospina* Watson and Waterbury 1971 (Approved Lists 1980).

**NITROSPIROTA CORRIG. PHYL. NOV.**

(Ni.tro.spi.ro'ta. N.L. fem. n. *Nitrospira*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Nitrospirota*, the *Nitrospira* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [35]. Correction of the effectively published synonym: *Nitrospirae* (sic) Garrity and Holt 2001.

Type genus: *Nitrospira* Watson *et al.* 1986.

**PLANCTOMYCETOTA CORRIG. PHYL. NOV.**

(Planc.to.my.ce.to'ta. N.L. masc. n. *Planctomyces*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Planctomycetota*, the *Planctomyces* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [19]. Correction of the effectively published synonym: *Planctomycetes* (sic) Garrity and Holt 2001.

Type genus: *Planctomyces* Gimesi 1924 (Approved Lists 1980).

**PSEUDOMONADOTA CORRIG. PHYL. NOV.**

(Pseu.do.mo.na.do'ta. N.L. fem. n. *Pseudomonas*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Pseudomonadota*, the *Pseudomonas* phylum)

The properties of the taxon are as described by Garrity *et al.*, 2005 [36]. Correction of the effectively published synonym: *Proteobacteria* (sic) Garrity *et al.* 2005.

Type genus: *Pseudomonas* Orla Jensen 1921 (Approved Lists 1980).

**RHODOTHERMOTA CORRIG. PHYL. NOV.**

(Rho.do.ther.mo'ta. N.L. masc. n. *Rhodothermus*, type genus of the phylum; *-ota*, ending to denote a phylum; N.L. pl. neut. n. *Rhodothermota*, the *Rhodothermus* phylum)



The properties of the taxon are as described by Munoz *et al.*, 2016 [37]. Correction of the effectively published synonym: *Rhodothermaeota* (sic) Munoz *et al.* 2016.

Type genus: *Rhodothermus* Alfredsson *et al.* 1995.

### **SPIROCHAETOTA CORRIG. PHYL. NOV.**

(Spi.ro.chae.to'ta. N.L. fem. n. *Spirochaeta*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Spirochaetota*, the *Spirochaeta* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [19]. Correction of the effectively published synonym: *Spirochaetes* (sic) Garrity and Holt 2001.

Type genus: *Spirochaeta* Ehrenberg 1835 (Approved Lists 1980).

### **SYNERGISTOTA CORRIG. PHYL. NOV.**

(Syn.er.gis.to'ta. N.L. masc. n. *Synergistes*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Synergistota*, the *Synergistes* phylum)

The properties of the taxon are as described by Jumas-Bilak *et al.*, 2009 [38]. Correction of the effectively published synonym: *Synergistetes* (sic) Jumas-Bilak *et al.* 2009.

Type genus: *Synergistes* Allison *et al.* 1993.

### **THERMODESULFOBACTERIOTA CORRIG. PHYL. NOV.**

(Ther.mo.de.sul.fo.bac.te.ri.o'ta. N.L. neut. n. *Thermodesulfobacterium*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Thermodesulfobacteriota*, the *Thermodesulfobacterium* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [39]. Correction of the effectively published synonym: *Thermodesulfobacteria* (sic) Garrity and Holt 2001. *Desulfobacterota* Waite *et al.* 2020 is a later heterotypic synonym.

Type genus: *Thermodesulfobacterium* Zeikus *et al.* 1995.

### **THERMOMICROBIOTA CORRIG. PHYL. NOV.**

(Ther.mo.mi.cro.bi.o'ta. N.L. neut. n. *Thermomicrobium*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Thermomicrobiota*, the *Thermomicrobium* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [40]. Correction of the effectively published synonym: *Thermomicrobia* (sic) Garrity and Holt 2001 emend. Hugenholtz and Stackebrandt 2004).

Type genus: *Thermomicrobium* Jackson *et al.* 1973 (Approved Lists 1980).

### **THERMOPROTEOTA CORRIG. PHYL. NOV.**

(Ther.mo.pro.te.o'ta. N.L. masc. n. *Thermoproteus*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Thermoproteota*, the *Thermoproteus* phylum)

The properties of the taxon are as described by Garrity and Holt, 2001 [41]. Correction of the effectively published synonym: *Crenarchaeota* (sic) Garrity and Holt 2001.

Type genus: *Thermoproteus* Zillig and Stetter 1982.

### **THERMOTOGOTA CORRIG. PHYL. NOV.**

(Ther.mo.to.go'ta. N.L. fem. n. *Thermotoga*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Thermotogota*, the *Thermotoga* phylum)

The properties of the taxon are as described by Reysenbach 2001 [42]. Correction of the effectively published synonym: *Thermotogae* (sic) Reysenbach 2001.

Type genus: *Thermotoga* Stetter and Huber 1986.

### **VERRUCOMICROBIOTA CORRIG. PHYL. NOV.**

(Ver.ru.co.mi.cro.bi.o'ta. N.L. neut. n. *Verrucomicrobium*, type genus of the phylum; -ota, ending to denote a phylum; N.L. pl. neut. n. *Verrucomicrobiota*, the *Verrucomicrobium* phylum)

The properties of the taxon are as described by Hedlund *et al.*, 1997 [43]. Correction of the effectively published synonym: *Verrucomicrobia* (sic) Hedlund *et al.* 1997.

Type genus: *Verrucomicrobium* Schlesner 1988.

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#### **Conflicts of interest**

The authors declare that there is no conflict of interest.

#### **Ethical statement**

No experiments with humans or animals were carried out.

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