**NOTE**

**Leptospirillum gen. nov. (ex Markosyan 1972), nom. rev., including Leptospirillum ferrooxidans sp. nov. (ex Markosyan 1972), nom. rev. and Leptospirillum thermoferrooxidans sp. nov. (Golovacheva et al. 1992)**

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The name *Leptospirillum ferrooxidans* is not in the Approved Lists of Bacterial Names (1980), nor has it been subsequently validly published. In accordance with the rules of the International Code of Nomenclature of Bacteria, the name *Leptospirillum* for the genus (gen. nov., nom. rev.) and *Leptospirillum ferrooxidans* for the species (sp. nov., nom. rev.) is revived here. The type species is *Leptospirillum ferrooxidans* strain L15\(^T\) (＝DSM 2705\(^T\)). The second species in the genus is *Leptospirillum thermoferrooxidans* (Golovacheva et al. 1992) (type strain L-88\(^T\); Institute of Microbiology, INMI, Moscow, Russia).

**Keywords:** *Leptospirillum ferrooxidans, Leptospirillum thermoferrooxidans, revived name, iron(II) oxidation*

Markosyan (1972) described a new acidophilic, ferrous-iron-oxidizing, vibrio-shaped bacterium, isolated from mine water of the Alaverda copper deposit in Armenia, for which he proposed the name *Leptospirillum ferrooxidans*. The genus and species name *L. ferrooxidans* was, however, not included in the Approved Lists of Bacterial Names (Skerman et al., 1980), nor has it been subsequently validly published. Markosyan sent the type strain, designated L15\(^T\), to the Institute of Microbiology (INMI), Moscow, Russia, where it was used in studies on the autotrophic growth, morphogenesis and fine structure of cells (Balashova et al., 1974; Pivovarova et al., 1981). In 1983, G. A. Zavarzin, Moscow, received another culture of *L. ferrooxidans* strain L15\(^T\) from Markosyan, and sent subcultures to the DSMZ, where it was deposited as DSM 2705\(^T\), and to A. P. Harrison, University of Missouri, Columbia, USA, who designated a derivative strain Z-2. Harrison used this in comparative studies with other isolates for DNA G + C content determinations and DNA–DNA hybridizations (Harrison, 1984; Harrison & Norris, 1985). Phylogenetic studies on strain L15\(^T\) have demonstrated its unique position, separate from *Thiobacillus ferrooxidans* as well as from any other division of the *Bacteria*, such as the *Proteobacteria*, Gram-positive bacteria and spirochaetes (Lane et al., 1992; Ehrich et al., 1995; De Wulf-Durand et al., 1997). Subsequently, additional strains were isolated which are morphologically and physiologically similar to *L. ferrooxidans* strain L15\(^T\) and were designated *Leptospirillum*-like bacteria. DNA–DNA hybridization studies and 16S rDNA analyses revealed, however, that the new isolates were not identical to strain L15\(^T\), but may represent different species (Groudev et al., 1978; Harrison, 1984; Harrison & Norris, 1985; Helle & Onken, 1988; Merrettig et al., 1989; Sand et al., 1992; Hallmann et al., 1992; Goebel & Stackebrandt, 1994; Battaglia et al., 1994). The important role of leptospirilli in bacterial leaching of sulphidic minerals in acidic environments is well documented (Norris & Kelly, 1982; Merrettig et al., 1989; Sand et al., 1992; Hallmann et al., 1992; De Wulf-Durand et al., 1997; Battaglia et al., 1998).

Although the inability to utilize sulphur or thiosulphate is a common property of *L. ferrooxidans* and *Leptospirillum*-like bacteria, pyrite is used for growth by *Leptospirillum*-like bacteria as shown, for example, by Sand et al. (1992) and Schippers et al. (1996) for strain R3 isolated from Ilba Mine in Romania, Helle & Onken (1988) for strain P\(_2\)A isolated in Peru, Merrettig et al. (1989) for a strain isolated from the Rammelsberg Mine in Germany and Battaglia et al. (1994) for strains...
L6 and L8 isolated from a cobaltiferous pyrite enrichment culture. In contrast, *L. ferrooxidans* strain L15\(^T\) was originally described to be unable to oxidize iron of pyrite and chalcopyrite, but was capable of growth and oxidation of pyritic iron in mixed culture with sulphur-oxidizing thiobacilli only (Balashova et al., 1974; Norris & Kelly, 1978). However, subsequently subcultures of strain L15\(^T\) were found to oxidize pyrite and chalcopyrite in pure culture after several weeks of adaptation (Norris & Kelly, 1982; W. Sand, personal communication).

A 2262 bp chromosomal DNA fragment from *L. ferrooxidans* strain Z-2, containing a chemoreceptor gene, has been cloned, sequenced and expressed in *Escherichia coli* (Delgado et al., 1998).

The qualitative chemical composition of the LPS of *Leptospirillum*-like bacterium strain BU-1 was examined by Yokota et al. (1988), and 2-keto-3-deoxyoctanoate, rhamnose, heptoses and glucosamine, but not phosphorous, were found. The exopolymeric substances (EPS) excreted by strain R3 after growth on pyrite or iron sulphate, were shown to consist mainly of neutral sugars, some uronic acids and iron species (Gehrke et al., 1995). As suggested by Sand et al. (1995), the EPS with ferric ions bound are a prerequisite for the attachment of leaching bacteria to the metal sulphide surface and the chemical attack.

Cell-free extracts of *L. ferrooxidans* strain L15\(^T\) contain ribulose bisphosphate carboxylase activity, demonstrating the autotrophic nature of this organism (Balashova et al., 1974). In ultrastructural studies, however, carboxysomes were not detected (Sand et al., 1992).

Recently, a moderate thermophilic *Leptospirillum*-like strain (L-88\(^T\)), exhibiting a low level of DNA homology with *L. ferrooxidans* strain L15\(^T\), was isolated from an acidic, iron-containing hydrothermal spring on Kunashir Island, Kuril Islands, Russia, and described as a new species, *Leptospirillum thermoferrooxidans* (Golovacheva et al., 1992). Another moderate thermophilic strain, C-L30A, capable of growth up to 45°C, has been isolated from a bioleaching reactor in Australia by Goebel & Stackebrandt (1994). A possible relationship to *L. thermoferrooxidans* has not been explored.

Here, the name *Leptospirillum* for the genus and the name *Leptospirillum ferrooxidans* for the species are revived, for the same organism for which this name was originally used by Markosyan (1972), in accordance with Rules 27, 28a and 33c of the International Code of Nomenclature of Bacteria (Lapage et al., 1992).

**Description of Leptospirillum gen. nov. (ex Markosyan 1972), nom. rev.**

*Leptospirillum* (lep’to.spi.ril’lum. Gr. adj. leptos thin, fine; Gr. n. speira a spiral; M.L. neut. n. *Leptospirillum* thin spiral).
References


