

The occurrence of gold in *Usnea auratiaco-atra*

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ABSTRACT

In Usnea auratiaco-atra (Jacq.) Bory, a lichen species collected in the Antarctica, the gold content was determined by the cupellation methods. 317 ppb and 1089 ppb dry weight were found in the lichen samples. A possible mechanism to explain the metal accumulation is discussed.

Key words: Antarctic lichens, *Usnea auratiaco-atra*, gold content, cupellation method.

Presencia de oro en *Usnea auratiaco-atra*

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RESUMEN

En especímenes de Usnea auratiaco-atra (Jacq.) Bory, líquen recolectado en la Antártica, se estudió el contenido en oro por copelación. Se discute un posible mecanismo de acumulación del metal en esta especie líquénica.

Palabras claves: Líquenes antárticos, *Usnea auratiaco-atra*, contenido de oro, método de copelación.

Lichens have the property to accumulate and tolerate amounts of minerals that would be lethal to higher plants (Seaward, 1973, 1974; Bates, 1978). The accumulation of radioactive elements (Touminen and Jaakkola, 1973) as well as the absorption of pollutants in urban and industrialized areas are well known (Le Blanc and De Sloover, 1970; Deruelle, 1978; Sigal and Nash, 1983; Holopainen, 1984). Since they lack organs in charge of absorption and protective cuticle, the lichens capacity of storing minerals is related to some of their properties, water and nutrient absorption is carried out throughout the entire thallus area; likewise, their uninterrupted activity and slow metabolism expressed as a weak growth rate and survival favor a continuous accumulation of elements commonly present in the environment.

Lithium, beryllium, zirconium, titanium, silver and gold are some of the various unbiological metals found in lichens (Touminen and Jaakkola, 1973; Boyle, 1979). Gold is a microconstituent of vascular and non-vascular plants. Plants that accumulate minerals have been considered as geobotanical indicators of mineral deposits (Cannon, 1979; Boyle, 1979).

A frequent and abundant lichen in the Antarctica is *Usnea auratiaco-atra* (Jacq.) Bory. Lichen specimens were collected in the near vicinity of Teniente Marsh Station, King George Island, in November 1983. The analytical procedure used to determine the gold content, cupellation or fire assay, in samples selected randomly are in accordance with those described previously (Lenahan and

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Murray-Smith, 1986). Analysis were carried out in GEOLAB Laboratory, Santiago, Chile. The samples were previously ground for homogenization.

The gold content was found to be high in *U. auratiaco-atra*. The figures quoted in this analysis refer to dry sample weight and not to the ashed sample weight (Table 1). Since there are insufficient data on the gold content in *U. auratiaco-atra* and other species, any satisfactory comparisons can not be made. A 1 to 1,3 ppm gold content for five ashed species has been reported (Boyle, 1979). The gold content determination in individuals of *Stereocaulon ramulosum* (Sw.) Räscher, obtained from different clones in a central Chilean location, varied from 31 to 496 ppb dry weight; this fluctuation may be attributed to differences in thallus age (Quilhot, unpublished results).

Table 1

**GOLD CONTENT IN
*Usnea auratiaco-atra***

Sample dry weight (g)	Au (ppb)
74,3410	317
91,9543	1089

Potential sources of minerals that may accumulate in lichens are atmospheric dust, rainfall, water currents and substrate itself (Bosserman and Hagner, 1981). Plants absorb ionized gold derived from solid particles particularly when the metal is in the colloidal state (Boyle, 1979). Lichens synthesize and store phenolic compounds which are effective chelating agents (Vicente, 1975); the occurrence and the concentration differences of these compounds in individuals may explain the appearance of higher mineral levels in lichens. According to this, it is possible that *U. auratiaco-atra*, that accumulates usnic acid (Huneck *et. al.*, 1984) a phenol containing compound with chelating properties, could immobilize the absorbed gold.

The mineral content can be regarded as a measure of the lichen internal state and should be correlated with spatial and temporal variation in the environment (Bosserman and Hagner, 1981). Lichens are longliving plants; therefore, the accumulation occurring in the thallus is a progressive process. The evaluation of the accumulation levels of minerals in lichens should be pursued in monospecific populations including individuals of different ages and different time of a year.

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