The lichen *Caloplaca felipponei* growing on quartz sandstone in Mar del Plata (Argentina): SEM observations

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RESUMEN — Rosato, Vilma G. 2007. “El liquen *Caloplaca felipponei* creciendo sobre arenisca cuarcítica en Mar del Plata (Argentina): observaciones en MEB”. *Lilloa* 44 (1-2). *Caloplaca felipponei* Zahlbr. (Teloschistales, Teloschistaceae) es una especie de liquen que crece sobre rocas en Mar del Plata (Provincia de Buenos Aires, Argentina), con colonias de color rojo naranja brillante que contrasta con el color del sustrato. Coloniza densamente las lajas de arenisca cuarcítica que decora el edificio utilizado anteriormente por el INIDEP (Instituto Nacional de Investigaciones Pesqueras). Pequeños trozos de roca se separaron y dejaron con el liquen; otros se trataron con peróxido de hidrógeno para eliminar la materia orgánica. Estas muestras, al igual que muestras de rocas no colonizadas, se cubrieron con oro en un “sputter” y se observaron bajo microscopio electrónico de barrido (MEB). También se realizaron microanálisis de Espectrometría de Dispersión de Electrones (EDE). La roca es dura y compacta, y el liquen sólo puede penetrar hasta 70 µm. Con respecto a los resultados de los microanálisis de EDE, no se pudo hallar evidencia de una acción química del liquen, aunque esto debería ser confirmado con estudios de difracción de rayos X-. En conclusión, *C. felipponei* afecta a la roca principalmente por acción mecánica provocando mesopitting (pequeños huecos visibles a ojo desnudo). Existe un daño estético, pero en este caso las colonias de líquenes en realidad agregan color al edificio.

PALABRAS CLAVE: Liquen, *Caloplaca*, Teloschistaceae, arenisca cuarcítica, MEB, colonias.

ABSTRACT — Rosato, Vilma G. 2007. “The lichen *Caloplaca felipponei* growing on quartz sandstone in Mar del Plata (Argentina): SEM observations”. *Lilloa* 44 (1-2). *Caloplaca felipponei* Zahlbr. (Teloschistales, Teloschistaceae) is a lichen species growing on rocks in Mar del Plata (Buenos Aires Province, Argentina), with bright orange-red colonies that contrast with the colour of the substratum. It densely colonizes quartz sandstone slabs decorating the building formerly used by INIDEP (National Institute of Fisheries Research). Small rock specimens were obtained and left with the lichen; others were treated with hydrogen peroxide to remove organic matter. These samples, as well as non-colonized rock specimens, were covered with gold in a sputter and observed under Scanning Electron Microscope (SEM). Electron Dispersive Spectrometry (EDS) microanalyses were also performed. The rock is hard and compact, and the lichen can penetrate it only up to 70 µm. However, the areolae of the thallus are inmersed in the rock up to 150 mm, creating mesopits. As regards EDS microanalyses results, no evidence of a chemical action of the lichen could be found, though this should be confirmed with X-ray diffraction studies. In conclusion, *C. felipponei* affects the rock mainly by mechanical action, causing mostly mesopits (Small pits visible to the naked eye). There is also an aesthetical damage, but in this case the lichen colonies add colour to the building.

KEYWORDS: Lichen, *Caloplaca*, Teloschistaceae, quartz sandstone, SEM, buildings.

INTRODUCTION

Lichens can cause aesthetical damage to buildings and monuments, but in some cases, they even weather the underlying material causing conservation concerns, as proved by the growing number of papers on the topic (see the lists of Piervittori *et al*. ,1994, 1996, 1998, 2004)

One of the methods used to assess that damage is OM (Optical Microscopy) and SEM (Scanning Electron Microscopy) (Gehr-

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mann *et al*, 1988). It is known that lichens affect stone by both meso- and micropitting (Saiz-Jimenez, 1999.)

Some of these studies involve Teloschistaceae like *Xanthoria parietina* (Salvadori and Lazzarini, 1991), *Caloplaca heppiana* (Gehrmann *et al.*, *op. cit*.), This is because these lichens are found very often on ancient monuments and buildings; their colonies have a bright colour that contrast with the colour of the substratum., and besides, some species like *Caloplaca citrina* (Hoffm.) Th. Fr. cause a mechanical damage due to the pressure exerted by the hyphae, and a chemical alteration because of the oxalic acid produced by it. (Rosato y Traversa, 2001; Traversa *et al.*, 2000) Other lichens found on quartzite, like *Staurothele monosporoides* or *Catillaria chalybaeoides* can also penetrate the substrate, but EDS microanalyses show there is no important change of the elemental composition of the substratum (Traversa *et al.,* 2001; Rosato, 2004)

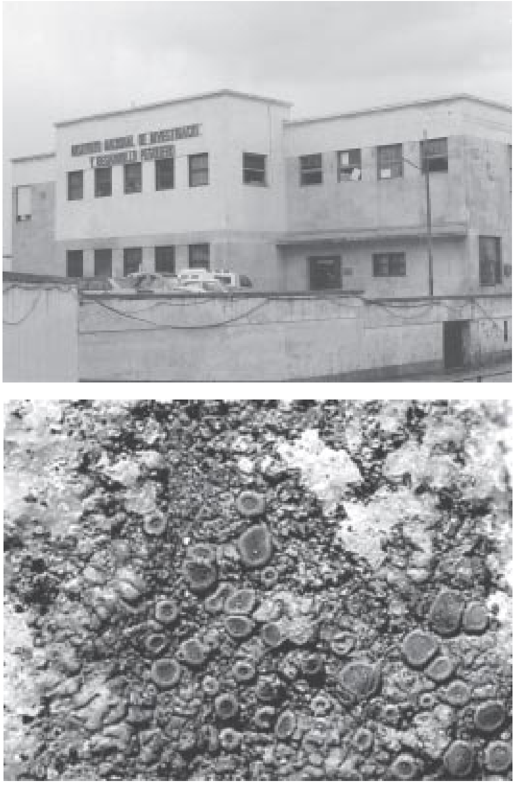

Figure 1. A) Normandie Building. See the rock slabs on the pavement and wall cover. B) Thallus habit of *Caloplaca felipponei.*

During a survey of public buildings of the Buenos Aires Province, Argentina, a lichen species was found growing on a quartzite slab decorating the Normandie building of Mar del Plata city, which was constructed in 1939. First it was used as a hotel and then as a building for INIDEP (National Institute of Fisheries Research). Now it is abandoned, but the city government intends to recover it.

The aim of this paper is to identify the lichen and assess whether it affects the stone or not by increasing the rugosity, the porosity or changing the chemical composition of the rock.

MATERIALS AND METHODS

Location.— The Normandie building is placed in Mar del Plata city, Buenos Aires Province, Argentina (Photos 1 and 2). The terrace faces directly the sea and is decorated with quartzite slabs, which were never cleaned since the building was inaugurated in 1939, and now are densely colonized by the lichen. After a visual assessment, a whole slab was selected as representative and removed.

Lichen studies.— Samples were observed under a Wild M-5 stereomicroscope and a Wild M-20 optical microscope, and thallus, asci and ascospores were measured and compared with samples from Uruguay. Photomicrographs were obtained with an Olympus camera attached to an Olympus microscope. Usual reactions (K, C, KC) were performed, as well as TLC (Culberson, 1972). Extracts of *Xanthoria parietina* and *Caloplaca citrina* (Hoffman) Th. Fr. were also run as controls. In *Teloschistaceae* there is not great biochemical diversity (Arup, comm. pers.; Osorio, comm. pers.), but Søchting (1997) described two major chemosyndromes for this family.

For scanning electron microscope (SEM) observations, specimens were covered with gold-palladium in a sputter and observed under SEM. The specimens observed included normal substratum, lichen samples and macerate samples obtained by separating small pieces of material and heating them gently in hydrogen peroxide with some drops of potassium hydroxide added to eliminate the lichen attached to it (Gehrman *et al.*, 1988) to compare and observe the extent of lichen attack and depth of penetration. Electron Dispersive Spectrometry (EDS) microanalyses were also performed in order to know the elemental composition of the colonized and non-colonized rock.

Specimens observed.— Argentina: Buenos Aires Province: Mar del Plata, on a quartz sandstone slab decorating the former INIDEP Building, 50 m. away from the sea (LPS 45829).

Uruguay: Depto. Canelones, Río de La Plata, Punta Piedras de Afilar (16 km from Atlantida city: 34º46' S/ 55º45' alt 0-5 m.s.m.) sobre rocas en la playa, localmente abundante, zona higrohalina 21/1/1984 Herbario H. S. Osorio 8344; Depto. Rocha, Punta del Diablo de la Coronilla 33º55' S/ 53º31' W alt 0-1 m s.m. sobre rocas en la playa, localmente abundante, zona higrohalina 11/06/1989 Herbario H. S. Osorio 8851; Depto. Rocha, Punta del Diablo de la Coronilla 33º55' S/ 53º31' W alt 0-1 m s.m. sobre rocas en la playa, localmente abundante, zona higrohalina 11/06/1989 Herbario H. S. Osorio 8852

RESULTS

DESCRIPTION OF THE LICHEN

Caloplaca felipponei Zahlbr.
Annales Mycologici 10: 382 (1912).
Holotypus: WU (missing)

Thallus crustose-areolate, slightly effigurate, diffuse, areolae convex, with a rounded outline, 0,3-0,4 mm. diam, orange red, without isidia or soredia. Cortex paraplectenchymatic, 80-100 μm thick. Algal layer 100-120 μm thick. Medulla immersed in the rock, 150-200 μm thick

Apothecia abundant, grouped, rarely solitary, scattered over the whole thallus, 0,4-0,6 mm. diam, margin entire, concolorous with the thallus. Disc flat to slightly convex, orange-red.

Margin 80-110 μm thick. Hymenium 85-90 μm. Paraphyses septate, not branched, 2-2,5 μm width; broadened pigmented tips 5 μm.

Asci claviform, but with thinner, nipple-like apices, 50-60 μm x 15-17 μm, containing 8 ascospores,

Ascospores ovoid-elipsoid, polardiblastic, bilocular, colourless, 10-12 x 4,5-5,5 μm.

Note.— This species characteristically has lobulate margins, but in the exemplar studied marginal lobes are rather short, although in other of the colonies lobulate marginal areolae could be observed. There are topotypes available (Obermayer, 2004) which were not observed, but this does not seem necessary because the rest of the characteristics of the studied material fit with the description of *C. felipponei* and, besides, in the herbarium samples used for comparison the

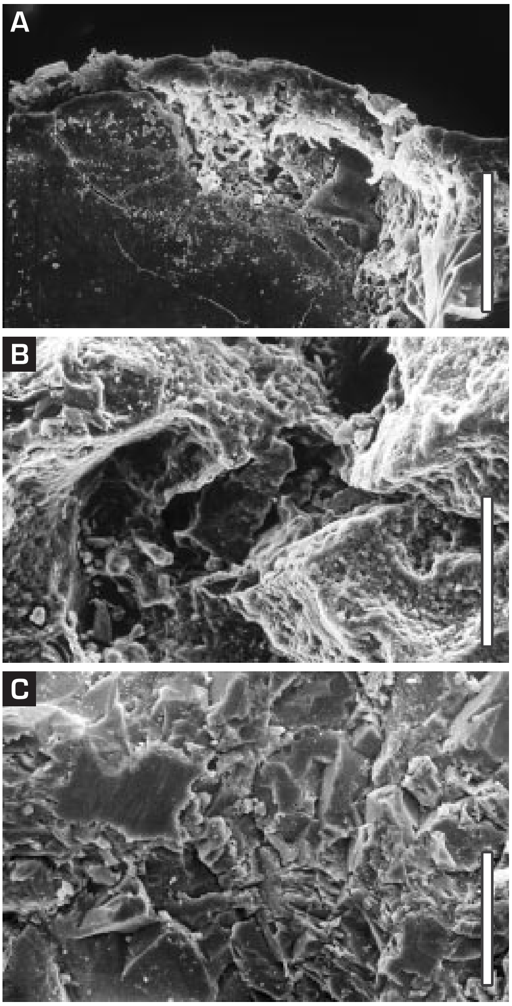

Figure 2. A) SEM photomicrograph of an areola of *Caloplaca felipponei*. B) Sandstone not attacked by the lichen. C) Macerate sample of a rock attacked by *Caloplaca felipponei*. Note the perforations. Bars: A= 100 μm; B, C = 10 μm.

Element	Material sample		
	Sandstone colonized by *C. felipponei*	Sandstone (Siliceous cement)	Sandstone (quartz clast)
Al	9,43	19,06	1,78
Si	69,22	72,50	96,86
K	3,04	8,44	
Ca	5,69	–	1,36
Fe	12,11	–	–

Table 1. Elemental composition of the Mar del Plata sandstone (both colonized and not colonized).

marginal areoles are not very long, either. Probably, in the studied sample the lobulate margin cannot be clearly seen because there are numerous thalli very close to each other, so the marginal areolae overlap each other.

Chemistry.— The TLC results are the same for the Mar del Plata, the Uruguay samples and the controls: the main substance is parietin, with other minor substances: fallacinal, emodin, teloschistin and parietinic acid. These are the same substances found in the *Caloplaca citrina* complex (Arup, 2006) and so, *Caloplaca felipponei* also belongs to chemosyndrome A (Søchting, 1997)

Habitat.— Osorio and Ranta (1985) already found this species along the Coast Avenue, which goes along the seaside and is subject to heavy traffic due to the commercial and tourism activity, especially during summer. They state it is very common, covering up to 90- 95% of the surface. This sample is also from the former INIDEP building, on a sandstone slab that decorates a rounded pavilion facing the sea, 50 m away from the coast. The Uruguay samples grow on rocks with quartz and also acid feldspars.

SEM

SEM observations confirmed that the hyphae of *C. felipponei* penetrate the substratum (Fig. 2 A). In spite of the hardness of the silica, the mycobiont is able to form boring channels (Figs. 2 C). Macerates allow observing such channels as pits and holes on the attacked stone (Fig. 2 C).

As it can be measured from SEM images, hyphae can penetrate up to 70 μm , attaching themselves to the substratum by the central part of the areolae, that is immersed in an 80-85 μm deep cavity (Fig. 2 A). Boring channel diameter ranges from 5,5 to 11 μm (Fig. 2 C).

This is different to other *Caloplaca* species observed, namely *C. heppiana* (Gehrmann *et a1.*, 1988) and *C. citrina* (Rosato and Traversa, 2001) that produce a great number of boring channels.

However, since the areolae of the thallus of *C. felipponei* are immersed in the substratum, it affects the rock by causing mesopits, (Pits with. a diameter of 0.1 up to 0.5 mm, visible with the naked eye) mainly by mechanical action.

CHARACTERISTICS OF THE SUBSTRATUM

Caloplaca felipponei was collected from a hard and compact quartz sandstone, with a specific weight of 2,42, the characteristic value for silica. The water absorption ratio is only 1,68% and the estimated porosity is very low, just 4,15%. EDS analyses revealed it consists of about 85-90% Si. The rest is a small amount of K, Al and Fe (Table 1). As already observed in *Staurothele monosporoides* (Traversa *et al.*, 2001) and *Catillaria monosporoides* (Rosato 2004) the elemental composition of the quartzite stone does not seem to be modified.

CONCLUSION

The characteristics of the lichen agree with those of *Caloplaca felipponei* Zahlbr. SEM observations demonstrate hyphae can penetrate the quartzite forming boring channels, but the main action is caused by the areolae that are immersed in the sandstone. As for the aesthetical impact, the bright orange-red colonies contrast with the colour of the sandstone, but in this case they add a colour touch to the building.

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