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Two new *Orthoseira* species (Bacillariophyceae) from lava tubes on Île Amsterdam and Big Island (Hawai´i)

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Abstract

Two new species of *Orthoseira* from lava tubes on Île Amsterdam and Big Island (Hawai´i) are described using light and scanning electron microscopy: *Orthoseira johansenii* Lowe & Kociolek *sp. nov.*, from Hawai'i, and *O. verleyenii* Van de Vijver *sp. nov.*, from the subantarctic. Both species have flat valve surfaces, the striae on the mantle are composed of uniseriate areolae and the valve face areolae are small and more or less irregularly scattered, occupying almost 2/3 of the total valve face surface. The areolae in *O. johansenii* are occluded by an internal velum; no velum was detected in *O. verleyenii*. In the centre of the valve is a small central hyaline area with 1–6 carinoportulae in *O. verleyenii*, 2–4 in *O. johansenii*. A distinct ring of marginal linking spines or straight, non-linking spines are present at the valve face/mantle junction. No caverns or internal undulations are present. Internal valves have not been encountered.

Both *Orthoseira johansenii* and *O. verleyenii* have valves of about the same dimensions. The two species differ in that *O. verleyenii* shows a rather regular striation pattern near the valve face/mantle junction is noted whereas this is not the case in *O. johansenii*. Moreover, *O. johansenii* short slits between the carinoportulae on the internal valve side are absent whereas in *O. verleyenii* most valves possesses these slits. The two new species are compared with others in this small (ca. 15 species) genus. The biogeographic implications of species separated by 15,000 km are discussed.

Key words: *Orthoseira*, Bacillariophyta, diatoms, new species, lava tubes, Hawai'i, Ile Amsterdam, morphology

Introduction

While studying algal biodiversity on the relatively remote volcanic archipelagos of Hawai'i in the northern Pacific Ocean (RLL & JPK) and Île Amsterdam in the southern Indian Ocean (BVDV), lava tubes present some of the habitats least impacted by human beings, based on the observation of many unique, endemic species. Lava tubes are particularly abundant near shield volcanoes that usually release lava in massive flows rather than explosive eruptions. These tubes are created when flowing lava, often 10s of meters thick, cools on the surface forming a crust over the still flowing lava stream below (Peterson *et al.* 1994). As the lava flow subsides, a channel remains below the crust resulting in a hollow cave-like tube. At the terminals of lava tubes light and water (often rain or humidity) provide the necessities for algal colonization.

Lava tubes represent interesting laboratories to study evolution. These systems are transient, relatively speaking, since they are formed during volcanic activity (MacDonald & Abbott 1970), become exposed and then collapse (Ziegler 2002). In Hawai'i, for example, many invertebrate species (over 100) have evolved in lava tubes, through reduction or loss of characters (e.g. Bousfield & Howarth 1976). Most of these species

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