



Two new species of *Navicula* (Bacillariophyta, Naviculales) from the Cascade Mountains of the American Northwest

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Abstract

Two species of *Navicula*—*N. volcanica* and *N. subwalkeri*—are described as new based on LM and SEM observations and a comparison with similar species. Modern distributions of the new species are restricted to two adjacent headwater streams along the crest of the Cascade Mountains in western Oregon, USA. Both species are established as extant based on observations of cells with intact chloroplasts. *Navicula volcanica* has uniquely structured areolae with small external openings fused into narrow and occasionally interrupted transapical slits, while in most other *Navicula* species both the external and internal openings are separate and apically elongated. When observed under LM, *N. volcanica* resembles *N. ludloviana*, from which it can be distinguished by its rhombic valve shape, unprotracted apices, and larger size. We present here the first SEM images of *N. ludloviana*, showing that unlike *N. volcanica*, this species has ultrastructure typical for *Navicula* sensu stricto. We also present new distribution records for *N. ludloviana* and populations that eclipse published ranges of valve size and shape for this species. *Navicula subwalkeri* is similar to *N. walkeri* in that both species possess an internal axial plate that partially covers the striae. It is distinguished from *N. walkeri* by its narrower valves and axial plate, protracted apices, smaller central area, curved striae, and higher density of areolae. *Navicula subwalkeri* and *N. walkeri* are sympatric species, although *N. walkeri* is much more widely distributed. Additional distribution records are provided for *N. walkeri*, including the first record from the State of Washington.

Key words: diatomite, diatoms, endemic species, lacustrine, Miocene, Neogene, Pleistocene, Pliocene, Recent, riverine, volcanism, volcanoes

Introduction

The inland freshwater diatom flora of the northwestern United States (Northwest) is readily distinguished from other regional floras by a large number of endemic species (Bahls 2011a). Many of these endemics were described from the Cascade Mountains of California, Oregon and Washington (Kociolek & Rosen 1984, Kociolek & Stoermer 1986, 1988a, 1988b, Sovereign 1958, 1963).

The dynamic volcanic history of the Cascades and the formation of numerous lacustrine refugia likely contributed to the large number of endemic species found here. Cascade volcanoes have produced large surface deposits of Pliocene to Quaternary volcanic and volcanoclastic vent rocks, predominantly basalt, basaltic andesite, scoria and tuff (DOGAMI 2009). Some Cascade volcanoes, notably Lassen Peak and Mount St. Helens, have been active in recorded history. Along the Cascade Crest are numerous lacustrine diatomite deposits of Pliocene to Pleistocene age, usually interbedded with lava flows (Bolm *et al.* 2003, Wallace *et al.* 2006). Many extant taxonomic elements of the Northwest diatom flora are also found in these deposits (Sovereign 1958, Kociolek & Stoermer 1988b). These relict taxa evidently survived to the present under conditions similar to those that occurred during periods of mountain building (Neogene to Recent) and glaciation (Pleistocene).

Among the most iconic of the Cascade endemics are three large-celled species in the genus *Navicula* Bory. The first of these to be published, from a collection near Port Ludlow in western Washington, was *N. ludloviana* A. Schmidt in Schmidt *et al.* (1876: Tafel 46, fig. 15). Much later, *N. walkeri* Sovereign (1958: 120), perhaps the most unique of the