

## Iron mineralization in the radular teeth of marine mollusks

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Most mollusks feed on flora using the radular teeth, which function as a scraper and a collector. Each tooth is composed of a cusp and a base to the radular substratum.

The hardness of the cusps is an important key in food selection for chitons and limpets that inhabit hard rocks. Magnetite, lepidocrocite, and apatite minerals were found in the major lateral teeth in some chitons. The teeth of some limpets were capped by goethite. Opal mineralizes the cusp and bases in the limpet family Acmaeidae.

As the metals concentrated in the radula are considered to be dissipated in the marine environment in the process of wearing and shedding during feeding. The amounts are likely to be small, the significance of these mollusks as contributors of magnetite and opal to sediments cannot be disregarded.

The molluscan shells, vertebrate hard parts and most of the additional hard tissues seen in living animals evolved from 544 million years ago, as part of a broader Cambrian diversification of animal groups. Most mollusks feed on microflora, macroflora, or both, using the radula, which function as a scraper and a collector. The radula bears a number of longitudinal rows of teeth. In general, central, lateral, and marginal teeth, which usually differ from one another in shape, are observed in each transverse row. Each tooth is composed of a cusp and a basal attachment to the radular substratum.

The hardness of the cusps is an important key in food selection for chitons and limpets that inhabit hard rocks and feed on epi- and endolithic microalgae. A high accumulation of Fe and Si commonly appeared in all limpets examined. The Fe concentrations in the radulae of seven species of chitons examined ranged from 74,700 to 13,8000  $\mu\text{g/g}$  on a dry weight basis. Magnetite, lepidocrocite, and apatite minerals were found in the mature major lateral teeth in some species of chiton. These minerals are localized in the colored cusp of the teeth. The teeth of some limpets were capped by goethite. Opal mineralizes the cusp and bases of the teeth in the limpet families Acmaeidae and Patellidae. Although the chemical form of Fe was different, the hardness of chiton and limpet teeth cusp appeared similar.

The radula has been known to wear and shed at the anterior end during feeding. As the metals concentrated in the radula are considered to be dissipated in the marine environment in the process of wearing and shedding, the radula may have a role in detoxification. The amounts are likely to be small, the significance of chitons and limpets as contributors of magnetite and opal to marine sediments cannot be disregarded.