Life on the rocks – just scraping by

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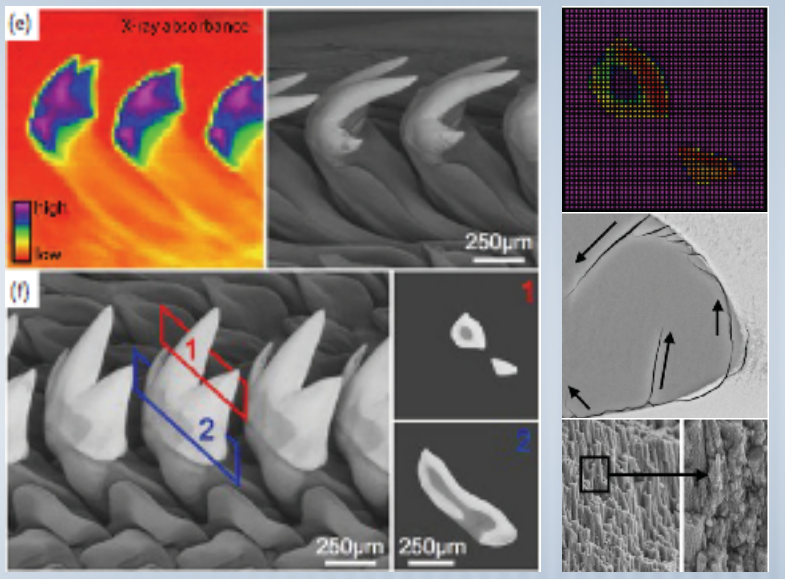
- Biomineralization produces ultra-hard mineralized tissues with surprising ways and means – such as the magnetic iron oxide teeth of chitons, evolved for a lifetime of scraping algae from rocks in ocean waters. By analyzing these teeth we learn how their ultrastructure correlates to their extreme damage tolerance.
- Chiton teeth are shown to exhibit the largest hardness and stiffness of any biomaterials reported to date. Microbeam x-ray diffraction is a key component of these studies, due to its unique capability to map mineral polytype, orientation, grain character, and coexistence with amorphous phases simultaneously.
- This study found that a soft iron phosphate core and hard iron oxide exterior work together to deflect cracks and allow the tooth to resist abrasion damage. Such studies inspire the design of novel nanocomposites with advanced strengths.



A battery of techniques is used to analyze the ultra-hard chiton radular teeth. False-color image shows x-ray absorbance mapped with the 5 micron beam at NSLS X13B. Backscattered SEM images show the three-dimensional structures of the tricuspid teeth, and show where sections were taken for indentation measurements, examination of crack propogation, and correlation with mineral ultrastructure.

James C. Weaver, Qianqian Wang, Ali Miserez, Anthony Tantuccio, Ryan Stromberg, Krassimir N. Bozhilov, Peter Maxwell, Richard Nay, Shinobu T. Heier, Elaine DiMasi, and David Kisailus, "Analysis of an ultra-hard magnetic biomineral in chiton redular teeth," Materials Today 13, 42 (2010).

Work performed on Beamlines X13B and X6B.