Much more than a biostratigraphic tool: A geochemical and histological reappraisal of the conodont

Poul Emsbo*†[1], Jed Day[2], Jay Thompson , Alyssa Bancroft[3], Richard Moscati[1], Patrick Mclaughlin[4], Michael Pribil[1], and Thijs Vandenbroucke[5]

[1]US Geological Survey – United States
[2]Illinois State University – United States
[3]Iowa Geological Survey – United States
[4]Illinois State Geological Survey – United States
[5]Ghent University – Belgium

Abstract

Conodont biostratigraphy, the backbone for much of the chronostratigraphic framework of the Paleozoic, is essential for understanding global patterns of geological and environmental change over much of Earth's history. Conodont apatite geochemistry is increasingly used as a proxy for measuring the chemical and isotopic composition of the ancient ocean. However, there is uncertainty about the source and timing of elemental enrichment in these fossils, with variable interpretations ranging from primary (in vivo) to postmortem recrystallization/exchange on the seafloor and during diagenesis/thermal maturation of the rocks. We have reduced this uncertainty by characterizing conodonts of different ages and thermal maturities using various geochemical and isotopic tools in combination with histologic studies.

The results show clear differences in the mineralogy, crystallinity, chemical and isotopic composition of morphologic components of individual conodonts which we interpret to reflect biologic growth. The highly crystalline components have not exchanged with the enclosing rock, while the less crystalline hard tissues are nearly completely exchanged. Geochemical maps of highly crystalline components also delineate wear/growth and resorption/regeneration surfaces, and ontogenetic differences that further support the hypothesis that the trace-element zones are a primary, and not diagenetic, record of biochemical uptake by the conodont organism.

These findings provide new insights into the biology, growth, and histology of the conodont animal, which may help identify the phylogenetic origins of this complex and enigmatic group. Moreover, the application of these new analytical tools and sampling methodologies in parallel with traditional biostratigraphic and chemostratigraphic approaches can improve the ability to correlate the global stratigraphic record at previously unattainable resolution. Therefore, when sampled correctly, conodont apatite biogeochemistry is an ideal proxy for measuring the chemical and isotopic composition of the ancient ocean.

*Speaker
†Corresponding author: pemsbo@usgs.gov

Keywords: conodont, biostratigraphy, chronostratigraphy, chemostratigraphy, mineralogy, geochemistry, isotope, paleocean chemistry, biology, histology, ontogeny