Strontium Isotope Chemostratigraphy: A Tool for Refining the Stratigraphic Framework of the Permian Basin

Stephen C. Ruppel
Bureau of Economic Geology, The University of Texas, Austin, TX,

Eric W. James
Department of Geological Sciences, The University of Texas, Austin, TX

ABSTRACT

It is well established that the strontium isotope composition of the world's oceans has changed continuously throughout the Phanerozoic. Secular changes in sea water $^{87}Sr/^{86}Sr$ constitute the basis for a powerful geochronometer in marine sedimentary rocks. For more than a decade, an ever increasing number of researchers have utilized these secular trends to define the age and timing of complex depositional and diagenetic events in the rock record.

Current studies of seawater $^{87}Sr/^{86}Sr$ in conodonts of Silurian, Devonian, and Permian age, however, indicate that previously defined secular trends of $^{87}Sr/^{86}Sr$ for the Paleozoic are too imprecise for use in accurate age dating. The primary causes of this imprecision are diagenesis and miscorrelation of sample materials. Both are problems in whole rock samples commonly used in many early studies and may be equally so in abiotic cements and non-luminescent brachiopods, two of the currently most popular sample materials.

Conodonts, which are ubiquitous in Paleozoic marine sedimentary rocks, overcome these problems. They contain high Sr concentrations, are resistant to diagenetic alteration, and can be temporally related based on conodont biozones, perhaps the best standard for global correlation in the Paleozoic. Using modern instrumentation and preparation techniques, high precision measurements of $^{87}Sr/^{86}Sr$ can be made from individual elements weighing less than 20 mg.

We have analyzed more than 160 conodont samples from continuous measured sections and biostratigraphically correlated Paleozoic sections on three continents, we have developed a greatly improved record of secular change in $^{87}Sr/^{86}Sr$ for the Silurian, Devonian, and Permian. These data are typically much less radiogenic than previous data sets and display much less scatter. Analysis of duplicates from the Silurian, both from the same samples and from separate samples from distinct geographic localities, suggests that conodonts can preserve a high-precision record of sea water $^{87}Sr/^{86}Sr$. Our newly established, high resolution secular trends for $^{87}Sr/^{86}Sr$ in the Silurian and Devonian, along with preliminary data from the Permian, have immediate applicability to resolving problems of stratigraphic correlation and the timing of depositional and diagenetic events in the Permian Basin.

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