Defining Chemostratigraphic Zones from Principle Component Curves: A Study from Cretaceous Carbonates

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Abstract

This paper presents a new method of identifying geological boundaries based on chemostratigraphic data and Principal Component Analysis Curves (PC curves). This technique links chemical signals with geological changes and adds confidence to the correlation between wells. In this example, two major flooding and anoxic events are captured that may be regionally correlatable that were based on the advanced understanding of the study of the Principle components. The rock samples were derived from 4 wells and included core and cuttings from carbonate sequences of the Cretaceous carbonates, in the Southeastern Arabian Platform. The traditional chemostratigraphic workflows involve the interpretation of chemical profiles for individual elements and elemental ratios, with as many as 250-300 profiles produced for each study section in each project. The chemostratigrapher reviews these profiles and based on experience identifies 4-12 ‘key’ or ‘index’ elements/ratios, after which correlative chemostratigraphic boundaries are placed. The methodology detailed in this study alleviates these time-consuming and often challenging tasks. In this study, PC profiles are used for stratigraphic boundary identification, rather than ‘key’ elements or ratios. The advantage of examining PC curves is that they are easier, for geologists, to interpret and use to build a geological framework. The scheme was then compared with an existing chemostratigraphic scheme proposed for the same study wells. By using the two schemes in combination, it was possible to add confidence to the placement of individual boundaries and to propose a more detailed correlation of higher resolution. Whilst PCA does not necessarily replace the traditional method of plotting profiles for individual elements/ratios, it is considered a very useful quick pass technique to identify stratigraphic boundaries and a method to recognize changes in sedimentary provenance. A significant advantage of this technique is that it provides meaningful interpretations of important changes within the stratigraphic record that can be linked to geological changes at the time of deposition.