Geophysical Research Abstracts
Vol. 19, EGU2017-9945-1, 2017
EGU General Assembly 2017

Integrated bio-chemostratigraphy of Late Cretaceous organic-rich marine sediments in Israel

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The Late Cretaceous was a time of great climatic and paleocanographic changes that had major impact on the global marine ecosystems. The timing of these events must be accurately determined based on a reliable chronostratigraphic framework that can be readily applied in various environmental settings. The Late Cretaceous planktic foraminiferal biostratigraphic zonation is mainly based on tropical-subtropical species that are typically found in normal pelagic settings. However, during this time, unique conditions of high water column productivity and oxygen deficiency prevailed throughout the Levant region, including Israel, causing a partial to total exclusion of some of these species. Consequently, establishing age framework based on biostratigraphic correlation of the Levant region is a challenging task, emphasizing the need to apply additional method to advance the regional chronostratigraphy. Among these, is chemostratigraphy based on the $^{87}Sr/^{86}Sr$ ratio in of the carbonate tests of foraminifera, which is now widely used for stratigraphic correlation.

The main objective of the present research was to improve the chronostratigraphic resolution for the Upper Cretaceous organic-rich sequence in Israel. This was accomplished by integrating detailed correlation of planktic and benthic foraminiferal bioevents, with $^{87}Sr/^{86}Sr$ ratio, correlated to the global $^{87}Sr/^{86}Sr$ ratio curve. This integration provides a new and much improved chronostratigraphic framework of the Late Cretaceous strata of Israel and the entire Levant region. It allows to integrate sections with poorly preserved or lack of the common biomarkers, define for the biozone. In general this should yield the best age control for economically valuable stratigraphic units (e.g., oil shale) deposited during this time.

The biozonation of the studied sections, RE-2 and RE-6 from the Negev basins (southern Israel), spans from the Late Santonian *Dicarinella asymetrica* Zone to the middle Maastrichtian *Abathomphalus mayaroensis* Zone and from the middle Coniacian *Dicarinella concavata* Zone to the early Maastrichtian *Pseudoguembelina palpebra* Zone, respectively. The zonation subdivision, and the regional correlation to Aderet borehole from the Shefela Basin, Central Israel, is based on 23 secondary and main planktic biomarkers and based on the LOs of seven benthic species namely *Anomalinoides praeacutus, Laevidentalina gracilis, Loxostomum decurrens, Angulogavelinella abudurbensis, Siphogenerinoides parva, Neoflabellina rugosa* and *Gaudryina rugosa* and the acme event of *Elhasaella alanwoodi*. Sr isotopes curves from the RE-2 and Aderet sections show a remarkable correlation to the global Sr curve and with good agreement with the biostratigraphy datum.

We took great measures to ensure that the analyzed $^{87}Sr/^{86}Sr$ ratio on ca. 200 tests per sample will represent the tests themselves and not impurities. Overall, the results are with agreement with the global $^{87}Sr/^{86}Sr$ ratio curve.

Ultimately, the results of this study assess the accuracy and applicability of the secondary planktic and benthic foraminiferal datum to determine important age intervals and for determining numerical ages based on the Sr isotope records. Our new chronostratigraphic framework of the high productivity sequence in Israel is not only essential for regional correlation of these economically important sediments but also valuable in a global context.