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Integrating chemostratigraphy and palynofacies into sequence stratigraphic models: A case study of the Lower Muschelkalk (Anisian) from the Germanic Basin

F.A. Conradi (1), A.E. Götz (2), N. Rameil (3) R. McCabe (1)

(1) ChemostratLtd., Unit 4 Llanfyllin Enterprise Park, Llanfyllin, Powys, SY22 5DD, UK, (florianconradi@chemostrat.co.uk), (2) Institute of Geoscience, Martin Luther University Halle-Wittenberg, D-06099 Halle (Saale), Germany (annette.goetz@geo.uni-halle.de), (3) Institute for Geology, Mineralogy and Geophysics, Ruhr-Universität Bochum, Universitätsstrasse 150, D-44801 Bochum, Germany (niels.rameil@ruhr-uni-bochum.de)

The Lower Muschelkalk (Middle Triassic) carbonates of the Germanic Basin show characteristic facies successions reflecting changes in relative sea level. In this study the integration of inorganic whole rock geochemical data, palynofacies data and microfacies data has been applied to define depositional facies, stratigraphic surfaces, cycles and sequences. 120 samples have been collected from the Steudnitz type section in E-Germany for geochemical analysis, in order to provide representative samples of all lithofacies and depositional environments present. The samples were subject to WD-XRF (wavelength dispersive x-ray fluorescence) analysis, palynofacies analysis and microfacies analysis.

Chemostratigraphy can be used to highlight changes in facies and palaeoenvironments in carbonate sequences. Subtle geochemical variations are attributed to the chemical alterations occurring during burial/diagenesis and to specific geochemical signatures of different depositional facies. That relates to the proportions and nature of allochems, matrix, cements and diagenetic phases composing carbonate rocks.

Palynofacies samples from shallow marine sequences contain two groups of sedimentary organic particles, a continental fraction including phytoclasts, pollen grains and spores, and a marine fraction composed of plankton and foraminiferal test linings. Stratigraphic variations in the composition of sedimentary organic matter display shallowing-deepening and transgressive-regressive trends within the depositional

system that have been used to constrain the stratigraphic model.

Geochemical data are used to differentiate variations in rock components and their relationship to facies. The results of this geochemical facies classification are compared and corroborated with palynofacies and sedimentological data. The integration of the techniques led to: a) identification of chemical signatures, which relate to specific rock components, such as skeletal and non-skeletal grains, calcite cement and dolomite, thus potentially allowing backtracking of depositional facies from chemostratigraphy; b) definition of sequence patterns and key surfaces c) interpretation of depositional environments and d) corroboration of the sequence stratigraphic model.

The results of this study prove that chemostratigraphy can be used for high-resolution stratigraphy within carbonate strata. Geochemical component modelling is an amendatory method that can help to backtrack depositional environments from whole rock inorganic geochemistry. Such an integrated sedimentological and geochemical analysis is a powerful, often overlooked tool for forward modelling of ditch cuttings. Its application is seen to be particularly useful in development areas, where sample sets are almost exclusively ditch cuttings.