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Chemostratigraphical Characterisation of the Lower Silurian Formigoso Formation: A Case Study from Aralla (Cantabrian Mountains, Province Leon, NW Spain)

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The Silurian black shale deposits of the peri-Gondwanan region are one of the most important Palaeozoic source rocks for hydrocarbons world-wide. Despite intensive research, questions regarding the genesis and the palaeoenvironmental and palaeogeographic factors controlling the deposition of these shales are a matter of ongoing debate.
The area investigated lies within the Cantabria-Asturias Arc of Northern Spain in the autonomous region of Castilla y León. The Cantabrian Arc formed as a result of the collision between Gondwana and Laurussia during the formation of the supercontinent Pangea and has been divided into five major tectonostratigraphic units. The 'Folds and Nappes' unit is of particular interest, especially the contained Somiedo-Corecillas thrust system, as here the best preserved Formigoso-sections and exposures can be found.
This study focuses on the deposition of the L-Silurian black shales of the Formigoso Formation (Fm) within the Somiedo-Corecillas thrust system at Aralla, approximately 10km east-southeast of San Emiliano. A high resolution geochemical analysis of major and trace elements has been utilised on a 25cm scale throughout the section. A total of 241 samples were prepared and analysed using a NITON XL3t X-ray fluorescence instrument. The data obtained have provided new insights into the sedimentation patterns and the prevailing environmental conditions during deposition of the Formigoso Fm.
Initial results show prominent regular cycles within the concentrations of red/ox-sensitive chemical elements, starting from the very onset of the anoxic black shales; these repetitions become less apparent towards to top of the formation. Eight cyclic pulses are clearly evident in the concentrations of the elements Uranium (U), Thorium (Th), Vanadium (V) and Chromium (Cr) and apparent in Rubidium (Rb), Zinc (Zn), Copper (Cu), Nickel (Ni), Titanium (Ti), Sulphur (S) and Barium (Ba). The cyclic behaviour of U4+ between 'Anoxia'-U enriched (18ppm)- and 'Dysoxia' -U depleted (8ppm)-, is here interpreted as the result of regular perturbations of the overlying oxygen-depleted water column during deposition, leading to rhythmic oxygenation of the bottom-water masses. These regular perturbations are seen here as the result of a complex interplay between orbital-forced sea-level changes and tectonically induced subsidence; the latter, a result of the widening Rheic Ocean.
The basal black shales of the Formigoso Fm represent a duration of approx. 4 Myrs, spanning from the Aeronian/Telychian boundary (436Ma) to the mid-Telychian Monoclimacis Graptolite Zone ($\sim$ 432Ma). Therefore, each single cycle seem to represent approximately 500 kyr. This consistent cyclic signal is tentatively interpreted to represent the dynamic sedimentological response to the Earth's 413ka eccentricity.
The cyclic geochemical patterns observed within the Lower Silurian Formigoso Fm shall be used for future stratigraphic correlations on an intrabasinal and interbasinal scale for the peri-Gondwanan margins.