Paleoenvironmental Indicators of Lower Aptian Organic-Rich Sediments Associated with OAE1a in the Cuchia Section, Basque-Cantabrian, Northern Spain

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Abstract

Organic-rich sediments of the Basque-Cantabrian Basin occur in a well-exposed sequence of lower Aptian rocks of the Cuchía section located along the Playa de los Caballos Beach, northern Spain. Biostratigraphic data (planktonic foraminifera, calcareous nannoplankton, and ammonite) and carbon isotope values from previous works correlated the section within the interval of unusual OM preservation associated with OAE1a. Eighty-three (83) samples collected from a 67 m succession were analyzed for further high-resolution analyses, including carbon geochemistry, major elements, biolimiting elements, redox sensitive trace elements (RSTEs), biomarkers, clay mineralogy, and bulk mineralogy. The main purpose is to better understand the local response in the production and preservation of OM during OAE1a in a mix siliciclastic-carbonate environment. The sequence changes from a cross-bedded bioclastic limestones containing hermatypic corals and rudists (Umbrera formation) to mostly dark OM-rich marly clays grading in the upper part to mica-rich claystones, siltstones, and quartz sandstones (Patrocinio formation). In the latter total inorganic carbon (TIC) varies from mostly shale (TIC 65 wt%) layers during OAE1a. Total organic carbon (TOC) content range from 0.25-1.15 wt% with higher values occurring mostly in the shales. Major elements (Al, Ti, & Si) have a positive correlation with TOC (r>0.5), indicative of a relationship between terrestrial fluxes and OM production and preservation. RSTEs V, Cr, and U share a strong correlation with TOC (r>0.5), yet Cu, Co, Ni,

and Mo have weak or no apparent correlation with TOC, implying weak reducing conditions in bottom waters. The clay content of 9 samples show varying amounts of smectite (0.8%-3.8%), chlorite (6.9%-10.9%), kaolinite (11.3%-21.5%), and illite (64.9%-78.6%). Relatively high kaolinite content throughout the section suggests a humid environment, which is supported by bulk mineralogy showing a strong terrestrial influence (42% quartz, 17% clay minerals, 11% feldspars). Lipid biomarkers from 20 samples revealed n-alkane distributions from nC11 to nC33 signifying a mixed source of OM in the basin, and the terrestrial aquatic ratio (TAR) also shows increased ratios of longer chain to shorter chain n-alkanes in the shale layers indicating higher terrestrial OM input in the basin during OAE1a.