
Application of magnetic prospection to the study of sedimentary cycles

Antonio Casas^{*1}, Carlos Liesa², Arsenio Muñoz Jiménez², and Alberto Tella Ortega²

¹University of Zaragoza – Espagne

²Universidad de Zaragoza – Espagne

Résumé

We propose the application of magnetic surveying (total magnetic field and vertical gradient by means of common-use proton-precession magnetometers) to the study of cyclicity in sedimentary basins. Under favorable conditions of bed orientation and topography (south-directed slopes and north-dipping beds with intermediate to steep dips), both the total magnetic field (after diurnal correction) and the vertical magnetic gradient provide a pseudo-continuous profile (with a measurement every 10 cm of the sedimentary sequence in average, or less, depending of the above-mentioned conditions) of the short-wavelength magnetic anomalies associated with the sedimentary sequence. These anomalies, that usually have a wavelength lower than 10 m or even less, depend on the magnetic properties of the sedimentary log, changing at a bed scale, namely magnetic susceptibility (dominant for low Koenigsberger ratios, a common scenario in sedimentary rocks) and magnetic remanence. The comparison with direct measurements of magnetic susceptibility in some segments of the profile provides a successful double-check in this case. The advantage of magnetometry vs. discrete measurements of susceptibility is the possibility of measuring even when the target strata are covered by soil. The cyclostratigraphic analysis of magnetic profiles of a ca. 6 km thick Lower Cretaceous sedimentary series in the eastern Cameros basin (Cidacos transect, N Spain) indicates the existence of cycles of 405 kyr (long eccentricity) and 100-125 kyr (short eccentricity), as well as other lower and higher frequency cycles. Cycles with close periodicities, and ascribed to the same frequency band, are the result of different sedimentation rates, which vary along the stratigraphic succession (mean of ~ 0.2 mm/yr, but with values ranging between ~ 0.1 and ~ 0.36 mm/yr). These results provide an indirect method for dating the 30.6 million year long sedimentary series between the lowermost Berriasian and the lowermost Albian (~ 143.1 to ~ 112.5 Ma), and imposes new constraints for basin evolution. The results obtained open a promising field for quick and reliable determination of magnetic properties and cyclicity in thick sedimentary sequences.

Mots-Clés: Magnetic surveying, susceptibility, cyclicity

^{*}Intervenant