Cyclicity of carbonate geochemistry in Lower Cretaceous pelagic limestones of the Vocontian trough (SE France)

L. Emmanuel *U.S.T. de Lille Laboratoire de Dynamique Sédimentaire et Structurale, F-59655 Villeneuve d'Ascq, France.*

M. Renard
V. Rohrlich *Laboratoire de Géologie des Bassins Sédimentares, Université P. et M. Curie, 4, pl.Jussieu F-75252 Paris Cédex 05, France.*

Introduction

The variation of the geochemistry of pelagic carbonates as a result of long term eustatic sea level changes in the Lower Cretaceous of the Vocontian trough (SE France) was established in several studies, such as Emmanuel and Renard, 1993 and Emmanuel ,1993. In order to define if a cyclic pattern exists, unobservable or difficult to observe on the distribution curves , autocorrelation functions of the carbonate content of limestone banks, minor elements (Mn, Mg, Sr, Fe), trace elements (Ni, Cr, Zn) and stable isotopes ($\delta^{13}C$ and $\delta^{18}0$) content from a 630 m. thick section (Berriasian to Barremian) from Angles were calculated. The massive limestone and limestone/marl alternations and its sequence stratigraphy as well as carbonate geochemistry were described in Jan Du Chene *et al.* 1993 and Emmanuel and Renard op cit.

Methods

In order to consider the changes in the carbonate geochemistry as time series, the space (meter - scale) data was transformed into time using the time-scale of Odin 1994. In the section of Angles the *Calpionella elipitca* zone (ap duration 1.8 Ma)

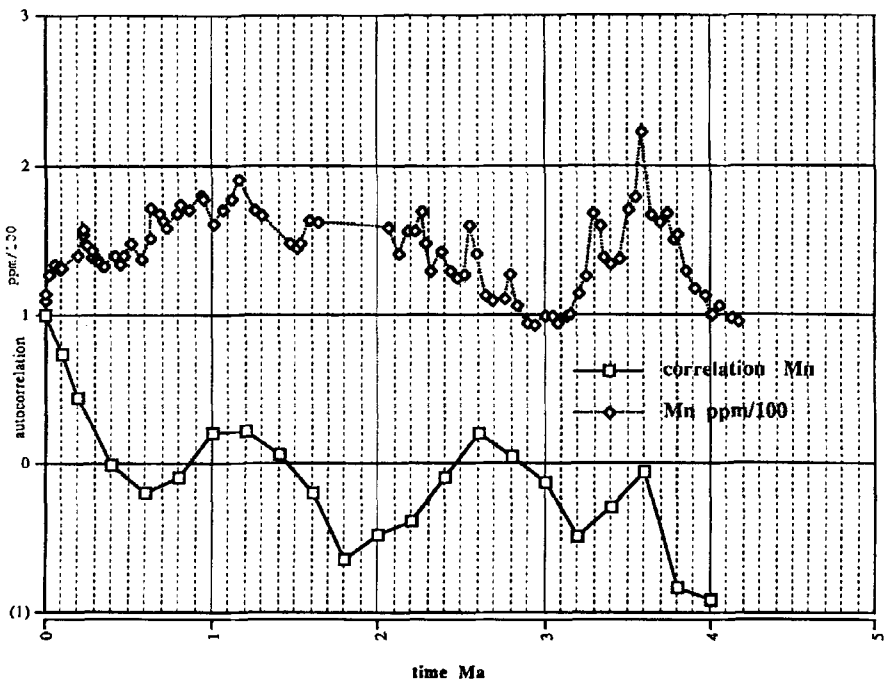

FIG. 1. Autocorrelation and evolution of manganese content in Barremian from Angles.

is missing due to a slump (Emmanuel and Renard *op. cit.*). Some of the beds above and below it are missing as well. A gap of about 2 Ma occurs.

Autocorrelation functions or correlogram (defined as the covariance between a series and itself standardized by the tail and head standard deviations) were calculated using the geostatistical software library of Deutch and Journel, 1992. The autocorrelation function reveals periodic components by showing peaks and troughs (figl). The number of lags (and as a consequence the distance between successive points) was calculated using the rule of thumb: number of samples divided by 4.

Results

Cyclicity shown by the autocorrelation functions means that the distribution of the elements in time can be divided into repetitive parts . Successive harmonics, trend or random noise reduce the ability to discern the periodic component of the signal (Davis 1973). However, it is possible to see more or less clearly the cyclicity from the resulting graphs which are generally rather complicated. Sometimes, a geochemical event, such as in the lower Valanginian, can be a 'disturbing/ factor.

Carbonate, trace elements (Mn, Sr, Mg, Fe, and Zn) and the stable isotope ratio ($\delta^{13}C$ and $\delta^{18}O$) show one or several cyclic periods. The autocorrelation functions show 3 degrees of cyclicities:

- The lowest ap 1- 1.5 Ma (observed for Mn and Fe) can be seen only on autocorrelation functions calculated on separate stages (i. e.. Barremian -fig 1), and could represent eustatic sea level change corresponding to third order sequences (sensu VAIL).

- The medium cycle (carbonate, also observed on Mn and Fe) of ap 3 Ma is tentatively attributed to dilution of Fe and Mn components by carbonates (productivity versus detritic fluxes).

- The 6.5–7 Ma cycle seen on autocorrelation functions of the $\delta^{13}C$, Mn and the Zn could represent periodical anoxies in the Lower Cretaceous ocean.

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