Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 16	Graz 2011
IGCP 596 Opening Meeting	Graz, 19-24th September 2011		

Magnetic susceptibility evolution on Paleozoic sedimentary settings, a clue for past paleoenvironments

DA SILVA, A.C.[1], PAS, D.[1], MABILLE, C.[1] & BOULVAIN, F.[1]

(1) Petrologie sedimentaire, B20, Boulevard du Rectorat, Université de Liège, Sart Tilman, 4000 Liège, Belgium; *ac.dasilva@ulg.ac.be*; *dpas@ulg.ac.be; cmabille@ulg.ac.be*; *fboulvain@ulg.ac.be*

Since the fifties, magnetic susceptibility (MS) technique is frequently used in order to correlate sediments or rocks and as a proxy for paleoclimatic changes in Recent sedimentary rocks. Since the nineteen's, magnetic susceptibility was also applied to Paleozoic rocks for correlations (CRICK *et al*. 1997). Magnetic susceptibility signal is interpreted as mainly related to lithogenic inputs (magnetic minerals like magnetite and clay in opposition with non magnetic minerals like carbonates) and lithogenic inputs are mainly related to sea level variations and climate. So a transgression will be associated with decreasing magnetic susceptibility and a regression will produce a MS peak. Increasing rainfalls as well as glaciations will also increase lithogenic inputs and so magnetic susceptibility. This relationship between MS and sea level and/or climate led to use the MS technique for high-resolution, global correlations of marine sedimentary rocks (CRICK *et al*. 1997).

In order to get a better understanding of the factor influencing the final magnetic susceptibility signal, we compare the record of magnetic susceptibility signal in different sedimentary settings, across different paleolocations and during different time interval (Devonian to Carboniferous and cycles of a few thousand years to million years).

Magnetic susceptibility measurements were performed on different carbonate systems:

(1) shallow-water carbonate shelf (Eifelian-Givetian and Frasnian)
(2) mixed siliciclastic-carbonate ramp (Eifelian and Carboniferous)
(3) carbonate isolated mud mounds and atolls (Frasnian)

(1) In the shallow water carbonate shelf of Belgium, magnetic susceptibility allows to perform precise correlations between the sections (fourth-order correlations). A strong relationship between MS and facies (increasing MS with more proximal facies, Fig. 1-1a-b) and MS and fourth order sequences (increasing MS at the top of a regressive sequence) is observed (DA SILVA *et al*. 2009). This relationship confirms the strong link between magnetic susceptibility and sea level variations.

(2) In the eifelian mixed siliciclastic-carbonate ramp, magnetic susceptibility provides also good correlations. It seems that magnetic susceptibility values are also linked to facies but in an opposite way. Actually the higher MS values are corresponding to the deepest facies (Fig. 1-2) and MS increases during transgressive phase. The higher agitation during deposition of shallow water facies (shoals, grainstones) probably prevented deposition of fine detrital magnetic particles.

(3) In the Frasnian carbonate mounds and atolls, magnetic susceptibility brings also good correlations between the mounds. As for carbonate ramp, magnetic susceptibility increases slightly during transgressive phases and towards deeper facies (Fig. 1-3). The sedimentation rates of the carbonate mounds and the surrounding deposit are very different and probably strongly influenced MS signal, as well as the fact that the mound was isolated and protected from the rest of the platform.

In synthesis, in the three cases, it appears that magnetic susceptibility is related to main sea level changes but in an opposite direction. For the carbonate attached platform, a transgression will decrease magnetic susceptibility but for the atolls and the ramp, a transgression will increase magnetic susceptibility. In these two cases, the lithogenic inputs will not be the main parameter but sedimentation rate and wave strength will also influence the amount of magnetic susceptibility (a strong carbonate production will dilute the magnetic minerals and an important agitation will probably scatter the minerals). It highlight also that correlations between different carbonate systems are highly speculative because of the different origin of magnetic peaks.

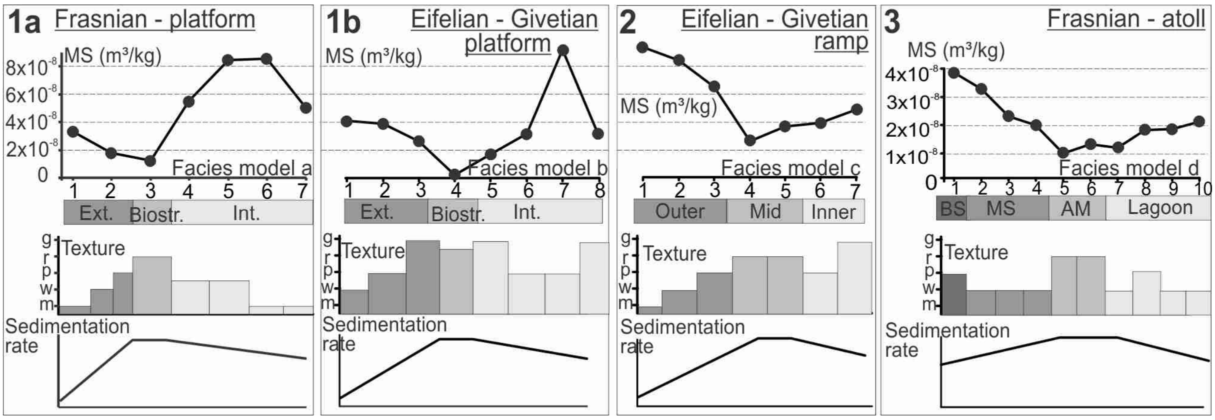

Fig. 1: Mean magnetic susceptibility values on relative proximality transects with corresponding textures and sedimentation rates. (1a) Frasnian carbonate platform. (1b) Eifelian and Givetian mixed platform. (2) Eifelian – Givetian mixed ramp. (3) Frasnian carbonate mound and atoll. Textures are ordered from the lower to the higher water energy during deposition: m = mudstone, w = wackestone – floatstone, p = packstone, r = rudstone and g = grainstone and boundstone. Abbreviations are: Ext. = External Distal facies; Biostr. = Biostromal facies; Int.= Internal facies; Outer = outer ramp; Mid = Mid ramp; Inner = Inner ramp; BS = Basinal and flank facies, MS = Mud or skeletal mound facies; AM = Algal and microbial mound facies; lagoon = lagoonal facies inside the crown. For complete explanation see DA SILVA *et al*. (2009).

References

CRICK, R.E., ELLWOOD, B.B., EL HASSANI, A., FEIST, R. & HLADIL, J. (1997): Magnetosusceptibility event and cyclostratigraphy (MSEC) of the Eifelian - Givetian GSSP and associated boudary sequences in north Africa and Europe. - Episodes, 20 (3): 167-175.

DA SILVA, A.C., MABILLE, C. & BOULVAIN, F. (2009): Influence of sedimentary setting on the use of magnetic susceptibility: examples from the Devonian of Belgium. - Sedimentology, 56: 1292-1306.