

EGU2020-1531

<https://doi.org/10.5194/egusphere-egu2020-1531>

EGU General Assembly 2020

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## Detecting original variations in calcite and aragonite input in limestone-marl alternations

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The origin of carbonatic rhythmically alternating lithologies, called limestone-marl alternations (LMA), is a lively debated topic. LMA are commonly used as high-resolution cyclostratigraphic record, but diagenetic studies indicate that not all LMA reflect genuine differences in the original composition driven by environmental changes. LMA with a clear difference between limestones and marls in their ratios of diagenetically inert elements such as  $\text{Al}_2\text{O}_3/\text{TiO}_2$  can be identified as the product of primary sedimentary differences, i.e. variation affecting the terrigenous compound of the precursor sediment. In contrast, LMA without these differences could be the product of (1) variations in the carbonate compounds of the precursor sediment, i.e. aragonite and calcite input, or of (2) the distortion of the latter by diagenetic carbonate redistribution, or of (3) diagenetic carbonate redistribution in a homogenous precursor sediment. The problem of differentiating these three cases is known as the diagenetic dilemma. The question is, how can the composition in the original  $\text{CaCO}_3$  compound (aragonite, calcite) of the precursor sediment be reconstructed? This study provides a new approach to tackle the diagenetic dilemma. According to the model of differential diagenesis, the concentration of trace elements is inversely proportional to the amount of diagenetically redistributed carbonate. Consequently, the difference between the ratios of diagenetically inert elements from two adjacent beds is a measure for carbonate redistribution between them. This is quantifiable by calculating the vector length between these ratios for two adjacent beds. The new approach is illustrated here by evaluating 75 contiguous limestone and marl beds from the Höglint Formation (Silurian) on Gotland, Sweden. To test the new method, trace elements in these beds were compared according to their relative solubility during diagenesis. All elements which are either bound to clay minerals or fit into the calcite lattice show the same pattern of vector lengths (