

## Trace fossils, water table and depositional evolution in eolian systems (Cretaceous Mulichinco Formation, subsurface of western Argentina)

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### Abstract:

Our knowledge of the ichnology of eolian systems is expanding at a relatively fast pace. However, previous research is based either on modern environments or on outcrops, with essentially no ichnologic work performed on core. Study of cores from the Lower Cretaceous (Valanginian) Mulichinco Formation, El Mangrullo oil field, Neuquén Basin, western Argentina, allows reconstructing trace-fossil distribution as a response to temporal changes in the position of the water table. Accordingly, this study yields insights into how ichnologic information may help to reconstruct depositional evolution in eolian systems. A combined ichnofacies-ichnofabric approach was used. In addition, ichnologic information was integrated with sedimentologic and sequence-stratigraphic datasets.

Four ichnofabric associations comprising ten ichnofabrics have been recognized. The eolian dune ichnofabric association comprises the *Digitichnus* isp., *Arenicolites* isp., and dwelling burrow ichnofabrics, as well as some occurrences of the *Skolithos linearis* ichnofabrics 1 and 2. This association occurs in the lower and middle intervals of the studied unit. The eolian sand sheet ichnofabric association comprises the *Planolites* isp.-*Palaeophycus* isp. ichnofabric 1 and the laminated filled vertical burrow ichnofabric, as well as some occurrences of the *Skolithos linearis* ichnofabrics 1 and 2. It is present in the lower and middle intervals of the Mulichinco Formation. The interdune ichnofabric association comprises the *Planolites* isp.-*Palaeophycus* isp. ichnofabric 2 and the *Taenidium* isp. ichnofabric 1. This association occurs in the middle interval of the studied unit. The fluvial sheet flood ichnofabric association is represented by the *Taenidium* isp. ichnofabric 2. It is present in the upper interval of the Mulichinco Formation.

The studied succession comprises a 3rd-order depositional sequence, which has been subdivided into three 4th-order sequences. The latter are stacked in a backstepping pattern as a result of a rise in the water table. The base of the 3rd-order sequence is represented by the intra-Valanginian unconformity that in the study area separates marine deposits below from continental deposits above. Overall, the 3rd-order sequence reflects the vertical transition from a dominance of eolian dune deposits to eolian sand sheet and fluvial sheet flood deposits, the latter intercalating with marginal-marine intervals. Integration of ichnologic, sedimentologic and sequence-stratigraphic datasets indicates a temporal evolution from hyper-arid to arid and semi-arid conditions.

Both the *Scoyenia* and *Entradichnus-Octopodichnus* ichnofacies are identified. The *Scoyenia* ichnofacies is present in damp interdune and ephemeral fluvial deposits. The *Entradichnus-Octopodichnus* ichnofacies occurs in eolian dune and sand sheet deposits. This study provides further support to the notion of an archetypal eolian ichnofacies.

**Keywords:** bioturbation, dunes, interdunes, continental ichnology, Neuquén Basin, reservoirs