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# Silurian deltaic progradation, Tassili n'Ajjer plateau, south-eastern Algeria: Sedimentology, ichnology and sequence stratigraphy

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## ABSTRACT

The economic potential for unconventional shale oil and gas production in the Silurian of the Berkine – Ghadames and Illizi basins (BGI) in south-eastern Algeria has been recently confirmed through exploration drilling. The aim of the present paper attempts a better understanding of the Intra-Tassilian depression within the entire Silurian of the Tassili n'Ajjer plateau. The continuous deposits of the Silurian are exposed at the southern margin of the prolific BGI basins, in the Tassili n'Ajjer plateau, offering the chance to understand the sedimentology, ichnology, and to present a detailed sequence stratigraphy framework for the region.

The 410 m-thick clastic Silurian sedimentary strata are subdivided into three formations in the context of sequence stratigraphy, namely: (i) the Oued Imihrou Fm. (Llandoveryan) overlain by (ii) the Atafaïtafa Fm. (late Llandoveryan to Wenlockian), and (iii) the Oued Tifernine Fm. (late Wenlockian to Pridolian). These can be also distinguished across the entire investigated area and laterally traceable over kilometers. Clear cyclic stacking patterns are identified within the four studied sections showing progressively a general trend of thickening- and coarsening-upward, over a complete 2nd-order megasequence (SIL-1 MS). This transgressive-regressive succession suggests deltaic progradation, shallowing and basin infilling as evidenced by numerous diagnostic sedimentary features and trace fossils, largely from eastern- to western-Tassili plateau. Indeed, the wealth of outcrop data in the Silurian siliciclastic succession enables us to distinct thirteen facies (facies A-M), ranging from shallow- to marginal-marine facies, and in turn, grouped into six facies associations (FA1-FA6). The lowermost part of the succession, which is the most prolific sources of hydrocarbons in North Africa, consists of thick organic-rich graptolite-yielding black 'hot' shales and 'lean' shales with sparse bioturbation with small *Thalassinoides* belonging to the distal *Cruziana* ichnofacies. In contrast, the uppermost part of the Silurian deposits becomes progressively coarser and fluvial in response to the progradation of the North African *Akakus* deltaic system, during regional sea level fall and uplifting of the region. These progradational deposits exhibit well-preserved trace fossils with moderate to high degree of bioturbation, such as *Skolithos* or the so-called "Tigillites" pipe-rock, *Cruziana* isp., *Rusophycus* isp., *Monocraterion* isp., and *Syringomorpha*.

The SIL-1 MS is bounded by a post-glacial latest Hirnantian unconformity on the basal (SB1), as confirmed by the moderately diverse early Silurian graptolite faunas, and by the Caledonian unconformity on the top (SB7). Each of the three formations of SIL-1 MS reveals two major 3rd-order progradational sequences,

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