*Young Researchers' Overseas Day*
Royal Academy for Overseas Sciences
Brussels, 7 December 2018

# Silurian Succession from North Africa (Algeria) – A Review for a New Era of Hydrocarbon Exploration

Hocine DJOUDER[1,2*], Tonguç UYSAL[2], Frédéric BOULVAIN[1], Julien BOURDET[2], Anne-Christine DA SILVA[1], Andrew TODD[2], Erick RAMANAÏDOU[2]

KEYWORDS. — Tassili n'Ajjer plateau; Black shales; Clay minerals; Thermal history.

SUMMARY. — The diagenetic grade and thermal history of the widespread graptolitic Silurian Oued Imihrou black shales (Llandoverian in age) and the overlying sandstone levels of the Atafaïtafa Formation (late Llandoverian to Wenlockian) from the Tassili n'Ajjer plateau have been investigated by integrating a variety datasets, such as illite crystallinity, graptolite-derived organic matter reflectance, source-rock maturity and illite K–Ar ages. Combination of X-ray diffraction and petrographic examinations allowed to confirm the occurrence of three distinct minerals of authigenic origin, i.e. kaolinite, illite, and iron-rich chlorite, within the Silurian succession. These clay minerals, as well as pyrite and quartz overgrowths, were neoformed at different times during diagenetic-to-hydrothermal conditions and conversion-precipitation reactions. Furthermore, formation processes of these minerals are found to be broadly controlled by the stratigraphical level, lithology of the host rocks and the paleogeographical location of the studied outcrop sections from the eastern- and western-Tassili n'Ajjer plateau (Djouder et al., 2018).

The illite crystallinity (i.e. Crystallinity index standards or CIS-calibrated *IC* values range between 1.58 to 0.38 $\Delta°2\theta$), paleotemperature estimates (~113–190°C) and graptolite reflectance (vitrinite reflectance equivalent, 0.65–1.5% $VR_{eqv}$) correspond to low grade diagenesis/anchi-metamorphic illite crystallization conditions and the oil-to-wet gas hydrocarbon generation zone. A paleothermal gradient towards the West is clearly present. This higher thermal maturity of the most western part of the Tassili ($T_{max}$=466–483°C) is intimately linked to the migration of hot fluids, notably along N-S lineaments mega-shear zones in the Hoggar Shield. The latter were repeatedly reactivated during the Phanerozoic orogenies and rifting phases.

K−Ar dating results indicate at least two generations of authigenic micrometric illite crystals, which are interpreted to reflect the timing of fluid flow events in association with fault reactivations within the Tassili n'Ajjer plateau at the northern Hoggar Shield. The older illite of 335 ± 8 Ma is consistent with the timing of the early Hercynian tectono-thermal activity in the region, accompanied probably by the first hydrocarbon generation, i.e. Carboniferous age 'Visean'. While, the younger illite precipitations at 238 ± 11 Ma (Mid–Upper Triassic) and at 204 ± 6 to 179 ± 4 Ma (Triassic–Jurassic transition) can be attributed to high temperature fluid flow and kerogen maturation of the Early Silurian black shales, following Tethys rifting and the later development of the Central Atlantic Magmatic Province, respectively.

REFERENCES

DJOUDER, H., LÜNING, S., DA SILVA, A-C., ABDALLAH, H. & BOULVAIN, F. 2018. Silurian deltaic progradation, Tassili n'Ajjer plateau, south-eastern Algeria: Sedimentology, ichnology and sequence stratigraphy. — *Journal of African Earth Sciences*, **142**, pp. 170-192 https://doi.org/10.1016/j.jafrearsci.2018.03.008

[1] University of Liège, Sedimentary Petrology, Liège, 4000, Belgium.
[2] CSIRO, Commonwealth Scientific and Industrial Research Organisation, Perth, 6151, Australia.
* Corresponding Author. Email: Hocine.Djouder@doct.uliege.be