DOI: https://doi.org/10.30836/igs.iies.2024.37

Arradj S.E., Chabou M.C.

Emerging Materials Research Unit (EMRU), Department of Earth and Universe Sciences, Farhat Abbas University, Algeria. E-mail: sifeddine.arradj@univ-setif.dz

LITHOLOGICAL DISCRIMINATION OF PHANEROZOIC MAGMATIC FORMATIONS IN THE DJANET TERRANE USING LANDSAT 9 AND SENTINEL 2 MSI SATELLITE IMAGE PROCESSING

The Saharan Platform in Algeria stands as a focal point for the investigation of magmatic events spanning the Phanerozoic era. While certain occurrences have received extensive scrutiny, such as the Triassic-Liassic magmatism linked to the opening of the Central Atlantic Ocean in southwestern Algeria, or the Cenozoic magmatism in the Hoggar region, others remain shrouded in limited understanding. Notably, the Paleozoic intrusive magmatic activities occurring in sedimentary basins situated east and south of the Targui Shield, along the western boundary of the Murzuq Basin, represent a prime example of such enigmatic phenomena [1].

To address these knowledge gaps, advanced remote sensing techniques were judiciously employed, leveraging multispectral satellite imagery obtained from various sensors, including the Landsat-9 Operational Land Imager (OLI) and the Sentinel-2 MultiSpectral Instrument (S2-MSI). The imagery underwent meticulous processing, including a spectral sampling of different geological formations based on fieldwork (Figure 1) and resampling to a spatial resolution of 10 meters and subsequent creation of an image stack.

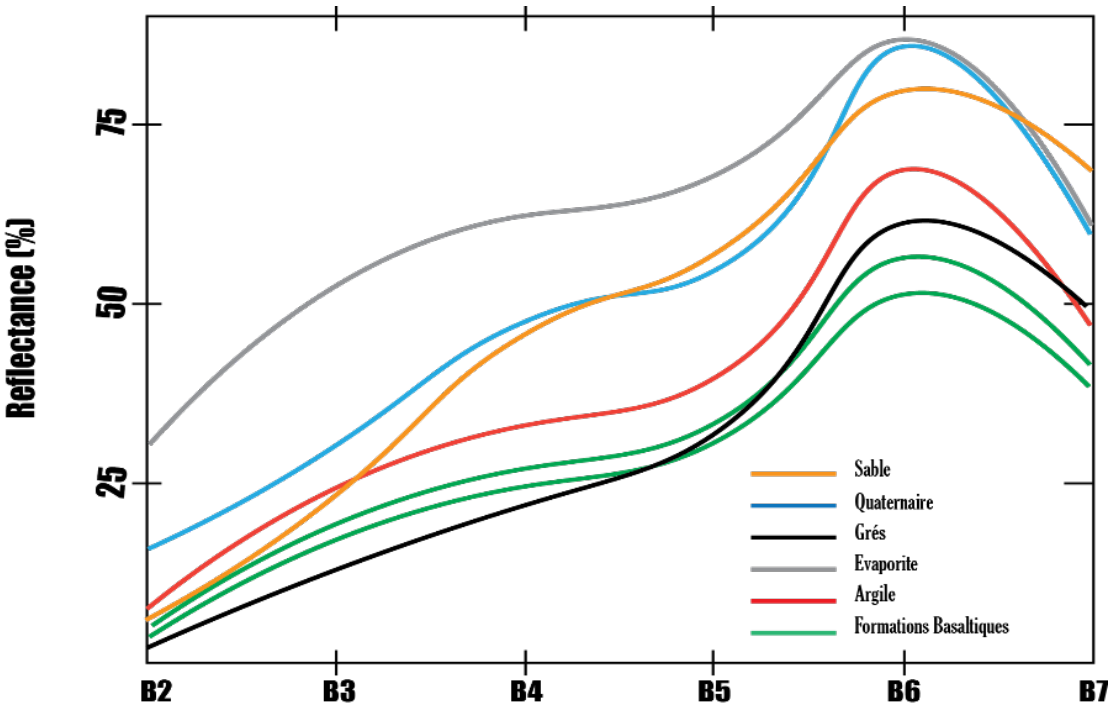

Fig. 4. Spectral sampling result following fieldwork

The Optimum Index Factor (OIF) served as a cornerstone in discriminating between magmatic rocks and sedimentary formations. By judiciously selecting specific bands from Landsat-9 and Sentinel-2 imagery – namely, Sentinel-2 band 4 (SB4), Landsat-9 band 6 (LB6), and Landsat-9 band 7 (LB7) – an optimal false-color combination was derived (Figure 2), facilitating enhanced visualization and discrimination of geological formations [2].

We utilized the Band Ratio algorithm integrated into the ENVI 5.3 software to map the magmatic formations. The combination (R: LB7/SB3, G: LB6/SB3, B: SB4/SB3) proved to be the most suitable. To ensure a clear interpretation of the results, we employed two algorithms integrated into the MNF software (Minimum Noise Factor) and IC software (Independent Component) [3].

In Figure 3, the extent of the Arrikine sill, notably to the north, is compared to Figure 2 where it appears in a dark violet hue. It is also worth noting a certain continuity of the sill to the southwest of the study area, as seen in Figure 4 and Figure 5. Fieldwork did not reveal this continuity; instead, it showed intense

hydrothermal alteration in the periphery of the Silurian sedimentary formations around the sill, similarly in the southwest area.

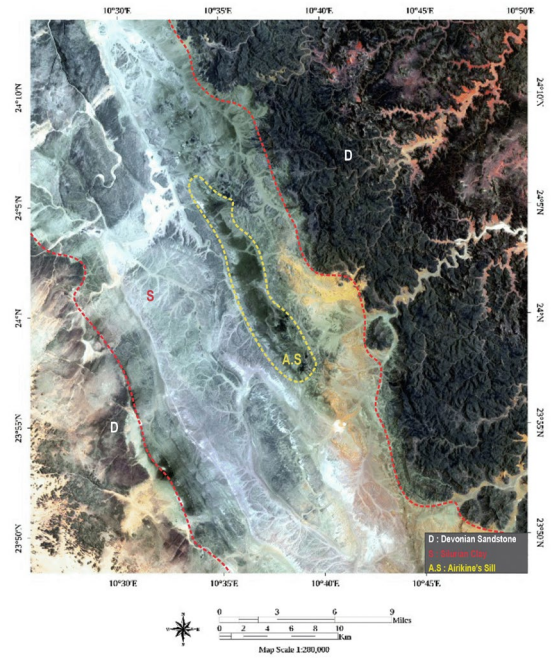

Fig. 2. Natural colors R: SB4, G: SB3, B: SB2

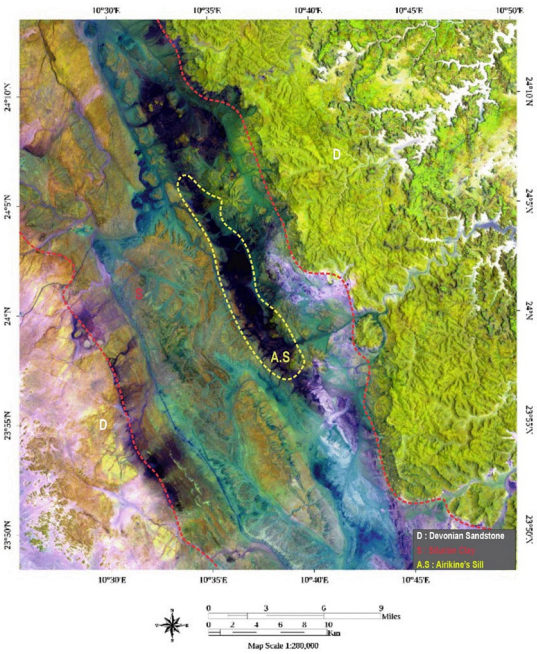

Fig. 5. Optimum index factor RGB (R: LB7 (Landsat 9), G: LB6 (Landsat 9), B: SB4 (Sentinel 2)

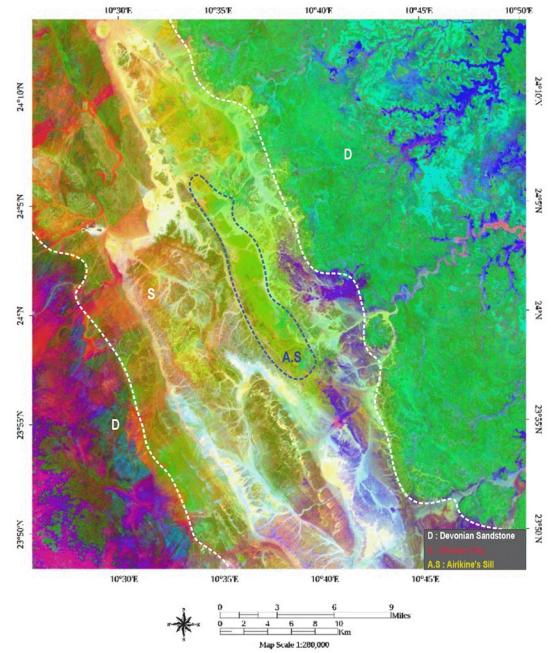

Fig. 4. Independent Component Analysis (ICA)

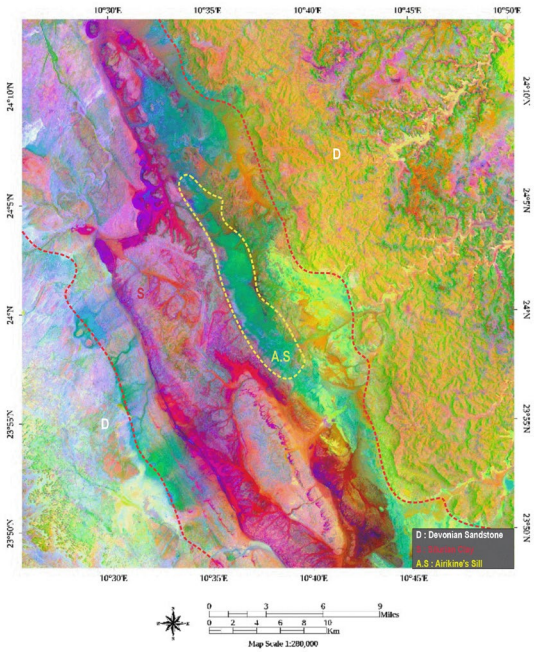

Fig. 5. Band Ratio (R: LB7/SB3 G: LB6/SB3 B: SB4/SB3)

The discovery of basaltic magmatism, exemplified by the Arrikine sill within the Silurian sedimentary formations along the western border of the Murzuk Basin in southeastern Algeria, has heralded a new era of insights into the Phanerozoic magmatic evolution of the Eastern Hoggar region. Recent advancements in multispectral satellite imagery, particularly those stemming from Landsat-9 and the Sentinel-2 MultiSpectral Instrument (S2-MSI), have significantly facilitated the mapping of this geological feature with unprecedented detail and precision.

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